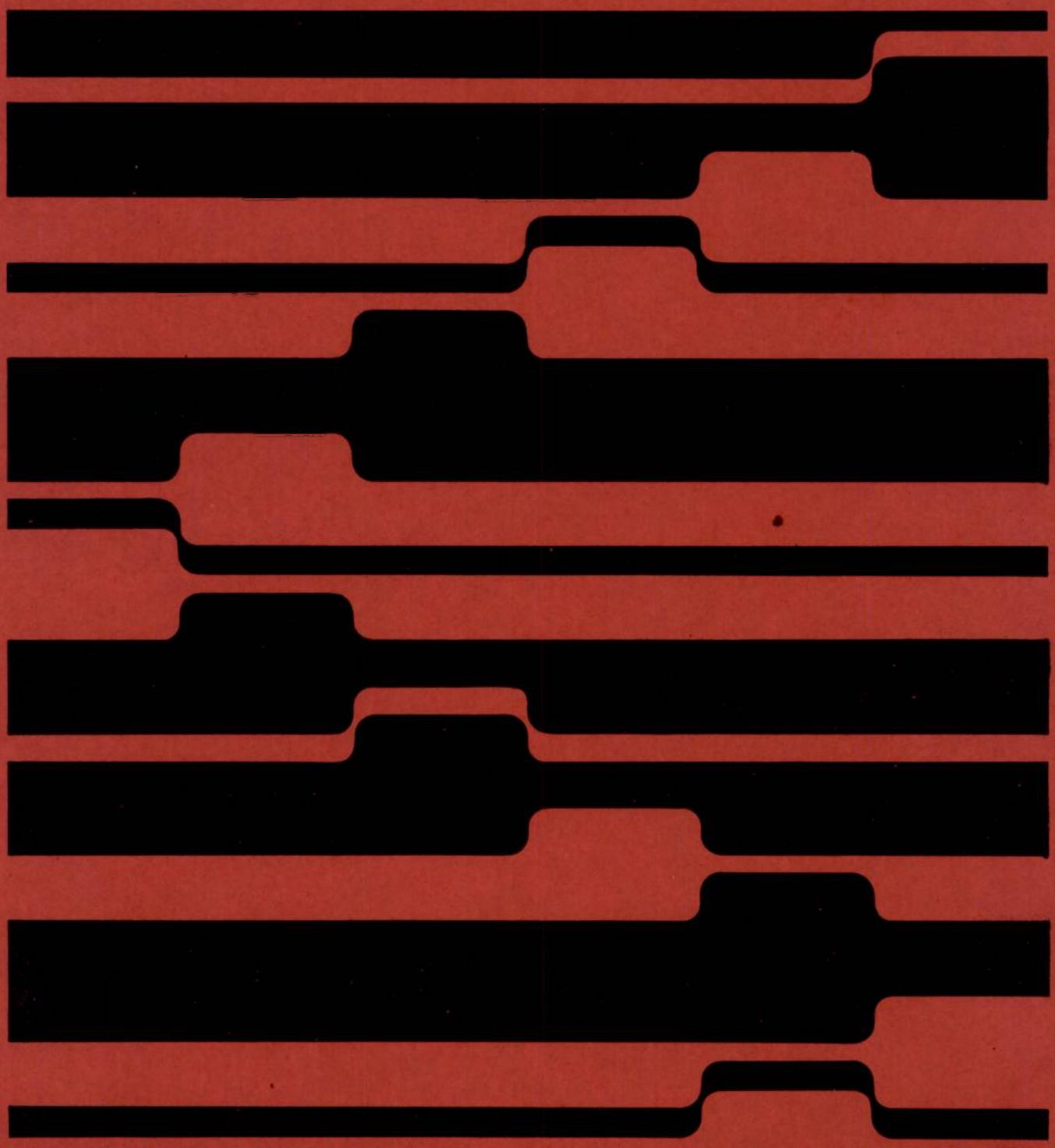
ICL

SCAN System 3 for Inventory Management

1900 Series



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User notice

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MANUAL (NOTICE NO.) 28/1/70

4186 SCAN SYSTEM 3 (1)

File one copy of this notice with each of the manuals indicated.

1900 SCAN SYSTEM 3 (Controlled Package)

Modifications to programs

X43H/1C

The errors in variable level supplier discount processing mentioned in the last user notice have been corrected.

X43V/1I

Errors in the calculation of branch weight factors and branch forecast have been corrected. An error has been corrected which caused the incorrect Investment Rate to be used in the calculation of economic order quantity. The calculation of total operating costs in the classical economic order quantity calculation was incorrect.

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MANUAL (NOTICE NO.) 20/2/70

4186 SCAN SYSTEM 3 (2)

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1900 SCAN SYSTEM 3 (Controlled Package)

Modifications to programs

#X43D/1E

Items containing a demand history of all zeros were being assigned a forecast interval of 4 instead of 26. This error has now been corrected.

#X43H/1D

Spurious sequence errors were being reported by the program during Type 1 processing. This error has now been corrected.

#X43J/1G

Back order records (type 20) were being incorrectly processed. This error has now been corrected.

#X43M/1B AND #X43N/1B

A check on item number has been inserted for record type 6.

#X43R/1E

All known errors have been corrected.

#X43V/1J

In certain cases the test for matching item numbers between the Stock Master and Demand History Files was incorrect. This error has now been corrected.

#X43W/1E

In certain cases spurious printing occurred on the output reports. This error has now been corrected.

FORM 1/230/45(3.69)

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User notice

MANUAL (NOTICE NO.) 25/3/70

4046 SCAN SYSTEM 1 (16)

4047 SCAN SYSTEM 2 (15)

4186 SCAN SYSTEM 3 (3)

File one copy of this notice with each of the manuals indicated.

1900 SCAN SYSTEM 1/2 (CONTROLLED PACKAGE)

Modifications to programs

X42A/4L

The error in the amendment of seasonal factors on the amendment run has now been corrected.

1900 SCAN SYSTEM 3 (Controlled Package)

Modifications to Programs

X43A/1E

1 The error causing looping when large numbers of modification records are input is now corrected.

2 The error in overflow procedure when writing to HSTRYOVERFLOW file is now corrected.

X43C/1F

A type 23 transaction (demand not requiring to be back ordered) has been added.

Note: As yet this is not included in X43J.

X43T/1E

The file extension procedure has been enhanced as for X43X (see below).

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FORM 1/230/45(3.69)

X43V/1K

1 The error whereby the classified EOQ may be incorrectly selected in preference to a lower annual operating cost associated with a price break EOQ has been corrected.

2 The omission of the maximum key record (↔↔↔...) as the last record on the SERIALHSTRY▽ has been corrected. Unless this record is present the addition of new items to the *end* of this file is not possible.

X43W/1F

A type 23 transaction (demand not requiring to be back ordered) has been added.

X43X/1B

An enhancement has been made to the file extension procedure whereby no data is lost when further space is unavailable. Where appropriate, other programs will also be enhanced with this modification. X43Z, X43T/1E, X43C and X43W have already been amended.

X43Y/1D AND X43Z/1E

The error whereby type 0 (zero) records were unacceptable on paper tape input has been corrected.

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User notice

MANUAL (NOTICE NO.) 25/3/70

4186 SCAN SYSTEM 3 (4)

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ERRORS IN THE NEW EDITION OF SCAN SYSTEM 3

1 Page xiii. Table 8 *Relationships between fields on the parameter record for program X43Q* appears on page 128, not on page 108 as shown in the list of tables.

2 Page 58. *Transaction amendment (code 10).* Up to five transaction amendments can be submitted, not up to ten as stated in the manual.

3 Page 87. *Function markers.* A reference is made in this section to Table 4. This should be Table 5.

4 Page 97. *Branch stock count.* Columns 21 and 22 have been omitted from the specification. They contain Location code (as for record code 5).

5 Page 102. *Marker number 10.* The action description says that the Demand Analysis routine is to be issued later. This routine has been issued.

6 Page 111. *Note 4.* The routines referred to in this note are available.

7 Page 119. *Program X43D.* Insert *Extension Size* at the end of the parameter card after *FGN Output P.R.*,

8 Page 122. *Program X43J.* There should be a comma after *FGN Transactions file* on the third parameter line.

9 Page 124. *Note 8* should read: If MIN/MAX Record Suppression and Order Suppression Marker = 1, then Extension size must not be specified.

10 Page 125. *Program X43K.* There should be a comma after *FGN Overlay Replenishment Orders file* on the third parameter line.

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11 Page 125. *Program X43K.* In the contents of column 8, 0 means no suppression.

12 Page 139. The table should read:

Value	Meaning	File required
0	Allocation Report and Transactions selection not required.	
1	Allocation Report and Transactions selection are required	OLDTRANSACTS NEWTRANSACTS
2	As for value = 1 but with generation of forward dated receipts	OLDTRANSACTS NEWTRANSACTS
3	As for value = 1 but with processing of orders file without creation of forward dated receipts	OLDTRANSACTS NEWTRANSACTS REPLENORDERS
4	As for value = 3 but with the creation of forward dated receipts	OLDTRANSACTS NEWTRANSACTS REPLENORDERS

13 Page 151. *File requirements.* Overlaid 2 should read *Serial disc file REPLENORDERS*, not *Sequential disc file REPLENORDERS.*

14 Page 201. *Hardware requirement.* The amount of core store required is 13000 words, not 11500.

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MANUAL (NOTICE NO.) 21/4/70

4186 SCAN SYSTEM 3 (5)

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The following corrections should be incorporated in Chapter 7 of the manual *SCAN System 3 for Inventory Management*:

1 Page 186.19, line 12

Delete "Contains D, F or M"
Insert "Contains F or M"

2 Page 186.20, line 15

Delete "...as shown in table 9.5 on page 186.25."
Insert "...as shown in the table on page 186.18."

3 Page 186.21, lines 25 and 26

The first sentence of *Range of levels used* should read: "This is an integer field which contains a space or a number greater than or equal to zero and less than or equal to nine."

4 Page 186.22, line 14

The last line under *Designated carrier level* should read: "... and has the same effect as setting supplier file marker 2 off."

5 Page 186.23, line 36

Word 10 of the table should read:
"Class code $^{1}/_{2}$ Character"

6 Page 186.24, lines 12 and 13

Words 31 and 32 of the table should be separated, thus:

31 Unit of issue, etc.
32 Spare, etc.

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7 Page 186.25, line 35

Note 3 should read: "... in character form as DDMMYY."

8 Page 186.34, line 7

Delete "10500 words of core store"
Insert "6500 words of core store"

9 Page 186.35, line 3

Delete "13568 words of core store"
Insert "12864 words of core store"

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User notice

MANUAL (NOTICE NO.) 6/5/70

4046 SCAN SYSTEM 1 (17)

4047 SCAN SYSTEM 2 (16)

4186 SCAN SYSTEM 3 (6)

File one copy of this notice with each of the manuals indicated.

1900 SCAN SYSTEMS 1 AND 2 (Controlled Package)

Modifications to programs

#X42K/4J and #X42U/4J

The programs have been recompiled with correct housekeeping to enable them to be run on 8K machines.

#X42V/4J

1 An error in the recalculation of seasonal factors has been corrected.

2 A new segment has been added which prints the message:

"Seasonal factors have been re-calculated".

1900 SCAN SYSTEM 3 (Controlled Package)

Modifications to programs

#X43A/1F
#X43B/1D
#X43D/1F
#X43F/1C
#X43G/1C
#X43H/1E
#X43J/1H
#X43K/1B
#X43T/1F
#X43Y/1E

All these programs have had a modification to the file extension procedure included.

#X43B/1D

1 Errors in modification, deletion and insertion of branches have been corrected.

2 An error whereby the scratch file overflows if a large number of amendments are made has been corrected.

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FORM 1/230/45(3.69)

	3	An error during writing to the STOCKOVERFLOW file has been corrected.
#X43C/1G		An enhancement has been made to the program allowing the proportional allocation marker to be set for a receipt transaction (Type 13). This has the effect of forcing this receipt during stock updating.
#X43F/1C		The program will now accept a maximum Forecast Interval entry of two digits on the run parameter record.
#X43G/1C		An error in data validation has been corrected.
#X43H/1E	1	An error in the processing of multi-branch warehouse records during an extraction run has been corrected.
	2	An error in the calculation of total annual cost has been corrected.
#X43J/1H	1	A new type of transaction (Type 23), Non-Back-Ordered Demand, has been included in the acceptable transaction types. This type of demand will never cause back orders to be generated.
	2	Forcing of receipts (see #X43C also) has been included in the processing.
	3	The processing of a branch stock count transaction (Type 22) has been modified. The program writes back into the Quantity 2 field the computed demand.
#X43K/1B		Errors in the stock activity report have been corrected.
#X43M/1C and #X43N/1C		A check to prevent division by zero has been inserted into the calculation of safety stock.
#X43R/1F		The SELECTSTOCK and SELECTHISTRY files are now processed sequentially and not serially.
#X43T/1F		Errors in the direct access file exception and extension messages have been corrected.
#X43Z/1F		An error in the file extension message has been corrected.

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User notice

MANUAL (NOTICE NO.)

27/5/70

4046 SCAN SYSTEM 1 (18)
4047 SCAN SYSTEM 2 (17)
4186 SCAN SYSTEM 3 (7)

File one copy of this notice with each of the manuals indicated.

1900 SCAN SYSTEMS 1 AND 2

Modifications to programs

X42A/4M

1 An error causing the description field to be zero filled if a type 02 card is not present in a creation run has been corrected.

2 The F.G.N. of the extracted file on an extraction run has been corrected to give F.G.N. of input master file +2.

3 Errors in the print out concerning seasonal factors have been corrected.

4 Errors on the output file concerning seasonal factors have been corrected.

X42F/4H

An error in the forecast subroutine which caused the first demand history value to be corrupted has been corrected.

1900 SCAN SYSTEM 3

Modifications to programs

X43A/1G

Errors concerning the modification of the functions markers have been corrected.

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X43C/1H

An error in the validation of the line count parameter which caused the program to go illegal has been corrected.

X43D/1G

1 An error in the stock value obtained when the group stock balance is negative has been corrected.

2 An error in the forecast interval calculated for items with very low average demand (less than 1) has been corrected.

X43F/1D

A missing SUSBY instruction which gave rise to a "Parameter error A" message (on the faster processors only) has been inserted.

X43J/1J

1 The bits in word 30 required for foreign language headings are now set up correctly.

2 An error whereby a price break of zero would be selected if less than three price breaks were present on the stock master file has been corrected.

3 Bulk orders are no longer raised for Warehouse records if the warehouse suppression parameter is set.

X43T/1G

The seasonal base count on the Demand History file on E.D.S. (SCAN 3) was being set to zero if the cycle base was zero on the Statistical file (SCAN 2). This has been corrected to give the value 1 to the seasonal base count.

X43V/1L

1 In an initial run the program attempted to evaluate the SIGN function with a zero argument causing a HALTED EE message on the console. This error has been corrected.

2 An error in the group stock balance field on the reports listing showing a group stock balance different from the sum of the branch stock balances has been corrected.

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User notice

MANUAL (NOTICE NO.)

1/7/70

4186 SCAN SYSTEM 3 (8)

File one copy of this notice with each of the manuals indicated.

1900 SCAN SYSTEM 3 (fgn 508) (controlled package)

Modifications to programs

X43C/1J An error which caused the printing of error code C when a single digit priority code was used has been corrected.

X43F/1E An error causing the program to loop when an item with a trend factor greater than 8 was met has been corrected.

X43K/1C An error which caused the extension size for the output orders file to be overwritten when a disc exception occurred has been corrected.

X43R/1G The program has been reduced in size to 9728 words. No other changes have been made.

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User notice

MANUAL (NOTICE NO.)

29/7/70

4186

SCAN SYSTEM 3 (9)

File one copy of this notice with each of the manuals indicated.

1900 SCAN SYSTEM 3

Modifications to Manual No. 4186 (SCAN System 3 for inventory management)

1 Page 7, line 8

Add the following after line 8:-

"The cost of capital invested in stock of an item is defined as the average stock quantity held multiplied by the cost price of the item multipled by the investment rate percentage for the item. The investment rate percentage (known hereafter as investment rate) is the percentage profit that investment of the money tied up in stock of an item would realise if it were invested otherwise (known as lost opportunity). Further costs which may also be considered in the investment rate for an item are cost of insurance, cost of obsolescence, perishability of stock, etc. The investment rate will vary from item to item according to the above mentioned factors. Items may be classified into one of ten investment rate groups according to the investment costs applicable to the item.

Investment rate may also be used as a management toll in order to attach a measure of importance to particular items in the inventory."

2 Page 7, line 13

Alter "Figure 4 Page 5" to read "Figure 5 Page 6".

3 Page 79, line -1

Add "(See page 7 STOCKHOLDING COST)" to end of line.

4 Page 96, line -18

Replace "25 to 29" by "23 to 29".

5 Page 103, line 2

Delete "... it is not suitable for use with SCAN System 3". Add "it is only suitable for use with the SCAN System 3 analysis programs."

6 Page 103, line 7

Insert a full stop after "... Demand History File" and delete the remainder of the sentence.

7 Page 104, line 21

Standard value for Conversion Factor should read "1" not "0".

8 Page 106, line -13

Insert Note 7 as follows:

"7 Users may add their own data to the end of the Stockmaster record. The maximum record size of a record (including user data) must not exceed the maximum possible record length for a Stockmaster record (279 words)."

9 Page 108, line -1

Insert Note 7 at bottom of page as follows:

"7 Users may add their own data to the end of the transaction record. Up to 80 user words are permitted."

10 Page 132

Insert the following at the bottom of page:

"Item Selection record. (Processing Indicator = 0)

1 2	3 18	19 20
4 0	ITEM NUMBER	GROUP CODE

Part file listing record. (Processing Indicator = 3)

1 2	3 18	19 20
4 1	ITEM NUMBER	GROUP CODE

21 36	37 38
ITEM NUMBER	GROUP CODE

Any number of either of the above record types may be input (but not a mixture of the two types) and the pack terminated with a **** record.

On paper tape each field is terminated by the character specified in the main parameter record and each record terminated with a NL character.

The Item Number/Group Code must be in ascending sequence for both record types.

11 Page 135

Insert "Comma" between line 10 and 11, i.e. between Investment rate and Order cost factor.

12 Page 135, line 10

Add "(See Page 7 STOCKHOLDING COST)" at the end of line.

13 Page 136, line -16

Add "(See Page 7 STOCKHOLDING COST)" at end of line.

14 Page 158, line 12

Line should read:

"2 Serial disc file OLDTRANSACTS".

15 Page 186.12, line 16

Insert after line 16:

"I_R is the Investment rate % that applies for this item. (See page 7 STOCKHOLDING COST)"

16 Page 186.30, line -7

Add at end of line:

"(See Page 7 STOCKHOLDING COST)"

17 Page 186.31, line -3

Add at end of line:

"(See Page 7 STOCKHOLDING COST)"

18 Page 215, line 16

Formula should read:

$$|T| > 2.4\gamma_0^1 / [2\gamma_0^1 - (\gamma_0^1)2]^{\frac{1}{2}}$$

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MANUAL (NOTICE NO.)

29./7/70

4046 SCAN SYSTEM 1 (20)
4047 SCAN SYSTEM 2 (19)
4186 SCAN SYSTEM 3 (10)

File one copy of this notice with each of the manuals indicated.

1900 SCAN SYSTEMS 1 AND 2

Modification to program

X42A/4N

An error which arose when correcting the complete array of seasonal factors, causing the message DISPLAY AV and closing the program prematurely, has been corrected.

1900 SCAN SYSTEM 3

Modifications to program

X43J/IK

An error whereby a forward demand within the lead time was updating the forward demand balance and the demand accumulators on every pass through the program until the demand became due for allocation, has been corrected.

X43V/IM

(1) When modifying the deseasonalised forecast to allow for added branches, no allowance was made for trend if it existed. This error has been corrected.

(2) An error which caused the program to halt with DA ERROR O I ABANDON if an unmatched stockmaster record occurred at the end of the stockmaster file has been corrected.

(3) An error which caused the program to halt EE (Error 57) for an item on system marker 3 or 8, with trend and no seasonality, and for which economic ordering was required, has been corrected.

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(4) For an item for which bulk ordering applied the bulk order interval count was not being updated. This error has been corrected.

(5) The summation of seasonal factors beyond the end of the seasonal cycle was being handled incorrectly if the item has both trend and seasonality. This error has been corrected.

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User notice

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MANUAL (NOTICE NO.) 2/9/70

4186 SCAN SYSTEM 3 (11)

File one copy of this notice with each of the manuals indicated.

MODIFICATIONS TO PROGRAMS

X43F/1F An error in the way trend factor was being used has been corrected.

X43J/1L Input of paper tape parameters did not allow for graphic shift characters. This error has been corrected.

X43K/1D No check was made on the input parameters to prevent the overlay and the output REPLENORDERS files having the same generation number. A check has been inserted to prevent this.

X43S/1F (1) The program has been modified to allow for graphic shift characters to be read in from paper tape.

(2) The program has been modified to print asterisks in fields where floating point quantities are greater than 9,999,999.

(3) The program has been modified to release the card or paper tape reader immediately after the parameters have been validated if a complete listing or listing by 11 is specified.

X43Y/1F When an output file was renamed and extended the extension message contained the old name of the file. The program now gives the new name of the file in the extension message.

X43Z/1G An error similar to that in X43Y above has been corrected.

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1900 SCAN SYSTEM 3

Modification to Manual No. 4186 (SCAN System 3 for inventory management)

P. 58 line 20. Add the following to the end of the line. "Records are matched by item number, group code, location code and units of issue. (In the case of a receipt transaction (type 13) unit of receipt is used instead of unit of issue)".

P. 58 line 26. Add the following to the end of the line. "The type 10 record must match the transaction being amended in all fields except the quantity fields and the transaction date".

P. 94 line -5. Remove the full stop and add the following to the end of the line:- "and deducted from the cumulative receipts".

P. 96 line 8. Remove the full stop at the end of the line and add the following:- "and is deducted from the cumulative demand".

P. 102 line -18 Add notes 7 and 8 after this line:-

7 Those fields which are common to both the stock master and the demand history files will be copied from the stock master to the demand history during a forecasting run (X43V) except for seasonal base and investment rate group which are copied the other way.

8 The demand history and stock master files have a final record set up with a key which is all "←"s, to enable insertion of records at the end of the file. This record is 14 words in length".

P. 107 line 19 Add the following at the end of the line:-
"On recirculating files words 10 and 11 and 12 and 13 contain the totals of the Quantity -1 and Quantity -2 fields respectively on the file. These are used in the control totals report in the updating programs".

P. 122 line -3 Add the following to the end of the line. "The program will attempt allocation of stock if the due date

of the transaction is earlier than or equal to the run date plus the pre-allocation period".

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User notice

MANUAL (NOTICE NO.) 11/11/70

4186 SCAN SYSTEM 3 (12)

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FORM 1/230/45(3.69)

1900 SCAN SYSTEM 3 (Controlled Package)

Modifications to programs

#X43C/1K

An error in reading paper tape parameters in previous versions of the program (Versions 1H and 1J) has been corrected. An error whereby graphic shift characters could not be input on paper tape has also been corrected.

#X43F/1G

An error which caused the fractional part of lead time to be zeroized has been corrected.

#X43K/1E

This version corrects an error whereby joint replenishment parameters were not set up correctly on the output REPLENORDERS file.

#X43A/1H

An error causing the program to loop on direct access error #17, which occurs on run types other than form where no area has been allocated to the overflow file, has been corrected. A similar error has been corrected in #X43B/1E.

#X43J/1M

The following errors have been corrected:

1 If a type 10 transaction to modify a type 13 (receipt) transaction was supplied, then the type 10 transaction was rejected with ERROR Q.

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Rejected type 10 transactions were recirculated by X43W because the transaction was not marked as having been in error.

2 The Quantity-2 field of a type 13 (receipt) transaction was not converted to issue units before processing, thus causing incorrect updating of the relevant fields on the STOCKMASTER file.

3 When a report required continuation on a new page the program halted:

DA ERROR A.

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User notice

MANUAL (NOTICE NO.)

9/12/70

4186 SCAN SYSTEM 3 (13)

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1900 SCAN SYSTEM 3

Unit numbers of basic peripherals used in SCAN 3 program for use in GEORGE job descriptions

Program	*LP unit number*	*CR unit number*	*TR unit number*
X43A	0	0	0
X43B	0	0	0
X43C	0	0	0
X43D	1	1	1
X43F	7	0	0
X43G	0	0	0
X43H	1	1	1
X43J	0	4	2
X43K	1	1	1
X43M	0	0	-
X43N	0	-	0
X43Q	1	1	1
X43R	1	1	1
X43S	1	1	1
X43T	1	1	1
X43V	0	0	0
X43W	1	1	1
X43X	0	0	0
X43Y	0	0	0
X43Z	0	0	0

Note

When using the Alterheads facility, unit numbers of 0 are used for the card/tape reader and all messages are output to the console.

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MANUAL (NOTICE NO.) 24/2/71

4186 SCAN SYSTEM 3 (14)

File one copy of this notice with each of the manuals indicated.

1900 SCAN SYSTEM 3 (fgn 515) 'Controlled Package)

Modifications to programs

#X43D/1H

An error has been corrected which occurred on files with other than monthly data, where the forecast interval for an item was first calculated as being 26 and the annual demand was less than 10; the subsequent recalculation of forecast interval gave an incorrect result for the item.

#X43J/1N

An error whereby a type 10 amendment to a back order record did not update the relevant balances and stock master record, has been corrected. This version of X43J has been enhanced so that if function marker 5 is set for an item, ordering is suppressed for that item. An error whereby a type 10 amendment did not find a record on the transactions file to amend, subsequently causing DA ERR A 1 has been corrected.

#X43K/1F

The program has been enhanced so that if function marker 5 is set for an item, ordering is suppressed for that item.

Note All versions of the Stock Master File Create/ Maintenance program, X43B, will set or unset function marker 5 on a type 6 record.

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User notice

MANUAL (NOTICE NO.) 14/7/71

4186 SCAN SYSTEM 3 (15)

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1900 SCAN 3

Program modifications

The following modified programs will be available shortly.

X43F/1H

An error in the simulation phase for lagged adaptive forecast items, which caused execution error 62 when the error term was zero, has been corrected.

X43J/1P

The program has been modified to produce a header record of 42 words in length on the REPLENORDERS file in order that it can be sorted correctly for use in the joint replenishment program.

X43K/1G

The program has been altered as in X43J above.

X43M and N/1D

An error similar to that described for X43F has been corrected.

X43T/1H

An error, whereby an extension size of zero was not rejected as a parameter error, has been corrected.

An error, causing the output record to be 10 words too long, has been corrected.

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An error whereby the branch demand accumulator was not zeroised for items on system marker L has been corrected.

An error in the initial forecasting run, which caused a forecast to be made for items whose Forecast internal count was equal to the Forecast interval, has been corrected.

Manual modifications

Page	*Line*	
81	-15	Add to the end of the line the sentence: "Negative entries will be rejected".
81	-12	Add the new sentence: "Negative entries will be rejected".
88	-11	In Table 5, marker 5. Replace "Not Used" by: "Suppress ordering for this item", and enter a 1 in the Value column.
102	-18	Add a new line, Note 8: "8 At the end of the file a record with a key of -1's, the highest possible key, is written to enable the insertion of new records after the last real item on the file."
106	-13	Add a new line, Note 7: "7 At the end of the file a record with maximum possible key is written as for the Demand History file."
109	3	Replace the full stop at the end of the sentence by: "and the record is 42 words in length."
109	-8	Alter the entry in Length in words column from $2^1/_2$ to $1^1/_2$.
186.33	3	Add a new sentence: "This field should only be used if an output file is present."
186.36	8	Insert a new line after line 8: "Note: If the SDREPLENORDS file is found to be not in the correct sequence it will be relabelled USREPLENORDS."

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User notice

MANUAL (NOTICE NO.) 17/11/71

4186 SCAN SYSTEM 3 (16)

File one copy of this notice with each of the manuals indicated.

User Notice 15 contained errors. The paragraph on X43V/IN should be amended as follows:

X43V/IN An error whereby the branch demand accumulators were not zeroised for items on system marker 0 has been corrected.

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User notice

RECEIVED 21 MAR 1972

MANUAL (NOTICE NO.) 8/12/71

4186 SCAN SYSTEM 3 (17)

File one copy of this notice with each of the manuals indicated.

1900 SCAN SYSTEM 3

Modifications to programs

X43A/1K

The program has been enhanced to allow the setting of marker 2. X43F will be enhanced such that if the user sets marker 2 then he does not want γ_0 and γ_1 from his parameter card to replace the values on the file.

X43B/1G

(i) An error which prevented the setting of marker 7 has been corrected.

(ii) An error, which caused the program to loop or give DA ERR A under certain circumstances when the scratch file became full, has been corrected.

X43C/2A

The program has been enhanced to allow input from a card image format magnetic tape. This is designed specifically for users with key edit facilities. The magnetic tape should contain 21 word card image records, the first word being a length indicator containing the value 21. The second parameter record on card or paper tape should have column 3 set equal to 1 of input from magnetic tape is required. All other information on the use of this facility is covered on pages 118 and 142 of the manual.

X43F/1J

(i) An error, whereby function marker 10 is not cleared after processing, has been corrected.

(ii) An error in the normalization of seasonal factors, which occurs when the user has specified no change in seasonal factors and the new minimum statistical forecast interval is larger than the old forecast interval, has been corrected.

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	(iii)	An error in the use of trend factor in the simulation phase has been corrected.
X43F/1K	(i)	An error which caused an erroneous message TREND FACTOR ≥ 8 has been corrected.
	(ii)	The program has been enhanced in accordance with the change to X43A above.
X43H/1F	(i)	An error, which caused DA ERR A 4, has been corrected.
	(ii)	A further error, which results in the "SEQUENCE ERROR" message and program suspension even though the files are in correct sequence, has been corrected.
X43K/1H		An error, which caused the order balance field on the STOCKMASTER file to be incorrectly updated when an order was raised, has been corrected.
X43M/1E X43N/1E		An error, whereby if the error step specified is zero then it is not always replaced by demand step, and therefore causes the error message "INSUFFICIENT PARAMETERS", has been corrected.
X43M/1F X43N/1F		An error, whereby the order interval used in the simulation phase was incorrect for cyclically ordered items whose forecast interval was not =1, has been corrected.
X43X/1C		An error which caused the input file name SPPLRINPUT to be rejected has been corrected.
X43Y/1G		An error in the handling of numeric fields for paper tape input has been corrected. An entry of zero in the extension size parameter will now be correctly flagged as an error.
X43Z/1E		The errors in X43Y above have also been corrected in this program.

Modifications to the Manual

Page 54	line 18	Add the following sentences after this line: "Input records may also be provided from E.D.S. on a file called TRCARDIMAGES. The records on this file will be 21 words long and will consist of card images. (See page 186.25 for details.)"
Page 62	line 10	Add the following after this line: "Error W: Input record out of sequence. This implies that the input transactions file has not been sorted into the sequence of the stockmaster file. The files involved will be closed and the activity report produced. This report will only contain details of those records from the stock-master file up to the record at which the error arose."
Page 83	line 20	Add the following section after this line: "Note: In a modification run it is not possible to increase the demand history series length or the seasonal base and then to both overwrite the existing demand points or seasonal factors and add new points to the existing series. The purpose of this is to prevent possible misinterpretation of the use of the records concerned, causing incorrect updating of the files."
Page 87	Line -9	Add after this line: "Note: Function markers 1 and 2 are combined and should be treated as one field. (See Card type F6, page 84.) If any entry is required in this field then all markers must be entered. Therefore columns 75-79 on card F6 (page 84) should contain zeros.

Page 198 line -14 Add after this line:

"An entry of 1 in the lead time field of this card would mean that an order raised during this system time period (assumed to be raised at the end of the period) would not arrive until two system time periods later. Since an order is assumed to be delivered at the beginning of a period, there is thus an elapsed time of 1 period. Misleading results can arise if these complications are not understood."

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MANUAL (NOTICE NO.) 1/3/72

4046 SCAN SYSTEM 1 (24)

4047 SCAN SYSTEM 2 (23)

4186 SCAN SYSTEM 3 (18)

File one copy of this notice with each of the manuals indicated.

MODIFICATIONS TO PROGRAMS

X43A/1L An error whereby the final summary listing contains information from a previous summary has been corrected.

X43B/1H An error as for X43A above has been corrected.

X43C/2B An error, whereby Direct Access error I occurs if transaction records are input to the program from a serial disc file, has been corrected.

X43J/1R An error in the proportional allocation system, whereby not all the available stock was allocated, has been corrected.

X43K/1J An error, which causes the order balance on the Stock Master file to be incorrectly updated, has been corrected.

X43S/1G The program has been altered to allow negative accumulations to be correctly printed.

X43V/1P On the report the value of demand -1 and forecast -1 was incorrect for items for which no movement occurred. Version 1P corrects this error.

X43W/1G Back order records with both quantity fields = 0 were carried forward in earlier versions of X43W. Version 1G will not carry these transactions forward.

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X43Y/1H Errors causing corruption of Function Markers in type 2 records and Demand History series length in type 3 records, when input is from paper tape, have been corrected.

X42J/4P An error in the checking of an end of file marker, which could cause the program to go illegal in obscure circumstances, has been corrected.

X42R/3J The previous version of the program was issued with segments missing. This fault has been corrected.

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RECEIVED 9 MAY 1972

MANUAL (NOTICE NO.) 12/4/72

4186 SCAN SYSTEM 3 (19)

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1900 SCAN System 3 Controlled Package

AMENDMENT TO MANUAL NUMBER 4186 (SCAN SYSTEM 3 FOR INVENTORY MANAGEMENT)

1 Page 55. Location code has been omitted from the sort key of the Transactions file. The following lines should read as shown:

Line 11: "item number/group code/location code/ transaction code/due date/priority."

Line 16: "item number/group code/location code/ transaction code/due date"

Line 18: "item number/group code/location code/ transaction code/due date"

2 Page 162. Add the following note after line 16:

"4 The optional facility in XJEZ of inserting a dummy highest key into the reorganised file, using a fifth parameter card or paper tape block, should not be used."

UNIT NUMBERS OF DISC FILES USED IN SCAN 3 PROGRAMS, FOR USE IN GEORGE JOB DESCRIPTIONS

Program	*File*		*Unit number*
X43A	SELECTHSTRY	(INPUT)	1
	SDHSTRYINPUT	(INPUT)	2
	SERIALHISTRY	(OUTPUT)	3
	DMANDHISTORY	(OVERLAY)	4
	HSTRYOVRFLOW	(OUTPUT)	5
	SELECTHSTRY	(OUTPUT)	6
	SCRATCH FILE	(OUTPUT)	7

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Program	*File*		*Unit number*
X43B	SELECTSTOCK	(INPUT)	1
	SDSTOCKINPUT	(INPUT)	2
	SERIALSTOCK	(OUTPUT)	3
	STOCKMASTER	(OVERLAY)	4
	STOCKOVRFLOW	(OUTPUT)	5
	SELECTSTOCK	(OUTPUT)	6
	SCRATCH FILE	(OUTPUT)	7
X43C	NEWTRANSACTS	(OUTPUT)	0
	TRCARDIMAGES	(INPUT)	1
X43D	DMANDHISTORY	(OVERLAY)	1
	SELECTHSTRY	(INPUT)	2
	PROFILERESLT	(OUTPUT)	3
X43F	DMANDHISTORY	(OVERLAY)	0
	SELECTHSTRY	(INPUT)	0
	SELECTHSTRY	(OUTPUT)	1
	HSTRYOVRFLOW	(OUTPUT)	1
X43G	SDSPPLRINPUT	(INPUT)	1
	SUPPLIERFILE	(OVERLAY)	2
	SERIALSPPLR	(OUTPUT)	2
	SPPLROVRFLOW	(OUTPUT)	3
X43H	STOCKMASTER	(OVERLAY)	1
	REPLENORDERS	(OUTPUT)	2
	SUPPLIERFILE	(OVERLAY)	3
	SDREPLENORDS	(OVERLAY)	4
	TRCARDIMAGES	(OUTPUT)	5
X43J	NEWTRANSACTS	(INPUT)	1
	STOCKMASTER	(OVERLAY)	3
	REPLENORDERS	(OUTPUT)	5
	MAXMINRECRDS	(OUTPUT)	6
X43K	STOCKMASTER	(OVERLAY)	1
	REPLENORDERS	(INPUT)	2
	REPLENORDERS	(OUTPUT)	3
	MAXMINRECRDS	(OUTPUT)	4
X43Q	PROFILERESLT	(OVERLAY)	1
X43R	PROFILERESLT	(OVERLAY)	1
	DMANDHISTORY	(OVERLAY)	2
	SELECTHSTRY	(OVERLAY)	3
	STOCKMASTER	(OVERLAY)	4
	SELECTSTOCK	(OVERLAY)	5
	DMANDHISTORY	(SELECTIVE)	6
	STOCKMASTER	(SELECTIVE)	7
X43S	DMANDHISTORY	(OVERLAY)	1
	SELECTHSTRY	(INPUT)	2
	STOCKMASTER	(OVERLAY)	3
	SELECTSTOCK	(INPUT)	4

Program	*File*		*Unit number*
X43T	SERIALHSTRY	(OUTPUT)	1
	SERIALSTOCK	(OUTPUT)	2
X43V	SERIALHSTRY	(OUTPUT)	0
	DMANDHISTORY	(OVERLAY)	0
	STOCKMASTER	(OVERLAY)	1
X43W	OLDTRANSACTS	(INPUT)	1
	MAXMINRECRDS	(INPUT)	2
	REPLENORDERS	(INPUT)	3
	NEWTRANSACTS	(OUTPUT)	4
X43X	SPPLRINPUT	(OUTPUT)	0
	SDSPPLRINPUT	(OUTPUT)	0
X43Y	HSTRYINPUT	(OUTPUT)	1
	SDHSTRYINPUT	(OUTPUT)	1
X43Z	STOCKINPUT	(OUTPUT)	1
	SDSTOCKINPUT	(OUTPUT)	1

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User notice

MANUAL (NOTICE NO.) 26/5/72

4046 SCAN SYSTEM 1 (26)
4047 SCAN SYSTEM 2 (25)
4186 SCAN SYSTEM 3 (21)

File one copy of this notice with each of the manuals indicated.

EXPLANATION

User Notice 20 for SCAN 3 and User Notice 25 and 24 for SCAN 1 and 2 should be destroyed and this one filed in their place.

1900 SCAN SYSTEM 1/2 Controlled package

Modifications to programs

#X42A/4V An error, causing the program to display error message AQ for the second item number onwards, and to halt end-of-run, before all the data has been processed, has been corrected.

#X42D/4G An error, such that the program will go illegal, when using cassette tape and suppressing the output Statistics File, has been corrected.

1900 SCAN SYSTEM 3 Controlled Package

Modifications to programs

#X43C/2C An error, such that if field overflow occurs for the cumulative control total of either Quantity-1 or Quantity-2, this is incorrectly indicated in the Transactions Validation Report as occurring in the corresponding batch total, has been corrected.

The program has been enhanced to facilitate the suppression of details of each successfully validated transaction from the Validation Report. This may be done by setting switch 21 on before entering the

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program. Details of incorrectly validated transactions will still be printed, as will batch and control totals.

#X43H/1G An arbitrary limit of 5 on the amount by which each demand quantity in the group may be increased by Joint Replenishment has been removed.

#X43J/1S The following errors have been corrected.

1 The proportional allocation marker in Demand (type 21) transactions, allowing proportional allocation to be switched off for individual transactions, was not checked by the program.

2 The quantity-1 field was not added to the demand accumulators for Non-Back Order (type 23) transactions.

#X43S/1H An error, whereby the program incorrectly gives a type C error when printing details of a type 40 record input from paper tape, has been corrected.

#X43V/1Q Mark 1P of the program was incorrectly issued with the Trace facility included. This has now been removed.

An error, whereby the program checks the seasonal base count when the seasonal base is zero, has been corrected.

An error, such that if a new branch is set up already containing a forecast made by the Demand Analysis routine, the program ignores and overwrites this forecast result, has been corrected.

MODIFICATIONS TO THE MANUAL

Page 54, line -8 Add after this line:

"Printing of the details of validated transactions may be suppressed (see page 118)"

Page 118, line -1 Add at the bottom of the page:

"If Switch 21 in word 30 is set on before the program is entered, transaction details for successfully validated transactions will not be output in the Validation Report. Transactions for which validation failed, however, will not be suppressed from the report."

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User notice

RECEIVED 1 SEP 1972

MANUAL (NOTICE NO.)

30/8/72

4186 SCAN SYSTEM 3 (22)

File one copy of this notice with each of the manuals indicated.

1900 SCAN System 3 Controlled Package

MODIFICATIONS TO PROGRAMS

#X43B/1J Under certain circumstances the program loops on printing a batch of the Summary Report. This has now been corrected.

#X43C/2D An error, whereby the minus sign for a negative Quantity-2 total will not be printed correctly in the Validation Report if the Quantity-1 total is positive, has been corrected.

The enhancement incorporated in Mark No. 2C, allowing suppression of successfully validated transactions from the Validation Report, contained an error. This has now been corrected.

#X43G/1D An error, causing Direct Access error Z when paper tape input is used, has been corrected.

#X43J/1T The program contains an error such that Direct Access error A occurs if more than five type 10 amendment transactions are input for the same item number. This has been corrected so that those after the first five are flagged with an error X on the Stock Updating Exceptions Report, and then ignored.

An error preventing the amendment of Forward Demands by type 10 transactions has been corrected.

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#X43V/1R The program contains an error such that a FORTRAN execution error (Halt EE) occurs if the Mean Absolute Deviation of Errors is zero. This has been corrected such that the tracking signal is taken as 1.0 if the Mean Absolute Deviation of Errors is less than 10^{-20}.

An error, such that the Forecast-1 value is not printed correctly in the Reported Items List if the Demand-1 and Demand-2 fields are both zero, has been corrected.

CORRECTION TO USER NOTICE 21

Paragraph 3 for #X43V/1Q under *Modifications to programs* should read:

"An error, such that if a new group is set up already containing a forecast made by the Demand Analysis routine, the program ignores and overwrites this forecast result, has been corrected".

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RECEIVED 4 DEC 1972

MANUAL (NOTICE NO.)

22/11/72

4186 SCAN SYSTEM 3 (23)

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1900 SCAN System 3 Controlled Package

MODIFICATIONS TO PROGRAMS

#X43J/1U

Errors, causing certain fields in the Stock Activity Report to be decreased by one and the omission of Quantity-1 and Quantity-2 data from the Exceptions Report, have been corrected.

#X43S/1J

A line-count error, occasionally causing wasteful paper throw when the run time parameter requests 66 lines per page, has been corrected.

#X43V/1S

An error in the evaluation of annual demand where trend is present, causing the program to halt EE (FORTRAN execution error), has been corrected.

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User notice

L

RECEIVED 2 3 MAY 1973

PUBLICATION (NOTICE NO.) 9/5/73

4186 SCAN SYSTEM 3 (24)

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1900 SCAN System 3 Controlled package

MODIFICATIONS TO PROGRAMS

#X43P/1M

Some floating point calculations are performed within the program. A check for the presence of floating point hardware of software ar run time has been included, causing the program to be abandoned at the start if these facilities are unavailable.

An error in Mark No IL, causing an entry of 58 in the demand history series to be rejected, has been corrected.

#X43D/IJ

An error, whereby the summary record on the Profile Results File is not created if printout of the Frequency Table is suppressed, has been corrected.

#X43H/IH

An error in the pallet rounding routine, such that an already-rounded order quantity will be increased by one pallet size, has been corrected.

MODIFICATIONS TO THE MANUAL (SCAN SYSTEM 3 FOR INVENTORY MANAGEMENT, TP 4186)

1 Page 59, line 15 Add to this line:

"Non-back-ordered demands, code 23, are processed in the same way as normal demands, but back order records are not generated by the Update Reports routine."

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2 Page 61, Table 2. Add the following transaction:

Transaction code	*Type*	*Activity report balances affected*	
"23	Non-back-ordered demand	BAL 11	BAL 16"

3 Page 97. Add the following before *Batch control record*

"Non-back-ordered demand

Columns	*Contents*
1 and 2	Record code 23.
3 to 80	As for *Demand*, record code 21"

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User notice

L1

PUBLICATION (NOTICE NO.) 30/1/74

4186 SCAN SYSTEM 3 (25)

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MODIFICATIONS TO PROGRAMS

#X43A/1N — The program has been amended to display OVERFLOW FILE USED on the console typewriter before halting EN at the end of run, if the SCAN overflow file has been used during the run. This is to enable operators and GEORGE job descriptions to recognise when master file reorganisation is required.

#X43B/1K — See amendment to #X43A above.

An error causing error C to be printed under column 79 of a type 6 card image if marker 7 is set in the resulting function marker field, has been corrected.

#X43C/2E — An error whereby, if the facility for suppressing printing of valid transactions (switch 21 set) is being used, the print line is not cleared before insertion of the error code for an invalid transaction, has been corrected.

#X43J/1V — An error such that branch-to-branch transfers (type 18 transactions) to a branch with a higher location code have the quantity added into the opening balance of the Activity Report, has been corrected.

An error preventing the amendment by type 10 transaction of a forward demand with its due date more than a lead time ahead, has been corrected.

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#X43K/1K

An error causing termination of the run after only part of the REPLENORDERS file has been processed, has been corrected. This error only occurred when function marker 7, preventing proportional allocation for individual items, was used.

An error causing only one data line to be printed per page in the Exceptions Report, has been corrected.

#X43R/1H

An error, whereby the program may open a master file of the wrong generation number (the first digit being carried over from the *fgn* of the Profile Results File), has been corrected.

#X43T/1J

The program has been amended to allow the use of a dummy STATISTICAL tape file (containing header and trailer labels only) when transcribing the Stock Master file from SCAN 1/2 to SCAN 3 format.

#X43W/1H

An error in the Allocation Report, such that the first item has no branch total after the Automatic Ordering section, has been corrected.

The program has been amended to accept more than one parameter record at the start of the MAXMINRECRDS file, which previously caused the Over Maximum and Under Maximum reports to be omitted. It will ignore all but the first parameter record. This will allow simple merging of these files before entry into the program.

An error, whereby a Back Order (type 20) transaction is not created from a partially allocated automatic order, has been corrected.

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User notice

C1

PUBLICATION (NOTICE NO.) 16/10/74

4186 SCAN SYSTEM 3 (26)

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MODIFICATIONS TO PROGRAMS

#X43J/1W An error whereby, under certain circumstances, Under Minimum/Over Maximum records are created even though the Warehouse Orders and MIN/MAX record suppression marker is set, has been corrected.

See also X43W

#X43R/1J An error causing Parameter Error B when the File Processing marker in the parameter record contains a null character N has been corrected.

#X43S/1K An error in the use of type 40 input records for selective printing, whereby a record with the same item number but greater group code than the last record is flagged as out of sequence (error W), has been corrected.

#X43W/1J An error causing the Total Stock Value in the Under Minimum Report to be incorrect when negative stock balances are involved, has been corrected.

The following errors, concerning forward-dated receipts created automatically from back-ordered demands, have been corrected:

(i) transaction date set equal to back-order date instead of to current executive date.

(ii) bit 0 set in status marker field.

An error whereby receipts and back-ordered demands created from automatic orders contain the warehouse instead of the branch leadtime, has been corrected. This correction also required amendment to #X43J

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PUBLICATION (NOTICE NO.) 28/5/75

4186 SCAN SYSTEM 3 (27)

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MODIFICATIONS TO PROGRAMS

#X43A/1P The action of the program at HALTED FILENAMEvvvv DISC EXCEPTION #15 has been amended to prevent the run from being abandoned. The program can now be restarted by typing GO when more space is available.

#X43B/1L Amendment as in #X43A above.

An error whereby the Summary Report print buffer was not fully cleared after a type P error has been corrected.

The program has been amended to halt SIZEWORD INCOMPATABILITY if the sizeword on the Stock Master file record is less than the record length computed by SCAN.

#X43V/1T An error whereby the Reported Items List print buffer still contained the out-of-control marker on subsequent items if their last period's demand was zero has been corrected.

An error causing the spare character in word 34 of the Stock Master file record to be overwritten has been corrected.

#X43Y/1J An error causing alphanumeric data input on paper tape to be transcribed to the card image file right justified has been corrected.

#X43Z/1J Error correction as in #X43Y above.

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SCAN System 3 for Inventory Management

1900 Series

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Preface

This manual is a second edition and supersedes the first edition of *SCAN System 3 for Inventory Management.*

The ICL SCAN System 3 is fully described in this manual, which includes details of supporting computer programs and a discussion of the mathematical foundation of the techniques used.

This manual has been written with three classes of reader in mind. Busy managers and those requiring only a general appreciation of adaptive inventory control and the ICL SCAN System need read only Chapters 1 and 2. Systems analysts, programmers, O & M practitioners and data processing managers require a much more detailed understanding of sophisticated systems of management control; this is provided by Chapters 3, 4, 5 and 6.

Detailed study of the action of the control system is sometimes necessary for special investigation. Moreover, such detailed study can be invaluable in obtaining an understanding of how the system will work in practice. The basic routines described in Chapters 2 and 3 have, therefore, been supplemented by a system simulation program which is described in Chapters 7, 8 and 9.

Appendix 1, the mathematical foundation of the system, will obviously be of interest to operational research workers, but it has been written with a wider readership in mind and to this end considerable explanatory comment is included. A bibliography is included for those wishing to make a deeper study of the subject but, here again, a few titles of interest to the general reader are included.

The SCAN System 3 programs may be run on any 1900 Series computer with the following configuration.

1 Central processor with 16K word core store; console typewriter and floating point facilities (hardware or extracode)

2 Two-cartridge disc system, but for test purposes only one cartridge will be suitable.

3 One line printer

4 One card reader or one paper tape reader

Contents

Illustrations

Tables

Chapter 1 Inventory control

As indicated in the Preface, Chapters 1 and 2 are intended for busy managers and those requiring only a general appreciation of adaptive inventory control and the ICL SCAN Systems. It is assumed that the reader is already familiar with the concepts of inventory control, and for this reason this chapter is not written as a basic introduction to the subject with extensive definitions.

The size of a company's inventory has always been of importance to management. To-day, in the face of increasing competition and rapid technological change, the skill with which an inventory is controlled can have far reaching influence on both financial management and trading success. Traditional methods for control of inventories are no longer adequate; they do not provide the information that progressive management needs; moreover, their response to changes in management policy caused by changing conditions tends to be slow and uncertain. If managers themselves attempt to fill this deficiency by close personal attention to the detail of stock control, the cost in management man hours is high and, particularly in an expanding industry, the strain on the organisation may be considerable.

ICL SCAN Systems for Inventory Management have been developed for use with 1900 Series computers. The systems provide adaptive control techniques that respond automatically to changing patterns and levels of demand. With the aid of the computer, the control of stock for each item is reduced to routine.

SCAN System 3 is a disc based stock management system that operates with fixed controls or with variable controls determined by forecasting. Stocks of an item may be held and controlled at more than one location and the system is therefore suited to the warehouse situation, the retail situation or a combination of the two. Also orders placed by a warehouse will take advantage of any quantity discounts offered by the supplier.

Inventory Analysis routines support the control system itself by enabling the profile and content of an inventory to be examined in detail so that the choice between control techniques can be made.

THE PURPOSE OF INVENTORY CONTROL

Unless supply can be matched exactly with demand at all times, stocks must be held. Such an exact match is seldom possible, except perhaps in large scale production plants, and even here external factors can and do destroy this balance. The stock held is intended to act as a buffer to absorb fluctuations in the rate and incidence of both supply and demand.

If the stock held absorbs the fluctuations in supply and demand then there will be enough stock to satisfy the demand at all times and thus continuity of customer service is maintained. If the fluctuations are not absorbed then sales may be lost, production plans dislocated or plants immobilised for lack of spare parts; customer goodwill may suffer, progress costs rise and business opportunities may be lost.

Inadequate stock always leads to reduced profits. If stocks are increased, however, the extra inventory must be housed, insured and accounted for. The extra financial investment must be serviced and extra provision must be made for wastage and obsolescence.

The opposing costs of inadequate stock holding and excessive stock holding must be balanced as nicely as possible by careful examination of every item in the inventory. However, such a balance assumes unlimited availability of funds which is never the case. In the life of a business there are usually competing demands for the available capital. Also, once extra capital has been invested in an inventory, it may be a long time before it can be recovered; where product development is rapid, the risk associated with such an investment is likely to be high.

Too much stock and too little stock are both expensive luxuries which no business should afford. Often, both extremes are found in the same inventory. Too much stock of the slower moving items, the items for which the demand is low and intermittent, gives rise to inflated inventory values; on the other hand, too little stock of fast moving items, the items for which demand is high, leads to frequent stock-outs, that is failures to meet demand. The situation is further aggravated when stocks of associated items normally used or sold together become unbalanced.

The principal objectives of inventory management may be briefly stated as follows:

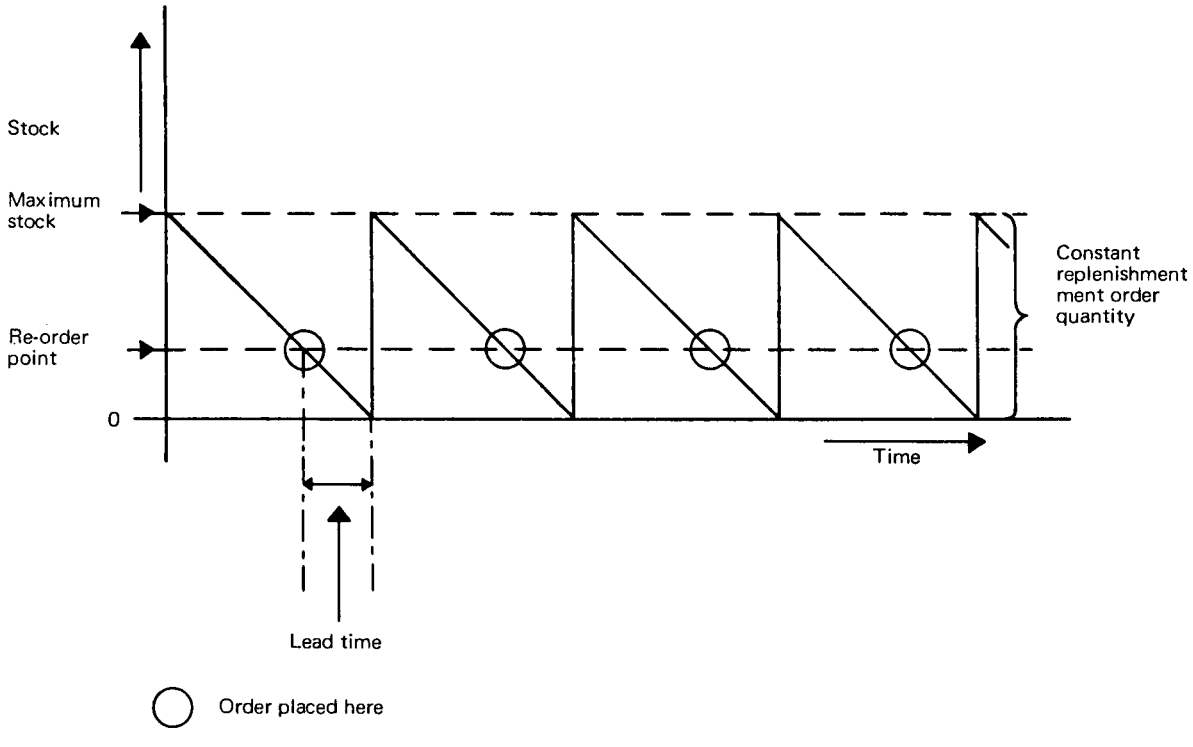


Figure 1 Variation of stock with constant demand and constant lead time

1 To set and maintain the correct level of customer service for each item in the inventory, thus ensuring that the frequency of stock-outs is kept within acceptable limits. (Customer service may be defined as a measure of the degree to which demand is met immediately from stock; the higher the service level, the fewer the number of stock-outs, but the stock holding costs will be correspondingly greater. Perfect customer service is unattainable and a balance must be struck between cost and service).

2 To achieve efficient operation of the stores or warehouse.

3 To ensure that the results achieved justify the amount of capital invested in stock and that this amount is within the limits dictated by the overall financial policy of the company.

No attempt has been made to place these objectives in order of importance; such an order can be decided only in a specific set of circumstances.

INVENTORY CONTROL AND THE COMPUTER

Computers can examine and analyze data quickly and easily and can report selectively on the findings, thus they can assist in achieving the aims outlined above.

However, setting up a computer based stock control system involves many man-years of effort in systems analysis and programming. The 1900 SCAN Systems for Inventory Management have been produced to save a substantial part of this work. The system philosophy used has been developed and tested over a number of years and takes advantage of Operational Research techniques that have become available in the last decade or so.

SCAN System 3 is supported by a series of interlocking programs; flexibility is achieved by a number of choices provided for the user to exercise his control over the way the programs operate. Also, files produced by the system can be accessed by user routines such as order control, invoicing and costing.

SCAN System 3 uses a re-order point system (see the next section) as the basic model and provides an adaptive control system which adjusts to changes in demand. Apart from the routines for day to day *control* of inventories a number of routines provide for *analysis* of inventories so that the most suitable method of control may be selected.

The system may be used for the control of stocks of finished goods in both warehouse and retail branch environments and in general for the control of stocks where future demand is unknown, for example maintenance spares, small tools and consumable materials.

Items, the control of which is basically a production problem, are excluded since the needs of production control are covered by ICL NIMMS (Nineteen hundred Integrated Modular Management System) and by the ICL 1900 PROMPT System (Production Reviewing, Organising and Monitoring of Performance Techniques).

RE-ORDER POINT CONTROL

Where future demand is unknown, inventory control reduces to continual and regular review of each item and a decision on either:

1 When to re-order and what quantity to order, or

2 What quantity to schedule for each new time period.

The first of these will give rise to a *re-order point control system;* the second will give rise to a *supply scheduling system.* The two systems are closely related and the second may easily be derived from the first. The SCAN system offers both facilities which may be used together in the same system for different groups of items.

A re-order point control system is a system in which stock is allowed to be consumed without control action being taken until a pre-set stock level, the *re-order point,* is reached. The re-order point is the amount of stock that it is estimated will be consumed in the time required to obtain a further supply. (This time period is known as the *lead time*). When the re-order point is reached a further supply is ordered. If the order is placed at the correct time, further supplies will be received just as the existing stock is exhausted. If the order is placed too early, there will be stock on hand when the new supply is received and the stock of that item will be higher than necessary. If the new supply is ordered too late, stock will be exhausted before the delivery arrives and for a time demand cannot be satisfied; a *stock-out* occurs and some demand must be back-ordered, that is, recorded for action when new supplies are received, assuming that customers are prepared to wait.

The ideal situation is one in which the rate of demand and the lead time are constant. Figure 1 page 2 , shows the effect of the re-order point control on the stock holding of an item with constant demand and constant lead time. Stock falls until the re-order point (shown by circle) is reached when a fresh supply of stock is ordered. The new

stock is received one lead time later, just as the existing stock is exhausted. Note that in such a situation, the same quantity of stock is ordered each time.

In practice, demand rates and lead times are seldom constant. If both the rate of demand and the lead time exceed maximum expectations during the same replenishment cycle, customer service is badly affected since a stock-out occurs. If both fall below the minimum expectations during the same cycle, over-stocking results. The effect of these extreme variations is shown in Figure 2, below. Because of these drawbacks, the variability of the rate of demand and of the lead time must be taken into account. If the rate of demand varies then it is inadvisable for the inventory to be controlled by fixed re-order points. Many simple inventory control systems fail because they are controlled by fixed re-order point.

Automatic revision of re-order points

Using operational research techniques, digital computers reduce control of stocks to a largely automatic process which:

1 Revises re-order points on a routine basis in response to changes in demand.

2 Indicates when and what replenishment quantities are required.

Automatic inventory control maintains any level of customer service set by management and depends on statistically minimized re-order points, which contain two elements:

1 Cycle stock to cover the average expected demand in replenishment delivery time.

2 Safety stock to maintain the service level specified by management.

Safety stock

The level of safety stock depends on the accuracy of demand predictions and on the service level required by management.

Safety stock is most important for those items with the highest usage rates since for these items ordering tends to be frequent and therefore the protection afforded by the order quantity itself is not present since the stock is consumed quickly. For items with low usage rates, ordering tends to be infrequent and consequently a high degree of protection is given by the order quantity since the stock will be consumed slowly over a long period of time. Therefore calculations of safety stock must take these factors into consideration.

Once the service level is fixed, the calculation of safety stock is automatic. The safety stock is recomputed whenever a new prediction of demand is made.

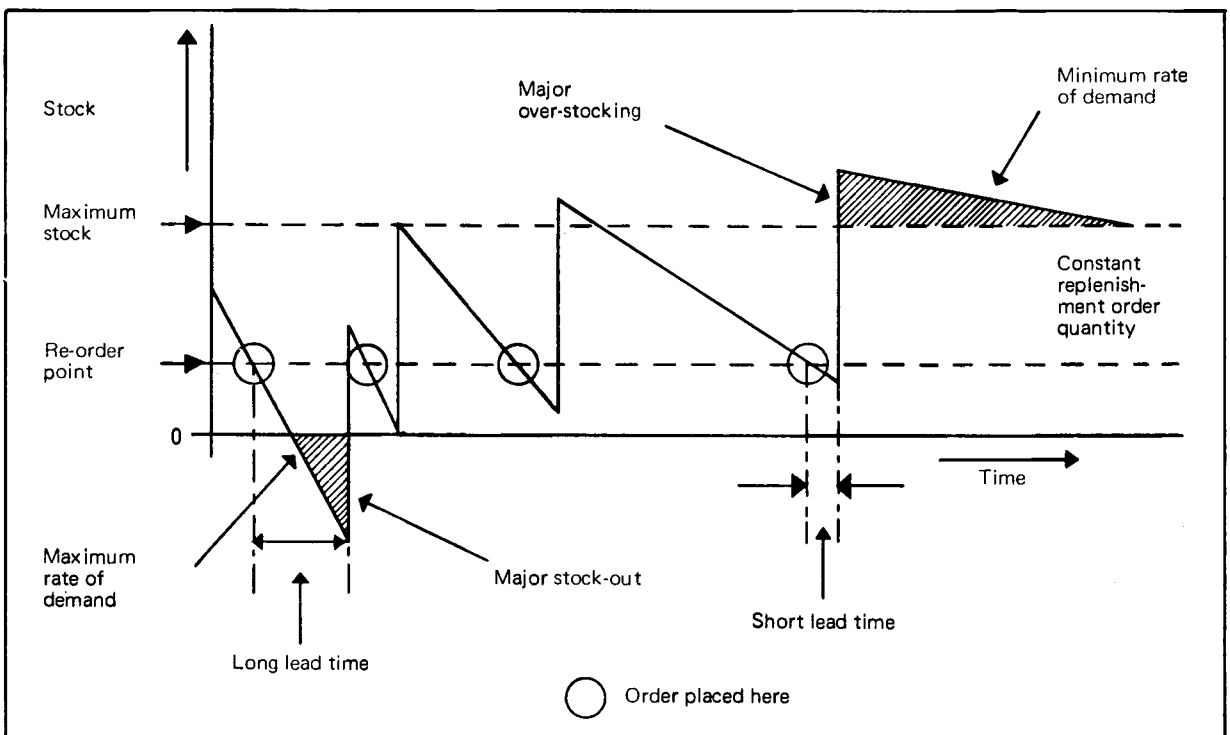


Figure 2 Variation of stock with variable demand and variable lead time.

The contribution which safety stock makes to re-order point in a variable re-order point system is illustrated in Figure 3 below.

This diagram shows how the severity of the stock-out and overstocking situations, shown in Figure 2, may be minimised by use of a variable re-order point, consisting of an estimate of stock usage and safety stock over the cycle.

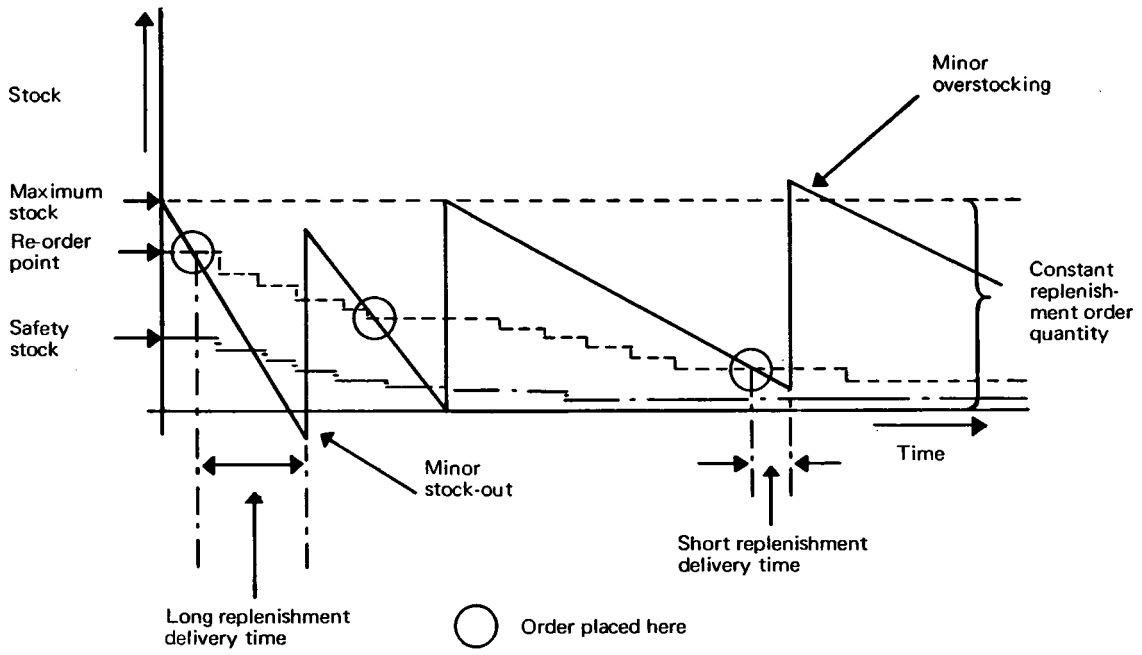


Figure 3 Variation of stock with variable re-order point and constant replenishment order quantity.

The effect of varying the replenishment order quantity is considered in the next section.

Figure 4 below shows the adaptive properties of a variable re-order point and variable re-order quantity system. Note that average stockholding levels depend on demand variability and specified customer service levels (safety stock) and on order cycle time.

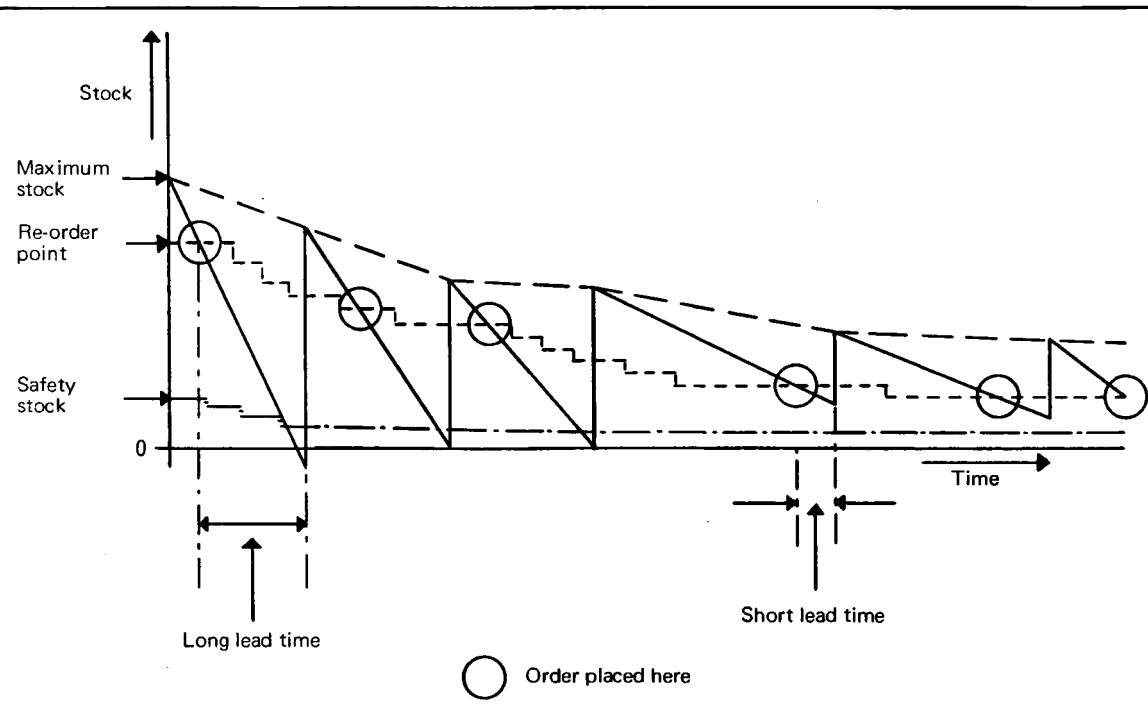


Figure 4 Variation of stock with variable re-order point and variable replenishment order quantity

Replenishment order quantity

The *replenishment order quantity* is the amount required to replenish the stock of an item.

A fundamental objective of adaptive inventory control is to adjust stocks to respond as closely as possible to changing demand. When the system detects a change in demand it will respond automatically. However, if management have advance warning of an impending change, it is desirable that they intervene in order to enhance the efficiency of the system.

For stockholding to be minimal, replenishment orders must not be initiated until stock is within one lead time of exhaustion. The final adjustment can be made only by varying the replenishment order quantity. Thus, if management wish to intervene, they can place an additional replenishment order outside the system, or they can delay an order requested by the system. This type of intervention should be required only in exceptional circumstances.

Accurate determination of the replenishment order quantity is essential and must depend on the estimated future demand. Large infrequent orders increase the range of variation of stock and inflate both the average and maximum stock levels. Small frequent orders have the reverse effect.

The system may be instructed to calculate a replenishment order quantity on the basis of either:

1 Economic order quantity calculation, which calculates a quantity on the criterion of cost minimisation, or

2 Various time based policies using the criterion of order cycle time.

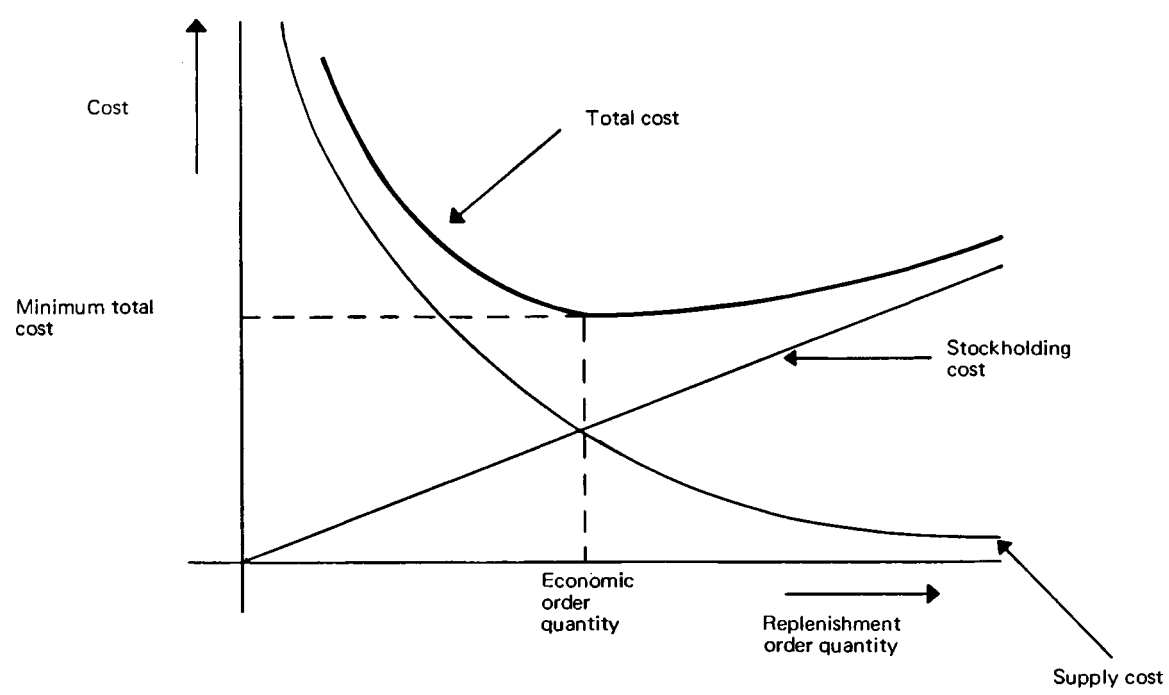


Figure 5 Effect of order quantity on cost

ECONOMIC ORDER QUANTITY

The major costs of operating a stores or warehouse are:

1 SERVICE COST. Service cost is the cost of satisfying demand; that is the cost of all operations that stem from the receipt of a customer order or stores requisition, including the associated data processing costs.

2 MAINTENANCE COST. Maintenance cost is the cost of providing, maintaining, heating, lighting and making secure the warehouse and its fittings and equipment plus supervision and control system cost.

3 SUPPLY COST. Supply cost is the cost of ordering, machine set-up (if appropriate), receiving, checking and supplier accounting.

4 STOCKHOLDING COST. Stockholding cost is the cost of holding stock including the cost of capital invested and the cost of insurance, obsolescence and losses in storage.

Service and maintenance costs influence stockholding policy and can impose restraints on the control system. Such restraints will be constant over relatively long periods of time and therefore are unlikely to affect routine control.

Supply and stockholding costs, however, directly influence control strategy. They work in opposition to each other in that orders for large quantities tend to make supply costs small and stockholding costs large; small orders have the opposite effect. Figure 5, page 6, shows the effect of order quantity on supply cost and stockholding cost and the resulting pattern of total cost.

The total cost first falls as the replenishment order quantity increases; it reaches a minimum value at the *economic order quantity*. Any further increases in the order quantity causes an increase in the total cost.

In practice it is difficult to determine the supply and stockholding costs accurately and thus calculations of the minimum total cost and the economic order quantity by this method will give only an approximate answer. However, it will be seen from Figure 4, page 5, that the total cost curve is relatively flat in the region of the minimum value; thus the choice of order quantity is not critical. The mathematical formula derived from the total cost curve and used to calculate the economic order quantity may, therefore, be used as a management regulator to secure acceptable levels of total inventory investment and ordering activity. These levels may be adjusted subsequently if trading conditions change. Management is thus able to adjust the inventory control system to suit prevailing conditions.

Economic order quantity policies and time based ordering policies (see below) have different effects on stock size, and so, indirectly, on costs. An economic order quantity policy takes into account the unit cost of the item, as well as the rate of demand, whereas a time based ordering policy ignores the unit cost of the item. The effect of this will be that an economic order policy will tend to order smaller quantities of items with high annual usage value compared with the quantities ordered by a time based ordering policy; similarly it will order more stock of the items with small annual usage value than a time based policy would. Therefore an economic order quantity policy should always be carefully considered as the basis for the replenishment ordering policy, especially for items of high annual usage value.

However there are occasions when an economic order quantity policy may not be suitable; for example, if the demand for an item is subject to strong seasonal variations.

TIME BASED POLICIES

The following time based ordering policies are available with SCAN System 3 to cater for situations where economic order quantity policies are not appropriate.

System minimum order quantity

This is the minimum order quantity required to ensure stable control for randomly ordered items. It is equal to the expected demand in one system time period. If this policy is used, stock investment will be reduced to the minimum possible at the expense of frequent ordering.

Preferred ordering interval

An ordering interval is specified by the user for each item and the system will base its order quantity calculations on that interval. For random re-ordering items there is an automatic check to ensure that the resulting order quantity is not less than the system minimum order quantity. The preferred ordering interval may be used in two ways: with random re-ordering or with cyclical re-ordering.

1 Random re-ordering. Random re-ordering is the true re-order point control system; a new replenishment order is requested as soon as the stock reaches the re-order point. If stock records are updated daily, new replenishment orders will be requested daily.

2 Cyclical re-ordering. It may be convenient to order items at a fixed frequency on a particular day in the week in which case cyclical re-ordering is used. The preferred ordering interval specified for each item controls the frequency with which the stock of that item is replenished and its specified ordering group controls the day on which the order is placed.

   Cyclical re-ordering is also used in two special situations. The first situation is when the stock records are updated weekly or less frequently and the lead time or ordering intervals are short (say one or two updating intervals). In such a situation random re-ordering introduces disturbances in the control system. These disturbances will be avoided if cyclical re-ordering is used. The second situation arises where it is required to operate a policy of joint replenishment. If preferred ordering intervals for a group of associated items are suitably set, these items will always be ordered together. Each time an order is made, the stock of the item in the group will be brought into

balance. It could be arranged for some items to be ordered each month and the remaining items in the group to be added to the list, say, every third month.

Bulk ordering and call off

With any of the types of ordering mentioned, it is possible to operate a bulk order call off system of ordering. A bulk order is negotiated with the supplier by management and SCAN System 3 is then able to call off from this bulk order using re-order point control.

Demand forecasting

Before any estimations of order quantities can be made, some estimations or forecasts, must be made of future customer demand. There are many mathematical techniques available for short term demand forecasting. Regularly the SCAN system makes a routine new prediction of future demand based on its previous prediction and the demand which has occurred since this prediction.

The revision of estimates of future demand forms part of the automatic routine which updates the re-order point and the replenishment order quantity for each item, taking into account the specified lead time, customer service level and replenishment ordering policy. The constants used in the equations for predicting demands may be specified for each item separately by management, or they may be established by the system, in which case fixed values are used for all items.

The system will follow trends and seasonal variations in demand, but will take time to adjust to sudden and large permanent changes in demand. When such changes are expected, it is advisable for management to intervene, rather than wait for the system to detect the change.

Forecasting frequency

The frequency of demand forecasting determines the minimum frequency of stock updating. The frequency of stock updating usually depends upon the systems problems and data collection problems, but it must be at least as frequent as demand forecasting and should always be as frequent as possible. In many situations, daily updating will be necessary; daily updating should be used if possible unless the demand is geared to a longer time cycle, for example single weekly demands which are always received on Monday.

The forecasting frequency depends on the statistical structure of the demand; in practice, the minimum permissible time interval is chosen unless the demand is geared to a longer time interval or the lead times are unduly long. The forecasting interval is seldom less than a week or more than a month for items in reasonably regular use.

Control optimality

The optimality of control, that is the most efficient balance between stockholding costs and customer service, depends on the accuracy of demand prediction and it is essential that prediction errors are as small as possible over time; if they are not, safety stock will be unnecessarily large and costs will be inflated.

Monitoring of system performance

The system checks its own performance and signals any danger of loss of control. If it is necessary for the system to signal any such danger, which should happen infrequently, the most recent demand data may be re-examined and any necessary adjustments made to the control factors. In the meantime, the system increases the sensitivity of the forecasting system so that adjustments to any permanent change in demand that may have occurred may be accelerated.

INVENTORY ANALYSIS

Any technical differences between the various items in an inventory are significant to an advanced inventory control system such as that encompassed by SCAN System 3. The system includes a number of programs which take care of this detailed analysis. The analysis is not essential prior to setting the control system to work and is not always possible, but it is desirable.

The technique used has been exploited by inventory managers, systems analysts and management consultants for a number of years. This is the facility of ranking the items of an inventory on the basis of commercial criteria such as annual usage value, gross profit margin, or stock value. The first two of these criteria place at the head of the stock list those items that are important to the business and at the bottom of the list those items whose continued retention in the stock list should be reviewed. The items at the head of this list are also those items which are likely to respond most quickly to automatic control; the reverse is true for those items at the bottom of the list. Thus, the

speed with which stocks will respond to automatic control may be estimated in round terms.

Such a list will also direct attention to the most fruitful items for investigation when it is wished to use the technique of Value Analysis.

A list in sequence of item stock value shows where the stock holding is concentrated.

Such lists are extremely valuable during initial investigation of an inventory and may also be used for periodic review (say, annual) of the performance of the control system.

It is common experience to find that some 10% to 20% of the items in an inventory account for more than three quarters of the total annual turnover of that inventory. To be able to isolate and list this important section of the inventory is obviously of considerable value to management.

Chapter 2 General description

SYSTEM CHARACTERISTICS

Scope of the system

The routines described in Chapter 3, page 21, form the basis of an integrated adaptive system for:

1 Analyzing demand history in order to:

   (a) Classify items on the basis of both frequency of movement and commercial importance.

   (b) Establish control parameters and initial values for use by the operational system.

   (c) Assist management in the selection of the most suitable operating policy in the light of prevailing conditions.

2 Processing stock transactions in order to maintain an up to date record of the stock situation.

3 Allocating physical stock to each demand in accordance with a predetermined system of priorities or rationing scheme.

4 Reporting on current stock values, unsatisfied customer demands, new stock replenishment orders required, and items requiring progress action.

5 Control of stock levels by use of variable re-order points and variable re-order quantities, which respond to changes in demand.

6 Monitoring of the system's own performance and reporting when there is risk of loss of control optimality.

The system includes links for integration between itself and other important data processing routines such as:

1 Purchase and manufacturing order control

2 Sales invoicing procedures

3 Production scheduling

4 Cost accounting

5 Continuous inventory stock audit control

Operation of the system

The criterion by which the SCAN System 3 operates is that a stock replenishment order is placed for an item either whenever its available stock falls to or below a re-order point, or at the end of a predetermined time period. This may occur at any time as casual stock transations are reported to the system (random re-ordering), or the user may choose to generate replenishment orders on a periodic basis, irrespective of the level of available stock during the ordering period (cyclical re-ordering).

The re-order point determines when to order in random re-ordering systems. In cyclical re-ordering systems, a replenishment order may be requested only when the system detects that the end of the specified cycle period has been reached.

The re-order quantity is computed to give management the opportunity to:

1 Minimize the sum of supply and stockholding costs, or

2 Order the minimum necessary to maintain system stability, or

3 Order at specified regular intervals.

The re-order quantity indicates howmuch to order when the system calls for replenishment action.

The choice between the various techniques may be made individually for each item.

By monitoring the errors (as indicated by the difference between actual demands and predicted demands or forecasts) and by referring to specified limits the system warns management of any loss of forecasting efficiency.

The system is particularly suitable for the control of finished product warehouse stocks or branch stocks or in a multi-level environment containing both types of location. In addition the techniques employed may be used in many other areas of inventory management where the stock holding is not directly dictated by a production programme.

OUTLINE OF SYSTEM ROUTINES

The routines forming the basis of the system fall into three classes:

1 File management

2 Analytical

3 Operational

The integrated control systems flowchart (see Figure 24 to 27, pages 174 to 179) shows the relationship between the analytical and operational routines. Chapter 6 page 165, suggests methods of integrating this control system with other important user commercial routines. Where applicable all routines will accept punched card or paper tape input under operator control.

A simulator is provided to examine the operation of many aspects of the system without the files being established (see Chapter 8, page 187).

File management routines

The file management routines are required:

1 Initially to create and subsequently to maintain the master files used in the system.

2 To provide a facility for examining on demand the contents of one or more item records in the master file.

3 To transcribe information from SCAN 1/2 main files to SCAN 3 main files.

MASTER FILE CREATE/MAINTENANCE ROUTINE

The master files must be created before any attempt is made to operate the system on the computer. After the files have been created, changes to the item records held on the master files will occur periodically in the normal course of events and provision must be made for these changes to be incorporated without hindrance to the system.

The system described in this manual uses two such master files, the *Stock Master* file and the *Demand History* file.

Stock Master file

The Stock Master file is the central file of the system; it must contain details of every item in the inventory. The record for each item will include the price of the item and descriptive information, all the balances required by the system, for example, the stock balance, and supplementary information designed to measure control efficiency. The Stock Master file is regularly updated by the system and thus records the effect of stores transactions; it initiates reports of unnacceptably high or dangerously low stock levels of items, stock-outs, replenishment order requisitions and unsatisifed customer demands. It also accumulates the data used for updating of the Demand History file (see below) and for user routines to provide periodic stock lists, stock status reports and detailed stock evaluations.

Demand History file

In any stock recording system, a record of demand history for each item in the inventory should be kept. Thus at any time when the need arises, the demand history can be reviewed.

The system provides for the disc file containing the demand history information to be updated regularly with more recent data; thus, access can be made to this information within a relatively short time. The system allows for a demand history of up to two years to be stored in the file. The length of the basic time unit over which individual period demand levels are stored is decided by the user when the system is first set up.

The Demand History file may be used in several ways:

1 For analyzing a sample of inventory items during preliminary study to establish the inventory profile, that is, the way the stock holding is distributed across the range of items relative to their contribution to annual usage value.

2 For analyzing and classifying the total inventory

   (a) Before the system is put into operation, if such analysis and classifications are required at that stage.

(b) Again when review of control performance is required; usually this review will be required annually.

3 To review special sections of the inventory, for example slow movers, when necessary.

4 To examine the demand histories of specific items.

5 To compute seasonal factors if required, and to recompute them periodically if necessary. In addition, statistical fields can be initialised.

6 To assist in the selection of operating policy both initially and when business conditions change.

The Demand History file is also used by SCAN System 3 as a matter of routine for those items included in the adaptive control system.

Operations available with Stock Master and Demand History files

The following types of operation are available for use with both the Stock Master file and the Demand History file.

1 FORM. Records formed using the FORM operation will either be used to create a master file on disc or be inserted into an existing disc file. A list is printed giving details of each item record that has been formed; the list may be used as a master file reference.

2 COMBINE. The COMBINE operation is used to replace in a disc file those records that have been removed using the SELECT operation (see item 3 below). Thus, a serial file, the file of selected records, is combined with a sequential file, the main file.

3 SELECT. The SELECT operation extracts selected records from a master file and writes them to an output disc file. The selected records are deleted from the master file. After the requisite action concerning the records has been taken, the extracted records may be merged with the main file using COMBINE (see 2 above).

4 DELETE. The DELETE operation deletes any specified item record from the master file and records the action on a listing.

5 MODIFY. Any field which can be formed by the user for either of the master files may be updated or altered using the MODIFY operation. A list is printed of the old (or previous) field values and the amendments.

Note: All the operations described above, except COMBINE, will produce a list recording the action taken.

DISC FILE RECORD LIST ROUTINE

The Disc File Record List routine is designed to list the contents of records in either the Demand History or the Stock Master file. The program will operate on both the main sequential files or the selected serial files. Any number of records may be printed in one run and the listed record contains the names of the fields as well as their contents.

The user has the option of listing selected individual records, all records which have not been printed since modification or creation, all records on the file, or all records within a range of item number/group codes.

MAGNETIC TAPE TO DISC MAIN FILE TRANSCRIPTION ROUTINE

The Magnetic Tape to Disc Main File Transcription routine converts a magnetic tape main file as used in the SCAN 1/2 system to the corresponding serial main file in SCAN 3 format.

The program has two functions. The first is to form a SCAN 3 Demand History serial file from information contained in the SCAN 1/2 Demand History file. The second is to form a SCAN 3 Stock Master serial file from information contained in the SCAN 1/2 Stock Master and Demand History files and the user supplied run parameter record.

Analysis routines

The analysis routines are used to study the structure of the inventory and to set up the control system parameters initially. They may also be used at subsequent times when:

1 Additional items are included.

2 The system's performance is re-evaluated.

3 The prediction parameters are to be re-set.

STOCK PROFILE ANALYSIS ROUTINE

The Stock Profile Analysis routine analyses demand history, item by item, and, by calculating the frequency of movement, determines the most suitable time interval for forecasting. This time interval is calculated in terms of

the basic time unit over which the demand data is collected. For example, if demand data were collected weekly, a minimum forecast interval of '1' in Figure 10, on page , would mean that a new prediction of demand should be made not more frequently than once a week. If demand data were collected once a month, a forecasting interval of '1' would mean that the forecasts of future demand should be made monthly.

The analysis performed by this routine will enable Management to select from the total inventory the fast moving items and thus possibly include them in the adaptive control system. Any item with a recommended forecast interval of more than four weeks (or one month) should not be chosen for inclusion in the adaptive control system; these items will normally be regarded as slow movers. If the unit cost of a slow moving item is high, then it may be necessary to maintain a tight manual control over the stock of the item or to operate the stock on an imprest system whereby each unit of stock is replaced when it is used. If the unit cost of a slow moving item is low, a simple fixed re-order point control system may be quite adequate because the economics of replenishment order size become the overriding consideration. However, any item may be included in the adaptive control system if the minimum forecast interval recommended by the Stock Profile Analysis routine is observed. For some fast moving items the cost of collecting data regularly and processing may not justify the inclusion of the items in the system.

The ABC analysis, described in the next section, assists in isolating items of this type, but the final choice of items to be included is made by management.

A *static* item is an item for which the forecast interval is zero, and for which there is no recorded demand in the data history examined. Static items should be reviewed individually to ascertain whether or not their continued retention in the inventory is justified.

Each item processed by the Stock Profile Analysis routine is analysed over the demand history supplied in terms of average annual sales (or usage), average annual gross margin (sales value minus cost value) and current stock value (at cost). The items included in the Stock Profile report (see Figure 10, page) may be selected on the basis of recommended forecast interval. Also, a summary table may be printed; if one is required, to show the item count, annual sales stock value and annual gross margin on a cumulative percentage basis, for each forecast interval in turn.

The Stock Profile report may be used for comparative study both before and after the control system is implemented to review system performance and to evaluate the stockholding position. If a more detailed study of these aspects is required, the ABC Analysis routine may be used.

ABC ANALYSIS ROUTINE

The ABC Analysis routine is an extension of the Stock Profile Analysis routine and it enables management to study the commercial aspects of an inventory in greater depth. This routine recognises the fact that such study must take into consideration the frequency of movement of items since it is this that determines the range of choice of control techniques.

If the individual items of an inventory are graded on the basis of the contribution each one makes to the value of the annual turnover, overhead expenses or gross profit, the range of variation is very large. If the items are arranged in a descending sequence of annual usage value for example; and the contribution of each is summed across the inventory, it is likely that the first 10% or 20% of the items account for more than three quarters of the total turnover; the last 20% of the items will probably contribute only a few percent of the turnover.

The same pattern will evolve again if the items are sequenced by gross margin or frequency of movement.

It is important to know how the stock value varies with the contribution each item makes to the value of annual turnover, with the gross margin and with the frequency of movement, across the inventory. One important purpose of inventory analysis is to highlight the pattern of this distribution so that corrective action can be taken. It will often be found that inadequate stocks of the important items are carried and, as a result, customer service is bad and high costs are incurred. Also, the stocks of the more numerous slow moving items are often excessive for the level of customer service required. Since the investment in stock of slow moving items can be recovered only slowly, the capital available for investment in increased stocks of the more rewarding high turnover items is restricted.

The Stock Profile Frequency Analysis table (see lower half of Figure 12, page 38) gives a first assessment of the stock profile, that is the distribution of stock value in relation to the frequency of movement, the annual usage value and the gross margin. The ABC Analysis routine can be used to provide a series of reports to supplement this information.

As a first possible run, the ABC Analysis routine may be used to print the Preliminary report (see Figure 13 page 42) which shows for each progressive 5% (approximately) of the annual usage value, the progressive percentage values of the gross margin, stock value and item cost.

Classification of each item according to its contribution to the annual turnover has been found useful in practice. A simple ABC classification is commonly used. Since the frequency of movement is important, the classification is

supplemented in the SCAN Systems by a suffix which may be 1, 2 or 3. Use of this combined class code, for example A1, in various reports produced by the system gives a quick appreciation of the importance and nature of the item in question.

The way in which the ABC classification divides the inventory is a matter for individual choice and will depend on local circumstances; a typical subdivision could be that the items included in the top 80% of the annual usage value would be items 'A', those included in the next 15% would be items 'B' and the remainder would be items 'C'.

Similarly, the user may decide the way in which the movement frequency suffix (1, 2 or 3) divides the range of recommended forecast intervals, which are derived directly from the calculation of the average frequency of movement for each item. A suffix '1' will always signify a forecast interval of 1. '2' and '3' may be used to distinguish either between the medium speed and the slow movers or between the slow moving items and the non-moving items; usually, the former will be preferred.

The ABC Analysis Summary and Stock Profile Frequency Analysis tables may be used to define the various classes of the ABC classification. Although the ABC Analysis routine may be used to list the items in any of a number of sequences, the preferred sequence will be descending value of item turnover. Either a full or a restricted listing of the items may be printed. For example, a list of low usage value items, or slow movers, could be produced so that these items can be specially reviewed. A typical list is shown in Figure 13 page 42.

The ABC Analysis routine will also produce the Summary report showing the contribution of each of the nine classes (A1 to C3) to turnover, gross margin and stock value (see Figure 13, page 42).

CONTROL SYSTEM SELECTION ROUTINE

1900 SCAN System 3 provides a number of control techniques to cater for the needs of the various classes of item to be found in a single inventory; one control technique must be chosen for each item. For fast moving items, the automatic adaptive control (see Chapter 1) is preferred; this may use a policy of either random or cyclical re-ordering and one of three types of forecasting.

Although the automatic adaptive control system can be used for every item (if the recommended forecast interval is observed), it may be preferred to use fixed re-order points and re-order quantities for items of low usage value. Again a choice may be made between random and cyclical re-ordering. For the slow moving, high cost items, it may be preferred to use an imprest system, using fixed re-order points (set to the stock level that it is desired to maintain) and fixed re-order quantities (set to zero). Only random re-ordering would be suited to this last system.

Thus there is an effective choice to be made between five different methods of control.

The choice of control system is indicated by allocating a *system marker* to each item. This may be done in the control system selection routine by allocating a system marker to each of the nine classifications generated by the ABC Analysis routine. The program is notified of this at run time and then each item is given a control system marker dependent on its ABC classification.

The Control System Selection routine records the ABC classification and the system markers in both the Stock Marker file and the Demand History file. Also, if the user wishes, the routine will initialize the Demand History file so that forecasting can be carried out for those items with the appropriate system marker. Initialization involves giving fixed values to the prediction parameters used in forecasting, unless supplied by the user where applicable, and setting estimates of certain statistical quantities (see *Processing* page 47) so that the forecasting routine can establish control quickly. If initialization is specified, use of the Demand Analysis routine is not required.

The routine also provides a printed list of stock items showing the system marker that has been assigned to each item.

DEMAND ANALYSIS ROUTINE

The object of the Demand Analysis routine is to perform further calculations on the demand history of an item presented to it, in order to obtain optimum initial values for fields used in forecasting and to test for the presence of seasonality and/or trend.

The routine will carry out no calculations for items for which forecasting is not to take place or for which demand history insufficient to span four forecast intervals has been provided. For processed items the prediction parameters will be set to standard values unless overridden by user supplied values. Only if more than one year plus twelve forecast intervals of demand history are provided will tests for trend take place. Similarly, seasonality tests will only take place if two years' data is provided.

The user is given a number of options to govern the processing of the routine by parameter. He can, for example, specify that no processing take place for all items with forecasting frequency less than that supplied. Similarly, he can choose not to calculate seasonal factors for an item for which he may have set up factors to reflect his knowledge of likely demand patterns. A full and abridged item record report is provided and the user may choose which format

he requires. He may also specify all forecast items or only those which have been processed are listed.

Note: It is not absolutely necessary to use the analytical routines, arbitrary classifications may be given on the basis of the Stock Controller's knowledge and then the operational routines will provide the desired control. However, Stock Controllers can gain valuable experience from processing their inventory records through the analytical routines described above.

Operational routines

The operational routines provided in SCAN System 3 form the basis of a user's data processing system. All stock transactions are recorded on disc and are processed against the Stock Master file to provide updated stock balances. The balances are used, in turn, to provide exception reports for management action and disc files for entry to computer routines in other business systems areas. Thus, the user may expand the system to include all desired areas of data processing.

TRANSACTIONS FILE CREATION ROUTINE

The Transactions File Creation Routine is described under the heading 'Operational routines' because it is the routine used to record all stock transactions; the file is then used as input to the operational routines.

A common input format is provided for each type of transaction and the transactions may be written to a disc file in any sequence providing the file is subsequently sorted using standard software (see page 55).

The following types of transactions may be input:

1 TRANSACTION ADJUSTMENT. A transaction adjustment is used to adjust or cancel any of the recirculating transactions.

2 AUDIT REQUEST. An audit request may contain details, to be matched against the Stock Master file record, of the current physical stock position for the item.

3 STOCK BALANCE/ORDER BALANCE ADJUSTMENT. The stock balance/order balance adjustment amends the stock balance or the order balance on a Stock Master file record.

4 STOCK RECEIPT AND SCRAP. This transaction notifies the system of receipts from the supplier or the factory and includes a facility for monitoring scrap.

5 RETURNS OUTWARD. The returns outward transaction caters for stock that has been returned to the supply source for replacement.

6 UNSCHEDULED ISSUES. If stores issues are made without using the system pre-allocation procedure, the Stock Master file must be updated in arrears. After processing in stock updating, the record remains on the Transactions file so that the issue can be invoiced if required.

7 SCRAP NOTIFICATION. Scrap notification records scrap that has occurred or has been detected on items after receipt.

8 RETURNS INWARD. The returns inward transaction records the return of goods from a customer for credit.

9 BRANCH TO BRANCH TRANSFER. A branch to branch transfer enables stock to be transferred from one branch to another within the same group.

10 DEMAND. Demands are orders placed on a store by customers or by a factory; these orders are to be pre-allocated by the system before issue.

11 STOCK COUNT. The stock count enables the branch to notify the computer of the counted stock balance. The computer then calculates the branch usage.

The routine will create the disc file and will list each transaction on the line printer for reference purposes. The routine will also give batch control totals if these are required.

SORT/MERGE ROUTINES

Standard sort/merge software may be used to sort the transactions file into the required sequence for processing by the next routine and, if required, to merge a recirculating file (containing outstanding transations) with the current transactions file; normally the sequence will be arranged with priority code within due date within transaction code within item number.

STOCK UPDATING AND ALLOCATION ROUTINE

This routine is the basis of the control system; it produces most of the exception reports and generates the data for use in other routines.

The routine maintains a record of stock availability for all stock items and applies re-order point control to all items with a system marker in the range 0 - 9; it also gives the necessary demand data to the Stock Forecasting and Monitoring routine so that variable re-order point control processing can be carried out on selected items and an historical demand array for all items can be built up for future analysis.

Not all items in an inventory will require the same control techniques, and therefore the Stock Updating and Allocation Routine updates all Stock Master file records affected by current stock transactions and applies the form of control indicated by the system marker contained within the record.

If an audit request is present, it is processed to give current stock balance information.

When each record has been updated, stock is allocated to demand; customer demands may be processed in one of the following ways:

1 The customer demands are processed separately against the stock balance in the sequence in which they are presented to the program until stock is fully consumed or all demands are satisfied.

2 The stock available is allocated proportionately to all the demands present.

The amount by which the demand has not been satisfied is written into the original demand record. This record can then be used by user routines for preparing an invoice, a despatch note and possibly for sales statistics, credit control and cost accounting routines.

If a demand cannot be fully allocated, the Updating Reports routine detects this from the information written into the transaction record and is then able to generate a back order record. This record is recirculated back into the system so that when it enters the Stock Updating and Allocation routine the next time it may be given attention before the new demands are processed.

A priority code may be used for each demand or for selected demands to control the priority of allocation.

Individual customer demands not requiring immediate allocation are recirculated until their due date is within one lead time from the current processing date. These demand records will then be classified as forward demands and will be added to the demand accumulators. In addition, the user may set a date so that when the due date of the forward demands is within the range of the date set by the user, an attempt will be made to satisfy the demand.

The user may decide to remove demands that do not require immediate allocation and to use some other form of control or processing.

Since SCAN System 3 uses a record key comprising the item number and the group code, it is possible that there will be records for many different locations all containing the same item number; one or more of these records may be records of warehouse stocks. Orders that are placed by branches on the warehouse stocks may be entered as being demands on the warehouse stocks in the usual way if the Stock Updating and Allocation routine is being used. If the records for warehouse stocks are to be updated automatically without any new transaction records being created (see Automatic Ordering routine), then a special group code must be used to signify which records are for warehouse stocks.

When all demands have been satisfied or back ordered, the available stock (that is the stock balance minus the back orders and plus the stock on order) is compared with the re-order point. If the re-order point is not less than the available stock, a replenishment order is requested. The order quantity may be one of the following:

1 A minimum quantity set by management.

2 An economic order computed to conform with parameters set by management.

3 An order quantity computed to last over a pre-selected ordering interval based on the usage rate.

A maximum order size may be specified.

Cyclical ordering may be used, that is replenishment order quantities will be requested at fixed time intervals rather than at time intervals approximately equal to the preferred ordering interval approximately equal to the preferred ordering interval (as with random re-ordering). Items may be grouped into ordering groups so that the orders for different ordering groups will be produced on different days of the week.

A bulk order call off system of replenishment may be used. The user and the supplier will negotiate a quantity that the user will order over an agreed period of time. This bulk order quantity and the agreed time limit are entered on the stock master record for the item. The system will then place a bulk order for the quantity and will place call off

orders using re-order point control theory on a random or a cyclical ordering basis.

If replenishment orders produced by the system are adjusted before being submitted to a supplier, the system must be notified of the amount of the adjustment; otherwise the stock on order balance will be incorrect, and control may be lost.

All receipt and issue transactions will be output together with the relevant cost data for use in the user's costing routines.

The system compares the physical stock balance with the maximum and minimum stock levels set by management. If these levels have been exceeded, stock monitoring records are output to disc. The user can suppress the check and the output of stock monitoring records by choosing suitable run-parameters for a run of the Updating routine. This may be of use if the user wishes to prevent the same condition being reported several times.

During a run of the Stock Updating and Allocation routine, only the following are printed.

1 Error reports on invalid transactions.

2 A summary of stock activity and opening and closing balances. This is printed to enable controls to be balanced and to provide for management a report on stores activity since the previous Stock Updating run.

At the beginning of a run, the Transactions file NEWTRANSACTS is renamed OLDTRANSACTS so that it cannot be resubmitted accidentally.

AUTOMATIC ORDERING ROUTINE

The Automatic Ordering routine, which is ancillary to the Stock Updating and Allocation routine, is for use in a two level system, where item/group records are placing replenishment orders upon internal warehouse records.

The routine will process orders placed on internal warehouses as if they were demand transactions on the warehouse records. It will then allocate stock accordingly (or back order if necessary) and update warehouse stock availability balances on the same basis as the Stock Updating and Allocation routine. Similarly, control action is taken to determine whether warehouse replenishment orders are necessary and whether stock levels infringe limits imposed by the user.

STOCK UPDATING REPORTS ROUTINE

The Stock Updating Reports routine provides reports associated with the previous Stock Updating and Allocation run, generates forward dated receipts records and carries forward recirculating transactions. Each of these functions is described more fully below.

The disc files produced by the Stock Updating and Allocation routine are also used by the Stock Updating Reports routine for the production of reports. The reports are described below; the listing of each report is optional so that the reports can be listed either all in one run or separately in different runs.

Allocation report

This reports allocations from stock made to meet demands entered by the user or made to meet back orders created because previous demands have not been allocated.

Stock Under Minimum report

This lists the branch records of items whose stock has fallen below a minimum stock warning limit set by the user.

Stock Over Maximum report

This lists the branch records of items whose stock has exceeded a maximum stock warning limit set by the user. This report is always produced on the same run as the Stock Under Minimum report.

Replenishment Orders report

This provides all the information concerning orders that the user will need if he is to place the orders manually.

The Stock Updating Reports routine optionally carries forward recirculating transactions for any one run but must be used once. Records selected from the input Transaction file must be carried forward to be input to the next Updating run. The selected records would be records of forward demands, back orders or forward dated receipts. Whilst this function is being carried out, the Allocation report is produced.

As an additional function, forward dated receipt records can be produced to complement the automatic orders requested by the updating run. The Orders file is searched for branch orders that have been placed automatically

on the warehouse stocks and corresponding forward dated receipts are produced. The due date of these receipts is one lead time in the future and so the receipts are recirculated until their due date is reached. When the order is assumed to have been delivered to the branch, the branch record is updated. This process is of most use when lead times are stable, for example if internal transport is being used, and if it is used in conjunction with Automatic ordering, the number of transaction records submitted to the computer will be considerably reduced.

When the Stock Updating Reports routine has been used, files are available for input to user routines as follows:

1 AUTOMATIC PURCHASE ORDER CONTROL. The Replenishment Orders file provides an entry to automatic purchase order control if required. If the frequency of stock updating is greater than the frequency of purchase order control then it will be necessary to merge the Replenishment Order files produced by several stock updating runs. However, in such a situation the user is advised to use cyclical re-ordering so that the orders will be generated in a single file when they are required.

   It should be noted that if any of the orders produced by the system are modified by the user routines then stock on order adjustment transactions must be submitted to the next stock updating run unless the user generates an automatic procedure for incorporating the adjustments.

2 INVOICING. If automatic invoicing is required, the Transactions file must be accessed. This file will contain full details of all stocks that have been allocated to demands or that have already been withdrawn by unscheduled issue during the last stock updating run.

Other control features, for example, Audit Control, Cost Accounting and Invoice Checking will be carried out by examination of the Transaction file.

STOCK FORECASTING AND MONITORING ROUTINE

The Stock Forecasting and Monitoring routine forms the basis of adaptive control as performed by SCAN System 3. Each group record in the adaptive control system is processed and a new prediction of demand for the next time period is computed by an automatic forecasting technique. If the group contains more than one branch then when the forecast at group level has been made a branch forecast is made; the branch forecast is based on the group forecast and on the contribution the branch makes to the total group demand.

The new predicted demand is then used in the computation of re-order point and re-order quantity for the branch.

If economic ordering is to be used at branch level then the re-order quantity will be determined from parameters selected by management, and taking into account quantity discounts if these apply. The re-order quantity is calculated without taking into consideration the requirements of any other branch stocking the same item.

During any one run of this routine, only the records of items due for reforecasting are fully processed since not every group will require a new forecast at every forecast run; for some groups forecasts made every alternate run or less will be sufficient. The seasonal factors calculated by the Demand Analysis routine or specified by management will be used in the calculation of the new forecast of demand.

The Demand History file is updated for every item/group record during the running of this routine so that there is always an up to date Demand History file available for analysis.

The validity of the prediction parameters is checked by automatic monitoring of the forecasting performance at group level.

All item records held on the Demand History file undergo some processing but forecasts are made only for those items whose item records include the appropriate system marker.

An important point to notice is that when the re-order point is recalculated, it may be greater than the available stock level. If the Stock Updating and Allocation routine is used frequently enough, new replenishment orders will be generated quickly. But, if there is a significant time lag between forecasting and normal updating then the Stock Updating and Allocation routine should be entered immediately without any transactions being submitted so that any additional replenishment orders required can be generated.

There is a facility in the Stock Forecasting and Monitoring routine for a separate run-type to generate a skeleton Demand History file from information contained in the Stock Master file. It is optional and the user may specify its use by run parameter. If he uses this facility, which will copy common information from the Stock Master to the Demand History file, he will save the extra cost and increased error risk from punching the information twice.

However, if it is required to use analysis on these items, then a skeleton Demand History file is inadequate. As well as demand history if available, extra information must be added to the Demand History records and this is done by means of the Master File Maintenance routines.

FILE FORMATS

The suite of programs supporting the 1900 SCAN System 3 includes file creation routines which may be used to create from punched cards or paper tape the main files used by the System. However, the user may prefer to write his own programs for creating the two master files if the data for these files is already recorded on other files in use in the user's own data processing routines.

Similarly, it may be more convenient for the user to generate some of the branch transaction records in his own routines, for example, Order Amendment Transactions from an automatic ordering routine. The formats for these records should be as specified in this manual; the file should be merged with the file created by the SCAN Transaction File Creation routine before the Stock Updating routine is entered.

If the SCAN File creation routines are to be used, the punching formats specified in this manual (see Chapter 4 page 77) must be used. Also, the specified disc file formats must be adhered to unless the user modifies the SCAN programs. The user is advised to avoid amending the SCAN programs since user-modified programs will not be maintained by ICL and it will be difficult for the user to take advantage of developments resulting from ICL's continuing work in the field of inventory management systems. The SCAN routines have been written to accomodate stock master records containing user information at the end of the record; but, such information must not cause the maximum record length to exceed 279 words. To take advantage of this facility, the user must write his own routine to create and maintain his part of the record. SCAN System 3 processing programs are designed to process the SCAN part of each record and to leave the user part unchanged. If this facility is used then the need for user amendments to SCAN programs will be minimized.

PROGRAM STRUCTURE

The SCAN System 3 processing routines are written in 1900 COBOL or 1900 FORTRAN, depending on the complexity of the program, and the file creation routines in which additional flexibility is required are written in PLAN 3. The 1900 FORTRAN routines have PLAN input and output sections.

Chapter 3 System descriptions

This chapter describes the basic specification of the ICL SCAN System 3 which comprises:

1 File management routines

2 Analytical routines

3 Operational routines

The information for each routine is divided into the following:

1 Objective

2 System flowchart

3 Input

4 Processing

5 Output

6 Peripherals

Note: The minimum system configuration is given in the Preface.

INPUT/OUTPUT RECORDS

The punched card or paper tape and disc file records described in Chapter 4, page 77 , and referred to in this chapter, contain the necessary fields to produce the results indicated on the report formats shown, and fields for data in common use for input to other commercial data processing systems.

PROCESSING FUNCTIONS

The major processing functions of the ICL 1900 SCAN System 3 are as follows:

1 From an analysis of demand history the minimum forecast interval is calculated, the items of the inventory are classified according to frequency of movement and annual usage value and Management is guided in the selection of the control system to be used for each item.

2 By analysis of demand history the following are computed:

   (a) Mean demand

   (b) Standard deviation of demand

   (c) Initial values to start the forecasting process

3 Prediction parameters are set for forecast items.

4 A suitable replenishment order strategy is applied.

5 The available stock is automatically allocated to demand.

6 Outputs are prepared indicating replenishment requirements, stock allocation and items requiring progress action.

7 Re-order points and replenishment order quantities are determined from predictions of future demand.

8 Prediction errors are monitored.

The following information for Management action is issued on a routine basis.

1 Replenishment order quantities selected to:

(a) Minimize the sum of supply and stockholding costs over time (economic re-order quantity), or

(b) Maintain system stability (system minimum re-order quantity), or

(c) Observe Management ordering policy (minimum or maximum re-order quantities), or

(d) Conform to a fixed size chosen by Management.

2 The replenishment order quantities may be requested on a random basis, that is, as need is detected, or on a fixed cycle, for example once a month, and either type may be a call off from a bulk order.

3 A report of all items whose forecast errors exceed stated limits

4 A report of all stock items below a minimum stock level

5 A report of all stock items above a maximum stock level

6 A report of all allocated demands showing quantities allocated and unallocated (back ordered)

FILE MANAGEMENT ROUTINES

Master File Maintenance Transcription routines (Demand History X43Y, Stock Master X43Z)

OBJECTIVE

The objective of these routines is to create from cards or paper tape a serial disc file containing card images suitable for input to the Master File Maintenance routines. Each Master file uses a different transcription routine. A system flowchart for these routines is shown in Figure 6 below.

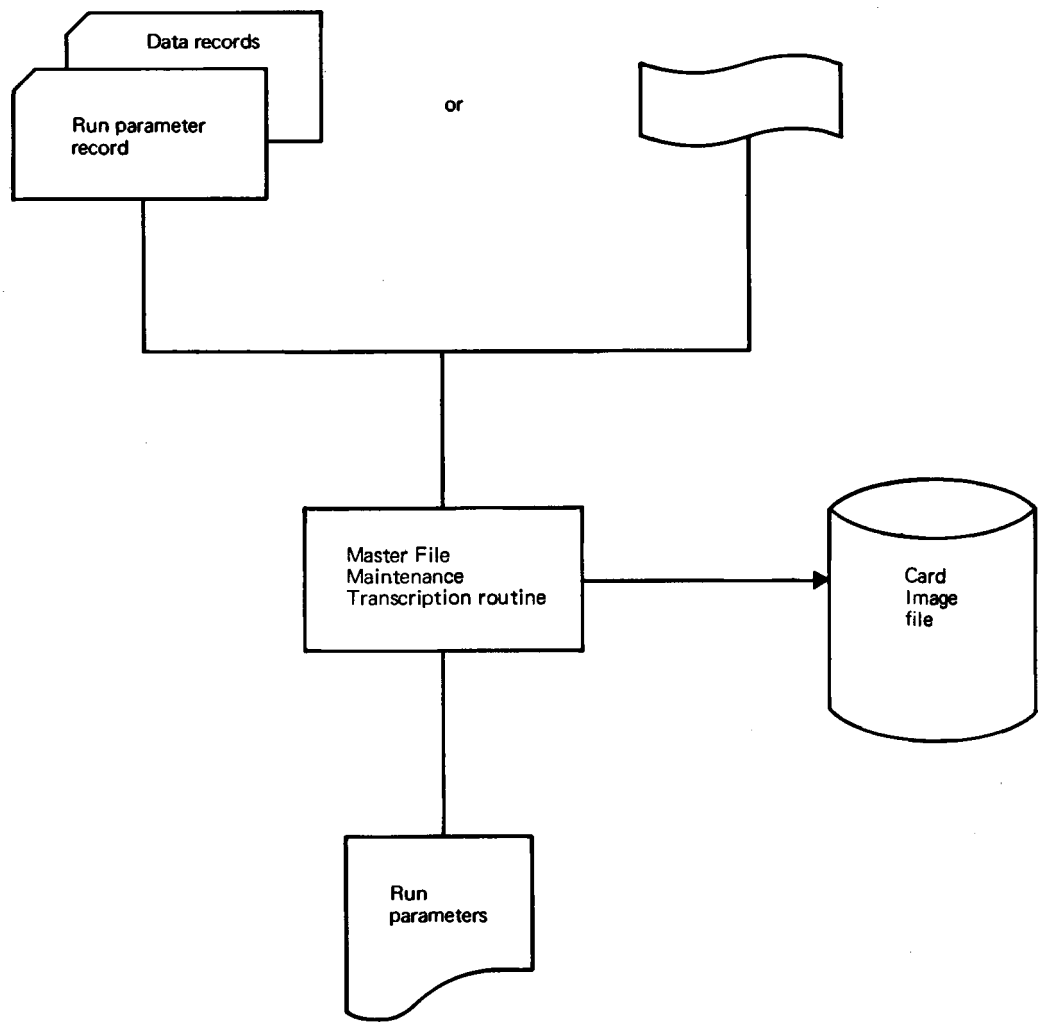


Figure 6 System flowchart for Master File Maintenance Transcription routine

INPUT

1 RUN PARAMETER RECORD. This record names the input file that is to be written to and gives the name of the output file.

2 DATA RECORDS. See Figure 21, page78, and Figure 22, page 84.

PROCESSING

The Master File Maintenance Transcription routines create serial disc files, in standard direct access format, for input to the Master File Maintenance routines. A different transcription routine is required for each file.

Data is read in random order either from cards or from paper tape and is stored on disc in card image form. No validity check is made by these routines since full validity checking facilities are available in the Master File Maintenance routines.

When the disc files have been created by the transcription routines they would normally be sorted using standard sort software, but if there are only small amounts of data then the data can be hand sorted and the sort phase of processing can be omitted; in this case, the appropriate file name should be selected by the user (see below).

OUTPUT

1 One serial disc file
The file for input to the Stock Master File Maintenance routine should be named either:

(a) STOCKINPUTVV if the data is being input randomly, or

(b) SDSTOCKINPUT if the data is hand sorted.

The file for input to the Demand History File Maintenance routine should be named either:

(a) HSTRYINPUTVV if the data is being input randomly, or

(b) SDHSTRYINPUT if the data is being hand sorted.

2 A printed statement of the run parameters

PERIPHERALS

The peripherals required by the transcription routines are:

1 One card reader or one paper tape reader

2 One disc transport

3 One line printer

SOURCE LANGUAGE

PLAN 3

Master File Maintenance routines (Demand History X43A, Stock Master X43B)

OBJECTIVES

The objectives of the Master File Maintenance routines are as follows:

1 To Combine two part disc files, one of which is a sequential part file and the other a serial part file.

2 To Form records into an existing sequential disc file.

3 To Form records on a new serial disc file.

4 To Modify fields of any records on a sequential disc file.

5 To Delete any record from a sequential disc file.

6 To Select any record from a sequential disc file on to a serial disc file.

7 To Renumber any record key (item number/group code) on a sequential disc file.

Notes:

1 A separate routine must be used for each of the two master files used in the 1900 Series SCAN System 3

The initial letter of each of the functions mentioned above is used for control purposes and therefore it is important that the SCAN System 3 terminology be retained when the system is used.

The terminology used in File Maintenance is similar at both file and record levels and therefore requires some clarification.

Master File Combine Operation

This combines two part master files. No data records containing record functions are processed.

Master File Form Operation

This forms a serial master file. Only record Form functions are processed.

Master File Modify Operation

This modifies an existing sequential master file by inserting new records or changing existing records. The record functions Form, Modify, Delete and Renumber are processed.

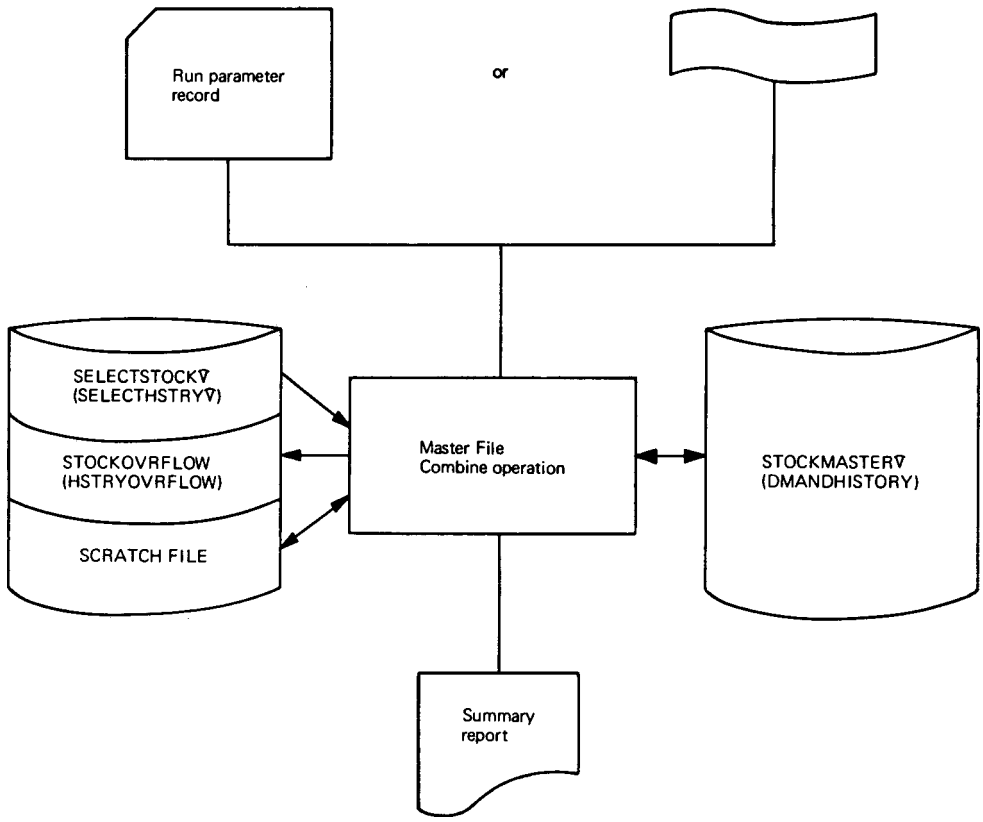
Master File Select Operation

This is a file Modification run in which, in addition to the above functions, the record Select functions are processed.

The separate operations Combine, Form and Select are described in the following pages. The File Modify operation is not shown since this is similar to the Select operation.

Master File Combine

A system flowchart for this operation is shown in Figure 7 below.



Note:
Unbracketed file names are used in Stock Master file maintenance
Bracketed file names are used in Demand History file maintenance.
Scratch file is used for both types of maintenance.

Figure 7 System flowchart for Master File Combine operation.

INPUT

1 Run parameter record. This record identifies the input and overlay disc files to be used.

2 One serial disc file containing records in master file format

3 One overlay sequential disc file containing the master file

PROCESSING

The Combine operation reads complete records in master file format from a serial file and inserts them into a sequential master file. If the file overflows the second level overflow area, records are written to the overflow file and then at the end of the run the 1900 File Reorganization routine must be used. Details of the records that have been inserted are written to the Scratch File during the run; at the end of the run, a report is printed from the Scratch File.

OUTPUT

1 One serial disc file if second level overflow area overflow has occurred during the run.

2 A printed list of items that have been added to the master file or have been written to the overflow file.

PERIPHERALS

The following peripherals are required by the Master File combine operation:

1 One card reader or one paper tape reader

2 Two disc transports

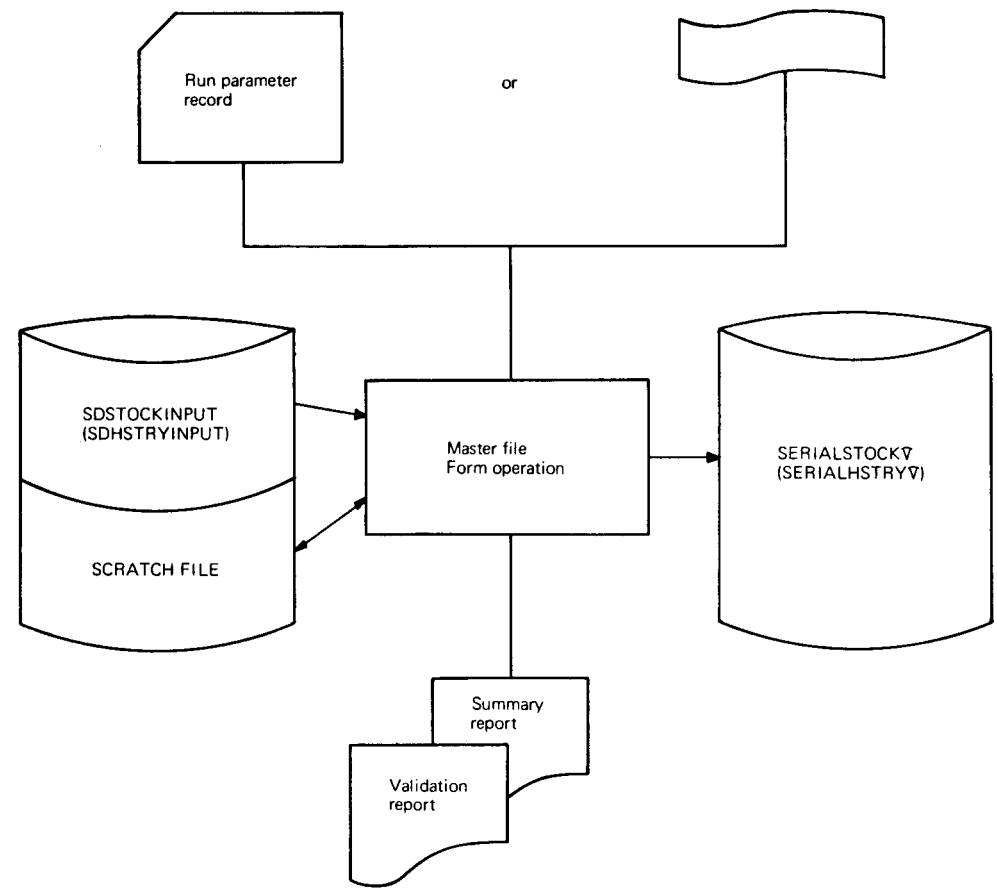
3 One line printer

SOURCE LANGUAGE

PLAN 3

Master File Form

A system flowchart for the Master File Form operation is shown in Figure 8 below.



Note:
Unbracketed file names are used in Stock Master file maintenance.
Bracketed file names are used in Demand History file maintenance.
Scratch file is used for both types of maintenance.

Figure 8 System flowchart for Master File Form operation.

INPUT

1 Run parameter record. This record identifies the input and output serial disc files that are to be used.

2 One serial disc file containing main file formation records in card image form

PROCESSING

For the Master File Form operation, records are present on the input file only; these records are used to generate master file records on a serial output file. (For forming records into an existing Master file, see page 30) A full validity check is carried out on the input data (see page 77) and input record images are printed out together with error codes beneath invalid fields. Also, when a main file record is formed, a record is written to the Scratch File to be printed at the end of the run. The input file is sequence checked and records that are out of sequence are rejected.

Note: When the serial file has been formed, the 1900 File Reorganization routine must be used to transform the file into the correct form before it is input to any of the SCAN System 3 routines.

OUTPUT

1 One serial disc file containing records in master file format

2 Printed validation report

3 Printed summary report

PERIPHERALS

The following peripherals are required for the Master File Form operation:

1 One card reader or one paper tape reader

2 Two disc transports

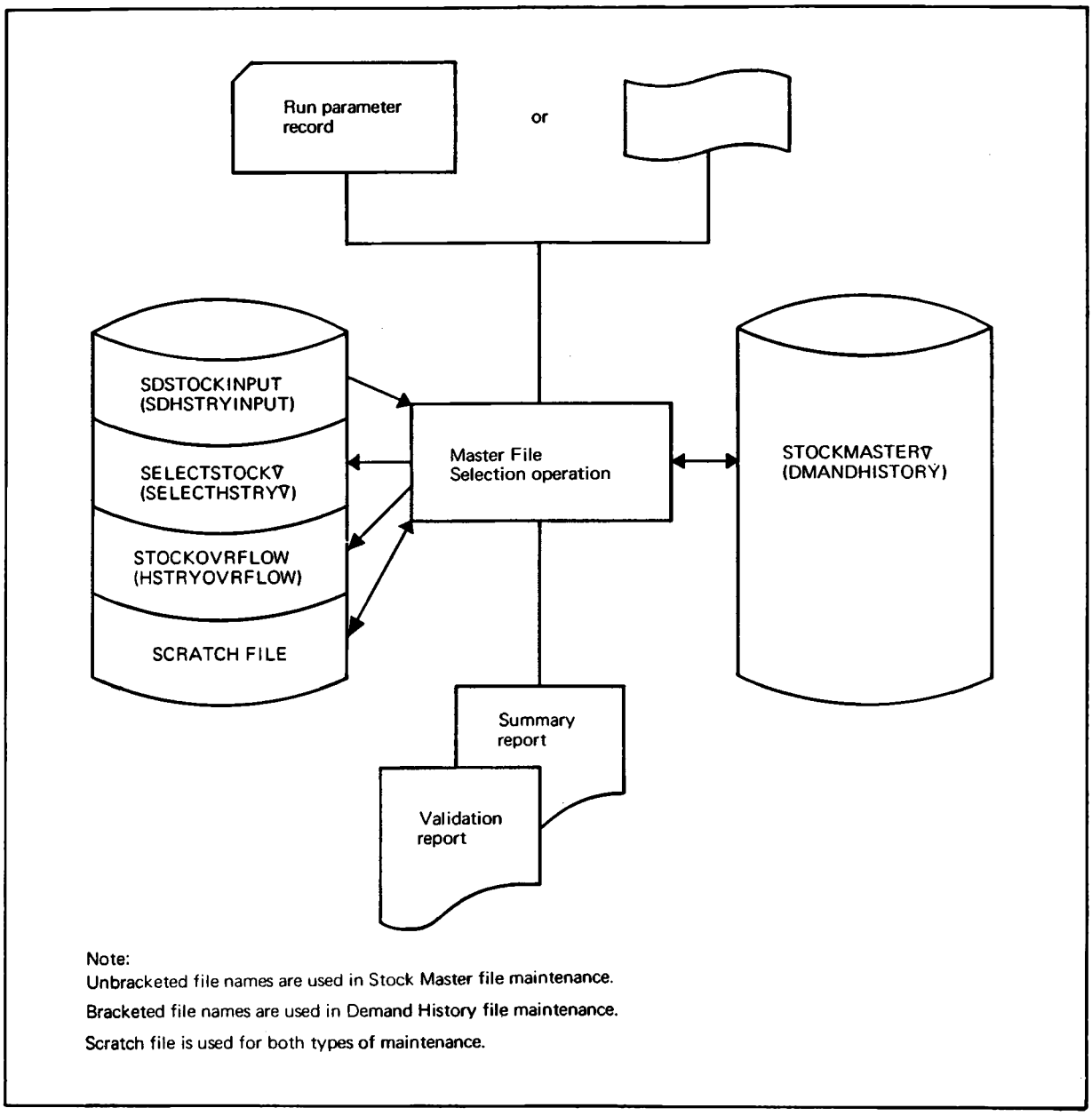
3 One line printer

SOURCE LANGUAGE

PLAN 3

Master File Selection

A system flowchart for the Master File Selection operation is shown in Figure 9 below.




```
DATA  VALIDATION  REPORT                                PROGRAM X43A                                DATE 27/09/68   PAGE    3

F1  AST/632/XZ/006F31 33 0.75          EACH          2.65    2.9 9.5    2796 53
F2  AST/632/XZ/006F3  ELECTRIC MOTOR TYPE 87C-220
F3  AST/632/XZ/006F3  0360 456 223 566 603 476 383 199 290 472 663 515 468 432
F3  AST/632/XZ/006F3 14226 371 868 613 306 531 761 499 300 186 378 206 416 563
F3  AST/632/XZ/006F3 28368 286 186 462 379 635 863 906 1063 871 613 729 488 317
F3  AST/632/XZ/006F3 42583 823 1013 1108 932 943 583 478 521 486 295 •
F1  BCD/111/AA/103D126 4 0.5            12          R.13    .2    6   893   28
                                                      C
F2  BCD/111/AA/103D1  FUSE HOLDERS BLK TYPE RX73A
F3  BCD/111/AA/103D1  0123 86 186 51 93 156 203 176 315 123 66 32 112 194 386
F3  BCD/111/AA/103D1 15154 76 53 133 96 234 206 130 86 94 106 231 168 •
DD  DAD/334/DA/426V8
U1  HUG/703/IN/060P3                          4670
 A
M3  JIM/135/LJ/546R5 546735
SD  LOO/233/LA/386C6
SD  SAK/003/IE/413H2
```

Figure 9 System flowcharts and reports for Master File Selection operation

```
SUMMARY  REPORT                                    PROGRAM X43A                                  DATE 27/09/68    PAGE    4
ITEM      AST/632/XZ/006  F3        FORMED
ITEM      DAD/334/DA/426  V8        DELETED
ITEM      JIM/135/LJ/546  R5  D054  MODIFIED FROM  735                          TO  6735
ITEM      LOO/233/LA/386  C6        SELECTED
ITEM      SAK/003/IE/413  H2        SELECTED




END OF RUN
```

```
DATA  VALIDATION  REPORT                            PROGRAM X43B                                  DATE 27/09/68    PAGE    3

F5  AST/632/XZ/006F3 6C  CX111A    100 2500.  1836      468   3200    650    170
                                              D
F5  AST/632/XZ/006F3 8A  JT368D   80    1750   960      580   2115    480   A25
                                                                             C
F6  AST/632/XZ/006F3 3  JK-763 9.5  2.65      10  4500 3.75        0201100   3
F7  AST/632/XZ/006F3    2.9             ELECTRIC MOTOR TYPE 87C-220      EACH
F8  AST/632/XZ/006F3  2500    2.6 3250     2.55   4000   2.4
M6  BCD/111/AA/103D1    TL-802                    3760
F2  CJK/125/LX/172R9  4 WAY HEAVY DUTY SWITCH ENCL.
 A
F5  CJK/125/LX/172R9 3S GS189J    500   7250   3760    1880  8880   3380  1000
F6  CJK/125/LX/172R9 4  FR-88  8.5  1.25      10  1000              1001000     1
F7  CJK/125/LX/172R9     1.5            4 WAY HEAVY DUTY SWITCH ENCL.
F9  CJK/125/LX/172R952   55000
M5  DOM/068/ZZ/001X7D8T
D0  EEL/006/JS/506K3
M6  GIG/776/MT/026I5                                            1
M9  GIG/776/MT/026I552   25000
M6  MIN/123/RS/664W6                                             0
```

```
SUMMARY  REPORT                                    PROGRAM X43B                                  DATE 27/09/68    PAGE    4
ITEM      AST/632/XZ/006  F3        FORMED      ERRORS
ITEM      BCD/111/AA/103  D1  SPCD  MODIFIED FROM  AB-601                      TO  TL-802
                              MXQT  MODIFIED FROM  3300                        TO  3760
ITEM      CJK/125/LX/172  R9        FORMED
ITEM      DOM/068/ZZ/001  X7        CONTRACTED
ITEM      EEL/006/JS/506  K3        DELETED
ITEM      GIG/776/MT/026  I5  MARK  MODIFIED FROM  030110000000                TO  13011000000
ITEM      GIG/776/MT/026  I5        EXPANDED
ITEM      MIN/123/RS/664  W6  MARK  MODIFIED FROM  020101000001                TO  000101000001
ITEM      MIN/123/RS/664  W6        CONTRACTED




END OF RUN
```

Figure 9 continued

INPUT

1 Run parameter record. This record identifies the input and output serial files and the overlay master file to be used.

2 One serial disc file containing card images of master file maintenance records

3 One overlay sequential disc file containing the master file

PROCESSING

The Select operation will perform any of the master file maintenance functions Form, Modify, Delete, Select or Renumber. The Form function causes a new record to be inserted in the master file; the remaining four functions affect existing records on the master file.

A full validity check is carried out on the input data (see page 77) and input record images are printed together with error codes beneath invalid fields. Any changes to master file records or any newly formed records cause a record to be written to the Scratch file for printing at the end of the run in the Summary report. The input file is sequence checked and any records that are out of sequence are rejected.

Two serial files may be produced by using the Select operation: the first is a selected records file which will be produced if the Select functions are present and the second is an overflow file which will be produced if second level overflow area overflow occurs. If overflow occurs then the 1900 File Reorganization routine must be used at the end of the run.

Processing for the File Modify operation is similar with the exception that a select file will not be opened and any Select functions present will be rejected.

OUTPUT

1 One serial disc file for selected records from the master file

2 One serial disc file if the master file has overflowed the second level overflow area.

3 Printed validation report. This report contains the input maintenance records in card image form. Invalid fields are denoted by an error code printed on the following line, beneath the field in error. The codes used are shown under *Run time errors*, page 143.

4 Printed summary report. This report contains a summary of any action that has affected a main file record. For a field modification, the relevant field is defined by a reference code following the item number/group code. The field references are shown on page 99.

PERIPHERALS

The Select operation requires the following peripherals:

1 One card reader or one paper tape reader

2 Two disc transports

3 One line printer

SOURCE LANGUAGE

PLAN 3

Disc File Record List routine (X43S)

OBJECTIVES

The objective of the Disc File Record List routine is to provide a printout of the contents of main file records.

A system flowchart of the Disc File Record List routine is shown in Figure 10 below.

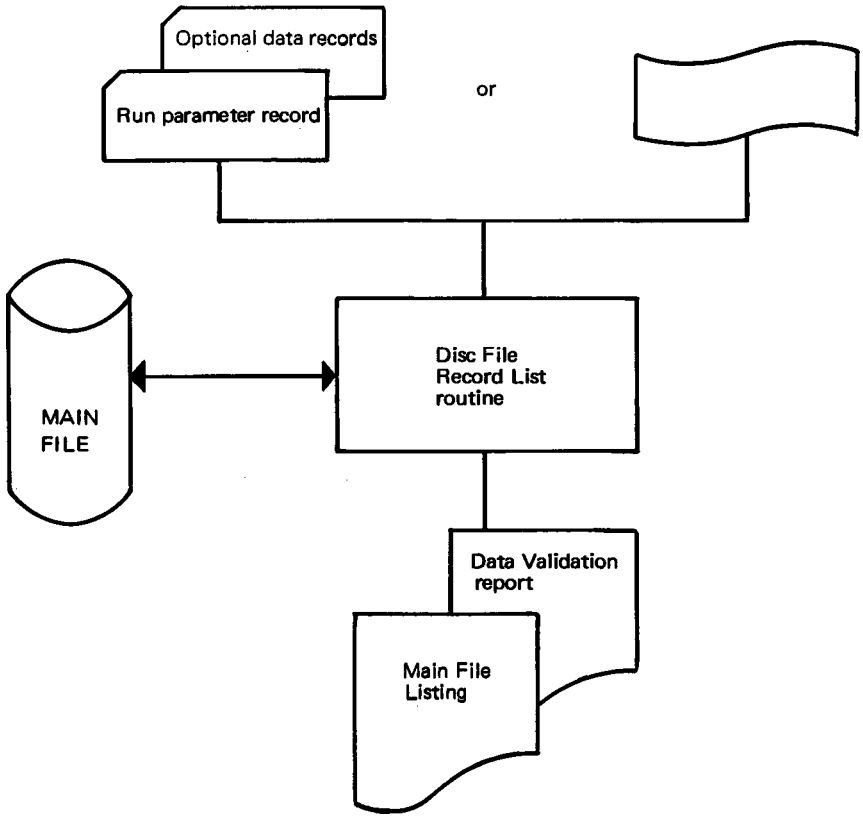


Figure 10 System flowchart and reports for Disc File Record List routine

```
STOCK MASTER FILE ITEM REPORT                    PROGRAM X43S              DATE 06/01/69          PAGE 9999

ITEM NUMBER      XXXXXXXXXXXXXXX      DESCRIPTION      XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
GROUP CODE                   XX       DISCOUNT CODE              XX       UNIT OF ISSUE              XXXX
ORDERING GROUP                X       SYSTEM MARKER               X       CLASS CODE                  A9
SCRAP FACTOR %               99       LEAD TIME                9999.999    FUNCTION MARKERS    1 3111111111
UNIT WEIGHT,TIME,VOLUME   999999·99999  SET UP TIME             9999.999    SUPPLIER CODE          XXXXXXXX
MINIMUM ORDER QUANTITY    9999999     MAXIMUM ORDER QUANTITY   9999999      ORDER INTERVAL COUNT        S99
ORDER INTERVAL              99        CUMULATIVE RECEIPTS  99999999999      RECEIPTS COUNT             9999
CUMULATIVE SCRAP      99999999999     BACKORDER COUNT             9999      CUMULATIVE DEMAND    99999999999
NO MOVEMENT COUNT           9999      CUM. BACK ORDERS     99999999999      SEASONAL BASE                99
CONVERSION FACTOR           9999      NUMBER OF BRANCHES            99
PURCHASE TAX           9999999.999999 SALES PRICE          9999999.999999 COST PRICE            9999999.999999
GROUP DEMAND ACCUMULATOR 9999999      UNIT OF RECEIPT            XXXX

              + BRANCH DATA :-        LOCATION CODE              XX       BIN LOCATION            XXXXXXXX
                                      MINIMUM STOCK LEVEL      9999999    MAXIMUM STOCK LEVEL      9999999
                                      STOCK BALANCE           S9999999    FORWARD DEMAND BALANCE   9999999
                                      BACK ORDER BALANCE       9999999    ORDER BALANCE            9999999
                                      DEMAND ACCUMULATOR       9999999    REORDER POINT            9999999
                                      REORDER QUANTITY         9999999    M.A.D. OF FORECAST ERRORS 999999.999
                                      WEIGHT FACTOR               9.999999

   * QUANTITY DISCOUNT DATA :-        PRICE BREAK QUANTITY     9999999    PRICE BREAK              9999999.999999
                                      PRICE BREAK QUANTITY     9999999    PRICE BREAK              9999999.999999
                                      PRICE BREAK QUANTITY     9999999    PRICE BREAK              9999999.999999

     * BULK ORDERING DATA :-          BULK ORDER INTERVAL        99       BULK ORDER INTERVAL COUNT     99
                                      BULK ORDER QUANTITY      9999999    BULK ORDER QUANTITY BAL.S9999999
```

\+ repeated for every branch

* does not appear unless field is present in record

```
DATA VALIDATION REPORT                          PROGRAM X43S                    DATE 06/01/69   PAGE 9999

RECD       ITEM NUMBER   GP       ITEM NUMBER   GP
TYPE                     CD                     CD

  99  XXXXXXXXXXXXXXX   XX   XXXXXXXXXXXXXXX   XX

  40            A1504   02
  40            A1783   01
  50            A1850   01
   &
  40            A1856   07
```

```
  41            A1256   01          A1282   04
  41            17351   01          A7892   09
                        M
  41            X4170   01          X7918   01


END OF REPORT
```

```
DEMAND HISTORY FILE ITEM REPORT                 PROGRAM X43S              DATE 06/01/69          PAGE 9999

ITEM NUMBER    XXXXXXXXXXXXXXX      DESCRIPTION    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

GROUP CODE                  XX      CLASS CODE                  A9      UNIT OF ISSUE              XXXX

COST PRICE          9999999.999999  SALES PRICE          9999999.999999 ORDERING COST        9999999.999999

LEAD TIME              9999.999     AVERAGE DEMAND          9999999.999 STD.DEVIATION OF DEMAND 9999999.999

DESEASONALIZED FORECAST 9999999.999 CUMULATIVE SUM OF ERRORS S9999999.999 STD.DEVIATION OF ERRORS 9999999.999

SMOOTHED ERROR        S9999999.999  SMOOTHED M.A.D. OF ERRORS 9999999.999 GROUP STOCK BALANCE    S9999999

SERVICE LEVEL GROUP            9    ORDERING INTERVAL              99     INVESTMENT RATE GROUP         9

SYSTEM MARKER                  X    FUNCTION MARKERS     111111111111     DEMAND HISTORY LENGTH       999

FORECAST INTERVAL             99    FORECAST INTERVAL COUNT        99

SEASONAL BASE                 99    SEASONAL BASE COUNT            99

GAMMA ZERO                 9.9999   GAMMA ONE                   9.9999

*
SEASONAL FACTORS    P  FACTOR    P  FACTOR    P  FACTOR    P  FACTOR    P  FACTOR    P  FACTOR    P  FACTOR    P  FACTOR
                   99 9999.99   99 9999.99   99 9999.99   99 9999.99   99 9999.99   99 9999.99   99 9999.99   99 9999.99


*
DEMAND HISTORY      P  DEMAND    P  DEMAND    P  DEMAND    P  DEMAND    P  DEMAND    P  DEMAND    P  DEMAND    P  DEMAND
                 9999 9999999  999 9999999  999 9999999  999 9999999  999 9999999  999 9999999  999 9999999  999 9999999

* does not appear unless field is present in record
```

INPUT

1 Overlay serial or sequential Demand History or Stock Master file.

2 A parameter card (or paper tape block) containing three options as follows:

(a) FILE INDICATOR. This specifies which main file is to be listed.

(b) PROCESSING INDICATOR. This specifies which item/group records are to be listed according to the following criteria:

(i) List items indicated by item selection (code 40) records.

(ii) List all records not previously listed since creation/amendment.

(iii) List all records on the file.

(iv) List all records within a range of item number/group codes indicated by code 41 records.

(c) REPORT PACKING INDICATOR . This specifies the desired packing (or layout) of the listing produced by the routine as either:

(i) a new page for every item/group record printed, or

(ii) as many item/group records per page as possible.

3 Data records (card or paper tape) which may be either:

(a) code 40 records; these specify the item numbers/group codes of records to be selected when using processing indicator (i) above.

(b) code 41 records; these specify a range of item numbers/group codes to be printed when using processing indicator (iv) above.

Note: An unlimited number of code 40 records may be input in any one run, and similarly any number of code 41 records may be input in any one run. However, in each case they must be in strict item number/group code sequence, leading spaces being regarded as zero.

PROCESSING

The run parameter record and data records are read. The print packing is set up to satisfy requirements specified by parameter and items are selected for listing according to the criteria specified. A data validation report is prepared for output.

Marker 11 on the main file is unset, if originally set, for each item number/group code record printed before the record is replaced in the main file.

OUTPUT

1 DATA VALIDATION REPORTS. These reports contain listings of the input selection records, with invalid fields denoted by an error code printed on the following line, beneath the field in error. The error codes used are shown under *Run time errors*, page 143.

2 ITEM REPORTS, each giving a full listing of the main file record specified.

PERIPHERALS

The Disc File Record List routine requires the following peripherals:

1 One card reader or one paper tape reader

2 One disc transport

3 One line printer

SOURCE LANGUAGE

1900 COBOL

Magnetic Tape to Disc Main File Transcription routine (X43T)

OBJECTIVE

The objective of the Magnetic Tape to Disc Main File Transcription routine is to transcribe to disc in SCAN 3 main file format records from standard magnetic tape in SCAN 1/2 main file format.

A system flowchart for the Magnetic Tape to Disc Main File Transcription routine is shown in Figure 11 below.

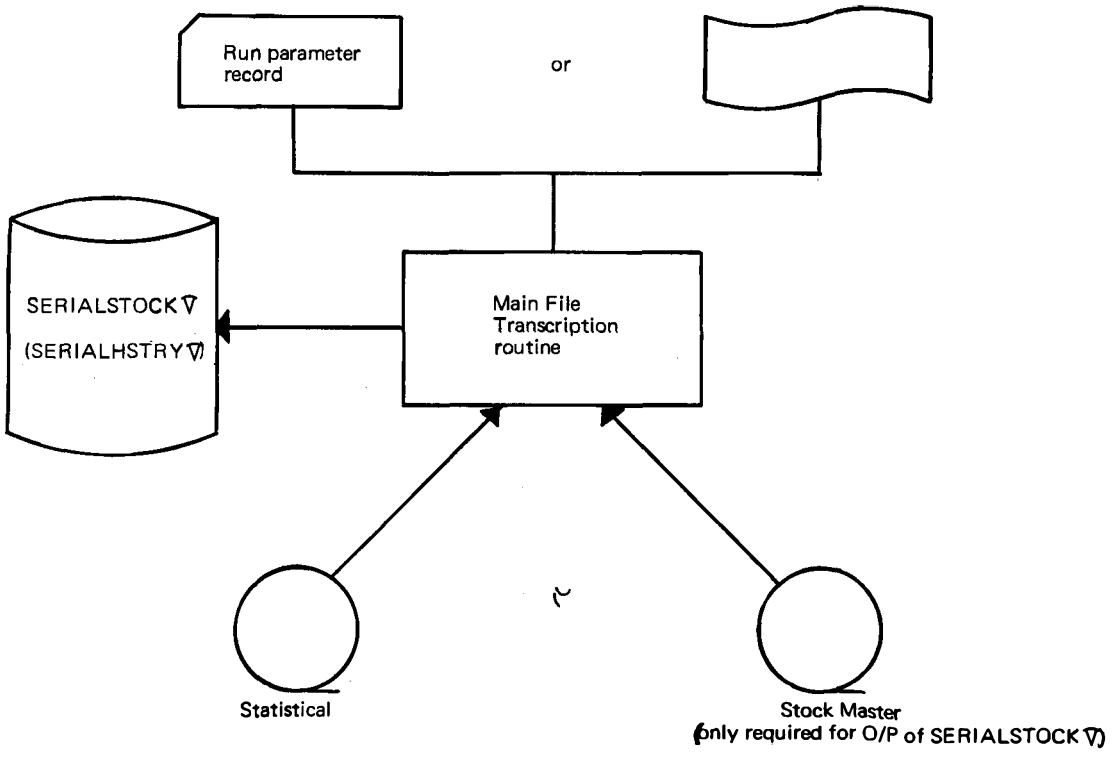


Figure 11 System flowchart for Magnetic Tape to Disc Main File Transcription routine.

INPUT

1 Parameter card (or paper tape block) containing the following options:

   (a) FILE INDICATOR. This specifies whether a Stock Master or Demand History serial file is to be output.

   (b) RECEIPT UNIT. This is used only when a Stock Master file is being transcribed.

2 One SCAN 1/2 Demand History magnetic tape file in item number sequence.

3 One SCAN 1/2 Stock Master magnetic tape file in item number sequence. This is only necessary when the Stock Master serial file is to be output.

PROCESSING

The run parameter record is read and the File Indicator examined. If Demand History file transcription is required, an input SCAN 1/2 Demand History magnetic tape file is opened and information is transferred from this file to the output SCAN 3 Serial Demand History disc file. An area large enough to accommodate two years' demand history points will be set up on the output file. Any unfilled fields at the end of the array, caused by there being less than two years' data on the input file, will be zero-filled.

If Stock Master transcription is required, both SCAN 1/2 Demand History and Stock Master files will be opened. Data will in general be obtained from the equivalent fields in the Stock Master file, but the following exceptions should be noted:

1 ORDERING INTERVAL. This is obtained from the input Demand History file.

2 UNIT OF RECEIPT. If the SCAN 1/2 Minimum Order Quantity on the input Stock Master file is equal to zero or one, the SCAN 1/2 unit of measure is copied to the SCAN 3 unit of receipt field, in addition to being copied to the unit of issue field. In all other cases the Unit of Receipt specified in the run parameter record is used.

3 BRANCH DEMAND ACCUMULATORS. This field is obtained by adding the most recent demand points from the input Demand History file. The number of points to be added is given by the SCAN 1/2 Forecast Interval Count.

4 The Mean Absolute Deviation of Branch Forecast Errors is obtained from the Demand History File.

Note: if on transcribing a Stock Master file no corresponding statistical record is present, standard values are given to those fields that would have been obtained from the statistical record.

OUTPUT

One serial Demand History or Stock Master disc file in SCAN 3 format

PERIPHERALS

The following peripherals are required by the Magnetic Tape to Disc Main File Transcription routine:

1 One card reader or paper tape reader

2 One or two magnetic tape devices

3 One disc transport

4 One line printer

SOURCE LANGUAGE

1900 COBOL

ANALYTICAL ROUTINES

Stock Profile Analysis routine (X43D)

OBJECTIVES

The objectives of the Stock Profile Analysis routine are as follows:

1 To examine the demand history for each Demand History file group record and determine a recommended minimum time interval, based on frequency of movement and average demand, at which a forecast should be made.

2 To evaluate for each record the total average annual sales value, the current stock value and the average annual gross margin.

3 To provide a profile of the total inventory within each recommended forecast interval.

4 To provide an entry point to the ABC Analysis routine (see page 42).

A system flowchart for the Stock Profile Analysis routine is shown in Figure 12 below.

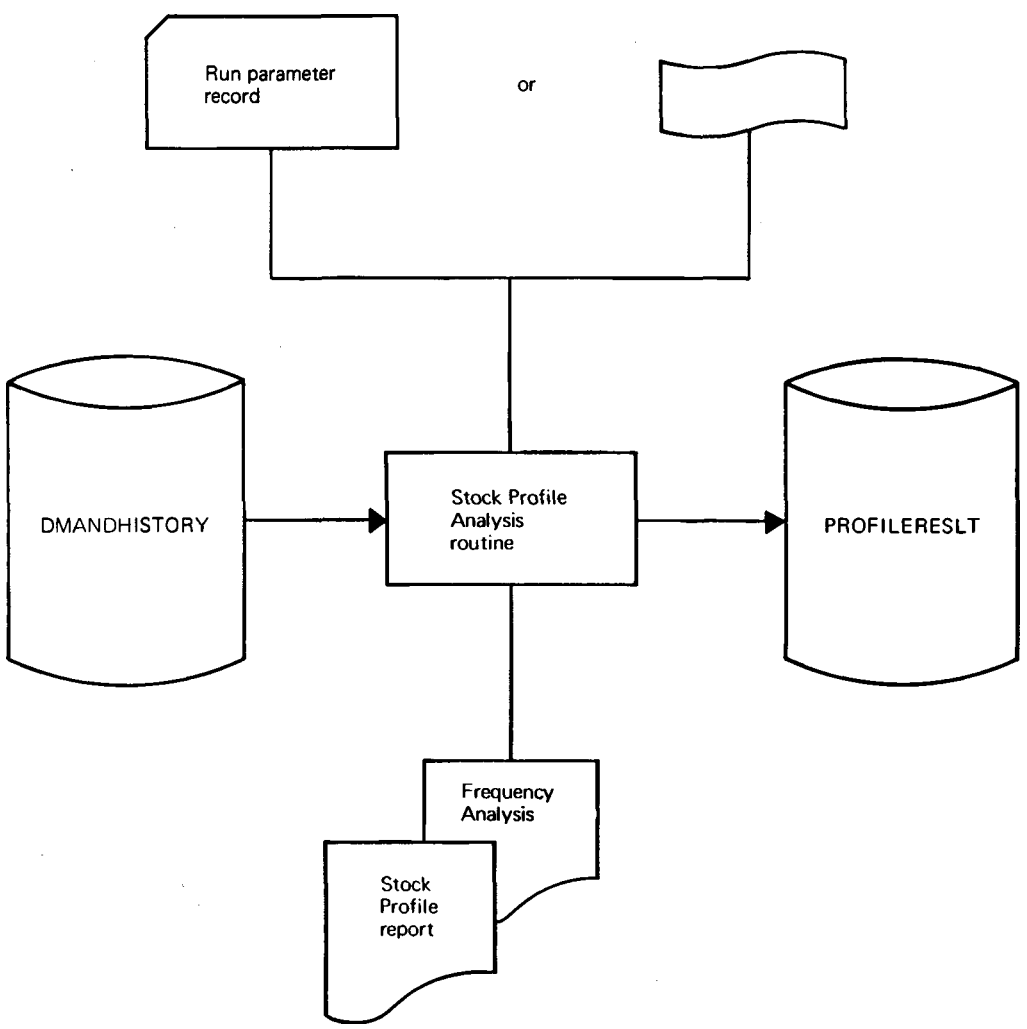


Figure 12 System flowchart and reports for Stock Profile Analysis routine

STOCK PROFILE REPORT PROGRAM X43D DATE 11/10/68 PAGE 2

ITEM NUMBER	GP CD	DESCRIPTION	MIN FCST INT	ANNUAL DEMAND	ANNUAL SALES VALUE £	STOCK BALANCE	STOCK VALUE £	AN. GROSS MARGIN £	SERIES LENGTH
XXXXXXXXXXXXXXX	XX	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	X99	9999999999	9999999999	9999999999	9999999999	9999999999	999
A001	C3	CHARAPYNE	1	5950	3571	482	256	416	104
A002	J6	SODA THAHPIT	1	9680	3872	972	291	968	104
A003	H1	LEMON DRINK SUMMER GOLD	• 2	3859	5017	328	361	771	104
A004	K4	ORANGE DRINK SUMMER GOLD	1	3920	5097	371	408	784	104
A005	C6	CAT FOOD PAWS	4	2000	5001	187	392	800	104
A006	R7	LASSIE LARGE	1	1218	4872	132	475	487	104
A007	X2	LASSIE SMALL	1	3113	4981	425	531	1089	104
A010	Y4	CHAPPIE LARGE	1	1561	4527	148	377	546	104
A011	N9	SWOOP WILD BIRD FOOD	1	1902	3996	173	294	761	104
A012	L8	TRILL BUDGIE SEED LARGE	1	2272	4999	157	298	682	104
TOTALS				2853721	2057891	230252	150491	226368	

FREQUENCY ANALYSIS PROGRAM X43D DATE 11/10/68 PAGE 3

FORECAST INTERVAL	CUMULATIVE NO. OF ITEMS	CUMULATIVE ITEM COUNT %	CUMULATIVE SALES VALUE %	CUMULATIVE STOCK VALUE %	CUMULATIVE GROSS MARGIN %
99	99999999	999.99	999.99	999.99	999.99
1	128	21.48	94.38	92.18	91.37
2	287	48.15	96.21	96.70	93.68
4	362	60.74	96.46	98.13	95.51
13	.				
26	.	100.00	100.00	100.00	100.00
TOTALS	596		2057891	150491	226368

END OF RUN

Figure 12 continued

INPUT

1 Stock profile parameter record. This record requires the following parameters.

(a) SELECTIVE LISTING PARAMETER. If this parameter is set, only those items with a forecast interval greater than or equal to the value of the parameter will be output on the Stock Profile report. The value of this parameter is the selected forecast interval. If the parameter is set equal to or greater than 27, all stock items will be listed; if it is set to zero, no list will be printed.

(b) FREQUENCY TABLE PARAMETER. If this parameter is set to 0 the four unit totals, together with the Frequency table (see Figure 12, page 39), will be accumulated and output in addition to the Stock Profile list.

If the parameter is set to 1, only the Stock Profile list will be printed (*see Selective listing parameter* above).

(c) PROFILE RESULTS PARAMETER. If this parameter is set to 0, no Profile Results disc file will be produced.

If the parameter is set to 1, a Profile Results disc file will be created.

(d) FILE IDENTIFICATION PARAMETERS. These parameters specify the file generation numbers of the Demand History file and the Profile Results file.

2 Overlay Demand History disc file (see page 100).

The only fields used in this program are as follows:

(a) Item number/group code

(b) Cost price

(c) Sales price

(d) Group stock balance

(e) Demand history

(f) Series length

(g) Description

PROCESSING

Each record on the Demand History file is scanned and the following calculations are performed.

1 Frequency of movement is calculated as the movement count divided by the demand history length (series length). The initial forecast interval is related to the frequency of movement as shown in Table 1. (The alternatives in column 3 of the table are for basic time intervals of one week and one month respectively.)

Probability of at least one movement per basic time interval or unit	*Forecast interval*	*Time period between successive forecasts*
$\geqslant 0.5$	1	Week or month
$\geqslant 0.25$	2	Fortnight or two months
$\geqslant 0.125$	4	Month or four months
$\geqslant 0.0385$	13	Other
$\geqslant 0$	26	

See also *Forecast interval*, page 205.

Table 1 Frequency of movement

The average demand in the forecast interval is then calculated and if it is less than 10, the smallest forecast interval is selected from the table so that the average demand test is satisfied.

2 The total demand is summed over the demand history provided and from this, the average annual demand is calculated by dividing by the number of demand points provided and multiplying by the number of demand points in a year (52 for weekly demand data, 13 for 4-weekly demand data and 12 for monthly data). The annual sales value is then obtained by multiplying the average annual demand by the sales price and similarly the annual gross margin is obtained by multiplying by the difference between the sales price and the cost price.

3 The stock value is calculated as the group stock balance multiplied by the cost price.

OUTPUT

1 PROFILE RESULTS SERIAL DISC FILE. (see page 112.) This is an optional file but if ABC Analysis is to be used then this file must be output (*see Profile results parameter*).

2 STOCK PROFILE REPORT. The output of this report is optional (*see Selective listing parameter*). As shown in Figure 12, page 39, the Stock Profile list may contain all items with a forecast interval equal to or less than that specified by input parameter, or it may contain all items on the input file. If this file already contains forecast intervals, changes from the existing values are denoted by asterisks adjacent to the newly calculated forecast interval. The new value is not written into the Demand History file.

3 FREQUENCY ANALYSIS. The Frequency Analysis is obtained by setting the appropriate parameter value (*see Frequency table parameter*).

PERIPHERALS

This routine requires the following peripherals:

1 One card reader or one paper tape reader

2 One or two disc transports

3 One line printer

SOURCE LANGUAGE

1900 COBOL

ABC Analysis routine (X43Q)

OBJECTIVES

The objectives of the ABC Analysis routine are as follows:

1 To enable Management to classify their inventory into three categories according to sales value and into three independent categories by frequency of movement thus giving a maximum of nine classifications; each item will be classified into one of the categories.

2 To provide Management with a guide to selecting the final percentages in which to group the three categories based on sales value.

3 To provide the entry point to the automatic Control System Selection routine if required.

4 To provide a listing of items in sequence of stock value, gross margin, item number or class code.

A system flowchart of the ABC Analysis routine is shown in Figure 13 below.

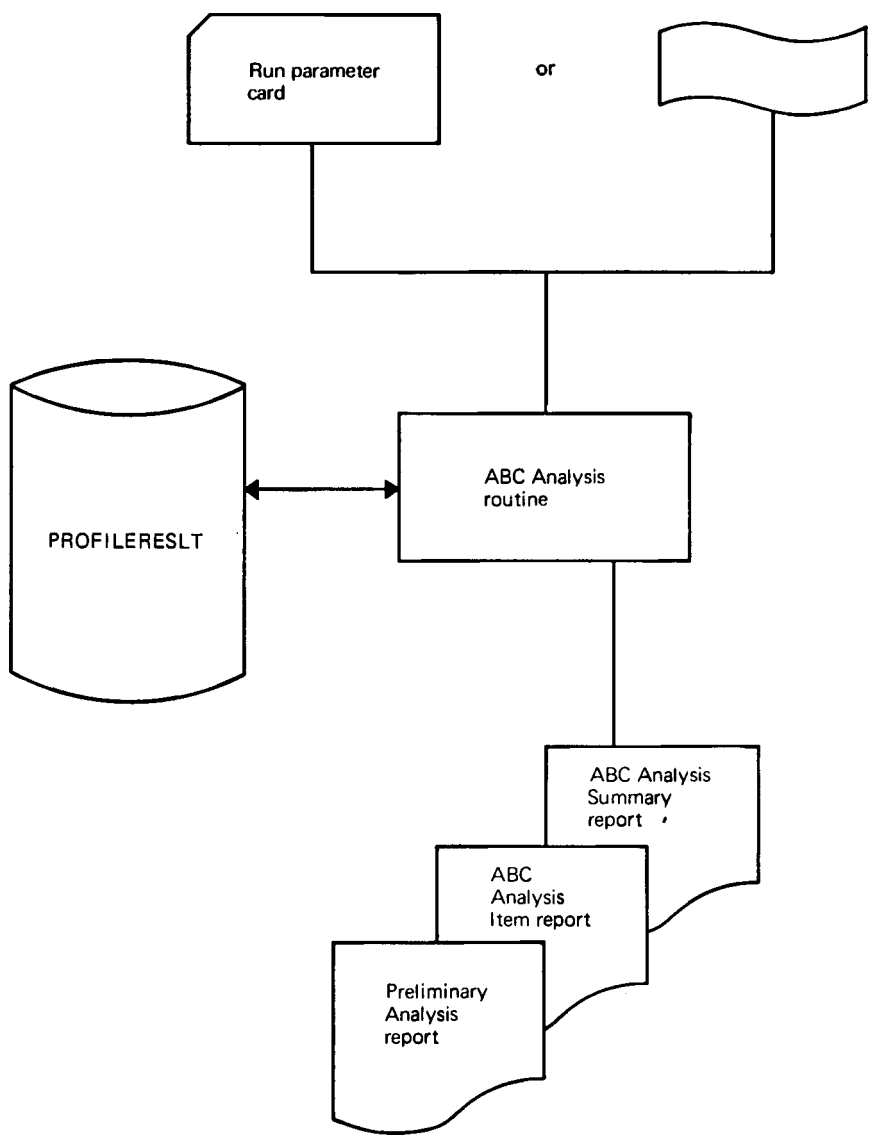


Figure 13 System flowchart and reports for ABC Analysis routine

A.B.C. ANALYSIS - PRELIMINARY REPORT PROGRAM X43Q DATE 11/10/68 PAGE 2

PERCENTAGE ANNUAL USAGE	ANNUAL USAGE £	ANNUAL USAGE CUM %	STOCKHOLDING £	STOCKHOLDING CUM %	GROSS MARGIN £	GROSS MARGIN CUM %	ITEM COUNT UNITS	ITEM COUNT CUM %
999	9999999999	999·9	9999999999	999·9	9999999999	999·9	999999	999·9
5	109282	5·3	8402	5·6	17380	7·7	5	0·8
10	102329	10·3	7143	10·3	17898	15·6	9	2·3
15	102123	15·3	7318	15·2	12003	20·9	9	3·9
20	101072	20·2	7526	20·2	9927	25·3	9	5·4
25	101578	25·1	7412	25·1	6529	28·2	10	7·0
30	102837	30·1	7521	30·1	6219	30·9	10	8·7
35	102973	35·1	11631	37·8	6828	33·9	11	10·6
40	103221	40·1	11258	45·3	5087	36·2	11	12·5
45	103118	45·1	7501	50·3	9937	40·6	10	15·1
50	102966	50·1	7488	55·3	10869	45·4	20	18·8
55	102998	55·1	7475	60·3	11621	50·5	24	22·8
60	102793	60·1	7301	65·1	10032	54·9	28	27·5
65	102985	65·1	7218	69·9	12438	60·6	35	33.4
70	102894	70·1	6817	74·4	14892	67·2	42	40·4
75	101262	75·0	5838	78·3	14999	73·8	50	48·8
80	103116	80·1	5488	81·2	14582	80·3	55	58·1
85	103005	85·1	7458	86·9	13923	86·4	57	67·6
90	102816	90·1	7215	91·7	12268	91·8	71	79·5
95	101936	95·0	5053	95·0	9268	95·9	65	90·4
100	102587	100·0	7428	100·0	9168	100·0	57	100·0
TOTALS	2057891		150491		226368		596	

END OF REPORT

END OF RUN

A.B.C. ANALYSIS - ITEM REPORT PROGRAM X43Q DATE 11/10/68 PAGE 2

ITEM NUMBER/ DESCRIPTION	GP CD	CC	UOM	SL	ANNUAL USAGE £	ANNUAL USAGE UNITS	STOCKHOLDING £	STOCKHOLDING UNITS	GROSS MARGIN £	ITEM COUNT	CUMULATIVE PERCENTAGES USAGE VALUE	STOCK VALUE	MARGIN	ITEM COUNT
XXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XX	X9	XXXX	999	9999999999999999999		9999999999999999999		9999999999	999999	999.9	999.9	999.9	999.9
A101 CHUNKY MARMALADE 1S ST. MARTIN	H4	A1	CASE	104	25043	9632	1831	872	4816	1	1.2	1.2	2.1	0.1
A103 FLOUR PLAIN MCDOUGALLS 1S	H2	A1	CASE	104	22550	8931	1770	885	4465	2	2.3	2.4	4.1	0.3
A105 FLOUR S.R. MCDOUGALLS 1S	T1	A1	CASE	104	21753	8879	1724	821	3107	3	3.4	3.5	5.5	0.5
A109 FLOUR S.R. MCDOUGALLS 3S	D7	A1	CASE	104	20112	5028	1456	416	2514	4	4.3	4.5	6.6	0.7
C008 NESCAFE SACHETS	P3	A1	GRSS	104	19824	8260	1621	772	2478	5	5.3	5.6	7.7	0.8
C109 NESCAFE 20Z	X4	A1	CASE	104	14595	973	1037	83	2432	6	6.0	6.3	8.8	1.0
C390 NESCAFE 80Z	L7	A1	CASE	104	12860	2572	911	217	2057	7	6.6	6.9	9.7	1.2
TOTALS					9999999999 2057891		9999999999 150491		9999999999 226368					

these fields are omitted if the Profile Results File is in item number order

END OF REPORT

A.B.C. ANALYSIS - SUMMARY REPORT PROGRAM X43Q DATE 11/10/68 PAGE 3

CLASS CODE	ANNUAL USAGE £	ANNUAL USAGE CUM %	STOCKHOLDING £	STOCKHOLDING CUM %	GROSS MARGIN £	GROSS MARGIN CUM %	ITEM COUNT UNITS	ITEM COUNT CUM %
X9	9999999999	999.9	999999999999	999.9	9999999999	999.9	999999	999.9
A1	830937	40.4	68548	45.5	81980	36.2	75	12.6
A2	397213	59.7	28721	64.6	41237	54.4	88	27.3
A3	13716	60.3	1092	65.4	1583	55.1	5	28.2
B1	679631	93.4	40732	92.4	85328	92.8	339	85.1
B2	87291	97.6	7016	97.1	10921	97.7	48	93.1
B3	1525	97.7	130	97.2	185	97.7	1	93.3
C1	45727	99.9	3842	99.7	4931	99.9	38	99.7
C2	960	99.9	180	99.8	105	99.9	1	99.8
C3	891	100.0	230	100.0	98	100.0	1	100.0
TOTALS	2057891		150491		226368		596	

END OF REPORT

END OF RUN

Figure 13 continued

INPUT

1 Overlay Profile Results disc file (see page 112)

2 A parameter card (or paper tape block) containing six options as follows:

(a) PRINT OPTION. The print option allows selective listing of the ABC Analysis.

(i) fast movers only

(ii) medium movers only

(iii) slow movers only

(iv) high value items only

(v) medium value items only

(vi) low value items only

(vii) complete list of all items

(viii) preliminary analysis table only

An ABC Analysis Summary table is printed with each of the above selections except the last.

(b) FILE SEQUENCE INDICATOR. The file sequence indicator specifies to the program which sequence must be checked:

(i) Descending sequence of sales value

(ii) Descending sequence of stock value

(iii) Descending sequence of gross margin

(iv) Ascending sequence of item number

(v) Ascending sequence of class code

(c) ABC ANALYSIS INDICATOR. The ABC analysis indicator specifies to the program whether or not the full ABC analysis is required.

(d) CLASS 'A' LIMIT. The class 'A' limit parameter is used only when the Profile Results file is in descending sequence of sales value. If the parameter has value zero, no ABC classification will be performed; only a Preliminary Analysis report will be produced.

Any other value of this parameter will set the limit for classifying the 'A' class of items, for example 20 would classify each item as an 'A' item until the first 20% of the total sales value had been reached.

(e) CLASS 'B' LIMIT. The class 'B' limit parameter sets the limit for classifying the 'B' class of items, for example if the class 'B' limit parameter were 60 then each item after the class 'A' items and until the first 60% of the sales had been reached would be classified as 'B' items.

(f) FILE CLASSIFICATION. The Profile Results file may be classified by overlay if the ABC Analysis is carried out during the run.

(g) MEDIUM MOVER LIMIT. The medium mover limit defines the limits of the forecast interval used to divide items into medium movers and slow movers. Fast movers (class 1) will always be classified as those items having a forecast interval of one. This parameter specifies the maximum forecast interval for medium movers.

PROCESSING

The parameter record is read into store and the Profile Results file is scanned to give the results required by the parameter settings.

If the Preliminary Analysis report is required first (to provide a guide to the selection of the A and B limits) the program aggregates the sales values in 5% increments and prints the Preliminary Analysis report. The input file must be in descending sales value sequence.

If the ABC Analysis Item report and classification is required, the Profile Results file must be in descending sequence of sales value, and the input parameters must be set to the correct values.

The program will classify each item, print the ABC Analysis Item report and Summary and overlay the Profile Results file for entry to the next routine (see *Control System Selection routine*, page 46).

The ABC Analysis Summary report is printed to give a summary of each of the classes A1, A2, A3, B1 etc; Sales value, stockholding, gross margin and item counts are accumulated for each class, including cumulative percentages.

OUTPUT

1 ABC Analysis Item report (optional). In order that all the information can be printed in 120 print positions the print format uses different terminology in the Item report from that used for describing the same information in the Profile Results file. The terms used are shown in the table below; the word currency in brackets is used where the report would carry the actual currency unit being used.

Item report field name	*Profile Results file field name*
Annual Usage (currency)	Annual sales
Annual Usage Units	Annual Demand
Stockholding (currency)	Stock Value
Stockholding Units	Stock Balance
Gross Margin (currency)	Annual Gross Margin

2 ABC Analysis Summary report (with Item report)

3 ABC Analysis Preliminary report (optional)

Each of the above reports is illustrated in Figure 13, page 43.

PERIPHERALS

The ABC Analysis routine requires the following peripherals:

1 One card reader or one paper tape reader

2 One disc transport

3 One line printer

SOURCE LANGUAGE

1900 COBOL

Control System Selection routine (X43R)

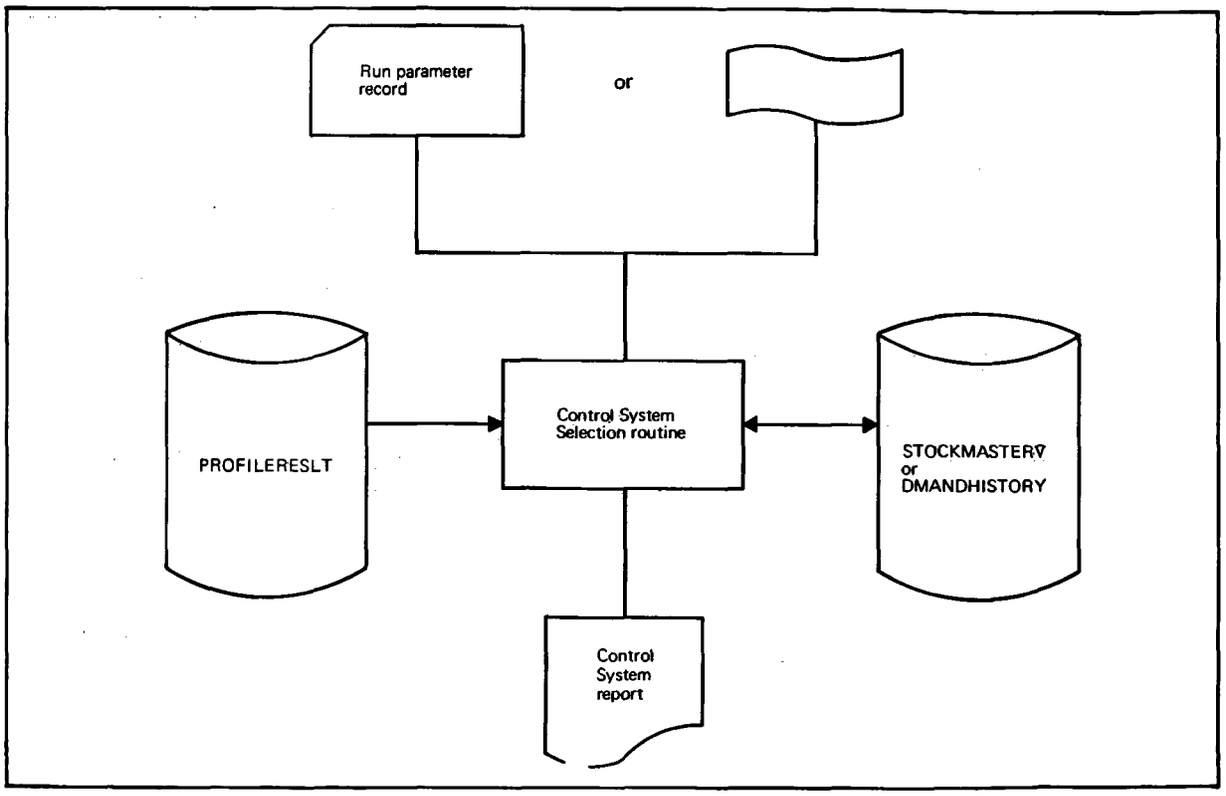
OBJECTIVES

The Objectives of the Control System Selection routine are:

1 To allow management to allocate automatically any one of six control systems to each item in the inventory.

2 Optionally to initialize the Demand History file so that forecasting can be carried out.

A system flowchart for the Control System Selection routine is shown in Figure 14 below



CONTROL SYSTEM REPORT PROGRAM X43R DATE 11/10/68 PAGE 2

ITEM NUMBER	GRP	DESCRIPTION	UOM	CC	S M	SL	ANNUAL USAGE £	ANNUAL USAGE UNITS	STOCKHOLDING £	STOCKHOLDING UNITS	GROSS MARGIN £
XXXXXXXXXXXXXXX	XX	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXX	X9	X	999	9999999999999999999		9999999999999999999		9999999999
A001	4H	CHARAPYNE	CASE	B1	1	104	3731	5950	256	482	416
A002	P7	SODA THAWPIT	CASE	B1	1	104	3872	9680	291	972	968
A003	T2	LEMON DRINK SUMMER GOLD	CASE	A1	1	104	5017	3859	361	328	771
A004	8X	ORANGE DRINK SUMMER GOLD	CASE	A1	1	104	5097	3920	408	371	784
A005	82	CAT FOOD PAWS	CASE	A1	1	104	5001	2000	392	187	800
A006	T7	LASSIE LARGE	CASE	A1	1	104	4872	1218	475	132	487
A007	4L	LASSIE SMALL	CASE	A1	1	104	4981	3113	531	425	1089
A010	T6	CHAPPIE LARGE	CASE	B1	1	104	4527	1561	377	148	546
A011	T5	SWOOP WILD BIRD FOOD	CASE	B1	1	104	3996	1902	294	173	761
A012	H2	TRILL BUDGIE SEED LARGE	CASE	A1	1	104	4999	2272	298	157	682
A013	KY	TRILL BUDGIE SEED SMALL	CASE	A1	1	104	4880	1952	353	168	781
A014	PP	WINALOT LARGE	CASE	B3	0	104	1280	853	71	79	512
A015	72	WINALOT SMALL	CASE	B3	0	104	1821	2276	78	195	910
A016	S7	KATKINS	CASE	A1	1	104	4564	2402	356	237	960
A017	S8	WHISKAS HANDY	CASE	A1	1	104	4227	1321	361	129	528
A018	T9	KIT-E-KAT HANDY	CASE	A1	1	104	4673	2124	403	237	1062
A019	D4	PAL MEAT LARGE	CASE	A1	1	104	4972	1184	396	113	829
		TOTALS					2057891		150491		226368

END OF REPORT

END OF RUN

Figure 14 System flowchart and report for Control System Selection routine

INPUT

1 Sequential or selected serial Stock Master file (see page 103) or Demand History file (see page 100) used in overlay mode.

2 Profile Results disc file (see page 112). This file may be in any sequence.

3 A punched card (or paper tape block) run parameter record containing the following:

(a) MAIN FILE MARKER. This indicates which file is to be used for the run.

(b) FILE PROCESSING MARKER. This indicates whether or not it is required to process the main file in random sequence, in which case no specific order of the Profile Results file is required.

(c) INITIALISATION MARKER. This indicates whether full initialisation is required on Demand History file processing.

(d) LIST SELECTION MARKER. This indicates whether or not a Control System Report is required.

(e) SYSTEM MARKERS. There are nine numbers selected to assign control system markers to each of the item records based on their classification. The nine numbers may be selected from the list below and the same control system may be associated with more than one classification.

0 = fixed re-order point, random ordering.

1 = variable re-order point, random ordering using Box-Jenkins two point predictor.

2 = variable re-order point, random ordering using single exponential smoothing.

3 = variable re-order point, random ordering using single exponential smoothing with a lagged adaptive response rate.

5 = fixed re-order point, cyclical ordering.

6 = variable re-order point, cyclical ordering using Box-Jenkins two point predictor.

7 = variable re-order point, cyclical ordering using single exponential smoothing.

8 = variable re-order point, cyclical ordering using single exponential smoothing with a lagged adaptive response rate.

PROCESSING

The run parameter record is read into store. The processing then varies depending on which master file has been loaded.

If the Demand History file has been loaded, the Profile Results record is matched with the appropriate Demand History record and a system marker is assigned to each Demand History record together with the forecast interval, class code and adjusted Forecast Interval Count and Seasonal Base Count. If the forecast interval is increased for a seasonal item, the number of seasonal factors is adjusted subject to the restrictions stated below. If, to avoid using the Demand Analysis routine, the user specifies file initialization by this routine, the following additional processing occurs. For all forecasting items, the forecasting parameters γ_0 and γ_1 are set in the item record so that forecasting can be carried out. The user may specify by run parameter record his own fixed values to be used for all forecasting items. Otherwise the values chosen are $\gamma_0 = 0.1$ and $\gamma_1 = 0.1$ for system markers 1 and 6; $\gamma_0 = 0.1$ and $\gamma_1 = 0.0$ for system markers 2 and 7; and $\gamma_0 = 0.0$ and $\gamma_1 = 0.0$ for system markers 3 and 8. To prevent the loss of control in the early stages of forecasting, estimates of the following quantities are made:

1 Smoothed mean absolute deviation of forecast errors

2 Smoothed forecast errors

3 Deseasonalised forecast

When the fields have been initialized, the Master file record is written back to the Master file. A list of the system markers assigned to each record will be printed, if not suppressed by user parameter.

It should be noted that under the following circumstances it is not possible to alter the Demand History record with values indicated by the Profile Results record:

1 If the forecast interval on the Profile Results file is less than that on the Demand History file, and seasonal factors are present

2 If the forecast interval on the Profile Results file is less than that on the Demand History file, and a user-specified function marker prevents reduction of the Demand History forecast interval

3 If for a seasonal item the forecast interval on the Profile Results file is greater than that on the Demand History file but there is a non-integer result from either of the two following calculations:

(a) $\frac{\text{Profile Results forecast interval}}{\text{Demand History forecast interval}}$

(b) $\frac{\text{Demand History Seasonal Base}}{N}$

where N = the result of expression (a)

Whether any of the above conditions has arisen is indicated on the Profile Results file in the Control Indicator field. If a system marker, forecast interval and class code are written into the Demand History file, the Control Indicator is set to one, otherwise it remains zero. For this reason the Demand History file must be processed before the Stock Master file, whose records will only be processed if the equivalent Profile Results records have a non-zero Control Indicator.

If the Stock Master file has been loaded, the Profile Results record is matched against the appropriate Stock Master file record and a system marker and class code are assigned to the Stock Master file record depending on the ABC classification. The Stock Master file record is then written back to the Master file.

OUTPUT

The Control System Selection routine outputs an Inventory listing, unless suppressed by the user, if the Demand History file is being processed.

PERIPHERALS

The following peripherals are required by the Control System Selection routine.

1 One card reader or one paper tape reader

2 Two disc transports

3 One line printer

SOURCE LANGUAGE

1900 COBOL

Demand Analysis routine (X43F)

OBJECTIVES

The Objectives of the Demand Analysis routine are:

1 To set up values for the prediction parameters γ_0 and γ_1, according to the value of the item record's system marker.

2 To calculate initial values for fields of a statistical nature referring to the demand history provided.

3 To test for the presence of seasonality or trend in the demand pattern and to calculate appropriate values to deal with these.

The following system flowcharts show the operation of the routine for (a) sequential demand history file and (b) serial selected demand history file:

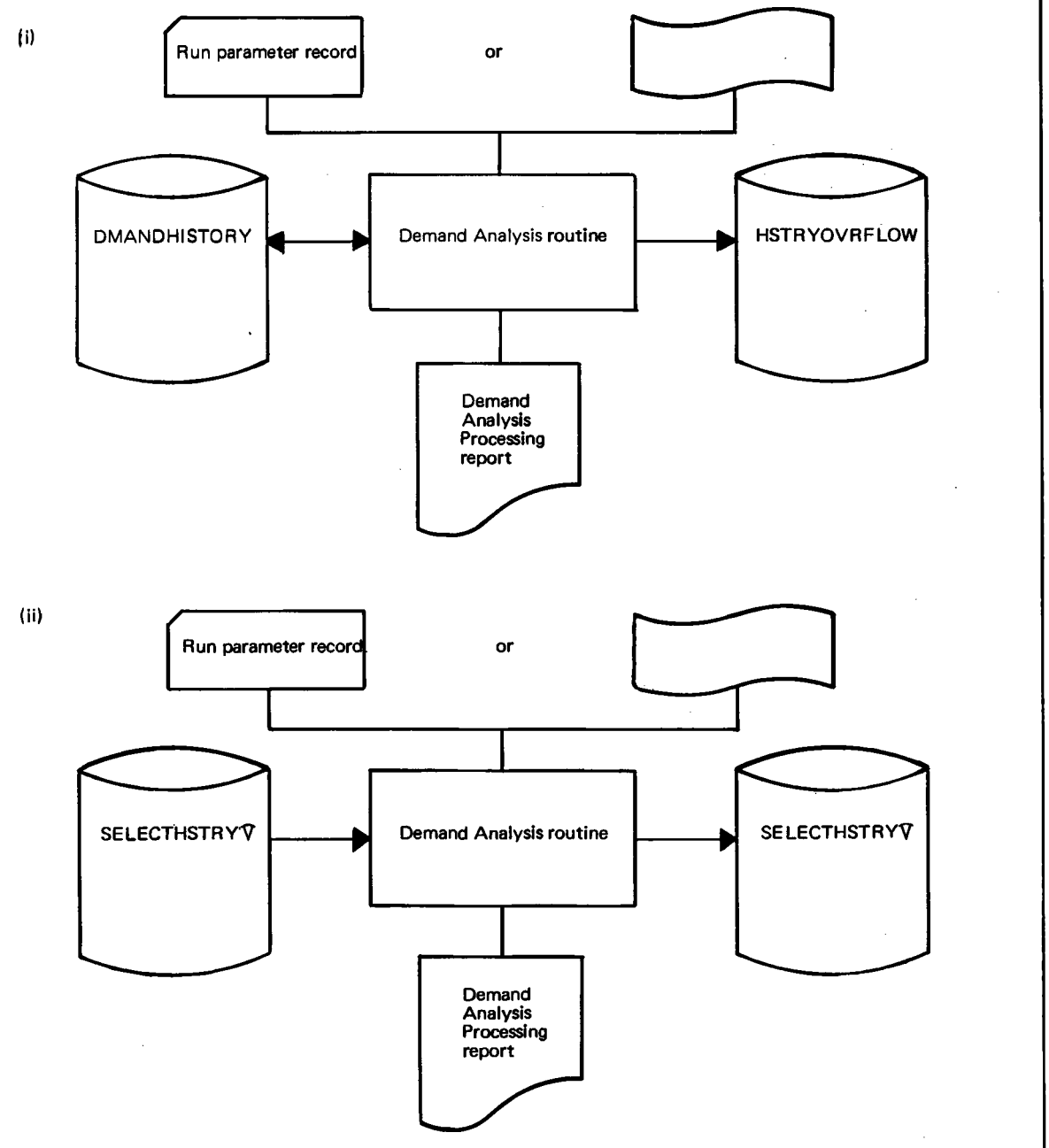


Figure 15 System flowcharts and reports for Demand Analysis routine

```
DEMAND ANALYSIS PROCESSING REPORT                    PROGRAM X43F                DATE 06/01/69            PAGE     3

ITEM NUMBER  XXXXXXXXXXXXXXXX     GROUP CODE      XX
FUNCTION MARKERS                  SYSTEM MARKER   9      GAMMA ZERO        9.99    R1↑ 99.99    TAU1↑ SX.XX#   LAMDA    9.99
FORECAST INTERVAL          •99    SERIES LENGTH 999      GAMMA ONE         9.99    RM↑ 99.99    TAUM↑ SX.XX#
MEAN DEMAND          999999.99    SD.DEMAND   999999.99  SEASONAL BASE •99
MEAN ERRORS         S999999.99    SD.ERRORS   999999.99  TREND FACTOR↑   9.99                   PAIRS↑SX.XX#

SEASONAL FACTORS:- 0  999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999
                  10  999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999
                  20  999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999
                  30  999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999
                  40  999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999
                  50  999.999   999.999   999.999


XXXXXXXXXXXXXXXX  XX  MIN. STAT. FORECAST INT. = 0

XXXXXXXXXXXXXXXX  XX  MIN. STAT. FORECAST INT. = 99, GREATER THAN MAX.

XXXXXXXXXXXXXXXX  XX  MIN. STAT. FORECAST INT. = 99, INCONSISTENT WITH USER SEASONAL FACTORS HAVING SEASONAL BASE = 99

XXXXXXXXXXXXXXXX  XX  USER FORECAST INT. GREATER THAN MAX.

XXXXXXXXXXXXXXXX  XX  NOT PROCESSED - LESS THAN 4 FULL FORECAST INTS. IN DH SERIES

END OF REPORT
END OF RUN
```

```
DEMAND ANALYSIS PROCESSING REPORT                    PROGRAM X43F                DATE 06/01/69            PAGE     3

ITEM NUMBER        GROUP  SYSTEM  FORECAST  SERIES     MEAN        MEAN      GAMMA  GAMMA  TREND      SEASONAL  TREND
                   CODE   MARKER  INTERVAL  LENGTH    DEMAND       ERROR     ZERO   ONE    SUSPECTED  BASE      FACTOR
                    XX      9        99•      999    999999.99  S999999.99  9.99   9.99     XXX       99•        9.99

SEASONAL FACTORS:- 0  999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999
                  10  999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999
                  20  999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999
                  30  999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999
                  40  999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999
                  50  999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999   999.999

XXXXXXXXXXXXXXXX  XX  MIN. STAT. FORECAST INT. = 0

XXXXXXXXXXXXXXXX  XX  MIN. STAT. FORECAST INT. = 99, GREATER THAN MAX.

XXXXXXXXXXXXXXXX  XX  MIN. STAT. FORECAST INT. = 99, INCONSISTENT WITH USER SEASONAL FACTORS HAVING SEASONAL BASE = 99

XXXXXXXXXXXXXXXX  XX  USER FORECAST INT. GREATER THAN MAX.

XXXXXXXXXXXXXXXX  XX  NOT PROCESSED - LESS THAN 4 FULL FORECAST INTS. IN DH SERIES


END OF REPORT
END OF RUN
```

Figure 15 continued

INPUT

1 Sequential Demand History disc file or selected serial Demand History disc file

2 Run parameter record allowing the user to specify the following:

(a) INPUT FILE. This specifies whether the sequential or the selected serial Demand History file is to be used.

(b) PROCESSING INDICATOR. This specifies whether all items on the file are to be processed or whether only those items requiring re-calculation of seasonal factors are to be processed. If the latter condition applies, only those Demand History records having marker 10 set by the Stock Forecasting and Monitoring routine will be processed.

(c) LISTING PARAMETERS. These specify:

(i) Whether reports should be produced only for those items which have sufficient data to commence analysis or whether, in addition, items for which insufficient data exists should be reported. Insufficient data, in this context, means that the item does not have demand history amounting to at least four forecast intervals.

(ii) Whether a full or abridged listing format is to be used.

(d) PREDICTION PARAMETERS. These, if valid, overrule the standard values used by the routine for γ_0 and γ_1 for system markers 1, 2, 6 and 7.

(e) MAXIMUM FORECAST INTERVAL. This specifies the maximum forecast interval that the routine will accept for an item record to continue processing. If the forecast interval of the record turns out to be greater than the maximum value, a report is output and no further analysis of that record occurs. If a value is not entered, the routine will assume a maximum forecast interval of 1.

(f) SIGNIFICANCE TEST LIMITS. These are used to specify the confidence limits that the routine will use in its tests for the presence of trend and seasonality. If they are not specified the routine will assume 99% confidence limits.

PROCESSING

The Demand History file is always accessed serially, but two methods of selection of the items to be processed are available. In the normal mode of operation all records are read and all items having system markers 1, 2, 3, 6, 7 or 8 enter full analysis. Records which do not satisfy this condition remain on the sequential file (if a sequential main file is being analysed) or are written to the output serial file unprocessed (if a serial main file is being analysed). In the alternative mode of operation, the only items which require processing are those for which the Stock Forecasting and Monitoring routine has set marker 10. This will indicate that the item is seasonal and has reached the end of its yearly cycle. The item can therefore be re-analysed and tested for the continuing presence of seasonality. In this mode of operation, therefore, marker 10 is tested before the system marker, and, if it is set, processing continues as before.

For those items selected as above, the minimum statistical forecast interval is computed and it overwrites the forecast interval present in Demand History record, unless function marker 0 prevents this. Three further conditions must then be satisfied for analysis of the items to continue:

The reduced demand series must contain at least four points to ensure that the later analysis is valid. The reduced series is obtained by summing the demands in each forecast interval in the actual series.

2 The forecast interval for the item must not be greater than the maximum specified by the user on the run parameter record.

3 The forecast interval for the item must not be greater than 4.

If the above conditions have been satisfied, the analysis continues by establishing values for the prediction parameters γ_0 and γ_1 as follows:

1 System markers 1 and 6 (Box-Jenkins forecasting): γ_0 and γ_1 will be determined by run parameter, but if the γ_0 field is omitted or is equal to zero, standard values of $\gamma_0 = \gamma_1 = 0.1$ will be used.

2 System markers 2 and 7 (Single Exponential Smoothing): γ_1 will be set to zero and γ_0 will be set to the run parameter value, unless it is omitted or equal to zero, when $\gamma_0 = 0.1$ will be used.

3 System markers 3 and 8 (Lagged Adaptive Response Smoothing): standard values of $\gamma_0 = \gamma_1 = 0$ will be used.

In order to test for the presence of trend and seasonality, provided that the reduced series contains at least eight points, the demand data are analysed statistically.

The serial correlation coefficients r_1 r_2 and r_3 for lags of 1, 2 and 3 periods are calculated and from these is calculated the optimum value of lamda (λ), the estimated minimum value of the error variance divided by the demand variance. This is later used in the test for seasonality.

If the reduced series contains at least one year plus twelve points of data, a test for the presence of trend is made using a pairs test. This involves taking corresponding pairs of demand points from consecutive years and testing for the presence of an increase or decrease. If, on statistical examination, an increase or decrease in demand is found to have occurred, a trend factor is calculated expressing the yearly change in demand.

Following the examination of trend characteristics, the routine tests for the presence of seasonality. Provided that two years' data are available and that the user has not suppressed calculation of seasonal factors by setting function marker 1 for the item, the serial correlation coefficient at lag 1 year (r_m) is calculated. The presence of seasonality is investigated using the following tests:

(1) Associated with r_m is a constant τ_m which indicates significance in relation to values of r_m which would be obtained by rearranging the series.

Seasonal factors are calculated if the significance factor τ_m is greater than the user-specified confidence limit and r_m is not less than 0.5.

(2) If test 1 above fails, a further test is carried out since, in certain situations, trend mixed with seasonality causes the correlation effects of seasonality to be masked. In this case, for seasonal factors to be calculated, τ_1 must be greater than the user-specified confidence limit, r_1 must not be less than 0.5 and the optimum value of λ must not be greater than 0.5.

Finally the routine enters the simulation phase. Using γ_0 and γ_1, the trend factor and seasonal factors, the routine carries out forecasting over the demand history provided. It is then able to compute the following statistics:

(a) Standard deviation of errors

(b) Smoothed mean absolute deviation of errors

(c) Smoothed forecast error

OUTPUT

1 Either one Demand History overflow file or one selected serial Demand History File

2 The Demand Analysis report, which is either a full or an abridged report of the processing that has been carried out. Against certain fields the symbols * or # may occur. The former (*) indicates that the field on the main file record has been changed as a result of processing. The latter (#) indicates that the value shown exceeds the user-specified confidence limits.

PERIPHERALS

The following peripherals are required by the Demand Analysis routine.

1 One card reader or one paper tape reader

2 Two disc transports

3 One line printer

SOURCE LANGUAGE

1900 PLAN

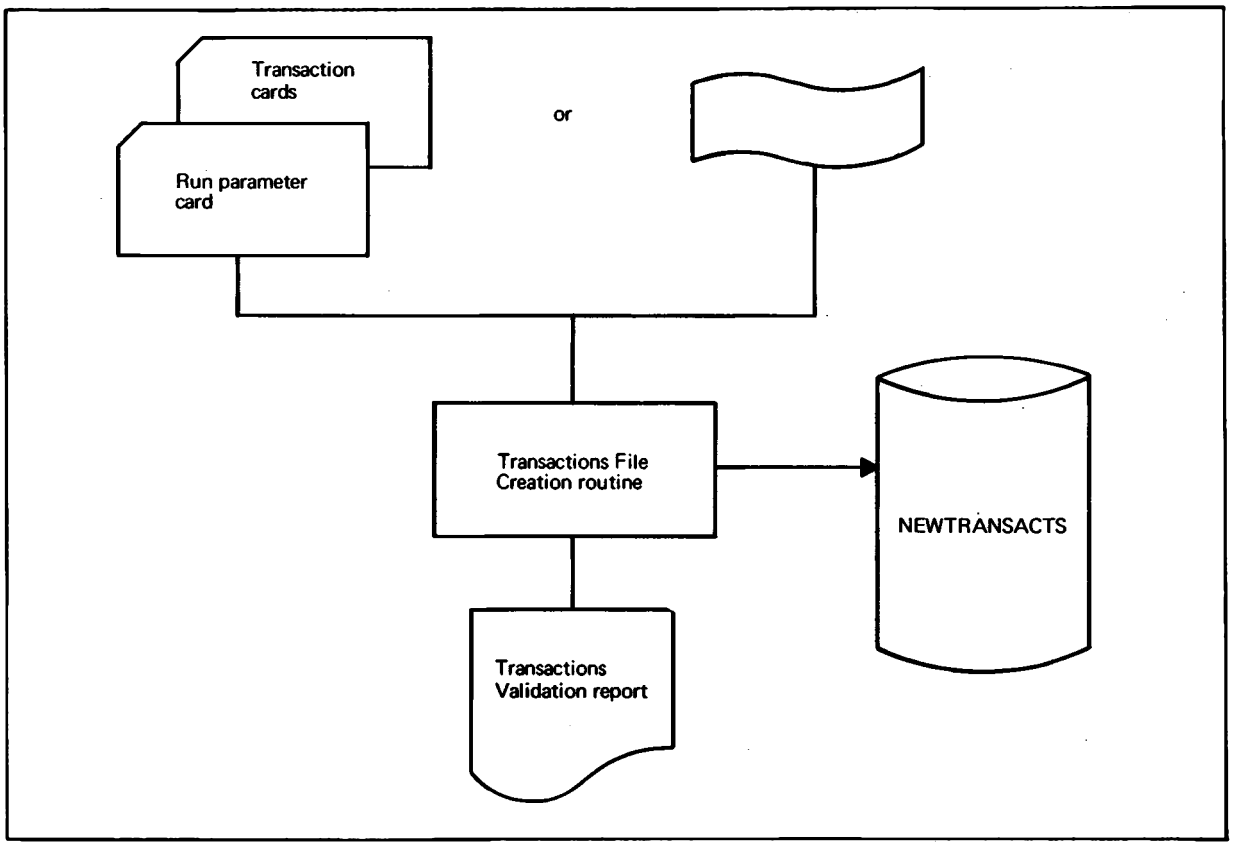
1900 FORTRAN IV

OPERATIONAL ROUTINES

Transaction File Creation routine (X43C)

OBJECTIVE

The objective of the Transaction File Creation routine is to create a disc file of stores transactions. A system flowchart for the Transaction File Creation routine is shown in Figure 16 below.



TRANSACTIONS VALIDATION REPORT PROGRAM X43C DATE 11/10/68 PAGE 2

TRAN TYPE	ITEM NO.	GRP CDE	LOC CDE	QUAN-1	QUAN-2	UNIT OF MEASURE	DUE DATE	TRANS DATE	PRIO	P.A M	LEDGER CODE	1ST DOC REFERENCE	2ND DOC REFERENCE	M.O D	COST PRICE
99	XXXXXXXXXXXXXXX	XX	XX	9999999	9999999	XXXX	999999	999999	99	9	XXXXXXXX	XXXXXXXX	XXXXXXXX	X	9999999
24 A	JCL/371/RA/010	C7	5B	408	410	EACH		290968			C24567	104L-9	S57B		
13	JCL/371/RA/010	C7	5B	1864	136	EACH	240968	011068	3		RJ-367	74C-1	T71L		
18	CER/107/KX/876	R2	7K	250		BOX		011068		6J		MT999			
10	LMO/007/ST/125	S1	2R	300		CASE	141168		21		C494	MT788	X-271		
12	RLT/386/AB/787	A4	4C	-50		EACH		011067 J			KM-034				
13	ABC/401/XY/076	J6	5X	850		DOZ					JC-446	368R-1	L73K		3.4
21	JCL/371/RA/010	C7	5B	306	1 K	EACH	081068	021068	50	1	7C01D	82R-4		R	
21	JCL/371/RA/010	C7	5B	200		EACH	101068	021068	30		8R34K	124J-6		L	

	SUM OF TRANS CODES	NUMBER OF TRANSACTIONS	QUANTITY 1 TOTAL	QUANTITY 2 TOTAL
OUTPUT FILE TOTALS.	75	5	3464	136
BATCH NUMBER 69876. DATE 091068	132	8	4128	547

END OF RUN. 5 TRANSACTIONS WRITTEN TO FILE. 3 TRANSACTIONS REJECTED.

Figure 16 System flowchart and Transactions Validation report for Transactions File Creation routine

INPUT

1 Run parameter record (card or paper tape). This record identifies the input file that is to be overwritten with transactions.

2 One or more batches of transactions (punched either on cards or on paper tape) separated by batch control records if required.

Note that the subsequent programs in SCAN System 3 process the following types of transactions:

(a) Transaction amendment

(b) Audit request

(c) Stock balance/order balance adjustment

(d) Stock receipt and scrap

(e) Returns outwards

(f) Unscheduled issue

(g) Scrap notification

(h) Returns inwards

(i) Branch to branch transfer

(j) Demand

(k) Branch stock count

See also Chapter 3 page 58 for a description of these transactions and Chapter 4 page 92 for the record formats.

PROCESSING

Validity checks are performed on the type of field content within each transaction record and then the record is written to an output disc file; at the same time, a listing of each transaction is printed. Invalid transactions are printed with an error code beneath the first error field.

Transactions that have invalid fields will not be accepted.

If batch control records are present, accumulated totals of the transaction codes and quantity fields are printed together with the batch control record before the transaction listing is resumed.

Note: It is not necessary to sort the transactions before they are processed; once the disc file has been created, standard ICL Sort software may be used.

OUTPUT

1 Transactions disc file (see page 107)

2 Transactions Validation report (see Figure 16, page 53)

PERIPHERALS

The following peripherals are required by the Transaction File Creation routine:

1 One card reader or one paper tape reader

2 One disc transport

3 One line printer

SOURCE LANGUAGE

PLAN 3

Sort/Merge routines

SORT

The transactions disc file output from the Transaction File Creation routine (see page 53) may be in any sequence. Standard ICL Sort software may be used to sort the file into the required sequence.

Each demand can be assigned a priority code; thus the important demands will receive priority allocation. This is especially useful if the stock is limited. The highest priority that can be assigned is 99 and the lowest is zero. Priority codes may be allocated only to Demand Transactions.

Due date may also be used to assign priority allocation.

If the due date overrides the priority code, that is if priority codes choose only between demands due on the same day, the Transaction file will be sorted to:

item number/group code/transaction code/due date/priority

Thus, since transaction code is more significant than priority, back orders (transaction code 20) will take precedence over demands (transaction code 21) irrespective of the relative priority codes.

If priority is to override the due date, even if the item is overdue and has already been back ordered, both the Transactions file and the Recirculating file (see page 67) must be sorted to:

item number/group code/priority code/transaction code/due date

If priority codes are not being used then the Transaction need be sorted only by:

item number/group code/transaction code/due date

All the keys used for sorting are in ascending sequence except priority code which is in descending sequence.

MERGE

The sorted Transaction file may need to be merged with a recirculating Transaction file (that has the same record format). Standard ICL Merge software may be used; care must be taken to ensure that both the files are in the same sequence as the required merge keys.

The disc file output from the merge will contain stock transactions in a sequence suitable for processing in the next program (see page 56).

Stock Updating and Allocation routine (X43J)

OBJECTIVES

The objectives of the Stock Updating and Allocation routine are as follows:

1 To update the stock position and to maintain stock balance records.

2 To allocate physical stock to each demand in an agreed priority sequence, or according to a specified rationing parameter.

3 To generate a Replenishment Orders file containing details of orders for all stock items requiring replenishment.

4 To provide a link to other commercial system areas.

5 To provide stock audits on selected items.

6 To apply re-order point control to all stock items.

7 To provide control information on an exceptions basis.

8 To provide an Over Maximum/Under Minimum Stock file from which Over Maximum and Under Minimum Stock reports can be made.

System flowcharts for the Stock Updating and Allocation routine are shown in Figure 17 below.

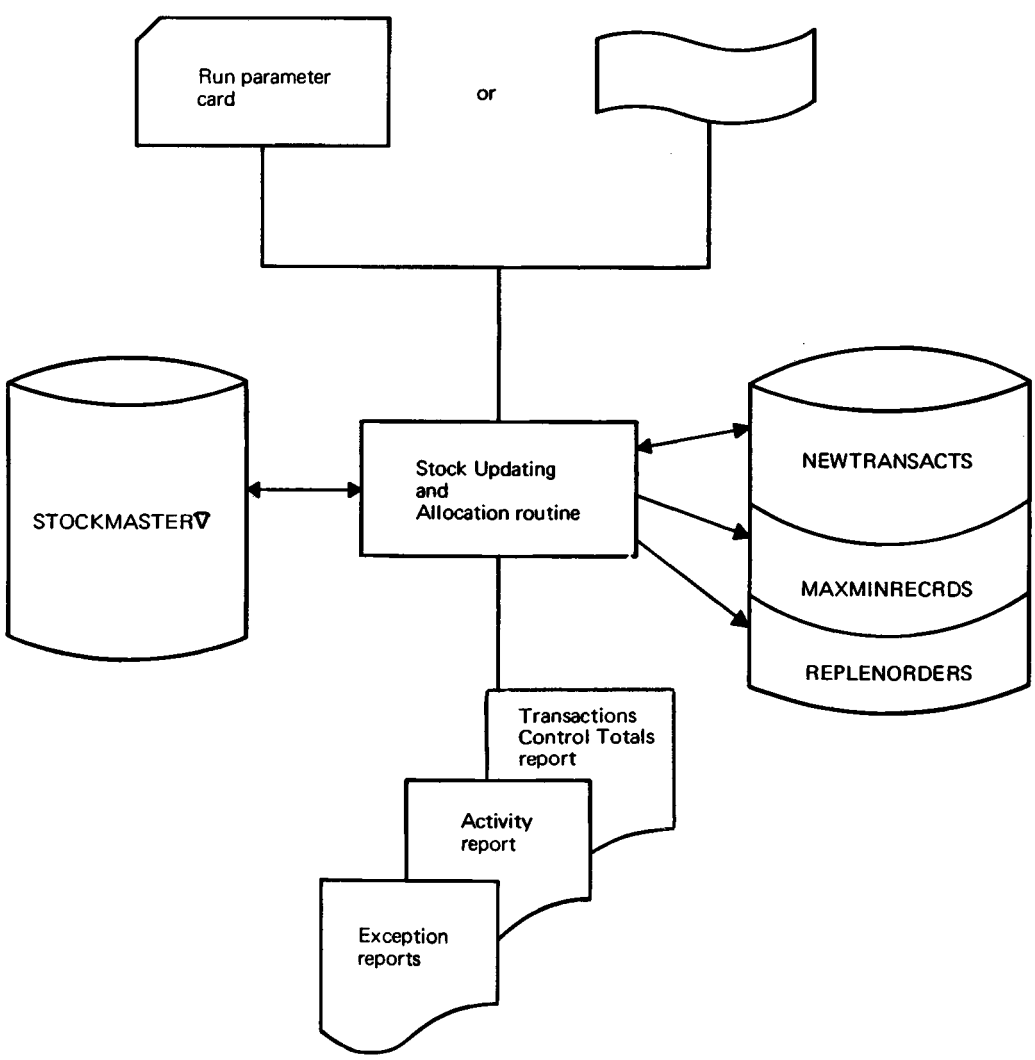


Figure 17 System flowchart and reports for Stock Updating and Allocation routine

STOCK UPDATING EXCEPTIONS REPORT PROGRAM X43J DATE 10/10/68 PAGE 2

ERROR	TRAN TYPE	ITEM NUMBER	GP CD	LN CD	NEGATIVE BALANCE	QUAN-1	QUAN-2	UOM	DUE DATE	TRANS DATE	TRAN TYPE	LEDGER CODE	1ST DOC REF	2ND DOC REF
X	99	XXXXXXXXXXXXXXXX	XX	XX	+9999999	9999999	9999999	XXXX	DD/MM/YY	DD/MM/YY	99	XXXXXXXX	XXXXXXXX	XXXXXXXX
Q	13	B479	77	42										
Q	21	B479	77	42										
Y		C110	26	04	- 22									
Z		C114	22	01	- 142									
Q	10	C490	27	02		142		EACH	14/11/68	10/10/68	21	Y17	2294	491
X	10	C520	14	04		21		EACH	29/10/68	10/10/68	21	A49	T22	5149
X	10	C520	14	04		430		EACH	02/11/68	10/10/68	21	B22	466	21

SUPPLEMENTARY ORDERING RUN REQUIRED

END OF REPORT

STOCK ACTIVITY REPORT (BY VALUE) PROGRAM X43J DATE 10/10/68 PAGE 3

	STOCK BALANCE	ORDER BALANCE	BACK ORDER BALANCE
OPENING BALANCES	125281	9278	85
SYSTEM ADJUSTMENTS		35	
INSERTED ADJUSTMENTS	32	50	0
RECEIPTS	8802	-8871	-69
NEW DEMAND	-12382		0
NEW ORDERS		6237	
SCRAP	0	0	
CLOSING BALANCES	121733	6729	16

END OF REPORT

END OF RUN

TRANSACTION CONTROL TOTALS REPORT PROGRAM X43J DATE 10/10/68 PAGE 4

	CONTROL TOTAL	QUANT-1 XXXXXXXXXX	QUANT-2 XXXXXXXXXX
	ALL I/P TRANSACTIONS	10062	641
LESS	RECIRCULATING I/P TRANSACTIONS	2480	0
GIVING	NEW I/P TRANSACTIONS	7582	641

END OF REPORT

END OF RUN

Figure 17 continued

INPUT

1 Overlay Stock Master disc file (see page 103)

2 Transactions disc file (see page 107)

3 Parameter record (punched on cards or paper tape). This record specifies the files to be used by the run and controls many of the functions available in the Stock Updating routine. The record determines whether the run is to be a normal run, or a supplementary ordering run and specifies whether or not production of orders and under minimum/over maximum records is to be suppressed. It also specifies whether or not proportional allocation of demand is allowed and if so, the minimum percentage allowed.

PROCESSING

Stock Master records are processed serial sequentially in ascending sequence of record key (item number/group code). Within each item number there may be more than one transaction and the transactions may be in various sequences.

The normal sequence is:

1 Item number (ascending)

2 Group code (ascending)

3 Transaction code (ascending)

4 Due date (ascending)

5 Priority (descending)

See page 55 for other possible sequences.

Unmatched records on the Transaction file are notified by error messages.

The processing is summarized below. Further details are given on page 91 .

1 (a) TRANSACTION AMENDMENT (code 10). Up to ten transaction amendments can be submitted for each branch record for any one run. The purpose of a transaction amendment is to amend the transaction records that are being recirculated. Transaction amendments could be used for example to change the quantity of a forward demand or to change the quantity of a back order because a customer has decided not to wait for new stocks to arrive.

If the amendment is to a forward demand, the forward demand balance and cumulative demand balance are updated. If the amendment is to a back order, the back order balance is updated. If the amendment is to a recirculating receipt, the order balance is updated.

(b) AUDIT REQUEST (code 11). Audit requests are used to compare the counted physical stock with the computer physical stock. The user enters the counted physical stock figure into the transaction record and SCAN enters the computer physical stock into the same record. The record does not recirculate but remains on the input Transactions file; the user must provide his own routine to access the information contained in the record.

(c) STOCK BALANCE/ORDER BALANCE ADJUSTMENT (code 12). The physical stock or stock on order balances (depending on what quantity field is used) are adjusted by the amount specified.

(d) STOCK RECEIPT AND SCRAP (code 13). When an amount of stock is received some of the stock will be acceptable (the quantity good) and some will not be acceptable (the quantity of scrap). If code 13 is used, the quantity good is added to the stock balance and the cumulative receipts; the quantity of scrap is added to the scrap accumulator. The total quantity of stock received is deducted from the stock on order balance and the receipts count is increased by one.

(e) RETURNS OUTWARD (code 14). Code 14 is used to record the quantity of goods returned to the supplier. The amount entered in the first quantity field will be deducted from the stock balance and the cumulative receipts balance. If all or part of the return is to be replaced by the supplier, the appropriate quantity should be entered in the second quantity field and this will be added to the order balance.

(f) UNSCHEDULED ISSUES (code 15). The unscheduled issues are deducted from the stock on hand balance and are added to the group and branch demand accumulators and the cumulative demand balance. Code 15 is of particular use when the user wishes to bypass the system allocation procedure.

(g) SCRAP NOTIFICATION (code 16). If any stock becomes or is discovered to be scrap after receipt, this is notified to the system by using code 16. The amount entered in the first quantity field is added to the cumulative scrap balance. The amount entered in the second quantity field is added to the cumulative scrap balance and subtracted from the stock balance.

(h) RETURNS INWARD (code 17). Code 17 is used to record the quantity of goods returned by the customer. The amount entered in the first quantity field is added to the stock balance and deducted from the cumulative demand balance. If it is required to ensure that the demand on which the forecast is based is reduced by the amount of the return, the second quantity field is also used; this amount is deducted from the group and branch accumulators.

(i) BRANCH TO BRANCH TRANSFER (code 18). Branch to branch transfer is used to transfer stock from one branch to another branch within the same group. The amount concerned is deducted from and added to the supplying and receiving branch stock balances respectively.

After the above transactions have been processed, stock is available for allocation to back orders, code 20 (these transactions are not input but are recirculated from the previous stock updating run) and for allocation to demands, code 21.

2 Stock can be allocated to back orders and demands in one of two ways:

(a) Back orders and demands are satisfied fully in the order they are presented.

(b) (i) Back orders are satisfied fully in the order they are presented.

(ii) Demands are satisfied on a proportional allocation basis. When the back orders have been satisfied, the total remaining demand for an item in one branch is compared with the stock balance for that item. If the stock balance is less than the total demands, the proportion of each demand that can be satisfied is calculated, and, provided this proportion is greater than the minimum value specified by the user, each demand is partially satisfied and partially back ordered. If the proportion of each demand that can be satisfied is less than the user specified minimum, then the demands are allocated the minimum amount in the order they are presented, unitl the stocks are depleted. The remaining demands are fully back ordered.

The first time an attempt is made to allocate stock to a demand, the quantity of stock to follow is indicated in the quantity 2 field of the Demand record. If the demand is satisfied fully then the quantity 2 field will be zero. If the quantity 2 field is non-zero, a back order record is generated by the Update Reports routine for recirculation. The back order record will then be presented to the next or subsequent Stock Updating runs until the back order can be satisfied. When the back order record is re-presented to the Stock Updating routine, the quantity 2 field will be zero, and will remain zero only if the back order can be satisfied. Creation of a back order record causes the back order balance and the cumulative back order balance to be increased by that amount; when the back order is satisfied the back order balance and stock balance are reduced by the amount.

Future demands, that is advance warning of demands, may be introduced to the system. If the due date of the future demand is more than one lead time away, the future demand record will be recirculated until the due date is within one lead time. The demand quantity is then added to the forward demand balance, the cumulative demand balance and to the group and branch demand accumulators. The record status markers (contained in the transaction record and used to indicate which stages of processing the record has undergone) are modified to indicate that the future demand has been recorded. If the demand accumulator is updated at this stage, then forecasting can be influenced by the forward demand at the earliest possible time. The demand recirculates until the due date comes within the pre-allocation period; then, stock is allocated to the demand. The pre-allocation period, if it is used, is specified on the run parameter card by the User. It is of use when several days are needed to deal with customers' orders after they have passed through the SCAN System; for example, if the processing is being carried out at a centre some distance from the warehouse or if the system is being used for manufacturing order control when it will be necessary to test for the availability of stock a few days before the stock is required.

Attempted allocation of stock to demand will cause one of the following to occur:

(a) If the demand were originally a forward demand, the amount of the demand is subtracted from the forward demand and the amount allocated is subtracted from the stock balance.

(b) If the demand were not a forward demand, the amount of the demand is added to the group and branch demand accumulators and to the cumulative demand balance. The amount allocated is subtracted from the stock balance.

In both cases, the quantity 2 field will be zero if there is no back ordering and will be equal to the amount of demand back ordered if back ordering occurs.

Transaction code 22 provides an additional means of indicating the amount of stock used. It is not normally used in conjunction with codes 15 and 21. Code 22 enables a branch to report on its stock count for an item at periodic intervals (at least once during each forecasting interval). The Updating routine can then calculate the sales that have occurred since the last stock count by subtracting the new stock count from the stock balance, the result being entered in the group and branch accumulators and added to the cumulative demand balance. The new stock count is then entered in the stock balance location.

3 When the stock has been updated and allocated, the following control action is carried out for each branch:

(a) If cyclical re-ordering is being used, the ordering interval count of the record is tested. For records with a non-zero ordering interval count, actions (b) and (c) below are carried out. For cyclical ordering records with a zero ordering interval count and for random ordering records, tests (b) and (c) follow the re-order point control tests. In these tests the re-order point is compared with the available stock (the sum of the stock balance and the order balance less the back ordered balance). If the re-order point is greater than or equal to the available stock, an order is calculated for the branch equal to the amount by which the available stock is exceeded plus the re-order quantity. Also, the forward demand balance is compared with the available stock and if it is found to be greater, an order quantity is calculated which is equal to the amount by which the available stock is exceeded plus the re-order quantity. The final order quantity for the branch is taken as the larger of the two calculated order quantities increased by the scrap factor percentage. This order quantity is then converted to receipt units by dividing by the conversion factor. When the whole group has been processed, a combined record for the requirements of all branches in the group is written to the Orders file. For cyclically ordered items, the order interval count in the item record is then set to the order interval. Note that for cyclically ordered items, the re-order quantity stored in the branch record on the Stock Master file is zero; consequently, the order quantity becomes the amount by which either the re-order point or the forward demand balance exceeds the available stock.

In both the above cases, a limit check is performed on the replenishment order quantity before it is output. The order quantity expressed in receipt units is compared with the minimum order quantity expressed in receipt units and the larger value is chosen. The quantity is then compared with the maximum order quantity expressed in receipt units and the smaller value is chosen. If this quantity is the maximum order quantity, an entry is made in the excess order field of the branch order record to be printed by the Update Reports routine. The stock on order balance is updated by the quantity of stock ordered.

For items that are being controlled by cyclical re-ordering, scheduling of orders will be made easier if item/group records are assigned to various ordering groups. The stock updating run parameter will then specify which ordering groups, for those records at the end of their ordering cycle, may order during the run concerned. Thus, cyclical orders can be conveniently spread over several stock updating runs.

(b) The stock balance minus the back orders is then compared with the minimum stock level. If the minimum stock level is the greater, a record is written to the Max-Min file.

Also, for cyclically ordered items not at the end of their ordering cycle, if the available stock (the stock on hand plus the stock on order minus the back orders) is less than the forward demand balance, an under minimum record is output.

(c) If the stock on hand is greater than the maximum stock level, a record is written to the Max-Min file.

Note: The stock updating run parameter can be set so that the output of records in (b) and (c) above is suppressed. This will be of use in avoiding excessive reporting of a continuing over maximum or under minimum condition. Thus, the user can produce these reporting records only, say, once a fortnight even though stock updating may be carried out daily.

Every branch record on the Stock Master file is examined by the Stock Updating routine, even if there are no transactions for the branch. Thus data can be extracted for use in the Activity report; also, it can be determined whether or not cyclical orders are due.

When all the records have been processed, a stock activity report gives details of the opening and closing balances and of the transactions encountered during the run. The Transactions file NEWTRANSACTS which was input is re-named OLDTRANSACTS at the beginning of the run to avoid accidental resubmission of the same file.

During the course of a Stock Updating and Allocation run the space allowed for the output files to be written into may become full; this should not happen in a configuration including three or more discs since new cartridges can be loaded as necessary. If the output discs do become full, no further output disc records will be produced but the input transactions file will continue to be fully processed. At the end of run a message will be written to the line printer indicating that a supplementary ordering run is required. The Stock Updating routine, run in supplementary ordering mode, carries out ordering and stock monitoring tests only and therefore no Transactions file is required. In this situation, no output difficulties should arise since new cartridges can be loaded as required.

Transaction code	*Type*	*Activity report balances affected*
10	Forward demand modification Back order modification Receipt modification	 BAL7 BAL18 BAL6 BAL17
11	Audit request	
12	Stock balance adjustment Order balance adjustment	BAL5 BAL16 BAL6 BAL17
13	Quantity received (good) Quantity received (scrap)	BAL8 BAL16 BAL9 BAL17 BAL15 BAL17
14	Returned quantity Re-ordered quantity	BAL8 BAL16 BAL13 BAL17
15	Unscheduled issue	BAL11 BAL16
16	Scrap (quantity 1) Scrap (quantity 2)	 BAL14 BAL16
17	Return (quantity 1) Return (quantity 2)	BAL8 BAL16
18	Branch to branch transfer	
20	Back order (when allocated)	BAL10 BAL18 BAL8 BAL16
21	Demand (when allocated) Demand (when back ordered)	BAL11 BAL16 BAL12 BAL18
22	Branch stock count	BAL11 BAL16
30	Replenishment order	BAL13 BAL17

Table 2 Effect of stock movements on the Activity Report balances

	Stock balance	*Order balance*	*Back order balance*
Opening balances	BAL1	BAL2	BAL3
System adjustments		BAL4	
Inserted adjustments	BAL5	BAL6	BAL7
Receipts	BAL8	BAL9	BAL10
New demand	BAL11		BAL12
New orders		BAL13	
Scrap	BAL14	BAL15	
Closing balances	BAL16	BAL17	BAL18

Table 3 Activity report balance references used in table 2

The user may suppress the production of the Replenishment Orders files or the Over Maximum/Under Minimum files during a Stock Updating and Allocation run to prevent excessive fragmentation as a matter of policy. Then a supplementary ordering run may be used to output the files. This decision will depend on the sizes of the master files and the type of configuration.

OUTPUT

1 Replenishment Orders disc file (see page 109)

2 Max-Min Stock disc file (see page 111)

3 Exception reports. These are concerned with both invalid transactions and negative balances. The type of exception is indicated by an error code (see page 143) in the ERROR column. The print format is determined as follows:

Error Q The complete record is printed.

Error X The complete record is printed.

Error Y The negative balance field indicates the amount by which the order balance was negative before it was zeroized.

Error Z The negative balance field indicates the amount by which the stock balance has gone negative. This balance is not zeroized.

4 Stock Activity report. This report is concerned with summarizing the effects of all movements that have occured during the run and with calculating the opening and closing total balances for the inventory. Addition of the opening balance to the movement balances in the same column (taking account of the sign where printed) gives the corresponding closing balance. The effect of each movement type on the activity report is illustrated in Tables 2 and 3.

5 Transaction Control Totals Report. This report provides check totals on the Transaction Quantity fields, thereby enabling the user to make sure that the correct number of transactions has been processed. The Stock Updating and Allocation routine accumulates the Quantity fields of all transactions input. This is printed out along with the total of Quantity fields of all transactions recirculating from a previous run of the routine, accumulated by the Updating Reports routine. Subtraction of the latter from the former gives a total which should agree with the new transactions quantity check total given by the Transactions Creation routine.

PERIPHERALS

The following peripherals are required:

1 One card reader or one paper tape reader

2 Two disc units

3 One line printer

SOURCE LANGUAGE

1900 COBOL

Automatic Ordering Routine (X43K)

OBJECTIVES

The objectives of the Automatic Ordering routine are as follows:

1 To process branch replenishment orders placed on internal warehouses, either allocating stock to the orders or backordering them.

2 To apply re-order point control to all warehouse stock items.

3 To generate a Replenishment Orders file containing details of all warehouse stock items requiring replenishment.

4 To provide control information on an exceptions basis.

5 To provide an Over Maximum/Under Minimum Stock file from which Over Maximum and Under Minimum Stock Reports can be made.

A system flowchart for the Automatic Ordering routine is shown in Figure 18 below.

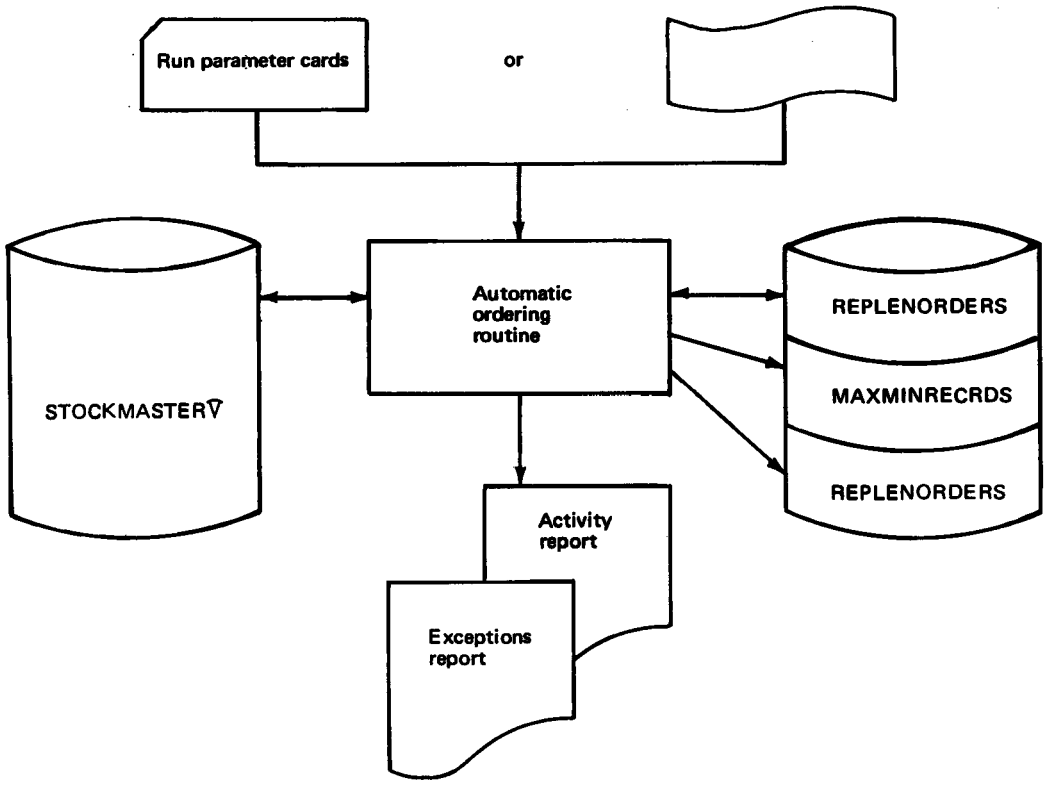


Figure 18 System flowchart and reports for Automatic Ordering routine

WAREHOUSE STOCK ACTIVITY REPORT(BY VALUE) PROGRAM X43K DATE 10/10/68 PAGE 3

	STOCK BALANCE -XXXXXXXXXX	ORDER BALANCE -XXXXXXXXXX	BACK ORDER BALANCE -XXXXXXXXXX
OPENING BALANCES	125281	9278	85
SYSTEMS ADJUSTMENTS		35	
INSERTED ADJUSTMENTS	0	0	0
RECEIPTS	0	0	0
NEW DEMAND	-12362		0
NEW ORDERS		6237	
SCRAP	0	0	
CLOSING BALANCES	112899	15550	85

END OF REPORT

END OF RUN

OPENING BALANCES

SYSTEMS ADJUSTMENTS

AUTOMATIC ORDERING EXCEPTIONS REPORT PROGRAM X43K DATE 10/10/68 PAGE 999

ERROR	TRAN TYPE	ITEM NUMBER	GP CD	LN CD	SUPPLIER CODE	NEGATIVE BALANCE	CLASS CODE	RECT UNIT	ORDER DATE	DUE DATE	SYST MARK	NO.OF BRANCHES ORDERING	CONV FACT
X	99	XXXXXXXXXXXXXXX	XX	XX	XXXXXXXX	-9999999	XX	XXXX	DD/MM/YY	DD/MM/YY	XX	99	9999
Q	30	A001	H4		←30000		A1	BOX	10/10/68	02/01/69	•1	12	1000
Y		B002	C1	03		- 875							
Z		B002	C1	07		- · 2000							
W	30	C004	D2		←1		A2	CASE	17/10/68	17/11/68	2	2	24

Figure 18 continued.

INPUT

1 Overlay Stock Master disc file (see page 103)

2 Replenishment Orders file (see page 109)

3 Parameters record (punched card or paper tape block). This record specifies the files to be used by the run and controls many of the functions available in the Automatic Ordering routine. The record specifies whether or not stock may be allocated on a proportional basis to branch orders, and whether or not production of warehouse orders and under minimum/over maximum records is to be suppressed.

PROCESSING

The Automatic Ordering routine will process with the following conditions in force:

1 Stock Master warehouse records are processed serial sequentially in ascending sequence of record key (item number / group code).

2 More than one branch replenishment order may apply to a warehouse Stock Master record.

3 The branch Replenishment Orders file must be in item Number/Supplier Code sequence.

4 Any warehouse record will have a group code containing "←" as its most significant character.

5 The supplier code of the branch Replenishment Orders record will have the group code/location code of the warehouse on which it places its orders as its most significant four characters.

The branch orders are treated in the same way as are demands in the Stock Updating run. Any non-allocation is indicated in the back order field of the order record. Following processing of all orders placed on a warehouse record, re-order point control and stock limit tests are performed in the same way as in the Stock Updating routine.

Note that the Activity report generated by the Automatic Ordering routine refers only to the balances of warehouse records. The difference between the opening and closing stock values then provides the value of goods that will be in transit as a result of this run and the total warehouse balances are clearly established in isolation from the branch stocks.

Again the user may choose to specify suppression of the Replenishment Orders or Under Minimum/Over Maximum files, and, as in the Stock Updating routine, these records will cease to be produced, even when no suppression is required, if the output files become full.

OUTPUT

1 Replenishment Orders disc file (see page 109)

2 Maximum – minimum Stock disc file (see page 111)

3 Exceptions reports. These are concerned with both unmatched input Replenishment Orders records and negative balances.

4 Stock Activity report. This report is concerned with summarizing by value the effects of all movements that have occurred during the run and with calculating the opening and closing total balances for warehouse stocks.

Table 4 shows which balances (see Table 2, page 61) are affected during the Automatic Ordering routine:

Transaction Code	*Transaction Type*	*Activity report balance affected*
30	Input replenishment order (when allocated)	BAL11 BAL16
30	Input replenishment order (when back ordered)	BAL12 BAL18
30	Output replenishment order	BAL13 BAL17

Table 4 Effect of Automatic Ordering routine on the Activity report balances

PERIPHERALS

The following peripherals are required by the Automatic Ordering routine:

1 One card reader or one paper tape reader

2 Two disc transports

3 One line printer

SOURCE LANGUAGE

1900 COBOL

Stock Updating Reports routine (X43W)

OBJECTIVES

The objectives of the Stock Updating Reports routine are as follows:

1 To print a list of all demands allocated or unallocated during the previous run of the Stock Updating and Allocation routine or the Automatic Ordering routine.

2 To print a list of all branches found by the previous Stock Updating or Automatic Ordering run to be holding less stock than the specified minimum stock level.

3 To print a list of all branches found by the previous Stock Updating or Automatic Ordering run to be holding more stock than the specified maximum stock level.

4 To print a list of all replenishment orders generated by the previous Stock Updating or Automatic Ordering run.

5 To select records from the Transactions file used in the previous Stock Updating run, or from the input Replenishment Orders file (of unallocated orders) to the previous Automatic Ordering run, and to recirculate these, after processing, to the next Stock Updating run.

6 To generate automatically forward dated receipt records so that branches that raised orders automatically during the last Automatic Ordering run can be automatically replenished.

A system flowchart for the Stock Updating Reports routine is shown in Figure 19

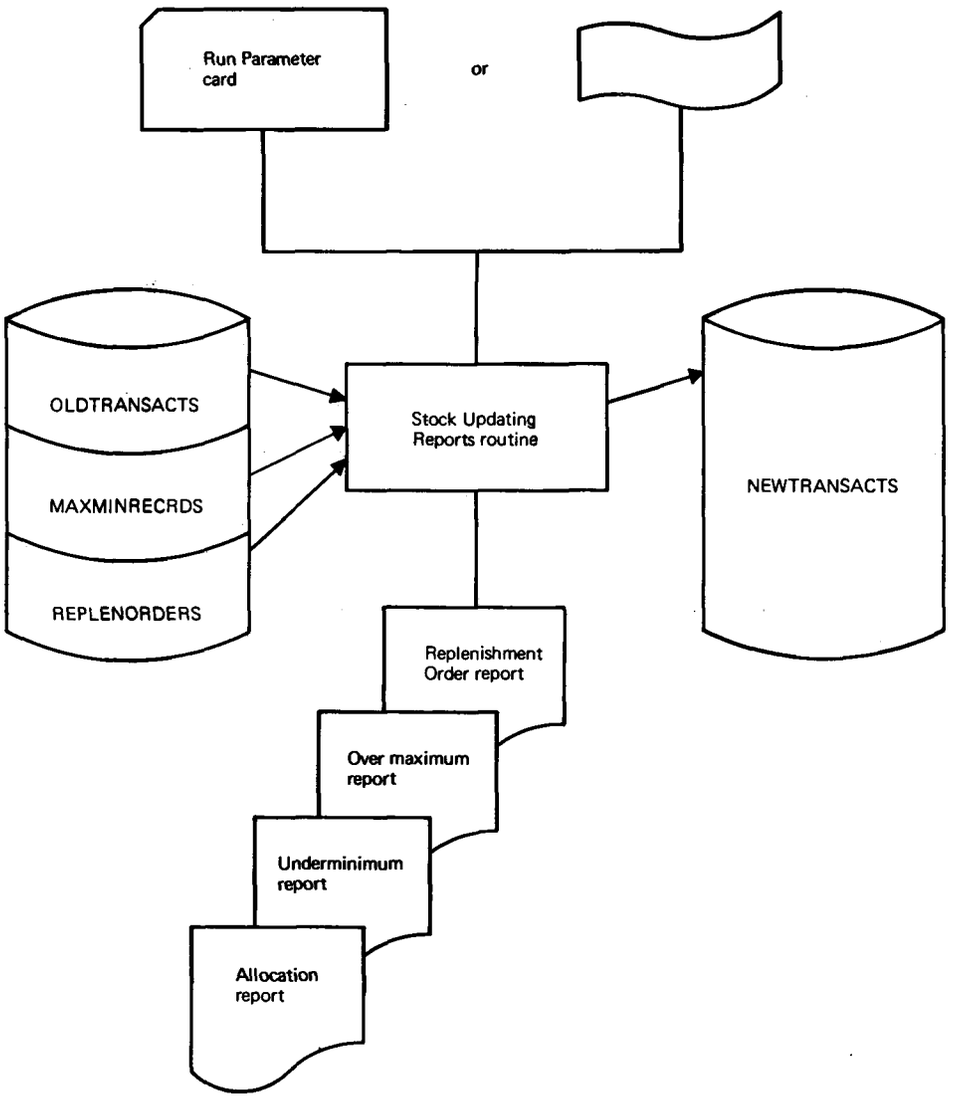


Figure 19 System flowchart and reports for Stock Updating Reports routine

```
ALLOCATION REPORT                                  PROGRAM X43W                                   DATE 11/10/68    PAGE     2

   ITEM NUMBER GRP LOC CLASS SYST  UOM DESCRIPTION                             BACK   ALLOC   ORDER DUE DATE CUSTOMER M
               CDE CDE  CODE MARK                                           ORDERED  DEMAND  NUMBER                 CODE D

XXXXXXXXXXXXXXX  XX  XX    X9   X9 XXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX 9999999 9999999 XXXXXXX DD/MM/YY XXXXXXX X

          A001  27  02    B1    1 CASE CHARAPYNE                                       15    2789 14/10/68      87 L
          A001  27  02    B1    1 CASE CHARAPYNE                             2         27    A374 16/10/68      28 L
                                                          BRANCH TOTALS      2         42

          A001  27  04    B1    1 CASE CHARAPYNE                                       72   93182 14/10/68      59 R
                                                          BRANCH TOTALS                72

          A002  21  01    B1    1 CASE SODA THAWPIT                                    28    5721 16/10/68      25 L
          A002  21  01    B1    1 CASE SODA THAWPIT                                    35    A371 16/10/68      23 L
          A002  21  01    B1    1 CASE SODA THAWPIT                         29              27245 16/10/68     A42 R
                                                          BRANCH TOTALS     29         63

          A004  21  01    A1   •1  DOZ ORANGE DRINK SUMMER GOLD                        87    A371 16/10/68      23 L
          A004  21  01    A1   •1  DOZ ORANGE DRINK SUMMER GOLD                        14     472 17/10/68     TT2‚C
                                                          BRANCH TOTALS               101



END OF REPORT

END OF RUN
```

```
STOCK UNDER MINIMUM REPORT                          PROGRAM X43W                                  DATE 10/10/68    PAGE     2

   ITEM NUMBER/ GRP LOC CLASS SYST  UOM FORWARD   ORDER   STOCK  BK ORD MINIMUM    FREE   STOCK   LEAD SUPPLIER
    DESCRIPTION CDE COE  CODE MARK       DEMAND BALANCE BALANCE BALANCE   STOCK   STOCK   VALUE   TIME     CODE
                                                                                              £

XXXXXXXXXXXXXXX  XX  XX    X9   X9 XXXX 9999999 9999999 9999999 9999999 9999999 9999999 9999999 999.99 XXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

          B008  H4  B2    A1    1 CASE      80     327       0      62       0     185       0   2.50  H19Ø33
SMALL PACKETS SUGAR

          C831  P2  A7    A2   •1 CASE      23      83       0       8       0      52       0   1.00  NT18721
SPECIAL MILK NESTLES 3/4 PINTS

          C937  M7  X2    A1    0 CASE       0      15       0       1       0      14       0   2.75  LTA492
BONIOS SPRATTS SMALL

          E811  ST  43    B2    1 CASE       0      39       0      15       0      24       0   1.00    15283
TIDYSAN 17X11

          G008  N7  04    A1    1 CASE       0       8       0       2       0       6       0   2.00  XY1624



                                  99999                    XXXX              9999999999            9999999999
END OF REPORT   NUMBER OF ITEMS      38       TOTAL VALUE(    £):  DEFICIENCY        4920  STOCK              0
```

Figure 19 continued

```
STOCK OVER  MAXIMUM REPORT                              PROGRAM X43W                                 DATE 10/10/68    PAGE     3

    ITEM NUMBER/ GRP LOC CLASS SYST  UOM FORWARD   ORDER   STOCK  BK ORD MAXIMUM    FREE   STOCK   LEAD SUPPLIER
     DESCRIPTION CDE CDE  CODE MARK       DEMAND BALANCE BALANCE BALANCE   STOCK   STOCK   VALUE   TIME     CODE
                                                                                               £

XXXXXXXXXXXXXXXX  XX  XX    X9   X9 XXXX 9999999 9999999 9999999 9999999 9999999 9999999 9999999 999.99 XXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

            A003  H7  09    A1   •1 CASE      69     483     528       0    500.     942     580   2.00   H18971
LEMON DRINK SUMMER GOLD
                                                                                                 •
            A014  A9  41    B3    0 CASE      10      61     291       0     250     342     262   3.50 XT20638
WINALOT LARGE

            C008  TY  02    A1    1 CASE       8      10    1093       0    1000    1095    2295   1.00    17833
NESCAFE SACHETS

            D801  TX  08    A1    1 CASE      83      58     758       0     750     733     303   1.75    16560
TIDYSAN 13X10




                                  99999                XXXX            9999999999          9999999999
END OF REPORT    NUMBER OF ITEMS    27          TOTAL VALUE(    £)•       EXCESS        5267  STOCK          9423

END OF RUN
```

```
REPLENISHMENT ORDER REPORT                              PROGRAM X43W                                 DATE 10/10/68    PAGE     2

    ITEM NUMBER/ GP CC S  UOM   LEAD SUPPLIER LN FORWARD   ORDER   STOCK  BK ORD REORDER   ORDER LOAD INDEX  EXCESS A
     DESCRIPTION CD    M        TIME     CODE CD  DEMAND BALANCE BALANCE BALANCE   POINT QUANTITY             ORDER O

XXXXXXXXXXXXXXXX XX X9 X XXXX 999.99 XXXXXXXX XX 9999999 9999999 9999999 9999999 9999999  9999999 9999999.99 9999999 X
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

            A001 H4 B1 1 EACH   1.00  TY20064 02       3      24      42       0      80       44       4.40
LININGS  4X10                                 04       0      10      23       0      43       30       3.00
                                              07       5      15      30       0      55       33       3.30
                                                                          GROUP TOTALS        107      10.70

          B74H29 AT A1 1 EACH   2.50   TXX429 01     142     404     622       0    1200      210      10.50
BALL UNIT SIZE TA                    BULK ORDER  BALANCE    4960   CONTRACT EXPIRY DATE 11/02/69

          C47729 W4      EACH   1.00    TAB22 01
SHAFT END CAP-MEDIUM                 BULK ORDER QUANTITY   10000   CONTRACT EXPIRY DATE 19/04/69

          TB2922 TC A1 0 EACH   2.00←4W9      TT       0       0      42       0      50       28       4.40          •
UNIT 4 SPROCKET



END OF REPORT

END OF RUN
```

Figure 19 continued

INPUT

1 Transactions disc file (see page 107)

2 Max-min Stock disc file (see page 111)

3 Replenishment Orders disc file (see page 109)

4 Parameter record punched on card or paper tape. This record identifies the files to be used and the reports required. Also, in this record, the user specifies whether or not forward dated receipts are to be generated during record selection.

PROCESSING

The Stock Updating Reports routine

The Stock Updating Reports routine is mainly concerned with

1 Providing reports associated with the previous run of the Stock Updating or Automatic Ordering run.

2 Selecting from the transactions input to the previous Stock Updating, run, those records to be recirculated to the next Stock Updating run.

The listing of all reports except the Allocation report is optional. By setting the run parameter appropriately, the user selects the type of report he requires and the routine prints out the appropriate listings. The reports are described below:

The Allocation report

The Allocation report gives details of stocks allocated to demands and the amount of demand backordered during the last Stock Updating or Automatic Ordering run. Also, any backorder to which stock was allocated is shown.

An asterisk printed next to the system marker indicates that the item possesses seasonal characteristics.

The Allocation report is printed automatically during transaction record selection (*see below*). In situations where records are not being recirculated (where for example, there are no backorders or forward demands) the production of the report is completely optional, since the user is not obliged to carry out record selection. Where recirculating records exist, the user must carry out record selection to preserve the integrity of the system, and therefore in this case the production of the report is not optional.

The Stock Under Minimum report

The Stock Under Minimum report gives details of all branches whose stocks were below the specified minimum after the last Stock Updating or Automatic Ordering run.

An asterisk printed next to the system marker indicates that the item possesses seasonal characteristics.

The Stock Over Maximum report

The Stock Over Maximum report gives details of all branches whose stocks were above the specified maximum after the last Stock Updating or Automatic Ordering run.

An asterisk printed next to the system marker indicates that the item possesses seasonal characteristics.

The Replenishment Order report

The Replenishment Order report lists orders that have been raised by the previous Stock Updating or Automatic Ordering run. An asterisk in the AO column indicates that the item was Automatically Ordered using the Automatic Ordering routine.

The Reports routine also provides for the selection of transaction records during printing of the allocation report. If the system is being operated in such a way that records are recirulated, then records must be selected from the Transactions file before the next Stock Updating run. If the user specifies in the run parameter record that he requires transaction record selection, the Transactions file is searched for the following types of record.

1 Demand records for which no attempt has been made to allocate stock; the record status field indicates which records are concerned. Such records are carried forward to the output Transactions file.

2 Demand records for which an attempt has been made to allocate stock, but the Quantity 2 field is non-zero. These demands were unsatisfied and the quantity of back ordered demand is the figure held in the Quantity 2 field. Therefore, a back order record is written to the output Transactions file.

3 Back order records with a non-zero Quantity 2 field, that is records of back orders still not satisfied. A back order of the amount held in the Quantity 2 field is written to the output Transactions file.

4 Any records, other than demand records or back order records, not having the processing marker set, thus indicating that the record was not processed by the last Stock Updating run (see *Transactions file*, note 4, page 108). If an Updating run does not function correctly and terminates prematurely leaving part of the Transactions file unprocessed, the processing marker enables the unprocessed records to be selected and transferred to the next Transactions file for input to the next stock updating run.

After the Transactions file OLDTRANSACTS has been scanned for the types of records given above to be extracted, it is renamed ENDTRANSACTS to avoid record selection being carried out more than once. The ENDTRANSACTS file is then available to be used by the user's Costing, Invoicing and Purchase Order Control routines.

Forward dated receipts records can be created to correspond to branch orders placed automatically in an automatic ordering stock updating run. During record selection, the Orders file is scanned for such branch orders; when they are encountered, receipts records for the amounts allocated are created with a due date one lead time in the future. If any part of the branch order could not be satisfied (signified by a non-zero entry in the quantity 2 field of the order record), a back order record is created for the back ordered amount, Marker 3 of the record status is set to indicate that the back order arose from an automatically placed order. The receipts and back order records are then written to the Transactions file.

In addition, the Transactions file is scanned for allocated back orders with marker 3 set. For these, a forward dated receipt record is raised for the quantity allocated, with a due date one lead time in the future. Forward dated receipts records then recirculate until they become due, when the delivery is assumed to be made to the branch and the branch record is updated.

OUTPUT

1 Transactions disc file (see page 107)

2 Allocation report

3 Stock Under Minimum report

4 Stock Over Maximum report

5 Replenishment Order report

PERIPHERALS

The Stock Updating Reports routine requires the following peripherals:

1 One card reader or one paper tape reader

2 Two disc transports

3 One line printer

SOURCE LANGUAGE

1900 COBOL

Stock Forecasting and Monitoring routine (X43V)

OBJECTIVES

The following are the objectives of the Stock Forecasting and Monitoring routine:

1 To estimate future demands for selected records using adaptive forecasting techniques.

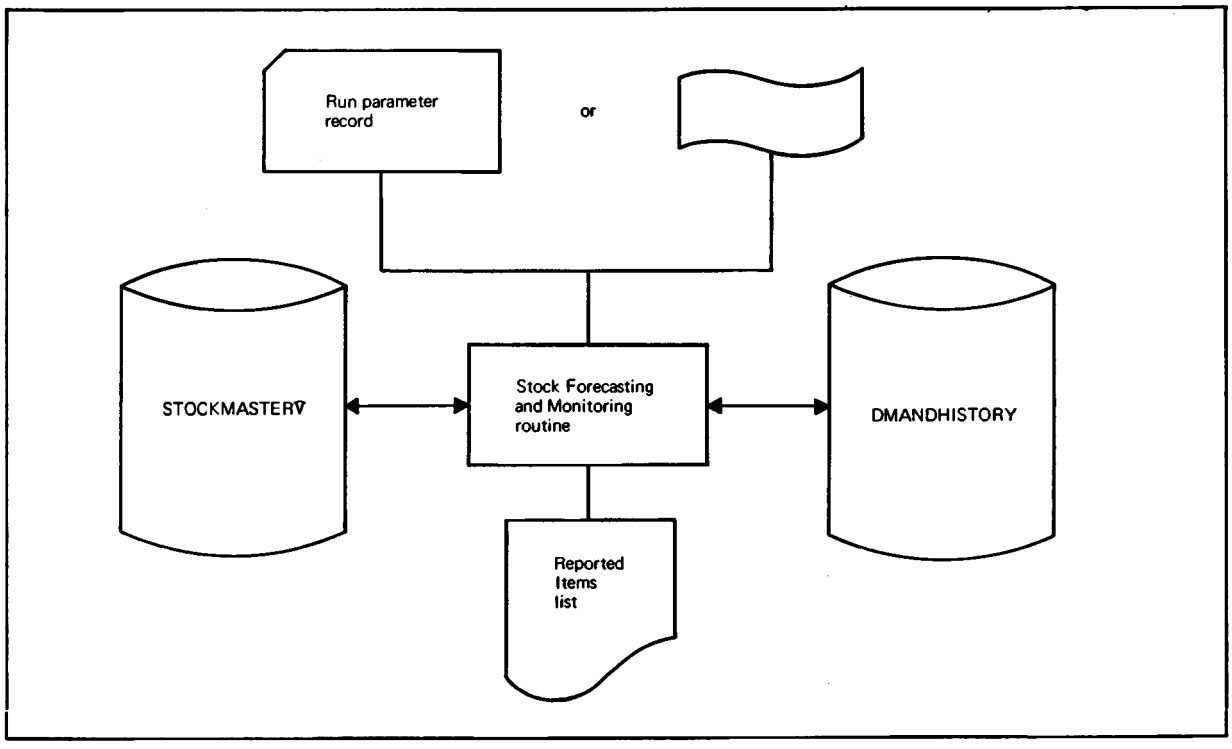
2 To recalculate the re-order point and re-order quantities for selected records.

3 To monitor the system performance and to provide control information on an exceptions basis.

4 To update demand history and system counts.

5 Optionally to report on all items for which a forecast is made during the run.

A system flowchart for the Stock Forecasting and Monitoring routine is shown in Figure 20 below.



REPORTED ITEMS LIST PROGRAM X43V DATE 02/10/68 PAGE 2

ITEM NUMBER	GP CD	LN CD	STOCK BALANCE	ORDER BALANCE	BACK ORDERS	FORWARD DEMAND	REORDER POINT	REORDER QTY	O I	F 1	S M	S I	DEMAND -2	DEMAND -1	FORECAST -1	FORECAST +1	
XXXXXXXXXXXXXXXX	XX	XX	9999999	9999999	9999999	9999999	9999999	9999999	9	99	9	A	9999999	9999999	9999999	9999999	
AJK/167/RL/470	G6		2205	1270	0	46			1	1	1	Y	559	254	942	149	•
		6C	1790	565	0	16	460	115						131		83	
		6D	415	705	0	30	423	96						123		66	
BOR/174/RL/504	F7		NO SM RECORD														
EFH/283/MO/803	D8		177	2500	158	0			1	1	1	Y	1003	1050	557	1097	•
		8A	233	633	0	0	1568	423						383		421	
		8F	-63	368	82	0	1460	476						276		273	
		8L	171	543	0	0	683	172						134		126	
		8S	-64	956	76	0	1136	315						257		277	
RXY/008/AK/814	G1		NO DH RECORD														

END OF RUN

Figure 20 System flowchart and report for Stock Forecasting and Monitoring routine

INPUT

1 Demand History overlay disc file (see page 100) containing all necessary fields to produce demand forecasts for the period ahead.

2 Stock Master overlay disc file (see page 103) containing updated stock positions and period demand date from previous Stock Updating and Allocation runs.

3 Forecast parameter record. The following Management parameters are held in this record.

(a) Five customer service levels chosen by Management and expressed as percentages. They correspond to the service level groups specified for each of the Demand History records. The routine determines for each record the safety factor used in the calculation of the safety stock (see page 211).

(b) Overriding ordering cost

(c) Overriding investment rate. This is expressed as a percentage.

(d) The investment rate as for (c) above. This is the investment rate for each of ten investment rate groups, any one of which is held in the Demand History file item record.

(e) Emergency cumulative control parameter (γ_{1e}) to be used as an emergency measure for any record in the control system that has a system marker 1 to 6 and for which the existing γ_1 is zero. Emergency action will be taken when loss of prediction optimality is detected by the tracking signal.

(f) Emergency proportional control parameter (γ_{0e}) to be used as an emergency measure for any record in the control system that has a system marker 2 or 7 and for which the existing γ_0 is less than the emergency value. Emergency action is taken when loss of prediction optimality is detected by the tracking signal.

Note: Parameters (b) and (c) are used as blanket values, in the formula for economic order quantities (see page 215).

If (c) is zero, parameter (d) is used provided that an ordering cost is available from either the item record or from parameter (b), otherwise no economic order quantity is computed for the item. If parameter (c) is non-zero, parameter (d) is not required.

PROCESSING

Unmatched item records on the Stock Master file having system markers in the range 0 to 9 remain unchanged except that the group and branch demand accumulators are zeroized in each forecast run and the non-move count is updated each time the group demand accumulator is found to contain zero. Also, for cyclical and bulk ordering items, the order interval count and bulk order interval count are updated.

Unmatched item records on the input Demand History file remain unchanged but are signalled by an error message.

For all matched item records, processing depends on the control system marker as follows.

System marker value '0'

This means that fixed re-order point control with random ordering will be used. The group period demand from the Stock Master file record is placed in the demand history array held on the Demand History file record. The series length, closing stock and non-move count are updated.

System marker value '1'

Adaptive control with random ordering will be used together with the two-point Box-Jenkins prediction technique (see page 206).

1 The forecast interval count is increased by one and, if a forecast is made, the seasonal base count is increased by one for seasonal items.

2 The demand array length (series length) is updated and the latest group demand is placed in its correct place in the demand array.

3 The closing stock balance is transferred from the Stock Master file record to the Demand History file record. If the forecast interval and the forecast interval count are equal, the forecast interval count is set to zero. Then, 4 to 9 below are computed.

4 Smoothed forecast error.

5 Smoothed mean absolute deviation of errors.

6 The tracking signal. This is compared with a statistical limit. If the limit is exceeded, details are printed in the Reported Items List and the cumulative control parameter (γ_{1e}) from the parameter card is used if normal $\gamma_1 = 0$.

7 The next period's forecast of demand.

8 The latest estimate of the proportion of the group demand due to each branch.

9 The new re-order point for each branch. This is computed using the appropriate input parameter customer service level.

10 Marker 1/2 of the stock master record is examined. If this does not specify economic ordering, an order quantity is computed using the preferred ordering interval and the demand forecast extrapolated over the order interval (and taking into account seasonal factors if any).

If marker 1/2 does specify economic ordering and if either input parameter (b) or the ordering cost field is non-zero, an economic order quantity is computed using either:

(a) The input parameter (c), if it is non-zero, as the investment rate for the item (a blanket value for the whole inventory).

(b) If (c) is zero, the value of input parameter (d) corresponding to the investment rate group for that item. If no parameter (d) is present for the item, a 15% default value is used.

If both the input parameter (b) and the ordering cost field in the item record in the Demand History file are non-zero, the former takes precedence. The order quantity corresponding to the preferred ordering interval is also calculated and the larger of the two quantities is output as the system re-order quantity. The calculation of the economic order quantity takes into account any quantity discounts that have been specified on the Stock Master record. See also page 215.

If the preferred order interval is zero it is assumed 1, if economic ordering has not been specified.

11 If γ_1 was amended, reset it to zero.

System marker value '2'

This means that records with this system marker are forecast using the Box-Jenkins one point predictor (that is γ_1 is set to zero). This method is exactly equivalent to single exponential smoothing. The remainder of the processing is identical to that for System marker value '1' with the exception of the use of emergency γ_0 (γ_{0e}) as opposed to emergency γ_1 for use with the two point predictor. With exponential smoothing, the emergency γ_0 parameter will, when forecast errors become excessive, overwrite the value being used for γ_0 if it is larger than the present value.

System marker value '3'

This means that lagged adaptive response rate forecasting is used (see Appendix 1, page 206). Again the processing is identical to that of System marker value 1, except that no emergency prediction parameters are used.

System marker value '5'

This means that fixed re-order point control with cyclical ordering is to be used.

Processing is identical to that for system marker '0' above except that the ordering interval count is reduced by one if it is greater than zero or, if it is zero, it is set to the order interval minus one.

System marker value '6'

This means that adaptive control with cyclical ordering will be used with the Box-Jenkins two point predictor.

Processing is identical to that for System marker value '1' except that the re-order point calculation is based on the lead time plus the preferred ordering interval in place of the lead time; the re-order quantity is set to zero and the order interval count is reduced by one if it is greater than zero or, if it is zero, it is set to the order interval minus one.

System marker value '7'

Processing for System marker value '7' is identical to that for System marker value '6' except that the one point Box-Jenkins predictor is used, and an emergency value of γ_0, rather than γ_1, is used (See *System marker value '2'*, above.)

System marker value '8'

Processing for this system is indentical to that of System marker 7 except that lagged adaptive response rate forecasting is used, and no emergency values of γ_0 and γ_1 are used.

Also, if both a demand history record and a stock master record exist for the item/group, in each forecast run for all system markers in the range 0 to 9, the demand accumulator in the stock master record is transferred to the end of the demand history in the demand history record. The accumulator is then zeroized. The branch demand accumulators are zeroized at each forecast interval. The non-move count is updated each time the group demand accumulator is found to be zero on transfer and the bulk order interval count is updated each forecast run (if necessary).

No system marker outside the range 0 to 9 will be controlled using SCAN System 3. System markers 4 and 9 are reserved for SCAN enhancements.

OUTPUT

Reported Items list. This list is concerned with reporting exceptions occurring during a forecast run. Unmatched demand history records are always reported. Unmatched stock master records are reported unless their system marker is 0 or 5. Any group for which forecasting at group level is unsatisfactory (that is, the tracking signal has fired) is reported together with enough information for the situation to be investigated. Marker 11 of the demand history record is set so that the record may be printed by the Master File Print routine without an item selection record being present. Exception reports of this kind are labelled with an asterisk at the right hand side; thus they can be identified easily when full reporting is being used. Full reporting is optional and can be specified by run parameter. If full reporting is being used, a forecast report is generated for every record for which a forecast has been made during the run.

For cyclically ordered items, the order interval count is continually reduced by successive forecast runs until it is zero. Then, the item is available for ordering by the Stock Updating routine, providing the user has nominated the ordering group for the item. The order interval count is set to the order interval when the order is placed. However, if the order interval count returns to the Forecast routine as zero, the user has not allowed the Stock Updating routine to order for that item. The Forecast routine resets the count as before but reports the item/group as not having been allowed to order at the end of the ordering cycle. Since the system will not have another opportunity to order before the end of the next ordering cycle, the user must raise an order manually for the appropriate amount.

The user is given the opportunity to indicate by parameter a separate run type by which he may create a skeleton Demand History file. Only Stock Master records need to be input on such a run, and the only processing carried out involves taking any information that is common to both main files from each Stock Master record, and using it to write a corresponding Demand History record. The user thus economises on data transcription to cards or paper tape, consequently reducing the risk of errors in punching. He may add extra demand history information by use of the file maintenance routines.

PERIPHERALS

The following peripherals are required:

1 One card reader or one paper tape reader

2 Two disc transports

3 One line printer

SOURCE LANGUAGE

PLAN 3 and 1900 FORTRAN IV

Chapter 4 File formats

This chapter describes the formats used for each of the files required or produced by the SCAN System 3.

GENERAL

An important point to note is that consistency must be maintained throughout the system when fields concerned with units of measure, costs or time periods are being used.

Units of measure

A unit of measure must be chosen to express the issue and receipt quantities for each item included in the system, once chosen each unit must be used consistently. All types of transaction have unit of measure fields; data corresponding to the main file value for the unit of measure must be entered into this field, otherwise the transaction will be rejected.

Costs

The currency unit used must be expressed as an integer (plus a fractional part if necessary) and must be the same for all items in the inventory.

Time periods

All time periods should be expressed in terms of the system time period, the time between forecast runs; for example, if the forecast routine is to be run weekly then time periods should be expressed in weeks (and fractions of a week, if necessary).

Reserved characters

Special significance is attached to the following characters by the SCAN System 3 and they must not be used unless for the purposes stated below.

1 The comma (,) is used for terminating certain parameter record fields. It may be selected, if required, as a terminator for data fields where paper tape input is used.

2 The left hand arrow (←) is used to denote warehouse records and to restore standard values for alphanumeric fields.

3 The character selected by the paper tape user to terminate data fields must be restricted to that use.

DEMAND HISTORY FILE

If forecasting and analysis of the inventory are not required then the system can operate without the Demand History file. However, if ABC classification or forecasting is required for some items, a demand history record must be created for each item/group concerned.

The Demand History file may be created either from punched cards or from paper tape (see Figure 21, page 78). The input format for demand history records is shown in card image form; for paper tape, the same format should be used except that each field is variable in length and must terminate with a field terminator chosen by the user and specified in the run parameter record; for any field that is not being used, up to and including the last field for which data is included, the field terminator must still be present. Every record will be terminated by a newline after the field terminator for the last field used. The space separators used for the input of demand history and the seasonal factors on cards are not used on paper tape input. A field is defined as the complete area referred to by name, as shown in Figure 21. Thus, when for example function markers are being used, only one terminator is used, not one for each marker. Demand history records are maintained by five maintenance operations D, F, M, S and R used in conjunction with six record codes 0, 1, 2, 3, 4 and #. One of the letters indicating the maintenance functions occurs as the first character of each record. The functions are as follows:

Figure 21 Demand history records input formats

International Computers Limited | Data processing | 1900 SCAN system 3 for inventory management | **Demand history records** | **ICL**

Company name XYZ Co. Ltd. Item number AB/010/53 Currency unit £ Time unit WEEK

1 2 3 4 5 6 7 8 9 10 1 2 3 4 5 6 7 8 9 20 1 2 3 4 5 6 7 8 9 30 1 2 3 4 5 6 7 8 9 40 1 2 3 4 5 6 7 8 9 50 1 2 3 4 5 6 7 8 9 60 1 2 3 4 5 6 7 8 9 70 1 2 3 4 5 6 7 8 9 80

Record type		Item number	Group code	S.L.G.	Order int.	I.R.G.	Ordering cost	S.M.	Forecast int.	Gamma zero	Gamma one	Unit of issue	Deseasonalised forecast	Cost price	Sales price	Lead time	Stock balance	Series length	Seasonal base
F	1	AB/010/53	J6	1	43		0.75	1	10.1			EACH	316	1.5	1.85	6.4	523	33	

Record type		Item number	Group code	Class code	Description	Cumulative sum of errors	Smoothed forecast errors	Mean absolute deviation of forecast errors	Function markers
F	2	AB/010/53	J6	A	ELECTRIC MOTOR 0.125HP. 240V.				

Record type		Item number	Group code	Start address	Demand history *(Last data item must be followed by field terminator and an asterisk)*
F	3	AB/010/53	J6	0	556 568 600 700 590 370 463 410 238 310 320 223 466 510
F	3	AB/010/53	J6	14	432 563 676 421 306 196 376 537 613 506 432 527 388 277
F	3	AB/010/53	J6	28	407 383 568 501 532 *

Record type		Item number	Group code	Start address	Seasonal factors *(Last factor must be followed by field terminator and an asterisk)*
	4				
	4				

Record type		Item number	Group code	Trend factor
F	#	AB/010/53	J6	1.2

Abbreviations

S.L.G. – Service level group
I.R.G. – Investment rate group
S.M. – System marker

The data contained in the above records are to be taken as an illustration of format only. Normally, Demand data and Forecasting parameters would not be input together.

FORM 14/36/6(1.69)

1 DELETE RECORD. The D operation deletes the Demand History record from the file; it can only be used for code 0 input records. The only other information in the input record is the item number and the group code.

2 FORM RECORD. The F operation forms a new Demand History record to be either added to a new file or inserted in an existing file; it can be used only with input record codes 1 to 4 and #.

3 MODIFY RECORD. The M operation modifies a Demand History record existing on a sequential main file; it can be used only for input record codes 1 to 4 and #.

4 SELECT RECORD. The S operation causes a demand history record to be selected from a sequential main file and written to a serial file; it can be used only with code 0 input records.

5 RENUMBER RECORD. The R operation changes the key (item number/group code) of a demand history record and inserts the record into its new position in the sequential main file; it can be used only with type 0 input records. The new item number and group code are given in character positions 21 to 38; both fields must be given even if only one field is being changed.

The following sections describe the way data is specified for each input field. If the user does not specify any information for a field during the formation of a record, the Maintenance routine will assume standard values (see *Demand History file*, page 100). Any invalid information submitted during a modification run will be rejected.

After information has been written to an alphanumeric field, the standard value for that field can be restored during a modification run if a ← character alone is entered in any character position in the field.

Information for a field input from cards or paper tape can be in any position in the input field. Alphanumeric data will be transferred to disc into the corresponding position; thus, if such information is input on paper tape it will be left justified when transferred to disc unless spaces precede the data. Numeric data will always be stored on disc in the format specified under *Demand History file*, page 100 irrespective of the layout of the input record field.

Record code 1

ITEM NUMBER

The item number field contains the item reference number in alphanumeric form.

If the item number is input on a card, it will be written to disc without any justification, but the field will be zero filled on the left by the Maintenance routine. The user may place the item number anywhere in the item number field but he must be consistent and always place it in the same position in the field; thus, the user is advised to enter the number either always right justified or always left justified.

If the item number is input on paper tape, the characters input for the item number field will be written to disc at the right hand end of the field by the Maintenance routine which will also zeroize the remainder of the field.

GROUP CODE

The group code field contains an alphanumeric reference to the group of branches.

If it is required that orders be placed automatically by branches on warehouses, or if it is required to operate the joint replenishment routines, the group records that represent warehouse records will be signified by a group code having a ← character in the most significant character position. The remaining character is chosen by the user (it must not be left blank).

SERVICE LEVEL GROUP (S.L.G.)

The S.L.G. field is a numeric field containing only one of the number 1, 2, 3, 4 or 5. The number chosen specifies the service level group into which the item falls. If no number is inserted into this field, a value 1 is used; therefore, it is recommended that group 1 is reserved for a default group.

ORDERING INTERVAL

The ordering interval field is an integer numeric field used to give the number of system time periods between orders. The number contained in this field must be in the range 0 to 99; a blank entry will be treated as an entry of 0.

INVESTMENT RATE GROUP (I.R.G.)

The I.R.G. field is an integer numeric field containing a number in the range 0 to 9. The number indicates which investment rate is to be used in the Stock Forecasting and Monitoring routine run. No entry is required in this field if economic ordering is not being used or if an overriding investment rate is specified in the parameter card for the Stock Forecasting and Monitoring routine.

ORDERING COST

The ordering cost field contains a decimal value expressed in the system currency unit and with a decimal point if one is required. The decimal point can occur anywhere in the field. No entry in this field is necessary if economic ordering is not being used or if an overriding ordering cost is specified in the parameter card for the Stock Forecasting and Monitoring routine.

SYSTEM MARKER

The system marker field is an alphanumeric field. The SCAN System will control items having system markers 0, 1, 2, 3, 5, 6, 7 or 8 but the remaining numeric system markers are reserved for SCAN enhancements. Non-numeric system markers may be used for those items that are to be controlled by the user.

If the Control System Selection routine is to be used or if the standard program value 0 (for fixed re-order point control and random ordering) is satisfactory then no entry is required in the system marker field.

FORECAST INTERVAL

The forecasting interval field contains a numeric value in the range 0 to 26 specifying the forecasting frequency in number of system time periods. No entry in this field is necessary if the Stock Profile Analysis routine is to be run or if the standard value 0 (for no forecasting, only data collection) is satisfactory.

GAMMA ZERO (γ_0)

Gamma zero (γ_0) is the proportional prediction parameter used in the forecasting equations. It has a decimal value in the range 0 to 1, with a decimal point if one is required. No entry in the γ_0 field is necessary if analysis is to be carried out or if forecasting is not required, or if forecasting using lagged adaptive response rate is to be used.

GAMMA ONE (γ_1)

Gamma one (γ_1) is the cumulative prediction parameter used in the Box-Jenkins forecast equation. It has a decimal value in the range 0 to 1 with a decimal point if one is required. No entry in the γ_1 field is necessary if analysis is to be carried out, if exponential smoothing is required, if lagged adaptive response rate forecasting is required, or if forecasting is not required.

UNIT OF ISSUE

The unit of issue field is an alphanumeric field indicating the standard unit of measure for the item, for example, feet, gross, etc. It indicates the units in which the item is issued from the branch. If this field is used, the unit of issue given must be the same for the item throughout the system. All quantities and values in the record should be expressed in terms of this unit.

DESEASONALIZED FORECAST

The deseasonalized forecast field contains a decimal value with a decimal point if one is required. No entry in this field is necessary if the Control System Selection routine is to be run or if forecasting is not required in the first instance. If the Stock Forecasting routine is to be used immediately, the value entered in the deseasonalized forecast will help the forecasting routine to settle down quickly.

COST PRICE

The cost price field contains a decimal value expressed in the system currency unit and including a decimal point if one is necessary. The value inserted in the cost price field specifies the standard cost price for the item; all 'at cost' valuations use this value for the cost price. If 'at cost' valuations or economic ordering are not required, this field may be left blank.

SALES PRICE

The sales price field contains a decimal value, expressed in the system currency unit and including a decimal point if one is necessary. The value inserted in the sales price field specifies the standard sales price for the item; all sales valuations use this value for the sales price. If no sales valuations are required, this field may be left blank.

LEAD TIME

The lead time field contains a decimal quantity expressed in system time periods and including a decimal point if one is necessary. The quantity inserted in this field must be chosen to represent the lead times adequately. If forecasting is to be carried out then an entry must be made in this field since the lead time value is used in the calculation of the re-order point.

GROUP STOCK BALANCE

The stock balance field is a numeric field containing an integer representing the stock on hand for the group at the time the record is formed. If analysis is to be carried out, an entry must be made in this field.

SERIES LENGTH

The series length field is an integer field specifying the number of demand points being provided for analysis.

The maximum number for this field is 104, but it should not exceed twice the number of system time periods in a year. For example, if the forecasting routine is to be run monthly, the number of time periods in a year is 12 and the maximum allowable number of demand points is 24. Less than two years" data may be provided. A blank entry is allowable provided no demand points are input for the item.

SEASONAL BASE

The seasonal base field is an integer numeric field specifying the number of seasonal factors being provided for the item. This number must not exceed the number of system time periods in a year and unless it is left blank (or zero) it must be equal to the number of system time periods in a year divided by the forecast interval

Record code 2

Use of this record is optional.

ITEM NUMBER

The item number field is as for record code 1.

GROUP CODE

The group code field is as for record code 1.

CLASS CODE

The class code field is an alphanumeric field containing the class code. If analysis is to be performed or if classification of the inventory is not necessary then this field may be left blank.

DESCRIPTION

The description field is an alphanumeric field containing information describing the item. Use of this field is optional.

CUMULATIVE SUM OF ERRORS

The cumulative sum of errors field contains a decimal quantity with a decimal point if one is required. This field will not normally be used during the formation of a demand history record. The field enables modifications to be carried out on the Box-Jenkins cumulative sum of forecasting errors.

SMOOTHED FORECAST ERRORS

The smoothed forecast errors field contains a decimal quantity with a decimal point if one is required. The entry is punched in card columns 62 to 68. This field may be left blank if analysis is to be carried out (see page 47).

MEAN ABSOLUTE DEVIATION OF FORECAST ERRORS

The mean absolute deviation of forecast errors field contains a decimal quantity with a decimal point if one is required. The entry is punched in card columns 69 to 75. This field may be left blank if analysis is to be carried out (see page 47).

FUNCTION MARKERS

The function markers field contains a set of markers that control the facilities available in the SCAN routines. During the formation of a record, a blank entry or an entry of zero in this field will give the marker the value zero. During modification a blank entry is ignored; thus to unset the marker, a zero must be input. Table on page 82 illustrates the marker values and their meanings. Two additional markers, which cannot be altered by users but which are stored in the same half word on the disc, are shown. The values given are the binary values occuring on the disc, corresponding exactly with the value the user must enter to achieve the required control.

Marker	*Character position on input record*	*Value*	*Condition for value shown*
0	76	1	Forecast interval may not be reduced.
1	77	1	Seasonal factors may not be overwritten.
The following markers may be altered only by the SCAN routines			
10		1	Recalculation of seasonal factors, by Demand Analysis routine, is required.
11		1	Printing of the record, by the Main File Listing routine, is required following creation or modification of the record.

Record code 3

This record may be omitted if no demand points are being entered.

ITEM NUMBER

The item number field is as for record code 1.

GROUP CODE

The group code field is as for record code 1.

START ADDRESS

The start address field contains an integer specifying the sequence number of the first demand point on the input record in relation to the total demand history, the count starts at zero. The use of this field in the Formation of records is shown in Figure 21, page 78. For modification, this address specifies the start address of the block of demand points being modified.

DEMAND HISTORY

The demand history field contains variable length integers, representing demands, separated by at least one space for data input on cards or by spaces as required plus a field terminator for data input on paper tape. The last demand point input on cards must be followed by a space and an asterisk. The last demand point input on paper tape must be followed by a field terminator, an asterisk and a new-line character. The demand points must be entered in the order in which they occurred that is, the oldest ones first and the most recent ones last. If no demand occurred for a time period, a zero must be punched. The demands must be entered for time intervals equal to the system time period, for example, if the system time period is one week, the demands will be accumulated and input for each week.

Record code 4

This record is not used if no seasonal factors are being entered.

ITEM NUMBER

The item number field is as for record code 1.

GROUP CODE

The group code field is as for record code 1.

START ADDRESS

The start address field contains an integer specifying the sequence number of the first seasonal factor on the input record in relation to the seasonal factor series; the count starts at zero. For modification, this address specifies the start address of the block of seasonal factors being modified.

SEASONAL FACTORS

The seasonal factors are as the demand history points in record code 3 except that the seasonal factors are decimal quantities with decimal points if required.

Record code #

Use of this record is optional.

ITEM NUMBER

The item number field is as for record code 1.

GROUP CODE

The group code field is as for record code 1.

TREND FACTOR

The trend factor field is a numeric field with a decimal point punched if required. Use of the field is optional, but any value entered must be greater than zero and not greater than 7.5. This figure is a control feature which, in the absence of historical demand data being supplied, allows management to specify to the system an expected yearly increase or decrease in demand. The estimate will be used in forecasting new demand. No factors should be entered if demand data has been supplied, as the demand Analysis routine will calculate the factor automatically (see Appendix 1, page 207). Examples of the format of this factor are 1.25 and 0.85 which advise the system of a 25% annual increase and a 15% annual decrease in demand respectively.

If seasonal factors are supplied for an item containing trend, the factors must include a trend component if a trend factor is also input or if sufficient data is supplied for the trend factor to be calculated by SCAN 3.

Termination record

The pack of input cards for a file maintenance run is terminated by a card having asterisks in the first four character positions. Paper tape input is terminated by a record containing four asterisks followed by a field terminator and a newline character.

STOCK MASTER FILE

Before the operational routines can be run a Stock Master file must be created on disc in SCAN System 3 format. The file can be created in one of two ways: either using an existing user's stock file and a user provided conversion routine or by inputting data directly on cards or paper tape.

The format for input data supplied on cards is shown in card image form in Figure 22, page 84. The format for input data supplied on paper tape is the same as that for cards except that each field is variable in length and is terminated by a field terminator chosen by the user and specified in the run parameter record. Field terminators must be used for all fields including blank fields up to and including the last field for which data has been entered. Each record must be terminated by a newline character as well as the field terminator for the last field used. A field is defined as the complete area referred to by name as shown in Figure 22. Therefore, when for example the card type is being used, only one terminator is used, not one for the operation and one for the code.

Stock Master records are maintained by five maintenance operations D, F, M, S and R used in conjunction with seven input record codes 0, 5, 6, 7, 8 9 and : . The functions are as follows:

1 DELETE RECORD. The D operation deletes the stock master record from the file; it can be used only with type 0 input records. The only other information in the input record is the item number and the group code.

2 FORM RECORD. The F operation forms a new stock master record to be either added to a new file or inserted in an existing file; it can be used only with input record types 5 to 9 and:

3 MODIFY RECORD. The M operation modifies a stock master record existing on a sequential main file; it can be used only with input record types 5 to 9 and :

4 SELECT RECORD. The S operation causes a stock master record to be selected from a sequential main file and written to a serial file; it can be used only with type 0 input records.

5 RENUMBER RECORD. The R operation changes the key (item number/group code) of a stock master record and inserts the record into its new position in the sequential main file; it can be used only with type 0 input records. The new item number and group code are given in character positions 21 to 38; both fields must be given even if only one field is being changed.

The following sections describe the way data is specified for each input field. If the user does not specify any information for a field during the formation of the record, the Maintenance routine will assume standard values (see *Stock Master file,* page 103). Any invalid information submitted during a modification run will be rejected.

Figure 22 Stock master records input formats

International Computers Limited | Data processing | 1900 SCAN system 3 for inventory management | **Stock master records** | **ICL**

Company name XYZ Co. Ltd. Item number AB/010/53 Currency unit £ Time unit WEEK

1 2 3 4 5 6 7 8 9 10 1 2 3 4 5 6 7 8 9 20 1 2 3 4 5 6 7 8 9 30 1 2 3 4 5 6 7 8 9 40 1 2 3 4 5 6 7 8 9 50 1 2 3 4 5 6 7 8 9 60 1 2 3 4 5 6 7 8 9 70 1 2 3 4 5 6 7 8 9 80

Record type	Item number	Group code	B.M.T.	Loc'n code	Bin Location	Minimum stock level	Maximum stock level	Stock balance	Order balance	Re-order point	Re-order quantity	Demand accumulator
F 5	AB/010/53	JG		12	CX113	20	200	53	160	250	160	48

Record type	Item number	Group code	Order int.	Supplier code	Lead time	Cost price	Minimum order qty.	Maximum order qty.	Unit weight, time, volume	Set-up time	Scrap factor	Function markers	O.G.
F 6	AB/010/53	JG	4	SEC12	6.4	1.5	10	300	5.5			0200000	3

Record type	Item number	Group code	Disc code	Sales price	Purchase tax	Seasonal base	Description	S.M.	Unit of issue	Class code
F 7	AB/010/53	JG		1.85			ELECTRIC MOTOR 0.125HP. 240V.		EACH	A1

Record type	Item number	Group code	Price break quantity	Price break	Price break quantity	Price break	Price break quantity	Price break
F 8	AB/010/53	JG	150	1.45	250	1.35		

Record type	Item number	Group code	B.O.I.	B.O.I. ct.	Bulk order quantity	Bulk order qty. balance
F 9						

Record type	Item number	Group code	Unit of receipt	Conversion factor
:	AB/010/53	JG	EACH	1

Abbreviations B.M.T. – Branch modification type.
O.G. – Ordering group.
B.O.I. – Bulk order interval.
B.O.I. CT. – Bulk order interval count

The data contained in the above records is to be taken as an illustration of format only. Normally, there will be one Record type 5 for each branch within the group.

FORM C14/36/4(1.69) FORM 14/36/4(1.69)

For any one key (item number/group code) only one record of the codes 6, 7, 8 9 and : may be entered. As many type 5 records may be entered as there are branches in the group. Use of records 6, 7, 8, 9 and : is optional.

Record code 5

ITEM NUMBER

The item number field contains the item reference number in alphanumeric form.

If the item number is input on a card, it will be written to disc without any justification, but the field will be zero filled on the left by the Mainenance routine. The user may place the item number anywhere in the item number field but he must be consistent and always place it in the same position in the field; thus, the user is advised to enter the number either always right justified or always left justified.

If the item number is input on paper tape, the characters input for the item number field will be written to disc at the right hand end of the field by the Maintenance routine which will also zeroize the remainder of the field.

GROUP CODE

The group code field contains an alphanumeric reference to the group of branches.

If it is required that orders be placed automatically by branches on warehouses or if it is required to operate the joint replenishment routines the group records that represent warehouse records will be signified by a group code having a ← character in the most significant character position. The remaining character is chosen by the user (it must not be left blank).

BRANCH MODIFICATION TYPE (B.M.T.)

The B.M.T. field is an alphanumeric field containing one of the letters D, F or M. It is used only where the record operation is M. The letter entered in this field signifies that branch records should be deleted, formed or modified on an existing stock master record.

LOCATION CODE

The location code field contains an alphanumeric reference to the stock location (the warehouse or branch code). If the group contains only one branch then this field may be left blank.

BIN LOCATION

The bin location field is an alphanumeric field used to identify the location of stock within the warehouse or branch. Use of this field is optional.

MINIMUM STOCK LEVEL

The minimum stock level field is an integer field containing a stock balance low limit specified by the user. If the stock balance falls below this limit during a stock updating run, a stock report is generated. Use of this field is optional.

MAXIMUM STOCK LEVEL

The maximum stock level field is an integer field containing a stock balance high limit specified by the user. If the stock balance rises above this limit during a stock updating run, a stock report is generated. Use of this field is optional but if it is used, a test will be carried out to ensure that the value inserted in this field is greater than or equal to that in the minimum stock level field.

STOCK BALANCE

The stock balance field contains an integer signifying the actual stock balance for the branch. This field must be used when records are formed if SCAN is to control the inventory realistically.

ORDER BALANCE

The order balance field contains an integer specifying the stock on order balance. This field must be used during the formation of a record if SCAN is to control the inventory realistically.

RE-ORDER POINT

The re-order point field contains an integer specifying the stock level which controls the initiation of new orders.

For items under forecast control, this field may be left blank since the appropriate value will be calculated by the Stock Forecasting and Monitoring routine. This field must be used for items having a fixed re-order point.

RE-ORDER QUANTITY

The re-order quantity field contains an integer quantity specifying the quantity of stock that will be ordered together with the re-order point deficiency when an order is initiated by re-order point control. No entry is necessary in this field for forecasting items. For fixed re-order point control items, an entry in this field is required if random ordering is used, but no entry is necessary if cyclical ordering is used. In this situation, ordering is achieved by estimating the re-order point for an effective lead time equal to the true lead time plus the ordering interval.

DEMAND ACCUMULATOR

The demand accumulator field normally contains an integer specifying the demand occurring for the branch during a forecast interval. When a complete group record of which the branch is part, is being formed, it is necessary to enter in this field only figures representing the relative demands on the branches without regard to the forecast interval concerned.

Following formation of the record, an initializing forecast run should be carried out to use the figures entered in this field to calculate branch weight factors; the field will then be zeroized. For this purpose it is sufficient to enter figures that reflect the relative importance of the branches within the group. Actual branch demand figures are not required. If the group contains only one branch then no entry in this field is necessary.

If a branch is being added to a group during a modification run, care must be taken to ensure that a representative figure is inserted in this field. However, branches may be added to a group with the demand accumulator field set to zero, immediately after the group has been forecast. During the following forecast interval, the demand accumulator field will be updated, thus during the next forecast run for the group the branch weight factor can be estimated. It should be noted that no re-order point control parameters will be available for the branch until the forecast has been made; therefore, it may be important that the user enters estimates of the re-order point and re-order quantity for temporary use. (The temporary estimates will be overwritten by the first SCAN forecast values.) Alternatively, the branch may be added immediately before the group forecast is made; then, no estimates for the re-order point or the re-order quantity will be required, but an estimate of the demand on the branch for one forecast interval must still be made and entered in the demand accumulator field.

Record code 6

ITEM NUMBER

The item number field is as for record code 5.

GROUP CODE

The group code field is as for record code 5.

ORDERING INTERVAL

The ordering interval field is an integer numeric field used to give the number of system time periods between orders. The number contained in this field must be in the range 0 to 99; a blank entry will be treated as an entry of 0.

SUPPLIER CODE

The supplier code field is an alphanumeric field identifying the supplier for the item/group. The contents of this field are used by purchase order control routines. Use of this field is optional unless branches are required to place orders on warehouses automatically, in which case the group code and location code of the warehouse must be entered in this field. The field will then contain a ← character in the most significant position followed by the remaining character of the group code and the two characters of the location code. (Warehouse group codes always have a ← character in the most significant character position.)

LEAD TIME

The lead time field contains a decimal quantity expressed in system time periods and including a decimal point if one is necessary. The quantity inserted in this field must be chosen to represent adequately the lead times. If forecasting is to be carried out then an entry must be made in this field since the lead time value is used in the calculation of the re-order point.

COST PRICE

The cost price field contains a decimal value with a decimal point if one is necessary. The price contained in this field is used for any stock valuations, for example, the Stock Updating Activity report, and orders will be made at this price unless quantity discount prices are supplied (*see Record code 8, page* 89). This field need not be used if no stock valuations or economic ordering are required.

MINIMUM ORDER QUANTITY

The minimum order quantity field contains an integer representing the smallest quantity the supplier will supply. If this field is left blank then an entry of 0 is assumed.

MAXIMUM ORDER QUANTITY

The maximum order quantity field contains an integer representing the largest quantity that can be ordered at any one time. If an attempt is made to order more than this quantity, an exception report is produced. Use of this field is optional.

UNIT WEIGHT, TIME OR VOLUME

This field contains a decimal quantity with a decimal point if one is necessary. The quantity contained in this field specifies the weight or the volume of a unit or the time taken to make it.

If the field is used for the weight or volume of a unit, it will provide information to help optimize loading of transport when supplying goods to customers or receiving goods from suppliers. If the field is used for the time taken to make a unit, it enables calculations to be made of the factory loadings; the time taken to make a unit will also be used in conjunction with the set up time (see below). Use of this field is optional.

SET UP TIME

The set up time field contains a decimal quantity with a decimal point if one is necessary; the quantity specifies the time taken to set up or tear down the production unit used for making the item. Use of this field is optional.

SCRAP FACTOR

The scrap factor field contains an integer quantity that represents the percentage of scrap that is likely to occur in each order when it is received. Order quantities will be increased to allow for this percentage of scrap. Use of this field is optional.

FUNCTION MARKERS

The function markers field contains a set of markers that control the several facilities available in the SCAN System 3 operational routines. During formation of a record, a blank entry or an entry of zero in this field will give the marker the value zero. During modification, a blank entry is ignored; thus, to unset the marker, a zero must be input. Table 4 illustrates the marker values and their meanings. For completeness an additional marker which cannot be altered by the user but which is stored in the same half word on the disc is shown. The values given are the binary values occurrring on the disc, corresponding exactly with the value the user must enter to achieve the required control.

ORDERING GROUP (O.G.)

The ordering group field is an alphanumeric field used only for cyclically ordered items. The cyclically ordered items may be assigned to various ordering groups so that orders may be placed in different stock updating runs. The ordering groups that are required to order stock during a given stock updating run are indicated on the stock updating run parameter card. The number of ordering groups that can be used is restricted, only by the size of the character set, to 64. However, in a system using daily updating, five groups will enable orders to be scheduled throughout the week and in weekly updating systems, four groups will enable orders to be scheduled throughout the month. Use of this field is optional.

Marker	*Character position on input record*	*Value*	*Condition for value shown*
0	68	1	Bulk ordering required
1/2	69	0	Preferred frequency ordering without price breaks
		1	Economic ordering without price breaks
		2	Preferred frequency ordering with price breaks
		3	Economic ordering with price breaks
3	70	1	Joint replenishment or economic ordering required after updating
4	71	1	Order size cannot be increased by joint replenishment
5	72		Not used
6	73	1	Demands placed on this group cannot be proportionately allocated
7	74	1	Orders placed by this group cannot be proportionately allocated
The following marker can be altered only by the SCAN routines			
11		1	Automatic printing required

For markers 0, 3, 4, 6 and 7, a zero value will give the opposite effect to that shown for value 1.

Table 5 Marker values for Stock Master file

Record code 7

ITEM NUMBER

The item number field is as for record code 5.

GROUP CODE

The group code field is as for record code 5.

DISCOUNT CODE

The discount code field is for use in the user's invoicing procedures. Use of this field is optional.

SALES PRICE

The sales price field contains a decimal value expressed in the system currency unit and including a decimal point if necessary. The quantity specifies the standard sales price of the item; all sales valuations will use this value for the sales price. If no sales valuations are required, this field may be left blank.

PURCHASE TAX

The purchase tax field contains a decimal value expressed in the system currency unit and including a decimal point if necessary. The quantity contained in this field will be used by the user's invoicing routines. Use of this field is optional.

SEASONAL BASE

The seasonal base field may be left blank since the appropriate value will be written to the Stock Master file during forecasting. The field is defined in record code 1.

DESCRIPTION

The description field contains an alphanumeric description of the item concerned. Use of this field is optional.

SYSTEM MARKER

The system marker field is an alphanumeric field. The SCAN System will control only those items having system markers 0, 1, 2, 3, 5, 6, 7 or 8 but the remaining numeric values are reserved for SCAN enhancements. The user may use non-numeric system marker values for items he wishes to control himself. If the Control System Selection routine is to be run or if the standard program value 0 (for fixed re-order point control with random ordering) is satisfactory, no entry in this field is necessary.

UNIT OF ISSUE

The unit of issue field is an alphanumeric field indicating the standard units of measure for the item, for example, feet, gross etc. It indicates the units in which the item is issued from the branch. If this field is used the unit of issue given must be the same for the item throughout the system. All quantities and values in the record should be expressed in terms of this unit.

CLASS CODE

The class code field is an alphanumeric field containing the class code. If analysis is to be performed or if classification of the inventory is not necessary then this field may be left blank.

Record code 8

This record is not used if marker 1/2 does not have one of the values 2 and 3.

ITEM NUMBER

The item number field is as for record code 5.

GROUP CODE

The group code field is as for record code 5.

PRICE BREAK QUANTITY

A price break quantity field contains an integer specifying the quantity of stock at which a price discount will be offered by the supplier. Up to three quantities may be entered. If more than one quantity is entered, the quantities must be in ascending order of magnitude; the smallest quantity must be greater than zero.

PRICE BREAK

The price break field contains a decimal value expressed in the system currency unit and with a decimal point if necessary. The quantities entered in this field specify the quantity discount prices corresponding to the price break quantities in the previous field. The prices must be in descending order of magnitude and the largest value must be less than the standard cost price. The number of price breaks entered must be the same as the number of price break quantities entered.

Record code 9

This record is not used if marker 0 is not set. Also, the group must contain only one branch and marker 3 must not be set.

ITEM NUMBER

The item number field is as for record code 5.

GROUP CODE

The group code field is as for record code 5.

BULK ORDER INTERVAL (B.O.I.)

The bulk order interval field is a numeric field containing an integer specifying in system time periods the contract period during which the user has agreed with the supplier to use the bulk order quantity by call off. The entry in this field must be greater than zero.

BULK ORDER INTERVAL COUNT (B.O.I.C.T.)

The bulk order interval count field is a numeric field containing an integer used for timing the placing of new bulk orders. The field will normally be left blank thus causing the next stock updating run to produce a bulk order record.

If a bulk order contract already exists, the period of the bulk order interval not yet expired should be entered in this field expressed in system time periods.

BULK ORDER QUANTITY

The bulk order quantity field is a numeric field containing an integer specifying the total quantity of stock the user has contracted to order from the supplier during the bulk order interval. The quantity entered in this field must be greater than zero and exactly divisible by the conversion factor.

BULK ORDER QUANTITY BALANCE

The bulk order quantity balance field is an integer field that will normally be left blank. If a bulk order contract already exists the amount of the bulk order quantity of stock still to be used should be entered in this field. This amount should be exactly divisible by the conversion factor.

Record code:

ITEM NUMBER

The item number field is as for record code 5.

GROUP CODE

The group code field is as for record code 5.

UNIT OF RECEIPT

The unit of receipt field is an alphanumeric field indicating the receipt unit being used for the item. It is four characters in length and is punched in card columns 21 to 24. The unit name mentioned on the receipts transaction record (code 13) must correspond with the name entered here.

CONVERSION FACTOR

The conversion factor field is an integer field giving the number of issue units contained by a receipt unit; for example, if the item were received in dozens and issued in ones, the conversion factor would be 12. The number is restricted to the range 1 to 2047. An entry of zero or space is treated as one. The number is a maximum of four digits in length punched in card columns 25 to 28.

Termination record

The pack of input cards for a file maintenance run is terminated by a card having asterisks in the first four character positions. Paper tape input is terminated by a record containing four asterisks followed by a field terminator and a newline.

STOCK MASTER FILE INPUT VALIDATION

The following validation is carried out on the data input for the Stock Master file in addition to the error checking already mentioned.

1 The number of branch records within a group must not exceed 16. Any records attempting to exceed the limit for one group being formed or modified will be rejected.

2 A group must contain at least one branch record. If an attempt is made to form a group containing no branches, the remaining input records for the group are rejected. If a group contains only one branch and an attempt is made, during modification, to delete the branch, the input record is rejected. If the last remaining branch in a group is to be deleted, the complete group must be deleted.

3 In general, the quantities held in maximum fields must not be less than those held in minimum fields. If an attempt is made to put a value in a maximum field less than the value in the corresponding minimum field, the minimum field is set to zero. If, during modification, a new pair of maximum and minimum values are submitted and are invalid, the old values are left in the fields. If a new value for one of a pair of maximum and minimum fields is submitted during modification and it is not consistent with the value in the other field of the pair, the new value will be rejected.

4 Up to 16 type 5 records will be accepted for a single item/group but only one of codes 6, 7, 8, 9 and : are allowed.

5 A group record having marker 0 set must not have marker 3 set, nor can the group contain more than one branch. If either of these occurs during formation of the file, the Master file record will not be formed. If, during modification, an attempt is made to produce one of the situations, the input will be rejected.

6 To initiate bulk ordering, marker 0 must be set and a valid type 9 record must be input. If a type 9 record is input during formation of the file and marker 0 is not set, the record will be rejected. If the marker is set but the type 9 record is invalid, the marker will be unset. If any type 9 record field is invalid during a modification run, the original data is left in the field.

7 If marker 1/2 has value 0 or 1 during formation, any type 8 records are rejected. If marker 1/2 has value 2 or 3, a type 8 record must be present; if no type 8 record is present, the marker value will be reduced by two to 0 or 1.

If, during modification, the value of marker 1/2 is changed from 0 or 1 to 2 or 3, a type 8 record must be present otherwise the marker will retain its original value. If the marker value is changed from 2 or 3 to 0 or 1, any type 8 records will be rejected.

8 If any marker associated with the SCAN System 3 functions that use the stock master record optional fields is unset, the stock master record will contract to exclude those fields.

TRANSACTIONS FILE

The Transactions file is used as input for the operational routines. Eleven types of transaction embracing most types occuring in a stock and order processing system may be written to the Transactions file. The file may be created from cards or from paper tape; the file will then require to be sorted and merged with a file of recirculating transactions, if one exists, before it is input to the Stock Updating and Allocation routine.

The types of transaction that may be input are described below in card image form and are shown in Figure 23 page 92.

The format for paper tape input is the same as that for cards except that each field is variable in length and is terminated by a field terminator chosen by the user and specified in the run parameter record. If on paper tape a field is empty, the field terminator must still be present; this applies for all fields up to and including the last field for which data is being input. Each record must be terminated by a record terminator following the field terminator of the last field used. Since the field terminator is specified at run time, a different terminator may be used for creating this file from the one used for creating the other two files.

The rules governing the positioning of data within the fields of records are the same rules that apply for the creation of the other two files. Note that the units used for any one item/group record must be consistent throughout the system. The fields described below are the only fields relevant to the transaction concerned. When quantity fields are used, the values in the fields must not be less than zero unless otherwise stated.

SCAN System 3 does not make use of any information contained in columns 56 to 80 except for printing purposes. Thus, these columns can be used to hold any alphanumeric information. Also, users may disregard the field boundaries given but then any SCAN printing of these fields will be meaningless. Users having paper tape can achieve this free format by punching the data with only one field terminator followed by a newline.

Transaction amendment

Columns	*Contents*
1 and 2	Record code 10
3 to 18	Item number (as for record code 1)
19 and 20	Group code (as for record code 1)
21 and 22	Location code (as for record code 5)
23 to 29	New quantity 1. This field is an integer field containing the new quantiy 1 figure for the transaction being amended. If the field is left blank, the quantity 1 field of the transaction being modified will be zeroized. Negative entries in this field are valid only when a type 12 transaction is being modified, in this situation, the minus sign can be punched anywhere in the field.
30 to 36	New quantity 2 (as for the previous field)
37 to 40	Unit of measure (as for record code 5)

Figure 23 Transactions records input formats

International Computers Limited | Data processing | 1900 SCAN system 3 for inventory management | **Transaction records** | **ICL**

Company name XYZ Co. Ltd. Currency unit £ Time unit WEEK

Record type	Item number	Group code	Loc'n code	Quantity 1	Quantity 2	Unit of measure	Due date	Transaction date	Priority	P.A.M.	Customer, supplier or dept. code	1st document reference no.	2nd document reference no.	M.O.D.
11	AB/010/53	FG	12	53		EACH		250968				MFT68		
12	AB/010/53	FG	12		-30	EACH		250968			GEC12	MFT68	STF6C	
13	AB/010/53	FG	12	68	2	EACH		250968	0		GEC12	EM01	9X37DC	
17	AB/010/53	FG	12	7	7	EACH		250968			QQMRD1	27006	STF6C	
21	AB/010/53	FG	12	5		EACH	031068	250968	250		EERD6	1368	STF6C	R
21	AB/010/53	FG	12	12		EACH	081068	250968	401		ABCØX4	33	STF6C	L

Abbreviations

P.A.M. – Proportional allocation marker.
M.O.D. – Method of despatch.

FORM C14/36/5(1.69) FORM 14/36/5(1.69)

Columns	*Contents*
41 to 46	Due date. The due date is entered in this field in the form *ddmmyy*. An entry is not permitted unless the transaction to be modified is code 13, 20 or 21. In these cases the due date must correspond with the original value.
53 and 54	Record code. This field contains an integer specifying the record code of the transaction record being modified. The value entered is stored in the utility 1 field on the disc file.
55 to 80	These character positions are used to hold alphanumeric data that must correspond exactly with the data entered for the original transaction.

Audit request

Columns	*Contents*
1 and 2	Record code 11
3 to 18	Item number (as for record code 1)
19 and 20	Group code (as for record code 1)
21 and 22	Location code (as for record code 5)
23 to 29	Stock count. This field contains an integer specifying the physical stock balance.
37 to 40	Unit of issue (as for record code 1)
47 to 52	Transaction date. This field may be left blank and if so the run date will be inserted in the field by the Transaction File Creation routine. If the field is used it must contain six figures zero filling being used where necessary.
64 to 71	Document reference. This is an alphanumeric field used to indicate the audit authority reference. This field may be left blank.

Stock balance/order balance adjustment

Columns	*Contents*
1 and 2	Record code 12
3 to 18	Item number (as for record code 1)
19 and 20	Group code (as for record code 1)
21 and 22	Location code (as for record code 5)
23 to 29	Stock balance adjustment. This is an integer field containing the positive or negative adjustment quantity. For a negative adjustment the sign may be punched anywhere in the field. The field is left blank if the adjustment is not being used.
30 to 36	Order balance adjustment (as for the previous field)
37 to 40	Unit of issue (as for record code 1)
47 to 52	Transaction date (as for record code 11)
56 to 63	Supplier code (as for record code 6) This field may be used when the adjustment is to the order balance.
64 to 71	Authority reference. This is an alphanumeric field used to indicate the authority for the adjustment. Use of this field is optional.
72 to 79	Cost code. This field is an alphanumeric field used as a reference for accounting purposes. Use of this field is optional.

Stock receipt and scrap

Columns	*Contents*
1 and 2	Record code 13
3 to 18	Item number (as for record code 1)

Columns	*Contents*
19 and 20	Group code (as for record code 1)
21 and 22	Location code (as for record code 5)
23 to 29	Quantity good. This field contains an integer specifying the quantity of stock received that meets specification.
30 to 36	Quantity scrap. This field contains an integer specifying the quantity of stock received that is substandard.
37 to 40	Unit of receipt (as for record code :)
41 to 46	Due date. The due date, the date when delivery is expected, is entered in this field in the form *ddmmyy*. The field may be left blank and if it is, the run date will be inserted in the record on disc by the Transactions File Creation routine. If the field is used, it must contain six figures, zero filling being used where necessary. If a date that has not yet been reached is entered in this field, the transaction will recirulate; the stock record will not be updated until the due date is reached.
47 to 54	The use of these columns depends on the use of column 54: 1 If column 54 contains an asterisk, columns 47 to 53 are a decimal field, with a decimal point if necessary, specifying the unit cost of the item as it is supplied. The receipt date is assumed to be the run date which is automatically written into the transaction date field of the disc record. 2 If column 54 contains a space, 0, 1, 2 or 3 columns 47 to 52 contains the transaction date (see record code 11). The value held in column 54 is stored in the utility 1 field of the disc record and is used by the Updating routine to price the receipt record as follows: space or 0 priced at standard cost price 1, 2 or 3 priced at the first second or third price breaks.
56 to 63	Supplier or department code (as for record code 6). Use of this field is optional.
64 to 71	Order or batch number. This field is an alphanumeric field used as a reference to the order placed originally. Use of this field is optional.
72 to 79	Cost code or GRN number. This field is an alphanumeric field that may be used either as a reference for accounting purposes or for the goods receipt note number or for other document reference. Use of this field is optional.

Note: Quantities entered on this record are in integer receipt units. In cases where the receipt and issue units are not the same this is likely to prevent use being made of the two quantity fields unless by chance, the scrap amount can be expressed exactly in receipt units. In this situation, only the first quantity field should be used to record the whole of the amount received. The amount of scrap present can then be recorded in issue units in the quantity 2 field of a code 16 record.

Returns outward

Columns	*Contents*
1 and 2	Record code 14.
3 to 18	Item number (as for record code 1).
19 and 20	Group code (as for record code 1).
21 and 22	Location code (as for record code 5).
23 to 29	Returned quantity. This field contains an integer specifying the amount of stock returned to the supply source. The quantity inserted in this field will be deducted from the stock balance.
30 to 36	Re-ordered quantity. This field contains an integer specifying the amount of stock that has been re-ordered as replacement. The quantity entered in this field is added to the order balance.
37 to 40	Unit of issue (as for record code 1).

Columns	*Contents*
47 to 52	Transaction date (as for record code 11)
56 to 63	Supplier or source code (as for record code 6). Use of this field is optional.
64 to 71	Order number. This is an alphanumeric field used for reference to the order placed originally. Use of this field is optional.
72 to 79	Advice note number. This is an alphanumeric field used for reference purposes. Use of this field is optional.

Unscheduled issue

Columns	*Contents*
1 and 2	Record code 15
3 to 18	Item number (as for record code 1).
19 and 20	Group code (as for record code 1).
21 and 22	Location code (as for record code 5).
23 to 29	Quantity issued. This field contains an integer indicating the quantity of stock that has been issued from the branch or the warehouse stock.
37 to 40	Unit of issue (as for record code 1).
47 to 52	Transaction date (as for record 11)
56 to 63	Customer or department code. This is an alphanumeric field used by invoicing procedures as a reference field. Use of this field is optional.
64 to 71	Customer order number. This is an alphanumeric field used for reference purposes. Use of this field is optional.
72 to 79	Cost code (as for record code 12).
80	Method of dispatch (M.O.D.) This is an alphanumeric code indicating the method of dispatch for use by invoicing procedures.

Scrap notification

Columns	*Contents*
1 and 2	Record code 16
3 to 18	Item number (as for record code 1)
19 and 20	Group code (as for record code 1)
21 and 22	Location code (as for record code 5)
23 to 29	Quantity scrapped. This field contains an integer indicating the quantity of scrap that has occurred since issue and does not require to be deducted from the stock balance.
30 to 36	Quantity scrapped. This field contains an integer indicating the quantity of scrap that has occurred before issue or has occurred since issue and requires replacement from stock. This quantity is deducted from the stock balance.
37 to 40	Unit of issue (as for record code 1)
47 to 52	Transaction date (as for record code 11)
56 to 63	Supplier code (as for record code 6) This field may be used to indicate the supplier for scrap that was his responsibility but that was undetected on receipt or it may be left blank.
64 to 71	Order or batch number (as for record code 13).
72 to 79	Cost code. This is an alphanumeric field that can be used for accounting purposes. Use of this field is optional.

Returns inwards

Columns	*Contents*
1 and 2	Record code 17
3 to 18	Item number (as for record code 1)
19 and 20	Group code (as for record code 1)
21 and 22	Location code (as for record code 5)
23 to 29	Quantity 1 returned. This field contains an integer specifying the amount that has been returned to stock. This quantity is added to the stock balance.
30 to 36	Quantity 2 returned. This field contains an integer specifying the amount to be subtracted from the branch and group demand accumulators. This field is used to ensure that the value of the demand used in forecasting does not include the amount of stock returned. However, this field has application only when the stocks are returned within the same system time period as the original demand. This field does not affect the stock balance.
37 to 40	Unit of issue (as for record code 1)
47 to 52	Transaction date (as for record code 11)
56 to 63	Customer code (as for record code 15)
64 to 71	Customer order number (as for record code 15)
72 to 79	Cost code (as for record code 12)

Branch to branch transfer

Columns	*Contents*
1 and 2	Record code 18.
3 to 18	Item number (as for record code 1)
19 and 20	Group code (as for record code 1)
21 and 22	Location code (as for record code 5)
	This field specifies the branch from which stock is being transferred.
25 to 29	Transfer quantity. This field contains an integer specifying the quantity of stock to be transferred to the branch specified in columns 56 and 57.
37 to 40	Unit of issue (as for record code 1).
47 to 52	Transaction date (as for record code 11)
56 and 57	Location code (as for record code 5)
	The field specifies the branch to which stock is to be transferred.
64 to 71	Authority reference. This is an alphanumeric field used to specify the authority for the transfer. Use of this field is optional.
72 to 79	Cost code. This is an alphanumeric field containing the cost code used as a reference for accounting purposes. Use of this field is optional.

Demand

Columns	*Contents*
1 and 2	Record code 21.
3 to 18	Item number (as for record code 1)
19 and 20	Group code (as for record code 1)
21 and 22	Location code (as for record code 5)
23 to 29	Demand quantity. This field contains an integer specifying the amount to be allocated from stock.

Columns	*Contents*
37 to 40	Unit of issue (as for record code 1)
41 to 46	Due date. This field contains the due date in the form *ddmmyy* indicating the date when allocation is to be attempted. This field may be left blank, and if so, the run date will be inserted in this field on disc by the Transaction File Creation routine. If the field is used, it must contain six figures, zero filling being used if necessary. If a date later than the present date is entered in this field the transaction will recirculate and will not update the stock record or cause allocation until the due date is reached.
47 to 52	Transaction date (as for record code 11)
53 and 54	Priority. This field contains an integer indicating the priority assigned to this demand for situations in which the stock balance is not large enough to meet all demands and proportional allocation is not being used.
55	Proportional allocation marker. This field, used only where a proportional allocation policy is being used either contains 1 or has no entry. This marker being set to 1 indicates that proportional allocation of this demand is not to take place.
56 to 63	Customer or department code (as for record code 15)
64 to 71	Customer order number (as for record code 15)
72 to 79	Cost code (as for record code 12)
80	Method of dispatch (as for record code 15)

Branch stock count

Columns	*Contents*
1 and 2	Record code 22.
3 to 18	Item number (as for record code 1)
19 and 20	Group code (as for record code 5)
23 to 29	Stock count. This field contains an integer specifying the branch count of the actual stock position for this item.
37 to 40	Unit of issue (as for record code 1)
47 to 52	Transaction date (as for record code 11)

Batch control record

This type of transaction is not written to disc and may be used as often as required in any set of input records. The batch totals are assumed to apply to all the records since the last batch control record encountered.

Use of all fields of this transaction type is optional. Note that the format for this type of transaction is different from that for the previous types; thus, for paper tape input, field terminators are required only for the fields mentioned below.

Columns	*Contents*
1 and 2	Record code 99
3 to 10	Batch number. This is an alphanumeric field.
11 to 16	Sum of transaction codes. This is an integer field.
17 to 20	Number of transactions. This is an integer field.
21 to 27	Sum of quantity 1 fields. This field contains a positive or a negative integer. If the integer is negative, the minus sign may be punched anywhere in the field.
28 to 34	Sum of quantity 2 fields (as for the previous field)
35 to 40	Transaction date. This field contains the transaction date in the form *ddmmyy*. If this field is used, it must contain six figures, zero filling being used if necessary.

Termination record

The pack of input cards for a file creation run must be terminated by a card containing four asterisks in the first four columns. Paper tape input must be terminated by a record containing four asterisks followed by a field terminator and a newline character.

Identifier	*Field name*	*Identifier*	*Field name*
BB	Back order balance	MX	Maximum stock level
BL	Bin location	MXQT	Maximum order quantity
BOIC	Bulk order interval count	NMCT	No movement count
BOIN	Bulk order interval	ODGP	Ordering group
BOQB	Bulk order quantity balance	OICT	Order interval count
BOQU	Bulk order quantity	ORIN	Order interval
BRCT	Number of branches	PBK1	First price break
BW	Branch weight factor	PBK2	Second price break
CLCD	Class code	PBK3	Third price break
COFA	Conversion factor	PBQ1	First price quantity
COPR	Cost price	PBQ2	Second price break quantity
CUBO	Cumulative back orders	PBQ3	Third price break quantity
CUDE	Cumulative demand	PRTX	Purchase tax
CURE	Cumulative receipts	RECT	Receipts count
CUSC	Cumulative scrap	RP	Re-order point
DA	Demand accumulator	RQ	Re-order quantity
DESC	Description	SAPR	Sales price
DSCD	Discount code	SB	Stock balance
FB	Forward demand balance	SCFR	Scrap factor
GPCD	Group code	SEBS	Seasonal base
GPDA	Group demand accumulator	SO	Order balance
ITNO	Item number	SOCT	Stock out count
JRPS	Joint replenishment parameters	SPCD	Supplier code
LC	Location code	SUTM	Set up time
LDTM	Lead time	SYSM	System marker
MARK	Function markers	UOIS	Unit of issue
MD	Mean absolute deviation of branch forecast errors.	UORE	Unit of receipt
		UWTV	Unit Weight, Time or Volume
MN	Minimum stock level		
MNQT	Minimum order quantity		

Two character codes are followed by the location code of the branch to which they refer.

Table 6 Index of Stock Master file identifiers

ERROR CHECKING

If errors are detected in records input for the creation or maintenance of any of the three main files, the field in error is indicated by an error code printed on the line following it on the line printer output. The error codes are shown in *Run time errors*, page 143.

The following are the actions taken when errors are detected in input records for the three different main files.

1 An error in a record input to the Transactions File Creation routine causes the record to be rejected without further checking being carried out.

2 An error in a field of a stock master file formation record causes the standard value for that field to be inserted in the disc record. Any other error in the same record is also reported and the standard value inserted. If no errors have occurred in the record, the run summary statement for the item/group states that the record has been FORMED. If non-fatal errors have occurred the summary statement is FORMED ERRORS (see page 31). Fatal errors, preventing the formation of the record, do not have a summary statement (see page 31).

   Errors in stock master file modification records cause the appropriate field to be ignored. Other input in the record will be accepted.

3 An error in a demand history file formation record always prevents formation of the main file record. Other errors in the input record will still be reported except for errors in demand series or seasonal factor sets. In these cases, only the first error will be reported.

   Errors in demand history file modification records cause the appropriate field to be ignored. Other input on the record will be accepted.

FIELD REFERENCE CODES USED IN MAIN FILE MAINTENANCE

During maintenance of the Stock Master file and the Demand History file, the user may modify fields using the M operation. A successful modification will cause a message to be output to the Summary report stating that the change has been made and indicating by means of a four character identifier, the field involved. The identifiers used are shown in Tables 6 and 7.

Identifier	*Field name*	*Identifier*	*Field name*
AVDE	Average demand	ORCO	Order cost
CLCD	Class code	ORIN	Order interval
COPR	Cost price	SAPR	Sales price
CUER	Cumulative sum of errors	SBCT	Seasonal base count
D	Demand history point	SEBS	Seasonal base
DESC	Description	SERL	Demand history length
FICT	Forecast interval count	SF	Seasonal factor
FOIN	Forecast interval	SIGD	Standard deviation of demand
GAM1	Gamma one	SIGE	Standard deviation of errors
GAMZ	Gamma zero	SLGP	Service level group
GPCD	Group code	SMAD	Mean absolute deviation of errors
GPSB	Group stock balance	SMER	Smoothed forecast errors
ITNO	Item number	SYSM	System marker
IRGP	Investment rate group	UOIS	Unit of issue
LDTM	Lead time	XCAP	Deseasonalized demand forecast
MARK	Function markers		

Identifier D will be followed by a number referring to the positions of the demand point in the history, 0 being the first point. Identifier SF will be followed by a number referring to the position of the seasonal factor in the series, 0 being the first factor.

Table 7 Index of Demand History file identifiers

DISC FILE FORMATS

The three main files used by SCAN System 3 are the Stock Master file, the Demand History file and the Transaction file. The system creates other files for output. The formats of all SCAN System 3 files are described on the following pages (the file names are given in brackets in the heading lines).

All numeric fields except floating point fields are in ICL COBOL compatible format. All fields greater than 24 bits in length have the 24th bit from the right hand end as null. Also, all integer parts at least 24 bits in length carry a sign or null in the most significant bit, even if this is not on a word boundary. Fields marked with an * also carry a sign bit.

Demand History file (DMANDHISTORY)

The Demand History file is a sequential file with bucket length 4 blocks.

The first record is a parameter record with the following format.

Words	*Field name*	*Length in words*	*Type*	*Standard value*	*Notes*
0	Software requirement	1	-	-	-
1 to 5	Dummy key	4½	Character	Always 0	-
	Spare	½	-	0	-
	†System time period name	2¾	Character	Spaces	-
6 to 8	†No. of system time periods in a year	¼	Integer	Not applicable	-
9	†Currency unit	1	Character	Spaces	-
10	Date of last forecast run	1	Binary day	0	-
11 to 30	Spare	20	-	0	-

The fields marked † are entered from the file formation run parameter records. The system time period is the interval between forecast runs; the name of this period should be entered as WEEKLY, MONTHLY etc. For a weekly system time period, the number in the year would be 52. Note that even if all items in a weekly system were being forecast with a forecast interval of 4, the period name would still be weekly with the number of system time periods in the year being 52. The currency unit is the name of the currency used in the system, for example £ or LIRA.

The format of the remaining records is as follows:

Words	*Field name*	*Length in words*	*Type*	*Standard value*	*Notes*
0	Software requirement	1	-	-	-
1 to 4	Item number	4	Character	Not applicable	-
5	Group code	½	Character	Not applicable	-
	Class code	½	Character	Spaces	-
6 to 13	Description	8	Character	Spaces	-
14	Unit of issue	1	Character	Spaces	-
15 and 16	Cost price	2	Fractional (24.24)	0	-
17 and 18	Sales price	2	Fractional (24.24)	0	-
19 and 20	Order cost	2	Floating point	0	1

Words	*Field name*	*Length in words*	*Type*	*Standard value*	*Notes*
21 and 22	Lead time	1½	Fractional (24.12)	0	-
	Trend factor	½	Fractional (3.9)	0	-
23 and 24	Average demand	2	Floating point	0	1, 6
25 and 26	Standard deviation of demand	2	Floating point	0	1
27 and 28	Deseasonalized demand forecast	2	Floating point	0	1
29 and 30	Cumulative sum of errors	2	Floating point	0	1
31 and 32	Standard deviation of errors	2	Floating point	0	1
33 and 34	Smoothed forecast errors	2	Floating point	0	1
35 and 36	Mean absolute deviation of errors	2	Floating point	1	1
37	Group stock balance	1	Integer	0	-
38	Service level group	1	Integer	1	-
39	Spare	½	-	0	-
	Ordering interval	½	Integer	0	-
40	Investment rate group	1	Integer	0	-
41	Spare	¼	-	Space	-
	System marker	¼	Character	0	-
	Function markers	½	Binary	0	2
42	Series length	1	Integer	0	-
43	Forecast interval	1	Integer	0	-
44	Forecast interval count	1	Integer	0	-
45	Seasonal base	1	Integer	0	-
46	Seasonal base count	1	Integer	1	-
47	Gamma zero	1	Compressed floating point	0	3
48	Gamma one	1	Compressed floating point	0	3
-	Demand history	0 to 104	Integer	0	4
-	Seasonal factors	0 to 52	Compressed floating point	0	3, 5

Notes:

1 These fields are in standard ICL floating point format with a sign bit, a 37-bit argument and a 9-bit exponent.

2 This field comprises 12 one-bit markers; the use of four of the markers is given on the next page.

Marker number	*Value*	*Action for value shown*
0	1	The forecast interval in the record cannot be reduced by the analysis routines.
1	1	The seasonal factors in the record cannot be altered by the analysis routines. Note: If the number of factors entered by the user implies a forecast interval which is too small, the analysis routines will, if possible, combine factors to produce a seasonal base implying a more acceptable forecast interval.
10	1	This marker is set by the forecast routine at the end of the year to indicate that the seasonal factors need to be recalculated. The Demand Analysis routine (to be issued later) serially processes the file and recalculates the seasonal factors for all records having this marker set; the routine unsets the marker after processing.
11	1	This marker is used by the File Maintenance and Print routines. The marker is set whenever a record is formed or modified. The File Print routine will then process the main file serially and will print only those records with this marker set; after printing, the marker is unset.

3 These fields are in a compressed floating point form with a sign bit, a 14-bit argument and a 9-bit exponent.

4 Each demand history point occupies one word. The number of words in the demand history area is always equal to twice the number of system time periods in a year even if the area contains no demand history points. Thus, the file overflow difficulties that could arise from the area being continually expanded to accomodate new demand history points during forecasting will be avoided.

5 Each seasonal factor occupies one word. Area is supplied only if seasonal factors apply for the item; the number of words supplied is given in the seasonal base field.

6 This is the average demand in a forecast interval.

The following files are used in the Demand History File Maintenance runs.

Demand History Maintenance file (HSTRYINPUT▽▽)

This is a serial file with bucket length 1 block. This file contains randomly ordered Demand History File Maintenance records (record codes 0 to 4) in card image form. The record length is 22 words. The first word is the software requirement; the next 20 words contain the card image and the last word contains 0 or 1; the field will contain zero if the input is on cards and will contain 1 if the input is on paper tape and any field size in the record has been exceeded. This is used by the maintenance routine to detect the F error (see *Run time errors,* page 143).

Sorted Demand History Maintenance file (SDHSTRYINPUT)

This is a serial file with bucket length 1 block.

This file contains sorted Demand History File Maintenance records (record codes 0 to 4) in card image form. The record length is 22 words as above.

Serial Demand History file (SERIALHSTRY▽)

This is a serial file with bucket length 4 blocks.

This file contains standard demand history records preceded by the parameter record. Since the file is not in indexed form, it is not suitable for use with SCAN System 3 until it has been reorganized into sequential form.

Selected Demand History Records file (SELECTHSTRY▽)

This is a serial file with bucket length 4 blocks.

This file contains selected standard demand history records preceded by the parameter record. Since the file is not in indexed form it is not suitable for use with SCAN System 3. The file can be merged as it is back into the standard Demand History file by use of the Combine operation but it must be reorganized into sequential form if it is to be used with other SCAN System 3 routines.

Demand History Overflow file (HSTRYOVRFLOW)

This is a serial file with bucket length 4 blocks.

This file contains standard Demand History records that have overflowed from the Demand History file during overflow from the second level overflow area. This file cannot be used by SCAN System 3 until it has been merged back into the main file by the standard merge and reorganize operations.

Stock Master File (STOCKMASTER▽)

This is a sequential file with bucket length 4 blocks.

The first record is a parameter record as follows:

Word	*Field name*	*Length in words*	*Type*	*Standard value*	*Notes*
0	Software requirement	1	-	-	-
1 to 5	Dummy key	4½	Character	Always contains 0	-
	Spare	½	-	0	-
6 to 8	†System time period name	2¾	Character	Spaces	-
	†No. of system time periods in a year	¼	Integer	Not applicable	-
9	†Currency unit	1	Character	Spaces	-
10	Date of last forecast run	1	Binary day	0	-
11 to 30	Spare	20	-	0	-

The fields marked † are entered from the file formation run parameter records. The system time period is the interval between forecast runs and the name of the period should be entered in the form WEEKLY, MONTHLY etc. If the system time period is WEEKLY, the number of system time periods in one year is 52. Note that even if all items in a weekly system are being forecast with a forecast interval of 4, the period name is still WEEKLY with the number of time periods in a year being 52. The currency unit is the name of the currency used in the system, for example £ or LIRA.

The format of the remaining records is as follows:

Words	*Field name*	*Length in words*	*Type*	*Standard value*	*Notes*
0	Software requirement	1	-	-	-
1 to 4	Item number	4	Character	Not applicable	-
5	Group code	½	Character	Not applicable	-
	Discount code	½	Character	Spaces	-
6 to 13	Description	8	Character	Spaces	-
14	Unit of issue	1	Character	Spaces	-
15	Ordering group	¼	Character	Space	-
	System marker	¼	Character	0	-
	Class code	½	Character	Spaces	-
16 and 17	Scrap factor	½	Integer	0	-
	Lead time	1½	Fractional (24.12)	0	-

Words	*Field name*	*Length in words*	*Type*	*Standard value*	*Notes*
18 and 19	Function markers	½	Binary	0	1
	Unit weight, time or volume	1½	Fractional (24.12)	0	-
20	Set up time	1	Fractional (16.8)	0	-
21 and 22	Supplier code	2	Character	Spaces	-
23	Minimum order quantity	1	Integer	0	-
24	Maximum order quantity	1	Integer	#37777777	-
25	Order interval count	½	Integer	0	-
	Order interval	½	Integer	0	-
26 and 27	Cumulative receipts	1½	Integer	0	-
	Receipts count	½	Integer	0	-
28 and 29	Cumulative scrap	1½	Integer	0	-
	Back order count	½	Integer	0	-
30 and 31	Cumulative demand	1½	Integer	0	-
	No movement count	½	Integer	0	-
32 and 33	Cumulative back orders	1½	Integer	0	-
	Seasonal base	½	Integer	0	-
34	Conversion factor	½	Integer	0	-
	Spare	¼	-	0	-
	Number of branches	¼	Integer	Not applicable	-
35 and 36	Purchase tax	2	Fractional (24.24)	0	-
37 and 38	Sales price	2	Fractional (24.24)	0	-
39 and 40	Cost price	2	Fractional (24.24)	0	-
41	Group demand accumulator	1	Integer	0	2
42	Unit of receipt	1	Character	Spaces	-

The following fields are repeated for each branch in the group.

Words	*Field name*	*Length in words*	*Type*	*Standard value*	*Notes*
1	Spare	½	-	Spaces	-
	Location code	½	Character	Not applicable	3
2 and 3	Bin location	2	Character	Spaces	-
4	Minimum stock level	1	Integer	0	-
5	Maximum stock level	1	Integer	#37777777	-
6	Stock balance	1	Integer	0	-
7	Forward demand balance	1	Integer	0	-
8	Back order balance	1	Integer	0	-
9	Order balance	1	Integer	0	-

Words	*Field name*	*Length in words*	*Type*	*Standard value*	*Notes*
10	Demand accumulator	1	Integer	0	4
11	Re-order point	1	Integer	0	-
12	Re-order quantity	1	Integer	0	-
13	Mean absolute deviation of branch forecast errors	1	Fractional (18.6)	0	-
14	Branch weight factor	1	Fractional (2.22)	0	-

The following area will be used if a joint replenishment policy is being used.

Words	*Field name*	*Length in words*	*Type*	*Standard value*	*Notes*
1	Spare	1	-	0	3
2	Investment rate group	¼	Integer	0	5
and					
3	Group annual demand	1¾	Integer	0	5

The following fields will be used if quantity discounts apply.

Words	*Field name*	*Length in words*	*Type*	*Standard value*	*Notes*
1	Price break quantity	1	Integer	0	3, 6
2 and 3	Price break	2	Fractional (24.24)	0	-
4	Price break quantity	1	Integer	0	-
5 and 6	Price break	2	Fractional (24.24)	0	-
7	Price break quantity	1	Integer	0	-
8 and 9	Price break	2	Fractional (24.24)	0	-

The following fields will be used if a bulk order call-off system applies.

Words	*Field name*	*Length in words*	*Type*	*Standard value*	*Notes*
1	Bulk order interval	½	Integer	Not applicable	3
	*Bulk order interval count	½	Integer	0	
2	Bulk order quantity	1	Integer	Not applicable	-
3	Bulk order quantity balance	1	Integer	0	-

Notes:

1 The various functions available in SCAN System 3 are controlled by the function markers, numbered from 0 to 11 to correspond with the bits in the half word.

Marker bit number	*Value*	*Action for value shown*
0	1	Bulk ordering required. Causes bulk order call off fields to be set up in the record.
1/2	0	Preferred frequency ordering without price breaks
	1	Economic ordering without price breaks

Marker bit number	*Value*	*Action for value shown*	
	2	Preferred frequency ordering with price breaks	Cause price breaks fields to be set up in the record
	3	Economic ordering with price breaks	
3	1	Joint replenishment or economic ordering after updating required. This marker also causes the joint replenishment parameters area to be set up.	
4	1	Order size cannot be increased by joint replenishment. Indicates that although orders for this group may be considered in the joint replenishment strategy, they may not be altered by it.	
5		Not used.	
6	1	Indicates that where a proportional allocation policy is being used, demands placed on this group cannot be proportionately allocated.	
7	1	This field is applied where automatic ordering of branches on warehouses is being used. It indicates that where a proportional allocation policy is being used, orders placed on the warehouse by branches in this group cannot be proportionately allocated.	
11	1	This field is used by the file maintenance and print routines. The bit is set whenever a record is formed or modified. The file print routine will then serially process the main file, printing only these records with the bit set. Printing unsets the bit.	

2 The group accumulator accumulates the demand for the group in a system time period. At each run of the Forecasting routine the quantity contained in the group demand accumulator is written into the demand history on the Demand History file. The accumulator is then zeroized.

3 The word numbers of the variable parts of the record refer to the beginning of the variable section the first word in the section being 1.

4 The demand accumulator accumulates the demand for the branch in a forecast interval. This field is used only by the Forecast routine when a forecast is being made for the branches, after which the field is zeroized.

5 Data is inserted into these fields during operations of the forecasting routine.

6 This section is always set up for three pairs of price break parameters. If less are entered the remaining fields are zero filled.

The following files are used in the Stock Master File Maintenance run.

Stock Master Maintenance file (STOCKINPUTVV)

This is a serial file with bucket length 1 block.

This file contains sorted Stock Master File Maintenance records (record codes 0 and 5 to 9 and:) in card image form. The record length is 22 words. The first word is the software requirement; the next 20 words contain the card image and the last word depends on the mode of data input. If the input medium is cards, the word contains zero; if the input medium is paper tape and any field size in the record has been exceeded the word contains 1. This is used by the Maintenance routine to detect the F error (see Table 5).

Sorted Stock Master Maintenance file (SDSTOCKINPUT)

This is a serial file with bucket length 1 block.

This file contains sorted Stock Master File Maintenance records (record codes 0 and 5 to 9 and:) in card image form. The record length is 22 words as above.

Serial Stock Master file (SERIALSTOCK∇)

This is a serial file with bucket length 4 blocks.

This file contains standard Stock Master records preceded by the parameter record. Since the file is not in indexed form it is not suitable for use with SCAN System 3 until it is reorganized into sequential form.

Selected Stock Master Records file (SELECTSTOCK∇)

This is a serial file with bucket length 4 blocks.

This file contains standard Stock Master records preceded by the parameter record. Since this file is not in indexed form it is not suitable for use with SCAN System 3. The file can be merged as it is back into the standard Stock Master file using the Combine operation but it must be reorganized into sequential form if it is to be used with other SCAN 3 routines.

Stock Master Overflow file (STOCKOVRFLOW)

This is a serial file with bucket length 4 blocks.

This file contains standard Stock Master records that have overflowed from the Stock Master file during overflow from the second level overflow area. The file cannot be used by SCAN System 3 until it has been merged back into the main file by the standard merge and reorganize operations.

Transactions file (NEWTRANSACTS, OLDTRANSACTS or ENDTRANSACTS)

This is a serial file with bucket length 8 blocks. Its key, which must be set up upon allocating the file, is Item Number/Group Code/Location Code. The file contains transactions records preceded by a parameter block identical to that for the Stock Master file except that the period name is zeroized.

The format for this file is as follows:

Words	*Field name*	*Length in words*	*Type*	*Standard value*	*Notes*
0	Software requirement	1	-		-
1	Transaction code	1	Integer	Not applicable	1
2 to 5	Item number	4	Character	Not applicable	-
6	Group code	½	Character	Spaces	-
	Location code	½	Character	Spaces	-
7	Quantity 1	1	Integer	0	-
8	Quantity 2	1	Integer	0	2
9	Unit of measure	1	Character	Spaces	-
10 and 11	Transaction date	2	Character *(00ddmmyy)*	Run date	-
12 and 13	Due date	2	Character *(00ddmmyy)*	0	-
14	Priority	1	Integer	See note	6
15 and 16	Customer/Supplier Code	2	Character	Spaces	-
17 and 18	First document reference	2	Character	Spaces	-
19 and 20	Second document reference	2	Character	Spaces	-
21	Method of dispatch	¼	Character	Space	-
	Utility 1	¼	Character	0	5
	Class code	½	Character	Spaces	3
22 to 29	Description	8	Character	Spaces	3
30 and 31	Cost price	2	Fractional (24.24)	0	3

Words	*Field name*	*Length in words*	*Type*	*Standard value*	*Notes*
32 and 33	Sales price	2	Fractional (24.24)	0	3
34 and 35	Purchase tax	2	Fractional (24.24)	0	3
36	Record status	½	Binary	0	4
	Discount code	½	Character	Spaces	3
37 and 38	Bin location	2	Character	Spaces	3
39	System marker	¼	Character	Space	3
	Cycle indicator	¼	Character	Space	3
	Conversion factor	½	Integer	Spaces	3
40 to 42	Unit weight, time or volume	1½	Fractional (24.12)	0	3
	Lead time	1½	Fractional (24.12)	0	3

Notes:

1 All transaction types, except back order records, (record code 20) and automatically raised receipt records (record code 13) both of which are created by the Updating Reports routine, are generated from records read by the Transactions File Creation routine.

2 For demand records (record code 21) and back order records (record code 20) an indication of the amount of the demand not allocated is written into this field during stock updating.

3 Information for these fields is copied during Stock Updating from the Stock Master record.

4 This field comprises 12 one-bit switches used to indicate which stage of the processing of the record has been reached by the Stock Updating routine. This information is used by the Updating Reports routine to decide whether or not the record should be reciculated to the next stock updating run. For all transaction types except demands, Bit 0 set indicates that the transaction was processed in the previous stock updating run; the transactions will not be recirculated. For demands, the effect of having Bit 0 set is given in Table 8. The demand transactions with Bit 0 of this field set will not be recirculated but a back order record will be created if the demand has not been fully allocated. Similarly, a back order record will be created for an old back order that was not fully allocated in the last stock updating run.

5 This field is used to store the pseudo values entered on record codes 10 and 13.

6 The standard value of 100 is used for all transactions except demands and back orders. For demands, the value is entered from the input record; spaces are treated as zero. Back orders take the priority of the demands which caused them.

Bit	*Value*	*Meaning*
0, 1	0	Future demand not yet added to the forward demand balance and no allocation attempted.
0	1	A due demand with allocation attempted.
1	0	
0	0	A forward demand which has updated the forward demand balance but for which no allocation has attempted.
1	1	
2	1	Proportional allocation may not be made for this demand.
3	1	This back order resulted from partial allocation to an automatically placed branch order.
4	1	This transaction did not match a main file record.

Table 8 Interpretations of various bit settings in the record status field.

Replenishment Orders file (REPLENORDERS)

This is a serial file with bucket length 2 blocks. It is preceded by a parameter block identical to that for the Stock Master file except that the period name is zeroized.

The Replenishment Orders file contains two types record.

1 The normal order record (type 30) which contains the order quantities for each branch calculated by re-order point control.

2 The bulk order record (type 31) which contains the bulk order quantity from which order quantities raised by re-order point control will be called off.

The format of the normal order record is as follows:

Words	*Field name*	*Length in words*	*Type*	*Notes*
0	Software requirement	1	-	-
1 and 2	Supplier code	2	Character	-
3 to 6	Item number	4	Character	-
7	Group code	½	Character	-
	Record type	½	Integer (contains 30)	-
8 and 9	Markers	½	Binary	1
	Lead time	1½	Fractional (24.12)	-
10 to 11	Class code	½	Character	-
	Unit weight, time or volume	1½	Fractional (24.12)	-
12	Set up time	1	Fractional (16.8)	-
13 to 20	Description	8	Character	-
21	Unit of receipt	1	Character	-
22 and 23	Date generated	2	Character *(00ddmmyy)*	-
24 and 25	Due date	2	Character *(00ddmmyy)*	-
26	Minimum order quantity	1	Integer	-
27	Maximum order quantity	1	Integer	-
28	System marker	¼	Character	-
	Cycle indicator	¼	*or space	
	Number of branches ordering	½	Integer	2
29 to 30	Conversion factor	½	Integer	-
	Spare	2½	spaces	-
31	Issue unit	1	Character	-
32 to 34	Joint replenishment/bulk order parameters	3	-	3

The following fields are repeated for each branch placing an order.

Words	*Field name*	*Length in words*	*Type*	*Notes*
1	Spare	½	-	-
	Location code	½	Character	-

Words	*Field name*	*Length in words*	*Type*	*Notes*
2 and 3	Bin location	2	Character	-
4 and 5	Cost price	2	Fractional (24.24)	-
6	Order quantity 1	1	Integer	4
7	Order quantity 2	1	Integer	5
8	Excess order	1	Integer	6
9	Stock balance	1	Integer	-
10	Forward demand balance	1	Integer	-
11	Back order balance	1	Integer	-
12	Order balance	1	Integer	-
13	Re-order point	1	Integer	-

The format of the bulk order record as follows:

Words	*Field name*	*Length in words*	*Type*	*Notes*
0	Software requirement	1	-	-
1 and 2	Supplier code	2	Character	-
3 to 6	Item number	4	Character	-
7	Group code	½	Character	-
	Record type	½	Integer (contains 31)	-
8 and 9	Location code	½	Character	-
	Lead time	1½	Fractional (24.12)	-
10 and 11	Class code	½	Character	-
	Unit weight, time or volume	1½	Fractional (24.12)	-
12	Set up time	1	Fractional (16.8)	-
13 to 20	Description	8	Character	-
21	Unit of receipt	1	Character	-
22 and 23	Date generated	2	Character *(00ddmmyy)*	-
24 to 28	Spare	5	Space filled	-
29	Conversion factor	½	Integer	-
	Spare	½	Space filled	-
30 and 31	Cost price	2	Fractional (24.24)	-
32	Bulk order quantity	1	Integer	-
33 and 34	Contract expiry date	2	Character *(00ddmmyy)*	-

Notes:

1 This field comprises 12 one-bit switches. Bits 0 to 7 are copied during stock updating, from the stock master record of the group raising the orders; Bit 10 is set while the joint replenishment routines are being operated if the order is to be cancelled due to the absence of an order for a status item for the supplier. Bit 11 is set during automatic ordering if the orders have been placed automatically on a warehouse.

2 This field contains the number of branches raising orders, not the total number of branches in the group.

3 The field is zero filled unless joint replenishment or bulk ordering is used; markers 3 or 0 respectively will be set. For bulk order call off, the contents are as follows.

Words	*Field name*	*Length in words*	*Type*
32	Bulk order balance	1	Integer
33 and 34	Contract expiry date	2	Character *(00ddmmyy)*

The bulk order balance is the amount remaining of the quantity the user agreed to order from the supplier during the contract period.

The contract expiry date is the date by which the whole of the bulk order quantity must have been ordered; that is, the date by which the bulk order balance must have reached zero.

For Joint Replenishment the format is:

Words	*Field name*	*Length in words*	*Type*
32	Spare	1	-
33 and 34	Investment rate group	¼	Integer
	Group annual demand	1¾	Integer

4 This field contains the order quantity that the system intends to be placed on the supplier. In a Replenishment Order file that has just been generated by the Stock Updating routine, this quantity is the order quantity calculated by that routine. If further order processing has been carried out by the system (when the routines are available) this field will contain the final order quantity.

5 If the record is processed by the Joint Replenishment routines, this field indicates the change made to the original order size raised by the Stock Updating routine.

Alternatively, the field is used in automatic ordering. If the warehouse is unable to allocate stock to a branch order fully, the amount of the order not allocated is written into this field. The update Reports routine is then able to generate the appropriate back order record.

6 This field indicates the amount by which the branch concerned attempted to exceed the maximum order quantity.

7 The following fields are held on this file in receipts units: order quantity 1, order quantity 2, excess order, bulk order quantity, bulk order balance.

Under Minimum/Over Maximum file (MAXMINRECRDS)

This is a serial file with bucket length 1 block. It is preceded by a parameter block identical to that for the Stock Master file except that the period name is zeroized.

The format of the Under Minimum/Over Maximum file is as follows. Under minimum records contain a transaction code of 24. The value for over maximum records is 25.

Words	*Field name*	*Length in words*	*Type*
0	Software requirement	1	-
1	Transaction code	1	Integer
2 to 5	Item number	4	Character
6	Group code	½	Character
	Location code	½	Character
7	Maximum/minimum stock level	1	Integer

Words	*Field name*	*Length in words*	*Type*
8	Stock balance	1	Integer
9	Unit of issue	1	Character
10 and 11	Date generated	2	Character *(00ddmmyy)*
12	Forward demand balance	1	Integer
13	Back order balance	1	Integer
14	Order balance	1	Integer
15 and 16	Supplier code	2	Character
17 to 20	Spare	4	Space filled
21	Spare	½	Space filled
	Class code	½	Character
22 to 29	Description	8	Character
30 and 31	Cost price	2	Fractional (24.24)
32 and 33	Lead time	1½	Fractional (24.12)
	Spare	½	Space filled
34 to 38	Spare	5	Space filled
39	System marker	¼	Character
	Cycle indicator	¼	*or space
	Spare	½	Space filled
40 and 41	Spare	2	Space filled

Profile Results file (PROFILERESLT)

This is a serial file with bucket length 4 blocks.

The format of the Profile Results file is as follows:

Words	*Field name*	*Length in words*	*Type*
0	Software requirement	1	-
1	Record code	1	Integer (Contains 1)
2 to 5	Item number	4	Character
6	Group code	½	Character
	Class code	½	Character
7 to 14	Description	8	Character
15	Unit of issue	1	Character
16	Series length	1	Integer
17	Control indicator	¼	Integer
	Forecast interval	¾	Integer
18 and 19	Annual demand	2	Integer
20 and 21	Annual sales	2	Integer
22	Stock balance	1	Integer
23 and 24	Stock value	2	Integer

Words	*Field name*	*Length in words*	*Type*
25 and 26	Annual gross margin	2	Integer

The Control Indicator field contains 0 when the record is first created by the Stock Profile Analysis Routine. The contents will be altered to 1 by the Control System Selection Routine if it is able to insert a system marker and class code into the corresponding Demand History record.

In addition to the above type of record, the Stock Profile Analysis routine produces a single summary record; in any subsequent sorting, this record must be placed at the head of the file by making the record code the primary key.

The format of the summary record is as follows:

Words	*Field name*	*Length in words*	*Type*
0	Software requirement	1	-
1	Record code	1	Integer (contains 0)
2 to 11	Spare	10	Space filled
12 to 14	System time period name	2¾	Character
	No. of system time periods in a year	¼	Integer
15	Currency	1	Character
16	Item count	1	Integer
17 to 19	Spare	3	Space filled
20 and 21	Total annual sales	2	Integer
22	Spare	1	Space filled
23 and 24	Total stock value	2	Integer
25 and 26	Total annual gross margin	2	Integer

Chapter 5 Operating information

The X43 Series Program Operating Information is broken down into five sections in this Chapter as follows:

1 Foreign Language headings

2 Parameter record descriptions

3 Operating instructions in the form of:

   (a) Program requirements

   (b) Run instructions

   (c) Error conditions

4 Main file reorganisation

5 File sort sequences

FOREIGN LANGUAGE HEADINGS

All SCAN 3 programs except the simulator incorporate a special subroutine for overwriting report headings with foreign text. The operating instructions for using the subroutine and the method of submitting new headings is available on request.

SCAN 3 PARAMETER RECORD DESCRIPTIONS

In addition to the detailed descriptions of individual parameter records for each routine, the following general points apply:

1 No spaces are allowed within the data area except where they form part of a file name.

2 The record code contains the program identification letter for the program being used. Thus, for program X43A the record code is A.

3 The record sequence number indicates the order in which the parameter records are to be submitted for the program.

4 The line count indicates the paper size being used. A value of 00 will be treated as 60. All other values less than 10 will be rejected.

5 Where file names occur a twelve character name must be used, spaces being entered where necessary.

6 File generation numbers are of variable length with a maximum value of 4095. A negative file generation number will cause the highest FGN file on line with correct name to be used except in the cases of the output files for routines X43C, X43X, X43Y and X43Z.

7 Extension size is of variable length and is entered as a multiple of eight blocks with a maximum value of 4088. Where this field is provided, a value greater than zero must be entered.

8 In all cases where data is not entered in a variable length field, the terminating comma must still be used.

9 Each record of parameters entered on paper tape must be terminated by a new line character following the final comma.

Program: X43A and X43B (1)

1	2	3 4	5	6 ⟶
Record Code	Record Sequence Number	Line Count	Function Code	FGN, FGN, FGN, FGN, FGN, FGN,

Column	*Contents*
1	Record Code: A for X43A, B for X43B
2	Record Sequence Number: value 1
3 and 4	Line Count
5	Function Code: S – Select M – Modify C – Combine F – Form
6	File Generation Numbers. These are as follows:

Function	FGN1	FGN1A	FGN1B	FGN2	FGN2A	FGN2B	FGN3A	FGN3B	FGN4
S	√				√	√	√	√	√
M	√						√	√	√
C	√			√			√	√	
F		√	√						√

For any particular run, only those FGNs indicated are to be included in the parameter record, the order being left to right as above.

FGN1 – Main overlay file

FGN1A – Main O/P Serial file OLD FGN

FGN1B – Main O/P Serial file NEW FGN

FGN2 – Select I/P file

FGN2A – Select O/P file OLD FGN

FGN2B – Select O/P NEW FGN

FGN3A – Overflow file OLD FGN

FGN3B – Overflow file NEW FGN

FGN4 – Stock and History I/P file.

Each FGN is separated by a comma. A comma is also punched after the last FGN. On paper tape, this will be followed by a newline character, NL. If the maintenance run being carried out uses only four FGNs, only four terminating commas are required.

Program: X43A and X43B (2)

1	2	3 ⟶		
Record Code	Record Sequence Number	System Time Period name,	No. of System Time Periods in a year ,	Currency unit ,

Columns	*Contents*
1	Record Code: A for X43A, B for X43B
2	Record Sequence Number: value 2
3	System Time Period name
	Comma
	Number of System Time Periods in a year
	Comma
	Currency Unit
	Comma
	NL (paper tape only)

X43A and X43B notes

1 A parameter record function code S indicates that a maintenance run with record selection is to be carried out. Data records on the input disc may carry the functions S, F, M, R, D.

2 A parameter record function code M indicates that a maintenance run without record selection is to be carried out. Any data records carrying function code S will be rejected.

3 Parameter record function code F is used for formation runs. Only data records carrying function code F will be accepted. This is the only mode of operation which requires a second parameter record.

4 Parameter record function code C indicates that records previously selected from the main file are to be combined with that file.

Program: X43C

1	2	3 4	5 6 7 8 9 10 11 12 13 14 15 16	17⟶
Record Code	Record Sequence Number	Line Count	F I L E N A M E ∇ ∇ ∇ ∇	FGN, FGN, Extension Size,

Column	*Contents*
1	Record Code: value C
2	Record Sequence Number: value 1
3 and 4	Line Count
5 to 16	File Name. This is the existing name of the output file, and must consist of 12 characters.
17	FGN: existing FGN of output file
	Comma
	FGN: new FGN of output file
	Comma
	Extension size. This is the number of blocks by which the file can be extended if necessary.
	Comma
	Field Terminator (paper tape only). This is a # symbol followed by the octal equivalent of the field terminator which has been used on the data records which are to be input to this program.
	Comma. (This comma is only required if the octal number has been entered.)
	NL (paper tape only).

X43C Notes

If it is required to submit the transaction data to this routine on disc instead of cards or paper tape, the record shown above should be followed by one containing the following information:

Column	*Contents*
1 and 2	Record Code: value C2
3	File indicator: value 0
4	File Generation Number
	Comma
	NL (paper tape only)

If the parameters are input on paper tape, the first parameter record must still specify the octal value of a field terminator even though this will not be used on the data records.

If this method of input is used, the transaction records must be held on disc in card image form in 21 word records, the first word containing the record. The last record must be a **** record. The bucket length should be one block and the file should be serial and named TRCARDIMAGES.

Program: X43D

1	2	3 4	5 6	7	8
Record Code	Record Sequence Number	Line Count	Selective Listing parameter	Frequency Table parameter	Profile Results parameter

9	10 ⟶
Main File Indicator	FGN Main File, FGN Input P.R., FGN Output P.R., ,

Column	*Contents*
1	Record Code: value D
2	Record Sequence Number: value 1
3 and 4	Line Count
5 and 6	Selective Listing Parameters. This is a 2-digit number restricting the listing of items to those having Forecasting Interval equal to or less than this parameter.
7	Frequency Table parameter: 0 – Frequency table and 4 totals output 1 – Stock Profile Report only output
8	Profile Results parameter: 0 – No Profile Results file output 1 – Profile Results file output
9	Main File Indicator: 0 – DMANDHISTORY processed 1 – SELECTHISTRY processed
10	FGN Main File Comma FGN Input Profile Result File Comma FGN Output Profile Results File Comma Extension size Comma NL (paper tape only).

Program: X43F

1	2	3 4	5	6	7
Record Code	Record Sequence Number	Line Count	Processing Indicator	Listing Parameter	Short List Parameter

8	9 →					
Main File Indicator	FGN Input, File	FGN Overflow, Output File	Extension, Size	Max. Forecast, Interval	Factor Tau , test	Factor Pairs , Test

→		
$Gamma_0$,	$Gamma_0$,	$Gamma_1$,

Column	*Contents*
1	Record Code: value F
2	Record Sequence Number: value 1
3 and 4	Line count
5	Processing Indicator: 0 – all items processed 1 – only items with function marker 10 set processed
6	Listing parameter: 0 – only items selected by routine listed 1 – all items listed
7	Short List parameter: 0 – full listing given 1 – abridged listing given
8	Main File Indicator: 0 – Demand History file 1 – Select History file
9	FGN of input file Comma FGN of (a) overflow file when main file indicator = 0 or (b) output file when main file indicator = 1 Comma Extension size Comma Maximum forecast interval Comma Factor for upper tail normal distribution test on Tau_1 , Tau_m . See normal probability table, appendix 2 for factor values. Comma Factor for two tail normal distribution test on pairs. See normal probability table appendix 2 for factor values.

Comma

Gamma zero. For use with system markers 2 and 7.

Comma

Gamma zero. For use with system markers 1 and 6.

Comma

Gamma one. For use with system markers 1 and 6.

Comma

NL (paper tape only).

Notes:

1 The listing parameter is used to suppress reporting of items which have less than four forecast intervals of demand history.

2 The maximum forecast interval field limits the items which will be processed. Items having a forecast interval greater than the value specified will not be analysed. Zero or no entry in the field will be treated as 1.

3 If no entry is made for the upper tail test on Tau_1 and Tau_m, a value 2.33 is assumed. This corresponds to a 99% confidence level.

4 If no entry is made for the two tail test on pairs, a value 2.58 is assumed. This corresponds to a 99% confidence level.

5 If no entries are made for the Gamma zero fields, values of 0.1 are assumed.

Program: X43J

1	2	3 4	5	6	7
Record Code	Record Sequence Number	Line Count	Run Type Marker	Proportional Allocation Marker	Order Suppression Marker

8	9	10 11	12 13
MIN/MAX Record Suppression	Warehouse Order and MIN/MAX Suppression	Pre-allocation Period	Min % Proportional Allocation

14 ⟶				
Ordering Groups,	FGN STOCKMASTER, file	FGN Transactions file	FGN OLD ORDERS, file	FGN NEW ORDERS, file

14 ⟶		
FGN OLD MIN/MAX, file	FGN NEW MIN/MAX, file	Extension size ,

Column	*Contents*
1	Record Code: value J
2	Record Sequence Number: value 1
3 and 4	Line Count
5	Run Type Marker 0 – Normal run 1 – Supplementary run
6	Proportional Allocation Marker 0 – No proportional allocation 1 – Proportional allocation
7	Order Suppression Marker 0 – No suppression of orders 1 – Suppression of orders
8	Min/Max record suppression 0 – No suppression 1 – Suppression
9	Warehouse Orders and Min/Max record suppression 0 – No suppression 1 – Suppression It is suggested that this field be set to 1 if the run is to be followed by X43K.
10 and 11	Pre-allocation Period, nn, where nn is the number of days from the current data.
12 and 13	Min % Proportional Allocation, nn, where nn is the minimum percentage of any one demand that can be allocated.

Column	*Contents*	
14	Ordering groups	Up to five groups may be specified in one run, each being a single character. No separators are required between groups, but the whole is terminated by a comma. This is used to indicate the groups of cyclically ordered items for which orders are to be raised during this run.
	Comma	
	FGN STOCKMASTER file	
	Comma	
	FGN Transactions file	
	Comma	
	FGN Old orders file	
	Comma	
	FGN New orders file	
	Comma	
	FGN Old Min/Max file	
	Comma	
	FGN New Min/Max file	
	Comma	
	Extension size	
	Comma	
	NL (paper tape only).	

X43J notes (These notes also apply to program X43K)

The following relationships must be observed between fields on the parameter record, N being a null character which must be punched as N:

1 If Run Type Marker = 1,

Proportional Allocation Marker = N,

Order Suppression Marker = 0,

Pre-Allocation Period = NN,

Minimum % Proportional Allocation = NN,

then the Transaction File Generation Number must not be specified.

2 If Run Type Marker = 0,

then the Transaction File Generation Number must be specified.

3 If Proportional Allocation Marker = 0,

the Minimum % Proportional Allocation must equal NN.

4 If Order Suppression Marker = 1,

then the OLD ORDERS and NEW ORDERS File Generation Numbers must not be specified.

5 If Order Suppression Marker = 0,

then the OLD ORDERS and NEW ORDERS File Generation Numbers must be specified. Extension size must also be specified.

6 If MIN/MAX Record Suppression = 1,

then the OLD MIN/MAX and NEW MIN/MAX File Generation Numbers must not be specified.

7 If MIN/MAX Record Suppression = 0,

then the OLD MIN/MAX and NEW MIN/MAX File Generation Numbers must be specified. Extension size must also be specified.

8 If MIN/MAX Record Suppression and Order Suppression Marker = 0,

then Extension size must not be specified.

Program: X43K

1	2	3 4	5	6	7
Record Code	Record Sequence Number	Line Count	Run Type Marker	Proportional Allocation Marker	Order Suppression Marker

8	9	10 11	12 13
MIN/MAX Record Suppression	Warehouse Orders and MIN/MAX Suppression	Pre-allocation Period	Min % Proportional Allocation

14 ⟶				
Ordering Groups ,	FGN STOCKMASTER, file	FGN Overlay Replenishment Orders file	FGN OLD ORDERS, file	FGN NEW ORDERS, file

⟶		
FGN OLD MIN/MAX, file	FGN NEW MIN/MAX, file	Extension Size ,

Column	*Contents*	
1	Record Code: value K	
2	Record Sequence Number: value 1	
3 and 4	Line Count	
5	Run type marker. This is not applicable to this program. N must be entered.	
6	Proportional Allocation Marker	0 – No proportional allocation
		1 – Proportional allocation
7	Order Suppression Marker	0 – No suppression of orders
		1 – Suppression of orders
8	Min/Max Record Suppression	0 – suppression
		1 – suppression
9	Warehouse Orders and Min/Max Record Suppression. This is not applicable to this program. N must be entered.	
10 and 11	Pre-allocation period. This is not applicable to this program. NN must be entered.	
12 and 13	Min % Proportional Allocation, nn, where nn is the minimum percentage of any one demand that can be allocated.	
14	Ordering Groups. Up to five groups may be specified in one run, each being a single character. No separators are required between groups, but the whole is terminated by a comma. This is used to indicate the groups of cyclically ordered items for which orders are to be raised during this run.	
	Comma	
	FGN STOCKMASTER file	
	Comma	

Column	*Contents*
	FGN Overlay Replenishment Orders file
	Comma
	FGN Old Orders file
	Comma
	FGN New Orders file
	Comma
	FGN Old Min/Max file
	Comma
	FGN New Min/Max file
	Comma
	Extension size
	Comma
	NL (paper tape only).

X43K notes

Please see the notes for program X43J.

Program: X43Q

1	2	3 4	5	6	7	8 9	10 11
Record Code	Record Sequence Number	Line Count	Print Option	File Sequence Indicator	ABC Marker	Class 'A' limit	Class 'B' limit

12	13 14	15	
Output file control	Medium Mover limit	FGN Profile Results, file	

Column	*Contents*	
1	Record code: value Q	
2	Record Sequence Number: value 1	
3 and 4	Line Count	
5	Print Options:	1 – fast movers only
		2 – medium movers only
		3 – slow movers only
		A – high value items only
		B – medium value items only
		C – low value items only
		L – complete list of all items
		T – Preliminary Analysis table only
6	File Sequence Indicator	0 – descending sequence of Sales value
		1 – descending sequence of Stock value
		2 – descending sequence of gross margin
		3 – ascending sequence of class code
		4 – ascending sequence of item number/group code
7	ABC Marker:	0 – No ABC analysis required
		1 – ABC analysis required
8 and 9	Class 'A' limit	This is a two-digit number representing the percentage up to which items will be classified as A items. Thus 20 means 20% by sales value.
10 and 11	Class 'B' limit	This is a two-digit number representing the percentage up to which items will be classified as B items. Thus 60, with 20 specified in Columns 8 and 9, would find the top 20% as class 'A' items, the next 40% as Class 'B' items and the remainder as Class 'C'
12	Output File Control.	0 – No Profile Results file output
		1 – Profile Results file with ABC classification required as output
13 and 14	Medium Mover Limit	This is a two-digit number defining the boundary between medium and slow movers.
15	FGN Profile Results file	
	Comma	
	NL (paper tape only).	

X43Q notes

In order to make use of the various facilities offered by this program, the following relationships must be observed between fields on the parameter record.

Facility	*Columns*						
	5	6	7	8 9	10 11	12	13 14
Preliminary analysis	T	0	0	0 0	0 0	0	0 0
ABC analysis and classification	not T	0	1	>0	⩾ 'A' value shown in 8,9	0 or 1	numeric
Profile results file listing	not T	⩽4	0	0 0	0 0 ·	0	0 0

Table 8 Relationships between fields on the parameter record for program X43Q

Program: X43R

1	2	3 4	5	6	7
Record Code	Record Sequence Number	Line Count	Main File Marker	File Processing Marker	Initialisation Marker

8	9	10	11	12	13	14
List Selection Marker	Al Marker	A2 Marker	A3 Marker	B1 Marker	B2 Marker	B3 Marker

15	16	17	18 ⟶		
C1 Marker	C2 Marker	C3 Marker	$Gamma_0$, $Gamma_0$, $Gamma_1$,	FGN Profile Results, file	FGN Main , file

Column	*Contents*	
1	Record Code: value R	
2	Record Sequence No. : value 1	
3 and 4	Line Count	
5	Main File Marker	0 – DMANDHISTORY processed
		1 – SELECTHSTRY∇ processed
		2 – STOCKMASTER∇ processed
6	File Processing Marker	0 – Main file processed in item number sequence
		1 – Main file processed in random sequence
7	Initialisation Marker	0 – Full initialisation to be done
		1 – Partial initialisation to be carried out
8	List Selection Marker	0 – Control System Report required
		1 – Control System Report to be suppressed
9	System marker for A1 items	
10	System marker for A2 items	
11	System marker for A3 items	
12	System marker for B1 items	
13	System marker for B2 items	
14	System marker for B3 items	
15	System marker for C1 items	
16	System marker for C2 items	
17	System marker for C3 items	
18	Gamma zero. For use with system markers 2 and 7	
	Comma	
	Gamma zero. For use with system markers 1 and 6	
	Comma	

Column	Parameter	Filename: DMANDHISTORY	SELECTHSTRY▽	STOCKMASTER▽	SELECTSTOCK▽
1	RECORD CODF	R	R	R	R
2	RECORD SEQ. NO.	1	1	1	1
3	LINE COUNT	0 1-9 incl.	0 1-9 incl.	0 1-9 incl.	0 1-9 incl.
4		and OR and	and OR and	and OR and	and OR and
		0 0-9 incl.	0 0-9 incl	0 0-9 incl.	0 0-9 incl.
5	MAIN FILE MARKER	0	1	2	3
6	MAIN FILE PROCESSING MARKER	0 or 1	N*	0 or 1	N*
7	INITIALISATION MARKER	0 or 1	0 or 1	N*	N*
8	LIST SUPPRESSION	0 or 1	0 or 1	N*	N*
9	A1	0, 1, 2, 3, 5, 6, 7, 8	0, 1, 2, 3, 5, 6, 7, 8	0, 1, 2, 3, 5, 6, 7, 8	0, 1, 2, 3, 5, 6, 7, 8
10	A2	,,	,,	,,	,,
11	A3	,,	,,	,,	,,
12	B1	,,	,,	,,	,,
13	B2	,,	,,	,,	,,
14	B3	,,	,,	,,	,,
15	C1	,,	,,	,,	,,
16	C2	,,	,,	,,	,,
17	C3	,,	,,	,,	,,
18	γ_0 VALUE,	x.xx, or ,	x.xx, or ,	,+	,+
	γ_0 VALUE,	x.xx ,	x.xx ,	,+	,+
		and or and	and or and	,	
	γ_1 VALUE,	x.xx ,	x.xx ,	,+	,+
	FGN PROFILERSLTS	FGN,	FGN,	FGN,	FGN,
	FGN MAIN FILE	FGN,	FGN,	FGN,	FGN,
PROFILERESLT SEQUENCE		When col. 6 = 0, Item no.	Item no.	When col. 6 = 0 Item no.	Item no.

*Fields marked thus, which contain N, a null character, will be checked. All other fields will be checked to ensure that the value is in the range given below.

+Fields marked thus will not be checked by the program.

System markers outside the range shown will be accepted and written to the main file. This will enable users to control the items of the appropriate classification using their own routines.

Table 9 Relationships between fields on the parameter record for program X43R

Column	*Contents*
	Gamma one. For use with system markers 1 and 6
	Comma
	FGN Profile Results file
	Comma
	FGN Main file
	Comma
	NL (paper tape only).

X43R notes

If Gamma (γ) values are entered, these must be in the format shown in the table below. If values are not entered and full initialisation has been specified, system marker 1 and 6 items will have $\gamma_0 = \gamma_1 = 0.1$, system marker 2 and 7 items will have $\gamma_0 = 0.1$ and $\gamma_1 = 0.0$. System marker 3 and 8 items are always assigned $\gamma_0 = \gamma_1 = 0.0$.

User specified values will always be checked to be in the ranges.

$$0.05 \leqslant \gamma_0 \leqslant 1.00$$

$$0.00 \leqslant \gamma_1 \leqslant 1.00$$

Relationships which must be maintained between fields on the parameter record are indicated on page 130.

Program: X43S

1	2	3 4	5	6	7	8
Record Code	Record Sequence Number	Line Count	File Indicator	Processing Indicator	Report packing Indicator	FGN Main File ,

Column	*Contents*	
1	Record Code: value S	
2	Record Sequence Number: value 1	
3 and 4	Line Count	
5	File Indicator.	Indicates which main files are to be listed: 0 – DMANDHISTORY 1 – SELECTHSTRYV 2 – STOCKMASTERV 3 – SELECTSTOCKV
6	Processing Indicator	0 – List items indicated by Code 40 records. 1 – List all items with marker 11 of function markers set. 2 – List all items on file. 3 – List all items from one point to another as determined by the part file listing records (Code 41). Values 0, 1, 2 and 3 are valid for any setting of the File Indicator in Column 5.
7	Report Packing Indicator:	0 – Throw to new page for each item/group record. 1 – Pack records onto page, but if a record cannot be printed in the remaining space then throw to new page unless it is the first record on the page, in which case the complete record will be printed (across the page boundaries if necessary) until the end of the record.
8	FGN Main Input file Comma Field terminator.	This is a # mark followed by the octal value of the field terminator used on the Code 40 or 41 records when input on paper tape
	Comma. This is only required if the octal number has been specified.	
	NL (paper tape only).	

Program: X43T

1	2	3 4	5	6 ⟶
Record Code	Record Sequence Number	Line Count	File Indicator	FGN Input Disc file , FGN Output Disc file ,

⟶			
FGN Statistical Mag. Tape ,	FGN STOCKMASTER Mag. Tape ,	Extension Size ,	Unit of Receipt ,

Column	*Contents*
1	Record Code: value T
2	Record Sequence Number: value 1
3 and 4	Line Count
5	File Indicator. This denotes which main file is being formed. 1 – SERIALHSTRYV 2 – SERIALSTOCKV
6	FGN Input disc file Comma FGN Output disc file Comma FGN Statistical magnetic tape file. This is always present. Comma FGN Stock master magnetic tape file. This is present only if File Indicator = 2. Comma Extension size Comma Unit of receipt. Four characters. This is not used if File Indicator = 1 Comma NL (paper tape only).

Program: X43V (1)

1	2	3 4	5	6	7 →
Record Code	Record Sequence Number	Line Count	Run type indicator	Report indicator	FGN Stockmaster file ,

→			
FGN Demand History file ,	Emergency $Gamma_0$,	Emergency $Gamma_1$,	

→					
Branch weight smoothing factor ,	Review time ,	Order cost ,	Investment rate ,	Order cost factor ,	

→			
Tracking signal report limit ,	Min. value of $Gamma_0$,	Constant A ,	

Column	*Contents*	
1	Record Code: value V	
2	Record Sequence Number: value 1	
3 and 4	Line Count	
5	Run type indicator	0 – Normal run
		1 – Initial run
		2 – Skeleton history generation run
6	Report indicator	0 – only 'out of control' items to be printed
		1 – all forecast items to be printed.
7	FGN Stockmaster file	
	Comma	
	FGN Demand History file	
	Comma	
	Emergency gamma zero (γ_{0e}).	This is used to replace the existing γ_0 for items with system markers 2 and 7 when control has been lost. It is used only if $\gamma_{0e} > \gamma_0$.
	Comma	
	Emergency gamma one (γ_{1e}).	This is used to replace the existing γ_1 for items with system markers 1 and 6 when control has been lost. It is used only if $\gamma_1 = 0$.
	Comma	
	Branch weight smoothing factor.	This is used as the smoothing constant for exponential smoothing of the branch weight factor.
	Comma	

Column	*Contents*	
	Review time.	This is entered as a fraction of the basic time period. It represents the interval between updating. Half of this figure will be added to the lead time when re-order point is calculated.
	Comma	
	Order cost.	This value when present will override the individual order cost within the item record.
	Comma	
	Investment rate.	This value when present will override the individual investment rates present on parameter record 2.
	Order cost factor.	Individual items order costs will be multiplied by an entry made in this field. No entry should be made if the facility is not required.
	Comma	
	Tracking signal report limit	This value, when present, will replace the program preset value of 0.7314 for τ. When τ for an item exceeds this limit the item will be considered to be out of control.
	Comma	
	Minimum value of gamma zero.	This will be the minimum allowable value of γ_0 for items with system markers 3 and 8.
	Comma	
	Constant A.	This is used in the calculation of γ_0 for items with system markers 3 and 8.
	Comma	
	NL (paper tape only).	

Program: X43V (2)

1	2	3 →			
Record Code	Record Sequence Number	Service level 1 ,	Service level 2 ,	Service level 3 ,	Service level 4 ,

→					
Service level 5 ,	Investment rate 0 ,	Investment rate 1 ,	Investment rate 2 ,	Investment rate 3 ,	Investment rate 4 ,

→				
Investment rate 5 ,	Investment rate 6 ,	Investment rate 7 ,	Investment rate 8 ,	Investment rate 9 ,

Column	*Contents*	
1	Record Code: value V	
2	Record Sequence Number: value 2	
3	Service level percentage.	Each item on the Demand History file may be classified into one of five groups. The five service levels which may be punched on this record correspond to these five groups. (Note: Service level group 1 may have a special significance. See Chapter 4, Demand History file creation, Service level group, page 79). Each percentage must occupy no more than four characters including the decimal point. A comma will terminate each field and must be used even if the field is omitted.
	Investment rate.	Each item on the Demand History file may be classified into one of ten investment rate groups. The ten investment rates which may be punched on this record correspond to these ten groups. Each value will be punched as a percentage and must occupy no more than four characters including the decimal point. A comma will terminate each field, even if the field is omitted.
	NL (paper tape only).	

X43V notes

Each of the following fields will be variable length, occupying not more than four characters including the decimal point. The decimal point need not be punched, in which case an integer value will be assumed.

Emergency gamma zero

Emergency gamma one

Branch weight smoothing factor (0.1)

Service level

Investment rate

The same applies to the following fields with the exception that they will occupy not more than five characters.

Review time

Order cost

Investment rate

Order cost factor

Tracking signal report limit (0.7314)

Minimum value of γ_0 (0.1)

Constant A (0.125)

In all cases where a field is omitted the comma indicating the termination of that field must still be punched. In the case of the fields shown above, the program uses the value shown in brackets if no value has been entered.

If the routine is being used for the generation of a skeleton Demand History File (that is, a file containing only the common data copied across from the Stockmaster file) the parameters are slightly different from those shown above.

Parameter record 2 is not required.

Parameter record 1 contains the following:

Column	*Contents*
1	Record Code: value V
2	Record Sequence Number: value 1
3 and 4	Line count
5	Run type indicator: value 2
6	Report indicator: value 0
7	FGN Stockmaster file
	Comma
	FGN Input serial history file
	Comma
	FGN Output serial history file
	Comma
	Extension size
	Comma
	NL (for use with paper tape input only).

Program: X43W

1	2	3 4	5	6	7
Record Code	Record Sequence Number	Line Count	Allocation report selection	Replenishment orders report selection	Min/Max report selection

8 →				
FGN Old Transacts file ,	FGN New Transacts file ,	FGN Replenorders file ,	FGN Min/Max records file ,	Extension size ,

Column	*Contents*	
1	Record Code: Value W	
2	Record Sequence Number: value 1	
3 and 4	Line Count	
5	Allocation report selection.	For values see note 1 below.
6	Replenishment Orders report selection	0 – No report required 1 – Replenishment orders report to be output
7	Min/Max report selection	0 – No report required 1 – Min/Max reports to be output
8	FGN Old transactions file	
	Comma	
	FGN New transactions file	
	Comma	
	FGN Replenishment orders file	
	Comma	
	FGN Min/Max file	
	Comma	
	Extension size	
	Comma	
	NL (paper tape only).	

X43W notes

1 Allocation report selection parameter.

The value of this parameter lies in the range 0 to 4 inclusive. Only certain of the files mentioned in the parameter record layout are needed for each setting of the parameter as follows

Value	*Meaning*	*Files required*
0	Allocation Report and Transactions selection not required.	OLDTRANSACTS
1	Allocation Report and Transactions selection are required.	NEWTRANSACTS
2	As for value = 1 but with generation of forward dated receipts.	OLDTRANSACTS NEWTRANSACTS
3	As for value = 1 but with processing of orders file without creation of forward dated receipts.	OLDTRANSACTS NEWTRANSACTS REPLENORDERS
4	As for value = 3 but with the creation of forward dated receipts.	OLDTRANSACTS NEWTRANSACTS REPLENORDERS

2 The FGN of NEWTRANSACTS is overwritten by FGN of OLDTRANSACTS + 1. After processing, OLDTRANSACTS is renamed ENDTRANSACTS to prevent it from being re-submitted accidentally.

Program: X43Y and X43Z

1	2	3 4	5 ⟶
Record Code	Record Sequence Number	Line Count	Filename FGN ,

⟶
Filename FGN , Extension size ,

Column	*Contents*	
1	Record Code: value Y or Z respectively.	
2	Record Sequence Number: value 1.	
3 and 4	Line Count	
5	Filename.	The existing name of the output file which must be twelve characters.
	Existing FGN of output file	
	Comma	
	Filename.	The new name of the output file which must be twelve characters.
	New FGN of output file	
	Comma	
	Extension size.	The number of blocks by which the file can be extended if necessary.
	Comma	
	Field terminator (paper tape only).	As for program #X43C.
	Comma	
	NL (paper tape only).	

X43Y and X43Z notes

1 The output file from X43Y may take either of the two names HSTRYINPUT▽▽ or SDHSTRYINPUT. If the data is input in random sequence, the output file should be named HSTRYINPUT▽▽. The standard SORT program should then be used to sort the file, and the sorted file should be named SDHSTRYINPUT.

If the original data has been hand sorted, the output file may be named SDHSTRYINPUT, and the use of the standard SORT program is not then required.

2 The output file from X43Z may take either of the two names STOCKINPUT▽▽ or SDSTOCKINPUT. The choice of name is made in the same way as in note 1 above.

PROGRAM SUMMARY

Program X43A

Priority 70

Hardware requirement

The minimum hardware requirement is:

1 10200 words of core store

2 One card/paper tape reader

3 One line printer

4 One disc transport

File requirements

FUNCTION: Select

Input

1 Run parameter record

2 Serial disc file SDHSTRYINPUT

Overlaid

1 Scratch disc file

2 Sequential disc file DMANDHISTORY

Output

1 Serial disc file SELECTHSTRYV

2 Serial disc file HSTRYOVRFLOW

3 Validation report

4 Summary report

FUNCTION: Modify

Input

1 Run parameter record

2 Serial disc file SDHSTRYINPUT

Overlaid

1 Scratch disc file

2 Sequential disc file DMANDHISTORY

Output

1 Serial disc file HSTRYOVRFLOW

2 Validation report

3 Summary report

FUNCTION: Form

Input

1 Run parameter record

2 Serial disc file SDHSTRYINPUT

Overlaid

1 Scratch disc file

Output

1 Serial disc file SERIALHSTRY∇

2 Validation report

3 Summary report

FUNCTION: Combine

Input

1 Run parameter record

2 Serial disc file SELECTHSTRY∇

Overlaid

1 Scratch disc file

2 Sequential disc file DMANDHISTORY

Output

1 Serial disc file HSTRYOVRFLOW

2 Summary report

Run instructions

These run instructions apply to all programs in the X43 series.

Narrative	*Console message*
1 Load cartridge(s)	
2 Load appropriate X43 program.	
3 If input on paper tape, activate by message:	GO #name 20
4 If input on punched cards, activate by message:	GO #name 21
5 At the end of the run, the program will output the message:	HALTED - EN

Exception conditions

These exception conditions apply to all programs in the X43 series.

PARAMETER ERRORS

Message	*Reason*
PARAM ERROR A LOAD NEW PARAMS AND GO	Error in record code or record sequence
PARAM ERROR B LOAD NEW PARAMS AND GO	Error in run parameters
PARAM ERROR C LOAD NEW PARAMS AND GO	Error in file specification or extension size
PARAM ERROR D LOAD NEW PARAMS AND GO	Error in forecasting parameters

DISC EXCEPTIONS

Message	*Reason*	*Action*
HALTED FILENAME∇∇∇∇ DISC EXCEPTION #13	File being used by another program.	Type GO when file becomes available.

Message	*Reason*	*Action*
HALTED FILENAMEVVVV DISC EXCEPTION #15	Insufficient space for scratch file or for extending a named file.	Supply more space if configuration allows. Type GO 28 to terminate run.
LOAD FILENAMEVVVV FGNV AND GO	Cartridge is not on line.	Ensure that cartridge gets on line and type GO.

In all cases where the following message appears: DISPLAY FILENAMEVVVV DISC EXCEPTION with an octal value other than those shown above, the job will terminate automatically. Details of these exceptions are listed in the Direct Access Techniques manual in the section on Housekeeping formats.

COBOL RUN TIME ERRORS

A full set of COBOL run time halts and messages may be found in the *COBOL* manual, page 247 et seq.

RUN TIME ERRORS

Error code	*Meaning*
A	Record not recognised.
B	Item number is all spaces or zero.
C	Illegal character in field
D	Decimal point in integer field
E	Entry out of range
F	Field length exceeded.
G	Day out of range
H	Month out of range
J	Year less than 1968
K	Quantity 2 entry not valid for this transaction.
L	Priority entry not valid for this transaction.
M	Checksum field exceeded.
N	Record already input. This code is also used following out-of-sequence records for all records having the item number that was being processed.
P	Inconsistent relationship with other fields, or marker not set for this record.
Q	Input record does not match main file. This is used to indicate: 1 Absence of the specific main file record or branch record during maintenance of the Stock Master file or Demand History file. 2 Absence of the specified stock master record during stock updating. 3 Absence of the specified recirculating record during stock updating. 4 Invalid units.
R	Record already present on main file (refers to complete main file or branch record).
S	Attempting to form too many branch records
T	Attempting to delete last remaining branch
U	Standard value used.
V	Series length error. This error applies during maintenance of seasonal factors and demand series and indicates: 1 The seasonal base or series length does not equal the number of factors or points input.

Error code	*Meaning*
	2 During modification, the start address of the block of data being modified is incompatible with the seasonal base or series length specified.
W	Input record out of sequence
X	Too many type 10 records for one branch
Y	Negative order balance set to zero.
Z	Negative stock balance
AA	Sequence error – STOCKMASTER∇
AB	Sequence error – SELECTSTOCK∇
AC	Sequence error – DMANDHISTORY
AD	Sequence error – SELECTHSTRY∇
CC	Sequence error – Class Code
GM	Sequence error – Gross Margin
NN	Sequence error – Item number/Group code
NT	No totals record present at the beginning of the Profile Results file.
QW	On the Profile Results file the Total Sales Value in the Totals record is zero or the Sales Value field of the first item record is zero.
SS	Sequence error – Sales Value
TT	Sequence error – Stock Value
WT	In ABC Analysis the Report Total does not agree with the total read from the totals record on the Profile Results file.
XX	Profile Results file not classified.

Program X43B

Priority 70

Hardware requirement

The minimum hardware required is:

1 10800 words of core store

2 One card/paper tape reader

3 One line printer

4 One disc transport

File requirements

FUNCTION: Select

Input

1 Run parameter record

2 Serial disc file SDSTOCKINPUT

Overlaid

1 Scratch disc file

2 Sequential disc file STOCKMASTER∇

Output

1 Serial disc file SELECTSTOCK∇

2 Serial disc file STOCKOVRFLOW

3 Validation report

4 Summary report

FUNCTION: Modify

Input

1 Run parameter record

2 Serial disc file SDSTOCKINPUT

Overlaid

1 Scratch disc file

2 Sequential disc file STOCKMASTER∇

Output

1 Serial disc file STOCKOVRFLOW

2 Validation report

3 Summary report

FUNCTION: Form

Input

1 Run parameter record

2 Serial disc file SDSTOCKINPUT

Overlaid

1 Scratch disc file

Output

1 Serial disc file SERIALSTOCK∇

2 Validation report

3 Summary report

FUNCTION: Combine

Input

1 Run parameter record

2 Serial disc file SELECTSTOCK∇

Overlaid

1 Scratch disc file

2 Sequential disc file STOCKMASTER∇

Output

1 Serial disc file STOCKOVRFLOW

2 Summary report

Run instructions

See *Run instructions*, page 142.

Exception conditions

See *Exception conditions*, page 142.

Program X43C

Priority 70

Hardware requirement

The minimum hardware required is:

1 4000 words of core store

2 One card/paper tape reader

3 One line printer

4 One disc transport

File requirements

Input

1 Run parameter record

2 Transaction records, terminated by ****, or

3 Second parameter record and serial disc file TRCARDIMAGES

Output

1 Serial disc file NEWTRANSACTS

2 Transactions validation report

Run instructions

See *Run instructions* page 142.

Exception conditions

See *Exception conditions*, page 142.

Program X43D

Priority 70

Hardware requirement

The minimum hardware requirement is:

1 9000 words of core store

2 One card/paper tape reader

3 One line printer

4 One disc transport

File requirements

Input

1 Run parameter record

2 Sequential disc file DMANDHISTORY, or

3 Serial disc file SELECTHSTRYV

Output

1 Serial disc file PROFILERESLT

2 Stock profile report

3 Frequency analysis

Run instructions

See *Run instructions,* page 142.

Exception conditions

See *Exception conditions,* page 142.

Program X43F

Priority 70

Hardware requirement

The minimum hardware required is:

1 13500 words of core store

2 One card/paper tape reader

3 One line printer

4 One disc transport

File requirements

FUNCTION: Sequential file processing

Input

1 Run parameter record

Overlaid

1 Sequential disc file DMANDHISTORY

Output

1 Serial disc file HSTRYOVRFLOW

2 Demand analysis processing report

FUNCTION: Selected serial file processing

Input

1 Run parameter record

2 Serial disc file SELECTHSTRYV

Output

1 Serial disc file SELECTHSTRYV

2 Demand analysis processing report

Run instructions

See *Run instructions*, page 142.

Exception conditions

See *Exception conditions*, page 142.

Program X43J

Priority 70

Hardware requirement

The minimum hardware required is:

1 13500 words of core store

2 One card/paper tape reader

3 One line printer

4 One disc transport

File requirements

FUNCTION: Normal run

Input

1 Run parameter record

Overlaid

1 Sequential disc file STOCKMASTER∇

2 Serial disc file NEWTRANSACTS renamed OLDTRANSACTS

Output

1 Serial disc file MAXMINRECRDS

2 Serial disc file REPLENORDERS

3 Stock updating exceptions report

4 Stock activity report

FUNCTION; Supplementary run

Input

1 Run parameter record

Overlaid

1 Sequential disc file STOCKMASTER∇

Output

1 Serial disc file MAXMINRECRDS

2 Serial disc file REPLENORDERS

3 Stock updating exceptions report

4 Stock activity report

Run instructions

See *Run instructions*, page 142.

Exception conditions

See *Exception conditions*, page 142.

Program X43K

Priority 81

Hardware requirement

The minimum hardware required is:

1 11000 words of core store

2 One card/paper tape reader

3 One line printer

4 One disc transport

File requirements

Input

1 Run parameter record

Overlaid

1 Sequential disc file STOCKMASTER∇

2 Sequential disc file REPLENORDERS

Output

1 Serial disc file REPLENORDERS

2 Serial disc file MAXMINRECRDS

3 Automatic ordering exceptions report

4 Warehouse stock activity report

Run instructions

See *Run instructions*, page 142.

Exception conditions

See *Exception conditions*, page 142.

Program X43Q

Priority 73

Hardware requirement

The minimum hardware required is:

1 7200 words of core store

2 One card/paper tape reader

3 One line printer

4 One disc transport

File requirements

Input

1 Run parameter record

Overlaid

1 Serial disc file PROFILERESLT

Output

1 ABC Analysis preliminary report, or

2 ABC Analysis item report, and

3 ABC Analysis summary report

Run instructions

See *Run instructions*, page 142.

Exception conditions

See *Exception conditions*, page 142.

Program X43R

Priority 76

Hardware requirement

The minimum hardware required is:

1 10600 words of core store

2 One card/paper tape reader

3 One line printer

4 One disc transport

File requirements

FUNCTION: Demand History Processing

Input

1 Run parameter record

Overlaid

1 Serial disc file PROFILERESLT

2 Sequential disc file DMANDHISTORY, or

3 Serial disc file SELECTHSTRYV

Output

1 Control system report

FUNCTION: Stock Master Processing

Input

1 Run parameter record

2 Serial disc file PROFILERESLT

Overlaid

1 Sequential disc file STOCKMASTERV, or

2 Serial disc file SELECTSTOCKV

Output

1 Control system report containing exceptions only

Run instructions

See *Run instructions*, page 142.

Exception conditions

See *Exception conditions*, page 142.

In addition, the following error codes are used by program X43R and are printed below the numeric position of the Class Code:

Error Code	*Meaning*
?	Applies only for seasonal items with the Profile Results forecast interval greater than the Demand History forecast interval if: 1 A non-integer relationship exists between the Profile Results forecast interval and the Demand History forecast interval, or 2 A non-integer relationship exists between the Demand History seasonal base and the Profile Results forecast interval.

Error Code	*Meaning*
	The Demand History Record is left unchanged.
<	Applies only for seasonal items with the Profile Results forecast interval less than the Demand History forecast interval. The Demand History record is left unchanged.
&	Applies if the Profile Results forecast interval is less than the Demand History forecast interval and marker 0 in the Demand History record is set. The Demand History record is left unchanged.

Program X43S

Priority 70

Hardware requirement

The minimum hardware required is:

1 13500 words of core store

2 One card/paper tape reader

3 One line printer

4 One disc transport

File requirements

Input

1 Run parameter record

2 Sequential disc file DMANDHISTORY, or

3 Sequential disc file STOCKMASTERV, or

4 Serial disc file, SELECTHSTRYV, or

5 Serial disc file SELECTSTOCKV

Output

1 Main File item report

Run instructions

See *Run instructions,* page 142.

Exception conditions

See *Exception conditions,* page 142.

Program X43T

Priority 79

Hardware requirement

The minimum hardware required is:

1 7200 words of core store

2 One card/paper tape reader

3 One line printer

4 One disc transport

5 One magnetic tape deck for Demand History file creation

Two magnetic tape decks for Stockmaster file creation

File requirement

FUNCTION: Demand History File Create

Input

1 Run parameter record

2 Magnetic tape file STATISTICALV

Output

1 Serial disc file SERIALHSTRYV

FUNCTION: Stock Master File Create

Input

1 Run parameter record

2 Magnetic tape file STATISTICALV

3 Magnetic tape file STOCKVMASTER

Output

1 Serial disc file SERIALSTOCKV

Run instructions

See *Run instructions*, page 142.

Exception conditions

See *Exception conditions*, page 142.

Program X43V

Priority 50

Hardware requirement

The minimum hardware required is:

1 11000 words of core store

2 One card/paper tape reader

3 One line printer

4 One disc transport

File requirements

FUNCTION: Normal run

Input

1 Run parameter records

Overlaid

1 Sequential disc file STOCKMASTER∇

2 Sequential disc file DMANDHISTORY

Output

1 Reported items list

FUNCTION: Skeleton History Generate run

Input

1 Run parameter record

2 Sequential disc file STOCKMASTER∇

Output

1 Serial disc file SERIALHSTRY∇

Run instructions

See *Run instructions*, page 142.

Exception conditions

See *Exception conditions*, page 142.

Program X43W

Priority 70

Hardware requirement

The minimum hardware required is:

1 12500 words of core store

2 One card/paper tape reader

3 One line printer

4 One disc transport

File requirements

Input

1 Run parameter record

2 Serial disc file OLTRANSACTS

3 Serial disc file MAXMINRECRDS

4 Serial disc file REPLENORDERS

Output

1 Serial disc file NEWTRANSACTS

2 Allocation report

3 Stock Under Minimum report

4 Stock Over Maximum report

5 Replenishment order report

} Selected by parameter.

Run instructions

See *Run instructions,* page 142.

Exception conditions

See *Exception conditions,* page 142.

Note: When this routine is being used for transaction selection, at the start of the run the output file is renamed U/STRANSACTS. It is renamed NEWTRANSACTS at the end of a successful run. If the run terminates prematurely, therefore, the user should not attempt to use the partially written file for recirculation. This device is intended to prevent recirculation of duplicate records which would have been caused by the user's subsequently carrying out the selection run successfully.

Program X43Y

Priority 70

Hardware requirement

The minimum hardware required is:

1 2500 words of core store

2 One card/paper tape reader

3 One line printer

4 One disc transport

File requirements

Input

1 Run parameter record

2 Demand History data records terminated by ****

Output

1 Serial disc file HSTRYINPUT▽▽, when file is to be sorted.

2 Serial disc file SDHSTRYINPUT, when input data records have been hand sorted to the correct sequence.

Run instructions

See *Run instructions*, page 142.

Exception conditions

See *Exception conditions*, page 142.

Program X43Z

Priority 70

Hardware requirement

The minimum hardware required is:

1 2500 words of core store

2 One card/paper tape reader

3 One line printer

4 One disc transport

File requirements

Input

1 Run parameter record

2 Stock Master data records terminated by ****

Output

1 Serial disc file STOCKINPUTVV, when file is to be routed.

2 Serial disc file SDSTOCKINPUT, when input data records have been hand sorted to the correct sequence.

Run instructions

See *Run instructions,* page 142.

Exception conditions

See *Exception conditions,* page 142.

Note: In all programs, following the Heading page, the parameter record(s) and the file headers are listed on the line printer.

MAIN FILE REORGANISATION #XJEZ

The creation of the main files used in SCAN System 3 (the Demand History and Stock Master files) starts by using a Card/Paper Tape to Disc routine followed by a routine which creates an output serial file containing records in main file format. The relevant routines are #X43Y and #X43A for the Demand History file, the output file from #X43A being called SERIALHSTRY∇, and #X43Z and #X43B for the Stock Master file, the output file from #X43B being called SERIALSTOCK∇.

SERIALHSTRY∇ and SERIALSTOCK∇, although containing records in main file format, are not suitable for processing by SCAN System 3. They must first be reorganised to produce the sequential indexed files DMANDHISTORY and STOCKMASTER∇. The program which will carry out this reorganisation is created by using the disc utility routine #XJEZ.

A guide for the setting up and use of a reorganisation routine suitable for producing either DMANDHISTORY or STOCKMASTER∇ files is given here. For fuller descriptions of the programs involved see the E.D.S. section of the ICL 1900 *Library Specifications* manual.

#XJEZ generates a segment for the complete file organisation program. The segment sets up preset areas, determines buffer sizes and contains CALL instructions to required segments on the Library file.

The magnetic tape output consists of a file in a format acceptable to the PLAN compilers #XPLV and #XPLW. The file is named COMPILE∇FILE and has a reel sequence number of 0, a generation number of 4095, and a retention period of seven days.

Each segment is contained in a subfile named xxxxSKELETON where xxxx is the name of the program for which this segment is required. Each segment is named SKELETONSEG and is provided with a steering line 'LIST OBJECT'.

#XJEZ parameters

Parameter		*Maximum size in characters*
(a)	Program identifier and sequence number (XJEZn where n is the sequence number starting at 1)	5 (fixed)
(b)	Name and priority of the required file organisation program	6 (fixed)
(c)	Number of characters in maximum record key length	2
(d)	Possible input devices for file 1: Number of possible device types Device type codes *	 1 (fixed) 2 each (fixed)
(e)	Buffer size for input file 1	4
(f)	Possible input devices for file 2: Number of possible device types Device type codes *	 1 (fixed) 2 each (fixed)
(g)	Buffer size for input file 2	4
(h)	Possible devices for output file: Number of possible device types Device type codes *	 1 (fixed) 2 each (fixed)
(i)	Buffer size for output file	4
(j)	Size of index area (Direct access output only)	4
(k)	Device type for PLAN source output. This is compulsory for E.D.S. but is optional for paper tape, cards, magnetic tape or line printer. If this is included it will cause #XJEZ automatically to start outputting the source segment without stopping and waiting to be restarted at the required entry point.	2 (fixed)
(l)	File identity	12
(m)	File generation number	4

* The device type codes are:

PT	Paper tape
CD	Punched cards
MT	Magnetic Tape
ED	E.D.S.
FD	F.D.S.
MC	M.C.F.

Notes:

1 If the number of possible device types for a file is zero, it must be punched as zero, but the device type codes and buffer size must be omitted for that file.

2 Buffers must be large enough to hold the largest card or paper tape records, magnetic tape block or direct access bucket, and must be at least twenty words long.

3 Parameter (j) refers to an area of core store for holding index tables for direct access output files and it is optional. If included it should be long enough to hold either one or two index buckets. If files contained on more than one E.D.S. cartridge are to be used and only one drive unit is available, it is advisable to provide space for at least one index bucket in order to avoid frequent cartridge changes.

Example

The following example will create a routine capable of accepting one input file from E.D.S. and outputting to E.D.S.

XJEZ1, REOR70, 18, 1, ED, 512, 0, 1, ED, 512, 512, *

These parameters would create the program REOR with a priority 70.

The output PLAN source program must then be compiled using #XPLV or #XPLW.

#XJEZ has a priority of 80.

Core store required 1472 words.

Run instructions

	Narrative	*Console message*
1	Load #XJEZ.	
2	Load scratch tape with W.P.R.	
3	Load parameters.	
4	If input or paper tape, activate by message:	GO #XJEZ 20
5	If input on punched cards, activate by message:	GO #XJEZ 21
6	The program will then halt:	HALTED – PARAMETERS ACCEPTABLE
7	To output to MT type the message:	GO #XJEZ 24
8	The program will then halt:	HALTED – SEGMENT GENERATED
9	Type the message:	GO #XJEZ
10	At the end of the run, the program will output the message:	HALTED – END OF RUN

Exception conditions

Message	*Reason*	*Action*
HALTED – A1	Parameter error. The program will halt	Type GO #XJEZ to close COMPILE▽FILE.

The use of the file reorganisation program

A full description of this program together with its halts and run time messages can be found following the #XJEY in the E.D.S. section of the ICL 1900 Series *Library Specifications* manual. An abstract of the information is given below.

#XJEZ generates a program for the reorganisation of SERIALHSTRY∇ to DMANDHISTORY or of SERIALSTOCK∇ to STOCKMASTER∇. The following parameters are an example of those needed.

Record 1. REOR1, 1, Y, 0, 18, 4,

Record 2. REOR2, ED, SERIALHSTRY∇, FGN,

or

SERIALSTOCK∇

Record 3. R1 OR4, ED, DMANDHISTORY, EXISTING FGN, 0, NEW FGN, Q, 0, 1, 0, 0,*

or

STOCKMASTER∇

Notes:

1 The record which would have the sequence REOR3 is not needed for this run because there is only one input file.

2 The appropriate file generation number must be inserted in place of FGN in the above example.

The core required by the above program is 5.5K

Run instructions

Narrative	*Console message*
1 Load cartridge.	
2 Load reorganisation program.	
3 Load parameters.	
4 If input on paper tape, activate by message:	GO #name 20
5 If input on punched cards, activate by message:	GO #name 21
6 When the program closes the files, the following message is output for each file in the run.	DISPLAY – CLOSED FILE n
7 The program then gives a count of the records read and the records written for input file 1, input file 2 and the output file respectively:	DISPLAY – COUNTS xxxxxxx xxxxxxx xxxxxxx
8 At the end of the run, the program will output the message:	HALTED – END OF RUN

The output file DMANDHISTORY or STOCKMASTER∇ must have been allocated using #XJEC. It will have four block buckets and will be a sequential indexed file with bucket headers. It must also be empty.

FILE SORT SEQUENCES

For several of the input disc files used by SCAN System 3, processing will be unsuccessful if records are not in the correct sequence. Individual file sequences are discussed below.

SDSTOCKINPUT

The file must be in ascending sequence of the following keys:

Item Number

Group Code

Record Function

Record Code

Columns 22, 23

The lowest key has significance for record code 5 only.

SDHSTRYINPUT

The file must be in ascending sequence of the following keys:

Item Number

Group Code

Record Function

Record Code

Columns 21, 22, 23

The lowest key has significance for records codes 3 and 4 only.

PROFILERESLT

The secondary key varies according to the nature of the processing selected by the user in the ABC Analysis routine. However, the primary key must be Record Code in ascending sequence. This ensures that the summary record is positioned at the beginning of the file.

Chapter 6 System implementation and integration

The SCAN System 3 Main File Maintenance routines create and maintain main files in SCAN 3 format from card or paper tape input. If the information is already held on a file in a different format then the user must provide his own transcription routines to generate the main files in SCAN 3 format. In some situations it may be convenient for the user to generate card image files similar to those provided by the SCAN System 3 Transcription routines #X43Y and #X43Z so that advantage can be taken of the validation of data carried out by the SCAN 3 Maintenance routines. All SCAN 3 routines assume that all data has been validated; thus the difficulties that would arise if data were not validated, will be avoided if the course of action outlined above is followed.

If the user's system is such that main files different from those used by SCAN System 3 are needed then the user must write his own routines to suit the format of his files. In this situation, the system logic described in this manual will still be of use.

The information given in this chapter is concerned with data collection, internal and external system relationships and operational control.

DATA COLLECTION

The record formats (see pages 78 and 84) provided for the creation of Master Files in the SCAN System 3 are subdivided so that the different departments within a business may provide their own data. However, before data collection can be completed, the group structure of each part of the inventory must be considered.

The format of Stock Master file records allows stocks of an item to be located at more than one location and, if necessary, the forecast of demand to be made for the total demand on the whole group of branches; thus

1 Fewer demand history records are required.

2 The demand, which may be sporadic at branch level, is made more stable.

3 Less time is used in forecasting.

4 More branch records can be accommodated in a given Stock Master file cartridge area.

The user should note that it is not essential for branches to be grouped. Particularly important stocks, for example warehouses, would be controlled by groups containing a single branch; this policy could apply for all stock locations. There is no practical limit to the number of branches that can be accommodated by the SCAN System 3. If single branch groups are used, 2116 different groups and hence branches can be identified using letters and numbers only for the two character group code; 4096 different groups (or branches) can be identified if the full character set is used. If there are eight branches in each group then the number of different branches that could be identified would be eight times the figures given above.

If branches are grouped, the following points should be noted.

1 Certain information is assumed to be common to all the branches in the group, for example the lead time, the supplier etc. (see *File format*, page 84). Therefore, the user must ensure that this condition is valid.

2 The main demand forecast occurs at group level, and the forecast for each branch is estimated from the group forecast; thus, branches having similar demand characteristics, qualitatively not quantitively, should be grouped together. It is particularly important that branches having a strong seasonal demand for an item should not be grouped with branches that do not have strong seasonal demands since seasonal factors if they are used will influence the forecasts for all branches in the group.

3 The use of cartridge space is dependent on the structure of the stock master records. The use made of the cartridge is acceptable for groups containing up to nine branches. If more than nine branches are included in each group then the record and bucket sizes will be incompatible, leading to inefficient use of the cartridge. If the optional fields for bulk ordering, quantity discount or joint replenishment are used, the maximum number of branches must be reduced to keep the maximum record size the same.

In certain circumstances, the SCAN System 3 may be used not only for groupingtogether branches but also for collecting together for one branch a range of similar items. Thus, a forecast of the total demand for the range can be made and then the control parameters for the individual items in the range can be estimated. If this procedure is used, the products must have a common primary key corresponding to the SCAN System 3 item number, followed by a secondary key, to differentiate between the products for example in terms of size or colour, corresponding to the branch location code.

The actual branch location code would be contained in the group code. For example, if for branch XY, stocks of an item having item numbers:

54321 YE

54321 GR

54321 BL

corresponding to the colours yellow, green and blue, are to be controlled, the SCAN System 3 field contents would be as follows:

Item Number	*Group Code*	*Location Code*	*Location Code*	*Location Code*
54321	XY	YE	GR	BL

The result of using this system would be that the forecast would be made for the total demand independent of colour and therefore would be more stable; stock control parameters and hence orders would be generated independently for each colour.

Stock Master file

The Stock Master file is concerned with the recording of stock and control operations.

Record code 5 records contain information relating to the branch. Record codes 6 and 7 records contain general group information common to all the branches in the group. Record codes 8 and 9 records contain information concerned with quantity discounts and bulk ordering respectively. Record code: records contain receipt unit information. The use of all records is optional except for code 5 records of which there must be at least one for the group.

Demand History file

The Demand History file is required for analysis and forecasting.

Record codes 1 and 2 records contain details of the item generally. Record codes 3 and 4 records contain demand histories and seasonal factors. Record code 3 records may be omitted if no analysis is required; record code 4 records may be omitted if there are no seasonal factors for the item/group. A Demand History record containing all standard values will be obtained by using only a record code 1 containing item number and group code.

The analysis phase relies mainly on the results of the ABC Analysis routine. The ABC Analysis routine must be able to calculate the annual sales of each item/group if it is to function effectively. Twelve points of monthly demand history or twenty four points of weekly data will usually be sufficient for this purpose, although greater accuracy will be obtained by using up to two years' data.

The ABC Analysis routine must be followed by the Control System Selection routine in order to assign system markers to each item according to the ABC classification. This routine will also, if required, initialise the Demand History file to enable forecasting to proceed without the need for further analysis by the Demand Analysis routine. This option should not be exercised if the system is required to calculate trend or seasonal factors for the item.

The Demand Analysis routine is provided to enable trend and seasonal characteristics to be investigated. This routine calculates trend and seasonal factors if required and sets up statistical values in the record following a simulation run over the demand history provided. This is a more accurate file initialisation procedure than the one offered optionally in the Control System Selection routine. It should be noted that the simulation procedure does not attempt to optimise on the forecasting constants gamma zero and gamma one. These constants are fixed for the inventory for system markers 1, 2, 6 and 7. It is suggested that for forecast items, system markers 3 and 8 are used, unless for reasons of familiarity Box-Jenkins two point prediction or exponential smoothing is required. System markers 3 and 8 will provide lagged adaptive response rate forecasting which will be found to provide reliable control in a wide range of circumstances.

If initially there is not enough data available for analysis, the user is advised to omit the analysis routines and set arbitrary control factors as discussed below. Demand histories can then be accumulated using the automatic demand

history updating feature in the forecasting routine and analysis can be carried out when enough demand history data has been collected.

In certain situations where analysis is being carried out, the User may wish to specify his own seasonal factors or minimum forecast interval for an item, while still making use of the full analysis procedures for the remaining items. This is achieved by setting function markers 0 and 1 in the Demand History record.

Transactions file

The Transactions file is required to be used as the medium of input of stock movements to the Updating routine.

Each transaction type is recorded on a separate record with a common format; the record code identifies the type of transaction (see page 91). In situations where this format does not apply because data is being punched directly from source documents the user must provide his own routine for writing the data to disc. The resulting disc file should be in either the same format as the SCAN System 3 Transactions file (see page 107) or more preferably in card image form corresponding to the SCAN System 3 transaction card format. This latter file would be input to the Transactions File Creation routine to undergo a full validity check using the appropriate entry point.

BASIC DATA

1 For an initial analysis of demand history the following fields are required in the Demand History file.

(a) Item number

(b) Group code

(c) Cost price

(d) Sales price

(e) Service level group

(f) Group stock balance

(g) Demand history length

(h) Demand history

(i) Selected lead time

(j) Description of product

(k) Unit of measure

Fields (j) and (k) are for identification only and may be omitted.

Note: If the group stock balance data is not provided, the Stock Profile report will print zero against the headings Stock Quantity and Stock Value.

2 After analysis, all control factors will be written to disc; any changes necessary in field content will be made by Management and a file maintenance program must be used to enter the appropriate values. This program may be written by the user to suit his special requirements or the user may use the SCAN System 3 Maintenance routines.

If the control system is being used without analysis having been carried out the following values are recommended for the control factors.

Field	*Initial value*
Forecast base (or interval)	1
Seasonal factors	As appropriate (omit if not applicable)
Seasonal base	0 for non-seasonal items; 12 13 or 52 (depending on the frequency of forecasting) for seasonal items.
System marker	Chosen to give the required control system. For forecast items, 3 or 8 is recommended

Field	*Initial value*
Box-Jenkins proportional control parameter (Gamma zero)	0.1 (omit if system markers 3 or 8 are used)
Box-Jenkins cumulative control parameter (Gamma one)	0.1 (omit if system markers 2, 3, 7 or 8 are used)
Deseasonalized demand forecast	Latest demand or best estimate
Cumulative sum of errors	0
Smoothed forecast error	Approximately one twentieth of the deseasonalized demand forecast
Mean absolute deviation of errors	Approximately one tenth of the deseasonalized demand forecast
Service level group	As required

3 If lead times (replenishment delivery times) are fixed or firmly promised then the value of the lead time appropriate to a given supplier for that item is used for the lead time value.

If the lead times are variable then

(a) Use the maximum known lead time, or

(b) Perform a distribution (or frequency) analysis of the lead time history and compute a value corresponding to one or two standard deviations above the mean value for the lead time.

The first method of choice of lead time may give rise to higher stock holdings depending on the difference between the maximum and minimum known lead times, but the customer service level will be increased. If there is a large range of lead time then method (b) of choosing the lead time value is recommended. One standard deviation above the mean value of the distribution will cover approximately 84% of all lead times encountered in practice. Similarly, two standard deviations above the mean value will cover approximately 98% of all lead times. This method limits the effect of any extremely long lead times.

The type of analysis outlined above may involve a large amount of manual calculation if the information does not already exist in a form suitable for processing by the computer. Therefore, the SCAN System 3 Receipts Transaction format carries both the due date and the actual receipts date (transaction date). Thus, the SCAN System 3 Transactions file should provide a useful entry to a user routine for analysing supplier performance. Modifications to the lead time value could then be made using the SCAN System 3 Main File Maintenance routines or a special user routine provided for the purpose.

The stock control functions of SCAN System 3 can be used without forecasting if fixed re-order points and re-order quantities are entered in the Stock Master file by the user. If this is done then demand history records need not be provided; however, it will still be necessary to run the Forecasting routine to update the count fields used in cyclical ordering and bulk ordering if these features of the system are being used.

INTERNAL SYSTEM RELATIONSHIP

The analysis routines require only one disc file, the Demand History file; however, if automatic control system selection is used a second file, the Stock Master File, is required.

The operational routines require the Stock Master file to be created initially and the Transactions file to be created before Stock updating is carried out. All further files used in the system are created by the relevant program.

Figures 24 to 27, pages 174 to 179 indicate the sequence of routines for both analysis and operation of the system.

Each program is described in general terms in Chapter 2 and in detail in Chapter 3; useful notes are given in this chapter.

File creation routines

The file creation routines are described in Chapter 2 and Chapter 3 and the input record formats in Chapter 4.

Comprehensive Master File Maintenance routines are provided; these routines use the same input format for main file record formation as for main file record modification. Thus, only information that can be supplied by the user may be modified.

Analysis routines

Whatever type of inventory control system is to be established, the Analysis routines improve on the traditional ABC analysis since they take into account the frequency of movement of each item. Annual usage is always a valuable criterion on which to base a selection of items for computer based inventory control, but the fast moving items will respond to control action most quickly. Therefore, the frequency of movement and annual usage value should be used as joint criterion when the selection is made.

It is recommended that adaptive control is used only for items that have a frequency of movement of at least ten units in one forecast interval; however, a practical maximum forecast interval is four weeks or one month since for items moving more slowly than this, fixed re-order parameters or special slow moving techniques will be more effective.

If weekly demand data is presented to the Stock Profile Analysis routine, the items selected first for computer based control will be those with a recommended forecast interval of 1, 2 or 4. The Frequency Analysis table shows what this means in terms of annual sales (or usage value), gross margin and stock-holding values relative to the total for all the items included for analysis.

The demand histories presented to the Stock Profile Analysis routine should refer to the same number of demand points for each item if possible, so that all items are comparable; however, whatever the number of demand points, the routine will calculate the average annual demand for each item (provided at least one demand point is present).

The Stock Profile Analysis routine may be used to review the control performance by comparing with reports produced during previous analysis. The comparison shows:

1 How the balance of stock-holding has changed in relation to annual sales value.

2 How the stock turnover ratio has changed for each section of the inventory.

3 How the stock-holding and number of non-moving or slow moving items has changed.

The ABC Analysis routine provides the user with a preliminary analysis table in steps of 5% so that a close estimate can be made of the desired high and medium usage value groupings.

After establishing classes of inventory items based on the combination of annual usage value and frequency of movement the user may apply automatic control system selection based on the following suggested table:

Class	*System marker*	
	Random ordering	*Cyclical ordering*
A1	1	6
A2	1	6
A3	0	5
B1	1	6
B2	1	6
B3	0	5
C1	0	5
C2	0	5
C3	0	5

The values 1 and 6 select forecasting using the Box-Jenkins two point predictor. Markers 2 and 7 should be used to obtain exponential smoothing (Box-Jenkins one point predictor). Markers 3 and 8 should be used to obtain lagged adaptive response note.

At this stage the operational routines may be entered, but for those users requiring a more detailed examination of their demand data, the Demand Analysis routine is provided. In this routine the presence of trend and seasonality is investigated and trend and seasonal factors automatically assigned if appropriate.

Operational routines

TRANSACTION FILE CREATION

Transactions being input are fully validity checked (see Chapter 4, page 91); if the transactions are correct they are written, in the order they are presented, to a disc file. This disc file must then be sorted using standard ICL sort software and merged with the file of recirculating transactions if there are any. The size and the position of the sorted transactions file are extremely important. Individual users' requirements may give rise to alternative schemes but a convenient general rule for a two-cartridge configuration is that the Stock Master file should be held on one cartridge and the Transactions file should occupy no more than half the other cartridge. The remaining half of the second cartridge should hold the Replenishment Orders file and the Under Minimum/Over Maximum file. Thus, multi-cartridge Stock Master files may be used. If the area available for output becomes full during stock updating, the output files are closed and processing continues without output records being generated. The output records may then be produced by rerunning the Stock Updating routine in supplementary ordering mode. The most satisfactory arrangement on a three cartridge installation will depend on the relative sizes of the output files. The most satisfactory arrangement will probably be to assign the Stockmaster file and Replenishment Orders file to a cartridge each and to hold the Transactions file and the Under Minimum/Over Maximum file on the remaining cartridge. As before, an output file will only be extended on its home cartirdges. When this becomes full, the file will be closed.

The individual types of transaction have been described in full in Chapters 2, 3 and 4. The Transactions File Creation routine includes in its batch totals only those records that have been written to disc. Thus whenever some invalid data is present, the machine's batch totals will be different from the user's batch totals. The user must make allowance for this when the batch total checks are being used for checking punching accuracy.

If paper tape is being used as the input medium, the user may choose his own field terminator and may choose a different terminator for each main file creation routine. However, if the user wishes to take advantage of the common format of transactions in the paper tape printed secondary output, it is suggested that the horizontal tabulation character is used for theTransactions File Creation routine.

STOCK UPDATING AND ALLOCATION ROUTINE

The allocation of cartridge space to the two output files, the Replenishment Orders file and the Under Minimum/ Over Maximum file is described in the previous section. These files should be allocated zero area and should be extended as required by the Stock Updating and Allocation routine, so that the best use can be made of cartridge space. The sizes of the extensions for the files are chosen by the user to suit his own configuration and are specified in a run parameter.

If the run has to be abandoned for any reason, any unprocessed transactions will be recirculated since marker 0 of the record status will be set during updating for all transactions that are processed.

During updating, in addition to marker 0 of the transaction record status being set, data is copied into the transaction record from the stock master record (see *Transactions file*,page 107). For demands and back orders, a quantity indicating the new back ordered quantity is written into the quantity 2 field. The updated transactions are available for use as input to user's routines, for example invoicing, credit control or purchase order control.

The user's requirements will dictate the method of allocation of stock. The system can operate by pre-posting requests for stock (demands) or by post-posting requests for stock (unscheduled issues) or using a mixture of both methods. When issues are being made from a warehouse, the difference between pre-posting and post-postings will be a difference in the route taken by the request for stock. In a pre-allocation system, where back orders can be generated, the requests for stock, the demands, are sent straight to the computer and are pre-posted. The program produces an Allocation report and allocation of stock takes place from the warehouse using the Allocation report or by processing the Transactions file. In a system where back orders cannot be generated, for example where shops are ordering from the warehouse, the requests for stock go directly to the warehouse. Stock is allocated from the warehouse if possible and the action reported to the computer as an unscheduled issue; these requests have then been post-posted.

Some demands will not require immediate allocation; issues of stock must not be pre-posted until the stock is due for dispatch. However, if a demand is known in advance then the system should be notified as early as possible so that the information may be used to influence the forecast of demand.

When such a demand becomes due for allocation, the quantity of the demand will be deducted from the forward demand balance and the demand will become available for immediate allocation.

The stores handling time varies from user to user. If, for example it takes an average of three days for a demand to be serviced then demands must be allocated three days before they are due and if stock is available pre-posted as issues or if stock is not available, back ordered.

The procedure outlined above may also be of use for manufacturing order control. The constituent requirements for planned manufacture may be input as forward demands to the Stock Updating routine. Stock will be allocated for say the next 14 days and any shortages will be reported as back orders.

A forward demand will not be included in the forward demand balance until the due date is within one lead time of the current date; thus very long term forward demands will be recirculated until action is required.

Unallocated demands are any demands due or overdue that cannot be satisfied because the stock is not available and that have been back ordered. Transaction records for back orders are recirculated until enough stock is available for the demands to be met.

Stock on order is the total quantity of the outstanding orders that have been placed to replenish the stock. Orders are automatically requisitioned by the system and are assumed to be placed immediately. Any difference between the size of the order requisitioned and the quantity of stock ordered must be notified to the system as soon as possible.

The total quantity received including rejects is assumed to be the quantity of the order requisitioned. Any rejects returned for replacement or re-work must be notified to the system in an order adjustment or a returns outward transaction.

If more stock is received than the quantity ordered, the order balance may go negative. If the excess quantity is accepted an order adjustment must be entered to correct the order balance unless the excess is credited to a following order. Similarly, if less stock than the quantity ordered is accepted as full satisfaction of an order, an order adjustment must be entered to clear the balance of that order from the order balance in the stock master record.

The group demand accumulator accepts all demands due within one lead time from the current date. The accumulated demand is entered in the Demand History file and the accumulator zeroized at each run of the Forecasting routine.

Similarly the branch demand accumulator accepts all demands due within one lead time from the current date and the accumulator is zeroized every time a forecast is made.

The following are further balances that are accumulated:

1 CUMULATIVE RECEIPTS TO DATE. Receipts are added to this accumulator; returns outwards are subtracted from it. Using this accumulator in conjunction with the scrap balance, the user may analyze his supplier performance.

2 CUMULATIVE SCRAP TO DATE. This is used to accumulate the total scrap reported when goods are received or subsequently discovered.

3 CUMULATIVE DEMAND TO DATE. Demands and unscheduled issues are added to this accumulator; returns inward are subtracted from it.

4 CUMULATIVE BACK ORDERS TO DATE. This is read in conjunction with the cumulative demand and it gives one indication of customer service.

5 RECEIPT COUNT. The receipt count is incremented by one every time a receipt occurs.

6 BACK ORDER COUNT. The back order count is incremented by one every time a quantity is added to the cumulative back order accumulator.

7 NO MOVEMENT COUNT. The no movement count is incremented by one each time the group demand accumulator is transferred to the Demand History file, provided the accumulator is zero.

The seven balances listed above must be zeroized by the user routine that produces the annual stock listing. The balance at any time therefore relates to the last occasion on which the balance was zeroized.

AUTOMATIC ORDERING ROUTINE

This routine carries out similar functions to the Stock Updating and Allocation routine for the special case of branches ordering automatically on the user's own warehouses.

In the non-automatic ordering case, if a branch raises an order to be supplied by the user's own warehouse, a demand transaction is created by the user to cause the amount to be allocated by the warehouse in the usual way. If it is required that the allocation be carried out automatically, the Replenishment Orders file produced by the Stock Updating and Allocation routine should be used as an input file to the Automatic Ordering routine. This routine then allocates stock to these branch orders as if they were demands. Following this allocation, re-order point control and

under minimum/over maximum tests are carried out and records written to the output file if necessary. This processing should therefore be suppressed for warehouse records during normal stock updating by using the appropriate fields on the Stock Updating and Allocation routine parameter record.

UPDATING REPORTS ROUTINE

The Updating Reports routine is used to produce the following listings:

1 The Replenishment Orders report

2 The Stock Under Minimum report

3 The Stock Over Maximum report

4 The Allocation report

Also, any Transactions file record not having marker 0 of the record status set is carried forward to the output Transactions file for re-input to the Stock Updating routine. The types of record having marker 0 unset are:

1 Forward and future demands

2 Forward dated receipts

3 Unprocessed transactions. These arise if the stock updating run has terminated prematurely leaving some transactions unprocessed.

Any due demands or back orders that were unsatisfied in the last stock updating run will be written to the output file as back orders.

The routine will also, if required, write forward dated receipts records to the output Transactions file to correspond with automatically raised branch orders.

This is achieved by using as an input file the input Replenishment Orders file used for the Automatic Ordering routine. The Updating Reports routine is then able to prepare an allocation report and backorder records if necessary by examination of the Quantity 1 and Quantity 2 fields in the order record. Just as in the case of a demand record, Quantity 1 contains the original branch order on the warehouse, and Quantity 2 contains the amount of the order which could not be allocated by the warehouse.

STOCK FORECASTING AND MONITORING ROUTINE

Two basic methods of inventory control are available:

1 Adaptive control with variable re-order points and variable re-order quantities.

2 Fixed re-order points and fixed re-order quantities.

Both these systems may be used with cyclical ordering; if so the order cover will be increased each time to a lead time plus an ordering interval and the order quantity will be set to zero.

In a fixed re-order point system, the fixed re-order points and the fixed re-order quantities will be decided by Management and will be input during file maintenance. For those items selected for adaptive control the Stock Forecasting and Monitoring routine forecasts the demand for the next time period and re-order points and re-order quantities are then re-evaluated using the new forecast.

The re-order point includes the safety stock allowances that has been calculated from the customer service level and the forecast errors experienced. The system order quantity may be based on the demand forecast extrapolated over the ordering interval (taking into consideration seasonal factors if they apply) or it may be an economic order quantity computed to conform to parameters set by Management.

An automatic monitoring feature is included in the system so that some measure of control can be kept over the forecasting efficiency. Monitoring is carried out by calculating a tracking signal from the errors (see Appendix 1, equation 57, page 215). In the case of the Box-Jenkins predictor if the tracking signal falls outside preset limits, emergency control parameters (gamma zero or one) are used. If lagged adaptive response rate forecasting is being used, no such action is necessary because the gamma zero value in use is proportional to the previous periodic tracking signal. Thus the system automatically becomes more responsive if the need arises.

All items held on the Demand History file will automatically collect demand data from the Stock Master file during a run of the Stock Forecasting and Monitoring routine.

If a new forecast results in the re-order points rising to a level equal to or above the available stock level then it may be necessary to run the Stock Updating routine with no Transactions file present so that new replenishment orders can be generated; this will be necessary only if the time before the Stock Updating routine should normally be run

is significant, say a quarter of the ordering interval or of the lead time.

EXTERNAL SYSTEM RELATIONSHIP

The ICL SCAN System 3 provides a framework upon which an integrated commercial data processing system may be developed. Control of stock affects the profitability of a company and the ability of the company to give prompt and efficient service when and where it is needed.

This section and Figures 24 to 27, pages 174 to 179, suggest ways in which the SCAN System 3 input and output can be linked with other commercial areas of a company.

The Stock Updating Reports routine provides a printed report of all order requisitions; these order requisitions will be validated by the Buying department before final purchase orders are printed. Any changes made to the orders must be notified to the system.

Invoicing can be carried out by a user routine using the Transactions file after it has been used for stock updating since at this stage the quantity 2 fields will indicate the degree of non-allocation for each demand and the records will contain standard data overlayed from the Stock Master file.

A typical invoice set consists of:

1 An invoice copy

2 A daybook copy (accounts)

3 A production control copy (progressing order) if appropriate

4 A consignment note copy (sent with the goods to the customer)

5 An advice note copy (sent by post to the customer)

The following information relevant to invoicing is contained in an updated demand record:

1 Customer number and/or code

2 Internal order or batch reference number

3 Date of demand

4 Item number

5 Unit of measure

6 Quantity allocated

7 Quantity unallocated (to follow)

8 Date required

9 Cost price

10 Sales price

11 Purchase tax

12 Discount code

13 Bin location (store reference location)

14 Unit weight

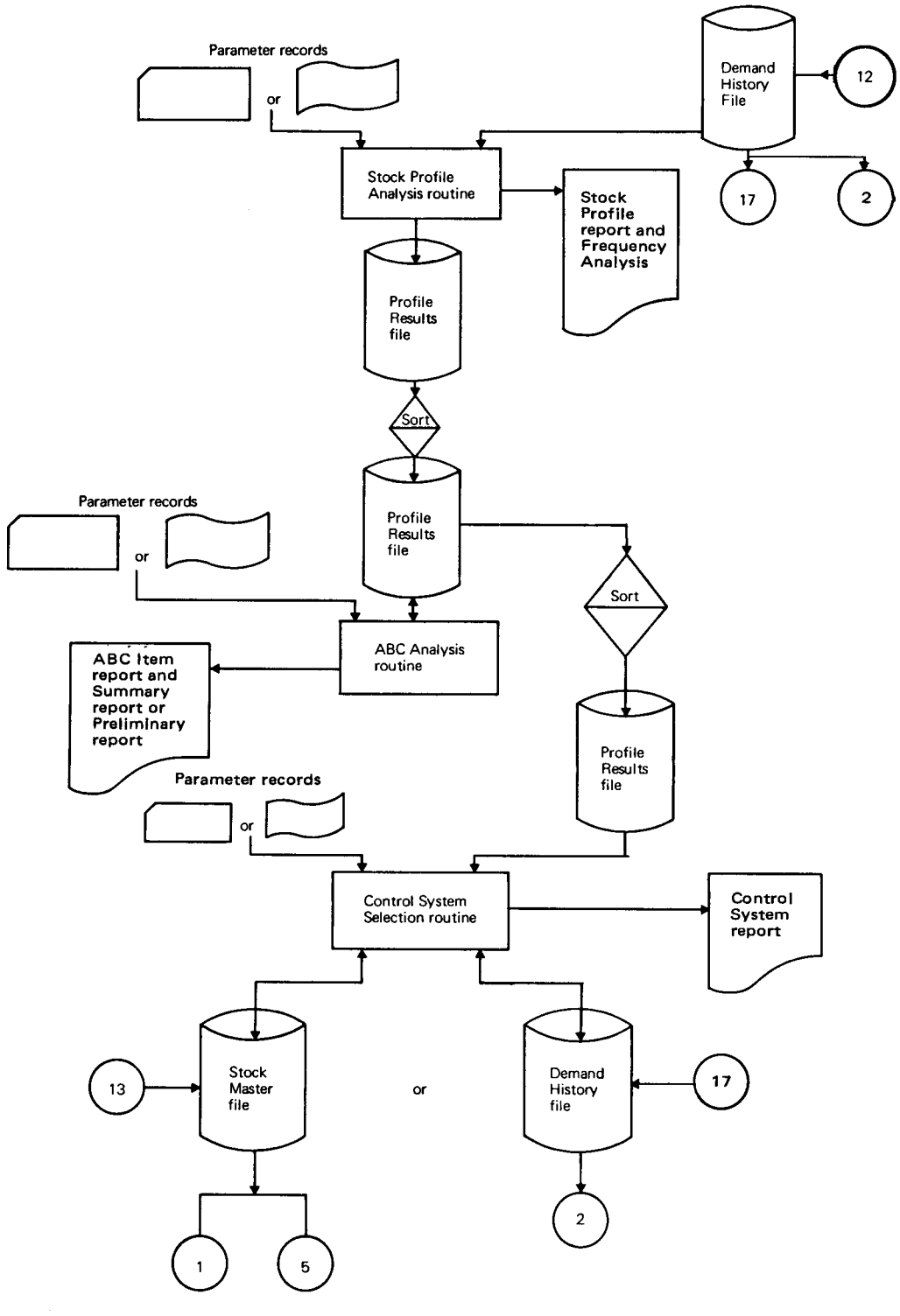


Figure 24 ICL 1900 SCAN System 3 Interrelationship of routines – Analysis

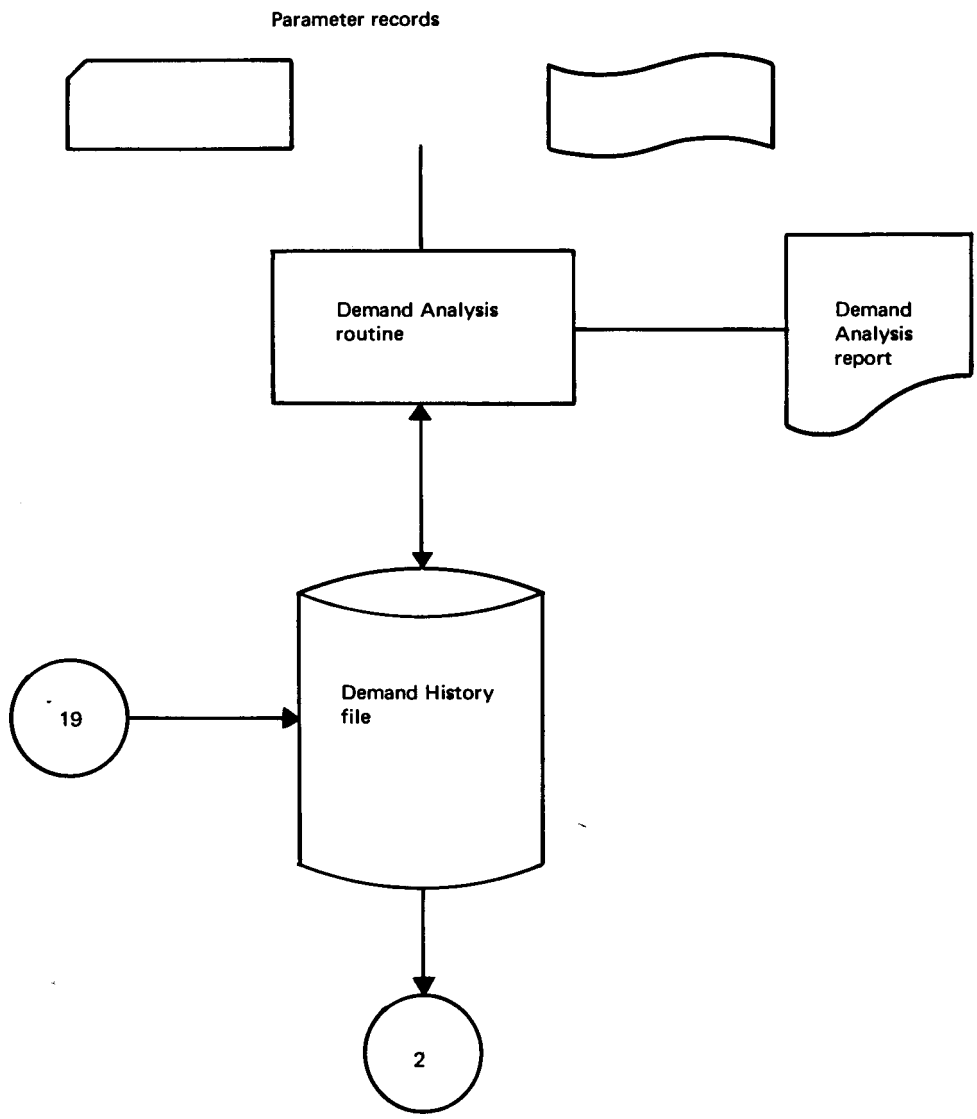


Figure 24 ICL 1900 SCAN System 3 Interrelationship of routines - Analysis (continued)

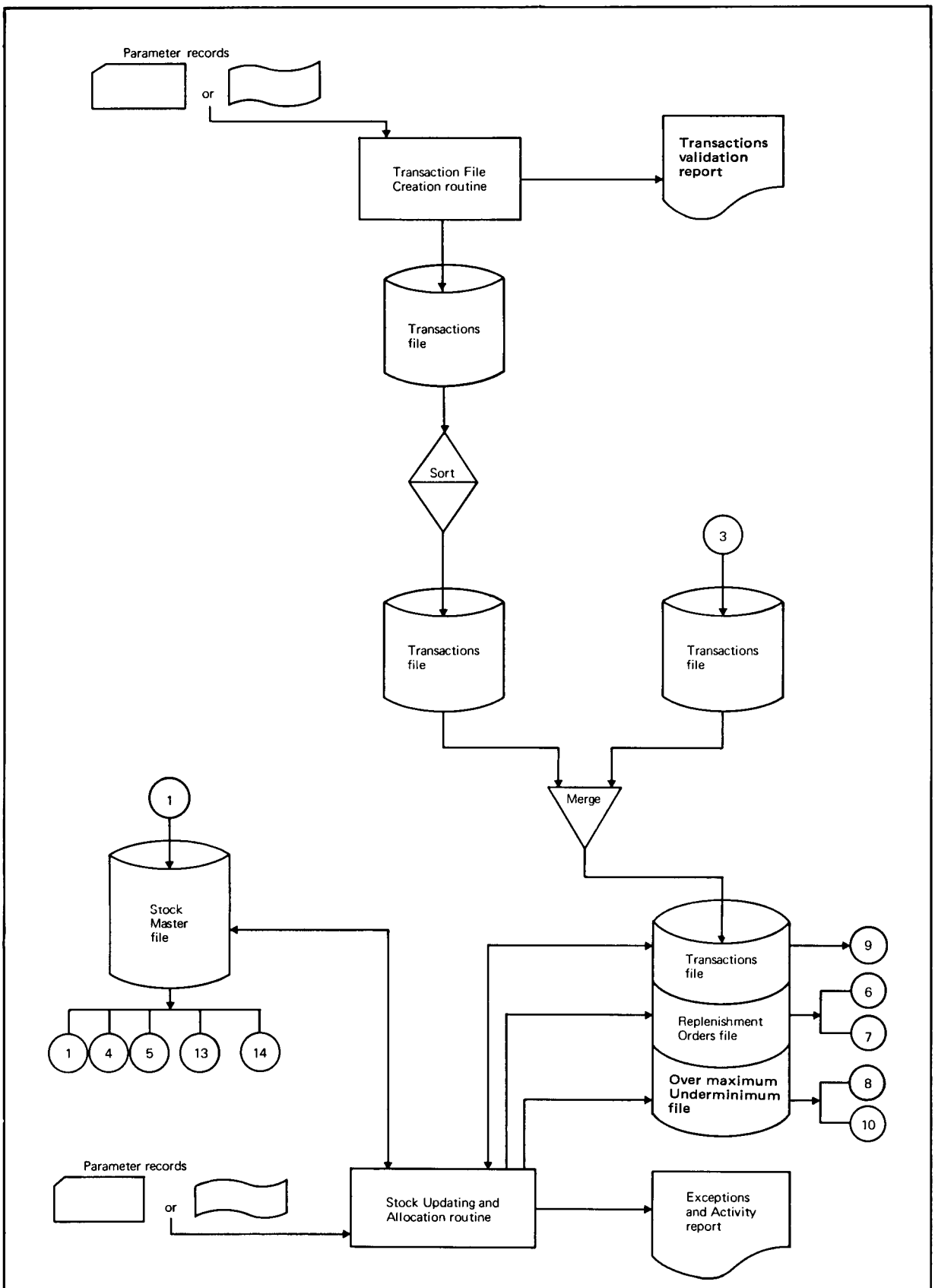


Figure 25 ICL 1900 SCAN System 3 Interrelationship of routines–Transaction file Creation and Stock Updating

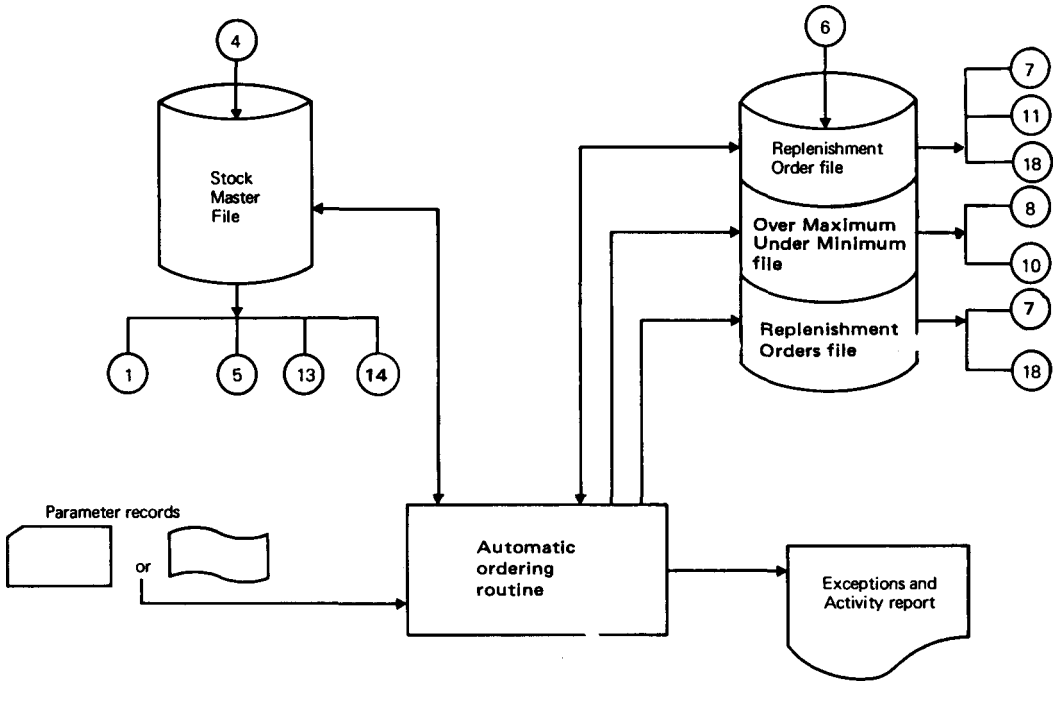


Figure 25 ICL 1900 SCAN System 3 Interrelationship of routines. – Transaction file Creation and Stock Updating (continued)

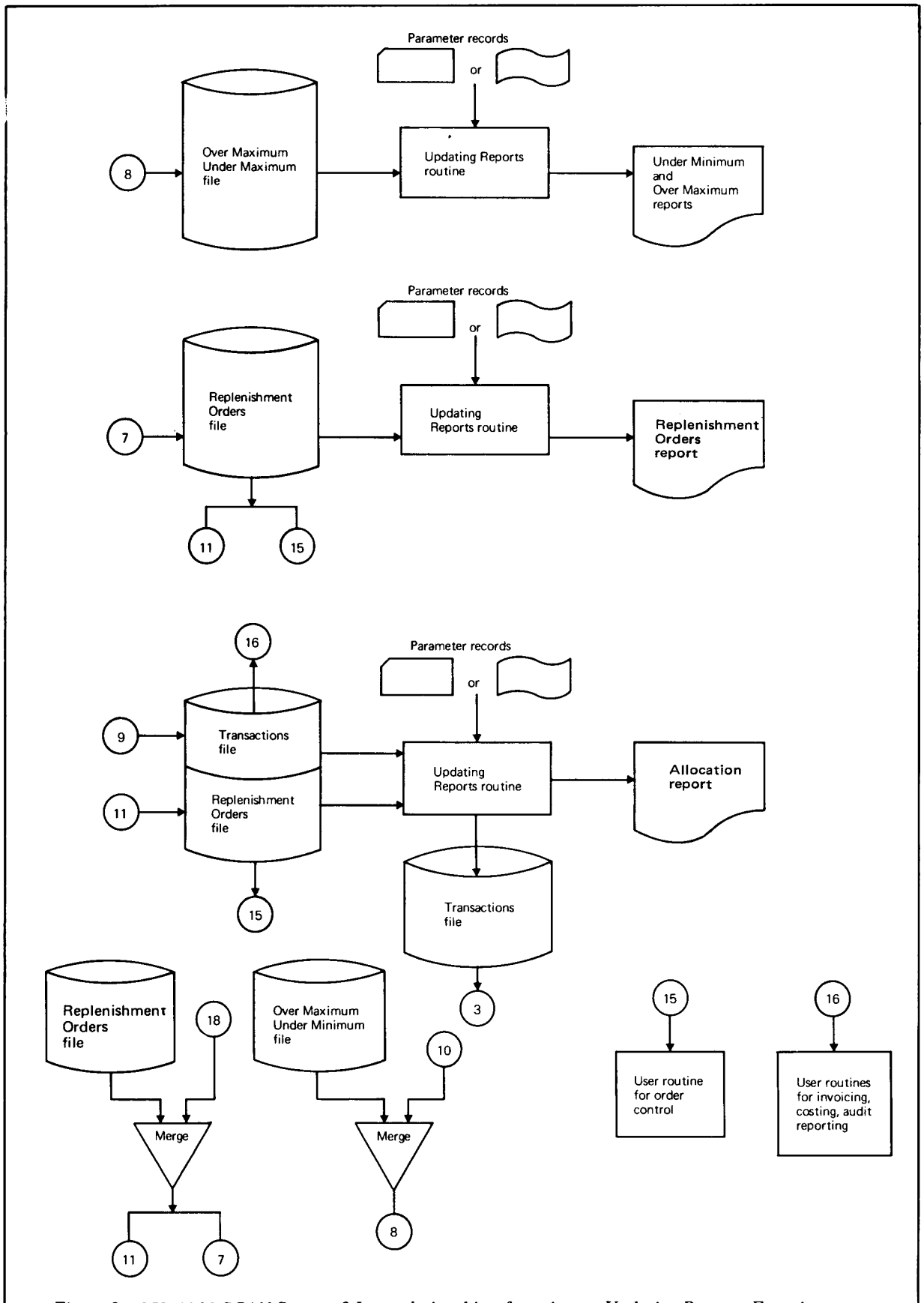


Figure 26 ICL 1900 SCAN System 3 Interrelationship of routines – Updating Reports Function

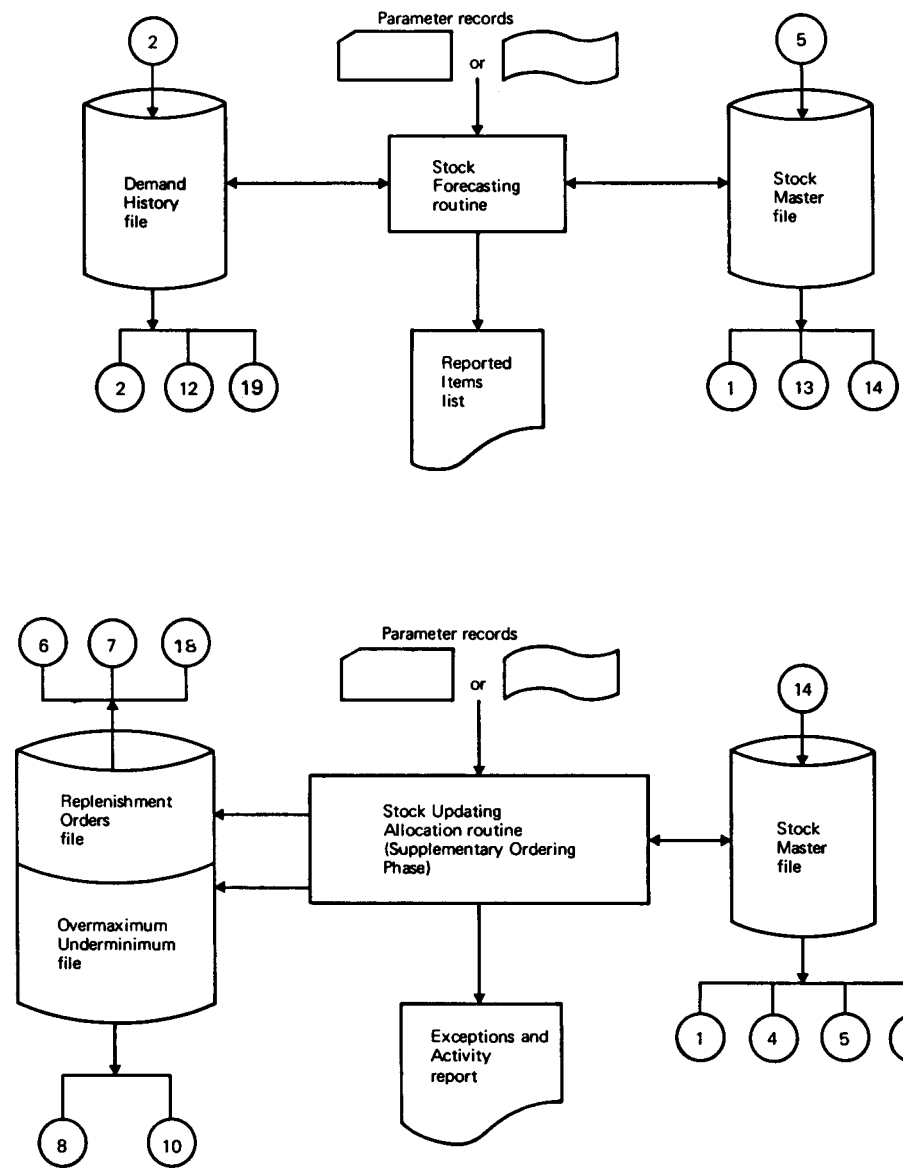


Figure 27
ICL 1900 SCAN System 3 Interrelationship of routines – Stock Forecasting and Supplementary Ordering

A demand (transaction code 21) would be processed to provide an invoice. An unscheduled issue (transaction code 15) may require an invoice. A returns inwards (transaction code 17) would be processed to provide a credit note.

All the types of transaction mentioned above will be present on the Transactions file after stock updating. There are several ways in which the file may be sorted before it is processed.

1 A straightforward invoice or credit note procedure normally requires that the file is sorted into customer number/item number/transaction code. The file would be matched against a customer master file containing the names and addresses, credit control details, special discount terms etc. Invoice sets would be prepared and an output file containing credit note details and invoice records would be written.

   When invoicing is completed the credit note file would be matched against the Customer Master file for the credit notes to be printed.

2 The unit weights together with the quantities may be used in conjunction with the route numbers held on the Customer Master file to schedule deliveries and vehicles (by user routine).

   The easiest way of carrying out the above would be to print the credit notes first and to produce an output file containing extended invoices together with the transport route numbers. This file would then be sorted by transport route number and the invoice sets printed. At the same time, the total weights could be aggregated in approximate vehicle loads.

The development of sales statistics depends entirely on the needs of the user but generally falls within two broad classifications.

1 Customer sales statistics which might reflect year-to-date (YTD) sales in total and/or by department including percentage changes in the previous year's performance. Another useful measure is customer sales and profit to company by product group as monthly and YTD figures, with perhaps a comparison with last year's corresponding figures.

2 Product statistics which reflect sales by product including number of times sold, bought, balance, profit, interest on stock value etc.

Either the Transaction files or the Invoice files or both types of file will be used.

Note: The information given above is intended only to suggest how the SCAN System 3 may be linked with other commercial routines. Individual circumstances will determine the complexity of invoicing, sales analysis, production scheduling purchase control, credit control and other related routines.

Monitoring of forecasting

The monitoring that is carried out on forecasts will detect excessive errors between predicted demands and actual demands at group level and will output details of such errors. Excessive errors may be caused by one of the following:

1 Large orders that differ substantially in size from the demands recorded in the original demand history used to derive control factors. Large demands such as these may be infrequent; If a large order is expected then a dummy product should be set up outside the control system and stocks should be built up separately so that normal demands for an item are not influenced. If the large order was not expected then it is too late for stocks to be built up and the tracking signal limits are exceeded.

   When an unusually large demand has occurred, Management must determine whether or not there is a likelihood that such a demand will occur again and if so, the safety stock must be set at a higher level to help cope with the situation. If there is no likelihood that such a demand will occur again, the control factors may be left unchanged.

2 A combination of two or more products causing changes in the market demand pattern for each individually. For the purposes of analysis, each could be regarded as a new product.

3 Marketing activity causing erratic trends in the demand pattern not present in the original demand history.

Both 2 and 3 above may mean that items have to be removed from the control system so that tighter manual

control can be exercised until the demand stabilizes; then, analysis can be carried out before the items are again included in the system.

The run parameters for the Forecast routine include the provision of user specifiable emergency control parameters for use with the Box-Jenkins one or two point predictor when excessive forecast errors occur. If forecasting using single exponential smoothing (one point predictor) is being used then the emergency parameter will, if it is larger than the present value, overwrite the value being used for gamma zero. A suitable emergency value for gamma zero would be 0.5 but any value less than 1 may be used. If forecasting using the two point Box-Jenkins equation is being used, the emergency parameter will be used if the main file value for gamma one is zero. A suitable emergency value would be 0.3 but any value less than 1 may be used.

For both types of forecasting, use of the emergency value will make the forecasting equation become more responsive and thus adapt to changed conditions more quickly. The emergency parameter would therefore remain in use until the forecast had stabilized at the new demand level and the errors had decreased to acceptable limits or alternatively until Management intervened. Emergency parameters are not required if lagged adaptive responsive rate forecasting is selected.

Other reports that the user may wish to include in the operational routines are:

1 Notification of items not previously included in the control system but which have an increased demand frequency such that the items should now be included.

2 Notification of items included in the system that are now in the slow moving category. This notification can be obtained by using the non-move count in the Stock Master file and either by writing a segment in the Stock Forecasting routine to produce the report or by writing a separate program.

3 As an extension of 2 above, the non-move count could be accessed by a user program to produce a static inventories list.

FREQUENCY OF PROCESSING

Analytical routines

If demand history data is available for analysis, the analytical routines will be used at least once to derive initial values for the control factors.

Subsequently the routines may be used by Management for review purposes or to establish new control factors for:

1 New items (where demand history is available).

2 Items previously excluded from the control system.

3 Items included in the control system whose control factors are no longer valid because of changes in the demand pattern causing excessive forecast errors.

Operational routines

Frequency of use of the operational routines is entirely the user's responsibility but the Stock Updating routine must be run at least as often as the Stock Forecasting routine.

If demand data is to be aggregated weekly and the recommended minimum forecast interval is one, the Stock Forecasting routine should be used weekly and the Stock Updating routine run possibly daily. The user may prefer, because of data collection and preparation problems, to use the Stock Forecasting routine once a month and to update stock balances weekly. In this situation, demand data would be aggregated on a monthly basis thus allowing time for data communication from remote warehouses, stores etc. to a centralized computer.

In general, the response to monthly forecasting is not as good as the response to weekly forecasting. However, monthly demand data will be more uniform than weekly demand data and therefore may lead to more uniform sized orders on a supplier or on a production line where items can be manufactured in batches.

OPERATIONAL CONTROL

The ICL SCAN System 3 may produce up to eight schedules:

1 Transactions validation report

2 Stock Updating Exceptions report

3 Stock Activity report

4 Replenishment Orders report

5 Allocation report

6 Stock Under Minimum report

7 Stock Over Maximum report

8 Reported Items list

Transactions Validation report

The Transactions Validation report is produced each time the Transaction file is created.

Items that are in error are denoted by an error code printed below the first field in error. If required, batch control totals computed on the transaction codes and on both quantity fields will also be listed.

Stock Updating Exceptions report

The Stock Updating Exceptions report lists two kinds of information:

1 Types of invalid transaction that are not detectable by the Transaction File Creation routine

2 Exceptional balance conditions (for example, negative stock balance)

Stock Activity report

The Stock Activity report is punched during the stock updating run; it summarizes all transactions in terms of opening, processed and closing balances by value at standard cost price.

Replenishment Orders report

The Replenishment Orders report is produced by the Updating Reports routine and is a request to the user to place a replenishment order for a specified minimum quantity; it also provides the information necessary for validation by the Buying department before they proceed with ordering. In general, all the order-requisition files produced by the Stock Updating routine must be merged, sorted and updated if necessary before the Purchase Order Control routine (written by the user) is run.

The *load index* has two uses:

1 If the set-up time field in the stock master item record has a value other than zero the load index expresses the total time required to set-up and manufacture the replenishment order, (the order quantity multiplied by the unit time, plus the set-up time).

2 If the set-up time field has value zero and unit weight or unit volume is entered instead of unit time, the load index expresses the total weight or volume of the replenishment order.

Allocation report

The Allocation report is produced during a run of the Update Reports routine; it lists all demands allocated during the previous run of the Stock Updating and Allocation routine. The list also includes the amount unallocated, if any.

Stock Under Minimum report

The records from which this report is printed are produced optionally by the Stock Updating routine. The report contains a list of all items for which the physical stock minus the back orders is less than the lower stock limit specified by Management. An additional test establishes whether or not the available stock (stock balance plus order balance less back orders balance) is greater than the forward demand balance. This report might serve as a progress document and be used in conjunction with a list of individual orders placed during the Purchase Order routines runs.

Stock Over Maximum report

The records from which this report is printed are produced optionally by the Stock Updating routine. The maximum stock level set by Management may represent a maximum financial limit to the physical stock or the stock quantity representing a fixed warehouse area limit. But, however the limit is set, if the physical stock exceeds the maximum level a report will be produced.

Reported Items list

The Reported Items list is produced by the Stock Forecasting routine. It lists the items under adaptive control for which the errors between the predicted demands and the actual demands exceed preset limits. The report can not give the reason for the large error; Management must investigate to discover the reason and must decide what action is to be taken.

The user has the option of requesting this report for all items forecasted. Such listings may be of particular use during the initial stages of running the system when the performance of the system is being evaluated.

PARALLEL RUN

It is recommended that before the SCAN System is used to control stocks, a pilot system should be run alongside the existing system for a period of time long enough to allow:

1 Control factors and computed demand forecasts, re-order points, re-order quantities etc. to become realistic.

2 Personnel to become familiar with the necessary procedures and with the system.

3 Any errors to be eliminated from the user's programs before the results are accepted as being valid

4 The monitoring procedure to detect obviously incorrect choices of prediction parameters.

The length of time required to achieve all the above could be as great as twenty weeks, depending on the difficulties encountered.

Use of a control system for an inventory could result in a reduction in stock holding value of 30% or more; also, the major part of the control activity will be reduced to a machine function thus giving Management more time to solve the problems of controlling the slow moving items.

If a more detailed study of the action of the system is to be made, the System Simulator (see Chapters 8 to 10) may be used. The simulation program is particularly valuable for studying the control response for selected very important items in the inventory.

INITIALIZING THE SYSTEM

The recommended method of initializing the system is to enter the Stock Forecasting routine with a special initializing marker set by run parameter, immediately after analysis has been carried out. The Stock Forecasting routine then calculates initial values of the re-order point and the re-order quantity without transferring any information to the Demand History file. A similar procedure can be followed if the user has initialized his own Demand History file (see *Basic data*, note 2 page 167) without using the Analysis routines.

Alternatively, the Stock Updating routine and associated routines can be run at the required frequency and the Stock Forecasting routine can be entered in the usual way. If this is done then the user must specify re-order points and re-order quantities and must enter them in the stock master records, to ensure that stock control will be effective until the first forecast is made.

When the first forecast run occurs, the user specified values for items with forecast intervals of one will be overwritten by system values. The values for slower moving items will be overwritten in subsequent forecast runs when these items are forecast for the first time.

Chapter 7 Joint replenishment

All the information relating to the SCAN System 3 joint replenishment programs has been assembled in this chapter.

JOINT REPLENISHMENT DISCUSSION

In many types of business it is the policy of the supplier to offer discounts which are dependent on the size of the order being placed. The discount may be offered for individual items as in the forecasting routine, or alternatively on the total order size when the order consists of a mixture of different items. It is the latter case which is particularly relevant in the context of joint replenishment. The size of the order may be measured in many ways; the more common units being value, volume, weight, points or number of cartons.

Normally the orders generated for individual items are a function of the rate of demand or of the order economics for the item. The purpose of joint replenishment is to consider the economics of joint ordering, by selectively grouping these order records by lead time or ordering warehouse. The order quantities of these selected orders, expressed in the relevant terms of measurement, must be examined and compared with the levels at which the different discounts apply.

As a result of this examination it may be found advantageous, in order to obtain a particular discount, to increase the order size up to the level at which that discount is offered.

There are basically two ways in which this increase can be effected. Either the size of existing orders can be increased or additional orders can be produced for those items for which the available stock is close to, but not yet at, its reorder point.

JOINT REPLENISHMENT ROUTINE (#X43H)

Objectives

The objectives of the Joint Replenishment routine are as follows:

1 To extract from the Stock Master file records of those items which may be used to increase the total order quantity for each supplier in order to take advantage of the discounts offered

2 To optimise the total order quantity of mixed items being ordered from each supplier based on supplier discounts

3 To optimise the total order quantity of mixed items being ordered from each supplier based on carrier discounts

4 To generate a card image transactions file containing order balance adjustment records

5 To provide a Joint Replenishment Report giving a summary of the order quantities for each supplier

The objectives of the Joint Replenishment routine are completely achieved by performing a maximum of four runs. These runs are indicated by a run parameter and are as follows:

Run 0: Extraction Run

Run 1: Supplier Discount Optimisation without regard to lead time

Run 2: Supplier Discount Optimisation with regard to lead time

Run 3: Carrier Discount Optimisation with regard to lead time

The Extraction Run is not directly concerned with discount Optimisation, and is optional. This run will be more fully discussed later (see page 186.2).

Run 1 is intended to perform supplier discount optimisation for items which may be ordered together but need not necessarily be delivered together. In this case there is no requirement to group together items with the same lead time.

Run 2 is intended to perform the same optimisation but on items which must be delivered together, that is having the same lead time.

In run 3 the economics of exactly filling transport containers are examined, and the carrier discount optimisation is based on the fact that the goods which have been used to fill the required number of containers are delivered together. It is important, therefore, that lead time is used as part of the key in the sequencing of records.

The possible variations of discount offered may be as follows:

SUPPLIER A Supplier discount without regard to lead time and carrier discount with regard to lead time

SUPPLIER B Supplier discount with regard to lead time and carrier discount with regard to lead time

SUPPLIER C Supplier discount without regard to lead time

SUPPLIER D Supplier discount with regard to lead time

SUPPLIER E Carrier discount with regard to lead time

In a large organisation there may be suppliers of all the above types. It will be necessary, in this situation, to perform:

Run 1 for suppliers of type A and C, and

Run 2 for suppliers of type B and D, and

Run 3 for suppliers of type A and B and E.

In a situation where only one or two of the supplier types are present it will be necessary to perform only the appropriate runs.

A record of one supplier may be processed in either Run 1 or Run 2 or Run 3, or may be processed in Run 1 or Run 2 and Run 3.

Security procedure

The Extraction Run of joint replenishment adds records to the Replenishment Orders File. This file is called REPLENORDERS.

Subsequent runs of the Joint Replenishment routine will accept as input a sorted Replenishment Orders File called SDREPLENORDS.

Normally, this file will be output with the same name, that is, SDREPLENORDS. If, however, it is required to examine the file using the Updating Reports routine it is necessary to set the appropriate run parameters, which will cause the file to be output with its name changed to REPLENORDERS.

It is recommended that the original REPLENORDERS file be retained until successful completion of all the required runs of the Joint Replenishment routine.

Output card image transactions file

This file will be produced during the run in which the last run indicator is set. It will contain records in transaction card image format. The transaction records will be type 12, that is stock balance/order balance adjustment and will contain in the quantity 2 field, the adjustment necessary to the Stock Master order balance caused by joint replenishment pallet rounding, that is filling an exact number of pallets with no wasted space, and discount optimisation. The name of this file will be TRCARDIMAGES.

Joint replenishment optimisation will only be performed on warehouse records. These records will be identified by the character ← in the left hand character position of group code.

Printing

The printout of the individual item information shown in Figure 27.3 on page 186.8 is produced for each record unless printing is suppressed by the appropriate run parameter.

In the case where the maximum order quantity has been exceeded the excess amount will be shown in the relevant columns.

The *optimising field* will be that used to obtain optimisation and is indicated by the discount type indicators on the supplier file. The name of this field will be COPR if optimisation is by cost, UWTV if optimisation is by volume, weight or points, and blank if optimisation is by number of cartons. The corresponding value will either be that contained in COPR or UWTV multiplied by the conversion factor, or equal to one.

For all order quantities measurement is given in receipt units and also optimising units. The latter units are calculated by multiplying receipt units by the value contained in the optimising field.

Terminating each grouping of records will be a summary. The full range of summaries is shown in Figure27.3 on page 186.8. For each grouping of records, however, only those messages which are applicable will be used.

Status items

A status item is one for which the order quantity raised by stock updating cannot be cancelled by joint replenishment. A non status item is one for which the order quantity raised by stock updating will be cancelled by joint replenishment unless an order for a status item for the supplier exists on the Replenishment Orders file at the same time. Status items have a class code which is not greater than the status indicator on the run parameter record.

Last run processing

The purpose of last run processing is firstly, to place in the order quantity 1 field of the replenishment order record the final amount to be ordered, after all adjustments have been made during the Joint Replenishment routine. Secondly, this processing outputs a transactions record containing in its quantity 2 field the adjustment necessary to the Stock Master order balance.

The type of last run processing carried out for an item depends on the value of marker 10 of the order record function markers.

If marker 10 is zero, this indicates that joint replenishment may have increased the order quantity and last run processing type 1 is required, possibly to produce a positive adjustment to the order balance for the item.

If marker 10 is one, this indicates that joint replenishment requires to cancel the original order quantity, and last run processing type 2 is required to produce a negative adjustment to the order balance for the item. This situation arises if the first order in a grouping of orders being placed on a supplier is not for a status item.

LAST RUN PROCESSING TYPE 1

The order quantity 2 field of the replenishment order record is examined and if found to contain zero, no further processing is performed on the record. If the contents are greater than zero, they are added to order quantity 1 but the order quantity 2 field is left unchanged.

An output record is written to the transactions file TRCARDIMAGES. The record contains in its quantity 2 field an amount equal to the quantity of the order record's order quantity 2 field multiplied by the conversion factor.

LAST RUN PROCESSING TYPE 2

The contents of order quantity 1 are copied into order quantity 2 and the order quantity 1 field is zeroised.

An output record is written to the transaction file TRCARDIMAGES, containing in its quantity 2 field a negative quantity, equal in magnitude to the quantity of the order record's order quantity 2 field multiplied by the conversion factor.

Joint replenishment optimizing factor

SUPPLIER PROCESSING

During supplier processing two factors are used, the optimizing factor and the rounding factor, whose values depend on the setting of the Supplier Discount Indicator.

Value of supplier discount indicator	*Value of the optimizing factor*	*Value of the rounding factor*
0	Cost price x conversion factor	Unit weight, time, volume x conversion factor
1	Unit weight, time, volume x conversion factor	Unit weight, time, volume x conversion factor
2	Unit weight, time, volume x conversion factor	Unit weight, time, volume x conversion factor

Value of supplier discount indicator	*Value of the optimizing factor*	*Value of the rounding factor*
3	Unit weight, time, volume x conversion factor	Unit weight, time, volume x conversion factor
4	1.0	1.0

The order quantity is expressed in optimizing units by multiplying the individual order quantities by their respective optimizing factors. This provides an order quantity which is expressed in the same terms as the supplier discounts.

If pallet rounding is specified, the individual order quantities are expressed in rounding factors. These order quantities are then increased, if necessary, to ensure that they are an integer multiple of the pallet size for the supplier.

CARRIER PROCESSING

During carrier processing the two factors are again calculated. In this case they are both equal to 1.0 if the supplier discount indicator is 4; otherwise they are both equal to unit weight, time, volume x conversion factor.

Systems philosophy

The objectives of the Joint Replenishment routine have been stated on page 185. The action of the routine may result in increases being made to the order quantities of the item on the Replenishment Orders File. In order to give the user full control of the order quantities, the original order quantity produced by either the Stock Updating and Allocation routine or by the Automatic Ordering routine is held in the order quantity 1 field of the record until last run processing is performed. All adjustments due to optimisation and rounding are placed in the order quantity 2 field. Only during last run processing are the contents of the order quantity 2 field added back into the order quantity 1 field. The order quantity 2 field remains unchanged.

The above philosophy allows the user to stop processing after any of the runs of the routine and still be in a position to investigate the adjustments made to the order records during the run.

Extraction run – run 0

OBJECTIVE

To extract from the Stock Master file, records of those items which may be used to increase the total order quantity for each supplier in order to take advantage of the discounts offered.

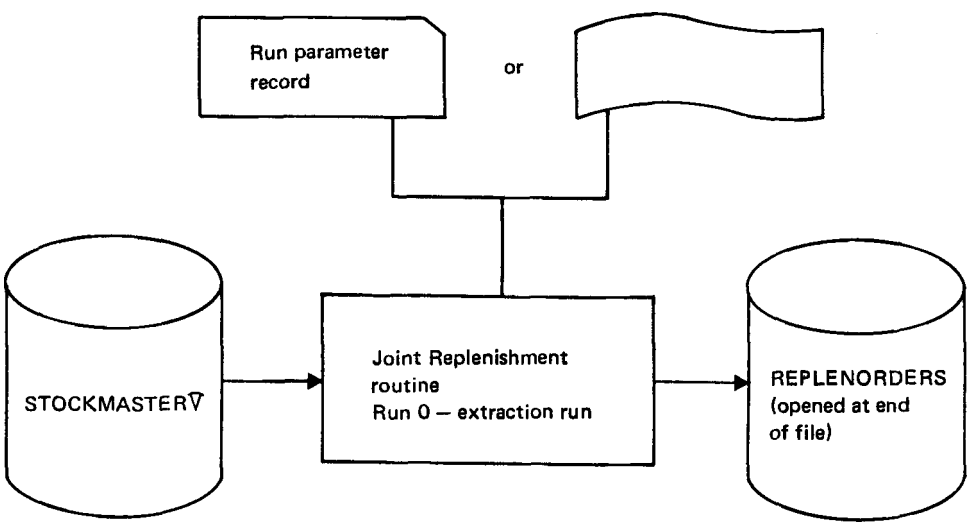


Figure 27.1 System flowchart – extraction run

INPUT

1 Stock Master Disc file (see page 83)

2 Parameter record (punched into cards or paper tape)

This record specifies the files to be used by the run, the run type and the selection indicator chosen by the user

PROCESSING

In order to take full advantage of the discounts offered by the supplier or carrier, it may be necessary to increase the total order size to a quantity greater than the total of the order quantities contained in the order records, produced by either the Stock Updating and Allocation routine or the Automatic Ordering routine. This increase may be achieved in one of two ways. Either the existing orders can be increased, or additional items, not yet at their reorder point, can be ordered early.

If the latter case is chosen information concerning these early ordering items must be extracted from the Stock Master File. This will be done using the Extraction Run of the Joint Replenishment routine. The criteria on which the extraction is made are as follows:

1 The item must have a group code containing the character ← in the left hand character position

2 The system marker of the item must be 1, 2 or 3, that is the item must be a forecast item and must be for random ordering

3 Function marker 3 must be equal to 1, that is it must be possible to include this item in joint replenishment optimisation

4 Function marker 4 must be equal to 0, that is it must be possible to increase the order cover of this item

5 The length of time that the available stock will last, at the current rate of consumption, before the reorder point is reached must be less than or equal to a user specified parameter, viz the selection indicator. The time period is calculated as a fractional quantity in terms of the basic time period of the system

If all these conditions are satisfied a record is written to the end of the current Replenishment Orders File. The record is similar in appearance to the normal one branch order record but is given a record type of 50.

The result of the calculation to determine the length of time that the available stock will last before the reorder point is reached is written to the order quantity 2 field of the record and is expressed in tenths, that is a value of 10.6 basic time periods is written as 106; the purpose being to retain the field type as integer for subsequent processing.

The value which is written to the order quantity 1 field is the result of a comparison, with each value expressed in receipt units, between the Stock Master record order quantity, the minimum order quantity and the maximum order quantity.

OUTPUT

Replenishment Orders disc file. This file contains the original order records together with the type 50 records placed there during this run.

Supplier discount optimisation – run 1 and run 2

OBJECTIVES

1 To optimise the total order quantity of mixed items being ordered from each supplier based on supplier discounts

2 To generate a card image transactions file containing order balance adjustment records (optional)

3 To provide a Joint Replenishment Report giving a summary of the order quantities for each supplier

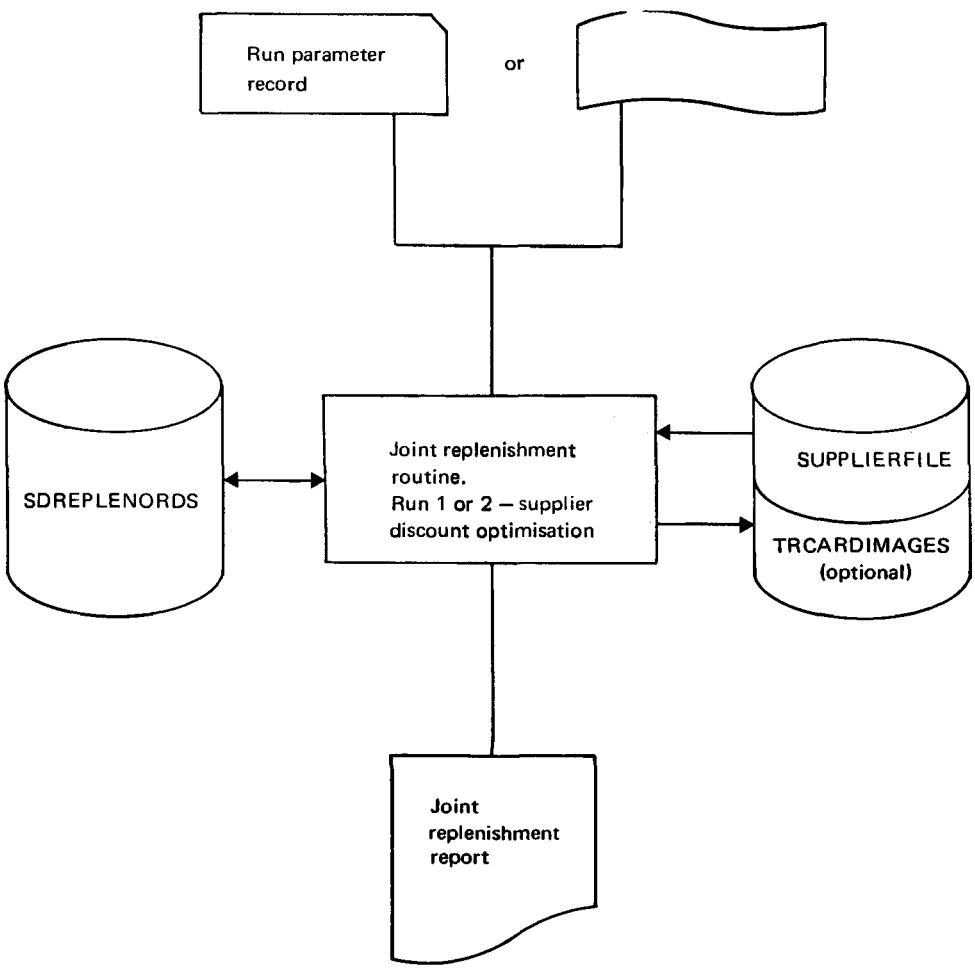


Figure 27.2 System flowchart – supplier discount optimisation

INPUT

1 Overlay Replenishment Orders disc File (see page 109)

2 Supplier disc file

3 Run parameter record (punched into cards or paper tape). This record specifies the files to be used by the run. The pallet rounding indicator and investment rates are also contained on this record for use during this run

PROCESSING

The purpose of this run is to increase the total order size to be placed on each supplier, if, by doing so, greater economy can be achieved. The criterion used in the choice of discount level is minimum total annual cost.

The following description covers the processing which takes place in both run 1 and run 2. In run 1 where processing is without regard to lead time the sequence of the sorted Replenishment Orders File will be:

Supplier code (ascending)

Group code (ascending)

Record type (ascending)

Expected time before reorder point is reached (ascending)

Class code (ascending)

In run 2 where processing is with regard to lead time the sequence of the file will be:

Supplier code (ascending)

Group code (ascending)

Lead time (ascending)

Record type (ascending)

Expected time before reorder point is reached (ascending)

Class code (ascending)

Processing is performed on groupings of records having the same key. For run 1 this key consists of supplier code and group code and for run 2, supplier code, group code and lead time. Within this key there may be present, in sequence, type 30 records, type 31 records and type 50 records. In this routine no processing will take place on the type 31 records and they will be ignored when met.

The decision to process any particular grouping of records depends firstly on the setting of the processing markers in the particular supplier record in the supplier file. The setting of these markers must indicate that optimisation may be attempted in this particular run.

Secondly the first record within the grouping must be a type 30 and the class code of this type 30 record must be less than or equal to the status indicator on the run parameter record.

Items satisfying this condition are called status items (see page 186.1). If both the above points are satisfied optimisation is attempted.

The type 30 records present on the file can be divided into three main groups:

1 Those items for which total annual cost cannot be calculated. These will be non-forecast items or items which are controlled under the bulk-ordering system

2 Those items for which total annual cost can be calculated, but whose order cover cannot be increased (function marker 4 = 1)

3 Those items for which total annual cost can be calculated and whose order cover can be increased

The discount levels on the supplier file may be measured in terms of value, weight, points or number of cartons, the actual measure being indicated by the discount type indicator. In order that a direct comparison may be made it is necessary to convert the order quantities of the order records into the same terms by applying an optimising factor. This optimising factor is calculated by multiplying the contents of the appropriate field (that is cost price or unit weight, time or volume) by the conversion factor (see table on page 186.1).

The pallet size on the supplier file is expressed either in the same terms as the unit weight, time , volume field on the order record or directly in number of cartons. In order that rounding to pallet size can be performed a rounding factor is calculated by multiplying the appropriate field's contents by the conversion factor.

Each type 30 record is processed. Rounding to an integer number of pallets occurs if required, and any increase in order size due to rounding placed in the order quantity 2 field. The total order quantities, in optimising terms, are accumulated separately for each of the three groups of records.

Processing then takes place either working with one fixed level of discount or with several of the levels.

Fixed level processing

The fixed discount indicator on the supplier file shows if only one of the levels of the discount structure is to be used. The chosen level is considered to be a minimum order quantity and either this fixed level or the original accumulated order quantity is ordered, depending on which is larger.

If the original accumulated order quantity is the greater no further processing is required other than to check the last run marker and, if set, to perform last run processing on each type 30 record.

If the fixed discount level is the greater, the order size is increased to this level by either increasing the order quantities of the existing order records, or if type 50 records are present, by incorporating the order quantities of these type 50 records.

1 TYPE 30 RECORDS ONLY: If only type 30 records are present it is necessary to increase the order quantities of these records for which the order cover can be increased. A suitable factor is calculated and applied to the appropriate records. Rounding to pallet size is performed, if required, and the necessary adjustments made to the order quantity 2 field. If the last run marker is set, last run processing is carried out for every record.

   All adjustments multiplied by the optimising factor are added to the original total accumulated order quantity. After each adjustment to a record has been made, the accumulated order quantity is compared with the level being aimed at, and if found to be equal to or greater than this level, the application of the factor ceases. If the last run marker is set, last run processing only is performed on the remaining type 30 order records, otherwise processing passes to the next grouping of records.

2 TYPE 30 AND TYPE 50 RECORDS: In this case use is made of the type 50 records present. For each type 50 record the quantity contained in the order quantity 1 field is copied into the order quantity 2 field, thus overwriting the time period contained there. The order quantity 1 field is zeroised. Rounding to pallet size is done if required, the necessary changes being made to the order quantity 2 field, and the record type being changed from 50 to 30. If the last run marker is set, last run processing is performed.

   The total order quantity (that is the contents of the order quantity 2 field) multiplied by the optimising factor is added to the original total accumulated order quantity and after the processing of each record this accumulation is compared with the level being aimed at. When this level is reached or passed inclusion of the order quantities of the type 50 records ceases, no more type 50 records are processed and processing passes to the next grouping of records.

Multi-level processing

The discount level into which the accumulated order quantity of the original type 30 record fits is established by searching the supplier discount structure on the supplier record. The range of discount levels to be processed is also established by examination of the appropriate field in the supplier record. In order that optimisation can be attempted it is necessary to examine the file for the presence of type 50 records within the key range being processed.

1 TYPE 30 RECORDS ONLY: If only type 30 records are present, optimisation is attempted by increasing the order quantities of those records for which the order cover can be increased. A suitable factor is calculated for each of the discount levels indicated. These factors are then used, with their corresponding discounts, to calculate the total annual cost of the type 30 records at each of the levels. This processing commences at the first type 30 record within the key range being processed. The accumulated total annual costs for each level of all type 30 records are stored separately. On completion of processing of all type 30 records the minimum accumulated total annual cost is established together with the factor used to calculate this minimum cost.

   If the minimum accumulated annual cost is given by the original order quantities, no further processing is done other than to test the last run marker. If this is set last run processing must be performed on all type 30 records.

   For any other value of minimum accumulated annual cost, it will be necessary to apply the factor associated with this minimum cost to the order quantities of those records for which the order cover can be increased. Rounding to pallet size is performed if required and the new order quantity is compared with the maximum order quantity, and the smaller is used subsequently.If the new order quantity is the greater the amount by which maximum order size is exceeded is indicated on the Joint Replenishment Report. The necessary adjustments are then made to the order quantity 2 field. If the last run marker is set, last run processing is carried out for every record.

   All adjustments multiplied by the optimising factor are added to the original total accumulated order quantity. After each adjustment to a record has been made the accumulated order quantity is compared with the level being aimed at and, if found to be equal to or greater than this level, the application of the factor ceases. If the last run marker is set, last run processing only is performed on the remaining type 30 order records, otherwise processing passes to the next grouping of records.

2 TYPE 30 AND TYPE 50 RECORDS: If type 50 records are present on the file for this key range, any increase necessary in the accumulated order quantity can be made by incorporating the order quantities of these type 50 records.

The total annual cost of the type 30 records is calculated using the discount for each of the levels to be processed. This processing commences at the first type 30 record within the key range being processed. After each type 30 record is processed the last run marker is tested and, if set, last run processing is performed. The accumulated total annual costs for each level of all type 30 records are stored separately. This processing continues through to the type 50 records, the key of the first type 50 record is stored for future reference, and the calculation of total annual cost is performed and stored in the appropriate accumulation. The order quantity of each type 50 record is rounded to pallet size if required, multiplied by the optimising factor and added to the original accumulated order quantity. No adjustment is made to the order quantity 2 field of the record at this stage.

As the accumulated order quantity reaches or passes each discount level the calculation and accumulation of the total annual cost associated with that level ceases. When the first order quantity level is reached (that is the accumulated order quantity given by the original type 30 records) the accumulated total annual cost is stored separately together with the key of the last record processed (that is the key of the last type 30 record) which gave this total annual cost. As each subsequent level is reached or passed a comparison is made of the total annual cost given by this level and the previously held total annual cost. The minimum of these two costs is then held together with the key of the last record processed which gave this minimum accumulated total annual cost. This processing continues until all the required levels have been reached or the type 50 records have been exhausted. In the latter case the minimum accumulated total annual cost found so far will be used as the optimum.

A comparison between the key of the first type 50 record and the key of the last record processed to give the minimum total accumulated annual cost will establish whether any type 50 records were needed to give a minimum accumulated total annual cost. If only type 30 records are necessary to give the minimum cost no further adjustment is needed to any record.

If type 50 records are required, it is necessary to convert these type 50 records to type 30 records and to make the necessary adjustments to the order quantity fields. At this stage processing returns to the first type 50 record. The contents of order quantity 1 field are rounded to pallet size if required and copied into the order quantity 2 field and the order quantity 1 field is zeroised. The record type is changed from 50 to 30. The last run marker is tested and, if set, last run processing is performed. The total order quantity (that is the contents of order quantity 2 field) of each type 50 record multiplied by the optimising factor, is added to the original total accumulated order quantity. The processing of type 50 records ceases when the record is reached which was the last record processed to give the minimum accumulated total annual cost.

OUTPUT

1 Card image transactions disc file (optional, see page 186.25)

2 Joint Replenishment Report. This report shows the contribution of each item to the total order quantity for the grouping concerned, and indicates where the order quantity for any record exceeds the maximum order quantity specified by the user. It also gives a summary of the final order position for each grouping of records

```
JOINT REPLENISHMENT REPORT                    PROGRAM X43H                    DATE 99/99/99   PAGE 9999

                                  OPTIMISING FIELD  MAXIMUM ORD QTY    ORDER QTY 1      ORDER QTY 2   EXCESS ORDER QTY

    ITEM NUMBER/ GP   CONV   UOM  NAME      VALUE  RECEIPT     OPT  RECEIPT     OPT  RECEIPT     OPT  RECEIPT     OPT
     DESCRIPTION CD FACTOR                          UNITS   UNITS    UNITS   UNITS    UNITS   UNITS    UNITS   UNITS

XXXXXXXXXXXXXXX  XX   9999  XXXX  XXXX 999999.999  9999999 9999999  9999999 9999999  9999999 9999999  9999999 9999999
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX


SUPPLIER  GROUP   LEAD
    CODE   CODE   TIME

XXXXXXXX     XX  999.99
                        NO STATUS ITEM PRESENT

                        NO CARRIER DISCOUNT OPTIMISATION REQUIRED, OPTIMISATION PERFORMED IN PREVIOUS RUN

                        NO OPTIMISATION REQUIRED FOR THIS SUPPLIER

                        ORIGINAL ORDER QTY 9999999.9999   CONTAINER SIZE 9999999.9999   DISCOUNT 9999999.9999
                        NO  OF CONTAINERS 9999.9999   TOTAL CONTAINER SIZE 9999999.9999
                        ACCUMULATED ORDER QTY 9999999.9999   UNALLOCATED SPACE 9999999.9999

                        INSUFFICIENT TYPE 50 RECORDS FOR COMPLETE OPTIMISATION

                        DISCOUNT LEVEL 9999999.9999   DISCOUNT 9999999.9999   ORIGINAL ORDER QTY 9999999.9999
                        ACCUMULATED ORDER QTY 9999999.9999   DISCOUNT LEVEL EXCESS 9999999.9999

                        NO CARRIER DISCOUNT OPTIMISATION DONE, MIN ALLOWABLE PERCENTAGE XX.X CALCULATED PERCENTAGE XX.X

                        FIXED DISCOUNT INDICATOR SET

                        ACCUMULATED ORDER QTY 9999999.9999   MAX. DISCOUNT LEVEL 9999999.9999

                        ORIGINAL ORDER QUANTITY IS OPTIMUM

                        NO SUPPLIER RECORD

ENTRIES WILL ONLY APPEAR IN
THESE FIELDS IF APPROPRIATE
FOR REPORT BEING
  GENERATED
```

Figure 27.3 Joint replenishment report

Carrier discount optimisation – run 3

OBJECTIVES

1 To optimise the total order quantity of mixed items being ordered from each supplier based on carrier discounts

2 To generate a card image transactions file containing order balance adjustment records (optional)

3 To provide a Joint Replenishment Report giving a summary of the order quantities for each supplier

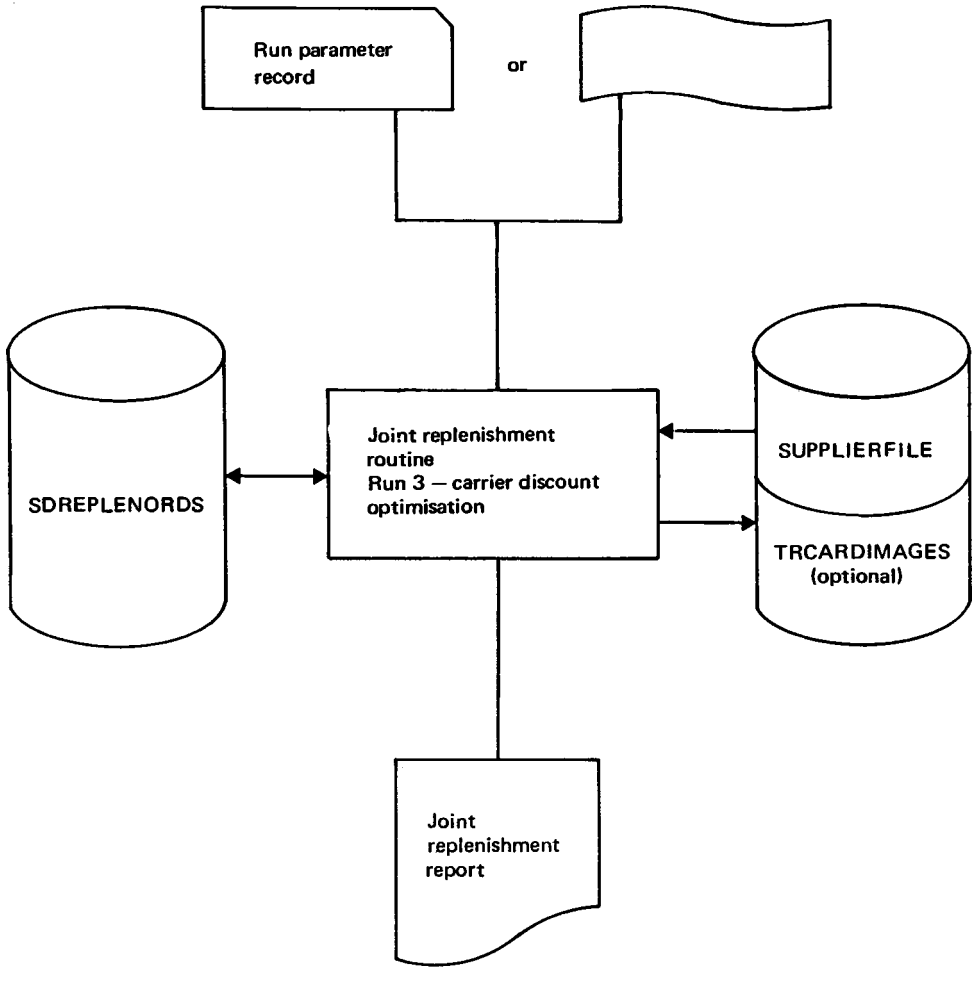


Figure 27. 4 Systems flowchart – carrier discount optimisation

INPUT

1 Overlay replenishment orders disc file (see page 109)

2 Supplier disc file

3 Run parameter record (punch into cards or paper tape)

This record specifies the files to be used by the run. Various indicators, including the pallet rounding indicator and status indicator are also contained on this record for use during this run.

PROCESSING

The purpose of this run is to increase the total order size to be placed on each supplier so as to fill completely an integer number of containers if, by doing so, greater economy can be achieved. The criteria on which the decision is made are given by a user specified minimum allowable percentage discount, on those

additional items needed to fill the container (see page 186.12).

For processing in this run the sequence of the file must be:

Supplier code (ascending)

Group code (ascending)

Lead time (ascending)

Record type (ascending)

Expected time before reorder point reached (ascending)

Class code (ascending)

Processing is performed on groupings of records having the same key. For this run the key will be supplier code, group code and lead time. Within this key there may be present, in sequence, type 30 records, type 31 records and type 50 records. In this routine no processing will take place on the 31 records and they will be ignored when met.

The processing done in this run depends on the setting of the appropriate markers on the supplier file. There may be present on the orders file groupings of records which, although not requiring optimisation in this run, may have been optimised in run 1 or run 2. If for this run the last run marker is set it will be necessary to do the appropriate type of last run processing for these records.

For those items not previously processed, within the particular grouping of records the first record must be a type 30 and the class code of this type 30 record must be less than or equal to the status indicator on the run parameter record. Items satisfying this condition are called status items.

The carrier discount levels or load units will be measured in weight or volume, and must be in the same terms as the unit weight, time or volume field in the orders record. Alternatively the load units will be measured directly in number of cartons. In order that a direct comparison can be made the order quantities of the order records must be expressed in the same terms as the load unit. This is done by using an optimizing factor of the UWTV field multiplied by the conversion factor, or alternatively making the optimizing factor equal to one. Rounding to pallet size will use a rounding factor equal to the conversion factor. It is also necessary to calculate a further cost factor used to indicate the value of the order. This factor will be the cost price multiplied by the conversion factor.

Each type 30 record is processed. Rounding to pallet size is performed if required, any increase due to rounding being added into the order quantity 2 field. The complete order quantity (that is the order quantity 1 + order quantity 2), is multiplied by the cost factor and accumulated. The complete order quantity is also multiplied by the optimizing factor and accumulated, two separate accumulations are kept; one for those items for which the order cover can be increased, and one for those for which the order cover cannot be increased.

By examination of the designated carrier level indicator the container size to be used can be determined. The number of containers needed to carry the total accumulated order quantity is calculated. If the total accumulated order quantity exactly fills an integer number of containers, the last run marker is tested and, if set, last run processing is performed for each type 30 record within this key.

If the containers are not full, the calculation to determine the effective discount on the additional items needed to fill the container is performed. The result of this calculation is compared with the minimum allowable discount on the run parameter record and, if found to be greater than or equal to this parameter, optimisation can proceed; if less then processing passes to the next grouping of records.

The increase in total accumulated order quantity is made by either increasing the order size of the existing type 30 records or by utilising the order quantities of type 50 records, if present for this key.

1 TYPE 30 RECORDS ONLY: A factor, by which to increase the order sizes of those records for which the order cover can be increased, is calculated. Processing returns to the first type 30 record within the key and the factor is applied to the appropriate records, followed by rounding to pallet size where required. The new order quantity is compared with maximum order quantity and the smaller used subsequently. The increase in order size multiplied by the optimizing factor is compared with the unfilled space in the container. If the increase is greater than this space, the order quantity 2 field of the record is increased by the amount of the unfilled space divided by the optimizing value, thus completely filling the required containers. The accumulated order quantity is made equal to the total container size and, if the last run marker is set, last run processing is performed on this and all subsequent type 30 records within this key.

If the increase for the record being processed is less than the unfilled space, the increase is added to the accumulated order quantity and also, after division by the optimizing factor, to the order quantity 2 field. The last run marker is tested and, if set, last run processing is performed. If the new order quantity is greater than the maximum order quantity the amount by which the maximum is exceeded is indicated on the Joint Replenishment Report.

On completion of optimisation of the records within this key, processing passes to the next grouping of records.

2 TYPE 30 AND TYPE 50 RECORDS: The increase in total accumulated order quantity is made by utilising the order quantities of the type 50 records. Processing commences with the first type 50 record. For each type 50 record, the contents of the order quantity 1 field are copied to the order quantity 2 field and the order quantity 1 field is zeroised. Rounding to pallet size takes place, if necessary, and the amount of unfilled space in the containers is calculated. The record type is changed from 50 to 30. The new order quantity (that is the result of rounding the original order quantity) multiplied by the optimizing factor is compared with the unfilled space. If this new order quantity is greater than the unfilled space, the following calculation is performed:

$$\frac{\text{Unfilled Space}}{\text{Optimising Factor}} - \text{Original Order Quantity}$$

The resulting amount is added into the order quantity 2 field. The total accumulated order quantity is then made equal to the total container size, and the containers will then be full.

The last run marker is tested and, if set, processing returns to the first type 30 record within this key and last run processing is performed on all type 30 records for this key. (Note that the type 30 records will include those records which were originally type 50 records.)

If the order quantity is less than the unfilled space, it is multiplied by the optimising factor and added into the total accumulated order quantity.

If all type 50 records within this key are processed but the containers are not full, no further attempt is made to optimize the order quantity. The last run marker is tested and, if set, processing returns to the first type 30 record within the key and last run processing is performed on all type 30 records within the key range.

Processing then proceeds to the next grouping of records.

OUTPUT

1 Card image transactions disc file (optional see page 186.25)

2 Joint Replenishment Report. This report shows the contribution of each item to the total order quantity for the grouping concerned, and indicates where the order quantity for any record exceeds the maximum order quantity specified by the user. It also gives a summary of the final order position for each grouping of records

PERIPHERALS

The following peripherals are required:

1 One card reader or paper tape reader

2 Two disc units

3 One line printer

SOURCE LANGUAGE

1900 COBOL

THE MATHEMATICS OF JOINT REPLENISHMENT

1 In the extraction run it is necessary to determine the length of time stock will last, at the current rate of consumption, before the reorder point is reached.

The current rate of consumption of stock can be calculated approximately in the following way:

Rate of Consumption $\triangleq$ Reorder Point/Lead Time

The length of time the stock will last before the reorder point is reached is then given by:

(Available Stock – Reorder Point)/Rate of Consumption where:

Available Stock = Stock Balance + Order Balance – Back Order Balance.

2 Total annual cost. Ideally, in the operation of a joint replenishment system, an attempt should be made to keep the total annual operating costs to a minimum.

The total annual cost, T, for an item is given by:

$$T = \bar{Y}Cp + \tfrac{1}{2} I_R \, Cpq \qquad 1$$

where

$\bar{Y}$ is the group annual demand

Cp is the effective cost price

q is the order quantity

If type 30 records only are present, q is derived by multiplying the item order quantity by a factor F, which increases the total order quantity on the supplier up to the supplier discount level. To correspond with this factor, a percentage discount in cost price exists. Hence:

$$Cp = \text{Item cost price} \times \left(1 - \frac{\text{Percentage discount}}{100}\right)$$

The total annual cost for the supplier is obtained by summing the right hand side of equation *1* across all the items in the order grouping. A total will exist for each pair of discount and factor, and the order increase factor is selected which corresponds with the minimum total annual cost.

If both types 30 and 50 records are present the procedure is slightly different. An effective cost price is calculated for each discount level but the individual order quantities of the type 30 records are not increased. Additional order quantity is obtained by using type 50 records. The discount level corresponding to the minimum total annual cost is thus determined and the appropriate number of type 50 records is converted to type 30 records to obtain the best supplier discount.

It will be noticed that the cost of ordering is omitted from the above equation. It is felt that this cost is not significant in the context of a joint replenishment policy and therefore can be disregarded.

Carrier discount calculations

A different method is used in carrier discount optimisation from that described above for supplier discount optimisation.

The user is allowed to specify a minimum allowable percentage discount on the additional items needed to fill the containers completely. A comparison is made with this parameter to determine whether or not to increase the order quantity to obtain the carrier discount.

The routine allows for each carrier discount to be expressed either as a percentage or as a currency value.

The calculation of the effective discount on the additional items is then performed as follows:

1 DISCOUNT AS A PERCENTAGE

$$\text{Effective Discount} = \text{Percentage Discount for Containers} \times \frac{\text{Unit Container Size}}{\text{Unfilled Space}}$$

2 DISCOUNT GIVEN IN CURRENCY UNITS. It is necessary to convert this currency discount into a percentage value, expressed as a function of the value of goods carried in one container.

The average cost per unit is given by:

$$\frac{\text{Total Value of Order}}{\text{Total Size of Order}}$$

The percentage discount for the container is then given by:

$$\frac{\text{Currency Discount for Container} \times 100}{\text{Unit Container Size} \times \text{Cost per Unit}}$$

The calculation of the effective discount on the additional items is then performed as above.

ROUNDING

In all cases where rounding to pallet size is performed, rounding up to the next integer is carried out.

Similarly, in the calculation to establish the number of containers, sufficient containers will be chosen to carry at least the existing order.

SUPPLIER FILE MAINTENANCE ROUTINES

In order to utilise the SCAN System 3 Joint Replenishment routine, a supplier file in the correct format must be available. This may be formed and maintained using the SCAN System 3 programs described below.

Supplier File Maintenance Transcription routine (X43X)

OBJECTIVE

The objective of this routine is to create from cards or paper tape a serial disc file containing card images suitable for input to the Supplier File Maintenance routine. A system flowchart is shown in figure 27.5 below.

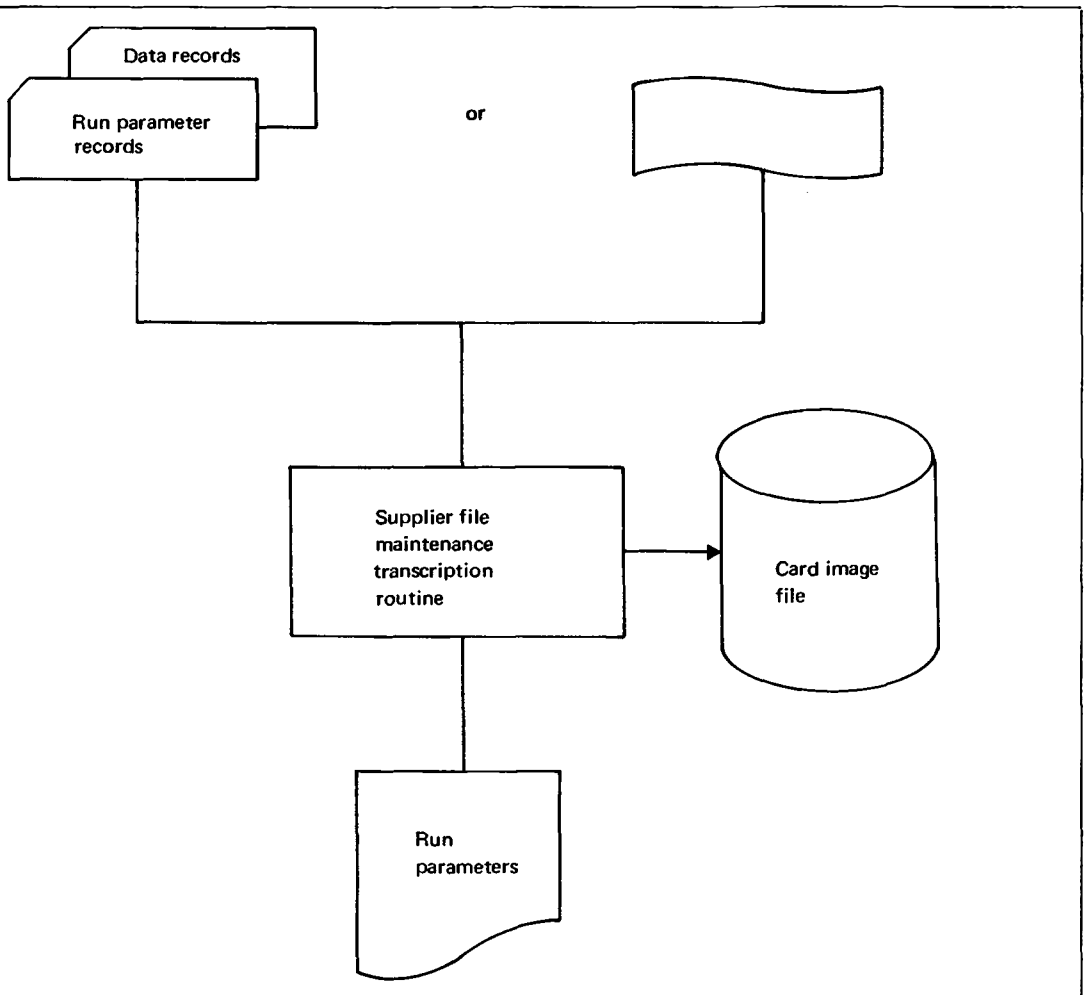


Figure 27.5 System flowchart – supplier file transcription routine

INPUT

1 RUN PARAMETER RECORD. This record names the input file that is to be written to and gives the name of the output file

2 DATA RECORDS. See page 186.20

PROCESSING

The Supplier File Maintenance Transcription routine creates a serial disc file, in standard direct access format, for input to the Supplier File Maintenance routine.

Data is read in random order either from cards or from paper tape and is stored on disc in card image form. No validity check is made by this routine since full validity checking facilities are available in the Supplier File Maintenance routine.

When the disc file has been created by the transcription routine, it would normally be sorted using standard sort software, but if there are only small amounts of data then the data can be hand sorted and the sort phase of processing can be omitted; in this case, the appropriate file name should be selected by the user (see below).

OUTPUT

1 One serial disc file.

The file should be named either:

(a) SPPLRINPUTVV if the data is being input randomly, or

(b) SDSPPLRINPUT if the data is hand sorted. Data which is hand sorted must be in ascending sequence of the following keys:

(i) Supplier code

(ii) Record function

(iii) Record code

(iv) Column 12

The last key does not have significance for record code 60.

2 A printed statement of the run parameters

PERIPHERALS

The peripherals required by this routine are:

1 One card reader or one paper tape reader

2 One disc transport

3 One line printer

SOURCE LANGUAGE

PLAN 3.

Supplier File Maintenance routine (#X43G)

OBJECTIVES

The objectives of the Supplier File Maintenance routine are as follows:

1 To form records into an exisiting sequential file

2 To form records on a new serial disc file

3 To modify fields of any records on a sequential disc file

4 To delete any record from a sequential disc file

Objective 2 is carried out using a file formation run; objectives 1, 3 and 4 are carried out using a file modification run. These operations are described below.

Supplier File Form

A system flowchart for the Supplier File Form operation is shown in figure 27.6 below.

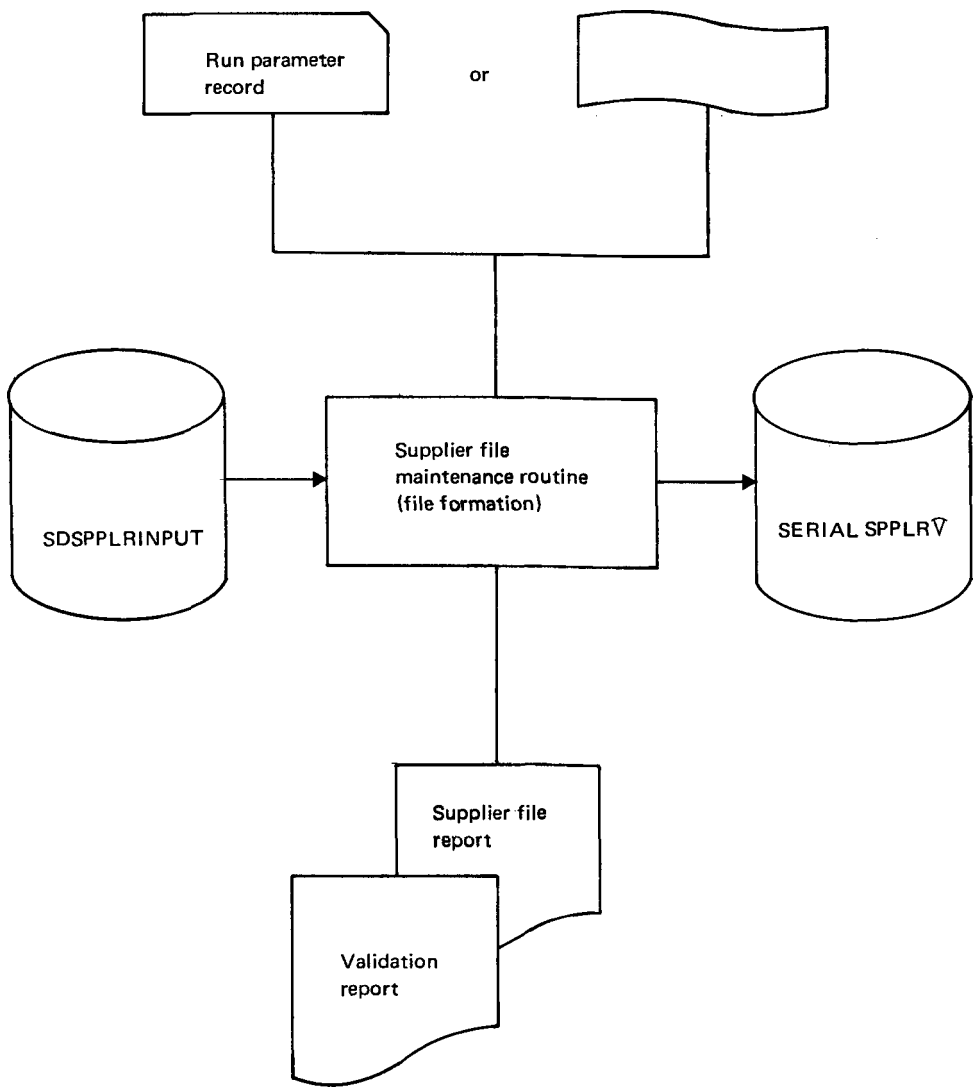


Figure 27.6 System flowchart – supplier file form operation

INPUT

1 Run Parameter record. This record identifies the input and output serial disc files that are to be used

2 One serial disc file containing main file formation records in card image form

PROCESSING

For the Supplier File Form operation, records are present on the input file only; these records are used to generate master file records on a serial output file. (For forming records into an existing master file, see Supplier File Modification on page 186.17) A full validity check is carried out on the input data (see Supplier file on page 186.20) and input record images are printed out together with error codes beneath invalid fields. At the end of the run, the program lists the contents of every main file record formed. The input file is sequence checked (see File Sort Sequences on page 186.36) and records that are out of sequence are rejected.

Note: When the serial file has been formed, the 1900 File Reorganisation routine must be used to transform the file into the correct form before it is input to any of the SCAN System 3 routines.

OUTPUT

1 One serial disc file containing records in master file format

2 Printed validation report. This report contains the input formation records in card image form. Invalid fields are denoted by an error code printed on the following line, beneath the field in error. The codes used are shown on page 143

3 Printed Supplier File report

```
DATA  VALIDATION  REPORT                              PROGRAM X43G                              DATE 12/08/69   PAGE    2

        1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

F60A492B672    20.5111          4    211
F61A492B67211.5 2.0 3.0
F61A492B67223.5 *
F62A492B67211000 2000 3000 4000 *
F63A492B67210.5 0.75 *
F64A492B6721205 410 *
F60B224K497    K1.2101          21
                 C
F61B224K49712.5 *

                V
F62B224K4971250 400 500 650 *
                      V


END OF REPORT


SUPPLIER  FILE  REPORT                                PROGRAM X43G                              DATE DD/MM/YY   PAGE 9999

                                 {DELETED
SUPPLIER CODE          XXXXXXXX  {FORMED
                                 {MODIFIED

SUPPLIER CODE          XXXXXXXX          PALLET SIZE   9999999.99999            PROCESSING MARKERS   111111111111

SUPPLIER DISCOUNT DATA:-

RANGE OF LEVELS USED         9           DISCOUNT TYPE       9                  FIXED DISCOUNT INDICATOR        9
DISCOUNT PERCENTAGE       999.99999      QUANTITY        9999999.999999
                          999.99999                      9999999.999999
                          999.99999                      9999999.999999




                          999.99999                      9999999.999999

CARRIER DISCOUNT DATA:-

DESIGNATED LEVEL INDICATOR   9           DISCOUNT TYPE       9
DISCOUNT BBBBBBBBBB     9999999.99999    LOAD UNIT        999999.99999


                       9999999.99999                     9999999.99999



END OF REPORT
```

Note: BBBBBBBBBB = *percentage* if discount type is 1

= *value* if discount type is 0

Figure 27.7 Validation report and supplier file report

PERIPHERALS

The following peripherals are required for the Supplier File Form operation.

1 One card reader or one paper tape reader

2 Two disc transports

3 One line printer

SOURCE LANGUAGE

PLAN 3.

Supplier File Modification

A system flowchart for the Supplier File Modification operation is shown in figure 27.8 below.

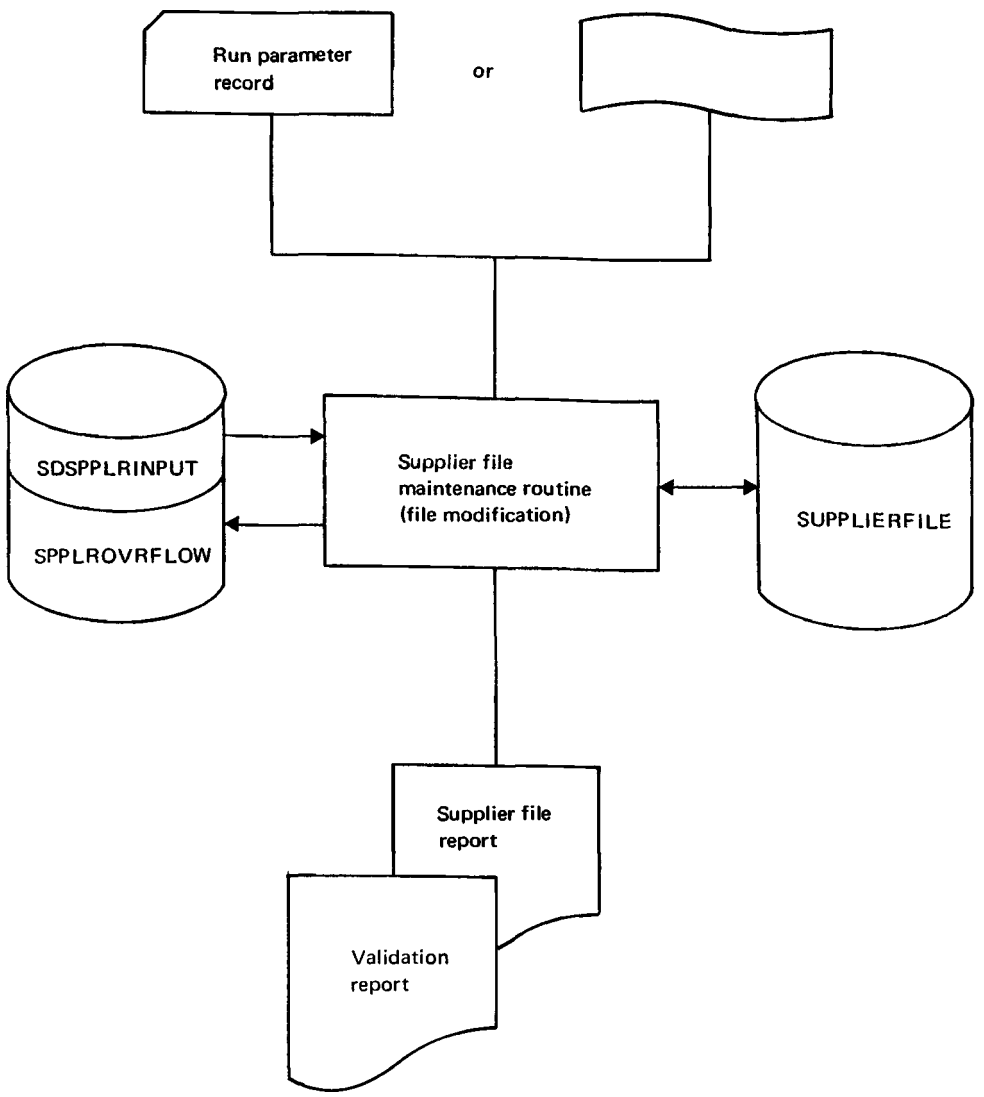


Figure 27.8 System flowchart and reports – supplier file modification operation.

INPUT

1 Run parameter record. This record identifies the input and output serial files and the overlay supplier file to be used

2 One serial disc file containing card images of supplier file maintenance records

3 One overlay sequential disc file containing the supplier file

Card formats

The following table shows the formats for supplier file maintenance records. The first format is for type 60 records, and the second is for types 61, 62, 63 and 64.

Columns	*Field name*	*Comments*
1	Function	Contains D, F or M
2 and 3	Record code	Contains 60

Columns	*Field name*	*Comments*
4 to 11	Supplier code	
12 to 19	Pallet size	
20 to 31	Processing markers	
32 and 33	Number of supplier discount levels	
34	Range of levels used	
35 and 36	Fixed discount indicator	
37	Discount type	
38	Number of carrier levels	
39	Designated carrier level	
40	Carrier discount type	
1	Function	Contains D, F or M
2 and 3	Record code	Contains 61, 62, 63 or 64
4 to 11	Supplier code	
12	Record sequence	
13 onwards	Quantity	Each entry is followed by a field terminator (see page 186.20). The last field terminator of the series is followed by an asterisk.

PROCESSING

The File Modification operation will perform any of the functions form, modify or delete. The form function causes a new record to be inserted in the supplier file; the remaining two functions affect existing records on the file.

A full validity check is carried out on the input data (see page 186.20) and input record images are printed together with error codes beneath invalid fields. The supplier code of any record affected is stored in core, and at the end of the run the Supplier File Report is printed by accessing the supplier file selective sequentially. The input file is sequence checked (see page 186.36) and records that are out of sequence are rejected.

During the run, if second level overflow area overflow occurs, records will be written to the overflow file SPPLROVRFLOW. If this condition arises, the 1900 File Reorganisation routine must be used at the end of the run.

OUTPUT

1 One serial disc file if the supplier file has overflowed the second level overflow area

2 Printed Validation Report. This report contains the input maintenance records in card image form. Invalid fields are denoted by an error code printed on the following line, beneath the field in error. The codes used are shown on page 143

3 Printed supplier file report

PERIPHERALS

The following peripherals are required for the Supplier File Modification operation:

1 One card reader or one paper tape reader

2 Two disc transports

3 One line printer

SOURCE LANGUAGE

PLAN 3.

FILE FORMATS

This section describes the formats for each of the additional files required for the Joint Replenishment routines. In addition, detailed information is supplied regarding maintenance of the supplier file.

Supplier file

This file is required by SCAN System 3 only if the Joint Replenishment routines are to be used.

The supplier file may be created either from punched cards or paper tape (see figure 27.5 on page 186.14). The input format for supplier file records is shown in card image form. For paper tape, the same format should be used except that each field is variable in length and must terminate with a field terminator chosen by the user and specified in the run parameter record; for any field that is not being used, up to and including the last field for which data is included, the field terminator must still be present. Every paper tape record will be terminated by a newline after the field terminator for the last field used.

The space separators used for the input of carrier and supplier discount information must be provided for card input. For paper tape input they are optional since in this case the user specified field terminators must be used, whether spaces are present or not.

A field is defined as the complete area referred to by name, as shown in table 9.5 on page 186.25. Thus, when processing markers are used, for example, only one terminator is used, not one for each marker.

Supplier records are maintained by three maintenance functions D, F and M used in conjunction with five record codes 60, 61, 62, 63 and 64. One of the letters indicating the maintenance functions occurs as the first character of each record. The functions are as follows:

1 DELETE RECORD. The D function deletes the supplier record from the file; it can only be used for type 60 input records. The only other information in the input record is the supplier code

2 FORM RECORD. The F function forms a new supplier record to be either added to a new file or inserted in an existing file; it can be used with record types 60, 61, 62, 63 and 64

3 MODIFY RECORD. The M function modifies a supplier record existing on a sequential main file; it can be used with record types 60, 61, 62, 63 and 64

The following sections describe the way data is specified for each input field. If the user does not specify any information for a field during the formation of a record, the Maintenance routine will assume standard values (see supplier file layout on page 186.25). Any invalid information submitted during formation of a record causes formation of the record to be abandoned. invalid information submitted during record modification causes the error field and any associated fields being input to be ignored.

Information for a field input from cards or paper tape can be in any position in the input field. Alphanumeric data is transferred to disc into the corresponding position; thus, if such information is input on paper tape it will be left justified when transferred to disc unless spaces precede the data. Numeric data is always stored on disc in the format specified in the supplier file layout (see page 186.25) irrespective of the layout of the input record field.

RECORD CODE 60

Supplier code

The supplier code field contains the supplier reference number in alphanumeric form.

The user may place the supplier code anywhere in the field, but he must be consistent and always place it in the same position in the field. In particular, it must be positioned in the same manner as the equivalent field on the Stock Master record. The user is advised to enter the contents either always right justified or always left justified.

Pallet size

This is a decimal quantity with a decimal point if one is required. It represents the unit pallet load for this supplier and must be expressed in the same terms as the unit weight, time, volume field on the Stock Master File. The amount entered could be either the full pallet capacity or, for example, the capacity of one layer. It represents the unit up to which the order size for individual items will be rounded if pallet rounding is specified by run parameter during operations of the Joint Replenishment routine.

Processing markers

The processing markers field contains a set of markers that control the facilities available in the Joint Replenishment routine. During formation of a record, a blank entry or an entry of zero in this field will give the marker the value zero. During modification, a blank entry is ignored; thus, to unset the marker, a zero must be input. Table 9.1 below illustrates the markers and their interpretations. The values given are the binary values occurring on the disc, corresponding exactly with the value the user must enter to achieve the required control.

Marker	*Character position on input record*	*Value*	*Condition for value shown*
0	20	0	No supplier discount required
		1	Supplier discount required
1	21	0	Supplier processing without regard to lead time.
		1	Supplier processing with regard to lead time
2	22	0	No carrier discount required
		1	Carrier discount with regard to lead time

Table 9.1 Marker values for supplier file

Number of supplier discount levels

This is an integer field which contains a space or a number greater than or equal to zero and less than or equal to ten. A space is treated as zero during formation and ignored during modification. If the contents are greater than zero, records 61 and 62 must be present.

Range of levels used

This is an integer field which contains a space or a number greater than or equal to zero and less than or equal to ten. A space is treated as zero during formation and ignored during modification. An entry greater than zero restricts the number of supplier discounts considered during supplier discount processing. Zero allows any discount to be used, non zero indicates the number of levels to be considered above the original order size.

Fixed discount indicator

This is an integer field which contains a space or a number greater than or equal to zero and less than or equal to the number of discount levels. A space is treated as zero during formation and ignored during modification. An entry greater than zero specifies a fixed discount level to be used during supplier discount processing. Zero allows any discount level to be used.

Discount type

This is an integer field which contains a space or a number greater than or equal to zero and less than or equal to four. A space is treated as zero during formation and ignored during modification. The value entered specifies the units in which the supplier discounts are offered. The interpretation is given in table 9.2 below.

Indicator	*Units of discount levels*	*Notes*
0	Value	Discount levels are in the same terms as the unit weight, time, volume field of the Stock Master File.
1	Weight	
2	Volume	
3	Points	

Indicator	*Units of discount levels*	*Notes*
4	Number of cartons	Discount levels are in receipt units. It is assumed that all supplies from a supplier are in cartons of the same size.

Table 9.2 Discount types available in supplier discount processing

Number of carrier levels

This is an integer field which contains a space or a number greater than or equal to zero and is less than or equal to five. A space is treated as zero during formation and is ignored during modification. If the quantity entered is greater than zero, records 63 and 64 must be present.

Designated carrier level

This is an integer field which contains a space or a number greater than or equal to zero and less than or equal to the number of carrier levels. A space is treated as zero during formation and ignored during modification. The quantity entered specifies the carrier discount level to be used in carrier discount processing. Zero causes no carrier discount processing to be performed and has the same effect as setting supplier file marker 4 off.

Carrier discount type

Only a space, zero or 1 may be entered. A space is treated as zero for formation and ignored for modification. Zero indicates that the carrier discount for filling the load unit is expressed as actual value. 1 indicates that the discount is expressed as a percentage of the order value which the load unit contains.

RECORD CODE 61

Use of this record is optional.

Supplier code

See record code 60.

Record sequence

These records must be in ascending sequence of the contents of this field. The value entered must be an integer not less than 1 and the first value used must be 1.

Supplier discount percentages

These fields contain variable length decimal quantities with a decimal point if required. Each field is terminated by at least one space if cards are being used or by the user's selected terminator and optional spaces if paper tape is being used. The sequence of entries may extend to more than one record and must ascend from left to right. The series is terminated by an asterisk following the last field terminator. A new line must follow the asterisk for paper tape input. The number of entries present during supplier record formation must equal the contents of the number of supplier discount levels field. The same condition applies during record modification if an entry has been made in the number of supplier discount levels field; otherwise, the number of percentages must equal the number already on the file.

RECORD CODE 62

Supplier code

See record code 60.

Record sequence

See record code 61.

Supplier discount quantities

The format rules are as for supplier discount percentages on record code 61. The field contains quantities at which the discount percentages of record code 61 are offered by the supplier.

RECORD CODE 63

Supplier code

See record code 60.

Record sequence

See record code 61.

Carrier discounts

The format rules are as for supplier discount percentages on record code 61, but the check on number of entries is made against the contents of the number of carrier levels field on record code 60.

RECORD CODE 64

Supplier code

See record code 60.

Record sequence

See record code 61.

Carrier load units

The format rules are as for supplier discount percentages on record code 61, but the check on number of entries is made against the contents of the number of carrier levels field on record code 60. The fields contain load units (expressed in the same terms as the unit weight, time, volume field on the Stock Master File) at which the carrier discounts are offered.

TERMINATION RECORD

The pack of input cards for a file maintenance run is terminated by a card having asterisks in the first four character positions. Paper tape input is terminated by a record containing four asterisks followed by a field terminator and a new line.

Disc file formats

EARLY ORDER INDICATOR RECORDS

These records are added to the end of an existing Replenishment Orders File using the Joint Replenishment Extraction procedure.

Words	*Field name*	*Length in words*	*Type*	*Standard value*	*Notes*
0	Software requirement	1			
1 and 2	Supplier code	2	Character		
3 to 6	Item number	4	Character		
7	Group code	½	Character		
	Record type	½	Integer	50	1
8 and 9	Function markers	½	Character		2
	Lead time	1½	Fractional (24.12)		
10 and 11	Class code	1½	Character		
	Unit weight, time or volume	1½	Fractional (24.12)		
12	Set up time	1	Fractional (16.8)		
13 to 20	Description	8	Character		
21	Unit of receipt	1	Character		

Words	*Field name*	*Length in words*	*Type*	*Standard value*	*Notes*
22 and 23	Date generated	2	Character	OODDMMYY	3
24 and 25	Due date	2	Character	OODDMMYY	4
26	Minimum order quantity	1	Integer		
27	Maximum order quantity	1	Integer		
28	Systems marker	¼	Character		
	Cycle indicator	¼	* or space		5
	Number of branches	½	Integer		6
29 and 30	Conversion factor	½	Integer		
	Spare	1½	–	Spaces	
31 and 32	Unit of issue	1	Integer		
	Spare	1	–	Spaces	
33 and 34	Investment rate group	¼	Integer		
	Group annual demand	1¾	Integer		
35	Spare	½	–		
	Location code	½	Character		
36 and 37	Bin location	2	Character		
38 and 39	Unit cost price	2	Fractional (24.24)		7
40	Reorder quantity (receipt units)	1	Integer		8
41	Reorder point excess	1	Integer		9
42	Excess order	1	Integer		
43	Stock balance	1	Integer		
44	Forward demand balance	1	Integer		
45	Back order balance	1	Integer		
46	Order balance	1	Integer		
47	Reorder point	1	Integer		

Table 9.3 Early order indicator record format

Notes:

1 This record has the same format as a single branch order record with a record type of 50. Except where otherwise stated, all fields are copied directly from the Stock Master record

2 Only markers 0 to 7 are copied from the Stock Master record. The remaining markers on this record are set to zero

3 This field contains the run date of the extraction run

4 This field contains run date plus lead time

5 Space indicates a non seasonal item, * indicates a seasonal item

6 This field always contains 1 for a type 50 record

7 The cost price is that for an issue unit. If price breaks apply for the item, a cost price is selected appropriate to the reorder quantity being used

8 The reorder quantity is initially taken from the reorder quantity field of the Stock Master record and is used provided it is within the range of the minimum and maximum order quantities. If it is not within range, the quantity at the end of the range exceeded is used

9 This field contains an estimate of the time in which the available stock above reorder point will be used. Since the field is defined as integer, the quantity is expressed in tenths of system time periods and is calculated from:

$$\text{Reorder Point Excess} = 10 \times (\text{Available Stock} - \text{Reorder Point}) \times \frac{\text{Lead Time}}{\text{Reorder Point}}$$

CARD IMAGE TRANSACTIONS FILE (TRCARDIMAGES)

The card image transactions file is a serial file with bucket length one block. Record format is shown in the following table:

Words	*Field name*	*Length in words*	*Type*	*Standard value*	*Notes*
0	Software requirement	1			
1 to 5	Record type	½	Character	12	1
	Item number	4	Character		
	Group code	½	Character		
6 to 10	Location code	½	Character		
	Quantity 1	1¾	–	Spaces	
	Quantity 2	1¾	Character		2
	Unit of issue	1	Character		
11 to 13	Due date	1½	–	Spaces	
	Transaction date	1½	Character		3
14 to 20	Priority	½	–	Spaces	
	Part allocation marker	¼	–	Space	
	Customer, supplier or department code	2	Character		4
	1st document reference no.	2	–	Spaces	
	2nd document reference no.	2	–	Spaces	
	Method of despatch	¼	–	Space	

Table 9.4 Card image transactions file record format

Notes:

1 In the Joint Replenishment routine the transaction output is record type 12, that is stock balance/order balance adjustment

2 Quantity 2 contains the adjustment necessary to the Stock Master order balance and is expressed as issue units in character form. If required, the field will also contain a negative sign in the character position adjacent to the most significant character of the number

3 The transaction date is the run date written in character form as OODDMMYY

4 In this field the supplier code taken from the replenishment orders record is written

SUPPLIER FILE (SUPPLIERFILE)

The supplier file is a sequential file with one block buckets. The key for the file is supplier code/record type. Record format is shown in the table below:

Words	*Field name*	*Length in words*	*Type*	*Standard value*	*Notes*
0	Software requirement	1			
1 and 2	Supplier code	2	Character		
3 and 4	Record type	½		0	1
	Pallet size	1½	Fractional (24.12)	0	2

Words	*Field name*	*Length in words*	*Type*	*Standard value*	*Notes*
5	Processing markers	½	Binary	0	3
	Spare	½		0	
6 to 10	Spare	5		0	
11	Number of supplier discount levels	1	Integer	0	
12	Range of supplier discount levels to be used	1	Integer	0	4
13	Supplier fixed discount indicator	1	Integer	0	5
14	Supplier discount type indicator	1	Integer	0	6
15	Number of carrier levels	1	Integer	0	
16	Designated carrier level indicator	1	Integer	0	7
17	Carrier discount type	1	Integer	0	8
	Supplier discounts:				
Repeated in pairs	Discount percentage	2	Fractional (24.24)		9
	Quantities	2	Fractional (24.24)		10
	Carrier discounts:				
Repeated in pairs	Carrier discount	2	Fractional (24.24)		11
	Load unit	2	Fractional (24.24)		12

Table 9.5 Supplier file record format

Notes:

1 For any supplier record created by SCAN System 3, this field contains zeros (but see note 13). The Joint Replenishment and Supplier File Maintenance routines will only be able to access such records. Thus, if the user is unable to accommodate all his own information in the record by extending it to 126 words, he may create his own records containing data in his own format and give the record the appropriate supplier code but a non zero record type

2 This is expressed in the same terms as the unit weight, time, volume field on the Stock Master file

3 This field comprises one bit markers whose interpretation is shown in the table:

Marker/bit	*Meaning*
0	Off: no supplier discount required On: supplier discount required
1	Off: supplier processing without regard to lead time On: supplier processing with regard to lead time
2	On: carrier discount with regard to lead time

4 Indicates the number of discount levels which are to be tried above the original order value:

1 = use next level

2 = use next two levels

0 = use any level

5 Indicates if only one of the discount range is to be used:

1 = use the first

2 = use the second

0 = use any

6 Identifies the units in which the supplier discounts are expressed:

Indicator	*Units of discount levels*	*Notes*
0	Value	
1 2 3	Weight Volume Points	Discounts are in the same terms as the unit weight, time, volume of the Stock Master File.
4	Number of cartons	Discount is in receipt units. It is assumed that all supplies from a supplier are in cartons of the same size.

7 Indicates which of the carrier levels supplied is to be used:

1 = use the first

0 = use none, that is it has the same effect as setting marker 2 off.

8 Indicates the type of carrier discount which applies:

0 = actual value discount for filling load unit.

1 = percentage discount on value for filling the load unit

9 Percentage discount on the value of the order if the associated quantity is exceeded

10 Quantity at which the discount applies. Units of the quantity are defined by note 6

11 Contains percentage or value (see note 8)

12 The load unit is expressed in the same terms as the unit weight, time, volume field on the Stock Master file unless the supplier discount type is 4. In this case the load unit is expressed in cartons

13 The last record on the file has a supplier code/record type which contains left hand arrows. The total record length is 20 words and all fields, except for record length and the key, contain zeros

The following files are used in the supplier file maintenance run.

SUPPLIER FILE MAINTENANCE FILE (SPPLRINPUT▽▽)

This is a serial file with bucket length 1 block.

This file contains randomly ordered supplier file maintenance records (record codes 60 to 64) in card image form. The record length is 22 words. The first word is the record length word, the next 20 words contain the card image and the last word depends on the mode of data input. If the input medium is cards, the word contains zero; if the input medium is paper tape and any field size in the record has been exceeded the word contains 1. This is used by the Supplier File Maintenance routine to detect the F error (see page 143).

SORTED SUPPLIER FILE MAINTENANCE FILE (SDSPPLRINPUT)

This is a serial file with bucket length 1 block.

This file contains sorted supplier file maintenance records (record codes 60 to 64) in card image form. The record length is 22 words as above.

SERIAL SUPPLIER FILE (SERIALSPPLR▽)

This is a serial file with bucket length 1 block.

This file contains standard supplier file records. Since the file is not in indexed form it is not suitable for use with SCAN System 3 until it is reorganised into sequential form.

SUPPLIER FILE OVERFLOW FILE (SPPLROVRFLOW)

This is a serial file with bucket length 1 block.

This file contains standard supplier file records that have overflowed from the supplier file during overflow from the record level overflow area. The file cannot be used by SCAN System 3 until it has been merged back into the main file by the standard merge and reorganize operations.

OPERATING INFORMATION

The information in this section comprises:

1 Run parameter formats

2 Operating instructions

Run parameter formats

All the run parameter formats described in this chapter are subject to the general system design criteria described in chapter 5.

SUPPLIER FILE MAINTENANCE ROUTINE (#X43G)

The parameter record format differs for file formation and file modification.

File formation

1	*2*	*3* *4*	*5*	*6* ⟶
Record code	Record sequence number	Line count	Run type indicator	FGN (old) supplier file , FGN (new) supplier file ,

⟶
FGN card image file , Extension size ,

Column	*Contents*
1	Record code; value G.
2	Record sequence number; value 1.
3 } 4 }	Line count
5	Run type indicator; must contain F to denote a file formation run.
6	FGN supplier file; existing FGN of SERIALSPPLRV.
	Comma.
	FGN supplier file; FGN to which SERIALSPPLRV will be changed prior to use as the output file.
	Comma.
	FGN card image file; identifies the SDSPPLRINPUT file containing maintenance records.
	Comma.
	Extension size; this is the file extension size to be applied to the supplier file.
	Comma.
	New line (paper tape only).

Table 9.6 #X43G – parameter record format for file formation

File modification

1	*2*	*3* *4*	*5*	*6* ⟶
Record code	Record sequence number	Line count	Run type indicator	FGN supplier file , FGN (old) overflow file ,

⟶
FGN (new) overflow file , FGN card image file , Extension size ,

Column	*Contents*
1	Record code; value G.
2	Record sequence number; value 1.
3 } 4 }	Line count
5	Run type indicator; must contain M to denote a file modification run.
6	FGN supplier file; indicates the requested file SUPPLIERFILE which is to be modified by overlay.
	Comma.
	FGN overflow file; existing FGN of SPPLROVRFLOW.
	Comma.
	FGN overflow file; FGN to which SPPLROVRFLOW will be changed whether overflow occurs or not.
	Comma.
	FGN card image file; identifies the SDSPPLRINPUT file containing maintenance records.
	Comma.
	Extension size; this is the file extension size to be applied to the overflow file.
	Comma.
	New line (paper tape only).

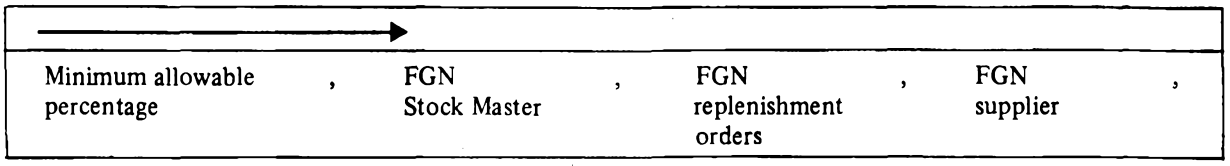
Table 9.7 #X43G – parameter record format for file modification

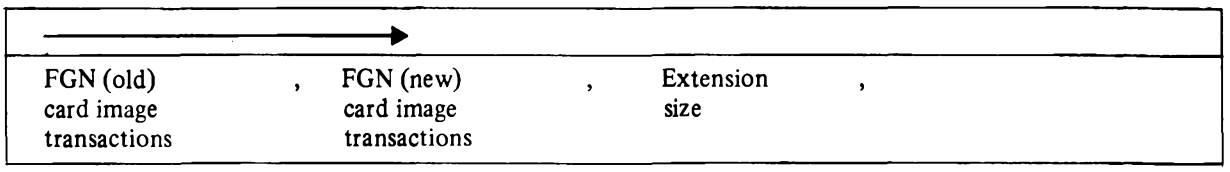
JOINT REPLENISHMENT ROUTINE (#X43H)

Parameter record 1

1	*2*	*3* *4*	*5*	*6*	*7*
Record code	Record sequence number	Line count	Run indicator	Last run indicator	Print suppression indicator

8 *9*	*10*	*11*	*12* ⟶
Status indicator	Pallet rounding indicator	Renaming indicator	Selection indicator , Investment rate ,





Column	*Contents*
1	Record code; value H.
2	Record sequence number; value 1.
3 4	Line count.
5	Run indicator; 0 – Extraction run 1 – Supplier discount optimisation without regard to lead time 2 – Supplier discount optimisation with regard to lead time 3 – Carrier discount optimisation with regard to lead time
6	Last run indicator; 0 – Not last run 1 – Last run, therefore last run processing will be performed.
7	Print suppression indicator; 0 – No suppression 1 – Suppression of all printout.
8 9	Status indicator; these two columns will contain a class code such that if the class code of an item is less than or equal to this parameter the item will be considered to be a status item and optimisation will proceed.
10	Pallet rounding indicator; this parameter will have the value 0, 1, 2 or 3 such that if the numeric part of the class code of a record is less than or equal to this parameter, pallet rounding will take place.
11	Renaming indicator; 0 – The file ŚDREPLENORDS will not be renamed on output 1 – The file SDREPLENORDS will be renamed to REPLENORDERS on output.
12	Selection indicator; if the length of time that the available stock will last at the current rate of consumption before the reorder point is reached is less than or equal to this parameter, a type 50 record will be produced for the item. The parameter will be a fractional quantity in terms of the basic time period of the system. Comma. Investment rate; if present, this value will be used in the calculation of total annual cost for all relevant records. Comma. Minimum allowable discount; this is the minimum percentage discount allowed by the user to justify increasing the order size to fill an integer number of the specified containers. If the effective discount calculated for the additional items is less than this parameter the order size remains unchanged. Comma.

Column	*Contents*
	FGN Stock Master File. Comma. FGN replenishment orders file. Comma. FGN supplier file. Comma. FGN (old) card image transactions file. Comma. FGN (new) card image transactions file. Comma. Extension size. Comma. New line (paper tape only).

Table 9.8 # X43H – parameter record 1 format

Program # X43H, parameter record 2.

1	*2*	*3* →
Record code	Record sequence number	Investment rate 0 , Investment rate 1 , Investment rate 2 ,

→
Investment rate 3 , Investment rate 4 , Investment rate 5 , Investment rate 6 ,

→
Investment rate 7 , Investment rate 8 , Investment rate 9 ,

Column	*Contents*
1	Record code; value H.
2	Record sequence number; value 2.
3	Investment rate; each item on the replenishment orders file may be classified into one of the investment rate group numbered 0 to 9. The ten investment rates which may be punched on this record correspond to these ten groups. A comma will terminate each value and must be present even if the value is omitted. The last comma will be followed by a new line if input is on paper tape.

Table 9.9 # X43H – parameter record 2 format

Parameter checking

Notes	*Record*	*Col.*	*Parameter*				
	1	1	Record code	H	H	H	H
		2	Rec seq. no.	1	1	1	1
1		3 4	Line count	Not checked by program	1 to 9 incl. and OR and 0 0 to 9 incl.	1 to 9 incl. and OR and 0 0 to 9 incl.	1 to 9 incl. and OR and 0 0 to 9 incl.
		5	Run indicator	0	1	2	3
		6	Last run indicator	N	0 or 1	0 or 1	0 or 1
		7	Print suppression marker	N	0 or 1	0 or 1	0 or 1
9		8 9	Status indicator	N N	A or B or C 1 or 2 or 3	A or B or C 1 or 2 or 3	A or B or C 1 or 2 or 3
		10	Pallet rounding indicator	N	1 or 2 or 3	1 or 2 or 3	1 or 2 or 3
		11	Renaming indicator	N	0 or 1	0 or 1	0 or 1
5		12	Selection indicator	XXXX.XX,	,	,	,
3 and 6			Investment rate	,	XX.X,	XX.X,	,
6			Min allowance percentage	,	,	,	XX.X,
			FGN Stock Master File	FGN,	,	,	,
7			FGN Orders file	FGN, (REPLENORDERS)	FGN, (SDREPLENORDS)	FGN, (SDREPLENORDS)	FGN, (SDREPLENORDS)
7			FGN Supplier file	,	FGN,	FGN,	FGN,
2 and 7			FGN (old) Transactions file	,	FGN,	FGN,	FGN,
2 and 7			FGN (new) Transactions file	,	FGN,	FGN,	FGN,
8			Extension size	Extension size,	Extension size,	Extension size,	Extension size,
3	2	1	Record code	This record not required	H	H	This record not required
		2	Rec seq. no.		2	2	
		3	Investment rate		XX.X,	XX.X,	
			The above field is repeated for a total of 10 times				

Table 9.10 Parameter checking

Notes on parameter checking:

1 Line Count. When the run indicator is 0, the line count will not be checked by program

2 FGNs for the transactions file. This file will only be required during the last run of the program, that is the fields concerned will only be present if the last run indicator is set to 1

3 Parameter record 2. This is only required when the run indicator is set equal to 1 or 2. If, however, the investment rate on parameter record 1 is non zero, then the parameter record 2 is not required

4 Where a field is not applicable in the fixed part of the record the user must punch N. e.g. *status indicator* when run indicator = 0. Where a field is not applicable in the variable part of the record it must be omitted but the comma must be punched

5 Selection indicator. This will have a maximum field width of seven characters including the decimal point. The maximum allowable value will be 9999.99, that is four places before and two after the decimal point. It will be possible for a value less than that stated above to be punched and also an integer; if this is done the integer must be less than or equal to 9999

6 Investment rate and minimum allowable percentage. These fields will have a maximum width of 4 characters including the decimal point. The maximum allowable value is 99.9, that is 2 places before and 1 after the decimal point. It will be possible for a value less than that stated above to be punched and also an integer, but this must not exceed 99

7 FGN. FGNs when input must be in the range 0 to 4095 inclusive. A negative value may be inserted causing the file of that name with the highest FGN to be picked up

8 Extension size. This is punched as a multiple of 8 and will be in the range 8 to 4088

9 This field will be used to indicate which item will cause the generation of joint replenishment optimisation. Thus if B2 is punched on the parameter record then an order with class code A1, A2, A3, B1 or B2 must be first in the grouping of orders for joint replenishment optimization to be performed.

10 A new line will be punched following the last comma on each parameter record when input is on paper tape

SUPPLIER FILE MAINTENANCE TRANSCRIPTION ROUTINE (#X43X)

1	*2*	*3* *4*	*5* ⟶
Record code	Record sequence number	Line count	File name (old) output file , FGN (old) output file ,

⟶			
File name (new) output file ,	FGN (new) output file ,	Extension size ,	Field terminator in octal ,

Column	*Contents*
1	Record code; value X.
2	Record sequence number; value 1.
3 } 4 }	Line count.
5	Output file name; this must be twelve characters, spaces being input if necessary. Together with the associated FGN it identifies the file to be renamed for output purposes. FGN output file; FGN of the file to be renamed. Comma. Output filename; this must be twelve characters, spaces being input if necessary. If the data records have been hand sorted, the file name SDSPPLRINPUT may be used. If the data records are input in random sequence, the file name should be SPPLRINPUTVV. The standard sort should then be used to sort the records and produce an output file SDSPPLRINPUT. FGN output file; FGN to be used for the output file. Comma. Extension size; this is the file extension size to be applied to the output file. Comma. Field terminator in octal; this entry is only required for paper tape input. The field contains # followed by the octal value of the field terminator being used on the data records. Comma (paper tape only). New line (paper tape only).

Table 9.11 #X43X – parameter record format

Operating instructions

PROGRAM #X43G

Priority

70

Hardware requirement

The minimum hardware required is:

1 10500 words of core store

2 One card/paper tape reader

3 One line printer

4 One disc transport

File requirements

Operation:

Form

Input:

1 Run parameter record

2 Serial disc file SDSPPLRINPUT

Output:

1 Serial disc file SERIALSPPLR∇

2 Validation report

3 Supplier file report

Operation:

Modify

Input:

1 Run parameter record

2 Serial disc file SDSPPLRINPUT

Overlaid:

Sequential disc file SUPPLIERFILE

Output:

1 Serial disc file SPPLROVRFLOW

2 Validation report

3 Supplier file report

Run instructions

See the run instructions for program # X43A on page 142.

Exception conditions

See the exception conditions for program # X43A on page 142.

PROGRAM #X43H

Priority

74

Hardware requirement

The minimum hardware required is:

1 13568 words of core store

2 One card/paper tape reader

3 One line printer

4 One disc transport

File requirements

Extraction run

Input:

1 Run parameter record

2 Sequential disc file STOCKMASTER∇

Output:

1 Serial disc file REPLENORDERS. This file is opened at end of file.

Optimisation run

Input:

1 Run parameter record

2 Sequential disc file SUPPLIERFILE

Overlaid:

Serial disc file SDREPLENORDS

Output:

1 Serial disc file TRCARDIMAGES (this file is only produced if the last run indicator is set to 1)

2 Joint Replenishment Report

Run instructions

See the run instructions for program # X43A on page 142.

Exception conditions

See the exception conditions for program # X43A on page 142.

PROGRAM #X43X

Priority

50

Hardware requirement

The minimum hardware required is:

1 2176 words of core store

2 One card/paper tape reader

3 One line printer

4 One disc transport

File requirements

Input:

1 Run parameter record

2 Supplier file data records, terminated by ****

Output:

1 Serial disc file SPPLRINPUTVV, when file is to be sorted

2 Alternatively, serial disc file SDSPPLRINPUT when the data records have been hand sorted to the correct sequence

Run instructions

See the run instructions for program # X43A on page 142.

Exception conditions

See the exception conditions for program # X43A on page 142.

FILE SORT SEQUENCES

To achieve successful operation of the Joint Replenishment and Supplier File Maintenance routines, the correct file sequences must be observed.

1 SDSPPLRINPUT. The file must be in ascending sequence of the keys:

Supplier code

Record function

Record code

Column 12

The lowest key has significance for record codes 61, 62, 63 and 64 only.

2 SDREPLENORDS. For carrier discount optimisation and supplier discount optimisation with regard to lead time, the file must be in ascending sequence of the keys:

Supplier code

Group code

Lead time

Record type

Expected time before reorder point reached

Class code

3 For supplier discount optimisation without regard to lead time, the file must be in ascending sequence of the keys:

Supplier code

Group code

Record type

Expected time before reorder point reached

Class code.

Chapter 8 SCAN System 3 simulator

The routines described in detail in Chapter 3, page 21 , provide all the elements essential for setting up a soundly based computer system for adaptive inventory control. The analysis routines, which form an integral part of the ICL SCAN System, cater for the initial processing which should preferably be carried out before the system is put into action; these routines may be used again for review purposes.

A System Simulator is provided for situations in which a detailed study of the action of the system is required. The System Simulator is intended to simulate the situation in which a group contains only one branch and includes a selection of ordering and forecasting facilities which may be summarised as follows:

ORDERING METHODS

1 Random re-ordering with preferred ordering interval

2 Cyclical re-ordering with specified ordering interval

3 Random re-ordering using economic order quantities without regard to quantity discounts

4 Random re-ordering using economic order quantities taking into account quantity discounts

FORECASTING METHODS

1 Box-Jenkins two point predictor

2 Single exponential smoothing

3 Single exponential smoothing using a lagged adaptive response rate

Note: The choice of forecasting method must be made separately for each item.

Using the ordering method and forecasting method chosen by the user, the action of the system is simulated over a selected period of recent history of, preferably, not less than 24 time intervals (weeks or months). Over each time interval the program computes the stock levels that would have resulted from the use of the SCAN System during this period. The actual stock levels may also be computed and the two sets of results printed in tabular form for direct comparison and detailed study. Usually it will be necessary to apply simulation to only a few selected key items in the inventory but the routine imposes no limit on the number of items that may be studied.

The System Simulator is an invaluable supplementary routine especially in situations that require a deep study of the action of the SCAN System. It is valuable also to anyone wishing to understand how the SCAN System works in practice.

INPUT SECTION

One version of the System Simulator accepts punched card input, whilst a second, otherwise identical version, accepts punched paper tape input. Each group of punched cards, or paper tape blocks, relating to one item and forming one input record, is read and fully processed before the next input record is read. The input file formats are given in Chapter 9.

PROCESSING SECTION

Processing is carried out in serial mode one record at a time. Thus, the number of records that can be processed in one pass is unlimited but it will not normally be necessary to process more than a few records, say less than twenty.

The program comprises three main segments:

1 Input, validation and control

2 Simulation

3 Performance analysis

Input, validation and control

This segment reads and checks the input data and is responsible for the overall control of the program. A record is read and its contents are checked for correct format and sequence; the contents are then listed for reference purposes and for a visual check to be made if necessary. If the record contents fail the computer checks then no further processing is carried out on that item and the next record is read. If the data is valid, the simulation segment is entered.

Simulation

In simulation, the process of stock updating, forecasting, ordering and system monitoring is reproduced on a diminished time scale. Time is advanced in the simulator in discrete steps. At each step, a delivery table is scanned and closing stock is updated by receipts. Then, the demand series is scanned, demands are allocated from stock and the closing stock is again updated. If there is insufficient stock to meet demand, the demand is assumed to be back ordered, that is, it is placed on shortage, to be satisfied as soon as further stock is received.

If the time interval currently being examined marks the end of a forecast interval, a new demand forecast is made using the selected forecasting method. The re-order point, re-order quantity and the monitoring signal are computed.

For random re-ordering, the re-order point calculation is based on the re-order point lead time expressed in terms of the forecast interval, without rounding. The order quantity is based on either the ordering interval expressed in the same terms, or on the economic order quantity, whichever is the larger. The economic order quantity calculation uses price breaks, if these have been supplied.

For cyclical re-ordering the re-order point calculation is based on the re-order point lead time plus the order interval, expressed in the same terms as above. The order quantity is set to zero. Economic order quantities cannot be used with cyclical re-ordering but an order interval may be chosen to give an order quantity approximating to the economic order quantity.

If the current period does not end a forecast interval, the re-order point and re-order quantity last calculated are used.

For random re-ordering, the available stock is then compared with the re-order point and if it is insufficient, the raising of a new order is simulated and the delivery table is updated accordingly.

For cyclical re-ordering, the re-order point and available stock are compared only at the end of each order interval. A new order is raised and the delivery table is updated to increase the available stock (physical stock plus stock on order minus back orders) to cover the estimated demand during one lead time plus an ordering interval.

If details of actual receipts have been provided, the closing stock that was actually experienced is calculated.

If the monitoring signal is found to be outside the fixed control limits, an asterisk will be printed. If this situation continues and occurs more than a number of times specified by parameter, emergency values of γ_0 or γ_1, also set by parameter, may be brought into use until the monitoring signal returns to within the fixed control limits.

At the end of the current period, information on the state of the system will be printed and the processing cycle will be repeated for the next period's data.

Initial conditions

In practice, when a new control system is brought into use there should be a period of time during which it is run in parallel with the existing system until the new system settles down and assumes smooth control. The length of time necessary will depend upon the circumstances in which the system is working. There may be outstanding replenishment orders not yet received at the time of handover. The opening stock figure may or may not be appropriate to current needs when judged by the criteria used in SCAN System 3.

The Simulator attempts to accelerate the settling down process so that the best use can be made of the available data.

INITIAL FORECAST

If the user wishes, he may enter an initial deseasonalised forecast. If a user specified value is not available the simulator sets the first forecast equal to the seasonally adjusted average demand in the first re-order point lead time.

If all the seasonal factors for this time period are set to zero, no seasonal adjustment is carried out.

INITIAL MEAN ABSOLUTE DEVIATION

If the instructions for setting up are followed correctly, the error step entered on the control parameter card (see page 196)will be approximately half the standard deviation of forecast errors. The error step is used by the simulator to derive an initial estimate of the mean absolute deviation of forecast errors from which the initial safety stock is then calculated.

From these two initial values, an initial re-order point is calculated (see equation 53 Appendix 1 page 214).

OUTSTANDING REPLENISHMENT ORDERS

The demand in the first lead time is summed and a single order scheduled into period 1 so that the amount delivered plus the opening stock covers that demand. If the opening stock is enough to cover this demand, no delivery is scheduled. This ensures that an inadequate opening stock is brought up to the required level as the simulation starts; this is particularly useful if no opening stock is specified. If, however, the opening stock is excessive, no attempt is made to reduce it artificially and hence the run down of stock by the system is seen in the simulation. This action corresponds roughly to that taken by the system. The system may correct any stock deficiency by a single replenishment order but excessive stock can only be used up. The control system prevents any further orders being placed until the stock has been depleted sufficiently.

If actual receipts and orders are present then the system will be initialized using the actual receipts in the first lead time plus one updating interval.

Performance analysis report

At the end of simulation, a summary of operational statistics is made and reported in tabular form.

OUTPUT SECTION

The output for each item comprises three reports.

1 Parameter Check list

2 Simulation report

3 Performance Analysis report

Parameter Check list

The Parameter Check list provides the opportunity for visual checking of the input data. It is available for reference during study of the reports and it provides a permanent record of the parameters and data on which the simulation was based (see Figure 28, page 190).

Simulation report

The Simulation report comprises a chronological table of which each line represents a time period. It includes details of the System stock, receipts, orders, forecast demand, monitoring signal (where appropriate) and the re-order point. Actual demand is also shown together with actual stock for comparison, if the input data included details (see Figure 29, page 191).

Performance Analysis report

The Performance Analysis report comprises a table summarizing the results of the simulation and quotes totals and averages with their associated standard deviations for the most important quantities in the simulation report (see Figure 30, page 192).

In the two frequency tables, all the abscissae except the last represent the inclusive upper limits of their respective cells. The last value in each case represents the exclusive lowest limit of the cell.

```
 1. 7.67.  RUN 1.                          1900 INVENTORY MANAGEMENT SIMULATOR                          PAGE 1
ITEM AB12345C  SAMPLE DATA
PARAMETER CHECK LIST
                      ITEM     DESCRIPTION  SAFE OI FB      OQ        CP      CO     CS CB CI SM PB TFAC    DES FORC
          CARD 1    AB12345C SAMPLE DATA      XX.X XX XX XXXXXXX XXXXX.XXX XX.XXX XX.XX XX  X  X  X X.XX XXXXXXX.XX
                      ITEM S    CYCLICAL FACTORS:
          CARD 2    AB12345C 1 XXXX.XX XXXX.XX XXXX.XX XXXX.XX XXXX.XX XXXX.XX XXXX.XX XXXX.XX XXXX.XX XXXX.XX
          CARD 2    AB12345C 2 XXXX.XX XXXX.XX XXXX.XX     .00     .00     .00     .00     .00     .00
                      ITEM  L AL      SL BSE DEM   STEP BSE ERROR     STEP   GO   GI  GMI   GP   GE CL STCK TRCON
          CARD 3    AB12345C XX XX     XXX XXXXXXX XXXXXX XXXXXX.XX XXXXX.XX X.XX X.XX X.XX X.XX X.XX XXXXXXX X.XXX
                      ITEM PER  L  DEMAND  RECPTS  ORDERS  L  DEMAND  RECPTS  ORDERS
          CARD 4    AB12345C XXX XX XXXXXXX XXXXXXX XXXXXXX XX XXXXXXX XXXXXXX XXXXXXX
          CARD 4    AB12345C XXX XX XXXXXXX XXXXXXX XXXXXXX XX XXXXXXX XXXXXXX XXXXXXX
          CARD 4    AB12345C XXX XX XXXXXXX XXXXXXX XXXXXXX XX XXXXXXX XXXXXXX XXXXXXX
```

```
          CARD 4    AB12345C XXX XX XXXXXXX XXXXXXX XXXXXXX XX XXXXXXX XXXXXXX XXXXXXX

CONTROL TOTALS      AB12345C   SAMPLE DATA
            ACCUMULATED CONTROLS  XXXXXXX  XXXXXXX  XXXXXXX
            CONTROLS PUNCHED      XXXXXXX  XXXXXXX  XXXXXXX
            DIFFERENCE                  0        0        0

                        ITEM   QUANT     PRICE   QUANT     PRICE   QUANT     PRICE
            CARD 6    AB12345C XXXXXXX XXXXX.XXX XXXXXXX XXXXX.XXX XXXXXXX XXXXX.XXX
```

Notes:

1 Cyclical factor cards only appear where cyclical data is indicated. In the case above the period of the cycle is 12, hence only 12 cyclical factors are present. Note that the remaining space on the second cyclical factor card is filled with zero.

Figure 28 Simulator parameter check list – print format

```
 1. 7.67.  RUN 1.                          1900 INVENTORY MANAGEMENT SIMULATOR                          PAGE 2
ITEM AB12345C  SAMPLE DATA
SIMULATION REPORT


                    RECEIPTS     OPENING STOCK   CLOSING STOCK       ORDERS      TOTAL                          TRACK   ORDER
 TIME    DEMAND  SYSTEM  ACTUAL  SYSTEM  ACTUAL  SYSTEM  ACTUAL  SYSTEM  ACTUAL  DEMAND    ERROR    FORECAST  SIGNL   POINT

  XXX   XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXX.XX XXXXXXX.XX XXX.XX XXXXXX.
  XXX   XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXX.XX XXXXXXX.XX XXX.XX*XXXXXX.
  XXX   XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXX.XX XXXXXXX.XX XXX.XX XXXXXX.
  XXX   XXXXXXX


  XXX   XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXXXX XXXXX.XX XXXXXXX.XX XXXX.XX XXXXXX.
```

Note that the asterisk to the right of the tracking signal of the second iine indicates that an out-of-control condition has occurred.
In this case, there need be no cause for alarm as this condition often occurs in the early stages while the system is "warming up".

Figure 29 Simulator report – print format

```
 1. 7.67.  RUN 1.                            1900 INVENTORY MANAGEMENT SIMULATOR                          PAGE 3
ITEM AB12345C  SAMPLE DATA
PERFORMANCE ANALYSIS
          MEAN DEMAND     .  XXXXXXX.X        MEAN ERROR          XXXXXXX.XX
          STD DEV OF DEMAND  XXXXXXX.X        STD DEV OF ERROR    XXXXXXX.XX
                                              MEAN ABS DEVIATION  XXXXXXX.XX

           DEMAND           FREQUENCY         ERROR               FREQUENCY

          XXXXXXX                 XXX        XXXXX.XX                 XXX
          XXXXXXX                 XXX        XXXXX.XX                 XXX
          XXXXXXX                 XXX        XXXXX.XX                 XXX
```

```
          XXXXXXX                 XXX        XXXXX.XX                 XXX
          XXXXXXX                 XXX        XXXXX.XX                 XXX

                             SYSTEM                                  ACTUAL

          TOTAL DEMAND       XXXXXXX                                XXXXXXX
          % MET EX STOCK         XX.XX                                  XX.XX

          SERIES LENGTH           XXX                                   XXX
          TOTAL STOCKOUTS         XXX                                   XXX
          ALARM SIGNALLED         XXX                                   --
                                     SYSTEM                                  ACTUAL
                                 MEAN        STD DEV                     MEAN         STD DEV
          TOTAL STOCK        XXXXXXX.X    XXXXXXX.X                 XXXXXXX.X    XXXXXXX.X
          ORDER SIZE         XXXXXXX.X    XXXXXXX.X                 XXXXXXX.X    XXXXXXX.X
          QTY. BACKORDERED   XXXXXXX.X    XXXXXXX.X                 XXXXXXX.X    XXXXXXX.X
          SAFETY STOCK       XXXXXXX.X    XXXXXXX.X                    ---          ---
          SYSTEM ACHIEVES XX.X% REDUCTION IN STOCK
```

The last line is printed only if actual data is provided

Figure 30 Simulator performance analysis – print format

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Chapter 9 Simulator input file formats

THE SIMULATOR FILE

This file may be punched on cards or paper tape. To avoid unneccessary duplication the following descriptions refer to the punched card record. Paper tape formats are identical in every respect, the paper tape being punched in 80-character blocks, each block corresponding to one card, with a newline character in position 81.

It should be noted that all fields should be punched right justified. All fields having the value of zero may be punched with a zero, or left blank, whichever is preferred. For paper tape input, any unfilled character positions must be punched with spaces or zeros.

The Simulator file is opened by a header card; it is followed by any number of item records and closes with a trailer card.

HEADER CARD

This card opens the Simulator file and must appear as the first card in the deck. It is identified by a card code '90' and holds the following information.

1 CURRENT DATE. The current date appearing in this field, is output on the title line of each page output. It should be punched in numeric form, with format: *dd mm yy*.

2 RUN NUMBER. The run number appearing in this field is output on the title line of each page of output.

3 PAGE LENGTH. The size in lines of the stationery in use. This should be 66 for 11 inch stationery.

4 RUN ABSTRACT. A short description of the run, output on the title page.

Header card format

Columns	*Field length*	*Field description*	*Remarks*
1 and 2	2	Card code	'90'
3 and 4	2	Day	Integer
5 and 6	2	Month	Integer
7 and 8	2	Year	Integer
9 and 10	2	Run number	Integer
11 and 12	2	Page length	Integer
13 to 16	4	Space	Leave
17 to 80	64	Run abstract	Alphanumeric

PRINCIPLE PARAMETER CARD

The principle parameter card, identified by a card code of 1, heads each item record. It bears the following information.

1 ITEM NUMBER. The item reference number is alphanumeric or plain numeric form and may be up to eight characters long. The item number appears on every card in the record and is sequence checked, it also appears on the output headings.

2 ITEM DESCRIPTION. The item description appears in the headings identifying the output. It may be up to 16 characters in length.

3 SERVICE LEVEL PERCENTAGE. The service level percentage determines the amount of safety stock held. The figure specified should be based on the percentage of demand to be met routinely from stock. The simulator then calculates the safety stock required as described in Appendix 1.

4 ORDERING INTERVAL. The ordering interval determines the approximate average number of periods, up to a maximum of 27, between orders. This should be selected by management.

5 FORECAST INTERVAL. The forecast interval determines the frequency of forecasting. It should be such that in a forecast period the probability of a stock movement is at least 0.5 and the average demand in the interval is at least 10.

6 ORDERING UNIT. The ordering unit is the minimum quantity that can be ordered. Orders are assumed to be made in integer multiples of this quantity.

7 COST PRICE. The cost price is the unit cost per item as used in the Economic Order Quantity (EOQ) formula. Sterling must appear in decimal format. Nine characters are allowed for this field, of which up to three may be the decimal fraction. If the figure entered has less than three places of decimals, the decimal point must be punched. If EOQ is not required this field should be omitted.

8 ORDER COST. The order cost is the order cost per item as used in the EOQ formula. Sterling must appear in decimal format. Six characters are allowed for this field of which up to three may be the fraction. If the figure entered has less than three decimal places the decimal point must be punched. If EOQ is not required this field should be omitted.

9 STOCKHOLDING COST. The stockholding cost is the annual cost of holding stocks expressed as a percentage of average stock value. Five characters are allowed for this field, of which up to two may be the decimal fraction. If the figure entered has less than two places of decimals, the decimal point must be punched. If EOQ is not required this field should be omitted.

10 ANNUAL TIME BASE. The annual time base is the number, in integer format, of forecast periods in a calendar year. If a cycle is present this figure also represents the number of cyclical factors to be expected.

11 CYCLE INDICATOR. The parameter is used to indicate the presence of a cycle in the data for the current item. If a cycle is indicated the program expects cyclical factor cards. If a cycle is not indicated, the program assumes that cyclical factor cards are absent. This parameter should be set to *zero* if a cycle is *present*, and *unity* if a cycle is *absent*.

12 SYSTEM MARKER. Enter the appropriate value from the table:

	Random re-ordering		*Cyclical re-ordering*		*Forecasting method*
System marker	1	,	6	–	Box-Jenkins two point predictor.
System marker	2	,	7	–	Single exponential smoothing.
System marker	3	,	8	–	Single exponential smoothing with lagged adaptive response rate.

13 PRICE BREAK INDICATOR. The price break indicator field should be used only if economic order quantity parameters have been input. A value '1' indicates that price break information is being entered for this item using card code 06 (see *Price breaks card* page 199). If price breaks are not being used, a space or a zero must be entered.

14 TREND FACTOR. The trend factor may be employed by the user to impose on the forecasting expected increase or decrease in demand annually. A factor of 1.25 would indicate a 25% increase in demand annually whereas a factor of 0.85 would indicate a 15% decrease (see Appendix 1). If the facility is not required, a space or a zero must be entered.

15 DESEASONALISED FORECAST. The deseasonalised forecast may be used to provide the simulator with an initial forecast value from which the simulator forecasting may start. If this facility is not required, a space or a zero must be entered, in which case an initial forecast as described in Chapter 8, page 189 will be calculated by the simulator.

Principal parameter card format

Columns	*Field length*	*Field description*	*Remarks*
1 and 2	2	Card code	01
3 to 10	8	Item number	Alphanumeric
11 to 26	16	Item description	Alphanumeric
27 to 30	4	Service level percentage	*xx.x* (see Appendix 2)
31 and 32	2	Order interval	Integer
33 and 34	2	Forecast interval	Integer
35 to 40	6	Order unit	Integer
41 to 49	9	Unit cost per item	*xxxxx.xxx* (only if EOQ)
50 to 55	6	Order cost per item	*xx.xxx* (only if EOQ)
56 to 60	5	Stockholding cost	*xx.xx* (only if EOQ)
61 to 62	2	Annual time base	Integer
63	1	Spare	Zero filled
64	1	Cycle indicator	1 if cycle absent 0 if cycle present
65	1	System marker	See text
66	1	Price break indicator	See text
67 to 70	4	Trend factor	*x.xx*
71 to 80	10	Deseasonalised forecast	*xxxxxxx.xx*

CYCLICAL FACTOR CARDS

Cyclical factor cards are necessary only if a cycle is present in the data; they hold a set of cyclical factors applicable to the current situation.

Cyclical factor cards, identified by a card code 2 hold the following information:

1 ITEM NUMBER. This item number must agree with that punched in the principal parameter card.

2 SEQUENCE NUMBER. Each cyclical factor card is numbered with a sequence number to ensure that cyclical factors are input in the correct sequence. Data input out of sequence is rejected.

3 CYCLICAL FACTORS. Seven characters are allowed for each cyclical factor, of which two may be decimal fractions. Note that if the figure entered contains less than two places, the decimal point must be punched.

Up to nine factors in their correct time sequence may appear on each card. If the sequence ends in mid-card, the remaining fields must be zero filled.

The number of cyclical factors appearing must agree with the time base of the annual cycle entered on the principal parameter card. Otherwise, the data may be rejected.

Cyclical factor card format

Columns	*Field length*	*Field description*	*Remarks*
1 and 2	2	Card code	02
3 to 10	8	Item number	As on principal parameter card
11	1	Card sequence	Must exceed predecessor. Integer.
12 to 18	7	Cyclical factor	*xxxx.xx*
19 to 25	7	Cyclical factor	*xxxx.xx*

Columns	*Field length*	*Field description*	*Remarks*
26 to 32	7	Cyclical factor	*xxxx.xx*
33 to 39	7	Cyclical factor	*xxxx.xx*
40 to 46	7	Cyclical factor	*xxxx.xx*
47 to 53	7	Cyclical factor	*xxxx.xx*
54 to 60	7	Cyclical factor	*xxxx.xx*
61 to 67	7	Cyclical factor	*xxxx.xx*
68 to 74	7	Cyclical factor	*xxxx.xx*
75 to 80	6	Spare	-

CONTROL PARAMETER CARD

The control parameter card, identified by a card code 3, holds the following information:

1 ITEM NUMBER. The item number must agree with that punched on the principal parameter card.

2 RE-ORDER POINT LEAD TIME. This is the length of time that is likely to elapse between the raising of an order and its subsequent delivery. This value is used as the basis for the calculation of the re-order point throughout simulation. It should be distinguished from the lead time used to schedule deliveries (see page 198).

3 ALARM LIMIT. This is the maximum number of consecutive forecast periods during which the system may be allowed to depart from prediction optimality before emergency action is taken.

In a real situation, the emergency action taken would depend on management's appreciation of the circumstances but the simulator uses a rule of thumb.

When the alarm limit is exceeded, different courses of action are followed by the simulator depending on the system marker in use:

(a) For system markers 1 and 6, if gamma one equals zero, it is reset to an emergency value which continues in use until control is regained, at which point it is set to zero again.

(b) For system markers 2 and 7, the gamma zero value is overwritten by an emergency value if that emergency value is greater than gamma zero. Use of the emergency value continues until control is regained, at which point gamma zero is restored to its original value.

(c) For system markers 3 and 8, no emergency action in addition to that inherent in the lagged adaptive response rate technique is required.

4 TOTAL SERIES LENGTH. This is the total number of demand points in the data series. The maximum permissible value for this item is 312.

5 BASE DEMAND. Demands are classified during performance analysis in the form of a frequency table. This field holds the starting value of demand from which 20 equal steps are made to form the 21 cells into which demands are classified and counted. The value entered in this field must be a positive integer.

6 DEMAND STEP. The demand step is the cell separation in the demand frequency table. 20 steps are made starting at the base value mentioned above. The value entered in this field must be a positive integer.

7 BASE ERROR. Errors are similarly classified during simulation for output during performance analysis. This field holds the starting value of the forecasting error from which 20 equal steps are made to form the 21 cells into which errors are classified and counted.

Errors tend to be spread evenly about zero. The base error should therefore be ten steps below zero (see *Error Step* below). If this parameter is set to zero, the base error is computed by program on this basis.

Seven characters are allowed for this parameter of which up to two may be the decimal fraction. The decimal point must be included as for 8 below. Note also that, for negative values, the minus sign must be punched.

8 ERROR STEP. The error step is the cell separation in the Error Frequency table. 20 steps are made starting at the base value mentioned above. The step size should approximate to one half the standard deviation of

forecast errors. If this parameter is set to zero, the program will use the demand step.

Six characters are allowed for this field, of which up to two may be the decimal fraction. The decimal point must be included if less than two places appear.

9 CONTROL PARAMETERS. This field holds the values of the control parameters used in the forecasting model and the system monitoring equations. Four characters are allowed for each parameter two of which may be the decimal fraction. If less than two places appear, the decimal point must be included.

(a) GAMMA ZERO (γ_0). This is the proportional control parameter in the Box-Jenkins forecasting model. A value must be entered for system markers 1, 2, 6 and 7. The value should be 0.1 in order to simulate the system, but users may select other values, although values greater than 0.5 are not normally used.. Any value entered for system markers 3 and 8 will be regarded as a minimum value to be used. If the field is left blank for system markers 3 and 8, the simulator will assume a value of 0.1.

(b) GAMMA ONE (γ_1). This is the cumulative control parameter in the Box-Jenkins forecasting model. In order to simulate the system a value of 0.1should be entered for system markers 1 and 6, but another value may be selected by the user, although values in excess of 0.3 are not normally used. Any value entered for system markers 2, 3, 7 and 8 will be ignored.

(c) GAMMA MINUS ONE (γ_{-1}). This is the difference control parameter in the Box-Jenkins forecasting model. This is not included in SCAN System 3 and should normally be set to zero. If this parameter is included, however, experiments can be carried out on the effects produced by non-zero values.

(d) GAMMA PRIME (γ_0^1). This is the smoothing parameter used in the calculation of the smoothed mean error, smoothed mean absolute deviation of the error and the tracking signal. A value of 0.17 is recommended.

(e) EMERGENCY GAMMA (γ_e). This emergency value of gamma is brought into use when the number of consecutive alarms reaches the alarm limit. The action then taken is described under *alarm limit* above. The value selected for γ_e will depend upon circumstances, but it should not exceed 1. For system markers 1 and 6 a value of 0.3 will usually give good control, whereas for system markers 2 and 7 a value as high as 0.5 may be better. Any value entered for system markers 3 and 8 will be ignored.

10 INITIAL CLOSING STOCK. This is the physical closing stock at the end of the period immediately preceding the first period simulated.

11 TRANSFORMATION CONSTANT. This is the parameter A to be used in the transformation process for lagged adaptive response rate (see Appendix 1, page 206). An entry is only applicable for system markers 3 or 8. A blank entry in these cases will cause the standard value of 0.125 to be used.

Control parameter card format

Columns	*Field length*	*Field description*	*Remarks*
1 and 2	2	Card code	03
3 to 10	8	Item number	As on principal parameter card
11 and 12	2	Re-order point lead time	Integer
13 and 14	2	Alarm limit	Integer
15 to 17	3	Spare	Zero filled
18 to 20	3	Total series length	Integer ($\leqslant$312)
21 to 27	7	Base demand	Integer
28 to 33	6	Demand step	Integer
34 to 40	7	Base error	*xxxx.xx*
41 to 46	6	Error step	*xxx.xx*
47 to 50	4	Gamma zero (γ_0)	*x.xx*
51 to 54	4	Gamma one (γ_1)	*x.xx*
55 to 58	4	Gamma minus one (γ_{-1})	*x.xx*

Columns	*Field length*	*Field description*	*Remarks*
59 to 62	4	Gamma prime (γ_0')	*x.xx*
63 to 66	4	Emergency gamma	*x.xx*
67 to 73	7	Initial closing stock	Integer
74 to 78	5	Transformation constant	*x.xxx*
79 and 80	2	Spare	-

DEMAND DATA CARDS

These cards give details of demand, orders and receipts. Two time periods are covered per card.

Demand data cards are identified by a card code of 4 and hold the following information:

1 ITEM NUMBER. This item number must agree with that punched on the principal parameter card.

2 PERIOD NUMBER. This is the date of the first set of data appearing on the current card. This item is sequence checked. The period number of the first data point on the first demand data card should be unity.

3 LEAD TIME. The lead time is the time interval that must elapse between the raising of an order and its receipt. This value controls the scheduling of deliveries. The re-order point is calculated using the value given for the lead time in the control parameter card.

The lead time must be included for every time period. A zero or blank will result in immediate delivery of any order raised at that time.

4 DEMAND. This is the actual demand experienced in the current period, the date of which is given by the period number above.

5 RECEIPTS. The receipts are the actual stock received during the current period. This is assumed to have been received in a single delivery at the beginning of the period. If this information is not available it may be omitted but if so, it may be impossible to compare the system with actual experience. If receipts are entered, the first few receipts are assumed to exist as outstanding orders at the beginning of simulation.

6 ORDERS. The orders are those actually placed by the user's system during the current period. This is assumed to have occurred at the end of the current period. If this information is not available, it may be omitted, in which case it will not be possible to compare system and actual order patterns.

7 LEAD TIME, DEMAND, RECEIPTS, ORDERS. These fields contain the same information as above but relating to the period following that covered by the first half of the card. If that period was the final one of the data provided, this second set of fields should be punched with zeros.

Demand data card format

Columns	*Field length*	*Field description*	*Remarks*
1 and 2	2	Card code	04
3 to 10	8	Item number	As on principal parameter card
11 to 13	3	Period number (t)	Integer
14 to 15	2	Lead time (t)	Integer
16 to 22	7	Demand (t)	Integer
23 to 29	7	Receipts (t)	Integer
30 to 36	7	Orders (t)	Integer
37 and 38	2	Lead time ($t + 1$)	Integer
39 to 45	7	Demand ($t + 1$)	Integer
46 to 52	7	Receipts ($t + 1$)	Integer

Columns	*Field length*	*Field description*	*Remarks*
53 to 59	7	Orders (t + 1)	Integer
60 to 80	21	Spare	-

CONTROL TOTALS CARD

In the absence of a Price Breaks Card (card code 06 below) this card marks the end of an item record. It holds control totals of demand, orders and receipts accumulated over the whole data series for that item. These totals are checked by program and control lines and are output giving the results of the control check. If the control totals do not agree, an error message is output, and simulation is not undertaken. In this case the program goes on to process the next item.

The Control Totals card is identified by a card code of 5 and holds the following information:

1 ITEM NUMBER. This item number must agree with that punched on the principal parameter card.

2 TOTAL DEMAND. This is the total demand accumulated over the data series of the current item.

3 TOTAL RECEIPTS. This is the total receipts accumulated over the data series for the current item.

4 TOTAL ORDERS. This is the total orders accumulated over the data series for the current item.

If the three totals fields are zero filled, this check will not be performed.

Control totals card format

Columns	*Field length*	*Field description*	*Remarks*
1 and 2	2	Card code	05
3 to 10	8	Item number	As on principal parameter
11 to 17	7	Total demand	Integer
18 to 24	7	Total receipts	Integer
25 to 31	7	Total orders	Integer
32 to 80	49	Spare	-

PRICE BREAKS CARD

This card should only be present if the *price break indicator* of card code 01, the principal parameter card, has been entered as 1. It carries information relating to supplier quantity discounts. Price break quantities, the quantities at each of which the supplier offers a reduction in unit price, must increase in sequence accross the card the smallest being greater than zero. Price breaks, the unit prices which correspond to the price break quantities, must decrease across the card, the largest being smaller than the *cost price* which appears on card 01. If less than three discounts are available, enter zero's for the missing pair(s). Any missing pair(s) must be the right hand entries on the card.

The Price Breaks card is identified by a card code of 6 and holds the following information:

1 ITEM NUMBER. This item number must agree with that punched on the principal parameter card.

2 PRICE BREAK QUANTITY

3 PRICE BREAK

4 PRICE BREAK QUANTITY

5 PRICE BREAK

6 PRICE BREAK QUANTITY

7 PRICE BREAK

Price breaks card format

Columns	*Field length*	*Field description*	*Remarks*
1 and 2	2	Card code	06
3 to 10	8	Item number	Alphanumeric
11 to 17	7	Price break quantity	*xxxxxxx*
18 to 26	9	Price break	*xxxxx.xxx*
27 to 33	7	Price break quantity	*xxxxxxx*
34 to 42	9	Price break	*xxxxx.xxx*
43 to 49	7	Price break quantity	*xxxxxxx*
50 to 58	9	Price break	*xxxxx.xxx*
59 to 80	22	Spare	-

TRAILER CARD

This card marks the end of the Simulator file. When it is detected, the program is brought to a halt and the message HALTED 1 is printed on the console typewriter.

The trailer card is identified by a card code of '99' punched in columns 1 and 2. This card bears no further information. When paper tape is being used, this record will have 99 punched in the first two positions followed by zeros or blanks to position 80, then a newline.

Trailer card format

Columns	*Field length*	*Field description*	*Remarks*
1 and 2	2	Card code	99

Chapter 10 Running the simulator

PROGRAM SUMMARY

Program

#X43M (punched card input)

#X43N (paper tape input)

Priority

The simulator program has a priority of 50.

Hardware requirement

The following hardware is required

1 11500 words of core store

2 One line printer (120 print positions)

3 One card/paper tape reader

4 Floating point facilities (hardware or extracode)

Use of peripherals

All peripherals are alloted by program. They are required for the whole of the program.

Description

See Chapter 8.

Input

The Simulator file is input on punched cards or paper tape (see Chapter 9).

Output

The following are output by the Simulator program:

1 Parameter check list (see Figure 28, page 190)

2 Simulation report (see Figure 29, page 191)

3 Performance analysis (see Figure 30, page 192)

All the above are described and illustrated in Chapter 8.

RUN INSTRUCTIONS

	Narrative	*Console Message*
1	Load input peripheral with simulator file.	
2	Load program #X43M (card input) Load program #X43N (paper tape input)	
3	If input on punched cards, activate by message:	GO#X43M 20
	If input on paper tape, activate by message:	GO#X43N 20

Narrative	*Console Message*
4 At end of run, program is suspended with message:	0#X43M HALTED 1 or 0#X43N HALTED 1

EXCEPTION CONDITIONS

Invalid input data is reported on the line printer in the Parameter Check list. Each report gives details of the item number and the type of error as follows:

1 CARD SEQUENCE ERRORS. Item records are input in card code sequence beginning with code '1' and ending with code '5' or '6'. Any departure from this sequence brings about a sequence error.

Sequence errors may be caused by mispunching, tranposition, omission or any combination of these. It should be noted that cyclical factor cards must appear only when a cycle is indicated. Any departure from this rule causes a sequence error. A sequence error may also be caused when the number of demand data cards is greater or less than the number indicated by the series length parameter on the control parameter card.

2 ITEM SEQUENCE ERROR. Each card in each record is identified on alphanumeric item number. The item number on each card is checked against the item number entered on card 1. Any departure from exact identity is rejected.

3 CYCLICAL FACTOR SEQUENCE. The sequence number entered on each cyclical factor card should exceed that of its predecessor. This prevents cyclical factors going into the machine in the wrong order.

4 SERIES LENGTH OMITTED. If the series length is omitted from the control parameter card, the program is unable to handle the demand data cards which follow, and this report is output.

5 PERIOD NUMBER SEQUENCE. The period number entered on each demand data card should exceed that of its predecessor. This prevents the demand series going into the machine in the wrong order.

6 LENGTH OF DATA SERIES EXCEEDS 312. The simulator is limited to 312 points of demand data and a series length in excess of this figure is unacceptable.

7 INSUFFICIENT PARAMETERS. This report is output if any of the following items of data is absent:

(a) Annual time base

(b) Forecast base

(c) All of the Box-Jenkins control parameters for an item with system marker 1 or 6

(d) Gamma zero for an item with system marker 2 or 7

8 CONTROL ERRORS. If the control totals entered on the Control Totals card do not agree with those calculated by machine, a non-zero difference is reported and simulation will not proceed.

Certain other reports may occur during running, after the Parameter Check List stage, as follows:

9 FIELD OVERFLOW. Where an item of data for output exceeds the space available to accommodate it, its space is filled with asterisks. This means that the data used is too great for the simulator to cope with and must be scaled down before re-running.

Note: the asterisk that appears alongside the tracking signal is the alarm signal and not an overflow.

10 END OF CYCLE RE-ANALYSIS REQUIRED. Where data is cyclical, this report is output at the end of each cycle to indicate that a re-analysis is necessary. Simulation does not stop, however, and no re-analysis actually takes place. The report merely indicates what should be done in a true operational environment.

11 ALARM LIMIT REACHED-EMERGENCY CUM CONTROL PARAMETER IN OPERATION. This report may appear during simulation where the number of consecutive alarms exceeds the alarm limit. Simulation continues using the emergency value until control is regained.

Appendix 1 Mathematical description

GENERAL

The logical procedures described in Chapter 3, page 21, provide the basic organization of an adaptive inventory control system which seeks to minimize stock holdings while taking account of the current level of demand and management policy on provisioning and customer service level. Each branch location is treated individually or, if required, in combination with others in the same group.

This chapter states the mathematical structure of the system and discusses the theoretical foundation of the techniques employed. Stated in these terms, the system is independent of the machine configuration used.

Those readers wishing to make a more detailed study of modern inventory control techniques, should refer to the bibliography of original sources in Appendix 3.

The basis of the ICL SCAN System 3 is an automatic forecasting process that regularly formulates a new estimate of future demand for each item in the inventory. This process requires information on actual demand at fixed, constant time intervals. Moreover, the demand must be expressed in relation to a constant time period, the basic time period of the system. Operationally the basic time period is the interval between successive runs of the Forecasting routine. Whatever basic time period is chosen, all other time intervals used by the system must be expressed as multiples of it.

In most cases, a basic time period of one week is to be preferred, but a two or four week period may be used on occasion. The use of the calendar month is to be avoided whenever possible unless the demand on the inventory is geared to the calendar month itself rather than the number of working days in the month. An accounting structure linked to the calendar month need have no influence on the basic period chosen for the inventory control system.

The system requires that the updating interval (the interval between successive stock updating runs) is no longer than the basic time period and that the two are in phase, that is, the end of each basic time period coincides with the end of a stock updating interval. Overall system considerations generally decide the stock updating interval.

The terms *movement* and *stock movement* are used in the general sense of meaning any event which, when recorded, will result in a change in one of the balance quantities in the stock record for the item concerned, for example, a demand or unscheduled issue, a replenishment order, a stock receipt or an adjustment entry. *Orders* relate to orders for stock replenishment. *Demand* is demand on the inventory for the supply of a quantity of an item; it is assumed to be satisfied immediately, or back-ordered if not covered by the stock balance.

The 1900 SCAN System offers a choice between random and cyclical re-ordering. The former allows replenishment orders to be requested by any stock updating run; the latter confines re-ordering to one selected updating run in each basic time interval. Operational requirements will usually determine the preferred method but if the updating interval is a week or longer, and if the lead time or the order cycle time is short, technical considerations will suggest cyclical re-ordering.

Demand may be notified to the system either prior to the issue of stock to satisfy that demand (pre-posting of issues) or in arrears of the issue (post posting of issues) using unscheduled issues or branch stock counts.

Where random re-ordering is used, the updating interval should be kept as short as possible.

The system assumes that all stock replenishment orders requested will be placed immediately and for the quantity stated. Any variation on quantity must be reported back as an adjusting entry. The replenishment, delivery or lead time (D) is the time required to secure delivery into stores counted from the point when the system requested the order. For items ordered at random, the forecasting routine adds half the updating interval to this lead time by run parameter card.

STOCK UPDATING ROUTINE

The inventory control system must be fed with data on an organized basis. In the practical situation it is convenient for the Stock Updating routine to perform this function.

This routine is also the point of action of the control system: it tests the available stock against the re-order point and issues requests for any replenishment orders required.

For each branch in the Stock Master file, for any stock updating interval (t'), let

$y(t')$ = demand
$D(t')$ = stores receipts
$R(t')$ = orders placed other than by the system

} during interval t'

Let

$C(t')$ = physical (bin) stock
$O(t')$ = outstanding order balance
$U(t')$ = unallocated demand, or back-order balance

} at end of interval t'

Let $C(t'-1)$, $O(t'-1)$ and $U(t'-1)$ have equivalent meanings as at the start of interval t' (that is, at the end of interval $t-1$).

Let $I(t')$ be the length of the updating interval and $I(t)$ be the length of the basic time unit of the control system. $I(t') \leqslant I(t)$ and $I(t)/I(t')$ is an integer.

Closing stock

$$S(t') = C(t'-1) - U(t'-1) + D(t') - y(t') \qquad 1$$

If $S(t') < 0$,

$$C(t') = 0 \text{ and } U(t') = -S(t)$$

Otherwise

$$C(t') = S(t') \text{ and } U(t') = 0$$

Available stock*

$$A(t') = S(t') + O(t'-1) + R(t') - D(t') \qquad 2$$

Re-order Quantity*

If $P_{T+1} > A(t')$,

$$R = R_M \left[\text{Integral part of} \frac{R_{T+1} + P_{T+1} - A(t')}{R_M} + 1 \right] \qquad 3$$

Unless $[R_{T+1} + P_{T+1} - A(t')]/R_M$ is an integer, when

$$R = R_{T+1} + P_{T+1} - A(t') \qquad 3a$$

If $P_{T+1} < A(t')$, 3b

$$R = 0$$

where

P_{T+1} = Re-order point (see equation 53, page 214).
R_{T+1} = System re-order quantity
R_M = Unit order size, such that quantity ordered must be an integer multiple of R_M. If not applicable, R_M is taken as 1.

and R = Quantity to be ordered.

*Quantities marked thus are appropriate only to stores items controlled on a re-order point basis. The stock record updating process must however, deal with all items in the inventory.

Notes:

1 Equation 3 is used for both cyclical and random re-ordering. In the former case, it increases the order cover to one lead time plus one ordering interval. In the latter case it prevents another replenishment order from following quickly after the current one if a large demand has depleted that stock well below the re-order point.

2 If a maximum order quantity has been specified for the item, R will not be allowed to exceed this. If the maximum is less than the calculated value, the reduction imposed on R is reported for management information.

3 If cyclical ordering is used for the item, R will not be calculated unless permitted by run parameter. When such permission is given, the system will respond only if the item is at the end of its ordering cycle. If permission for cyclical reordering is given twice in the same basic interval, the second occasion will be ignored by the system.

Outstanding order balance

$$O(t') = O(t' - 1) + R(t') - D(t') + R \qquad 4$$

DEMAND FORECASTING

Forecast interval

It is desirable that the demand is relatively homogeneous with respect to the forecast interval (T) since short-term forecasting techniques are not appropriate to an item which 'moves' infrequently. The forecasting system treats the total demand in each forecast interval as a single item of data. Consequently, extending the forecast interval increases the frequency of movement as seen by the forecasting system. The observed demand in each forecast interval (T) is a sample taken from the demand time series y_T. Increasing the forecast interval increased the sample size and hence stabilizes y_T.

At the same time, the speed of response of the system to real changes in demand is reduced. A balance between the two effects must be achieved by selection of a suitable $I(T)$, the length of the forecast interval, for each item.

The criterion used is:

Select $I(T)/I(t) = 1, 2, 4, 13, 26$ to satisfy: 5

$P(y_T>0)\geqslant 0.5$ and $\bar{y}_T \geqslant 10$ 6

where

$I(t)$ = basic time unit of the system (usually one week).

$P(y_T>0)$ = probability that demand y_T in forecast interval T is not zero.

$\bar{y}_T$ = average value of y_T.

Thus the length of the forecast interval is chosen to secure at least one movement in each two intervals, for example (T) and ($T+1$), and in addition an average demand in a forecast interval of not less than 10. This is the minimum forecast interval: overall system considerations may require a longer interval.

The above rule is generally sufficient for $I(T) \leqslant 4$ weeks. If $I(T) > 4$ weeks, it is recommended that an alternative method of control be applied. This is not a theoretical necessity, however, and any item may be included in the adaptive control system (subject to observance of 6 above) if other considerations demand it.

Consideration of adaptive prediction techniques to be used at group level

The traditional method of demand forecasting is the moving average, defined as:

$$\hat{y}_{T+1} = \frac{1}{N}\sum_{i=1}^{N} y_{T-N+i} \qquad 7$$

where

y_{T+1} is the one-period ahead forecast made at time (T)

$NI(T)$ = the time base period of the moving average.

y_j = the demand in period j; $j = T-N+i$

This method is reasonably satisfactory if the demand is stable, or changes only slowly with time. It has some advantages in dealing with cyclical variations in demand, provided that N is chosen to correspond to the base period of the cycle and that there is no large change in mean level of demand between one cycle and the next.

However, unless N is small, the moving average is sluggish in responding to step changes in demand and in following trends. Whilst the effect of an impulse (a single large demand) is minimized by large N, this effect is retained in the forecast for full N periods. Moreover, it is difficult to change the sensitivity of the system (N must be changed to do this) and almost impossible to do so if cyclical variations in demand are present.

To overcome these disadvantages, considerable research has been conducted into short-term forecasting techniques in recent years, the work by Brown (1959 and 1963) on exponential smoothing being the most widely known. The later technique employs the classical approach of assuming a fixed time-series model, giving for the linear case a one-period ahead prediction as:

$$\hat{y}_{T+1} = U_T + b_{T/p} \qquad 8$$

where Average Value $U_T = py_t + (1 - p)U_{T-1}$ 9

and Trend Value $b_T = q(U_T - U_{T-1}) + (1-q)b_{T-1}$ 10

and $0 < p \leqslant 1$ and $0 \leqslant q \leqslant 1$ 11

A predictor is unbiased when $\bar{e} = 0$ (e = forecast error) and is assumed to be optimal when Σe^2 is a minimum. Minimum Σe^2 is preferred to minimum σ_e^2 (σ_e^2 = error variance) as a criterion of optimality because the former, used as a sole criterion, is not influenced by bias in the error.

Use of exponential smoothing may in practice require a computer simulation using historic y_T to find appropriate p and q for optimal forecasting.

Box and Jenkins (1962) have developed a generalized adaptive prediction technique, derived from automatic control theory, which gives a one-period ahead forecast (y_{T+1} made at time T for period $T + 1$) as:

$$y_{T+1} = y_T + \gamma_{-1}\,\Delta e_T + \gamma_0 e_T + \gamma_1 \sum_{j=1}^{T} e_j \qquad 12$$

where $\hat{y}_T$ = forecast for period (T) made at time ($T - 1$)

e_T = forecast error at time (T) ($e_T = y_T - \hat{y}_T$)

y_T = demand in period (T)

$\Delta e_T = e_T - e_{T-1}$

and γ_{-1}, γ_0 and γ_1 are prediction parameters.

The second, third and fourth terms of the R.H.S. of equation 12 are known as the difference, proportional and cumulative control terms respectively, and correspond to the differential, proportional and integral terms, respectively, in automatic control theory.

Box and Jenkins (1962, page 314) state that the difference control term is not generally required for prediction purposes, and it is therefore necessary to derive a suitable pair of γ_0 and γ_1 to ensure that Σe^2 for the item being forecast is minimized. In many cases, satisfactory control is established by the choice of $\gamma_0 = \gamma_1 = 0.1$, whereas in special situations other values may be more appropriate. The SCAN System 3 is based on the use of the fixed γ_0 and γ_1 values although other values may be entered by the user at file maintenance time or during the analysis phase (Control System Selection or Demand Analysis).

Alternatively the user may use the one point Box-Jenkins predictor (single exponential smoothing) in which case $\gamma_0 = 0.1$ and $\gamma_1 = 0$. The user may overwrite the value of γ_0 by the file amendment if he requires.

During operation of the Forecasting routine, prediction optimality is tested using a tracking signal (see equation 57). In the case of the two point predictor, loss of optimality causes the use of a user specified emergency γ_1 (0.3 is suggested) where the existing demand history record value is zero. This would normally cause the forecast system to become very responsive and to assume the new level of demand quickly. When acceptable forecasting is achieved, the emergency γ_1 value is relinquished. A similar course of action applies for the one point predictor except that in this case an emergency γ_0 is used (0.5 is suggested).

If the introduction of the emergency γ_1 or γ_0 fails to restore system optimality, fuller investigation is necessary before the prediction parameters can safely be changed.

In addition to the two forecasting techniques described above, a development of single exponential smoothing is offered which uses an automatically updated proportional control constant. This method exists in several versions, but the one adopted in SCAN System 3 is the lagged adaptive response rate technique. In its simplest form, the constant γ_0 is set equal to the tracking signal (see page 215) for the last period.

Hence $\hat{y}_{T+1} = \hat{y}_T + |\tau_T| e_T$ 13

where $\tau_T = \hat{e}_T / \hat{d}_T$ 14

For practical reasons the method is not used exactly as stated in equation 13. Direct equality between the proportional control constant and the tracking signal is found to give a system which is too responsive. In addition, in situations where reversal of the sign of the smoothed error is occurring and where good response is required the tracking signal becomes very small. It is therefore necessary to transform the tracking signal using the following relationship:

$$\gamma_0 = A\left[e^{K(|\tau| - q)} - 1\right] + q \quad 15$$

where $K = [1/(1-q)]\ log_e\ [1+(1-q)/A]$

A = a transformation constant

q = the minimum value to which γ_0 may be allowed to fall.

The preset values for A and q in the SCAN 3 system are 0.125 and 0.1 respectively, although they may be overwritten by the user at forecasting run time if required.

This technique is found to give very good performance over a wide range of demand patterns and is particularly suitable in situations where impulse and step changes occur. It has the additional benefit that it requires no prior analysis to establish a suitable control constant since it will rapidly establish the required value automatically. This will be continually adjusted in the light of prevailing conditions.

Because of this system's automatic response to changing demand levels the concept of emergency constants being brought into use under certain situations is not required.

DEMAND ANALYSIS PHILOSOPHY

In certain circumstances it is preferable to carry out a detailed analysis of historical demand data prior to running the operational routines. Not only does this allow error statistics to be accumulated (smoothed mean absolute deviation, for example) in order to enable the forecasting routine to achieve control accurately from its first use, but it also means that an item can be examined for the special characteristics of trend and seasonality. In the context of SCAN System 3 these may be broadly defined as follows:

1 *Trend* is present if the demand for an item demonstrates a reasonably steady increase or decrease from one forecast period to the next.

2 *Seasonality* is present if the demand for an item varies according to a repeating cycle of values, that is if peaks and troughs in the demand curve for one year occur in the same places as peaks and troughs in adjacent years.

The most satisfactory method of dealing with these characteristics in SCAN System 3 is by the use of a trend factor and seasonal factors.

All Demand Analysis processing is performed on a demand series which has been reduced to a series expressed in terms of the forecast interval (see equations 5 and 6, page 205). Thus, for example, with a forecast interval of 2, the adjacent demand points 1 and 2 would be added together, as would be the adjacent demand points 3 and 4, 5 and 6, 7 and 8, and so on, reducing the demand series to half its original length. If the reduced series does not contain at least 4 points, no further processing is carried out.

Evaluation of the trend component

It is not possible to detect reliably the presence of well established trend using SCAN System 3 unless the length of the reduced series is at least one year plus twelve points. If this condition is not satisfied the trend factor, which indicates any increase or decrease in demand from one year to the next, is set equal to 1. The user may overwrite this value if he wishes.

If sufficient points are available in the reduced series, then corresponding points for each of the two years are compared.

Let x_i be the reduced demand series for the first year and $x_{M'+i}$ be the reduced demand series for the second year (in which, to satisfy the condition stated above, there must be at least twelve points).

Comparison of the corresponding points results in 0 or 1 being added into an accumulation S according to the following conditions:

If $x_i \geqslant x_{M'+i}$: score 0

$x_i < x_{M'+i}$: score 1

Assuming a binomial distribution for S, then the mean and standard deviation for S are given by $N/2$ and $\sqrt{(N)}/2$ respectively, where N is the number of accumulations made.

For sufficiently large N, the binomial distribution approximates to a normal distribution, and a standardised S may be derived:

$$P = \frac{S - N/2}{\sqrt{(N)}/2}$$

$$= 2S - N/\sqrt{N} \qquad 16$$

In addition, the following ratio between demand summations is established:

$$R = \sum_{1}^{N} x_{M'+i} \Big/ \sum_{1}^{N} x_i \qquad 17$$

The hypothesis that trend is present is accepted if

$$P > \text{SIG2 and } R > 1.05 \qquad 18$$

or $$P < -\text{SIG2 and } R < 0.95 \qquad 19$$

where SIG2 is the confidence level specified by the user at run time.

If the presence of trend is accepted, the demand history record value of trend factor is set equal to R.

Evaluation of the seasonal component

It is a requirement that two years' demand history be available for the calculation of seasonal factors in SCAN System 3. In the absence of this, if an item is known to be seasonal, the user must specify his own seasonal factors during file maintenance.

It would be a sufficient test of the significance of cyclical variations (seasonality) present in a demand series if correction for them led to better forecasting (evidence of which would be smaller safety stocks). However to test the demand history of every inventory item would require a long simulation which should be avoided.

The serial correlation coefficients of a demand series respond to the presence of seasonality if the time lag for which the coefficient is calculated is small, or is approximately equal to the cycle base (M') which is the length of the cycle. Where r_k = serial correlation coefficient for lag k, it is therefore necessary to test $r_{M'}$ for significance. For reasons explained later, r_1 is also examined in the same way.

The test used is a non-parametric one which has the effect of studying the distribution of the correlation coefficients (for constant k) arising from all possible arrangements of the demand points and deciding (at a preset level of confidence - 90% is suggested) if the actual r_k could have been due to chance causes. If the demand pattern is such that it could be explained by a model containing both trend and seasonality, $r_{M'}$ may, because of the nature of the test used, appear to be non-significant. Since r_1 is generally found to be present if either trend or seasonality or both are present, r_1 is subjected to the same test.

For computational convenience, the circular form of the serial correlation coefficient is used, and of this, only the cross product term need be examined because the other terms (see equation 21) would not change if the sequence of demand points were re-arranged.

Serial Correlation Coefficient

$$r_k = \frac{\sum_{i=1}^{N'-k} x_i y_i - (N'-k)\,\bar{x}\,\bar{v}}{(N'-k)\,\sigma_x \sigma_y} \quad \text{standard form} \qquad 20$$

$$r_k = \frac{\sum_{i=1}^{N'} x_i y_i - N'\,\bar{x}\,\bar{y}}{N'\sigma_x \sigma_y} \quad \text{circular form} \qquad 21$$

where k = lag = 1, 2, 3, . . ., M'

y_i = demand in period i = 1, 2, 3, . . . , N'

x_i = y_{i+k} (i to modulo N')

Significance Test

Only the cross product term $\sum_{i=1}^{N'} x_i y_i$ in equation 21 need be considered as noted above.

If $r'_k = \sum_{i=1}^{N'} x_i y_i$ it has been shown that

$$\bar{r}'_k = \frac{S_1^2 - S_2}{N' - 1} = \text{mean } (r'_k) \qquad 22$$

and $$\sigma^2 (r'_k) = \frac{S_2^2 - S_4}{N' - 1} + \frac{S_1^4 - 4S_1^2 S_2 + 4S_1 S_3 + S_2^2 - 2S_4}{(N' - 1)(N' - 2)} - (\bar{r}'_k)^2 \qquad 23$$

= variance (r'_k)

where $S_i = \sum_{j=1}^{N'} y_j^i$

Then $$\tau_k = \frac{r'_k - \bar{r}'_k}{\sigma (\bar{r}'_k)} \qquad 24$$

and for the 90% confidence level, $\tau_k \geqslant 1.28$

For other confidence levels, the limiting value of τ_k may be taken from the normal probability table – see Appendix 2. Further details of this test will be found in Hoel (1965, pp. 343-345).

For additional information in connection with the test for seasonality, the following equation developed by Kay (then of Management Sciences Ltd.) is used:

$$\lambda = \sigma_e^2 / \sigma_y^2$$

$$= [2/(2 - \gamma_0)]\left[1 - \gamma_0 \sum_{j=0}^{\infty} (1 - \gamma_0)^j r_{j+1}\right] \qquad 25$$

where σ_e^2 = error variance

σ_y^2 = demand variance

r_{j+1} = serial correlation coefficient of the demand series for lag $(j+1)$

and $0 < \gamma_0 \leqslant 1$

It is sufficient in practice to consider only $j = 0, 1, 2$. The range of γ_0 specified above is examined to produce a minimum value of λ.

The test for seasonality is made as follows:

seasonality is present if

$\tau_M > \text{SIG1}$ and $r_M \geqslant 0.5$ 26

or $\tau_1 > \text{SIG1}, r_1 \geqslant 0.5$ and minimum $\lambda \leqslant 0.5$ 27

where SIG1 is the confidence level specified by the user at run time.

Equation 27 is a practical test for seasonality which has been arrived at empirically. It has been found that where data contains both trend and seasonality, the correlation effects of seasonality become masked, and rejection of the hypothesis that seasonality is present by equation 26 cannot be conclusive.

Demand partial sum

If the presence of seasonality is established, then seasonal factors are calculated which relate each forecast interval in a year to the forecast interval having the smallest non zero demand. Hence factors are calculated which range from 1 upwards. Forecast intervals having zero demands have zero seasonal factors.

$$S_i = \sum_{j=0}^{1} y_{i+jM'} \qquad 28$$

where i = positional count within cycle in terms of $I(T)$

M' = seasonal base in terms of $I(T)$ i.e. $M' = MI(t)/I(T)$. M must be an integer.

M = seasonal base in units of $I(t)$, the basic time unit of the system.

From equation 28 select

$$S_{min} = \text{Minimum } S_i > 0 \qquad 29$$

Then $$S_T = S_i/S_{min} \qquad 30$$

Simulation phase

Following the calculation of trend and seasonal factors, the Demand Analysis routine enters the simulation phase. In this part of the routine, forecasting is carried out over the history supplied using trend and seasonal factors if appropriate. The values of γ_0 and γ_1 used are either the fixed values specified by the user, or, in the case of lagged adaptive response rate, a continually modified value of γ_0. Following this simulation phase, values are written to all the statistical fields of the Demand History record to enable the Forecasting routine to assume control accurately during its first run.

Forecasting using seasonal factors

Applying seasonal factors to equation 12, page 206, with $\gamma_{-1} = 0$

$$\hat{Y}_{T+1} = \hat{y}_T S_{T+1}/S_T + \gamma_0 e_T + \gamma_1 \sum_{j=1}^{T} e_j \qquad 31$$

Also, $\hat{Y}$, the expected demand in the lead time, is given by

$$\hat{Y} = (\hat{y}_{T+1}/S_{T+1}) \left[\left(\sum_{j=1}^{L'} S_{T+j} \right) + lS_{T+L'+1} \right] \qquad 32$$

D is the lead time expressed in basic time periods and

$$DI(t)/I(T) = L = L' + l \qquad 33$$

L' and l being the integer and fractional parts respectively of the lead time expressed as L forecast intervals.

At the end of the year if a trend component exists in the seasonal factors, the forecast equation must be modified to prevent a sharp discontinuity in the forecast caused by operating on two seasonal factors which are displaced by one year along the trend time. Hence the forecast for the first period in the new year is

$$\hat{y}_{T+1} = \hat{y}_T \, (S_1/S_{M'}) \text{(trend factor)} + \gamma_0 e_T + \gamma_1 \sum_{j=1}^{T} e_j \qquad 34$$

and the deseasonalised forecast becomes:

$$\hat{x}_{T+1} = \hat{y}_{T+1} / S_1 \qquad 35$$

where M' is the number of forecast intervals in a year.

It will be seen from this that where a user enters his own seasonal factors, these should include a trend component if a trend factor also applies for the item.

Forecasting using the trend factor

In the absence of seasonal factors, the trend factor is used each time a forecast occurs.

$$\hat{y}_{T+1} = \hat{y}_T(\text{trend factor})^{1/M'} + \gamma_0 e_T + \gamma_1 \sum_{j=1}^{T} e_j \qquad 36$$

and the expected demand in the lead time becomes

$$\hat{Y} = \hat{y}_{T+1} + \hat{y}_{T+1}.T + y_{T+1} T^2 + \ldots \hat{y}_{T+1} T^{L'-1} + \hat{y}_{T+1} T^{L'}.l \qquad 37$$

$$= \hat{y}_{T+1} (1-T^{L'}) / (1-T) + \hat{y}_{T+1} T^{L'}.l \qquad 38$$

where $T = (\text{trend factor})^{1/M'}$

and L' and l are defined in equation 33.

Prediction of demand at branch level

To ensure that a suitable balance is achieved between the requirement to control stocks adaptively at the branch level while not incurring excessive processing time or excessive disc storage space, a technique is employed estimating the branch demand from a forecast made at the group level. The preceding sections have discussed the type of prediction made at the group level using one of three types of predictor together with seasonal factors where appropriate. To deduce the forecast at branch level, the group forecast is multiplied by a factor for each branch; the factor represents the contribution of that branch to the total group demand. This may be expressed as follows:

y_T = total group demand in period T

z_T = demand for branch concerned in period T

b_T = z_T/y_T the proportion of total group demand for which the branch was responsible.

then $\hat{b}_{T+1} = \hat{b}_T + \alpha(b_T - \hat{b}_T)$ 39

where $\hat{b}$ is the smoothed value of the branch proportion, known as the branch weight factor. The value of α recommended for use in SCAN System 3 is 0.1.

The one period ahead prediction for the branch is $\hat{B}_{T+1}$, where

$$\hat{B}_{T+1} = \hat{y}_{T+1} . \hat{b}_{T+1} \qquad 40$$

The group forecast made for any other period in the future is similarly modified by $\hat{b}_{T+1}$.

In the case where the group contains only one branch, the value of $\hat{b}$ is always 1 and consequently the branch and group forecasts are identical.

Safety stock

A fundamental aspect of a re-order point control system is that an estimate should be made of the maximum demand that may be satisfied during the replenishment delivery time (L). If available stock is not greater than this, a stock replenishment order must be issued. This estimate of maximum demand is the re-order point for the item in question.

The forecasting process estimates the mean level of demand but because a random component is found in the demand patterns for most items, this forecast must be qualified to allow for this when the re-order point is calculated. The qualification used is to include a safety stock component in the re-order point. The safety stock provides protection against running out of stock should the demand exceed the forecast while fresh supplies are awaited; it is computed for a specific risk of stock out that must be specified by Management in terms of the customer service level required. Customer service level in this context is defined as the percentage probability of satisfying requirements

from stock on demand. The size of safety stock implied by a given service level setting depends both on the size of forecasting errors and the order strategy. Large forecasting errors imply high safety stocks, large order quantities imply small safety stocks.

Let the re-order point be

$$ROP = \hat{Y}_L + \frac{k}{1.25}\sigma_L \qquad 41$$

where $\hat{Y}_L$ is the expected demand in the lead time L

k is the safety factor corresponding with the specified customer service level

σ_L is the standard deviation of forecast errors for the lead time.

The value of k that achieves the specified customer service level must be found.

Let the demand in the lead time be

$$Y_L = \hat{Y}_L + x\sigma_L \qquad 42$$

and let the demand distribution be described by a density function $p(x)$. It is convenient at this stage to reduce equations 41 and 42 to equations dealing with statistics for the individual forecast intervals in the lead time.

Since the estimate of demand in the lead time is made by estimating the demand for each period in the lead time separately, then the standard deviation of errors in the lead time may be related to the standard deviations for its component periods by

$$\sigma_L^2 = \sum_i^L \sigma^2 \qquad 43$$

hence

$$\sigma_L = L^{1/2}\sigma \qquad 44$$

This relation is used as a reasonable practical approximation even where L is non-integral.

A satisfactory estimate of the standard deviation is

$$\sigma = 1.25\hat{d} \text{ (see Brown, 1959, page 93)} \qquad 45$$

where $\hat{d}$ is the smoothed mean absolute deviation of forecast errors.

Hence using equation 44, equations 41 and 42 become

$$ROP = \hat{Y}_L + \frac{k}{1.25}L^{1/2}\sigma \qquad 46$$

and $$Y_L = \hat{Y}_L + xL^{1/2}\sigma \qquad 47$$

For values of $x < \frac{k}{1.25}$, the demand does not exceed the re-order point and no shortages occur.

For values of $x > \frac{k}{1.25}$, demand is greater than the re-order point by an amount $\left(x - \frac{k}{1.25}\right)L^{1/2}\sigma$

Taking account of zeros and positive values of shortage the average size of shortage, $\bar{s}$, is given by

$$\bar{s} = L^{1/2}\sigma \int_{k/1.25}^{\infty} \left(x - \frac{k}{1.25}\right).p(x)dx \qquad 48$$

Let $$f\left(\frac{k}{1.25}\right) = \int_{k/1.25}^{\infty} \left(x - \frac{k}{1.25}\right).p(x)dx \qquad 49$$

$$= P\left(\frac{k}{1.25}\right) - \frac{k}{1.25}\int_{k/1.25}^{\infty} p(x)dx \qquad 49a$$

Hence $\bar{s} = L^{1/2}\sigma f\left(\frac{k}{1.25}\right)$ 48a

Substituting from equation 45

$$\bar{s} = L^{1/2}\hat{d}\,1.25f\left(\frac{k}{1.25}\right) \qquad 48b$$

$$= L^{1/2}\hat{d}\,F(k) \qquad 48c$$

The expected shortage $\bar{s}$ may be compared with the total expected demand during the order cycle to give the fraction of demand that cannot be satisfied. If the quantity ordered to meet the demand is Q then the fraction of unfulfilled demand is

$$P = \frac{\bar{s}}{Q} = \frac{L^{1/2}\hat{d}F(k)}{Q} \qquad 50$$

If the required customer service level is c then

$$c = 1 - P \qquad 51$$

$$F(k) = \frac{Q(1-c)}{L^{1/2}\hat{d}} \qquad 52$$

Service function (F(k))	*Safety factor (k)*
0.49868	0.0
0.40505	0.2
0.32399	0.4
0.25505	0.6
0.19746	0.8
0.15026	1.0
0.11232	1.2
0.08243	1.4
0.05937	1.6
0.04194	1.8
0.02905	2.0
0.01972	2.2
0.01311	2.4
0.00854	2.6
0.00544	2.8
0.00340	3.0
0.00208	3.2
0.00124	3.4
0.00073	3.6

Table 10 Relationship between values of the service function and safety factor (continued overleaf)

Service function (F(k))	*Safety factor (k)*
0.00041	3.8
0.00023	4.0

Table 10 Relationship between values of the service function and safety factor

Using a table of values of $F(k)$ and k similar to that shown in Table 10, the required safety factor is calculated by the Forecasting routine. c is the Management specified customer service level, Q is the branch order quantity and $\hat{d}$ is the most recent estimate of the smoothed mean absolute deviation of forecast errors at the branch level; consequently the value $F(k)$ can be calculated. Using this as an entry point into Table 10, above, the corresponding value of k, the safety factor is established, and hence the safety stock becomes

$$S_s = k\hat{d}_{T+1}L^{½} \qquad 53$$

The smoothed mean absolute deviation $\hat{d}_{T+1}$ is defined by equation 56, page 215.

Note that this evaluation of safety stock occurs for each branch within the group.

Variability of replenishment delivery times

Equation 53 does not take into account possible variation in the replenishment delivery time (L). In general, there are two practical difficulties that make it unwise to adjust automatically for this.

1 Supply sources may not stay stable over long periods of time and any analysis of delivery times should be based on recent history. Unless the item is ordered frequently, there will thus tend to be insufficient data for a reliable statistical analysis if each item is considered independently.

2 It cannot safely be assumed that the causal influences on demand and on delivery times are independent, but they may be in some cases. Theoretically, a different treatment is required for each of the two cases.

In the absence of reliable information to the contrary, the safe course is to group items which have similar lead times and which may be expected to have much the same lead time variability, and to analyse experience over, say, the preceding six months; hence to derive a reasoned estimate of L to be used in the system.

RE-ORDER POINT

The operational rule of the re-order point inventory control system is:

Order a new supply if, and only if, the available stock is not greater than the re-order point.

Effect is given to this rule in equations 3, 3a and 3b (see page 204).

The re-order point is thus the maximum expected consumption of stock in the replenishment delivery time, appropriate to the selected level of customer service. The re-order point may, therefore, be derived from equations 32 (page 210) and 53 (above) thus:

$$P_{T+1} = (\hat{b}_{T+1}\hat{y}_{T+1}/s_{T+1})\left[\sum_{j=1}^{L} s_{T+j} + ls_{T+L'+1}\right] + \hat{k}d_{T+1}L^{½} \qquad 54$$

Note that P_{T+1} is recomputed each forecasting interval, but the above operational rule is applied at the end of each updating interval (t') throughout period (T+1). It may also have to be applied immediately after the forecasting process has been used to revise P_{T+1}, since P_{T+1} may thereby be increased above the available stock (A_T). If system considerations warrant it, however, this check may be left until the next subsequent stock updating run.

There is a minimum order quantity required to maintain system stability but if this is satisfied there is no other limit on the number of orders which may be raised in one replenishment delivery time. This is achieved by controlling on available stock ($A(t')$) instead of physical stock ($S(t')$). To prevent the same order being requested twice in two successive updating runs, the on-order balance is updated immediately a replenishment order is requested by the system – see equation 4, page 205. If Management intervenes to withold an order, or to vary the quantity, this must be reported to the system (see $R(t')$ in equation 2, page 204).

CONTROL OF PREDICTION OPTIMALITY AT THE GROUP LEVEL

Clearly, the minimum stock holding, P_{T+1} must be a minimum consistent with the customer service level required by Management. This implies that the safety stock must also be a minimum which occurs when $[\,|e_T|\,] \rightarrow 0$. The magnitude of e_T however, depends upon the prediction parameters used in equation 16 and it is obvious from equation 53, page 214, that minimizing d_{T+1} results in a reduction of safety stocks with corresponding reduction in stock holding costs. The selection of satisfactory γ_0 and γ_1 values is, therefore, of fundamental importance to inventory control. Considerable increases in the cost of holding safety stock may arise from the use of unsuitable prediction parameters.

The method of monitoring prediction optimality by Trigg (1964) is the most suitable available.

Smoothed Error

$$\hat{e}_{T+1} = \hat{e}_T + \gamma'_0 (e_T - \hat{e}_T) \qquad 55$$

Mean Absolute Deviation

$$\hat{d}_{T+1} = \hat{d}_T + \gamma'_0 (|e_T| - \hat{d}_T) \qquad 56$$

Tracking Signal

$$\tau = \hat{e}_{T+1} / \hat{d}_{T+1} \qquad 57$$

Whenever $|\tau| > 2.4\gamma'_0 / [2\gamma'_0 - (\gamma'_0)]^{\frac{1}{2}}$, a report denoting departure from prediction optimality is output. At the same time, if lagged adaptive response rate forecasting is not being used, the prediction parameters are overridden by emergency values input by run parameter as follows:

1 For the single point Box-Jenkins predictor (single point exponential smoothing) an emergency γ_0 is used if it is greater than the existing value.

2 For the two point Box-Jenkins predictor, an emergency γ_1 is used if the existing value is zero.

After forecasting, the modified prediction parameter is reset to its original value. This process is repeated each forecast interval until its use results in an acceptable value of the tracking signal. The report is output each time the tracking signal falls outside limits. When this happens a number of times in succession, arrangements should be made to modify the prediction parameters in use.

It has been found experimentally that γ'_0 used in equations 55 and 56 gives best results with a value of 0.17 and this is used as a fixed program constant.

Replenishment order quantity

Ideally, any inventory control system should ensure that total annual operating costs (C_h) are kept to a minimum over time. Assuming that the cost of stock holding is a linear function of the average stock value then C_h is given by

$$C_h = YC_p(r) + \frac{Y}{R} C_o + IC_p(r)\frac{R}{2} \qquad 58$$

where Y = annual demand rate

$C_p(r)$ = the unit price that applies for order quantities not less than $Q(r)$.

C_o = cost of placing an order for the items.

R = order quantity

I = annual investment rate.

The terms on the right hand side of equation 58 represent respectively, the cost price of a year's replenishments. the cost of placing orders during the year and the average stock holding cost.

By differentiation, the classical economic order quantity is determined from equation 58 as

$$R = \sqrt{\frac{2YC_o}{IC_p(r)}} \qquad 59$$

For this to be feasible, R must not be less than $Q(r)$. In practice, in a given range of price breaks, only one feasible classical economic order quantity exists. When this quantity is determined, its associated inventory costs are compared with the costs at all the price breaks offering a lower unit price, and an order quantity is specified which corresponds with the minimum of those costs.

Substitution of equation 59 into equation 58 gives the annual stock holding cost using the classical economic order quantity as

$$C_h = YC_p(r) + \left[2YIC_p(r)C_0\right]^{\frac{1}{2}} \qquad 60$$

The annual stock holding cost for a policy that orders the order quantity corresponding to the $(r+n)$th price break is

$$C_h = YC_p(r+n) + \frac{YC_0}{Q(r+n)} + IC_p(r+n)\frac{Q(r+n)}{2} \qquad 61$$

where $C_p(r+n)$ is the cost price for order quantities not less than $Q(r+n)$.

Equation 61 is evaluated for all price breaks $C_p(r+n)$ having a lower unit price than that used by the classical economic order quantity formula. Hence, the lowest cost strategy is selected from equation 60 and the set of strategies represented by equation 61.

The annual demand quantity Y is determined by forecasting the demand for 1 year ahead.

$$Y = \left(\hat{b}_{T+1}\hat{y}_{T+1} \Big/ S_{T+1}\right)\sum_{j=1}^{M'} S_{T+j} \qquad 62$$

Where M' is the number of forecast intervals in a year.

Although this equation allows for seasonal variations in demand in the calculation of Y it will give only approximate results for all cases other than a constant demand. Where strong seasonality is present in the demand pattern of an item, the equation should be used with discretion.

Tate (1964) has discussed the validity of economic replenishment order quantities. Hadley and Whitin (1963) give a detailed description of their derivation.

A practical alternative to the economic ordering techniques discussed above is the selection of order quantities such that the ordering interval is approximately constant. If the ordering interval is $OI(t)$ then expressed in forecast intervals it becomes

$$\frac{OI(t)}{I(T)} = W + w \qquad 63$$

Where W and w are the integer and fractional parts respectively. To enable summations to be correctly positioned in situations where non-integral lead times may apply, it is necessary to calculate W' and w' where

$$W + w - (1-l) = W' + w'$$

and hence the order quantity Q_{T+1} is defined as follows (L' and l are defined in equation 33, page 210.)

$(1-l) < W + w$ and $W' > 0$

$$Q_{T+1} = \left(\frac{\hat{b}_{T+1}\hat{y}_{T+1}}{S_{T+1}}\right)\left[(1-l)S_{T+L'+1} + \sum_{j=1}^{W'} S_{T+L'+1+j} + w'S_{T+L'+2+W'}\right] \qquad 65$$

$(1-l) < W + w$ and $W' = 0$

$$Q_{T+1} = \left(\frac{\hat{b}_{T+1}\hat{y}_{T+1}}{S_{T+1}}\right)\left[(1-l)S_{T+L'+1} + w'S_{T+L'+2}\right] \qquad 66$$

$(1-l) \geqslant W+w$

$$Q_{T+1}=\left(\frac{\hat{b}_{T+1}\hat{y}_{T+1}}{S_{T+1}}\right)\ [wS_{T+L'+1}] \qquad 67$$

Equations 65, 66 and 67 are not affected by a non-constant demand pattern, but they are likely to give a higher C_h than equation 58 if C_o and I can be accurately determined for the latter.

If cyclical ordering is to be used, economic ordering is not appropriate, although it may be used to help choose the ordering interval $O\ I(t)$.

Minimum order quantities

There are two minimum order quantities which the system may have to recognize. One of these, the system minimum order quantity, is imposed by the system itself and must always be observed, the second may be imposed by the supply source when orders must be placed in terms of a quantity unit larger than that used for recording and issuing stock. Equation 3, page 204, takes account of this latter minimum quantity.

The system minimum order quantity is used when the user fails to specify economic ordering parameters or a system ordering interval. In this case, an order quantity appropriate to an ordering interval of one system time period is calculated.

In the case of random re-ordering, the user has effectively a choice of three policies.

1 If economic ordering is not specified, the order quantity is calculated on the basis of the preferred ordering interval.

2 If an ordering interval is not specified, the order quantity is based on the economic order quantity parameters supplied.

3 If both preferred frequency ordering and economic ordering are specified for the item, the system uses the larger order quantity.

For cyclical re-ordering, $R_{T+1} = 0$. This, in conjunction with equation 54 with a lead time increased by the ordering interval, ensures that a regular order increases the order cover to $(D + O)$ basic time periods every O periods. D and O are the lead time and ordering interval respectively expressed in system time periods.

SUPPLEMENTARY FORMULAE

A number of equations omitted from the foregoing discussion are included here for reference.

Mean Demand

$$\bar{y} = \frac{1}{N}\sum_{i=1}^{N} y_i \qquad 68$$

Standard Deviation of Demand

$$\sigma_y = \left[\frac{1}{N}\sum_{i=1}^{N} y_i^2 - (\bar{y})^2\right]^{1/2} \qquad 69$$

Forecast Error

$$e_T = y_T - \hat{y}_T \qquad 70$$

Mean Error

$$\bar{e} = \frac{1}{N}\sum_{i=1}^{N}{}_{1}\, e_i \qquad 71$$

Standard Deviation of Error

$$\sigma_e = \left[\frac{1}{N}\sum_{i=1}^{N} e_i^2 - (\bar{e})^2\right]^{1/2} \qquad 72$$

Appendix 2 Demand analysis confidence level percentages

Tau test level (%)	*Pairs test level (%)*	*Factor*	*Tau test level (%)*	*Pairs test level (%)*	*Factor*
80.0	60.0	0.84	90.0	80.0	1.28
80.5	61.0	0.86	90.5	81.0	1.31
81.0	62.0	0.88	91.0	82.0	1.34
81.5	63.0	0.90	91.5	83.0	1.37
82.0	64.0	0.91	92.0	84.0	1.41
82.5	65.0	0.93	92.5	85.0	1.44
83.0	66.0	0.95	93.0	86.0	1.48
83.5	67.0	0.97	93.5	87.0	1.51
84.0	68.0	0.99	94.0	88.0	1.55
84.5	69.0	1.02	94.5	89.0	1.60
85.0	70.0	1.04	95.0	90.0	1.64
85.5	71.0	1.06	95.5	91.0	1.69
86.0	72.0	1.08	96.0	92.0	1.75
86.5	73.0	1.10	96.5	93.0	1.81
87.0	74.0	1.13	97.0	94.0	1.88
87.5	75.0	1.15	97.5	95.0	1.96
88.0	76.0	1.17	98.0	96.0	2.05
88.5	77.0	1.20	98.5	97.0	2.17
89.0	78.0	1.23	99.0	98.0	2.33
89.5	79.0	1.25	99.5	99.0	2.58
			99.9	99.8	3.09

Table 11 Confidence levels with corresponding factors for use with the Demand Analysis

Appendix 3 Bibliography

Box, G.E.P., and Jenkins, G.M. (1962)
"Some statistical aspects of adaptive optimization and control"
J.R. *Statist. Soc.* (B)., vol. 24, No. 2, pp. 297 – 343 (with discussion).

*Brown, R.G. (1959)
Statistical Forecasting for Inventory Control McGraw-Hill: New York.

(1963)
Smoothing, Forecasting and Prediction of Discrete Time-series Prentice-Hall: NJ

Brown, R.G., and Meyer, R.F. (1961)
"The fundamental theorem of exponential smoothing"
J. Op. Res. Soc. Am., vol. 9, No. 5, pp. 673 – 687.

*Coutie, G.A., *et al.*, (1964)
Short-term Forecasting I.C.I. Monograph No. 2. Oliver & Boyd: Edinburgh

Cox, D.R. (1961)
"Prediction by exponentially weighted moving averages and related methods"
J.R. Statist. Soc. (B)., vol. 23 No. 2, pp. 414 – 422.

Hadley, G., and Whitin, T.M. (1963)
Analysis of Inventory Systems Prentice-Hall: NJ.

Hannan, E.J. (1960)
Time Series Analysis Methuen: London.

Hoel, P.G. (1965)
Introduction to Mathematical Statistics Wiley: New York

Holt, C.C. (1957)
"Forecasting seasonals and trends by exponentially weighted moving averages"
Off Naval Res. Research Memorandum No. 52.

Kay, E., and Hampton, J.S. (1963)
"An experiment in short-term forecasting"
Proc. 3rd. Int. Conf. on Op, Res. pp. 120 – 141 (with discussion).

Kendall, M.G. (1953)
"The analysis of economic time-series – Part 1: Prices"
J.R. Statist. Soc (A) vol. 116, No. 1 pp. 11-34.

Leong, Y.S. (1962)
"The use of an iterated moving average in measuring seasonal variations"
J. Amer, Stat. Assoc., vol. 57, pp. 149 – 171.

*Muir, A. (1958)
"Automatic sales forecasting"
Comp. J., vol. 1., No. 3 pp. 113-116.

Shiskin, J., and Eisenpress, H. (1958)
Seasonal Adjustments by Electronic Computer Methods.
Nat. Bur. Econ, Res., Technical paper No. 12.

Tate, T.B. (1964)
"In defence of the economic batch quantity"
Operat. Res. Quart., vol. 15, No. 4 pp. 329 – 340

Trigg, D.W. (1964)
"Monitoring a forecasting system"
Operat. Res. Quart., vol. 15, No. 3, pp. 271-274

Vassian, H.J. (1955)
"Application of discrete variable servo theory to inventory control"
J. Op. Res. Soc. Am, vol. 3, No. 3., pp. 272-282.

Ward, D.H. (1963)
"Comparison of different system of exponentially weighted prediction".
The Statistician, vol. 13, No. 3., pp. 173-185.

Whittle, P. (1963)
Prediction and Regulation by Linear Least-square Methods
The English Universities Press: London.

*Winters, P.R. (1960)
"Forecasting sales by exponentially weighted moving averages"
Mang. Sci., vol. 6, No. 3 pp. 324-342.

*These references are particularly recommended to any reader wishing to make a deeper non-technical study of the subject.

A more extensive bibliography is given by Brown (1963, pp. 453-462).

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