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COMPUTATION AND TABULATION OF ANNUAL FLUCTUATIONS (A Microcomputer Program)

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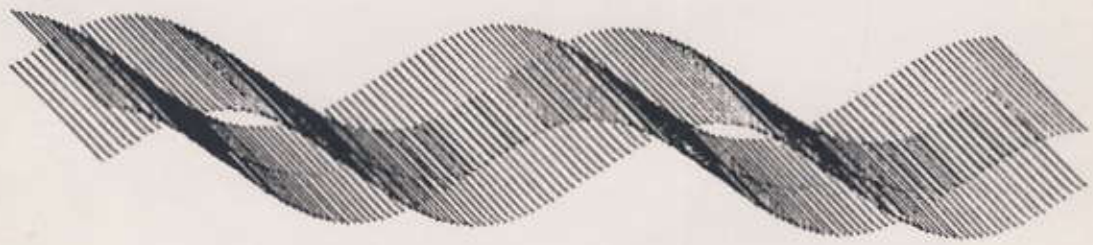


1. INTRODUCTION

For a stock assessment study, it is indispensable to analyse the actual situation of fishery production before engaging in analyses using the theoretical model(s). A knowledge of the actual situation is of great value not only for the study of fish stock assessment, but also for general management of the fishery industry.

By means of the present computer program, it is possible to analize the actual situation, especially annual changes in fishery production, and ascertain (i) whether annual production is increasing or decreasing; (ii) the extent of the increase or decrease during the period under study; and (iii) the extent of annual fluctuation in production, in other words, whether the tendency to rise or fall is steady or not. An examination of these factors can be made by AREA (statistical area) and by CATEGORY (species or group of species, types of fishing gear, etc.). If there is no classification by area, '1' should be input when the computer requests the number of AREAs (see 4.1, step 4). For instance, in the case of comparison of different places (not statistical areas), the number of areas is 1, and the number and names of regions or "by species (or group of species)", or "by species (or group of species) and by gear", input number and name of gear instead of area, input species (or group of species) as categories, input number and names of species (or group of species) instead of area, and input number and name of gear as category in the latter case. This program can, therefore, be applied to many different combinations of parameters.

One important point to be considered is the definition of production. There are two different kinds of production, that is, (i) total production, such as total landings (in terms of weight or value), and (ii) unit production, such as CPUE (catch per unit fishing effort; in terms of weight or value). The interpretation of the results will, naturally, differ according to the kind of input data (total production or unit production).

The microcomputer used here is a SHARP PC-1500 (CPU with a 8K bytes additional module and a printer-cassette interface). The language is expanded BASIC.

2. PROGRAM OUTLINE

When Table 1 on page 3 is given as an input data sheet, Table 3 on page 18 can be obtained as a direct computer printout.

In the first part of the program you are required to input the information on pen number, the number of years, the initial year, the number of areas, the number of categories, and the name of each category. These appear as line numbers 20 to 96 in the program list, and steps 1 to 7 in the key operation procedure. Then the computer prints the head column of the table as shown on page 16 below.

The second part consists of the data input based on the figures in Table 1 (line numbers 100 to 160, steps 8 and 9 in the key operation procedure). Then the computer prints all figures (line numbers 162 to 320 with sub-routine program 800 to 830) and the computer work is finished. For the reader's reference, the list of memory contents is attached at the end of this booklet.

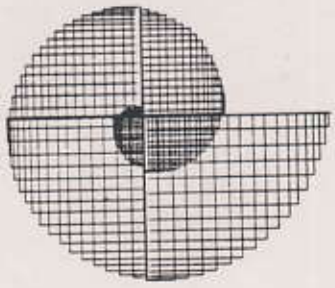


Table 1. Table of original statistical data to be analysed by the present program (unit : kg.)

AREA	CATEGORY	1980	1981	1982	1983	1984	1985
1	MAJOR SPP.	1,240.2	1,324.1	1,532.0	1,421.9	1,423.5	1,987.6
	OTHER FISH	666.1	645.2	543.1	531.8	432.8	422.1
	MOLLUSCS	23.1	24.0	25.0	26.6	19.9	18.5
	CRUSTACEAN	2.3	8.8	7.1	0.0	12.3	5.6
2	MAJOR SPP.	789.0	776.1	659.8	888.2	898.4	752.3
	OTHER FISH	123.0	321.0	456.2	654.8	541.2	666.6
	MOLLUSCS	452.9	854.0	749.6	457.3	569.9	899.8
	CRUSTACEAN	12.0	32.0	41.0	52.3	54.1	65.2
3	MAJOR SPP.	456.0	654.0	765.0	756.4	745.9	845.3
	OTHER FISH	123.0	321.0	258.1	147.9	132.9	265.8
	MOLLUSCS	23.0	32.0	43.0	34.0	45.0	54.1
	CRUSTACEAN	3.9	10.2	8.7	6.3	4.2	5.1
4	MAJOR SPP.	3,211.5	654.3	741.9	8,521.0	9,541.3	8,984.0
	OTHER FISH	456.6	654.0	741.0	852.0	963.0	987.0
	MOLLUSCS	56.0	65.0	85.0	74.1	96.5	51.3
	CRUSTACEAN	0.0	2.1	3.9	4.0	5.6	6.8
5	MAJOR SPP.	1,234.0	2,345.6	3,456.2	2,358.0	2,989.6	4,569.5
	OTHER FISH	654.0	546.2	789.2	852.4	951.0	753.0
	MOLLUSCS	123.0	234.0	456.0	789.2	798.5	654.2
	CRUSTACEAN	0.0	0.0	1.2	3.9	5.4	6.2

3. MATHEMATICAL FORMULAE

3.1 A.C. (Angular Coefficient)

As mentioned earlier, the linear relationship between X (year) and Y (data of catch, CPUE, etc.) is examined first in order to establish whether the curve of annual fluctuation is rising or falling.*

The general form of linear equations (linear regression in statistics) can be expressed as follows:

$$Y = ax + b$$

Where the factor of the first order a is called the angular coefficient. If a is a positive number, the line shows a rising trend; if it is negative, the line descends, as in A and B of Fig. 1. In the present program, a is obtained by the following formula using the least squares method:

$$a = \left(\sum_{i=1}^{i=N} Xi\ Yi\right) / \left(\sum_{i=1}^{i=N} Xi^2 - n\ x^{-2}\right) \quad \ldots\ldots\ldots\ldots (1)$$

3.2 RATIO

The value called RATIO in the present paper denotes the ratio given by the following formula:

$$\bar{Y}n/\bar{Y}1 \ .\ 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (2)$$

For example, if $\bar{Y}n$ is 2.5 times larger than $\bar{Y}1$, the notation ("USING" in computer language) will be *** 2.50, as shown in Table 3. In this way the decreasing or increasing tendency of annual fluctuation can be read easily from the table.

---

* There is no mathematical formula showing the relationship between X and Y, because Y depends on a vast number of social and environmental factors, such as the price of fish, fisheries regulations, oceanographic conditions of fishing grounds, etc. The application of the linear relationship in the present paper is, therefore, only "borrowing" a mathematical technique.

3.3 S.D. (Standard Deviation)

Standard deviation (of Yi) represents the extent of fluctuation and is given by the formula:

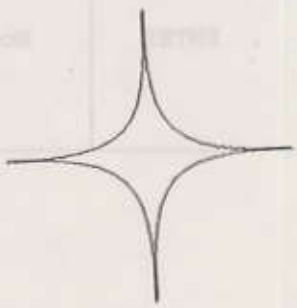
$$S.D. = \sqrt{\left(\sum_{i=1}^{i=N} (Yi - \bar{Y})^2/n \right)} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

3.4 C.V. (Coefficient of Variation)

The coefficient of variation is obtained as follows:

$$C.V. = S.D./\bar{X} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Standard deviation varies depending upon the magnitude of values of the data. When data figures are large, the standard deviation automatically increases. Consequently, we cannot compare the values of different categories of data. However, the value of coefficient of variation which is devided by mean of Yi ($\bar{Y}$) can compare the extent of fluctuation between different categories. S.D. and C.V. are indicators of the extent of fluctuation of the Yi series of data. The other formulae used in this program appear in the table of memory contents at the end of the present paper.



4. KEY OPERATION PROCEDURE

4.1 Table of key operations

STEP	KEYSTROKE	DISPLAY (Screen)
0	ON	>
1	DEF A	* FACTORS ON FLUCTUATIONS * PEN SELECT (0 - 3) = ?_
2	3 ENTER	No. of YEARs (1 to 10) = ?_
3	8 ENTER	INITIAL YEAR = ?_
4	1976 ENTER	No. of AREAs (1 to 10) = ?_
5	9 ENTER	No. of CATEGORIES (1 - 5) = ?_

	REMARKS
	Make sure that the prompt character is on the screen; this means that the computer is ready for operation.
	BEEP. The program title is displayed on the screen. Four small boxes enclosing pen number (0 to 3) for pen selection are printed out on paper. After that, the computer asks the required pen number.
	If you select pen number 3, press 3 and the key marked ENTER (N.B.: the ENTER key must be pressed after every step in the procedure. This instruction will therefore be omitted from now on). BEEP. The computer asks the number of years in your data. If eight years, press 8 (the number of years should be more than one and less than ten).
	BEEP. The computer requests the initial year of your data. If it is 1976, type 1976.
	BEEP. The computer requests the number of areas in your data. If it is nine, press 9 (the number of years should be between one and ten).
	BEEP. The computer requests the number of categories in your data. The meaning of category is an attribute of data. (Ref. p. V). If four categories are in your statistical data, press 4.

STEP	KEYSTROKE	DISPLAY (Screen)
	4 ENTER	* NAME, CATG (1-20 charact.) *
6		NAME OF CATG. 1 = ?
	EDIBLE FISH ENTER	
7		NAME of CATG. 2 = ? (Repeat)
		--- PRINT HEAD COLUMN ---
		(Printing)
8		--- DATA KEY-IN ---
		1976/ITEM-1 = ?
	23.6 ENTER	1977/ITEM-1 = ?
9		(Repeat)
		* COMPUTING AND PRINTING *
		>

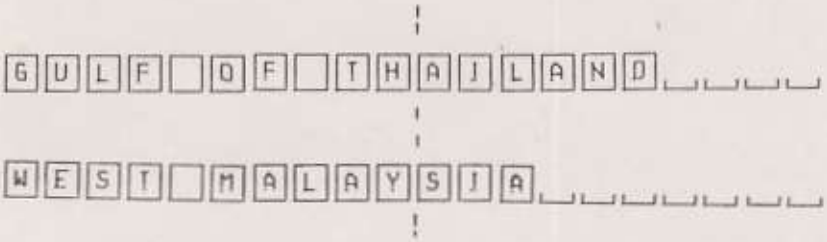
	REMARKS
	BEEP. A reminder on the number of letters in the name of each category; it should be 20 or less, and will be input in the next step. This reminder is deplayed on the screen for about two seconds. After that the computer asks the name of Category 1. If it is "Edible Fish", type this in (Ref. advice on this keystroke on p. 10).
	The above procedure should be repeated for each of the categories.
	The computer prints the head column. "PRINT HEAD COLUMN" is displayed on the screen during printing. After printing, "DATA KEY-IN" is displayed on screen for about one second. BEEP. The computer requests the first data, that is, data of Area 1, Category 1, first year. Type in the figure.
	The same procedure will be repeated until the last data, that is, data of Area 9, Category 4, 1983. The correspondence between category and item is explained on p. 12.
	The computer starts making a table. When the work is finished, "---TABLE END---" is printed out on paper and the prompt character < appears on the screen.

4.2 Additional notes

4.2.1 Name of CATEGORY (Ref. 4.1, Step 6)

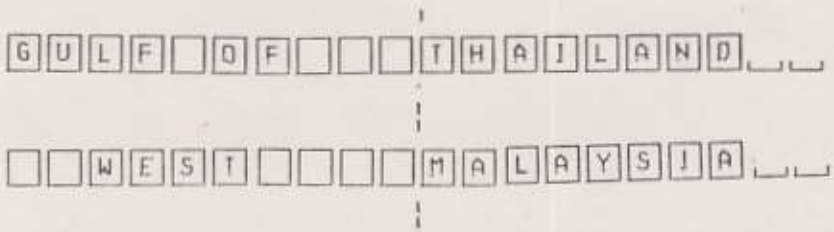
Twenty spaces are provided for the name of CATEGORY. We can input letters of alphabet, punctuation marks, figures and symbols (eg. =, *, ?...) into each space.

The twenty spaces are devided into two groups. In the printout, the first ten spaces appear on the first line and the second group is on the second line. Therefore, when we key-in:



the result of printout will be as shown at the top of Example A in Fig. 1.

A small adjustment will give a clearer result:



On the printout the name of category will then appear as shown of the top of Example B in Fig. 1.

EXAMPLE A		EXAMPLE B	
CATEGORY	FACTOR	CATEGORY	FACTOR
GULF OF TH AILAND	A.C. RATIO S.D. C.V.	GULF OF THAILAND	A.C. RATIO S.D. C.V.
WEST MALAY SIA	A.C. RATIO S.D. C.V.	WEST MALAYSIA	A.C. RATIO S.D. C.V.
INSHORE WA TERS	A.C. RATIO S.D. C.V.	INSHORE WATERS	A.C. RATIO S.D. C.V.
OFFSHORE W ATERS	A.C. RATIO S.D. C.V.	OFFSHORE WATERS	A.C. RATIO S.D. C.V.

Fig. 1. The results of printout by two different key-in procedures.

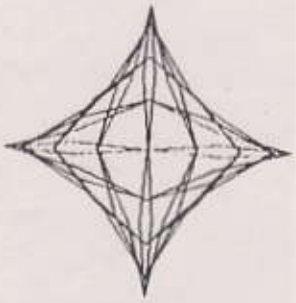
4.2.2 Relation between CATEGORY and ITEM number (Ref. 4.1, Step 8)

As shown in Table 1, there are three dimensions, namely, AREA, CATEGORY and YEAR. It is possible to make an array of one and two dimensions by the PC-1500 computer. Therefore, AREA and CATEGORY are combined together as one dimension which is called ITEM, as shown in Fig. 2. As explained in Step 8 of the key operation procedure, "1976/ ITEM-1 = ?" is displayed on the screen before we key-in the data. As described above, ITEM-1 denotes CATEGORY-1 in AREA-1. In the same manner, ITEM-5 denotes CATEGORY-1 in AREA-2 in the case when the number of CATEGORIES is four. (see Example 1 in Fig. 2).

If we have five categories, ITEM-7 denotes CATEGORY-1 in AREA 2, and so on. When we input data from Table 1, it is recommended that the ITEM number starting from 1 ..... be marked in pencil on the Table, in order to avoid confusion.

4.2.3 Correction of input data

Table 2 shows the form of memory of data which are inside the CPU, while the actual data are in Table 1. In our examples, A(0,0) is 1,240.2 and A(1,1) is 645.2 etc. Consequently, when we type in (in PRO-mode or in RUN-mode) A(0,0) and press the key marked ENTER, the figure of 1240.0 appears on the display screen. If we wish to make a correction in the data (when we become aware of a miss-key-in after having already pressed the ENTER key), it is not necessary to key-in all the data again. For example, if we type in 1420.0 for A(0,0) (1980/ITEM-1 = ? on the screen) instead of 1240.0, we simply type in A(0,0) = 1240.0 and press the key marked ENTER. Then the figure for A(0,0) appears correctly as 1240.0 instead of the wrong figure 1420.0



EXAMPLE 1

AREA	CATEGORY	ITEM NUMBER
1	MAJOR SPP.	1
	OTHER FISH	2
	MOLLUSCS	3
	CRUSTACEAN	4
2	MAJOR SPP.	5
	OTHER FISH	6
	MOLLUSCS	7
	CRUSTACEAN	8
3	MAJOR SPP.	9
	OTHER FISH	10
	MOLLUSCS	11
	CRUSTACEAN	12
4	MAJOR SPP.	13
	OTHER FISH	14
	MOLLUSCS	15
	CRUSTACEAN	16
5	MAJOR SPP.	17
	OTHER FISH	18
	MOLLUSCS	19
	CRUSTACEAN	20

EXAMPLE 2

AREA	CATEGORY	ITEM NUMBER
1	MAJOR SPP.	1
	OTHER FISH	2
	MOLLUSCS	3
	CRUSTACEAN	4
	TRASH FISH	5
	TOTAL	6
2	MAJOR SPP.	7
	OTHER FISH	8
	MOLLUSCS	9
	CRUSTACEAN	10
	TRASH FISH	11
	TOTAL	12
3	MAJOR SPP.	13
	OTHER FISH	14
	MOLLUSCS	15
	CRUSTACEAN	16
	TRASH FISH	17
	TOTAL	18
4	MAJOR SPP.	19
	OTHER FISH	20
	MOLLUSCS	21
	CRUSTACEAN	22
	TRASH FISH	23
	TOTAL	24
5	MAJOR SPP.	25
	OTHER FISH	26
	MOLLUSCS	27
	CRUSTACEAN	28
	TRASH FISH	29
	TOTAL	30

Fig. 2. Relation between CATEGORY and ITEM NUMBER.

Table 2. Form of memory of data (two-dimension array) inside the CPU (Central Processing Unit) of the computer.

AREA	CATEGORY	1980	1981	1982	1983	1984	1985
1	MAJOR SPP.	A(0,0)	A(1,0)	A(2,0)	A(3,0)	A(4,0)	A(5,0)
	OTHER FISH	A(0,1)	A(1,1)	A(2,1)	A(3,1)	A(4,1)	A(5,1)
	MOLLUSCS	A(0,2)	A(1,2)	A(2,2)	A(3,2)	A(4,2)	A(5,2)
	CRUSTACEAN	A(0,3)	A(1,3)	A(2,3)	A(3,3)	A(4,3)	A(5,3)
2	MAJOR SPP.	A(0,4)	A(1,4)	A(2,4)	A(3,4)	A(4,4)	A(5,4)
	OTHER FISH	A(0,5)	A(1,5)	A(2,5)	A(3,5)	A(4,5)	A(5,5)
	MOLLUSCS	A(0,6)	A(1,6)	A(2,6)	A(3,6)	A(4,6)	A(5,6)
	CRUSTACEAN	A(0,7)	A(1,7)	A(2,7)	A(3,7)	A(4,7)	A(5,7)
3	MAJOR SPP.	A(0,8)	A(1,8)	A(2,8)	A(3,8)	A(4,8)	A(5,8)
	OTHER FISH	A(0,9)	A(1,9)	A(2,9)	A(3,9)	A(4,9)	A(5,9)
	MOLLUSCS	A(0,10)	A(1,10)	A(2,10)	A(3,10)	A(4,10)	A(5,10)
	CRUSTACEAN	A(0,11)	A(1,11)	A(2,11)	A(3,11)	A(4,11)	A(5,11)
4	MAJOR SPP.	A(0,12)	A(1,12)	A(2,12)	A(3,12)	A(4,12)	A(5,12)
	OTHER FISH	A(0,13)	A(1,13)	A(2,13)	A(3,13)	A(4,13)	A(5,13)
	MOLLUSCS	A(0,14)	A(1,14)	A(2,14)	A(3,14)	A(4,14)	A(5,14)
	CRUSTACEAN	A(0,15)	A(1,15)	A(2,15)	A(3,15)	A(4,15)	A(5,15)
5	MAJOR SPP.	A(0,16)	A(1,16)	A(2,16)	A(3,16)	A(4,16)	A(5,16)
	OTHER FISH	A(0,17)	A(1,17)	A(2,17)	A(3,17)	A(4,17)	A(5,17)
	MOLLUSCS	A(0,18)	A(1,18)	A(2,18)	A(3,18)	A(4,18)	A(5,18)
	CRUSTACEAN	A(0,19)	A(1,19)	A(2,19)	A(3,19)	A(4,19)	A(5,19)

5. PRINTOUT

```
[0] [1] [2] [3]                  -57.80          -104.20
                                  20.54            57.99
                                  88.20           147.67
                                   0.50             0.18

--------

 CATEGORY  FACTOR                  9.80           500.40
                                ***2.63          ***2.66
           A.C.                  13.89          1719.44
EDIBLE     RATIO                  0.31             0.78
FISHES     S.D.
           C.V.
                                111.00
                               ***4.60
           A.C.                156.97
MOLLUSCS   RATIO                  0.45
           S.D.
           C.V.
                                679.80           767.10
                               ***2.12          ***2.11
           A.C.                1145.92          1262.28
TRUSTECIAN RATIO                  0.30             0.29
           S.D.
           C.V.
                                                   2.40
                                                ***1.81
           A.C.      --------                     4.07
TRASH FISH RATIO                                  0.24
           S.D.      AREA 2
           C.V.
                                 96.20            -9.90
                               ***1.54            36.94
           A.C.                157.40            15.55
  TOTAL    RATIO                  0.17             0.36
(AVERAGE)  S.D.
           C.V.
                                117.30           -24.80
                               ***4.29            96.71
                                199.25            86.01
--------                          0.52             0.02

  AREA 1

                                  9.30
   900.00                      ***2.58
  ***4.00                       13.17
  1414.21                        0.31
     0.47                                  --TABLE END--
```

6. TABLE LAYOUT

CATEGORY	FACTOR	AREA 1	AREA 2	AREA 3
EDIBLE FISHES	A.C.	900.00	96.20	618.00
	RATIO	***4.00	***1.54	***2.66
	S.D.	1414.21	157.40	1090.91
	C.V.	0.47	0.17	0.40
MOLLUSCS	A.C.	-57.80	117.30	118.50
	RATIO	20.54	***4.29	***1.87
	S.D.	88.20	199.25	182.00
	C.V.	0.50	0.52	0.23
CRUSTACEAN	A.C.	9.80	9.30	
	RATIO	***2.63	***2.58	
	S.D.	13.89	13.17	
	C.V.	0.31	0.31	
TRASH FISH	A.C.	111.00	-104.20	
	RATIO	***4.60	57.99	
	S.D.	156.97	147.67	
	C.V.	0.45	0.18	
TOTAL (AVERAGE)	A.C.	679.80	500.40	
	RATIO	***2.12	***2.66	
	S.D.	1145.92	1719.44	
	C.V.	0.38	0.78	

7. PROGRAM LISTING

```
 5:REM PROG.-830
 6:REM   DEF -A-
10:REM **********
   *   FACTORS  *
   *  on ANNUAL *
   *FLUCTUATIONS*
   **************
11:REM A.C.=ANGUL
   AR COEFFICIENT
   of LINEAR REGR
   ESSION: RATIO=
   DECREASE(in %)
         and
12:REM INCREASE(T
   imes):S.D.=STA
   NDARD DEVIATIO
   N:C.V.=COEFFIC
   IENT of VARIAT
   ION
15:"A":CLEAR :
   WAIT 0:BEEP 3:
   PRINT " *FACTO
   RS ON FLUCTUAT
   IONS*:BEEP3
20:TEST :CSIZE 1:
   LF -9:LPRINT "
     0       1
    2       3":
   CSIZE 2:LF 4:
   BEEP 3
30:INPUT "PEN CEL
   ECT(0-3)=?";P:
   IF P>=4GOTO 30
31:COLOR P
39:REM **INPUT***
40:BEEP 3:INPUT "
   No.of YEARs(1-
   10)=?";X
50:BEEP 3:INPUT "
   INITIAL YEAR=?
   ";T:Q=T
60:BEEP 3:INPUT "
   No.of AREAs(1-
   10)=?";E
70:BEEP 3:INPUT "
   No.of CATEGORI
   Es(1-5)=?";Y
75:DIM A$(Y-1)*20
79:BEEP 5:WAIT 15
   0:PRINT "*NAME
   ,CATG(1-20 Cha
   ract.)*":WAIT
   :CLS
80:WAIT 0:FOR I=0
   TO Y-1:BEEP 3:
   A$="":CLS :A$=
   "NAME of CATG.
    "+STR$ (I+1)+
   "=?"
82:PRINT A$;
84:INPUT A$(I)
86:NEXT I:CLS
89:WAIT 80:PRINT
   "  ---PRINT HE
   AD COLUMN---":
   LPRINT "------
   --":LF 1:
   LPRINT " CATEG
   ORY  FACTOR":
   LF 2
90:FOR I=0TO Y-1
91:IF LEN A$(I)<=
   10LPRINT A$(I)
   :GOSUB 800
92:IF LEN A$(I)<=
   10GOTO 96
93:IF LEN A$(I)>=
   11GOTO 94
94:B$=LEFT$ (A$(I
   ),10):LPRINT B
   $:C$=RIGHT$ (A
   $(I),LEN A$(I)
   -10):LPRINT C$
   :GOSUB 800
96:NEXT I
100:BEEP 10:PAUSE
   "    ---DATA K
   EY-IN---":WAIT
   0
105:DIM A(X-1,Y*E-
   1)
110:FOR J=0TO Y*E-
   1:FOR I=0TO X-
   1
120:IF Q>=T+XLET Q
   =T
130:E$="":CLS
140:E$=STR$ Q+"/IT
   EM-"+STR$ (J+1
   )+"="
150:PRINT E$;
155:INPUT A(I,J)
160:BEEP 2:Q=Q+1:
   NEXT I:BEEP 5:
   NEXT J:BEEP 10
   :CLS
162:REM **PRINTING
    & COMPUTING**
164:CLS :WAIT 80:
   PRINT " *COMPU
   TING and PRINT
   ING*":WAIT
166:W=0:N=0:F=0:A=
   0:B=0:QQ=0:PP=
   Y-1
168:FOR H=0TO E-1
170:LPRINT "------
   --":LF 1:
   LPRINT "  AREA
   ";H+1:LF 1
180:FOR J=QQTO PP
185:FOR I=0TO X-1
190:W=W+A(I,J):N=N
   +(I+1):F=F+A(I
   ,J)*(I+1):Q=Q+
   (I+1)^2:NEXT I
200:SXX=Q-X*(N/X)^
   2:SYX=F-X*(N/X
   )*(W/X):F=0
210:A=SYX/SXX:B=(W
   /X)-A*(N/X):M=
   W/X
220:USING "######.#
   #"
230:LPRINT TAB 1;A
235:U=0:N=0:SXX=0:
   SYX=0:Q=0
240:FOR I=0TO X-1:
   U=U+(A(I,J)-M)
   ^2:NEXT I
250:S=SQR (U/X):K=
   S/M
255:U=0:M=0:R=0
260:R=(A*X+B)/(A*I
   +B)*100
262:IF R>=99LET R=
   (A*X+B)/(A*I+B
```

```
    ):USING "*####
    .##":LPRINT
    TAB 1;R:USING
    :GOTO 270
263:USING "######.#
    #"
264:LPRINT TAB 1;R
270:USING "######.#
    #":LPRINT TAB
    1;S:LPRINT TAB
    1;K
275:R=0:A=0:S=0:K=
    0:LF 2
280:USING :W=0:N=0
    :O=0
290:NEXT J:LF 1
300:QQ=QQ+Y:PP=PP+
    Y:LF 1:NEXT H
310:LF 2:LPRINT "
      --TABLE END-
    -":LF 4
320:END
799:REM SUB-PROG.
800:IF LEN A$(I)<=
    10LF -2
810:IF LEN A$(I)>=
    11LF -3
820:LPRINT TAB 12;
    "A.C.":LPRINT
    TAB 12;"RATIO"
    :LPRINT TAB 12
    ;"S.D.":LPRINT
    TAB 12;"C.V.":
    LF 3
830:RETURN
840:END
```

STATUS (1)

1995

By S.SHINDO

FEB.1984 SEAFDEC

8. MEMORY CONTENTS

A	SYX/SXX $(\Sigma x_i\ y_i)/(\Sigma x_i^2 - n\ x^{-2})$	S	SQR (U/X) $\sqrt{\Sigma\ (y_i - \bar{y})^2/n} = S.D.$
B	(W/X) - A * (N/X) $\bar{y} - A\ .\ \bar{x}$	T	Initial YEAR
		U	Σ ((A (I,J) - M)^2) $\Sigma\ (y_i - \bar{y})^2$
E	Number of AREAS		
F	Σ (A(I,J) * (I + 1)) $\Sigma\ x_i\ y_i$	W	Σ A(I,J) $\Sigma\ y_i$
I	Roop	X	Number of YEARS n
J	Roop		
K	S/M S.D./$\bar{y}$ = C.V.	Y	Number of CATEGORIES
		A$	LEFT $, (Y$)
M	W/X $\bar{y}$	B$	RIGHT $, (Y$)
N	Σ (I + 1) $\bar{x}$	E$	(YEAR)/(ITEM)
		Y$	Name of CATEGORY
O	Σ (I + 1) ^ 2 $\Sigma\ x_i^2$	A (I,J)	DATA y_i
P	Pen number	SXX	O - X * (N/X) ^ 2 $\Sigma\ x_i^2 - n\ .\ x^{-2}$
Q	YEAR (Display)		
R	(A * X + B)/(A * 1 + B) $\bar{y}_n/\bar{y}_1$ = RATIO	SYX	F - X * (N/X) * (W/X) $\Sigma\ x_i\ y_i - \bar{x}\ .\ \bar{y}$