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No. 1

COMPUTER PROGRAM MANUAL

edited by

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P R E F A C E

The Internal Report series is produced primarily for the convenience of staff members of the Inter-American Tropical Tuna Commission. It contains reports of various types. Some will eventually be modified and published in the Commission's Bulletin series or in outside journals. Others are methodological reports of limited interest or reports of research which yielded negative or inconclusive results.

These reports are not to be considered as publications. Because they are in some cases preliminary, and because they are subjected to less intensive editorial scrutiny than contributions to the Commission's Bulletin series, it is requested that they not be cited without permission from the Inter-American Tropical Tuna Commission.

P R E F A C I O

Se ha producido una serie de Informes Internos con el fin de que sean útiles a los miembros del personal de la Comisión Interamericana del Atún Tropical. Esta serie incluye varias clases de informes. Algunos serán modificados eventualmente y publicados en la serie de Boletines de la Comisión o en revistas exteriores de prensa. Otros son informes metodológicos de un interés limitado o informes de investigación que han dado resultados negativos o inconclusos.

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C O N T E N T S

COMPUTER PROGRAM MANUAL

INTRODUCTION

Included in this report are descriptions of most of the important programs used by the Inter-American Tropical Tuna Commission. Some of these were written by Tuna Commission personnel, while others were adapted from programs prepared by other organizations. Descriptions of the UCLA BMD programs are not included, since these are adequately described in a readily available manual (Dixon, 1964), nor are the programs which were written to solve specific problems which are not likely to be encountered again.

With this manual and the BMD manual (Dixon, 1964) any scientist or technician should be able to use the available programs to process his data on the computer facilities at UCSD.

PERIPHERAL EQUIPMENT

The following peripheral equipment is available at the UCSD Computer Center:

MACHINES	FUNCTION
IBM 26 Printing Card Punch	Punches and prints information on cards
IBM 26 Interpreting Card Punch	Interprets information punched on cards
IBM 83 Card Sorting Machine	Arranges cards in any chosen order and counts them
IBM 407 Accounting Machine	Prints a listing of cards, or with a suitable wire board does elementary accounting
IBM 519 Reproducing Punch Machine	Punches new decks of cards from other decks; compares decks of cards
IBM 557 Alphabetic Interpreter	Interprets information punched on cards in adjustable fields

COMPUTERS

The Control Data 3600 computer has a 32,768 word memory of 48 binary digits. The words can be read from memory in 0.7 of a micro second (0.7 millionth of a second); operations take 4 micro seconds for addition and 6 micro seconds for multiplication. There are 12 magnetic tape units, a magnetic tape controller with three read-write controls, and a 1200-card-per-minute reader with an automatic Hollerith to BCD conversion.

Two smaller computers, a CDC 160-A and an IBM 1401 processing unit, are used with the CDC 3600. These machines control the input and output operations and card punching (CDC 415), printing (CDC 501), and plotting (CALCOMP 565).

The magnetic tape units use recording densities of 200, 556, or 800 characters per inch in the standard format. The tape speed is 150 inches per second and the transfer rates for the respective recording densities are 30,000, 83,000, and 120,000 characters per second.

The CDC 501 printer prints a maximum of 1100 lines per minute.

PROCEDURE FOR SUBMITTING A JOB

The following cards are necessary to submit programs to the computer; for a more complete description see Anonymous (1964-1965).

<u>System cards</u>. These cards are required by the Computer Center for accounting purposes. The system card formats are as follows:

1. MCS card (master control card) - beginning in column 1 $account number $name $T/estimate of maximum time to execute program in minutesT $P/estimate of maximum number of pages required for outputT $C/estimate of maximum number of cards to be punchedT $SCP/CØØPSIM $comment $.

   The estimate of the maximum number of cards to be punched and/or the comment (any desired identification) are optional, and if they are not used the card will read as in Example 1 below. If the estimate of the number of cards to be punched is omitted 100 will be designated by the system. Except for the account number and name the items can be in any order, and the spacing between the symbols is optional.

2. Fortran card (optional) - beginning in column 1
   $FTN,L,E,P. This causes the computer to list and execute the Fortran program and punch a binary deck. If it is not used the program will still list and execute, but the binary deck will not be punched.

3. Finis card - beginning in column 10

   FINIS

4. TRA card
   7
   9 (a 7 and a 9 punched in column 1)

Program cards. These are prepared by a computer programmer.

Data cards. These vary according to the program, and are therefore described with their respective programs.

Card order. The card order is as follows: (1) MCS card; (2) Fortran card (optional); (3) program cards; (4) FINIS card (used only with a Fortran program deck); (5) TRA card; (6) data cards.

EXAMPLES

Example No.1 - problem using Fortran program deck

```
$JB1 $STEPHENSON $T/2T $P/50T $SCP/CØØPSIM $.

$FTN,L,E,P.

(program deck)

        FINIS

7
9 (TRA card)

(data cards)
```

Example No.2 - problem using Fortran program deck with subroutines

```
$JB4 $BAYLIFF $T/2T $P/60T $CØØPSIM $ACENTØ CRUISE 2 $.

$FTN,L,E,P.

(main program deck)

(first subroutine deck)
```

.

.

.

(last subroutine deck)

FINIS

7
9 (TRA card)

(data cards)

Example No.3 - problem using binary program deck

$JB7 $CHATWIN $T/10T $P/150T $VESSELS AT SEA $SCP/CØØPSIM $.

(binary program deck)

7
9 (TRA card, which is last card of binary deck)

7
9 (TRA card)

(data cards)

Example No.4 - problem using mixed Fortran and binary decks

$JB9 $PELLA $SCP/CØØPSIM $T/2T $P/20T $.

$FTN,L,E,P.

(program deck)

(first subroutine deck)

.

.

.

(last subroutine deck)

FINIS

(first binary deck)

7
9 (TRA card, which is last card of first binary deck)

.

.

.

(last binary deck)

7
9 (TRA card, which is last card of last binary deck)

7
9 (TRA card)

(data cards)

FORMAT SPECIFICATIONS

The instructions for the various programs in this manual specify formats to be used in preparing various cards, and in some cases instruct the user to prepare his own format cards. Good descriptions of F-, I-, and A-type formats, the most commonly used input formats, are available in Dixon (1964:22-28).

The output of some of the programs in this manual is in the E-type format. Thus a number in the output will appear as a series of digits, followed by an E (exponent), followed by two more digits with or without a minus sign. The last two digits represent a power of 10 by which the first series of digits is multiplied to get the value.

Example	Value
1234 E 02	$1234 \times 10^{2} = 123,400$
1234 E 00	$1234 \times 10^{0} = 1,234$
1234 E-02	$1234 \times 10^{-2} = 12.34$

REFERENCES

Anonymous. 1964. FORTRAN63/REFERENCE MANUAL. Control Data Corporation, Documentation and Evaluation Department, Palo Alto.

Anonymous. 1964-1965. Computer Center Notes. Computer Center, UCSD, Series B, Numbers 4 through 7, October 1964 to June 1965.

Dixon, W. J. (editor). 1964. BMD Biomedical Computer Programs. Health Sciences Computing Facility, Department of Preventive Medicine and Public Health, School of Medicine, University of California, Los Angeles: vi+585 p.

A. IDENTIFICATION

CIAT B01 - Relative yield per recruit at various fishing intensities

Method by: W. H. Bayliff

Programmer: C. T. Psaropulos

Description by: W. H. Bayliff

B. DESCRIPTION

This program calculates the relative yield in weight per recruit at various fishing intensities by the method of Beverton (1963:Formula (1)). With Option 1 the program calculates the ratios of the yields per recruit at selected values of E to the yield per recruit at E = 1. With Option 2 it calculates the relative yield per recruit at selected values of F. The input data are: M (coefficient of natural mortality); F (coefficient of fishing mortality) or E (F/F + M); K (constant in von Bertalanffy growth equation); and l_c/l_∞ (l_c= average length at which the fish enter the catch; l_∞ = constant in von Bertalanffy growth equation).

1. Input

Card 1 - option card

Column	Format	Item	Example
1-7		OPTION=	OPTION=
8	I1	option	1

Card 2 - parameter card

Column	Format	Item	Example
1-6	F6.2	lowest of 10 trial values of M	2.00 (entered as 200)
7-12	F6.2	increment to be successively added to the first trial value of M to get the other 9 trial values of M	0.10 (entered as 10)
13-18	F6.2	lowest of n values of E (Option 1) or F (Option 2)	0.10 (entered as 10)

Column	Format	Item	Example
19-24	F6.2	increment to be successively added to the first value of E (Option 1) or F (Option 2) to get the other n-1 values of E or F	0.10 (entered as 10)
25-28	I4	n=number of values of E (Option 1) or F (Option 2)	10
29-34	F6.3	K	1.267(entered as 1267)
35-40	F6.3	l_c/l_∞	0.711 (entered as 711)

2. Output: The output is a value or a matrix of values of ratios (Option 1) or relative yields per recruit (Option 2).

3. Limitations: No more than 10 values of M, nor more than 1000 values of E or F, can be used for a single problem

4. Space required: 1200_{10} cells

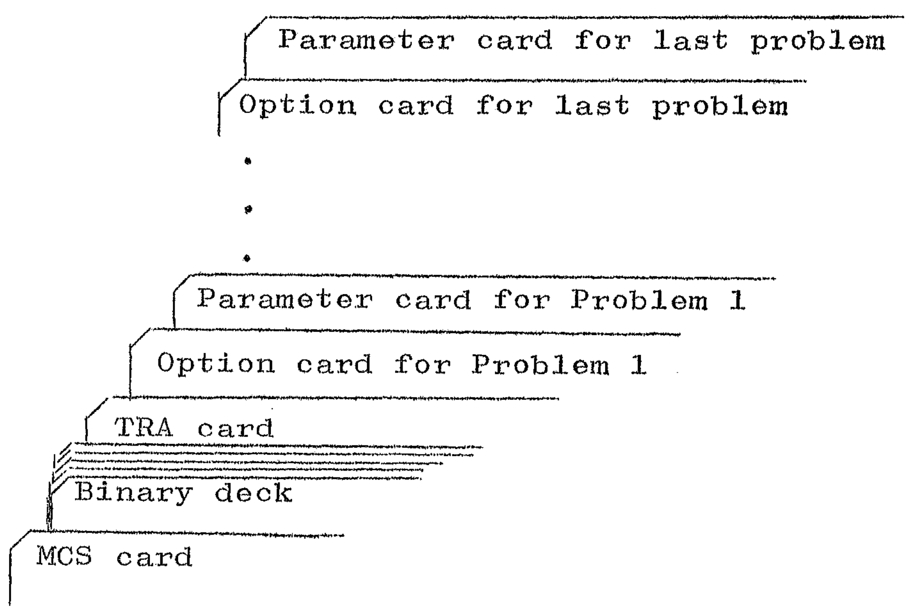
5. Input and output tape mountings: standard input and output for PRESTO MONITOR

6. Timing: 28 seconds for 26 (10x25) matrices of values.

7. Caution to users: M cannot equal 0 in Option 1

8. Equipment configuration: PRESTO COOPSIM with FORTRAN 63 on CDC 3600 Computer

C. ORDER OF CARDS



REFERENCE

Beverton, R. J. H. 1963. Maturation, growth and mortality of clupeid and engraulid stocks in relation to fishing. Rapp. Proc. Verb. 154:44-67.

A. IDENTIFICATION

CIAT CO2 - California Fish and Game annual domestic landing summary

Methods by: C. J. Orange

Programmer: C. T. Psaropulos

Description by: C. T. Psaropulos

B. DESCRIPTION

Given any number of domestic landing data cards in any order, this program summarizes the annual Californi domestic landings of yellowfin and skipjack tunas by area (see map), month, and gear.

1. Input

Card 1 - first area card

Column	Format	Item
1-5	A5	0000 (all areas north of 33°N)
6-10	"	3910
11-15	"	3911
16-20	"	3912
21-25	"	3913
26-30	"	3914
31-35	"	3916
36-40	"	3917
41-45	"	3918
46-50	"	3920
51-55	"	3921
56-60	"	3922
61-65	"	3923
66-70	"	3924
71-75	"	3926
76-80	"	3928

Card 2 - second area card

Column	Format	Item
1-5	"	3929
6-10	"	3930
11-15	"	3931
16-20	"	3932
21-25	"	3933
26-30	"	3934
31-35	"	3936
36-40	"	3938
41-45	"	3940
46-50	"	3941
51-55	"	3942
56-60	"	3943

Column	Format	Item
61-65	A5	3944
66-70	"	3946
71-75	"	3948
76-80	"	3950

Card 3 - third area card

1-5	"	3951
6-10	"	3952
11-15	"	3953
16-20	"	3954
21-25	"	3955
26-30	"	3956
31-35	"	3957
36-40	"	3958
41-45	"	4960
46-50	"	4961
51-55	"	4962
56-60	"	4963
61-65	"	4964
66-70	"	4965
71-75	"	4966
76-80	"	4967

Card 4 - fourth area card

1-5	"	4968
6-10	"	4969

All of the above data are left adjusted in their fields. The 3 or 4 preceding the area code designates the areas north or south of 2°S respectively.

Cards 5 to n - CF and G domestic landing cards

Column	Format	Item	Example
1,2	A2	gear	baitboat (entered as 02)
3-6	I4	area of origin	3910
7,8	I2	month	June (entered as 06)
9	I1	species	yellowfin (entered as 1)
10-16	I7	pounds	10,000 (entered as 10000)
17-40		blank	
41-44	I4	year	1965
45-80		blank	

The gears are as follows: 02, baitboat; 03, other (i.e. sport fishing); 71, purse seine. The species are as follows: 1, yellowfin; 2 skipjack.

2. Output

Report 1: sums by area, gear, and month for each species, Report 2: sums by gear and month for each species,

Report 3: sums by area for each species,

Report 4: sums by area and gear for each species.

3. Limitations: The maximum number of areas is 50 and the maximum number of types of gear is 3.

4. Space required: 4030_{10} cells

5. Alarms or Print-outs: The program checks for the correct gear, and if in error prints out an error message.

6. Error stops: for incorrect gear

7. Input and output tape mountings: standard input and output for PRESTO MONITOR

8. Timing: 50 seconds for 3500 data cards

9. Equipment configuration: PRESTO COOPSIM with FORTRAN 63 on CDC 3600 Computer

C. METHOD

The input catch data are summed by area, month, and gear

$$SY_{ijk} = \sum_{ijk} LY_{ijk} \text{ and}$$

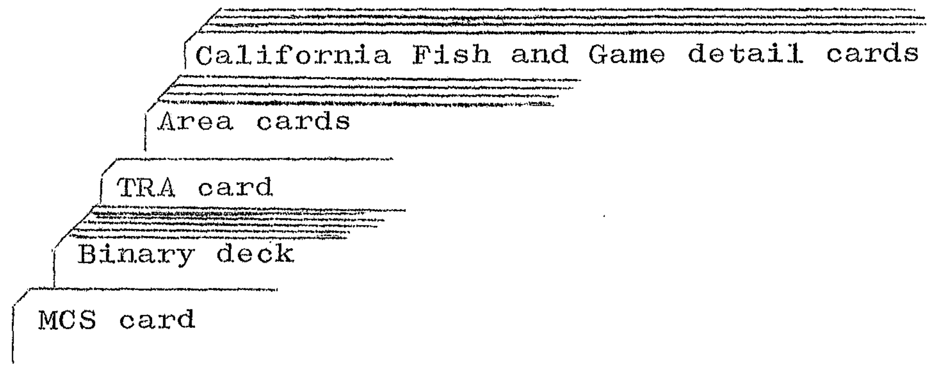
$$SS_{ijk} = \sum_{ijk} LS_{ijk} \text{ by area } (i = 1,\ 2,\ldots.50)$$

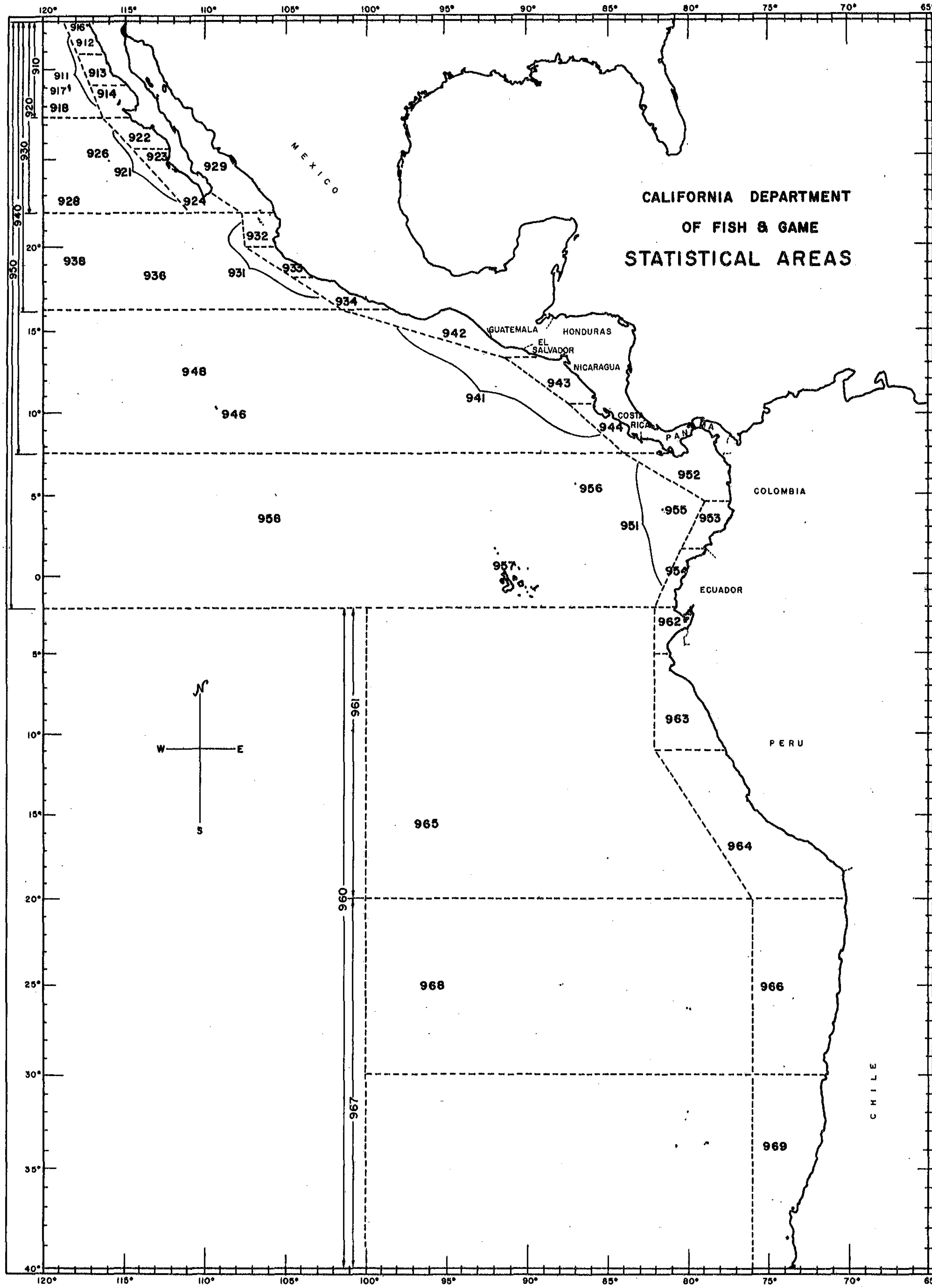
$$\text{month } (j = 1,\ 2,\ldots.12)$$

$$\text{gear } (k = 1,2,3)$$

Where SY is the sum of the yellowfin, SS is the sum of the skipjack, LY is the landed weight of yellowfin, and LS is the landed weight of skipjack by the above 3 parameters.

D. ORDER OF CARDS




CALIFORNIA DEPARTMENT
OF FISH & GAME
STATISTICAL AREAS
MEXICO
GUATEMALA
HONDURAS
EL SALVADOR
NICARAGUA
COSTA RICA
PANAMA
COLOMBIA
ECUADOR
PERU
CHILE
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A. IDENTIFICATION

CIAT C03 - Vessels at Sea

Methods by: B. M. Chatwin

Programmer: C. T. Psaropulos

Description by: C. T. Psaropulos

B. DESCRIPTION

This program uses "boat card" data on completed fishing trips to make a listing of the vessels at sea on any given date by IATTC number, California Fish and Game number, vessel capacity, vessel size class, gear, date of departure, date of return, number of days out, number of days spent in port before the trip, tons of yellowfin, skipjack, and other fish hailed, pounds of yellowfin, skipjack, and other fish caught, and a comment. The program then calculates the sums of the capacity at sea, days out, days in port before the trip, hail weights, and actual weights for each date.

1. Input

Card 1 - year card

Column	Format	Item	Example
1-5	5X	comment	YEAR=
6-9	I4	year	1965
10-20	11X	comment	PERIODS=
21-22	I2	number of days desired	3 (entered as 03)

Card 2,3,...n - date cards

1-8	I8	date desired	January 4 1965 (entered as 650104)
9-16	I8	" "	January 11 1965 (entered as 650111)
17-24	I8	" "	January 18 1965 (entered as 650118)

This continues until all the desired dates have been designated, continuing from one card to the next.

Card n + 1, n + 2,...,k - boat cards

Column	Format	Item	Example
1-3	A3	IATTC number	536
4-8	A5	CF and G number	3516
9-12	I4	vessel capacity	50 tons (entered as 50)
13	I1	vessel size class	1
14	I1	gear	baitboat (entered as 1)
15-16	I2	year of departure	1964 (entered as 64)
17-18	I2	month of departure	June (entered as 06)
19-20	I2	date of departure	10
21-22	I2	year of return	64
23-24	I2	month of return	07
25-26	I2	date of return	17
27-29	I3	number of days out	37
30-31	I2	number of days spent in port before the trip	15
32	A1	logbook data (T= tabulated, N=not tabulated)	T
33	1X	trip number	1
34-35	2X	country of unloading	California (entered as CA)
36-39	I4	yellowfin hailed	2 tons (entered as 2)
40-43	I4	skipjack hailed	20 tons (entered as 20)
44-46	I3	other species hailed	7 tons (entered as 7)
47-53	I7	yellowfin weigh out	7,183 lbs (entered as 7183)
54-60	I7	skipjack weigh out	59,974 lbs (entered as 59974)
61-66	I6	bluefin weight out	0 lbs (entered as 0)

Column	Format	Item	Example
67-68	A2	days of fishing effort	24
69-70	A2	days of baiting effort	6
71-80	A8, A2	comment (10 spaces)	13,676 pounds of albacore (entered as 13676 ALB)

The country of unloading codes are as follows: CA, California; CR, Costa Rica; EA, East America; ME, Mexico; PE, Peru; PR, Puerto Rico. The gear codes are as follows: 1, baitboat; 2, purse seine.

The data on all the cards are right adjusted in their fields.

2. Limitations: The number of dates is limited to 60.

3. Space required: 560_{10} cells

4. Alarms or printouts: If a parity error occurs the program will print an error message and stop.

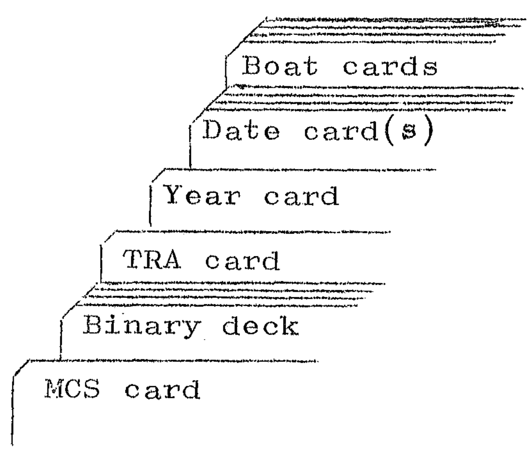
5. Error stops: if parity error occurs

6. Input and output tape mountings: standard input, output, and scratch tape for PRESTO MONITOR

7. Timing: 8 minutes for 850 boat cards and 52 dates

8. Equipment configuration: PRESTO COOPSIM with FORTRAN 63 on CDC 3600 Computer

C. ORDER OF CARDS



A. IDENTIFICATION

CIAT C04 - Baitboat bait catch summary

Methods by: C. J. Orange

Programmer: C. T. Psaropulos

Description by: C. T. Psaropulos

B. DESCRIPTION

This program summarizes by country the annual catch and effort of tuna-bait fishes by area, month, and size class of vessel for nine species of bait (see Appendix). It prorates the catch by month and area for the days of effort when the quantity of bait caught is unknown. The prorated catch and effort is adjusted by a "bait factor" which corrects for the unlogged trips.

1. Input

Card 1 - area card

Column	Format	Area
1,2	A2	01
3,4	"	11
5,6	"	21
7,8	"	22
9,10	"	23
11,12	"	24
13,14	"	25
15,16	"	26
17,18	"	31
19,20	"	32
21,22	"	33
23,24	"	34
25,26	"	35
27,28	"	36
29,30	"	41
31,32	"	42
33,34	"	51
35,36	"	52
37,38	"	53
39,40	"	54
41,42	"	61
43,44	"	62
45,46	"	71
47,48	"	81

Column	Format	Area
49,50	A2	82
51,52	"	83
53,54	"	91
55,56	"	92
57,58	"	93

Card 2 - bait factor card

Column	Format	Item	Example
1-13	13X	comment	BAIT FACTORS=
14	I1	number of bait factors	6
15		blank	
16-21	F6.3	bait factor for Size Class 1	1.094 (entered as 1094)
22-27	"	same for Size Class 2	1.003 (entered as 1003)
28-33	"	same for Size Class 3	1.002 (entered as 1002)
34-39	"	same for Size Class 4	1.000 (entered as 1000)
40-45	"	same for Size Class 5	1.000 (entered as 1000)
46-51	"	same for Size Class 6	1.000 (entered as 1000)

Card 3 - country card

Column	Format	Item	Example
1-7	7X	comment	YEAR=19
8,9	A2	year (last two digits)	64
10-21	12X	comment	COUNTRY
22	A1	country	California based vessel (entered as 0)
23-41	19X	comment	PRORATION DESIRED=
42	I1	proration	yes (entered as 1; "no" would be entered as 0)
43-80		blank	

Card 4 to n - catch detail cards

Column	Format	Item	Example
1	1X	country	0
2,3	I2	area	11
4	I1	size class	2

Column	Format	Item	Example
5,6	I2	month	May (entered as 05)
7,9	F3.1	effort	10 days (entered as 100)
10-14	F5.0	catch	100 scoops (entered as 100)
15	I1	species of bait	anchovy (entered as 1)
16-18	F3.1	effort for which catch is unknown	10.5 days (entered as 105)
19,20	2X	year	1965 (entered as 65)
21-80		blank	

The catch detail card data are right adjusted in their fields.

Card n + 1 - termination card

1-20		blank	
21-23	I3	termination code	999
24-80		blank	

2. Output: Given any number of catch detail cards for a given year separated by country where the vessels are based this program will print the following reports for each country:

Report 1: the sums of the catches by species for each area, size class, and month, and the sumsof the effort by area, size class, and month,

Report 2: the sums of the catches by species for each area, month, and size class, and the sums of the effort by area, month, and size class,

Report 3: the sums of the catches by species for each area, and the sums of the effort for each area.

3. Limitations: The maximum number of areas that can be used is 29, and the maximum number of countries is 10.

4. Space required: $25{,}000_{10}$ cells

5. Input and output tape mountings: standard input and output for PRESTO MONITOR

6. Timing: 37 seconds for 1000 cards of data for three countries

7. Equipment configuration: PRESTO COOPSIM with FORTRAN 63 on CDC 3600 Computer

C. METHOD

The catch data are summed by area, month, size class, and species where SC is the sum of C, the catch,

$$SC_{ijk} = \sum_{ijk} C_{ijk}$$

by area (i=1,2,....29)
month(j=1,2,....12)
size class and species (k=1,2,....54)

The restriction of a 3-parameter computer forces size class and species to be stored as follows:

Size Class	Species	Indexed
1	1,....9	k=1,2,....9
2	1,....9	k=10,11,....18
3	1,....9	k=19,20,....27
4	1,....9	k=28,29,....36
5	1,....9	k=37,38,....45
6	1,....9	k=46,47,....54

The effort is summed by area, month, and size class.

$$SE_{ijk} = \sum_{ijk} E_{ijk}$$

$$SEUC_{ijk} = \sum_{ijk} EUC_{ijk}$$

by area (i=1,2,....29)
month (j=1,2,....12)
size class (k=1,2,.... 6)

$$TE_{ijk} = SE_{ijk} + SEUC_{ijk}$$

where SE represents the sum of the effort E, TE the total effort, and SEUC the sum of the effort for which the catch is unknown, EUC.

The proration is accomplished by

$$TC_{ijk} = SC_{ijk} \times TE_{ijk}/SE_{ijk}$$

where TC represents the prorated catch.

The bait factor correction is made for each size class for the prorated catch and the total effort

$$TC'_{ijk} = TC_{ijk} \times BF_k$$

$$TE'_{ijk} = TE_{ijk} \times BF_k$$

where BF is the bait factor for each size class.

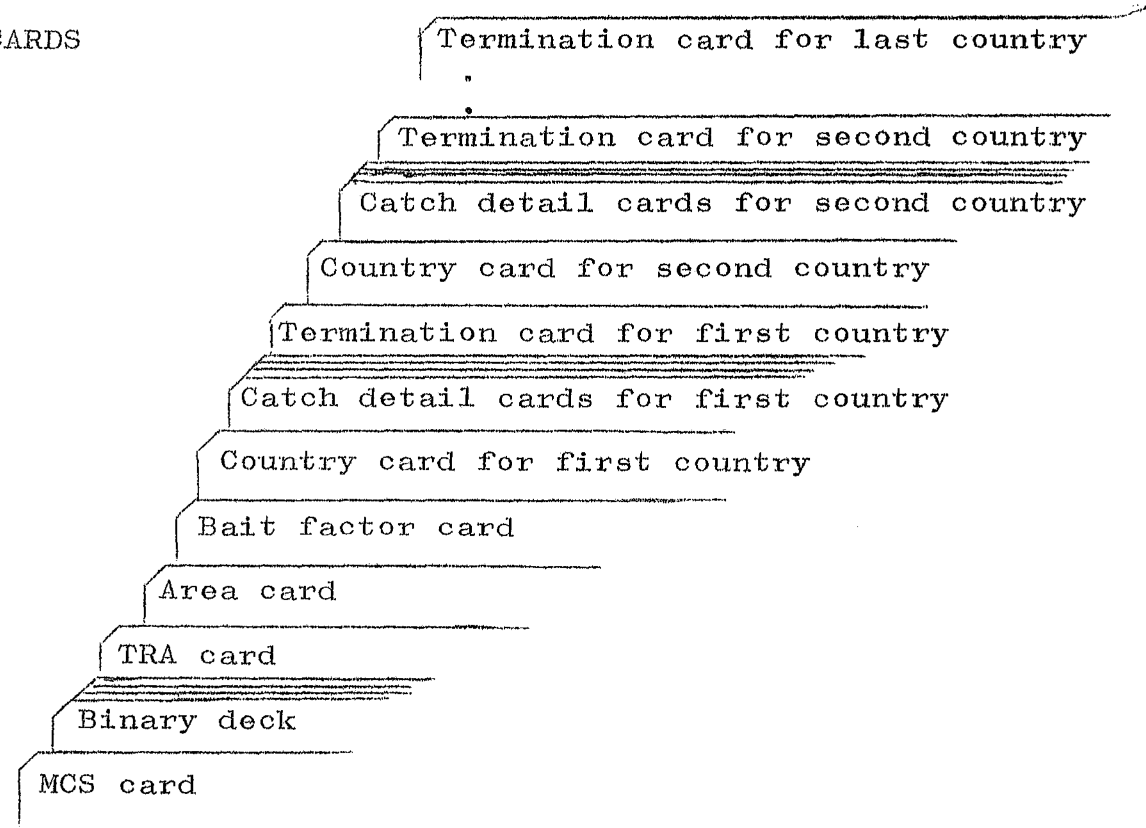
To avoid error due to machine rounding the following method is used:

$$TC'_{ijk} = \text{INTF } (TC'_{ijk} + .5) \text{ and}$$

$$TE'_{ijk} = \text{INTF } (TE'_{ijk} + .05) \times 10)/10$$

where a 5 is added in the place to the right of the last digit to be retained and then the digits to the right are dropped off by the machine function INTF which truncates to the right of the decimal place.

D. ORDER OF CARDS



E. OPTION

To check for keypunching errors or missing data cards the proration for unlogged catch can be eliminated by punching 0 in column 42 of the country cards, while the adjustment for unlogged trips can be eliminated by punching 1000 in columns 16-51 of the bait factor cards.

REFERENCE

Alverson, F.G. and Shimada, B.M. 1957. A study of the eastern Pacific fishery for tuna baitfishes, with particular reference to the anchoveta (Cetengraulis mysticetus). Bull. Inter-Amer. Trop. Tuna Comm., 2(2):25-80.

APPENDIX

BAIT STATISTICAL AREAS

01 - High Seas
11 - California Waters
21 - Mexican Border to Pt.Eugenio
22 - Pt. Eugenio to C.San Lazaro
23 - Santa Maria Bay
24 - Magdalena Bay
25 - Almejas Bay
26 - Redondo Pt. to C. Falso
31 - Gulf of Calif.-Misc. West
32 - Gulf of Calif.-Misc. East
33 - Kino Pt.
34 - Guaymas
35 - Ahome Pt. to Macapule I.
36 - Banderas Bay
41 - C.Corrientes to Puerto Angel
42 - Gulf of Tehuantepec
51 - San Benito to C. Blanco, C.R.
52 - Gulf of Fonseca
53 - Gulf of Nicoya
54 - Judas Pt. to C. Mala
61 - Montijo Bay
62 - Gulf of Panama
71 - Piñas Pt. to Mangles Pt.
81 - Mangles Pt. to C. Santa Elena
82 - Gulf of Guayaquil
83 - Galapagos I.
91 - C. Blanco, Peru to Aguja Pt.
92 - Aguja Pt. to Peru-Chile Border
93 - South of Peru-Chile Border

COUNTRY

0 - Vessels based in California
1 - Vessels based in Puerto Rico
2 - Vessels based in Peru
3 - Vessels based in Mexico
4 - Vessels based in Costa Rica
5 - Vessels based in Panama

SIZE CLASS

1 - up through 50 tons capacity
2 - 51 through 100 tons capacity
3 - 101 through 200 tons capacity
4 - 201 through 300 tons capacity
5 - 301 through 400 tons capacity
6 - 401 tons capacity and up

SPECIES OF BAIT

Abbrevation	Key punch code	Species
A	1	Anchovy
S	2	Sardine
AV	3	Anchoveta
AP	4	Anchovy-Peru
A/S	5	Anchovy and Sardine
SG/SP	6	Sardine-Galapagos or Sardine-Peru
H	7	Herring
SL	8	Salima
M	9	Miscellaneous or mixed species

A. IDENTIFICATION

CIAT D01 - Weighted linear regression for two variables

Methods by: G. J. Paulik and L. E. Gales

Programmer: L. E. Gales; modified by C. T. Psaropulos

Description by: W. H. Bayliff

B. DESCRIPTION

This program computes the regression line $Y_i = b_0 + b_1X_i$ where the Y_i may have different weights. The user may transform the data by any of three transformations, natural logarithms of X, Y, and/or W (weight), common logarithms of X, Y, and/or W, and/or powers of X, Y, and/or W. The two variables and the weights may be transformed independently. The program normalizes the weights (or the transformations of the weights) by dividing each weight by the mean weight.

1. Input

Card 1 - variable format card for Cards 3 through n - 1 of the first problem. (Three fields must be specified even though only two are used when there is no weighting.)

Card 2 - control card

Column	Format	Item
1-6	A6	transformation for X
7-12	"	transformation for Y
13-18	"	transformation for W
19-22	F4.0	value of D if transformation X^D is used for X
23-26	F4.0	value of D if transformation Y^D is used for Y
27-30	F4.0	value of D if transformation W^D is used for W
31-40	F10.0	B_1 value for test of H; $b_1 = B_1$

Column	Format	Item
41-50	F10.0	value of X_0 to be used in prediction, $Y(\text{predicted}) = b_0 + b_1X_0$
51-54	I4	9999 if weighting is not used (otherwise leave blank)

When it is desired to transform the X, Y, and/or W values the following should be punched in Columns 1-6, 7-12, and/or 13-18:

Transformation	Punch
natural logarithm	LN(Z) (left adjusted)
common logarithm	LOG(Z)
power	Z**D (left adjusted)

Usually not all fields in this card are used. If none are used the card must still be included.

Card 3 - first card with X, Y, and W values (format as specified in Card 1, with X in first field, Y in second field, and W (optional) in third field)

Card 4 - second card with X, Y, and W values

.
.
.

Card n - 1 - last card with X, Y, and W values

Card n - blank card

Card n + 1 - variable format card for Cards 3 through n - 1 of the second problem

etc.

Example 1. It is desired to determine of there is a statistically significant correlation between the sea-surface temperature and the catch per unit of effort, to calculate the constants of the regression between these two (X = temperature, Y = catch per unit of effort), to determine if the slope of the regression differs from some chosen value (say 0.567), and to predict the catch per unit of effort for some chosen temperature (say 25.3). Weighting is not to be used.

Card 1

Column	Item
1-7	(3F6.0)

Card 2

1-30	(blank)
31-40	.567
41-50	25.3
51-54	9999

Card 3

1-6	(first temperature value)
7-12	(first catch per unit of effort value)
13-18	(blank)

.
.
.

Card n - 1

1-6	(last temperature value)
7-12	(last catch per unit of effort value)
13-18	(blank)

Card n

1-80	(blank)

Example 2. It is desired to fit a parabola to data on the relationship between recruits (R) and spawners (S). The equation is of the form $R = b_0S - b_1S^2$, which may be transformed to $R/S = b_0 - b_1S$, R/S being equivalent to Y and S being equivalent to X. The data are to be weighted according to the squares of the reciprocals of the Y values.

Card 1

Column	Item
1-7	(3F6.0)

Card 2

Column	Item
1-12	(blank)
13-18	Z**D
19-26	(blank)
27-30	-2
31-54	(blank)

Card 3

1-6	(first S value)
7-12	(first R/S value)
13-18	(first R/S value)

.
.
.

Card n - 1

1-6	(last S value)
7-12	(last R/S value)
13-18	(last R/S value)

Card n

1-80	(blank)

Example 3. It is desired to fit the equation $R = \alpha Se^{-\beta S}$ to data on the relationship between recruits (R) and spawners (S). This equation can be transformed to $R/S = \alpha e^{-\beta S}$ and then to $\ln(R/S) = \ln\alpha - \beta S$, $\ln(R/S)$ being equivalent to Y and S being equivalent to X. The data are not to be weighted.

Card 1

Column	Item
1-7	(3F6.0)

Card 2

1-6	(blank)
7-12	LN(Z)
13-50	(blank)
51-54	9999

Card 3

Column	Item
1-6	(first S value)
7-12	(first R/S value)
13-18	(blank)

.
.
.

Card n - 1

1-6	(last S value)
7-12	(last R/S value)
13-18	(blank)

Card n

1-80	(blank)

Example 4. It is desired to fit the equation $R = 1/[(\alpha/S) + \beta]$ to data on the relationship between recruits (R) and spawners (S). This equation can be transformed to $R = S/(\alpha + \beta S)$ and then to $(R/S)^{-1} = \alpha + \beta S$, $(R/S)^{-1}$ being equivalent to Y and S being equivalent to X. The data are to be weighted according to the squares of the reciprocals of the Y values.

Card 1

Column	Item
1-7	(3F6.0)

Card 2

1-6	(blank)
7-12	Z**D
13-18	Z**D
19-22	(blank)
23-26	-1
27-30	2
31-54	(blank)

Card 3

1-6	(first S value)
7-12	(first R/S value)
13-18	(first R/S value)

.
.
.

Card n - 1

Column	Item
1-6	(last S value)
7-12	(last R/S value)
13-18	(last R/S value)

Card n

1-80	(blank)

2. Output

Below is a list of the notation in the output, with the equivalent notation of Natrella (1963: Chapter 5), when available.

Notation in output	Notation in Natrella	Remarks
$\overline{X}$	$\overline{X}$	
$\overline{Y}$	$\overline{Y}$	
SUM W	n	
SUM W*X	ΣX	
SUM W*Y	ΣY	
SUM W*X*Y	ΣXY	
SUM W*X^2	ΣX^2	
SUM W*Y^2	ΣY^2	
SUM W*V^2	$(n - 2)s^2_Y$	
D		
VAR(B1)	s^2b_1	
S.D.OF B1		square root of VAR(B1)
VAR(B0)	s^2b_0	
S.D.OF B0		square root of VAR(B0)
COVAR(B0,B1)		
T		*t*-statistic for testing the hypothesis: $b_1 = B_1$, where B_1 is entered on Card 2, Columns 31-40
B0	b_0	b_0 in the equation $Y_i = b_0 + b_1X_i$

Notation in output	Notation in Natrella	Remarks
B1	b_1	b_1 in the equation $Y_i = b_0 + b_1X_i$ (not to be confused with the B_1 entered in Card 2, Columns 31-40)
VAR LINE	s^2Y	
S.D.LINE	s_Y	
VAR PR VAL		variance of PRED VAL (see below)
S.D.PR VAL		standard deviation of PRED VAL (see below)
PRED VAL		predicted value of Y for the value of X_0 entered in Card 2, Columns 41-50
R		this is r, the coefficient of correlation of Snedecor (1956:Chapter 7). It is calculated by $r = [T^2/(\text{SUM W} + T^2 - 2)]^{1/2}$.

3. Limitations: maximum of 4,000 observations (can be changed by altering dimension statement); one observation per data card

4. Space required: $20{,}017_{10}$ cells

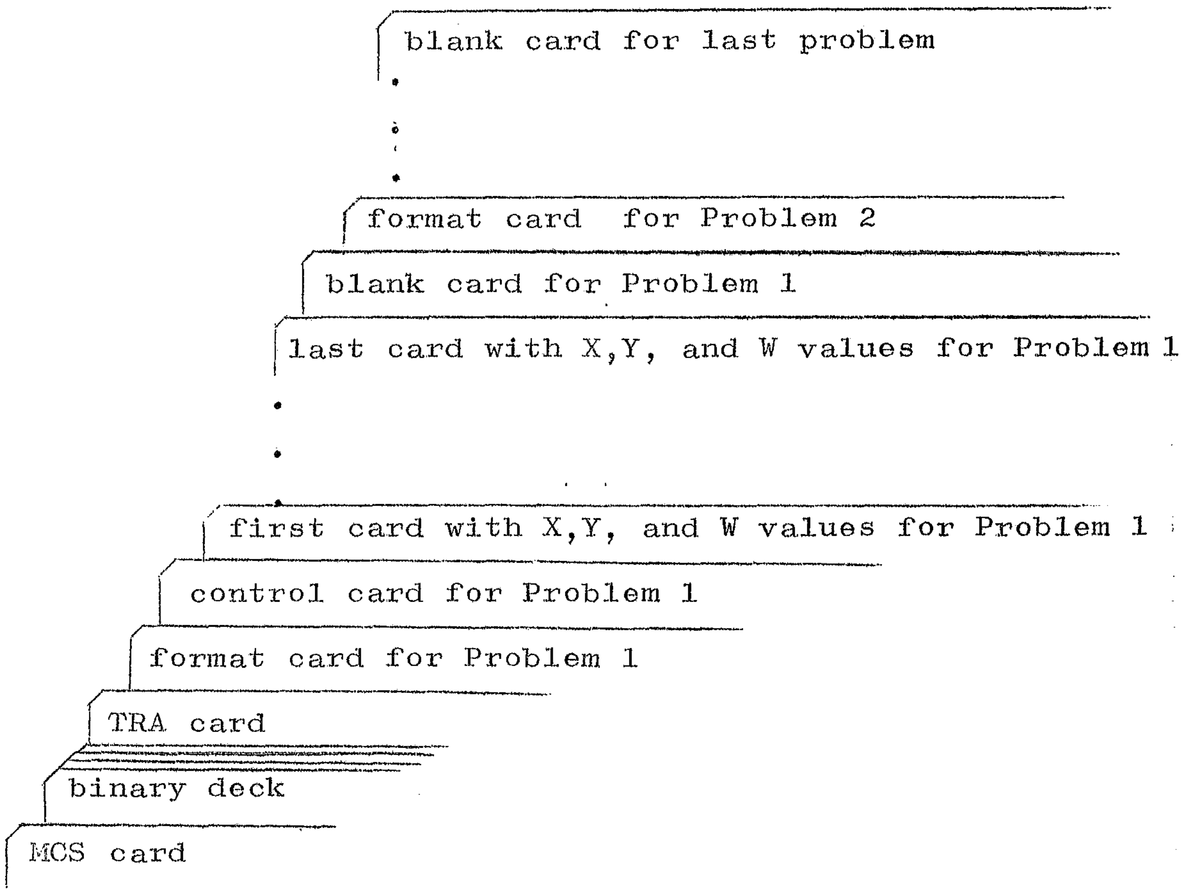
5. Input and output tape mounting: standard input and output for PRESTO MONITOR

6. Timing: The maximum time for most problems (about 30 observations) is about 16 seconds.

7. Caution to users: The most common error made with this program is specifying only two fields on the format card.

8. Equipment configuration: PRESTO COOPSIM with FORTRAN 63 on CDC 3600 Computer

C. ORDER OF CARDS



REFERENCES

Natrella, Mary Gibbons. 1963. Experimental Statistics. National Bureau of Standards Handbook 91.

Paulik, G. J., and Lawrence E. Gales. 1965. Weighted linear regression for two variables, IBM 709, Fortran II. Trans. Amer. Fish. Soc., 94(2):196.

Snedecor, George W. 1956. Statistical Methods Applied to Experiments in Agriculture and Biology. The Iowa State College Press, Ames, Iowa: xii + 534 p.

A. IDENTIFICATION

CIAT D02 - Best current estimate of the numbers, percentages, and weights of fish caught at each length-frequency interval, and the average weights of the fish

Methods by: E. B. Davidoff

Programmer: C. T. Psaropulos

Description by: C. T. Psaropulos

B. DESCRIPTION

Given any number of "length detail cards" for fish sampled during a given bimonthly (or other) period, this program calculates by primary area (see Appendix) and gear: (1) the number of fish sampled at each length-frequency interval; (2) the percentage of fish sampled at each length-frequency interval; (3) the smoothed percentage of fish sampled at each length-frequency interval; and (4) the average weight of the fish. With the input of the corresponding catch data the program makes estimates of the numbers of fish caught at each length-frequency interval for the given period by primary area and gear.

The program makes estimates for the given period for both gears combined for each of the primary and secondary areas (see Appendix) of: (1) the number of fish caught at each length frequency-interval; (2) the percentage of fish caught at each length-frequency interval; (3) the smoothed percentage of fish caught at each length-frequency interval; and (4) the average weight of the fish. It estimates the same thing for each gear separately for each of the secondary areas.

Finally the program makes estimates for the given period and all preceding periods of that year combined for each gear separately and both gears combined for each of the primary and secondary areas of: (1) the number of fish caught at each length-frequency interval; (2) the percentage of fish caught at each length-frequency interval; (3) the smoothed percentage of fish caught at each length-frequency interval; (4) the total weight of fish caught at each length-frequency interval; and (5) the average weight of the fish.

1. Input

Card A - year and species card

Columns	Format	Item	Example
1-5	5X	comment	YEAR=
6-9	A4	year	1965
10-80	8A8,A2	comment	SPECIES=YELLOWFIN

Card B - length interval card

Columns	Format	Item	Example
1-8	8X	comment	MINIMUM=
9-11	I3	minimum length interval of fish sampled	400
12-22	11X	comment	INTERVAL=
23,24	F2	interval length	20
25-43	19X	comment	NO.OF INTERVALS=
44,45	I2	number of intervals	80

Card C - length-weight equation card

Columns	Format	Item	Example
1-38	38X	comment	LENGHT-WEIGHT EQUA-TION, A*L**B WHERE A=
39-50	E12	value of A	3.894E-08
51-53	3X	comment	,B=
54-57	F4.0	value of B	3.02

Card D - option card

Columns	Format	Item	Example
1-52	52X	comment	LAST PERIOD TO BE REPRESSED=
53,54	I2	last period to be repressed	2

If the most recent available data were for the third bimonthly period it would be desired to omit the data for the first and second bimonthly periods from the calculations described in the first two paragraphs above. This would be accomplished by punching 2 in Column 54. (The entry is right adjusted in its field.)

Card E - catch card

Columns	Format	Item	Example
1,2	2X	year	1965(entered as 65)
3	1X	species	1
4	I1	period	4
5	1X	gear	1
6-11	F6.1	catch, area 102	329.6 tons(entered as 3296)
12-17	"	" " 105	etc.
18-23	"	" " 106	etc.
24-29	"	" " 107	etc.
30-35	"	" " 110	etc.
36-41	"	" " 115	etc.
42-47	"	" " 120	etc.

Card F - same as card 5 except for gear 2

Card 1,2,--,n - length detail cards

1,2	2X	year	1965(entered as 65)
3	1X	species	1
4,5	2X	area according to Hennemuth (1957:Figure 1)	01
6,7	2X	month	June(entered as 06)
8	I1	gear	1
9	1X	sampling method	1
10	I1	card number (see below)	1
11-14	4X	sample size	50 fish(entered as 50)

Columns	Format	Item	Example
15,16	2X	number of sample taken during a given year and month in a given area	1(entered as 01)
17	1X	period	2
18,19		blank	
20	I1	area according to Appendix	
21-80	20F3.0	number of fish sampled per length interval	5,10,8,......

The length intervals in columns 21 through 80 are determined by the card number i.e., card 1, intervals 1-20; card 2, intervals 21-40; card 3, intervals 41-60; card 4, intervals 61-80. All the data are right adjusted in their fields.

Card n + 1 - blank card

2. Limitations

a) The cards for each period must be kept separatedly, and the periods must be in chronological order.

b) Gear 2 must follow gear 1 in the catch cards.

c) Although any number of periods may be run consecutively, it must be kept in mind that all of the periods will be summed to compute the best current estimate.

d) The maximum number of length frequencies is 80, gears 2, and primary areas 7.

3. Storage required: $16,727_{10}$ cells

4. Input and output tape mountings: standard input and output for PRESTO MONITOR

5. Timing: 1-1/2 minutes for a problem with six groups

6. Equipment configuration: PRESTO COOPSIM with FORTRAN 63 on CDC 3600 Computer

C. ORDER OF CARDS

For each period

card n+1 - blank card
cards 1,2,...,n - length detail cards
card F - catch card, gear 2
card E - catch card, gear 1

Job deck order

Cards for last period
⋮
Cards for second period
Cards for first period
Card D - option card
Card C - length-weight equation card
Card B - length interval card
Card A - year and species card
TRA card
Binary deck
MCS card

D. OPTIONS

a) The number of periods for which that the user desires the data not to be printed is controllable, although in order to insure that a mix-up, i.e. missing data cards etc., has not occurred since the last running of the program it will print the data for the combined gear for all the repressed groups for areas 216 and 516.

E. METHOD

The equations listed here are in order similar to that of execution in the program.

The weight per length frequency is generated by the equation:

$$W_k = aL_k^b \quad \text{for } k = 1,2.....n \text{ length-frequency intervals}$$

where

W = weight in pounds per length frequency

a = constant

L = length in millimeters using the midpoint of the interval which is found by $L = [(\text{lower limit} + \text{length of the interval})/2]$ minus 0.5

b = constant

The number of samplings, F, for the area, gear, and length-frequency is read into memory and classified by:

F_{ik} where $i = 1,2....,7$ for areas and gear 1

$i = 8,9....,14$ for areas and gear 2

$k = 1,2....,n$ length-frequency intervals

The number of samplings, SF, for each area and gear is found by:

$$SF_i = \sum_k F_{ik}$$

The smoothed percentages, SP, are found by:

$$SP_{ik} = 25\ (F_{ik-1} + 2F_{ik} + F_{ik+1})/SF_i$$

The rough percentages, RP, are found by:

$$RP_{ik} = 100F_{ik}/SF_i$$

The average weight, $\bar{W}$, is found by:

$$\bar{W}_i = \sum_k W_k\ RP_{ik}/100$$

The number of fish, N, for each area and bi-monthly period is estimated by:

$$N_i = 2000\ C_i/\bar{W}_i$$

where C_i is the catch data in tons for each area and gear.

The number of fish, NF, caught by area and frequency distribution is estimated by:

$$NF_{ik} = RP_{ik}\ N_i/100$$

The number of fish for each gear, CNF, are combined by areas and length-frequency distributions:

$$CNF_{1,k} = NF_{3,k} + NF_{4,k}$$

$$CNF_{2,k} = NF_{1,k} + NF_{6,k}$$

$$CNF_{3,k} = NF_{7,k} + CNF_{2,k}$$

$$CNF_{4,k} = NF_{5,k} + NF_{2,k} + CNF_{1,k}$$

$$CNF_{5,k} = CNF_{3,k} + CNF_{4,k}.$$

For the combined areas the smooth and raw percentage distributions and the average weight of fish are found using the above methods.

The best current estimate, SNF, frequency distributions summed over all grouped periods is found by:

$SNF_{ik} = \sum_{B} NF_{ik}$, where B represents the grouped period.

The smooth and raw percentage distributions are found by the above method and the tonnage distribution, T, is found by:

$$T_{ik} = SNF_{ik}\ W_k/2000.$$

REFERENCE

Hennemuth, Richard C. 1957. An analysis of methods of sampling to determine the size compositions of commercial landings of yellowfin tuna (Neothunnus macropterus) and skipjack (Katsuwonus pelamis). Bull., Inter-Amer. Trop. Tuna Comm., 2(5):174-243.

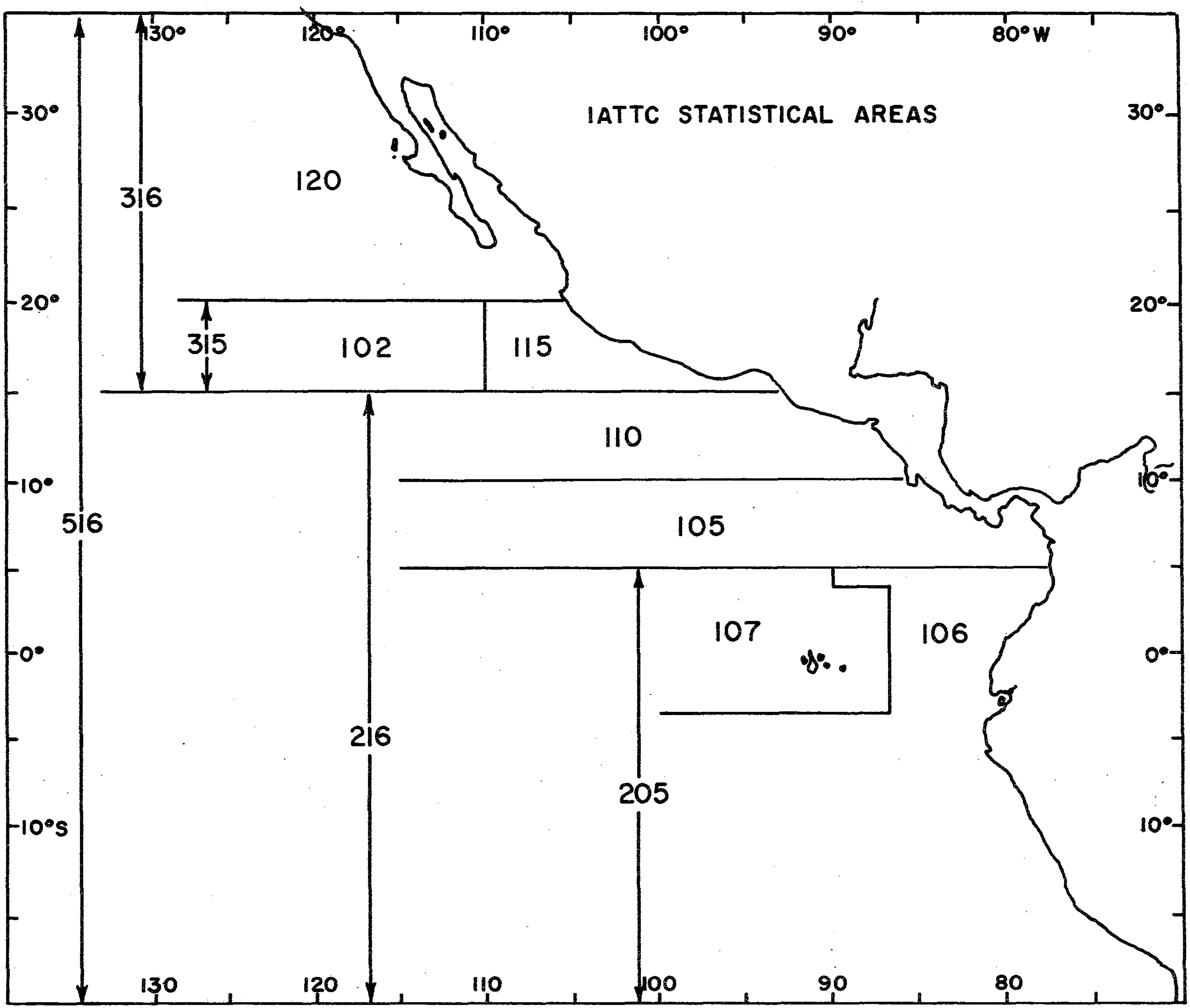
APPENDIX

Gear	Punched on cards	Read on output
baitboat	1	1
purse-seine	2	2
combined		3

IATTC sampling areas (see map	Punched on cards	Read on output
102	1	102
105	2	105
106	3	106
107	4	107
110	5	110
115	6	115
120	7	120
106,107		205
102,115		315
102,115,120		316
105,106,107,110		216
102,105,106,107,110,115,120		516

Species	Punched on cards
yellowfin	1
skipjack	2

Sampling methods	Punched on cards
systematic table	1
bucket	2
systematic flume	3
grab	4


IATTC STATISTICAL AREAS
130°
120°
110°
100°
90°
80° W
30°
20°
10°
0°
10°S
120
316
315
102
115
110
105
516
216
107
106
205
130
120
110
100
90
80

A. IDENTIFICATION

CIAT D03 - Solutions for the constants in Schaefer's model for determining the status of a stock of fish in regard to fishing.

Methods by: M. B. Schaefer and E. B. Bennett

Programmer: C. T. Psaropulos

Description by: W. H. Bayliff

B. DESCRIPTION

This program uses three simultaneous equations to solve for the constants, *a*, *M*, and k_2, in Schaefer's (1957) model for determining the status of a stock of fish in regard to fishing. Schaefer (1957) used an iterative procedure to evaluate these constants, but in another publication (Schaefer and Beverton, 1963) it was indicated that evaluation of the constants by the solution of three simultaneous equations would be acceptable.

The first and last years for which catch and catch-per-unit-of-effort data are available are not used because ΔU_i values cannot be obtained for these years. Thus Schaefer (1957) had catch and catch-per-unit-of-effort data for 1934-1955, but was able to use only the data for 1935-1954. The data are divided into two equal, or nearly equal, parts on the basis of time, i.e. 1935-1944 and 1945-1954 in Schaefer's paper. Using the values from Schaefer's Tables 1 and 4, the input data are as follows:

1. Input

Card 1

Column	Format	Item	Example
1-10	F10.0	sum of $\Delta U_i/\bar{U}$ for the first period	-.11520
11-14	F4.1	number of years in the first period	10 (entered as 100)

Column	Format	Item	Example
15-24	F10.0	-(sum of $\overline{U}_i$ for the first period)	-100289.
25-34	F10.0	-(sum of $C_i/\overline{U}_i$ for the first period)	-77290.
	Card 2 (same as Card 1 for the second period)		
1-10			-.37665
11-14			100
15-24			-75700.
25-34			-234242.
	Card 3		
1-10	F10.0	sum of the absolute values of $\Delta U_i/\overline{U}_i$ for both periods	2.11843
11-14	F3.1	number of years in which ΔU_i was positive minus the number of years in which ΔU_i was negative	-6 (entered as -60)
15-24	F10.0	sum of $\overline{U}_i$ for the years in which ΔU_i was negative minus the sum of $\overline{U}_i$ for the years in which ΔU_i was positive	60109.
25-34	F10.0	sum of $C_i/\overline{U}_i$ for the years in which ΔU_i was negative minus the sum of $C_i U_i$ for the years in which ΔU_i was positive	100696.

2. Output

Printout	Schaefer's Notation	Definition
K	k_2	coefficient of catchability, *i.e.* coefficient of fishing mortality resulting from one unit of effort
A	a	minus the reciprocal of the slope of the regression of catch per unit of effort on effort
M	M	Y-intercept of the above regression

3. Space required: 20_{10} cells

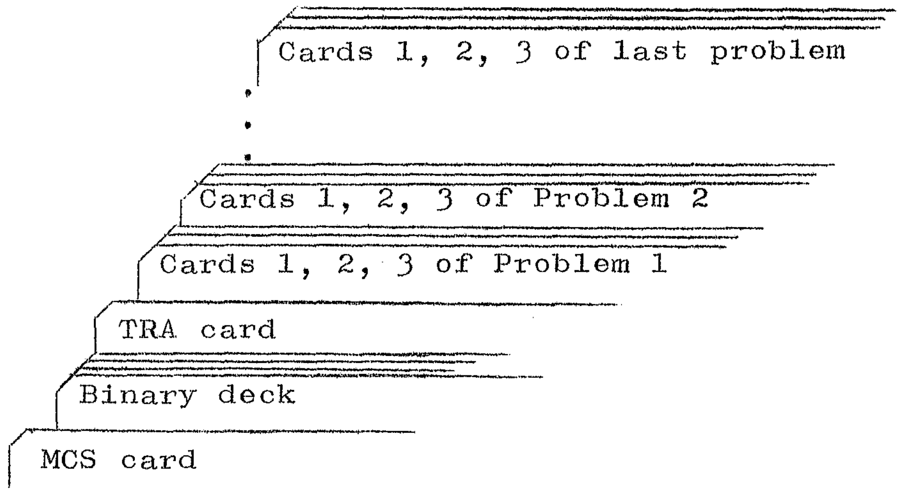
4. Input and output tape mountings: standard input and output for

for PRESTO MONITOR

5. Timing: 12 seconds for about four problems

6. Equipment configuration: PRESTO COOPSIM with FORTRAN 63 on CDC 3600 Computer

C. ORDER OF CARDS



REFERENCES

Schaefer, M.B. 1957. A study of the dynamics of the fishery for yellowfin tuna in the eastern tropical Pacific Ocean. Bull., Inter-Amer. Trop. Tuna Comm., 2(6):245-285.

__________ and R. J. H. Beverton. 1963. Fishery dynamics - their analysis and interpretation. p. 464-483. In M.N. Hill, The Sea, Vol. 2. Interscience Publishers, New York: xv+554 p.

A. IDENTIFICATION

CIAT D05 - von Bertalanffy growth curve for unequal age intervals

Methods by: P. K. Tomlinson and N. J. Abramson

Programmer: N. J. Abramson; modified by C. T. Psaropulos

Description by: N. J. Abramson; modified by W. H. Bayliff

B. DESCRIPTION

This program uses the method of Tomlinson and Abramson (1961) to fit length at age data to the von Bertalanffy growth equation

$$l_t = l_\infty \left(1 - e^{-K(t - t_0)}\right)$$

where

l_t = length at time t,

l_∞ = asymptotic length,

K = growth constant, and

t_o = theoretical time at which l_t = 0.

The age intervals do not need to be equal.

1. Input

Card 1 - description card for first problem

Column	Format	Item
1-80	10A8	blank in Column 1 followed by alpha-numeric information for label-ing the output

Card 2 - variable format card for length data (Cards 5 through n)

Card 3

Column	Format	Item
1-2	F2.0	number of age groups used
3-5	F3.0	number of lengths in first (youngest) age group
6-8	F3.0	number of lengths in second age group
9-11	F3.0	number of lengths in third age group

etc.

Card 3A - continuation of Card 3, if necessary

Column	Format	Item
1-3	F3.0	number of lengths in 27th age group
etc.		

Card 4

1-4	F4.0	age of fish in first (youngest) age group
5-8	F4.0	age of fish in second age group
9-12	F4.0	age of fish in third age group
etc.		

Card 4A - continuation of Card 4, if necessary

1-4	F4.0	age of fish in 21st age group
etc.		

Cards 5, 6, 7,...n - lengths of the fish punched according to the format of Card 2. The lengths for each age group must begin on a new card, and the cards are arranged in order of increasing age.

Card n + 1 - description card for second problem

etc.

All the data are right adjusted in their fields.

2. Output

The output includes: (1) estimates of $\underline{l_\infty}$, $\underline{K}$, and $\underline{t_o}$ from each iteration of the fitting process; (2) final estimates of $\underline{l_\infty}$, $\underline{K}$, and $\underline{t_o}$; (3) standard errors of $\underline{l_\infty}$, $\underline{K}$, and $\underline{t_o}$; (4) fitted lengths for age 0 through the maximum included in the input; (5) mean lengths of the samples at each age; (6) standard errors of the mean lengths in the samples; (7) number of lengths in each age group; (8) variance-covariance matrix; (9) standard error of estimate.

3. Limitations: The number of lengths for each age group must be at least 2 and not more than 500. (If only one length, or a single mean length, is available for a given age group it may be punched twice.) The maximum number of age groups is 40.

4. Space required: $20{,}000_{10}$ cells

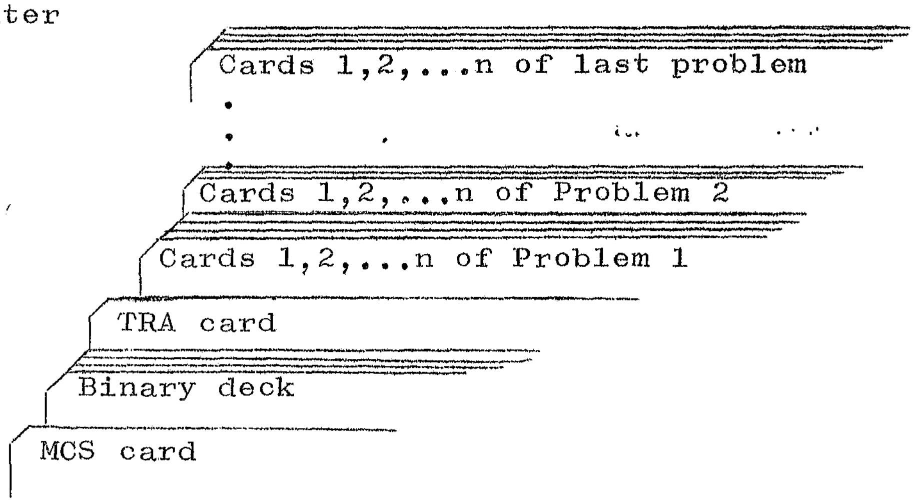
5. Alarms or printouts: If the data do not converge the printout will say NOT CONVERGING-DATA SET DELETED.

6. Input and output tape mountings: standard input and output for PRESTO MONITOR

7. Timing: .5 minutes for 11 problems

8. Equipment configuration: PRESTO COOPSIM with FORTRAN 63 on CDC 3600 Computer

C. ORDER OF CARDS



REFERENCES

Abramson, Norman J. 1963. Computer programs for fisheries problems. Trans. Amer. Fish. Soc., 92(3):310.

Tomlinson, Patrick K., and Norman J. Abramson. 1961. Fitting a von Bertalanffy growth curve by least squares including tables of polynomials. Fish. Bull. Calif. Dept. Fish Game, 116:69 p.

A. IDENTIFICATION

CIAT D06 - von Bertalanffy growth curve for equal age intervals

Methods by: P. K. Tomlinson and N. J. Abramson

Programmer: N. J. Abramson; modified by C.T. Psaropulos

Description by: N. J. Abramson; modified by W. H. Bayliff

B. DESCRIPTION

This program uses the method of Tomlinson and Abramson (1961) to fit length at age data to the von Bertalanffy growth equation

$$l_t = l_\infty \left(1 - e^{K(t - t_o)}\right)$$

where

l_t = length at time t,

l_∞ = asymptotic length,

K = growth constant, and

t_o = theoretical time at which $l_t = 0$.

The age intervals must be equal. The program always yields estimates when a least squares solution exists, and immediately terminates the run when there is no solution. In this respect it is superior to CIAT D05, which occasionally does not converge to estimates even when a solution exists.

1. Input

Card 1 - description card for first problem

Column	Format	Item
1-80	10A8	blank in Column 1 followed by alpha-numeric information for labelling the output

Card 2 - variable format card for length data (Cards 5 through n)

Card 3

1-2	F2.0	number of age groups used
3-6	F4.3	age of the youngest age group

Column	Format	Item
7-10	F4.3	time interval between age groups

Card 4

1-4	F4.0	number of lengths in first (youngest) age group
5-8	F4.0	number of lengths in second age group
9-12	F4.0	number of lengths in third age group
etc.		

Card 4A - continutation of Card 4, if necessary

1-4	F4.0	number of lengths in 21st age group
etc.		

Cards 5, 6, 7,...n - lengths of the fish punched according to the format of Card 2. The lengths for each age group must begin on a new card, and the cards are arranged in order of increasing age.

Card n + 1 - description card for second problem

etc.

All the data are right adjusted in their fields.

2. Output

The output includes:(1) estimates of $\underline{l_\infty}$, $\underline{K}$, and $\underline{t_o}$; (2) standard errors of $\underline{l_\infty}$, $\underline{K}$, and $\underline{t_o}$; (3) fitted lengths for age 0 through the maximum included in the input; (4) mean lengths of the samples at each age; (5) standard errors of the mean lengths in the samples; (6) number of lengths in each age group; (7) variance-covariance matrix; (8) standard error of estimate.

3. Limitations: The number of lengths for each age group must be at least 2 and not more than 500. (If only one length, or a single mean length, is available for a given age group it may be punched twice.) The maximum number of age groups is 40.

4. Space required: $25{,}000_{10}$ cells

5. Alarms or printouts: DATA SET DELETED - MATRIX INVERSION NOT POSSIBLE OR THERE IS NO SOLUTION FOR Z = EXP (-KQ) BETWEEN .001 and .999

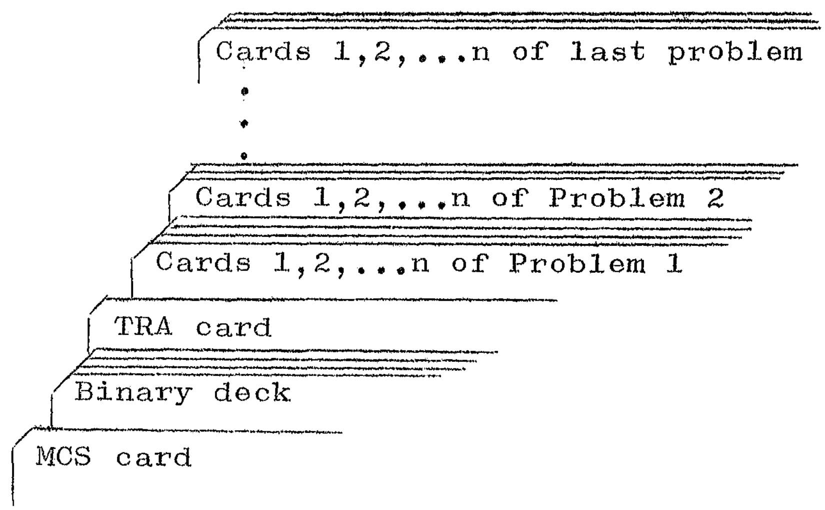
5. Alarms or printouts: DATA SET DELETED - MATRIX INVERSION NOT POSSIBLE OR THERE IS NO SOLUTION FOR Z = EXP (-KQ) BETWEEN .001 and .999

6. Input and output tape mountings: standard input and output for PRESTO MONITOR

7. Timing: .6 minutes for 27 problems

8. Equipment configuration: PRESTO COOPSIM with FORTRAN 63 on CDC 3600 Computer

C. ORDER OF CARDS



REFERENCE

Tomlinson, Patrick K., and Norman J. Abramson. 1961. Fitting a von Bertalanffy growth curve by least squares including tables of polynomials. Fish. Bull. Calif. Dept. Fish Game, 116:69 p.

A. IDENTIFICATION

CIAT D09 - Eumetric yield

Methods by: R. J. H. Beverton and S. J. Holt

Programmer: L. E. Gales; modified by C. T. Psaropulos

Description by: W. H. Bayliff

B. DESCRIPTION

This program uses Beverton and Holt's (1957:36:4.4) equation to compute the population in numbers, the biomass, the yield in numbers, and the yield in weight theoretically obtainable from one recruit with various combinations of growth, mortality, and age of entry into the fishery.

1. Input: The data in the example are for the North Sea plaice (Beverton and Holt, 1957:310).

Card 1 - data card for first problem

Column	Format	Item	Example
1-8	F8.1	t_λ= maximum age	15.0
9-13	F5.1	M = coefficient of natural mortality	0.10
14-19	F6.1	t_p= age at recruitment	3.72
20-26	F7.1	t_0= origin of growth curve	-0.8150
27-37	F11.1	w_∞= asymptotic weight	2867.0
38-44	F7.1	K = coefficient of catabolism	0.0950
45-49	F5.1	ΔF= increments of trial values of F	0.10
50-54	F5.1	upper limit of F	1.5
55-62	F8.1	t_p'= age at entry to fishery (=lower limit of t_p')	3.72
63-70	F8.1	$\Delta t_p'$ = increments of trial values of t_p'	1.0
71-78	F8.1	upper limit of t_p'	14.72

Card n - termination card

Column	Format	Item	Example
1-79		blank	
80	A1	\$	\$

2. Output

Block 1 - annual mean numbers in post-recruit phase per recruit

Block 2 - annual yield in numbers per recruit

Block 3 - annual mean biomass per recruit

Block 4 - annual mean yield in weight per recruit

Each block contains values for all the specified values of F and one value of t_p'. The blocks are repeated for each value of t_p'.

3. Limitations: $t_\lambda \leq 9999$

$0 \leq M \leq 5$

$0 \leq t_p' \leq 99$

$-99 \leq t_o \leq 99$

$0 \leq w_\infty \leq 999{,}999$

$0 \leq K \leq 9$

$0 \leq F \leq 5$

$t_p' \geq t_p$

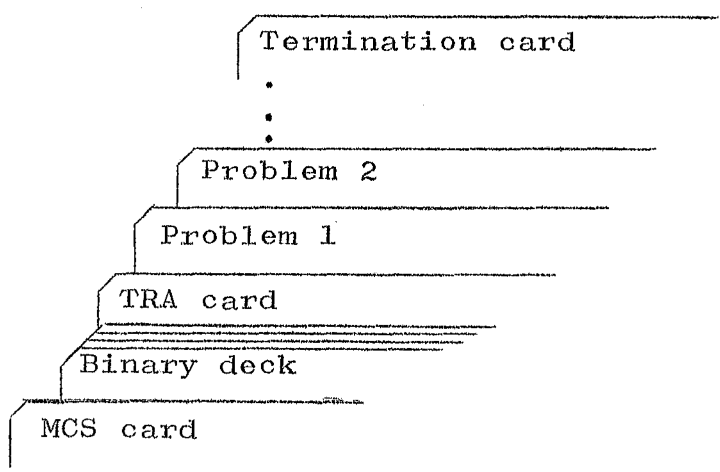
t_p' limit $\leq t_\lambda$

4. Space required: 1000_{10} cells

5. Input and output tape mounting: standard input and output for PRESTO MONITOR

6. Equipment configuration: PRESTO COOPSIM with FORTRAN 63 on CDC 3600 Computer

C. ORDER OF CARDS



REFERENCE

Beverton, R. J. H., and S. J. Holt. 1957. On the dynamics of exploited fish populations. Fish. Inves., Minis. Agri. Fish. Food, Ser. 2, 19:533 p.