



## Program "JOLLYAGE" : User Instructions

by

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This program is used to compute survival rate, population size, and birth/immigration estimates for an age-stratified capture-recapture data set using a stochastic model developed by S. L. Stokes. The program assumes the population to be stratified onto young (who remain young for one sampling period) and adult. The adult estimates of survival rate, population size, and birth/immigration, and young estimates of survival rate are computed for each sampling period.

### Definition of variables:

- N(i) - Number of adults in the population just before the i-th sample
- M(i) - Number of marked adults in the i-th sample
- B(i) - Number of adults caught before the i-th sample which are not caught in the i-th sample, but are caught later before and after sample i
- R(i) - Number of marked adults which are released from the i-th sample which are subsequently recaptured
- R'(i) - Number of marked young which are released from the i-th sample which are subsequently recaptured
- Phi(i) - Survival rate of adults from samples i to i+1
- Phi'(i) - Survival rate of young from samples i to i+1
- p(i) - Capture probability of adults in sample i  
year adults

### Data input:

The input file for program JOLLYAGE must contain some control records, followed by the data records. The control records are used to tell the program the title of the data, number of capture periods, and data type. The format of the control records is:

PARAMETER=value

Only one program parameter may be set on each record, and the equal sign is required. No spaces may be entered on the right of the equal sign except in the TITLE record. The following are example control records:

```
TITLE=Sample data for program JOLLYAGE
NUMBER OF PERIODS=12
FIRST=1966
DATA TYPE=TOTALS
```

The data records may be in one of three forms. The default is capture-history record format type. The other types of input data are "CAP/REL HISTORY RECORDS" and "TOTALS".

Capture history records are strings of digits which indicate the status of each animal in each time period. One record is entered for each animal banded in the experiment.

Each column contains a one (1) if the animal was captured and released in the sampling period. If the animal was not captured in the period, a zero (0) is entered in the column corresponding to that period.

Occasionally, animals are killed in the traps and not released back into the population. In this case, a two (2) is entered in the column to indicate capture but not released.

If an animal is resighted between two sampling periods, codes three (3) or four (4) are used. Code three (3) indicates that the animal was not captured in the current period, but was resighted before the next sampling period. Code four (4) indicates that an animal was captured in the current sample and was resighted before the next sample.

To reduce the amount of input, a weighting variable is read in at the end of each capture-history record. This variable indicates the number of animals which the capture-history represents. IMPORTANT: Even if you do not enter anything for this weighting variable, it must be accounted for in the format! (ie. If you have x time periods, the format must allow for:

x+2 variables under capture-history record format, or

2x+2 variables under cap/rel-history record format.)

#### **Example 1 (Capture-history record format):**

The following is an example of an experiment with 5 time-periods:

```
CARD | _____
  1  !TITLE=Example data set for JOLLYAGE user instructions
  2  !PERIODS=5
  3  !FIRST=1971
  4  !DATA TYPE=CAPTURE HISTORY RECORDS
  5  !ADULT=1
  6  !YOUNG=2
  7  !FORMAT=(6X,A1,1X,5I2,1X,I2)
  8  !      1  1 1 0 2 0  2
  9  !      1  1 0 0 0 0 15
 10  !      1  0 1 1 1 1  7
 11  !      2  1 1 0 1 1 21
 12  !      2  1 1 0 3 4  1
 13  !      2  0 2 0 0 0  1
 14  !      0  1 1 1 0 0  1
```

**Explanation:**

Card 1 identifies the data set.  
 Card 2 contains the number of time-periods in the experiment.  
 Card 3 sets the number of the first time period to 1971.  
 Card 4 indicates that the data type will be capture history records.  
 (0=not captured, 1=captured & released, 2=captured & not released)  
 Card 5 sets the adult age code = 1 (instead of 'A').  
 Card 6 sets the young age code = 2 (instead of 'Y').  
 Card 7 contains the FORTRAN format of the data records.  
 Age-code is in column 7, the status  
 codes will start in column 10 and the number of occurrences  
 will be in column 21.  
 Card 8 is the first recapture record. This recapture record contains:  
 Age-code in column 7 (age=1 - adult),  
 Status in period 1 (1 - captured and released),  
 Status in period 2 (1 - captured and released),  
 Status in period 3 (0 - not captured),  
 Status in period 4 (2 - captured and not released),  
 Status in period 5 (0 - not captured),  
 Number of occurrences of this capture-history = 2.  
 Card 9 is the second recapture record. These 15 animals are adults and  
 were captured and released in period 1 only.  
 Card 10 : 7 adults, captured and released in periods 2,3,4,5,6,8.  
 Card 11 : 21 young, captured and released in periods 1,2,4,5,7,8.  
 Card 12 : 1 young, captured and released in periods 1 and 2,  
 sighted between periods 4 and 5,  
 captured in period 5, and  
 sighted after period 5.  
 Card 13 : 1 young, captured but not released from period 2.  
 Card 14 : 1 unknown age at first capture. This record would be ignored.

#### Summary totals format:

Program JOLLYAGE can read the summary statistics instead of the capture history records of each individual. This is done by setting the data type to TOTALS. In this case, the program will read 8 variables from the next n cards (where n is the number of time-periods).

#### Example

RECORD	
1	TITLE=CANADA GOOSE TRAPPING DATA, TENN. (FROM CROMER 1978)
2	PERIODS=10
3	TYPE=TOTALS
4	FORMAT=(8F5.0)
5	0 88 98 88 98 68 63 0
6	111 126 78 126 78 106 59 20
7	144 168 121 168 121 126 74 41
8	158 196 143 196 143 171 116 83
9	305 327 302 327 290 232 235 65
10	442 515 286 515 230 415 201 90
11	615 721 305 721 257 527 224 91
12	722 840 307 840 86 606 53 120
13	644 834 395 834 95 529 71 135
14	735 1149 828 1149 436 0 0 0

Card 1 : Title

Card 2 : Number of trapping periods

Card 3 : Summary totals read in

Card 4 : 8 variables per record, 5 cols. each

Card 4 : Summary totals for time-period 1.

Variables are:

$m(1)$  : Number marked adults caught in period 1

$n(1)$  : Number adults caught in period 1

$n'(1)$  : Number young caught in period 1

$R(1)$  : Number adults released in period 1

$R'(1)$  : Number young released in period 1

$r(1)$  : Number adults caught in period 1 which were also caught after period 1

$r'(1)$  : Number young caught in period 1 which were also caught after period 1

$b(1)$  : Number adults caught before period 1 which were not caught in period 1 and were caught after period 1

Cards 5-13 : Summary totals for time-periods 2-10.

### Program Output:

Output from the program consists of:

- A page of definitions(optional),
- Input summary statistics,
- Estimates of the parameters for model A2,
- Variances and covariances(optional),
- Likelihood-ratio test of the single-age Jolly-Seber model vs. the age-stratified model,
- Goodness-of-fit test of the age-stratified model (A2),
- Estimates for reduced parameter models (B2 & D2),
- Likelihood ratio tests and goodness-of-fit tests for A2,B2 & D2.

All of the parameters contained in the printout are defined in the page of definitions. However, there may be some confusion about the standard error of the estimates. There are two standard errors printed out for some parameters.

One standard error is computed using the full multinomial variance, which includes both error of estimation or sampling variation and binomial variation associated with the actual survival process. The other standard error omits the binomial variation and can be thought of as reflecting only sampling variation associated with the estimation process.

### Restrictions:

- The number of trapping periods must be less than or equal to 50.
- The FORTRAN format which describes the recapture records must specify the data to be of type INTEGER
- The FORTRAN format which describes values in the TOTALS table must specify the data to be of type REAL.

Note:

Error number 3023 indicates that a carriage return and/or linefeed character is missing at the end of the input file. Use your word-processor to check the input file.

If you have questions, problems or comments with this program please contact:

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