8. Diagnostics on accuracy

In this section readers will be presented with some general points concerning numerical treatment of primary data (i.e. samples of boat activities and landings), including the formulation of statistical indicators relating to the reliability of resulting catch/effort estimates.

8.1 Estimation process

An estimation process usually involves the following computational steps:

8.1.1 Estimation of fishing effort

(a) Boat activity samples, active days and frame survey data are directed to the appropriate estimation context of a minor stratum, a month and a boat/gear type.
(b) BACs (Boat Activity Coefficients) are formulated in each context.
(c) The accuracy of BAC estimates is computed.
(d) The overall BAC variability and its confidence limits are computed.
(e) BAC variability is explained in space and time.
(f) BACs are combined with frame survey data and active days to produce estimates of fishing effort.
(g) Effort variability and confidence limits are computed.

8.1.2 Estimation of catch

(a) Sample landings are directed to the appropriate estimation context of a minor stratum, a month and a boat/gear type.
(b) Overall CPUEs are formulated in each context.
(c) The accuracy of CPUE estimates is computed.
(d) The overall CPUE variability and its confidence limits are computed.
(e) CPUE variability is explained in space and time.
(f) Sample species proportions are formulated.

(g) Sample prices are formulated.
(h) Estimates of average fish size (in weight units) are produced.
(i) Estimated CPUEs are combined with estimated effort to produce estimates of total catch.
(j) Variability of catch estimates and related confidence limits are computed. This compound parameter is based on the computed variances of effort and CPUE.
(k) Sample species proportions are combined with estimated total catch to produce estimated catch by species.
(l) Sample prices are combined with catch by species to produce estimated values by species.
(m) Values by species are added up to produce total values for landings.

8.1.3 Data grouping

The computational steps given above are repeated for each estimation context of a minor stratum, a month and a boat/gear type. At the end of this process the following data grouping procedures are performed:

(a) Catch, effort and values are grouped at major stratum and grand total levels.
(b) Average CPUEs and prices are formulated at major stratum and grand total levels.

8.2 Basic reporting

There are several ways to prepare basic reports on estimated data and this topic only provides some examples. Generally, monthly catch/effort estimates constitute “first generation” statistics that do not require much sophistication in its reporting functions. The following points may be considered:

(a) First reporting level must be that of the estimation context where all computations and related statistical indicators and diagnostics are produced.
(b) Before analyzing the results, users should check the system messages and diagnostics to ascertain the level of completion of each estimating context.
(c) All data involved in the estimation process must be reported so as to allow manual verification of the results if needed.
(d) Reporting sequence usually follows the computational steps discussed earlier.

8.3 System diagnostics

8.3.1 Messages issued during an estimation process

The example given below illustrates system messages that were produced during an estimation process. For each estimation context messages are displayed describing the outcome of the estimations.

```
KETA                          Beach Seine                   Estimated

Accuracy for CPUE below 90%

.....................................................................................
KETA                          Hook & Line                   Not estimated

No active days
No frame data
.....................................................................................
KETA                          Set Net                       Not estimated

No landings
No effort data
.....................................................................................
KETA                          Drifting Gillnet              Estimated

Only one site for landings
Only one site for effort
Accuracy for BAC below 90%
Accuracy for CPUE below 90%
No variance computed for CPUE
```

Figure 8.1. Messages issued during an estimation process

Messages displayed for different estimation contexts inform users that:

(a) Accuracy for CPUE is below 90 percent. Estimation continued.
(b) No extrapolating factors. Estimation failed.
(c) No landings and no effort data. Estimation failed.
(d) Limited geographical coverage. Accuracy levels for BAC and CPUE are below 90 percent.

8.3.2 Messages relating to estimated effort

```
KETA : Beach Seine
═══════════════════════════════════════════

Estimation of effort

BAC - Boat Activity Coefficient..... 25.000 %
Accuracy level...................... 91.173 %
Units sampled....................... 120
Active.............................. 30

# sites............................. 2
# days.............................. 10
BAC variability..................... 28.912 %
BAC var component (space)........... 8.393 %
BAC var component (time)............ 20.520 %
BAC lower limit at 95%.............. 10.833 %
BAC upper limit at 95%.............. 39.167 %

Units in frame survey............... 168
Active days......................... 27.000
Estimated effort (days)............. 1 134
Effort lower limit at 95%........... 491
Effort upper limit at 95%........... 1 777
```

Figure 8.2 Messages relating to estimated effort

In the example given by Figure 8.2, estimated effort is described in three sections.

(a) The estimation of BAC and resulting accuracy can be verified with the sampling information displayed.
(b) The variability of BAC is high (29 percent) and is explained in space and time. Note that variability in time (20.5 percent) is the primary cause.
(c) The estimation of fishing effort can be verified using the estimated BAC and the data on active days and frame survey extrapolating factors. Confidence limits for estimated effort are also displayed.

8.3.3 Messages relating to estimated CPUE and catch

```
Estimation of catch

CPUE..................................... 402.967
Accuracy level........................... 89.798 %
Smp. size required for accuracy  90%.... 31
Landings sampled......................... 30
Sample catch............................. 12 089
Sample effort............................ 30

# sites................................... 2
# days.................................... 10
CPUE variability......................... 31.993 %
CPUE var component (space)............... 4.421 %
CPUE var component (time)................ 27.572 %
CPUE lower limit at 95%.................. 150.284
CPUE upper limit at 95%.................. 655.650

Estimated catch (Kg) .................... 456 964
Catch variability........................ 43.121 %
Catch lower limit at 95% (Kg) ........... 70 747
Catch upper limit at 95% (Kg) ........... 843 182
```

Figure 8.3. Messages relating to estimated CPUE and catch

In this example given by Figure 8.3, estimated CPUE and catch are described in three sections.

(a) The estimation of overall CPUE and resulting accuracy can be verified with the sampling information displayed. It should be noted that the resulting accuracy is slightly below the acceptable level of 90 percent because 30 samples, instead of the 31 required, were used.
(b) The variability of CPUE is high (32 percent) and is explained in space and time. Note that variability in time (27.5 percent) is the primary cause.
(c) The estimation of total catch was verified using the estimated CPUE and the estimated fishing effort described earlier. The compound variability of catch is very high (43 percent) because of the high variability in CPUE and fishing effort. Confidence limits for estimated total catch are also displayed.

8.3.4 Catch by species

Total value (1000 C) 221 571
Average price (1000 C/Kg) 0.485

Catch by species	Quant. Effort	CPUE Aver.W	Value Price
Anchovy	362 899 (79.4%) 1 134	320.017 0.000	152 244 (68.7%) 0.420
Burrito	26 366 (5.8%) 1 134	23.250 0.000	8 490 (3.8%) 0.322
Round Sardinella	29 030 (6.4%) 1 134	25.600 0.000	28 341 (12.8%) 0.976
Scad Mackerel	38 669 (8.5%) 1 134	34.100 0.000	32 496 (14.7%) 0.840

Figure 8.4. Example of a report showing catch by species

In the example given by Figure 8.4, results by species are displayed in three columns describing:

(a) Estimated catch by species and related effort.

(b) CPUE by species.
(c) Average weight per species.
(d) Sample price and estimated value by species.

Total value of all landings and their unit-value are displayed on the top.

8.3.5 Grand totals

GRAND TOTALS : Drifting Gillnet

Units in frame survey..... 4
Estimated effort (days)..... 27
CPUE..... 35.000
Estimated catch (Kg) 945
Total value (1000 C) 851
Average price (1000 C/Kg) 0.900

Catch by species	Quant. Effort	CPUE Aver.W	Value Price
Atlantic Little Tuna	203 (21.4%) 27	7.500 0.000	162 (19.0%) 0.800
Sharks	473 (50.0%) 27	17.500 0.000	473 (55.6%) 1.000
Skipjack Tuna	270 (28.6%) 27	10.000 0.000	216 (25.4%) 0.800

Figure 8.5. Example of a report on grand totals

In the example given by Figure 8.5, grand totals are computed for a specific boat/gear type (drifting gillnet). These figures have resulted from grouping all statistics for this boat/gear type that were produced in different minor strata.

SUMMARY

In this section readers have reviewed general aspects concerning automatic processing of basic fishery data. The following topics were presented:

(a) Processing of primary data. Boat Activities and Landings.
(b) Data checking and monitoring.
(c) Estimation process. Data involved. Statistical indicators and diagnostics.
(d) Basic reporting functions.