FSA – R Functions for Fisheries Stock Assessment

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Need Statement

The estimation of population size, mortality, growth rates, recruitment, condition, yield, and other critical parameters of fish stocks requires maximum likelihood, linear model, and non-linear model methods. These methods rely on several statistical and biological assumptions and require substantial data manipulation to prepare field data for analysis. The relevance and importance of assumptions, the meanings of model parameters, and methods of data preparation and analysis are often difficult for young fisheries biologists to grasp. We have developed the FSA package to aid students in the understanding and computation of critical parameters in many fish stock assessment studies.

Target Audiences

- Primary – advanced undergraduate and graduate students in fisheries or aquatic science programs.
- Secondary – practicing fisheries biologists or managers.

Objectives / Purposes

- Promote understanding of mathematical and statistical principles and assumptions underlying common fisheries stock assessment methods.
- Promote accurate computation of parameter estimates and variability for common fisheries stock assessment methods.

Guiding Principles

1. Greater understanding of key concepts is developed through visualization of underlying principles.
2. Greater understanding of assumptions and parameter interpretations is developed through simulations.
3. Some methodologies are sufficiently complex or tedious to warrant use of special purpose functions.
4. No methodology should be reduced completely to an unconsciously accepted "black box."
5. The code of special purpose functions should not be "hidden" from the user.
6. Students should have the opportunity to work with "real" data.
7. Methodologies should represent the latest accepted thinking on the subject.

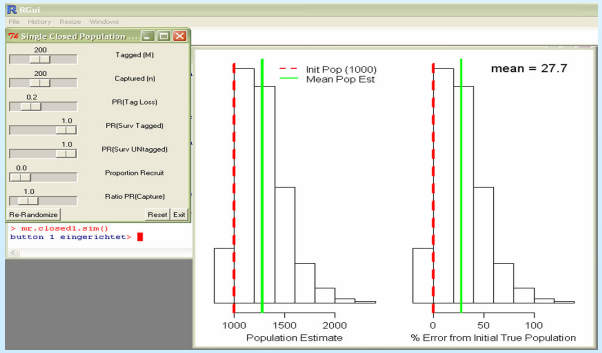
Select Functions:

age.key
age.tests
caphist.sum
catch.curve
cc.sim
chapman.robson
delury
growmodel.sim
lenfreq.expand
leslie
leslie.sim
mr.closed1
mr.open
pass.removal
sim.age.key
stock.recruit

Mark-Recapture Assumption Violations

Function: mr.closed1.sim()

Use: Slider bar control of the probabilities of tag loss and survival of marked and unmarked fish; proportion of population that will recruit; and a ratio of probability of capture for marked and unmarked fish. Sampling distributions of population estimates and proportional error are immediately updated.

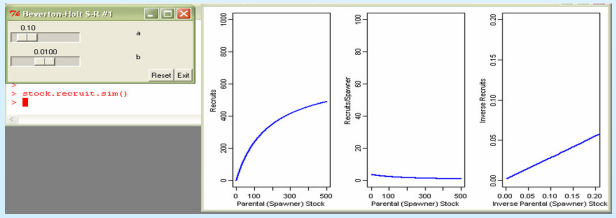


Guiding Principles 1 & 2: Allow student to understand direction and magnitude of bias when assumptions of Petersen mark-recapture method are violated.

Stock-Recruit Model Parameter Interpretations

Function: stock.recruit.sim()

Use: Argument control of six parameterizations of the Beverton-Holt and Ricker stock-recruit models. Slider bar control of the two parameters in each model. Plots of (i) recruits vs. spawners, (ii) recruits/spawner vs. spawners, and (iii) inverse recruits vs. inverse spawners are immediately updated.

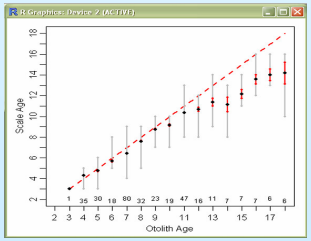


Guiding Principles 1 & 2: Allow student to develop a feel for what parameters represent in original (recruits vs. spawners) and linearized (inverse recruits vs. inverse spawners) models. Develop visual understanding of difference between Beverton-Holt and Ricker models. Demonstrate that model parameterizations represent the same fit with different parameter meanings.

Age-Bias Plot

Function: age.biasplot()

Use: Age estimates from two different methods (e.g., scales and otoliths; novice and expert analyst) submitted as arguments. Age-bias plot as defined by Campana *et al.* (1995), modified to include the range of age estimates for the y-estimates at each x-estimate, is produced.



Guiding Principles 3, 6 & 7: Allow student to easily produce an age bias plot which is currently accepted as a method for visualizing differences in assigned ages between two different methods.

Special Thank You: Greg Snow for the `slider()` function in the `TeachingDemos` package.