Quantifying the efficiency of harvest control rules in data limited situations

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Introduction

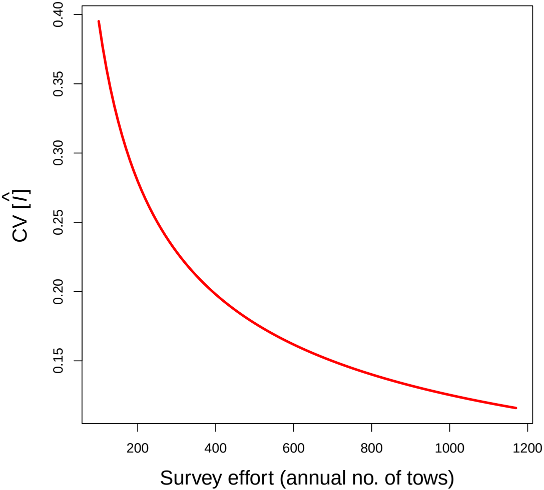
Efficiency

The efficiency of estimation reflects ability of the harvest control rule to match the catch that would be expected with perfect knowledge of the resource

$$e(T) \propto \frac{1}{E[(\theta - \hat{\theta})^2]}$$

Data uncertainty

Observation error



Data uncertainty

Quantifying the information available to the control rule

If ε is the observation error residual, then the probability distribution of the mean residual is:

$$E[ln(\varepsilon)] \sim N\left(0, \sigma^2/n\right)$$

from which we obtain our measure of data uncertainty:

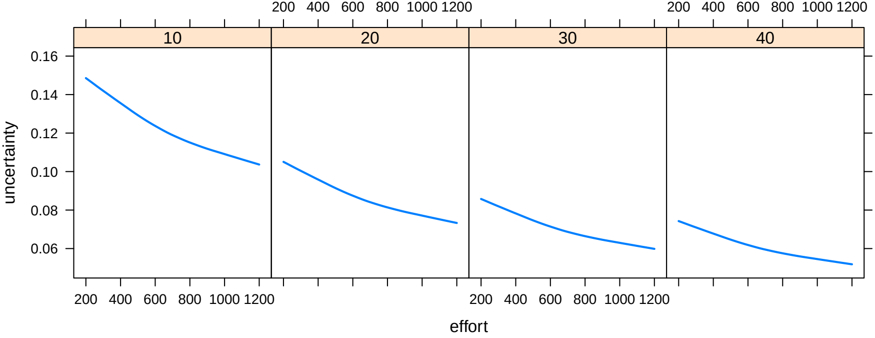
$$u(D) := \frac{\sigma}{\sqrt{n}}$$

where n is the number of years of observation.

Data uncertainty

Simulation framework

By changing the years of data available to the control rule (n) and the observation error (σ) we can modify the data uncertainty.



Experimental design

We tested efficiency of the harvest conrol rule:

$$C_{y+1} = \frac{\hat{I}_{y+1} C^{TAR}}{I^{TAR}}$$

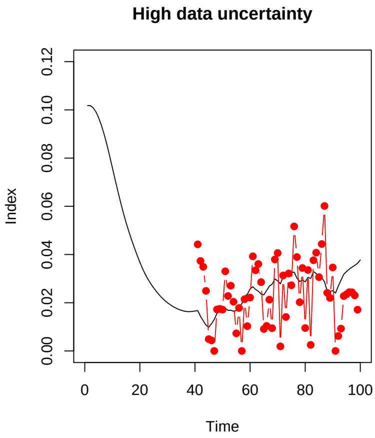
with four methods used to predict $\hat{I}_{y+1}$:

- Moving average
- Linear regression
- Smoothed index
- Model based (Stock reduction analysis)

Simulations were repeated over a range of values for n and σ.

Simulation results

Illustrative results



Simulation results

Combined results