

Finding efficient harvest control rules for data limited management

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Introduction

Objective: to find control rules that perform well in data poor situations.

- How do we measure performance?
- What do we mean by data poor?

Overview of study:

- Introduce a measure of **control rule performance**
- Define control rules
- Define different data scenarios
- Quantify **data uncertainty**
- Compare performance relative to data uncertainty

Efficiency

How do we measure performance?

Statistical efficiency measures the deviation of an estimated value $\hat{\theta}$ from the true value θ :

$$e(f) = \frac{1/I(\theta)}{E[(\theta - \hat{\theta})^2]}$$

From this definition we obtain our measure of performance.

Performance statistic:

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

Harvest control rules

How do we calculate C and \hat{C} ?

Harvest control rule:

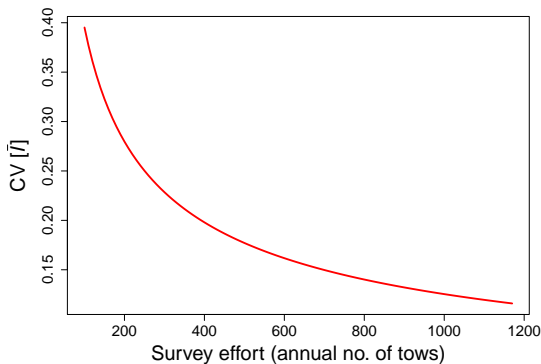
$$C_{y+1} = \frac{I_{y+1} C^{TAR}}{I^{TAR}}$$

Tested four methods of predicting $\hat{I}_{y+1} \rightarrow \hat{C}_{y+1}$:

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

Data scenarios

Information input for the control rule



Experimental design: by changing the **years of data** available to the control rule (n) and the **observation error** (σ) we can modify the data uncertainty.

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:

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

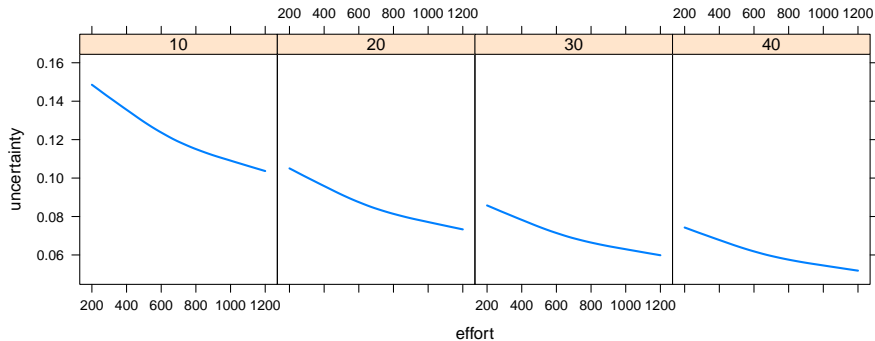
From this observation we obtain our measure of data uncertainty.

Data uncertainty:

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

Data uncertainty

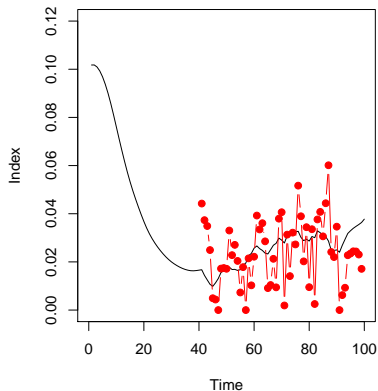
Quantifying the information available to the control rule



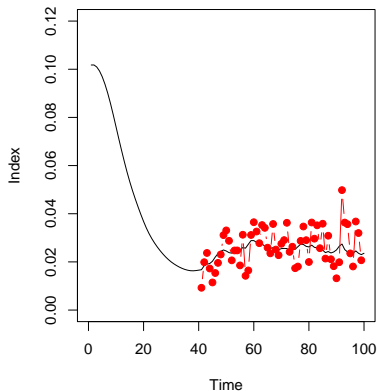
Simulation results

Illustrative results

High data uncertainty

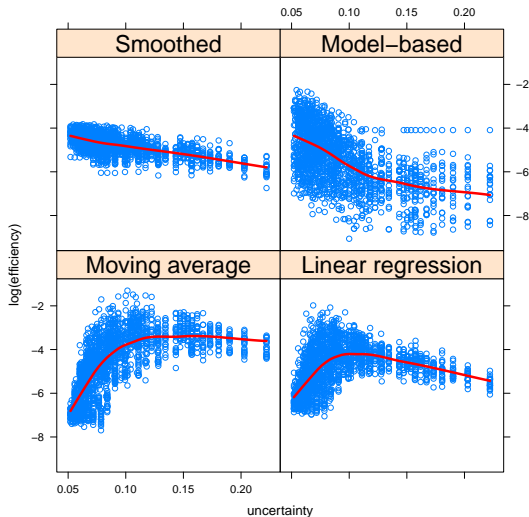


Low data uncertainty



Simulation results

Efficiency against uncertainty



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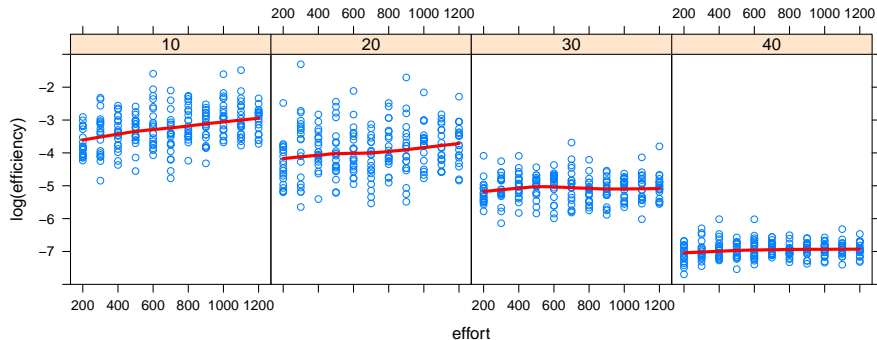
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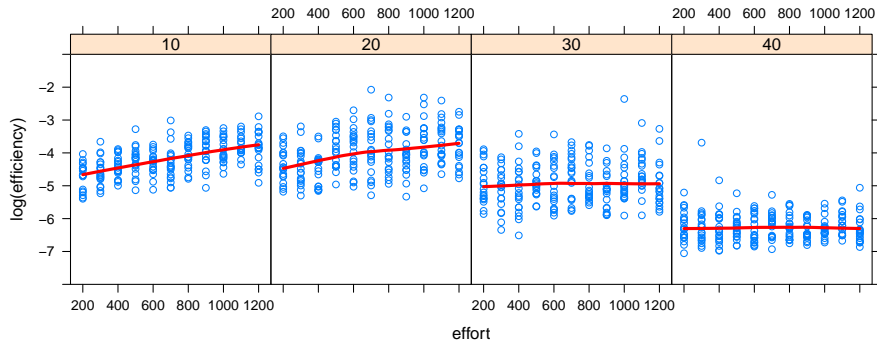
Simulation results

Moving average control rule



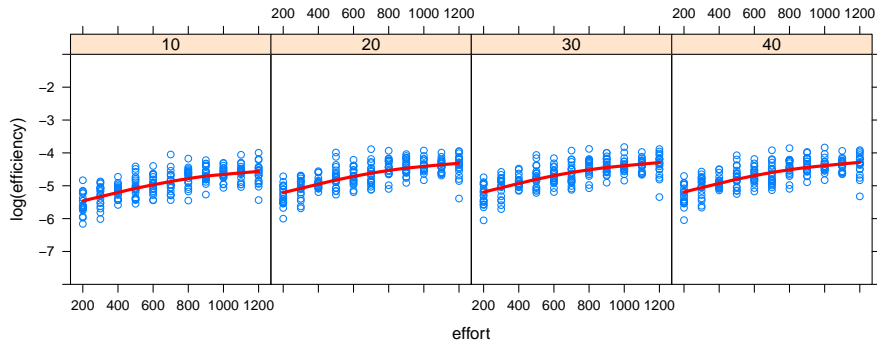
Simulation results

Regression-based control rule



Simulation results

Smoothed index control rule



Simulation results

Model-based control rule

