Metamodeling for Bias Estimation of Biological Reference Points.

Nick Grunloh

Introduction

- Hello. My name is Nick Grunloh.
- Talking about: A Metamodeling approach for assessing estimation bias in population dynamics models.
- Collaboration with UC Santa Cruz, SWFSC, and funded by NOAA Sea Grant.

Basic Modeling Structure

- Context: Single Species Surplus-Production Models.
- Production models are an admittadly simple setting, but...
  - have plenty of dark secrets that we dont tend to talk about.
- Even being simple:
  - they capture many relevant dynamics for management sake
  - and are plenty instructive.
- General Structure:
  - Observe an index of abundance
  - Assume the index is proportional to biomass with proportionality constant q.
  - I_t forms a response variable with lognormal residuals.
- Most of the action here comes from the biomass process model.
  - Biomass is modeled as a (typically) nonlinear ODE.
  - Growth via a nonlinear production function, $P(B)$
  - Removals via natural mortality and catch.
    - Instantaneous removal rates lumped here under $Z(t)$.
- For management mostly interested in Biological RP Inference.
- Commonly RPs are ways of noticing MSY.
  - Here I focus on two:
    - Fmsy: fishing rate to result in MSY (Relative Fmsy)
    - Bmsy: biomass of the populaiton at MSY (Relative Bmsy)

RP Constraints

- Conceptually $\frac{F^*}{M}$ and $\frac{B^*}{B_0}$ coexist in an entire 2D space.
- (Mangel et.al., 2013) Canadian Journal of Fisheries
  - Two parameter BH model: RP space is limited to a 1D curve
  - **Right:** Plot Relative Bmsy against Relative Fmsy
    - black: posterior samples of the RPs for a 3 parameter Shepherd-like model. (cowcod)
    - red: posterior samples of the RPs for a 2 param BH model.
    - the red posterior is squashed into the curve $\frac{1}{x+2}$
  - **Next:** Mangel et. al. suggests looking into 3-parameter curves

Breadcrumb Slide

- Understanding the mapping of broad RP space onto these constrained 2 parameter spaces is complicated even in simple cases.
  - Chaos in the Dynamical System
  - Time Integrator Inaccuracy
  - Model Identifiability
  - Global Optimization
- Production models are simplified places which are easier to hunt down the many computational issues, and are simple enough to make it possible to understand the mechanisms
- At the link provided here you can see our anlysis of the mechanisms of Bias for the Schaefer Model.