Likelihood functions for including CPUE based indices of abundance in stock assessment models

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Outline

• Current approach
• Indices from spatio-temporal models
  • Age/length
• Practicalities
• Catch composition
Current approach

• Total Catch
  • Know without error
  • Fit to catch using a lognormal likelihood with small sd

• Catch composition data
  • Independent of index
  • Multinomial (or similar) likelihood
  • Sample size semi-arbitrarily fixed or estimated

• Index of abundance
  • Aggregated across ages/size
  • Fit using a lognormal likelihood
  • sd semi-arbitrarily fixed or estimated
Current approach

\[ \mathcal{L}(\text{parameter}|\text{data}) = \text{Multi(composition, parameters)} \times \ln \mathcal{N}(\text{CPUE, parameters}) \times \ln \mathcal{N}(\text{catch, parameters}) \times \ldots. \]
Indices from spatio-temporal models

- Joint time and age/size index
- Estimated variance-covariance matrix
- Fit using a multivariate distribution (e.g. normal or lognormal)
- Use Estimated variance-covariance matrix in likelihood
- How to deal with unmodeled process variation and model misspecification
Practicalities

• General models don’t have multivariate likelihood
• Independent age/size specific indices
  • May be too many lengths
• Aggregated index and composition likelihoods
Catch composition

• Calculated in spatio-temporal model using same data
  • Index composition weighted by CPUE
  • Catch composition weighted by catch
• Joint time, age/size, index, and catch
• Estimated variance-covariance matrix
• Fit using a multivariate distribution (e.g. normal or lognormal)
• Use Estimated variance-covariance matrix in likelihood
• How to deal with unmodeled process variation and model misspecification
  • Are data weighting issues enough to treat it independently?