Assessment For All (a4a)

The stock assessment model

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Model detail

$$e^{\mathrm{E}[\log C]} = \frac{F}{F+M}\left(1 - e^{-F-M}\right) R e^{-\sum F+M}$$

and

$$e^{\mathrm{E}[\log I]} = QRe^{-\sum F+M}$$

and

$$\mathrm{Var}\left[\log C_{ay}\right] = \sigma^2_{ay} \qquad \mathrm{Var}\left[\log I_{ays}\right] = \tau^2_{ays}$$

Model detail

linear models for

- log F
- log Q
- log observation variances
- log initial age structure

Recruitment is modelled as a fixed variance random effect with linear models for

- log a
- log b

where relevant. Models available: Ricker, Beverton Holt, smooth hockeystick, geometric mean

Linear models

It is not always obvious that stock assessments are often composed of linear models.
For example, the classical separable F assumption is simply that

$$F_{ay} = S_a \times F_y$$

which, in linear modelling parlance is

$$\log F \sim \text{age} + \text{year}$$

Intuitive Modelling

The "language" of linear models has been developing within the statistical community for many years:

- 1965 J. A. Nelder, notation for randomized block design
- 1973 Wilkinson and Rodgers, symbolic description for factorial designs
- 1990 Hastie and Tibshirani, introduced notation for smoothers
- 1991 Chambers and Hastie, further developed for use in S

Many modelling software use this language: Minitab, spss, genstat, SAS, R, S-plus.

Some examples

A separable model where the level of F is smooth through time

$$\log F \sim \text{age} + \text{s(year)}$$

Some examples

A separable model where F is smooth over age

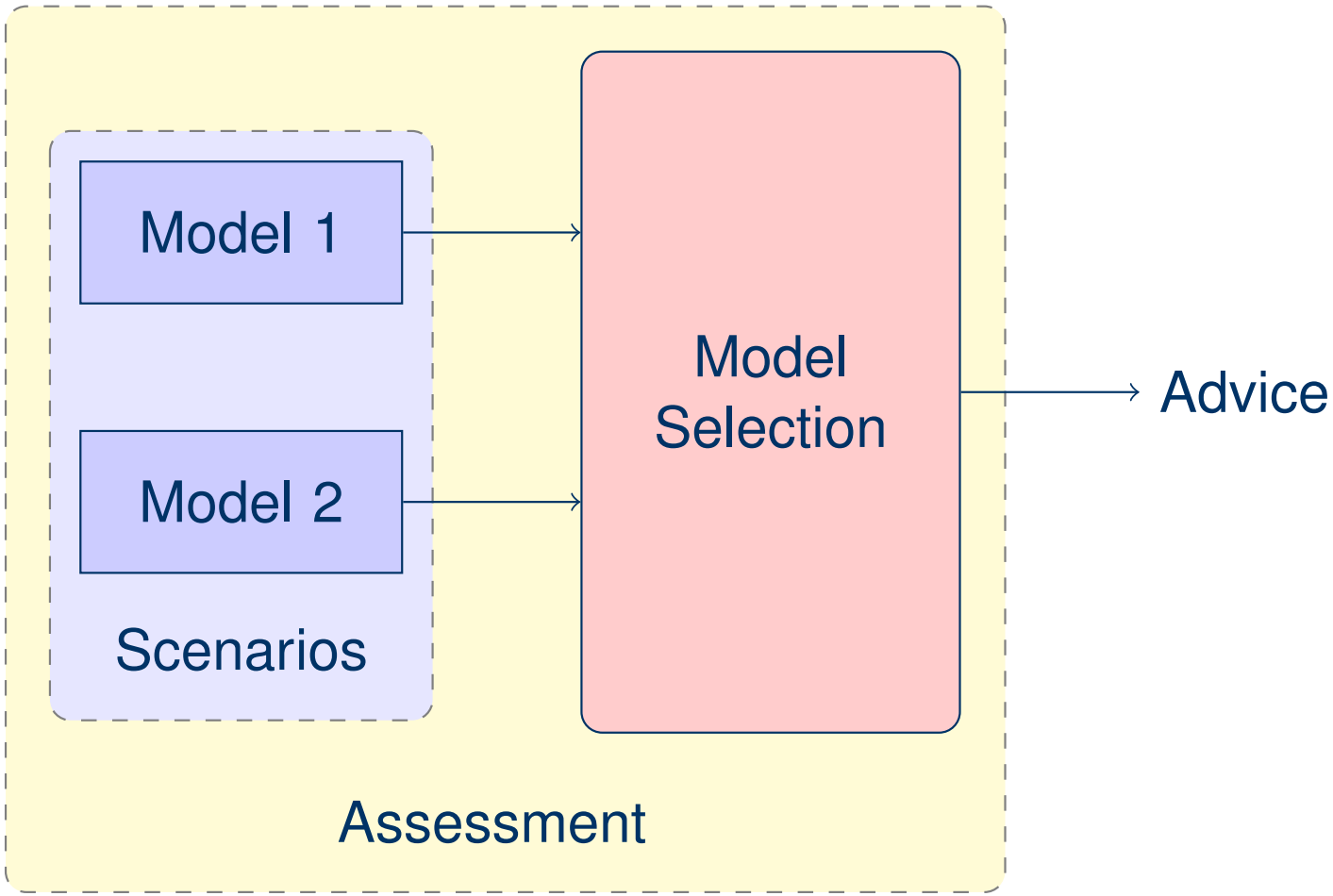
$$\log F \sim \mathrm{s}(\mathrm{age}) + \mathrm{year}$$

Some examples

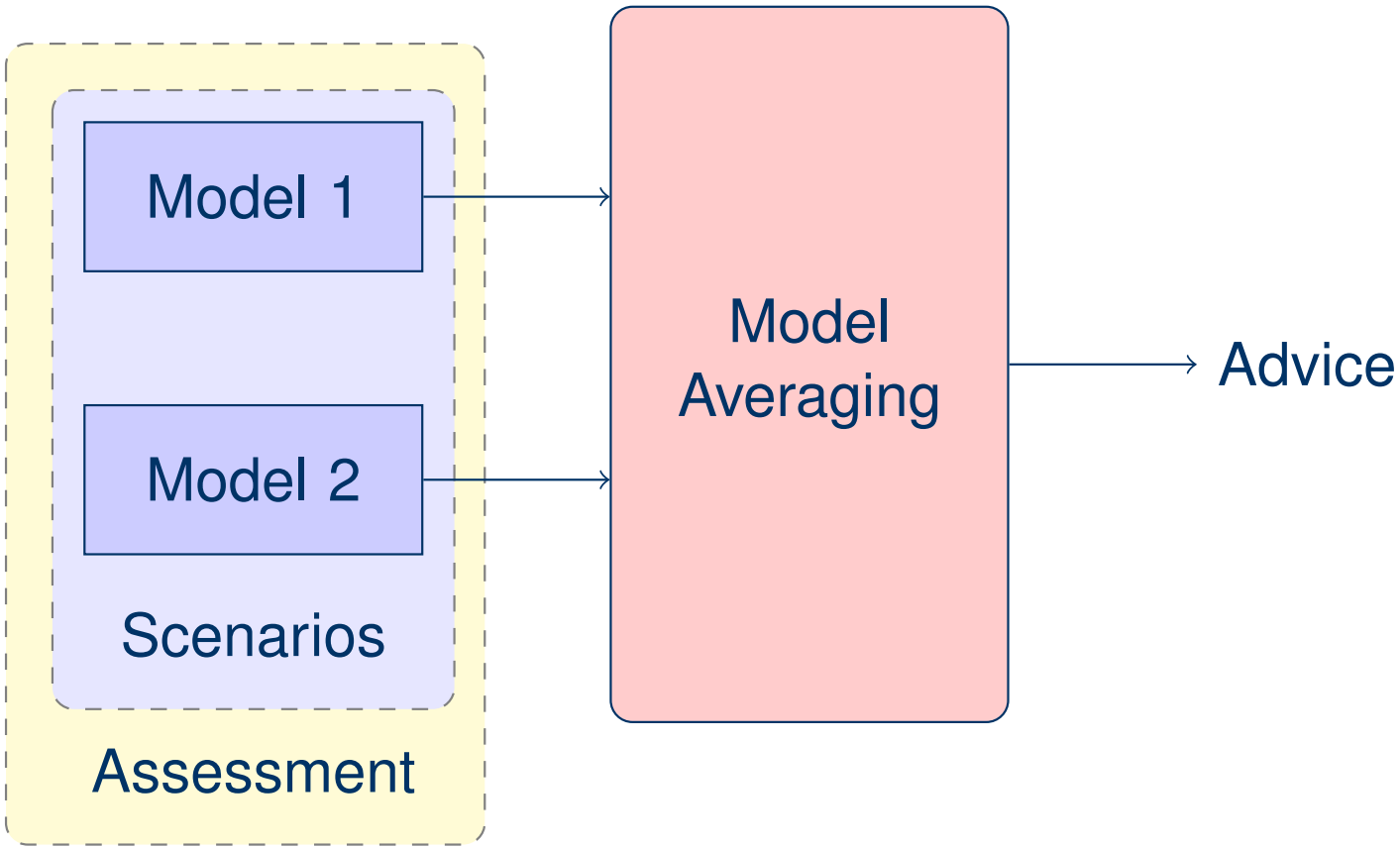
F is smooth over age and year

$$\log F \sim s(\text{age}, \text{year})$$

An Assessment Process



Model Averaging can help automation



Expert knowledge for model specification

Different plausible models for different levels

- Management area level (North Sea, Baltic Sea, ...)
- Species type (roundfish, flatfish, pelagic, Nephrops)
- specific groups (North Sea gadoids)

This provides a framework for setting up plausible models for new species.

Can lots of simple models averaged = a good model?
Kearns: Can a set of weak learners create a single strong learner

Thank you for listening!

What we can do, what we can't do

Can:

- missing values: missing at random
- multiple surveys
- variable Q, F, variance
- splines (fixed degreed of freedom)
- stock recruit relationship (fixed variance)
- stock recruit relationship (estimated variance) SLOW
- *fixed variance random effects: RW1, RW2, seasonal, user specified*

Can't:

- estimate random effect variance
- estimate smoothing parameters
- estimate growth parameters

What we can do

- simulate from the distribution of model params
  - normal approx
  - avoids the need for delta approx
  - can be biased, but we can also use MCMC if desired
- we can approximate the (joint) distribution of
  - terminal year Fs and Ns
  - terminal year Fbar and Fmsy
  - F / Fmsy