Forecast
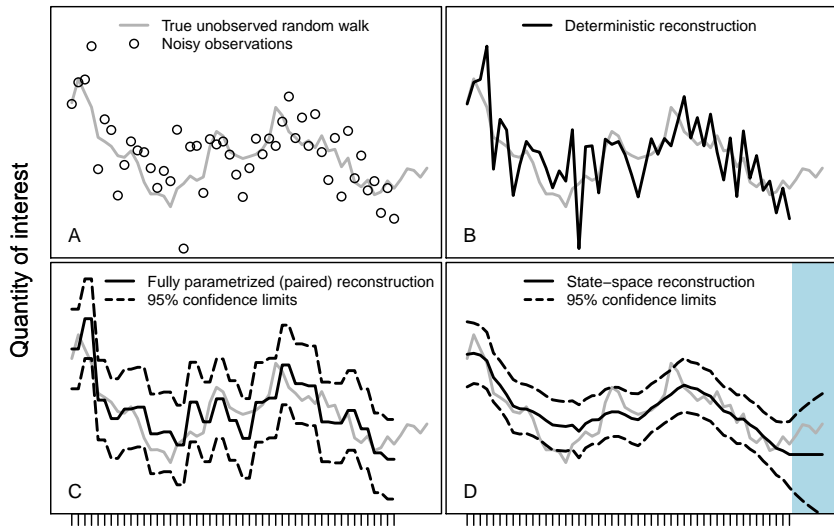
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State-space models can predict!

What will happen next year?

- The estimated model provides information about the population dynamics
- We have an estimate (with uncertainty) about $\mathbf{N}_y$ and $\mathbf{F}_y$
- Future scenarios are predicted by simulating the future given what we think we can control

Remember we assume:

$$\log N_{1,y} = \log R(\mathbf{N}_{y-1}) + \eta_{1,y}$$
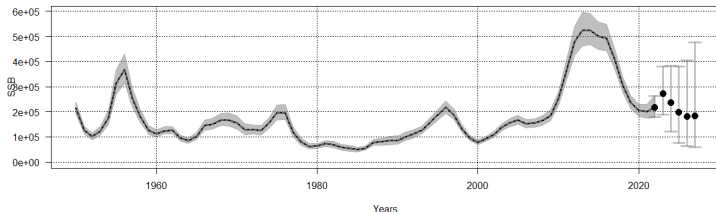$$\log N_{a,y} = \log N_{a-1,y-1} - F_{a-1,y-1} - M_{a-1,y-1} + \eta_{a,y}$$
$$\log N_{A,y} = \log(N_{A-1,y-1}e^{-F_{A-1,y-1}-M_{A-1,y-1}} + N_{A,y-1}e^{-F_{A,y-1}-M_{A,y-1}}) + \eta_{A,y}$$

were

$$\log \mathbf{F}_y = \log \mathbf{F}_{y-1} + \boldsymbol{\xi}_y.$$

Propagating uncertainty

- We are uncertain about current state
- Uncertainty in current state is represented with simulation
- Simulate the process forward in time
  - We use the estimated process with noise, but fix what we think we control

Predicting covariates

- Beside using the model to predict the stock, we also need:
- Stock weight, catch weights, natural mortality, maturity, ...
- They are just covariates in the model, so how do we predict them?
- Try plotting e.g. stock weights

```
1  library(stockassessment)
2  sw <- read.ices("sw.dat")
3  matplot(sw,type ="l")
```

- What is it next five years?
- Average of last (e.g. 5) years is often used.
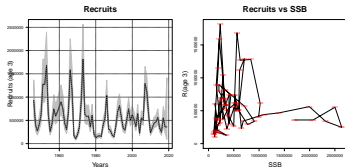- Using process for describing future covariates is included in SAM
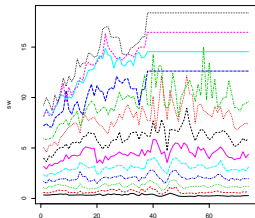
Predicting recruitment

- This is the most difficult (weakest link)
- Most important for medium and long term forecast
- Try plotting the historical recruitment

```
1  recplot(fit)
2  srplot(fit)
```

- The model we use in assessment may not be what we want?
- Sampling from a recent period (e.g. 10 years) is often used

The forecast function for SAM

- Start with fitting a model to get `fit`
- From (and including) last assessment year scenarios are specified
- E.g. as in :

```
1  forecast(fit,catchval = c(800000,NA,NA),fval = c(NA,0.503,NA),fscale =c(NA,NA,1))
```

- More options available available (see `?forecast`)
- Remember to mention `ave.years`, `rec.years` and `processNoiseF`

Forecast exercise

Based on the NEA haddock assessment, forecast catches and SSB the three following years when:

- Catch equals 200000 tons in 2024 and $\bar{F} = 0.4$ in the following three years.

Try out different forecasting scenarios

- Note: ssbplot(), catchplot() etc work on the forecasting object