Forecasting with FLR - an introduction to FLash

FISHREG
Maritime Affairs Unit - IPSC
European Commission
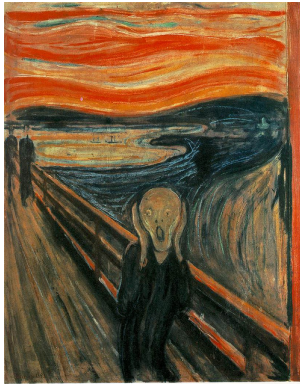Joint Research Center

FLash!

Ahhhhhhhh!

FLash!

Aggggghhh!

Performing projections

Why?

- Predict the future
- Understand potential consequences of management actions

Results depend on many, many assumptions

Performing projections

Things to consider:

- Time scale - 3 years? 5? 20?
- Stock biology - growth and recruitment?
- Incorporate uncertainty
- Model the management scenario

Again: Results depend on many, many assumptions

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The importance of F

Management can have many aims.
To achieve these aims it sets targets:

- Effort
- Catch (Landings or Discards)
- Biomass (SSB)
- Economic (Revenue)

To hit these targets all we can really control is the fishing mortality, F

Introducing `fwd()`

`fwd()` is the engine of projection in FLR
Can be easy to set up - just need to combine the right components
Very easy to get wrong
Success tastes great!

Cake

Making a cake requires combining several ingredients
Some cakes are more difficult to make than others
Can go badly wrong
Success tastes great!
`fwd()` = cake

Basic ingredients

- Stock to be projected
- Stock-recruitment relationship
- Projection control (set targets)

The stock

Obviously, this means an `FLStock`

- Need to set up the stock 'future'
- Requires assumptions to be made, e.g. future stock weights, natural mortality etc.
- `stf()`

A simple example. . .

The control object

- `fwdControl`
- Set target type and value for each year of the projection
- Can have multiple targets
- Can include bounds on the targets (min and max)
- Target values can be relative
- Target values can have multiple iterations (stochasticity)
- Can be complicated...

But it does not have to be complicated.
Sometimes, the simplest things are the tastiest...

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Recipe 1 - Flapjack

Setting F as a target

Recipe 2 - Welsh cake

Setting Catch as a target

Other target types include:
F, SSB, Landings, Discards, Z, Effort, Costs, Revenue. . .

Recipe 3 - Muffin (blueberry)

SSB as a target

Be careful with timing:
The target year is the year that F is set
SSB in year Y is a result of F in year Y-1

Recipe 4 - Cupcake

Setting catch as a RELATIVE target

Recipe 5 - Clootie dumpling

http://en.wikipedia.org/wiki/Clootie

Multiple targets, one with bounds

The order of targets in the control object is important

Recipe 6 - Panettone

Combining bounds AND relative targets

A moment of reflection

So far we have looked at projections with:

- absolute target values,
- relative target values,
- bounds on targets, and
- mixed target types.

But all of the projections have been deterministic
No consideration of uncertainty
Prepare yourself!
Because we are about to enter the 6th Dimension...

(mangiamo)

Projecting with uncertainty

`fwd()` is happy to work over iterations
Each iteration is treated separately
There are several main ways of introducing iterations into fwd():

- Residuals to the stock-recruitment function
- Through the control object (set targets with multiple values)
- The stock object you have set up (e.g. stochastic weights-at-age)

You can actually use all of these methods at the same time
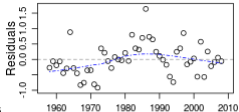As you can probably imagine, this can quickly become very complicated

Before cooking, we need to some preparation with the stock object. . .
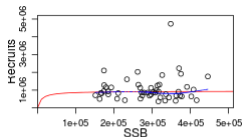
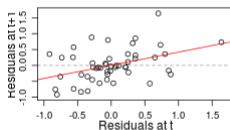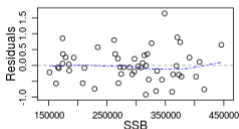# Using stock-recruitment residuals
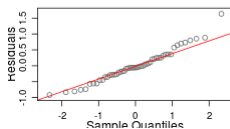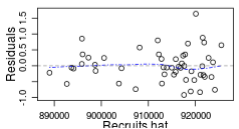
Using stock-recruitment residuals

Two arguments to `fwd()` we have not used yet

- sr.residuals - FLQuant of residuals
- sr.residuals.mult - The residuals are multiplicative or additive

We need to make an `FLQuant` of residuals. . .

Recipe 7 - Rum and ginger cake

Introducing stock recruitment residuals

Recipe 8 - Wedding cake

Stochastic targets

Recipe 9 - Just a huge cake

Everything all at once...