

Welcome to: Advanced stock assessment with RTMB

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$$M2_i = \frac{\sum_j \frac{dR}{dt} N_j \frac{\varphi_{ji}}{\varphi_j}}{N_i \omega_i} \int_a^b \varepsilon \Theta^{\sqrt{17}} + \Omega \int \delta e^{i\pi} = \{2.7182818284\} \chi^2 \Sigma !$$

Time and place

Time:

15—19 January 2024. Each day from 9am—4:30pm

Place:

Compass BC room, Maritime Centre, 1505 Barrington St, Halifax. It is connected to the Four Points hotel by a maze of hallways and there will be signage to direct participants from the hotel lobby.

Proposed agenda

Day 1:

- Intro, RTMB, Maximum likelihood
- Full parametric assessment

Day 2:

- Random effects, multivariate normal, simple state-space
- Dissecting SAM 1: Process options for recruitment, mortality, and survival

Day 3:

- Quantifying uncertainties (delta, profile, simulations, bootstrap, mcmc)
- Dissecting SAM 2: Observations (distribution and correlation options)

Day 4:

- Babysam in total and various extensions
- Validating and comparing models

Day 5:

- Intro to spatial models
- extra requests, splines, tagging model, geolocation, ...

Prepare for course by:

- Review the proposed agenda and suggest changes
- Install RTMB on your computer via the instructions on:
<https://github.com/kaskr/RTMB>
- Try replicating the linear regression example on the next slides
- Report any problems to an@aqua.dtu.dk

Example: Linear regression in RTMB - 1

- 10 observations are assumed to follow a linear regression model:
- Copy the following lines to a plain text file named `linreg.dat`

```
x    y
-1   1.4
0    4.7
1    5.1
2    8.3
3    9.0
4   14.5
5   14.0
6   13.4
7   19.2
8   18
```

linreg.dat

- Two columns of paired (x, y) observations
- The model we want to fit is $y_i = \alpha + \beta x_i + \varepsilon_i$, where $\varepsilon_i \sim \mathcal{N}(0, \sigma^2)$ all independent.

Example: Linear regression in RTMB - 2

- Try to run the following lines in R

```
1 library(RTMB)
2 dat <- read.table("linreg.dat", header=TRUE)
3
4 nll<-function(par){
5   getAll(dat,par)
6   pred <- alpha+beta*x
7   -sum(dnorm(y,pred,exp(logSigma),TRUE))
8 }
9
10 par <- list(alpha=0, beta=0, logSigma=0)
11
12 obj <- MakeADFun(nll,par)
13 opt <- nlminb(obj$par,obj$fn,obj$gr)
14 sdrep <- sdreport(obj)
15 summary(sdrep)
```

linreg.R

- line 1 Includes the RTMB library
- line 2 Reads the data
- lines 4-8 Defines the model and the corresponding objective function we want to minimize
- line 10 Sets the initial values for our model parameters
- line 12 Uses RTMB to allow fast computations
- line 13 Finds the best parameters (by minimizing objective function)
- lines 14-15 calculate and print model summaries

See you soon!

- If all went well you should be setup to run all examples and exercises needed in the course
- If you got strange error messages, then please contact an@aqua.dtu.dk
- Special requests or questions w.r.t. the agenda — please don't hesitate to ask.
- Looking forward to seeing you all in Halifax!