# Welcome to: Introduction to RTMB

## Olav Nikolai Risdal Breivik

Norweigan computing center

Forkurs til det 21. norske statistikermøtet, 17-18 juni 2024

**NR** Norsk Regnesentral
ANVENDT DATAFORSKNING

# Time and place

Time:

17 June 2024 14:00-18:00

18 June 2024 09:00-13:00

Place:

Quality Hotel Tønsberg

# Tentative agenda

Day 1:

- ▶ Introduction, TMB/RTMB
- ▶ Random effects
- ▶ Laplace approximation
- ▶ Markov models, temporal and spatial

Day 2:

- ▶ Spatial modeling
- ▶ Validation with RTMB
- ▶ MCMC with RTMB
- ▶ Non-standard models

# Prepare for course by:

- ▶ 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 olavbr@nr.no
- ▶ Review the proposed agenda and feel free to suggest changes

- ▶ 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 0.5
2 1.8
3 5.1
4 6.3
5 10.9
6 12.3
7 14.3
8 17.7
9 19.3
10 21.5
```

linreg.dat

- ▶ The model we want to fit is $y_i = \alpha + \beta x_i + \varepsilon_i$, where $\varepsilon_i \sim \mathcal{N}(0, \sigma^2)$ are all independent.

▶ 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 maximum likelihood
▶ lines 14-15 calculate and print model summaries

- If all went well you should be setup to run everything needed in the course
- If you got strange error messages, then please contact `olavbr@nr.no`
- Special requests or questions w.r.t. the agenda — please don't hesitate to ask.
- Looking forward to seeing you all in Tønsberg!