**Spatiotemporal Models for Ecologists**

**Homework #3 – Forecast interval coverage**

Goal: Practice and demonstrate ability to (1) estimate parameters for linear and nonlinear state-space models, and (2) explore forecast interval coverage using a parametric bootstrap given model mis-specification.

Files to turn in:

1. Please submit a written description of your results. The whole thing should be (I imagine) less than 3 pages.
2. Please also submit a single R script, and a single TMB Template file provided code that can replicate the analysis.

**Parametric bootstrap**

Download data for Alaska pollock using package FishData (see Week 3 lab for code). Then fit a state-space Gompertz model estimating biomass given average CPUE data for all years 1982-2017:

while specifying that process errors and measurement errors have equal variance ()[[1]](#footnote-1), and record the maximum-likelihood estimates for this fitted model.

Now conduct a parametric bootstrap for this model. To do so:

1. simulate new a new biomass time-series for all years 1982-2017, and simulate new CPUE data for these years, using the Gompertz state-space model and parameter values estimated previously.
2. re-fit the state-space Gompertz model to data for all years except the final five, i.e., 1982-2012, while estimating biomass for all years 1982-2017. Estimated biomass in 2013-2017 is the forecast for this replicate of the parametric bootstrap. Record forecasted biomass and its standard errors for 2013-2017, and record whether the true biomass for this bootstrap replicate is within the 50% forecast interval.
3. Repeat steps 1-2 to generate 100 replicates of the parametric bootstrap, and calculate the forecast interval coverage for each forecast year.
4. Repeat steps 1-3 but replacing the state-space Gompertz model in Step #2 with a state-space Ricker model:

while still specifying that process errors and measurement errors have equal variance (), and again record the forecast interval coverage in each year and each bootstrap replicate.

Questions:

1. What do you notice about forecast interval coverage when the model is correctly specified?
2. What do you notice about parameter estimates for each bootstrap replicate for the correctly specified model?
3. What do you notice about forecast interval coverage when the model is mis-specified? Do these patterns change for short forecasts (i.e., in 2013) vs. longer forecasts (i.e., in 2017)?

1. We impose this restriction during the simulation experiment to avoid having to deal with complications arising when the MLE for or . In practice, this assumption would likely be replaced with a more biologically meaningful restriction, although we do not explore this here. [↑](#footnote-ref-1)