Boston Marathon

1. (a) The data `boston_marathon` is in the fpp3 package. Plot the winning times in the Men's open division. Note that the winning times are stored as a variable of type Time. That won't play well with our model later, so convert them to numeric.

   (b) Fit a simple exponential smoothing model (additive error, no trend) to the winning times. What value of the smoothing parameter α was chosen? Make residual plots and comment on the fit of the model.

   (c) Plot the data with the fitted values.

   (d) Make a 10-year forecast of winning times and plot it with the data.

Mexico GDP

2. (a) The data `global_economy` is in the fpp3 package. Plot the gross domestic product (GDP) of Mexico.

   (b) Fit two ETS models to Mexico's GDP: One with additive error and additive trend (Holt's linear method), one with additive error and damped trend. Make 10-year forecasts for each and plot along with the original data.

   (c) Fit the same two models but use the log of GDP. Plot the forecasts and compare.

Cement

3. (a) The data `aus_production` is in the fpp3 package. Plot the Australian production of Cement. This is a quarterly series.

   (b) Auto-fit an ETS model to cement production. What model was chosen? What was the level smoothing parameter α?

   (c) Plot the data and a 5-year forecast.

4. Cross validation

   (a) Create a stretched data window with initial size of 5 years. This should result in 199 series.

   (b) Fit three models to the 199 training series: 1) Holt-Winters multiplicative, which has multiplicative error and season components, and additive trend. 2) Holt-Winters multiplicative with damped trend. 3) Seasonal naive.

   (c) Create a 1-year forecast for all models on all series and check the accuracy against the original data. Which model performed the best for this 1-year forecast?