02417: Time Series Analysis
Rune Grønborg Junker   DTU Compute
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Assignment 1: Forecasting temperature anomalies

Global warming is a great concern around the globe. Scientists at the Climatic Research Unit (CRU) at University of East Anglia have made several datasets with temperatures on the globe covering the past +150 years. The temperatures are expressed as anomalies from 1961-90 and in this assignment the focus will be on the changes in the average annual anomalies for the Northern hemisphere. The tempertures are estimated based on a number of measurement stations and do include measurement errors.
The data is provided in `A1_annual.txt` and includes three columns:

year Year for the observations

  sh Temperature anomality for the Southern hemisphere (Not used)

  nh Temperature anomality for the Northern hemisphere

You should not use the observations from 2014 through 2018 (Last five observations) for estimations - only for comparisons.

Question 1.1: Plot the temperature anomalies for the Northern hemissphere as a function of time. Do indicate which data is used for training and testing. Comment on the evolution of the temperature over time.

Question 1.2: Use a global linear trend model to predict the temperature anomalies on the Northern hemisphere. Plot the data and the corresponding one step predictions for all observations in the training data. **This means that you should update the parameter estimates for each time step.** Plot the one step prediction errors **along with corresponding 95% prediction intervals**. Make a plot and a table with the predictions for the five years that were left out - do include a 95% prediction interval. **You should not update parameter estimates using the test data.** Compare with the test data. Comment on the results.

Question 1.3: Use a local linear trend model to predict the temperature anomalies on the Northern hemisphere using $\lambda = 0.8$. Plot the data and the corresponding one step predictions **with prediction intervals** for all observations in the training data. Plot the one step prediction errors. Make a plot and a table with the predictions for the five years that were left out - again including a 95% prediction interval **and without using the updating the parameter estimates using the test data**. Compare with the test data.

Comment on the results.

(Hint: Consult the example in Sec. 3.6 of the lecture notes).

Question 1.4: Find an optimal value of the forgetting factor for use in the local trend model suggested in the previous question. (Optimize 1-step prediction errors. Do disregard the first 5 1-step prediction errors as burn in period.)

Present the performance with the optimal value as above.

Question 1.5: Comment on the results. Which model do you prefer? Do you trust the forecasts? Do you have ideas for improving the forecast method?