Time Series, semester 2, 2017-2018
To be submitted in by 23.59, Sunday February 18, 2018.
This assignment is worth 5% of your final grade for the course

Expectations

- Assignments can be typed (LaTeX, word etc.) or handwritten.

- Answers to questions should be in full sentences.

- Any output (e.g. graphs, tables) from `R` that you use to answer questions must be printed out and included with the assignment.

- `R` output should be clearly labelled, i.e., it should be clear from your answer to the question which pieces of the included output you are using.

Marks

- The assignment is out of 25 marks.

Background

The data `UKGDP.RData` can be downloaded from `Learn`.

```
> load(file="../UKGDP.RData")
> UKGDP
```

These data are taken from the website of the Office for National Statistics, and give the GDP (gross domestic product, £millions) in each of the 236 quarters from 1955 to 2013. Let $\{X_t\}$ be the GDP at time t, for $t \in \{1, \dots, 236\}$. Let $\{Z_t\} \sim WN(0, \sigma^2)$. The aim of this assignment is to model the UK GDP $\{X_t\}$ with an ARIMA(p, d, q) process and to forecast the GDP in the UK for the next year.

Assignment

1. Plot the GDP against time and explain why a stationary ARMA(p, q) model is not appropriate for the data. [*2 marks*]

2. Fit the following three models to the data (each including a constant term):

- an ARIMA(0,1,1),
- an ARIMA(1,1,0), and
- an ARIMA(1,1,1).

(a) Based on an analysis of the residuals for each of the models, select your preferred model for the data (of the three given above), and explain your choice. [*8 marks*]

(b) Using the parameter estimates for your chosen model, write down the fitted equation for X_t, in terms of past values of the series and the white noise terms. [*3 marks*]

3. Use the Box-Jenkins forecasting approach to obtain equations for X^{236}_{236+h} (the h-step ahead forecast at time 236) for $h = 1$ and $h = 2$, assuming your chosen model. Your equations should be in terms of the observations $x_1, \ldots x_{236}$ and the forecast X^{235}_{236} [*6 marks*]

4. Use R to obtain the following forecasts:

(a) A forecast of GDP in quarter one of 2014, using exponential smoothing.

(b) A forecast of GDP in quarter one of 2014, using Holt's method.

(c) A forecast of GDP for quarters one, two, three and four of 2014 using the standard Box-Jenkins approach. Give a 95% prediction interval for each forecast.

Which of the above forecasting methods is least appropriate for the dataset, and why? [*6 marks*]