STAT 443: Time Series and Forecasting

Lab 8: Forecasting - Part I

- The lab must be completed in `R Markdown`. Display all the `R` code used to perform your analysis.
- Create a pdf file and use it as your lab submission.
- Please ensure that the file you submit is in good order (e.g., not corrupted and contains the work you intend to submit). No late (re-)submissions will be accepted.

During this lab you will apply the Holt–Winters forecasting method in `R`. The time series in this case study is to be split into a *training set* from January 1987 until January 1993, inclusive (on which the model is fitted) , and a *test set* from February to December of 1993 (on which predictions from the model can be assessed).

Download the data file `souvenir.txt`. It contains monthly sales (in A$) for a souvenir shop at a beach resort town in Queensland, Australia, for January 1987–December 1993. Import the data into `R` as a time series object.

1. Plot the time series and its sample acf and comment on what you see. If you deduce there is a seasonal effect, is it additive or multiplicative? Explain your reasoning.
2. Fit a prediction model based on the training data using the `R` function `HoltWinters()`. Set the options according to what you decided above. Provide the parameter values for your smoothing model. Plot the data along with the fitted values by applying the `plot()` function on the `HoltWinters` object.
3. Plot the estimates of level L_t, expected change per unit time of the trend component T_t and seasonal effect I_t over your training period. You can do this by applying `fitted()` function on the `HoltWinters` object and then plotting the output.
4. Now use the prediction model from above to predict monthly sales from February to December of 1993 via the `predict` function. Plot the predicted values along with 95% prediction intervals and the actual data from the test set on the same plot. Make sure to use different line types (option `lty`) and line colours (option `col`) to distinguish different lines, and remember to include a legend. Use options `type="b"` and `pch=19` to display points and connecting lines for point forecasts and observations.

   Comment on the accuracy of forecasts.
5. Report the forecast values for February, March and April of 1993.
6. If you were to perform a transformation on the time series, what would you consider and why?