LAB EXERCISES 1, March 9, 2023

We'll work with the monthly domestic dishwasher sales (from January 1993 to December 2002) data for this lab. The data file is available on the blackboard page.

1. Download the sales data from the file.
2. Plot the data and visually assess whether there is significant trend and seasonality.
3. Plot the data and visually assess whether there is significant trend and seasonality.
4. Implement the naive estimator: $\hat{y}_t = y_{t-1}$.
   (a) Compute the Mean Absolute Error (MAE), Mean Squared Error (MSE), Root Mean Squared Error (RMSE) and the Mean Absolute Percentage Error (MAPE).
   (b) Plot the naive forecast agains the sales data (and the errors). What observations can you make?
   (c) Check the residual diagnostics (normalized residual plot, histogram, Q-Q plot, auto-correlation plot).
5. Implement a three-period moving average forecast $\hat{y}_t = (y_{t-1} + y_{t-2} + y_{t-3})/3$.
   (a) Compute the Mean Absolute Error (MAE), Mean Squared Error (MSE), Root Mean Squared Error (RMSE) and the Mean Absolute Percentage Error (MAPE).
   (b) Plot the naive forecast agains the sales data (and the errors). What observations can you make?
   (c) Check the residual diagnostics (normalized residual plot, histogram, Q-Q plot, auto-correlation plot).
6. Implement a short term trend forecast $\hat{y}_t = y_{t-1} + (y_{t-2} - y_{t-3})$.
   (a) Compute the Mean Absolute Error (MAE), Mean Squared Error (MSE), Root Mean Squared Error (RMSE) and the Mean Absolute Percentage Error (MAPE).

(b) Plot the naive forecast agains the sales data (and the errors). What observations can you make?

(c) Check the residual diagnostics (normalized residual plot, histogram, Q-Q plot, auto-correlation plot).

7. Implement a naive seasonal forecast $\hat{y}_t = y_{t-12}$.

   (a) Compute the Mean Absolute Error (MAE), Mean Squared Error (MSE), Root Mean Squared Error (RMSE) and the Mean Absolute Percentage Error (MAPE).

   (b) Plot the naive forecast agains the sales data (and the errors). What observations can you make?

   (c) Check the residual diagnostics (normalized residual plot, histogram, Q-Q plot, auto-correlation plot).

8. Implement an exponential smoothing l forecast $\hat{y}_t = \alpha y_{t-1} + (1 - \alpha)\hat{y}_{t-1}$. You can take $\alpha = 0.7$ to start but make sure to experiment with different values of α.

   (a) Compute the Mean Absolute Error (MAE), Mean Squared Error (MSE), Root Mean Squared Error (RMSE) and the Mean Absolute Percentage Error (MAPE).

   (b) Plot the naive forecast agains the sales data (and the errors). What observations can you make?

   (c) Check the residual diagnostics (normalized residual plot, histogram, Q-Q plot, auto-correlation plot).

Exercises for You to Complete Later

9. Implement two-period and three-period ahead forecasts for the MA and short-term trend forecasts and compare the error performance.

10. Find the optimal exponential smoothing parameter α that minimizes the MSE for this data set by running an exhaustive search in the range from 0 to 1.

11. Implement a five-period moving average and compare the error performance with the three period moving average.

12. Implement the following forecast that takes into account both seasonality and trend: $\hat{y}_t = \hat{w}_t + y_{t-12}$ where $\hat{w}_t = w_{t-1} + (w_{t-2} - w_{t-3})$ and w_t is the seasonal difference: $w_t = y_t - y_{t-12}$.