MATH6011 FORECASTING

Solution guidelines for worksheet 2 – Section 2.5 of Chapter 2

For all the exercises, follow the series of corresponding Demos to apply the same steps to the corresponding data sets.

Exercise 2.1 NF1 and NF2 are generally not reliable as seen in Demo 2.1. However, for the sake of the analysis, we have:

1. It is clear from all the error measures that NF2 method is more accurate than NF1; see ErrorMeasuresBuildingMaterials.py.
2. It can be seen that the residuals from NF1 retain the seasonality from the original time series. This is further confirmed in the ACF plot of the residual plot. As for NF2, the local trend at the beginning of the original time series is retained in the residuals, as it can be seen in the plot error and ACF plots; cf. ACFErrorsBuildingMaterials.py.

Exercise 2.2 All the models tried, i.e., $\alpha = 0.5$, $\alpha = 0.8$, and optimized value, generally seem to fit well to the original data from the visual perspective of the graphs. However, from the MSE measure, the optimized one generates more accurate results; run SESEmploymentPrivateServices.py for details.

Exercise 2.3 A few scenarios of Holt's methods are included in HoltEmployment-PrivateServices.py with the linear trend model being the one that we have in the second equation (b_t) of Section 2.3.2. Other versions for the trend are possible, including the exponential and damped version of the trend; the later can often lead to more accurate results for various applications; see, e.g., otexts.com/fpp2/holt for details. However, we mainly focuss on linear additive trend in this course. You can see in the code that the optimized versions of the damped and linear trend methods generate the same MSE.

Exercise 2.4 We focus here on a few scenarios for the Holt-Winter method; following the process in Exercise 2.3, the LES (Holt's linear method) can also be included in the comparisons. See the code HoltWinterCementProduction.py for details of the results:

1. It is clear from the graph (first picture) and MSE measure that the manually selected parameters lead to very bad forecast results. However, the optimized versions of the Holt-Winter method with additive and multiplicative trend are more accurate, with the latter generating the best result (lowest MSE of approximately 1204).
2. The residuals confirm the trend observed in 1, as their time plots and ACF plots show that seasonality is preserved for models 1 and 2, while a significant improvement can be seen for models 3 and 4. However, the latter models might not be 100% accurate as some elements of the patterns from original data seem to be still be present in the residual plots.