Hyndman and Athanasopoulos – Chapter 3 (answers)

1. The box-cox transformation is characterized by a parameter alpha. If alpha is equal to zero, then the transformation is equivalent to the natural logarithm. However, if the alpha parameter is different than zero, it consists in a power transformation. It is useful to normalize variables (normality is usually required for a variety of statistical tests). In the time-series context, it is used to perform variance stabilization.
2. Cangas dataset: because it does not address one of the main problems of the cangas time-series. The seasonal variation does not stabilize or shrink after the transformation was applied. The variation increases, stabilizes, and then shrinks again, just like in the original series.
3. Notice that the appropriate box-cox transformation reduces the greater variation in more recent events.
4. A transformation won’t likely stabilize the dole series. A box-cox transformation does not reduce the variation, which is likely tied to the business cycle and not necessarily a product of seasonality. For the usdeaths series, it definitely shrunk the variability. Meaningless for bricksq series, since the seasonal variability still changes considerably/
5. The mean of the residuals is not zero, which suggests that the forecasts from the seasonally naïve method are biased downward. This could be easily fixed by adding the constant to the original series. However, the results of the autocorrelation plot and of the Ljung-box test show that there is enough evidence to reject the null hypothesis that the residuals are uncorrelated. It is possible, at least in theory, to predict the next residual using past values, suggesting thus there is information contained in the residuals that should be used in the model.
6. The residuals of the naïve forecast are biased upward; and show a high degree of autocorrelation. Finally, the Ljung-box test rejects the null of no autocorrelation in the residuals. Same problems as wwwusage series. Forecasts are biased upward and the correlogram and the Ljung-box test show evidence of autocorrelation.
   1. False. Normality is an auxiliary property that helps in the calculation of prediction intervals. Good forecast methods obey at least two residual properties:
      1. They are uncorrelated.
      2. They have mean 0.
   2. False. The reliability of a forecasting method can only be determined by considering how well a model performs on new data that was not used to fit the model. Small residuals could be a sign of overfitting.
   3. False. MAPE has the advantage of being unit free, but they have the disadvantage compared to scale-dependent error measures of being infinite or undefined if the true value at time t is 0.
   4. False. More complicated models will fit the data “harder”, and might, therefore, follow noise too closely.
   5. True.
7. No. The correlogram shows that, at least until lag 36, there is a significant correlation between the residuals. The Ljung-box test also presents evidence against the null hypothesis that there is no residual autocorrelation. Finally, the residuals show a “snake-like” pattern. Regarding normality, they seem to have a slightly long right tail.
8. The best performing model on the training set was the second one (omitting the last two years). On average, the forecasts were around 3% off.
9. Naïve method (forecasts will be equal to last available value) performs better than the drift method using cross validation.
10. Drift method had the lowest MAPE on the test set. Residuals, however, do not resemble white noise, since there is evidence of autocorrelation on the correlogram and in the results of Ljung-Box test.