Report

The data we currently use for this forecasting model is the sales data for product X1 from 2014 to 2017, which we forecast using the Holt-Winters model (model below).

𝐹𝑡+𝑚 = (𝐿𝑡 + 𝑚𝑏𝑡 )𝑆𝑡+𝑚−𝑠

where

𝐹𝑡+𝑚 is the 𝑚-step ahead forecast

𝐿𝑡 is the level of the underlying stationary series at time 𝑡

𝑏𝑡 is the trend at time 𝑡

𝑆𝑡 is the seasonal index at time 𝑡

𝑠 is the length of season in time periods

Although all predictions are made using the Holt-Winters model, I have used three different ways of building the prediction model here. However, the final result is that sheet1 clearly has a smaller error value, and after re-fitting the data, you have a better summation, so the sheet1 model is recommended. sheet2 and sheet3 differ in that sheet2 extracts data from the second, third and fourth quarters of 2018 for testing the model, and therefore does not include the modelling. The most obtained square error values are larger and using only three years and one quarter of data is not suitable to support the whole model. Whereas sheet3 used all the data for modelling. But the final error proves that both models are inferior to sheet1's model. Therefore, sheet1's model is recommended here.

The specific use of this model is explained in the next section (note: in the excel document, some important parts are also noted)

1. First put the data into excel and set up a time series starting from 1 by time.

2. Try to plot a graph with the x-axis being the time series and the y-axis representing the sales of product X1 and evaluate the pattern of X1 sales. The results show that the data set shows a systematic increasing linear trend and also a regular periodicity, so we need to capture these patterns through the Holt-Winters model.

The time periods for making forecasts is the 4 periods in each year. Since our data has 4 periods, we use MA(4) to smooth the data. As this moving average is used to smooth the data, we record the calculated value of the moving average in the cell aligned with the centre point (but our data is even, so I will put it in the third data and centre it on this data). 3.

3. after completing this step you should have a new column with the value of MA(4) aligned with the midpoint of a set of values from which the average was calculated

Now we want to obtain the slope parameter. first create a new column that records the calculated differences between successive moving averages. Next, calculate the average of these differences and record this value in a cell. The average difference provides an initial estimate of the slope of the linear trend. The local slopes are averaged over several successive times to obtain an estimate of the overall slope for all past data as an estimate of the global slope. This global slope becomes the estimate of the trend parameter.

5. Set up a new column containing the trend values for each time period in the past and each time period in the future for each time period. We do this by setting the midpoint of the historical trend values to equal the smoothed moving average. The row aligned to the midpoint of the past data set is first identified, and then the average of the smoothed MA(4) values is recorded in this cell. The remaining trend values can then be inferred by subtracting or adding the slope values for the time periods before or after the midpoint, respectively.

6. Estimate the seasonal effect for all past observations. In a new column, calculate the seasonal value, i.e. the ratio between the appropriate observed data and the sales data.

7. Averaging the seasonality index for each "season". In the initialisation dataset, we obtain the seasonality index for each 'season' by averaging the seasonality values for the corresponding 'season' for each year. Record and label these four seasonal indices Appropriately record and label them in the space you have reserved for parameter estimation.

8. Having obtained all parameter estimates for the past data, you are ready to start making forecasts. We start by forecasting each period in 2019 and 2020. It is easiest to simply add the values of the trend parameters (created in Step 2) to each row from Period 1, 2017 to Period 5, 2018 as an extension of the past trend column created in Step 3. This is a This is a practical way of implementing a linear trend expression and is at the heart of the Holt-Winters model.

9. we now need to adjust the forecast trend to take account of seasonal effects by multiplying by the appropriate seasonal index. That is, we record our forecast in a new column and calculate it as the product of the forecast trend value from step 6 multiplied by the relevant seasonal index calculated in step 5.

10. Plot the time series of the forecast values and place the forecast values into the graph for observation.

11. To observe the fit, forecasts are also made for past data. Calculate the prediction errors for the available data and calculate ME, MAD, MSE, MPE and MAPE. record a summary of your prediction errors. The final result is that the model in sheet 1 is a better fit.

As a dynamic model, sheet1's model can be matched to other products and used to forecast for the following year. However, in order to better test the fit of the model, it is recommended that the data can be put into three different models for observation and the most appropriate model can be selected.