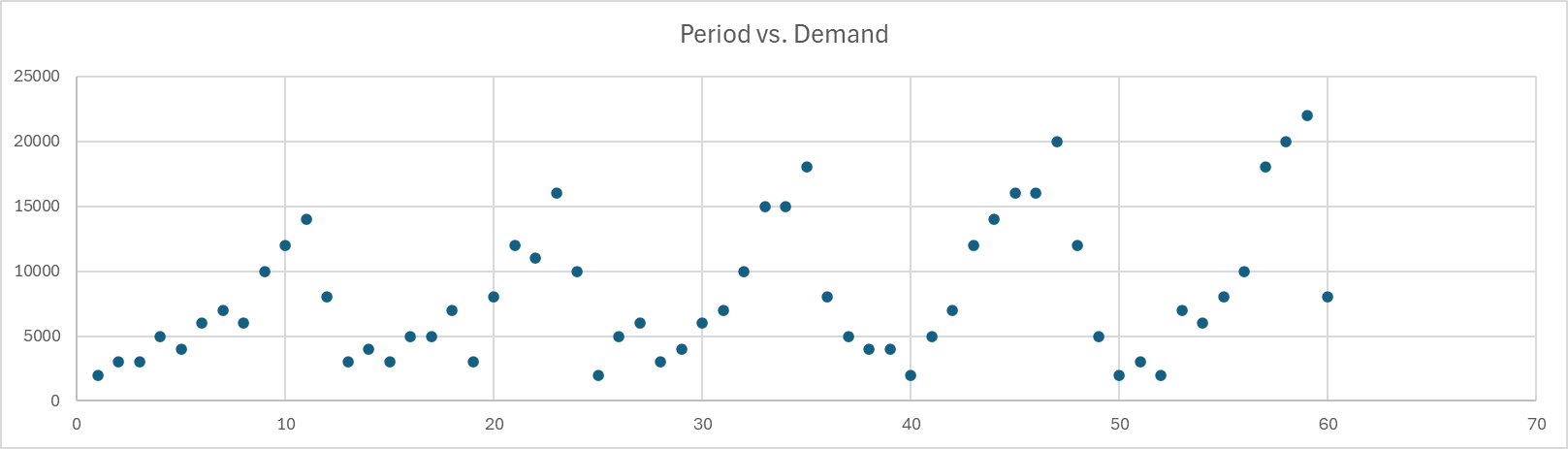
**Question 1.**

**a.** First, I analyzed the data trend by plotting sales over the given periods. The detailed calculations are available in the sheets named “Question1.a-sheet1” and “Question1.a-sheet2”



From this visualization, we can observe that the sales exhibit both yearly seasonality and an overall trend.

Next, the deseasonalized demand and seasonal factors were calculated by the following relations.

The table below summarizes the results.



Next, to estimate future demand, I formulated the static model as follows.

To determine each parameter, I first performed linear regression on the deseasonalized demand.



Additionally, I calculated the seasonal factor for each month by averaging the corresponding seasonal factors derived from the data.

The resultant parameters were obtained as follows.



Here, , for and

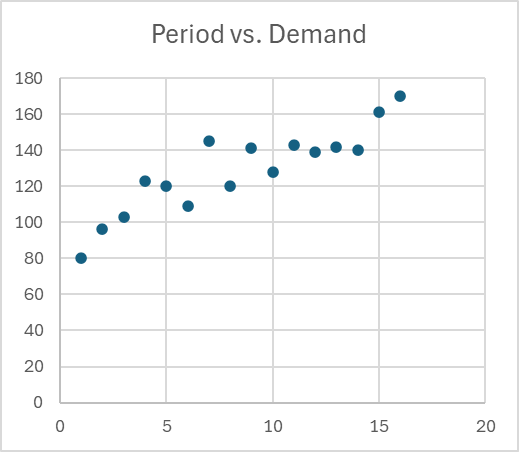
Finally, the Year 6 forecast is as follows.



With this model, TS, MAD, MAPE, MSE are calculated as follows.



**b.** To analyze the overall trend, I plotted the demand against the period.



The demand shows a clear trend that cannot be adequately captured by just a single parameter (i.e., level). Therefore, I initially hypothesized that Holt’s model would provide a better fit.

Exponential smoothing, detailed calculations are in “Question1.b-sheet1”





Holt’s method, detailed calculations are in “Question1.b-sheet2” and “Question1.b-sheet3.” Note that linear regression was performed to obtain and , with its result in “Question1.b-sheet3.”





All the metrics of Holt’s model are smaller than exponential smoothing’s, implying that the Holt’s model fits better than the other. Therefore, the initial guess I had seems correct.

**Question 2.**

a.

b.