**Problem Set 4: Forecasting**

**Note:** Display your answers to two decimal places, but carry the full value in the calculations, i.e. do not round the numbers while you are performing your calculations.

**Question 1**

Toyota Motors introduced a hybrid car *Hybrid G* in the U.S. market in 2014. In the first three years, the sales of the *Hybrid G* were strong, but the sales figures started to decline in 2017 following the introduction of a new hybrid model by Honda. Toyota is in critical need of a better forecasting method. They need your help to evaluate alternative forecasting methods and provide suggestions. The following table contains the past 12 months of sales data

**Note:** Month 1 refers to sales made 12 months ago, month 12 refers to sales made last month.

|  |  |
| --- | --- |
| **Month** | **Sales** |
| 1 | 1,243 |
| 2 | 1,358 |
| 3 | 1,342 |
| 4 | 1,298 |
| 5 | 1,277 |
| 6 | 1,183 |
| 7 | 1,053 |
| 8 | 992 |
| 9 | 852 |
| 10 | 910 |
| 11 | 823 |
| 12 | 744 |

Use a 3-month simple moving average to forecast sales for months 4 to 13. Compute the Mean Absolute Deviation (MAD) and the Mean Square Error (MSE) of the forecasts for months 4 to 12.

**Question 2**

Toyota Motors would like to move beyond the moving average method and explore a more sophisticated alternative. They want you to consider exponential smoothing.

1. Using simple exponential smoothing, compute two sets of forecasts for the sales of *Hybrid G* for months 2 to 13, corresponding to α values of 0.5 and 0.7. Assume that the forecast for Month 1 is 1,243.
2. Calculate the MAD and Mean Absolute Percentage Error (MAPE) using the forecast errors from months 2-12 for each of these two sets of forecasts. Which α value seems to be most appropriate? Please explain why.

**Question 3**

Toyota Motors observes from the sales data that sales of *Hybrid G* has been decreasing over the last year. As mentioned earlier, this is due to introduction of a new hybrid model by Honda at the beginning of 2017. Toyota Motors wants to incorporate this decreasing trend into its forecasts. You have learned that the double exponential smoothing method accounts for such trends in the data.

1. Use the double (trend-adjusted) exponential smoothing method to forecast sales for months 2 to 13, assuming S1 = 1,243 and T1 = -30 and set α=0.7 and β=0.4.
2. Compute MAD and MAPE for months 2 through 12 for the double exponential smoothing forecast and compare them with those of simple exponential smoothing in problem 2(b). Based on your calculations, is single or double exponential smoothing a better approach in this specific case? Why?