IE 500: Supply Chain Engineering – FORECASTING TECHNIQUES

Submitted by: Abhishek Shirsat

Solution 1 A – Computing forecasts using Last Value, Averaging, Moving average and Exponential Smoothing

Method	Sales forecast (month 13)
Last value method	41
Averaging method	36.58333333
Three month moving average method	35.66666667
Exponential smoothing (α = 0.25)	35.65203571

Solution 1 B – Evaluating accuracy for above methods

	MAD	MSE	STD	MAPE
Last value method	6.555555556	55	7.416198	18.0992375
Averaging method	3.442051252	20.69716	4.549414	8.842560598
Three month moving average method	3.61242916	19.53386	4.419713	9.53409403
Exponential smoothing	4.102072716	23.23597	4.82037	10.97325206

Solution 1 C

Based on the values obtained above, we conclude that three month moving average is the best method for this scenario.

Solution 2 A

Calculating MAD, MSE AND BIAS FOR THE 2 forecasts given

	MAD	MSE	BIAS
Forecast 1	49.1666667	2856.166667	-12.16666667
Forecast 2	46.6666667	2583	-17.33333333

Solution 2 B

1. Both the forecasting methods used here are under-forecasting.
2. Based on the MSE values, I would recommend the second method since the MSE value is lower. MSE value tells us how close our predictions are to the actual values.

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Solution 3 A – Forecasting based on historical quarterly sales data

Initial estimates of seasonal factors for each quarter using the data for years 2007 – 2010:

Year	Quarter	period	Demand	Quarter_Average	Seasonality Index	Deseasonalized demand (D/F)	Deseaonalized Forecast (0.2G+0.8H)	Acutal Forecast(H*F)
2007	1	1	800	2120	1.023907269	781.3207547	600	614.3443613
2007	2	2	750	2202	1.063511229	705.2111717	636.2641509	676.6740692
2007	3	3	600	1176	0.567978749	1056.377551	650.0535551	369.2166051
2007	4	4	1500	2784	1.344602753	1115.571121	731.3183543	983.3326724
2008	1	5	1700	2120	1.023907269	1660.306604	808.1689076	827.4900188
2008	2	6	1100	2202	1.063511229	1034.309718	978.5964468	1040.74831
2008	3	7	680	1176	0.567978749	1197.227891	989.7391011	562.1507766
2008	4	8	2000	2784	1.344602753	1487.428161	1031.236859	1386.60392
2009	1	9	2100	2120	1.023907269	2050.966981	1122.475119	1149.310434
2009	2	10	2200	2202	1.063511229	2068.619437	1308.173492	1391.257198
2009	3	11	1300	1176	0.567978749	2288.818027	1460.262681	829.3981708
2009	4	12	3100	2784	1.344602753	2305.513649	1625.97375	2186.288781
2010	1	13	2400	2120	1.023907269	2343.962264	1761.88173	1804.00351
2010	2	14	3060	2202	1.063511229	2877.26158	1878.297837	1997.590841
2010	3	15	1800	1176	0.567978749	3169.132653	2078.090586	1180.311291
2010	4	16	4000	2784	1.344602753	2974.856322	2296.298999	3087.609956

Solution 3 B – Using seasonality method to determine forecasts

Sales prediction for 1st four quarters of 2011 using seasonality method:

2011	1	17	3600	2120	1.023907269	3515.943396	2432.010464	2490.153191
2011	2	18	3900	2202	1.063511229	3667.098093	2648.79705	2817.025407
2011	3	19	1500	1176	0.567978749	2640.943878	2852.457259	1620.135106
2011	4	20	3320	2784	1.344602753	2469.130747	2810.154582	3778.541588

Average	2070.5
Alpha	0.3
Initial Forecast	780

Solution 3 C - Validating the forecast using STD and Bias:

Summation	-5813.184683	5813.184683	4129188.276		5.718216
number of periods	12	12	12		12
MAD = G24/G25		484.4320569			
MSE = H24/H25			344099.023		
STD=sqrt(MSE) = sqrt(H28)			586.5995423		
Bias = F24	-5813.184683				
MAPE=(J15/J16)*100					47.6518

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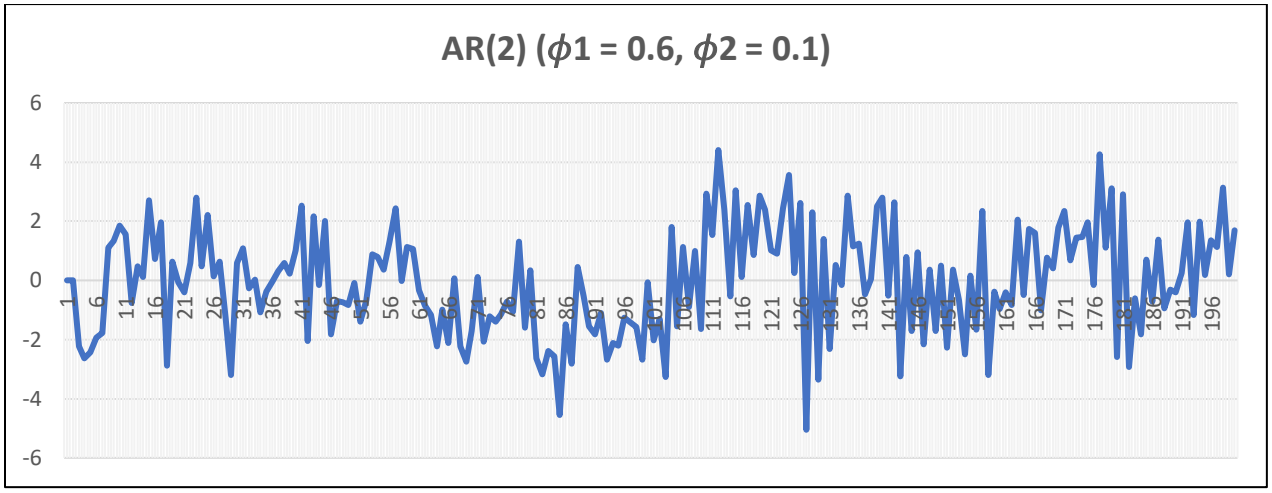
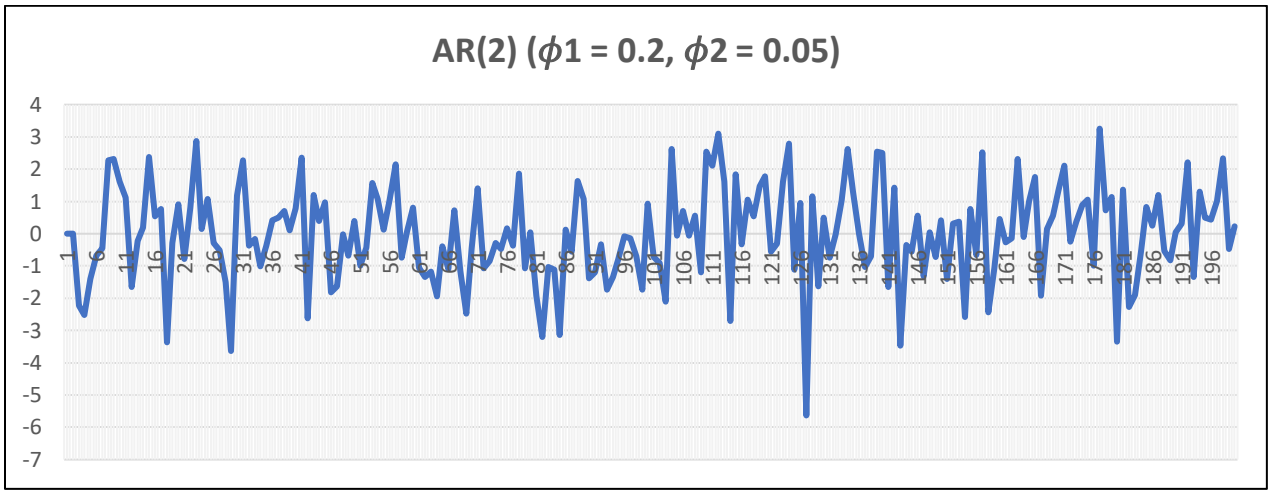
Solution 5 A – ARMA MODEL

- Using the excel file uploaded, 200 number of Gaussian white noises (σ^2 = 2) were generated and placed in column C of the file.
- The random variables were given and =NORM.INV() function in excel was used here.

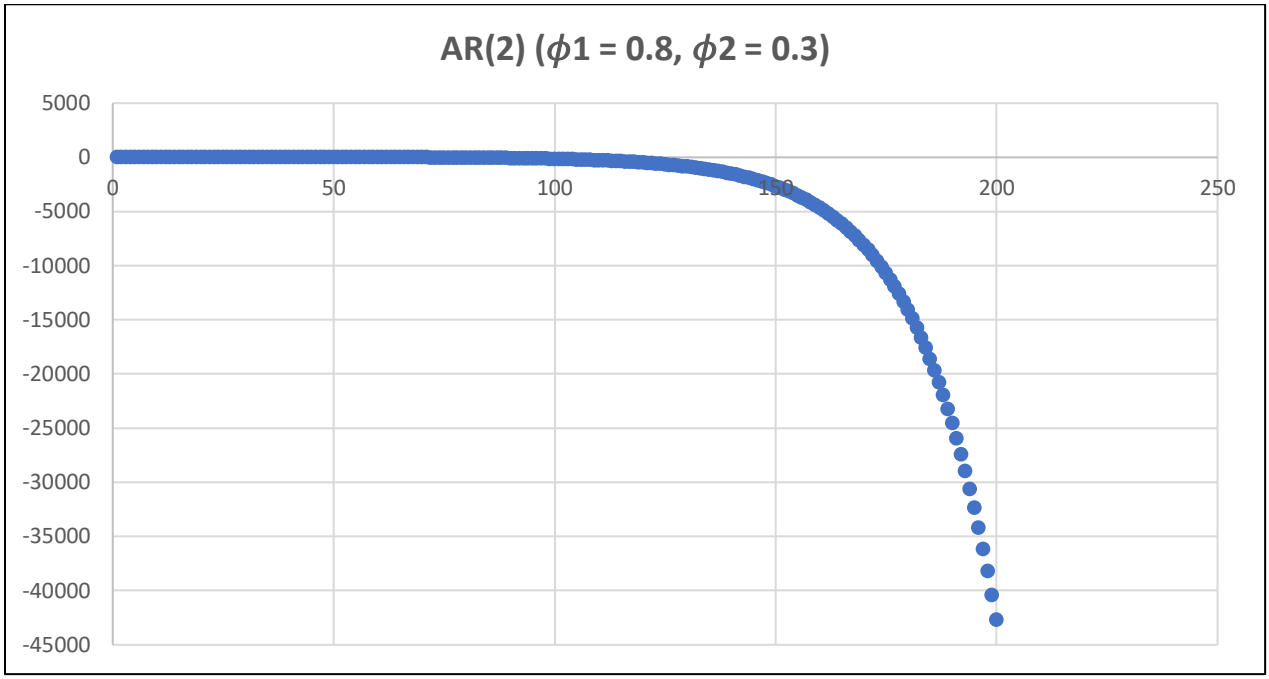
Solution 5 B



Solution 5 C



Solution 5 D - AR(2) with $\phi 1 = 0.8$, $\phi 2 = 0.3$



Solution 5 E

- As the value of ϕ decreases, the variance in yesterday's and today's values (forecast) increases.
- The model turns exponential when the sum of $\phi \geq 1$
- AR is a stochastic method. Today's demand is linearly dependent on the last few days demand.

Solution 5 F

$\sigma^2 = 0.9882$

We use the mean square error as an estimator since it tells us how close our predicted values are to the actual values.

Solution 5 G – Viewpoint

- In my opinion, MA (1) with $\theta_1 = 0.5$ is the better model.
- MAD is a better measure of error than MSE when the forecast error does not have a symmetric distribution.
- The MSE penalizes large errors much more significantly than small errors because all errors are squared. Because of this, it is a good idea to use the MSE to compare forecasting methods if the cost of a large error is much larger than the gains from very accurate forecasts.
- In this case, we are unsure about the type of data we have and thus use MSE as the baseline for comparison.