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T.I.M 125
Homework 4

Homework 4

Plan
Sunday – Review notes, Do readings
Monday – Work on problem 1&2 and finish project work
Tuesday – Work on problem 3&4
Wednesday- Work on problem 5&6 check answers
Thursday – review and submit homework

1 Cycle inventory

1. Define the problem

Cycle inventory: D 10.1, 10.2 10.3

D10.1 Consider a supermarket deciding on the size of its replenishments order from proctor & Gamble what costs should it take into account when making this size order from Proctor and Gamble.

D10.2 – Discuss how various costs for the supermarket change as it decreases the lot size order from Proctor and Gamble.

D10.3 As demand at the supermarket chain grows, how would you expect the cycle inventory measured in days of inventory to change? Explain

2. Plan

What information is available for solving the problem?

- Chapter 10 form the text
- Lecture notes

3. Execute

D10.1 – Consider a super market deciding on the size of its replenishment order from Proctor & Gamble. What costs should it take into account when making this decision?

When a super market is dividing on its size of its replenishment order form Proctor & Gamble, they should consider three main costs: Material. Ordering, and Holding. Material cost is cost for the production. Generally, varies from products. Material cost will be fixed because orders will be made with the same amount. Ordering costs encapsulate increment costs associated with making and placing an order. Buyer time is time it takes the buyer to place an additional order. Receiving cost refers to admin work and efor for updating inventory. Other costa refers to how much it will take for inventory be held or stored in warehouses. It also takes into account of facts as expiration, shrinkage on select items.

D 10.2 Discuss how various costs for the supermarket change as it decreases the lot size order form Proctor & Gamble

The super market decreasing their lot size will generally cause a decrease in other costs such as material, order, and holding cost; as mentioned previously. Assuming that the supermarket will decrease their orders of product means that they will also decrease the materials assuming this is a permanent annual effect. Oder cost will also decrease in the sense that if there are fewer inventories to transport, each shipment will be larder. Lastly, the holding cost will also decreasea because since the lot size is smaller, it wll take less space for inventoriesare stored smaller space leads to a smaller price to pay for the space. All in all, due to the decrease of the super market lot size, every other factor will decrease as well.

D 10.3 As demand at the supermarket chain grows, how would you expect the cycle inventory measured in days of inventory to change ?

As demand grows within a supermarket chain, I expect demand to increase as well as inventory turnover. The owner will the want to order products for the supermarket. Which would require more space (holding cost) and increase the trips for transportation. This includes more products being transported, it will tighten the tracking inventories so there will be less inconsistency, Here is the optimal of lot size equation:

Q* = root(2DS/hC)

D= Annual demand

S = fixed cost

C= cost per unit

H = holding cost

This equation can be derived by using total cost equation. $C_T = C_M + C_S + C_I$. By taking the derivative of this equation, one can get the optimal equation of Q*.

4. Check your work

I have checked my work by making sure that I answered every problem to the best of my ability and reread my answers in that they make coherent sense in context and relevance.

5. Learn and Generalize

This problem allowed for an understanding on how a company needs to consider detail when it comes to changing a simple order. There are many costs that must be taken into account no matter the size. This chapter also demonstrated the miniscule change can affect the company. We also see how altering an equation can be used in different departments. Optimizing the equation will change what the equation is originally for.

Tahoe Salt (continued)

1. **Define**

   Forecast demand using holt and Winter Forecasting methods. Your solutions should match the solutions in the book.

2. **Plan**

   What information is available for solving the problem ?
   - Tahoe Salt(ch7)
   - Excel Worksheet
   - Lecture notes

3. **Execute**

L= Estimate of level at t= 0

T = Estimate of Trend

S_t = Estimate of seasonal factor for Period t

D_t = Actual demand observed for Period t

F_t = Forecast of demand for Period t

$F_{t+l} + [L+(t+l)T]S_{t+l}$

Year	Quarter	Period, T	Demand, Dt
1	2	1	8,000
1	3	2	13,000
1	4	3	23,000
2	1	4	34,000
2	2	5	10,000
2	3	6	18,000
2	4	7	23,000
3	1	8	38,000
3	2	9	12,000
3	3	10	13,000
3	4	11	32,000
4	1	12	41,000

Holt Model

The Holt method is used when the demand uses both the level and trend.

To Estimate the forecast, we use:

$F_2 = L_1 + T_1 \ldots F_7 = L_6 + T_6$

Period t	Demand D_t	Level L_t	Trend T_t	Forecast F_t	Error E_t	Absolute Error A_t	Squared Error MSE_t	MAD_t	% Error	$MAPE_t$	TS_t
0		12,015	1,549								
1	8,000	13,008	1,438	13,564	5,564	5,564	30,958,096	5,564	70	70	1.00
2	13,000	14,301	1,409	14,445	1,445	1,445	16,523,523	3,505	11	40	2.00
3	23,000	16,439	1,555	15,710	-7,290	7,290	28,732,318	4,767	32	37	-0.06
4	34,000	19,594	1,875	17,993	-16,007	16,007	85,603,146	7,577	47	40	-2.15
5	10,000	20,322	1,645	21,469	11,469	11,469	94,788,701	8,355	115	55	-0.58
6	18,000	21,570	1,566	21,967	3,967	3,967	81,613,705	7,624	22	49	-0.11
7	23,000	23,123	1,563	23,137	137	137	69,957,267	6,554	1	42	-0.11
8	38,000	26,018	1,830	24,686	-13,314	13,314	83,369,836	7,399	35	41	-1.90
9	12,000	26,262	1,513	27,847	15,847	15,847	102,010,079	8,338	132	52	0.22
10	13,000	26,298	1,217	27,775	14,775	14,775	113,639,348	8,981	114	58	1.85
11	32,000	27,963	1,307	27,515	-4,485	4,485	105,137,395	8,573	14	54	1.41
12	41,000	30,443	1,541	29,270	-11,730	11,730	107,841,864	8,836	29	52	0.04

Winter Model

Winter model is a method used when there is a given, trend, and seasonality, The using Smoothing constants a= 0.1, b = 0.2, and y =0.1

Systemic component of demand is now equal to (level + trend)(Season factor)

$F_{t+1} = (L_t + T_t)S_{t+1}$ … $F_{t+1} = (L_t + lT_t)S_{t+1}$

On observing demand for Periof t+1 wer change the estimantes for the level, trend, seasnality,

$L_{t+1} = \alpha(D_{t+1}/S_{t+1}) + (1- \alpha)(L_t + T_t); 0<\alpha<1$

$T_{t+1} = \beta(L_{t+1}-L_t) + (1- \beta)T_t; 0<\beta<1$

$S_{t+p+1} = \Upsilon(D_{t+1}/L_{t+1}) + (1 - \Upsilon)S_{t+1}; 0<\Upsilon<1$

Period t	Demand D_t	Level L_t	Trend T_t	Seasonal Factor S_t	Forecast F_t	Error E_t	Absolute Error A_t	Squared Error MSE_t	MAD_t	% Error	$MAPE_t$	TS_t
0		18,439	524									
1	8,000	18,866	514	0.47	8,913	913	913	832,857	913	11	11.41	1.00
2	13,000	19,367	513	0.68	13,179	179	179	432,367	546	1	6.39	2.00
3	23,000	19,869	512	1.17	23,260	260	260	310,720	450	1	4.64	3.00
4	34,000	20,380	512	1.67	34,036	36	36	233,364	347	0	3.50	4.00
5	10,000	20,921	515	0.47	9,723	-277	277	202,036	333	3	3.36	3.34
6	18,000	21,689	540	0.68	14,558	-3,442	3,442	2,143,255	851	19	5.98	-2.74
7	23,000	22,102	527	1.17	25,981	2,981	2,981	3,106,508	1,155	13	6.98	0.56
8	38,000	22,636	528	1.67	37,787	-213	213	2,723,856	1,037	1	6.18	0.42
9	12,000	23,291	541	0.47	10,810	-1,190	1,190	2,578,653	1,054	10	6.59	-0.72
10	13,000	23,577	515	0.69	16,544	3,544	3,544	3,576,894	1,303	27	8.66	2.14
11	32,000	24,271	533	1.16	27,849	-4,151	4,151	4,818,258	1,562	13	9.05	-0.87
12	41,000	24,791	532	1.67	41,442	442	442	4,432,987	1,469	1	8.39	-0.63
13				0.47	11,940							
14				0.68	17,579							
15				1.17	30,930							
16				1.67	44,928							

4. Check your work

I have checked my work by making sure that I answered the question fully. I then double checked my charts with the textbook to make sure that the inputs were correct.

5. Learn and Generalize

I learned how to better utilize Excel. It, would be great, however, if we could spend more time in class learning these methods in class and how to do them properly.

3 Hot Pizza

1. Define

Estimate demand for the next four weeks using a four-week moving average as well as simple exponential smoothing with a= 0.1. Evaluate the MAD, MAPE,MSE, bias, and TS in each case. Which of the two methods do you prefer? Why?

2. Plan

What information is available for solving the problem?

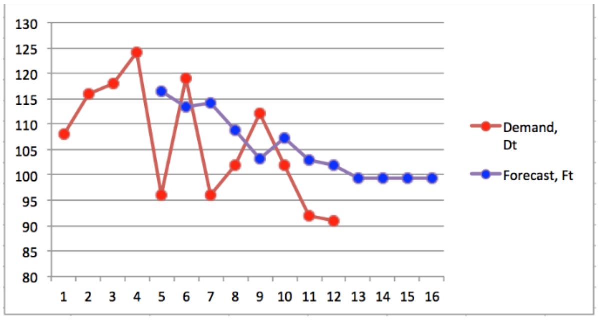
- Chapter 7
- Lecture notes
- Chapter 7 exercise 2

3. Execute

Base case

Period, t	Demand, D_t
1	108
2	116
3	118
4	124
5	96
6	119
7	96
8	102
9	112
10	102
11	92
12	91

Four week moving average



The graph above plots according to the given data points and the forecasts that we have calculated. From the looks of it, one can see that they are both having a sawtooth movement, so it shows two sets of data points are in a sense correlated. However, you can see that there are up and down jumps of demand data while forecast data is mainly decreasing as the calculation goes on. However, the Fluctuation of demand data does make it harder for forecast to continue.

Week	Demand, D_t	Level, L_t	Forecast, F_t	Error, E_t	Absolute Error, A_t	Squared Error MSE_t	MAD_t	% Error	$MAPE_t$	TS_t
1	108									
2	116									
3	118									
4	124	116.50								
5	96	113.50	116.50	20.50	20.50	420.25	20.50	21.35	21.35	1.00
6	119	114.25	113.50	-5.50	5.50	225.25	13.00	4.62	12.99	1.15
7	96	108.75	114.25	18.25	18.25	261.19	14.75	19.01	15.00	2.25
8	102	103.25	108.75	6.75	6.75	207.28	12.75	6.62	12.90	3.14
9	112	107.25	103.25	-8.75	8.75	181.14	11.95	7.81	11.88	2.62
10	102	103.00	107.25	5.25	5.25	155.54	10.83	5.15	10.76	3.37
11	92	102.00	103.00	11.00	11.00	150.61	10.86	11.96	10.93	4.38
12	91	99.25	102.00	11.00	11.00	146.91	10.88	12.09	11.08	5.38
13			99.25							
14			99.25							
15			99.25							
16			99.25							

MAD (Mean Absolute Deviation) – is the average of the absolute deviation over all periods. Looking at the data from Excel Worksheet, the MAD value seemed to begin large. It gradually got smaller as the demand.

MAPE (Mead absolute percentage error) – is the average absolute error percentage of the demand. Looking at data from Excel. The MAPE value seemed to begin a bit larger than expected. MAPE value is low meaning that the forecast is accurate. The lower the percentage the better the accuracty of the forecast. According to this data, the forecast we made is accurate in relevance to the demand data.

MSE (Mean Square Error) is a good error measurement of the forecast error has a distribution that is systemic about zero. The MSE penalizes large erros much more significantly than small errors because all erros are squared.

Bais: the Bias is the average of the errors that were calculated in the excel worksheet above. However, looking at the data that we calculated, it seems as though there is a bias in the data because there are only positive values and no negative values. This basically means that the data are all skewed to one side, the positive side. Also, as we continue with the forecast, the data seems to increase as well.

TS (Tracking signal) is the ratio of the bias and the MAD. A good range for the tracking signal to be is from -6 to +6. The data calculated seems to have more TS having more negative values rater than positive, but since all the values are within the range of -6 to +6 the TS is adequate

Which of the two methods do you prefer? Why?

Of the two methods, I would prefer simple exponential smoothing method than the moving average because it makes predictions accurately. Both methods are not perfect, but the simple exponential smoothing has a lower MAPE percentage.

4. Check your work

I checked my work by looking at the book and making sure that I have followed the questions.

5. Learn and Generalize

Throughout this Hot Pizza exercise I was able to look and use different methods with excel. I also was able to understand the terminology better.

4. Flower Wholesale

1. Define

Given the quarterly demand for flowers at a wholesale, forecast quartery demand for year 5 using simple exponential smoothing with a=0.1 as well as Holt model with a=0.1 and b=0.1. Which of the two methods do you prefer? Why?

2. Plan

What information is available for solving the problem ?

- Lecture notes
- Textbook
- Holt Method
- Exponential smoothing

3. Execute

Base case

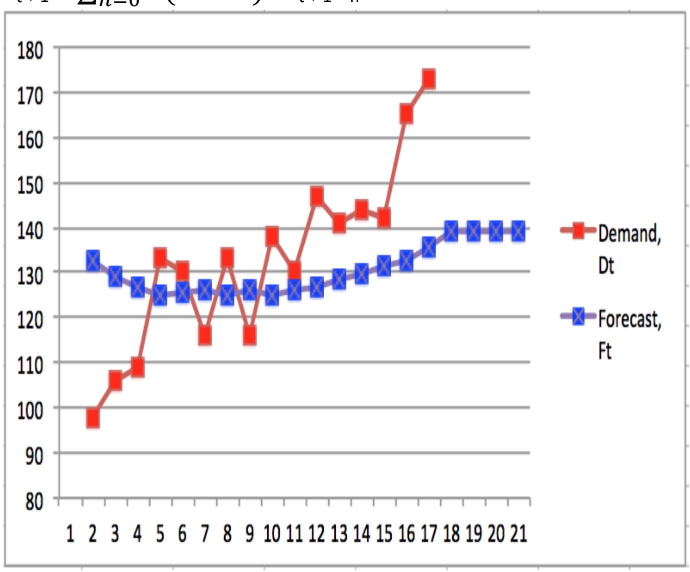
Year	Quarter	Sales ('000 $)
1	1	98
1	2	106
1	3	109
1	4	133
2	1	130
2	2	116
2	3	133
2	4	116
3	1	138
3	2	130
3	3	147
3	4	141
4	1	144
4	2	142
4	3	165
4	4	173

From the text book

Simple Exponential smoothing method

$L_0 = 1/n \sum_{t=1}^{n} D_i$

$L_{t+1} = \sum_{n=0}^{t+1} \alpha(1 - \alpha)^n D_{t+1-n}$

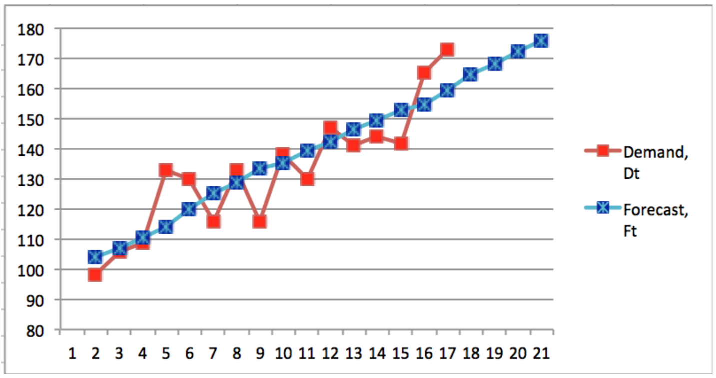


Looking at the forecast it seems like the forecast gave a good prediction of demand. Towards the end around quarter 14 or 4thday the forecasts gave a straight line prediction while the actual demand increased. This discrepancy seems to have not considered the products life cycle. I would not use this method for this given data set seeing how the difference in forecasted is towards the midpoint of the graph.

Simple exponential smoothing method

Period, t	Demand, D_t	Level, L_t	Forecast, F_t	Error, E_t	Absolute Error, A_t	Mean Square Error MSE_t	MAD_t	% Error	$MAPE_t$	BIAS	TS_t
0		133									
1	98	129.11	132.56	34.56	34.56	1194.60	34.56	35.27	35.27	34.56	1.00
2	106	126.80	129.11	23.11	23.11	864.26	28.83	21.80	28.53	57.67	2.00
3	109	125.02	126.80	17.80	17.80	681.74	25.16	16.33	24.46	75.47	3.00
4	133	125.81	125.02	-7.98	7.98	527.24	20.86	6.00	19.85	67.48	3.23
5	130	126.23	125.81	-4.19	4.19	425.29	17.53	3.22	16.52	63.30	3.61
6	116	125.21	126.23	10.23	10.23	371.87	16.31	8.82	15.24	73.53	4.51
7	133	125.99	125.21	-7.79	7.79	327.41	15.09	5.86	13.90	65.74	4.36
8	116	124.99	125.99	9.99	9.99	298.96	14.46	8.61	13.24	75.73	5.24
9	138	126.29	124.99	-13.01	13.01	284.55	14.30	9.43	12.81	62.72	4.39
10	130	126.66	126.29	-3.71	3.71	257.47	13.24	2.85	11.82	59.01	4.46
11	147	128.70	126.66	-20.34	20.34	271.66	13.88	13.84	12.00	38.67	2.79
12	141	129.93	128.70	-12.30	12.30	261.64	13.75	8.73	11.73	26.37	1.92
13	144	131.33	129.93	-14.07	14.07	256.75	13.78	9.77	11.58	12.29	0.89
14	142	132.40	131.33	-10.67	10.67	246.54	13.55	7.51	11.29	1.63	0.12
15	165	135.66	132.40	-32.60	32.60	300.95	14.82	19.76	11.85	-30.97	-2.09
16	173	139.39	135.66	-37.34	37.34	369.28	16.23	21.58	12.46	-68.31	-4.21
17			139.39								
18			139.39								
19			139.39								
20			139.39								

Holt Model



Holts method gives both lines an upward slope. The forecast line also goes through the demand data in the center which makes it the best fit line for the dataset. That being said, the forecast is accurate which makes holts method a contender for the better of the two methods.

Period, t	Demand, D_t	Level, L_t	Trend, T_t	Forecast, F_t	Error, E_t	Absolute Error, A_t	Mean Square Error MSE_t	MAD_t	% Error	$MAPE_t$	BIAS	TS_t
0		100	3.82									
1	98	103	3.76	103.90	5.90	5.90	34.78	5.90	6.02	6.02	5.90	1.00
2	106	107	3.74	107.07	1.07	1.07	17.96	3.48	1.01	3.51	6.97	2.00
3	109	111	3.71	110.71	1.71	1.71	12.94	2.89	1.56	2.86	8.67	3.00
4	133	116	4.08	114.24	-18.76	18.76	97.67	-2.52	14.10	5.67	27.43	-10.88
5	130	121	4.28	120.20	-9.80	9.80	97.34	-3.98	7.54	6.05	37.23	-9.36
6	116	125	4.09	125.46	9.46	9.46	96.03	-1.74	8.15	6.40	46.69	-26.87
7	133	129	4.18	128.60	-4.40	4.40	85.08	-2.12	3.31	5.96	51.09	-24.13
8	116	131	3.83	133.22	17.22	17.22	111.51	0.30	14.84	7.07	68.31	227.90
9	138	136	3.89	135.33	-2.67	2.67	99.91	-0.03	1.93	6.50	70.98	-2356.40
10	130	139	3.70	139.48	9.48	9.48	98.91	0.92	7.30	6.58	80.46	87.33
11	147	143	3.79	142.23	-4.77	4.77	91.99	0.40	3.24	6.27	85.23	210.85
12	141	146	3.68	146.50	5.50	5.50	86.84	0.83	3.90	6.08	90.73	109.44
13	144	149	3.57	149.63	5.63	5.63	82.61	1.20	3.91	5.91	96.36	80.40
14	142	152	3.36	152.64	10.64	10.64	84.79	1.87	7.49	6.02	107.00	57.13
15	165	156	3.56	154.93	-10.07	10.07	85.90	1.08	6.10	6.03	117.07	108.71
16	173	161	3.83	159.50	-13.50	13.50	91.92	0.17	7.81	6.14	130.57	788.29
17				164.68								
18				168.50								
19				172.33								
20				176.16								

Which of the two methods do you prefer? Why?

Comparing the two methods of exponential smoothing and Holts model method. I would prefer the Holts model. The Holts model gives an accurate estimate of the best fit line. Also, if we were to follow with statistical regression and statistical analysis for both the methods, Holts' model will have better results. The simple smoothing method fails to represent the actual demand accurately. The Holts method kept a good correlation consistent which makes it a good method to use.

4. **Check your Work**

I have checked my work by going back and making sure the methods where computed courectly double checking the work when I finished the problem. I then looked back at me excel spreadsheet to make sure that there were no errors or any large numbers that didn't belong. Lastly, I went over the problems to make sure I addressed every question presented.

5. **Learn and Generalize**

I have gained a better understanding in regard to how tables with the excel sheets. However, I have issues with some questions such as the tracking signal column. There two methods have shown me that if you take more factors into account it will give you an accurate result as to only using the alpha smoothing.

5. ABC Corporation

1. **Define**

Consider monthly demand for the ABC corporation as shown in table 7-3. Forecast the monthly demand for year 6 using winters model. In each case, evaluate the bias, TS, MAD, MAPE, and MSE. Which forecasting method do you prefer? Why?

2. **Plan**

What information is available for solving the problem?

- Chapter 7
- Winter Model
- Lecture Notes

3. **Execute**

Monthly Demand for ABC Corporation					
Sales	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
January	2000	3000	2000	5000	5000
February	3000	4000	5000	4000	2000
March	3000	3000	5000	4000	3000
April	3000	5000	3000	2000	2000
May	4000	5000	4000	5000	7000
June	6000	8000	6000	7000	6000
July	7000	3000	7000	10000	8000
August	6000	8000	10000	14000	10000
September	10000	12000	15000	16000	20000
October	120000	12000	15000	16000	20000
November	14000	16000	18000	20000	22000
December	8000	10000	8000	12000	8000
Total	780000	89000	98000	115000	113000

Figure 7-3 from the text

Winter Model

Period t	Demand D_t	Deseasonalized Demand D_t	Seasonal Factor, S_t	Level, L_t	Trend, T_t	Forecast F_t	Error E_t	Absolute Error MSE_t	Mean Squared Error MSE_t	MAD_t	% Error	$MAPE_t$	TS_t
				5997.261	70.25								
1	2000	4688	0.42662116	5930	56.45	2,589	589	589	346,364	589	29	29	1.00
2	3000	3000	1	5687	(117.99)	5,986	2,986	2,986	4,631,302	1,787	100	64	2.00
3	3000	3791.666667	0.791208791	5392	(27.03)	5,569	2,569	2,569	5,288,161	2,048	86	72	3.00
4	3000	4625	0.648648649	5291	59.01	5,365	2,365	2,365	5,363,965	2,127	79	73	4.00
5	4000	5625	0.711111111	5377	153.11	5,350	1,350	1,350	4,655,487	1,972	34	65	5.00
6	6000	5750	1.043478261	5552	150.30	5,530	(470)	470	3,916,342	1,721	8	56	5.45
7	7000	6541.666667	1.070063694	5786	214.43	5,703	(1,297)	1,297	3,597,342	1,661	19	51	4.87
8	6000	6625	0.905660377	6063	201.32	6,001	1	1	3,147,674	1,453	0	44	5.57
9	10000	6666.666667	1.5	6305	185.36	6,265	(3,735)	3,735	4,348,255	1,707	37	43	2.55
10	12000	6750	1.777777778	6516	175.16	6,490	(5,510)	5,510	6,949,217	2,087	46	44	(0.55)
11	14000	6875	2.036363636	6710	170.14	6,691	(7,309)	7,309	11,173,521	2,562	52	44	(3.30)
12	8000	7000	1.142857143	6892	165.63	6,880	(1,120)	1,120	10,346,957	2,442	14	42	(3.92)
13	3000	6916.666667	0.43373494	7043	140.73	7,057	4,057	4,057	10,817,436	2,566	135	49	(2.15)
14	4000	6833.333333	0.585365854	7149	118.32	7,184	3,184	3,184	10,768,955	2,610	80	51	(0.90)
15	3000	7000	0.428571429	7241	123.16	7,267	4,267	4,267	11,265,058	2,721	142	57	0.71
16	5000	7083.333333	0.705882353	7336	119.18	7,364	2,364	2,364	10,910,213	2,698	47	57	1.59
17	5000	7166.666667	0.697674419	7426	115.59	7,455	2,455	2,455	10,622,945	2,684	49	56	2.51
18	8000	7333.333333	1.090909091	7521	120.70	7,542	(458)	458	10,044,451	2,560	6	53	2.46
19	3000	7375	0.406779661	7615	112.80	7,642	4,642	4,642	10,649,691	2,670	155	59	4.09
20	8000	7375	1.084745763	7692	101.52	7,728	(272)	272	10,120,914	2,550	3	56	4.18
21	12000	7500	1.6	7765	103.86	7,794	(4,206)	4,206	10,481,391	2,629	35	55	2.45
22	12000	7500	1.6	7832	93.48	7,868	(4,132)	4,132	10,780,875	2,697	34	54	0.86
23	16000	7375	2.169491525	7870	71.63	7,925	(8,075)	8,075	13,147,134	2,931	50	54	(1.96)
24	10000	7250	1.379310345	7873	51.97	7,942	(2,058)	2,058	12,775,867	2,895	21	53	(2.70)
25	2000	7333.333333	0.272727273	7865	55.10	7,924	5,924	5,924	13,668,807	3,016	296	62	(0.63)
26	5000	7583.333333	0.659340659	7887	74.59	7,920	2,920	2,920	13,471,126	3,012	58	62	0.34
27	5000	7791.666667	0.64171123	7944	87.97	7,961	2,961	2,961	13,296,994	3,010	59	62	1.33
28	3000	8041.666667	0.373056995	8033	104.17	8,032	5,032	5,032	13,726,547	3,082	168	66	2.93
29	4000	8250	0.484848485	8149	114.59	8,137	4,137	4,137	13,843,510	3,119	103	67	4.22
30	6000	8250	0.727272727	8262	103.13	8,263	2,263	2,263	13,552,809	3,090	38	66	4.99
31	7000	8291.666667	0.844221106	8358	96.98	8,365	1,365	1,365	13,175,733	3,035	20	65	5.53
32	10000	8375	1.194029851	8447	95.62	8,455	(1,545)	1,545	12,838,612	2,988	15	63	5.10
33	15000	8291.666667	1.809045226	8517	77.72	8,542	(6,458)	6,458	13,713,229	3,093	43	62	2.84
34	15000	8208.333333	1.827411168	8556	61.62	8,595	(6,405)	6,405	14,516,478	3,191	43	62	0.75
35	18000	8208.333333	2.192893401	8577	55.45	8,618	(9,382)	9,382	16,616,649	3,368	52	62	(2.08)
36	8000	8291.666667	0.964824121	8598	58.24	8,632	632	632	16,166,187	3,292	8	60	(1.93)
37	5000	8458.333333	0.591133005	8637	69.09	8,657	3,657	3,657	16,090,639	3,301	73	60	(0.82)
38	4000	8750	0.457142857	8710	91.34	8,706	4,706	4,706	16,249,973	3,338	118	62	0.60
39	4000	8958.333333	0.446511628	8817	103.04	8,802	4,802	4,802	16,424,479	3,376	120	63	2.01
40	2000	9041.666667	0.221198157	8932	101.07	8,920	6,920	6,920	17,211,148	3,465	346	71	3.96
41	5000	9166.666667	0.545454545	9047	103.46	9,034	4,034	4,034	17,188,182	3,478	81	71	5.10
42	7000	9416.666667	0.743362832	9177	118.12	9,150	2,150	2,150	16,889,032	3,447	31	70	5.77
43	10000	9583.333333	1.043478261	9324	122.97	9,295	(705)	705	16,507,820	3,383	7	68	5.67
44	14000	9500	1.473684211	9452	102.34	9,447	(4,553)	4,553	16,603,800	3,410	33	68	4.29
45	16000	9375	1.706666667	9537	79.61	9,555	(6,445)	6,445	17,158,028	3,477	40	67	2.36
46	16000	9333.333333	1.714285714	9588	67.48	9,616	(6,384)	6,384	17,670,964	3,540	40	66	0.51
47	20000	9416.666667	2.123893805	9632	69.07	9,655	(10,345)	10,345	19,571,818	3,685	52	66	(2.31)
48	12000	9458.333333	1.268722467	9676	66.33	9,701	(2,299)	2,299	19,274,225	3,656	19	65	(2.96)
49	5000	9333.333333	0.535714286	9702	47.19	9,743	4,743	4,743	19,339,914	3,678	95	66	(1.65)
50	2000	9083.333333	0.220183486	9682	17.47	9,749	7,749	7,749	20,154,036	3,760	387	72	0.44
51	3000	9083.333333	0.330275229	9638	15.73	9,700	6,700	6,700	20,639,016	3,817	223	75	2.19
52	2000	9416.666667	0.212389381	9630	47.49	9,654	7,654	7,654	21,368,699	3,891	383	81	4.12
53	7000	9666.666667	0.724137931	9677	67.74	9,678	2,678	2,678	21,100,799	3,868	38	80	4.83
54	6000	9583.333333	0.626086957	9728	52.63	9,744	3,744	3,744	20,969,673	3,866	62	80	5.80
55	8000				(910.97)	9,781	1,781	1,781	20,646,069	3,828	22	79	6.33
56	10000				(819.87)	-911	(10,911)	10,911	22,403,267	3,955	109	79	3.36
57	20000				(737.88)	-820	(20,820)	20,820	29,614,910	4,250	104	80	(1.77)
58	20000				(664.09)	-738	(20,738)	20,738	36,519,131	4,535	104	80	(6.23)
59	22000				(597.68)	-664	(22,664)	22,664	44,606,284	4,842	103	81	(10.52)
60	8000				(537.92)	-598	(8,598)	8,598	45,094,849	4,905	107	81	(12.13)
61					(484.12)	-538	(538)	538	44,360,332	4,833	#DIV/0!	#DIV/0!	(12.43)
62					(435.71)	-484	(484)	484	43,648,623	4,763	#DIV/0!	#DIV/0!	(12.71)
63					(392.14)	-436	(436)	436	42,958,801	4,694	#DIV/0!	#DIV/0!	(12.99)
64					(352.93)	-392	(392)	392	42,289,973	4,627	#DIV/0!	#DIV/0!	(13.26)
65					(317.63)	-353	(353)	353	41,641,274	4,561	#DIV/0!	#DIV/0!	(13.53)
66					(285.87)	-318	(318)	318	41,011,874	4,497	#DIV/0!	#DIV/0!	(13.79)
67					(257.28)	-286	(286)	286	40,400,977	4,434	#DIV/0!	#DIV/0!	(14.05)
68					(231.56)	-257	(257)	257	39,807,818	4,373	#DIV/0!	#DIV/0!	(14.31)
69					(208.40)	-232	(232)	232	39,231,670	4,313	#DIV/0!	#DIV/0!	(14.56)
70					(187.56)	-208	(208)	208	38,671,838	4,254	#DIV/0!	#DIV/0!	(14.81)
71					(168.80)	-188	(188)	188	38,127,660	4,197	#DIV/0!	#DIV/0!	(15.06)
72					(151.92)	-169	(169)	169	37,598,505	4,141	#DIV/0!	#DIV/0!	(15.30)

MAD : is the average of absolute deviation over all periods. Viewing the data the MAD value is high. With the high variation in demand, this dataset includes outliers

MAPE : is the average absolute percentage error of the demand. Looking the data from the Excel Worksheet. The MAPE value is low meaning the forecast made is accurate. The lower the percentage the better the accuracy. At period 22 the dataset seems to be high in the case where it also varies. However, the error percentage is low.

MSE : is the mean absolute percentage error is a measurement if the forecast error has a distribution that is symmetric about zero. The MSE penalize large errors much more significantly than small errors.

Bias: The bias is simply the average of the errors that were calculated in the Excel Worksheet above. Looking at the data, the bias for this set seems to be relatively high for this method. There are a few negative values bt the dataset isn't skewed to either side. This shoes that the forecast and demand do not vary due to lower error percentage, which is something we want.

Ts: The tracking signal is the ratio of the bias and the MAD. According to the dataset we have obtained, there seems to be values that are outside the range of -6 and 6 which shows the forecasting method may not be the best. It seems as though the results are something that are harder to avoid unless we do very precise corrections.

4. **Check your work**

   I checked my chart with the book. Then preceded to answer all the questions that were given. I noticed that the professor asked for Winders method. I doubled checked with the textbook with the formulas to make sure that I was doing it right.

5. **Learn and Generalize**

   I now have a better understanding on Winters method after performing the process. I notied that this method helps for long term projections.

6.Harley Davidson

1. **Define**

   Exercise 1 – Harley Davison has its engine assembly plant in Milwaukee and its motorcycle assembly plan is Pennsylvania. Engines are transported between the two plants using trucks, with each trip costing $1k. the motorcycle plant assembles and sells 300 motorcycles each day. Each engine cost $500, and Harley incurs a holding cost of 20 percent per year. How many Engines should Harley load onto each truck? What is the cycle inventory of engines at Harley?

   Exercise 2- As part of its initiative to implement just in time manufacturing at the motorcycle assembly plant in excersise1, Harley has reduced the number of engines loaded on each truck to 100. If each truck trip costs $1000, how does this decision impact inventory costs at Harley? What should the cost of each truck be if a load of 100 engines is to be optimal for Harley?

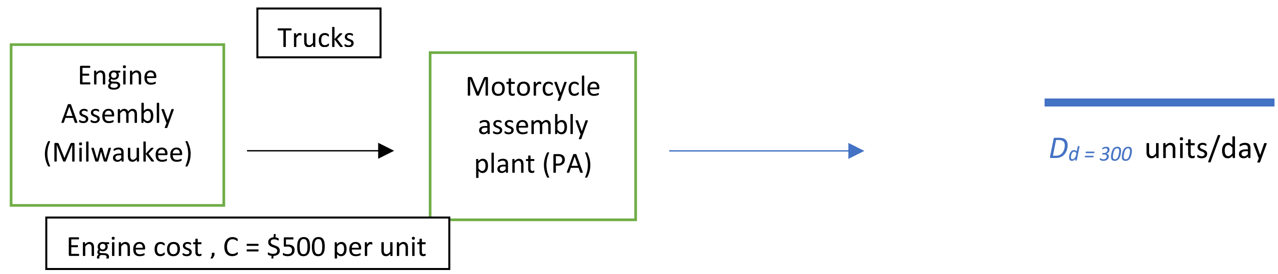
2. **Plan**

   What info do is available for solving the problem?

   - Lecture notes
   - Chapter 10

3. **Execute**

   Exercise 1:
   Truck = $1000
   Engine = $500
   Holding Cost = 20%/year
   300 Motorcycles per day



Problems Determine

Optimal lot size, Q^*_L to minimize total cost
Cycle inventory
Annual shipment frequency, n shipments/year
Replenishment cycle time, T
% holding cost = ,h =20% per dollar

Daily Demand = 300 units/day = D_d
Annual demand, D (D_d) (days/year)
= 300 units/day x 365 days/year
D = 109,500 units per year

Optimal lot size, $Q^*_L = \sqrt{2Ds/hC} = \sqrt{2} *109{,}500*1{,}000/.20*500$
$Q^*_L = \sqrt{219{,}000{,}000/100}$
= 1480 units/Shipment

Number of shipments = D/Q^*_L = 109,500/1480 = ~ **74 shipments**

Average or cycle inventory = $Q_L/2$ = 1480/2 = **740 engines/year**

<u>Exercise 2</u>
Optimal lot size $Q_L*100 = \sqrt{(219{,}000s / 100)}$
= 1,000,000 = 219,000s
S = 4.6

Average inventory holding cost $C_I = (Q_L/2)(hC)$
740*.2*500
= $74,000/year

Replenishment cycle time, T = 365/n shipments/year
= 365/60
= 6 Days/cycle

The results demons tact that the fixed cost for each order of engine is $4.57 if the optimal size of the truck is loading 100 engineers at a time.

Comparing both the results, you can see that the difference between the 2 is the shipping cost. Originally the shipping cost is 1,000 while the new cost is 4.6 dollar. The difference is 995 which is due to the different units that are loaded in a single truck. All the calculations are shown, the different is in their inventory cost.

4. **Check your work**

   I have checked my work by making sure I answered the questions completely. I then also made sure that I used the equations correctly and double-checked my simple math. Lastly, U looked at my notes and compared the results.

5. **Learn and Generalize**

   Working on this problem, I left with the idea of shipping costs, inventory cost, cycle time, and others. This Is a real situation on how a company would check if shipping costs is worth it.