N14C47 Supply Chain Planning and Management

Solutions Forecasting

Problem 1:

1.a)

$$(1) F_{April} = \frac{180 + 220 + 290}{3} = 230,$$
$$(2)\ F_{May} = \frac{220 + 290 + 310}{3} = 273.33,$$
$$(3)\ F_{June} = \frac{290 + 310 + 370}{3} = 323.33$$

1.b)

For $\alpha = 0.1$

$$F_{April} = 230$$
$$F_t = \alpha \times D_{t-1} + (1 - \alpha) \times F_{t-1}$$
$$(1)\ F_{May} = 0.1 \times 310 + 0.9 \times 230 = 238$$
$$(2)\ F_{June} = 0.1 \times 370 + 0.9 \times 238 = 251.2$$
$$(3)\ F_{July} = 0.1 \times 380 + 0.9 \times 251.2 = 264.08$$

For $\alpha = 0.8$

$$(1)\ F_{May} = 0.8 \times 310 + 0.2 \times 230 = 294$$
$$(2)\ F_{June} = 0.8 \times 370 + 0.2 \times 294 = 354.8$$
$$(3)\ F_{July} = 0.8 \times 380 + 0.2 \times 354.8 = 374.96$$

1.c)

$$\begin{cases} a = 42 \\ b = 145 \end{cases}$$
$$(1)\ F_{May} = 42 \times 5 + 145 = 355$$
$$(2)\ F_{June} = 42 \times 6 + 145 = 397$$
$$(3)\ F_{July} = 42 \times 7 + 145 = 439$$

1.d)

For exponential smoothing with $\alpha = 0.8$:

$$\frac{|294 - 370| + |354.8 - 380| + |374.96 - 376|}{3} = 34.08$$

For regression:

$$\frac{|355 - 370| + |397 - 380| + |439 - 376|}{3} = 31.66$$

Regression gave better results.

Problem 2:

2.a) (Regression Method)

Slope = 100, Intercept = 42 →

$$F_{Nov} = 11 \times 100 + 42 = 1142, F_{Dec} = 12 \times 100 + 42 = 1242$$

2.b) (Holt's Method One Step ahead)

$$S_{Sept} = 900, G_{Sept} = 100 \ (September\ is\ assumed\ to\ be\ period\ 0)$$

$$S_t = \alpha D_t + (1-\alpha)(S_{t-1} + G_{t-1})$$
$$G_t = \beta(S_t - S_{t-1}) + (1-\beta)G_{t-1}$$

$$S_{Oct} = 0.2 \times 1014 + 0.8 \times (900 + 100) = 1002.8$$
$$G_{Oct} = 0.1 \times (1002.8 - 900) + 0.9 \times 100 = 100.28$$
$$F_{Nov} = 1002.8 + 100.28 = 1103.08$$

$$S_{Nov} = 0.2 \times 1140 + 0.8 \times (1103.08) = 1110.464$$
$$G_{Nov} = 0.1 \times (1110.464 - 1002.8) + 0.9 \times 100.28 = 101.018$$
$$F_{Dec} = 1110.464 + 101.018 = 1211.482$$

2.c) (Holt's Method K-Steps ahead)

$$S_t = \alpha D_t + (1-\alpha)(S_{t-1} + G_{t-1})$$
$$G_t = \beta(S_t - S_{t-1}) + (1-\beta)G_{t-1}$$

$$S_{Dec} = 0.2 \times 1230 + 0.8 \times 1211.482 = 1215.186$$
$$G_{Dec} = 0.1 \times (1215.186 - 1110.464) + 0.9 \times 101.018 = 101.388$$
$$F_{Feb} = 1215.186 + 2 \times 101.388 = 1417.962$$

2.d) (Evaluating Errors)

Month	Actual Demand	Regression (2.a)	Holt's Method (2.b)
November	1140	1142	1103.08
December	1230	1242	1211.482

MAD for regression: $\frac{|1140-1142|+|1230-1242|}{2} = 7$

MAD for Holt's method: $\frac{|1103.08-1140|+|1211.48-1230|}{2} = 27.71$

MSE for regression: $\frac{(1140-1142)^2+(1230-1242)^2}{2} = 74$

MSE for Holt's method: $\frac{(1103.08-1140)^2+(1211.48-1230)^2}{2} = 853.04$

Problem 3:

3.a) The average of the data is 30.

Corresponding seasonal factors are as following:

$$Average = 30 \rightarrow \begin{cases} season\ 1: & 0.5, \quad 0.8, \quad 1.2, \quad 1 \\ season\ 2: & 0.7, \quad 0.9, \quad 1.7, \quad 1.2 \end{cases}$$
$$\rightarrow seasonal\ factors: 0.6, \quad 0.85, \quad 1.45, \quad 1.1$$

3.b) The deseasonalized data is calculated by dividing the data points over their corresponding seasonal factor.

Year	Season	Demand	Seasonal Factor	Deseasonalized
1	1	15	0.6	25
	2	24	0.85	28.24
	3	36	1.45	24.83
	4	30	1.1	27.27
2	1	21	0.6	35
	2	27	0.85	31.76
	3	51	1.45	35.17
	4	36	1.1	32.73

3.c)

Year	**Season**	**Demand**	**Un adjusted**	**demand/forecast**	**Seasonal Factor**	**Adjusted Regression**
1	**1**	**15**	**20**	0.75	0.70	14.06
	2	**24**	**23**	1.04	0.91	20.87
	3	**36**	**26**	1.38	1.36	35.45
	4	**30**	**29**	1.03	0.96	27.73
2	**5**	**21**	**32**	0.66	0.70	22.50
	6	**27**	**35**	0.77	0.91	31.76
	7	**51**	**38**	1.34	1.36	51.81
	8	**36**	**41**	0.88	0.96	39.21
3	**9**		**44**		0.70	30.94
	10		**47**		0.91	42.65
	11		**50**		1.36	68.17
	12		**53**		0.96	50.68

Following graph shows the performance of the adjusted forecast.