Answers

16.2.

a. An example of a short-term forecast would be a prediction made of the demand requirements for the next few weeks. This demand forecast could then be used in constructing the anticipated build schedule (i.e., master production schedule) for a manufacturing firm. The firm would use the production schedule to determine workforce levels, manage capacity at critical work centers, and ensure that needed parts and materials were available.

b. A medium term forecast, generally made for a period of time between 3 months to two years, is often used for staff planning decisions, purchasing and distribution decisions, and other issues related to capacity management decisions.

c. Long term forecasts, generally made for a forecast horizon of more than two years, serve to support capacity planning and facility expansion decisions. For example, an integrated circuit manufacturer forecasts the demand for dynamic random access memory chips several years into the future to determine whether the firm will have sufficient capacity at that time to meet the predicted level of demand. Due to the long lead time in constructing new fabrication facilities the firm uses the forecast to help determine whether demand will be sufficiently high to support the construction of a new plant.

16.25

a. As an example, the first moving averages is calculated as $\frac{2+12+23+20}{4}$ = 14.25.

Minitab output:

t	Yt	MA
1	2	*
2	12	14.25
3	23	18.25
4	20	23.25
5	18	29.50
6	32	34.75
7	48	39.00
8	41	44.00
9	35	51.75
10	52	57.25
11	79	*
12	63	*

b. The centered moving average is the average of each adjacent pair of moving averages. As an example, the moving average for time period 2 = $\frac{14.25+18.25}{2}$ = 16.25

Minitab output:

t	Yt	MA	Centered MA
1	2	*	*
2	12	14.25	*
3	23	18.25	16.250
4	20	23.25	20.750
5	18	29.50	26.375
6	32	34.75	32.125
7	48	39.00	36.875
8	41	44.00	41.500
9	35	51.75	47.875
10	52	57.25	54.500
11	79	*	*
12	63	*	*

c. To calculate the ratio-to-moving-averages, each time series value is divided by the corresponding centered moving average. As an example, the first ratio-to-moving-average is calculated as 23/16.25 = 1.41538. The ratio-to-moving-averages are

t	Yt	MA	Centered MA	Ratio
1	2	*	*	*
2	12	14.25	*	*
3	23	18.25	16.250	1.41538
4	20	23.25	20.750	0.96386
5	18	29.50	26.375	0.68246
6	32	34.75	32.125	0.99611
7	48	39.00	36.875	1.30169
8	41	44.00	41.500	0.98795
9	35	51.75	47.875	0.73107
10	52	57.25	54.500	0.95413
11	79	*	*	*
12	63	*	*	*

d. To calculate the seasonal indexes, the average of the ratio-to-moving-averages are calculated for each quarter. As an example, the seasonal index for the first quarter is calculated as $\frac{0.68246+0.73107}{2}$ = 0.70676; the second quarter = 0.97512; the third quarter = 1.35854; and the fourth quarter = 0.97590. The sum of the seasonal indexes = 4.01632. The indexes are adjusted by dividing each by the sum of the seasonal indexes and multiplying the result by 4 (for quarterly data). Thus, the first = [0.70676/4.01632]4 = 0.70389, the second 0.97116, the third 1.35302, and the fourth 0.97194.

e. We deseasonalize the data by dividing the actual data by the appropriate seasonal index. As example, the first observation is deseasonalized by 2/0.70389 = 2.84135.
Minitab output:

t	Yt	Deseasonalized
1	2	2.8414
2	12	12.3564
3	23	16.9990
4	20	20.5774
5	18	25.5722
6	32	32.9503
7	48	35.4762
8	41	42.1837
9	35	49.7237
10	52	53.5442
11	79	58.3879
12	63	64.8188

f. The trend line is produced using Minitab
Minitab output:

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Regression Analysis: Deseasonalized versus t

The regression equation is
Deseasonalized = - 0.607 + 5.42 t

Predictor     Coef  SE Coef      T      P
Constant   -0.6067   0.8505  -0.71  0.492
t           5.4194   0.1156  46.90  0.000

S = 1.38186   R-Sq = 99.5%   R-Sq(adj) = 99.5%

Analysis of Variance

Source          DF      SS      MS        F      P
Regression       1  4199.9  4199.9  2199.40  0.000
Residual Error  10    19.1     1.9
Total           11  4219.0

Predicted Values for New Observations

New
Obs     Fit  SE Fit       95% CI           95% PI
  1  69.845   0.850  (67.950, 71.740)  (66.230, 73.461)
  2  75.265   0.954  (73.139, 77.390)  (71.523, 79.006)
  3  80.684   1.060  (78.322, 83.046)  (76.803, 84.565)X
  4  86.103   1.168  (83.501, 88.706)  (82.072, 90.135)X
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The equation is $\hat{y}_t$ = -0.607 + 5.42t

g. The unadjusted forecasts are produced, as an example, by $\hat{y}_{13}$ = -0.607 + 5.42(13) = 69.845, $\hat{y}_{14}$ = 75.265, $\hat{y}_{15}$ = 80.684, and $\hat{y}_{16}$ = 86.103. To provide the seasonalized adjusted forecasts, the unadjusted forecasts are multiplied by the appropriate seasonal index. So $\hat{y}_{13}$ = 0.70389(69.845) = 49.1632, $\hat{y}_{14}$ = 0.97116(75.265) = 73.0944, $\hat{y}_{15}$ = 1.35302(80.684) = 109.1671, and $\hat{y}_{16}$ = 0.97194(86.103) = 83.6870.

16.34

Equation 16-16 is used for this exercise.

a.

Year	Quarter	Actual Guests	Forecast Guests	Forecast Error	Absolute Forecast Error
Year 1	Q1	242	250.00	-8.00	8.00
	Q2	252	249.20	2.80	2.80
	Q3	257	249.48	7.52	7.52
	Q4	267	250.23	16.77	16.77
Year 2	Q1	272	251.91	20.09	20.09
	Q2	267	253.92	13.08	13.08
	Q3	276	255.23	20.77	20.77
	Q4	281	257.30	23.70	23.70
Year 3	Q1		259.67		
				Sum	112.73

Alpha	0.1
MAD	14.091

b.

Year	Quarter	Actual Guests	Forecast Guest	Forecast Error	Absolute Forecast Error
1	Q1	242	250.00	-8.00	8.00
1	Q2	252	248.00	4.00	4.00
1	Q3	257	249.00	8.00	8.00
1	Q4	267	251.00	16.00	16.00
2	Q1	272	255.00	17.00	17.00
2	Q2	267	259.25	7.75	7.75
2	Q3	276	261.19	14.81	14.81
2	Q4	281	264.89	16.11	16.11
3	Q1		268.92		
				Sum	91.67

Alpha	0.25
MAD	11.459

c. MAD for part a was 14.091
MAD for part b was 11.459 so $\alpha = 0.25$ produced the smaller MAD