education equals

Topic: Time Series skills and Applications II

Time: 45 mins Marks: /45 marks

Calculator Assumed

Question One: [6, 4, 4, 2, 6: 22 marks]

The number of visitors to Western Australia's Adventure World Theme Park follows a quarterly seasonal pattern each year. The following data for 2014 and 2015 is in thousands of people per quarter.

Quarter	2014	2015
1	636	671
2	320	311
3	130	141
4	506	504
Total	**1592**	**1627**

An Adventure World's company analyst predicts that there will be 1 680 000 visitors to Adventure world in 2016.

a) Complete the following table. (Give your answer to 2 decimal places).

Quarter		Attendance	Yearly average	Attendance as % of average
2014	1	636		
	2	320		
	3	130		
	4	506		
2015	1	671		
	2	311		
	3	141		
	4	504		

b) Calculate the seasonal indices for each quarter and explain what each figures means. (Give your answer to 2 decimal places).

Q1	Q2	Q3	Q4

c) Calculate the deseasonalised attendance figures for 2014 and 2015. (Give your answer to 2 decimal places).

	Deseasonalised data
1	
2	
3	
4	
1	
2	
3	
4	

d) State the rule for the least squares regression line for the deseasonalised data. (Give your answer to 2 decimal places).

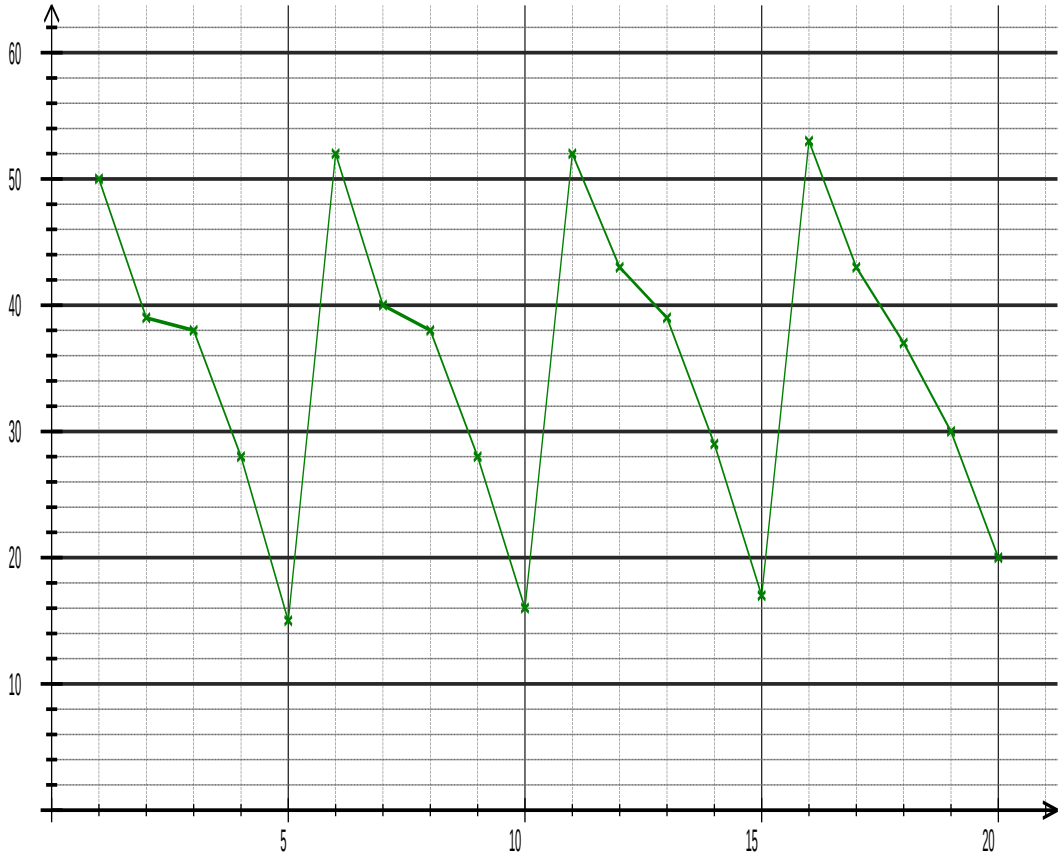
e) Predict the actual attendance figures for 2016, rounding your answer to the nearest 1000 and compare this prediction to the prediction made by the company analyst.

Question Two: [4, 2, 2, 6, 4, 2, 3: 23 marks]

Consider the following data.

Day	Actual figures	5 point moving average	Average per cycle
1	50		
2	39		
3	38	34	34
4	28	34.4	
5	15	34.6	
6	52	34.6	
7	40	34.6	
8	38	34.8	34.8
9	28	34.8	
10	16	35.4	
11	52	35.6	
12	43	35.8	
13	39	36	36
14	29	36.2	
15	17	36.2	
16	53	35.8	
17	43	36	
18	37	36.6	36.6
19	30		
20	20		

a) Label the axis and add the 5 point moving average figures to the graph below of the actual data figures.



b) State the rule for the least squares regression line for the moving average data and the correlation coefficient.

To predict the actual figures using the moving average, the seasonal component needs to be added into the prediction. The seasonal component for day 21 is 17.

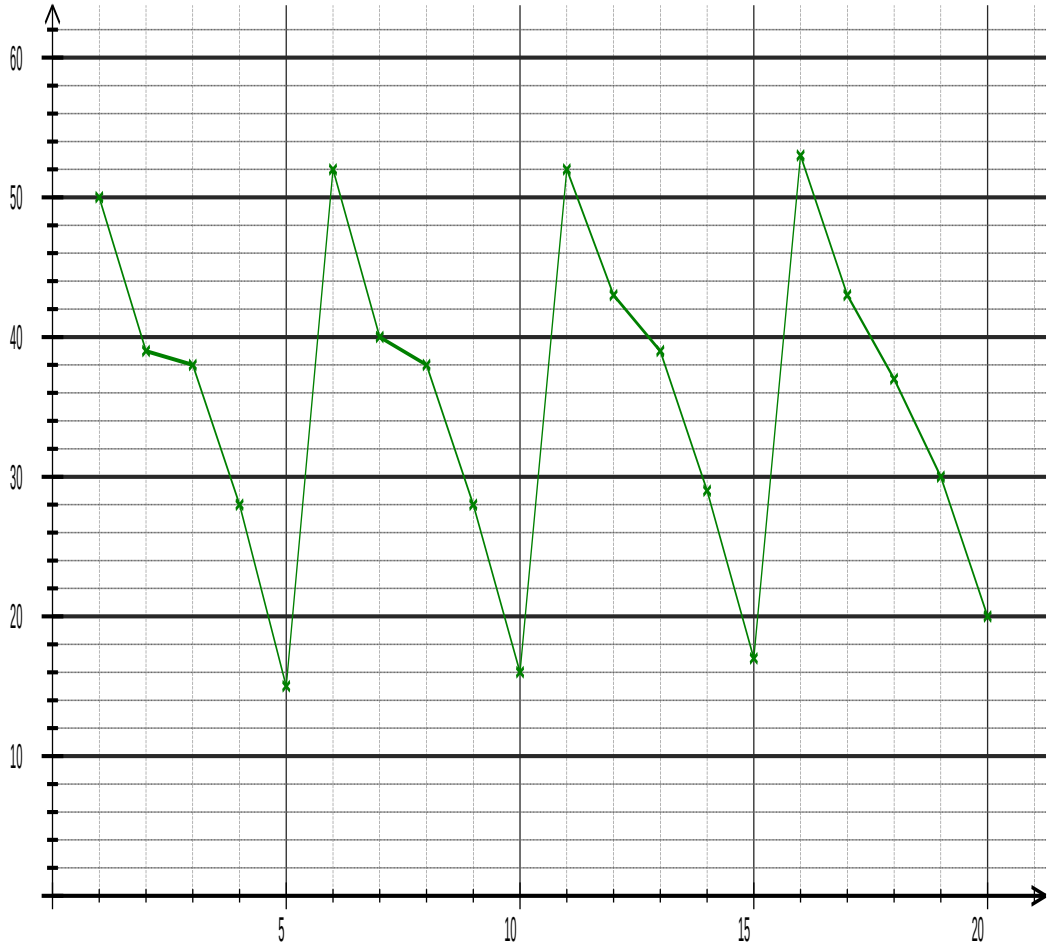
c) Use the least squares regression line to predict the moving average figure for the 21st day and add in the seasonal component to predict the actual figure.

d) Complete the following table to calculate the % of average figures and deseasonalised data.

Day	Actual figures	5 point moving average	Average per cycle	% of average	Deseasonalised data
1	50			147.06	
2	39			114.71	
3	38	34	34	111.76	
4	28	34.4		82.35	
5	15	34.6		44.12	
6	52	34.6			35.51
7	40	34.6			34.29
8	38	34.8	34.8		35.32
9	28	34.8			34.43
10	16	35.4			33.34
11	52	35.6		144.44	35.51
12	43	35.8		119.44	36.86
13	39	36	36	108.33	36.25
14	29	36.2		80.56	35.66
15	17	36.2		47.22	35.42
16	53	35.8		144.81	36.19
17	43	36		117.49	36.86
18	37	36.6	36.6	101.10	34.39
19	30			81.97	36.89
20	20			54.64	41.67

Seasonal Index day 1	**Seasonal Index day 2**	**Seasonal Index day 3**	**Seasonal Index day 4**	**Seasonal Index day 5**

e) Label the axis and add the deseasonalised data figures to the graph containing the actual figures below.



f) State the rule for the least squares regression line for the deseasonalised data and the correlation coefficient.

g) Use the deseasonalised data and the seasonal index to predict the figures for the 21st day. Compare this to the prediction made in part c).

Topic: Time Series Skills and Applications II
SOLUTIONS

Time: 45 mins Marks: /45 marks

Calculator Assumed

Question One: [6, 4, 4, 2, 6: 22 marks]

The number of visitors to Western Australia's Adventure World Theme Park follows a quarterly seasonal pattern each year. The following data for 2014 and 2015 is in thousands of people per quarter.

Quarter	2014	2015
1	636	671
2	320	311
3	130	141
4	506	504
Total	**1592**	**1627**

An Adventure World's company analyst predicts that there will be 1 680 000 visitors to Adventure world in 2016.

a) Complete the following table (give your answer to 2 decimal places).

	Quarter	Attendance	Yearly average	Attendance as % of average
2014	1	636		159.80
	2	320	398	80.40 ✓
	3	130 ✓		32.66 ✓
	4	506		127.14
2015	1	671		164.97
	2	311	406.75	76.46 ✓
	3	141 ✓		34.67 ✓
	4	504		123.91

b) Calculate the seasonal indices for each quarter and explain what each figures means. (give your answer to 2 decimal places)

Q1	Q2	Q3	Q4
162.39	78.43	33.67	125.53

First quarter attendance tends to be about 62.39% above the average, second quarter attendance tends to be about 21.57% below the average, third quarter attendance tends to be about 66.33% below the average and fourth quarter attendance tends to be 25.53% above the average.

c) Calculate the deseasonalised attendance figures for 2014 and 2015.

(give your answer to 2 decimal places).

	Deseasonalised data
1	391.65
2	408.01
3	386.10
4	403.09
1	413.20
2	396.53
3	418.77
4	401.50

d) State the rule for the least squares regression line for the deseasonalised data.

(give your answer to 2 decimal places).

$$\hat{y} = 1.95x + 393.56$$

e) Predict the actual attendance figures for 2016, rounding your answer to the nearest 1000 and compare this prediction to the prediction made by the company analyst.

	Predictions for deseasonalised data for 2016	Multiply by seasonal index to get actual predictions →	Attendance Predictions
9	411.15		667.67
10	413.10		323.99
11	415.06		139.75
12	417.01		523.47

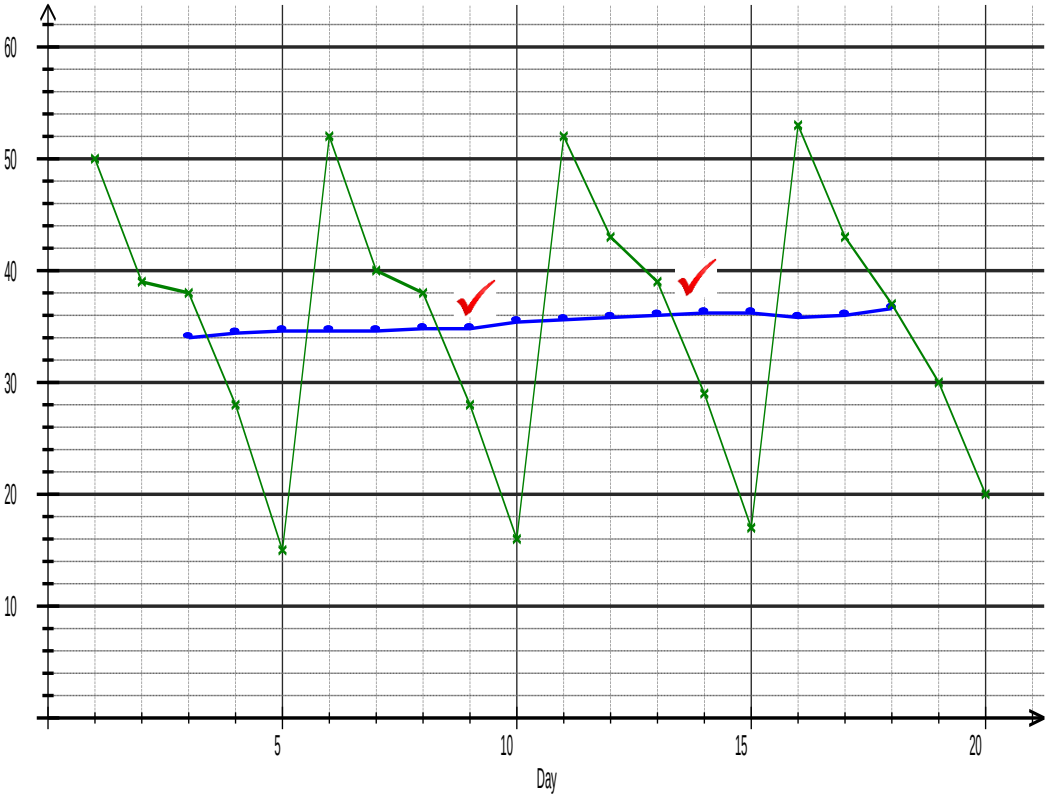
Total number of attendees in 2016 is predicated to be approximately 1 655 000 ∴ the analyst was a little bit too generous with the prediction.

Question Two: [4, 2, 2, 6, 4, 2, 3: 23 marks]

Consider the following data.

Day	Actual figures	5 point moving average	Average per cycle
1	50		
2	39		
3	38	34	34
4	28	34.4	
5	15	34.6	
6	52	34.6	
7	40	34.6	
8	38	34.8	34.8
9	28	34.8	
10	16	35.4	
11	52	35.6	
12	43	35.8	
13	39	36	36
14	29	36.2	
15	17	36.2	
16	53	35.8	
17	43	36	
18	37	36.6	36.6
19	30		
20	20		

a) Label the axis and add the 5 point moving average figures to the graph below of the actual data figures.



b) State the rule for the least squares regression line for the moving average data and the correlation coefficient.

Correlation Coefficient $r = 0.9566$

$\hat{y} = 0.1585x + 33.6729$

To predict the actual figures using the moving average, the seasonal component needs to be added into the prediction. The seasonal component for day 21 is 17.

c) Use the least squares regression line to predict the moving average figure for the 21st day and add in the seasonal component to predict the actual figure.

$x = 21, \quad \hat{y} = 37.0021$

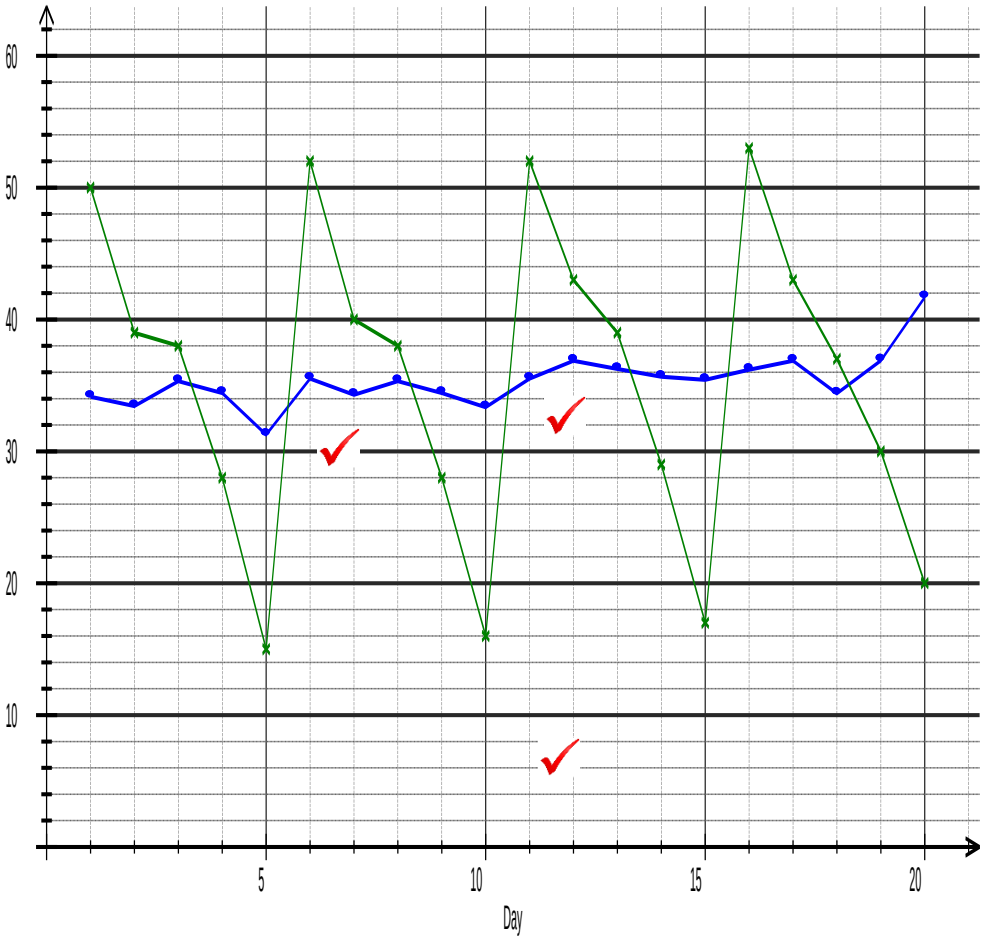
$37.0021 + 17 = 54.00 \ (2dp)$

d) Complete the following table to calculate the % of average figures and deseasonalised data.

Day	Actual figures	5 point moving average	Average per cycle	% of average	Deseasonalised data
1	50			147.0588	34.14
2	39			114.7059	33.43
3	38	34	34	111.7647	35.32
4	28	34.4		82.35294	34.43
5	15	34.6		44.11765	31.26
6	52	34.6		149.4253	35.51
7	40	34.6		114.9425	34.29
8	38	34.8	34.8	109.1954	35.32
9	28	34.8		80.45977	34.43
10	16	35.4		45.97701	33.34
11	52	35.6		144.4444	35.51
12	43	35.8		119.4444	36.86
13	39	36	36	108.3333	36.25
14	29	36.2		80.55556	35.66
15	17	36.2		47.22222	35.42
16	53	35.8		144.8087	36.19
17	43	36		117.4863	36.86
18	37	36.6	36.6	101.0929	34.39
19	30			81.96721	36.89
20	20			54.64481	41.67

Seasonal Index day 1	Seasonal Index day 2	Seasonal Index day 3	Seasonal Index day 4	Seasonal Index day 5
146.43	116.64	107.60	81.33	47.99

e) Label the axis and add the deseasonalised data figures to the graph containing the actual figures below.



f) State the rule for the least squares regression line for the deseasonalised data and the correlation coefficient.

$r = 0.6504$

$\hat{y} = 0.2230x + 33.0165$

g) Use the deseasonalised data and the seasonal index to predict the figures for the 21st day. Compare this to the prediction made in part c).

$x = 21\ \hat{y} = 37.7005 \quad 37.7005 \times 1.4643 = 55.20\ (2dp)$

The correlation coefficient is higher for the moving average data than for the deseasonalised data. Both predictions are very very similar.