



Topic: Time Series Skills and Applications

Time: 45 mins

Marks: /45 marks

Calculator Assumed

Question One: [3, 2, 2, 2, 2, 2: 13 marks]

Use the information in the partially completed table below to calculate the values of **A, B, C, D, E** and **F**.

Year/Quarter	Company Earnings (\$ 000's)	4 Point Centred Moving Average	Average for the Year	Company Earnings as a percentage of Yearly average
2012 – 1	38		B	
2012 – 2	45			C
2012 – 3	20	A		
2012 – 4	78	44.25		
2013 – 1		43.75	43	80%
2013 – 2	43			100%
2013 – 3	18			41.86%
2013 – 4	D	41.625		176.74%
2014 – 1	E		40.25	
2014 – 2	40	40.375		
2014 – 3		40.125		
2014 – 4		39.75		
2015 – 1	30	39.625	38.5	
2015 – 2	38	39.125		
2015 – 3	16			
2015 – 4	F			

Working space for question one.

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Question Two: [2, 2, 3, 3, 4, 2, 3, 3: 22 marks]

A street market has recently opened. It is open 3 days a week. Attendance is recorded and tracked for the first three weeks of the market opening.

Week/Day	Attendance (000's)	Weekly Mean	Attendance Percentage of Mean
Week 1 / 1	12	8.3	144%
Week 1 / 2	8		96%
Week 1 / 3	5		60%
Week 2 / 1	9	7.6	117.39%
Week 2 / 2	8		104.35%
Week 2 / 3	6		78.26%
Week 3 / 1	9	8.3	108%
Week 3 / 2	9		108%
Week 3 / 3	7		84%

The seasonal index for Day 2's is 102.78%. The seasonal index for Day 3's is 74.09%.

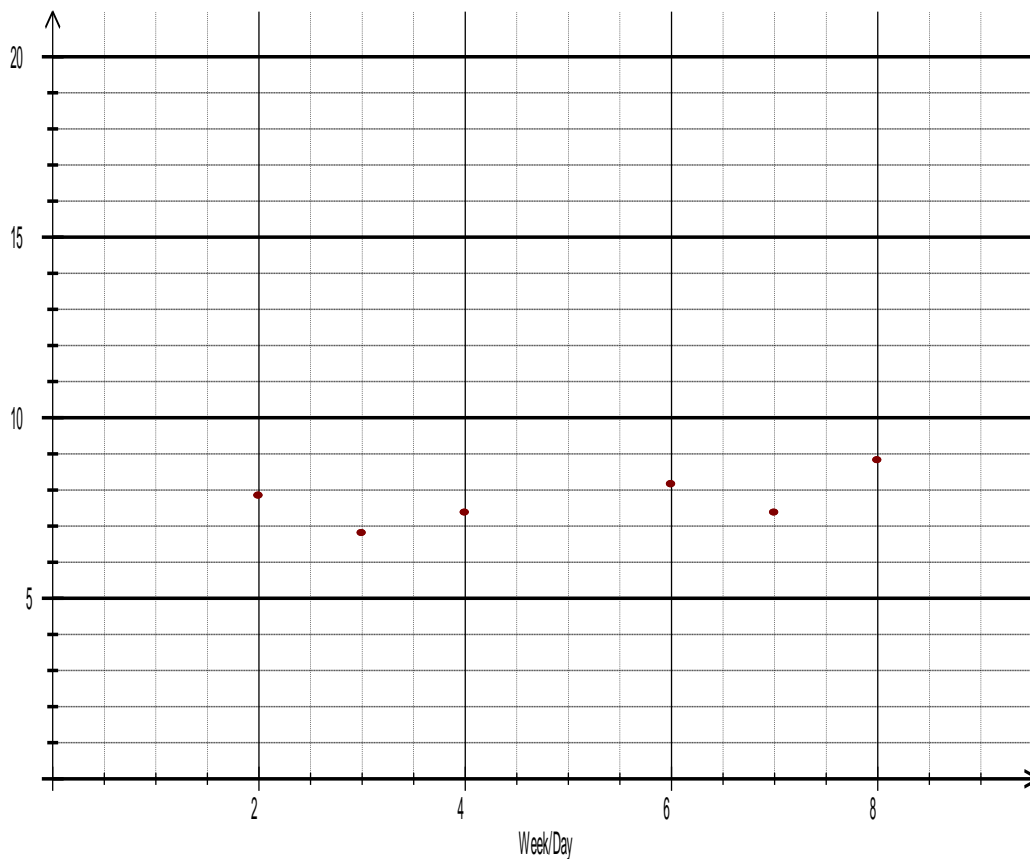
- a) Explain what these figures mean.
- b) Calculate the seasonal index for Day 1's.

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c) Complete the following table of the deseasonalised data for attendance at the street market.

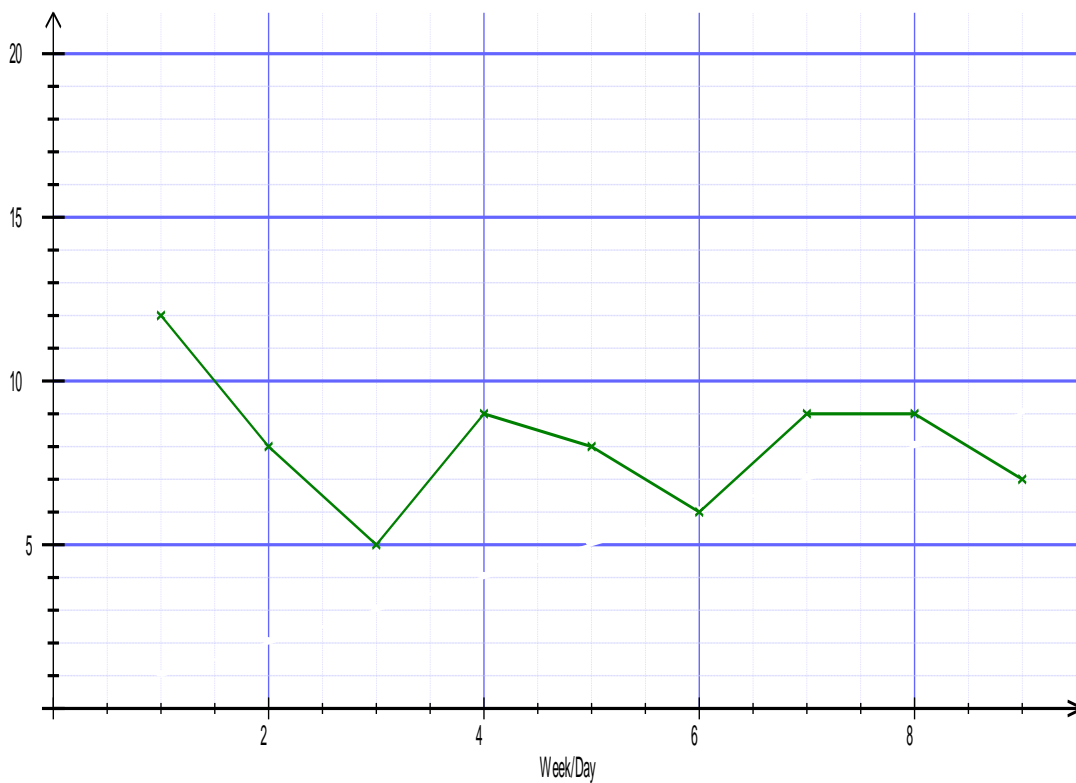
Week/Day	Deseasonalised Attendance (000's)
1 / 1	
1 / 2	7.78
1 / 3	6.75
2 / 1	7.31
2 / 2	
2 / 3	8.10
3 / 1	7.31
3 / 2	8.76
3 / 3	

d) Complete the following graph for the deseasonalised data.



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- e) State the rule for the least squares regression line for the deseasonalised data and add this line to the scatterplot of the deseasonalised attendance.
- f) Compare the scatterplot for the deseasonalised data to that of the actual data shown below and comment on the effect of deseasonalising the data.



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- g) Calculate the deseasonalised attendance figure for each day in the fourth week.
- f) Using deseasonalised attendance prediction, estimate the actual attendance for the fourth week.

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Question Three: [2, 2, 4: 8 marks]

The following table shows the seasonal indices for the weekly sales figures for a particular company.

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Seasonal Index	98%	80%	79%		102%	141%	70%

- a) Calculate the seasonal index for Thursday.

The actual sales figure for Friday is \$25 300.

- b) Calculate the deseasonalised sale figure for Friday.

The least squares regression line for predicting the deseasonalised sale figure for this week of sales is given by *deseasonalised sales figure* = $20.2 + 0.89 \times \text{day number}$, where day 1 is Monday, day 2 is Tuesday etc and sales are in thousands of dollars.

- c) Calculate the actual sales figure for Sunday.

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Question Four [3 marks]

The following table shows the seasonal indices for the weekday sales figures for a particular company.

Day	Monday	Tuesday	Wednesday	Thursday	Friday
Seasonal Index	70%		48%		110%

Tuesday's seasonal index figure is 0.7 of Thursday's.

Calculate the seasonal index for Tuesday and Thursday.



Topic: SOLUTIONS

Time: 45 mins

Marks: /45 marks

Calculator Assumed

Question One: [3, 2, 2, 2, 2, 2: 13 marks]

Year/Quarter	Company Earnings (\$ 000's)	4 Point Centred Moving Average	Average for the Year	Company Earnings as a percentage of Yearly average
2012 – 1	38		✓ ✓ B 45.25	
2012 – 2	45			C 99.45%
2012 – 3	20	A 44.8 ✓	43	✓ ✓
2012 – 4	78	44.25		
2013 – 1	34.4 ✓	43.75		80%
2013 – 2	43			100%
2013 – 3	18		41.86%	
2013 – 4	✓ D 76	41.625	40.25	176.74%
2014 – 1	✓ E 31			
2014 – 2	40	40.375		
2014 – 3		40.125		
2014 – 4		39.75		
2015 – 1	30	39.625	38.5	
2015 – 2	38	39.125		
2015 – 3	16			
2015 – 4	70 F ✓ ✓			

Question Two: [2, 2, 3, 3, 4, 2, 3, 3: 22 marks]

A street market has recently opened. It is open 3 days a week. Attendance is recorded and tracked for the first three weeks of the market opening.

Week/Day	Attendance (000's)	Weekly Mean	Attendance Percentage of Mean
Week 1 / 1	12	8.3	144%
Week 1 / 2	8		96%
Week 1 / 3	5		60%
2 / 1	9	7.6	117.39%
2 / 2	8		104.35%
2 / 3	6		78.26%
3 / 1	9	8.3	108%
3 / 2	9		108%
3 / 3	7		84%

The seasonal index for Day 2's is 102.78%. The seasonal index for Day 3's is 74.09%.

- a) Explain what these figures mean. ✓

For this street market the attendance on day 2's is 2.78% above the average and the day 3's tend to see their attendance dropped by 25.91% of the average. ✓

- b) Calculate the seasonal index for Day 1's.

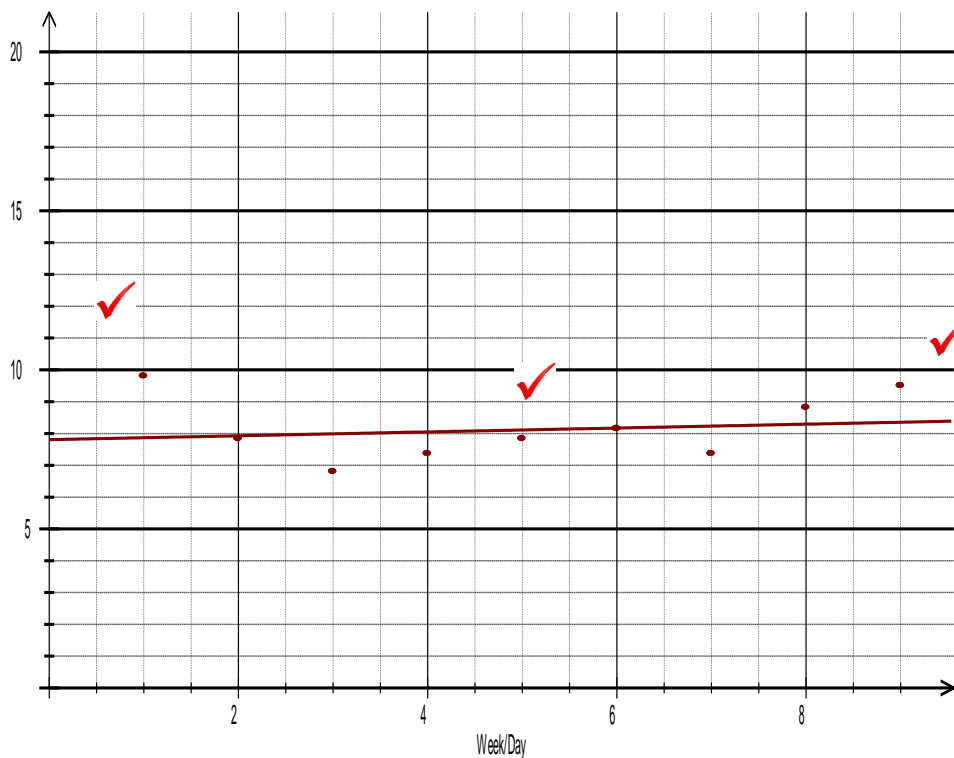
$$\frac{144 + 117.39 + 108}{3} = 123.13\% \quad \checkmark$$

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c) Complete the following table of the deseasonalised data for attendance at the street market.

Week/Day	Deseasonalised Attendance (000's)
1 / 1	9.75 ✓
1 / 2	7.78
1 / 3	6.75
2 / 1	7.31
2 / 2	7.78 ✓
2 / 3	8.10
3 / 1	7.31
3 / 2	8.76
3 / 3	9.45 ✓

d) Complete the following graph for the deseasonalised data.



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- e) State the rule for the least squares regression line for the deseasonalised data and add this line to the scatterplot of the deseasonalised attendance.

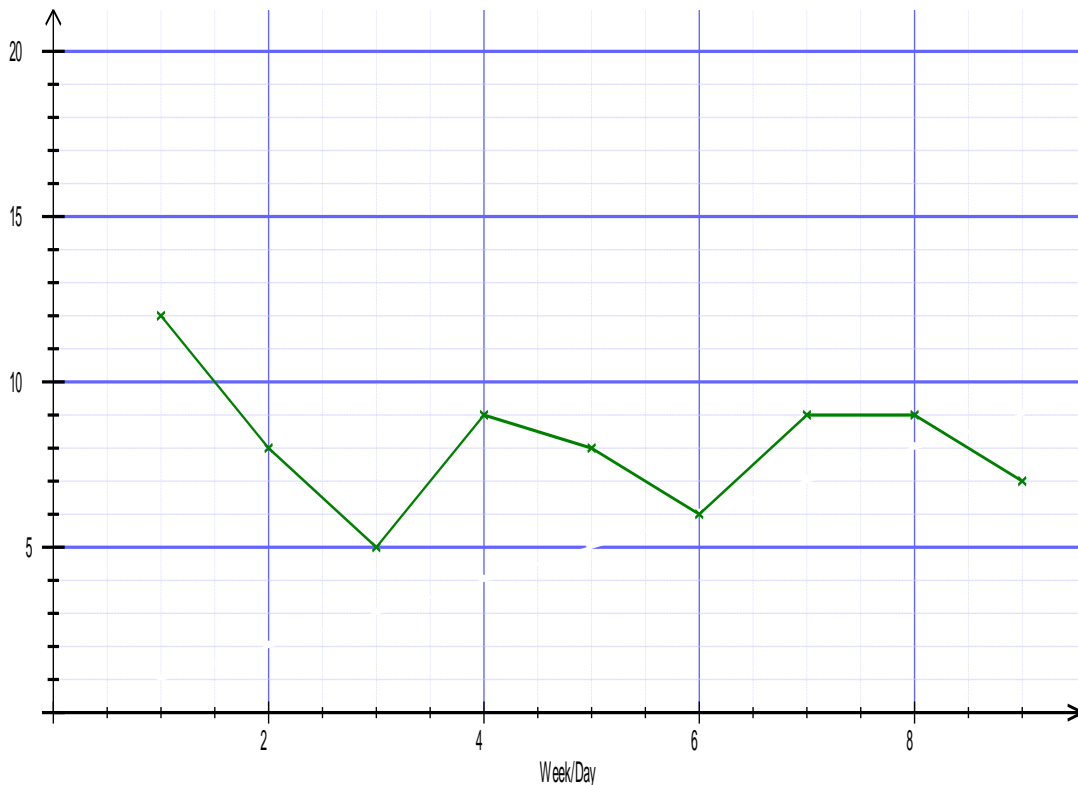
$$\hat{A} = 0.0608d + 7.8058$$



Line ✓ ✓

- f) Compare the scatterplot for the deseasonalised data to that of the actual data shown below and comment on the effect of deseasonalising the data.

Deseasonalising the data smooths out the peaks and bumps and allows us to see certain key features of this data such as the fact that day 1 week 1 appears to be high even once deseasonalised. Perhaps this was because it was opening night of the street market and they had a special event for the opening.



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g) Calculate the deseasonalised attendance figure for each day in the fourth week.

Week/Day		Deseasonalised Attendance (000's)
4/1	✓	8.4138
4/2	✓	8.4746
4/3	✓	8.5354

f) Using deseasonalised attendance prediction, estimate the actual attendance for the fourth week.

$$8.4138 \times 1.2313 = 10.34$$



$$8.4746 \times 1.0278 = 8.71$$



$$8.5354 \times 0.7409 = 6.32$$

Total estimated attendance for the fourth week is estimated to be approximately:

25 370 people



Question Three: [2, 2, 3: 7 marks]

The following table shows the seasonal indices for the weekly sales figures for a particular company.

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Seasonal Index	98%	80%	79%		102%	141%	70%

- a) Calculate the seasonal index for Thursday.

$$7 - (0.98 + 0.8 + 0.79 + 1.02 + 1.41 + 0.7) = 1.3$$



The actual sales figure for Friday is \$25 300.

- b) Calculate the deseasonalised sale figure for Friday.

$$\frac{25300}{1.02} = \$24\,803.92$$



The least squares regression line for predicting the deseasonalised sale figure for this week of sales is given by *deseasonalised sales figure* = $20.2 + 0.89 \times \text{day number}$, where day 1 is Monday, day 2 is Tuesday etc and sales are in thousands of dollars.

- c) Calculate the actual sales figure for Sunday.

$$D = 20.2 + 0.89 \times 7 = 26.43$$

$$A = 26.43 \times 0.7$$

$$= 18.501$$

$$= \$18\,501$$



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Question Four [3 marks]

The following table shows the seasonal indices for the weekday sales figures for a particular company.

Day	Monday	Tuesday	Wednesday	Thursday	Friday
Seasonal Index	70%		48%		110%

Tuesday's figure is 0.7 of Thursday's.

Calculate the seasonal index for Tuesday and Thursday.

$$0.7 + 0.7x + 0.48 + x + 1.1 = 5 \quad \checkmark$$

$$1.7x = 2.72$$

$$x = 1.6 \quad \checkmark$$

\therefore Thursday's figure is 160%, Tuesday is 112% \checkmark

Day	Monday	Tuesday	Wednesday	Thursday	Friday
Seasonal Index	0.7	1.12	0.48	1.60	1.1