

Full Name: SOLUTIONS



**MATHEMATICS**  
**Applications Units 3 & 4**

**Test 4 – Time Series**  
**Chapter 6**

**Semester 2 2018**

**Section One – Calculator Free**

**Time allowed for this section**

Working time for this section: 20 minutes  
Marks available: 20 marks

**Material required/recommended for this section**

**To be provided by the supervisor**

This Question/Answer booklet  
Formula sheet

**To be provided by the candidate**

Standard items: pens, pencils, pencil sharpener, eraser, correction fluid, ruler, highlighters

Special items: Nil

**Important note to candidates**

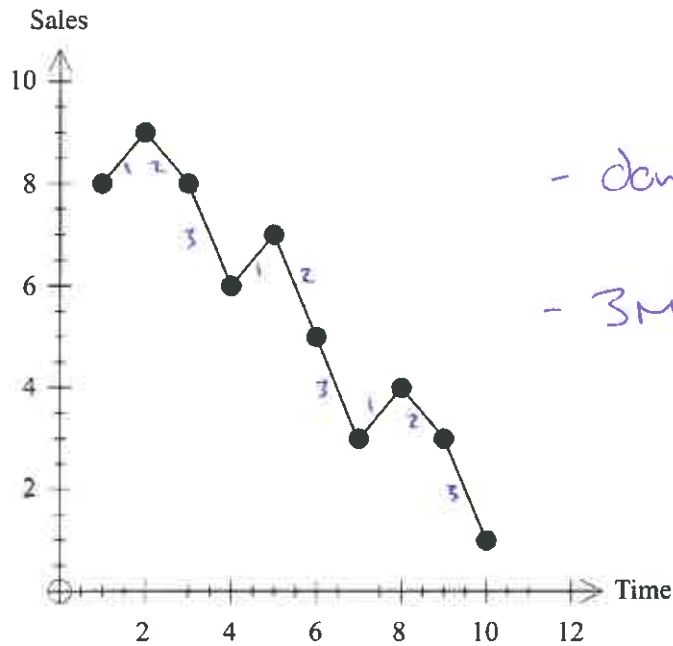
No other items may be used in this section of the examination. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

1. (4 marks)

Describe the **overall trend** suggested by each of the following time series and the appropriate **moving average** that you would fit to the data.

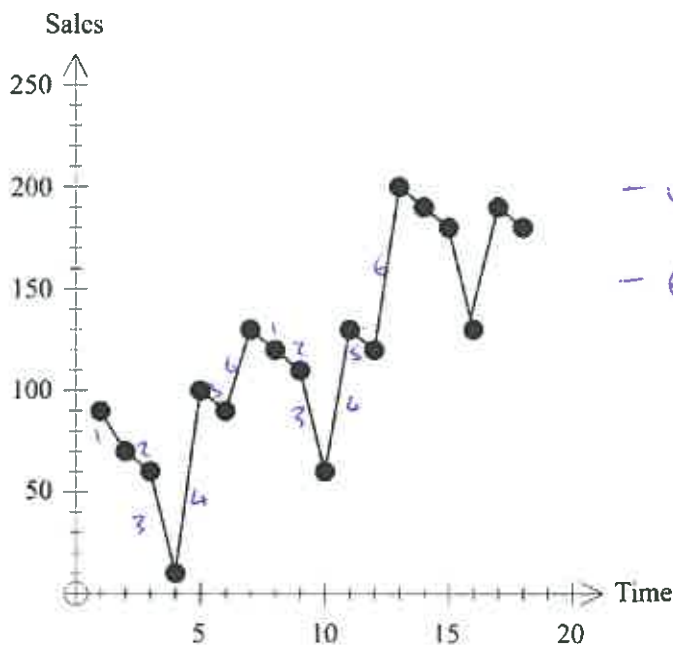
a)

[2]



b)

[2]



/ 4

2. (14 marks)

A shops sales figures over a four-day cycle are shown below:

Day	Sales (\$,000)	4CMA
Monday	2	
Tuesday	3	
Thursday	6	3.5
Friday	3	3.625
Monday	2	3.875
Tuesday	4	A
Thursday	7	4.125
Friday	3	4.375
Monday	B	4.625
Tuesday	5	5
Thursday	8	
Friday	5	

a) What is the purpose of creating moving averages? [1]

To smooth a time series in order to forecast/predict

b) Explain why there are blank fields in the 4CMA column. [1]

To centre, two values either side of the centre value are needed so the first two and last two spots will be blank.

c) There are two methods for creating a centred moving average. Explain each method for creating a 4CMA. [4]

Create Moving Averages then average them.

- Use 4 points and record each average. These will not line up.
- Average the pairs of moving averages to create centred MA's.

✓  
1/2

Create CMA's directly.

- use 5 points, half of first and last, then divide by 4.

$$\frac{\frac{1}{2}A + B + C + D + \frac{1}{2}E}{4}$$

4

✓  
1/2

6

d) Calculate values A and B from the table showing your calculations.

[4]

$$A = \frac{\frac{1}{2} \times 3 + 2 + 4 + 7 + \frac{1}{2} \times 3}{4} \checkmark$$

$$= 4 \checkmark$$

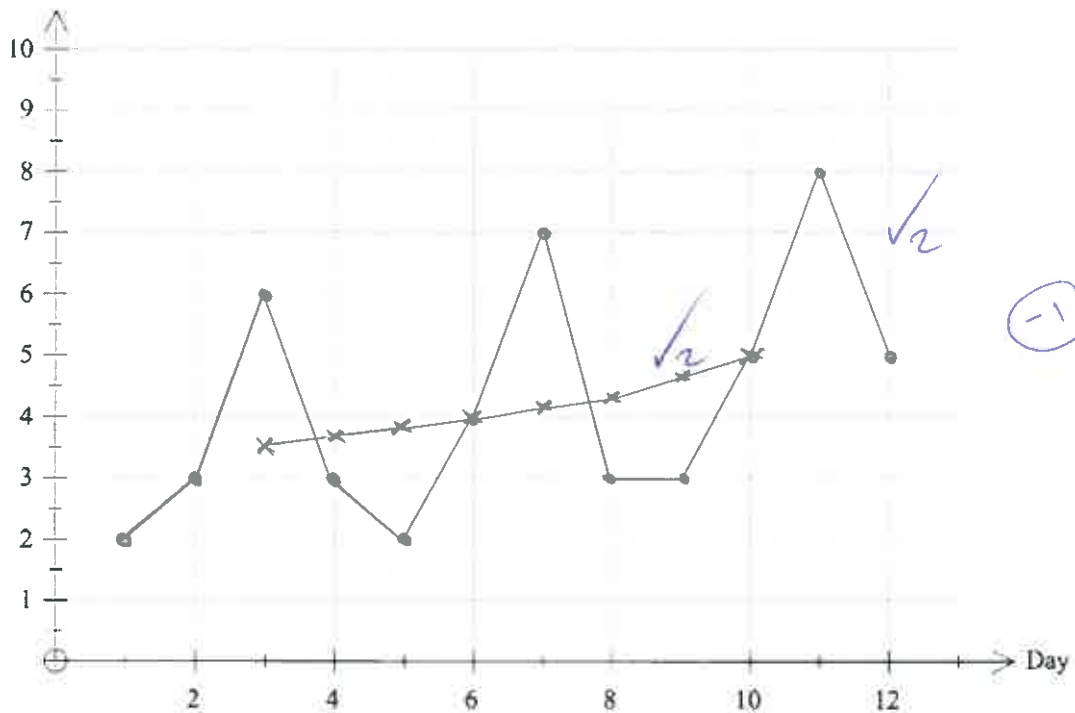
$$5 = \frac{\frac{1}{2} \times 3 + B + 5 + 8 + \frac{1}{2} \times 5}{4} \checkmark$$

$$B = 3 \checkmark$$

e) Draw on the axes below, the original sales and the moving averages, labelling points A and B.

[4]

Sales (\$,000)



① for one error in each.

18

3. (2 marks)

Seasonal Indices for a time series are:

Q1	Q2	Q3	Q4
127%	71%	114%	88%
1.27	0.71	1.14	0.88



Determine the seasonal index values for Q4.

$$\begin{array}{r} 127 \\ 71 \\ 114 \\ \hline 312 \end{array}$$

$$400 - 312 = 88$$

End of Section One

Full Name: SOLUTIONS



## **MATHEMATICS**

### **Applications Units 3 & 4**

#### **Test 4 – Time Series**

#### **Chapter 6**

**Semester 2 2018**

#### **Section Two – Calculator Assumed**

##### **Time allowed for this section**

Working time for this section: 25 minutes  
Marks available: 25 marks

##### **Material required/recommended for this section**

###### **To be provided by the supervisor**

This Question/Answer booklet  
Formula sheet

###### **To be provided by the candidate**

Standard items: pens, pencils, pencil sharpener, eraser, correction fluid, ruler, highlighters

Special items: Nil

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1. (2 marks)

Quarterly sales figures for wood heaters were 1250. The seasonal index for the quarter was 0.872.

a) Explain the meaning of the seasonal index.

The seasonal index is a measure of how a season sits compared to the mean value (100% or 1). A value less than one results in lesser values than that season. A value more than one results in higher values than that season. ✓

b) Calculate the deseasonalised value.

$$\frac{1250}{0.872} = \underline{1433.5} \quad \checkmark$$

2. (5 marks)

Sales for icecream for 2012-2014 per quarter are shown below.

	Q1	Q2	Q3	Q4	Average
2012	140	36	61	170	101.75
2013	155	45	68	185	113.25
2014	172	51	75	201	124.75
Seasonal Index	1.3744 $\frac{1}{2}$	0.3867	0.6004 $\frac{1}{2}$	1.6385 $\frac{1}{2}$	1 or 100 $\frac{1}{2}$

a) Calculate the missing entries in the table above.

[3]

b) What does the Seasonal Index for Q1 and Q3 indicate about the sales of icecream?

[2]

Sales in Q1 are above the mean ✓  
Sales in Q3 are below the mean ✓

7

3. (12 marks)

A table of export data from Australia is given below.

Time Period (t)	Year	Period	Value of exports (\$million)	Yearly mean	% of the mean
1	2012	1	A	16.3	96.3
2		2	16.0		98.2
3		3	17.2		105.5
4	2013	1	17.5	17.7	98.9
5		2	18.5		C
6		3	17.0		96.0
7	2014	1	17.5	18.4	95.1
8		2	17.6		95.7
9		3	20.0		108.7
10	2015	1	17.0	B	97.7
11		2	17.3		99.4
12		3	18.0		103.4

a. Determine the values of A, B and C.

[3]

$$\frac{A}{16.3} \times 100 = 96.3$$

$$A = 15.7 \quad \checkmark$$

$$B = \frac{17 + 17.3 + 18}{3}$$

$$= 17.4\bar{3} \quad (17.4) \quad \checkmark$$

$$C = \frac{18.5}{17.7} \times 100$$

$$= 104.5 \quad \checkmark$$

3



The following table shows the seasonal indices.

Year	Period 1	Period 2	Period 3
2012	96.3	98.2	105.5
2013	98.9	104.5	96.0
2014	95.1	95.7	108.7
2015	97.7	99.4	103.4
Seasonal Index (%)	97.0	D	E

b. Determine the values of D and E.

[2]

$$D = \frac{98.2 + 104.5 + 95.7 + 99.4}{4} = 99.45 \quad \checkmark$$

$$E = \frac{105.5 + 96.0 + 108.7 + 103.4}{4} = 103.4 \quad \checkmark \text{ OR}$$

$$E = 300 - 99.45 - 97 = 105.55$$

d.s. due to rounding errors in original data.

c. Determine the **deseasonalised values** for:

i. Period 1, 2012

[1]

$$\frac{15.7}{0.97} = 16.2 \quad \checkmark$$

ii. Period 3, 2013

[1]

$$\frac{17}{1.034} = 16.4 \quad \checkmark \quad \left( \frac{17}{1.056} = 16.1 \right)$$

either

A regression line is fitted to the deseasonalised values and its equation is

$$y = 0.19x + 16.2$$

d. Is the export value increasing or decreasing with time? Justify your answer with reference to the regression line.

[2]

Export value is increasing  $\checkmark$  as shown by the positive gradient of 0.19  $\checkmark$

/6

e. What is the potential value of the exports for Period 1, 201<sup>6</sup>?

[3]

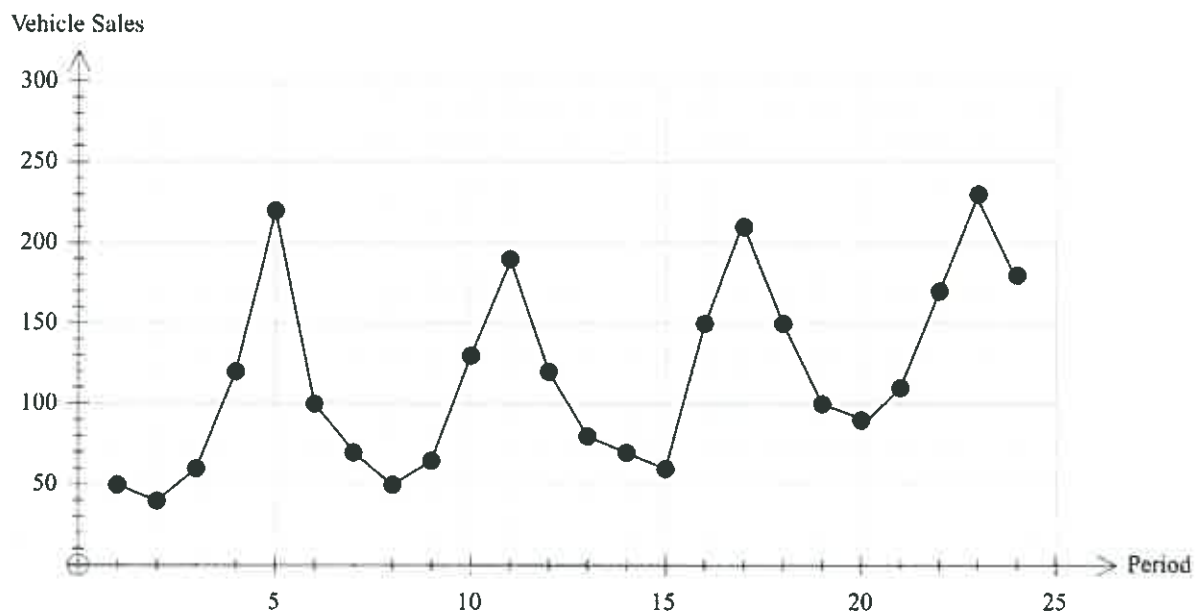
$$y = 0.19 \times 13 + 16.2$$

$$= 18.67 \checkmark$$

$$18.67 \times 0.97 = 18.1 \checkmark$$

4. (6 marks)

The graph below shows the sales of vehicles in a small city for the various periods between 2015 and 2018 inclusive.



a) Describe the long-term trend and period in this time series.

[2]

long-term increasing sales, period 1 year

b) Describe any unusual fluctuations in this time series.

[4]

at 5, it is higher than expected. would expect a value around 180.

at 15, value is lower than expected. Usually this value is moving up from previous.