TRINITY COLLEGE

Year 12 Mathematics Applications
Test 4 2019

Calculator Assumed

Time Series Data

STUDENT'S NAME Solutions

DATE: Friday 28th June **TIME:** 50 minutes **MARKS**: 51

INSTRUCTIONS:

Standard Items: Pens, pencils, drawing templates, eraser

Special Items: Three calculators, notes on one side of a single A4 page (these notes to be handed in with this assessment)

Questions or parts of questions worth more than 2 marks require working to be shown to receive full marks.

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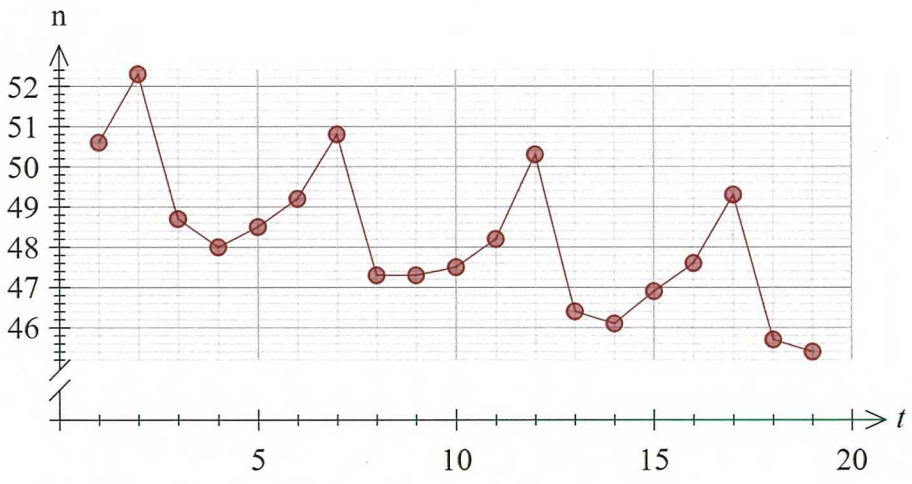
1. (4 marks)



The time series graph above displays a cyclical component.

(a) Describe the time series in terms of its period, trend and seasonal fluctuations. [3]

· 5 pt cycle ✓ · Peaks on second point ✓

· Negative trend ✓ (any valid responses

(b) Suggest a possible situation which would produce a time series graph such as the one above. [1]

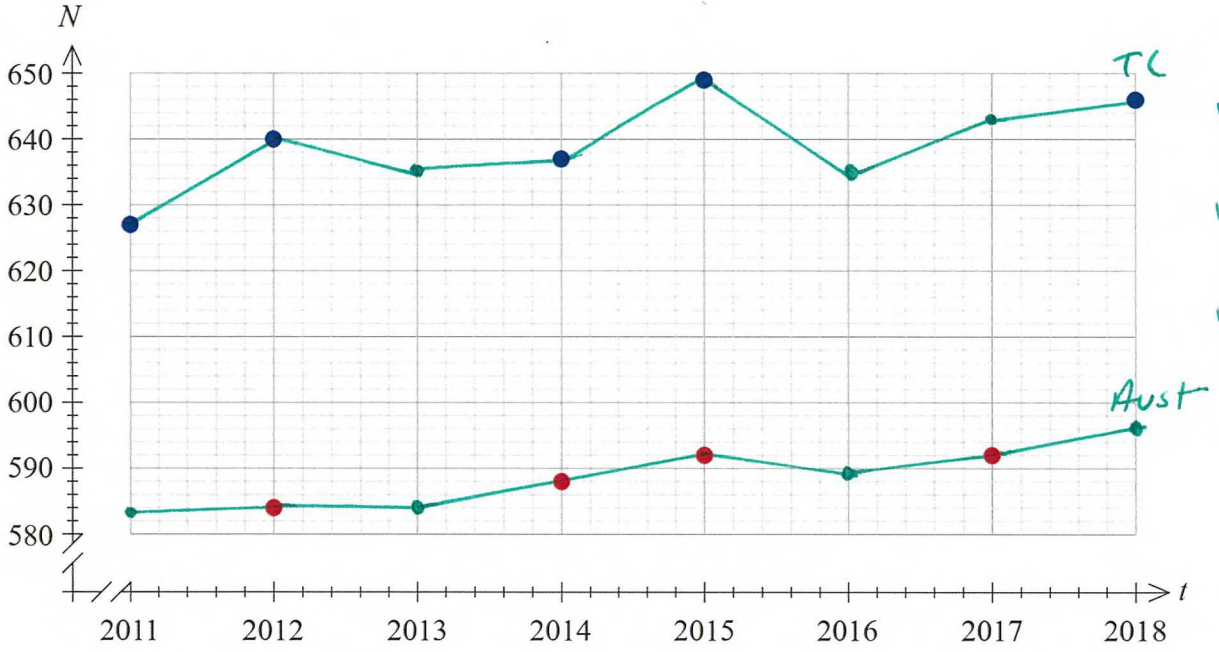
Any valid response. ✓

2. (7 marks)

Below are the average Year 9 Numeracy NAPLAN scores from 2011 to 2018 for Trinity College and Australia.

Time (t)	2011	2012	2013	2014	2015	2016	2017	2018
TC NAPLAN (N)	627	640	635	637	649	635	643	646
Aust Average NAPLAN (N)	583	584	584	588	592	589	592	596

(a) Plot the missing data points from the table on the graph below. Connect the appropriate points and label each set of data. [3]



✓ points
✓ connecta
✓ label.

(b) Comment on the overall trend of the Australian average. [2]

Increasing. ✓✓

(c) With reasoning, comment on which year Trinity College demonstrated the greatest achievement in Year 9 Numeracy NAPLAN. [2]

2015 ✓, gap between TC & Australian average was greatest ✓

3. (6 marks)

The table below contains some of the seasonal effects of sales at a company for each quarter of a year from 1995 to 1997.

	Q1	Q2	Q3	Q4
1995	1.05	0.61	0.98	1.36 ✓
1996	1.04 ✓	0.55	1.01	1.40
1997	1.09	0.59	0.97	1.35

(a) Determine and enter the appropriate missing values in the table. [2]

(b) Explain the significance of the value of 0.55 in the table. [1]

Q2 in 1996 was 45% less than the yearly mean. ✓

(c) The yearly mean in 1997 was \$476 000.

(i) Calculate the actual value of Q3 1997. [1]

$0.97 = \frac{x}{476000}$ $x = \$461720$ ✓

(ii) Calculate the deseasonalised value of Q3 1997. [2]

$SI = \frac{0.98 + 1.01 + 0.97}{3}$

$= 0.9867$ ✓

$d = \frac{461720}{0.9867} = \$467944$ ✓

4. (11 marks)

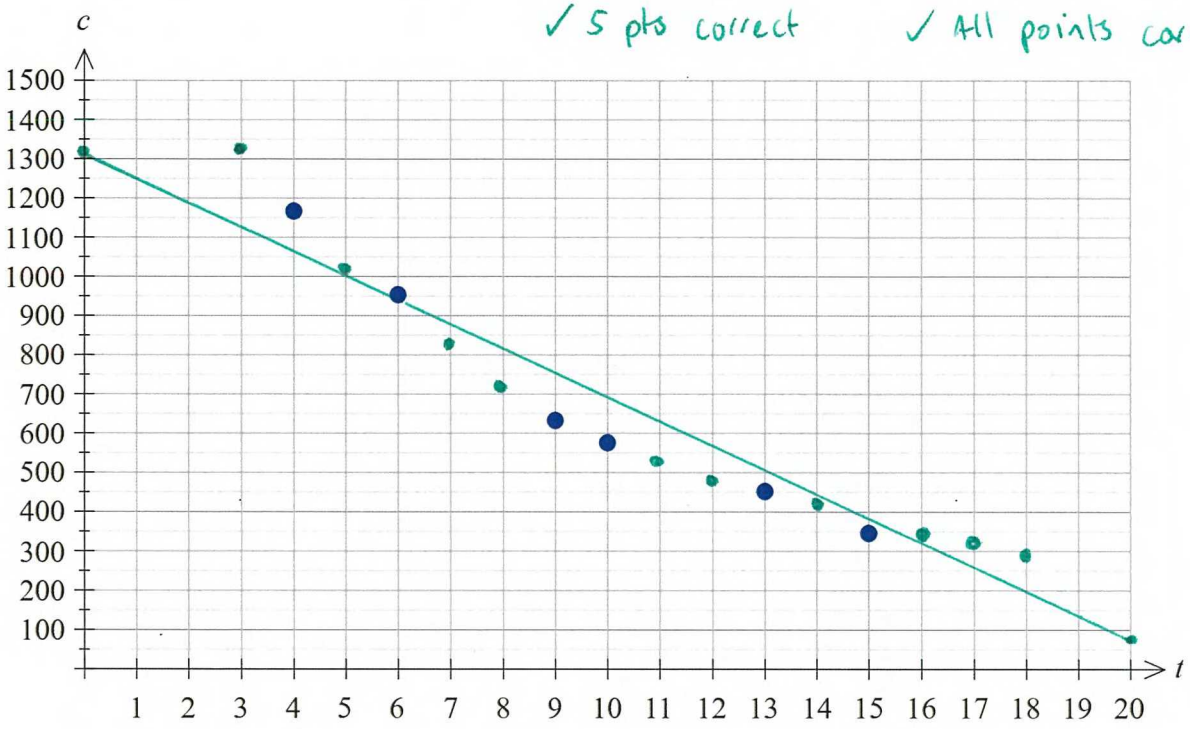
The number of downloads per quarter over of a phone app for the 5 years after its initial release are shown in the table below.

Year	Quarter	Time (t)	Number of Downloads	4 pt CMA (c)
1	Dec	1	1958	
	Mar	2	1455	
	June	3	1047	1326
	Sept	4	1215	1167
2	Dec	5	1212	1061
	Mar	6	932	954
	June	7	723	823
	Sept	8	684	713
3	Dec	9	697	633
	Mar	10	561	576
	June	11	458	527
	Sept	12	489	484
4	Dec	13	503	452
	Mar	14	412	422 ✓
	June	15	346	388
	Sept	16	366	351
5	Dec	17	349	320
	Mar	18	274	290 ✓
	June	19	233	
	Sept	20	245	

(a) Calculate the missing 4 pt CMA(s) possible from the table above and enter the value in the table. [2]

(b) Plot the remaining 4 pt CMA value on the axes below. [2]

✓ 5 pts correct ✓ All points correct.



(c) A business manager used linear regression to predict the downloads for the next two years.

(i) Determine the equation of the least squares regression line between the time and the 4 pt MA and plot it on the graph. [3]

$C = -62.5927t + 1318.91$

✓ values
✓ variables
✓ line plotted

(ii) Predict the deseasonalised number of downloads for the September quarter in the 7th year. [1]

$t = 28 \qquad C = -62.5927(28) + 1318.91$

$= -433.7 \qquad \approx -434$ ✓

(iii) Give three reasons as to why the business manager was incorrect in their prediction. [3]

* other possible answers.

- Cannot have negative downloads
- Linear regression not appropriate
- Too far extrapolated
- No seasonality.

5. (14 marks)

A cinema manager recorded the number of tickets sold each day over a three-week period. The data is recorded in the table below, along with some calculations.

Week	Day	Day number	Ticket sales (1000s)	Weekly Mean	Percentage of weekly mean	Seasonally Adjusted sales
1	Mon	1	1.8	4.33	41.6%	4.3
	Tues	2	***A***		***B***	4.6
	Wed	3	2.3		53.1%	4.5
	Thurs	4	2.9		67.0%	4.6
	Fri	5	4.1		94.7%	4.4
	Sat	6	8.2		***C***	4.2
	Sun	7	6.7		154.8%	4.1
2	Mon	8	2.0	4.74	42.2%	4.7
	Tues	9	4.0		84.3%	4.2
	Wed	10	2.5		52.7%	4.9
	Thurs	11	3.1		65.4%	4.9
	Fri	12	4.8		101.2%	5.1
	Sat	13	9.2		194.0%	4.8
	Sun	14	7.6		160.2%	4.7
3	Mon	15	1.9	***D***	42.6%	4.5
	Tues	16	4.4		98.7%	4.7
	Wed	17	2.1		47.1%	4.1
	Thurs	18	2.6		58.3%	***E***
	Fri	19	3.8		85.3%	4.1
	Sat	20	8.8		197.4%	4.5
	Sun	21	7.6		170.5%	4.7

(a) Determine the values of *A*, *B*, *C* and *D* [4]

A

$4.33 = \frac{1.8 + A + 2.3 + 2.9 + 4.1 + 8.2 + 6.7}{7}$

$A = 4.3$ ✓

B

$\frac{4.3}{4.33} = \therefore 99.3\%$.

or $700 - £1$

$= 99.4\%$. ✓

C

$\frac{8.2}{4.33} = 189.4\%$. ✓

D

$\frac{1.9 + 4.4 + 2.1 + 2.6 + 3.8 + 8.8 + 7.1}{7}$

$= 4.46$ ✓

(b) (i) Use the average percentage method to complete the table below by calculating the seasonal index for Thursday. Show evidence of the method. [2]

$$\frac{0.67 + 0.654 + 0.583}{3}$$ ✓

Mon	Tues	Wed	Thurs	Fri	Sat	Sun
0.4213	0.9413	0.5099	0.6357 ✓	0.9373	1.9362	1.6185

(ii) Calculate the value of E from the table. [1]

$$\frac{2.6}{0.6357} = 4.09 \approx 4.1$$ ✓

(c) The equation of the least-squares line used to predict the deseasonalised number of ticket sales, where n is the day number and d is deseasonalised sales is:

$$d = 0.0004n + 4.5055$$

(i) Describe the trend in the number of ticket sales over time. [2]

Steady / slight increase ✓✓

(ii) Predict the actual number of ticket sales for Friday of week four. [3]

$n = 26$ ✓

$d = (0.0004(26) + 4.5055) \times 0.9373$

$= 4.2$ ✓

$\therefore$ 4200 ✓

(d) How does the seasonally adjusted figure for Thursday of week 2 compare to the 7 point moving average? [2]

$$7\text{ pt MA} = \frac{2.0 + 4.0 + 2.5 + 3.1 + 4.8 + 9.2 + 7.6}{7}$$

$= 4.7$ ✓

Seasonall adjusted is slightly higher than 7 pt MA. ✓

6. (9 marks)

The table below time series data with a seasonal component.

Time	Data	3 pt MA	4 pt CMA	5 pt MA	6 pt CMA
1	61				
2	38	45			
3	37	49	52	53	
4	73	55	52	50	53
5	55	58	57	57	55
6	47	***A***	***B***	***C***	***D***
7	71	59	58	57	61
8	58	61	62	63	62
9	55	65	66	66	63
10	83	67	64	63	66
11	62	67	68	69	68
12	56	70	70	69	68
13	90	70	67	72	69
14	62	70	71	72	71
15	56	72	73	74	71
16	98	72	70	69	73
17	63	75	75	75	74
18	65	73	76	78	75
19	93	76	73	72	
20	70	77			
21	67				

(a) Calculate the values of A, B, C and D. [4]

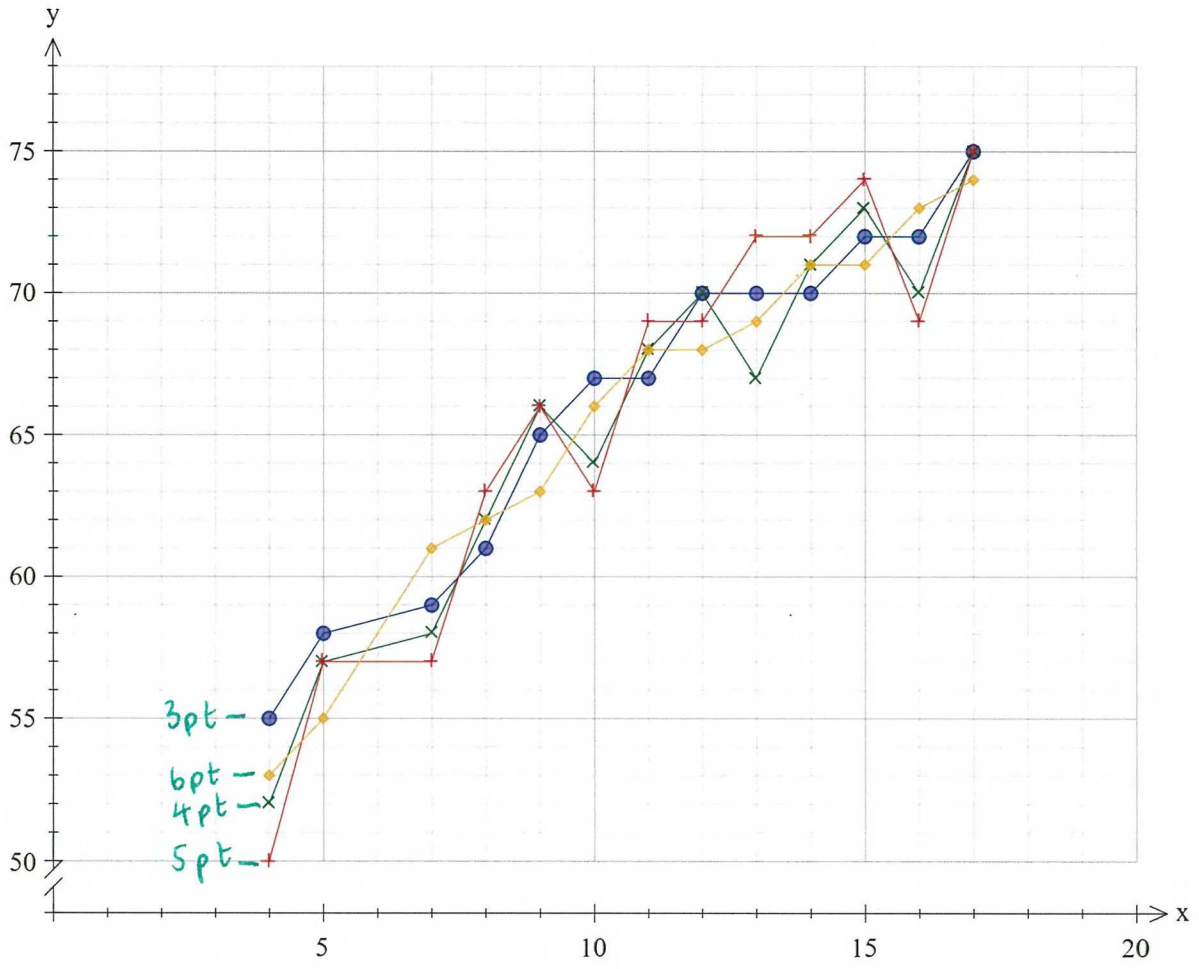
A = 58 ✓

C = 61 ✓

B = 60 ✓

D = 58 ✓

(b) The graph below shows all four sets of moving averages from the table above.



(i) Identify which moving average corresponds to each set of data graphed. [2]

✓2 correct ✓All correct.

(ii) Two of the moving averages graphed do not appear appropriate for the data. Which moving averages are not effective in smoothing the data? [2]

4pt ✓ and 5pt ✓

(iii) Give a reason as to why there is two sets of moving averages that smooth the data appropriately. [1]

3 is correct and 6 is a multiple of 3. ✓