TRINITY ⚜ COLLEGE

Year 12 Mathematics Applications
Test 4   2021

Calculator Assumed
Time Series Data

STUDENT'S NAME   *Solutions   (SP)*

DATE: Friday 25th June   **TIME:** 40 minutes   **MARKS:** 38
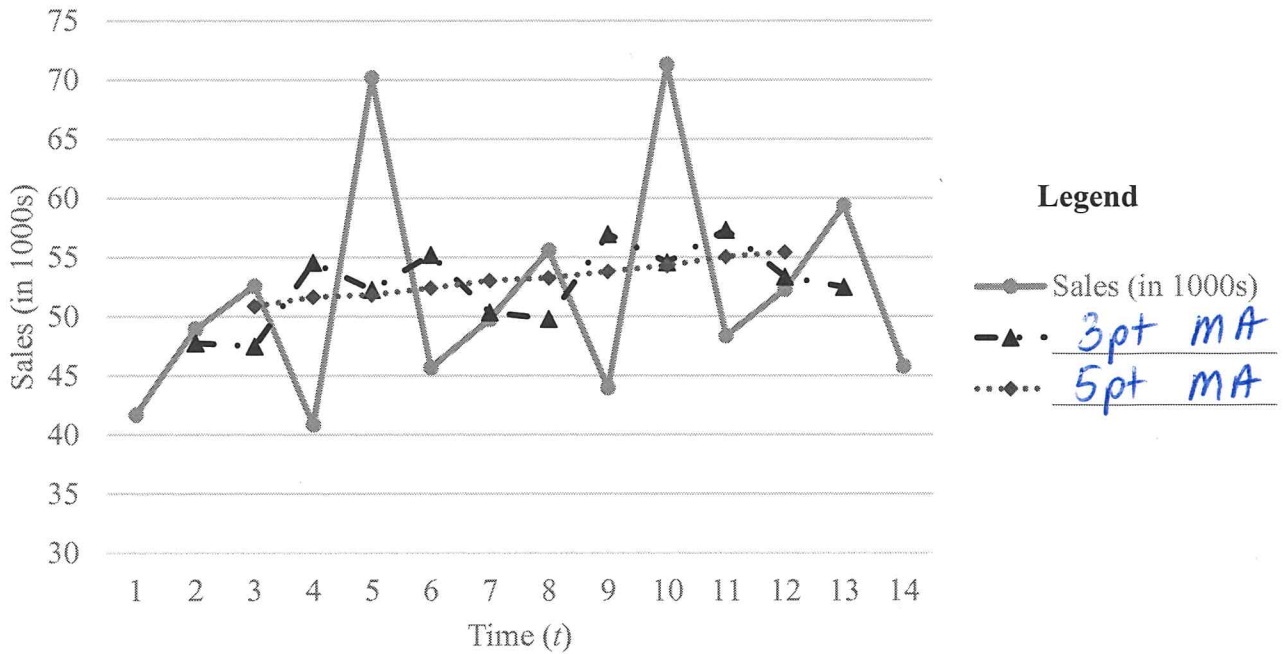
INSTRUCTIONS:
Standard Items: Pens, pencils, drawing templates, eraser
Special Items: Three calculators, notes on one side of a single A4 page (these notes to be handed in with this assessment)

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

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1. (5 marks)

The graph above shows the sales at a local restaurant over a 14 day period. A 3 point moving average and a 5 point moving average have been fit to the model.

(a) On the legend in the graph clearly label the 3 point moving average and the 5 point moving average. [1]

✓ both correct

(b) Which moving average is most appropriate for the given data? Explain your answer. [2]

The 5 pt MA is the best fit for this data.
It best smooths the data and 5 seasons make a cycle in this data set.

✓ concludes 5 pt
✓ 1 valid reason

(c) Explain the purpose of fitting a moving average to time series data. [2]
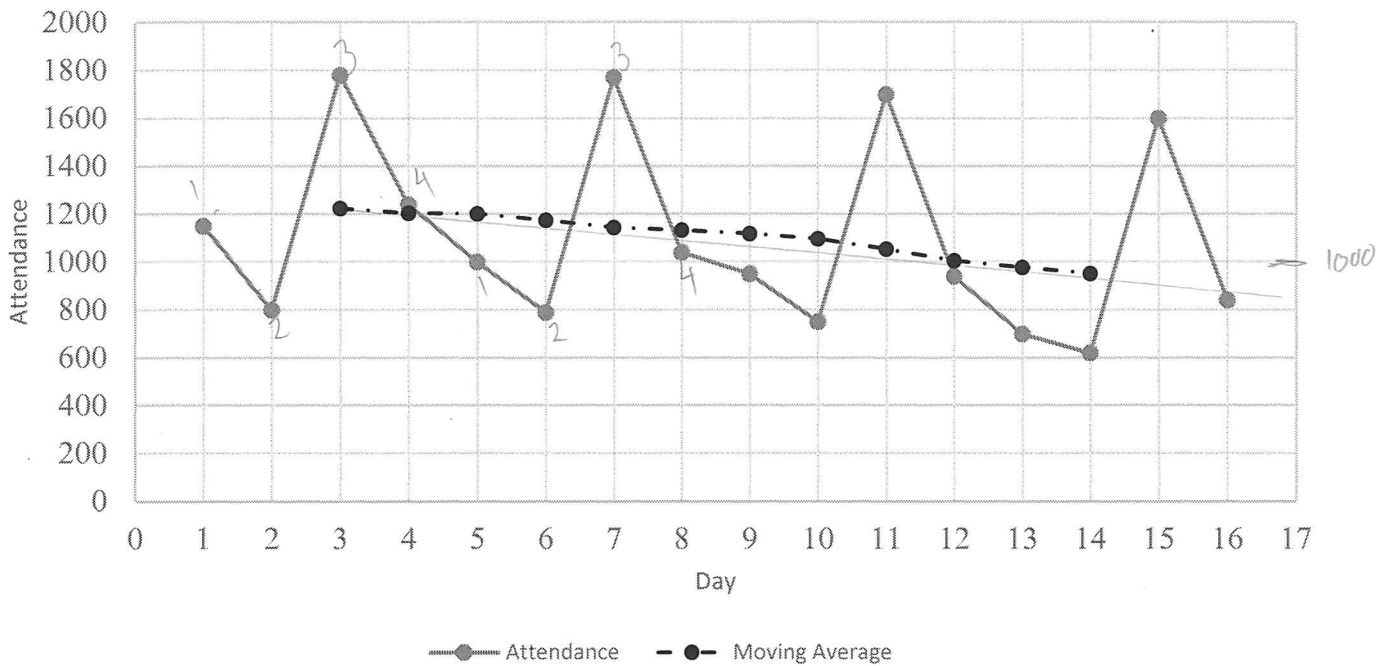
To smooth the data and show the underlying trend.

✓ smooth data
✓ underlying trend

2.   (5 marks)

Cirque De Moon performed a certain number of times a week for the past four weeks. The attendance data and associated moving averages for the first four weeks have been plotted below.

(a)   What moving average is most appropriate for this data?   [2]

4 pt   C M A

✓ 4pt
✓ Centered

(b)   Describe the trend in attendance over these four weeks.   [1]

There is a long term decreasing trend.

✓ decreasing

(c)   Cirque De Moon need 1000 attendees on average per day to make their performance financially worthwhile. Should the company continue its performances into a 5th week? Explain your answer.   [2]

The moving average dips below 1000 at the end of week 4, therefore not worthwhile to continue performances in week 5.

✓ concludes No
✓ discusses M.A. in suitable explanation

3.   (17 marks)

The table below shows the number of plastic bags purchased during the week (Mon to Fri) over a three-week period.

Week	Day	Time (t)	Bags (in 100s)	5 Pt MA	Cycle Mean	Seasonal Effect	Seasonally Adjusted Data
1	Monday	1	14			26.62%	58.4
	Tuesday	2	17			32.32%	47.8
	Wednesday	a 3	22	53	b	41.83%	44.9
	Thursday	4	120	53	53	228.14%	55.5
	Friday	5	90	54		171.10%	51.4
2	Monday	6	15	57		24.27%	62.6
	Tuesday	7	24 a	59		38.83%	67.5
	Wednesday	8	35 b	62	61·8 ≈ 62	56.63%	71.4
	Thursday	9	c 130	62		d	60.1
	Friday	10	105 d	63		169.90%	60.0
3	Monday	11	16 e	63		21.05%	66.7
	Tuesday	12	27	e 69		35.53%	75.9
	Wednesday	13	37	76	76	48.68%	75.4
	Thursday	14	160			210.53%	74.0
	Friday	15	140			184.21%	80.0

Bag Sales

Legend: —●— Bags (in 100s)   – ◆ – 5 Pt MA
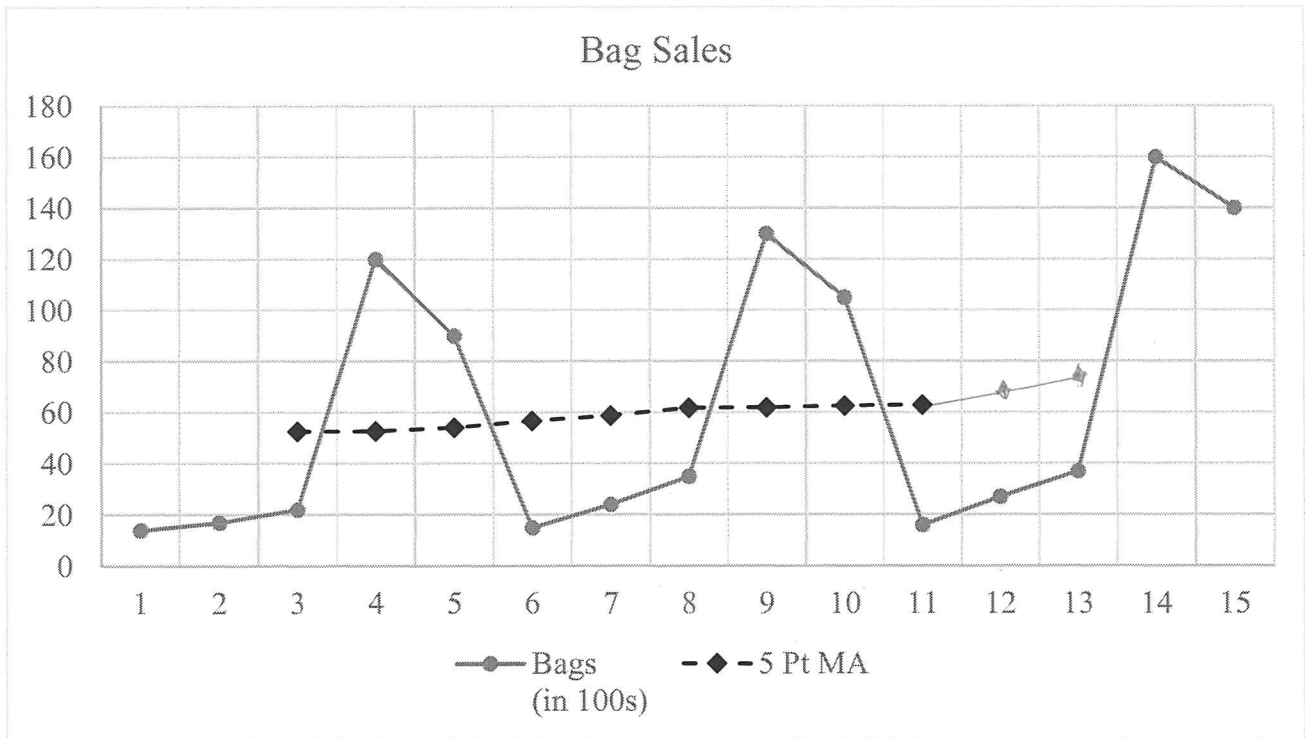
(a)   Determine the values of *a*, *b*, *c*, *d*, and *e* in the table on the previous page.   [5]

$a = 3$

$b = \dfrac{14 + 17 + 22 + 120 + 90}{5}$

$= 52.6 \quad or \quad 53$

$c : \dfrac{24 + 35 + c + 105 + 16}{5} = 62$

$c = 130$

$d = \dfrac{130}{61.8} \times 1000$

$= 210.36\%$

$e = \dfrac{105 + 16 + 27 + 37 + 160}{5}$

$= 69$

(b)   Complete the table showing the seasonal index for each season.   [2]

Monday	Tuesday	Wednesday	Thursday	Friday
24.0%	35.6 %	49.0%	216.3%	175.1 %

$\dfrac{32.32 + 38.83 + 35.53}{3} = 35.56$

$500 - 24 - 35.6 - 49 - 216.3 = 175.1$

✓ plots 1 correctly (c)   Complete the graph on the previous page by plotting the last two moving averages.   [2]

✓ plots both &
joins points

(d)   Show how the seasonally adjusted figure of 55.5 for Thursday week 1 was calculated.   [2]

✓ correctly uses division

✓ correct values

$\dfrac{120}{216.3} \times 100 = 55.478..$

≈ 55.5

or

$\dfrac{120}{2.163} = 55.478$

≈ 55.5

(e)   Determine the least squares line using the seasonally adjusted figures.   [2]

$D = 2.0564\, t + 46.9886$

✓ correct a value

✓ correct b value, uses "t"

(f)   Using your line from part (e), estimate the number of bags that will be purchased on Wednesday of week 4.   [4]

$t = 18$

$D(18) = 2.0564(18) + 46.9886$

$= 84.004$

$D(18) \times 0.49 = 41.162$

$\therefore 4100 \text{ bags}$

✓ t = 18

✓ subs to get a deseasonalised value

✓ multiplies by SI

✓ gives reasonable answer in terms of 100s of bags

4. (10 marks)

The quarterly seasonal index for the number of visitors to the local swimming pool for the 2nd quarter of the year is 0.73.

(a) Comment on the number of visitors to the pool in relation to the average quarterly number. [2]

During the second quarter attendance is 27% below the average quarterly number of visitors

✓ 27%
✓ below

(b) The number of visitors to the pool in the 2nd quarter of 2019 was 21 000.

(i) Determine the seasonally adjusted number of visitors to the pool in this quarter. [2]

$$\frac{21\ 000}{0.73} = 28767.123..$$

$$\approx 28\ 800$$

✓ divides by SI
✓ rounds to whole number (ones, tens, hundreds)

(ii) Determine the total number of visitors to the pool in 2019. [1]

$$\frac{21\ 000}{0.73} \times 4 = 115\ 068.4932...$$

$$\approx 115\ 000 \text{ visitors}$$

✓ estimate using SI

(c) The line of best fit through the seasonally adjusted figures for the quarterly visitors for 2017 to 2020 is $s = 1400t + 13\ 000$ where the 1st quarter of 2017 is $t = 1$. Predict the number of visitors to the pool in 2nd quarter of 2025. [3]

$$t = 33$$

$$s(33) = 1400(33) + 13000$$

$$= 475\ 000$$

$$475\ 000 \times 0.73 = 346\ 750 \text{ visitors}$$

✓ $t = 33$
✓ subs value
✓ multiplies by 0.73 and states estimate

(d) Comment on the reliability of your prediction in part (c). [2]

The prediction is unreliable as it is 5 years into the future and we only have 4 years of data.

✓ unreliable
✓ suitable reason