Student Name: _____

GENERAL MATHEMATICS 2024

Unit 3
Key Topic Test 4 – Data Analysis Investigating and Modelling Time Series Data

Recommended writing time: 45 minutes
Total number of marks available: 25 marks

QUESTION BOOK

* The recommended writing time is a guide to the time students should take to complete this test. Teachers may wish to alter this time and can do so at their own discretion.

Conditions and restrictions
- Students are permitted to bring into the room for this test: pens, pencils, highlighters, erasers, sharpeners and rulers, approved CAS calculator and one bound reference book.
- Students are NOT permitted to bring into the room for this test: blank sheets of paper and/or white out liquid/tape.

Materials supplied
- Question and answer book of 8 pages.

Instructions
- Print your name in the space provided on the top of the front page.
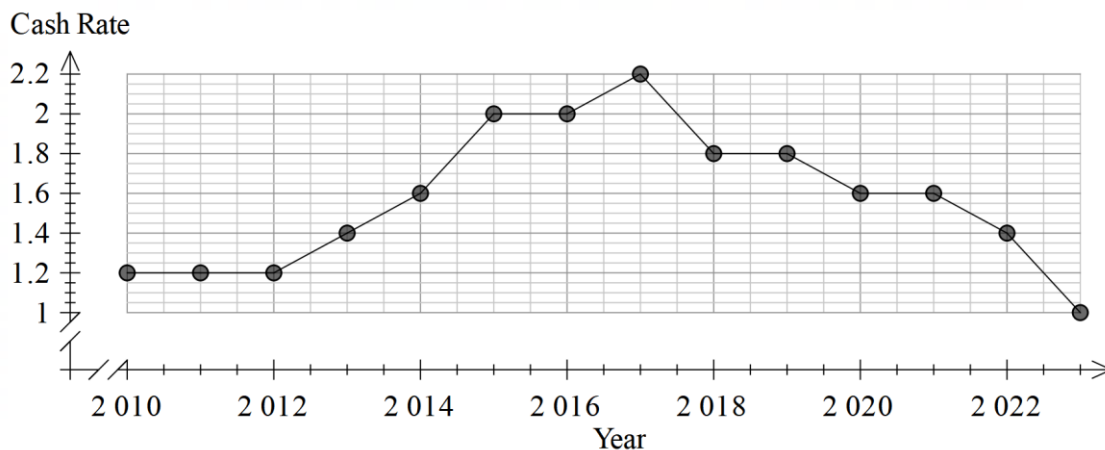- All written responses must be in English.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic communication devices into the room for this test.

SECTION A – Multiple-choice questions

Instructions for Section A
• All questions are worth one mark.
• Answer all questions by circling the correct response.
• Marks are not deducted for incorrect answers.
• No marks will be awarded if more than one answer is completed for any question

The following information relates to Question 1, 2 and 3

The following times series plot shows the cash rate (%) from 2010 to 2023 for a particular country.

Question 1

The time plot is best described as having:

A. Seasonality only

B. Irregular fluctuations with a structural change

C. Seasonality with irregular fluctuations

D. Cyclical trends with irregular fluctuations

E. No trends evident

Question 2

The data is smoothed using a 5 median smoothing. The smoothed value for 2016 is:

A. 1.6

B. 1.8

C. 2.0

D. 2.2

E. 2.4

Question 3

The data is smoothed using a 4 mean smoothing, with centring. The smoothed value for 2014 is:

  A. 1.55

  B. 1.65

  C. 1.75

  D. 1.85

  E. 1.6

The following information relates to Question 4 and 5

Quarterly sales data is kept for a fashion outlet. The seasonal indices of each quarter are given below:

Quarter	1	2	3	4
Seasonal Index	1.53	a	0.87	1.04

Question 4

The statement that is __not__ correct is:

  A. Sales for Quarter 4 are 4% above the seasonal average
  B. Sales for Quarter 2 are 44% below the seasonal average
  C. Sales for Quarter 1 are 47% below the seasonal average
  D. To correct for seasonality
  E. Sales for Quarter 3 are 13% below the seasonal average

Question 5

The deseasonalised sales number for Quarter 3 of last year is 14 220. The actual sales were closest to:

  A. 12 371

  B. 16 345

  C. 14 220

  D. 15 232

  E. 13 471

SECTION B - Short-answer questions

<table>
<tr><td colspan="2" align="center">Instructions for Section B</td></tr>
<tr><td>•</td><td>Answer each question in the space provided.</td></tr>
<tr><td>•</td><td>Please provide appropriate workings and use exact answers unless otherwise specified.</td></tr>
</table>

Question 1 **(9 marks)**

The monthly number of members at a gym last year are shown in the table below.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
820	910	720	690	650	600	610	615	701	755	840	900

a. Show that the seasonal average is 734.25

_____

_____

1 mark

b. Complete the seasonal indexes for June and July in the table below, rounding answers to 2 decimal places.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
S.I.	1.12	1.24	0.98	0.94	0.89			0.84	0.95	1.03	1.14	1.23

2 marks

c. Find the deseasonalised value for members in September. Round your answer to the nearest person.

_____

_____

1 mark

d. By setting Jan = 1, Feb = 2… , find the equation of the least squares regression line for deseasonalised member numbers. Give answers to 3 significant figures.

$$\textit{Deseasonalised Members} = \boxed{} + \boxed{} \times \textit{month number}$$

2 marks

e. Use the equation found in d. to predict the number of members for March of the following year. Round your answer to the nearest person.

_____

_____

2 marks

f. Complete the sentence below by filling in the box and circling the correct above/below:

The month of August is [   ] %   above / below the seasonal average.

1 mark

$1 + 2 + 1 + 2 + 2 + 1 = 9$ marks

Question 2   (6 marks)

The total rainfall in mm for each month of 2023 in Rainswana is recorded below:

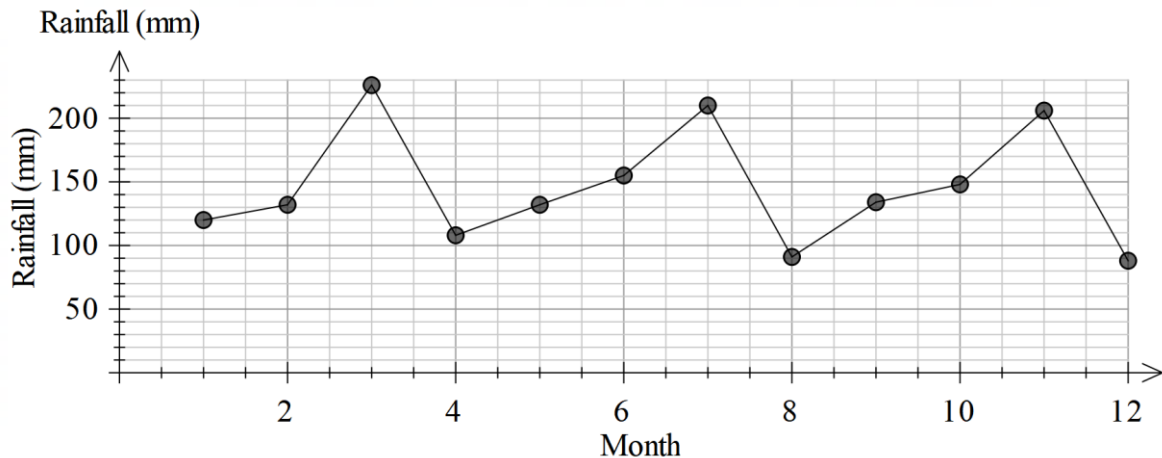| Month	Rainfall (mm)
Jan	120
Feb	132
Mar	226
Apr	108
May	132
Jun	155
Jul	210
Aug	91
Sep	134
Oct	148
Nov	206
Dec	88

a. Find the 3 mean smoothed value for the month of March. Round your answer to the nearest integer.

_____

1 mark

b. Find the 4 mean (with centring) smoothed value for the month of September. Round your answer to 1 decimal place.

_____

_____

2 marks

Using January = 1, February = 2… ,the times series plot for this data is shown below.

Rainfall (mm)

c. On the scatterplot above, complete a 3 median smoothing
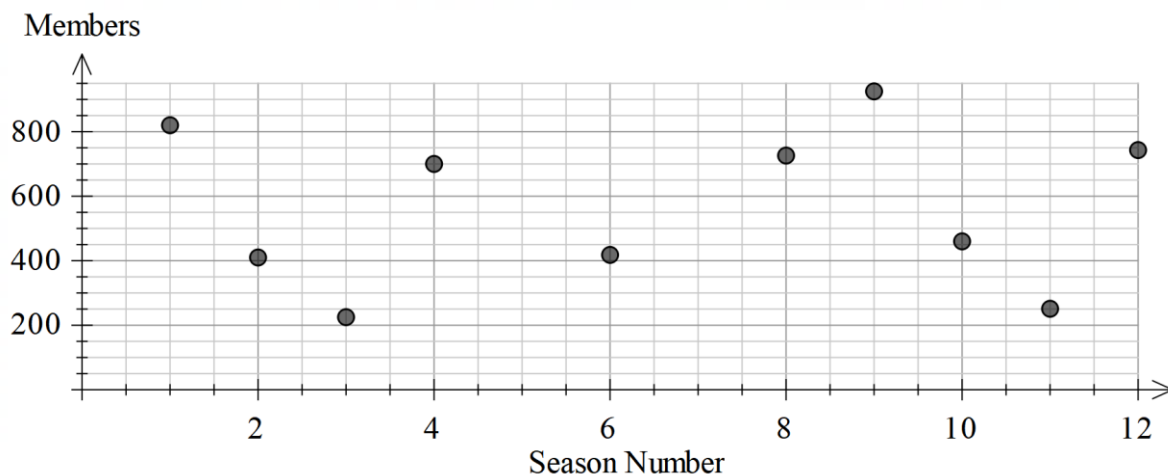
3 marks

$1 + 2 + 3 = 6$ marks

Question 3 (5 marks)

The total members at a swimming pool, for each of the four seasons of 2021, 2022 and 2023 are shown below.

Year	Summer	Autumn	Winter	Spring
2021	820	410	225	700
2022	850	418	240	726
2023	925	460	251	743

a. Setting $t = 1$ for Summer of 2021, complete the times series plot below by adding the data for Summer and Winter of the year 2022. Once plotted, join the dots of the times series plot.

Members

2 marks

A competing gym opened in 2022 and collected their membership each season below.

Year	Summer	Autumn	Winter	Spring
2022	650	325	280	701
2023	632	308	266	692

b. Using both years of data, find the seasonal index for each month. Round your answers to 3 decimal places. (working out space provided below)

	Summer	Autumn	Winter	Spring
S. I.				

_____

_____

_____

_____

_____

_____

3 marks

2 + 3 = 5 marks

END OF KEY TOPIC TEST