Student Name: _____

GENERAL MATHEMATICS 2024

Unit 3
Key Topic Test 3 – Data Analysis Investigating and Modelling Linear Associations

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.

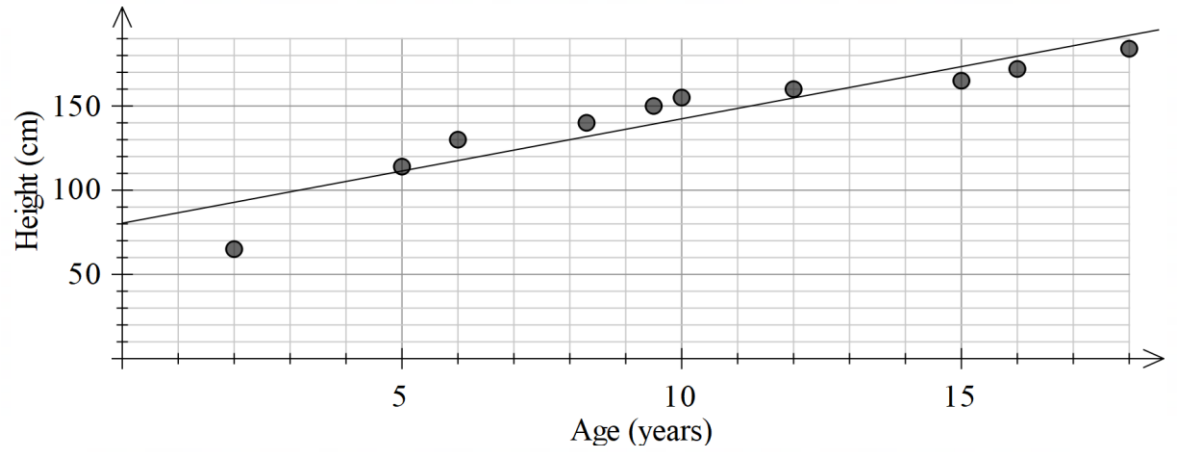
SECTION A – Multiple-choice questions

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

Use the following information to answer Question 1 and Question 2

The age and height of 10 people are shown on the scatterplot below. The least squares regression line is shown.



Question 1

The equation of the least squares regression line is closest to:

A. $Height = 6 + 80 \times Age$

B. $Height = 80 + 6 \times Age$

C. $Age = 80 + 6 \times Height$

D. $Age = 6 + 80 \times Height$

E. $Height = 80 \times Age$

Question 2

The strength and direction of the relationship between Age and Height is best described as:

A. Weak and positive

B. Medium and positive

C. Strong and positive

D. Linear and strong

E. Linear and positive

Question 3

The amount of study (hours) and test score (%) were plotted and a least squares regression line found. Using the least squares regression line, the predicted value for 3 study hours was 72%. The residual value for 3 hours was found to be -2.4%. The actual value for test score of someone that did 3 hours of study is:

A. 72

B. 74.4

C. -2.4

D. 69.6

E. 69.4

Question 4

For a bivariate set of data, the following statistics are recorded-

$\bar{x} = 11.2, \quad S_x = 0.9, \quad \bar{y} = 22.1, \quad S_y = 1.1 \ \ and \ \ r = 0.9$

The y-intercept of the least squares regression line of this data set is closest to

A. 1.10

B. 9.78

C. -9.24

D. 15.13

E. -0.92

Question 5

The relationship between two numerical variables can be modelled by the least squares regression line $y = 21.82 - 0.04x$. The predicted value of y when $x = 25$ is closest to;

A. 0.04

B. 22.82

C. 20.82

D. 15.51

E. -79.50

SECTION B - Short-answer questions

Instructions for Section B

- Answer each question in the space provided.
- Please provide appropriate workings and use exact answers unless otherwise specified.

Question 1 (10 marks)

The index finger length (mm) and height (cm) of 15 people was collected and shown in the table below.

Index finger length (mm)	Height (cm)
80	163
69	156
80	171
90	185
75	150
89	169
80	150
82	172
79	175
76	169
78	166
85	188
95	179
74	162
85	170

a. Find the mean index finger length. Round your answer to the nearest mm.

_____

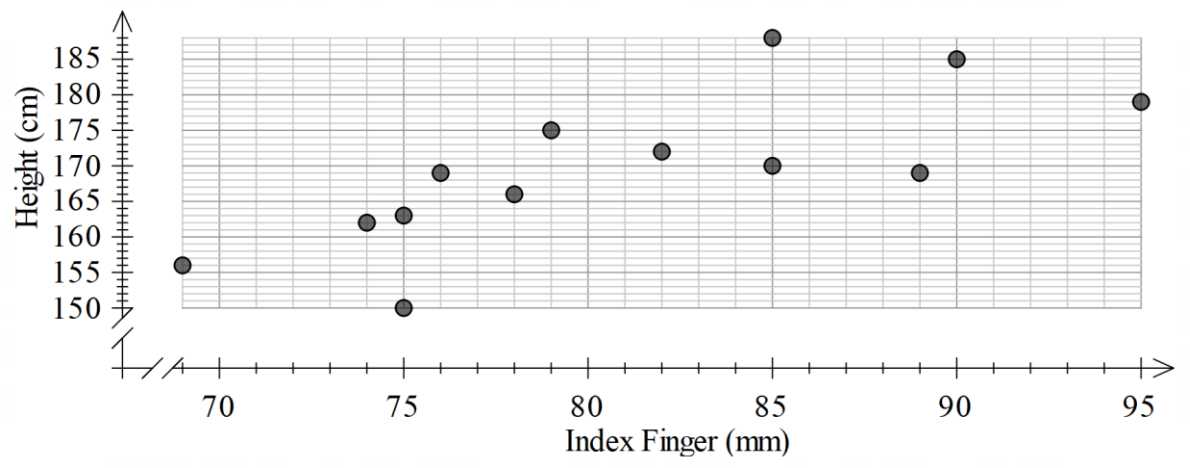
1 mark

b. Complete the boxes below for the equation of the least regression line using Index finger length to predict height. State answers to 3 significant figures.

$$\text{Height (cm)} = \square + \square \times \text{Index Finger Length (mm)}$$

2 marks

c. Complete the scatterplot below by plotting the 2 points for an index finger length of 80mm (these are highlighted in the table).



2 marks

d. Describe the scatterplot in terms of strength, direction and form.

_____

_____

1 mark

e. Interpret the slope of the least squares regression line.

_____

_____

1 mark

f. Complete the following sentence, rounding answers to one decimal place where appropriate.

[ ] % of variation in [ ] can be explained by variation in [ ] .

2 marks

For another set of 15 people, the least squares regression line was found to be:

$$\text{Height(cm)} = 85.2 + 0.9 \times \text{Index finger length (mm)}$$

g. Use this equation to predict the height of someone with an index finger length of 82 mm.

_____

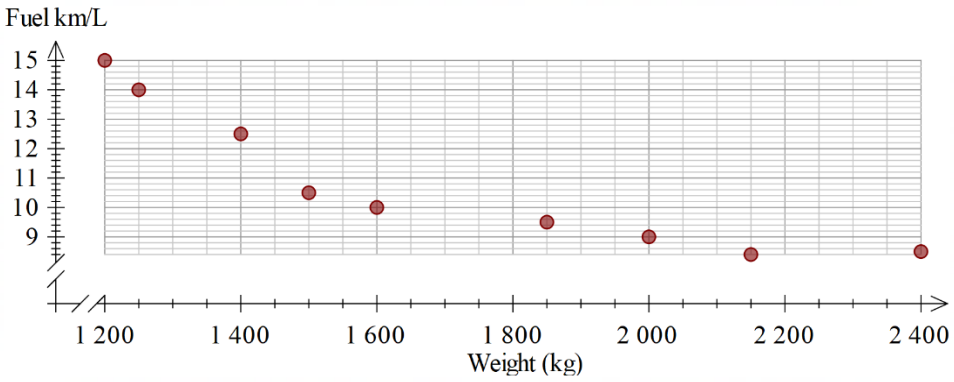
1 mark

1 + 2 + 2 + 1 + 1 + 2 + 1 = 10 marks

Question 2 (10 marks)

The weight (kg) and fuel consumption (km/L) of several cars is shown below along with the scatterplot.

Weight (kg)	Fuel Consumption (km/L)
1200	15
1250	14
1400	12.5
1500	10.5
1600	10
1850	9.5
2000	9
2150	8.4
2400	8



a. State the explanatory variable

_____

1 mark

b. Find the correlation coefficient, correct to 2 decimal places.

_____

1 mark

c. Describe the relationship in terms of strength, direction and form.

_____

1 mark

The least squares regression line for this relationship is found to be:

$$\text{Fuel consumption} = 19.777 - 0.005 \times \text{Weight}$$

d. Find the weight that would give a predicted fuel consumption of 10 km/L. Round your answer to the nearest kg.

_____

1 mark

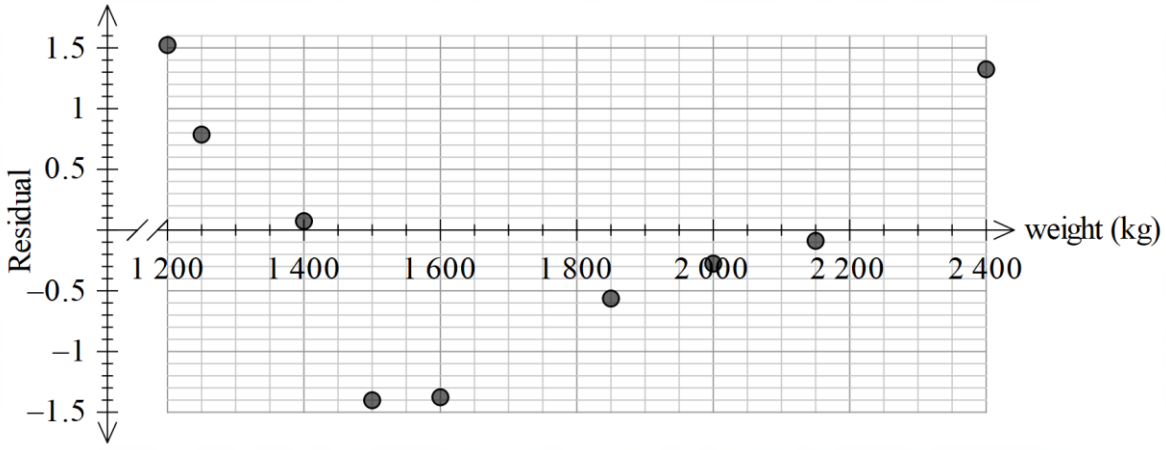
e. Use the least squares regression equation to calculate the residual value for a car with a weight of 1600 kg.

_____

_____

2 marks

The residual plot for this relationship is shown below.



f. Explain what the residual plot tells us about the relationship between weight and fuel consumption and why.

_____

_____

1 mark

A log (weight) transformation is applied to linearise the date.

g. State the equation of the least squares regression equation after the transformation. Round all values to 3 decimal places.

_____

2 marks

h. Explain, using a relevant statistical value, why the transformation has linearised the data.

_____

1 mark

1 + 1 + 1 + 1 + 2 + 1 + 2 + 1 = 10 marks

END OF KEY TOPIC TEST