2011 MATHEMATICAL APPLICATIONS, Semester 2

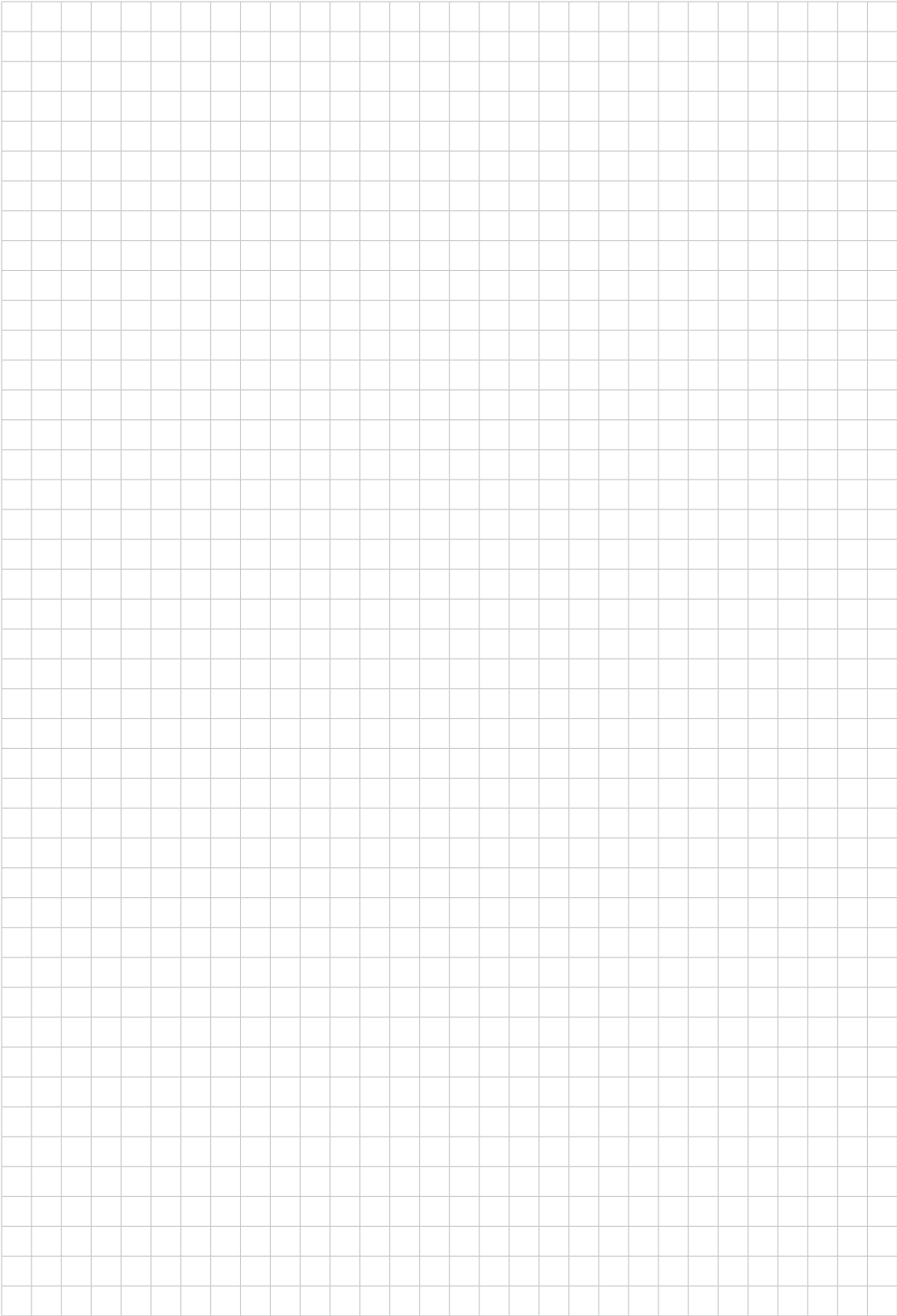**Topic 7: Statistics and Working with Data**

Examination material: two question booklets
two SACE registration number labels

Approved dictionaries, notes, calculators, and computer software may be used.

Instructions to Students

1. You will have 10 minutes to read the question booklets. You must not write in your question booklets or use a calculator during this reading time but you may make notes on the scribbling paper provided.

2. Each of the following five topics is printed in a separate question booklet. ***Tick the boxes by the two topics you have studied in Semester 2***:

    Topic 1: Applied Geometry ☐

    Topic 2: Investment and Loans ☐

    Topic 3: Mathematics and Small Business ☐

    Topic 6: Share Investments ☐

    Topic 7: Statistics and Working with Data. ☐

3. The total mark for each topic is 35.

4. Answer ***all*** parts of Questions 1 to 3 in the spaces provided in this question booklet. There is no need to fill all the space provided.

5. Show all working in this booklet. (You are strongly advised ***not*** to use scribbling paper. Work that you consider incorrect should be crossed out with a single line.)

6. Write on page 5 if you need more space. Make sure to label each answer carefully.

7. Use only black or blue pens for all work other than graphs and diagrams, for which you may use a sharp dark pencil.

8. Appropriate steps of logic and correct answers are required.

9. Marks may be deducted if you do not clearly show all steps in the solution of problems, if your answers have an inappropriate number of decimal places, or if you use incorrect units.

10. Diagrams, where given, are not necessarily drawn to scale.

11. Complete the box on the top right-hand side of this page with information about the electronic technology you are using in this examination.

12. Attach one of your SACE registration number labels to the box at the top of this page.

13. At the end of the examination, place one question booklet inside the back cover of the other question booklet.

TOPIC 7

QUESTION 1

The call centre for a marketing company employs people to enter information into a database. A new employee is trained and then monitored at random intervals, using a standard test. The test is checked to see how many mistakes the employee has made.

The scatter plot below shows the test results for one particular employee over his first 6 weeks of employment:

Employee's Monitored Results

(a) Name the dependent variable in this scenario.

(1 mark)

(b) Tick the appropriate box to indicate which *one* of the following values for Pearson's correlation coefficient (r) is the *most* appropriate for the scatter plot above. Give a reason for your answer.

$r = 0.51$ ☐ $r = 0.84$ ☐ $r = -0.84$ ☐

(1 mark)

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(c) With reference to the variables, describe the relationship shown in the scatter plot on page 2.

(1 mark)

(d) (i) *On the scatter plot on page 2*, circle the data point that is most likely to be considered an outlier.

(1 mark)

(ii) The coefficient of determination for the original data, including the outlier, is $r^2 = 0.71$.

Tick the appropriate box to indicate which *one* of the following values is most likely to be the new r^2 value, once the outlier has been removed from the data. Give a reason for your answer.

$r^2 = 0.71$ ☐ $r^2 = 0.82$ ☐ $r^2 = -0.65$ ☐

(1 mark)

(e) The equation of the least squares regression line (line of best fit) for the data is $y = -2.89x + 23.7$.

(i) Predict the number of mistakes this employee might make in the test after he has worked at the call centre for 4 weeks.

(2 marks)

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(ii) Suppose that the employee made seventeen mistakes in the test.

Predict the number of weeks the employee has been working at the call centre.

(2 marks)

(iii) Discuss the reasonableness of using the equation of the least squares regression line (line of best fit) to predict the number of mistakes the employee might make in the test after he has worked at the call centre for several months.

(2 marks)

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You may write on this page if you need more space to finish your answers to Topic 7. Make sure to label each answer carefully (e.g. 'Question 1(e)(ii) continued').

QUESTION 2

A school is concerned about the weight of the backpacks that students carry. A survey is conducted and students are invited to bring their backpacks to the principal's office to be weighed.

(a) What is *one* limitation of this method of collecting a sample of data for this survey?

(1 mark)

It is found that two teachers have already weighed all the backpacks of the students in their classes and recorded the data. The raw data (in kilograms) for the Year 9 class are shown below:

7.0	4.2	3.0	12.3	8.1	8.3	8.8	5.1	6.5	7.6	4.8	9.0
13.1	8.8	2.9	4.7	4.2	9.4	4.0	4.9	3.1	8.6	3.8	5.4

(b) The weights of the backpacks of the Year 7 class are shown on the stem plot below.

Add the data for the Year 9 class to complete the back-to-back stem plot.

Weights of Backpacks

YEAR 7	Stem	YEAR 9
1	1	
3	2	
8 8 5	3	
7 7 4 1 0	4	
9 8 8 6 4 2 1	5	
7 5 2 2 1 0	6	
8 4	7	
2	8	
	9	
	10	
	11	
	12	
	13	

Leaf 1 = 0.1

(2 marks)

6

(c) Calculate the mean, standard deviation, and median for the data for the Year 9 class (to two decimal places), and complete the table below.

Class	Mean	Standard Deviation	Median
Year 7	5.24	1.58	5.50
Year 9			

(3 marks)

(d) Why is the median the most appropriate value to use when comparing the weights of the backpacks of the two classes?

(1 mark)

(e) How do the weights of the backpacks of the Year 7 class compare with those of the Year 9 class, according to the sample data? Support your answer with information from the stem plot and the statistical values from part (c).

(2 marks)

QUESTION 3

Michaela keeps her favourite songs on her digital audio player. The data on her audio player show that the lengths of these songs are distributed normally, with a mean of 196 seconds and a standard deviation of 22 seconds.

(a) Estimate the approximate length of the shortest song on Michaela's audio player.

(1 mark)

(b) What percentage of songs on Michaela's audio player is likely to be more than 4 minutes in length?

(2 marks)

(c) (i) Suppose that Michaela uses her audio player's shuffle function to play a song at random.

What percentage of songs would be between 152 seconds and 218 seconds in length?

(2 marks)

(ii) If Michaela had 1250 songs on her digital audio player, calculate how many songs would be between 152 seconds and 218 seconds in length.

(1 mark)

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(d) Michaela decides to delete 12% of the songs. She does this by removing the shortest songs.

What will be the length (to the nearest whole second) of the shortest song left on her audio player when she has finished? Show your working.
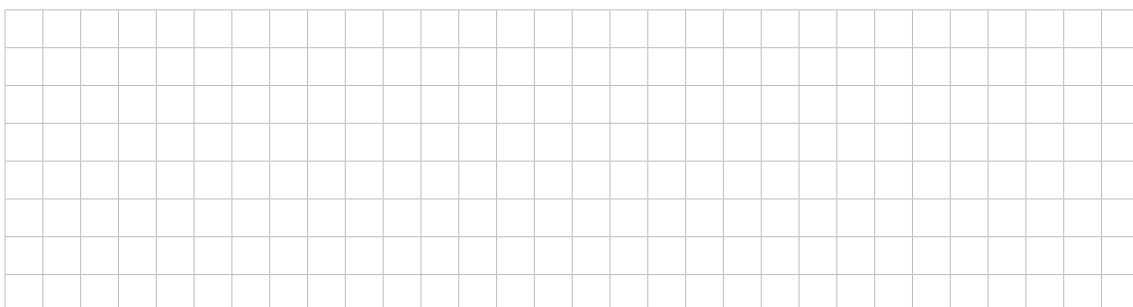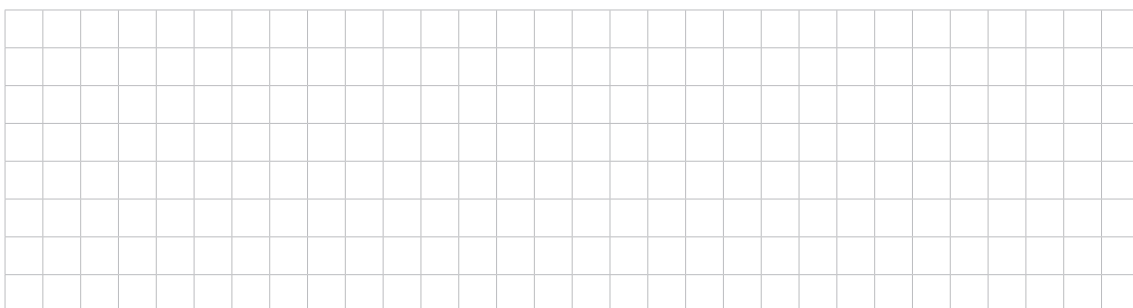
(3 marks)

Michaela's friend Eleni also keeps her favourite songs on a digital audio player.
The following graph shows the distribution of lengths of songs on Eleni's audio player:

Eleni's Songs

length of songs (seconds)
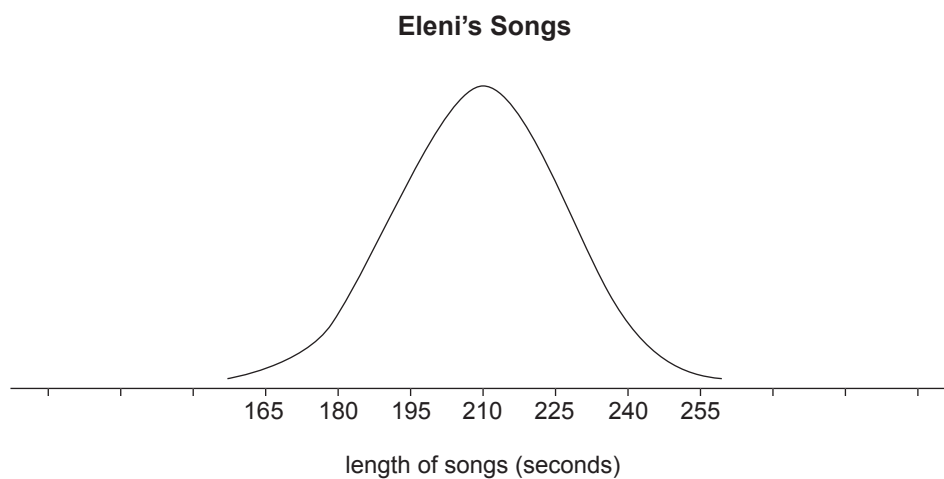
(e) (i) Estimate the mean and the standard deviation of the distribution shown in the graph above.

(2 marks)

(ii) Using the mean and the standard deviation, compare the lengths of Eleni's songs and Michaela's songs.

(2 marks)

(f) What percentage of songs on Eleni's audio player is likely to be less than 195 seconds in length?

(2 marks)