

2023 VCE General Mathematics 2 examination report

General comments

Students were required to attempt four sections:

- Data analysis (24 marks)
- Recursion and financial modelling (12 marks)
- Matrices (12 marks)
- Networks and decision mathematics (12 marks).

Scanned images are used during assessment, so students should ensure their answers can be clearly read. Students are urged to take great care with the presentation of their responses. Students should ensure their responses are written in a dark colour (for example, blue or black pen or 2B pencil) so they are readable when scanned.

A formula sheet is provided with the examination. Students should familiarise themselves with this formula sheet well before the examination. Students should bring a ruler to accurately draw straight lines. This is often required in the 'Data analysis' section.

Throughout the examination, students needed to read each question carefully to ensure that they were addressing the specific requirements of the question. For example, in Question 13a. students were asked to give a minimum distance but sometimes gave the correct route and did not go on to do the additional simple sum calculation.

Transcription errors were often seen, and students needed to take greater care when transferring their answers from the calculator. For example, in Question 1d. an extra zero or one zero too few was often seen as a final answer.

When descriptive responses are required, students need to keep answers brief (point form is acceptable) and not provide additional information. For example, in Question 3d. students were asked to interpret the value of the intercept from the equation of the least squares line. The convention for General Mathematics is that a reference by a question to 'the intercept' means the vertical axis intercept, as read directly from the equation. It was not appropriate to comment further on the horizontal intercept (which would require additional calculation) or the slope of the line.

For any questions worth more than one mark, students are advised to show working. An incorrect answer on its own is not awarded any marks. A method mark can, where appropriate, be awarded to students who show the development of their answer.

Any question with an instruction to 'show that' a particular answer could be obtained remained a challenge for many students. Direct substitution of a value alone, or 'showing' only part of the calculation, was not sufficient to attract full marks. All working steps are expected to be clearly and logically shown. For example,

in Question 4c. many students correctly showed the final calculation of $\frac{0.183}{0.167}$ but failed to show how 0.167

was obtained.

Question 5b. required students to show recursive calculations. This type of question has appeared numerous times in recent years. The mark could only be obtained by showing the correct recursive, step-by-step approach. An answer on its own was not sufficient.

In questions where no instruction to round was given, an exact answer was required. This instruction is clearly given at the top of page 2 of the examination booklet. For example, in Question 1bi. the required answer was 11.42 and, because rounding was not specific, an answer such as 11.4 could not be accepted.

In some questions where rounding did apply, partial marks could still be awarded, despite a rounding error, in either of the following circumstances:

- A correct calculation was shown prior to the final incorrectly rounded answer.
- Additional correct decimal places could be seen.

If rounding did apply, students needed to remember not to round to the required accuracy until the final answer is obtained. For example, in Q5b. and Q6b. students sometimes obtained incorrect final answers by rounding off during the calculation.

Many students were unable to demonstrate that they understood the difference between rounding to decimal places and rounding to significant figures. This was seen in Question 1d. in particular.

In the section on recursion and financial modelling, answers were often required to the nearest cent. This is exactly the same as rounding the final answer to two decimal places.

Specific information

Note: This report provides sample answers, or an indication of what answers may have been included. Unless otherwise stated, these are not intended to be exemplary or complete responses.

The statistics in this report may be subject to rounding, resulting in a total more or less than 100 per cent.

Data analysis

Question 1a.

Marks	0	1	Average
%	50	50	0.5

2

A number of students didn't answer the question. There was no need to provide additional information to identify the variables, which were ID and Size.

Question 1bi.

Marks	0	1	Average
%	14	86	0.9

11.42

Some students rounded to 11.4; rounding should only be done when there is an instruction to do so.

Question 1bii.

Marks	0	1	Average
%	61	39	0.4

14.1

A large number of students gave the median of the whole data set as 11.4.

Question 1ci.

Marks	0	1	Average
%	12	88	0.9

volume

This question was well done.

Question 1cii.

Marks	0	1	Average
%	73	27	0.3

9.53

This question was not answered well. A frequent response was 0.953.

Question 1d.

Marks	0	1	2	Average
%	38	26	37	1.0

$$\text{volume} = 0.002\ 857 + 2.571 \times \text{image size}$$

Many students appeared to have difficulty in giving the coefficients rounded to four significant figures. A number of students wrote responses with incorrect placement of coefficients and/or variables.

Question 1e.

Marks	0	1	2	Average
%	67	3	29	0.6

mean = 4.4; standard deviation = 0.1

Question 2ai.

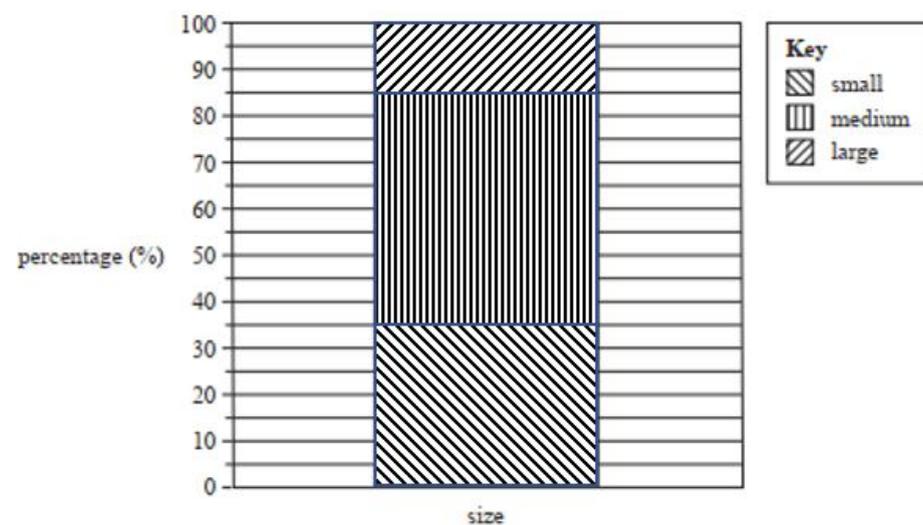
Marks	0	1	Average
%	5	95	1.0

Size	Frequency	
	Number	Percentage (%)
small	7	35
medium	10	50
large	3	15
Total	20	100

This question was well done. A few students omitted the total or wrote tally marks instead of numbers, which was not accepted.

Question 2aii.

Marks	0	1	Average
%	16	84	0.8



This question was well done.

Question 2bi.

Marks	0	1	Average
%	13	87	0.9

17%

This question was well done.

Question 2bii.

Marks	0	1	2	Average
%	19	32	50	1.3

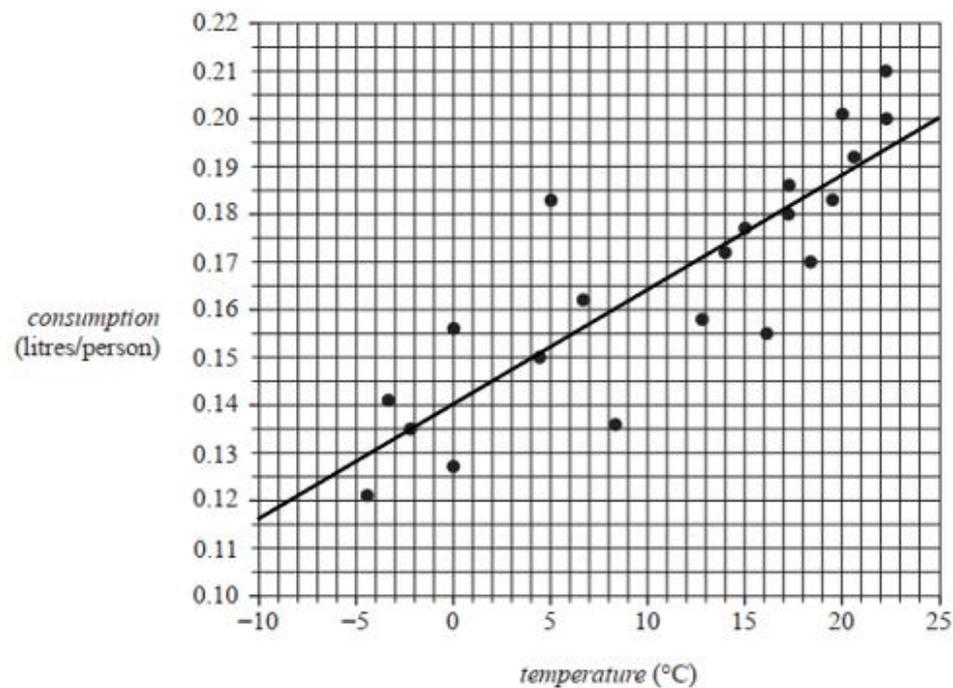
yes

The percentage of large oysters at farm A (21%) was greater than the percentage of large oysters at farm B (14%).

Students needed to ensure that they explicitly answered the question and that they indicated that the farm A percentage was higher than that of farm B.

Question 3a.

Marks	0	1	Average
%	60	40	0.4



Students needed to take care when plotting their least squares lines. Many students showed evidence of correct coordinate points, but placed their dots at the wrong points or took insufficient care when drawing the line. A ruler should be used.

Question 3b.

Marks	0	1	Average
%	31	69	0.7

0.849

This question was quite well done. Some students squared the value of the coefficient of determination.

Question 3c.

Marks	0	1	Average
%	42	58	0.6

strength	strong
direction	positive
form	linear

Some students wrote 'moderate' for the strength, which indicates consideration of the coefficient of determination rather than the correlation coefficient.

Question 3d.

Marks	0	1	Average
%	57	43	0.4

On average, when the temperature is 0 °C, ice cream consumption per person is predicted to be 0.1404 litres.

Many students needed to read the question more carefully, providing a response that interpreted the slope rather than the intercept. Some interpreted both slope and intercept, which was not accepted.

Question 3e.

Marks	0	1	Average
%	25	75	0.8

0.126

This question was quite well done. A number of students incorrectly rounded to 0.13.

Question 3f.

Marks	0	1	Average
%	59	41	0.4

extrapolation

This question was not answered well, given that there were only two options. Students need to ensure they understood fully the difference between extrapolation and interpolation. Even though the value of average temperature (-6 °C) fits on the axes given, it is outside the range of data values of average temperature (with the smallest being around -4.5 °C).

Question 4a.

Marks	0	1	Average
%	74	26	0.3

Maximum values occur 12 months apart.

This question was not answered well. Many students wrote a definition of 'seasonality'.

Question 4b.

Marks	0	1	Average
%	28	72	0.7

0.17

This question was well done.

Question 4c.

Marks	0	1	2	Average
%	50	29	21	0.7

$$\text{Monthly mean consumption for 2011} = \frac{2.004}{12} = 0.167$$

$$\text{Seasonal index} = \frac{\text{July value}}{\text{monthly mean}}$$

$$= \frac{0.183}{0.167}$$

$$= 1.09580\dots$$

$$= 1.10$$

Both calculations were required to attract the 2 marks.

Recursion and financial modelling

Question 5a.

Marks	0	1	Average
%	24	76	0.8

24

This was an accessible first question with a wide range of incorrect answers.

Question 5b.

Marks	0	1	Average
%	49	51	0.5

$$A_1 = 1.016 \times 30\,000.00 - 1515.18 = 28\,964.82$$

$$A_2 = 1.016 \times 28\,964.82 - 1515.18 = 27\,913.077\dots = 27\,913.08$$

Many students were not paid the mark for this question because they didn't show recursive calculations, they rounded values too early (often 28 964.82 to 28 964.8) or made transcription errors.

Question 5c.

Marks	0	1	Average
%	75	25	0.3

\$1515.04

This question was not answered well. Some students added the \$0.14 future value instead of subtracting.

Question 6a.

Marks	0	1	Average
%	30	70	0.7

5.04%

Question 6b.

Marks	0	1	Average
%	60	40	0.4

3973.00	2507.77	1465.23	595 622.67
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This question was not answered well. Incorrect rounding of values in the calculation sequence was frequently observed. Some students wrote only the repayment amount.

Question 6c.

Marks	0	1	Average
%	59	41	0.4

$V_0 = 600\,000$

$V_{n+1} = 1.0042 \times V_n - 3973$

A number of students had the relation fully correct, although some took insufficient care in the writing of the recurrence relation. Calculation of the correct multiplying factor proved challenging for some students.

Question 6d.

Marks	0	1	Average
%	41	59	0.6

perpetuity

Question 7a.

Marks	0	1	Average
%	68	32	0.3

$$(1.0015 - 1) \times 52 \times 100 = 7.8\%$$

Students needed to show all working steps that led to the given result.

A response with 'solve' CAS syntax was not considered appropriate.

Question 7bi.

Marks	0	1	Average
%	53	47	0.5

90

Question 7bii.

Marks	0	1	Average
%	60	40	0.4

278.86

Good use of the finance solver was evident in a number of student responses.

Question 7c.

Marks	0	1	Average
%	68	32	0.3

350.01

Question 7d.

Marks	0	1	Average
%	89	11	0.1

0

This question was not well responded to by most students.

Matrices

Question 8a.

Marks	0	1	Average
%	52	48	0.5

n_{31}

Students often used a capital N despite being explicitly directed towards the correct notation. Correct subscript order proved challenging for some students.

Question 8b.

Marks	0	1	Average
%	56	44	0.4

$$\begin{bmatrix} 1 & 0 & 0 \end{bmatrix}$$

This question was not answered well. A CAS calculator could be used to check if the calculation was correct.

Question 8c.

Marks	0	1	Average
%	66	34	0.3

$$\begin{bmatrix} 204 & 0 & 0 \\ 0 & 162 & 0 \\ 0 & 0 & 176 \end{bmatrix}$$

This question was not answered well. A row or column matrix was frequently seen.

Question 9a.

Marks	0	1	Average
%	75	25	0.3

$$\begin{bmatrix} 1 \\ 20 \end{bmatrix} \times R = [48000 \ 49525 \ 47005 \ 46040 \ 45065]$$

Many students demonstrated difficulty in determining the correct scalar multiple.

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Question 9b.

Marks	0	1	Average
%	53	47	0.5

1.25

Many students gave an answer of 0.25.

Question 9c.

Marks	0	1	Average
%	32	68	0.7

 $I - H - E - G - F$

This question was well done.

Question 9d.

Marks	0	1	Average
%	0	100	1.0

Following the identification of an error in the question stimuli, this question was invalidated.

Question 10a.

Marks	0	1	Average
%	26	74	0.7

 $C - S - M - D$

This question was well done.

Question 10bi.

Marks	0	1	Average
%	34	66	0.7

$$H = \begin{matrix} \text{sender} \\ D \\ M \\ P \\ S \\ C \end{matrix} \begin{bmatrix} \dots & \mathbf{2} & \mathbf{1} & \mathbf{2} & \mathbf{2} \\ \dots & \mathbf{3} & \mathbf{1} & \mathbf{2} & \mathbf{2} \\ \dots & \mathbf{0} & \mathbf{1} & \mathbf{1} & \mathbf{1} \\ \dots & \mathbf{0} & \mathbf{1} & \mathbf{2} & \mathbf{1} \\ \dots & \dots & \dots & \dots & \dots \end{bmatrix}$$

In most instances where students had completely filled in the matrix, it was done accurately.

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Question 10bii.

Marks	0	1	Average
%	75	25	0.3

Managers can directly communicate with directors but not indirectly via one other person.

Students who dealt with each element separately tended to write more accurate responses.

Question 11a.

Marks	0	1	Average
%	66	34	0.3

$$T = \begin{bmatrix} 0.95 & 0 \\ 0.05 & 1 \end{bmatrix}$$

0.5 was often given in place of 0.05. 1 was often left out or placed in the first row.

Question 11b.

Marks	0	1	Average
%	61	39	0.4

$$B = \begin{bmatrix} 9 \\ 0 \end{bmatrix}$$

It was also acceptable to give the second element as -9 .

Networks and decision mathematics

Question 12a.

Marks	0	1	Average
%	24	76	0.8

14

Question 12bi.

Marks	0	1	Average
%	10	90	0.9

$$\boxed{5} \underset{v}{=} + \boxed{4} \underset{f}{=} = \boxed{7} \underset{e}{=} + \boxed{2}$$

Question 12bii.

Marks	0	1	Average
%	19	81	0.8

planar

This was well done by most students, although some answered 'complete'.

Question 12c.

Marks	0	1	Average
%	29	71	0.7

<i>B</i>	3
<i>C</i>	2
<i>D</i>	4
<i>E</i>	1

A good proportion of students were successful in answering this question correctly.

Question 13a.

Marks	0	1	Average
%	30	71	0.7

5.9 km

6.4 km was a common error. Some students wrote the correct path but did not address the specific requirement of the question.

Question 13b.

Marks	0	1	Average
%	56	44	0.4

G – H – K – I – J – M – O – L – N – G

or

G – N – L – O – M – J – I – K – H – G

Many students had a mostly correct response but missed or misplaced a landmark in the middle of the sequence or didn't end the route with *G*.

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Question 13c.

Marks	0	1	Average
%	88	12	0.1

vertex L and vertex N

vertex J and vertex M

This question was not answered well. Very few students had both pairs correct.

Question 14a.

Marks	0	1	Average
%	27	73	0.7

C, G

Question 14b.

Marks	0	1	Average
%	41	59	0.6

16

There was a good number of correct answers to this question.

Question 14c.

Marks	0	1	Average
%	65	35	0.4

5

Some students erroneously counted the dummy activity.

Question 14d.

Marks	0	1	Average
%	67	33	0.3

2

A few students wrote the new completion time of 22 days rather than the reduction in time.

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Question 14e.

Marks	0	1	Average
%	91	9	0.1

Activity	Reduction in completion time (0, 1 or 2 days)
<i>A</i>	2
<i>B</i>	2
<i>F</i>	0
<i>H</i>	2
<i>I</i>	2
<i>K</i>	1