Statistics

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of candidates</th>
<th>VHA</th>
<th>HA</th>
<th>SA</th>
<th>LA</th>
<th>VLA</th>
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<tr>
<td>2009</td>
<td>82</td>
<td>16</td>
<td>23</td>
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</table>

Multiple-choice questions

**Paper One**

<table>
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<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
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<th>4</th>
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<td>Correct response</td>
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<td>C</td>
<td>A</td>
<td>D</td>
<td>B</td>
<td>C</td>
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<td>B</td>
<td>D</td>
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**Paper Two**

<table>
<thead>
<tr>
<th>Question</th>
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<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
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</thead>
<tbody>
<tr>
<td>Correct response</td>
<td>D</td>
<td>B</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>C</td>
<td>A</td>
<td>C</td>
<td>C</td>
<td>B</td>
</tr>
</tbody>
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Characteristics of good responses

**Knowledge and procedures**

The majority of candidates demonstrated sound understanding of the essential principles of the syllabus across the full range of contexts. Good responses provided:

- clear justification and working to support the solution or conclusions reached
- substantial use of diagrams and an attempt to show the significant intermediate calculation steps. This was particularly evident in questions assessing *Linking two and three dimensions* in Paper One and *Navigation* and *Exploring and understanding data* in Paper Two. Significantly, what presented as a weakness in Paper One (*Managing Money 1*) showed as a strength in Paper Two in the simpler context of investment and depreciation
- a significant attempt to reach a conclusion, with many candidates recognising the importance of supporting conclusions with reasoned mathematical argument.
**Modelling and problem solving**

Successful responses displayed the full range of characteristics required in this criterion. These responses also characteristically exhibited a significant attempt to explore the strengths and limitations of proposals and/or conclusions reached in those scenarios involving mathematical modelling. This was particularly evident in the problem-solving associated with Operations research — networks and queuing, Managing money and Navigation.

**Communication and justification**

Many candidates appreciated the need to justify and validate their solutions. This was clearly evident in those successful responses which exhibited a developed argument and some exploration of the strengths and limitations of models.

**Common weaknesses**

**Knowledge and procedures**

Common weaknesses included:

- working with instruments — not showing the essential detail and calculations of chart work in Navigation; working inconsistently with scale and units of measure in Linking two and three dimensions; drawing inaccurate box plots in Introduction to data and its presentation
- transferring information — incorrect currency conversions and working algebraically in Managing money
- magnetic bearings — insufficient detail in calculation stages hindered the successful transfer of information in the chart work of Navigation
- understanding of critical paths — although some candidates could draw networks and confidently manage queuing.

**Modelling and problem solving**

To achieve success in this criterion, candidates must:

- explore the strengths and limitations of models
- make use of clearly labelled, neatly drawn diagrams to support the arguments and conclusions reached. These diagrams are a significant part of a candidate’s justification of an argument even if only of an exploratory nature.

**Communication and justification**

To achieve success in this criterion, candidates must:

- effectively build supporting arguments to show clarity and depth of thinking. This should be done across a range of subject matter
- give more attention to the requirements of this criterion when developing solutions to problems.
Sample solutions

The following solutions are not necessarily prescriptive model responses and are not necessarily the only way of solving a problem. Other approaches and problem-solving strategies may be just as acceptable.

Paper One Part B

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
</tr>
</thead>
</table>

(a) (i) Marked down price = $225 - $50 = $175

(ii) \% Mark-down = \( \frac{50}{225} \times 100 \)

= 22.2 \% \text{ approximately} \ (KP)

(b) (i) Friday → 7 hours @ 1 → 7 hours.
    Saturday → 7 hours @ 1\frac{1}{2} → 10\frac{1}{2} hours
    Sunday → 5\frac{1}{2} hours @ 2 → 11 hours.

Total number of hours = 28\frac{1}{2} @ $18/\text{hour}

= $513

Helen's gross pay is $513

(ii) PAYG tax = 20\% of gross pay

\( = 0.2 \times 513 \)

= $102.60 \ (KP)

(ii) Gross pay = retainer + commission

2700 = 2100 + 0.04 \times \text{sales}

Sales = \( \frac{2700 - 2100}{0.04} \)

= $15000

Su Yin made $15000 worth of sales. \ (MP)
2.

(a) (i) \(2550 \text{ cm} = \frac{2550}{100} \text{ m} = 25.5 \text{ m}\)

(ii) \(7.024 \text{ m}^2 = 7.024 \times 1000 \times 1000 \text{ mm}^2 = 7024000 \text{ mm}^2\) (KP)

(b) (i) Same meridian of longitude.

Difference in latitude = 15°.

\(10^\circ = 111 \text{ km} \) from resource book.

\(\therefore \text{ Distance} = 111 \times 15\)

\(= 1665 \text{ km}\).

(ii) Along a meridian of longitude.

\(1^\circ = 60\text{n-miles}\)

\(\therefore 15^\circ = 15 \times 60\)

\(= 900 \text{ n-miles}\)

Travelling at 10 knots, the yacht will take \(\frac{900}{10} = 90 \text{ hours}\).

(iii) Departs 7am Sunday 8th November 2009

Arrives ?

3 days = 24 hours.

Wednesday + 18 hours = Thursday 1am Nov. 12th.

\(\therefore \text{ The yacht will arrive on time with 11 hours to spare}\) (KP)
(c)(i) \[ AE = \sqrt{(1.8^2 + 1.2^2)} \]  
\[ = 2.163 \text{ m approximately.} \]  

(ii) \[ \tan \theta = 1.2/1.8 \]  
\[ \theta = \tan^{-1}\left(\frac{1.2}{1.8}\right) \]  
\[ \approx 33.7^\circ \]  
or \[ 34^\circ \text{ correct to the nearest degree.} \]

(iii) \[ BF = 0.4 + BD \]  
\[ \sin 48^\circ = \frac{BD}{2.96} \]  
\[ = 0.64 + 2.96 \sin 48^\circ \]  
\[ = 2.600 \text{ metres} \]  
\[ \therefore BD = 2.96 \sin 48^\circ \]  
correct to the nearest millimetre.
Question 3.

(a) Scale = 1:150.

Dining and living rooms measure 65 x 21 mm

approximately (allowance of ±1 mm is ok)

Converting to \( \frac{65 \times 150}{1000} = 9.75 \text{ metres} \)

\[ \frac{21 \times 150}{1000} = 3.15 \text{ metres} \]

Area of rooms = \( 9.75 \times 3.15 \)

= \( 30.713 \text{ m}^2 \)

Cost at $60 per square metre

\[ = 60 \times 30.713 \]

\[ = $1842.75 \]

\( \text{GST (of 10\%)} = 0.1 \times $1842.75 \)

\[ = $184.28 \]

\[ \therefore \text{Cost of carpeting is } $2027.03 \]

\( \text{Note: If candidates give the width to be 20 mm, their answers will differ slightly.} \)

\[ \rightarrow \text{Cost} = 60 \times $29.25 \]

\[ = $1755 \]

\( \text{GST component} = $175.50 \)

\[ \therefore \text{Cost of carpeting = $1930.50.} \]

(KP)
(b) \[ \text{Volume} = \pi r^2 h \] (resource book)
\[ = \pi \times 4^2 \times 3.5 \]
\[ = 175.929 \text{ m}^3 \]
\[ \approx 176 \text{ m}^3 \text{ correct to the nearest cubic metre.} \] (KP)

(c) Scale = 1 : 200

\[ 32 \text{ m square block} = \frac{32000 \text{ mm}}{200} \]
\[ = 160 \text{ mm} \]

\[ 32 \text{ m square block} = 16 \text{ cm, squared area.} \]

\[ 6 \text{ m in from eastern side} = \frac{6000}{200} \]
\[ = 30 \text{ mm} \]
\[ = 3 \text{ cm.} \]

\[ 4 \text{ m in from northern fence} = 2 \text{ cm.} \]

Block (house) 87 mm \times 85 mm (ignoring foyer)
94 mm \times 85 mm (including foyer)

Note: Both measures are acceptable.

87 \times 85 \rightarrow 13.05m \times 12.75m \rightarrow 65.25mm \times 63.75mm
on plan provided
\[ \approx (65 \times 64\) \]
scaled to 1 : 200

94 \times 85 \rightarrow 14.1m \times 12.75m \rightarrow 70.5mm \times 63.75mm
\[ \approx (71 \times 64\) \]

Flat 8m \times 5m \rightarrow 40mm \times 25mm

(New scale)
Water tank diameter is 8meters which would convert to 40mm on the plan.
(a)(i) At work = 35 hours
    = 32 hours regular time + 3 hours at 1 1/2 regular.
    = 32 + 4 1/2
    = 36 1/2 hours pay each week for 48 weeks
    = $42048.

On holidays = 32 x 24 x 4
    = $3072

Gross pay = $45120.

(ii) PAYG = $240 x 52
    = $12480.

(iii) Taxable income = Gross income - deductions
    = 45120 - 4500
    = $40620

(iv) Medicare levy = 1.5% x Taxable income
    = 0.015 x 40620
    = $609.30

Tax on taxable income
    = $2652 + 0.13(40620 - 21600)
    = $8358

Total tax payable = $8358 + 609.30
    = $8967.30

Since Miguel has already paid $12480
then he is entitled to a refund of $3512.70

(KP)
(b) Sale price = $390,000

Funds which can be used as a deposit include:

Savings = $9,000
First Home Owners Grant = $7,000
(The other half used to cover fees and charges)
Inheritance = $25,000.

Should all of these assets be used as a deposit then the deposit would be $41,000.

Total after tax income = $85,000.
Applying the maximum 40% of disposable income to attract a loan then

\[0.4 \times 85,000 = 34,000\text{ per annum}\]

is available for mortgage repayments.

Existing debt = \(350 \times 12\) = $4,200

This reduces the repayment capacity.

\[\text{Capacity to repay} = 34,000 - 4,200 = 29,800\text{ per annum}\]

Over 25 years at 7.5% p.a the cost will be
\[7.07 \times \frac{390,000 - 4,100}{1000} = 2467.43\text{ per month}\]

This equates to $29,609.16 per annum.
This is less than the maximum capacity. 

i. They can afford to repay the loan.

Should the interest rate increase from 7% p.a. to 8% p.a., the following would need some thought:

Loan still paid over 25 years. Each $1000 will attract a repayment of $7.72.

The cost will be:

\[
\frac{(39000 - 41000)}{1000} \times 7.72 = ? \text{ $2694.28}
\]

This monthly amount is equivalent to $32331.36 per annum. This is over budget and is a limitation on their proposal. The gap is $32331.36 - 29800 = $2531.36. This could be a problem at $4868 per week.

A strength is that the car will soon be paid off and if so, $34,000 will be sufficient to manage the increase in the mortgage rate. Problems will emerge if the rate increases further or one or both of them lose employment. Refinance over a longer period is an option as well.

(MP)
5. (a) Eucalyptus tree seedlings’ growth.

<table>
<thead>
<tr>
<th>Height in centimetres</th>
<th>Time in weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
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<td>3</td>
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<td>10</td>
<td>9</td>
</tr>
<tr>
<td>11</td>
<td>10</td>
</tr>
</tbody>
</table>

Graph showing the growth of Eucalyptus tree seedlings over time.
(b) Seedling height = 1.5 x Time + 4.6

The proposed model is reasonable for the first 7 to 8 weeks only. Beyond this period, there is insufficient data to draw out meaningful predictions. A problem would be that growth itself isn’t a linear function as it would suggest the seedlings just keep growing. The linear model distorts the reality and is therefore limited in its ability to predict outside the first seven weeks or so.
Question 1

(a) \( V = P \left(1 + \frac{r}{2}\right)^{nh} \)  

\[
\begin{align*}
\text{(i)} & \quad P = \$25000 \\
& \quad r = \frac{0.08}{2} \\
& \quad V = 25000 \left(1 + \frac{0.08}{2}\right)^{6} \\
& \quad n = 2 \times 3 \\
& \quad = N6. \\
\end{align*}
\]

Lewis' investment is worth $31632.98

(iii) Interest earned = \( V - P \)

\[
\begin{align*}
& \quad = 31632.98 - 25000 \\
& \quad = 6632.98. \quad \text{(KP)}
\end{align*}
\]

(b) (i) Amount borrowed = $3990 - deposit

\[
\begin{align*}
& \quad = 3990 - 500 \\
& \quad = 3490.
\end{align*}
\]

(ii) Simple interest = \( \frac{\text{Prn}}{100} \)

\[
\text{(resource book)}
\]

\[
\begin{align*}
& \quad = 3490 \times 0.21 \times 4 \\
& \quad = 2931.60
\end{align*}
\]

(iii) Monthly repayment = \( \frac{3490 + 2931.60}{48} \)

\[
\begin{align*}
& \quad = \$133.78
\end{align*}
\]
(iv) \[ E = \frac{2Rh}{n+1} \]  \[ R = 0.21 \]

\[ = \frac{2 \times 0.21 \times 48}{49} \]

\[ = 0.4114 \]

The effective interest rate is 41.1% p.a.  

(KP)

(e)(i) July 2010 \rightarrow $42,000
July 2011 \rightarrow $34,000.  

(KP)

(ii) \[ S = V_0 \cdot (1 - r)^n \] \text{(resource book)}

\[ 16000 = 34000 \cdot (1 - r)^2 \]

\[ (1 - r)^2 = \frac{16000}{34000} \]

\[ 1 - r = \sqrt{\frac{16000}{34000}} \]

\[ r = 1 - \sqrt{\frac{16000}{34000}} \]

\[ \approx 31.4\% \text{ p.a.} \]

The average rate is approximately 31.4% p.a.  

(MP)
2. (a) (i) Min. = 8
Max. = 43
\[ \text{Med} = 21 \]
\[ Q_1 = 10 \]
\[ Q_3 = 37 \]  
Note: sufficiently accurate to clearly show the five number summary

(ii) Interquartile range \( = Q_3 - Q_1 \)
\[ = 37 - 10 \]
\[ = 27. \] (KP)

(b) (i) 

<table>
<thead>
<tr>
<th>Movie patrons who liked one or more of the presentations</th>
<th>Movie patrons aged ( \leq 30 ) years</th>
<th>Movie patrons aged ( &gt;30 ) years</th>
<th>Total surveyed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Movie patrons who did not like any of the presentations</td>
<td>68</td>
<td>88</td>
<td>156</td>
</tr>
<tr>
<td>Patron totals</td>
<td>A</td>
<td>B</td>
<td>227</td>
</tr>
</tbody>
</table>

\[ 156 - 88 = 68 \therefore A = 68 + 43 \quad \text{and} \quad B = 227 - 111 \]
\[ = 111 \quad = 112 \]

(ii) One method would be for Rosa to interview every fifth person in the queue at the ticket office.

(iii) \[ 116 - 88 = 28 \therefore \frac{28}{227} \approx 0.123 \] approximately (KP)
### Quality Control

<table>
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<th>MACHINE A</th>
<th>MACHINE B</th>
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<tr>
<td>4</td>
<td>159</td>
</tr>
<tr>
<td>23</td>
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<td>26</td>
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<tr>
<td>667</td>
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<tr>
<td>27</td>
<td>1</td>
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<tr>
<td></td>
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</tr>
</tbody>
</table>

**Key:** 27.1 = 271 g

With machine A the packaging is consistently around 240 < X < 260. Machine B is less consistent. Within this weight range, Machine A has 18/20, while machine B has 11/20. Repair machine B first.

(MP)
(a)

(i) 

The angle at B is a right angle.

\[ AC = \sqrt{(48.4^2 + 26.5^2)} \]
\[ = 55.180 \text{ n.miles} \]

AC = 55 n-miles correct to the nearest nautical mile

(ii) Mark angle C as θ

\[ \tan \theta = \frac{48.4}{26.5} \]

\[ \theta = \tan^{-1} \left( \frac{48.4}{26.5} \right) \]

\[ \approx 61^\circ 18' \]

Required bearing → 90° + 67° + 61° 16' = 218° 16'

\[ \approx 218^\circ 16' \]
(iii) Total distance travelled = AB + BC + CD

\[ = 48.4 + 26.5 + 55 \]

\[ = 129.9 \text{ n.miles} \]

Time taken = 5 hours.

Average speed = \( \frac{129.9}{5} \)

\[ = 25.98 \text{ knots} \]

\approx 26 \text{ knots.} \quad (KP) \]

(b) (ii) Magnetic bearing.

1989 to 2009 = 20 years

Variation = 20 \times 0.06'

\[ = 2' \]

Change in 2009 = 9°05' + 2'

\[ = 11°05' \]

:. Magnetic bearing = 097° - 11°05' M

\[ = 85°55' M \]

\approx 86° M

(iii) Distance \approx 12.2 \text{ cm} \text{ which translates to an arc of } 1030' \text{ along the side axis.}

\[ 1' = 1 \text{ n.mile} \quad \therefore 90' \approx 90 \text{ n.miles} \quad (KP) \]
(c) 305° T has a reverse bearing of 125° T
from Cape Lincoln. (1300 hours)

At 1430 hours the bearing of Cape Lincoln
changed to 250° T. The reverse bearing
being 070° T

Speed = 20 knots
In 1½ hours → distance travelled through
the water is 30 n.miles.

Bearing of Kings Point from the Lady Galiway
at 1430 is 06° T approximately at a
distance of 60 n.miles approximately.

Note
Allow a variation in the bearing of ± 2° as
reasonable accuracy, ie any measure
between 04° T to 08° T is reasonable.

(MP)
(a) (i) 30 days
(ii) Critical path: AGHKNP

(iii) An extra 10 days would change the critical path to BDJMN = 32 days.
So it would lead to a net increase of 2 days. (K.P.)

(b) (i) At the start, only customers A and B were waiting. This means 2 customers were waiting.

(ii) Customer I queues for 20 minutes.
So too does customer F.

(iii) \( \frac{110}{9} = 12 \frac{2}{9} \) minutes. (K.P.)
(c)

START AT A and FINISH AT G.

Path ABCBEG = 50 + 30 + 50 + 45 + 40 + 80

= 295 metres

There is a requirement to see all exhibits without repetition. The above is one way of starting and finishing as prescribed.

Entering at points other than A and exiting at points other than G will not change the spanning tree since all nodes must be visited. Hence a minimum spanning tree is sought.

(MP)
Question 5

(a) (i) Cost of shares = 6,500 \times 0.28

= $1,820

Brokerage = 5 \times 2.5\% \text{ of } $1,820

= 5 \times 0.025 \times 1,820

= $50.50

\therefore \text{ Brokerage } = $50.50

(ii) 10,000 \times $4.95 = $49,500

\text{Stamp duty} = 495 \text{ lots of } $100

= 0.6 \times 495

= $297

\text{Brokerage} = 45 + 0.025 \times 5,000

+ 0.02 \times 10,000

+ 0.015 \times 34,500

= $847.50

\text{Amount received} = \text{cost of shares} - \text{stamp duty} - \text{brokerage}

= 49,500 - 297 - 847.50

\therefore \text{ Charley received } = $48,355.50.

(KP)
(b) \[ \text{Mara's earnings} = 105 \times 2 \times 40 \]
\[ = \$8400 \text{ p.a.} \]

\[ \text{Mara's costs} = 15 \times 2 \times 40 \]
\[ = \$1200 \text{ p.a.} \]

\[ \text{Available income = earnings - costs} \]
\[ = 8400 - 1200 \]
\[ = \$7200 \text{ p.a.} \]

\[ \text{Rebate reduction} \]
\[ 0.25 \times (8400 - 282) = \$2029.50 \]

\[ \therefore \text{No rebate possible.} \]

This couple might be better off if Mara works even though they miss out on the spouse rebate – they still gain \$7200 in income.

\[ \therefore \text{Mara should accept the job.} \] (MP)