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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</table>

Characteristics of good responses

Knowledge and procedures

The majority of candidates made a satisfactory attempt at the full range of subject matter in both papers. Candidates provided good-quality responses to Questions 1 and 3 in Paper One and to Question 2 in Paper Two.

These three questions covered all strands, which again reinforced the fact that candidates generally demonstrated a sound knowledge across all topics, and were able to effectively interpret diagrams and provided all necessary calculation steps. The Navigation questions were either well done, showing a strong knowledge and understanding of this work, or poorly attempted.

Modelling and problem solving

Responses to Question 2f and Question 4e of Paper One and Question 5c of Paper Two demonstrated C level criteria showing candidates’ sound understanding across the core strands. However, the higher order criteria covering the Networks and Queuing topics were not successfully demonstrated by candidates, showing a lack of understanding of these concepts. Provision of strengths and limitations of models was quite well attempted.

Communication and justification

Many candidates appreciated the need to justify their solutions, providing correct formulas and notations within their responses. Working steps were clearly shown and concise explanations given in written responses.
Common weaknesses

Knowledge and procedures

Common errors in responses to Paper One included incorrect calculations in Question 2, an inability to interpret the graphs in Question 4 and poor income tax calculations in Question 5.

In Paper Two, the minimum spanning tree concept was poorly understood, and few candidates could draw a network diagram to correctly represent the tasks given in 4c. The queuing table in 4d was very poorly completed and most candidates did not attempt to draw the graph to represent this information. In Question 5d, candidates generally failed to correctly calculate the flat rate of interest.

Modelling and problem solving

Many candidates failed to show mathematical calculations where justification was required, such as in Question 1b (iv) where many good strengths and limitations were given but no mathematical calculations.

Communication and justification

The main failures in communication and justification were not using correct notation (writing money correctly, correct units in measurement) and the lack of organisation of information and mathematical reasoning in extended response questions such as Paper Two Question 3b.

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

Question 1

a. i. Weekly net pay = Gross pay – Deductions
   = $1500 – ($184.40 + $12.50 + $33)
   = $1500 - $230.40
   = $1269.60

   ∴ Steven’s weekly net pay is $1269.60

ii. 4 weeks gross pay = 4 × $1500
    = $6000

   Leave Loading = \(\frac{17.5}{100} \times 6000\)
   = $1050

   ∴ Steven’s annual leave loading is $1050

b. i. % commission = \(\frac{10000}{400000}\) × 100
     = 2.5%

   ∴ the agent is paid 2.5% commission.

ii. Commission = $2640 – (2 × $200)
                = $2640 – $400
                = $2240

   Number of items = \(\frac{2240}{$40}\)
   = 56 items

   ∴ the salesperson needs to sell 56 items.

c. Original price = \(\frac{896.50}{1.1}\)
                 = $815

   GST refund = $896.50 – $815
             = $81.50

   ∴ Peta’s GST refund was $81.50

d. i. Hours worked = 20 hours normal + 4 hours time-and-a-half
     = 26 hours

   Hourly rate of pay = \(\frac{291.20}{26}\)
             = $11.20

   ∴ Andrew’s hourly rate of pay is $11.20

ii. Hours at normal rate = \(\frac{291.20}{$11.20}\)
     = 26 hours

   ∴ Andrew must work 26 hours at the normal rate of pay.
Question 2

a. \[
\begin{align*}
\cos \theta &= \frac{adj}{hyp} \\
\cos \theta &= \frac{0.75}{1.3} \\
\theta &= \cos^{-1} \left( \frac{0.75}{1.3} \right) \\
\theta &= 55^\circ
\end{align*}
\]

\[
A = \frac{1}{2} bh
\]

b. i. Top Triangle: \[A = \frac{1}{2} \times 10 \times 52\]

\[A = 26m^2\]

\[A = \frac{1}{2} \times bh\]

Bottom Triangle: \[A = \frac{1}{2} \times 10 \times 6.3\]

\[A = 31.5m^2\]

Total Area = 26 + 31.5

\[= 57.5\ m^2\]

\[
V = A \times h
\]

ii. \[V = 57.5 \times 0.05\]

\[V = 2.875m^3\]

Number of bags of mulch \[= \frac{2.875}{0.25}\]

\[= 11.5\]

\[
\therefore\ \text{there are}\ 12\ \text{bags}\ \text{of mulch required.}
\]

iii. Using Pythagoras, \[c^2 = a^2 + b^2\]

\[c^2 = 6^2 + 5.2^2\]

\[c^2 = 63.04\]

\[c = \sqrt{63.04}\]

\[c = 7.939773297\]

\[c = 8\ \text{metres}\]

\[
\therefore\ \text{the length of the fence is}\ 8\ \text{metres}
\]
Question 2 continued.

c. Uluru and Darwin are the same longitude, calculating distance along Great Circle

\[
\text{Angle difference} = 25^\circ - 12^\circ \\
= 13^\circ \\
\text{Distance} = \text{angle difference} \times 111 \\
= 13 \times 111 \\
= 1443 \text{ km}
\]

\[\because\text{ the distance between Uluru and Darwin is }1443 \text{ km}\]

d. Longitude difference \[= 140^\circ + 60^\circ = 200^\circ\]

\[
\text{Time difference} = 200^\circ \times 4 \\
= 800 \text{ mins} \\
= 13 \text{ hours 20 mins}
\]

Adelaide is further East \[\therefore\text{ it is ahead of Buenos Aires}\]

\[
\text{Time in Adelaide} = 7 \text{ pm Friday} + 13 \text{ hours 20 mins} \\
= 8.20 \text{ am Saturday morning}
\]

\[\because\text{ Barry should make the phone call at }8.20 \text{ am Saturday morning}\text{ Adelaide time.}\]

e. Area of one sheet of paper: \[A = L \times B\]

\[
A = 0.21 \times 0.3 \\
A = 0.063 m^2
\]

Mass of one sheet of paper: \[M = 0.063 \times 80\]

\[
M = 5.04 g
\]

Number of sheets of paper \[
= \frac{25200}{5.04} \\
= 5000 \text{ sheets}
\]

\[\therefore\text{ there are }5000 \text{ sheets of paper in the pile.}\]
MAPS Level C:

f. Determine the number of cm\(^2\) / olive on the circular pizzas:

Area Mini:
\[ A = \pi \times 10^2 \]
\[ A = 314.16 \text{ cm}^2 \]

Ratio olives: \[ \frac{314.16}{8} = 39.27 \text{ cm}^2 / \text{ olive} \]

Area Standard:
\[ A = \pi \times 15^2 \]
\[ A = 706.86 \text{ cm}^2 \]

Ratio olives: \[ \frac{706.86}{18} = 39.27 \text{ cm}^2 / \text{ olive} \]

Area Large:
\[ A = \pi \times 20^2 \]
\[ A = 1256.6 \text{ cm}^2 \]

Ratio olives: \[ \frac{1256.6}{32} = 39.27 \text{ cm}^2 / \text{ olive} \]

\[ A = L \times B \]
Area square pizza:
\[ A = 25 \times 25 \]
\[ A = 625 \text{ cm}^2 \]

Number of olives = \[ \frac{625}{39.27} \]
\[ = 15.9 \]

\[ \therefore \textbf{16 olives} \] will be needed on the square pizza.
Question 3

a. i. Scale: 1 cm : 250 cm

1 cm : 2.5m
11 cm : 27.5m

1 cm : 2.5m
9.3 cm : 23.25m

1 cm : 2.5m
8.5 cm : 21.25m

Total fencing = 27.5 + 23.25 + 21.25
= 72 metres

∴ 72 metres of fencing will be required.

MAPS Level B:

ii. Northern fence House Any other fence

1 cm : 2.5m 1 cm : 2.5m 1 cm : 2.5m

2.4 cm : 6m 1.6 cm : 4m 0.8 cm : 2m

Pool A:

1 cm : 2.5m 1 cm : 2.5m

2.6 cm : 6.5m 2.6 cm : 6.5m

A = L × B

A = 6.5 × 6.5

A = 42.25 m²

Pool B:

1 cm : 2.5m 1 cm : 2.5m

1.3 cm : 3.25m 5.4 cm : 13.5m

A = L × B

A = 3.25 × 13.5

A = 43.875 m²

∴ the area of the largest pool possible is 43.875 m²

b. Using Pythagoras to determine if the corner is square:

\[ c^2 = a^2 + b^2 \]

1200^2 = 400^2 + 1150^2

1440000 = 1482500

∴ corner is not square as Pythagoras does not hold true.
Question 4

a. 
- the scale on the vertical axis is not at equal intervals – does not start at 0, only at 6000
- being 3-dimensional shapes makes the volume of Brand Y look much larger than the volume of Brand X

b. 
   i. 15°C
   
   ii. February
   
   iii. May, June, July, August, September

b. 
   i. 5-Number summary: 8, 11, 21, 35, 45
   
   ii. IQR = Q₃ − Q₁
        = 35 − 11
        = 24 kg

   iii. 

   ![Boxplot](image)

   -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60
   
   Weight (kg)

   

d. 
   i. Mode = 4 marks
   
   ii. Mean = 2.53
   
   Median = \( \frac{75th + 76th\text{ scores}}{2} \)
   
   \( = \frac{2}{2} \)

   ii. \( s = 1.15 \)
   
   \( \sigma_s = 1.15 \)

   iii. Number of students = \( \frac{10}{150} \times 30 \)
   
   = 2 students

   \( \therefore \) the number of students in this group expected to score five marks is 2 students

MAPS Level C:

e. Two outlier scores that need specific mention:
20 in Algebra → 55 in Geometry
95 in Algebra → 35 in Geometry

"Doing well" in algebra can be taken as an 'A' standard which is above 85.
Of the top 7 students above 85, only 4 of them also scored above 85 in Geometry.
Question 5

a. Number of days from 25 May to 20 June → 7 + 20 = 27 days

Simple Interest: \( I = Prt \)

\[
I = \$125 \times \frac{19.39}{100} \times \frac{27}{365}
\]

\[
I = \$1.79
\]

\[\therefore \text{ the amount of interest charged on the account is } \$1.79\]

b. i. Tax payable = \$3572 + 0.325 \times (\$50000-\$37000)

= \$3572 + 0.325 \times \$13000

= \$3572 + \$4225

= \$7797

\[\therefore \text{ the tax payable on } \$50000 \text{ is } \$7797\]

ii. Calculate the tax payable on \$90000:

Tax payable = \$17547 + 0.37 \times (\$90000-\$80000)

= \$17547 + 0.37 \times \$10000

= \$17547 + \$3700

= \$21247

\[
\% \text{ Increase } = \frac{\$21247 - \$7797}{\$7797} \times 100
\]

\[
= \frac{\$13450}{\$7797} \times 100
\]

\[
= 172.5\%
\]

\[\therefore \text{ the percentage increase in tax paid was } 172.5\%\]

MAPS Level A:

c. i.

**Paul:**

\[
E = \frac{(1+r)^n - 1}{n}
\]

\[
E = \frac{\left(1 + \frac{6.1}{100}\right)^4 - 1}{4}
\]

\[
E = 0.26724777
\]

\[
E = 0.0668
\]

\[
E = 6.68\% \text{ p.a. } \text{S I}
\]

**Mary:**

\[
E = \frac{(1+r)^n - 1}{n}
\]

\[
E = \frac{\left(1 + \frac{6}{12 \times 100}\right)^{4 \times 12} - 1}{4 \times 12}
\]

\[
E = \frac{\left(1 + 0.005\right)^{48} - 1}{48}
\]

\[
E = 0.270489161
\]

\[
E = 0.564\% \text{ per mth}
\]

\[
E = 0.564 \times 12
\]

\[
E = 6.76\% \text{ p.a.}
\]

\[\therefore \text{ Mary has the higher effective interest rate therefore agree that Mary has the better deal.}\]

**Strengths:**

- Mary’s deal compounds more often so money grows at a faster rate than Paul’s

**Limitations:**

- Interest rates must remain constant for 4 years
- No money was withdrawn from either investment
Paper Two

Question 1

a. \[ S = V_0 (1 - r)^n \]
\[ S = 2500 \left(1 - \frac{r}{100}\right)^3 \]
\[ S = 2500 \times 0.216 \]
\[ S = \$540 \]
\[ \therefore \text{the value of the computer is} \ \$540 \]

b. i. During \textbf{2003 or 3\textsuperscript{rd} year} of savings

ii. Remaining money = Savings - Cost of caravan
\[ = \$7200 - \$6000 \]
\[ = \$1200 \]

\[ \therefore \text{Tanya would have} \ \$1200 \text{ left.} \]

iii. 2001: \$2000
2007: \$6000

\[ A = P \left(1 + \frac{r}{100}\right)^n \]
\[ \text{\$6000} = \text{\$2000} \left(1 + \frac{r}{100}\right)^6 \]
\[ 3 = \left(1 + \frac{r}{100}\right)^6 \]
\[ 1.200936955 = 1 + \frac{r}{100} \]
\[ r = 0.200936955 \times 100 \]
\[ r = 20\% \text{p.a.} \]

\[ \therefore \text{annual rate of price increase for the caravan is} \ 20\% \text{p.a.} \]

MAPS Level A:

iv. In 2012 price of caravan was \$14800.
Using \( r = 20\% \text{p.a.} \),
Expected price in 2013 = \$14800 \times 1.2
\[ = \$17760 \]

Tanya’s savings = \$1200 per year
Expected savings in 2013 = \$13200 + \$1200
\[ = \$14400 \]

\[ \therefore \text{Tanya did} \ \text{not have sufficient money to buy the caravan in 2013:} \ \$17760 - \$14400 = \$3360 \]

Strengths:
- Can predict both savings amount and price of caravan in future
- Relationship between savings and costs clear so allows for forward planning

Limitations:
- Savings do not appear to be earning interest
- Rate of increase for caravan remains constant
- No money is withdrawn from savings
- Rate of savings remains constant
Question 2

a. i. 

<table>
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<tr>
<th>Colour</th>
<th>Tally</th>
<th>Frequency</th>
</tr>
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<tbody>
<tr>
<td>Red</td>
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<tr>
<td>Blue</td>
<td>1 1 1</td>
<td>3</td>
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<td>Green</td>
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<tr>
<td>Yellow</td>
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</tr>
<tr>
<td>Purple</td>
<td>1 1 1</td>
<td>8</td>
</tr>
</tbody>
</table>

ii. 

\[ P(\text{Blue}) = \frac{3}{24} = \frac{1}{8} \]

\[ \therefore \text{ the probability that a blue pencil will be selected is } \frac{1}{8} \]

b. 

\[ P(\text{choc, choc}) = \frac{1}{3} \times \frac{1}{3} = \frac{1}{9} \]

\[ \therefore \text{ the probability that chocolate is selected on both days is } \frac{1}{9} \]

c. i. \( A = 43 \) and \( B = 18 \)

ii. The total number of cars surveyed is \(123\) cars.

iii. Fraction of cars with female drivers = \(\frac{70}{123}\)

iv. \% of cars with female drivers with headlights on = \(\frac{8}{70} \times 100 = 11.4\%\)

\[ \therefore \text{ the percentage of female drivers with headlights on is } 11.4\% \]

d. i. 

1st selection 2nd selection

\[ \frac{3}{8} \] Female \[ \frac{2}{7} \] Female \[ \frac{5}{7} \] Male

\[ \frac{5}{8} \] Male \[ \frac{3}{7} \] Female \[ \frac{4}{7} \] Male

MAPS Level B:

ii. 

\[ P(2 \text{ females}) = \frac{3}{8} \times \frac{2}{7} = \frac{3}{28} \]

\[ \therefore \text{ the chance that Helen will } \text{not} \text{ be chosen to leave the house} \]

\[ \therefore \text{ Agree with Helen’s conclusion.} \]
ii. \(308^\circ T\)

iii. \(2013 - 1995 = 18\) years

Magnetic Variation in 2013

\[
= 8^\circ 50' + 18 \times 04'
= 8^\circ 50' + 72'
= 8^\circ 50' + 1^\circ 12'
= 10^\circ 02' E
\]

Compass bearing \(= 308^\circ - 10^\circ 02'\)

\(= 297^\circ 58'\)

\(\therefore\) the tourist boat must sail on a compass bearing of \(297^\circ 58'\)
Question 3 continued

b. Distances for all four legs of the trip:

Leg A: Lindeman Island to P: 8.3 cm → 5.7 n miles
Leg B: P to Thomas Island: 5.6 cm → 3.8 n miles
Leg C: Thomas Island to Shaw Island: 5 cm → 3.4 n miles
Leg D: Shaw Island to Lindeman Island Resort: 5 cm → 3.4 n miles

Total Distance: 29 cm → 16.3 n miles

Time of sailing: \[ T = \frac{D}{S} \]
\[ T = \frac{16.3}{8} \]
\[ T = 2.0375 \text{ hours} \]
\[ T = 2 \text{ hours 2 mins} \]

Time for stopovers: 2 hours

Expected time of arrival back at Lindeman Island Resort = 9am + 2 hours 2 mins + 2 hours = 1.02 p.m.

\[ \therefore \text{the expected time of arrival back at Lindeman Island Resort is 1.02 p.m.} \]
Question 4

a. Vertex Q

b. 

Minimum length of pipe needed is **430 metres**

c. 

d. 

<table>
<thead>
<tr>
<th>Time (mins)</th>
<th>Arrivals</th>
<th>Customer Served (Server 1)</th>
<th>Customer Served (Server 2)</th>
<th>Customers Queued</th>
<th>Queue Length</th>
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<td>Q</td>
<td>R</td>
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</tbody>
</table>
Question 4 continued

ii.

MAPS Level D:

iii. During the 15 minute interval no customer queued for more than 3 minutes. Arrivals are relatively low in the first 10 minutes, however, a backlog forms in the last 2 minutes, with Customer S exceeding the wait time of 3 minutes.
Question 5

a. Amount owed before repayment: \[ A = P(1+r)^n \]
   \[ A = 420000 \left(1 + \frac{5.75}{12 \times 100}\right) \]
   \[ A = 420000 \times 1.00475 \]
   \[ A = 421995 \]

   Amount owed after repayment = $421995 - $4000
   = $417995

   \[ \therefore \text{Bill owes } $417995 \text{ at the end of the first month.} \]

b. Total paid = $500 + 12 \times $115 \times 2
   = $500 + $2760
   = $3260

   Balance remaining = price – deposit
   = $2700 - $500
   = $2200

   Interest paid: \[ I = Prn \]
   \[ $560 = $2200 \times r \times 2 \]
   \[ r = \frac{560}{4400} \times 100 \]
   \[ r = 12.7\% \text{ p.a.} \]

   \[ \therefore \text{the annual flat rate of interest is } 12.7\% \text{ p.a.} \]

MAPS Level C:

c. \[ A = M \left(\frac{(1+r)^n - 1}{r}\right) \]
   \[ A = 200 \left(\frac{12^{-4}}{12 \times 100} \right) - 1 \]
   \[ A = 200 \left(\frac{6}{12 \times 100} \right) - 1 \]
   \[ A = 200 \left(\frac{1+0.005}{48} - 1 \right) \]
   \[ A = 200 \times 0.005 \times 54.9783222 \]
   \[ A = $10819.57 \]

   As Dave requires $10500 for his holiday, he will exceed his goal by:
   \[ $10819.57 - $10500 \]
   \[ = $319.57 \]

   \[ \therefore \text{Dave will exceed his goal by } $319.57 \]