

2011 Further Mathematics Trial Exam 2 Solutions

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Core – Data analysis

Q1a 50%

Q1b Higher, uptrend for median age.

Q1c Tasmania

Q1d $37 - 32 = +5$

Q2a Increased with age, peaked at the 35-44 age group, then decreased with age.

Q2b The missing entries are 37 and 35.

Q2c By calculator: $a \approx -0.93$, $b \approx 81$

Q2d Either
the reciprocal of percentage for education vs centre of age group, $r = 0.97$
or
percentage for education vs the reciprocal of centre of age group, $r = 0.98$

Q3a

$$a = \frac{1350 + 1300 + 1400}{3} = 1350$$

$$b = \frac{1400 + 1500 + 1450}{3} = 1450$$

Q3b The 3-year moving average shows a linear uptrend.

Q3c Predicted value $= 883.3 + 59.4 \times 1 = 942.7$

Residual $= 850 - 942.7 = -92.7$ cm

Q3d In the period 1999 – 2010, the average increase of the annual rainfall is 59.4 cm per year.

Q4a $r^2 = 0.5098$, $r = \sqrt{0.5098} \approx 0.7140$ (Note: It is reasonable to assume that the correlation is positive.)

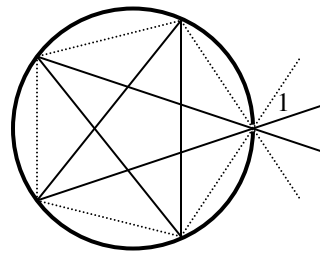
$$m = r \times \frac{s_y}{s_x} = 0.7140 \times \frac{15.3960}{5.7155} \approx 1.9233$$

$$c = \bar{y} - m\bar{x} = 71.4138 - 1.9233 \times 20.8966 \approx 31.22$$

Q4b 51% of the variation of the *atar* score can be explained by the variation of the average number of hours of study per week.

Module 2: Geometry and trigonometry

Q1a and c



$$Q1b \quad 180 - \frac{360}{5} = 108^\circ$$

Q2a The dotted line divides the quadrilateral into 2 triangles.

$$\text{For the lower triangle, } s = \frac{20 + 32 + 16}{2} = 34,$$

$$A = \sqrt{34(34 - 20)(34 - 32)(34 - 16)} \approx 130.9$$

$$\text{For the upper triangle, } s = \frac{24 + 32 + 28}{2} = 42,$$

$$A = \sqrt{42(42 - 24)(42 - 32)(42 - 28)} \approx 325.3$$

Total area of the block of land $\approx 130.9 + 325.3 \approx 456 \text{ m}^2$

Q2b Area scale factor is $(1 \text{ cm} / 5 \text{ m})^2 = 1/25 \text{ cm}^2/\text{m}^2$.

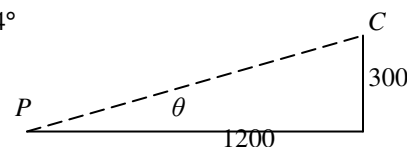
$$\text{Area of the drawing} \approx \frac{1}{25} \times 456 \approx 18 \text{ cm}^2.$$

Q2c The corner opposite to the dotted line in the lower triangle has a greater angle. Let the angle be θ .

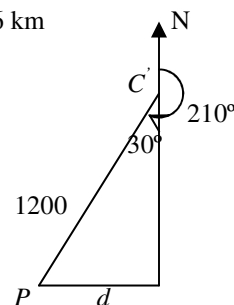
$$32^2 = 20^2 + 16^2 - 2(20)(16)\cos\theta$$

$$\cos\theta = \frac{20^2 + 16^2 - 32^2}{2(20)(16)}, \quad \theta \approx 125^\circ$$

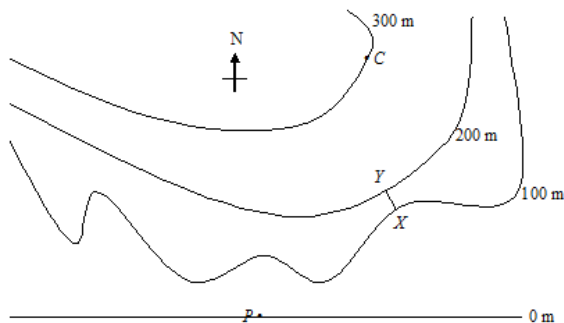
$$Q3a \quad \theta = \tan^{-1}\left(\frac{300}{1200}\right) \approx 14^\circ$$



$$Q3b \quad d = 1200 \sin 30^\circ = 600 \text{ m or } 0.6 \text{ km}$$



Q3c



Q4a Height of air = $20 - 12 = 8$ cm

air : container

Linear ratio:- 8 : 20

or 2 : 5

Volume ratio:- $2^3 : 5^3$

or 8 : 125

$\therefore$ air : container : water

8 : 125 : 117

$$\frac{\text{volume of air}}{\text{volume of water}} = \frac{8}{117}$$

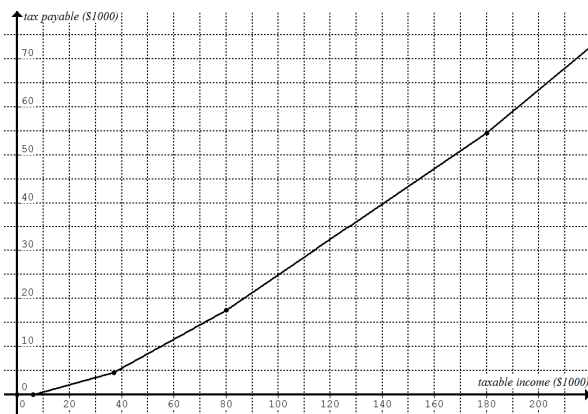
Q4b

$$\frac{\text{volume of water}}{\text{volume of pyramid}} = \frac{117}{125}$$

$$\text{Volume of water} = \frac{117}{125} \times \left(\frac{1}{3} \times 125 \times 20 \right) = 780 \text{ cm}^3$$

Module 3: Graphs and relations

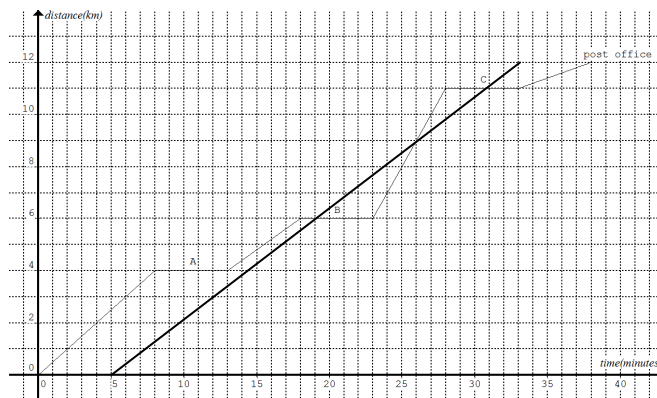
Q1a



Q1b Tax = tax on taxable income + flood levy
 $= (17550 + 0.37(120000 - 80000)) + (250 + 0.01(120000 - 100000))$
 $= 32800$ dollars

Q2a Average speed = $\frac{12}{\frac{38}{60}} \approx 19 \text{ km h}^{-1}$

Q2b At $t = 5 + 14 = 19$ minutes, the postal van was at post box B.

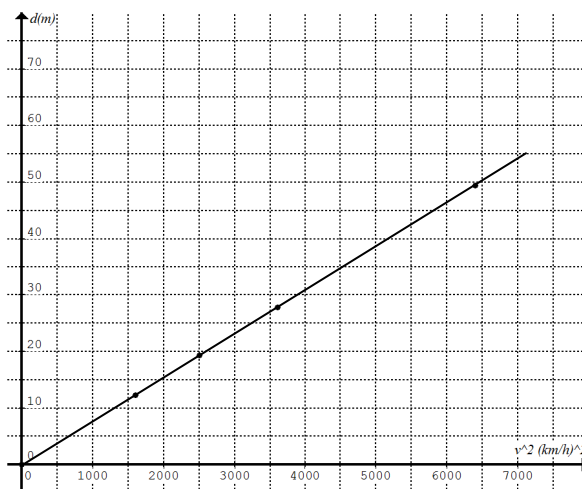


Q2c $t = 31$ min, after travelling 11 km

Q2d From the graph, 20 to 21 km h^{-1} or 29 to 60 km h^{-1}

Q3a

v	40	50	60	70	80
v^2	1600	2500	3600	4900	6400
d	12.3	19.3	27.8	37.8	49.4



Q3b d against v^2 is a straight line through the origin.

$$\therefore d \propto v^2$$

The constant of proportionality is the gradient of the line

$$= \frac{35}{4500} \approx 0.0078$$

$$\therefore d = 0.0078 v^2$$

Q4a $\frac{x}{30} + \frac{y}{60} = 1, \therefore 2x + y = 60$

$$\frac{x}{90} + \frac{y}{30} = 1, \therefore x + 3y = 90$$

Linear inequalities are:

$$x \geq 0, y \geq 0, 2x + y \leq 60, x + 3y \leq 90$$

Q4b Maximum value of P occurs at the intersection of
 $2x + y = 60$ and $x + 3y = 90$, i.e. when $x = 18$ and $y = 24$.
 $P_{\max} = 11 \times 18 + 5 \times 24 = 318$.

Module 4: Business-related mathematics

Q1a Discount = $999 - 799 = 200$

$$\% \text{ discount} = \frac{200}{999} \times 100\% \approx 20\%$$

Q1b Let $\$x$ be the discounted price without GST.
 $\therefore$ discounted price including 10% GST = $1.1x = 799$
 $\therefore x = 726.3636$
GST = $799 - 726.3636 \approx \$72.64$

Q2a By calculator.

TVM Solver:

$$N = 300$$

$$I\% = 7.25$$

$$PV = 300\,000$$

$$PMT =$$

$$FV = 0$$

$$P/Y = 12$$

$$C/Y = 12$$

Monthly repayment $\approx \$2168.42$

Q2b

TVM Solver:

$$N = 12$$

$$I\% = 7.25$$

$$PV = 300\,000$$

$$PMT = -2168.42$$

$$FV =$$

$$P/Y = 12$$

$$C/Y = 12$$

Amount owing after the first 12 months $\approx \$295584.13$

TVM Solver:

$$N =$$

$$I\% = 7.25$$

$$PV = 295584.13$$

$$PMT = -2400$$

$$FV = 0$$

$$P/Y = 12$$

$$C/Y = 12$$

$$N \approx 226.27$$

Number of months earlier $\approx 300 - 12 - 226.27 \approx 62$

Q2c Savings in interest

$$= 2168.42 \times (300 - 12) - 2400 \times 226.27 \\ \approx \$81500$$

Q3a Average % rise over the three years

$$= \frac{174.0 - 162.2}{162.2} \times 100\% \approx 7.27497\%$$

Average annual % rise over the three years

$$= 7.27497\% \div 3 \approx 2.425\%$$

$$\text{Q3b } \$100 \times \frac{172.1}{178.3} \approx \$96.52$$

$$\text{Q3c } \$96.52 \text{ plus } 3.5\% \text{ interest} = 96.52 + \frac{3.5}{100} \times 96.52 \approx \$99.90$$

$\therefore$ behind by $\$0.10$

Q4a $\$4127.00$

$$\text{Q4b Total interest} = 6257 \times \frac{5.25}{100} \times \frac{8}{12} + 4127 \times \frac{5.25}{100} \times \frac{4}{12} \\ \approx \$291$$

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