PART 1 – Algebraic Modelling

Examiners found that the main areas that candidates and teachers need to address are in the area of answering the question asked, in context and concisely. It is apparent that many candidates do not know the difference between $r$ and $r^2$ and the correct use of these statistical values. General communication also needs to be improved and rounding needs addressing. Candidate’s need to improve their understanding of residuals.

Algorithm:

\[ A = 2A, 4B, 3C \]
\[ B = 5B, 3C \]
\[ C = 6C \]

**Question 1**

a) This question was quite well done by most candidates. Common errors were that the candidates didn’t relate statements made to the question. The magnitude of the residuals were often omitted. An explanation of $r^2$ was often confused with $r$. Candidates often incorrectly commented that a pattern in the residuals indicated a good model.

b) This question was quite poorly done by most candidates. Common errors were that candidates omitted the reference to the model’s prediction and quoting a double negative. There was a general misunderstanding of what a residual is.

**Question 2**

a) (i) This question was very well done by most candidates. Some candidates neglected to write the answer as an equation.

(ii) This question was very well done by most candidates. Some candidates neglected to write the answer as an equation.

(iii) This question was very poorly done by almost all candidates. Candidates did not understand how to construct a bent revenue equation. The most common incorrect answer was $R=35x$.

b) This question was quite well done by most candidates. Candidates were able to find when the company breaks-even (26), but the common error was that candidates did not read the question and hence determine the number required to make a minimum profit (27).
c) This question was well done by some candidates. Candidates were often able to create a graph using the story without being able to construct all of the equations from part a). Common errors in graphing included lines not being labelled, break-even not being shown and candidates not recognising that a domain had been set for each equation.

Question 3

a) This question was quite well done by most candidates. Common errors were that data was not entered correctly and checked by candidates. The linear and exponential equations were omitted at times, with only the r and $r^2$ stated. The r value was often incorrectly used to back up the validity of a model rather than the $r^2$ value or residuals. Candidates commonly neglected to use the pro-numerals given in the table and didn’t round to 3 decimal places as was instructed.

b) This question was very well done by most candidates.

c) This question was very well done by most candidates.

d) This question was quite well done by most candidates. The main omission was a referral to the goodness of fit of the selected model when deciding on the reliability of interpolated predictions.

PART 2 – Calculus

Examiners found that the main areas that candidates and teachers need to address are in the area of graphing skills, and reading and interpretation of the questions asked. General communication needs to be improved, with the expected inclusion of units with all answers. When a question starts with the statement use Calculus, this infers that the solution is required to have an initial statement about max/min occurs when $\frac{dy}{dx} = 0$. Candidates should be aware that questions that include phrases such as ‘use calculus’ or ‘hence show’ require written justification. Graphs need to contain the requirements stated in the question (e.g. y-intercept, end point, zero etc.) and must also have labelled axis with units, some scale on each axis and points given as coordinates. The concept of a restricted domain was often ignored and a general graph was given.

Algorithm:
A = 3A, 3B, 3C
B = 4B, 4C
C = 5C
**Question 4**

a) This question was quite well done by most candidates. Weaker candidates could not determine the algebraic expressions. Markers expected to see an attempt to expand the expression in the last part of this section.

b) This question was very well done by most candidates.

c) This question was quite well done by most candidates. Common errors were that candidates forgot to make a statement about max occurs when $\frac{dR}{dx} = 0$ and general poor communication of the answer. Many candidates failed to read the questions properly to establish the price ($11), rather than the maximum revenue.

**Question 5**

a) This question was very poorly done by most candidates. Very few candidates could generate the expression for the width of the gutter (0.4-2x) and consequently could not find the volume. Many candidates made little or no attempt at this question.

b) This question was quite well done by most candidates. Common errors were that candidates forgot to make a statement about max occurs when $\frac{dV}{dx} = 0$ and general poor communication of the answer with incorrect units given. A common error was to find the x value (0.1 m), but not find the maximum volume. Another common error was to find the figure for the max volume (0.3 m$^3$), and then use it in some way to calculate an incorrect maximum volume (e.g. 0.1 x 0.3 = 0.03 m$^3$)

c) This question was quite poorly done by most candidates. As above, the common error was to generate an 'average speed/time'. Candidates did not read the information given in the question and failed to generate the derivative.

**Question 6**

a) This question was very well done by most candidates.

b) This question was quite well done by most candidates. A common error was to interpret this as 'average distance/time', i.e. 2/0.2 = 10 m/s rather than find the derivative $\frac{dD}{dt}$ then substitute t into this expression. Most candidates gave the correct units.

c) This question was quite poorly done by most candidates. As above, the common error was to generate an 'average speed/time'. Candidates did not read the information given in the question and failed to generate the derivative.

**Question 7**

a) This question was very well done by most candidates.
b) This question was quite poorly done by most candidates. The correct right hand end point (24, 38.72) was frequently not indicated. Another common problem was that the graph was extended beyond the given domain. It appears that many candidates had difficulty generating a graph on their calculator taking into account the given domain. Many candidates didn’t indicate the required points clearly enough.

c) This question was quite poorly done by most candidates, with very few candidates obtaining an A. The markers expected to see an expanded form of $H$ written down and $H’=0$ in order to demonstrate the use of calculus. Many candidates stopped their calculations at $x=22$, rather than finding the maximum height.

PART 3 – Applied Geometry

Some candidates appeared to have difficulty in completing the section within the time available.

Most candidates appeared be poorly prepared for the examination of this section.

Candidates found this section of the paper challenging, but the examiners agreed that the section was well within the difficulty and scope of the course. Examiners found that the main areas candidates and teachers need to focus on is communication, the general reading of the question and construction of diagrams using bearings. Candidates need to write in a well-structured manner in order to display solutions. The process was often either not shown or shown in a very convoluted manner. Candidates are advised to take the time to understand what the question is asking before commencing. A large number of candidates were able to secure a C level overall by attempting every question. In particular a C award was obtained easily by attempting an A standard question.

Algorithm:
$A = 2A, 4B, 4C$
$B = 5B, 4C$
$C = 6C$

Question 8

a) This question was very poorly done by most candidates. Common errors were that candidates assumed the distance was to the base of the cliff. They also misunderstood the angle of depression and took the angle of depression from the vertical. Some candidates drew a 3D diagram.

b) This question was quite poorly done by most candidates. Common errors were the inability to select the appropriate trig rule. Some candidates were unable to use the sine rule appropriately.
Question 9

a) This question was quite well done by most candidates. Some candidates assumed bearings were given from the mountain rather than the boat. This reversed their diagram but did not affect their answers. The selection of the correct trig ratio and transposition of the equation also caused difficulty with some candidates.

b) This question was quite well done by most candidates. Common errors were poor calculator skills and some candidates made correct substitutions but failed to evaluate correct answers. In part (ii) Many candidates expressed answer with incorrect or no units.

Question 10

a) This question was very well done by most candidates. A small number of candidates were unclear where to label the bearings on the diagram.

b) This question was very poorly done by most candidates. A common error was not being able to identify a suitable strategy for solving the question. A number of candidates applied right angle trig rules. Some candidates had an inability to transpose the sine rule. Candidates also had difficulty in being able to use the angle in the triangle to calculate the final bearing.

Question 11

a) This question was quite well done by most candidates. Many candidates selected the correct strategy however; calculator errors and poor substitution were common. Many candidates were also unable to correctly process the degrees and minutes or truncated the minutes altogether. A number of candidates confused longitude and latitude.

b) This question was very poorly done by most candidates. Candidates were unable to determine a strategy for solving this problem many attempting to find a distance to the horizon instead of treating it as an angle question. (as this was the type of question they are used to).

Question 12

a) This question was very poorly done by most candidates. Most candidates divided the longitudes by 15 rather than reading the correct time zones from the formula sheet. Another common error was many candidates specified time zones rather time difference.
b) This question was quite poorly done by most candidates. Many candidates selecting the incorrect formula. Poor substitution and inaccuracy with degrees and minutes was also a major problem.

c) This question was quite poorly done by most candidates. Many candidates neglected to change decimal hours into hours and minutes. They also omitted or subtracted the time difference. Errors were also made in adding and subtracting hours and minutes.

PART 4 – Data Analysis

Examiners found that the main areas that candidates and teachers need to address are in the area of communication and reading questions. Teachers need to focus on graphing skills; including the use of units, inclusion of scales and accuracy of construction. Teachers need to ensure that candidates show the process used in calculating answers. Teachers need to focus more on the setting out of t - tests.

Candidates need to check data entry in their calculator before preforming any statistical calculations – a process that would not take much time, but would limit the chance of data entry issues. They also need to use quantitative data to support any statements.

Algorithm:
A = 3A, 4B, 5C
B = 6B, 4C
C = 8C

Question 13

a) This question was quite poorly done by most candidates. Most candidates show a lack of precision when reading from the graph.

b) This question was quite well done by most candidates. Some candidates gave a range rather than the value. Also answers in days were given rather than as a temperature value.

c) This question was quite poorly done by most candidates. While most candidates were able to state the median, most candidates had difficulty stating what the median represents. There was also some confusion between median and mean.

Question 14

a) This question was quite well done by most candidates. Common errors included rounding off to the nearest whole number, not understanding which statistical data is used for the five figure summary and errors in data entry.
b) This question was quite poorly done by most candidates. While most candidates attempted to graph the side-by-side box-and-whisker plot there were many common errors displayed. These included not using a ruler, using an inconsistent scale, neglecting to label the axis and/or plot, and a lack of care with positioning the points (lines) for the plot.

c) This question was well done by some candidates. Candidates often failed to back up statements with quantitative data. There was some inappropriate use of other data not supplied in parts a) and b), e.g. mean. Generally not enough points were used to enable an ‘A’ rating in this question - needed to give at least 4 points, backed up with quantitative information.

**Question 15**

a) This question was quite well done by most candidates. Errors were in rounding and there was confusion between sample and population standard deviation.

b) This question was quite well done by most candidates. Errors were in rounding and there was confusion between sample and population standard deviation. New mean was at times incorrectly quoted as \( \sum x \) or mean was missed out altogether.

c) This question was well done by some candidates. Common errors were that candidates used the sample standard deviation instead of the population standard deviation. The question was often not completed or number of people not rounded to a whole number. Most successful candidates in this question constructed a diagram to help with an explanation.

d) This question was quite well done by most candidates. Common errors were that candidates used the left tail, units missed out and sample standard deviation used as in part c). Some candidates incorrectly converted 8% to 0.8 rather than 0.08

e) This question was quite well done by most candidates. Candidates often received a ‘C’ rating in this question because they could not find another limitation other than the small sample size.

**Question 16**

a) This question was quite poorly done by most candidates. While most candidates recognised that an independent means t-test was that correct one to use, many candidates were not able to state the hypotheses correctly. Symbols were given without explanations and the null hypothesis set up with < or > rather than =.
b) This question was quite poorly done by most candidates. Too many candidates did not understand what was required when stating the results. Candidates also had difficulty interpreting scientific representation of decimal numbers.

c) This question was quite poorly done by most candidates. Firstly the candidates often did not answer whether the researcher’s claim was justified or not. Poor decisions were made regarding the p value and candidates were confused on the use of greater and less than signs. Basic numeracy errors converting decimals to percentages were common.

PART 5 – Finance

All candidates need to read the questions with care and answer the questions asked as reading time has changed. They should also consider the reasonableness of their answers and make appropriate corrections. Candidates should be careful of carrying over rounding errors and in Finance all significant figures should be used until the final answer. For questions requiring written answers, candidates should include mathematical reasoning and evidence. Candidates must also recognise where they need to use the TVM/finance solver on their calculators. Ensuring they provide enough evidence to support their answer, especially when writing information from the calculator. Candidates who didn’t use their calculator were disadvantaged in some questions. Errors also occurred when putting information into the calculator. However when asked to do things algebraically candidates were assigned a t rating if they obtained the answer directly from the TVM/finance solver part of the calculator.

Algorithm:
A = 2A, 2B, 4C
B = 3B, 4C
C = 5C

Question 17

a) This question was quite well done by most candidates. Common errors were that candidates found the incorrect conversion of i and n. Candidates also had difficulty in putting the information into the formula correctly.

b) This question was quite poorly done by most candidates. Common errors were that some candidates tried to use the Simple Interest formula. Also algebraic errors were made where it was advisable to use the calculator.

Question 18

a) These questions were very well done by most candidates. Some candidates didn’t find the depreciation amount correctly as they used the incorrect depreciation rate as the question was not read carefully enough.
b) This question was quite well done by most candidates. However some candidates didn’t read the question and approximated from the graph.

c) This question was very poorly done by most candidates. Many candidates looked at the value of the machine and when it was best to sell, rather than for tax purposes. Some candidates thought they could switch between Reducing Balance and Straight Line depreciation which is not allowed by the Tax department. Once the method is determined at the start that method of depreciation is carried through to the end of that product. Candidates also failed to give support statements for their comments. Many candidates did not understand the relationship between depreciation and tax.

Question 19

a) This question was quite well done by most candidates. Some candidate didn’t use all significant figures in the interest rate. Candidates who did not use the formula and found the answer via the calculator were awarded a t rating.

b) This question was very poorly done by most candidates. A common error was that candidates misunderstood how to do the question and failed to find the interest and only found the total paid.

Question 20

a) This question was quite well done by most candidates. Most candidates approached the question correctly however many minor errors were made between I%, P/Y, C/Y.

b) This question was very poorly done by most candidates. Candidates struggled to figure out the correct approach for the question and did not demonstrate a clear understanding of the multiple steps required to answer this question. Rather than comparing the total amount paid from each scenario many candidates incorrectly looked at future values.
SUGGESTED SOLUTIONS

Question 1

a) The $r^2$ value of 0.9748 indicates that $\approx 97\%$ of the length of the flounder can be associated with the age of the fish. This is a high value, which generally indicates that the model can be reliably used to predict lengths of flounder over an age range of 0 to 15 years. On closer inspection, the final residual at age 15 years is -10. This means that using this model to predict a flounder’s length at this age would result in $\approx 12\%$ error.

The regression graph shows a distinct pattern which indicates that the power model is not suited well for modelling this data and some other type of model should be chosen.

b) The residual point (13, -5.57) means that the actual average length of a 13 year old flounder is 5.57 cm shorter that what the current model would predict.

Question 2

a) (i) Let $x$ be the number of passengers.  $C = 20x + 650 \quad \{0 \leq x \leq 50\}$

(ii) $R_1 = 45x \quad \{0 \leq x \leq 30\}$

(iii) $R_2 = 45(30) + 35(x - 30) \quad \{30 < x \leq 50\}$

$= 1350 + 35x - 1050$

$= 35x + 300$

b) Breaks even when $R_1 = C$

$45x = 20x + 650$

$25x = 650$

$x = \frac{650}{25}$

$\therefore x = 26$

The minimum number of passengers required to make a profit is 27. 

*Note: This is one more than the number required to break even.*
Question 3

a) Linear Model: \[ P = 0.051t + 0.788 \quad r^2 = 0.932 \]
Exponential Model: \[ P = 1.433(1.014)^t \quad r^2 = 0.984 \]

The best model to use is the exponential model.

One of the following three points would be required to justify your decision:
- This model results in a higher co-efficient of determination of 0.984. This means that ≈ 98% of the population can be associated with years since 1900 compared to only ≈ 93% using the linear model.
- The residual plot has a distinct pattern with the linear model, whereas the residual plot from the exponential model shows random variation.
- The data points lie closer to the exponential trend line than the linear trend line.

b) \[ P(38) = 1.433(1.014)^{38} = 2.43 \]
This model predicts the world population to be 2.43 billion in 1938.

*Note: If full display was used then the model would predict 2.45 billion.*

c) \[ 10 = 1.433(1.014)^t \]
\[ t = 139.74 \]
This model predicts the year in which the world population will be 10 billion during 2040.

*Note: If full display was used then the model would predict 137.61 years after 1900 which is during 2038. (These answers may also be interpreted as 2039 and 2037, depending on when the initial measurement was referenced, i.e. at the beginning or end of the year.)*
d) The first prediction, part b), can be considered **reliable due to interpolation of a reliable model** ($r^2 = 0.984$). The second prediction, part c), can be considered **unreliable due to such a large extrapolation** of the model.

**Question 4**

a) | Number of $\$1 Price Reductions | 0  | 1  | 2  | x  |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Price of Evening Meals ($)</td>
<td>16</td>
<td>15</td>
<td>14</td>
<td>(16 - x)</td>
</tr>
<tr>
<td>Number of Patrons</td>
<td>120</td>
<td>140</td>
<td>160</td>
<td>(120 + 20x)</td>
</tr>
<tr>
<td>Revenue ($)</td>
<td>1920</td>
<td>2100</td>
<td>2240</td>
<td>(16 - x)(120 + 20x)</td>
</tr>
</tbody>
</table>

\[
R = (16 - x)(120 + 20x) \\
= 1920 + 320x - 120x - 20x^2 \\
\therefore R = -20x^2 + 200x + 1920 \text{ as required}
\]

b) \[
\frac{dR}{dx} = -40x + 200
\]

c) Max revenue occurs when \[
\frac{dR}{dx} = 0 \\
-40x + 200 = 0 \\
x = \frac{200}{40} \\
\therefore x = 5
\]

The price of the evening meal which enables the maximum revenue is $11.

**Question 5**

a) Let \( l = 15 \), \( w = (0.4 - 2x) \) and \( h = x \)

\[
V = lwh \\
= 15(0.4 - 2x)(x) \\
\therefore V = 6x - 30x^2 \text{ as required}
\]
b) Maximum \( V \) when \( V' = 0 \)
\[
\begin{align*}
V' &= 6 - 60x \\
0 &= 6 - 60x \\
x &= \frac{-6}{-60} \\
\therefore x &= 0.1 \\
V(0.1) &= 6(0.1) - 30(0.1)^2 \\
V &= 0.3 \\
\end{align*}
\]

The maximum volume of the gutter is 0.3 m\(^3\)

**Question 6**

a) \( D = -12.5t^2 + 12.5t \)

b) \( S = -25t + 12.5 \)
\[
\begin{align*}
S(0.2) &= -25(0.2) + 12.5 \\
S &= 7.5 \\
\end{align*}
\]

The speed of the football was 7.5 m/s at \( t=0.2 \) seconds.

c) \( a = -25 \)

The acceleration is -25 m/s\(^2\).
Question 7

a) \[ H(8) = -0.01(8 - 2)^2(8 - 32) \]
\[ H = 8.64 \]
The height is 8.64 m when \( x = 8 \).

b)

![Graph of H vs x]

\[ (0, 1.28), (24, 38.72) \]

(c) Maximum height when \( H' = 0 \)

\[ H' = -0.03x^2 + 0.72x - 1.32 \]
\[ 0 = -0.03x^2 + 0.72x - 1.32 \]
\[ 0 = -0.03(x - 2)(x - 22) \]
\[ \therefore x = 2 \text{ or } x = 22 \]

Choose \( x = 22 \) as the maximum from the graph.

\[ H(22) = -0.01(22 - 2)^2(22 - 32) \]
\[ = -0.01(20)^2(-10) \]
\[ = 40 \]

The maximum height of the spillway is 40 m.
Question 8

a) 

\[ \frac{a}{\sin(A)} = \frac{b}{\sin(B)} \]

\[ x = \frac{119 \sin(10)}{\sin(9)} \]

\[ x = \frac{119 \sin(10)}{\sin(9)} \]

\[ : x = 132.09 \]

\[ h = 132.09 \sin(19) \]

\[ : h = 43.00 \]

Margaret is approximately 43 m above sea level.

b)  

\[ \sin(\theta) = \frac{h}{x} \]

\[ h = \frac{119}{\sin(9)} \]

\[ : h = 43.00 \]

Question 9

a)  

\[ \tan(\theta) = \frac{\theta}{h} \]

\[ \tan(8) = \frac{620}{x} \]

\[ x = \frac{620}{\tan(8)} \]

\[ x = 4411.53 \]

The horizontal distance from the yacht to the base of Mount Freycinet when the first measurement was taken is 4412 m.

b)  

\[ \tan(\theta) = \frac{\theta}{h} \]

\[ \tan(10) = \frac{620}{y} \]

\[ y = \frac{620}{\tan(10)} \]

\[ y = 3516.19 \]

The horizontal distance from the yacht to the base of Mount Freycinet when the second measurement was taken is 3516 m.
b) \[ a^2 = b^2 + c^2 - 2bc\cos(A) \]
\[ x^2 = 4412^2 + 3516^2 - 2(4412)(3516)\cos(40) \]
\[ x^2 = 8061330.2 \]
\[ \therefore x = 2839.25 \]

The yacht travelled 2839 m in the 10-minute interval.

c) \[ S = \frac{D}{t} \]
\[ S = \frac{2839}{10} \]
\[ \therefore S = 283.9 \]

The yacht travelled with an average speed of 283.9 m/min over the 10-minute interval. (Other answers could be 17 km/h or 4.73 m/s.)

Question 10

a) Diagram for part a), including all information required to answer part b).
b) \[
\frac{a}{\sin (A)} = \frac{b}{\sin (B)}
\]
\[
\frac{1.95}{\sin (\beta)} = \frac{1.25}{\sin (35)}
\]
\[
\sin (\beta) = \frac{1.95 \sin (35)}{1.25}
\]
\[
\sin (\beta) = 0.8948
\]
\[
\therefore \beta = 63^\circ 29'
\]

Now, \( \theta = \beta + 65^\circ \) (alternate angles)
\[
\therefore \theta = 128^\circ 29'
\]

The true bearing of point C from point B is 128^\circ 29' T

Question 11

(a) \( \cos(\theta) = \sin(LatP) \sin(LatQ) + \cos(LatP) \cos(LatQ) \cos(LongDiff) \)

Since both places are in the same hemisphere use positive latitudes.

\[
\cos(\theta) = \sin(20^\circ 16') \sin(10^\circ 42') + \cos(20^\circ 16') \cos(10^\circ 42') \cos(6^\circ 11')
\]
\[
\cos(\theta) = 0.9807
\]
\[
\therefore \theta = 11.266^\circ
\]
\[
D = 2\pi R \frac{\theta}{360}
\]
\[
D = 2\pi (6371) \frac{11.266}{360}
\]
\[
\therefore D = 1252.7
\]

The shortest distance from Airlie Beach to the tip of Cape York is 1252.7 km.

(b)

\[
\cos(\theta) = \frac{R}{R+h}
\]
\[
\cos(\theta) = \frac{6371}{6371 + 0.8}
\]
\[
\therefore \theta = 0^\circ 54' \quad \text{(nearest minute)}
\]

Latitude of the weather balloon is 19°22' S (20°16' - 0°54'). Therefore the weather balloon was at the global position of (19°22' S, 148°43’ E)
**Question 12**

a) Canberra (EST) = +10hrs GMT       Adelaide (CST) = +9.5hrs GMT

Therefore the time zone difference could be stated as either:
- Canberra is 0.5hrs ahead of Adelaide or
- Adelaide is 0.5hrs behind Canberra.

b) \[ D = 60\theta \cos(\alpha) \quad \text{where } \alpha = 35^\circ 10' \text{ and } \theta = 10^\circ 48' \]
\[ D = 60(10^\circ 48')\cos(35^\circ 10') \]
\[ \therefore D = 529.73 \]
It is 529.73 nautical miles from Adelaide to Canberra heading directly east.

\[ \text{Travel Time} = \frac{\text{Distance}}{\text{Speed}} \]
\[ \text{Travel Time} = \frac{529.73}{245} \]
\[ \text{Travel Time} = 2\text{hrs 10mins} \]

\[ \text{ETA} = \text{Departure Time} + \text{Travel Time} \pm \text{Standard Time Difference} \]
\[ \text{ETA} = 1015 + 0210 + 0030 \]
\[ \text{ETA} = 1255 \]
The ETA for the plane is 12:55pm on Monday.

c) The ETA for the plane is 12:55pm on Monday.

**Question 13**

a) \( 345 - 250 = 95 \text{ days.} \)

b) IQR: \( 21^\circ \text{C} - 14^\circ \text{C} = 7^\circ \text{C} \)

c) Median is 17.5°C. This means that 50% of the time, the maximum daily temperature was less than or equal to 17.5°C.
Question 14

   Elderly: 19, 23.5, 31, 38.5, 50.

b)

[c] At least four points were required with quantitative justification. For example:
   • All of the five figure values for the elderly are greater than for the young.
   • The median for elderly is 10.5 mm higher than for young.
   • 50% of elderly people studied moved a greater amount than all of the young people studied.
   • The young group had a smaller range (17 mm) compare to the elderly group (31 mm).
   • The young group's IQR was 7.5 mm, half a large as the elderly group's IQR (15 mm).
   • Over 25% of the young people studied moved less than any of the elderly people studied.
   • The young's maximum of 31 was equal to the elderly's median.

Question 15

a) \( \bar{x} = 42.5 \text{ mg/L} \quad \delta_x = 9.51 \text{ mg/L} \)

b) \( \mu = 42.5 \text{ mg/L} \quad S_x = 9.93 \text{ mg/L} \)

c) 

\( p(X > 30) = \text{normalCDf}(30, \infty, 9.93, 42.5) \)

\( p(X > 30) = 0.8960 \)

\[ n = 0.8960 \times 1500 \]

\[ n = 1344 \]
1344 out of the 1500 people would have the antibiotic at an effective concentration level after 2 hours.

d)

\[ X = \text{invNormCDF}(R, 0.08, 9.93, 42.5) \]

\[ X = 56.45 \]

This level would be 56.45 mg/L.

e) Two limitations are far too small a sample size to extrapolate to the greater population and the sample was from a small town – not a representative sample of the greater population. Many questions relating to how the sample was chosen could be mentioned here – location, groupings, etc. No mention of random sampling.

**Question 16**

2 Sample t-Test

a) \( H_0: \mu_1 = \mu_2 \) (There is no difference between the size of cuckoo eggs found in robin and wren nests, on average.)

\( H_1: \mu_1 > \mu_2 \) (Cuckoo eggs found in robin nests are larger than those found wren nests, on average).

b) \( \bar{x}_1 = 22.4 \text{ mm} \quad \bar{x}_2 = 20.96 \text{ mm} \quad p = 3.83 \times 10^{-4} \) (0.000383)

c) If there is no difference between the size of cuckoo eggs found in robin and wren nests, then the probability of obtaining samples with means of 22.4 and 20.96 is 0.0383%. Since \( p < 5\% \) we reject \( H_0 \) and conclude that cuckoo eggs found in robin nests are larger than those found in wren nests. The researcher’s claim is justified.

**Question 17**

a) \( A = P(1 + i)^n \) where \( P = 4500, \quad i = \frac{0.0625}{12} \) and \( n = 36 \)

\[ A = 4500(1 + \frac{0.0625}{12})^{36} \]

\[ A = 5425.50 \]

The balance is $5425.40 after three years.
b) \[ A = P(1 + i)^n \]
\[ 40 = 20(1 + i)^2 \]
\[ i = 0.2649 \] (solve on calculator)
The rate of increase was 26.49\% p.a.

or Using TVM

\begin{center}
\begin{tabular}{|l|}
\hline
\textbf{Compound Interest} \\
\hline
\hline
\textbf{N} & 2 \\
\hline
\textbf{I/Y} & 26.49105641 \\
\hline
\textbf{P/Y} & 1 \\
\hline
\textbf{F/V} & 0 \\
\hline
\textbf{C/Y} & 1 \\
\hline
\end{tabular}
\end{center}

\textbf{Question 18}

a) \[ V = C - Dn \] where \( C = 80000, \ D = 12000 \) and \( n = 3 \)
\[ V = 80000 - 12000(3) \]
\[ V = 44000 \]
The book value would be $44000 after three years using a straight line method of 15\% p.a.

b) \[ A = P(1 - i)^n \] where \( P = 80000, \ i = 0.20 \) and \( n = 3 \)
\[ A = 80000(1 - 0.2)^3 \]
\[ A = 40960 \]
The book value would be $40960 after three years using a reducing balance method of 20\% p.a.

c) Using CAS calculator:
solve\((80000(1 - 0.2)^x = 80000 - 12000x)\)
Ans: \{0, 3.8312\}

The two depreciation methods produce the same book value at 3.8312 years.

d) The type of depreciation model that should be used depends on the period of time that an item is to be depreciated over. The two methods of deprecation given here produce the
same book value at ~3.8 years. The graph shows that the reducing balance method produces a lower book value under 3.8 years whereas the straight line method produces a lower book value after this time. This is backed up by the calculations in parts a) and b), where the reducing balance method gives a lower book value of $40960 after three years. A lower book value at the end of the depreciation period will enable an overall greater claim against tax. Therefore if Sally wishes to depreciate the new machine for only 1 – 3 years, then she should use the reducing balance method, otherwise she should use the straight line method. She will be able to claim the total cost of the machine in 7 years using the straight line method.

Question 19

a) \[ F = \frac{R(1+i)((1+i)^n-1)}{i} \]
\[ 1500000 = \frac{R(1+0.075/12)((1+0.075/12)^{540} -1)}{(0.075/12)} \]
\[ 1500000 = R(4494.95) \]
\[ R = \frac{1500000}{4494.95} \]
\[ R = 333.71 \]
Maali needs to invest $333.71 per month to achieve her goal.

b) The total amount invested is $180203.40 (540 x$ 333.71)
Value of investment after 45 years is $150000
The total interest would be expected to be $1319796.60 ($1500000 – $180203.40)
Question 20

a) Using TVM

Amount remaining assuming $1017.77 is the exact payment required over 25 years.

**ACTUAL AMOUNT REMAINING**

(Method 1)

Amount Remaining = $309455.73

(Method 2)

Amount Remaining = $309453.98

b) Using TVM (and method 1 above)

There are 477.59 payments required at the new interest rate, while there were 598 payments required at the original interest rate.

This means a saving of 120.41 payments @ $1017.77 per payment – a total saving of $122549.69
## Award Distribution

<table>
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<th>EA</th>
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<th>CA</th>
<th>SA</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>This year</td>
<td>9%</td>
<td>18%</td>
<td>38%</td>
<td>35%</td>
<td>1513</td>
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<tr>
<td>Last year</td>
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<td>21%</td>
<td>37%</td>
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<td>19%</td>
<td>39%</td>
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<tr>
<td>Previous 5 years</td>
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<td>18%</td>
<td>37%</td>
<td>35%</td>
<td></td>
</tr>
<tr>
<td>Previous 5 years (all examined subjects)</td>
<td>11%</td>
<td>19%</td>
<td>40%</td>
<td>30%</td>
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## Student Distribution (SA or better)

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<th>Year 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>This year</td>
<td>47% (712)</td>
<td>53% (801)</td>
<td>64% (974)</td>
<td>36% (539)</td>
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<tr>
<td>Last year</td>
<td>49% (731)</td>
<td>51% (768)</td>
<td>59% (876)</td>
<td>41% (621)</td>
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<tr>
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<td>47%</td>
<td>53%</td>
<td>51%</td>
<td>49%</td>
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