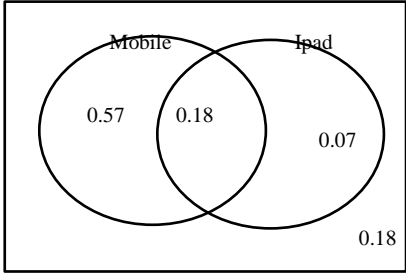
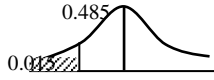


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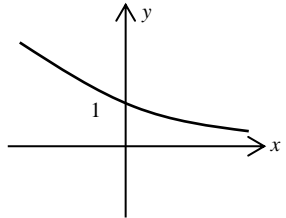
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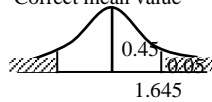
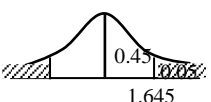
| Probability |  |   |  |  |   |
|-------------|--|---|--|--|---|
| Item Number | Solution   | Skill Level   |  |  |   |
|             |  | 1   | 2  | 3  | 4 |
| 1.1         | D  | Correct Choice, D   |  |  |   |
| 1.2         | <b>Independent events</b> are events whose occurrence is not dependent on any other event  | Correct definition  |  |  |   |
| 1.3         |  <p>Probability = <math>0.57 + 0.07</math><br/>= 0.64</p>   | One of the following <ul style="list-style-type: none"> <li>• Draws the Venn diagram without probabilities or incorrect probabilities</li> <li>• Finds or fills one of the probabilities correctly</li> </ul>   | Two of the following <ul style="list-style-type: none"> <li>• Draws the Venn diagram</li> <li>• Finds or fills two probabilities correctly</li> </ul>  | Correct answer [ allow for slips]  |   |
| 1.4a        | <b>Properties</b> <ul style="list-style-type: none"> <li>• Symmetrical</li> <li>• Unimodal</li> <li>• Mean, median and mode are equal</li> <li>• Total area under the curve is 1</li> </ul>  | Gives one of the properties   |  |  |   |
| 1.4b        | C  | Correct choice, C   |  |  |   |
| 1.4c        | $p = 0.8, n = 5, q = 0.2$<br>$P(X \geq 3) = [P(X = 3) + P(X = 4) + P(X = 5)]$<br>$= \left[ \binom{5}{3} 0.8^3 0.2^2 + \binom{5}{4} 0.8^4 0.2^1 + \binom{5}{5} 0.8^5 0.2^0 \right]$<br>$= 0.2048 + 0.4096 + 0.32768$<br>$= 0.94208$ | <ul style="list-style-type: none"> <li>• Identifies p or q or n correctly</li> <li>• Identifies correct probability interval</li> <li>• Identifies correct formula</li> <li>• Finds one correct probability value<br/><math>X = 3</math> or <math>X = 4</math> or <math>X = 5</math></li> </ul> | <ul style="list-style-type: none"> <li>• Identifies p or q or n correctly</li> <li>• Identifies correct probability interval</li> <li>• Identifies correct formula</li> <li>• Finds two correct probability values<br/><math>X = 3</math> or <math>X = 4</math> or <math>X = 5</math></li> </ul> | Finds all three correct probability values and adds them to get correct answer obtained using correct formula [ allow for slips] |   |

| Probability |   |   |  |  |  |
|-------------|---|---|--|--|--|
| Item Number | Solution  | Skill Level   |  |  |  |
|             |   | 1   | 2  | 3  | 4  |
| 1.5a        | C   | Correct choice, C   |  |  |  |
| 1.5b        | <b>Standard deviation</b> is the square root of variance or it is the measure of spread   | Correct definition  |  |  |  |
| 1.5c        | $E(X) = \sum x P(x)$ $= 1(0.1) + 2(0.3) + 3(0.2) + 4(0.3) + 5(0.1)$ $= 3$   | One of the following <ul style="list-style-type: none"> <li>Identifies correct formula</li> <li>Finds at least one term correctly</li> </ul>  | Correct answer obtained using correct formula<br><i>[ allow for slip]</i>  |  |  |
| 1.5d        | $Var(X) = E(X^2) - [E(X)]^2$ $= [0.1(1)^2 + 0.3(2)^2 + 0.2(3)^2 + 0.3(4)^2 + 0.1(5)^2] - 3^2$ $= 10.4 - 9$ $= 1.4$ $\sigma = \sqrt{1.4} = 1.18$   | One of the following <ul style="list-style-type: none"> <li>Identifies correct formula</li> <li>Finds <math>E(X^2)</math> correctly</li> <li>Finds <math>[E(X)]^2</math> correctly</li> </ul>             | Correct answer obtained using correct formula<br><i>[ allow for slip]</i>  |  |  |
| 1.6         | $P = 0.485, Z = 2.17$ $Z = \frac{x - \mu}{\sigma}$ $-2.17 = \frac{x - 7.2}{2.2}$ $-4.774 = x - 7.2$ $x = 2.426$ <p><i>Guarantee period = 2.43 years</i></p>  | One of the following <ul style="list-style-type: none"> <li>Finds correct Z value</li> <li>Draws the normal curve with the values</li> <li>Finds 0.485</li> <li>Identifies the correct formula</li> </ul> | Two of the following <ul style="list-style-type: none"> <li>Finds correct Z value</li> <li>Draws the normal curve with the values</li> <li>Finds 0.485</li> <li>Identifies the correct formula</li> <li>Correctly substitutes</li> </ul> | Three of the following <ul style="list-style-type: none"> <li>Finds correct Z value</li> <li>Draws the normal curve with the values</li> <li>Finds 0.485</li> <li>Identifies the correct formula</li> <li>Correctly substitutes</li> </ul> | Correct probability obtained using correct formula <i>[Allow for slip]</i> |

## Modelling Using Graphical Methods

| Item Number | Solution   | Skill Level   |   |   |   |
|-------------|--|---|---|---|---|
|             |  | 1   | 2   | 3   | 4 |
| 2.1         | Features of quadratic function <ul style="list-style-type: none"> <li>• General form <math>y = ax^2 + bx + c</math></li> <li>• Graph is a parabola</li> <li>• The highest power of x or independent variable is 2</li> <li>• The graph is symmetrical</li> </ul> | Gives one of the features listed  |   |   |   |
| 2.2         | A <b>discontinuous function</b> is a function with breaks or gaps in its graph.  | Correct definition  |   |   |   |
| 2.3a        | The general form of a powerfunction is $y = ax^n$ , where $x$ and $y$ are variables and $n$ is any real number   | Correct answer (note that different variables can be used, e.g. $S = ax^b$ ; what is important is that the function is power function   |   |   |   |
| 2.3b        | $f(1) + 1 = 2 + 1$<br>$= 3$  | Finds $f(1)$ correctly:<br>$f(1) = 2$   | Correct answer  |   |   |
| 2.4         | $y = \begin{cases} -1, & x < -1 \\ -x, & -1 \leq x < 0 \\ 1, & 0 \leq x < 1 \end{cases}$   | One of the following <ul style="list-style-type: none"> <li>• Finds one equation with/without restrictions correctly</li> <li>• <math>-1, x &lt; -1</math></li> <li>• <math>-x, -1 \leq x &lt; 0</math></li> <li>• <math>1, 0 \leq x &lt; 1</math></li> </ul> | Two of the following <ul style="list-style-type: none"> <li>• Finds two equation with/without restrictions correctly</li> <li>• <math>-1, x &lt; -1</math></li> <li>• <math>-x, -1 \leq x &lt; 0</math></li> <li>• <math>1, 0 \leq x &lt; 1</math></li> </ul> | All Correct equations with correct conditions |   |
| 2.5a        |   | Correct shape of the graph with y intercept at (0, 1)   |   |   |   |

| Modelling Using Graphical Methods |   |  |   |                                    |   |  |
|-----------------------------------|---|--|---|------------------------------------|---|--|
| Item Number                       | Solution  | Skill Level  |   |                                    |   |  |
|                                   |   | 1  | 2   | 3                                  | 4 |  |
| 2.5b                              | $2^x = 32$<br>$\log(2^x) = \log 32$<br>$x \log 2 = \log 32$<br>$x = \frac{\log 32}{\log 2}$<br>$= 5$                | Using same base<br>$2^x = 32$<br>$2^x = 2^5$<br>$x = 5$                      | One correct idea<br><ul style="list-style-type: none"> <li>Takes log or ln of both sides</li> <li>Equates to same base</li> </ul> | Correct answer with correct method |   |  |
| 2.6a                              | Solve $N = 100$<br>$100 = 10e^{1.5t}$<br>$t = \frac{\ln\left(\frac{100}{10}\right)}{1.5}$<br>$= 1.54 \text{ hours}$ | Starting to solve the equation by letting $N = 100$ (Cannot proceed further) | Correct answer obtained through correct method [ allow for slips]   |                                    |   |  |
| 2.6b                              | <b>Objective function</b> is a function that is to be maximized or minimized subject to the constraints.            | Correct definition   |   |                                    |   |  |
| 2.7a                              | <b>Vertex</b><br>The corner points of feasible region where maximum and minimum values occur.                       | Correctly states the definition  |   |                                    |   |  |
| 2.7b                              | $x \geq 0$<br>$y \geq 0$<br>$2x + 0.5y \leq 15$<br>$x + y \leq 10$  | Any one constraint correct   | Any two constraints correct   |                                    |   |  |

| Statistical Investigations |   |  |   |  |   |
|----------------------------|---|--|---|--|---|
| Item Number                | Solution  | Skill Level  |   |  |   |
|                            |   | 1  | 2   | 3  | 4 |
| 3.1a                       | A   | Correct choice, A  |   |  |   |
| 3.1b                       | <b>Properties</b> <ul style="list-style-type: none"> <li>It is number without any units</li> <li>The numerical value ranges between -1 and 1</li> <li>A negative value suggests the relationship is strong and negative and when r approaches 1, it means the relationship is strong and positive</li> <li>It measures a linear relationship between 2 variables</li> </ul> | Any one correct property   |   |  |   |
| 3.2                        | <b>Central Limit theorem</b><br>states that the mean of all the given samples of a population is the same as the mean of the population (approx) if the sample size is sufficiently large enough with a finite variation  | States the theorem   |   |  |   |
| 3.3                        | There is strong and positive relationship between hours studied and the midterm score. This means that as the number of hours studied increase, the midterm score also increases.   | Only gives one idea e.g. the strength (strong or positive) without any description.  | Gives the two features of the description (strong strength with positive relationship) with a statement between the 2 variables.  |  |   |
| 3.4                        | For 95 % Confidence level, $Z = 1.96$<br>$MOE = Z \times \frac{\sigma}{\sqrt{n}}$ $1 = 1.96 \times \frac{7}{\sqrt{n}}$ $n = 188.23$ $\therefore n = 189$  | One of the following <ul style="list-style-type: none"> <li>Correct Z value</li> <li>Correct formula</li> <li>Correct substitution</li> </ul>  | Correct answer using correct formula  |  |   |
| 3.5                        | For 90 % Confidence level, $Z = 1.645$<br>$\sigma = 44, n = 144, \bar{X} = 680$<br>$\bar{X} \pm Z \times \sigma_{\bar{x}} = 680 \pm 1.645 \times 44$ $= 680 \pm 72.38$ $\therefore 607.62 < \mu < 752.38$ 90% confident that the weight of coconuts lies between 607.62 and 752.38 grams  | One of the following <ul style="list-style-type: none"> <li>Identifies correct Z value</li> <li>Correct formula</li> <li>Correct <math>\sigma</math> value</li> <li>Correct n value</li> <li>Correct mean value</li> <li>  </li> </ul> | Two of the following <ul style="list-style-type: none"> <li>Identifies correct Z value</li> <li>Correct formula</li> <li>Correct <math>\sigma</math> value</li> <li>Correct n value</li> <li>Correct mean</li> <li>  </li> </ul> | Correct answer using correct formula and method [ allow for slips] |   |

| Numerical and Algebraic Methods |  |  |   |   |   |
|---------------------------------|--|--|---|---|---|
| Item Number                     | Solution   | Skill Level  |   |   |   |
|                                 |  | 1  | 2   | 3   | 4 |
| 4.1                             | Infinitely many solutions or one/unique solution or no solution  | Any one correct idea   |   |   |   |
| 4.2                             | <b>Advantages of the Bisection method</b> <ul style="list-style-type: none"> <li>• Always convergent</li> <li>• Easy to understand</li> <li>• Does not involve complex calculations</li> <li>• Fast in case of multiple roots</li> <li>• Guaranteed error bound</li> </ul>   | Any one correct idea   |   |   |   |
| 4.3                             | $12x + 3y = 180$<br>$8x + 3y = 124$  | Any one equation correct   | Both equations correct  |   |   |
| 4.4                             | $(5x + y = 4) \times 3$ <i>To find y, substitute in one</i><br>$+ (2x - 3y = 5)$ <i>equation</i> $5(1) + y = 4$<br>$17x = 17$ $y = 4 - 5$<br>$x = 1$ $y = -1$<br><br>Since the lines intersect at one point thus it has only one solution  | One of the following <ul style="list-style-type: none"> <li>• Finds the value of x or y</li> <li>• Starts to solve the equations by multiplying equation 1 by 2</li> </ul>       | Gives the nature as well as describes the type of solution.   |   |   |
| 4.5                             | $x + y - z = 4$ $2(x + y - z = 4)$<br>$-(x - 2y + 3z = -6)$ $-(2x + 3y + z = 7)$<br>$3y - 4z = 10$ $-y - 3z = 1$<br><br>$3y - 4z = 10$ $3y - 4z = 10$<br>$+ [(-y - 3z = 1) \times 3]$ $3y - 4(-1) = 10$<br>$-13z = 13$ $3y = 6$<br>$z = -1$ $y = 2$<br><br>$x + y - z = 4$<br>$x + 2 - (-1) = 4$<br>$x + 3 = 4$ $\therefore (x, y, z) = (1, 2, -1)$<br>$x = 1$ | Any one of the following <ul style="list-style-type: none"> <li>• Eliminates one variable to get one equation in 2 variables</li> <li>• Finds any one value x, y or z</li> </ul> | Both of the following <ul style="list-style-type: none"> <li>• Eliminates one variable to get one equation in 2 variables</li> <li>• Finds any two values from x, y or z</li> </ul> | Correct answer using correct method [Allow for slips] |   |

| Numerical and Algebraic Methods |   |   |                                  |                                    |   |
|---------------------------------|---|---|----------------------------------|------------------------------------|---|
| Item Number                     | Solution  | Skill Level   |                                  |                                    |   |
|                                 |   | 1   | 2                                | 3                                  | 4   |
| 4.6                             | $f'(x) = 4x^3 - 15x^2 + 9$ $x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$ $x_1 = 5 - \frac{5^4 - 5(5)^3 + 9(5) + 3}{4(5)^3 - 15(5)^2 + 9}$ $= 4.641791045$ $x_2 = 4.537543959$ $x_3 = 4.528973727$ $x_4 = 4.52891796$ | One of the following <ul style="list-style-type: none"> <li>• Identifies correct formula</li> <li>• Computes one iterative correctly</li> <li>• Finds the derivative correctly</li> </ul> | Computes two iterative correctly | Computes three iterative correctly | Correct answers using correct formula and method <i>[Allow for slips]</i> |