

# Mark Scheme (Results)

## January 2008

GCE

GCE Mathematics (6683/01)

January 2008  
6683 Statistics S1  
Mark Scheme

Question Number	Scheme	Marks
<p>1. (a)</p> <p>(b)</p>	$\sum x = 773, \sum y = 724$ $r = \frac{10 \times 56076 - 773 \times 724}{\sqrt{(10 \times 60475 - 773^2)(10 \times 53122 - 724^2)}} \quad \text{o.e.}$ $r = 0.155357 \dots$ <p>Both weak correlation Neither score is a good indication of future performance Interview test is slightly better since correlation is positive</p>	<p><b>B1, B1</b></p> <p><b>M1 A1ft</b></p> <p><b>A1</b></p> <p><b>(5)</b></p> <p><b>B1g B1h</b></p> <p><b>(2)</b></p> <p><b>Total 7 marks</b></p>
<p>NB</p> <p>(a)</p> <p>(b)</p>	$S_{xx} = 60475 - \frac{(773)^2}{10} = 722.1, \quad S_{yy} = 53122 - \frac{(724)^2}{10} = 704.4, \quad S_{xy} = 56076 - \frac{773 \times 724}{10} = 110.8$ <p>1<sup>st</sup> B1 for <math>\sum x</math> and 2<sup>nd</sup> B1 for <math>\sum y</math>, should be seen or implied.</p> <p>M1 for at least one correct attempt at one of <math>S_{xx}</math>, <math>S_{yy}</math> or <math>S_{xy}</math> and then using in the correct formula</p> <p>1<sup>st</sup> A1ft for a fully correct expression. (ft their <math>\sum x</math> and their <math>\sum y</math>) or 3 correct expressions for <math>S_{xx}</math>, <math>S_{xy}</math>, and <math>S_{yy}</math> but possibly incorrect values for these placed correctly in <math>r</math>.</p> <p>2<sup>nd</sup> A1 for awrt 0.155</p> <p>If <math> r  &gt; 0.5</math> they can score B1g in (b) for saying that it (skills test) is not a good guide to performance but B0h since a second acceptable comment about both tests is not possible.</p> <p>Give B1 for one correct line, B1B1 for any 2. If the only comment is the test(s) <u>are</u> a good guide: scores B0B0 If the only comment is the tests are not good: scores B1B0 (second line)</p> <p>The third line is for a comment that suggests that the interview test is OK but the skills test is not since one is positive and the other is negative.</p> <p>Treat 1<sup>st</sup> B1 as B1g and 2<sup>nd</sup> as B1h</p> <p>An answer of “no” alone scores B0B0</p>	

Question Number	Scheme	Marks
<p>2.</p> <p>(a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p>	<p>mean is <math>\frac{2757}{12}, = 229.75</math>      AWRT 230</p> <p>sd is <math>\sqrt{\frac{724961}{12} - (229.75)^2}, = 87.34045</math>      AWRT 87.3</p> <p>[Accept <math>s =</math> AWRT 91.2]</p> <p>Ordered list is: 125, 160, 169, 171, 175, 186, 210, 243, 250, 258, 390, 420</p> <p><math>Q_2 = \frac{1}{2}(186 + 210) = 198</math></p> <p><math>Q_1 = \frac{1}{2}(169 + 171) = 170</math></p> <p><math>Q_3 = \frac{1}{2}(250 + 258) = 254</math></p> <p><math>Q_3 + 1.5(Q_3 - Q_1) = 254 + 1.5(254 - 170), = 380</math>      Accept AWRT (370-392)</p> <p>Patients <math>F</math> (420) and <math>B</math> (390) are outliers.</p> <p><math>\frac{Q_1 - 2Q_2 + Q_3}{Q_3 - Q_1} = \frac{170 - 2 \times 198 + 254}{254 - 170}, = 0.\dot{3}</math>      AWRT 0.33</p> <p>Positive skew.</p>	<p><b>M1, A1</b></p> <p><b>M1, A1</b></p> <p>(4)</p> <p><b>B1</b></p> <p><b>B1</b></p> <p><b>B1</b></p> <p>(3)</p> <p><b>M1, A1</b></p> <p><b>B1ft B1ft</b></p> <p>(4)</p> <p><b>M1, A1</b></p> <p><b>A1ft</b></p> <p>(3)</p> <p><b>Total 14 marks</b></p>
<p>(a)</p> <p>NB</p> <p>(b)</p> <p>S.C.</p> <p>(c)</p> <p>(d)</p>	<p>1<sup>st</sup> M1 for using <math>\frac{\sum x}{n}</math> with a credible numerator and <math>n = 12</math>.</p> <p>2<sup>nd</sup> M1 for using a correct formula, root required but can ft their mean</p> <p>Use of <math>s = \sqrt{8321.84...} = 91.22...</math> is OK for M1A1 here.</p> <p><b>Answers only from a calculator in (a) can score full marks</b></p> <p>1<sup>st</sup> B1 for median= 198 only, 2<sup>nd</sup> B1 for lower quartile 3<sup>rd</sup> B1 for upper quartile</p> <p>If all <math>Q_1</math> and <math>Q_3</math> are incorrect but an ordered list (with <math>\geq 6</math> correctly placed) is seen and used then award B0B1 as a special case for these last two marks.</p> <p>M1 for a clear attempt using their quartiles in given formula,</p> <p>A1 for any value in the range 370 - 392</p> <p>1<sup>st</sup> B1ft for any one correct decision about <math>B</math> or <math>F</math> - ft their limit in range (258, 420)</p> <p>2<sup>nd</sup> B1ft for correct decision about both <math>F</math> and <math>B</math> - ft their limit in range (258, 420)</p> <p>If more points are given score B0 here for the second B mark.</p> <p>( Can score M0A0B1B1 here)</p> <p>M1 for an attempt to use their figures in the correct formula – must be seen (<math>\geq 2</math> correct substitutions)</p> <p>1<sup>st</sup> A1 for AWRT 0.33</p> <p>2<sup>nd</sup> A1ft for positive skew. Follow through their value/sign of skewness .</p> <p>Ignore any further calculations.</p> <p>“positive correlation” scores A0</p>	

3.

Width	1	1	4	2	3	5	3	12
Freq. Density	6	7	2	6	5.5	2	1.5	0.5

$0.5 \times 12$  or 6

Total area is  $(1 \times 6) + (1 \times 7) + (4 \times 2) + \dots = 70$

$$(90.5 - 78.5) \times \frac{1}{2} \times \frac{140}{\text{their } 70}$$

“70 seen anywhere”

Number of runners is 12

**M1**

**A1**

**M1**

**B1**

**A1**

**(5)**

**Total 5 marks**

1<sup>st</sup> M1 for attempt at width of the correct bar (90.5 - 78.5)  
[Maybe on histogram or in table]

1<sup>st</sup> A1 for  $0.5 \times 12$  or 6 (may be seen on the histogram. Must be related to the area of the bar above 78.5 - 90.5.

2<sup>nd</sup> M1 for attempting area of correct bar  $\times \frac{140}{\text{their } 70}$

B1 for 70 seen anywhere in their working

2<sup>nd</sup> A1 for correct answer of 12.

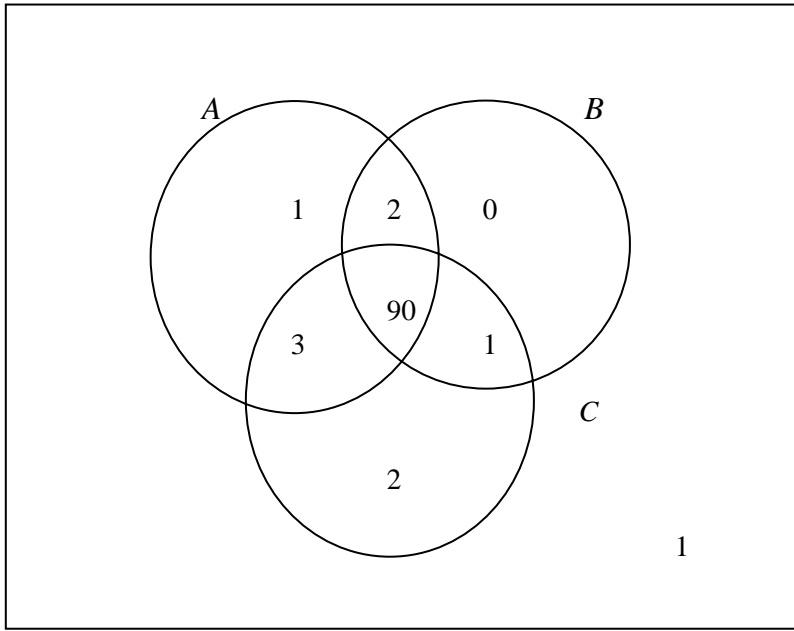
Minimum working required is  $2 \times 0.5 \times 12$  where the 2 should come from  $\frac{140}{70}$

Beware  $90.5 - 78.5 = 12$  (this scores M1A0M0B0A0)

Common answer is  $0.5 \times 12 = 6$  (this scores M1A1M0B0A0)

If unsure send to review e.g.  $2 \times 0.5 \times 12 = 12$  without 70 being seen

<p>4.</p> <p>(a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p>	$S_{xy} = 1818.5 - \frac{41 \times 406}{10}, = 153.9$ <p>(could be seen in (b))</p> $S_{xx} = 188 - \frac{41^2}{10} = 19.9$ <p>(could be seen in (b))</p> $b = \frac{153.9}{19.9}, = 7.733668....$ $a = 40.6 - b \times 4.1 (= 8.89796....)$ $y = 8.89 + 7.73x$ <p>A typical car will travel 7700 miles every year</p> $x = 5, y = 8.89 + 7.73 \times 5 (= 47.5 - 47.6)$ <p>So mileage predicted is</p> <p style="text-align: right;">AWRT 48000</p>	<p>AWRT 154</p> <p>AWRT 7.73</p> <p>AWRT 48000</p> <p>M1, A1</p> <p>A1</p> <p>M1, A1</p> <p>M1</p> <p>A1</p> <p>B1ft</p> <p>M1</p> <p>A1</p> <p>(3)</p> <p>(4)</p> <p>(1)</p> <p>(2)</p> <p><b>Total 10 marks</b></p>
<p>(a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p>	<p style="text-align: center;"><b>Accept calculations for <math>S_{xx}</math> and <math>S_{xy}</math> in (a) or (b)</b></p> <p>M1 for correct attempt or expression for either</p> <p>1<sup>st</sup> A1 for one correct</p> <p>2<sup>nd</sup> A1 for both correct</p> <p><b>Ignore the open marks for part (b) they should be awarded as per this scheme</b></p> <p>1<sup>st</sup> M1 for <math>\frac{\text{their } S_{xy}}{\text{their } S_{xx}}</math></p> <p>1<sup>st</sup> A1 for AWRT 7.73</p> <p>2<sup>nd</sup> M1 for attempt at correct formula for <math>a</math> (minus required). Ft their <math>b</math>. Quoting a correct formula but making one slip in sub.eg. <math>\bar{y} = 406</math> is OK</p> <p>2<sup>nd</sup> A1 for correct equation with 2dp accuracy. Accept <math>a = 8.89</math>, and <math>b = 7.73</math> even if not written as final equation.</p> <p><b>Correct answers only (from calc) score 4/4 if correct to 2dp or 3/4 if AWRT 2dp</b></p> <p>B1ft for their <math>b \times 1000</math> to at least 2 sf. Accept “7.7 thousand” but value is needed</p> <p>M1 for substituting <math>x = 5</math> into their final answer to (b).</p> <p>A1 for AWRT 48000 (Accept “48 thousands”)</p>	

<p>5. (a)</p>	<p><b>Diagram may be drawn with <math>B \subset (A \cup C)</math> or with the 0 for <math>B \cap (A \cup C)</math>' simply left blank</b></p> <div style="text-align: center;">  </div> <p>Accept decimals or probs. in Venn diagram</p> <p>3cc 90,3,2,1 1,(0),2 1 outside Box</p>	<p><b>M1</b> <b>A1</b> <b>M1A1</b> <b>A1</b> <b>B1</b></p> <p style="text-align: right;"><b>(6)</b></p>
<p>(b)</p> <p>(c)</p> <p>(d)</p> <p>(e)</p> <p>(f)</p>	<p>P(none)=0.01</p> <p>P(A but not B)=0.04</p> <p>P(any wine but C)=0.03</p> <p>P(exactly two)=0.06</p> <p><math>P(C A) = \frac{P(C \cap A)}{P(A)} = \frac{93}{96}</math> or <math>\frac{31}{32}</math> or AWRT 0.969</p>	<p><b>B1ft</b></p> <p style="text-align: right;"><b>(1)</b></p> <p><b>M1 A1ft</b></p> <p style="text-align: right;"><b>(2)</b></p> <p><b>M1A1ft</b></p> <p style="text-align: right;"><b>(2)</b></p> <p><b>M1A1ft</b></p> <p style="text-align: right;"><b>(2)</b></p> <p><b>M1A1ft,A1</b></p> <p style="text-align: right;"><b>(3)</b></p> <p><b>Total 16 marks</b></p>
<p>(a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p> <p>(e)</p> <p>(f)</p>	<p>1<sup>st</sup> M1 for 3 closed, labelled curves that overlap. A1 for the 90, 3, 2 and 1  2<sup>nd</sup> M1 for one of 1, 0 or 2 correct or a correct sum of 4 values for A, B or C  2<sup>nd</sup> A1 for all 7 values correct. Accept a blank instead of 0.  <b>NB final mark is a B1 for the box not an A mark as on EPEN</b>  <b>In parts (b) to (f) full marks can be scored for correct answers or correct ft</b></p> <p>B1ft Follow through their '1' from outside divided by 100</p> <p>M1 for correct expression eg <math>P(A \cup B) - P(B)</math> or calculation e.g. 3 + 1 or 4 on top  A1 for a correct probability, follow through with their '3+1' from diagram</p> <p>M1 for correct expression or calculation e.g. 1+2+0 or 99-96 or 3 on top  A1 for a correct probability, follow through their '2+1+0' from diagram</p> <p>M1 for a correct expression or calculation e.g. 3+2+1 or 6 on top</p> <p>M1 for a correct expression upto “,” and <u>some</u> correct substitution, ft their values.  One of these probabilities must be correct or correct ft. If P(C) on bottom M0  1<sup>st</sup> A1ft follow through their <math>A \cap C</math> and their A but the ratio must be in (0, 1)  2<sup>nd</sup> A1 for correct answer only. Answer only scores 3/3, but check working <math>P(A \cap C) / P(C)</math> is M0</p>	<div style="border: 1px solid black; padding: 5px; width: fit-content;"> <p>For M marks in (c) to (e) they must have a fraction</p> </div>

<p>6. (a)</p> <p>(b)</p> <p>(c)</p>	<p>200 or 200g</p> <p><math>P(190 &lt; X &lt; 210) = 0.6</math> or <math>P(X &lt; 210) = 0.8</math> or <math>P(X &gt; 210) = 0.2</math> or diagram (o.e.) Correct use of 0.8 or 0.2</p> $Z = (\pm) \frac{210 - 200}{\sigma}$ $\frac{10}{\sigma} = 0.8416$ $\sigma = 11.882129\dots$ <p>0.8416</p> <p>AWRT 11.9</p> $P(X < 180) = P\left(Z < \frac{180 - 200}{\sigma}\right)$ $= P(Z < -1.6832)$ $= 1 - 0.9535$ $= 0.0465 \text{ or AWRT } 0.046$	<p><b>B1</b></p> <p><b>M1</b></p> <p><b>A1</b></p> <p><b>M1</b></p> <p><b>B1</b></p> <p><b>A1</b></p> <p><b>M1</b></p> <p><b>M1</b></p> <p><b>A1</b></p> <p><b>(1)</b></p> <p><b>(5)</b></p> <p><b>(3)</b></p> <p><b>Total 9 marks</b></p>
<p>(a)</p> <p>(b)</p> <p>(c)</p>	<p>“mean = 200g” is B0 but “median = 200” or just “200” alone is B1</p> <p><b>Standardization in (b) and (c).</b> They must use <math>\sigma</math> not <math>\sigma^2</math> or <math>\sqrt{\sigma}</math>.</p> <p>1<sup>st</sup> M1 for a correct probability statement (as given or eg <math>P(200 &lt; X &lt; 210) = 0.3</math> o.e.) or shaded diagram - must have values on z-axis and probability areas shown</p> <p>1<sup>st</sup> A1 for correct use of 0.8 or <math>p = 0.2</math>. Need a correct probability statement. May be implied by a suitable value for z seen (e.g. <math>z = 0.84</math>)</p> <p>2<sup>nd</sup> M1 for attempting to standardise. Values for <math>x</math> and <math>\mu</math> used in formula. Don't need <math>z =</math> for this M1 nor a z-value, just mark standardization.</p> <p>B1 for <math>z = 0.8416</math> (or better) [<math>z = 0.84</math> usually just loses this mark in (a)]</p> <p>2<sup>nd</sup> A1 for AWRT 11.9</p> <p>1<sup>st</sup> M1 for attempting to Standardise with 200 and their sd(&gt;0) e.g. <math>(\pm) \frac{180 - 200}{\text{their } \sigma}</math></p> <p>2<sup>nd</sup> M1 <b>NB on open this is an A mark ignore and treat it as 2<sup>nd</sup> M1</b> for 1 – a probability from tables provided compatible with their probability statement.</p> <p>A1 for 0.0465 or AWRT 0.046 (Dependent on both Ms in part (c))</p>	

7.(a)	$P(R = 3 \cap B = 0) = \frac{1}{4} \times \frac{1}{4} = \frac{1}{16}$	<b>M1, A1</b>  (2)																														
(b)	<table border="1" style="margin-left: auto; margin-right: auto;"> <tbody> <tr><td>3</td><td>0</td><td>3</td><td>6</td><td>9</td></tr> <tr><td>2</td><td>0</td><td>2</td><td>4</td><td>6</td></tr> <tr><td>1</td><td>0</td><td>1</td><td>2</td><td>3</td></tr> <tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td><i>B</i></td><td></td><td></td><td></td><td></td></tr> <tr><td><i>R</i></td><td>0</td><td>1</td><td>2</td><td>3</td></tr> </tbody> </table>	3	0	3	6	9	2	0	2	4	6	1	0	1	2	3	0	0	0	0	0	<i>B</i>					<i>R</i>	0	1	2	3	All 0s All 1,2,3s All 4,6,9s  <b>B1</b> <b>B1</b> <b>B1</b>  (3)
3	0	3	6	9																												
2	0	2	4	6																												
1	0	1	2	3																												
0	0	0	0	0																												
<i>B</i>																																
<i>R</i>	0	1	2	3																												
(c)	$a = \frac{7}{16}, b = c = d = \frac{1}{16}$	<b>B1, B1 B1</b>  (3)																														
(d)	$E(T) = \left(1 \times \frac{1}{16}\right) + \left(2 \times \frac{1}{8}\right) + \left(3 \times \frac{1}{8}\right) + \left(4 \times \frac{1}{16}\right) + \dots$ $= 2\frac{1}{4} \text{ or exact equivalent e.g. } 2.25, \frac{9}{4}$	<b>M1</b>  <b>A1</b>  (2)																														
(e)	$\text{Var}(T) = \left(1^2 \times \frac{1}{16}\right) + \left(2^2 \times \frac{1}{8}\right) + \left(3^2 \times \frac{1}{8}\right) + \left(4^2 \times \frac{1}{16}\right) + \dots - \left(\frac{9}{4}\right)^2$ $= \frac{49}{4} - \frac{81}{16} = 7\frac{3}{16} \text{ or } \frac{115}{16} \quad (\text{o.e.})$	<b>M1A1, M1</b>  AWRT 7.19 <b>A1</b> (4)																														
<b>Total 14 marks</b>																																
(a)	<b>M1</b> for $\frac{1}{4} \times \frac{1}{4}$																															
(c)	<b>1<sup>st</sup> B1</b> for $\frac{7}{16}$ ,																															
	<b>2<sup>nd</sup> B1</b> for only one error in $b, c, d$ ( $b = c = d \neq \frac{1}{16}$ or $b = c = \frac{1}{16} \neq d$ etc), <b>3<sup>rd</sup> B1</b> all of $b, c, d = \frac{1}{16}$																															
(d)	<b>M1</b> for attempting $\sum tP(T = t)$ , 3 or more terms correct or correct ft. Must Attempt to sum. NB calculating $E(T)$ and then dividing by a number other than 1 scores <b>M0</b> .																															
(e)	<b>1<sup>st</sup> M1</b> for attempt at $E(T^2)$ , 3 or more terms correct or correct ft.																															
	<b>1<sup>st</sup> A1</b> for $\frac{49}{4}$ (o.e.) or a fully correct expression (all non-zero terms must be seen)																															
	<b>2<sup>nd</sup> M1</b> for subtracting their $[E(T)]^2$ , Must be some attempt to square $-\frac{9}{4}$ is <b>M0</b> but $-\frac{9}{16}$ could be <b>M1</b>																															
	<b>2<sup>nd</sup> A1</b> for correct fraction or AWRT 7.19 Full marks can still be scored in (d) and (e) if $a$ is incorrect																															