

## EDEXCEL 6683 STATISTICS S1 JANUARY 2004 MARK SCHEME

Question	Mark Scheme	Marks
1. (a)	$\sum m = 150 ; \sum m^2 = 5500$ $\sum t = 71.6 ; \sum t^2 = 930 ; \sum mt = 2147$ $S_{mt} = 2147 - \frac{150 \times 71.6}{6} = \underline{357}$ $S_{mm} = 5500 - \frac{150^2}{6} = \underline{1750}$ <p>No working shown SR: B1 B1 only</p>	<p>5500 &amp; 2147 seen</p> <p>Accept <math>\frac{357}{60} = 59.5</math></p> <p>Accept <math>291.\dot{6}</math></p> <p>B1</p> <p>M1 A1</p> <p>A1 (4)</p>
(b)	$b = \frac{357}{1750} = \underline{0.204}$ $a = \frac{71.6}{6} - 0.204 \times \frac{150}{6} = \underline{6.8\dot{3}}$ $\therefore t = \underline{6.83 + 0.204m}$ <p>No working seen SR: <math>t = 6.83 + 0.204m</math> B1 only</p>	<p>M1</p> <p>M1</p> <p>(Accept <math>6.8\dot{3}</math>, 6.83, <math>6\frac{5}{6}\%</math>)</p> <p>A1 (3)</p>
(c)	$7.35 \Rightarrow m = 35$ $\therefore t = 6.8\dot{3} + 0.204 \times 35 = \underline{13.97\dot{3}}$	<p>14.0 AWRT</p> <p>M1 A1 (2)</p>
(d) (i)	$9.00 \Rightarrow m = 120$ <p>No; outside range of data (after 7.50 am)</p>	<p>B1; B1</p>
(ii)	<p>No; No evidence model will apply one month later</p>	<p>B1; B1 (4)</p>

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2. (a)	<p>Symmetrical (about the mean <math>\mu</math> )</p> <p>Mode = mean = median</p> <p>Horizontal axis asymptotic to curve</p> <p>Distribution is ‘bell shaped’ – accept sketch</p> <p>95% of data lies within 2 sd’s of the mean</p>	<p>B1;B1;B1 (3)</p> <p>Any 3 sensible properties</p>
(b)	<p><math>X \sim N(27, 10^2)</math></p> <p><math>\therefore P(26 &lt; x &lt; 28) = P\left(\frac{26 - 27}{10} &lt; Z &lt; \frac{28 - 27}{10}\right)</math></p> <p><math>= P(-0.1 &lt; Z &lt; 0.1)</math></p> <p><math>= \Phi(0.1) - \{1 - \Phi(0.1)\}</math>  or <math>2 \times \{\Phi(0.1) - 0.5\}</math></p> <p><math>= \underline{0.0796}</math></p>	<p>Standardising with <math>\mu = 27,</math>  <math>\sigma = 10</math> or <math>\sqrt{10}</math></p> <p>M1</p> <p>A1</p> <p>One correct (seen)</p> <p>-0.1 or 0.1</p> <p>A1</p> <p>0.0796 or 0.0797</p> <p>A1</p> <p>(4)</p>

- Data is continuous B0
- Area under curve = 1 B0
- Limits are  $-\infty$  &  $\infty$  B0
- IQR contains 50% of data B0
- 68% between  $\mu \pm \sigma$  B1
- Most of data within 3 s.d of mean B1
- No +ve or –ve skew B1
- Never touches axes at either side B1  
(ie asymptotic)

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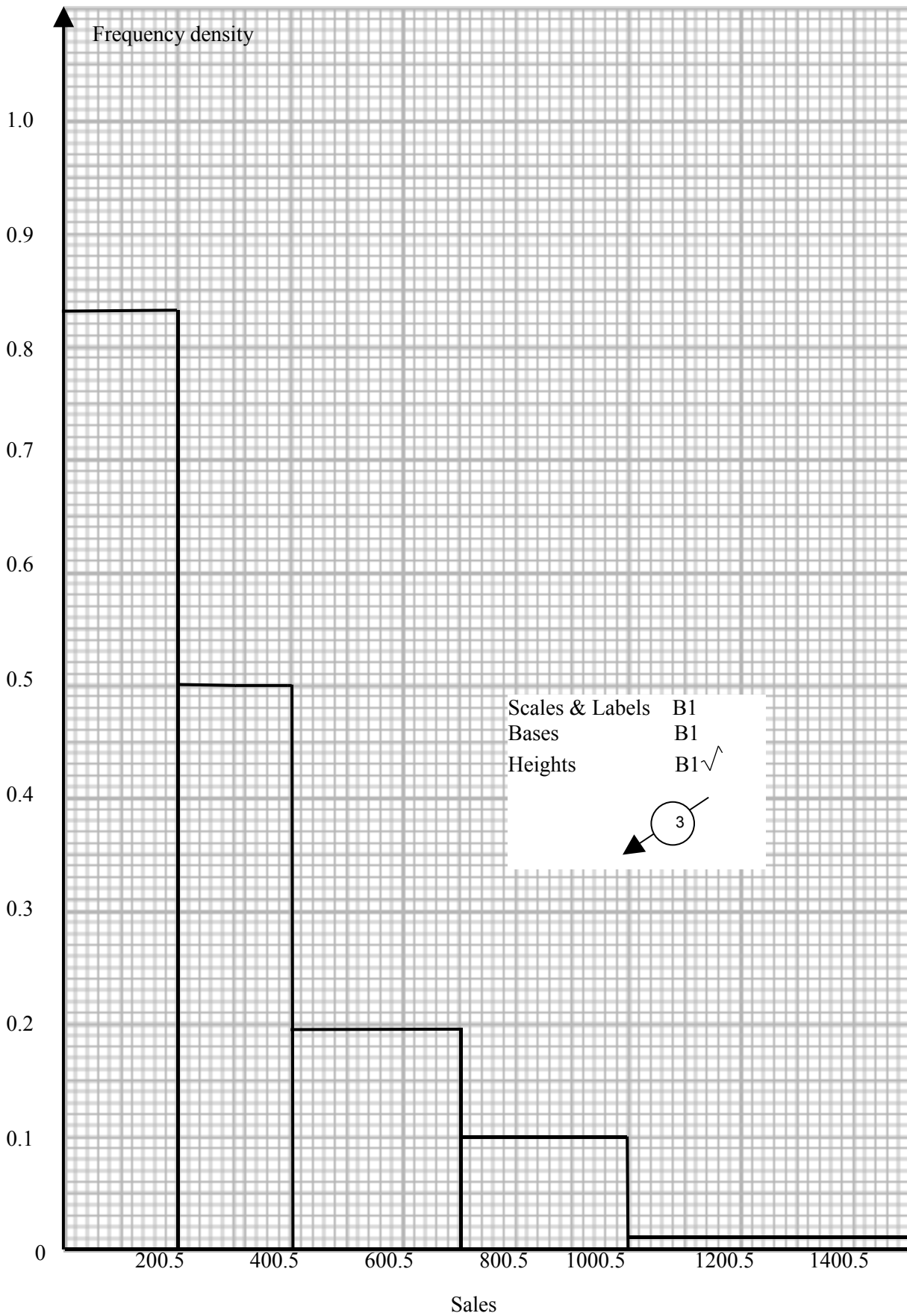
Question	Mark Scheme	Mark
3. (a)	$P(1 < X \leq 3) = P(X = 2) + P(X = 3)$ $= \frac{1}{12} + \frac{1}{12} = \frac{2}{12} = \frac{1}{6}$	M1 A1 (2)
(b)	$F(2.6) = P(X \leq 2) = 1 - P(X = 3) = 1 - \frac{1}{12} = \frac{11}{12}$ <p>(or: <math>P(X \leq 2) = \frac{1}{3} + \frac{1}{2} + \frac{1}{12} = \frac{11}{12}</math>)</p>	$\frac{11}{12}$ ; 0.917; 0.916 B1 (1)
(c)	$E(X) = \left(0 \times \frac{1}{3}\right) + \dots + \left(3 \times \frac{1}{12}\right) = \frac{11}{12}$	Use of $\sum xP(X = x)$ $\frac{11}{12}$ ; AWRT 0.917 M1 A1 (2)
(d)	$E(2X-3) = 2E(X)-3$ $= 2 \times \frac{11}{12} - 3 = -\frac{14}{12} = -\frac{7}{6}$	Use of $E(ax + b)$ $-\frac{7}{6}$ ; $-1\frac{1}{6}$ ; AWRT -1.17 M1 A1 (2)
(e)	$\text{Var}(X) = 1^2 \times \frac{1}{2} + \dots + 3^2 \times \frac{1}{12} - \left(\frac{11}{12}\right)^2$ $= \frac{107}{144}$	Use of $E(X^2) - \{E(X)\}^2$ Correct substitution $\sqrt{\frac{107}{144}}$ ; AWRT 0.743 M1 A1 A1 (3)

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<b>4. (a) (i)</b>	$P(A \cap B') = P(A/B') P(B') = \frac{4}{5} \times \frac{1}{2} = \frac{4}{10} = \frac{2}{5}$ Use of $P(A/B')P(B')$	M1 A1
<b>(ii)</b>	$P(A \cap B) = P(A) - P(A \cap B')$ $= \frac{2}{5} - \frac{2}{5}$ $= \underline{0}$	M1  A1
<b>(iii)</b>	$P(A \cup B) = P(A) + P(B) - P(A \cap B)$ $= \frac{2}{5} + \frac{1}{2} - 0$ $= \underline{\frac{9}{10}}$	M1  A1
<b>(iv)</b>	$P(A/B) = \frac{P(A \cap B)}{P(B)} = 0$	B1  (7)
<b>(b) (i)</b>	since $P(A \cap B) = 0$ seen A and B are mutually exclusive	B1 B1 (2)
<b>(ii)</b>	Since $P(A/B) \neq P(A)$ or equivalent A and B are NOT independent	B1 B1 (2)

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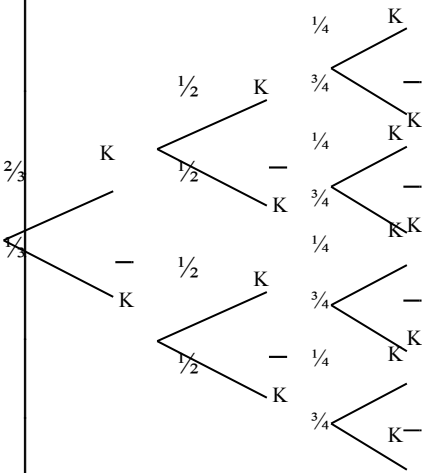
Question	Mark Scheme	Marks																								
5. (a)	<table border="1"> <thead> <tr> <th>Sales</th> <th>No. of days</th> <th>Class width</th> <th>Frequency density</th> </tr> </thead> <tbody> <tr> <td>1-200</td> <td>166</td> <td>200</td> <td>0.830</td> </tr> <tr> <td>201-400</td> <td>100</td> <td>200</td> <td>0.500</td> </tr> <tr> <td>401-700</td> <td>59</td> <td>300</td> <td>0.197</td> </tr> <tr> <td>701-1000</td> <td>30</td> <td>300</td> <td>0.100</td> </tr> <tr> <td>1001-1500</td> <td>5</td> <td>500</td> <td>0.010</td> </tr> </tbody> </table>	Sales	No. of days	Class width	Frequency density	1-200	166	200	0.830	201-400	100	200	0.500	401-700	59	300	0.197	701-1000	30	300	0.100	1001-1500	5	500	0.010	Frequency densities M1 A1 Graph (3) (5)
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1001-1500	5	500	0.010																							
	NB Frequency densities can be scored on graph																									
(b)	$Q_2 = 200.5 + \frac{(180 - 166)}{100} \times 200 = \underline{228.5}$	228/229/230	M1 A1																							
	$Q_1 = 0.5 + \frac{90}{166} \times 200 = \underline{108.933\dots}$	109 AWRT	A1																							
	$Q_3 = 400.5 + \frac{(270 - 266)}{59} \times 300 = \underline{420.838}$	AWRT 421/425	A1																							
	$(n = 270.75 \Rightarrow Q_3 = 424.6525)$																									
	$\text{IQR} = 420.830\dots - 108.933\dots = \underline{311.905\dots}$		B1 (5)																							
(c)	$\sum fx = 110980 ; \sum fx^2 = 58105890$	Attempt at $\sum fx$ or $\sum fy$	M1																							
	$\sum fy = 748 ; \sum fy^2 = 3943.5 \text{ where } y = \frac{x - 100.5}{100}$	Attempt at $\sum fx^2$ or $\sum fy^2$	M1																							
	$\mu = 308.277\dot{7}$	308 AWRT	M1 A1																							
	$\sigma = 257.6238$	258 AWRT	M1 A1																							
	No working shown: SR B1 B1 only for $\mu, \sigma$ .		(6)																							



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<b>Question</b>	<b>Mark Scheme</b>	<b>Marks</b>
(d)	Median & IQR  Sensible reason e.g. Assuming other years are skewed.	B1  B1 dep (2)

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<p>6. (a)</p>		<p>Tree with correct number of branches</p> <p>M1</p> <p>A1</p> <p>A1</p> <p>A1 (4)</p>
<p>(b)</p>	<p><math>P(\text{All 3 Keys}) = \frac{2}{3} \times \frac{1}{2} \times \frac{1}{4} = \frac{2}{24} = \frac{1}{12}</math></p>	<p><math>\frac{1}{12}</math>; 0.083̇; 0.0833</p> <p>M1 A1 (2)</p>
<p>(c)</p>	<p><math>P(\text{exactly 1 key}) = \left(\frac{2}{3} \times \frac{1}{2} \times \frac{3}{4}\right) + \left(\frac{1}{3} \times \frac{1}{2} \times \frac{3}{4}\right) + \left(\frac{1}{3} \times \frac{1}{2} \times \frac{1}{4}\right)</math> 3 triples added</p> <p><math>= \frac{10}{24} = \frac{5}{12}</math></p>	<p>Each correct</p> <p><math>\frac{10}{24}</math>; <math>\frac{5}{12}</math>; 0.416̇; 0.417</p> <p>A1 A1 A1 A1 (5)</p>
<p>(d)</p>	<p>P (Keys not collected on at least 2 successive stages)</p> <p><math>= \left(\frac{2}{3} \times \frac{1}{2} \times \frac{3}{4}\right) + \left(\frac{1}{3} \times \frac{1}{2} \times \frac{1}{4}\right) + \left(\frac{1}{3} \times \frac{1}{2} \times \frac{3}{4}\right)</math></p> <p><math>= \frac{10}{24} = \frac{5}{12}</math></p>	<p>3 triples added</p> <p>Each correct</p> <p><math>\frac{10}{24}</math>; <math>\frac{5}{12}</math>; 0.416̇; ; 0.417</p> <p>M1 A1 A1 A1 A1 (5)</p>



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6. (d)	<p><b>Alternative:</b></p> <p><math>1 - P(\text{Keys collected on at least 2 successive stages})</math></p> $= 1 - \left\{ \left( \frac{2}{3} \times \frac{1}{2} \times \frac{1}{4} \right) + \left( \frac{2}{3} \times \frac{1}{2} \times \frac{3}{4} \right) + \left( \frac{1}{3} \times \frac{1}{2} \times \frac{1}{4} \right) \right\}$ $= \frac{5}{8}$	<p>M1</p> <p>A1 A1 A1</p> <p>A1</p> <p>(5)</p>