Mark Scheme 4766
January 2007

GENERAL INSTRUCTIONS

Marks in the mark scheme are explicitly designated as **M**, **A**, **B**, **E** or **G**.

M marks ("method") are for an attempt to use a correct method (not merely for stating the method).

A marks ("accuracy") are for accurate answers and can only be earned if corresponding **M** mark(s) have been earned. Candidates are expected to give answers to a sensible level of accuracy in the context of the problem in hand. The level of accuracy quoted in the mark scheme will sometimes deliberately be greater than is required, when this facilitates marking.

B marks are independent of all others. They are usually awarded for a single correct answer.

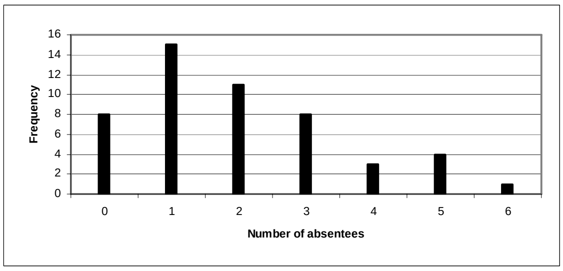
E marks ("explanation") are for explanation and/or interpretation. These will frequently be sub divisible depending on the thoroughness of the candidate's answer.

G marks ("graph") are for completing a graph or diagram correctly.

- Insert part marks in **right-hand** margin in line with the mark scheme. For fully correct parts tick the answer. For partially complete parts indicate clearly in the body of the script where the marks have been gained or lost, in line with the mark scheme.
- Please indicate incorrect working by ringing or underlining as appropriate.
- Insert total in **right-hand** margin, ringed, at end of question, in line with the mark scheme.
- Numerical answers which are not exact should be given to at least the accuracy shown. Approximate answers to a greater accuracy *may* be condoned.
- Probabilities should be given as fractions, decimals or percentages.
- FOLLOW-THROUGH MARKING SHOULD NORMALLY BE USED WHEREVER POSSIBLE. There will, however, be an occasional designation of '**c.a.o.**' for "correct answer only".
- Full credit MUST be given when correct alternative methods of solution are used. If errors occur in such methods, the marks awarded should correspond as nearly as possible to equivalent work using the method in the mark scheme.
- The following notation should be used where applicable:

FT	Follow-through marking
BOD	Benefit of doubt
ISW	Ignore subsequent working

<table>
<tr><td>Q 1 (i)</td><td>Mean = 127.6/13 = 9.8

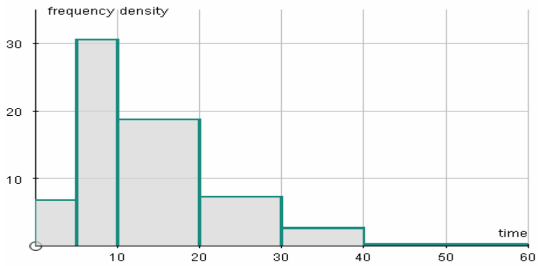
Median = 8.6
Midrange = 14.5</td><td>M1 for 127.6/13 soi
A1 CAO
B1 CAO
B1 CAO</td><td>4</td></tr>
<tr><td>(ii)</td><td>Mean slightly inflated due to the outlier
Median good since it is not affected by the outlier
Midrange poor as it is highly inflated due to the outlier</td><td>B1
B1
B1</td><td>3</td></tr>
<tr><td></td><td></td><td>TOTAL</td><td>7</td></tr>
<tr><td>Q 2 (i)</td><td>
</td><td>G1 labelled linear scales on both axes
G1 heights</td><td>2</td></tr>
<tr><td>(ii)</td><td>Mean $= \dfrac{99}{50} = 1.98$

$S_{xx} = 315 - \dfrac{99^2}{50}$ (= 118.98)

$rmsd = \sqrt{\dfrac{118.98}{50}} = 1.54$
NB full marks for correct results from recommended method which is use of calculator functions</td><td>B1 for mean

M1 for attempt at S_{xx}

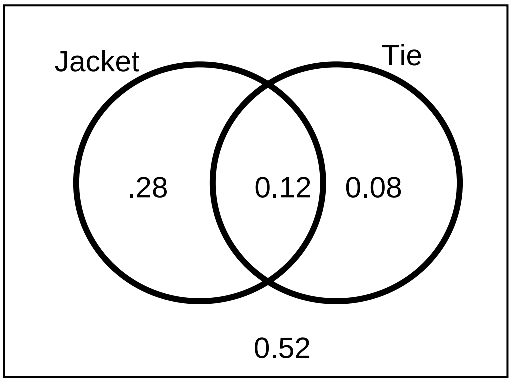
A1 CAO</td><td>3</td></tr>
<tr><td>(iii)</td><td>New mean = 30 – 1.98 = 28.02

New rmsd = 1.54 (unchanged)</td><td>B1 FT their mean
B1 FT their rmsd</td><td>2</td></tr>
<tr><td></td><td></td><td>TOTAL</td><td>7</td></tr>
<tr><td>Q 3 (i)</td><td><table>
<tr><th>time</th><th>freq</th><th>width</th><th>f dens</th></tr>
<tr><td>0-</td><td>34</td><td>5</td><td>6.8</td></tr>
<tr><td>5-</td><td>153</td><td>5</td><td>30.6</td></tr>
<tr><td>10-</td><td>188</td><td>10</td><td>18.8</td></tr>
<tr><td>20-</td><td>73</td><td>10</td><td>7.3</td></tr>
<tr><td>30-</td><td>27</td><td>10</td><td>2.7</td></tr>
<tr><td>40-</td><td>5</td><td>20</td><td>0.25</td></tr>
</table>

</td><td>M1 for fds
A1 CAO

Accept any suitable unit for fd such as eg freq per 5 mins.

G1 linear scales on both axes and label
G1 width of bars

G1 height of bars</td><td>5</td></tr>
<tr><td>(ii)</td><td>Positive skewness</td><td>B1 CAO (indep)</td><td>1</td></tr>
<tr><td></td><td></td><td>TOTAL</td><td>6</td></tr>
</table>

Q 4(i)	<table><tr><td>r</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>P(X = r)</td><td>k</td><td>$3k$</td><td>$5k$</td><td>$7k$</td><td>$9k$</td><td>$11k$</td></tr></table> $36k = 1$, so $k = \frac{1}{36}$	B1 for $3k$, $5k$, $7k$, $9k$ M1 for sum of six multiples of k = 1 A1 CAO **MUST BE FRACTION IN SIMPLEST FORM**	**3**
(ii)	E(X) = $1\times\frac{1}{36}+2\times\frac{3}{36}+3\times\frac{5}{36}+4\times\frac{7}{36}+5\times\frac{9}{36}+6\times\frac{11}{36}=\frac{161}{36}=4.47$	M1 for $\Sigma\, rp$ A1 CAO	**2**
(iii)	P(X=16) = $6\times\left(\frac{1}{6}\right)^3$ $=\frac{6}{216}=\frac{1}{36}$	M1 for 6 × M1 indep for $\left(\frac{1}{6}\right)^3$ A1 CAO	**3**
		TOTAL	**8**
Q 5(i)	P(jacket and tie) = 0.4 × 0.3 = 0.12	M1 for multiplying A1 CAO	**2**
(ii)		G1 for two intersecting circles labelled G1 for 0.12 and either 0.28 or 0.08 G1 for remaining probabilities <u>Note</u> FT their 0.12 provided < 0.2	**3**
(iii)	*(A)* P(jacket or tie) =P(J) + P(T) – P(J∩T) = 0.4 + 0.2 – 0.12 = 0.48 *OR* = 0.28 + 0.12 + 0.08 = 0.48 (*B*) P(no jacket or no tie) = 0.52 + 0.28 + 0.08 = 0.88 *OR* 0.6 + 0.8 – 0.52 = 0.88 *OR* 1 – 0.12 = 0.88	B1 FT B2 FT <u>Note</u> FT their 0.12 provided < 0.2	**3**
		TOTAL	**8**

Q 6 (i)	Median = 3370 Q_1 = 3050 Q_3 = 3700 Inter-quartile range = 3700 – 3050 = 650	B1 B1 for Q_3 or Q_1 B1 for IQR	**3**
(ii)	Lower limit 3050 – 1.5 × 650 = 2075 Upper limit 3700 + 1.5 × 650 = 4675 Approx 40 babies below 2075 and 5 above 4675 so total 45	B1 B1 M1 (for either) A1	**4**
(iii)	Decision based on convincing argument: eg 'no, because there is nothing to suggest that they are not genuine data items and these data may influence health care provision'	E2 for convincing argument	**2**
(iv)	All babies below 2600 grams in weight	B2 CAO	**2**
(v)	(*A*) $X \sim B(17, 0.12)$ $P(X = 2) = \binom{17}{2} \times 0.12^2 \times 0.88^{15} = 0.2878$ (*B*) $P(X > 2)$ $= 1 - (0.2878 + \binom{17}{1} \times 0.12 \times 0.88^{16} + 0.88^{17})$ $= 1 - (0.2878 + 0.2638 + 0.1138) = 0.335$	M1 $\binom{17}{2} \times p^2 \times q^{15}$ M1 indep $0.12^2 \times 0.88^{15}$ A1 CAO M1 for $P(X=1)+ P(X=0)$ M1 for $1 - P(X \leq 2)$ A1 CAO	**3** **3**
(vi)	Expected number of occasions is 33.5	B1 FT	**1**
		TOTAL	**18**

Q 7 (i)	(*A*) P(both) = $\left(\frac{2}{3}\right)^2 = \frac{4}{9}$ (*B*) P(one) = $2\times\frac{2}{3}\times\frac{1}{3}=\frac{4}{9}$ (*C*) P(neither) = $\left(\frac{1}{3}\right)^2 = \frac{1}{9}$	B1 CAO B1 CAO B1 CAO	**3**
(ii)	Independence necessary because otherwise, the probability of one seed germinating would change according to whether or not the other one germinates. May not be valid as the two seeds would have similar growing conditions eg temperature, moisture, etc. *NB Allow valid alternatives*	E1 E1	**2**
(iii)	Expected number = 2 × $\frac{2}{3}=\frac{4}{3}$ (= 1.33) E(X^2) = $0\times\frac{1}{9}+1\times\frac{4}{9}+4\times\frac{4}{9}=\frac{20}{9}$ Var(X) = $\frac{20}{9}-\left(\frac{4}{3}\right)^2=\frac{4}{9}$ = 0.444 *NB use of npq scores M1 for product, A1CAO*	B1 FT M1 for E(X^2) A1 CAO	**3**
(iv)	Expect $200\times\frac{8}{9}=177.8$ plants So expect 0.85 × 177.8 = 151 onions	M1 for 200 × $\frac{8}{9}$ M1 dep for × 0.85 A1 CAO	**3**
(v)	Let X ~ B(18, p) Let p = probability of germination (for population) H_0: p = 0.90 H_1: p < 0.90 P($X \le 14$) = 0.0982 > 5% So not enough evidence to reject H_0 Conclude that there is not enough evidence to indicate that the germination rate is below 90%. Note: use of critical region method scores M1 for region {0,1,2,…, 13} M1 for 14 does not lie in critical region then A1 E1 as per scheme	B1 for definition of p B1 for H_0 B1 for H_1 M1 for probability M1 dep for comparison A1 E1 for conclusion in context	**7**
		TOTAL	**18**