Question Number	Scheme	Marks	
1.	[Sum of probs = 1 gives] $a+b+c+0.3=1$ (o.e.)	M1	
	[F(1) = 0.63 gives ] $0.15 + a + b = 0.63$ or $0.63 + c + 0.15 = 1$ (o.e.)	M1	
	Solving $c = 0.22$	A1	
	[Use of $E(X) = 1$ or symmetry gives ] $a = c$ $a = 0.22$	M1	
	Therefore $b = \underline{0.26}$	A1	
		[5]	
	Notes		
	Each of the 3 Ms can be awarded at any point for either the correct equation seen or		
	clearly implied by its use e.g. choosing their b ( $0 \le b \le 0.7$ ) so that $a + b + c$	$= 0.7 (1^{st} M1)$	
	$1^{st}$ M1for use of sum of probabilities to form an equation in $a, b$ and $c$ . Can allow the use of their value for $c$ in the equation or implied by its use to find $b$ $2^{nd}$ M1for equation in $a$ and $b$ from using $F(1) = 0.63$ e.g. $a + b = 0.48$ or $c + 0.15 = 0.37$ $1^{st}$ A1for deducing $c = 0.22$ $3^{rd}$ M1for using $E(X) = 1$ to deduce $a = c$ ft their value of $c$ (provided $0 \le a \le 0.35$ )NB $E(X) = 1$ gives $-a + b + 3c = 0.7$ but only scores M1 when they state $a = c$ or give their value of $a$ ( $0 \le a \le 0.35$ ) = their value of $c$		
	$2^{nd}$ A1 for $b = 0.26$		
	All 3 correct answers only (no working) scores 5 marks (they may be seen in the table)		
	If answers seen in the table contradict answers with working in the body of the script the		
	script takes preference.		

Question Number	Scheme	Marks
2. (a)	$ \begin{array}{c c} \hline D \\ \hline 10 \\ \hline 2 \\ \hline 4 \\ \hline 7 \\ \hline R \end{array} $	B1 B1 B1 B1
(b)	Since no family has a dog and a rabbit a mutually exclusive pair is $\underline{D, R}$	(4) B1
(c)	$\begin{bmatrix} \frac{2+"4"}{40} \end{bmatrix} = \frac{3}{\underline{20}}$	(1) B1ft (1)
(d)	e.g. $P(D \cap C) = \frac{1}{40} = \frac{1}{20}$ $P(D) = \frac{1}{40} = \frac{1}{10}$ $P(C) = \frac{1}{40} = \frac{1}{20}$ <u>or</u> $\frac{1}{10} \neq \frac{3}{40} \times \frac{7}{10} = \begin{bmatrix} \frac{21}{10} \end{bmatrix}$ so they are not independent	MI A1
ALT	$P(C) = \frac{14}{40} = \frac{7}{20} \text{ vs } P(C D) = \frac{2}{12} = \frac{1}{6} \text{ or } P(D) = \frac{12}{40} = \frac{3}{10} \text{ vs } P(D C) = \frac{2}{14} = \frac{1}{7}$	
(e)	e.g. $[P(R   C) = ] \frac{P(R \cap C)}{P(C)}$ or $\frac{"\frac{4}{40}"}{\frac{14}{40}}$	(2) M1
	$-\frac{1}{14}=\frac{1}{2}$	Alft
(f)	$\frac{"10"+"7"}{"10"+"7"+9}$ (o.e.) ;= $\frac{17}{\underline{26}}$ (accept 0.6538461)	(2) M1; A1
		[12]
(a)	<b>Notes</b> 1 <sup>st</sup> B1 for 3 intersecting circles with $p(D \cap R) = 0$ (either diagram)[Blank is n	ot equiv'to 0]
	$2^{nd} B1 \text{ for a box and 9 outside the circles}$ $3^{rd} B1 \text{ for } n(D \cap C) = 2 \text{ and } n(D \cap C') = 10$ $4^{th} B1 \text{ for 8, 4 and 7 correctly placed}$ Allow pro- of 40) or d integers.	babilities (out lecimals or
(b)	B1 for <i>D</i> and <i>R</i> with a suitable reason (extra pairs is B0) e.g. $P(D \cap R) = 0$ Condone $\emptyset$ for 0 or no intersection/overlap. Must see an attempt at a reason. Must be <i>D</i> , <i>R</i> not $P(D)$ , $P(R) = P(D \cup R) = P(D) + P(R)$ is not a suitable reason though.	
(c)	For (c) onwards if their $N \neq 40$ allow denominators of probs with 40 or N B1ft ft their "4" (but must give a proper fraction) ft blank as $0 \text{ or } \frac{3}{20}$ or exact equivalent	
(d)	<ul> <li>M1 for stating <u>all</u> the probabilities (values) required for a suitable test, must be labelled. Must use <i>D</i> and <i>C</i> ft their VD. Must be clear which test they are trying to use.</li> <li>A1 for the correct probabilities <u>and</u> correct calculation or comparison <u>and</u> correct conclusion</li> </ul>	
(e)	M1 for a correct ratio of probabilities (ft their 4): either as an expression or values A1ft for $\frac{2}{7}$ or exact equivalent (allow ft of their 4 [ $\neq$ 0] provided it gives an exact fraction)	
(f)	M1 for a correct ratio (possibly of probabilities) ft their 10 and their 7 [Not exp A1 for $\frac{17}{26}$ or exact equivalent (e.g. 0.654 will score M1A0)	ression here]

Question Number	Scheme	Marks	
3. (a)	$S_{mp} = 32958 - \frac{1124 \times 281}{10}$ [= 1373.6] (*)	B1cso	
(b)	$[r =] \frac{1373.6}{\sqrt{6046.4 \times 382.9}}$	(1) M1	
	= 0.9027 awrt <u>0.903</u>	A1 (2)	
(c)	In scatter diagram points are close to a line <u>or</u> $r$ is close to (or near to) 1 It is consistent with the manager's belief	B1 (1)	
(d)	$\frac{\sum m}{\sum p} = \frac{1124}{281}  (\text{o.e})$	M1	
	So $k = \underline{4}$	A1 (2)	
(e)	$b = \frac{1373.6}{6046.4}  [= 0.22717]$	M1	
	$a = 28.1 - "0.2271" \times 112.4$ [= 2.5653]	M1	
	p = 2.565 + 0.2271m $p = 2.57 + 0.227m$	A1; A1	
(f)	$[2.565+0.2271\times70 = ]$ 18.467 accept answers in range [18, 18.6]	(4) B1	
		(1)	
(g)	Manager's model (when $m = 70$ ) estimates $p = 17.5$	B1ft dB1	
	So use manager's model since wants the lower estimate. (0.e.)	(2)	
		[13]	
	Notes		
(a)	BIcso for a correct expression seen (need all 4 numbers seen)		
(b)	M1 for a correct expression or an answer only of 0.90 (2sf) or 0.902 (truncation A1 for awrt 0.903	on)	
(c)	B1 for "points close to a line" <u>or</u> " <i>r</i> is close to 1" <u>or</u> "strong correlation" (o.e.) <u>but</u> "near <u>er</u> to 1	1" is B0	
	and "consistent with manager" or " consistent with belief" (o.e.) or "yes"	,	
(b)	M1 for a correct calculation or equation in $k$		
(u)	A1 for $k = 4$ NB using the point (140, 35) is M0A0 despite givin	$\log k = 4$	
(e)	$1^{\text{st}}$ M1 for a correct expression for b		
	$2^{nd}$ M1 for a correct equation in <i>a</i> (ft their value of <i>b</i> or even letter <i>b</i> in correct	formula)	
	1 <sup>st</sup> A1 for $b = awrt 0.227$ in an equation in $p$ and $m$ or allow $y$ and $x$		
	Allow a transciption error (e.g. 0.277 etc) if 0.227 is seen in earlier working.		
	$2^{nd}$ A1 for $a = awrt 2.57$ in an equation in $p$ and $m$ only		
(g)	1 <sup>st</sup> B1ft for 17.5 or $70 \div k$ for their value of k		
(6/	$2^{nd}$ dB1 (dep on $1^{st}$ B1) for therefore choosing manager's model because it has	the lower	
	estimate. (o.e.) (Must be true for their values)		

Question Number	Scheme	Marks	
4. (a)	Width = 0.5 (cm)	B1	
	$1 \text{ cm}^2 \text{ rep's 4 babies } \underline{\text{or}} 0.25 \text{ cm}^2 \text{ rep's 1 baby } \underline{\text{or}} \text{ their } h \times w = 3.5 \text{ or} \text{ area} = 3.5 \text{ cm}^2$	M1	
	Height = $\frac{14}{16} \times 4 \div 0.5 = \underline{7}$ (cm)	A1	
		(3)	
(b)	Lower Quartile = $[2.5] + \frac{\frac{98}{4} - 16}{24} \times 0.5 = [2.5] + \frac{8.5}{24} \times 0.5$	M1	
	= 2.50 + 0.177 = awrt 2.68	A1 (2)	
(c)	$Q_2 - Q_1 = 3.14 - 2.68 = 0.46 > 0.41 = 3.55 - 3.14 = Q_3 - Q_2$	M1	
	So <u>negative</u> skew	A1	
	211.5	(2)	
(d)	$\overline{w} = \frac{311.5}{98} = 3.17857 = \text{awrt } \underline{3.18}$	B1	
	1051.125 - 2	M1	
	$\sigma_w = \sqrt{-98} - w^2 = \sqrt{0.622448}; = 0.78895 = awrt 0.789$	A1	
	3("3 18" - 3 14)	(3)	
(e)	$\frac{5(-5.18) - 5.14}{"0.789"} = 0.152  \text{awrt } \underline{0.15}$	M1A1	
(f)(i)	49 <sup>th</sup> value now 3.25 [or median in group 3.25 < $w < 3.50$ ] so median increases	(2) B1	
(i)(i)	more higher values or $\Sigma fx$ increases so mean increases	B1	
		(2)	
	Notes	[14]	
(a)	B1 0.5 only		
	M1 may be implied by correct height A1 correct height of 7(cm)		
(b)	M1 for any correct equation leading to correct fraction as part of $m = \dots$ or $(m - [2, 3])$	5]) =	
	Ignore incorrect end point and watch out for "working down" Using 25 for 24.5	5 is M0	
	A1 awrt 2.68 allow exact fraction e.g. $\frac{257}{96}$ (allow 8.75 for 8.5 [ or $\frac{515}{192}$ ] if $n + 1$ used	l)	
(c)	M1 for use of $Q_2 - Q_2$ and $Q_2 - Q_2$ (o.e.) ft their Q. [ or correct inequality and -ve skew]		
	or a correct quartile inequality <b>and</b> statement that negative skew	-	
	A1 for correctly concluding negative skew from their values. Their ft calc should b	e correct.	
(d)	B1 for awrt 3.18 (allow $\frac{89}{28}$ )		
	M1 for a correct expression (including square root) ft their mean ( $\frac{\sqrt{122}}{3}$ scores M1)		
	A1 for awrt 0.789 (accept $s = 0.79301 = awrt 0.793$ )		
(e)	M1 for correct substitution (ft their values and condone missing 3) A1 for awrt 0.15		
(f)(i)	1 <sup>st</sup> B1 for median increases with a suitable reason to support this (must mention the	3.25)	
(i)(i)	$2^{nd}$ B1 for mean increases with a suitable reason to support this (Recalc of $\overline{x} = 3.196$	5 is B0)	

Question Number	Scheme	Marks
5. (a)	$P(X < 7) = P\left(Z < \frac{7-10}{6}\right) = P(Z < -0.5)$	M1
	= 1 - 0.6915; $= 0.308537$ awrt <u>0.309</u>	M1; A1
(b)	$\frac{10+k-10}{10} = 0.8416$	(3) M1 B1
	k = 5.0496 awrt <b><u>5.05</u></b>	A1
(c)	Area of rectangle is $X(X-3)$	(3) M1
	Need $X(X-3) > 40$	M1
	$X^2 - 3X - 40 > 0 \implies (X - 8)(X + 5) > 0$	M1
	So critical values are $8 \text{ and } -5$	A1 M1
	So $P(Z > -0.33) + P(Z < -2.5)$ of $1 - P(-3 < X < 8)$	M1 M1
	= 0.6293 + 0.0062	dM1
	$= 0.6355 \ [0.6355 \sim 0.637]$	A1
		(8)
	Notes	
(a)	$1^{\text{st}}$ M1 for standardising 7 (or 13) with 10 and 6 (allow <u>+</u> )	
	A1 for awrt 0.309 (calc. 0.3085375) (Ans only scores 3/3)	
(b)	M1 Standardising 10 $\pm k$ with 10 and 6 and setting equal to z value $0.8 <  z  < 100$	< 0.9
	B1 for $z = \pm 0.8416$ or better (calc gives $0.8416212$ ) used in a linear equation for k	
A	A1 $k = 5.05$ or better (or use of $z = 0.84$ and answer of 5.04)	
Ans only Ans only	awrt 5.04 scores M1B0A1 Answer in the range 5.049 $\sim$ 5.0499 scores M1B1A1 but answer only of 5.05 is M1B0A1	
J	This wer in the funge 5.615 Stores for Birth fut this wer only of 5.65 is with bort	
(c)	1 <sup>st</sup> M1 for a suitable expression for the area of the rectangle (in x or X) $[\Rightarrow$ by 2 <sup>t</sup> 2 <sup>nd</sup> M1 for a correct guadratic inequality (accent $x(x = 3) > 40$ [ $\Rightarrow$ e ])	<sup>ad</sup> or 3 <sup>rd</sup> M1]
	$2^{-1}$ W1 for a correct quadratic inequality (accept $x(x-3) > 40$ [o.e.]) $3^{rd}$ M1 for an attempt to solve their 3TO to find critical values (allow = 0) (e.g. factorise)	
	Allow $(X+8)(X-5)$ or use of formula with $\leq 1$ sign error or $(X-\frac{3}{2})^2 - k$	-40 (k>0)
	$1^{st}$ A1 for the correct critical values (cvs) of 8 and $-5$	
	4 <sup>th</sup> M1 for solving their quadratic inequality - taking the "outside" region (ft their	r cvs)
	5 <sup>th</sup> M1 for standardising at least one of their values (with 10 and 6) correctly (ft	their cys)
	$6^{\text{th}} \text{ dM1}$ for an attempt at both probabilities: one $\approx 0.006$ and one $> 0.6$ and adding	
	or for $1 - q$ where $q = 0.36$ or better	
	or for $1 - q$ where $q = 0.36$ or better	0
	or for $1 - q$ where $q = 0.36$ or better This mark is dependent on all the other 5 M marks being scored $2^{nd}$ A1 for answer in range [0.6355, 0.637] with clear attempt at both probabilities	es used
	<u>or</u> for $1 - q$ where $q = 0.36$ or better This mark is dependent on all the other 5 M marks being scored $2^{nd}$ A1 for answer in range [0.6355, 0.637] with clear attempt at both probabilitie (calc 0.636768)	es used

Qu N	No.	Scheme	Marks
6.	(a)	[Sum of probs = 1 gives] $k \left[ 1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} \right] \{=1\} \text{ or } \frac{147k}{60} = 1$	M1
		$k = \frac{20}{\underline{49}}$	A1 cso
			(2)
	(b)	$E(S) = \frac{1}{147} \left( 60 \times \frac{1}{2} + 120 \times \frac{1}{3} + 180 \times \frac{1}{4} + 240 \times \frac{1}{5} + 300 \times \frac{1}{6} \right)  \underline{\text{or}}  3.55k$	M1A1
		$=\frac{71}{\underline{49}}$	A1
	(c)	Expected profit = $260P(S = 5) - 10$ <u>or</u> $-10 \times P(S \neq 5) + 250 \times P(S = 5)$	(3) M1M1
		$= \left[ 260 \times \frac{10}{147} - 10 \right] = 7.68707 = \text{awrt} (\$) \underline{7.69}$	A1
	<b>(d)</b>	$n^2$ because Person must win 1 <sup>st</sup> and 2 <sup>nd</sup> round (accept "wins 2 rounde")	(3)
	(u)	(1-p) because Roger loses in 3 <sup>rd</sup> round match	B1
			(2)
	(e)	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	BI M1A1
			(3)
	(f)	$E (\text{profit}) = 260 \times p^5 - 10$	M1 A1
		$\left[ \text{E(profit)} \ge 7.69 \right] \implies p^5 \ge \frac{17.69}{260} \text{ so } p \ge 0.58418$	M1; A1
			(4) [ <b>17</b> ]
		Notes	
	(a)	M1 for clear attempt to find sum of probs. (Condone $\frac{147k}{60} = 1$ )	
Ver	ify	A1cso for the correct answer with M1 clearly scored and no incorrect working seen. Need to see all 6 probs added and = 1 for M1 and a comment (e.g. therefore $k =$ ) for A1	
	(b)	M1 for an attempt at $E(S)$ – at least 4 correct products (allow use of <i>k</i> or <i>k</i> = 0.408 or better) 1 <sup>st</sup> A1 for a fully correct expression (allow 3.55 <i>k</i> ) 2 <sup>nd</sup> A1 for $\frac{71}{49}$ (accept 1.45 or better [calc:1.44897]) (Ans only 3/3)	
	(c)	$1^{st}$ M1 for $260 \times P(S = 5)$ or $250 \times P(S = 5)$ Probabilities can be in terms of k or ft their values $2^{nd}$ M1 for $N \times P(S = 5) - 10$ or $N \times P(S = 5) - 10 \times P(S \neq 5)$ ( $N \in \mathbb{N}$ )Probabilities can be in terms of k or ft their valuesA1 for awrt (\$)7.69	
	(d)	$1^{st}$ B1 for an explanation of the $p^2$ term (e.g. use of tree diagram)WWL alone scores $1^{st}$ B1 but $2^{nd}$ B1 for an explanation that must lose the $3^{rd}$ round matchWWL and $pp(1-p)$ will get B1B1	
	(e)	B1 for correct set of values for $R$ (in a table or a list) M1 for at least 3 correct values [apart from P( $R = 2$ )] for $R$ and correct probabilities A1 for a fully correct probability distribution	
	(f)	1 <sup>st</sup> M1 for 260×P(R = 5) (ft their P(R = 5) implied by 2 <sup>nd</sup> M1   1 <sup>st</sup> A1 for 260× $p^5-10$ or $p^5 \ge \frac{10}{147}$	
		$2^{nd}$ M1 for forming a correct ft of $P(R = 5) \ge P(S = 5)$ (accept > or allow =) [ft their (c)]	
		$2^{nd}$ A1 for awrt 0.58 or 0.59 [ If equals sign is used we need to see awrt 0.59 for the A	.1]
A	LT	$200p^{\circ} - 10 \ge 200 \times \frac{10}{147} - 10 \text{ (M1A1)} \Rightarrow p^{\circ} \ge \frac{10}{147} \text{ (M1) etc (A1)}$	