Edexcel Maths S1

Mark Scheme Pack

2005–2013

GCE

Edexcel GCE

Statistics S1 (6683)

Summer 2005

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Mark Scheme (Results)

Edexcel GCE
Statistics S1 (6683)

June 2005
6683 Statistics S1
Mark Scheme

Question Number	Scheme	Marks
1.	Diagram A : y & x : r = - 0.79; As x increases, y decreases <u>or</u> most points lie in the 2nd and 4th quadrant.	B1;B1dep
	Diagram B : v & u: r = 0.08; No real pattern. Several values of v for one value of u or points lie in all four quadrants, randomly scattered.	B1;B1dep
	Diagram C : t & s : r = 0.68; As s increases, t increases or most points lie in the 1st and 3rd quadrants	B1;B1dep (6)
2. (a)	Distance is a continuous. continuous	B1 (1)
(b)	F.D = freq/class width $\Rightarrow$ 0.8, 3.8, 5.3, 3.7, 0.75, 0.1 or the same multiple of	M1 A1 (2)
(c)	$Q_2 = 50.5 + \frac{(67-23)}{53} \times 10 = 58.8$ awrt 58.8/58.9	M1 A1
	$Q_1 = 52.48$; $Q_3 = 67.12$ awrt 52.5/52.6 67.1/67.3	A1 A1 (4)
	Special case : no working B1 B1 B1 ($\equiv$ A's on the epen)	
(d)	$\bar{x} = \frac{8379.5}{134} = 62.5335...$ awrt 62.5	B1
	$s = \sqrt{\frac{557489.75}{134} - \left(\frac{8379.5}{134}\right)^2}$	M1 A1√
	s = 15.8089…. ($S_{n-1} = 15.86825...$) awrt 15.8 (15.9)	A1 (4)
	Special case : answer only B1 B1 ($\equiv$ A's on the epen)	
(e)	$\frac{Q_3 - 2Q_2 + Q_1}{Q_3 - Q_1} = \frac{67.12 - 2\times 58.8 + 52.48}{67.12 - 52.48}$ subst their Q_1, Q_2 & Q_3 need to show working for A1√ and have reasonable values for quartiles	M1 A1√
	$= 0.1366 \Rightarrow$; +ve skew awrt 0.14	A1; B1 (4)
(f)	For +ve skew Mean > Median & 62.53 > 58.80 <u>or</u> $Q_3 - Q_2$ (8.32) > $Q_2 - Q_1$(6.32) Therefore +ve skew	B1 (1)

Question Number	Scheme		Marks
3. (a)	$S_{xy} = 8880 - \frac{130 \times 48}{8} = (8100)$	may be implied	B1
	$S_{xx} = 20487.5$		
	$b = \frac{s_{xy}}{s_{xx}} = \frac{8100}{20487.5} = 0.395363...$	allow use of their S_{xy} for M awrt 0.395	M1 A1
	$a = \frac{48}{8} - (0.395363...)\frac{130}{8} = -0.424649...$	allow use of their b for M awrt -0.425	M1 A1
	$y = -0.425 + 0.395x$	3s.f.	B1 √ (6)
	Special case answer only B0 M0 B1 M0 B1 B1(fully correct 3sf) (≡ to B0 M0 A1 M0 A1 B1 on the epen)		
(b)	$f - 100 = -0.424649... + 0.395...(m - 250)$	subst f - 100 & m - 250	M1 A1√
	$f = 0.735 + 0.395m$	3 s.f.	A1 (3)
(c)	$m = 235 \Rightarrow f = 93.64489....$	awrt 93.6/93.7	B1 (1)

4(a)	$1.5\,(Q_3 - Q_1) = 1.5\,(28 - 12) = 24$	may be implied	B1
	$Q_3 + 24 = 52 \;\Rightarrow\;$ 63 is an outlier	att Q3 +… or Q1 - …, 52 and -12or <0 or evidence of no lower outliers	M1, A1
	$Q_1 - 24 < 0 \;\Rightarrow\;$ no outliers	63 is an outlier	A1
			M1 A1 A1
			(7)
(b)	Distribution is +ve skew; $Q_2 - Q_1\ (5) < Q_3 - Q_2\ (11)$;		B1; B1 (2)
(c)	Many delays are small so passengers should find these acceptable or sensible comment in the context of the question.		B1 (1)

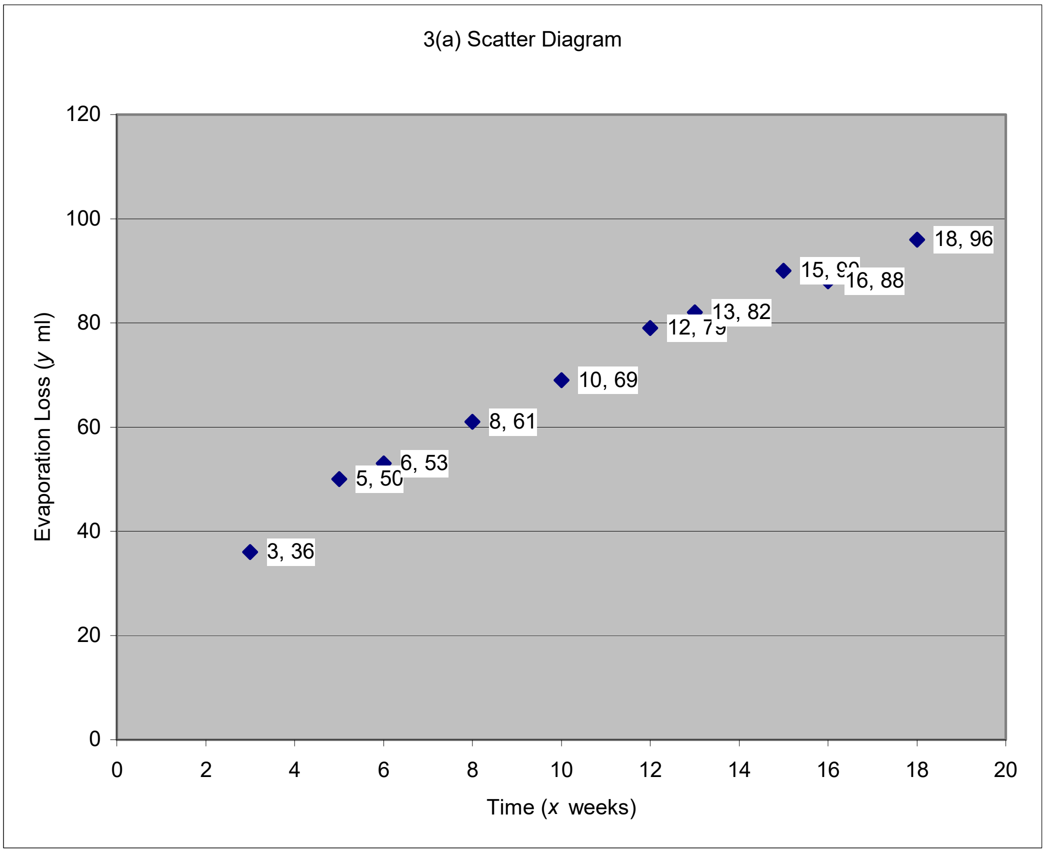
5.(a)	$k + 2k + 3k + 5k + 6k = 1$ use of $\sum P(X = x) = 1$	M1	
	$17k = 1$		
	$k = \dfrac{1}{17} = 0.0588$	A1	(2)
(b)	$E(X) = 1 \times \dfrac{1}{17} + 2 \times \dfrac{2}{17} + ... + 5 \times \dfrac{6}{17} = \dfrac{64}{17}$ use of $\sum xP(X = x)$ and at least 2 prob correct	M1	
	$= 3\dfrac{13}{17}$ Do not ignore subsequent working	A1	
(c)	$E(X^2) = 1^2 \times \dfrac{1}{17} + 2^2 \times \dfrac{2}{17} + ... + 5^2 \times \dfrac{6}{17} = \left(\dfrac{266}{17} = 15.6\right)$ use of $\sum x^2 P(X = x)$ and at least 2 prob correct	M1 A1	
	$\text{Var}(X) = \dfrac{266}{17} - \left(\dfrac{64}{17}\right)^2$ use of $\sum x^2 P(X = x)$ - $(E(X))^2$	M1	
	$= 1.4740...$ awrt 1.47	A1	(4)
(d)	$\text{Var}(4 - 3X) = 9\,\text{Var}(X) = 9 \times 1.47 = 13.23 \Rightarrow 13.2$ or $9 \times 1.4740... = 13.266 \Rightarrow 13.3$ cao 9 Var X	M1 A1	(2)

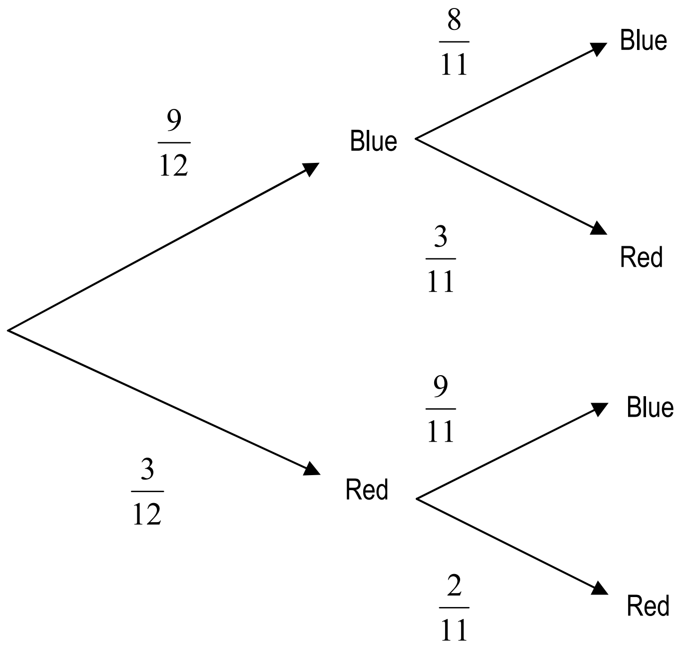
6(a)	$M \sim N(155, 3.5^2)$	
	$P(M > 160) = P\left(z > \frac{160-155}{3.5}\right)$ standardising $\pm(160-155)$, σ, σ^2, $\sqrt{\sigma}$	M1
	$= P(z > 1.43)$	A1
	$= 0.0764$	A1 (3)
(b)	$P(150 \le M \le 157) = P(-1.43 \le z \le 0.57)$ awrt -1.43, 0.57	B1 B1
	$= 0.7157 - (1 - 0.9236)$ p>0.5	M1
	$= 0.6393$ 0.6393 - 0.6400 4dp	A1 (4)
	special case : answer only B0 B0 M1 A1	
(c)	$P(M \le m) = 0.3 \Rightarrow \frac{m-155}{3.5} = -0.5244$ -0.5244 att stand = z value for A1 may use awrt to -0.52.	B1 M1 A1
	$m = 153.2$ cao	A1 (4)
7.		

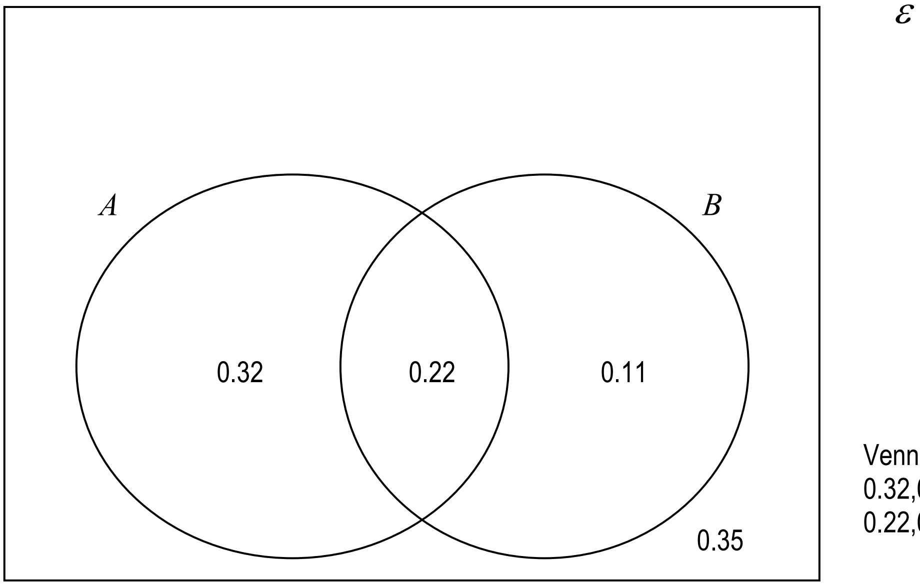
	Glasses	No Glasses	Totals		
Science	18	**12**	30		
Arts	**27**	**23**	**50**	50 may be seen in (a)	
Humanities	44	**24**	68	23 may be seen in (b)	B1
					B1
Totals	89	**59**	148		

(a)	$P(\text{Arts}) = \frac{50}{148} = \frac{25}{74} = 0.338$ a number/148	M1 A1 (4)
(b)	$P(\text{No glasses / Arts}) = \frac{23/148}{50/148} = \frac{23}{50} = 0.46$ $\frac{\text{prob}}{\text{their(a)prob}}$ or $\frac{\text{number}}{\text{their } 50}$	M1 A1 (2)
(c)	$P(\text{Right Handed}) = (\frac{30}{148} \times 0.8) + (\frac{50}{148} \times 0.7) + (\frac{68}{148} \times 0.75)$ attempt add three prob; A1 √ on their (a)	M1 A1 √
	$= \frac{55}{74} = 0.743$ awrt 0.743	A1 (3)
(d)	$P(\text{Science /Right handed}) = \frac{\frac{30}{148} \times 0.8}{(c)} = \frac{12}{55} = 0.218$ √ on their (c)	M1 A1√ A1 (3)

Question Number	Scheme		Marks
1. (a)	Mode is 56		B1 (1)
(b)	$Q_1 = 35, Q_2 = 52, Q_3 = 60$		B1,B1,B1 (3)
(c)	$\bar{x} = \dfrac{1335}{27} = 49.\dot{4} \text{ or } 49\dfrac{4}{9}$	exact or awrt 49.4	B1
	$\sigma^2 = \dfrac{71801}{27} - \left(\dfrac{1335}{27}\right)^2 = 214.5432...$		M1A1ft
	$\sigma = 14.6 \text{ or } 14.9$	awrt 14.6(5) or 14.9	A1 (4)
(d)	$\dfrac{49.4\text{-}56}{14.6} = -0.448$	awrt range -0.44 to -0.46	M1A1 (2)
(e)	For negative skew;		
	Mean<median<mode	2 compared correctly	M1
	(49.4<52<56 not required)	3 compared correctly	A1
	$Q_3\text{-}Q_2 < Q_2\text{-}Q_1$		M1
	8 and 17		A1 ft (4)
	Accept other valid reason eg. 3(mean-median)/sd as alt for M1A1		
			Total 14 marks
2. (a)	$p + q = 0.4$		B1
	$2p + 4q = 1.3$	Consider with (b).	M1A1 (3)
(b)	Attempt to solve		M1
	$p = 0.15, q = 0.25$	If both seen, award 3.	A1A1 (3)
(c)	$\mathrm{E}(X^2) = 1^2 \times 0.10 + 2^2 \times 0.15 + ... + 5^2 \times 0.30 = 14$		M1A1ft
	$\mathrm{Var}(X) = 14 - 3.5^2 = 1.75$		M1A1 (4)
(d)	$\mathrm{Var}(3 - 2X) = 4\mathrm{Var}(X) = 7.00$		M1A1ft (2)
			Total 12 marks

3. (a)	Sensible graph scales, labels, shape 	B1,B1,B1 (3)
(b)	Points lie close to a straight line	B1 (1)
(c)	$S_{xy} = 8354 - \frac{106 \times 704}{10} = 891.6$	B1
	$S_{xx} = 1352 - \frac{106^2}{10} = 228.4$	B1
	$b = \frac{891.6}{228.4} = 3.903677...$ awrt 3.9	M1A1
	$a = \frac{704}{10} - b\frac{106}{10} = 29.021015...$ awrt 29	M1A1
	29.02, 3.90	A1ft (7)
(d)	For every extra week in storage, another 3.90 ml of chemical evaporates	B1 (1)
(e)	(i) 103.12 (ii) 165.52	B1B1 (2)
(f)	(i) Close to range of x, so reasonably reliable (ii) Well outside range of x, could be unreliable since no evidence that model will continue to hold	B1,B1 B1 B1 (4)
		Total 18 marks

4. (a)		
	Tree	M1
	$\frac{9}{12}, \frac{3}{12}$	A1
	Complete & labels	A1 (3)
(b)	$\text{P(Second ball is red)} = \frac{9}{12} \times \frac{3}{11} + \frac{3}{12} \times \frac{2}{11} = \frac{1}{4}$	M1A1 (2)
(c)	$\text{P(Both are red} \mid \text{Second ball is red)} = \dfrac{\frac{3}{12} \times \frac{2}{11}}{\frac{1}{4}} = \frac{2}{11}$ exact or awrt 0.182	M1A 1 (2)
		Total 7 marks
5. (a)	To simplify a real world problem To improve understanding / describe / analyse a real world problem Quicker and cheaper than using real thing To predict possible future outcomes Refine model / change parameters possible Any 2	B1B1 (2)
(b)	(i) e.g.s height, weight (ii) score on a face after tossing a fair die	B1B1 (2)
		Total 4 marks

6. (a)	 Venn Diagram 0.32,0.11 & A,B 0.22,0.35 & box	M1 A1 A1 (3)
(b)	$\mathrm{P}(A) = 0.32 + 0.22 = 0.54; \mathrm{P}(B) = 0.33$	M1A1ft;A1ft (3)
(c)	$\mathrm{P}(A\vert B') = \dfrac{\mathrm{P}(\mathrm{A} \cap B')}{\mathrm{P}(B')} = \dfrac{32}{67}$ awrt 0.478	M1A1 (2)
(d)	For independence $\mathrm{P}(\mathrm{A} \cap B) = \mathrm{P}(\mathrm{A})\mathrm{P}(B)$ For these data $0.22 \neq 0.54 \times 0.33 = 0.1782$ (OR $\mathrm{P}(A\vert B') \neq \mathrm{P}(\mathrm{A})$ for M1A1ft OR $\dfrac{2}{3} = \mathrm{P}(A\vert B) \neq \mathrm{P}(\mathrm{A}) = 0.54$ for M1A1ft) $\therefore$ NOT independent	M1A1ft A1ft (3) **Total 11 marks**
7. (a)	Let H be rv height of athletes, so $H \sim \mathrm{N}(180, 5.2^2)$ $\mathrm{P}(H>188) = \mathrm{P}(Z > \dfrac{188-180}{5.2}) = \mathrm{P}(Z>1.54) = 0.0618$ ± stand. √, sq, awrt 0.062	M1A1A1 (3)
(b)	Let W be rv weight of athletes, so $W \sim \mathrm{N}(85, 7.1^2)$ $\mathrm{P}(\mathrm{W}<97) = \mathrm{P}(Z < 1.69) = 0.9545$ standardise, awrt 0.9545	M1A1 (2)
(c)	$\mathrm{P}(H>188 \text{ \& } W < 97) = 0.0618(1 - 0.9545)$ allow (a)x(b) for M $= 0.00281$ awrt 0.0028	M1A1ft A1 (3)
(d)	Evidence suggests height and weight are positively correlated / linked Assumption of independence is not sensible	B1 (1) **Total 9 marks**

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(Results)

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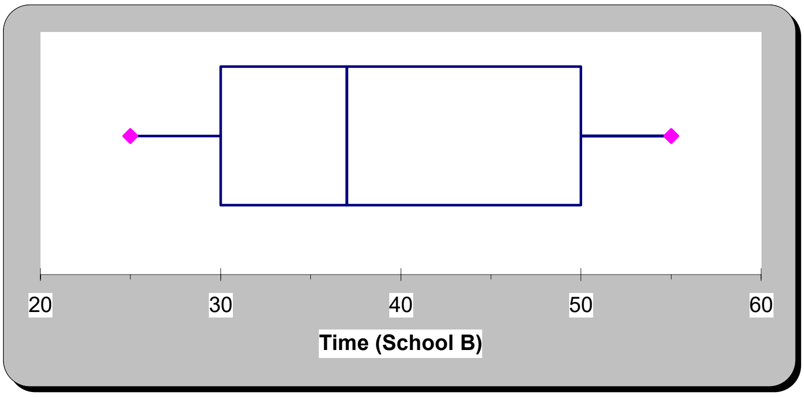
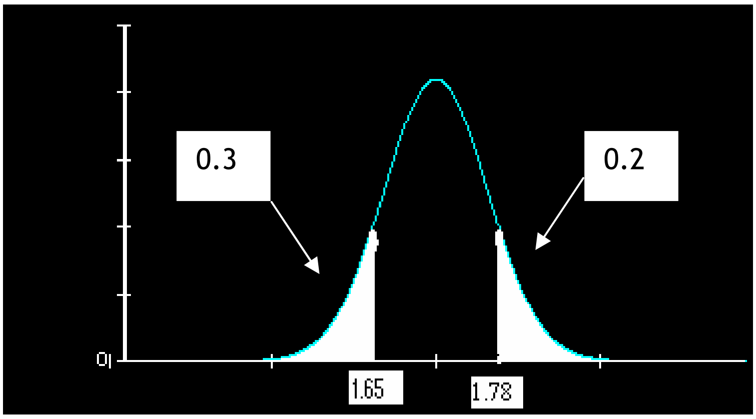
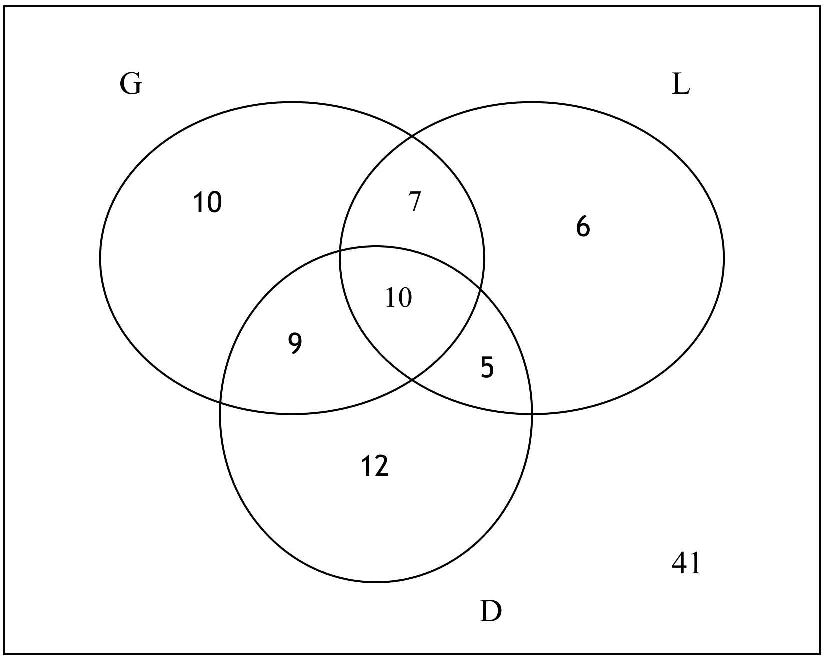
Question Number	Scheme	Marks
1(a)	Indicates max / median / min / upper quartile/ lower quartile (2 or more)	**B1**
	Indicates outliers (or equivalent description)	**B1**
	Illustrates skewness (or equivalent description e.g. shape) Any 3 rows	**B1**
	Allows comparisons	
	Indicates range / IQR / spread	
		(3)
(b)(i)	37 (minutes)	**B1**
(ii)	Upper quartile or Q_3 or third quartile or 75^{th} percentile or P_{75}	**B1**
		(2)
(c)	Outlier s	
	How to calculate correctly	
	'Observations that are very different from the other observations	
	and need to be treated with caution'	**B1**
	These two children probably walked / took a lot longer Any 2	**B1**
		(2)
(d)		
	Box & median & whiskers	**M1**
	Sensible scale	**B1**
	30,37,50	**B1**
	25,55	**B1**
		(4)
(e)	Children from school A generally took less time Any **correct** 4 lines	**B1**
	50% of B $\leq$ 37 mins, 75% of A < 37 mins (similarly for 30)	**B1**
	Median/Q1/Q3 of A < median/Q1/Q3 of B (1 or more)	**B1**
	A has outliers, (B does not)	**B1**
	Both positive skew	
	IQR of A<IQR of B, range of A>range of B	
		(4)
		Total 15

Question Number	Scheme		Marks
2. (a)	P(both longer than 24.5)= $\frac{11}{55}\times\frac{10}{54}=\frac{1}{27}$ or $0.\dot{0}3\dot{7}$ or 0.037	2 fracs x w/o rep. awrt 0.037	**M1A1**
			(2)
(b)	Estimate of mean time spent on their conversations is $\bar{x}=\frac{1060}{55}=19\frac{3}{11}$ or $19.\dot{2}\dot{7}$ or 19.3	1060/total, awrt 19.3 or 19mins 16s	**M1A1**
			(2)
(c)	$\frac{1060+\sum fy}{80}=21$	21x80=1680	**B1**
	$\sum fy=620$	Subtracting 'their 1060'	**M1**
	$\therefore \bar{y}=\frac{620}{25}=24.8$	Dividing their 620 by 25	**M1A1**
			(4)
(d)	Increase in mean value.		**B1**
	Length of conversations increased considerably during 25 weeks relative to 55 weeks	context - ft only from **comment** above	**B1$\int$**
			(2)
			Total 10
3. (a)	$\sum x=\sum t=337.1$, $\sum y=16.28$	Can be implied	**B1,B1**
	$S_{xy}=757.467-\frac{337.1\times16.28}{8}=71.4685$	either method, awrt 71.5	**M1A1**
	$S_{xx}=15965.01-\frac{337.1^2}{8}=1760.45875$	awrt 1760	**A1**
			(5)
(b) **M1A1**	$\mathrm{b}=\frac{71.4685}{1760.45875}=0.04059652$	/ correct way up, awrt 0.0406	
	$\mathrm{a}=\frac{16.28}{8}-\mathrm{b}\times\frac{337.1}{8}=0.324364$	using correct formula, awrt 0.324	**M1A1**
	$y=0.324+0.0406x$	3 sf or better but award for copying from above	**A1$\int$**
			(5)
(c)	At $t=40$, $x=40$, $y=1.948$, $l=2461.948$	sub x=40, awrt 1.95, awrt 2461.95	**M1A1A1$\int$**
			(3)
(d)	$l-2460=0.324+0.0406t$	LHS required	**M1**
A1	$l=2460.324+0.0406t$	awrt 2460.32, f.t. their 0.0406, l and t	
			(2)
(e)	At $t=90$, $l=2463.978$	awrt 2464	**B1**
			(1)
(f)	90°C outside range of data unlikely to be reliable		**B1**

4 (a)	$\mathrm{E}(X)=3;$	**B1**
	$\mathrm{Var}(X)=\frac{25-1}{12}=2$ ****AG****	
	$\mathrm{Var}(X)=1^2\times\frac{1}{5}+2^2\times\frac{1}{5}+3^2\times\frac{1}{5}.....-3^2=11-9=2$ ****AG****	**M1A1**
	Accept (55/5)-9 as minimum evidence.	
		(3)
(b)	$\mathrm{E}(3X-2)=3\mathrm{E}(X)-2=7$	
M1A1∫		
		(2)
(c)	$\mathrm{Var}(4-3x)=3^2\,\mathrm{Var}(X)=18$	**M1A1**
		(2)
		Total 7
5(a)		
	2 separate sketches OK. Bell Shape	**B1**
	1.78 & 0.2	**B1**
	1.65 & 0.3	**B1**
	Accept **clear** alternatives to 0.3: 0.7/0.5/0.2	
		(3)
(b)	$\frac{1.78-\mu}{\sigma}=0.8416\Rightarrow 1.78-\mu=0.8416\sigma$ either for method	**M1**
	0.8416	**B1**
	$\frac{1.65-\mu}{\sigma}=-0.5244\Rightarrow 1.65-\mu=-0.5244\sigma$ (-)0.5244	**B1**
	N.B. awrt 0.84, 0.52 B1B0	
	Solving gives $\mu=1.70,\sigma=0.095$ awrt 1.7, 0.095 cao	**M1A1A1**
		(6)
(c)	$\mathrm{P}(\text{height}\geq 1.74)$=1-P(height<1.74) 'one minus'	**M1**
	$=1-\mathrm{P}\left(Z<\frac{1.74\text{-}1.70}{0.095}\right)$ standardise with their mu and sigma	**M1**
	$=1-\mathrm{P}(Z<0.42)=0.3372$ awrt 0.337	**A1**
		(3)
		Total 12

6.(a)		
	3 closed curves that intersect	**M1**
	Subtract at either stage	**M1**
	9,7,5	**A1**
	10,6,12	**A1**
	41 & box	**A1**
		(6)
(b)	$P(G, \overline{LH}, \overline{D}) = \frac{10}{100} = \frac{1}{10}$	**B1**$\int$
		(1)
(c)	$P(\overline{G}, \overline{LH}, \overline{D}) = \frac{41}{100}$	**B1**$\int$
		(1)
(d)	P(Only two attributes)$= \frac{9+7+5}{100} = \frac{21}{100}$	**M1A1**$\int$
		(2)
(e)	$P(G \mid LH\&DH) = \frac{P(G \,\&\, LH \,\&\, DH)}{P(LH \,\&\, DH)} = \frac{\frac{10}{100}}{\frac{15}{100}} = \frac{10}{15} = \frac{2}{3}$ awrt 0.667	**M1A1**$\int$**A1**
	N.B. Assumption of independence M0	
		(3)
		Total 13

Mark Scheme (Results)

January 2007

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GCE Mathematics

Statistics (6683)

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Question number	Scheme	Marks
1. (a)	(£) 17 Just **<u>17</u>**	B1 (1)
(b)	$\sum t = 212$ and $\sum m = 61$ (Accept as totals under each column in qu.)	B1, B1
	$S_{tm} = 2485 - \frac{61 \times 212}{10}$, = 1191.8 awrt **<u>1190</u>** or 119 (3sf)	M1, A1
	$S_{tt} = 983.6$ (awrt <u>984</u>) and $S_{mm} = 1728.9$ (awrt <u>1730</u>) (or 98.4 and 173)	A1, A1 (6)
(c)	$r = \frac{1191.8}{\sqrt{983.6 \times 1728.9}}$	M1, A1f.t.
	= 0.913922… awrt **<u>0.914</u>**	A1 (3)
(d)	0.914 (Must be the same as (c) or awrt 0.914)	B1f.t. ($\lvert r \rvert < 1$)
	e.g. linear transformation, coding does not affect coefficient (or recalculate)	dB1 (2)
(e)	0.914 suggests longer spent shopping the more spent. (Idea more time, more spent)	B1
	0.178 different amounts spent for same time.	B1 (2)
(f)	e.g. might spend short time buying 1 expensive item <u>OR</u> might spend a long time checking for bargains, talking, buying lots of cheap items.	B1g (1)
		15 marks

(b)	M1	for one correct formula seen, f.t. their $\sum t, \sum m$ [Use 1st A1 for 1 correct, 2nd A1 for 2 etc]
(c)	M1	for attempt at correct formula, $\frac{2485}{\sqrt{2101 \times 5478}}$ scores M1A0A0
	A1ft	f.t. their values for S_{tt} etc from (b) but don't give for $S_{tt} = 5478$ etc (see above)
		Answer only (awrt 0.914) scores 3/3, 0.913 (i.e. truncation) can score M1A1ft by implication.
(d)	2nd B1	dependent on 1st B1 Accept $\sum m = 261, \sum m^2 = 8541, \sum tm = 6725 \to 0.914$
(e)		One mark for a sensible comment relating to each coefficient For 0.178 allow "little or no link between time and amount spent". Must be in context. Just saying 0.914 is strong +ve correlation between amount spent and time shopping and 0.178 is weak correlation …scores B0B0.
(f)	B1g	for a sensible, practical suggestion showing that other factors might affect the amount spent. E.g. different day (weekend vs weekday) or time of day (time spent queuing if busy)

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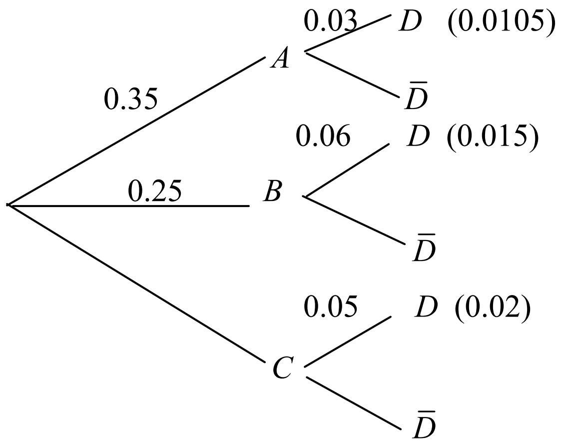
2. (a)		Correct tree shape	M1
		A, B and *C* and 0.35 and 0.25	A1
		D (x3) and 0.03, 0.06, 0.05 (May be implied by seeing $\mathrm{P}(A \cap D)$ etc at the ends)	A1 (3)
(b)(i)	$\mathrm{P}(A \cap D) = 0.35 \times 0.03$, $= \underline{\mathbf{0.0105}}$ or $\dfrac{21}{2000}$		M1, A1
		P(*C*) = 0.4 (anywhere)	B1
(ii)	P(*D*) = (i) + 0.25x 0.06 + (0.4x0.05)		M1
	$= \underline{\mathbf{0.0455}}$ or $\dfrac{91}{2000}$		A1 (5)
(c)	$\mathrm{P}(C \mid D) = \dfrac{\mathrm{P}(C \cap D)}{\mathrm{P}(D)}$, $= \dfrac{0.4 \times 0.05}{\text{(ii)}}$		M1, A1ft
	$= 0.43956\ldots$ or $\dfrac{40}{91}$	$\underline{\mathbf{0.44}}$ or awrt $\underline{\mathbf{0.440}}$	A1 (3)
	[Correct answers only score full marks in each part]		**11 marks**

(a)	M1	for tree diagram, 3 branches and then two from each. At least one probability attempted.
(b)	1st M1	for 0.35x0.03. Allow for equivalent from <u>their</u> tree diagram.
	B1	for P(*C*) = 0.4, can be in correct place on tree diagram or implied by 0.4x0.05 in P(*D*).
	2nd M1	for all 3 cases attempted and <u>some</u> correct probabilities seen, including +. Can ft their tree. Condone poor use of notation if correct calculations seen. E.g. $\mathrm{P}(C \mid D)$ for $\mathrm{P}(C \cap D)$.
(c)	M1	for attempting correct ratio of probabilities. There must be an attempt to substitute some values in a correct formula. If no correct formula and ration not correct ft score M0. Writing P(*D*|*C*) and attempting to find this is M0. Writing P(*D*|*C*) but calculating correct ratio – ignore notation and mark ratios.
	A1ft	must have their 0.4 x0.05 divided by their (ii). If ratio is incorrect ft (0/3) unless correct formula seen and part of ratio is correct then M1.

<table>
<tr><th>Question number</th><th>Scheme</th><th>Marks</th></tr>
<tr><td>3. (a)</td><td>N.B. Part (a) doesn't have to be in a table, could be a list P(X = 1) = …etc

x	1	2	3	4	5	6
$\mathrm{P}(X=x)$	$\frac{1}{36}$	$\frac{3}{36}$	$\frac{5}{36}$	$\frac{7}{36}$	$\frac{9}{36}$	$\frac{11}{36}$

0.0278, 0.0833, 0.139, 0.194, 0.25, 0.306 (Accept awrt 3 s.f)</td><td>B1, B1, B1

(3)</td></tr>
<tr><td>(b)</td><td>P(3) + P(4) + P(5) =, $\underline{\frac{21}{36} \text{ or } \frac{7}{12}}$ <u>or awrt 0.583</u></td><td>M1, A1 (2)</td></tr>
<tr><td>(c)</td><td>$\mathrm{E}(X) = \frac{1}{36} + 2\times\frac{3}{36} + \ldots, = \underline{\frac{161}{36}}$ or $4.47\dot{2}$ or $4\frac{17}{36}$</td><td>M1, A1 (2)</td></tr>
<tr><td>(d)</td><td>$\mathrm{E}(X^2) = \frac{1}{36} + 2^2\times\frac{3}{36} + \ldots, = \frac{791}{36}$ or full expression or $21\frac{35}{36}$ or awrt 21.97

$\mathrm{Var}(X) = \frac{791}{36} - \left(\frac{161}{36}\right)^2$, = <u>1.9714… *</u></td><td>M1, A1

M1, A1c.s.o. (4)</td></tr>
<tr><td>(e)</td><td>Var(2 – 3X) = 9×1.97 or $(-3)^2\times1.97$, = 17.73 awrt <u>17.7</u> or $\frac{2555}{144}$</td><td>M1, A1 (2)
13 marks</td></tr>
<tr><td>(a)</td><td colspan="2">1st B1 for $x = 1, \ldots 6$ and at least one correct probability N.B. $\frac{3}{36} = \frac{1}{12}$ and $\frac{9}{36} = \frac{1}{4}$
2nd B1 for at least 3 correct probabilities
3rd B1 for a fully correct probability distribution.</td></tr>
<tr><td>(b)</td><td colspan="2">M1 for attempt to add the correct three probabilities, ft their probability distribution</td></tr>
<tr><td>(c)</td><td colspan="2">M1 for a correct attempt at E(X). Minimum is as printed. Exact answer only scores M1A1.
[Division by 6 at any point scores M0, no ISW. Non-exact answers with no working score M0.]</td></tr>
<tr><td>(d)</td><td colspan="2">1st M1 for a correct attempt at $\mathrm{E}(X^2)$. Minimum as printed. $\frac{791}{36}$ or awrt 21.97 scores M1A1.
2nd M1 for their $\mathrm{E}(X^2) - (\text{their } \mathrm{E}(X))^2$.
2nd A1 cso needs awrt 1.97 <u>and</u> $\frac{791}{36} - \left(\frac{161}{36}\right)^2$ or $\frac{2555}{1296}$ or any fully correct expression seen.
Can accept <u>at least 4 sf</u> for both. i.e. 21.97 for $\frac{791}{36}$, 4.472 for $\frac{161}{36}$, 20.00 for $\left(\frac{161}{36}\right)^2$.</td></tr>
<tr><td>(e)</td><td colspan="2">M1 for correct use of Var(aX + b) formula or a <u>full</u> method.
NB $-3^2\times1.97$ followed by awrt 17.7 scores M1A1 <u>BUT</u> $-3^2\times1.97$ alone, or followed by – 17.7, scores M0A0.</td></tr>
</table>

Question number	Scheme	Marks
4. (a)	Positive skew (both bits)	B1 (1)
(b)	$19.5 + \frac{(60-29)}{43}\times 10, = 26.7093\ldots$ awrt **26.7**	M1, A1 (2)
	(N.B. Use of 60.5 gives 26.825… so allow awrt 26.8)	
(c)	$\mu = \frac{3550}{120} = 29.5833...$ or $29\frac{7}{12}$ awrt **29.6**	B1
	$\sigma^2 = \frac{138020}{120} - \mu^2$ or $\sigma = \sqrt{\frac{138020}{120} - \mu^2}$	M1
	$\sigma = 16.5829...$ or ($s = 16.652...$) awrt **16.6** (or s = 16.7)	A1 (3)
(d)	$\frac{3(29.6-26.7)}{16.6}$	M1A1ft
	= 0.52…. awrt **0.520** (or with s awrt 0.518)	A1 (3)
	(N.B. 60.5 in (b) ...awrt 0.499[or with s awrt 0.497])	
(e)	0.520 > 0 correct statement about their (d) being >0 or < 0	B1ft
	So it is consistent with (a) ft their (d)	dB1ft (2)
(f)	Use Median	B1
	Since the data is skewed or less affected by outliers/extreme values	dB1 (2)
(g)	If the data are symmetrical or skewness is zero or normal/uniform distribution	B1 (1)
	("mean =median" or "no outliers" or "evenly distributed" all score B0)	**14 marks**

(b)	M1 for (19.5 or 20) + $\frac{(60-29)}{43}\times 10$ or better. Allow 60.5 giving awrt 26.8 for M1A1 Allow their $0.5n$ [or $0.5(n+1)$] instead of 60 [or 60.5] for M1.
(c)	M1 for a correct expression for σ, σ^2, s or s^2. NB $\sigma^2 = 274.99$ and $s^2 = 277.30$ Condone poor notation if answer is awrt16.6 (or 16.7 for s)
(d)	M1 for attempt to use this formula using their values to any accuracy. Condone missing 3. 1st A1ft for using their values to at least 3sf. Must have the 3. 2nd A1 for using accurate enough values to get awrt 0.520 (or 0.518 if using s) NB Using only 3 sf gives 0.524 and scores M1A1A0
(e)	1st B1 for saying or implying correct sign for their (d). B1g and B1ft. Ignore "correlation" if seen. 2nd B1 for a comment about consistency with their (d) and (a) being positive skew, ft their (d) only This is dependent on 1st B1: so if (d)>0, they say yes, if (d)<0 they say no.
(f)	2nd B1 is dependent upon choosing median.

Question number	Scheme	Marks	
5. (a)	Time is a continuous variable or data is in a grouped frequency table	B1	(1)
(b)	Area is proportional to frequency or $A \propto f$ or $A = kf$	B1	(1)
(c)	$3.6 \times 2 = 0.8 \times 9$	M1 dM1	
	1 child represented by 0.8	A1 cso	(3)
(d)	(Total) = $\frac{24}{0.8}$, = **30**	M1, A1	(2)
		7 marks	
(b)	1^{st} B1 for one of these correct statements. "Area proportional to frequency density" or "Area = frequency" is B0		
(c)	1^{st} M1 for a correct combination of any 2 of the 4 numbers: 3.6, 2, 0.8 and 9 e.g. 3.6×2 or $\frac{3.6}{0.8}$ or $\frac{0.8}{2}$ etc BUT e.g. $\frac{3.6}{2}$ is M0 2^{nd} M1 dependent on 1^{st} M1 and for a correct combination of 3 numbers leading to 4^{th}. May be in separate stages but must see all 4 numbers A1cso for fully correct solution. Both Ms scored, no false working seen and comment required.		
(d)	M1 for $\frac{24}{0.8}$ seen or implied.		

Question number	Scheme	Marks
6. (a)	Used to simplify <u>or</u> represent a real world problem Cheaper <u>or</u> quicker <u>or</u> easier (than the real situation) <u>or</u> more easily modified To improve understanding of the real world problem Used to predict outcomes from a real world problem (idea of predictions)	(any two lines) B1 B1 (2)
(b)	(3 or 4) Model used to make predictions. (Idea of predicted values based on the model) (4 or 3) (Experimental) data collected (7) Model is refined.	B1 B1 B1 (3) **5 marks**
(a)	1st B1 For one line 2nd B1 For a second line Be generous for 1st B1 but stricter for B1B1	
(b)	1st & 2nd B1 These two points can be interchanged. Idea of values from (experimental) data and predicted values based on the model. 1st B1 for predicted values from model e.g. "model used to gain suitable data" 2nd B1 for data collected. Idea of experimental data but "experiment" needn't be explicitly seen 3rd B1 This should be stage 7. Idea of refinement or revision or adjustment	

Question number	Scheme		Marks
7. (a)	$P(X < 91) = P(Z < \frac{91-100}{15})$	Attempt standardisation	M1
	$= P(Z < -0.6)$		A1
	$= 1 - 0.7257$		M1
	$= 0.2743$	awrt **<u>0.274</u>**	A1 (4)
(b)	$1 - 0.2090 = 0.7910$	0.791	B1
	$P(X > 100+k) = 0.2090$ <u>or</u> $P(X < 100+k) = 0.7910$	(May be implied)	M1
		Use of tables to get $z = 0.81$	B1
	$\frac{100+k-100}{15}$,=0.81	(ft their $z = 0.81$, but must be z not prob.)	M1, A1ft
	<u>***k* = 12**</u>		A1 cao (6)
			10 marks

(a) 1^{st} M1 for attempting standardisation. $\pm\frac{(91-\mu)}{\sigma \text{ or } \sigma^2}$. Can use of 109 instead of 91.Use of 90.5 etc is M0

1^{st} A1 for -0.6 (or $+0.6$ if using 109)

2^{nd} M1 for 1 – probability from tables. Probability should be > 0.5)

(b) 1^{st} B1 for 0.791 seen or implied.

1^{st} M1 for a correct probability statement, but must use X or Z correctly. Shown on diagram is OK

2^{nd} B1 for awrt 0.81 seen (or implied by correct answer - see below) (Calculator gives 0.80989…)

2^{nd} M1 for attempting to standardise e.g. $\frac{100+k-100}{15}$ or $\frac{k}{15}$

$\frac{X-100}{15}$ scores 2^{nd} M0 until the 100+ k is substituted to give k, but may imply 1^{st} M1 if k= 112.15 seen

1^{st} A1ft for correct equation for k (as written or better). Can be implied by k = 12.15 (or better)

2^{nd} A1 for k = 12 only.

<u>Answers only</u>

k = 112 or 112.15 or better scores 3/6 (on EPEN give first 3 marks)

k = 12.15 or better (calculator gives 12.148438…) scores 5/6 (i.e loses last A1 only)

k = 12 (no incorrect working seen) scores 6/6

NB Using 0.7910 instead of 0.81 gives 11.865 which might be rounded to 12. This should score no more than B1M1B0M1A0A0.

Mark Scheme (Results)

Summer 2007

GCE

GCE Mathematics

Statistics S1 (6681)

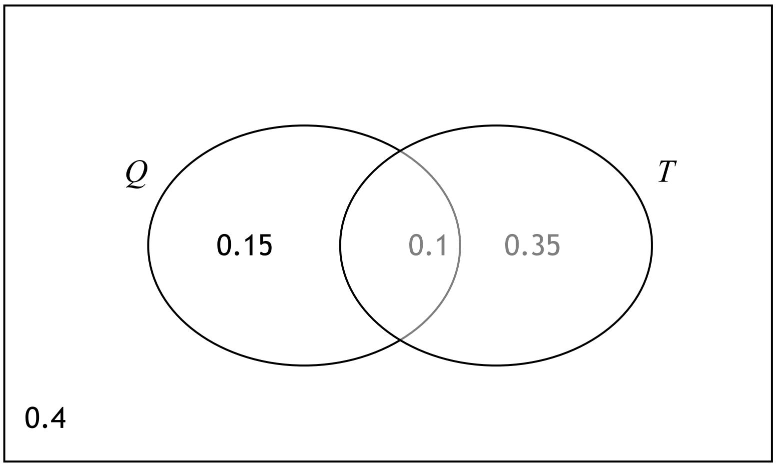
A PEARSON COMPANY

June 2007
6683 Statistics S1
Mark Scheme

Question Number	Scheme	Marks
1. (a)	$r = \dfrac{S_{xy}}{\sqrt{S_{xx}S_{yy}}} \quad = \dfrac{-808.917}{\sqrt{113573 \times 8.657}}$	**M1**
	$= -0.81579...$	**A1** **(2)**
(b)	Houses are <u>cheaper</u> further away from the station or equivalent statement **B1**	**(1)**
(c)	-0.816	**B1**∫ **(1)**
		Total 4 marks
Notes:		
1(a)	M1 for knowing formula and clear attempt to sub in correct values from question. Root required for method. Anything that rounds to -0.82 for A1. Correct answer with no working award 2/2	
(b)	Context based on negative correlation only required. Accept <u>Houses</u> are <u>more expensive</u> closer to the <u>station</u> or equivalent statement. Require 'house prices' or 'station' and a clear correct comparison.	
(c)	Accept anything that rounds to -0.82 or 'the same' or 'unchanged' or equivalent. Award B1 if value quoted same as answer to (a).	

Question Number	Scheme	Marks
2(a)	$\frac{1}{2}$	B1 (1)
(b)	54	B1 (1)
(c)	+ is an 'outlier' or 'extreme value' Any heavy musical instrument or a statement that the instrument is heavy **B1**	B1 (2)
(d)	$Q_3 - Q_2 = Q_2 - Q_1$ so symmetrical or no skew Dependent – only award if B1 above	B1 B1 (2)
(e)	$\mathrm{P}(W < 54) \quad = 0.75$ (or $\mathrm{P}(W > 54) \quad = 0.25$)or correctly labelled and shaded diagram	M1
	$\frac{54-45}{\sigma} \quad = 0.67$	M1B1
	$\sigma = 13.43.....$	A1 (4)
		Total 10 marks
Notes 2(a)	Accept 50% or half or 0.5. Units not required.	
(b)	Correct answer only. Units not required.	
(c)	'Anomaly' only award B0 Accept '85kg was heaviest instrument on the trip' or equivalent for second B1. Examples of common acceptable instruments; double bass, cello, harp, piano, drums, tuba Examples of common unacceptable instruments: violin, viola, trombone, trumpet, french horn, guitar	
(d)	'Quartiles equidistant from median' or equivalent award B1 then symmetrical or no skew for B1 Alternative: 'Positive tail is longer than negative tail' or 'median closer to lowest value' or equivalent so slight positive skew. B0 for 'evenly' etc. instead of 'symmetrical' B0 for 'normal' only	
(e)	**Please note that B mark appears first on ePEN** First line might be missing so first M1 can be implied by second. Second M1 for standardising with sigma and equating to z value NB Using 0.7734 should not be awarded second M1 Anything which rounds to 0.67 for B1. Accept 0.675 if to 3sf obtained by interpolation Anything that rounds to 13.3 – 13.4 for A1.	

3(a)	Use overlay	**B2** **(2)**
(b)	$S_{xy} = 28750 - \frac{315 \times 620}{8} = 4337.5$ **answer given** so award for method	**M1**
	$S_{xx} = 15225 - \frac{315^2}{8} = 2821.875$	**M1A1** **(3)**
(c)	$b = \frac{4377.5}{S_{xx}}, = 1.537... = 1.5$	**M1,A1**
	$a = \overline{y} - b\overline{x} = \frac{620}{8} - b\frac{315}{8} = 16.97... = 17.0$	**M1,A1** **(4)**
(d)	Use overlay	**B1** **B1** **(2)**
(e)	Brand D,	**B1**
	since a long way above / from the line dependent upon 'Brand D' above	**B1**
	Using line: $y = 17 + 35 \times 1.5 = 69.5$	**M1A1** **(4)**
		Total 15 marks
Notes:		
3(a)	Points B2,within 1 small square of correct point, subtract 1 mark each error minimum 0.	
(b)	Anything that rounds to 2820 for A1	
(c)	Anything that rounds to 1.5 and 17.0 (accept 17)	
(d)	Follow through for the intercept for first B1.. Correct slope of straight line for second B1.	
(e)	Anything that rounds to 69p-71p for final A1. Reading from graph is acceptable for M1A1. If value read from graph at $x = 35$ is answer given but out of range, then award M1A0.	

4(a)	$\mathrm{P}(Q \cup T) = 0.6$ $\mathrm{P}(Q) + \mathrm{P}(T) - \mathrm{P}(Q \cap T) = 0.6$ $\mathrm{P}(Q \cap T) = 0.1$	**B1** **M1** **A1** **(3)**
(b)	 Venn 0.15, 0.35 0.4 and box	**M1** **A1$\int$** **B1** **(3)**
(c)	$P(Q \cap T' \mid Q \cup T) = \dfrac{0.15}{0.60} = \dfrac{1}{4}$ or 0.25 or 25%	**M1A1$\int$A1** **(3)** **Total 9 marks**
Notes:		
4(a)	B1 for 0.6 M1 for use of $\mathrm{P}(Q) + \mathrm{P}(T) - \mathrm{P}(Q \cap T) = \mathrm{P}(Q \cup T)$ 0.1 Correct answer only for A1 Alternative: (25+45+40=)110% B1 110-100=10% M1A1 0.1 stated clearly as the final answer with no working gets 3/3	
(b)	Two intersecting closed curves for M1, no box required. At least one label (*Q* or *T*) required for first A1. Follow through (0.25-‘their 0.1’) and (0.45-‘their 0.1’) for A1. 0.4 and box required, correct answer only for B1 Using %, whole numbers in Venn diagram without % sign, whole numbers in correct ratio all OK	
(c)	Require fraction with denominator 0.6 or their equivalent from Venn diagram for M1 Follow through their values in fraction for A1 Final A1 is correct answer only. <u>No working no marks.</u>	

5(a)	18-25 group, area=7x5=35	**B1**
	25-40 group, area=15x1=15	**B1**
		(2)
(b)	(25-20)x5+(40-25)x1=40	**M1A1**
		(2)
(c)	Mid points are 7.5, 12, 16, 21.5, 32.5	**M1**
	$\sum \text{f} = 100$	**B1**
	$\frac{\sum \text{f}t}{\sum \text{f}} = \frac{1891}{100} = 18.91$	**M1A1**
		(4)
(d)	$\sigma_t = \sqrt{\frac{41033}{100} - \bar{t}^2}$ $\quad\sqrt{\frac{n}{n-1}\left(\frac{41033}{100} - \bar{t}^2\right)}$ alternative OK	**M1**
		M1
	$\sigma_t = \sqrt{52.74...} = 7.26$	**A1**
		(3)
(e)	$Q_2 = 18$ or 18.1 if (n+1) used	**B1**
	$Q_1 = 10 + \frac{15}{16} \times 4 = 13.75$ or 15.25 numerator gives 13.8125	**M1A1**
	$Q_3 = 18 + \frac{25}{35} \times 7 = 23$ or 25.75 numerator gives 23.15	**A1**
		(4)
(f)	0.376…	**B1**
	Positive skew	**B1**∫
		(2)
		Total 17 marks
Notes:		
5(b)	5x5 is enough evidence of method for M1. Condone 19.5, 20.5 instead of 20 etc. Award 2 if 40 seen.	
(c)	Look for working for this question in part (d) too. Use of some mid-points, at least 3 correct for M1. These may be tabulated in (d). Their $\frac{\sum \text{f}t}{\sum \text{f}}$ for M1 and anything that rounds to 18.9 for A1.	
(d)	Clear attempt at $\frac{41033}{100} - \bar{t}^2$ or $\frac{n}{n-1}\left(\frac{41033}{100} - \bar{t}^2\right)$ alternative for first M1. They may use their $\bar{t}$ and gain the method mark. Square root of above for second M1 Anything that rounds to 7.3 for A1.	
(e)	Clear attempt at either quartile for M1 These will take the form 'their lower limit'+ correct fraction x 'their class width'. Anything that rounds to 13.8 for lower quartile. 23 or anything that rounds to 23.2 dependent upon method used.	
(f)	Anything that rounds to 0.38 for B1 or 0.33 for B1 if (n+1) used. Correct answer or correct statement that follows from their value for B1.	

6(a)	$P(X > 25) \quad = P\left(Z > \frac{25-20}{4}\right)$	M1
	$= P(Z > 1.25)$	M1
	$= 1 - 0.8944$	
	$= 0.1056$	A1
		(3)
(b)	$P(X < 20) = 0.5$ so $P(X < d) = 0.5 + 0.4641 = 0.9641$	B1
	$P(Z < z) = 0.9641$, $z = 1.80$	B1
	$\frac{d-20}{4} = 1.80$	M1
	$d = 27.2$	A1
		(4)
		Total 7 marks
Notes:		
(a)	Standardise with 20 and 4 for M1, allow numerator 20-25 1- probability for second M1 Anything that rounds to 0.106 for A1. Correct answer with no working award 3/3	
(b)	0.9641 seen or implied by 1.80 for B1 1.80 seen for B1 Standardise with 20 and 4 and equate to z value for M1 Z=0.8315 is M0 Anything that rounds to 27.2 for final A1. Correct answer with no working 4/4	

7(a)	$p+q=0.45$.	B1
	$\sum x\mathrm{P}(X=x)=4.5$	M1
	$3p+7q=1.95$	A1
		(3)
(b)	Attempt to solve equations in (a)	M1
	$q=0.15$	A1
	$p=0.30$	A1
		(3)
(c)	$\mathrm{P}(4<X<7)=\mathrm{P}(5)+\mathrm{P}(7)$	M1
	$=0.2+q=0.35$	A1$\int$
		(2)
(d)	$\mathrm{Var}(X)=\mathrm{E}(X^2)-[\mathrm{E}(X)]^2=27.4-4.5^2$	M1
	$=7.15$	A1
		(2)
(e)	$\mathrm{E}(19-4X)=19-4\times 4.5=1$	B1
		(1)
(f)	$\mathrm{Var}(19-4X)=16\mathrm{Var}(X)$	M1
	$=16\times 7.15=114.4$	A1
		(2)
		Total 13 marks

Notes:

7(a)	$0.55+p+q=1$ award B1. Not seen award B0. $0.2+3p+1+7q+1.35=4.5$ or equivalent award M1A1 $3p+7q+k=4.5$ award M1.	
(b)	Attempt to solve must involve 2 linear equations in 2 unknowns Correct answers only for accuracy. Correct answers with no working award 3/3	
(c)	Follow through accuracy mark for their q, $0<q<0.8$	
(d)	Attempt to substitute <u>given</u> values <u>only</u> into correct formula for M1. 7.15 only for A1 7.15 seen award 2/2	
(f)	Accept ‘invisible brackets’ i.e. -4^2 Var (X) provided answer positive. Anything that rounds to 114 for A1.	

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Mark Scheme (Results)
January 2008

GCE

GCE Mathematics (6683/01)

A PEARSON COMPANY

January 2008
6683 Statistics S1
Mark Scheme

Question Number	Scheme	Marks
1. (a)	$\sum x = 773, \sum y = 724$	B1, B1
	$r = \dfrac{10\times 56076 - 773\times 724}{\sqrt{(10\times 60475 - 773^2)(10\times 53122 - 724^2)}}$ o.e.	M1 A1ft
	$r = 0.155357.....$	A1
		(5)
(b)	Both weak correlation Neither score is a good indication of future performance Interview test is slightly better since correlation is positive	B1g B1h
		(2)
		Total 7 marks
NB	$S_{xx} = 60475 - \dfrac{(773)^2}{10} = 722.1,\ S_{yy} = 53122 - \dfrac{(724)^2}{10} = 704.4,\ S_{xy} = 56076 - \dfrac{773\times 724}{10} = 110.8$	
(a)	1st B1 for $\sum x$ and 2nd B1 for $\sum y$, should be seen or implied. M1 for at least one correct attempt at one of S_{xx}, S_{yy} or S_{xy} and then using in the correct formula 1st A1ft for a fully correct expression. (ft their Σx and their Σy) or 3 correct expressions for S_{xx}, S_{xy}, and S_{yy} but possibly incorrect values for these placed correctly in r. 2nd A1 for awrt 0.155	
(b)	If $\lvert r\rvert > 0.5$ 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. 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) 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. Treat 1st B1 as B1g and 2nd as B1h An answer of "no" alone scores B0B0	

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

3.

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

M1

0.5×12 or 6 **A1**

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

$(90.5-78.5)\times\frac{1}{2}\times\frac{140}{\text{their } 70}$ **M1**

"70 seen anywhere" **B1**

Number of runners is 12 **A1**

(5)

Total 5 marks

1^{st} M1 for attempt at width of the correct bar (90.5 - 78.5)
[Maybe on histogram or in table]

1^{st} A1 for 0.5×12 or 6 (may be seen on the histogram. Must be related to the area of the bar above 78.5 - 90.5.

2^{nd} M1 for attempting area of correct bar$\times\frac{140}{\text{their } 70}$

B1 for 70 seen anywhere in their working

2^{nd} 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)

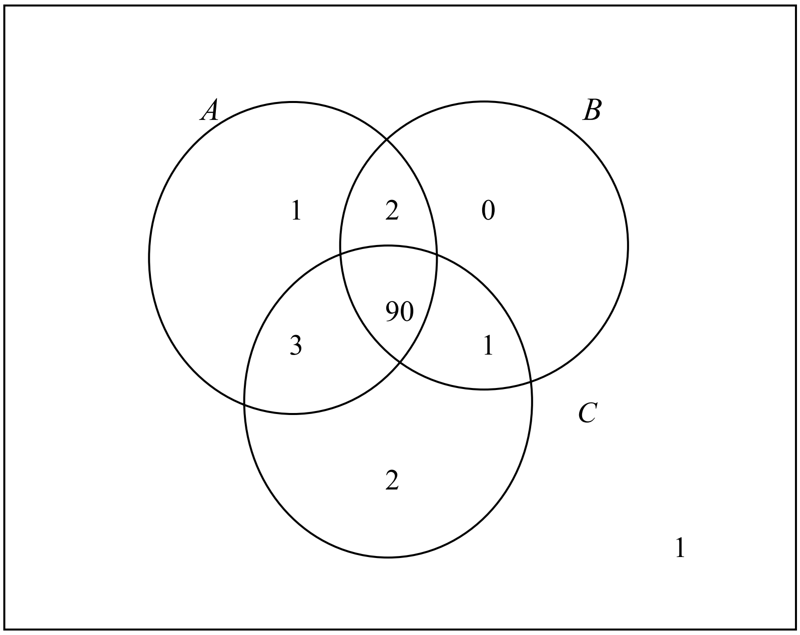
Common answer is $0.5\times 12=6$ (this scores M1A1M0B0A0)

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

4.		
(a)	$S_{xy} = 1818.5 - \frac{41 \times 406}{10}, = 153.9$ (could be seen in (b)) AWRT 154	**M1, A1**
	$S_{xx} = 188 - \frac{41^2}{10} = 19.9$ (could be seen in (b))	**A1**
		(3)
(b)	$b = \frac{153.9}{19.9}, = 7.733668....$ AWRT 7.73	**M1, A1**
	$a = 40.6 - b \times 4.1 (= 8.89796....)$	**M1**
	$y = 8.89 + 7.73x$	**A1**
		(4)
(c)	A typical car will travel 7700 miles every year	**B1ft**
		(1)
(d)	$x = 5, y = 8.89 + 7.73 \times 5 (= 47.5 - 47.6)$	**M1**
	So mileage predicted is AWRT 48000	**A1**
		(2)
		Total 10 marks

Accept calculations for S_{xx} and S_{xy} in (a) or (b)

(a)	M1	for correct attempt or expression for either
	1st A1	for one correct
	2nd A1	for both correct
(b)		**Ignore the epen marks for part (b) they should be awarded as per this scheme**
	1st M1	for $\frac{\text{their } S_{xy}}{\text{their } S_{xx}}$
	1st A1	for AWRT 7.73
	2nd M1	for attempt at correct formula for *a* (minus required). Ft their *b*. Quoting a correct formula but making one slip in sub.eg. $\bar{y}$ =406 is OK
	2nd A1	for correct equation with 2dp accuracy. Accept *a* = 8.89, and *b* = 7.73 even if not written as final equation.
		Correct answers only (from calc) score 4/4 if correct to 2dp or 3/4 if AWRT 2dp
(c)	B1ft	for their $b \times 1000$ to at least 2 sf. Accept "7.7 thousand" but value is needed
(d)	M1	for substituting x = 5 into their final answer to (b).
	A1	for AWRT 48000 (Accept "48 thousands")

5. (a)	**Diagram may be drawn with $B \subset (A \cup C)$ or with the 0 for $B \cap (A \cup C)'$ simply left blank**	
	Accept decimals or probs. in Venn diagram  3cc 90,3,2,1 1,(0),2 1 outside Box	**M1** **A1** **M1A1** **A1** **B1** **(6)**
(b)	P(none)=0.01	**B1ft** **(1)**
(c)	P(A but not B)=0.04	**M1 A1ft** **(2)**
(d)	P(any wine but C)=0.03	**M1A1ft** **(2)**
(e)	P(exactly two)=0.06	**M1A1ft** **(2)**
(f)	$\mathrm{P}(C \mid A) = \dfrac{\mathrm{P}(C \cap A)}{\mathrm{P}(A)} =, \dfrac{93}{96}$ or $\dfrac{31}{32}$ or AWRT 0.969	**M1A1ft,A1** **(3)**
		Total 16 marks

(a)	1st M1	for 3 closed, labelled curves that overlap. A1 for the 90, 3, 2 and 1	
	2nd M1	for one of 1, 0 or 2 correct <u>or</u> a correct sum of 4 values for *A, B* or *C*	
	2nd A1	for all 7 values correct. Accept a blank instead of 0.	
		NB final mark is a B1 for the box not an A mark as on EPEN	
		In parts (b) to (f) full marks can be scored for correct answers or correct ft	
(b)	B1ft	Follow through their '1' from outside divided by 100	For M marks in (c) to (e) they must have a fraction
(c)	M1	for correct expression eg $\mathrm{P}(A \cup B) - \mathrm{P}(B)$ or calculation e.g. 3 + 1 or 4 on top	
	A1	for a correct probability, follow through with their '3+1' from diagram	
(d)	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	
(e)	M1	for a correct expression or calculation e.g. 3+2+1 or 6 on top	
(f)	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	
	1st A1ft	follow through their $A \cap C$ and their A but the ratio must be in (0, 1)	
	2nd A1	for correct answer only. Answer only scores 3/3, but check working P($A \cap C$)/P(C) is M0	

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

7.(a) $P(R=3\cap B=0)=\frac{1}{4}\times\frac{1}{4},=\frac{1}{16}$ **M1, A1** **(2)**

(b)

3	0	3	6	9
2	0	2	4	6
1	0	1	2	3
0	0	0	0	0
B / *R*	0	1	2	3

All 0s **B1**
All 1,2,3s **B1**
All 4,6,9s **B1** **(3)**

(c) $a=\frac{7}{16}, b=c=d=\frac{1}{16}$ **B1, B1 B1** **(3)**

(d) $\mathrm{E}(T)\ =\left(1\times\frac{1}{16}\right)+\left(2\times\frac{1}{8}\right)+\left(3\times\frac{1}{8}\right)+\left(4\times\frac{1}{16}\right)+\ldots$ **M1**

$=2\frac{1}{4}$ or exact equivalent e.g. 2.25, $\frac{9}{4}$ **A1** **(2)**

(e) $\mathrm{Var}(T)=\left(1^2\times\frac{1}{16}\right)+\left(2^2\times\frac{1}{8}\right)+\left(3^2\times\frac{1}{8}\right)+\left(4^2\times\frac{1}{16}\right)+,\ldots-\left(\frac{9}{4}\right)^2$ **M1A1,M1**

$=\frac{49}{4}-\frac{81}{16}=7\frac{3}{16}$ or $\frac{115}{16}$ (o.e.) AWRT 7.19 **A1** **(4)**

Total 14 marks

(a) M1 for $\frac{1}{4}\times\frac{1}{4}$

(c) 1st B1 for $\frac{7}{16}$,

2nd B1 for only one error in *b, c, d* ($b=c=d\neq\frac{1}{16}$ or $b=c=\frac{1}{16}\neq d$ etc), 3rd B1 all of *b, c, d* $=\frac{1}{16}$

(d) M1 for attempting $\sum t\mathrm{P}(T=t)$, 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 M0.

(e) 1st M1 for attempt at $\mathrm{E}(T^2)$, 3 or more terms correct or correct ft.

1st A1 for $\frac{49}{4}$ (o.e.) or a fully correct expression (all non-zero terms must be seen)

2nd M1 for subtracting their $[\mathrm{E}(T)]^2$, Must be some attempt to square $-\frac{9}{4}$ is M0 but $-\frac{9}{16}$ could be M1

2nd A1 for correct fraction or AWRT 7.19
Full marks can still be scored in (d) and (e) if *a* is incorrect

Mark Scheme (Results)
June 2008

GCE

GCE Mathematics (6683/01)

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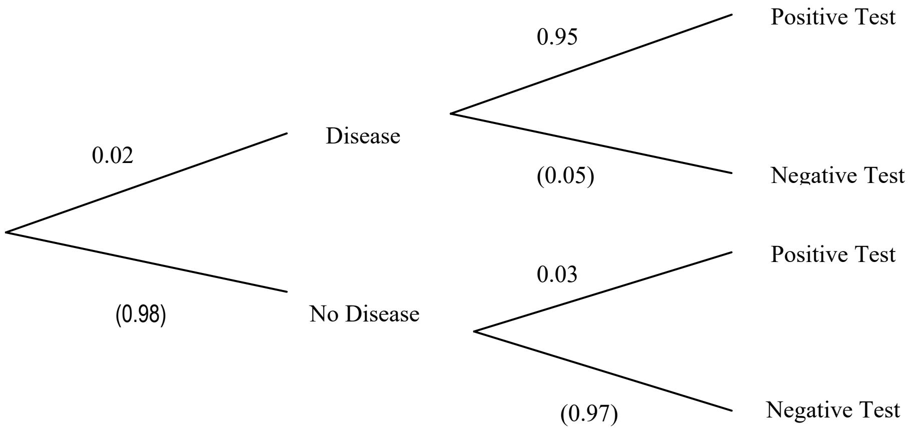
June 2008
6683 Statistics S1
Mark Scheme

Question Number	Scheme	Marks
Q1 (a)		
	Tree without probabilities or labels	M1
	0.02(Disease), 0.95(Positive) on correct branches	A1
	0.03(Positive) on correct branch.	A1 [3]
(b)	P(Positive Test) $=0.02\times0.95+0.98\times0.03$	M1A1ft
	$=0.0484$	A1 [3]
(c)	$\text{P(Do not have disease} \mid \text{Postive test)} \quad =\dfrac{0.98\times0.03}{0.0484}$	M1
	$=0.607438..$ awrt 0.607	A1 [2]
(d)	Test not very useful OR High probability of not having the disease for a person with a positive test	B1 [1]
		Total 9
	<u>Notes</u>: (a) M1:All 6 branches. Bracketed probabilities not required. (b) M1 for sum of two products, at least one correct from their diagram A1ft follows from the probabilities on their tree A1 for correct answer only or $\frac{121}{2500}$ (c) M1 for conditional probability with numerator following from their tree and denominator their answer to part (b). A1 also for $\frac{147}{242}$.	

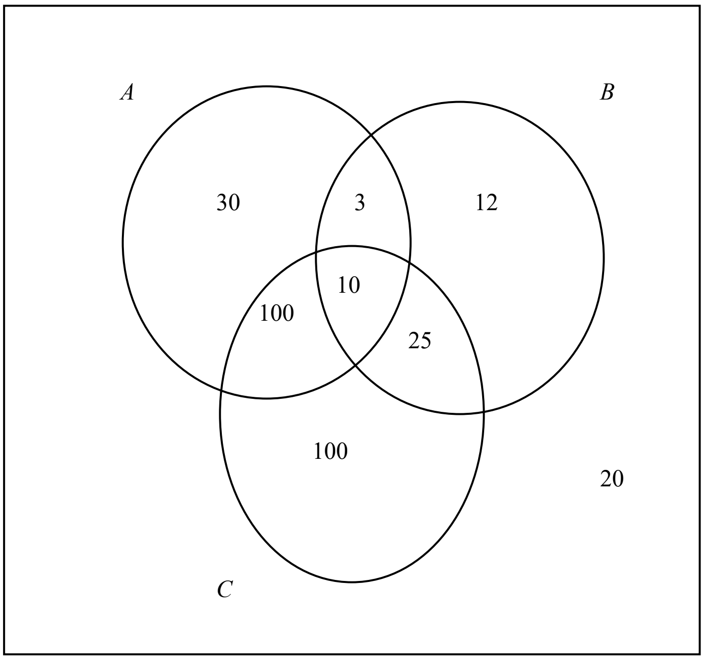
Question Number	Scheme	Marks
Q2 (a)	50	B1 [1]
(b)	$Q_1 = 45$	B1
	$Q_2 = 50.5$ ONLY	B1
	$Q_3 = 63$	B1 [3]
(c)	Mean $= \frac{1469}{28} = 52.464286..$ awrt 52.5	M1A1
	Sd $= \sqrt{\frac{81213}{28} - \left(\frac{1469}{28}\right)^2}$	M1
	=12.164…. or 12.387216…for divisor n-1 awrt 12.2 or 12.4	A1 [4]
(d)	$\frac{52.46.. - 50}{sd} =$ awrt 0.20 or 0.21	M1A1 [2]
(e)	1. mode/median/mean Balmoral>mode/median/mean Abbey 2. Balmoral sd < Abbey sd or similar sd or correct comment from their values, Balmoral range<Abbey range, Balmoral IQR>Abbey IQR or similar IQR 3. Balmoral positive skew or almost symmetrical AND Abbey negative skew, Balmoral is less skew than Abbey or correct comment from their value in (d) 4. Balmoral residents generally older than Abbey residents or equivalent. Only one comment of each type max 3 marks	B1B1B1 [3] **Total 13**
	Notes: (c) M1for their 1469 between 1300 and 1600, divided by 28, A1 for awrt 52.5 .. Please note this is B1B1 on Epen M1 use of correct formula including sq root A1 awrt 12.2 or 12.4 Correct answers with no working award full marks. (d) M1 for their values correctly substituted A1 Accept 0.2 as a special case of awrt 0.20 with 0 missing (e) Technical terms required in correct context in lines 1 to 3 e.g. ‘average’ and ‘spread’ B0 1 correct comment B1B0B0 2 correct comments B1B1B0 3 correct comments B1B1B1	

Question Number	Scheme	Marks
Q3 (a)	$-1\times p+1\times 0.2+2\times 0.15+3\times 0.15 \quad = 0.55$	**M1dM1**
	$p = 0.4$	**A1**
	$p+q+0.2+0.15+0.15 \quad = 1$	**M1**
	$q = 0.1$	**A1**
		[5]
(b)	$\text{Var}(X) = (-1)^2\times p+1^2\times 0.2+2^2\times 0.15+3^2\times 0.15, -0.55^2$	**M1A1,M1**
	$= 2.55-0.3025 = 2.2475$ awrt 2.25	**A1**
		[4]
(c)	E(2*X*-4) =2E(*X*)-4	**M1**
	$= -2.9$	**A1**
		[2]
		Total 11
	<u>Notes:</u> (a) M1 for at least 2 correct terms on LHS Division by constant e.g. 5 then M0 dM1 dependent on first M1 for equate to 0.55 and attempt to solve. Award M1M1A1 for p=0.4 with no working M1 for adding probabilities and equating to 1. All terms or equivalent required e.g. $p+q$=0.5 Award M1A1 for q=0.1 with no working (b) M1 attempting E(X^2) with at least 2 correct terms A1 for fully correct expression or 2.55 Division by constant at any point e.g. 5 then M0 M1 for subtracting their mean squared A1 for awrt 2.25 Award awrt 2.25 only with no working then 4 marks (c) M1 for 2x(their mean) -4 Award 2 marks for -2.9 with no working	

Question Number	Scheme	Marks
Q4 (a)	$S_{tt} = 10922.81 - \frac{401.3^2}{15} = 186.6973$ awrt 187	**M1A1**
	$S_{vv} = 42.3356 - \frac{25.08^2}{15} = 0.40184$ awrt 0.402	**A1**
	$S_{tv} = 677.971 - \frac{401.3 \times 25.08}{15} = 6.9974$ awrt 7.00	**A1** **[4]**
(b)	$r = \frac{6.9974}{\sqrt{186.6973 \times 0.40184}}$	**M1A1ft**
	$= 0.807869$ awrt 0.808	**A1** **[3]**
(c)	*t* is the explanatory variable as we	**B1**
	can control temperature but not frequency of noise or equivalent comment	**B1** **[2]**
(d)	High value of *r* or *r* close to 1 or Strong correlation	**B1** **[1]**
(e)	$b = \frac{6.9974}{186.6973} = 0.03748$ awrt 0.0375	**M1A1**
	$a = \frac{25.08}{15} - b \times \frac{401.3}{15} = 0.6692874$ awrt 0.669	**M1A1** **[4]**
(f)	*t*= 19, *v*=0.6692874+0.03748x19=1.381406 awrt 1.4	**B1** **[1]** **Total 15**

Notes:

(a) M1 any one attempt at a correct use of a formula.
Award full marks for correct answers with no working.
Epen order of awarding marks as above.
(b) M1 for correct formula and attempt to use
A1ft for their values from part (a)
NB Special Case for $\frac{677.971}{\sqrt{10922.81 \times 42.3356}}$ M1A0
A1 awrt 0.808
Award 3 marks for awrt 0.808 with no working
(c) Marks are independent. Second mark requires some interpretation in context and can be statements such as 'temperature effects / influences pitch or noise'
B1 'temperature is being changed' BUT B0 for 'temperature is changing'
(e) M1 their values the right way up
A1 for awrt 0.0375
M1 attempt to use correct formula with their value of *b*
A1 awrt 0.669
(f) awrt 1.4

Question Number	Scheme	Marks
Q5 (a)	 3 closed intersecting curves with labels 100 100,30 12,10,3,25 Box	M1 A1 A1 B1 [4]
(b)	P(Substance C) $=\dfrac{100+100+10+25}{300}=\dfrac{235}{300}=\dfrac{47}{60}$ or exact equivalent	M1A1ft [2]
(c)	$\text{P}(\text{All } 3 \mid A)=\dfrac{10}{30+3+10+100}=\dfrac{10}{143}$ or exact equivalent	M1A1ft [2]
(d)	P(Universal donor) $=\dfrac{20}{300}=\dfrac{1}{15}$ or exact equivalent	M1A1 cao [2] Total 10
	Notes: (a) 20 not required. Fractions and exact equivalent decimals or percentages. (b) M1 For adding their positive values in C and finding a probability A1ft for correct answer or answer from their working (c) M1 their 10 divided by their sum of values in A A1ft for correct answer or answer from their working (d) M1 for 'their 20' divided by 300 A1 correct answer only	

Question Number	Scheme	Marks
Q6 (a)	F(4)=1 $(4+k)^2=25$ $k=1$ as $k>0$	 **M1** **A1** **[2]**
(b)	<table><tr><td>x</td><td>2</td><td>3</td><td>4</td></tr><tr><td>P(X=x)</td><td>$\frac{9}{25}$</td><td>$\frac{7}{25}$</td><td>$\frac{9}{25}$</td></tr></table>	**B1ftB1B1** **[3]** **Total 5**
	Notes: (a) M1 for use of F(4) = 1 only If F(2)=1 and / or F(3)=1 seen then M0. F(2)+F(3)+F(4)=1 M0 A1 for k=1 and ignore k= -9 (b) B1ft follow through their k for P(X=2) either exact or 3sf between 0 and 1 inclusive. B1 correct answer only or exact equivalent B1 correct answer only or exact equivalent	

Question Number	Scheme	Marks
Q7 (a)	$z = \dfrac{53-50}{2}$ Attempt to standardise	M1
	P(X>53)=1-P(Z<1.5) 1-probability required can be implied	B1
	=1-0.9332	
	=0.0668	A1
		[3]
(b)	$\mathrm{P}(X \le x_0) = 0.01$	M1
	$\dfrac{x_0 - 50}{2} = -2.3263$	M1B1
	$x_0 = 45.3474$ awrt 45.3 or 45.4	M1A1
		[5]
(c)	P(2 weigh more than 53kg and 1 less) $= 3 \times 0.0668^2(1-0.0668)$	B1M1A1ft
	$= 0.012492487..$ awrt 0.012	A1
		[4]
		Total 12
	Notes: (a) M1 for using 53,50 and 2, either way around on numerator B1 1- any probability for mark A1 0.0668 cao (b) M1 can be implied or seen in a diagram or equivalent with correct use of 0.01 or 0.99 M1 for attempt to standardise with 50 and 2 numerator either way around B1 for ± 2.3263 M1 Equate expression with 50 and 2 to a z value to form an equation with consistent signs and attempt to solve A1 awrt 45.3 or 45.4 (c) B1 for 3, M1 $p^2(1-p)$ for any value of p A1ft for p is their answer to part (a) without 3 A1 awrt 0.012 or 0.0125	

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Mark Scheme (Results)

January 2009

GCE

GCE Mathematics (6683/01)

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January 2009
6683 Statistics S1
Mark Scheme

Question Number	Scheme	Marks
1 (a)	$S_{xx} = 57.22 - \frac{(21.4)^2}{10} = 11.424$	M1 A1
	$S_{xy} = 313.7 - \frac{21.4 \times 96}{10} = 108.26$	A1 (3)
(b)	$b = \frac{S_{xy}}{S_{xx}} = 9.4765...$	M1 A1
	$a = \overline{y} - b\overline{x} = 9.6 - 2.14b = (-10.679...)$	M1
	$y = -10.7 + 9.48x$	A1 (4)
(c)	Every (extra) <u>hour </u>spent using the programme produces about <u>9.5 marks improvement</u>	B1ft (1)
(d)	$y = -10.7 + 9.48 \times 3.3, = 20.6$ awrt 21	M1,A1 (2)
(e)	Model may not be valid since [8h is] outside the range [0.5 - 4].	B1 (1) **[11]**
(a)	M1 for a correct expression 1st A1 for AWRT 11.4 for S_{xx} 2nd A1 for AWRT 108 for S_{xy} Correct answers only: One value correct scores M1 and appropriate A1, both correct M1A1A1	
(b)	1st M1 for using their values in correct formula 1st A1 for AWRT 9.5 2nd M1 for correct method for *a* (minus sign required) 2nd A1 for equation with *a* and *b* AWRT 3 sf (e.g. y = -10.68 + 9.48x is fine) Must have a full equation with *a* and *b* correct to awrt 3 sf	
(c)	B1ft for comment conveying the idea of <u>*b* marks per hour</u>. Must mention value of *b* but can ft their value of *b*. No need to mention "extra" but must mention "marks" and "hour(s)" e.g. " …9.5 times per hour …" scores B0	
(d)	M1 for sub x = 3.3 into their regression equation from the end of part (b) A1 for awrt 21	
(e)	B1 for a statement that says or implies that it may <u>not</u> be valid because <u>outside the range</u>. They do not have to mention the values concerned here namely 8 h or 0.5 - 4	

Question Number	Scheme	Marks
2	E = take regular exercise $\quad B$ = always eat breakfast	
(a)	$P(E \cap B) = P(E \mid B) \times P(B)$	M1
	$= \dfrac{9}{25} \times \dfrac{2}{3} \quad = \quad 0.24 \quad \text{or} \quad \dfrac{6}{25} \quad \text{or} \quad \dfrac{18}{75}$	A1 (2)
(b)	$P(E \cup B) = \dfrac{2}{3} + \dfrac{2}{5} - \dfrac{6}{25}$ or $P(E' \mid B')$ or $P(B' \cap E)$ or $P(B \cap E')$	M1
	$= \dfrac{62}{75}$ $\quad = \dfrac{13}{25}$ $\quad = \dfrac{12}{75}$ $\quad = \dfrac{32}{75}$	A1
	$P(E' \cap B') = 1 - P(E \cup B) = \dfrac{13}{75} \quad \text{or} \quad 0.17\dot{3}$	M1 A1 (4)
(c)	$P(E \mid B) = 0.36 \neq 0.40 = P(E) \quad \text{or} \quad P(E \cap B) = \dfrac{6}{25} \neq \dfrac{2}{5} \times \dfrac{2}{3} = P(E) \times P(B)$	M1 A1 (2)
	So E and B are <u>not</u> statistically independent	**[8]**

(a) M1 for $\frac{9}{25} \times \frac{2}{3}$ or $P(E|B) \times P(B)$ <u>and</u> at least one correct value seen. A1 for 0.24 or exact equiv.

NB $\frac{2}{5} \times \frac{2}{3}$ alone or $\frac{2}{5} \times \frac{9}{25}$ alone scores M0A0. Correct answer scores full marks.

(b) 1st M1 for use of the addition rule. Must have 3 terms and some values, can ft their (a)

<u>Or</u> a full method for $P(E'|B')$ requires 1 - $P(E|B')$ and equation for $P(E|B')$: (a) $+ \frac{x}{3} = \frac{2}{5}$

<u>Or</u> a full method for $P(B' \cap E)$ <u>or</u> $P(B \cap E')$ [or other valid method]

2nd M1 for a method leading to answer e.g. $1 - P(E \cup B)$

<u>or</u> $P(B') \times P(E' \mid B')$ <u>or</u> $P(B') - P(B' \cap E)$ <u>or</u> $P(E') - P(B \cap E')$

<u>Venn Diagram</u> 1st M1 for diagram with attempt at $\frac{2}{5} - P(B \cap E)$ or $\frac{2}{3} - P(B \cap E)$. Can ft their (a)

1st A1 for a correct first probability as listed or 32, 18 and 12 on Venn Diagram

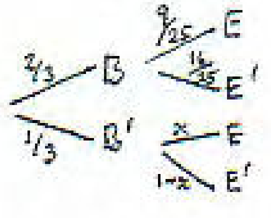
2nd M1 for attempting 75 - their (18 +32 + 12)

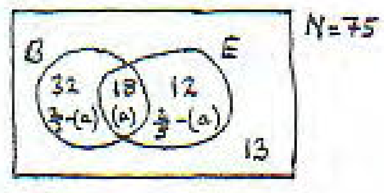
(c) M1 for identifying suitable values to test for independence e.g. $P(E) = 0.40$ and $P(E|B) = 0.36$

<u>Or</u> $P(E) \times P(B) = \ldots$ and $P(E \cap B) =$ their (a) [but their (a) $\neq \frac{2}{5} \times \frac{2}{3}$]. Values seen somewhere

A1 for correct values and a correct comment

<u>Diagrams</u> You may see these or find these useful for identifying probabilities.





<u>Common Errors</u>

(a) $\frac{9}{25}$ is M0A0

(b) P(EUB)= $\frac{53}{75}$ scores M1A0

$1 - P(E \cup B) = \frac{22}{75}$ scores M1A0

(b) $P(B') \times P(E') = \frac{1}{3} \times \frac{3}{5}$ scores 0/4

Question Number	Scheme	Marks
3 (a)	$\mathrm{E}(X) = 0\times 0.4 + 1\times 0.3 + ... + 3\times 0.1, \quad = \quad 1$	M1, A1 (2)
(b)	$\mathrm{F}(1.5) = \left[\mathrm{P}(X \le 1.5) =\right]\ \mathrm{P}(X \le 1), \quad = 0.4 + 0.3 = 0.7$	M1, A1 (2)
(c)	$\mathrm{E}(X^2) = 0^2\times 0.4 + 1^2\times 0.3 + ... + 3^2\times 0.1 \quad , = \ 2$	M1, A1
	Var(X) = $2 - 1^2$, = 1 (*)	M1, A1cso (4)
(d)	$\mathrm{Var}(5-3X) = (-3)^2\ \mathrm{Var}(X), \quad = \ 9$	M1, A1 (2)
(e)	(see table below)	B1B1B1 M1 A1
	Total probability = 0.03 + 0.03+0.04 +0.02 + 0.02 + 0.01 = 0.15	A1 (6) **[16]**

Total	Cases	Probability
4	$(X=3)\cap(X=1)$	$0.1\times 0.3 = 0.03$
	$(X=1)\cap(X=3)$	$0.3\times 0.1 = 0.03$
	$(X=2)\cap(X=2)$	$0.2\times 0.2 = 0.04$
5	$(X=3)\cap(X=2)$	$0.1\times 0.2 = 0.02$
	$(X=2)\cap(X=3)$	$0.2\times 0.1 = 0.02$
6	$(X=3)\cap(X=3)$	$0.1\times 0.1 = 0.01$

(a) M1 for at least 3 terms seen. Correct answer only scores M1A1. Dividing by $k(\ne 1)$ is M0.

(b) M1 for F(1.5) = P($X \le 1$).[**Beware**: $2\times 0.2 + 3\times 0.1 = 0.7$ but scores M0A0]

(c) 1st M1 for at least 2 non-zero terms seen. $\mathrm{E}(X^2) = 2$ alone is M0. Condone calling $\mathrm{E}(X^2)$ =Var(X).
1st A1 is for an answer of 2 or a fully correct expression.
2nd M1 for $-\mu^2$, condone 2 – 1, unless clearly 2 - □. Allow $2-\mu^2$, with □ = 1 even if E(X) $\ne 1$
2nd A1 for a fully correct solution with no incorrect working seen, **both** Ms required.

ALT

$\sum (x-\mu)^2 \times \mathrm{P}(X = x)$

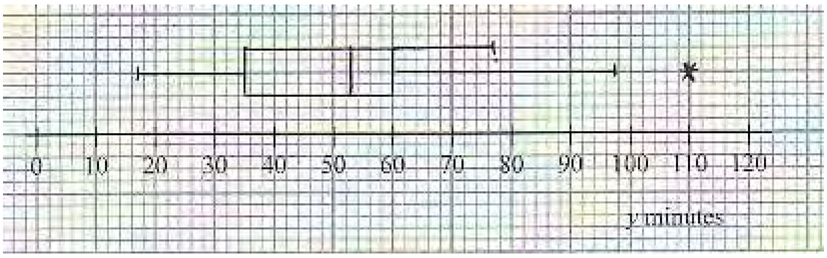
1st M1 for an attempt at a full list of $(x-\mu)^2$ values and probabilities. 1st A1 if all correct
2nd M1 for at least 2 non-zero terms of $(x-\mu)^2 \times \mathrm{P}(X = x)$ seen. 2nd A1 for 0.4 + 0.2 + 0.4 = 1

(d) M1 for use of the correct formula. -3^2 Var(X) is M0 unless the final answer is >0.
Can follow through their Var(X) for M1

(e)
1st B1 for all cases listed for a total of 4 or 5 or 6 . e.g. (2,2) counted twice for a total of 4 is B0
2nd B1 for all cases listed for 2 totals }
3rd B1 for a complete list of all 6 cases }These may be highlighted in a table

ALT

Using Cumulative probabilities
1st B1 for one or more cumulative probabilities used e.g.2 then 2 or more or 3 then 1 or more
2nd B1 for both cumulative probabilities used. 3rd B1 for a complete list 1, 3; 2, $\ge$2; 3, $\ge$1
M1 for one correct pair of correct probabilities multiplied
1st A1 for all 6 correct probabilities listed (0.03, 0.03, 0.04, 0.02, 0.02, 0.01) needn't be added.
2nd A1 for 0.15 or exact equivalent only as the final answer.

Question Number	Scheme	Marks
4 (a)	$Q_2 = 53, \quad Q_1 = 35, \quad Q_3 = 60$	B1, B1,B1 (3)
(b)	$Q_3 - Q_1 = 25 \Rightarrow Q_1 - 1.5\times 25 = -2.5$ (no outlier)	M1
	$Q_3 + 1.5\times 25 = 97.5$ (so 110 is an outlier)	A1 (2)
(c)		M1 A1ft A1ft (3)
(d)	$\sum y = 461, \sum y^2 = 24\ 219 \therefore\ S_{yy} = 24219 - \frac{461^2}{10}$, $= 2966.9$ (*)	B1, B1, B1cso (3)
(e)	$r = \frac{-18.3}{\sqrt{3463.6\times 2966.9}}$ or $\frac{-18.3}{3205.64...} = -0.0057$ AWRT - 0.006 or -6×10^{-3}	M1 A1 (2)
(f)	*r* suggests correlation is close to zero so parent's claim is not justified	B1 (1) **[14]**
(a)	1^{st} B1 for median 2^{nd} B1 for lower quartile 3^{rd} B1 for upper quartile	
(b)	M1 for attempt to find one limit A1 for both limits found and correct. No explicit comment about outliers needed.	
(c)	M1 for a box and two whiskers 1^{st} A1ft for correct position of box, median and quartiles. Follow through their values. 2^{nd} A1ft for 17 and 77 or "their" 97.5 and *. If 110 is not an outlier then score A0 here. Penalise no gap between end of whisker and outlier. Must label outlier, needn't be with *. <u>**Accuracy**</u> should be within the correct square so 97 or 98 will do for 97.5	
(d)	1^{st} B1 for $\sum y$ N.B. $\left(\sum y\right)^2 = 212521$ and can imply this mark 2^{nd} B1 for $\sum y^2$ or at least three correct terms of $\sum\left(y - \bar{y}\right)^2$ seen. 3^{rd} B1 for complete correct expression seen leading to 2966.9. So all 10 terms of $\sum\left(y - \bar{y}\right)^2$	
(e)	M1 for attempt at correct expression for *r*. Can ft their S_{yy} for M1.	
(f)	B1 for comment <u>rejecting</u> parent's claim on basis of <u>weak or zero</u> correlation Typical error is "negative correlation so comment is true" which scores B0 Weak negative or weak positive correlation is OK as the basis for their rejection.	

Question Number	Scheme	Marks
5 (a)	8-10 hours: width = 10.5 - 7.5 = 3 represented by 1.5cm 16-25 hours: width = 25.5 - 15.5 = 10 so represented by <u>5 cm</u> 8- 10 hours: height = fd = 18/3 = 6 represented by 3 cm 16-25 hours: height = fd = 15/10 = 1.5 represented by <u>0.75 cm</u>	 B1 M1 A1 (3)
(b)	$Q_2 = 7.5 + \frac{(52-36)}{18} \times 3 = 10.2$ $Q_1 = 5.5 + \frac{(26-20)}{16} \times 2[= 6.25 \text{ or } 6.3]$ or $5.5 + \frac{(26.25-20)}{16} \times 2$ [=6.3] $Q_3 = 10.5 + \frac{(78-54)}{25} \times 5[=15.3]$ or $10.5 + \frac{(78.75-54)}{25} \times 5$ [=15.45 \15.5] IQR = (15.3 - 6.3) = <u>9</u>	M1 A1 A1 A1 A1ft (5)
(c)	$\sum fx = 1333.5 \Rightarrow \bar{x} = \frac{1333.5}{104} =$ AWRT <u>12.8</u> $\sum fx^2 = 27254 \Rightarrow \sigma_x = \sqrt{\frac{27254}{104} - \bar{x}^2} = \sqrt{262.05 - \bar{x}^2}$ AWRT <u>9.88</u>	M1 A1 M1 A1 (4)
(d)	$Q_3 - Q_2 [= 5.1] > Q_2 - Q_1 \ [= 3.9]$ or $Q_2 < \bar{x}$ So data is positively skew	B1ft dB1 (2)
(e)	Use median and IQR, since data is skewed <u>or</u> not affected by extreme values or outliers	B1 B1 (2) **[16]**
(a)	M1 For attempting both frequency densities $\frac{18}{3}(=6)$ and $\frac{15}{10}$, <u>and</u> $\frac{15}{10} \times \text{SF}$, where SF ≠ 1 NB Wrong class widths(2 and 9) gives $\frac{h}{1.66...} = \frac{3}{9} \to h = \frac{5}{9}$ or 0.55… and scores M1A0	
(b)	M1 for identifying correct interval and a correct fraction e.g. $\frac{\frac{1}{2}(104)-36}{18}$. Condone 52.5 or 53 1st A1 for 10.2 for median. Using (n + 1) allow awrt 10.3 2nd A1 for a correct expression for either Q_1 or Q_3 (allow 26.25 and 78.75) 3rd A1 for correct expressions for both Q_1 and Q_3 4th A1ft for IQR, ft their quartiles. Using (n + 1) gives 6.28 and 15.45 <u>NB</u>: <u>Must see some method</u>	
(c)	1st M1 for attempting $\sum fx$ and $\bar{x}$ 2nd M1 for attempting $\sum fx^2$ and $\sigma_x, \sqrt{\ }$ is needed for M1. Allow s = awrt 9.93	
(d)	1st B1ft for suitable test, values need not be seen but statement must be compatible with values used. Follow through their values 2nd dB1 Dependent upon their test showing positive and for stating positive skew If their test shows negative skew they can score 1st B1 but lose the second	
(e)	1st B1 for choosing median and IQR. Must mention <u>both</u>. }<u>Award independently</u> 2nd B1 for suitable reason } e.g. "use median because data is skewed" scores B0B1 since IQR is not mentioned	

Question Number	Scheme	Marks
6 (a)	$\text{P}(X<39) = \text{P}\left(Z<\frac{39-30}{5}\right)$	M1
	$= \text{P}(Z<1.8) = \underline{0.9641}$ (allow awrt 0.964)	A1 (2)
(b)	$\text{P}(X<d) = \text{P}\left(Z<\frac{d-30}{5}\right) = 0.1151$	
	$1-0.1151 = 0.8849$	M1
	$\Rightarrow z = -1.2$ (allow $\pm$ 1.2)	B1
	$\therefore \frac{d-30}{5} = -1.2$ $\underline{d = 24}$	M1A1 (4)
(c)	$\text{P}(X>e) = 0.1151$ so $e = \mu + (\mu$ - their $d)$ $\underline{\text{or}}$ $\frac{e-30}{5} = 1.2$ or $-$ their z	M1
	$\underline{e = 36}$	A1 (2)
(d)	$\text{P}(d<X<e) = 1-2\times 0.1151$	M1
	$= 0.7698$ AWRT $\underline{0.770}$	A1 (2) **[10]**

Answer only scores all marks in each section BUT check (b) and (c) are in correct order

(a)
M1 for standardising with σ, $z = \pm\frac{39-30}{5}$ is OK
A1 for 0.9641 or awrt 0.964 but if they go on to calculate 1 – 0.9641 they get M1A0

(b)
1st M1 for attempting 1- 0.1151. Must be seen in (b) in connection with finding d
B1 for $z = \pm$ 1.2. They must state $z = \pm$ 1.2 or imply it is a z value by its use.
This mark is only available in part (b).
2nd M1 for $\left(\frac{d-30}{5}\right) =$ their negative z value (or equivalent)

(c)
M1 for a full method to find e. If they used z = 1.2 in (b) they can get M1 for $z = \pm$ 1.2 here
If they use symmetry about the mean $\mu + (\mu$ - their $d)$ then ft their d for M1
Must explicitly <u>see</u> the method used unless the answer is correct.

(d)
M1 for a complete method or use of a correct expression e.g. "their 0.8849" - 0.1151
<u>or</u> **If their d < their e** using their values with $\text{P}(X<e)$ - $\text{P}(X<d)$
If their $d \geq$ their e then they can only score from an argument like 1 – 2x0.1151
A negative probability or probability > 1 for part (d) scores M0A0

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Mark Scheme (Results)

Summer 2009

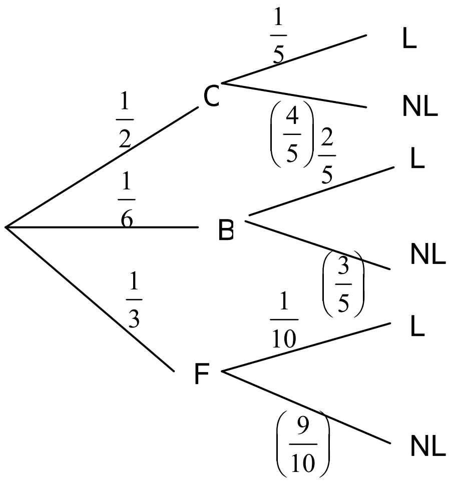
GCE

GCE Mathematics (6683/01)

A PEARSON COMPANY

June 2009
6683 Statistics S1
Mark Scheme

Question Number	Scheme	Marks
Q1 (a)	$(S_{pp} =)\ 38125 - \frac{445^2}{10}$	M1
	$= 18322.5$ awrt 18300	A1
	$(S_{pt} =)\ 26830 - \frac{445 \times 240}{10}$	
	$= 16150$ awrt 16200	A1 (3)
(b)	$r = \frac{"16150"}{\sqrt{"18322.5" \times 21760}}$ Using their values for method	M1
	$= 0.8088...$ awrt 0.809	A1 (2)
(c)	As the temperature increases the pressure increases.	B1 (1) **[6]**
Notes	1(a) M1 for seeing a correct expression $38125 - \frac{445^2}{10}$ or $26830 - \frac{445 \times 240}{10}$ If no working seen, at least one answer must be exact to score M1 by implication. 1(b) Square root and their values with 21760 all in the right places required for method. Anything which rounds to (awrt) 0.809 for A1. 1(c) Require a correct statement in **context** using temperature/heat and pressure for B1. Don't allow " as t increases p increases". Don't allow proportionality. Positive correlation only is B0 since there is no interpretation.	

Question Number	Scheme	Marks
Q2 (a)	 Correct tree All labels Probabilities on correct branches	B1 B1 B1 (3)
(b)(i)	$\frac{1}{3}\times\frac{1}{10} = \frac{1}{30}$ or equivalent	M1 A1 (2)
(ii)	$\text{CNL} + \text{BNL} + \text{FNL} = \frac{1}{2}\times\frac{4}{5}+\frac{1}{6}\times\frac{3}{5}+\frac{1}{3}\times\frac{9}{10}$	M1
	$= \frac{4}{5}$ or equivalent	A1 (2)
(c)	$\mathrm{P}(F'/L) = \dfrac{\mathrm{P}(F'\cap L)}{\mathrm{P}(L)}$ Attempt correct conditional probability **but see notes**	M1
	$= \dfrac{\frac{1}{6}\times\frac{2}{5}+\frac{1}{2}\times\frac{1}{5}}{1-(ii)}$ $\quad \dfrac{\text{numerator}}{\text{denominator}}$	$\dfrac{\text{A1}}{\text{A1ft}}$
	$= \dfrac{\frac{5}{30}}{\frac{1}{5}} = \dfrac{5}{6}$ or equivalent cao	A1 (4) **[11]**
Notes	Exact decimal equivalents required throughout if fractions not used e.g. 2(b)(i) $0.0\dot{3}$ Correct path through their tree given in their probabilities award Ms 2(a) All branches required for first B1. Labels can be words rather than symbols for second B1. Probabilities from question enough for third B1 i.e. bracketed probabilities not required. Probabilities and labels swapped i.e. labels on branches and probabilities at end can be awarded the marks if correct. 2(b)(i) Correct answer only award both marks. 2(b)(ii) At least one correct path identified and attempt at adding all three multiplied pairs award M1 2(c) Require probability on numerator and division by probability for M1.Require numerator correct for their tree for M1. Correct formula seen and used, accept denominator as attempt and award M1 No formula, denominator must be correct for their tree or 1-(ii) for M1 1/30 on numerator only is M0, P(L/F') is M0.	

Question Number	Scheme	Marks
Q3 (a)	1(cm) cao	B1
(b)	10 cm^2 represents 15 10/15 cm^2 represents 1 or 1cm^2 represents 1.5 Therefore frequency of 9 is $\frac{10}{15}\times 9$ or $\frac{9}{1.5}$ Require x$\frac{2}{3}$ or $\div 1.5$ height = 6(cm)	 M1 A1 **[3]**
Notes	If 3(a) and 3(b) incorrect, but their (a) x their (b)=6 then award B0M1A0 3(b) Alternative method: f/cw=15/6=2.5 represented by 5 so factor x2 award M1 So f/cw=9/3=3 represented by 3x2=6. Award A1.	

Question Number	Scheme	Marks
Q4 (a)	$Q_2 = 17 + \left(\frac{60-58}{29}\right) \times 2$	M1
	$= 17.1$ (17.2 if use 60.5) awrt 17.1 (or17.2)	A1 (2)
(b)	$\sum fx = 2055.5$ $\sum fx^2 = 36500.25$ Exact answers can be seen below or implied by correct answers.	B1 B1
	Evidence of attempt to use midpoints with at least one correct	M1
	Mean = 17.129… awrt 17.1	B1
	$\sigma = \sqrt{\frac{36500.25}{120} - \left(\frac{2055.5}{120}\right)^2}$	M1
	$= 3.28$ ($s = 3.294$) awrt 3.3	A1 (6)
(c)	$\frac{3(17.129 - 17.1379...)}{3.28} = -0.00802$ Accept 0 or awrt 0.0	M1 A1
	No skew/ slight skew	B1 (3)
(d)	The skewness is very small. Possible.	B1 B1dep (2) **[13]**
Notes	4(a) Statement of $17 + \frac{\text{freq into class}}{\text{class freq}} \times \text{cw}$ and attempt to sub or $\frac{m-17}{19-17} = \frac{60(.5)-58}{87-58}$ or equivalent award M1 cw=2 or 3 required for M1. 17.2 from cw=3 award A0. 4(b) Correct $\sum fx$ and $\sum fx^2$ can be seen in working for both B1s Midpoints seen in table and used in calculation award M1 Require complete correct formula including use of square root and attempt to sub for M1. No formula stated then numbers as above or follow from (b) for M1 $(\sum fx)^2, \sum (fx)^2 or \sum f^2 x$ used instead of $\sum fx^2$ in sd award M0 Correct answers only with no working award 2/2 and 6/6 4(c) Sub in their values into given formula for M1 4(d) No skew / slight skew / 'Distribution is almost symmetrical' / 'Mean approximately equal to median' or equivalent award first B1. Don't award second B1 if this is not the case. Second statement should imply 'Greg's suggestion that a normal distribution is suitable is possible' for second B1 dep. If B0 awarded for comment in (c).and (d) incorrect, allow follow through from the **comment** in (c).	

Question Number	Scheme	Marks
Q5 (a)	$b = \dfrac{59.99}{33.381}$	M1
	$= 1.79713.....$ 1.8 or awrt 1.80	A1
	$a = 32.7 - 1.79713... \times 51.83$	M1
	$= -60.44525...$ awrt -60	A1
	$w = -60.445251... + 1.79713...l$ l and w required and awrt 2sf	A1ft
		(5)
(b)	$w = -60.445251... + 1.79713... \times 60$	M1
	$= 47.3825...$ In range 47.3 – 47.6 inclusive	A1
		(2)
(c)	It is extrapolating so (may be) unreliable.	B1, B1dep
		(2) **[9]**
Notes	5(a) Special case $b = \dfrac{59.99}{120.1} = 0.4995$ M0A0 $a = 32.7 - 0.4995 \times 51.83$ M1A1 $w = 6.8 + 0.50l$ at least 2 sf required for A1 5(b) Substitute into their answer for (a) for M1 5(c) 'Outside the range on the table' or equivalent award first B1	

Question Number	Scheme	Marks
Q6 (a)	$\begin{array}{|c|c|c|c|}\hline 0 & 1 & 2 & 3 \\ \hline 3a & 2a & a & b \\ \hline\end{array}$	B1 (1)
(b)	$3a + 2a + a + b = 1$ or equivalent, using Sum of probabilities =1	M1
	$2a + 2a + 3b = 1.6$ or equivalent, using E(X)=1.6	M1
	$14a = 1.4$ Attempt to solve	M1dep
	$a = 0.1$ cao	B1
	$b = 0.4$ cao	B1 (5)
(c)	$P(0.5 < x < 3) = P(1) + P(2)$ 3a or their $2a$+their a	M1
	$= 0.2 + 0.1$	
	$= 0.3$ Require $0<3a<1$ to award follow through	A1 ft (2)
(d)	$E(3X - 2) = 3E(X) - 2$	M1
	$= 3 \times 1.6 - 2$	
	$= 2.8$ cao	A1 (2)
(e)	$E(X^2) = 1\times0.2 + 4 \times0.1 + 9 \times0.4$ (= 4.2)	M1
	Var (X) = "4.2" – 1.6^2	M1
	= 1.64 **given answer** cso	A1 (3)
(f)	$\text{Var}(3X - 2) = 9 \text{ Var }(X)$	M1
	$= 14.76$ awrt 14.8	A1 (2) **[15]**
Notes	6(a) Condone a clearly stated in text but not put in table. 6(b) Must be attempting to solve 2 different equations so third M dependent upon first two Ms being awarded. Correct answers seen with no working B1B1 only, 2/5 Correctly verified values can be awarded M1 for correctly verifying sum of probabilities =1, M1 for using E(X)=1.6 M0 as no attempt to solve and B1B1 if answers correct. 6(d) 2.8 only award M1A1 6(e) Award first M for at least two non-zero terms correct. Allow first M for correct expression with a and b e.g. $E(X^2) = 6a+9b$ Given answer so award final A1 for correct solution. 6(f) 14.76 only award M1A1	

Question Number	Scheme	Marks
Q7(a) (i)	$P(A \cup B) = a + b$ cao	B1
(ii)	$P(A \cup B) = a + b - ab$ or equivalent	B1 (2)
(b)	$P(R \cup Q) = 0.15 + 0.35$ $= 0.5$ 0.5	B1 (1)
(c)	$P(R \cap Q) = P(R\|Q) \times P(Q)$ $= 0.1 \times 0.35$ $= 0.035$ **0.035**	M1 A1 (2)
(d)	$P(R \cup Q) = P(R) + P(Q) - P(R \cap Q)$ OR $P(R) = P(R \cap Q') + P(R \cap Q)$ $= 0.15 +$ their (c) $0.5 = P(R) + 0.35 - 0.035$ $= 0.15 + 0.035$ $P(R) = 0.185$ $= 0.185$ 0.185	M1 A1 (2) **[7]**
Notes	7(a) (i) Accept $a + b - 0$ for B1 **Special Case** If answers to (i) and (ii) are (i) P(A)+P(B) and (ii) P(A)+P(B)-P(A)P(B) award B0B1 7(a)(i) and (ii) answers must be clearly labelled or in correct order for marks to be awarded.	

Question Number	Scheme	Marks
Q8 (a)	Let the random variable X be the lifetime in hours of bulb	
	$P(X < 830) = P(Z < \frac{\pm(830-850)}{50})$ Standardising with 850 and 50	M1
	$= P(Z < -0.4)$	
	$= 1 - P(Z < 0.4)$ Using 1-(probability>0.5)	M1
	$= 1 - 0.6554$	
	$=$ 0.3446 or 0.344578 by calculator awrt 0.345	A1
		(3)
(b)	0.3446×500 Their (a) x 500	M1
	$= 172.3$ Accept 172.3 or 172 or 173	A1
		(2)
(c)	Standardise with 860 and σ and equate to z value $\frac{\pm(818-860)}{\sigma} = z$ value	M1
	$\frac{818-860}{\sigma} = -0.84(16)$ or $\frac{860-818}{\sigma} = 0.84(16)$ or $\frac{902-860}{\sigma} = 0.84(16)$ or equiv.	A1
	$\pm 0.8416(2)$	B1
	$\sigma = 49.9$ 50 or awrt 49.9	A1
		(4)
(d)	Company Y as the ***mean*** is greater for Y. both	B1
	They have (approximately) the same ***standard deviation*** or ***sd***	B1
		(2)
		[11]
Notes	8(a) If 1-z used e.g. 1-0.4=0.6 then award second M0 8(c) M1 can be implied by correct line 2 A1 for completely correct statement or equivalent. Award B1 if 0.8416(2) seen Do not award final A1 if any errors in solution e.g. negative sign lost. 8(d) Must use statistical terms as underlined.	

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Mark Scheme (Results)
January 2010

GCE

Statistics S1 (6683)

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January 2010

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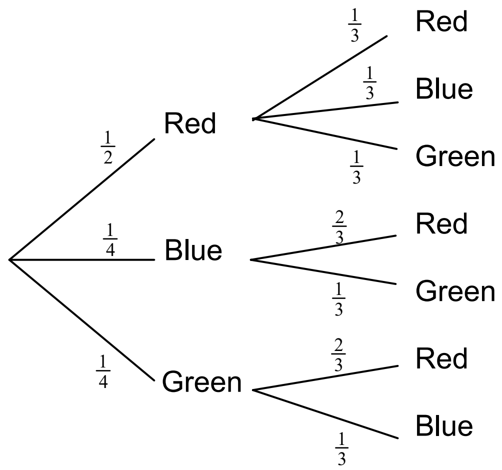
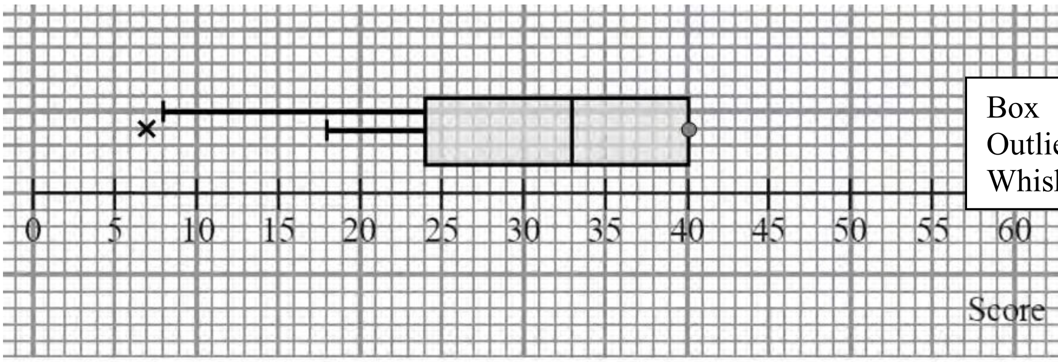
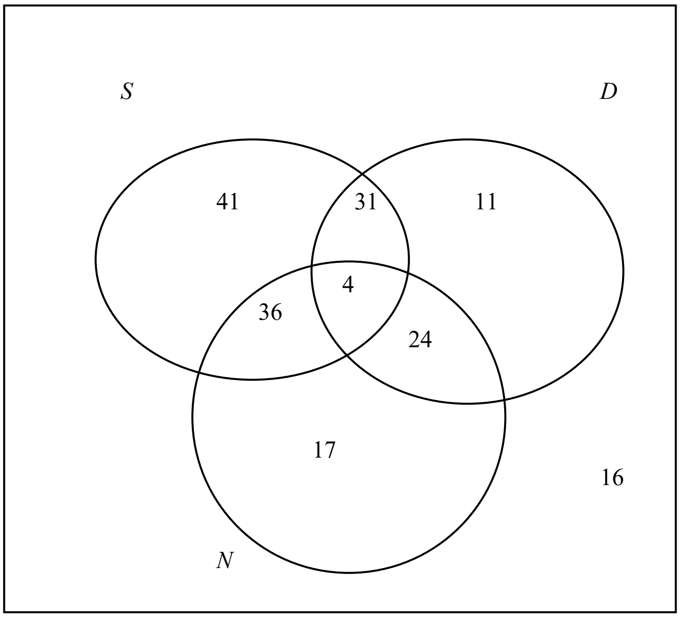
6683 Statistics S1
Mark Scheme

Question Number	Scheme	Marks
Q1 (a)		M1 A1 A1 (3)
(b)	P(Blue bead and a green bead) $=\left(\frac{1}{4}\times\frac{1}{3}\right)+\left(\frac{1}{4}\times\frac{1}{3}\right)=\frac{1}{6}$ (or any exact equivalent)	M1 A1 (2) **Total [5]**
Q1 (a)	M1 for shape and labels: 3 branches followed by 3,2,2 with some *R, B* and *G* seen Allow 3 branches followed by 3, 3, 3 if 0 probabilities are seen implying that 3, 2, 2 intended Allow blank branches if the other probabilities imply probability on blanks is zero Ignore further sets of branches 1st A1 for correct probabilities and correct labels on 1st set of branches. 2nd A1 for correct probabilities and correct labels on 2nd set of branches. (accept 0.33, 0.67 etc or better here)	
(b)	M1 for identifying the 2 cases *BG* and *GB* and adding 2 products of probabilities. These cases may be identified by their probabilities e.g. $\left(\frac{1}{4}\times\frac{1}{3}\right)+\left(\frac{1}{4}\times\frac{1}{3}\right)$ NB $\frac{1}{6}$ (or exact equivalent) with no working scores 2/2	
Special Case	With Replacement (This oversimplifies so do not apply Mis-Read: max mark 2/5) (a) B1 for 3 branches followed by 3, 3, 3 with correct labels and probabilities of $\frac{1}{2},\frac{1}{4},\frac{1}{4}$ on each. (b) M1 for identifying 2, possibly correct cases and adding 2 products of probabilities but A0 for wrong answer $\left[\left(\frac{1}{4}\times\frac{1}{4}\right)+\left(\frac{1}{4}\times\frac{1}{4}\right)\right]$ will be sufficient for M1A0 here but $\frac{1}{4}\times\frac{1}{2}+\ldots$ would score M0	

Question Number	Scheme	Marks
Q2 (a)	Median is 33	B1 (1)
(b)	$Q_1 = 24, Q_3 = 40, \text{IQR} = 16$	B1 B1 B1ft (3)
(c)	$Q_1 - \text{IQR} = 24 - 16 = 8$ So 7 is only outlier	M1 A1ft (2)
(d)	 Box Outlier Whisker (accept either whisker)	B1ft B1 B1ft (3) **Total [9]**
Q2 (b)	1st B1 for Q_1 = 24 and 2nd B1 for Q_3 = 40 3rd B1ft for their IQR based on their lower and upper quartile. Calculation of range (40 – 7 = 33) is B0B0B0 Answer only of IQR = 16 scores 3/3. For any other answer we must see working in (b) or on stem and leaf diagram	
(c)	M1 for evidence that Q_1-IQR has been attempted, their "8" (>7) seen or clearly attempted is sufficient A1 ft must have seen their "8" and a suitable comment that only one person scored below this.	
(d)	1st B1ft for a clear box shape and ft their Q_1, Q_2 and Q_3 readable off the scale. Allow this mark for a box shape even if Q_3 = 40, $Q_1 = 7$ and $Q_2 = 33$ are used 2nd B1 for only one outlier appropriately marked at 7 3rd B1ft for either lower whisker. If they choose the whisker to their lower limit for outliers then follow through their "8". (There should be no upper whisker unless their $Q_3 < 40$, in which case there should be a whisker to 40) A typical error in (d) is to draw the lower whisker to 7, this can only score B1B0B0	

Question Number		Scheme	Marks
Q3	(a)	2.75 or $2\frac{3}{4}$, 5.5 or 5.50 or $5\frac{1}{2}$	B1 B1 (2)
	(b)	Mean birth weight = $\frac{4841}{1500} = 3.227\dot{3}$ **awrt 3.23**	M1 A1 (2)
	(c)	Standard deviation = $\sqrt{\frac{15889.5}{1500} - \left(\frac{4841}{1500}\right)^2} = 0.421093...$ or $s = 0.4212337...$	M1 A1ft A1 (3)
	(d)	$Q_2 = 3.00 + \frac{403}{820} \times 0.5 = 3.2457...$ (allow 403.5….. $\to$ 3.25)	M1 A1 (2)
	(e)	Mean(3.23)<Median(3.25) (or very close) Negative Skew (or symmetrical)	B1ft dB1ft (2) **Total [11]**
Q3	(b)	M1 for a correct expression for mean. Answer only scores both.	
	(c)	M1 for a correct expression (ft their mean) for sd or variance. Condone mis-labelling eg sd=… with no square root or no labelling 1st A1ft for a correct expression (ft their mean) including square root and no mis-labelling Allow 1st A1 for $\sigma^2 = 0.177... \to \sigma = 0.42...$ 2nd A1 for awrt 0.421. Answer only scores 3/3	
	(d)	M1 for a correct expression (allow 403.5 i.e. use of n + 1) but must have 3.00, 820 and 0.5 A1 for awrt 3.25 provided M1 is scored. NB 3.25 with no working scores 0/2 as some candidates think mode is 3.25.	
	(e)	1st B1ft for a comparison of their mean and median (may be in a formula but if $\pm$(mean - median) is calculated that's OK. We are not checking the value but the sign must be consistent.) Also allow for use of quartiles provided correct values seen: $Q_1 = 3.02, Q_3 = 3.47$ [They should get $(0.22 =)Q_3 - Q_2 < Q_2 - Q_1 (= 0.23)$ and say (slight) negative skew or symmetric] 2nd dB1ft for a compatible comment based on their comparison. Dependent upon a suitable, correct comparison. Mention of "correlation" rather than "skewness" loses this mark.	

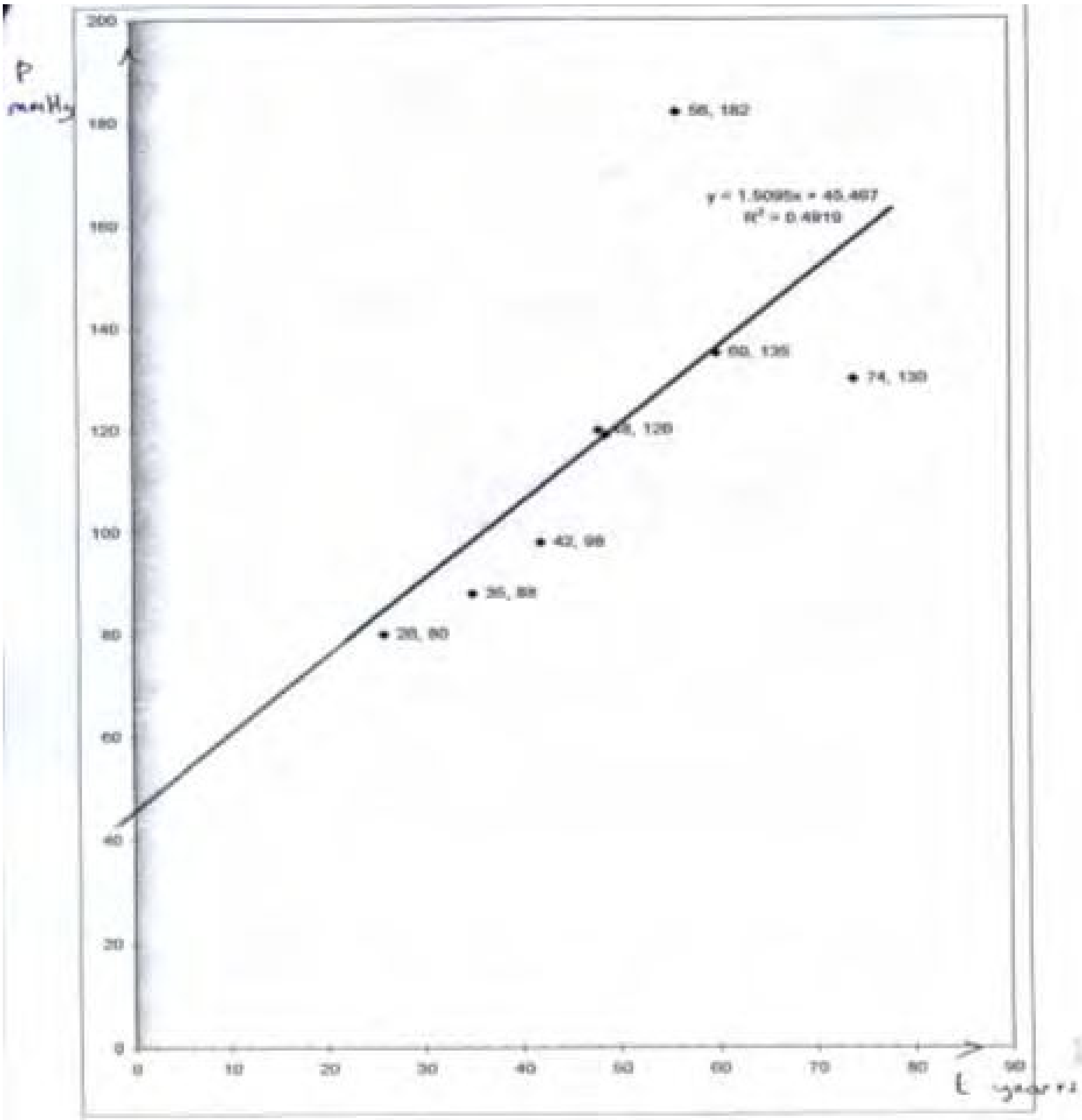
Question Number	Scheme	Marks
4 (a)		
	3 closed curves and 4 in centre	M1
	Evidence of subtraction	M1
	31,36,24	A1
	41,17,11	A1
	Labels on loops, 16 and box	B1
		(5)
(b)	P(None of the 3 options)= $\frac{16}{180}=\frac{4}{45}$	B1ft
		(1)
(c)	P(Networking only)= $\frac{17}{180}$	B1ft
		(1)
(d)	P(All 3 options/technician)= $\frac{4}{40}=\frac{1}{10}$	M1 A1
		(2)
		Total [9]
4 (a)	2nd M1 There may be evidence of subtraction in "outer" portions, so with 4 in the centre then 35, 40 28 (instead of 31,36,24) along with 33, 9, 3 can score this mark but A0A0 N.B. This is a common error and their "16" becomes 28 but still scores B0 in part (a)	
(b)	B1ft for $\frac{16}{180}$ or any exact equivalent. Can ft their "16" from their box. If there is no value for their "16" in the box only allow this mark if they have <u>shown</u> some working.	
(c)	B1ft ft their "17". Accept any exact equivalent	
(d)	If a probability greater than 1 is found in part (d) score M0A0 M1 for clear sight of $\frac{\mathrm{P}(S\cap D\cap N)}{\mathrm{P}(S\cap N)}$ and an attempt at one of the probabilities, ft their values. Allow P(all 3 | $S\cap N$) = $\frac{4}{36}$ or $\frac{1}{9}$ to score M1 A0. Allow a correct ft from their diagram to score M1A0 e.g. in 33,3,9 case in (a): $\frac{4}{44}$ or $\frac{1}{11}$ is M1A0 A ratio of probabilities with a <u>product</u> of probabilities on top is M0, even with a correct formula. A1 for $\frac{4}{40}$ or $\frac{1}{10}$ or an exact equivalent Allow $\frac{4}{40}$ or $\frac{1}{10}$ to score both marks if this follows from their diagram, otherwise some explanation (method) is required.	

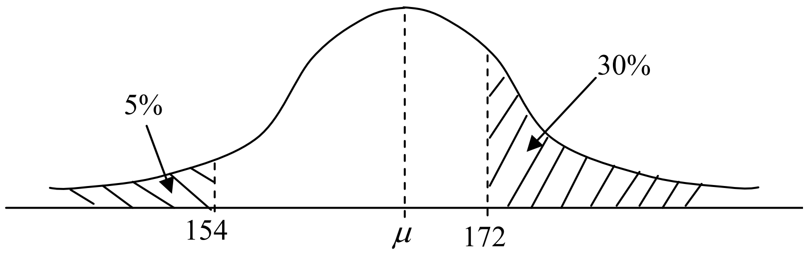
Question Number	Scheme	Marks
Q5 (a)	$k + 4k + 9k = 1$	M1
	$14k = 1$	
	$k = \frac{1}{14}$ **given** cso	A1 (2)
(b)	$P(X \geq 2) = 1 - P(X = 1)$ or $P(X = 2) + P(X = 3)$	M1
	$= 1 - k = \frac{13}{14}$ or 0.92857... **awrt 0.929**	A1 (2)
(c)	$E(X) = 1 \times k + 2 \times k \times 4 + 3 \times k \times 9$ or $36k$	M1
	$= \frac{36}{14} = \frac{18}{7}$ or $2\frac{4}{7}$ (or exact equivalent)	A1 (2)
(d)	$\text{Var}(X) = 1 \times k + 4 \times k \times 4 + 9 \times k \times 9, -\left(\frac{18}{7}\right)^2$	M1 M1
	$\text{Var}(1 - X) = \text{Var}(X)$	M1
	$= \frac{19}{49}$ or 0.387755... **awrt 0.388**	A1 (4)
		Total [10]
Q5 (a)	M1 for clear attempt to use $\sum p(x) = 1$, full expression needed and the "1" must be clearly seen. This may be seen in a table. A1cso for no incorrect working seen. The sum and "= 1" must be explicitly seen somewhere. A verification approach to (a) must show addition for M1 and have a suitable comment e.g. "therefore $k = \frac{1}{14}$" for A1 cso	
(b)	M1 for 1- $P(X \leq 1)$ or $P(X = 2) + P(X = 3)$ A1 for awrt 0.929. Answer only scores 2/2	
(c)	M1 for a full expression for $E(X)$ with at least two terms correct. NB If there is evidence of division (usually by 3) then score M0 A1 for any exact equivalent - answer only scores 2/2	
(d)	1st M1 for clear attempt at $E(X^2)$, need at least 2 terms correct in $1 \times k + 4 \times 4k + 9 \times 9k$ or $E(X^2) = 7$ 2nd M1 for their $E(X^2)$ $-(\text{their } \mu)^2$ 3rd M1 for clearly stating that $\text{Var}(1 - X) = \text{Var}(X)$, wherever seen A1 accept awrt 0.388. All 3 M marks are required. Allow 4/4 for correct answer only but must be for $\text{Var}(1 - X)$.	

Question Number	Scheme	Marks
Q6 (a)	$S_{pp} = 106397 - \frac{833^2}{7} = 7270$	M1 A1
	$S_{tp} = 42948 - \frac{341 \times 833}{7} = 2369$, $S_{tt} = 18181 - \frac{341^2}{7} = 1569.42857...$ or $\frac{10986}{7}$	A1 A1 (4)
(b)	$r = \frac{2369}{\sqrt{7270 \times 1569.42857..}}$	M1 A1ft
	$= 0.7013375$ **awrt (0.701)**	A1 (3)
(c)	(Pmcc shows positive correlation.) Older patients have higher blood pressure	B1 (1)
(d) + (f)	(d) Points plotted correctly on graph: -1 each error or omission (within one square of correct position) * see diagram below for correct points	B2
	(f) Line drawn with correct intercept, and gradient	B1ft B1 (2+2)
(e)	$b = \frac{2369}{1569.42857..} = 1.509466...$	M1 A1
	$a = \frac{833}{7} - b \times \frac{341}{7} = 45.467413...$	M1
	$p = 45.5 + 1.51t$	A1 (4)
(g)	$t = 40, p = 105.84...$ from equation or graph. **awrt 106**	M1 A1 (2)
		Total [18]

Q6 (a)	M1 for at least one correct expression 1st A1 for $S_{pp} = 7270$, 2nd A1 for $S_{tp} = 2369$ or 2370, 3rd A1 for $S_{tt} =$ awrt 1570
(b)	M1 for attempt at correct formula and at least one correct value (or correct ft) M0 for $\frac{42948}{\sqrt{106397 \times 18181}}$ A1ft All values correct or correct ft. Allow for an answer of 0.7 or 0.70 Answer only: awrt 0.701 is 3/3, answer of 0.7 or 0.70 is 2/3
(c)	B1 for comment in context that interprets the fact that correlation is positive, as in scheme. Must mention age and blood pressure in words, not just "t" and "p".
(d)	Record 1 point incorrect as B1B0 on epen. [NB overlay for (60, 135) is slightly wrong]
(e)	1st M1 for use of the correct formula for b, ft their values from (a) 1st A1 allow 1.5 or better 2nd M1 for use of $\bar{y} - b\bar{x}$ with their values 2nd A1 for full equation with a = awrt 45.5 and b = awrt 1.51. Must be p in terms of t, not x and y.
(f)	1st B1ft ft their intercept (within one square). You may have to extend their line. 2nd B1 for correct gradient i.e. parallel to given line (Allow 1 square out when $t = 80$)
(g)	M1 for clear use of their equation with $t = 40$ or correct value from their graph. A1 for awrt 106. Correct answer only (2/2) otherwise look for evidence on graph to award M1

Question Number	Scheme
Q6 (d) + (f)	Diagram for Q6 (d) + (f)



Question Number	Scheme	Marks
Q7 (a)	 bell shaped, must have inflexions	B1
	154,172 on axis	B1
	5% and 30%	B1 (3)
(b)	$\text{P}(X < 154) = 0.05$	
	$\frac{154-\mu}{\sigma} = -1.6449$ or $\frac{\mu-154}{\sigma} = 1.6449$	M1 B1
	$\mu = 154 + 1.6449\sigma$ **given**	A1 cso (3)
(c)	$172 - \mu = 0.5244\sigma$ or $\frac{172-\mu}{\sigma} = 0.5244$ (allow z = 0.52 or better here but must be in an equation)	B1
	Solving gives $\sigma = 8.2976075$ (**awrt 8.30**) and $\mu = 167.64873$ (**awrt 168**)	M1 A1 A1 (4)
(d)	P(Taller than 160cm) = $\text{P}\left(Z > \frac{160-\mu}{\sigma}\right)$	M1
	$= \text{P}(Z < 0.9217994)$	B1
	$= 0.8212$ **awrt 0.82**	A1 (3)
		Total [13]
(a)	2nd B1 for 154 and 172 marked but 154 must be < μ and 172 > μ. But μ need not be marked. Allow for $\frac{154-\mu}{\sigma}$ and $\frac{172-\mu}{\sigma}$ marked on appropriate sides of the peak. 3rd B1 the 5% and 30% should be clearly indicated in the correct regions i.e. LH tail and RH tail.	
(b)	M1 for $\pm\frac{(154-\mu)}{\sigma} = z$ value (z must be recognizable e.g. 1.64, 1.65, 1.96 but NOT 0.5199 etc) B1 for $\pm$ 1.6449 seen in a line before the final answer. A1cso for no incorrect statements (in μ, σ) equating a z value and a probability or incorrect signs e.g. $\frac{154-\mu}{\sigma} = 0.05$ or $\frac{154-\mu}{\sigma} = 1.6449$ or $\text{P}(Z < \frac{\mu-154}{\sigma}) = 1.6449$	
(c)	B1 for a correct 2nd equation (NB $172 - \mu = 0.525\sigma$ is B0, since z is incorrect) M1 for solving their two linear equations leading to $\mu = ...$ or $\sigma = ...$ 1st A1 for σ = awrt 8.30, 2nd A1 for μ = awrt 168 [NB the 168 can come from false working. These A marks require use of correct equation from (b), and a z value for "0.5244" in (c)] NB use of z = 0.52 will typically get σ=8.31 and μ = 167.67… and score B1M1A0A1 No working and both correct scores 4/4, only one correct scores 0/4 Provided the M1 is scored the A1s can be scored even with B0 (e.g. for z =0.525)	
(d)	M1 for attempt to standardise with 160, their μ and their σ (> 0). Even allow with symbols μ and σ. B1 for z = awrt $\pm$ 0.92 No working and a correct answer can score 3/3 provided σ and μ are correct to 2sf.	

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Statistics S1 (6683)

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Summer 2010

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General Marking Guidance

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

   - **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
   - **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
   - **B** marks are unconditional accuracy marks (independent of M marks)

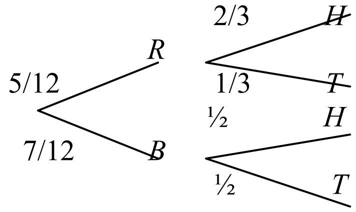
3. Abbreviations

   These are some of the marking abbreviations that will appear in the mark scheme

   - ft – follow through
   - awrt – answers which round to
   - oe – or equivalent (and appropriate)
   - isw – ignore subsequent working
   - cao – correct answer only
   - cso - correct solution only. There must be no errors in this part of the question to obtain this mark
   - SC: special case

Statistics S1 6683
Mark Scheme

Question Number	Scheme	Marks
Q1 (a)	$r = \dfrac{8825}{\sqrt{1022500 \times 130.9}}$, = awrt **<u>0.763</u>**	M1 A1 (2)
(b)	Teams with high attendance scored more goals (oe, statement in context)	B1 (1)
(c)	0.76(3)	B1ft (1)
		Total 4
(a)	M1 for a correct expression, square root required Correct answer award 2/2	
(b)	Context required (attendance and goals). Condone causality. B0 for 'strong positive correlation between attendance and goals' on its own oe	
(c)	Value required. Must be a correlation coefficient between -1 and +1 inclusive. B1ft for 0.76 or better or same answer as their value from part (a) to at least 2 d.p.	

Question Number	Scheme		Marks
Q2 (a)		P(R) and P(B) 2^{nd} set of probabilities	B1 B1 (2)
(b)	P(H) = $\frac{5}{12}\times\frac{2}{3}+\frac{7}{12}\times\frac{1}{2}, = \frac{41}{72}$ or awrt 0.569		M1 A1 (2)
(c)	P($R\|H$) = $\dfrac{\frac{5}{12}\times\frac{2}{3}}{"\frac{41}{72}"}, = \dfrac{20}{41}$ or awrt 0.488		M1 A1ft A1 (3)
(d)	$\left(\frac{5}{12}\right)^2+\left(\frac{7}{12}\right)^2$ $=\frac{25}{144}+\frac{49}{144}=\frac{74}{144}$ or $\frac{37}{72}$ or awrt 0.514		M1 A1ft A1 (3)
			Total 10

(a)	1^{st} B1 for the probabilities on the first 2 branches. Accept $0.41\dot{6}$ and $0.58\dot{3}$ 2^{nd} B1 for probabilities on the second set of branches. Accept $0.\dot{6}$, $0.\dot{3}$, 0.5 and $\frac{1.5}{3}$ Allow exact decimal equivalents using clear recurring notation if required.
(b)	M1 for an expression for P(H) that follows through their sum of two products of **probabilities** from their tree diagram
(c) Formula seen	M1 for $\dfrac{\mathrm{P}(R\cap H)}{\mathrm{P}(H)}$ with denominator their (b) substituted e.g. $\dfrac{\mathrm{P}(R\cap H)}{\mathrm{P}(H)}=\dfrac{\frac{5}{12}}{\text{(their (b))}}$ award M1.
Formula not seen	M1 for $\dfrac{\text{probability}\times\text{probability}}{\text{their } b}$ but M0 if fraction repeated e.g. $\dfrac{\frac{5}{12}\times\frac{2}{3}}{\frac{2}{3}}$. 1^{st} A1ft for a fully correct expression or correct follow through 2^{nd} A1 for $\frac{20}{41}$ o.e.
(d)	M1 for $\left(\frac{5}{12}\right)^2$ or $\left(\frac{7}{12}\right)^2$ can follow through their equivalent values from tree diagram 1^{st} A1 for both values correct or follow through from their original tree and + 2^{nd} A1 for a correct answer Special Case $\frac{5}{12}\times\frac{4}{11}$ or $\frac{7}{12}\times\frac{6}{11}$ seen award M1A0A0

Question Number	Scheme	Marks
Q3 (a)	$2a+\frac{2}{5}+\frac{1}{10}=1$ (or equivalent)	M1
	$\underline{a=\frac{1}{4}\text{ or }0.25}$	A1 (2)
(b)	E(X) = $\underline{\mathbf{1}}$	B1 (1)
(c)	$\text{E}(X^2)=1\times\frac{1}{5}+1\times\frac{1}{10}+4\times\frac{1}{4}+9\times\frac{1}{5}$ (= 3.1)	M1
	Var(X) = $3.1-1^2$, $\underline{= 2.1\text{ or }\frac{21}{10}\text{ oe}}$	M1 A1 (3)
(d)	Var(Y) = $(-2)^2\,\text{Var}(X)$, $= \underline{8.4\text{ or }\frac{42}{5}\text{ oe}}$	M1 A1 (2)
(e)	$X \geq Y$ when X = 3 or 2, so probability = "$\frac{1}{4}$"+$\frac{1}{5}$	M1 A1ft
	$= \underline{\frac{9}{20}\text{ oe}}$	A1 (3)
		Total 11
(a)	M1 for a clear attempt to use $\sum \text{P}(X=x)=1$ Correct answer only 2/2. **NB Division by 5 in parts (b), (c) and (d) seen scores 0. Do not apply ISW.**	
(b)	B1 for 1	
(c)	1st M1 for attempting $\sum x^2\text{P}(X=x)$ at least two terms correct. Can follow through. 2nd M1 for attempting $\text{E}(X^2)-[\text{E}(X)]^2$ or allow subtracting 1 from their attempt at E(X^2) provided no incorrect formula seen. Correct answer only 3/3.	
(d)	M1 for $(-2)^2\,\text{Var}(X)$ or 4Var(X) Condone missing brackets provided final answer correct for their Var(X) . Correct answer only 2/2.	
(e)	Allow M1 for distribution of $Y=6-2X$ and correct attempt at $\text{E}(Y^2)-[\text{E}(Y)]^2$ M1 for identifying X = 2, 3 1st A1ft for attempting to find their P(X=2) + P(X = 3) 2nd A1 for $\frac{9}{20}$ or 0.45	

Question Number	Scheme	Marks
Q4 (a)	$\dfrac{2+3}{\text{their total}} = \dfrac{5}{\text{their total}} = \dfrac{1}{6}$ **(** given answer**)**	M1 A1cso (2)
(b)	$\dfrac{4+2+5+3}{\text{total}}, \quad = \dfrac{14}{30}$ or $\dfrac{7}{15}$ or $0.4\dot{6}$	M1 A1 (2)
(c)	$\mathrm{P}(A \cap C) = 0$	B1 (1)
(d)	$\mathrm{P}(\mathrm{C} \mid \text{reads at least one magazine}) = \dfrac{6+3}{20} = \dfrac{9}{20}$	M1 A1 (2)
(e)	$\mathrm{P}(B) = \dfrac{10}{30} = \dfrac{1}{3}, \ \mathrm{P}(C) = \dfrac{9}{30} = \dfrac{3}{10}, \quad \mathrm{P}(B \cap C) = \dfrac{3}{30} = \dfrac{1}{10}$ or $\mathrm{P}(B \mid C) = \dfrac{3}{9}$	M1
	$\mathrm{P}(B) \times \mathrm{P}(C) = \dfrac{1}{3} \times \dfrac{3}{10} = \dfrac{1}{10} = \mathrm{P}(B \cap C)$ or $\mathrm{P}(B \mid C) = \dfrac{3}{9} = \dfrac{1}{3} = \mathrm{P}(B)$	M1
	So yes they are statistically independent	A1cso (3)
		Total 10
(a)	M1 for $\dfrac{2+3}{\text{their total}}$ or $\dfrac{5}{30}$	
(b)	M1 for adding at least 3 of "4, 2, 5, 3" and dividing by their total to give a probability Can be written as separate fractions substituted into the completely correct Addition Rule	
(c)	B1 for 0 or 0/30	
(d)	M1 for a **denominator of 20** or $\dfrac{20}{30}$ leading to an answer with denominator of 20 $\dfrac{9}{20}$ only, 2/2	
(e)	1st M1 for attempting all the required probabilities for a suitable test 2nd M1 for use of a correct test - must have attempted all the correct probabilities. Equality can be implied in line 2. A1 for fully correct test carried out with a comment	

Question Number	Scheme	Marks
Q5 (a)	23, 35.5 (may be in the table)	B1 B1 (2)
(b)	Width of 10 units is 4 cm so width of 5 units is **<u>2 cm</u>**	B1
	Height = 2.6×4 =**<u>10.4 cm</u>**	M1 A1 (3)
(c)	$\sum \text{f}x = 1316.5 \Rightarrow \bar{x} = \frac{1316.5}{56} =$ awrt **<u>23.5</u>**	M1 A1
	$\sum \text{f}x^2 = 37378.25$ can be implied	B1
	So $\sigma = \sqrt{\frac{37378.25}{56} - \bar{x}^2} =$ awrt**<u>10.7</u>** allow s = 10.8	M1 A1 (5)
(d)	$Q_2 = (20.5) + \frac{(28-21)}{11} \times 5 = 23.68\ldots$ **awrt <u>23.7 or 23.9</u>**	M1 A1 (2)
(e)	$Q_3 - Q_2 = 5.6,\quad Q_2 - Q_1 = 7.9 \quad (\text{or } \bar{x} < Q_2)$	M1
	[7.9 >5.6 so] **<u>negative skew</u>**	A1 (2)
		Total 14
(b)	M1 for their width x their height=20.8. Without labels assume width first, height second and award marks accordingly.	
(c)	1st M1 for reasonable attempt at $\sum x$ and /56 2nd M1 for a method for σ or s , $\sqrt{}$ is required Typical errors $\sum (\text{f}x)^2 = 354806.3$ M0, $\sum \text{f}^2 x = 13922.5$ M0 and $(\sum \text{f}x)^2 = 1733172$ M0 Correct answers only, award full marks.	
(d)	Use of $\sum \text{f}(x-\bar{x})^2$ = awrt 6428.75 for B1 lcb can be 20, 20.5 or 21, width can be 4 or 5 and the fraction part of the formula correct for M1 - Allow 28.5 in fraction that gives awrt 23.9 for M1A1	
(e)	M1for attempting a test for skewness using quartiles or mean and median. Provided median greater than 22.55 and less than 29.3 award for M1 for $Q_3 - Q_2 < Q_2 - Q_1$ without values as a valid reason. SC Accept mean close to median and no skew oe for M1A1	

Question Number	Scheme	Marks
Q6 (a)	See overlay	B1 B1 (2)
(b)	The **points** lie reasonably close to a straight **line** (o.e.)	B1 (1)
(c)	$\sum d = 27.7, \quad \sum f = 146$ (both, may be implied)	B1
	$S_{dd} = 152.09 - \dfrac{(27.7)^2}{6} = 24.208\ldots.$ **awrt <u>24.2</u>**	M1 A1
	$S_{fd} = 723.1 - \dfrac{27.7 \times 146}{6} = 49.06\ldots.$ **awrt <u>49.1</u>**	A1 (4)
(d)	$b = \dfrac{S_{fd}}{S_{dd}} = 2.026\ldots.$ **awrt <u>2.03</u>**	M1 A1
	$a = \dfrac{146}{6} - b \times \dfrac{27.7}{6} = 14.97\ldots..$ so <u>$\boldsymbol{f = 15.0 + 2.03d}$</u>	M1 A1 (4)
(e)	A flight costs **£2.03 (or about £2)** for every extra **100km** or about **2p** per **km**.	B1ft (1)
(f)	$15.0 + 2.03d < 5d$ so $d > \dfrac{15.0}{(5 - 2.03)} = 5.00 \sim 5.05$	M1
	So $\boldsymbol{t} > 500 \sim 505$	A1 (2)
		Total 14

(a) 1st B1 for at least 4 points correct (allow $\pm$ one 2mm square)
2nd B1 for all points correct (allow $\pm$ one 2 mm square

(b) Ignore extra points and lines
Require reference to points and line for B1.

(c) M1 for a correct method seen for either - a correct expression
1st A1 for S_{dd} awrt 24.2
2nd A1 for S_{fd} awrt 49.1

(d) 1st M1 for a correct expression for b - can follow through their answers from (c)
2nd M1 for a correct method to find a - follow through their b and their means
2nd A1 for f=.... in terms of d and all values awrt given expressions. Accept 15 as rounding from correct answer only.

(e) Context of cost and distance required. Follow through their value of b

(f) M1 for an attempt to find the intersection of the 2 lines. Value of t in range 500 to 505 seen award M1.
Value of d in range 5 to 5.05 award M1.
Accept t greater than *500* to 505 inclusive to include graphical solution for M 1A1

Question Number	Scheme	Marks
Q7 (a)	$\text{P}(D > 20) = \text{P}\left(Z > \dfrac{20-30}{8}\right)$	M1
	$= \text{P}(Z > -1.25)$	A1
	$=$ **<u>0.8944</u>** **<u>awrt 0.894</u>**	A1 (3)
(b)	$\text{P}(D < Q_3) = 0.75$ so $\dfrac{Q_3 - 30}{8} = 0.67$	M1 B1
	$Q_3 =$ **awrt** **<u>35.4</u>**	A1 (3)
(c)	$35.4 - 30 = 5.4$ so $Q_1 = 30 - 5.4 =$ **awrt** **<u>24.6</u>**	B1ft (1)
(d)	$Q_3 - Q_1 = 10.8$ so $1.5(Q_3 - Q_1) = 16.2$ so $Q_1 - 16.2 = h$ or $Q_3 + 16.2 = k$	M1
	h=**<u>8.4 to 8.6</u>** and k= **<u>51.4 to 51.6</u>** both	A1 (2)
(e)	$2\text{P}(D > 51.6) = 2\text{P}(Z > 2.7)$	M1
	$= 2[1 - 0.9965]$ = awrt **<u>0.007</u>**	M1 A1 (3)
		Total 12
(a)	M1 for an attempt to standardise 20 or 40 using 30 and 8. 1st A1 for $z = \pm 1.25$ 2nd A1 for awrt 0.894	
(b)	M1 for $\dfrac{Q_3 - 30}{8}$ = to a z value M0 for 0.7734 on RHS. B1 for (z value) between 0.67~0.675 seen. M1B0A1 for use of $z = 0.68$ in correct expression with awrt 35.4	
(c)	Follow through using their of quartile values.	
(d)	M1 for an attempt to calculate 1.5(IQR) and attempt to add or subtract using one of the formulae given in the question - follow through their quartiles	
(e)	1st M1 for attempting $2\text{P}(D >$ their $k)$ or ($\text{P}(D >$their $k)$+ $\text{P}(D <$ their $h)$) 2nd M1 for standardising their h or k (may have missed the 2) so allow for standardising $\text{P}(D > 51.6)$ or $\text{P}(D < 8.4)$ Require boths Ms to award A mark.	

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Mark Scheme (Results)

January 2011

GCE

GCE Statistics S1 (6683) Paper 1

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January 2011

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General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

   - **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
   - **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
   - **B** marks are unconditional accuracy marks (independent of M marks)
   - Marks should not be subdivided.

3. Abbreviations

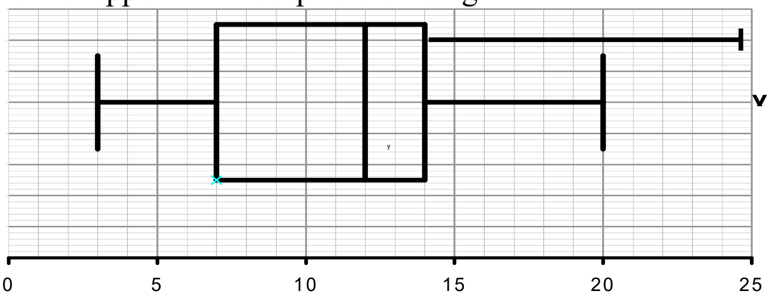
   These are some of the traditional marking abbreviations that will appear in the mark schemes.

   - bod – benefit of doubt
   - ft – follow through
   - the symbol $\surd$ will be used for correct ft
   - cao – correct answer only
   - cso - correct solution only. There must be no errors in this part of the question to obtain this mark
   - isw – ignore subsequent working
   - awrt – answers which round to
   - SC: special case
   - oe – or equivalent (and appropriate)
   - dep – dependent
   - indep – independent
   - dp decimal places
   - sf significant figures
   - $\ast$ The answer is printed on the paper
   - $\llcorner$ The second mark is dependent on gaining the first mark

January 2011
Statistics S1 6683
Mark Scheme

Question Number	Scheme	Marks
1.		
(a)	$S_{ll} = 327754.5 - \frac{4027^2}{50} = 3419.92$	M1 A1
	$S_{lw} = 29330.5 - \frac{357.1 \times 4027}{50} = 569.666$	A1
		(3)
(b)	$r = \frac{569.666}{\sqrt{3419.92 \times 289.6}} = 0.572$ awrt 0.572 or 0.573	M1 A1
		(2)
(c)	As the length of the salmon increases the weight increases	B1ft
		(1)
		[6]
	Notes	
(a)	M1 for at least one correct expression 1st A1 for $S_{ll} =$ awrt 3420 (Condone $S_{xx} = \ldots$ or even $S_{yy} = \ldots$) 2nd A1 for $S_{lw} =$ awrt 570 (Condone $S_{xy} = \ldots$)	
(b)	M1 for attempt at correct formula. Must have their S_{ll}, S_{lw} and given S_{ww} in the correct places If S_{ll}, S_{lw} are correct and an answer of awrt 0.57 is seen then award M1A0 M0 for $\frac{29330.5}{\sqrt{327754.5 \times 289.6}}$	
(c)	B1ft for a comment mentioning "length" and "weight", not just l and w, and the idea of longer salmon weighing more. e.g. "positive correlation between weight and length" is B0 since the idea of positive correlation is not explained. Allow "larger" instead of "heavier" or "longer" Ignore any spurious values mentioned such as 0.572 If their r is negative (but must be $r > -1$) ft an appropriate comment. Condone $r > 1$ if comment is correct. If $\lvert r \rvert < 0.4$ allow a comment of no or little relationship between weight and length but for $0 < r < 0.4$ the printed answer is still acceptable too. Treat mention of "skewness" as ISW if a correct interpretation is given	

Question Number	Scheme	Marks
2. (a)	$2.8 + 5.6 + 2.3 + 9.4 + 0.5 + 1.8 + 84.6 = 107$	M1
	mean = 107 / 28 (= 3.821…) **(awrt 3.8)**	A1 (2)
(b)	It will have no effect since	B1
	one is 4.5 under what it should be and the other is 4.5 above what it should be.	dB1 (2) **[4]**
	Notes	
(a)	M1 for a clear attempt to add the two sums. Accept a full expression or $2.8 + 5.6 + \ldots + 84.6 = x$ where $100<x<110$ i.e. seeing at least two correct terms of Keith's and the 84.6 with a slip. A1 for awrt 3.8 (Condone 1 dp/2sf here since data is given to 1 dp or 2 sf) Accept $\frac{107}{28}$ or $3\frac{23}{28}$ or any exact equivalent **Correct answer implies M1A1**	
(b)	1st B1 for clearly stating that it will have no effect. ("roughly the same" is B0 B0) 2nd dB1 for a supporting reason that mentions the fact that the increase and decrease are the same and gives some numerical value(s) to support this. e.g. Sum of Keith's observations is still 22.4 (or mean is still 3.2) or Sum is still 107 or $9.4 - 4.9 = 5 - 0.5$ (o.e.) This second B1 is dependent on their saying there is no effect so B0B1 is not possible.	

Question Number	Scheme	Marks
3. **(a)**	Outliers $14 + 1.5\times(14-7) = 24.5$ $7 - 1.5\times(14-7) = -3.5$ Outlier 25 either upper limit acceptable on diagram  Sales in £'000	 M1 A1 M1 A1ft B1 (5)
(b)	Since $Q_3 - Q_2 < Q_2 - Q_1$. Allow written explanation negatively skew	B1 dB1 (2)
(c)	not true since the lower quartile is 7000 and therefore 75% above 7000 not 10000 or 10 is inside the box or any other sensible comment	B1 dB1 (2) **[9]**
	<u>Notes</u>	
(a)	**A fully correct box-plot (either version) with no supporting work scores 5/5. Otherwise read on** 1st M1 for at least one correct calculation seen 1st A1 for 24.5 and -3.5 (or just negative noted) seen. May be read off the graph. If both values are seen but no calculation is given then M1A1,one value M1A0. 2nd M1 for a box with an upper and a lower whisker(s) with at least 2 correct values (condone no median marked) 2nd A1ft for 3,7, 12, 14 and 20 or 24.5 in appropriate places and readable off their scale If <u>both</u> upper whiskers are seen A0 Apply ft for their <u>whiskers</u> being compatible with their <u>outlier limits</u> e.g. if their lower limit is + 3.5 then a lower whisker ending at 4 or 3.5 is OK B1 for only one outlier appropriately marked at 25 **Apply <u>+</u> 0.5 square accuracy for diagram**	
(b)	1st B1 for $Q_3 - Q_2 < Q_2 - Q_1$ statement or an equivalent statement in words Use of $Q_3 - Q_2 < Q_2 - Q_1$ does not require differences to be seen. 2nd dB1 for "negative skew" dependent on suitable reason given above. "correlation" is B0 "positive skew" with a supporting argument based on whiskers can score B1B1 e.g. "right hand whisker is longer than LH one so positive skew" $Q_3 - Q_2 < Q_2 - Q_1$ followed by "positive skew" is B1B0	
(c)	1st B1 for rejecting the company's claim 2nd dB1 for an appropriate supporting reason. Dependent on rejecting company's claim.	

Question Number	Scheme	Marks
4. (a)	$b=\dfrac{1.688}{5.753}=0.293$	M1A1
	$a=3.22-4.42\times 0.293=1.9231...$	M1
	$p=1.92+0.293v$	A1
		(4)
(b)	$v=\dfrac{85-5}{10}=8$	M1
	$p=1.92+0.293\times 8=4.3$ **(awrt 4.3)**	A1
		(2) **[6]**

	Notes
(a)	**Can ignore (a) and (b) labels here** 1st M1 for a correct expression for *b*. $\dfrac{1.688}{1.168}$ is M0 1st A1 for awrt 0.29 2nd M1 for use of $a=\bar{p}-b\bar{v}$ follow through their value of *b*(or even just the letter *b*) 2nd A1 for a complete equation with *a* = awrt 1.92 and *b* = awrt 0.293 *y* or *p* = 1.92 + 0.293*x* is A0 Correct answer with no working is 4/4
(b)	M1 for an attempt to find the value of *v* when *x* = 85 (at least 2 correct terms in $\pm\dfrac{85-5}{10}$) <u>or</u> for an attempt to find an equation for *p* in terms of *x* <u>and</u> using *x* = 85 Attempt at equation of *p* in *x* requires $p=1.92+0.293\dfrac{(x-5)}{10}$ A1 for awrt 4.3 (award when first seen and apply ISW) N.B. $p=1.92+0.293\times 85$ (o.e.) is M0A0

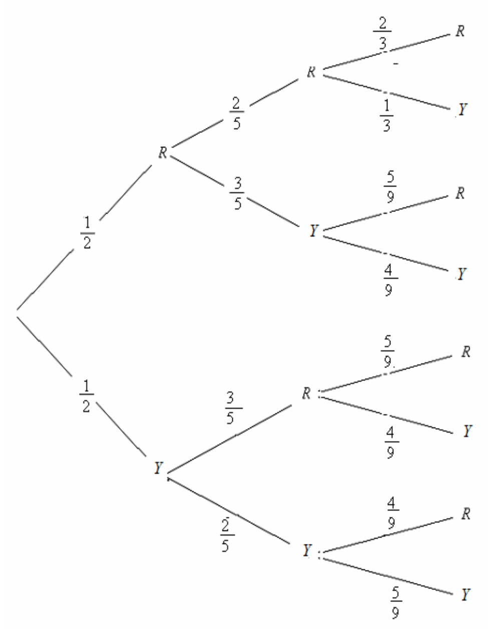
Question Number	Scheme	Marks
5. (a)	Median = 32/2 = 16th term (16.5) $\frac{x-39.5}{49.5-39.5}=\frac{16-14}{25-14}$ or $x=39.5+\left(\frac{2}{11}\times 10\right)$ Median = 41.3 (use of n + 1 gives 41.8) **(awrt 41.3)**	M1 A1 (2)
(b)	Mean$=\frac{1414}{32}=44.1875$ **(awrt 44.2)** Standard deviation $=\sqrt{\frac{69378}{32}-\left(\frac{1414}{32}\right)^2}$ = 14.7 (or s = 14.9)	B1 M1 A1 (3)
(c)	mean > median therefore <u>positive skew</u>	B1ft B1ft (2) **[7]**
	<u>Notes</u>	
(a)	M1 for an attempt to use interpolation to find the median. Condone use of 39 or 40 for 39.5 e.g. allow $39+\frac{2}{11}\times 10$ (o.e.) or $40+\frac{2}{11}\times 10$ (o.e.) to score M1A0 but must have the 10 A1 for awrt 41.3 (or awrt 41.8 if using (n + 1))	
(b) **Mid-points**	B1 for awrt 44.2 M1 for a correct expression including square root. (Allow ft of their mean) A1 for awrt 14.7 (If using s for awrt 14.9) You may see $\sum t=1339\to \bar{t}=41.8$ and $\sum t^2=62928\to$ σ 14.7 or s = 14.9 this scores B0 for the mean but can score M1 for a correct st.dev expression and A1 for ans. **Correct answer only in (a) and (b) can score full marks but check (n +1) case in (a)**	
(c) **Quartiles**	1st B1ft for a correct comparison of their mean and their median (may be in a formula) Calculating median – mean as negative is OK for this B1 but must say +ve skew for 2nd B1 Only allow comparison to be ≈ 0 if $\lvert\text{mean} - \text{median}\rvert \le 0.5$ 2nd B1ft for a correct description of skewness <u>based on their values of mean and median</u>. ft their values for mean and median not their previous calculation/comparison Must be compatible with their previous comparison (if they have one) "Positive skew" with no reason is B0B1 provided you can see their values that imply that. Description should be "positive" or "negative" or "no" skew or "symmetric" "Positive correlation" is B0 1st B1ft if Q_1 = awrt 32 <u>and</u> Q_3 = awrt 49 seen and a correct comparison made. ft Q_2 2nd B1ft if Q_1 = awrt 32 <u>or</u> Q_3 = awrt 49 seen and a correct description based on their quartiles and their comparison is made. (Should get "negative skew")	

Question Number	Scheme	Marks
6. (a)	$k + 2k + 3k + 4k = 1$ or $10k = 1$ $k = 0.1$ (*) [allow verification with a comment e.g. "so $k = 0.1$"]	B1cso (1)
(b)	$\mathrm{E}(X) = 1\times0.1 + 2\times0.2 + 3\times0.3 + 4\times0.4 = 3$	M1 A1 (2)
(c)	$\mathrm{E}(X^2) = 1\times0.1 + 4\times0.2 + 9\times0.3 + 16\times0.4 = 10$	M1 A1 (2)
(d)	$\mathrm{Var}(X) = 10 - 9 (= 1)$ $\mathrm{Var}(2 - 5X) = 5^2\,\mathrm{Var}(X) = 25$	M1 M1 A1 (3)
(e)	$\mathrm{P}(1,3) + \mathrm{P}(2,2) = 2\times0.1\times0.3 + 0.2\times0.2 = 0.1$ (*)	M1 A1cso (2)
(f)	see table below	B1 B1 (2)
(g)	$\mathrm{P}(2) + \mathrm{P}(3) = 0.05$	M1A1 (2) **[14]**

$X_1 + X_2$	2	3	4	5	6	7	8
p	0.01	0.04	0.1	**0.2**	0.25	0.24	**0.16**

Question Number	Scheme	Marks
	Notes	
(a)	B1 for a clear attempt to use sum of probabilities = 1. Must see previous line as well as $k = 0.1$ **A correct expression for** $\mathrm{E}(X)$ or $\mathrm{E}(X^2)$ **that is later divided by 4 scores M0**	
(b)	M1 for a completely correct expression. May be implied by correct answer of 3 or $30k$ A1 for 3 only.	
(c)	M1 for a completely correct expression. May be implied by correct answer of 10 or $100k$ A1 for 10 only. [For $\mathrm{E}(X^2) = 0.1 + 0.8 + 2.7 + 6.4 - 9 = 1$ scores M0A0 but accept this as Var(X) in (d)]	
(d)	1st M1 for using Var(X) = $\mathrm{E}(X^2) - \mathrm{E}(X)^2$, f.t their values from (b) and (c) Allow this mark for Var(X) = $10 - 9$ or better. May be implied if this is seen in (c). 2nd M1 for 5^2Var(X) or 25Var(X) can f.t. their Var(X). Allow -5^2 if it later becomes +25 A1 for 25 only. Dependent upon both Ms Forming distribution for $Y = 2 - 5X$ gets M1 for E(Y^2)=194 then M1A1 for 194-169=25	
(e)	M1 for correctly identifying (1, 3) <u>or</u> (3, 1) <u>and</u> (2, 2) as required cases ($3k^2 + 4k^2$ or better) A1 cso for 0.1 only but must see evidence for M1	
(f)	1st B1 for 0.2 correctly assigned. May be in table. 2nd B1 for 0.16 correctly assigned. May be in table	
(g)	M1 for P(2) + P(3). May be implied by correct answer of 0.05 A1 for 0.05 only. **Correct answer only can score full marks in parts (b), (c), (f) and (g)**	

<table>
<tr><th>Question Number</th><th>Scheme</th><th>Marks</th></tr>
<tr><td>7.
(a)</td><td>



$\frac{2}{15}$ $\frac{1}{6}$ $\frac{1}{6}$ $\frac{4}{45}$ $\left(\frac{1}{9}\right)$
both $\frac{2}{3},\frac{1}{3}$
$\frac{4}{9}$
both $\frac{3}{5},\frac{2}{5}$
all three of $\frac{4}{9},\frac{4}{9},\frac{5}{9}$</td><td>B1
B1
B1
B1
(4)</td></tr>
<tr><td>(b)</td><td>$\mathrm{P}(A)=\mathrm{P}(RR)+\mathrm{P}(YY)=\frac{1}{2}\times\frac{2}{5}+\frac{1}{2}\times"\frac{2}{5}"=\frac{2}{5}$
B1 for $\frac{1}{2}\times\frac{2}{5}$ (oe) seen at least once</td><td>B1 M1 A1
(3)</td></tr>
<tr><td>(c)</td><td>P(B) = P(RRR) + P(RYR) + P(YRR) + P(YYR)
M1 for at least 1 case of 3 balls identified. (Implied by 2nd M1)
$\left(\frac{1}{2}\times\frac{2}{5}\times"\frac{2}{3}"\right)+\left(\frac{1}{2}\times\frac{3}{5}\times\frac{5}{9}\right)+\left(\frac{1}{2}\times"\frac{3}{5}"\times\frac{5}{9}\right)+\left(\frac{1}{2}\times"\frac{2}{5}"\times"\frac{4}{9}"\right)\quad=\underline{\frac{5}{9}}$ (*)</td><td>M1
M1,A1cso
(3)</td></tr>
<tr><td>(d)</td><td>$\mathrm{P}(A\cap B)=\mathrm{P}(RRR)+\mathrm{P}(YYR)$
M1 for identifying both cases and + probs.
may be implied by correct expressions
$=\left(\frac{1}{2}\times\frac{2}{5}\times\frac{2}{3}\right)+\left(\frac{1}{2}\times\frac{2}{5}\times\frac{4}{9}\right)\qquad=\underline{\frac{2}{9}}$ (*)</td><td>M1
A1cso
(2)</td></tr>
<tr><td>(e)</td><td>$\mathrm{P}(A\cup B)=\mathrm{P}(\mathrm{A})+\mathrm{P}(\mathrm{B})-\mathrm{P}(A\cap B)$ Must have some attempt to <u>use</u>
$="\frac{2}{5}"+\frac{5}{9}-\frac{2}{9}\quad=\underline{\frac{11}{15}}$</td><td>M1
A1cao
(2)</td></tr>
</table>

Question Number	Scheme		Marks
(f)	$$\frac{\text{P}(RRR)}{\text{P}(RRR)+\text{P}(YYY)} = \frac{\frac{1}{2}\times\frac{2}{5}\times\frac{2}{3}}{\left(\frac{1}{2}\times\frac{2}{5}\times\frac{2}{3}\right)+\left(\frac{1}{2}\times\frac{2}{5}\times\frac{5}{9}\right)} = \frac{6}{11}$$	Probabilities must come from the product of 3 probs. from their tree diagram.	M1 A1ft A1 cao (3) **[17]**

	<u>Notes</u>
(b)	M1 for both cases, and +, attempted, ft their values from tree diagram. May be 4 cases of 3 balls.
(c)	2nd M1 for all 4 correct expressions, ft their values from tree diagram. A1 is cso
(e)	M1 for clear attempt to <u>use</u> the correct formula, must have some correct substitution. ft their (b)
(f)	M1 for identifying the correct probabilities and forming appropriate fraction of probs. 1st A1ft for a correct expression using probabilities from their tree **Accept exact decimal equivalents. Correct answer only is full marks except in (c) and (d)**

Question Number	Scheme	Marks
8.		
(a)	$\mathrm{P}(X > 168) = \mathrm{P}\left(Z > \frac{168-160}{5}\right)$	M1
	$= \mathrm{P}(Z > 1.6)$	A1
	$= 0.0548$ **awrt 0.0548**	A1 (3)
(b)	$\mathrm{P}(X < w) = \mathrm{P}\left(Z < \frac{w-160}{5}\right)$	
	$\frac{w-160}{5} = -2.3263$	M1 B1
	$w = 148.37$ **awrt 148**	A1 (3)
(c)	$\frac{160-\mu}{\sigma} = 2.3263$	M1 B1
	$\frac{152-\mu}{\sigma} = -1.2816$	B1
	$160 - \mu = 2.3263\sigma$	
	$152 - \mu = -1.2816\sigma$	
	$8 = 3.6079\sigma$	M1
	$\sigma = 2.21\ldots.$ **awrt 2.22**	A1
	$\mu = 154.84\ldots$ **awrt 155**	A1 (6)
		[12]
	<u>Notes</u>	
(a)	M1 for an attempt to standardize 168 with 160 and 5 i.e. $\pm\left(\frac{168-160}{5}\right)$ or implied by 1.6 1st A1 for P(Z > 1.6) or P(Z < -1.6) ie z = 1.6 and a correct inequality or 1.6 on a shaded diagram **Correct answer to (a) implies all 3 marks**	
(b)	M1 for attempting $\pm\left(\frac{w-160}{5}\right)$ = recognizable z value (|z| > 1) B1 for $z = \pm$ 2.3263 or better. Should be z =… or implied so: $1 - 2.3263 = \frac{w-160}{5}$ is M0B0 A1 for awrt 148. This may be scored for other z values so M1B0A1 is possible **For awrt 148 only with no working seen award M1B0A1**	
(c)	M1 for attempting to standardize 160 or 152 with μ and σ (allow $\pm$) <u>and</u> equate to z value (|z|>1) 1st B1 for awrt $\pm$ 2.33 or $\pm$ 2.32 seen 2nd B1 for awrt $\pm$ 1.28 seen 2nd M1 for attempt to solve their two linear equations in μ and σ leading to equation in just one variable 1st A1 for σ = awrt 2.22 . Award when 1st seen 2nd A1 for μ = awrt 155. Correct answer only for part (c) can score all 6 marks. NB σ = 2.21 commonly comes from z = 2.34 and usually scores M1B0B1M1A0A1 **The A marks in (c) require both M marks to have been earned**	

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Mark Scheme (Results)

June 2011

GCE Statistics S1 (6683) Paper 1

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EDEXCEL GCE MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

   - **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
   - **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
   - **B** marks are unconditional accuracy marks (independent of M marks)
   - Marks should not be subdivided.

3. Abbreviations

   These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used if you are using the annotation facility on ePEN.

   - bod – benefit of doubt
   - ft – follow through
   - the symbol $\sqrt{}$ will be used for correct ft
   - cao – correct answer only
   - cso - correct solution only. There must be no errors in this part of the question to obtain this mark
   - isw – ignore subsequent working
   - awrt – answers which round to
   - SC: special case
   - oe – or equivalent (and appropriate)
   - dep – dependent
   - indep – independent
   - dp decimal places
   - sf significant figures
   - $\ast$ The answer is printed on the paper
   - The second mark is dependent on gaining the first mark

June 2011
Statistics S1 6683
Mark Scheme

Question Number	Scheme	Marks
1. **(a)**	$S_{yy} = 4305 - \frac{181^2}{8}$	M1
	$= \underline{209.875}$ **(awrt 210)**	A1 (2)
(b)	$r = \frac{(-)23726.25}{\sqrt{3535237.5 \times "209.875"}}$	M1
	$= -\underline{0.87104...}$ **(awrt −0.871)**	A1 (2)
(c)	Higher towns have lower temperature or temp. decreases as height increases	B1 (1)
(d)	$S_{hh} = 3.5352375$ **(awrt 3.54)** (condone 3.53)	B1 (1)
(e)	$r = -\underline{0.87104...}$ **(awrt −0.871)**	B1ft (1) **(7 marks)**
	Notes	
(a)	M1 for a correct expression. Allow one slip e.g. 4350 for 4305	
(b)	M1 for a correct expression for *r*, follow through their answer to (a). Condone no "_ " Allow M1 for $\pm$ 0.87 with no working. (-0.871 is M1A1)	
(c)	B1 Must mention <u>temperature</u> (o.e.) and <u>height</u> (above sea level) and interpret the relationship between them. Must be a correct <u>and sensible</u> comment. e.g. "As temperature increases the height <u>of the sea</u> decreases" is B0. BUT simply stating "As temperature increases the height decreases" is B1 although "As height increases the temperature decreases" would be better. Treat mention of 0.87... as ISW "strong negative correlation between height and temp" is B0 (no interpretation) " as *x* increases *y* decreases" is B0 (no mention of height and temperature)	

Question Number	Scheme	Marks
(d)	B1 accept awrt 3.54 and condone 3.53 (i.e truncation)	
(e)	B1ft for awrt -0.871 or ft their final answer to part (b) to the same accuracy (or 3 sf) provided $-1 < r < 1$ Answer to part (e) must be a number "it's the same" is B0	
2. **(a)**	awrt $\pm$ 1.40	B1
	$\frac{23-\mu}{5} = "1.40"$ (o.e)	M1A1ft
	$\underline{\mu = 16}$ (or awrt 16.0)	A1
		(4)
(b)	$\underline{0.4192}$	B1 (1) **5**

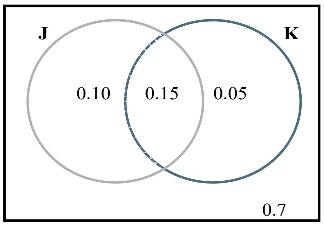
	Notes
(a)	B1 for awrt $\pm$ 1.40 or better seen anywhere. Condone 1.4 instead of 1.40 M1 for attempting to standardise with 23 and 5 and μ, accept $\pm$ e.g. $\frac{23-\mu}{25} = 1.40$ can score B1M0 (since using 25 not 5 for standardising) $\frac{23-\mu}{5} = 0.9192$ can score B0M1 (since have correct standardisation) Can accept equivalent equations e.g. $23-\mu = 5 \times "1.40"$ 1st A1ft for standardised expression = to a z value ($\lvert z \rvert > 1$). Signs must be compatible. Follow through their z e.g. $\frac{23-\mu}{5}$ = their z where $z > 1$ or $\frac{\mu-23}{5}$ = their z where $z < -1$ 2nd A1 for 16 or awrt 16.0 if they are using a more accurate z **Correct answer only scores 4/4 but if any working is seen apply scheme**
(b)	B1 for 0.4192 (but accept 3sf accuracy if 0.9192 – 0.5 is seen)

Question Number	Scheme	Marks
3. **(a)**	$a = \underline{0.1}$	B1
	$[\mathrm{F}(3) = \mathrm{F}(2) + \mathrm{P}(Y=3) = (0.5 + 0.3)]$ $d = \underline{0.8}$	B1
	$b = \mathrm{F}(2) - a = 0.5 - 0.1$ <u>or</u> $a + b = 0.5$	M1
	$b = \underline{0.4}$	A1
	$c = 1 - \mathrm{F}(3)$ <u>or</u> $1 - (a + b + 0.3)$ <u>or</u> $a + b + c = 0.7$ $c = \underline{0.2}$	A1
		(5)
(b)	$\mathrm{P}(3Y + 2 \geq 8) = \mathrm{P}(Y \geq 2)$ <u>or</u> $1 - \mathrm{P}(Y \leq 1)$	M1
	$= b + 0.3 + c$ <u>or</u> $1 - a$ $= \underline{0.9}$	A1ft
		(2) **7**
	Notes	
	Correct answers with no (or irrelevant) working score full marks	
(a)	1st B1 for $a = 0.1$	
	2nd B1 for $\mathrm{F}(3) = 0.8$ or $d = 0.8$	
	M1 for a method for b or c. E.g. sight of $a + b = 0.5$ or $a + b + c = 0.7$ If their values satisfy one of these equations then score M1 provided their values are genuine probabilities (i.e. $0 < p < 1$) This M1 may be implied by a correct answer for b or c	
	1st A1 for b or $\mathrm{P}(2) = 0.4$	
	2nd A1 for c or $\mathrm{P}(3) = 0.2$	
(b)	M1 for rearranging to $\mathrm{P}(Y \geq 2)$ or $1 - \mathrm{P}(Y \leq 1)$ or selecting cases $Y = 2$, 3 and 4	
	A1ft for 0.3 + their b + their c or 1 - their a, provided final answer < 1 and their values are probabilities.	

Question Number	Scheme	Marks
4.		
(a)	$\left(z=\pm\right)\dfrac{15-16.12}{1.6}\left(=-0.70\right)$	M1
	P(Z < -0.70) = 1 - 0.7580	M1
	= <u>0.2420</u> **(awrt 0.242)**	A1
		(3)
(b)	[P(T < t)=0.30 implies] $z=\dfrac{t-16.12}{1.6}=-0.5244$	M1 A1
	$\dfrac{t-16.12}{1.6}=-0.5244 \Rightarrow t=16.12-1.6\times\text{"}0.5244\text{"}$	M1
	t = awrt <u>15.28</u> (allow awrt 15.28/9)	A1
		(4)
		7
	Notes	
	Allow slips e.g. 16.2 for 16.12 for 1st M1 in (a) and (b)	
(a)	1st M1 for standardising expression with 15, 16.12 and 1.6 - allow ±	
	2nd M1 for 1 - a probability (> 0.5) from tables or calculator based on their standardised value	
	Correct answer only scores 3/3	
	In part (b) they can use any letter or symbol instead of *t*	
(b)	1st M1 for standardising with t (o.e.), 16.12 and 1.6, allow ±, and setting equal to a z value	
	1st A1 for an equation with z = ± 0.5244 or better	
	e.g. $\dfrac{t-16.12}{1.6}=\pm 0.52$ (or 0.525) scores M1 (but A0)	
	2nd M1 for solving <u>their</u> linear equation as far as $t = a \pm b\times 1.6$. Not dependent on 1st M1	
	e.g. solving $\dfrac{t-16.12}{1.6}=0.3$ to give $t=16.12+1.6\times 0.3$ scores this M1	
	Allow $\dfrac{t-16.12}{1.6^2}=0.3$ to give $t=16.12+1.6^2\times 0.3$ to score M1 too	
	2nd A1 dependent on both M marks. Allow awrt 15.28 or awrt 15.29	
	Condone awrt 15.3 if a correct expression for t = ... is seen.	
	Answers with no working:	
	15.28 is M1A1M1A1, 15.29 is M1A0M1A1, 15.3 is M1A0M1A0	

<table>
<tr><th>Question Number</th><th>Scheme</th><th>Marks</th></tr>
<tr><td>5.
(a)</td><td>$\underline{10.5}$</td><td>B1
(1)</td></tr>
<tr><td>(b)</td><td>$(Q_2 =)\ (15.5+)\ \frac{\frac{1}{2}\times 30-14}{8}\times 3$ or $\frac{\frac{1}{2}\times 31-14}{8}\times 3$
$= \underline{15.875 \text{ or } 16.0625}$</td><td>M1
A1
(2)</td></tr>
<tr><td>(c)</td><td>$\bar{x} = \frac{477.5}{30} = \underline{15.9}$ $(15.91\dot{6})$ [Accept $\frac{191}{12}$ or $15\frac{11}{12}$]
$\sigma = \sqrt{\frac{8603.75}{30} - \bar{x}^2}$ $,= \underline{5.78}$ (accept $s = 5.88$)</td><td>M1, A1
M1A1ft, A1
(5)</td></tr>
<tr><td>(d)</td><td>Since <u>mean and median are similar (or equal or very close)</u> a normal distribution may be suitable. [Allow mean or median close to <u>mode/modal class</u>]</td><td>B1
(1)</td></tr>
<tr><td>(e)</td><td>$Q_3 - Q_2 (= 8) > (4.5 =) Q_2 - Q_1$
Therefore <u>positive skew</u></td><td>M1
A1
(2)
(11 marks)</td></tr>
<tr><td></td><td colspan="2">Notes</td></tr>
<tr><td>(a)</td><td colspan="2">In parts (a) to (c) a correct answer with no working scores full marks for that value.
B1 for 10.5 which may be in the table</td></tr>
<tr><td>(b)</td><td colspan="2">M1 for a correct ratio and times 3, ignore the lower boundary for this mark
A1 for awrt 15.9 (if n =30 used) or awrt 16.1 (if n+1 = 31 is used)</td></tr>
<tr><td>(c)</td><td colspan="2">1st M1 for attempt at $\sum fx$ (this may be seen in the table as fx: 10, 73.5, 70, 136, 82, 106 [condone 1 slip] or awrt 500) and use of $\frac{\sum fx}{\sum f}$ <u>or</u> a correct expression for mean.
1st A1 for awrt 15.9
2nd M1 for an attempt at σ or σ^2, can ft their mean, condone mis-labelling $\sigma^2 = \sqrt{\ldots}$ etc Allow use of their $\sum fx^2$ (awrt 9000)
2nd A1ft for a correct expression including square root, ft their mean but not their $\sum fx^2$.
No label or correct label is OK but wrong label (e.g. $\sigma^2 = \sqrt{\ldots}$) is A0
3rd A1 for awrt 5.78, allow s = awrt 5.88. SC Allow M1A1A0 for awrt 5.79 if $\bar{x}$ correct</td></tr>
<tr><td>(d)</td><td colspan="2">B1 for a reason implying or stating symmetry. "Time is continuous" or “evenly distributed” is B0</td></tr>
</table>

Question Number	Scheme	Marks
(e)	M1 for a clear reason or comparison, values not essential but comparison implying they have been found is required. A1 for stating "positive skew". Condone just "positive" but "positive correlation" is A0 **Do not allow arguments based on mean and median since this part relates to a different set of data.**	
6.		
(a)	$\text{P}(J \cup K) = 1 - 0.7$ or $0.1 + 0.15 + 0.05 =$ <u>0.3</u>	B1 (1)
(b)	P(K) = 0.05 + 0.15 or "0.3" – 0.25 + 0.15 or "0.3" = 0.25 +P(K) – 0.15	M1
	May be seen on Venn diagram = <u>0.2</u>	A1 (2)
(c)	$\left[\text{P}(K \mid J)\right] = \dfrac{\text{P}(K \cap J)}{\text{P}(J)}$	M1
	$= \dfrac{0.15}{0.25}$	A1
	$= \underline{\dfrac{3}{5}}$ <u>or 0.6</u>	A1 (3)
(d)	$\text{P}(J) \times \text{P}(K) = 0.25 \times 0.2 (= 0.05)$, $\text{P}(J \cap K) = 0.15$ <u>or</u> $\text{P}\left(K \mid J\right) =$ 0.6, $\text{P}\left(K\right)$ = 0.2 <u>or</u> may see P(J|K) = 0.75 and P(J) = 0.25	M1
	not equal therefore not independent	A1ft (2)
(e)	Not independent so confirms the teacher's suspicion <u>or</u> they are linked (This requires a statement about independence in (d) or in (e))	B1ft (1) **(9 marks)**

Question Number	Scheme	Marks
	Notes	
(b)	M1 for a complete method, follow through their 0.3, leading to a linear equation for P(K) NB You may see this Venn diagram. A correct diagram (Venn or table) implies M1 in (b) Need not include box or 0.7 **Correct answer only is 2/2**  **In parts (c) and (d) they must have defined *A* and *B***	
(c)	M1 for a correct expression (including ratio) in symbols. 1st A1 for a correct ratio of probabilities (if this is seen the M1 is awarded by implication) Must be in (c). Condone no LHS but wrong LHS (e.g. P(K) or P(J|K)) is M0A0 2nd A1 for correct answer as printed only. **Correct answer only 3/3** **Mark (d) and (e) together**	
(d)	M1 for a correct comparison of known probabilities for an independence test - ft their values. E.g. $\mathrm{P}(J)\times\mathrm{P}(K)$ with $\mathrm{P}(J\cap K)$ <u>or</u> P(K|J) with P(K) [Must have expressions] The values of these probabilities should be given unless they are in the question or stated elsewhere. A1ft for correct calculations and correct comment for their probabilities	
(e)	B1ft ft their conclusion on independence so not independent confirms teacher…independent contradicts teacher. **Methods leading to negative probabilities should score M0**	

Question Number	Scheme	Marks
7.		
(a)	$\left(\text{S}_{fh} =\right)25291-\dfrac{186\times 1085}{8}$	M1
	$= \underline{64.75}$ (accept 64.8)	A1
		(2)
(b)	$b=\dfrac{\text{"64.75"}}{39.5}$, $= \underline{1.6392\ldots}$ (awrt 1.6)	M1, A1
	$a=\dfrac{1085}{8}-b\times\dfrac{186}{8}$, $= \underline{97.512\ldots}$ (awrt 97.5)	M1, A1
	$\underline{h = 97.5 + 1.64f}$	A1ft (dep on M1M1)
		(5)
(c)	$h = 97.5+ 1.64\times 25$, $= \underline{138\sim139}$ (final answer in [138, 139])	M1, A1
		(2)
(d)	Should be reliable, since 25 cm(or f or footlength) is within the range of the data	B1, B1
		(2)
(e)	Line is for children – a different equation would apply to adults <u>or</u> Children are still growing, height will increase more than foot length	B1
		(1)
		12

	Notes
	[NB $r = 0.871$ so do not confuse this with question 1]
(a)	M1 for attempting a correct expression [allow a copying slip e.g. 25921]
(b)	1st M1 for a correct expression for *b,* ft their part (a) but not $\text{S}_{fh} = 25291$
	1st A1 for awrt 1.6
	2nd M1 for use of $a=\bar{h}-b\times\bar{f}$, ft their value for *b*. Must use $\bar{h}$ and $\bar{f}$ not values from table.
	2nd A1 for awrt 97.5 [NB $a = 135 – 1.63\times 23 = 97.51$ but M0A0 since not using $\bar{h}$ and $\bar{f}$]
	3rd A1ft for an equation for *h* and *f* with <u>their</u> coefficients to 3sf. **Dependent on both Ms** Must be 3sf not awrt. Give this mark if seen in (c). Equation must be in *h* and *f* not *y* and *x*.
(c)	M1 for using <u>their</u> equation and $f = 25$ to find *h* A1 for their final answer in [138, 139]. Can give if they have 137.7... but round to 138
(d)	1st B1 for suggesting it <u>is</u> reliable 2nd B1 for mentioning that 25 cm is within range of data. “interpolation”or“not extrapol’B1 Use of “it” or a comment that height is in range is B0 but apply ISW
(e)	B1 for some comment that states a difference between children and teachers(adults) Must mention <u>teacher/adults</u> and <u>children</u> e.g. ".teacher is not in same age group as the children", "equation is for children not adults" “children and adults are different populations” "teacher will be taller" is B0 since no mention of children. “equation is <u>only</u> valid for children” is OK since “only” implies not suitable for adults <u>Or</u> Reference to different growth rates

Question Number	Scheme	Marks
8.		
(a)	$1 = p + (0.25+0.25+0.2+0.2), \Rightarrow p = \underline{\frac{1}{10} \text{ or } 0.1}$	M1, A1
		(2)
(b)	E(S) = $\frac{1}{4} + 2\times\frac{1}{4} + 4\times\frac{1}{5} + 5\times\frac{1}{5}$, (or equiv. in decimals) $= \underline{2.55}$	M1, A1
		(2)
(c)	$\text{E}\left(S^2\right) = \frac{1}{4} + \frac{2^2}{4} + \frac{4^2}{5} + \frac{5^2}{5}$ <u>or</u> $0.25 + 1 + 3.2 + 5 = \underline{9.45}$ (*)	M1, A1cso
		(2)
(d)	Var(S) = $9.45 - (\text{E}(S))^2$, $= \underline{2.9475 \text{ or } \frac{1179}{400}}$ (accept awrt 2.95)	M1, A1
		(2)
(e)	P(5 and 5) = $\left(\frac{1}{5}\right)^2$, $= \underline{\frac{1}{25} \text{ or } 0.04}$	M1, A1
		(2)
(f)	P(4, 4, 2) $= \left(\frac{1}{5}\right)^2 \times \frac{1}{4} \times 3$ ($= 0.03$ or $\frac{3}{100}$)	M1, M1
	P(4, 4, 4) $= \left(\frac{1}{5}\right)^3$ ($= 0.008$ or $\frac{1}{125}$)	B1
	P(Tom wins in 3 spins) = <u>0.038</u>	A1
		(4)
(g)	$\text{P}\left(\overline{5} \cap 5 \cap 5\right) + \text{P}(5 \cap \overline{5} \cap 5) = \frac{4}{5} \times \left(\frac{1}{5}\right)^2 \times 2 = \underline{0.064 \text{ or } \frac{8}{125}}$	M1, M1, A1
		(3)
		17

	Notes
(a)	M1 for clear attempt to use sum of probabilities = 1 (fractions or decimals) Ans only 2/2
(b)	M1 for at least 2 correct terms ($\neq 0$) of the expression. 2.55 with no working scores M1A1
	Any division by *k* (usually 5) in (b) or (c) or (d) scores M0
(c)	M1 for at least 3 correct, non-zero terms of the expression seen, allow decimals. A1cso for the full expression (with 9.45) seen. Must be cso but can ignore wrong p.
(d)	M1 for a correct expression (9.45 seen), can ft their E(S). May see $\sum (x - \text{"}2.55\text{"})^2 \times \text{P}(X = x)$ A1 accept awrt 2.95 Answer only can score M1 for correct ft and A1 for awrt 2.95
	Answer only in (e) and (f) is full marks, in (g) is no marks
(e)	M1 for $\left(\frac{1}{5}\right)^2$ Condone $\text{P}(5)\times\text{P}(5) = 0.25 \times 0.25$. [Beware 0.4 is A0]
(f)	1st M1 for $\left(\frac{1}{5}\right)^2 \times \frac{1}{4}$ <u>or</u> 0.01 seen 2nd M1 for multiplying a $p^2 q$ probability by 3($p, q \in (0,1)$). B1 for $(0.2)^3$ or better seen
(g)	1st M1 for $\frac{4}{5} \times \left(\frac{1}{5}\right)^2$ or all cases considered and correct attempt at probabilities. 2nd M1 for multiplying a $p^2(1-p)$ probability by 2. **Beware $(0.4)^3$ = 0.064 is M0M0A0**

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Rewarding Learning

Mark Scheme (Results)

January 2012

GCE Statistics S1 (6683) Paper 1

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(But note that specific mark schemes may sometimes override these general principles).

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$$(x^2 + bx + c) = (x + p)(x + q),\ \text{where} \left|pq\right| = \left|c\right|$$, leading to x = ...

$$(ax^2 + bx + c) = (mx + p)(nx + q),\ \text{where} \left|pq\right| = \left|c\right| \text{ and } \left|mn\right| = \left|a\right|$$, leading to x = …

2. Formula

Attempt to use correct formula (with values for a, b and c), leading to x = …

3. Completing the square

Solving $x^2 + bx + c = 0$: $\left(x \pm \frac{b}{2}\right)^2 \pm q \pm c, \quad q \neq 0$, leading to x = …

Method marks for differentiation and integration:

1. Differentiation

Power of at least one term decreased by 1. ($x^n \rightarrow x^{n-1}$)

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Power of at least one term increased by 1. ($x^n \rightarrow x^{n+1}$)

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Where a method involves using a formula that has been learnt, the advice given in recent examiners' reports is that the formula should be quoted first.

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January 2012
6683 Statistics S1
Mark Scheme

Question Number	Scheme	Marks
1 (a)	14, 5	M1 A1
		(2)
(b)	21 + 45 + 3 = 69	M1 A1
		(2)
		Total 4
NOTES		
(a)	M1 for 2x7 or 14 or 5x1 or 5	
	A1 for both 14 and 5	
(b)	M1 for 21+45+(0<frequency <9)	
	A1 for 69 only.	
	69 no working, award M1A1 Incorrect answer with no working M0A0	

Question Number	Scheme	Marks
2 (a)	(R and S are mutually) exclusive.	B1 (1)
(b)	$\frac{2}{3}=\frac{1}{4}+\mathrm{P}(B)-\mathrm{P}(A\cap B)$ use of Addition Rule	M1
	$\frac{2}{3}=\frac{1}{4}+\mathrm{P}(B)-\frac{1}{4}\times\mathrm{P}(B)$ use of independence	M1 A1
	$\frac{5}{12}=\frac{3}{4}\mathrm{P}(B)$	
	$\mathrm{P}(B)=\frac{5}{9}$	A1 (4)
(c)	$\mathrm{P}(A'\cap B)=\frac{3}{4}\times\frac{5}{9}=\frac{15}{36}=\frac{5}{12}$	M1A1ft (2)
(d)	$\mathrm{P}(B'\vert A)=\frac{(1-(\mathrm{b}))\times 0.25}{0.25}$ or $\mathrm{P}(B')$ or $\frac{\frac{1}{9}}{\frac{1}{4}}$	M1
	$=\frac{4}{9}$	A1 (2)
		Total 9
NOTES		
(a)	B1 for '(mutually) exclusive' or 'cannot occur at the same time' seen or equivalent. 'Intersection is zero' or 'no overlaps' without further explanation is B0.	
(b)	M1 for use of Addition Formula, including an intersection, with at least one probability substituted. Intersection must be explicitly considered for this mark. Accept $\frac{2}{3}=\frac{1}{4}+\mathrm{P}(B)-0$ for M1. M1 for $\mathrm{P}(A\cap B)=\frac{1}{4}\mathrm{P}(B)$ A1 for completely correct equation or equivalent. A1 for $\frac{5}{9}$ or exact equivalent.. Venn Diagram with 2 overlapping closed curves and correct values possibly without $\frac{1}{3}$, award M1M1A1.	
(c)	M1 for $\frac{3}{4}$ x 'their P(B)' or 'their P(B)' - P($A\cap B$) or P(AUB)-P(B) = $\frac{2}{3}-\frac{1}{4}$ Or $\mathrm{P}(A'\cap B)=\mathrm{P}(A')$ + 'their P(B)' – P(A'UB) = $\frac{3}{4}+\frac{5}{9}-\frac{8}{9}$ A1 for $\frac{5}{12}$ or follow through from their method. Accept exact equivalent. Correct answer only with no working M1A1 but must be clearly labelled (c).	

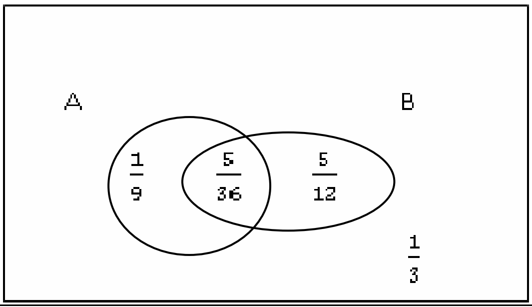
(d) M1 for using 1-‘their P(B)’ or (P($A \cup B$) – P(A))/P(A) or (P(A) – P($A \cap B$))/P(A) with a correct attempt at the numerator and denominator. If mutually exclusive is assumed then the last option gives $\frac{\frac{1}{4}}{\frac{1}{4}}$ for M1.

A1 for $\frac{4}{9}$ or exact equivalent.

For part (c) follow through their stated values; **do not** follow through incorrectly labelled regions on a Venn Diagram.

Throughout the question we require probabilities between 0 and 1 for method marks.

Venn Diagram:



Question Number	Scheme	Marks
3 (a)	$\frac{5}{21}+\frac{2k}{21}+\frac{7}{21}+\frac{k}{21}=1$	M1
	$\frac{12+3k}{21}=1$	
	$k=3$ * AG required for both methods	A1
		(2)
(b)	$\frac{11}{21}$	B1
		(1)
(c)	$\text{E}(X)=2\times\frac{5}{21}+3\times\frac{6}{21}+4\times\frac{7}{21}+6\times\frac{1}{7}$	M1
	$=3\frac{11}{21}$ or $\frac{74}{21}$ or awrt 3.52	A1
		(2)
(d)	$\text{E}(X^2)=2^2\times\frac{5}{21}+3^2\times\frac{6}{21}+4^2\times\frac{7}{21}+6^2\times\frac{1}{7}$	M1
	$=14$	A1
		(2)
(e)	$\text{Var}(X)=14-\left(3\frac{11}{21}\right)^2$	M1
	$=1\frac{257}{441}$ or $\frac{698}{441}$ or awrt 1.6	A1
	$\text{Var}(7X-5)=7^2\,\text{Var}(X)$	M1
	$=77\frac{5}{9}$ or $\frac{698}{9}$ or awrt 77.6	A1
		(4)
		Total 11
NOTES		
(a)	M1 Award for verification. Sub in k=3 and show $\sum x\text{P}(X=x)=1$. Require at least three correct terms seen or line 2 of scheme. A1 Correct solution only including verification.	
(b)	B1 Award for exact equivalent.	
(c)	M1 At least two correct terms required for method, follow through 'their *k*' for method. Correct answer only, award M1 A1.	
(d)	M1 At least two correct terms required for method. M0 if probability is squared. Correct answer only, award M1 A1. Accept exact equivalent of 14 for A1.	
(e)	M1 for use of correct formula in both. 1.6 can be implied by correct final answer. Working needs to be clearly labelled to award first method mark without second stage of calculation. If a new table for values of 7X – 5 is used, so Y = 7X – 5 $\text{E}(Y^2)=\frac{9751}{21}$; $\text{Var}(Y)=77\frac{5}{9}$ or $\frac{698}{9}$ or awrt 77.6 Award M1A1; M1A1 If any attempt to divide by 4 seen as part of working award M0 for that part.	

Question Number	Scheme	Marks
4 (a)	60	B1 (1)
(b)	$Q_1 = 46$ $Q_2 = 56$ $Q_3 = 64$	B1 B1 B1 (3)
(c)	mean = 55.48…. or $\frac{2497}{45}$ awrt 55.5	B1
	sd = $\sqrt{\frac{143369}{45}-\left(\frac{2497}{45}\right)^2}$	M1
	= 10.342… (s = 10.459..) anything which rounds to 10.3 (or s = 10.5)	A1 (3)
(d)	Mean < median < mode or $Q_2 - Q_1 > Q_3 - Q_2$ with or without their numbers or median closer to upper quartile (than lower quartile) or (mean-median)/sd <0;	B1
	negative skew;	B1dep (2)
(e)	mean = $(55-5)\times 0.9$ = 45 sd = 10×0.9 = 9	M1 A1 M1 A1 (4) **Total 13**
NOTES		
(a)	B1 60 only	
(b)	Award each B1 for correct answer only in this order.	
(c)	M1 for use of correct formula, including square root. Correct answers with no working B1M1A1.	
(d)	B1 any correct comparison of a pair of mean, median and mode using their values. B1 for 'negative skew' or allow (almost) symmetrical dependent upon correct reason.	
(e)	M1 for (55 or 55.5 - 5)$\times$0.9 A1 for the correct answer only. M1 for (10 or 10.3 or 10.5))$\times$0.9 A1 for the correct answer only.	

Question Number	Scheme	Marks
5 (a)	$S_{tt} = 2688 - \dfrac{158^2}{10} = 191.6$ awrt 192	M1 A1
	$S_{tw} = 1760.62 - \dfrac{158 \times 111.75}{10} = -5.03$ awrt -5.03	A1
		(3)
(b)	$r = \dfrac{-5.03}{\sqrt{191.6 \times 0.16}} = -0.908469\ldots$ awrt -0.908(5)	M1A1
		(2)
(c)	$b = \dfrac{-5.03}{191.6} = -0.0263$ awrt -0.026	M1 A1
	$a = 11.175 + 0.0263 \times 15.8$	M1
	$= 11.59$	
	$w = 11.6 - 0.0263t$	A1
		(4)
(d)	The explanatory variable is the age of each coin. This is because the age is set and the weight varies.	B1 B1
		(2)
(e) (i)	awrt 11.5	B1
(ii)	Decrease(in weight of coin of 0.1052 g) = 0.1 or -0.1 or increase of -0.1 awrt(-0.1)	B1
		(2)
(f)	Decrease; removing the fake will result in a better linear fit so *r* will be closer to -1	B1;B1
		(2)
		Total 15

NOTES

(a) M1 for correct attempt at either method,
A1 awrt 192
A1 awrt -5.03

(b) M1 for correct attempt at use of formula, square root required.
A1 awrt -0.908(5)

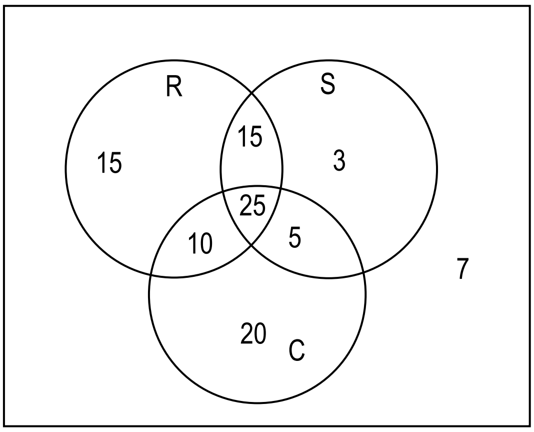
(c) M1 require 'their -5.03' as numerator and /their 191.6' as denominator.
A1 awrt -0.026
M1 for use of correct formula with *b* or 'their *b*'; require $--$or + and values in the correct place.
A1 for equation as written with values awrt 3 sf. with *w* and *t*.
Accept fractional answers that are accurate to 3sf when evaluated as decimals

(d) B1 for 'Age' or *t* or 'years'
B1 for 'you use age / t to predict w' or 'you can control t/ age' or 'weight depends on age' or similar

(e) B1 awrt 11.5
B1 awrt -0.1 but 'decrease of -0.1' is B0.

(f) B1 for Decrease only but 'mod r increases' explicitly stated in words or symbols award B1.
B1 accept 'stronger correlation' or 'increase in correlation' or 'better linear fit' or '*r* closer to -1' or 'points are closer to a straight line' or 'point is an outlier' or equivalent

Special Case 1	Attempt to calculate S_{tw}		
	$\sum tw = 1669.62, \sum t = 153, \sum w = 91.75$ or $S_{tw} = 1660.62 - \frac{153 \times 91.75}{9}$ or awrt 101		
	or $S_{tw} > 0$ with some calculation	B1	
	"Increase"	B1	
			(2)
Special Case 2	Attempt to calculate S_{ww}		
	$\sum w^2 = 1248.96625 - 400 = 848.96625$ or awrt 849 or $S_{ww} = 848.96625 - \frac{91.75^2}{9}$		
	or awrt -86.4 or $S_{ww} < 0$	B2	
			(2)
Special Case 3	Argument based on standard deviation.		
	e.g. $\sigma_w \approx 0.126$ and $\overline{w} = 11.175$ so fake coin is over 69 sds away from the mean	B1	
	'(very) unlikely' or 'impossible'	B1	
			(2)

Question Number	Scheme	Marks
6 (a)	 3 closed curves and 25 in correct place	M1
	15,10,5	A1
	15,3,20	A1
	Labels *R*, *S* ,*C* and box	B1
	All values/100 or equivalent fractions award accuracy marks.	(4)
(b)	7/100 or 0.07 M1 for ('their 7'in diagram or here)/100	M1 A1
		(2)
(c)	(3+5)/100 = 2/25 or 0.08	M1A1
		(2)
(d)	(25+15+10+5)/100 = 11/20 or 0.55	M1 A1
		(2)
(e)	$\mathrm{P}\left(S \cap C' \middle\| R\right) = \frac{P\left(S \cap C' \cap R\right)}{P(R)}$ Require denominator to be 'their 65' or 'their $\frac{65}{100}$'	M1
	$= \frac{15}{65}$ require 'their 15' and correct denominator of 65	A1
	$= \frac{3}{13}$ or exact equivalents.	A1
		(3)
		Total 13
NOTES		
(b)	M1 for 'their 7'/100 seen. A1 Correct answer only In parts (c) and (d) we require "/100" for methods to be awarded. Also check their values and award correct method if they follow from their Venn Diagram.	
(c)	M1 For ('their 3'+'their 5')/100. $\frac{8}{48}$ award M0. A1 Correct answer only or equivalent.	
(d)	M1 Accept sum of their 4 values from the Venn diagram /100. A1 Correct answer only or equivalent	
(e)	M1 Attempt to use correct formula for conditional probability. Award for correct formula and a denominator of 'their 65' or 'their 65/100'. A1 for 'their 15'/65 only. A1 for exact equivalent answers, including 15/65. In all parts correct answers with no working award full marks.	

Question Number	Scheme	Marks
7 (a)	$P(W < 224) \quad = P\left(z < \dfrac{224-232}{5}\right)$	M1
	$= P(z < -1.6)$	
	$= 1 - 0.9452$	M1
	$= 0.0548$ awrt 0.0548	A1
		(3)
(b)	$0.5 - 0.2 = 0.3$ 0.3 or 0.7 seen	M1
	$\dfrac{w-232}{5} = 0.5244$ 0.5244 seen	B1; M1
	$w = 234.622$ awrt 235	A1
		(4)
(c)	$0.2\times(1-0.2)$	M1
	$2\times 0.8\times(1-0.8) = 0.32$	M1 A1
		(3)
		Total 10
NOTES (a)	M1 for standardising with 232 and 5. (i.e. not 5^2 or $\sqrt{5}$). Accept $\pm\dfrac{w-232}{5}$. M1 for finding (1- a probability > 0.5) A1 awrt 0.0548	
(b)	M1 Can be implied by use of ± 0.5244 or $\pm$ (0.52 to 0.53) B1 for ± 0.5244 only. Second M1 standardise with 232 and 5 and equate to z value of (0.52 to 0.53) or (0.84 to 0.85) 1 – z used award second M0. Require consistent signs i.e. $\dfrac{232-w}{5} = -0.5244$ or negative z value for M1. A1 dependent upon second M mark for awrt 235 but see note below. Common errors involving probabilities and not z values: $P(Z<0.2) = 0.5793$ used instead of z value gives awrt 235 but award M0B0M0A0 $P(Z<0.8) = 0.7881$ used instead of z value award M0B0M0A0. M1B0M0A0 for 0.6179, M1B0M0A0 for 0.7580	
(c)	M1 for 0.16 seen M1 for '$2\times p(1-p)$' A1 0.32 correct answer only	

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Mark Scheme (Results)

Summer 2012

GCE Statistics S1
(6683) Paper 1

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6683 Statistics S1
Mark Scheme

Question	Scheme	Marks
1. (a)	x: -1, 0, 1, 2; $\mathrm{P}(X=x)$: $4k$, k, 0, k	M1
	$4k + k + (0) + k = 1$ (Allow verify approach)	A1
	$6k = 1 \Rightarrow k = \frac{1}{6}$ (*)	A1cso (3)
(b)	$[\mathrm{E}(X)] = -4k\ (+0+0) + 2k$ or $-2k$ or $-1\times\frac{4}{6} + 2\times\frac{1}{6}$	M1
	$= -\frac{1}{3}$ (or $-0.\dot{3}$)	A1 (2)
(c)	$\left[\mathrm{E}\left(X^2\right)\right] = (-1)^2\times 4k + (0+0) + 2^2 k$ or $4k+4k$ or $(-1)^2\times\frac{4}{6} + 2^2\times\frac{1}{6}$ (o.e.)	M1
	$= \frac{4}{3}$ (*)	A1cso (2)
(d)	$[\mathrm{Var}(X)] = \frac{4}{3} - \left(-\frac{1}{3}\right)^2$ or $8k - 4k^2 = \left[\frac{11}{9}\right]$; $Y = 1-3X$: 4, 1, -2, -5; Prob: $4k$, k, 0, k; And $\mathrm{E}(Y) = 12k$	M1
	$\mathrm{Var}(1-3X) = (-3)^2\,\mathrm{Var}(X)$ or $9\mathrm{Var}(X)$; $\mathrm{E}(Y^2) = 90k$ and $\mathrm{Var}(Y) = 90k - 144k^2$	M1
	$= 11$	A1 cao (3)
		[10]

Notes

(a) M1 for attempt at $\mathrm{P}(X=x)$ with at least 2 correct. Do not give for 4, 1, etc but $\frac{4}{6}, \frac{1}{6}$ are OK

1st A1 for at least $4k + k + k = 1$ seen. Allow $\frac{4}{6}+\frac{1}{6}+\frac{1}{6}=1$ [Must see = 1]

2nd A1cso provided previous 2 marks are scored and no incorrect working seen

It's not essential to see $\mathrm{P}(X=-1) = 4k$ etc but if wrongly assigned probabilities such as $\mathrm{P}(X=2) = 4k$ and $\mathrm{P}(X=-1) = k$ are seen then the final A1 is lost.

Verify To score final A1cso there must be a comment such as "therefore $k = \frac{1}{6}$"

Division by 4 (or any other n) in (b), (c) or (d) is M0. Do not apply ISW

(b) M1 for a full correct expression for E(X), ft their <u>probabilities</u>. Allow in terms of k.

A1 for $-\frac{1}{3}$ or exact equivalent only. Just $-\frac{1}{3}$ scores M1A1

(c) M1 for evidence of both non-zero terms seen. May be simplified but 2 terms needed.

A1cso for M1 seen leading to $\frac{4}{3}$ or any exact equivalent. Condone $-1^2\times 4k$ but not $-4k$

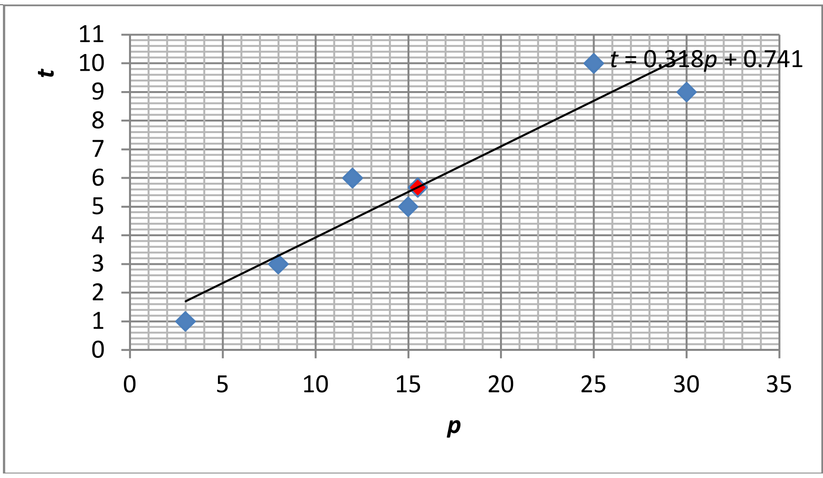
(d) 1st M1 for correct attempt at Var(X) - follow through their E(X) and allow in terms of k. Award if a correct formula is seen and some correct substitution made.

2nd M1 for correct use of Var(aX+b). Condone $-3^2\,\mathrm{Var}(X)$ if it eventually yields 9Var(X)

A1cao for 11 only

Question	Scheme	Marks
2. (a)	$\left[S_{xy} =\right]\ 23070 - \frac{477 \times 480}{12} \quad [= 3990]$	B1
	$r = \frac{"3990"}{\sqrt{5606.25 \times 4244}}$	M1
	$= 0.81799\ldots$ **awrt 0.818**	A1 (3)
(b)	**0.818**	B1ft (1)
(c)	Positive correlation <u>or</u> value of r is close to 1 <u>or</u> value of $r > 0$ (NOT "high/ strong correlation")	B1
	So there <u>is support</u> for the bank's claim <u>or</u> "increase in unemployment is accompanied by increase in house repossessions"	B1 (2)
		[6]

	Notes
(a)	**Marks for part (a) must be seen in (a), do not award if only seen in (b)** B1 for a correct expression for S_{xy} M1 for correct attempt at r f.t. their 3990 but $\frac{23070}{\sqrt{5606.25 \times 4244}}$ is M0 A1 for awrt 0.818 If an answer of 0.82 only is seen then B1M1A0 can be given
(b)	B1ft for awrt 0.818 or f.t. their answer to part (a) for $\lvert r \rvert < 1$. Allow 2sf or 1sf follow through Answer in (b) must be correct or match one of their answers in (a). Must be a number.
(c)	1st B1 for a reason of positive correlation (allow even if $r > 1$) "positive skew" or "positive gradient" is B0 but 2nd B1 is still possible 2nd B1 for a comment that suggest this supports the claim. Marks in (c) are independent but first B1 requires some idea of <u>positive</u> correlation
(c) SC	If $\lvert r \rvert < 0.2$ allow this alternative to the mark scheme: 1st B1 for saying there is no or little correlation 2nd B1 for a comment that says this does <u>not</u> support the bank's claim

3.	**(a)**		Use overlay B1 B1 (2)
	(b)	Points (appear to) lie close to a (straight) line <u>or</u> "strong /high correlation"	B1 (1)
	(c)	$\sum p = 93$ and $\sum t = 34$ (may be seen in table) $S_{pt} = 694 - \frac{"93" \times "34"}{6} = [167]$ <u>or</u> $S_{pp} = 1967 - \frac{"93"^2}{6} = [525.5]$ $S_{pt} = 167$; $S_{pp} =$ awrt 526	M1 M1 A1; A1 (4)
	(d)	$b = \left[\frac{S_{pt}}{S_{pp}} = \right] \frac{"167"}{"525.5"} = [0.31779...]$ **(check their answer if expression not seen)** $a = \frac{"34"}{6} - "0.31779..." \times \frac{"93"}{6} = 5.666... - 0.31779... \times 15.5 =, 0.74088...$ awrt 0.74 t **= 0.741 + 0.318*p*** (Accept $a = \frac{2336}{3153}$ and $b = \frac{334}{1051}$ in their equation)	B1ft M1, A1 A1 (4)
	(e)	$(\bar{p}, \bar{t}) = (15.5, 5.7)$ plotted on the graph (not wholly outside the circle) Correct line plotted as per overlay. For $p = 5$; $2 < t < 3$ <u>and</u> for $p = 30$; $10 < t < 11$ Their line must stretch roughly as far as the points and go through the $(\bar{p}, \bar{t})$ circle	B1 B1 (2)
	(f)	$t = "0.741" + "0.318" \times 16$ $= 5.825...$ **awrt 5.8**	M1 A1 (2) **[15]**

Notes

(a)	B2	for all 6 data points plotted correctly. B1 for any 5 correct. Points not wholly outside the circles.
(c)	1st M1	for attempting $\sum p$ and $\sum t$. Allow $80 < \sum p < 100$ and $30 < \sum t < 40$
	2nd M1	for one correct expression for S_{pt} or S_{pp}, f.t. their $\sum p$ and $\sum t$. 1st A1 for S_{pt} 2nd for S_{pp}
(d)	B1ft	for correct expression for the gradient, f.t. their 167 and 525.5 from (c)
	M1	for correct use of $a = \bar{t} - b\bar{p}$ f.t. their values. Condone 5.6 for $\bar{t}$
	1st A1	for awrt 0.74 NB use of 526 gives 0.745566… and gets A0
	2nd A1	for a correct equation for *t* in terms of *p* with *a* and *b* awrt 3sf An equn in *y* or *x* is A0
(f)	M1	for clear use of their line (equation or on graph) and *p* = 16 to estimate *t*. This may be an expression or lines marked on the diagram
	A1	for awrt 5.8, even if their line is not fully correct. Accept "*t* > 5.8"(oe). Answer only 2/2

Question	Scheme	Marks
4. (a)	B, W <u>or</u> T, W [accept $B \cup T, W$ <u>or</u> $B \cap T, W$] [Condone P(B), P(W) etc]	B1
	Since there is no <u>overlap</u> between the events <u>or</u> cannot happen together (o.e.) (Accept comment in context e.g. "no one walks and takes the train")	B1 (2)
(b)	e.g. $\mathrm{P}(B)=\frac{9}{25},\ \mathrm{P}(T)=\frac{8}{25},\ \mathrm{P}(B\cap T)=\frac{5}{25}$	M1
	$\mathrm{P}(B\cap T)\neq \mathrm{P}(B)\times\mathrm{P}(T)$ $[0.2 \neq 0.36\times 0.32 = 0.1152$ o.e.]	M1
	So B and T are <u>not</u> independent	A1cso (3)
(c)	[P(W) =] $\frac{7}{25}$ <u>or</u> 0.28	B1 (1)
(d)	[P($B\cap T$) =] $\frac{5}{25}$ <u>or</u> $\frac{1}{5}$ <u>or</u> 0.2	B1 (1)
(e)	$[\mathrm{P}(T \mid B) =]\ \frac{\mathrm{P}(T\cap B)}{\mathrm{P}(B)}=\frac{\text{"(d)"}}{(5+4)/25}$	M1
	$=\frac{5}{9}$ or $0.\dot{5}$	A1 (2)
		[9]

	Notes
(a)	1st B1 for a suitable pair. Do not accept universally exclusive pairs such as B and B' etc 2nd B1 for any <u>correct</u> statement. Accept use of symbols e.g.: $B\cap W=\varnothing$ <u>or</u> $\mathrm{P}(T\cap W)=0$ etc But $T\cap W=0$ is B0 (since it is not a correct statement)
(b)	1st M1 for an attempt at all required probabilities with labels for a suitable test (allow one error). Accept use of A and B as long as they can be identified as B and T by correct probabilities Must be probabilities not integers such as 5, 9, 8 etc for both these M marks 2nd M1 for $\mathrm{P}(B)\times\mathrm{P}(T)$ evaluated (correct for <u>their</u> probabilities) <u>or</u> $\mathrm{P}(B\cap T)\neq\mathrm{P}(B)\times\mathrm{P}(T)$ stated or implied in symbols or using their probabilities. <u>or</u> $\mathrm{P}(B\mid T)\neq\mathrm{P}(B)$ <u>or</u> $\mathrm{P}(T\mid B)\neq\mathrm{P}(T)$ stated or implied in symbols or using their probabilities. A1 for a conclusion of <u>not</u> independent. Requires all probabilities used to be correct and seen. This A mark is dependent on both Ms NB $\mathrm{P}(B\mid T)=\frac{5}{8}$ & $\mathrm{P}(B)=\frac{9}{25}$ <u>or</u> $\mathrm{P}(T\mid B)=\frac{5}{9}$ & $\mathrm{P}(T)=\frac{8}{25}$ seen, followed by a correct conclusion scores 3/3
(e)	M1 for a correct ratio of probabilities e.g. $\frac{5/25}{(5+4)/25}$ <u>or</u> $\frac{5}{5+4}$ <u>or</u> A correct ratio expression and at least one correct (or correct f.t.) probability substituted. A1 for $\frac{5}{9}$ with no incorrect working seen but $\frac{5}{9}$ following from P($B \mid T$) is 0/2. $\frac{5}{9}$ alone is 2/2

5. (a)	One large square = $\frac{450}{"22.5"}$ <u>or</u> one small square = $\frac{450}{"562.5"}$ (o.e. e.g. $\frac{"562.5"}{450}$)	M1	
	One large square = 20 cars <u>or</u> one small square = 0.8 cars <u>or</u> 1 car = 1.25 squares	A1	
	No. > 35 mph is: $4.5\times"20"$ <u>or</u> $112.5\times"0.8"$ (or equivalent e.g. using fd)	dM1	
	= <u>**90**</u> (cars)	A1	(4)
(b)	$[\bar{x}] = \frac{30\times12.5+240\times25+90\times32.5+30\times37.5+60\times42.5}{450}$ $\left[=\frac{12975}{450}\right]$	M1 M1	
	$= 28.83...$ <u>or</u> $\frac{173}{6}$ **awrt <u>28.8</u>**	A1	(3)
(c)	$[Q_2 =]\ 20+\frac{195}{240}\times10$ (o.e.) [Allow use of (n + 1) giving 195.5 instead of 195]	M1	
	= 28.125 [Use of (n + 1) gives 28.145…] **awrt <u>28.1</u>**	A1	(2)
(d)	$Q_2 < \bar{x}$ So <u>positive skew</u> | [Condone $Q_2 \approx \bar{x}$] [so (almost) <u>symmetric</u>]	B1ft dB1ft	(2)
(e)	[If chose <u>skew</u> in (d)] **median (Q_2)** Since the data is skewed or median not affected by extreme values | [If chose <u>symmetric</u> in (d)] **mean ($\bar{x}$)** Since it uses all the data	B1 dB1	(2)
			[13]
	Notes		
(a)	1st M1 for attempt to count squares (accept "22.5" in [22, 23] and "562.5" in [550, 575]) **and** use 450 to obtain a measure of scale. [If using fd must use 450 to obtain scale factor] 1st A1 for a correct calc. for 20 or 0.8 or 1.25 etc [May be fd = 4 to 1 large sq. or 0.8 to 1 small sq. May be on the diagram.] 2nd dM1 dep on 1st M1 for correctly counting squares for > 35 mph and forming suitable expr' 2nd A1 for 90 with no incorrect working seen. e.g. $\frac{4.5}{22.5}\times450$ scores M1A1M1 and A1 when = 90 is seen. Answer only is 4/4		
(b)	1st M1 for clear, sensible use of mid-points at least 3 of (12.5, 25, 32.5, 37.5, 42.5) seen 2nd M1 for an expression for $\bar{x}$ (at least 3 correct terms on num' and a compatible denominator) Follow through their frequencies. You may see these fractions: $\frac{16218.75}{562.5}$ (small squares), $\frac{12975}{450}$ (frequencies), $\frac{648.75}{22.5}$ (large squares) A1 for awrt 28.8 (answer only is 3/3)		
(c)	M1 for a full expression for median (using their frequencies). May see e.g. $25+\frac{75}{120}\times5$ etc Do nor accept boundaries of 19.5 or 20.5, these are M0A0 A1 for awrt 28.1 (answer only is 2/2) [For use of (n + 1) accept 28.15 but not 28.2]		
(d)	1st B1ft for a correct statement about their Q_2 and $\bar{x}$ [Condone $Q_2 \approx \bar{x}$ only if $\lvert Q_2 - \bar{x}\rvert < 1$] Do not accept an argument based on the shape of the graph alone. 2nd dB1ft dependent on 1st B1 for a <u>compatible</u> description of skewness. F.t. their values		
Quartiles	If $Q_1 = 23.4$ and $Q_3 = 33.7 \sim 33.8$ are seen allow comparison of quartiles for 1st B1 in (d)		
(e)	1st B1 for a correct choice based on their skewness comment in (d). If no choice made in (d) only Q_2 2nd dB1 for a suitable compatible comment		

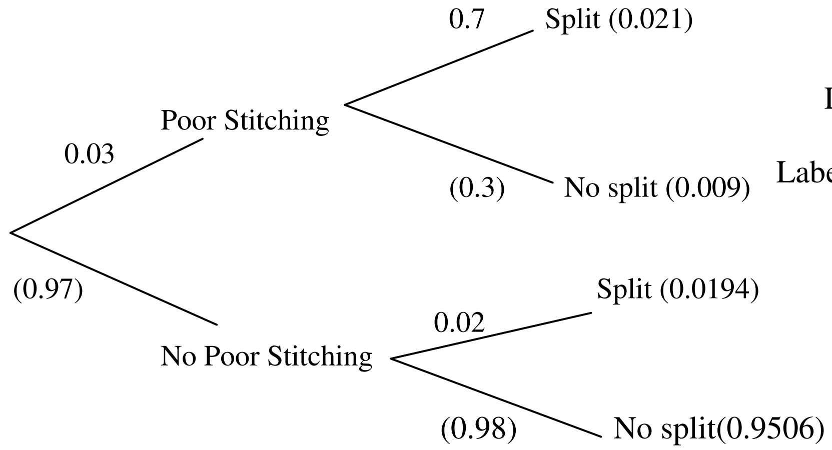
<table>
<tr><th>Question</th><th>Scheme</th><th>Marks</th></tr>
<tr><td>6. (a)</td><td>$[z=]\pm\left(\frac{150-162}{7.5}\right)$
$[z=]-1.6$
$[\mathrm{P}(F>150)=\mathrm{P}(Z>-1.6)=]=0.9452(0071\ldots)$ awrt <u>0.945</u></td><td>M1
A1
A1 (3)</td></tr>
<tr><td>(b)</td><td>$z=\pm 0.2533$ (or better seen)
$(\pm)\frac{s-162}{7.5}=0.2533(47\ldots)$
$s=163.9$ awrt <u>164</u></td><td>B1
M1
A1 (3)</td></tr>
<tr><td>(c)</td><td>$z=\pm 1.2816$ (or better seen)
$\frac{162-\mu}{9}=-1.2815515...$

$\mu=173.533\ldots$ awrt <u>174</u></td><td>B1
M1
A1
A1 (4)

[10]</td></tr>
<tr><td></td><th>Notes</th><td></td></tr>
<tr><td>(a)</td><td colspan="2">M1 for attempting to standardise with 150, 162 and 7.5. Accept $\pm$
Allow use of symmetry and therefore 174 instead of 150
1st A1 for -1.6 seen. Allow 1.6 seen if 174 used or awrt 0.945 is seen. Sight of 0.945(2) is A1.
2nd A1 for awrt 0.945 Do not apply ISW, if 0.9452 is followed by 1 – 0.9452 then award A0
Correct answer only 3/3</td></tr>
<tr><td>(b)</td><td colspan="2">B1 for $(z=)\pm 0.2533$ (or better) seen.
Giving $z=\pm 0.25$ or ± 0.253 scores B0 here but may get M1A1
M1 for standardising with s (o.e.), 162 and 7.5, allow $\pm$, and setting equal to a z value
Only allow $0.24\le z\le 0.26$ Condone e.g. 160 for 162 etc
A1 for awrt 164 (Correct answer only scores B0M1A1)</td></tr>
<tr><td>(c)

NB</td><td colspan="2">B1 for $(z=)\pm 1.2816$ (or better) seen. Allow awrt $\pm$ 1.28 if B0 scored in (b) for $z=$ awrt$\pm$ 0.25
M1 for attempting to standardise with 162, 9 and μ, and setting equal to a z value where $1.26<|z|<1.31$. Allow $\pm$ here so signs don't have to be compatible.
1st A1 for a correct equation <u>with</u> compatible signs and $1.26<|z|<1.31$
2nd A1 for awrt 174 (Correct answer only scores B0M1A1A1). Dependent on 1st A1

An equation $\frac{162-\mu}{9}=1.2816$ leading to an answer of $\mu=174$ is A0A0 <u>unless</u> there is clear correct working such as: $\frac{162-x}{9}=1.2816\Rightarrow x=\ldots\therefore\ \mu=162+(162-x)=174$ then award A1A1
A common error is: $\frac{162-\mu}{9}=1.2816$ followed by $\mu=162+9\times1.2816$ = awrt 174 It gets A0A0</td></tr>
</table>

7. (a)	 Shape Labels & 0.03 Labels & 0.7,0.02	B1 B1 B1 (3)
(b)	P(Exactly one defect) = $0.03\times0.3+0.97\times0.02$ <u>or</u> $\text{P}(PS\cup Split)-2\text{P}(PS\cap Split)$ = [0.009 + 0.0194 =] <u>**0.0284**</u>	M1A1ft A1 cao (3)
(c)	P(No defects) = $(1-0.03)\times(1-0.02)\times(1-0.05)$ (or better) = 0.90307 **awrt <u>0.903</u>**	M1 A1 cao (2)
(d)	P(Exactly one defect) = $(\text{b})\times(1-0.05)+(1-0.03)\times(1-0.02)\times0.05$ = "0.0284"$\times0.95+0.97\times0.98\times0.05$ = [0.02698 + 0.04753] = 0.07451 **awrt <u>0.0745</u>**	M1 M1 A1ft A1 cao (4) **[12]**
	Notes	

Allow MR of 0.2 for 0.02 or 0.3 for 0.03 on tree diagram to score all M and A1ft marks only

(a) 1st B1 for 2 branch then 4 branch shape

2nd dB1 dep. on 1st B1 for labels showing stitching (accept letters) and 0.03 value correctly placed

3rd dB1 dep. on 1st B1 for labels showing splitting and 0.7 and 0.02 correctly placed

[probabilities shown in brackets are <u>not</u> required and any such values given can be ignored in (a)]

(b) M1 for $0.03\times p+0.02\times q$ where p and q follow from their tree diagram. Extra terms is M0

1st A1ft for a fully correct expression. Accept $1-0.7$ for 0.3 and $1-0.03$ for 0.97

Follow through 0.2 and 0.3 MR only

MR 0.2 for 0.02 $\rightarrow$0.203 or 0.3 for 0.03 $\rightarrow$ 0.104 or both $\rightarrow$ 0.23 should score M1A1A0

2nd A1 cao for 0.0284 only (or exact equivalent such as $\frac{71}{2500}$)

Do not allow 0.5 as MR of 0.05 so no M or A marks in (c) or (d)

(c) M1 for (their 0.97)$\times$(their 0.98)$\times(1-0.05)$ (or better) f.t. values from their tree diagram

A1 cao for awrt 0.903

(d) 1st M1 for one correct triple (or correct ft from their tree) of:

$$[0.03\times0.3\times(1-0.05)]+[0.97\times0.02\times(1-0.05)]+[0.97\times0.98\times0.05]$$

2nd M1 for two correct triples or correct ft from their tree and adding <u>or</u> their (b) $\times(1-0.05)$

1st A1ft for a fully correct expression or f.t. their (b) and 0.2 or 0.3 MR only

MR 0.2 for 0.02$\rightarrow$0.23165 or 0.3 for 0.03$\rightarrow$0.1331 or both$\rightarrow$0.2465 (or awrt 3sf) scores M1M1A1A0

2nd A1 cao for awrt 0.0745

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Rewarding Learning

Mark Scheme (Results)

January 2013

GCE Maths – Statistics S1 (6683/01)

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- Unless indicated in the mark scheme a correct answer with no working should gain full marks for that part of the question.

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EDEXCEL GCE MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

- **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
- **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- **B** marks are unconditional accuracy marks (independent of M marks)
- Marks should not be subdivided.

In some instances, the mark distributions (e.g. M1, B1 and A1) printed on the candidate's response may differ from the final mark scheme.

3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used.

- bod – benefit of doubt
- ft – follow through
- the symbol $\sqrt{}$ will be used for correct ft
- cao – correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC: special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- dp decimal places
- sf significant figures
- ∗ The answer is printed on the paper
- ⎣ The second mark is dependent on gaining the first mark

4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but incorrect answers should never be awarded A marks.

5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.

6. If a candidate makes more than one attempt at any question:
   - If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
   - If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

7. Ignore wrong working or incorrect statements following a correct answer.

8. The maximum mark allocation for each question/part question(item) is set out in the marking grid and you should allocate a score of '0' or '1' for each mark, or "trait", as shown:

	0	1
aM		•
aA	•	
bM1		•
bA1	•	
bB	•	
bM2		•
bA2		•

January 2013
6683 Statistics S1
Mark Scheme

Question Number	Scheme	Marks
1.		
(a)	$\left(S_{tt}\right) = 8702 - \dfrac{258^2}{10}$ or $\left(S_{gt}\right) = 1550.2 - \dfrac{258 \times 63.6}{10}$	M1
	$\left(S_{tt} =\right) 2045.6$, $\left(S_{gt} =\right) -90.68$ awrt (2046), awrt – 90.7	A1, A1
		(3)
(b)	$r = \dfrac{-90.68}{\sqrt{2045.6 \times 7.864}} = -0.714956...$ awrt -0.715	M1 A1
		(2)
(c)	Positive	B1
	e.g. high *v* corresponds to low *t* and low *t* corresponds to high *g* so expect high *v* to corresponds to high *g* <u>or</u> expect more revision to result in a better grade	B1 (2)
		7
	Notes	
(a)	M1 for at least one correct expression 1st A1 for S_{tt} = awrt 2046 (Condone S_{xx} =… or even S_{yy} =…) 2nd A1 for S_{gt} = awrt -90.7 (Condone S_{xy} =…)	
(b)	M1 for attempt at correct formula. Must have their S_{tt}, S_{gt} and given S_{gg} in the correct places. Condone missing "$-$" Award M1A0 for awrt -0.71 with no expression seen M0 for $\dfrac{1550.2}{\sqrt{8702 \times 7.864}}$ Correct answer only is 2/2	
(c)	1st B1 for saying "positive". Ignore mention of skew. 2nd B1 for suitable reason that mentions at least *v* and *g* and supports positive correlation. e.g. "the less <u>revision</u> done the lower the <u>grade</u>" is B1 "should do better with more <u>revision</u>" is B0 since does not mention <u>grades</u> "both coefficients are similar" or two sketches of negative correlation with labelled axes is B1 since *v, t* and *g* are implied Allow use of letters *v* and *g* Allow equivalent terms e.g. "study" instead of "revision" or "score" instead of "grade"	

Question Number	Scheme	Marks
2.		
(a)	F(3) = 1 gives $\dfrac{3^3+k}{40}=1$	M1
	So $k=$ **<u>13</u>**	A1cso
		(2)
(b)	$\mathrm{P}(X=1)=\dfrac{14}{40}$ or 0.35 (o.e.)	B1
	Use of $\mathrm{P}(X=2)=\mathrm{F}(2)-\mathrm{F}(1)$ <u>or</u> $\mathrm{P}(X=3)=\mathrm{F}(3)-\mathrm{F}(2)$	M1
	$\mathrm{P}(X=2)=\dfrac{7}{40}$ or 0.175 , $\mathrm{P}(X=3)=\dfrac{19}{40}$ or 0.475	A1, A1
		(4)
(c)	$\mathrm{Var}(4X-5)=4^2\,\mathrm{Var}(X)$	M1
	So $\mathrm{Var}(4X-5)=\dfrac{259}{20}$ or 12.95	A1 (2)
		8
	Notes	

(a) M1 for use of F(3) = 1 Attempt at $\dfrac{3^3+k}{40}=1$ must be seen

$27+k=40$ without reference to F(3) = 1 is M0

A1cso for no incorrect working seen and M1 scored.

<u>Verify</u> Allow M1 for $\dfrac{3^3+13}{40}=1$ but the A1 requires an <u>explicit</u> comment such as "so $k=13$"

(b) If a table such as this is seen then award B1M1A1A1. Ignore labels on 2nd row

	1	2	3
	$\frac{7}{20}$ or 0.35	$\frac{7}{40}$ or 0.175	$\frac{19}{40}$ or 0.475

Otherwise apply the following:

B1 for $\dfrac{14}{40}$ or 0.35 or any exact equivalent. Can be labelled F(1), P($X=1$) or p(x) and associated with $x=1$ or given in a table but must have <u>a</u> label.

M1 for clear method showing how to obtain P($X=$...) from F(x)
M1 can be implied if either P($X=2$) <u>or</u> P($X=3$) is correct

1st A1 for $\mathrm{P}(X=2)=\dfrac{7}{40}$ or 0.175 or exact equivalent

2nd A1 for $\mathrm{P}(X=3)=\dfrac{19}{40}$ or 0.475 or exact equivalent

(c) M1 for correct use of the variance formula ($4^2\mathrm{Var}(X)$ alone secures M1)
A value for Var(X) is not required for this M1

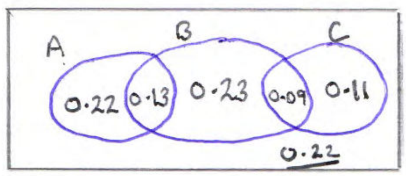
A1 for any exact equivalent to 12.95 Correct answer only is 2/2

Question Number	Scheme	Marks
3.		
(a)	$\sum t = 140$ (or $\bar{t} = 17.5$) and $\sum m = 32$ (or $\bar{m} = 4$)	B1 B1
	$(\mathrm{S}_{tm}) = 469.5 - \dfrac{"140" \times "32"}{8}$	M1
	$(\mathrm{S}_{tm} =) -90.5$	A1cso
		(4)
(b)	$b = \dfrac{\mathrm{S}_{tm}}{\mathrm{S}_{tt}} = \dfrac{-90.5}{354}$	M1
	$b = -0.255649...$ (allow $\frac{181}{708}$) -0.25 or awrt -0.26	A1
	$a = \dfrac{"32"}{8} - b \times \dfrac{"140"}{8}$	M1
	So equation of the line is <u>***m* = 8.47 – 0.256*t***</u> (allow $m = \frac{11999}{1416} - \frac{181}{708}t$)	A1
		(4)
(c)	$(8.47 - 0.256 \times 10 =) 5.9...$ awrt <u>**5.9**</u>	B1 (1)
(d)	Should be reliable since 10 is in the range (of the data)	B1 (1)
		10
	Notes	
(a)	1st B1 for 140 seen in correct context or correctly labelled 2nd B1 for 32 seen in correct context or correctly labelled. (allow a fully correct expression – not "...+...+...") 4480 used correctly is B1B1 M1 for attempting a correct expression. Follow through their 140 and their 32 You may see attempt at $\sum (t - \bar{t})(m - \bar{m})$. This must have all the products seen. A1cso requires a correct expression seen and no incorrect working leading to -90.5	
(b)	1st M1 for a correct expression for *b*. Follow through their S_{tm}. Condone missing "$-$" 1st A1 for awrt -0.26 or condone -0.25 2nd M1 for a correct method for *a*. Follow through their sums from part (a) and their value of *b* 2nd A1 for a correct equation for *m* and *t* with *a* = awrt 8.47 and *b* = awrt -0.256 Must be an equation in *m* and *t*, use of *x* or *y* scores A0 here.	
(c)	B1 for awrt 5.9 Accept 6 if the correct expression (awrt $8.47 - 10 \times$ awrt 0.256) is seen	
(d)	B1 for suggesting it is reliable and mentioning 10 within the range (of the data.) <u>or</u> suggesting it is reliable since <u>interpolating</u> or <u>not extrapolating</u> NB "it is reliable since <u>it</u> is in the range" is B0 since "<u>it</u>" is not explicit enough Condone extra non-relevant comments but penalise contradictory comments. e.g. "near the extreme so <u>not reliable</u> but not extrapolated so reliable" is B0 since <u>contradicts</u> "reliable since 10 is within the range (of temps) <u>and 5.9 within range of times</u>" is B1 since <u>irrelevant</u>	

Question Number	Scheme	Marks
4.		
(a)	$\frac{127-100}{15}$	M1
	So P(L > 127) = P(Z > 1.8) or $1-\text{P}(Z<1.8)$ o.e.	A1
	= 1 – 0.9641 = **<u>0.0359</u>** (awrt **<u>0.0359</u>**)	A1
		(3)
(b)	$\frac{d-100}{15}=-1.2816$ (Calculator gives $-1.2815515\ldots$)	M1, B1
	d = 80.776 (awrt **<u>80.8</u>**)	A1
		(3)
(c)	Require P(L > 133 | L > 127)	M1
	$=\left[\frac{\text{P}(L>133)}{\text{P}(L>127)}\right]=\frac{\text{P}(Z>2.2)}{\text{P}(L>127)}$	dM1
	$=\left[\frac{1-0.9861}{1-0.9641}\right]=\frac{0.0139}{[0.0359]}$	A1
	= 0.3871... = awrt **<u>0.39</u>**	A1
		(4)
S.C.	An attempt at P(L < 133| L > 127) that leads to awrt 0.61 (M0M1A0A0)	
		10
	Notes	
(a)	M1 for attempting to standardise with 127, 100 and 15 . Allow $\pm$ 1st A1 for Z > 1.8. Allow a diagram but must have 1.8 and correct area indicated. Must have the Z so P(L > 127) with or without a diagram is insufficient. May be implied by 0.0359 2nd A1 for awrt 0.0359 (calc. gives 0.035930266…). Correct ans only 3/3. M1A0A1 not poss.	
(b)	M1 for an attempt to standardise with 100 and 15 and set = $\pm$ any z value ($\|z\|$ > 1) B1 for $z = \pm$ 1.2816 (or better) seen anywhere [May be implied by 80.776(72…) or better seen] A1 for awrt 80.8 (can be scored for using 1.28 but then they get M1B0A1) The 80.8 must follow from correct working.	
Calc	If answer is awrt 80.8 **and** awrt 80.777 or 80.776… or better seen then award M1B1A1 If answer is awrt 80.8 or 80.77 then award M1B0A1 (unless of course z = 1.2816 is seen)	
(c)	1st M1 for clear indication of correct conditional probability or attempt at correct ratio So clear attempt at $\frac{\text{P}(L>133)}{\text{P}(L>127)}$ is sufficient for the 1st M1 2nd dM1 dependent on 1st M1 for P(L > 133) leading to P(Z > 2.2). 1st A1 for 0.0139 or better seen coming from P(Z > 2.20). Dependent on both Ms 2nd A1 for awrt 0.39. Both Ms required	
ALT	If they assume Alice did not check that the phone was working you may see: [P(L< 127).0] + P(L > 127).<u>P(L > 133| L > 127)</u> Provided the <u>conditional probability</u> is seen as part of this calculation the 1st M1 can be scored and their final answer will be 0.0139(4/4) An answer of 0.0139 without sight of the conditional probability is 0/4.	

Question Number	Scheme	Marks
5. (a)	Width = 4 (cm)	B1
	Area of 14 cm^2 represents frequency 28 and area of 4h represents 18	M1
	Or $\frac{4h}{18}=\frac{14}{28}$ (o.e.) $\quad$ $\boldsymbol{h}$ **=** **2.25** (cm)	A1
		(3)
(b)	$m=(240)+\frac{10}{22}\times 80$ (o.e.)	M1
	$= 276.36...$ $\left(\frac{3040}{11}\right)$ $\quad$ ((£)**276** $\le m <$ (£)276.5)	A1
		(2)
(c)	$\sum fy = 31600$ leading to $\bar{y}=316$	M1A1
	$\sigma_y=\sqrt{\frac{12452800}{100}-\left(\bar{y}\right)^2}$ $= 157.07...$ (awrt **157**) Allow $s = 157.86...$	M1A1
		(4)
(d)	Skewness = 0.764... (awrt **0.76** or **0.75**) [If n+1 used in (b) and m = £278 accept awrt 0.73 or 0.72]	B1
	Positive skew	B1ft
		(2)
(e)	$z=\pm\frac{80}{150}$	M1
	P(240< X < 400) = **0.40 ~ 0.41**	A1
		(2)
(f)	(e) suggests a reasonable fit for this range BUT	B2/1/0
	(d) since skew it will not be a good fit overall	(2)
		15
	Notes	
(a)	B1 for width (ignore units) M1 for clear method using area and frequency or their width $\times$ their height = 9 e.g. seeing both fd of 0.7 and 0.225 (may see fd in the table) [Must use correct interval]	
(b)	M1 for $\frac{10}{22}\times 80$ or $\frac{10.5}{22}\times 80$ (o.e.). Allow use of (n + 1) leading to £278 .18... or [278, 278.5) A1 Do not award if incorrect end-point seen but answer only is 2/2	
(c)	1st M1 attempt at $\sum fy$ with at least 3 correct products or ans. that rounds to 30 000 (to 1 sf) &/100 2nd M1 for correct expression including $\sqrt{}$. Follow through $\bar{y}$. Need $\sum fy^2$ correct but condone a minor transcription error e.g. 12458200.	
(d)	1st B1 for awrt 0.76/0.75 for m = £276 or awrt 0.73/0.72 for m = £278 2nd B1ft for a correct description of their skew based on their measure or if no measure given based on their values of mean and median. (correlation is B0)	
(e)	M1 for an attempt to standardise using the 320 and 150 and either 240 or 400 (implied by 0.53) A1 for answer in range [0.40 , 0.41] (tables gives 0.4038, calculator 0.40619...) Ans only 2/2	
(f)	For B2 we need 2 comments that make reference to each of part (e) and part (d) One comment should suggest it is not good since skew. The other it is since matches range in (e) 1st B1 for one relevant comment 2nd B1 for both comments NB Do not use B0B1	

Question Number	Scheme	Marks
6. (a)	b: 1, 3, 5; $P(B=b)$: $\frac{1}{3}$, $\frac{1}{3}$, $\frac{1}{3}$ Also allow b values 1,1,3,3,5,5 and probabilities all $\frac{1}{6}$	B1 B1 (2)
(b)	Discrete Uniform {distribution}	B1 (1)
(c)	[E(B) =] 3 (by symmetry)	B1 (1)
(d)	$[\text{E}(R) =]\ 2\times\frac{2}{3}+4\times\frac{1}{6}+6\times\frac{1}{6}$ $= \underline{\mathbf{3}}$	M1 A1 (2)
(e)	$[\text{E}(R^2) =]\ 2^2\times\frac{2}{3}+4^2\times\frac{1}{6}+6^2\times\frac{1}{6}$ $\left[=\frac{34}{3}\right]$ $[\text{Var}(R) =]\frac{34}{3}-3^2=,\frac{7}{3}$ (or any exact equivalent. NB 2.33 is A0)	M1 dM1, A1 (3)
(f)	Coin lands on **2**, choose **blue** die; coin lands on **5** choose **red** die P(Avisha wins) = $\frac{1}{2}\times\left(\frac{1}{3}+\frac{1}{3}\right)+\frac{1}{2}\times\frac{1}{6}$ $=\frac{5}{12}$ (allow awrt 0.417)	B2/1/0 M1 A1 (4) **13**
	Notes	
(a)	1st B1 for correctly identifying values of b as 1, 3, 5 or 1,1,3,3,5,5 2nd B1 for probabilities all $=\frac{1}{3}$ or exact equivalent (or of course 6 cases of $\frac{1}{6}$) Any correct probability distribution or probability function is 2/2. Must be in part (a)	
(b)	B1 for "Discrete Uniform" . Both words required.	
(c)	B1 for answer of 3 o.e. Accept E(X) = 3	
(d)	M1 for an attempt at correct formula. At least 2 correct products seen. If later divide by $n(\neq 1)$ M0 A1 for an answer of 3. Correct answer only scores both marks.	
(e)	1st M1 for a correct attempt at $\text{E}(R^2)$. At least 2 correct products seen. Condone Var(R) = etc May be implied by sight of $\frac{34}{3}$ or 11.3 or better. 2nd dM1 Dep. on 1st M1 for clear attempt at $\text{E}(R^2)-[\text{E}(R)]^2$ Must see their values <u>used</u>. NB Var(R) = $\text{E}(R^2)-[\text{E}(R)]^2=\text{"}\frac{34}{3}\text{"}-\text{"}3\text{"}$ is M1M0A0 since do not <u>use</u> their $[\text{E}(R)]^2$	
(f)	B2/1/0 Both correct B1B1, one correct B1B0. Do not use B0B1[e.g. always red or RR is B1B0] NB Allow other descriptions of the die e.g. 1st or fair for blue, 2nd for red if they are clear. M1 for evaluating correct probabilities i.e. only $\frac{1}{3},\frac{1}{12}$ seen <u>or</u> if incorrect choice made: M1 for an answer of : if choose RR ($\frac{1}{4}$), if choose BB ($\frac{1}{3}$), if choose RB ($\frac{1}{6}$) NB $\frac{5}{12}$ as answer scores M1A1. Need to see choices of die stated for B marks.	

Question Number	Scheme	Marks
7.		
(a)	$P(A \cup B) = 0.35 + 0.45 - 0.13$ <u>or</u> $0.22 + 0.13 + 0.32$	M1
	$= \underline{\mathbf{0.67}}$	A1
		(2)
(b)	$P(A' \mid B') = \dfrac{P(A' \cap B')}{P(B')}$ or $\dfrac{0.33}{0.55}$	M1
	$= \dfrac{3}{5}$ or 0.6	A1
		(2)
(c)	$P(B \cap C) = 0.45 \times 0.2$	M1
	$= \underline{\mathbf{0.09}}$	A1
		(2)
(d)	 Allow 1st B1 for 3 intersecting circles in a box with zeros in the regions for $A \cap C$. Do not accept "blank" for zero	B1 B1ft B1 B1
		(4)
(e)	$P(B \cup C)' = 0.22 + \underline{0.22}$ or $1 - [0.56]$ or $1 - [0.13 + 0.23 + 0.09 + 0.11]$ o.e.	M1
	$= \underline{\mathbf{0.44}}$	A1 (2)
		12
	Notes	
	NB May see Venn diagram for A and B only used for (a) and (b) but M marks are awarded for <u>correct expressions only</u>. No ft from an incorrect diagram for M marks.	
(a)	M1 for attempt to use the addition rule. Correct substitution i.e. correct expression seen A1 for 0.67 only. Correct answer only scores 2/2	
(b)	M1 for a correct ratio of probabilities or a correct formula and at least one correct prob For a correct formula allow "1 − their (a)" instead of 0.33 but not for correct ratio case. Do not award for assuming independence i.e. $\frac{P(A' \cap B')}{P(B')} = \frac{0.65 \times 0.55}{0.55}$ is M0. M0 if num>denom A1 for 3/5 or any exact equivalent.	
(c)	M1 for correct expression. Need correct values for $P(B)$ and $P(C)$ seen. A1 for 0.09 or any exact equivalent. Correct answer only is 2/2	
(d)	**No labels *A, B, C* in (d) loses 1st B1 but can score the other 3 by implication** B1 for box with B intersecting A and C but C not intersecting A. No box is B0 B1ft for 0.13 and their 0.09 in correct places. [ft $P(B \cap C)$ from (c)] B1 for any 2 of 0.22, <u>0.22</u>, 0.11 and 0.23 correct B1 for all 4 values correct	
(e)	M1 for a correct expression or follow through from their Venn diagram NB $P(B') \times P(C') = 0.55 \times 0.8$ is OK. Do not ft "blank" for zero and M0 for negative probs. A1 for 0.44 only. Correct answer only is 2/2	

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Rewarding Learning

Mark Scheme (Results)

Summer 2013

GCE Statistics 1 (6683/01R)

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

EDEXCEL GCE MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

- **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
- **A** marks: accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- **B** marks are unconditional accuracy marks (independent of M marks)
- Marks should not be subdivided.

3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes:

- bod – benefit of doubt
- ft – follow through
- the symbol $\sqrt{}$ will be used for correct ft
- cao – correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC: special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- dp decimal places
- sf significant figures
- $\ast$ The answer is printed on the paper
- The second mark is dependent on gaining the first mark

4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.

6. If a candidate makes more than one attempt at any question:
   - If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
   - If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

7. Ignore wrong working or incorrect statements following a correct answer.

8. In some instances, the mark distributions (e.g. M1, B1 and A1) printed on the candidate's response may differ from the final mark scheme

Question	Scheme	Marks
1. (a)	$b = \dfrac{18.35}{312.1}\left[= 0.058795...\right]$	M1
	$a = 5.8 - "0.058795..." \times 4.8$	M1
	$\underline{a = \textbf{awrt 5.52}}$	A1
	So $\underline{y = \mathbf{5.52 + 0.0588}x}$	A1 (4)
(b)	$\dfrac{e}{10} = "5.52" + "0.0588" \times \left(\dfrac{g-60}{4}\right)$	M1
	$4e = 220.71 + 0.588(g - 60)$	dM1
	$\underline{e = \mathbf{46 + 0.15}g}$	A1A1 (4)
(c)	$e = "46" + "0.15" \times 100$	M1
	$= \underline{\mathbf{61}}$	A1 (2)
		[10]
	Notes	
(a)	1st M1 for a correct expression for b 2nd M1 for a correct expression for a – ft their value of b 1st A1 for a = awrt 5.52 2nd A1 for a correct equation in y and x with a and b correct to awrt 3 sf	
(b)	1st M1 for substitutions into <u>their</u> equation to get an equation in e and g. Need $y = \frac{e}{10}$ and $x = \frac{g-60}{4}$ 2nd dM1 Dep. on 1st M1 for an attempt to simplify (at least removing fractions). Allow one slip 1st A1 for an equation e = awrt 46 $\pm$ ….. 2nd A1 for an equation e = ….+ awrt 0.15g	
ALT	1st M1 for use of $d = \dfrac{10 \times \text{"their } b\text{"}}{4}$ or sight of 0.15 used as gradient 2nd dM1 Dep. on 1st M1 for use of $\overline{e} = 10 \times \text{"their } \overline{y}\text{"}$ or sight of 58 and use of $\overline{g} = 4 \times \text{"their } \overline{x}\text{"} + 60$ or sight of 79.2 and use of these values to find c in $c = \overline{e} - d\overline{g}$	
(c)	M1 for substituting g = 100 into their new equation (or x = 10 and then attempting to $\times$ ans.by 10) A1 for awrt 61	

<table>
<tr><th>Question</th><th>Scheme</th><th>Marks</th></tr>
<tr><td>2. (a)</td><td>
<table>
<tr><td>x</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>$\mathrm{P}(X=x)$</td><td><u>0.4</u></td><td>0.25</td><td>0.35</td></tr>
</table>
$\mathrm{P}(X=2) = \mathrm{F}(2) - \mathrm{F}(1)$ (o.e.)
$\mathrm{P}(X=2) = \mathbf{\underline{0.25}}$
$\mathrm{P}(X=3) = \mathbf{\underline{0.35}}$</td><td>M1
A1
A1 (3)</td></tr>
<tr><td>(b)</td><td>[$\mathrm{F}(1.8) = \mathrm{P}(X \le 1.8) = \mathrm{P}(X \le 1) =$] $\mathbf{\underline{0.4}}$</td><td>B1 (1)
[4]</td></tr>
<tr><td></td><td>Notes</td><td></td></tr>
<tr><td>(a)</td><td colspan="2">M1 for $\mathrm{P}(X=1) = 0.4$ and evidence of a correct method for finding $\mathrm{P}(X=2)$ or $\mathrm{P}(X=3)$.
Implied by correct ans.
1st A1 for $\mathrm{P}(X=2) = 0.25$
2nd A1 for $\mathrm{P}(X=3) = 0.35$</td></tr>
<tr><td>(b)</td><td colspan="2">B1 for 0.4</td></tr>
</table>

Question	Scheme	Marks
3. (a)	Width = 2×1.5 = **3 (cm)**	B1
	Area = $8\times1.5=12$ cm^2 Frequency = 24 so 1 cm^2 = 2 plants (o.e.)	M1
	Frequency of 12 corresponds to area of 6 so height = **2 (cm)**	A1 (3)
(b)	$[Q_2=]\ (5+)\ \frac{19}{24}\times5$ **or** (use of $(n+1)$) $(5+)\frac{19.5}{24}\times5$	M1
	= 8.9583… **awrt 8.96** **or** 9.0625… awrt 9.06	A1 (2)
(c)	$[\bar{x}=]\ \frac{755}{70}$ or **awrt 10.8**	B1
	$[\sigma_x=]\ \sqrt{\frac{12037.5}{70}-\bar{x}^2}\ =\sqrt{55.6326...}$	M1A1ft
	= **awrt 7.46** (Accept s = awrt 7.51)	A1 (4)
(d)	$\bar{x}>Q_2$	B1ft
	So positive skew	dB1 (2)
(e)	$\bar{x}+\sigma\approx18.3$ so number of plants is e.g. $\frac{(25-\text{"18.3"})}{10}\times12\ (+4)$ (o.e.)	M1
	= 12.04 so **12** plants	A1 (2) **[13]**
	Notes	
(a)	M1 for forming a relationship between area and no. of plants or their width$\times$their height = 6 A1 for height of 2 (cm). Make sure the 2 refers to height and not plants!	
(b)	M1 for a suitable fraction $\times5$ (ignore end points) A1 for awrt 8.96 (or $\frac{215}{24}$ or $8\frac{23}{24}$) or 9.06 (or $\frac{145}{16}$ or $9\frac{1}{16}$) if using $(n+1)$	
(c)	B1 for a correct mean. Accept exact fraction or awrt 10.8 M1 for a correct expression for σ or σ^2. Condone mixed up labelling- ft their mean A1ft for a correct expression – ft their mean but must have square root A1 for awrt 7.46 (use of s = awrt 7.51). Condone correct working and answer called variance.	
(d) **ALT**	1st B1ft for a correct comparison of their $\bar{x}$ and their Q_2 Allow use of a formula for skewness that involves $(\bar{x}-Q_2)$ or use of quartiles but must have correct values NB $Q_1=5.31$, $Q_3=14.46$ (awrt 14.5), $Q_3-Q_2\approx5.5$, $Q_2-Q_1\approx3.7/6$ 2nd dB1 Dependent on a suitable reason for concluding "positive skew". "correlation" is B0	
(e)	M1 for a suitable expression involving some interpolation (condone missing 4 so accept awrt 8) Condone use of end points of 25.5 and 14.5 in their interpolation expressions. A1 for 12 (condone awrt 12). Answer only 2/2	

Question	Scheme	Marks
4. (a)	$\left[\mathrm{P}(M<145)=\right]\ \mathrm{P}\left(Z<\frac{145-150}{10}\right)$	M1
	$=\mathrm{P}(Z<-0.5)$ or $\mathrm{P}(Z>0.5)$	A1
	= **awrt <u>0.309</u>**	A1 (3)
(b)	$\left[\mathrm{P}(B>115)=0.15\Rightarrow\right]\ \frac{115-100}{d}=1.0364$ (Calc gives 1.036433...)	M1B1A1
	<u>***d* = 14.5**</u> (Calc gives 14.4727...)	A1 (4)
(c)	$[\mathrm{P}(X>\mu+15 \mid X>\mu-15)=]\ \frac{\mathrm{P}(X>\mu+15)}{\mathrm{P}(X>\mu-15)}$	M1
	$=\frac{0.35}{1-0.35}$	A1
	$=\underline{\frac{7}{13}}$ or **<u>awrt 0.538</u>**	A1 (3)
		[10]
	Notes	
	Condone poor use of notation if a correct line appears later.	
(a)	M1 for standardising with 145, 150 and 10. Allow $\pm$ and use of symmetry so 155 instead of 145 1st A1 for $\mathrm{P}(Z<-0.5)$ or $\mathrm{P}(Z>0.5)$ i.e. a z value of $\pm$ 0.5 and a correct region indicated 2nd A1 for awrt 0.309 Answer only is 3/3	
(b)	M1 for $\pm\frac{115-100}{d}=z$ where $\lvert z\rvert>1$ Condone MR of μ = 150 instead of 100 for M1B1only B1 for a standardised expression = $\pm$ 1.0364 (do not allow for use of 1 – 1.0364) 1st A1 for z = awrt 1.04 and compatible signs i.e. a correct equation with z = awrt 1.04 2nd A1 for awrt 14.5 (allow awrt 14.4 if z = awrt 1.04 is seen)	
Calc	Answer only of awrt 14.473 scores M1B1A1A1 Answer only of awrt 14.48 scores M1B0A1A1	
(c)	M1 for a correct ratio expression need $\mathrm{P}(X>\mu+15)$ on numerator. Allow use of a value for μ May be implied by next line. NB $\frac{0.35\times0.65}{0.65}=\frac{0.2275}{0.65}$ is M0 1st A1 for a correct ratio of probabilities 2nd A1 for awrt 0.538 or $\frac{7}{13}$ (o.e.). Allow 0.5385 provided 2nd A1 is scored.	

Question	Scheme	Marks
5. (a)	$S_{yy} = 393 - \frac{61^2}{10} = \underline{\mathbf{20.9}}$	M1A1
	$S_{xy} = 382 - \frac{61 \times 60}{10} = \underline{\mathbf{16}}$	A1 (3)
(b)	$[r =]\frac{"16"}{\sqrt{"20.9" \times 28}}$	M1
	$= 0.66140\ldots$ **<u>awrt 0.661</u>**	A1 (2)
(c)	Researcher's belief suggests <u>negative</u> correlation, data suggests <u>positive</u> correlation So data does <u>not</u> support researcher's belief	B1 dB1 (2)
(d)	New x equals $\bar{x} = 6$	B1
	Since $S_{xx} = \sum(x - \bar{x})^2$ the value of S_{xx} is the same = 28	dB1 (2)
(e)	$S_{xy} = \sum(x - \bar{x})(y - \bar{y}) = \sum(x - \bar{x})y$ so the new term will be zero (since mean = x) and since S_{yy} increases	B1
	So r will decrease	dB1 (2) **[11]**

	Notes
(a)	M1 for a correct expression for S_{yy} or S_{xy} 1st A1 for $S_{yy} = 20.9$ 2nd A1 for $S_{xy} = 16$
(b)	M1 for a correct expression for r – ft their 20.9 (provided it is > 0) and their 16. Use of 382 for 16 or 393 for 20.9 is M0 A1 for awrt 0.661
(c)	1st B1 for a suitable reason <u>contrasting</u> belief with data. They must state the sign (positive or negative) of the correlation of data or the belief and imply the other is opposite 2nd dB1 Dependent on a correct reason for saying it does <u>not</u> support the claim e.g. State "does not support the belief because data has positive correlation" scores B1B1 BUT State "does support the belief because data has positive correlation" scores B0B0
(d)	1st B1 for clearly stating that new value of x = (6 =) mean 2nd dB1 Dep. on 1st B1 for a reason that shows S_{xx} is unchanged e.g. extra term is 0 so S_{xx} is the same
ALT	1st B1 for seeing $\sum x = 66$ and new $\sum x^2 = 424$ (or 388 + 6^2) and attempt at S_{xx} 2nd B1 for showing S_{xx} = 28 with n = 11 and no incorrect working seen and a final comment
(e)	1st B1 for a clear reason that mentions S_{xy} is the same <u>and</u> the increase in S_{yy} Saying that r increases or stays the same is B0B0 2nd dB1 Dependent on 1st B1 for saying r will decrease.

Question	Scheme	Marks
6. (a)	[P(B) = 0.4, P(A) = p + 0.1 so] $0.4\times(p+0.1)=0.1$ or $0.4\times\text{P}(A)=0.1$	M1
	$p=\dfrac{1}{4}-0.1$ $\underline{\boldsymbol{p}\textbf{ = 0.15}}$	M1A1 (3)
(b)	$\dfrac{5}{11}=\left[\dfrac{\text{P}(B\cap C)}{\text{P}(C)}=\right]\dfrac{0.2}{0.2+q}$ or $\dfrac{5}{11}=\dfrac{0.2}{\text{P}(C)}$	M1
	$11\times0.2=5\times(0.2+q)$	dM1
	$\underline{\boldsymbol{q}\textbf{ = 0.24}}$	A1
	r = 0.6 – (p + q) i.e. $\underline{\boldsymbol{r}\textbf{ = 0.21}}$	A1ft (4)
(c)	$\left[\dfrac{\text{P}((A\cup C)\cap B)}{\text{P}(B)}\right]=\dfrac{0.3}{0.4}$	M1
	= **<u>0.75</u>**	A1 (2)
		[9]

	Notes
(a)	1st M1 for using independence in an attempt to form an equation in p or P(A) 2nd M1 for a correct attempt to solve their linear equation leading to p = … A1 for 0.15 or exact equivalent
(b)	1st M1 for a clear attempt to use P(B|C) to form an equation for q or P(C). Assuming indep M0 2nd dM1 Dep. on 1st M1 for correctly simplifying to a linear equation in q or P(C) e.g. accept $11\times0.2=5\times0.2+q$ or 5P(C) = 2.2 1st A1 for q = 0.24 or exact equivalent 2nd A1ft for 0.6 – their (p + q) Dependent on 1st M1 in (b) only.
(c)	M1 for a correct ratio expression and one correct value (num < denom) <u>or</u> a fully correct ratio. Allow $\dfrac{\text{P}(A\cup C\cap B)}{\text{P}(B)}$ with one probability correct but only if num < denom. A numerator of $\text{P}(A\cup C)\times\text{P}(B)$ scores M0 A1 for 0.75 or an exact equivalent

Question	Scheme	Marks
7. (a)	E(S) = $0+1\times0.2+2\times0.1+4\times0.3+5\times0.2$ = [0.2 + 0.2 + 1.2 + 1.0]	M1
	<u>2.6</u>	A1 (2)
(b)	$E(S^2)=0+1\times0.2+2^2\times0.1+4^2\times0.3+5^2\times0.2$ <u>or</u> 0.2 + 0.4 + 4.8 + 5	M1
	<u>10.4</u> (*)	A1cso (2)
(c)	Var(S) = $10.4-(\text{"}2.6\text{"})^2$	M1
	<u>3.64</u> or $\frac{91}{25}$ (o.e.)	A1 (2)
(d)(i)	5E(S) – 3 = 5×"2.6" – 3 , = **<u>10</u>**	M1, A1
(ii)	$5^2\,\text{Var}(S)=25\times3.64$, = **<u>91</u>**	M1, A1 (4)
(e)	$5S-3>S+3 \Rightarrow 4S>6$ or $S>1.5$, so need P($S\geq2$)	M1, A1
	P($S\geq2$) = **<u>0.6</u>**	A1 (3)
(f)	$\text{P}(S_1=1)\times\text{P}(S_2\leq4),=0.2\times0.8=0.16$ **(*)**	M1,A1cso(2)
(g)	$\text{P}(S_1=2)\times\text{P}(S_2\leq2)=0.1\times0.5 \quad =0.05$	
	$\text{P}(S_1=4)\times\text{P}(S_2\leq1)=0.3\times0.4 \quad =0.12$ Full method – all cases listed	M1
	$\text{P}(S_1=5)\times\text{P}(S_2=0)=0.2\times0.2 \quad =0.04$	
	$\text{P}(S_1=0)\times\text{P}(S_2=\text{any value})=0.2\times1=0.20$ all correct products	A1
	= **<u>0.57</u>**	A1 (3) **[18]**
	Notes	
(a)	M1 for an attempt at $\sum x\text{P}(X=x)$, at least 2 non-zero terms seen. Correct answer 2/2 A1 for 2.6 or any exact equivalent	
(b)	M1 for a correct attempt, at least 3 non-zero terms seen A1cso for 10.4 provided M1 is scored and no incorrect working seen	
(c)	M1 for $10.4-\mu^2$, ft their μ. Must see their value of μ squared (A1 for 3.64 or any exact equiv.)	
(d)(i) **(ii)**	M1 for a correct expression using their 2.6 (A1 for 10) M1 for 25×Var(S)- ft their Var(S) (A1 for 91)	
(e)	M1 for solving the inequality as far as $pS>q$ where one of p or q are correct 1st A1 for P($S\geq2$) 2nd A1 for 0.6 (provided $S>1.5$ was obtained). Ans only of 0.6 scores 3/3	
(f)	**A table showing all 25 cases can only score M1 in (*g*) if the correct cases are indicated.** M1 for using independence (so multiplying) and attempting P($S_2\leq4$) e.g. $0.2\times(0.2+0.2+0.1+0.3)$ or 0.04+0.04+0.02+0.06 score M1 BUT $\frac{4}{25}$ (not from 0.2×0.8) is M0A0 A1cso for a fully correct explanation leading to 0.16. Must come from 0.2×0.8 not $\frac{4}{25}$	
(g)	M1 for all cases for S_1 or all 15 cases for X 1st A1 for all correct probability products for S_1 or X 2nd A1 for 0.57 Correct answer scores 3/3. Probabilities out of 25 score A0A0	

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Mark Scheme (Results)

Summer 2013

GCE Statistics 1 (6683/01)

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

EDEXCEL GCE MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

- **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
- **A** marks: accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- **B** marks are unconditional accuracy marks (independent of M marks)
- Marks should not be subdivided.

3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes:

- bod – benefit of doubt
- ft – follow through
- the symbol $\sqrt{}$ will be used for correct ft
- cao – correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC: special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- dp decimal places
- sf significant figures
- * The answer is printed on the paper
- The second mark is dependent on gaining the first mark

4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

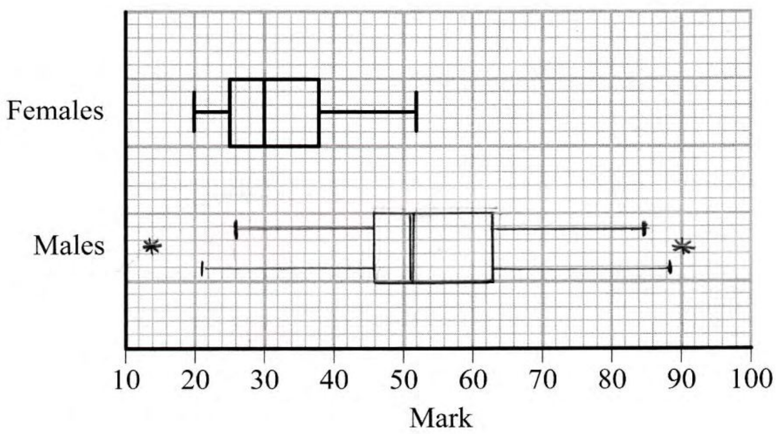
5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.

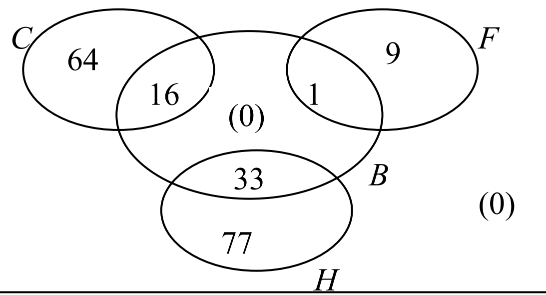
6. If a candidate makes more than one attempt at any question:
   - If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
   - If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

7. Ignore wrong working or incorrect statements following a correct answer.

8. In some instances, the mark distributions (e.g. M1, B1 and A1) printed on the candidate's response may differ from the final mark scheme.

Question	Scheme	Marks
1. (a)	$\left(S_{th}\right) = 64980 - \dfrac{7150 \times 110}{9} = -22408.9\ldots$ $\quad -\underline{\mathbf{22\ 400}}$	M1 A1
	$\left(S_{hh}\right) = 7171500 - \dfrac{7150^2}{9} = 1491222.2\ldots$ $\quad \underline{\mathbf{1\ 490\ 000}}$	A1
		(3)
(b)	$r = \dfrac{-22408.9}{\sqrt{1491222 \times 371.56}} = -0.95200068\ldots$ $\quad$ awrt $-\underline{\mathbf{0.952}}$	M1A1
		(2)
(c)	Yes as r is close to -1 (if $-1 < r < -0.5$) <u>or</u> Yes as r is close to 1 (if $1 > r > 0.5$) [If $-0.5 \le r \le 0.5$ allow "no since r is close to 0"] [If $\lvert r\rvert > 1$ award B0]	B1ft **(1)**
(d)	$b = \dfrac{-22408.9}{1491222.2} = -0.015027...$ $\quad \left(\text{allow } \frac{-56}{3725}\right)$ $\quad$ awrt -0.015	M1 A1
	$a = \dfrac{110}{9} - \text{"their } b\text{"} \times \dfrac{7150}{9} = (12.2 - -0.015 \times 794.4), = 24.1604...$ so $\boldsymbol{t = 24.2 - 0.015h}$	M1, A1
		(4)
(e)	0.015 is the <u>drop</u> in temp, (in ^{0}C), for every 1(m) <u>increase</u> in height above sea level.	B1
		(1)
(f)	Change = ("24.2 – 0.015"$\times$500) – ("24.2 – 0.015"$\times$1000) <u>or</u> 500 $\times$"0.015" $= \pm 7.5$ $\quad$ (awrt $\underline{+}$ 7.5) $\quad$ (only ft a value < 100)	M1 A1ft **(2)** **(13 marks)**
	Notes	
(a)	M1 for at least one correct expression (condone transcription error) 1st A1 for S_{hh} = awrt 1 490 000 or S_{th} = awrt $-22\ 400$ (Condone S_{xx} or S_{xy} =… or even S_{yy} =...) 2nd A1 for S_{th} = $-22\ 400$ <u>and</u> S_{hh} = 1 490 000 only. [This mark is assessing correct rounding] (Allow no labels but mis-labelling S_{th} as S_{hh} etc loses the final A1)	
(b)	M1 for attempt at correct formula. Allow minor transcription errors of 2 or 3 digits. Must have their S_{hh}, S_{th} and given S_{tt} (3sf or better) in the correct places. Condone missing "$-$" Award M1A0 for awrt -0.95 with no expression seen. M0 for $\dfrac{64980}{\sqrt{7171500 \times 7.864}}$	
(c)	B1ft must comment on supporting **and** state: <u>high/strong/clear</u> (negative or positive) <u>correlation</u> "points lie close to a straight line" is B0 since there is no evidence of this.	
(d)	1st M1 for a correct expression for b. Follow through their S_{hh} & S_{th}. Condone missing "$-$" 1st A1 for awrt -0.015 or allow exact fraction from rounded values. 2nd M1 for a correct method for a. Follow through their value of b 2nd A1 for a correct equation for t and h with a = awrt 24.2 and b = awrt -0.015 No fractions	
(e)	B1 Must mention h (or height) and t (or temperature) and their (1 sf) <u>value</u> of b in a correct comment	
(f)	M1 for a correct expression seen based on their equation. Allow transcription error of 1 digit. If answer is 500$\times$ their b to 2sf and < 100 (M1A1), If answer is 500$\times$ their b to 2sf and $\underline{>}$100 (M1A0)	

Question	Scheme	Marks
2. (a)	25 (allow any x where $24 < x < 26$)	B1 **(1)**
(b)	**Q2** (or median or m) = **51** **IQR** = 63 – 46 ,= **17** (or $Q_3 - Q_1 = 17$)	B1 M1, A1 **(3)**
(c)	Outliers given by 46 – 1.5 × 17 = 20.5 <u>or</u> 63 + 1.5 × 17 = 88.5 Outliers limits are **20.5** <u>and</u> **88.5**  Allow lower whisker to 20.5 and upper whisker to 88.5 Do **not** allow a mix of whiskers e.g 20.5 and 85 Do **not** allow both sets of whiskers	M1 A1 M1 A1ft B1 **(5)**
(d)	**Medians:** Median for females lower than males **IQR:** IQR for females smaller than males. Allow “lower/higher” but not “wider” **Range:** Range of females is less than males **Skewness:** Male and female marks are both positively skew Ignore other statements about average, spread, mean, st. Dev, variation, outliers etc	B1ft B1ft **(2)** **(11 marks)**
	Notes	
	Mark (b) and (c) together BUT must see clear statement that median (or m or Q_2) = 51 and IQR = 17	
(b)	M1 for 2 quartiles (at least one correct) and attempt to find the difference. Must see their 63 – their 46 A1 for 17 only. [Answer only of IQR= 17 scores M1A1]	
(c)	**A fully correct box-plot (either version) with no supporting work scores 5/5. Otherwise:** 1st M1 for correct attempt to calc’ at least one limit for outliers, ft their quartiles or IQR <u>or</u> award for sight of 20.5 or 88.5 1st A1 for identifying both limits of 20.5 and 88.5 2nd M1 for a box with an upper and a lower whisker(s) with at least 2 correct values (or correct ft) (condone no median marked) (condone 2 upper or 2 lower whiskers) 2nd A1ft for their 20.5 or 26 ,46, 51, 63 and 85 or their 88.5 in appropriate places and readable off their scale. Follow through their 20.5 and their 88.5 only, other values need to be correct If there are 2 upper or 2 lower whiskers A0 B1 for only 2 outliers appropriately marked at 14 and 90 Do not award if whiskers go beyond these values. **Apply ± 0.5 square accuracy for diagram** A box plot <u>not</u> on the graph paper can only score the 1st M1A1 **In (d) ft from their diagrams (if no diagram then use their values)**	
(d)	1st B1ft for one correct comment comparing median, IQR , range or skewness 2nd B1ft for a second correct comment comparing median, IQR, range or skewness Do not allow contradictory statements	

Question	Scheme	Marks
3. (a)	$\dfrac{35+75}{200}=0.55$	M1 A1 **(2)**
(b)	$\dfrac{200-2}{200}=0.99$	M1 A1 **(2)**
(c)	$\left[\mathrm{P}(W\mid C)\right]=\dfrac{\mathrm{P}(W\cap C)}{\mathrm{P}(C)}=\dfrac{30/200}{80/200}=\dfrac{30}{80}=0.375$	M1 A1 **(2)**
(d)	 Allow diagrams with intersections between *F, C* and *H* provided these are marked with 0. If their diagram indicates extra empty regions do not treat a blank as 0.	M1 B1 for 9, 1 B1 for 77,33 B1 for 64,16 **(4)**
(e)	$\dfrac{1+16+33}{200}=0.25$	M1 A1 **(2)** **(12 marks)**
	Notes	
	Correct answers only score full marks for each part **If a probability is not in [0, 1] award M0**	
(a)	M1 for denominator of 200 and attempt to add 2 + 8 or 35 + 75 or 30 + 50 A1 for 0.55 or exact equivalent fraction e.g. $\frac{11}{20}$	
(b)	M1 for a fully correct expression (e.g. $1-0.01$) A1 for 0.99 or an exact equivalent fraction	
(c)	M1 for a correct ratio or a correct formula and at least one correct prob (i.e. a correct num or denom). BUT award M0 if num is $\mathrm{P}(W)\times\mathrm{P}(C)=\frac{67}{200}\times\frac{80}{200}$ or if num>denom A1 for 0.375 or 3/8 or any exact equivalent.	
(d)	M1 for a box and the 3 regions *F, C* and *H* labelled or <u>implied</u> and single set *B* labelled. There should be no intersections between *F, C* and *H* unless marked by zeros. They may have 3 circles for *F, C* and *B* with $H=F'\cap C'$ etc. Condone lack of zero in the <u>given</u> diagram.	
F	1st B1 for the 9 and 1 <u>or</u> 0.045 and 0.005 (o.e.) in the correct regions	
H	2nd B1 for the 77 and 33 <u>or</u> 0.385 and 0.165 (o.e.) in the correct regions	
C	3rd B1 for the 64 and 16 <u>or</u> 0.32 and 0.08 (o.e.) in the correct regions. May have *B* in 3 bits that are disconnected.	
(e)	M1 for a numerator made up of their 1 + their 16 + their 33 and a denom of 200 and num < 200 Also allow sum of their probabilities (provided sum < 1) A1 for 0.25 or any exact equivalent	

Question	Scheme	Marks
4. (a)	$\sum \text{f}t = 4837.5$ (allow 4838 or 4840)	B1
	Mean $= \dfrac{\text{"4837.5"}}{200} = 24.1875$ awrt **<u>24.2</u>** or $\dfrac{387}{16}$	M1 A1
	$\sigma = \sqrt{\dfrac{134281.25}{200} - \left(\dfrac{4837.5}{200}\right)^2}$	M1
	$= 9.293$ …….. (accept s =9.32) awrt **<u>9.29</u>**	A1 **(5)**
(b)	$\text{Q}_2 = [20.5] + \dfrac{(100/100.5 - 62)}{88} \times 5 = 22.659...$ awrt **<u>22.7</u>**	M1 A1 **(2)**
(c)	$\text{Q}_1 = 10.5 + \dfrac{(50/50.25)}{62} \times 10 [= 18.56]$ (*) (n + 1 gives 18.604…)	B1 cso **(1)**
(d)	Q_3= 25.5 (Use of n + 1 gives 25.734…)	B1
	IQR = 6.9 (Use of n + 1 gives 7.1)	B1 ft **(2)**
(e)	The data is skewed (condone "negative skew")	B1 **(1)**
(f)	Mean decreases and st. dev. remains the same. [Must mention mean and st. dev.] (from(a))	B1
	The median and quartiles would decrease. [Must refer to median <u>and</u> at least Q_1.] ((b)(c))	B1
	The IQR would remain unchanged (from (d))	B1 **(3)**
		(14 marks)
	Notes	
	Correct answers only score full marks in each part except (c)	
(a)	B1 for 4837.5 or 4838 or 4840 seen. If no $\sum \text{f}t$ seen (or attempt at $\sum \text{f}t$ seen), B1 can be implied by a correct mean of awrt 24.2 1st M1 for attempt at their $\frac{\sum \text{f}t}{\sum \text{f}}$ allow 1sf so $\sum \text{f}$ = awrt 200 and $\sum \text{f}t$ = awrt 5000. <u>Or</u> award M1 for a clear attempt at mean where at least 4 correct products of $\sum \text{f}t$ are seen 2nd M1 for correct expression including square root seen. Follow through their mean. Allow a transcription error in 134281.25 but not an incorrect re-calculation.	
(b)	M1 for a correct fraction $\times 5$. Ignore end point but must be +. Allow use of (n + 1) giving 100.5…	
(c)	B1cso for a fully correct expression including end point. NB Answer is given. Allow use of (n + 1) giving 50.25…but use of 50.5 scores B0	
(d)	1st B1 for 25.5 (or awrt 25.7 using n + 1) 2nd B1ft for their $Q_3 -$ their Q_1 (or 18.6) (provided > 0) Accept awrt 2sf . Correct ans. only scores 2/2	
(e)	B1 Must mention that the data is skewed or not symmetrical. Do not award for "outliers"	
(f)	1st B1 for one correct comment from the above. May refer to parts (a), (b), (c) or (d) 2nd B1 for two correct comments from the above 3rd B1 for all 3 correct comments from the above	

Question	Scheme	Marks
5. (a)	$3a + 2b = 0.7$	M1
	$a + 2a + 3a + 4b + 5b + 1.8 = 4.2$ or $6a + 9b = 2.4$	M1
	$5b = 1$ Attempt to solve	M1
	$b = \underline{\mathbf{0.2}}$ cao	B1
	$a = \underline{\mathbf{0.1}}$ cao	B1
		(5)
(b)	$\text{E}(X^2) = 1\times0.1 + 2^2\times0.1 + 3^2\times0.1 + 4^2\times0.2 + 5^2\times0.2 + 6^2\times0.3$ (= 20.4) (*)	B1cso
		(1)
(c)	[Var (X) =] $20.4 - 4.2^2$ [= 2.76]	M1
	Var$(5 - 3X)$ = 9 Var (X)	M1
	= $\underline{\mathbf{24.84}}$ or $\underline{\mathbf{24.8}}$ (allow $\frac{621}{25}$) cao	A1
		(3)
(d)	[$5k = 1$ so] $k = \underline{\mathbf{0.2}}$	B1
		(1)
(e)	P(Y = 1) = 0.1	B1
	e.g. P(Y = 2) = F(2) – F(1) = 0.1	M1
	y: 1, 2, 3, 4, 5; P($Y = y$): 0.1, 0.1, 0.4, 0.2, 0.2 — Condone use of $X(x)$ instead of $Y(y)$. Ignore incorrect or no label if table fully correct	A1
		(3)
(f)	P(X = 1)× P(Y = 1) ,= $\underline{\mathbf{0.01}}$ cao	M1, A1 **(2)**
		(15 marks)

y	1	2	3	4	5
P($Y = y$)	0.1	0.1	0.4	0.2	0.2

	Notes
	Probabilities outside [0, 1] should be awarded M0
(a)	1st M1 for an attempt at a linear equation in a and b based on sum of probs. = 1
	2nd M1 for an attempt at a second linear equation in a and b based on E(X) = 4.2 Allow one slip.
	3rd M1 for an attempt to solve their 2 linear equations based on sum of probs and E(X) . Must reduce to a linear equation in one variable. 1st B1 for b and 2nd B1 for a. Answers only score B1B1 only
	The 3rd M1 may be implied if M2 is scored and both correct answers are given.
ALT	B1B1 for stating b and a.
	1st M1 for showing that sum of probs. = 1
	2nd M1 for showing that E(X) = 4.2
	3rd M1 for an overall comment "(therefore) a = …and b = …" No comment loses this mark.
(b)	B1cso for a fully correct expression (no incorrect work seen). E.g. allow $14\times0.1 + 41\times0.2 + 36\times0.3$ Or $0.1 + 0.4 + 0.9 + 3.2 + 5 + 10.8$. Allow in a table (with 20.4) but without "+" explicitly seen.
(c)	1st M1 for a correct expression for Var(X). Must see -4.2^2
	2nd M1 for $(-3)^2$ Var(X) or better, no need for a value. Accept -3^2 if it clearly is used as +9 later.
(e)	B1 for P(Y = 1) = 0.1
	M1 for correct use of F(y) to find one other prob. Can ft their k if finding P($Y = y$) for y >2
	Can be implied by one other prob. correct or correct ft Look out for P(3) = $3k$ – 0.2 or P(4) = P(5) = k.
	A1 for a fully correct probability distribution. Correct table only is 3/3
(f)	M1 for a correct expression or answer ft their P(Y = 1) and their P(X = 1)
	A1 for 0.01 or exact equivalent only
	Don't ISW here e.g. $0.1\times0.1 + 0.1\times0.1$ or $2\times0.1\times0.1$ are M0A0

Question	Scheme	Marks
6. (a)	[Let X be the amount of beans in a tin. $\mathrm{P}(X < 200) = 0.1$]	
	$\dfrac{200-\mu}{7.8} = -1.2816$ [calc gives 1.28155156…]	M1 B1
	$\mu = 209.996….$ awrt 210	A1
		(3)
(b)	$\mathrm{P}(X > 225) = \mathrm{P}\left(Z > \dfrac{225-"210"}{7.8}\right)$	M1
	$= \mathrm{P}(Z > 1.92)$ <u>or</u> $1 - \mathrm{P}(Z < 1.92)$ (allow 1.93)	A1
	$= 1 - 0.9726$ $= 0.0274$ (or better) [calc gives 0.0272037…]	
	$= 0.0274$	
	= awrt <u>**2.7%**</u> allow <u>**0.027**</u>	A1
		(3)
(c)	[Let Y be the new amount of beans in a tin]	
	$\dfrac{210-205}{\sigma} = 2.3263$ <u>or</u> $\dfrac{200-205}{\sigma} = -2.3263$ [calc gives 2.3263478…]	M1 B1
	$\sigma = \dfrac{5}{2.3263}$	dM1
	$\sigma = 2.15$ (2.14933…)	A1
		(4)
		(10 marks)
	Notes	
	Condone poor handling of notation if answers are correct but A marks must have correct working.	
(a)	M1 for an attempt to standardise (allow $\pm$) with 200 and 7.8 and set = $\pm$ any z value ($\lvert z\rvert > 1$) B1 for $z = \pm$ 1.2816 (or better used as a z)[May be implied by 209.996(102…) or better seen] A1 for awrt 210 (can be scored for using 1.28 but then they get M1B0A1) The 210 must follow from correct working − sign scores A0 If answer is awrt 210 **and** 209.996… or better seen then award M1B1A1 z = 1.28 gives 209.984 and z = 1.282 gives 209.9996 and both score M1B0A1 If answer is awrt 210 or awrt 209.996 then award M1B0A1 (unless of course z = 1.2816 is seen)	
(b)	M1 for attempting to standardise with 225, their mean and 7.8 . Allow $\pm$ 1st A1 for $Z >$ awrt 1.92/3. Allow a diagram but must have 1.92/3 and correct area indicated. Must have the Z so $\mathrm{P}(X > 225)$ with or without a diagram is not sufficient. Award for 1 – 0.9726 or 1 – 0.9732 2nd A1 for 2.7 % or better (calculator gives 2.72…) Allow awrt 0.027. Correct ans scores 3/3	
(c)	1st M1 for an attempt to standardise with 200 or 210, 205 and σ and set = $\pm$ any z value ($\lvert z\rvert > 2$) B1 for $z = 2.3263$ (or better) **and** compatible signs. If B0 in (a) for using a value in [1.28, 1.29) but not using 1.2816: allow awrt 2.33 here 2nd dM1 **Dependent on the first M1** for correctly rearranging to make $\sigma = ...$ May be implied e.g. $\frac{5}{\sigma} = 2.32 \rightarrow \sigma = 2.16$ (M1A0) BUT must have $\sigma > 0$ A1 for awrt 2.15 . Must follow from correct working but a range of possible z values will do. NB $2.320 < z \leq 2.331$ will give an answer of awrt 2.15	

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