

# **Mark Scheme for June 2011**

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All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

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Note: "(3 sfs)" means "answer which rounds to ... to 3 sfs". If correct ans seen to  $\geq 3$ sfs, ISW for later rounding  
 Penalise over-rounding only once in paper.

lia	$\frac{3247 - \frac{251 \times 65}{5}}{\sqrt{(14323 - \frac{251^2}{5})(855 - \frac{65^2}{5})}}$ or $\frac{-16}{\sqrt{1722.8 \times 10}}$ $= -0.1219...$	M2	M1 for correct subst in any correct <i>S</i> formula M2 for correct subst'n in any correct <i>r</i> formula	or $\frac{-80}{\sqrt{8614 \times 50}}$ Allow -0.1218
b	Poor/no/little/weak/not strong corr'n or rel'nship or link between income & distance oe	A1 3  B1 1	Must see at least 4 sfs  or slight neg/weak corr'n (oe) between income & distance  In context, ie <u>any</u> comment on income & distance, even if incorrect	eg, Poor neg corr'n, so higher distance, lower income No rel'nship. Low income doesn't cause low distance  NOT "Not proportional ..." NOT "negative corr'n ..."  No recovery of this mark in (ii)
c	No effect or -0.122 oe	B1 1	eg "Nothing" or "None" oe	Ignore other NOT "Little effect" NOT "Not much effect"
ii	<i>r</i> close to 0, or small, or poor corr'n oe or <i>r</i> = -0.122  Unreliable	B1  B1dep 2	or Weak/no corr'n or poor rel'nship oe or No evidence to link sales & distance  Condone "innacurate" or "incorrect" or "less reliable" or "not that reliable" "The data is unreliable"  Must have correct reason	or because small sample Ignore other  Allow: "Unreliable because pts do not fit a st line" "Unreliable because pts are scattered" "Unreliable because not strong neg ...." "Unreliable because <i>r</i> not close to -1" "Unreliable because <i>r</i> smaller than (-)0.7"  NOT "Unreliable because extrapolated": B0B0 but "Unreliable because extrapolated and poor corr'n": B1B1
<b>Total</b>		<b>7</b>		

2	<p>Attempt ranks  4 1 2 3 or 1 2 3 4 or 1 2 3 4 oe  2 1 3 4      1 3 4 2      1 4 2 3</p> <p><math>\Sigma d^2</math> attempted (or 6)  <math>1 - \frac{6\Sigma d^2}{4(4^2-1)}</math>  <math>= \frac{2}{5}</math> oe</p>	<p>M1  A1  M1  M1  A1 5</p>	<p>Ignore labels of rows or columns</p> <p>No ranks seen, <math>d = (0), \pm 1, \pm 1, \pm 2</math>, or  <math>d^2 = (0), 1, 1, 4</math> any order: M1A1</p> <p>NOT <math>(\Sigma d)^2</math></p>	<p>No wking, <math>\Sigma d^2 = 6</math>: M1A1M1  No wking, <math>\Sigma d^2 = \text{eg } 14</math>: M0A0M0, but can gain 3<sup>rd</sup> M1</p> <p>No wking, ans <math>\frac{2}{5}</math>: Full mks  Allow both sets of ranks reversed</p> <p>NB incorrect method:  2 3 4 1  2 1 3 4 OR <math>d = (0), \pm 2, \pm 1, \pm 3</math> any order  OR <math>d^2 = (0), 4, 1, 9</math> any order  (leading to <math>\Sigma d^2 = 14</math> and <math>r_s = -\frac{2}{5}</math>):  M0A0M1M1A0</p>
<b>Total</b>		<b>5</b>		
3ia	<p><math>(1 - 0.5565)</math> or <math>12 \times 0.85^{11} \times (1 - 0.85) + 0.85^{12}</math>  <math>= 0.4435</math> or <math>0.443</math> or <math>0.444</math> (3 sf)</p>	<p>M1  A1 2</p>	<p>or <math>1 - ((1-0.85)^{12} \dots^{12} C_{10} \times 0.85^{10} (1-0.85)^2)</math>  ie 1 - (all 11 correct binomial terms)</p>	<p>or <math>1 - 0.557</math>  NB <math>1 - 0.4435</math> (oe): M0A0</p>
b	<p><math>0.5565 - 0.2642</math> or <math>^{12}C_{10}(1 - 0.85)^2(0.85)^{10}</math>  <math>= 0.2923</math> or <math>0.2924</math> or <math>0.292</math> (3 sf)</p>	<p>M1  A1 2</p>		<p>or <math>0.557 - 0.264</math></p>
c	<p><math>12 \times 0.85 \times (1 - 0.85)</math>  <math>= 1.53</math> oe</p>	<p>M1  A1 2</p>		
ii	<p><math>(\frac{3}{4})^2</math> AND <math>\frac{3}{4} \times \frac{1}{4}</math> seen (possibly <math>\times 2</math>)</p> <p><math>(\frac{3}{4})^2 \times 2 \times \frac{3}{4} \times \frac{1}{4}</math> oe or <math>\frac{27}{128}</math> or <math>0.211</math>  <math>2 \times (\frac{3}{4})^2 \times 2 \times \frac{3}{4} \times \frac{1}{4}</math> oe  <math>= \frac{27}{64}</math> or <math>0.422</math> (3 sfs)</p>	<p>M1  M1  M1  A1 4</p>	<p>eg <math>(\frac{3}{4})^2 + \frac{3}{4} \times \frac{1}{4}</math> or <math>2 \times (\frac{3}{4})^2 + 2 \times \frac{3}{4} \times \frac{1}{4}</math>  or <math>0.5625 + 0.1875</math> or <math>0.5625 + 0.375</math></p> <p>or eg <math>0.5625 \times 0.375</math></p> <p>Fully correct method</p>	<p>or <math>\frac{9}{16}</math> and <math>\frac{3}{16}</math> or <math>\frac{9}{16}</math> and <math>\frac{3}{8}</math> eg in table or list</p> <p>Allow even if further incorrect wking</p> <p>Ans 0.211: check wking but probably gets  M1M1M0A0</p> <p>Use of 0.85 instead of <math>\frac{1}{4}</math>: MR max M1M1M1A0</p>
<b>Total</b>		<b>10</b>		

4i	Method is either: Just $4 \div 3$ or $\frac{4}{3}$ or: Use of ratio of correct frequencies AND ratio of widths (correct or 4 and 2)			
4i	$5.6 \times \frac{4}{28} \times \frac{5}{3}$ or $0.8 \times \frac{5}{3}$ or $(5.6 \div \frac{28}{5}) \times \frac{4}{3}$ or $\frac{4}{3}$ or $4 \div 3$ oe  $= 1 \frac{1}{3}$ or $\frac{4}{3}$ or 1.33 (3 sf) oe	M2  A1 3	M1 for $5.6 \times \frac{4}{28} \times \frac{4}{2}$ or $0.8 \times \frac{4}{2}$ or $(5.6 \div \frac{28}{4}) \times \frac{4}{2}$ or $0.8 \times 2$ oe (= 1.6)  No wking, ans 1.3: M2A0  Ans 1.6: Check wking but probably M1M0A0	Correct calc'n using 5.6, 28, 4, 5, 3 oe: M2 Correct calc'n using 5.6, 28, 4, 4, 2 oe: M1  ie fully correct method: M2 or: incorrect class widths, otherwise correct method: M1  $\frac{4}{3}$ correctly obtained (or no wking) then further incorrect: M1M0A0  Use of ratio of widths OR freqs but not both: M0 eg $5.6 \times \frac{4}{28}$ (= 0.8) or $5.6 \times \frac{3}{5}$ (= 3.36): M0  $\frac{4}{2} = 2$ : M0M0A0
ii	25 or 26 or 25.5  Med is 21 <sup>st</sup> (or 22 <sup>nd</sup> or 21.5 <sup>th</sup> ) in 31-35 class or "25 - 4" Can be implied by calc'n  Med > 33 or "more than"	B1  B1  B1 3	or 25 & 26  or med in last $\approx 7$ in class or $33 \approx 14^{\text{th}}$ in class or $33 \approx 18^{\text{th}}$ in whole set Can be implied by diagram  indep	May be implied, eg by 21 or 22 or 21.5  Calc'ns need not be correct but need to contain relevant figures for gaining B1B1  The " $\approx$ " sign means $\pm 2$  <u>Alternative Method:</u> $33 \approx 18^{\text{th}}$ value B1 More values above 33 than below oe B1 Med > 33 B1  Ignore comment on skew  NB Use EITHER the main method OR the <u>Alternative Method</u> (above), not a mixture of the two. Choose the method that gives most marks.

iii	$\geq 3$ mid-pts attempted $\Sigma fx \div 50$ attempted $(= \frac{1819}{50})$ $= 36.38$ or $36.4$ (3 sf)  $\Sigma fx^2$ attempted $(= 68055.5)$  $\sqrt{\frac{68055.5}{50} - (\frac{1819}{50})^2}$ or $\sqrt{1361.11 - 36.38^2}$ $(= \sqrt{37.6056})$  $= 6.13$ (3 sfs)  Alt for variance: $\Sigma f(x - \bar{x})^2 (= 1880.28)$ M1 $\sqrt{\frac{1880.28}{50}}$ M1 $= 6.13$ (3 sf) A1	M1 M1 A1  M1  M1  A1 6	seen or implied  $\geq 3$ terms. or 36 with correct working  $\geq 3$ terms.  completely correct method except midpts & ft their mean, dep not $\sqrt{(\text{neg})}$	Not nec'y correct values (29, 33, 40.5, 53)  Allow on boundaries. Not class widths  Allow on boundaries. Not class widths (3364, 30492, 22963.5, 11236)  Allow class widths for this mark only NB mark is not just for “– mean <sup>2</sup> ”, unlike q5(iii)  $\Sigma(fx)^2$ : M0M0A0  If no wking for $\Sigma fx^2$ , check using their $x$ and $f$  If no wking or unclear wking: full mks for each correct ans for incorrect ans: $35.8 \leq \mu \leq 36.9$ M0M1A0 $6.0 \leq \text{sd} \leq 6.25$ M1M0A0
iv	(a) Decrease (b) Increase (c) Same (d) Same	B1B1 B1B1 4	Ignore other, eg “slightly” or “probably”	Ignore any comments or reasons, even if incorrect
<b>Total</b>		<b>16</b>		
5	If done with replacement, no marks in any part of this question.			
5i	All correct probs correctly placed, matching labels, if any	B2 2	B1 for 4 correct probs anywhere	Allow B2 with missing labels but only if probs consistently placed, ie R above B throughout
ii	$\frac{4}{10} \times \frac{6}{9} + \frac{6}{10} \times \frac{4}{9} \times \frac{5}{8} + \frac{6}{10} \times \frac{5}{9} \times \frac{4}{8}$ or $\frac{4}{15} + \frac{1}{6} + \frac{1}{6}$  $(= \frac{3}{5}$ <b>AG</b> )	B2 2	B1: two of these products (or their results) added (not multiplied)  or $1 - (\frac{6}{10} \times \frac{5}{9} \times \frac{4}{8} + \frac{6}{10} \times \frac{4}{9} \times \frac{3}{8} + \frac{4}{10} \times \frac{3}{9})$  or $1 - (\frac{1}{6} + \frac{1}{10} + \frac{2}{15})$	B1: 1 – two of these products (or results) added (not multiplied)  NB incorrect methods can lead to correct ans <b>AG</b> so no wking no mks  No ft from tree in (i)

iii	$\Sigma xp$ attempted $= \frac{16}{15}$ oe or 1.07 (3 sfs)	M1 A1	Both non-zero terms $\div 3$ etc or $\frac{1}{\Sigma xp}$ : M0	
	$\Sigma x^2 p$ attempted (= $\frac{23}{15}$ or 1.53) $- \frac{16^2}{15}$	M1 M1	Both non-zero terms $\div 3$ etc: or $\frac{1}{\Sigma x^2 p}$ : M0 indep but dep +ve result	Not $\Sigma xp^2$ NB easier to gain than equiv mark in qu 4(iii)
	$= \frac{89}{225}$ oe or 0.395 or 0.396 (3 sfs)	A1 5	Ans 0.388: check wking but probably comes from $\mu = 1.07$ ; premature rounding: M1M1A0	not 0.395, but check for dot over 5 for recurring
	Alt for Var(X): $\Sigma(x-\bar{x})^2 p$	M2	$\frac{1}{6} \times \frac{16^2}{15} + \frac{3}{5} \times \frac{1^2}{15} + \frac{7}{30} \times \frac{14^2}{15}$ all correct M2, 2 terms correct M1	
<b>Total</b>		<b>9</b>		
6ia	5040	B1 1		
b	$6!$ or $5! \times 6$ or 720 $\div 7!$ or $\div$ "5040" or 1440 or $(5! \text{ or } 6!) \times 2$ $= \frac{2}{7}$ oe or 0.286 (3 sf)	M1 M1 A1 3	$\frac{1}{7} \times \frac{1}{6}$ M1* Any $\div 7!$ or "5040" $\times 6$ or $\times 2$ M1 dep* but NOT any $\times 2$	NOT $6!$ in denom eg $\frac{6!}{5040}$ or $\frac{1}{7}$ or 0.143 or $\frac{1}{21}$ (3 sfs): M1M1A0
iiia	$3! \times 4!$ alone or 144 ( $\div 7!$ or "5040") $= \frac{1}{35}$ oe or 0.0286 (3sf)	M1 A1 2	$\frac{4}{7} \times \frac{3}{6} \times \frac{3}{5} \times \frac{2}{4} \times \frac{2}{3} \times \frac{1}{2}$ oe or $\frac{1}{7C3 \text{ or } 7C4}$	Not $3! \times 4! \times \dots$ (eg not $3! \times 4! \times 5$ ) not $\frac{1}{3! \times 4!}$ , not $\frac{1}{144}$ NB no mark for $\div 7!$ or "5040" in this part
b	5 seen or $5!$ seen $3! \times 4! \times 5$ or $5! \times 3!$ or 720 or $5 \times 144$ ( $\div 7!$ or "5040") $= \frac{1}{7}$ oe or 0.143 (3 sf)	M1 M1 A1 3	or $5 \times \frac{3}{7} \times \frac{2}{6} \times \frac{1}{5} (\times \frac{4}{4} \times \frac{3}{3} \times \frac{2}{2})$ oe: M2 or $5 \times \frac{1}{7C3 \text{ or } 7C4}$ : M2 or $5 \times$ "(iiia)": M2	or GGGBBBB, BGGBBBB, BBGGGBB, BBBGGGB, BBBBGGG NB no mark for $\div 7!$ or "5040" in this part
<b>Total</b>		<b>9</b>		

7i	$x$	B1 1	Ignore explanations. “Neither” or “Both”: B0	
ii	Diag showing vertical differences only  State that sum of squares of these is min oe	B1  B1 2	Allow description instead of diag: “Distances from pts to line // to y-axis” oe  dep vert or horiz lines (not both) drawn or described	Allow $\geq$ one line, from a point to the line  Must have Min, Squares, Distances & Sum
iii	-1 Ranks opposite or reversed or <u>perfect</u> neg corr’n between <u>ranks</u> oe	B1 B1dep 2	Not approx -1 As $x$ increases, $y$ decreases	Allow eg: -1 because neg corr’n so ranks must be reversed  Ignore other NOT neg corr’n or strong neg rel’nship oe NOT comment about “disagreement” or “agreement”
iv	“Negative”  or “Not -1”	B1 1	eg “Strong neg” or any negative value $> -1$ or “Close to -1”	Any implication of Negative, except NOT “Negative gradient” and NOT “-1” given as the value of $r$
<b>Total</b>		<b>6</b>		
8	Incorrect $p$ (eg “cubical die means 18 sides hence $p = \frac{1}{18}$ ”): can gain all B & M marks.			
8i	$\frac{25}{216}$ oe or 0.116 (3 sfs)	B1 1		
ii	$(\frac{5}{6})^7 \times \frac{1}{6}$ alone  $= 0.0465$ (3 sfs) or $\frac{78125}{1679616}$	M2  A1 3	M1 for $(\frac{5}{6})^8 \times \frac{1}{6}$ alone	
iii	$(\frac{5}{6})^8$ oe alone $= 0.233$ (3 sfs) or $\frac{390625}{1679616}$	M1 A1 2	$1 - P(X \leq 8)$ , with exactly 8 correct terms	NOT $1 - (\frac{5}{6})^8$ , NOT $(\frac{5}{6})^8 \times \dots$
iv	NB If more than 5 products are added (eg $P(1 \leq X \leq 12)$ ): no marks			
	$(\frac{5}{6})^9 \times \frac{1}{6} + (\frac{5}{6})^{10} \times \frac{1}{6} + (\frac{5}{6})^{11} \times \frac{1}{6} + (\frac{5}{6})^{12} \times \frac{1}{6}$ (= 0.0323 + 0.0268 + 0.0224 + 0.0187)  $= 0.100$ (3 sfs)	M3   A1 4	M3 for all correct  or M2 for 3 of these added or these 4 plus 1 extra or 0.0817 or 0.0680 or 0.139 or 0.116  or M1 for $\geq 1$ of these terms or values seen; ignore incorrect  Allow 0.1 with wking	$(\frac{5}{6})^9 - (\frac{5}{6})^{13}$ or $1 - (\frac{5}{6})^{13} - [1 - (\frac{5}{6})^9]$ M3  or $(\frac{5}{6})^{8,9 \text{ or } 10} - (\frac{5}{6})^{12, 13 \text{ or } 14}$ or $1 - (\frac{5}{6})^{12, 13 \text{ or } 14} - [(1 - (\frac{5}{6})^{8,9 \text{ or } 10})]$ M2  or $\pm[(\frac{5}{6})^9 - (1 - (\frac{5}{6})^{13})]$ or $\pm [1 - (\frac{5}{6})^9 - (\frac{5}{6})^{13}]$ M1
<b>Total</b>		<b>10</b>		

Total 72 marks



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