



GCE

Mathematics

Advanced GCE

Unit **4732**: Probability and Statistics 1

Mark Scheme for June 2011

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Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

Note: “(3 sfs)” means “answer which rounds to ... to 3 sfs”. If correct ans seen to ≥ 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
Total		7		

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

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 0.8×2 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 st (or 22 nd or 21.5 th) 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 ≈ 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 ± 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	≥ 3 mid-pts attempted $\Sigma fx \div 50$ attempted $(= \frac{1819}{50})$ $= 36.38$ or 36.4 (3 sf) Σfx^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 ≥ 3 terms. or 36 with correct working ≥ 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 ² ”, unlike q5(iii) $\Sigma(fx)^2$: M0M0A0 If no wking for Σfx^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
Total		16		
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 $\frac{4}{15} + \frac{1}{6} + \frac{1}{6}$ $(= \frac{3}{5} \text{ AG})$	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 AG so no wking no mks No ft from tree in (i)

iii	Σxp attempted $= \frac{16}{15}$ oe or 1.07 (3 sfs) $\Sigma x^2 p$ attempted (= $\frac{23}{15}$ or 1.53) – “ $\frac{16}{15}$ ” ² $= \frac{89}{225}$ oe or 0.395 or 0.396 (3 sfs) Alt for Var(X): $\Sigma(x-\bar{x})^2 p$	M1 A1 M1 M1 A1 5 M2	Both non-zero terms $\div 3$ etc or $\frac{1}{\Sigma xp}$: M0 Both non-zero terms $\div 3$ etc: or $\frac{1}{\Sigma x^2 p}$: M0 indep but dep +ve result Ans 0.388: check wking but probably comes from $\mu = 1.07$; premature rounding: M1M1A0 $\frac{1}{6} \times \frac{16}{15}^2 + \frac{3}{5} \times \frac{1}{15}^2 + \frac{7}{30} \times \frac{14}{15}^2$ all correct M2, 2 terms correct M1	Not Σxp^2 NB easier to gain than equiv mark in qu 4(iii) not 0.395, but check for dot over 5 for recurring
Total		9		
6ia b	5040 $6!$ 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)	B1 1 M1 M1 A1 3	$\frac{1}{7} \times \frac{1}{6}$ M1* $\times 6$ or $\times 2$ M1 dep* Any $\div 7!$ or “5040” 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
iia	$3! \times 4!$ 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 5×144 ($\div 7!$ 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 $5 \times$ “(iia)” : M2	or GGGBBBB, BGGBBBB, BBGGGBB, BBBGGGB, BBBBGGG NB no mark for $\div 7!$ or “5040” in this part
Total		9		

4732

Mark Scheme

June 2011

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
Total		6		
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 ≥ 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
Total		10		

Total 72 marks

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

14 – 19 Qualifications (General)

Telephone: 01223 553998

Facsimile: 01223 552627

Email: general.qualifications@ocr.org.uk

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