GCE

Mathematics

Mark Scheme for June 2011

1ia	$\dfrac{3247-\frac{251\times65}{5}}{\sqrt{(14323-\frac{251^2}{5})(855-\frac{65^2}{5})}}$ or $\dfrac{-16}{\sqrt{1722.8\times10}}$ $=-0.1219\ldots$	M2 A1 3	M1 for correct subst in any correct S formula M2 for correct subst'n in any correct r formula Must see at least 4 sfs	or $\dfrac{-80}{\sqrt{8614\times50}}$ Allow -0.1218
b	Poor/no/little/weak/not strong corr'n or rel'nship or link between income & distance oe	B1 1	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	r close to 0, or small, or poor corr'n oe or $r=-0.122$ 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 r not close to -1" "Unreliable because r smaller than (–)0.7" NOT "Unreliable because extrapolated": B0B0 but "Unreliable because extrapolated and poor corr'n": B1B1
Total		**7**		

2	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	M1 A1	Ignore labels of rows or columns No ranks seen, d = (0), ±1, ±1, ±2, or $\qquad\qquad d^2$ = (0), 1, 1, 4 any order: M1A1	No wking, $\Sigma d^2 = 6$: M1A1M1 No wking, $\Sigma d^2 = $ eg 14: M0A0M0, but can gain 3rd M1
	Σd^2 attempted (or 6) $1 - \dfrac{6\Sigma d^2}{4(4^2-1)}$ $= \frac{2}{5}$ oe	M1 M1 A1 5	NOT $(\Sigma d)^2$	No wking, ans $\frac{2}{5}$: Full mks Allow both sets of ranks reversed NB incorrect method: 2 3 4 1 2 1 3 4 OR d = (0), ±2, ±1, ±3 any order $\qquad\qquad$ OR d^2 = (0), 4, 1, 9 any order $\qquad$ (leading to $\Sigma d^2 = 14$ and $r_s = -\frac{2}{5}$): $\qquad\qquad\qquad\qquad\qquad$ M0A0M1M1A0
Total		**5**		
3ia	$(1 - 0.5565)$ or $12\times0.85^{11}\times(1-0.85) + 0.85^{12}$ $= 0.4435$ or 0.443 or 0.444 (3 sf)	M1 A1 2	or $1 - ((1-0.85)^{12}\dots.^{12}C_{10}\times0.85^{10}(1-0.85)^2)$ ie $1 - $ (all 11 correct binomial terms)	or $1 - 0.557$ NB $1 - 0.4435$ (oe): M0A0
b	$0.5565 - 0.2642$ or $^{12}C_{10}(1-0.85)^2(0.85)^{10}$ $= 0.2923$ or 0.2924 or 0.292 (3 sf)	M1 A1 2		or $0.557 - 0.264$
c	$12 \times 0.85 \times (1-0.85)$ $= 1.53$ oe	M1 A1 2		
ii	$(\frac{3}{4})^2$ AND $\frac{3}{4}\times\frac{1}{4}$ seen (possibly $\times 2$) $(\frac{3}{4})^2 \times 2 \times \frac{3}{4}\times\frac{1}{4}$ oe $\qquad$ or $\frac{27}{128}$ or 0.211 $2 \times (\frac{3}{4})^2 \times 2 \times \frac{3}{4}\times\frac{1}{4}$ oe $= \frac{27}{64}$ or 0.422 (3 sfs)	M1 M1 M1 A1 4	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 $0.5625 + 0.375$ or eg 0.5625×0.375 Fully correct method	or $\frac{9}{16}$ and $\frac{3}{16}$ or $\frac{9}{16}$ and $\frac{3}{8}$ $\qquad$ eg in table or list Allow even if further incorrect wking Ans 0.211: check wking but probably gets $\qquad\qquad\qquad\qquad\qquad\qquad$ M1M1M0A0 Use of 0.85 instead of $\frac{1}{4}$: MR max M1M1M1A0
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 <br> or: incorrect class widths, otherwise correct method: M1

 $\frac{4}{3}$ correctly obtained (or no wking) then further incorrect:
 $\qquad\qquad\qquad\qquad\qquad\qquad$ M1M0A0

 Use of ratio of widths OR freqs but not both: M0 <br> 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 21st (or 22nd 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 <br> or 33 ≈ 14th in class or 33 ≈ 18th 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 "≈" sign means ± 2

 <u>Alternative Method</u>:
 33 ≈ 18th value $\qquad\qquad\qquad\qquad$ B1
 More values above 33 than below oe $\quad$ B1
 Med > 33 $\qquad\qquad\qquad\qquad\qquad$ 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	M1	seen or implied	Not nec'y correct values (29, 33, 40.5, 53)
	$\Sigma fx \div 50$ attempted $\quad (= \frac{1819}{50})$	M1	≥ 3 terms.	Allow on boundaries. Not class widths
	$= 36.38$ or 36.4 (3 sf)	A1	or 36 with correct working	
	Σfx^2 attempted $\quad (= 68055.5)$	M1	≥ 3 terms.	Allow on boundaries. Not class widths $\quad\quad\quad$ (3364, 30492, 22963.5, 11236)
	$\sqrt{\frac{68055.5}{50} - (\frac{1819}{50})^2}$ or $\sqrt{1361.11 - 36.38^2}$ $\quad\quad\quad (= \sqrt{37.6056})$	M1	completely correct method except midpts & ft their mean, dep not $\sqrt{(neg)}$	Allow class widths for this mark only NB mark is not just for "$- mean^2$", unlike q5(iii)
	$= 6.13$ (3 sfs)	A1 $\quad$ 6		$\Sigma(fx)^2$: M0M0A0
				If no wking for Σfx^2, check using their x and f
	Alt for variance: $\Sigma f(x - \bar{x})^2 (= 1880.28) \quad\quad$ M1			If no wking or unclear wking:
	$\sqrt{\frac{1880.28}{50}} \quad\quad\quad\quad$ M1			$\quad\quad$ full mks for each correct ans $\quad\quad$ for incorrect ans:
	$= 6.13$ (3 sf) $\quad\quad\quad\quad$ A1			$\quad\quad\quad\quad 35.8 \leq \mu \leq 36.9 \quad$ M0M1A0 $\quad\quad\quad\quad 6.0 \leq sd \leq 6.25 \quad$ M1M0A0
iv	(a) Decrease (b) Increase (c) Same $\quad$ (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 $\quad$ 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 $\frac{4}{15} + \frac{1}{6} + \frac{1}{6}$ $(= \frac{3}{5}$ **AG**$)$	B2 $\quad$ 2	B1: two of these products (or their results) added $\quad\quad\quad\quad\quad\quad\quad\quad$ (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 $\quad\quad\quad\quad\quad\quad\quad\quad\quad$ (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)	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$)$	M1	Both non-zero terms $\div$ 3 etc: or $\frac{1}{\Sigma x^2 p}$: M0	Not Σxp^2	
	$- \quad \text{``}\frac{16}{15}\text{''}^2$	M1	indep but dep +ve result	NB easier to gain than equiv mark in qu 4(iii)	
	$= \frac{89}{225}$ oe or $0.39\dot{5}$ 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		$\frac{1}{6} \times \frac{16}{15}^2 + \frac{3}{5} \times \frac{1}{15}^2 + \frac{7}{30} \times \frac{14}{15}^2$ all correct M2, 2 terms correct M1		
Total		**9**			
6ia	5040	B1 1			
b	6! or 5!×6 or 720	M1		$^1/_7 \times ^1/_6$ M1*	NOT 6! in denom
	$\div$ 7! or $\div$ "5040" or 1440 or (5! or 6!) $\times$ 2	M1	Any $\div$ 7! or "5040" but NOT any $\times$ 2	$\times$ 6 or $\times$ 2 M1 dep*	eg $^{6!}/_{5040}$ or $^1/_7$ or 0.143 or $^1/_{21}$ (3 sfs): M1M1A0
	$= ^2/_7$ oe or 0.286 (3 sf)	A1 3			
iia	3! $\times$ 4! alone or 144	M1	$^4/_7 \times ^3/_6 \times ^3/_5 \times ^2/_4 \times ^2/_3 \times ^1/_2$ oe or $\overline{7C3\text{or}7C4}$		Not 3! $\times$ 4! $\times$… (eg not 3! $\times$ 4! $\times$ 5) not $\frac{1}{3!\times 4!}$, not $\frac{1}{144}$
	$(\div$ 7! or "5040") $= ^1/_{35}$ oe or 0.0286 (3sf)	A1 2			NB no mark for $\div$ 7! or "5040" in this part
b	5 seen or 5! seen	M1			or GGGBBBB, BGGGBBB, BBGGGBB, BBBGGGB, BBBBGGG
	3! $\times$ 4! $\times$ 5 or 5! $\times$ 3! or 720 or 5 $\times$ 144	M1	or 5 $\times ^3/_7 \times ^2/_6 \times ^1/_5 (\times ^4/_4 \times ^3/_3 \times ^2/_2)$ oe: M2 or 5 $\times \overline{7C3\text{or}7C4}$: M2 or 5 $\times$ "(iia)": M2		NB no mark for $\div$ 7! or "5040" in this part
	$(\div$7! or "5040") $= ^1/_7$ oe or 0.143 (3 sf)	A1 3			
Total		**9**			

7i	x	B1	1	Ignore explanations. "Neither" or "Both": B0	
ii	Diag showing vertical differences only	B1		Allow description instead of diag: "Distances from pts to line // to y-axis" oe	Allow ≥ one line, from a point to the line
	State that sum of squares of these is min oe	B1	2	dep vert or horiz lines (not both) drawn or described	Must have Min, Squares, Distances & Sum
iii	-1	B1		Not approx -1	Allow eg:
	Ranks opposite or reversed or <u>perfect</u> neg corr'n between <u>ranks</u> oe	B1dep	2	As x increases, y decreases	-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"			eg "Strong neg" or any negative value > -1	Any implication of Negative, except NOT "Negative gradient" and
	or "Not -1"	B1	1	or "Close to -1"	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	$^{25}/_{216}$ oe or 0.116 (3 sfs)	B1	1		
ii	$(^{5}/_{6})^{7} \times {}^{1}/_{6}$ alone	M2		M1 for $(^{5}/_{6})^{8} \times {}^{1}/_{6}$ alone	
	$= 0.0465$ (3 sfs) or $\frac{78125}{1679616}$	A1	3		
iii	$(^{5}/_{6})^{8}$ oe alone	M1		$1 - P(X \le 8)$, with exactly 8 correct terms	NOT $1 - (\frac{5}{6})^{8}$, NOT $(\frac{5}{6})^{8} \times$ ….
	$= 0.233$ (3 sfs) or $\frac{390625}{1679616}$	A1	2		
iv	NB If more than 5 products are added (eg $P(1 \le X \le 12)$: no marks				
	$(^{5}/_{6})^{9} \times {}^{1}/_{6} + (^{5}/_{6})^{10} \times {}^{1}/_{6} + (^{5}/_{6})^{11} \times {}^{1}/_{6} + (^{5}/_{6})^{12} \times {}^{1}/_{6}$ $(= 0.0323 + 0.0268 + 0.0224 + 0.0187)$	M3		M3 for all correct	$(^{5}/_{6})^{9} - (^{5}/_{6})^{13}$ or $1 - (^{5}/_{6})^{13} - [1 - (^{5}/_{6})^{9}]$ M3
				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 $(^{5}/_{6})^{8, 9 \text{ or } 10} - (^{5}/_{6})^{12, 13 \text{ or } 14}$ or $1 - (^{5}/_{6})^{12, 13 \text{ or } 14} - [(1 - (^{5}/_{6})^{8, 9 \text{ or } 10}]$ M2
				or M1 for ≥ 1 of these terms or values seen; ignore incorrect	or $\pm[(^{5}/_{6})^{9} - (1 - (^{5}/_{6})^{13})]$ or $\pm [1 - (^{5}/_{6})^{9} - (^{5}/_{6})^{13}]$ M1
	$= 0.100$ (3 sfs)	A1	4	Allow 0.1 with wking	
Total		**10**			

Total 72 marks

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