

OCR Maths S1

Topic Questions from Papers

Bivariate Data

Answers

1	(i)	A Points lie close to straight line	B1 B1	2	Valid reason, eg “linear”. Not “strong correlation”
	(ii)	C Non-linear relationship	B1 B1	2	eg curve or quadratic

(Q1, Jan 2005)

2	(i)	$\begin{array}{c c} 2 & 3 & 4 & 1 & 6 & 5 & 7 \\ \hline 1 & 2 & 3 & 4 & 5 & 6 & 7 \end{array}$ $\Sigma d^2 = 14$ $r_s = 1 - \frac{6\Sigma d^2}{7(7^2 - 1)}$ $r_s = \frac{3}{4}$	$\begin{array}{c c} 6 & 5 & 4 & 7 & 2 & 3 & 1 \\ \hline 7 & 6 & 5 & 4 & 3 & 2 & 1 \end{array}$	M1 M1 A1 M1 A1	5	Rank both sets consistently Find Σd^2 , dep ranks attempted. Allow arith errors $\Sigma d^2 = 14$ Use formula correctly, dep 2 nd M1 Answer $\frac{3}{4}$ or a.r.t. 0.750
	(ii)	Rankings generally agree dep $r_s > 0.5$	B1f	1	Must have “agree” or “similar” etc, Not ‘rankings well correlated’ If $r_s < 0.5$, “generally don’t agree”: B1	

(Q3, Jan 2005)

3	(i)	$\frac{264 - \frac{90 \times 15}{5}}{1720 - \frac{90^2}{5}} \text{ or } \frac{264 - 5 \times 18 \times 3}{1720 - 5 \times 18^2}$ $= -0.06 \text{ AG}$ $y - \frac{15}{5} = -0.06(x - \frac{90}{5})$ $y = 4.08 - 0.06x$	M1 A1 M1 A1	4	Formula correctly used -0.06 correctly obtained or $a = \frac{15}{5} - (-0.06) \times \frac{90}{5}$ Complete equation correct
	(ii)	Substitute $x = 20.5$ ($y = 2.85$) Substitute $x = 19.5$ ($y = 2.91$) $2.91 - 2.85 = 0.06$	M1 M1 A1	3	Allow 20 ($y = 2.88$) or 20.49 Answer 0.06 or -0.06, c.w.d
	(iii)	-0.6, 0.5	B1 B1	2	-0.6 correct 0.5 correct
	(iv)	1.5 Calculated equation minimises this quantity	B1 B1	2	Not “Low value for Σe^2 means points near line”
	(v)	$\bar{e} = \Sigma e_i / 5$ $= 0$ $\Sigma e_i^2 / 5 \quad (- \text{ her } \bar{e})^2$ $= 0.3$	M1 A1 M1 A1	4	$\Sigma e_i / 5$ used Answer 0, cwd, cao $\Sigma e_i^2 / 5$ 0.3 only, must see -0^2 or -0 in variance. ie: No working: $\bar{e} = 0$: M1A1; Var = 0.3: M1A0

(Q9, Jan 2005)

<p>4 (i) Σd^2 $= 14$ $1 - \frac{6 \times \text{their } 14}{5 \times (25 - 1)}$ $= 0.3$</p>	<p>M1 A1 M1 A1</p>	<p>Subtr & squ 5 pairs & add</p> <p>dep 1stM1</p> <hr/> $S_{xy} = 48 - \frac{15 \times 15}{5}$ } { = 3 } $S_{xx} = 55 - \frac{15^2}{5}$ } { = 10 } $S_{yy} = 55 - \frac{15^2}{5}$ } { = 10 } <p>their $\frac{S_{xy}}{\sqrt{(S_{xx}S_{yy})}}$ M1dep = 0.3 A1</p>
<p>(ii) Reverse rankings attempted 2 5 3 4 1</p>	<p>M1 A1</p>	<p>3 correct T & I to make $\Sigma d^2 = 40$: 2 mks or 0 mks</p>
6		

(Q1, June 2005)

<p>5 (i) Correct subst in \geq two S formulae</p> $\frac{14464.1 - \frac{265 \times 274.6}{5}}{\sqrt{\left(14176.54 - \frac{265^2}{5}\right)\left(15162.22 - \frac{274.6^2}{5}\right)}}$ <p>$= -0.868$ (3 sfs)</p>	<p>M1 M1 A1</p>	<p>Any correct version</p> <p>or</p> $\frac{14464.1 - 5 \times 53 \times 54.92}{\sqrt{(14176.54 - 5 \times 53^2)(15162.22 - 5 \times 54.92^2)}}$ <p>or fully correct method with $(x - \bar{x})^2$ etc</p>
<p>(ii) No difference oe</p>	<p>B1</p>	<p>1 Or slightly diff or more acc because of rounding errors when mult by 2.54 oe</p>
<p>(iii) Choose y on x stated</p>	<p>B1ind</p>	<p>Not just "more accurate" or implied, eg by S_{xy}/S_{xx} or $y = ax + b$</p>
$\frac{14464.1 - \frac{265 \times 274.6}{5}}{14176.54 - \frac{265^2}{5}}$ <p>or -0.682</p> <p>$y - \frac{274.6}{5} = (\text{their } -0.682)(x - \frac{265}{5})$ $y = 91(.1) - 0.68(2) x$ 49.9 (3sfs) or 50</p>	<p>M1 M1ind A1 A1</p>	<p>If state x on y, but wking is y on x: B1 or their $\frac{-89.7}{131.54}$ seen or $\frac{14464.1 - 5 \times 53 \times 54.92}{14176.54 - 5 \times 53^2}$ or correct subst into a correct formula $\frac{S_{xy}}{S_{xx}}$ or $a = \frac{274.6}{5} - (\text{their } -0.682) \times \frac{265}{5}$ Simplif to 3 terms. Coeffs to ≥ 2 sfs cao Use of x on y: equiv M mks as above</p>
9		

(Q4, June 2005)

6 (i)	Negative, because (grad or coeff of x in 1 st equn or x -value or reg coeff or B or -0.6) is negative	B1	1	Neg because x incr & y decr
(ii)	$x = -1.6 \times 7.0 + 21$ $x = 9.8$	M1 A1	2	Sub $y=7.0$ in 2 nd eqn. Allow 1 sign error If sub in both must choose 2nd
(iii)	$y = -0.6(-1.6y + 21) + 13$ or similar $\bar{x} = 5, \bar{y} = 10$	M1 A1A1	3	Obtain correct eqn in 1 variable. Allow 1 num'l error Allow without bars
Total			6	

(Q1, June 2006)

7 (ia)	Ranks: 2 4 7 5 3 1 6 6 4 1 3 5 7 2 7 1 6 3 2 5 4 1 7 2 5 6 3 4 Σd^2 (= 60) $r_s = 1 - \frac{6 \times 60}{7 \times 48}$ $= -1/14$ or -0.071 (3 dps)	M1 A1 M1 M1 A1	5	≥ 5 ranks correct in each set all correct dep ranks attempted even if opp orders, allow arith errors Correct formula with $n = 7$, dep 2 nd M1 calc r for ranks: $S_{xx}=S_{yy}= 140 - 28^2/7. \quad S_{xy} = 110 - 28^2/7$ $(= 28) \quad \quad \quad (= -2)$ corr subst in one corr S (any version):M1 corr subst in $r = S_{xy} / \sqrt{(S_{xx}S_{yy})} \quad :M1$ -0.07 without wking: M1A1M2A0
(b)	Little (or no) connection (agreement, rel'nship) between dist and commission Allow disagreement	B1ft	1	No mks unless $ r_s \leq 1$ ft their r_s Must refer to context. Not "little corr'n between dist and com" not "strong disagreement" Ignore other comment
(c)	Unchanged. No change in rank	B1B1	2	
(ii)(a)	$= -1$	B1	1	indep
(b)	Close to -1 or, eg ≈ -0.9	B1		cao not referring to "corr'n" rather than r allow "neg", not neg corr'n or neg skew
Total			10	

(Q6, June 2006)

8 (i)	$x=20; y=11; x^2=96; y^2=31; xy=52$ $S_{xx} = 16$ or 3.2 $S_{yy} = 6.8$ or 1.36 $S_{xy} = 8$ or 1.6 $r = \frac{8}{\sqrt{(16 \times 6.8)}} \text{ or } \frac{1.6}{\sqrt{(3.2 \times 1.36)}}$ $= 0.767$ (3 sfs)	B1 B1 B1 M1 A1	5 dep $-1 \leq r \leq 1$ ft their S 's (S_{xx} & S_{yy} +ve) for M1 only
ii	Small sample oe	B1f	1
Total		6	

(Q2, Jan 2007)

9 (i)	$\frac{2685 - \frac{140 \times 106.8}{8}}{3500 - \frac{140^2}{8}}$ or $\frac{2685 - \frac{8 \times 17.5 \times 13.35}{2500}}{2500 - \frac{8 \times 17.5^2}{2500}}$ $= \frac{136}{175}$ or 0.777 (3 sfs)	M1	Correct sub in any correct formula for b (incl. $(x - \bar{x})$ etc)
	$y - \frac{106.8}{8} = 0.777(x - \frac{140}{8})$ $y = 0.78x - 0.25$ or better or $y = \frac{136}{175}x - \frac{1}{4}$	A1	or $a = \frac{106.8}{8} - 0.777 \times \frac{140}{8}$ ft b for M1 ≥ 2 sfs sufficient for coeffs
ii	$0.78 \times 12 - 0.25$ $= 9.1$ (2 sfs)	M1	M1: ft their equn
iiia	Reliable	A1f	A1: dep const term in equn
b	Unreliable because extrapolating oe	B1	Just "reliable" for both: B1
Total		8	

(Q5, Jan 2007)

10	UK Fr Ru Po Ca 1 2 3 4 5 or 5 4 3 2 1 4 3 1 5 2 2 3 5 1 4 Σd^2 (= 24) $r_s = 1 - \frac{6 \times "24"}{5 \times (5^2 - 1)}$ $= -\frac{1}{5}$ or -0.2	M1 A1 M1 M1 A1 5	Consistent attempt rank other judge <div style="border: 1px solid black; padding: 5px; display: inline-block;"> RCFUP 3 5 2 1 4 3 1 4 5 2 1 2 3 4 5 5 4 3 2 1 </div> All 5 d^2 attempted & added. Dep ranks att'd Dep 2 nd M1 <div style="border: 1px solid black; padding: 5px; display: inline-block;"> $\frac{43 - \frac{15^2}{5}}{\sqrt{((55 - \frac{15^2}{5})(55 - \frac{15^2}{5}))}}$ Corr sub in ≥ 2 S's M1 All correct: M1 </div>
Total		5	

(Q2, June 2007)

11 (i)	$r = \frac{212 - \frac{24 \times 39}{5}}{\sqrt{(130 - \frac{24^2}{5})(361 - \frac{39^2}{5})}}$	B2 2	$\frac{24.8}{\sqrt{14.8 \times 56.8}}$ or $\frac{24.8}{\sqrt{840.64}}$ or $\frac{24.8}{3.85 \times 7.54}$ or $\frac{24.8}{29}$ B2 for correct subst in r B1 for correct subst in any S
ii	$R = 0.7$ or (B) Definition of r_s is PMCC for ranks	B1 B1 2	(A) and (B) true: B0B0 dep 1 st B1
iii	$r = 0.855$ $r_s = 0.7$	B1 B1 2	or "unchanged": B1B1 Interchanged: B1
Total		6	

(Q3, Jan 2008)

12 (ia)	$\frac{8736.9 - \frac{202 \times 245.3}{7}}{7300 - \frac{202^2}{7}}$ or $\frac{1658.24}{1470.86}$ $= 1.127...$ (= 1.13 AG)	M1 A1 2	correct sub in any correct formula for b eg $\frac{236.8921}{210.1249}$
(b)	$y - \frac{245.3}{7} = 1.13(x - \frac{202}{7})$ $y = 1.1x + 2.5$ (or 2.4) or $y = 1.13x + 2.43$	M1 A1 2	must see 1.127... ; 1.127.. alone: M1A1 or $a = \frac{245.3}{7} - 1.13 \times \frac{202}{7}$ 2 sfs suff. (exact: $y = 1.127399..x + 2.50934...$)
(ii)(a)	$(1.1(..) \times 30 + 2.5(..)) = 35.5$ to 36.5	B1f 1	
(b)	$(1.1(..) \times 100 + 2.5(..)) = 112.4$ to 115.6	B1f 1	
(iii)	(a) Reliable (b) Unreliable because extrapolated	B1 B1 2	Both reliable: B1 Ignore extras (a) more reliable than (b) B1 because (a) within data or (b) outside data B1
Total		8	

(Q2, Jan 2009)

13 (i)	Because growth may depend on pH oe or expt is investigating if y depends on x	B1 1	In context. Not x is controlled or indep
ii	$S_{xy} = 17082.5 - 66.5 \times 1935/8 (= 997.8125)$ $S_{xx} = 558.75 - 66.5^2/8 (= 5.96875)$ $b = S_{xy}/S_{xx}$ $= 167$ (3 sfs) $y - 1935/8 = "167"(x - 66.5/8)$ $y = -1150 + 167x$	M1 A1	Correct sub into any correct b formula or $a = 1935/8 - "167" \times 66.5/8$ cao NB 3 sfs
iii	$y = -1150 + 167 \times 7$ $= 19$ to 23	M1 A1 2	ft their eqn for M1 only
iv	No (or little) relationship or correlation	B1 1	or weak or small corr'n. Not "agreement"
va	Reliable as r high oe	B1 1	Allow without "interpolation" oe, but must include r high
b	Unreliable as extrapolation oe	B1 1	or unreliable as gives a neg value
vi	Unreliable (or No) because r near 0 or because little (or no or small) corr'n (or rel'n)	B1 1	or No because Q values vary widely for pH = 8.5
Total		11	

(Q9, Jan 2008)

14 (i)	1 2 3 4 5 or 5 4 3 2 1 3 5 4 1 2 3 1 2 5 3 $\Sigma d^2 (= 32)$ $1 - \frac{6 \times "32"}{5(25 - 1)}$ $= -0.6$	M1 A1 M1dep M1dep A1 5	attempt ranks correct ranks S_{xx} or $S_{yy} = 55 - 15^2/5 (= 10)$ or $S_{yy} = 39 - 15^2/5 (= -6)$ $^{-6}/\sqrt{(10 \times 10)}$
(ii)	1 & 3 Largest neg r_s or large neg r_s or strong neg corr'n or close(st) to -1 or lowest r_s	B1ind B1dep 2	ft if $-1 < (i) < -0.9$, ans 1 & 2 NOT: furthest from 0 or closest to ± 1 little corr'n most disagreement
Total		7	

(Q4, Jan 2009)

15	first two d's = ± 1 Σd^2 attempted (= 2) $1 - \frac{6 \times "2"}{7(7^2 - 1)}$ $= \frac{27}{28}$ or 0.964 (3 sfs)	B1 M1 M1dep A1	S_{xx} or $S_{yy} = 28$ B1 $S_{xy} = 27$ B1 $S_{xy}/\sqrt{(S_{xx}S_{yy})}$ M1 dep B1 1234567 & 1276543 (ans $^2/7$): MR, lose A1
Total		4	

(Q2, June 2009)

16 (a)	A: diag or explanation showing pts close to st line, always increasing B: Diag or expl based on $r=1 \Rightarrow$ pts on st line $\Rightarrow r(s)=1$	B1 B1 B1 3	. Diag or expl based on $r(s) \neq 1 \Rightarrow$ pts not on st line $\Rightarrow r \neq 1$ $r=1 \Rightarrow$ pts on st line & $r(s) \neq 1 \Rightarrow$ pts not on st line B1B1 $r=1 \Rightarrow r(s)=1$ B2
(b)	$\bar{y} = 2.4 \times 4.5 + 3.7$ $= 14.5$ $4.5 = 0.4 \times "14.5" - c$ $c = 1.3$ $a' = x - b'y \therefore 14.5$ M1A1; then $a' = 4.5 - 0.4 \times 14.5 = -1.3$ M1A1	M1 A1 M1 A1 4	Attempt to sub expression for y $x = 0.96x + 1.48 - c$ oe sub $x = 4.5$ and solve $c = 1.3$ 14.5 M1A1. $(y - 3.7)/2.4 = 0.4y - c$ and sub 14.5 M1 $c = 1.3$ A1
Total		[7]	

(Q6, Jan 2010)

17 (i)	x independent or controlled or changed Value of y was measured for each x x not dependent	B1 1	Allow Water affects yield, or yield is dependent or yield not control water supply Not just y is dependent Not x goes up in equal intervals Not x is fixed
ii	(line given by) minimum sum of sqs	B1 B1 2	B1 for "minimum" or "least squares" with inadequate or no explanation
iii	$S_{xx} = 17.5$ or 2.92 $S_{yy} = 41.3$ or 6.89 $S_{xy} = 25$ or 4.17 $r = \frac{S_{xy}}{\sqrt{(S_{xx}S_{yy})}}$ $= 0.930$ (3 sf)	B1 M1 A1 3	or $91 - 21^2/6$ or $394 - 46^2/6$ B1 for any one or $186 - 21 \times 46/6$ dep B1 0.929 or 0.93 with or without wking B1M1A0 SC incorrect n : max B1M1A0
iv	Near 1 or lg, high, strong, good corr'n or relnshp oe Close to st line or line good fit	B1ft B1 2	$ r $ small: allow little (or no) corr'n oe Not line accurate. Not fits trend
Total		8	

(Q3, June 2009)

18 (i)	$S_{hm} = 0.2412$ $S_{hh} = 0.10992$ $S_{mm} = 27.212$ $r = \frac{S_{hm}}{\sqrt{(S_{hh}S_{mm})}}$ $= 0.139$ (3 sfs)	B1 M1 A1 3	Allow x or \div 5 any one S correct ft their Ss
(ii)	Small, low or not close to 1 or close to 0 oe pts not close to line oe	B1 ft B1	1 st B1 about value of r 2 nd B1 about diag
(iii)	none or unchanged or "0.139" oe	B1 1	
(iv)	Larger oe	B1 1	
Total		[7]	

(Q3, Jan 2010)

19 (i)	Opposite orders or ranks or scores or results or marks $r_s = -1$	B1 1	or reversed, or backwards, or inverse or as one increases the other decreases Needs reason AND value
ii	Attempt Σd^2 (= 6) $1 - \frac{6 \times \Sigma d^2}{3(3^2 - 1)}$ $= -\frac{1}{2}$ oe	M1 M1 A1 3	dep 1 st M1 Allow use wrong table for M1M1
iii	$3!$ or 3P_3 or 6 $1 \div$ their '6' $\frac{1}{6}$ oe eg $\frac{6}{36}$	M1 M1 A1 3	r attempt list possible orders of 1,2,3 (≥ 3 orders) 2 nd M1 for fully correct method only or $\frac{1}{3} \times \frac{1}{2} (\times 1)$: M1M1
Total		7	

(Q2, June 2010)

20 (i)	If x is contr (or indep) or y depend't, use y on x	B1	Allow x increases constantly, is predetermined, you choose x , you set x , x is fixed, x is chosen
	If neither variable contr'd (or indep) AND want est y from x : use y on x	B1 2	Allow y not controlled AND want est y from x
iia	$S_{xx} = 510000 - \frac{1800^2}{9} \quad (= 150000)$ $S_{xy} = 4080 - \frac{1800 \times 14.4}{9} \quad (= 1200)$ $b = \frac{1200}{150000} \quad (= 0.008)$ $y - \frac{14.4}{9} = 0.008(x - \frac{1800}{9})$ $y = 0.008x (+ 0)$	M1	Ignore incorrect comments or $\frac{510000}{9} - 200^2 \quad (= 16666.7)$ or $\frac{4080}{9} - 200 \times 1.6 \quad (= 133.33)$ M1 for either S
		M1	$b = \frac{133.33}{16666.7}$ dep correct expressions both S 's
		M1	or $a = \frac{14.4}{9} - 0.008 \times \frac{1800}{9} \quad (= 0)$ Must be all correct for M1
		A1 4	CAO
iib	312.5 or 313	B1ft 1	ft their equn in (iia)
iic	-0.4	B1ft 1	ft their equn in (iia)
iid	Contraction oe	B1(ft)	or length decreased, shorter, pushed in, shrunk, smaller
	Unreliable because extrapolated oe	B1 2	or not in the range of x or not in range of previous results
Total		10	

(Q3, June 2010)

<p>21 (i)</p>	$\frac{7351.12 - \frac{86.6 \times 943.8}{12}}{\sqrt{(658.76 - \frac{86.6^2}{12})(83663 - \frac{943.8^2}{12})}}$ <p>or $\frac{540.03}{\sqrt{33.80 \times 9433}}$</p> <p>= 0.9564... or 0.956 or 0.96</p>	<p>M1 M1 A1 3</p>	<p>Must see at least 2 sfs</p>	<p>1st M1 for correct subst in any correct <i>S</i> formula 2nd M1 for all correct subst'n in any correct <i>r</i> formula</p> <p>0.96 or correct better, no working: M1M1A1</p> <p>eg 0.958 → 0.96 with correct working M1M1A0 without working: M0M0A0</p>
<p>ii</p>	<p>Strong (or high or good or close etc) relationship (or corr'n or link) between amount spent on advert & profit</p>	<p>B1 1</p>	<p>Allow Almost complete relationship or Very positive corr'n or Very reliable relationship or Near perfect relationship between spend on advert & profit</p> <p>oe, in context</p>	<p>Must state or imply "strong" or "good" or equiv & in context but NOT Strong <i>agreement</i> between etc</p> <p>NOT High spend on ads produces high profits NOT The more spent on adverts, the higher the profit NOT Positive corr'n between spend on ads & profits NOT There is a relationship between spend on ads & profit NOT There is a great relationship between etc NOT ans involving "proportion(al)"</p> <p>Ignore irrelevant or incorrect If incorrect <i>r</i> (< 0.9) in (i), no ft for ans "weak rel'nship" here; but correct ans here scores B1 even if inconsistent with their <i>r</i></p>
<p>iii</p>	<p>Relationship may not continue</p> <p>Corr'n not imply causation</p>	<p>B1 B1 2</p>	<p>Can't extrapolate</p> <p>Any indication that pattern may not continue</p> <p>Must state or imply referring to future</p> <p>Increase in profit may not be due to increase in spend on advertising.</p> <p>Variables may be increasing separately</p>	<p>Allow without context</p> <p>Examples: Can't predict future; Things can change May be recession ahead; Economic situation may change Cost of advertising may increase If spend too much on ads, profit may be reduced as a result Advertising may not be as successful in the future Item may go out of fashion</p> <p>NOT Spending on adverts may not bring high profits NOT Spending more on adverts may not bring higher profits (Since these just restate the question) NOT More money spent on ads will not affect profit</p> <p>Both variables may be affected by a third Other factors may affect profits Advertising not the sole factor affecting profits</p> <p>Two different categories of reason needed, as given above. Two reasons which both fall under the same category: only B1</p> <p>NOT Because corr'n not equal to 1</p>
<p>iv</p>	$b = \frac{7351.12 - \frac{86.6 \times 943.8}{12}}{658.76 - \frac{86.6^2}{12}}$ <p>= 15.9788 or 16.0</p> $y - \frac{943.8}{12} = "16.0"(x - \frac{86.6}{12})$ <p>$y = 16x - 37$ or better</p>	<p>M1 A1 M1 A1 4</p>	<p>or $\frac{S_{xy}}{S_{xx}}$</p> <p>or $a = \frac{943.8}{12} - "16.0" \times \frac{86.6}{12}$</p> <p>($y = 15.9788x - 36.664$)</p>	<p>ft values of S_{xy} & S_{xx} if clearly shown in (i)</p> <p>Coeffs not nec'y rounded, but would round to 16 & 37 These marks can be earned in (v) if not contradicted in (iv)</p> <p>If <i>x</i> on <i>y</i> line found: M-marks only ($x = 2.71 + 0.0572y$)</p>
<p>v</p>	<p>"16" × 7.4 – "37" 81400 to 81750</p>	<p>M1 A1f 2</p>	<p>81.4 thousand to 81.7 thousand: M1A1 but 81.4 to 81.7 alone: M1A0</p>	<p>"16" × 7400 – "37": M0A0</p> <p>ft their (iv)</p>
<p>Total</p>		<p>12</p>		

(Q3, Jan 2011)

22 (i)	EDCBA	B1 1	A 5 B 4 C 3 D 2 E 1	NOT just 5, 4, 3, 2, 1
iii	$1 - \frac{6\Sigma d^2}{5(5^2-1)} = 0.9$ $1 - \frac{6\Sigma d^2}{5 \times 24} = 0.9$ or $0.1 = \frac{6 \times \Sigma d^2}{5 \times 24}$ $(\Sigma d^2 = 2 \text{ AG})$	M1 A1 2	One correct step or better & nothing incorrect for A1	$1 - \frac{6 \times 2}{5(5^2-1)}$ $= 1 - \frac{6 \times 2}{5 \times 24}$ or $1 - \frac{12}{5 \times (5^2-1)}$ One correct step or better & nothing incorrect for A1 (= 0.9 AG)
b	d^2 : 0, 0, 0, 1, 1 any order BACDE or similar	M1 A1 2	or d : 0, 0, 0, 1, -1 any order Any two adjacent dogs interchanged	May not be seen If clearly comparing second race with third; DECBA or similar: B1, but must be clear
Total		5		

(Q8, Jan 2011)

23 (ia)	$\frac{3247 - \frac{251 \times 65}{5}}{\sqrt{(14323 - \frac{251^2}{5})(855 - \frac{65^2}{5})}}$ or $\frac{-16}{\sqrt{1722.8 \times 10}}$ $= -0.1219...$	M2 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 slight neg/weak corr'n (oe) between income & distance	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	B1 1	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 ..."
c	No effect or -0.122 oe	B1 1	eg "Nothing" or "None" oe	No recovery of this mark in (ii) 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	Ignore other 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": BOB0 but "Unreliable because extrapolated and poor corr'n": B1B1
Total		7		

(Q1, June 2011)

24	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 Σd^2 attempted (or 6) $1 - \frac{6\Sigma d^2}{4(4^2-1)}$ $= \frac{2}{5}$ oe	M1 A1 M1 M1 A1 5	Ignore labels of rows or columns No ranks seen, $d = (0), \pm 1, \pm 1, \pm 2$, or $d^2 = (0), 1, 1, 4$ any order: M1A1 NOT (Σd^2)	No wking, $\Sigma d^2 = 6$: M1A1M1 No wking, $\Sigma d^2 = \text{eg } 14$: M0A0M0, but can gain 3 rd M1 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 $d = (0), \pm 2, \pm 1, \pm 3$ any order OR $d^2 = (0), 4, 1, 9$ any order (leading to $\Sigma d^2 = 14$ and $r_s = -\frac{2}{5}$): M0A0M1M1A0
Total		5		

(Q2, June 2011)

25 (i)	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 \geq 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 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		

(Q7, June 2011)

26	(i)	x because values (or depths) are fixed (or controlled or chosen or predetermined or manipulated or given oe) because they can be changed or it is changed or because it is not measured ie not "read off" oe or because we change the values ourselves	B1 [1]	Allow "because it goes up in intervals" or "because it is taken at set intervals" Ignore all else NB "x is changed" B1, but "x changes" B0	NOT: x, as values are constant x, as y depends on x x as % sand depends on depth Depth, as not affected by % sand content x, as it is not dependent x, because y is measured x, because it changes y, which is the depth and this is controlled
	(ii)	$S_{xx} = 7344 - \frac{216^2}{9} \quad (= 2160)$ $S_{yy} = 30595 - \frac{512.4^2}{9} \quad (= 1422.36)$ $S_{xy} = 10674 - \frac{216 \times 512.4}{9} \quad (= -1623.6)$ $r = \frac{-1623.6}{\sqrt{2160 \times 1422.36}}$ $= -0.926$ (3 sfs)	M1 M1 A1 [3]	correct subst in any S formula correct subst in all Ss & in r	
	(iii) (a)	$b = \frac{-1623.6}{2160}$ or $-0.75\dots$ or $-\frac{451}{600}$ $y - \frac{512.4}{9} = "-0.75\dots"(x - \frac{216}{9})$ $y = -0.75x + 75(.0)$ (2 sf) or $y = -\frac{451}{600}x + \frac{5623}{75}$	M1 M1 A1 [3]	fit S_{xy} & S_{xx} from (ii) or $a = \frac{512.4}{9} - 0.75\dots \times (-\frac{216}{9})$ or $\frac{5623}{75}$ 2 sf is enough Allow $y = -0.75x + (-75)$	If ans to (i) is y, & x on y found here: $b' = \frac{-1623.6}{1422.36} \quad (= -1.14)$ M1 $x - \frac{216}{9} = "-1.14"(y - \frac{512.4}{9})$ M1 $x = -1.14y + 89(.0)$ A1 If ans to (i) is x, but x on y found here: B1 only for $x = -1.14y + 89(.0)$
	(iii) (b)	r close to -1 (or high or strong), r close to 1 25 within range of data oe, so reliable 100 outside range of data oe, so unreliable Must give reasons Allow "accurate" instead of "reliable"	B1 B1 [3]	Allow strong or good or high corr'n or rel'nship etc or so more reliable or so less reliable If (ii) $ r < 0.7$: poor corr'n oe B1f 25 unreliable B1f 100 unreliable B1f	or strong neg corr'n. Award this mark even if comment linked to 100 instead of linked to 25. BUT: "r close to -1, so unreliable": B0 Can still score next marks if mention "within" and "outside range" or 100 gives neg %age

(Q2, Jan 2012)

29	(i)	(a)	1	B1 [1]		NOT close to 1
	(i)	(b)	-1	B1 [1]		NOT close to -1
	(ii)		Σd^2 attempted (= 10) $1 - \frac{6 \times \Sigma d^2}{4(4^2-1)}$ = 0	M1 if $\Sigma d^2 = 10$, may be implied by next line if $\Sigma d^2 \neq 10$, must see working dep M1 A1 Use of $(\Sigma d)^2$ M0M0A0 [3]		S_{xx} or $S_{yy} = 30 - \frac{100}{4}$ (= 5) or $S_{xy} = 25 - \frac{100}{4}$ (= 0) M1 $\frac{0}{\sqrt{5 \times 5}}$ M1
	(iii)		No fit from (i)(a), (i)(b) & (ii) ia: Total (or perfect or max or complete) agreement They have the same opinions/ranks/numbers etc They were identical ib: Opposite/reverse opinions/views/marks/ranks/ decisions/results oe ii: For $r = 0$ must state or imply: either <u>NO</u> relationship or similar or indicate <u>BOTH</u> agreement & disagreement or <u>NEITHER</u> agree nor disagree or <u>DIFFERENT</u> but <u>NOT OPPOSITE</u>	B1 Identical opinions/views/marks/ranks/ decisions/results/numbers oe Agree on all the ranks B1 Total (or max or complete or perfect) disagreement A's highest is B's lowest oe "Opposite" seen is sufficient No relationship/pattern/link/similarity between opinions/views/marks/ranks/ decisions/results oe opinions/etc... not related scoring appears random Neither agree nor disagree oe Both agree & disagree oe Agree for some, disagree for others oe mixed/varied opinions on the ranks B1 All three parts: Must refer to (or imply) opinions/views/marks/ranks/scores or (dis)agreement, or relationship or pattern oe, NOT just corr'n [3]		NOT: They agree or Strongly agree They agree most ranks Similar rankings As A's ranks increase so do B's Perfect relnshp NOT: Don't agree any ranks Disagree or Strongly disagree Disagree on all ranks Perfect neg relnshp NOT: Different views Don't agree but some rel'nshp Ranks all different No corr'n betw judges' views Don't agree nothing in common at all not much in common completely different orders opinions completely different half way between (a) and (b) Ignore all other

(Q5, June 2012)

30	(i)	$S_{xx} = 8700000 - \frac{7000^2}{6} \quad (= 533333)$ $S_{yy} = 509900 - \frac{7000 \times 456}{6} \quad (= -22100)$ $b = -\frac{"22100"}{"533333"} \quad \text{or} \quad -\frac{663}{16000} \quad (= -0.0414)$ $y - \frac{456}{6} = "-0.0414"(x - \frac{7000}{6})$ $y = -0.0414x + 124 \quad (3 \text{ sf})$	M1 M1 M1 A1 [4]	Correct subst'n in any correct S formula Correct subst'n in any correct b formula from two correct S formulae fit their b except if using r or $y = -\frac{663}{16000}x + \frac{3979}{32}$ or $y = -0.041x + 124$	or $a = \frac{456}{6} - (" -0.0414") \times \frac{7000}{6}$ oe ft "b" Allow $y = -0.04x + 124$ if $-0.041 \dots$ seen above
	(ii)	70 to 72	B1 [1]	or 71 per thousand, NOT 71000	No ft from (i) Ignore method
	(iii)	Extrapolation oe Corr'n not high or small sample	B1 B1 [2]	Allow "2400 is beyond graph" } "Not shown on the graph" or } 1 st B1 only "Line drops low, or below 0" } "Outlier" }	"Line only allows for countries poorer than Nigeria" 1 st B1 Allow "Value for Nigeria is -ve" 1 st B1 NOT "Other factors may apply" oe Ignore all else
	(iv)	$S_{xx} = 8700000 + 1300^2 - \frac{(7000+1300)^2}{7}$ $S_{yy} = 36262 + 96^2 - \frac{(456+96)^2}{7}$ $S_{xy} = 509900 + 1300 \times 96 - \frac{8300 \times 552}{7}$ $r = \frac{"-19814.3"}{\sqrt{"548571" \times "1948.86"}}$ $= -0.606 \quad (3 \text{ sf})$	M1 A1 M1 A1 [4]	or $10390000 - \frac{(8300)^2}{7} = \frac{3840000}{7}$ or 548571 or $45478 - \frac{552^2}{7} = \frac{13642}{7}$ or 1948.86 or $634700 - \frac{8300 \times 552}{7} = -\frac{138700}{7}$ or -19814.3	Correct sub in any correct S formula M1 Correct value of any S seen or implied by r A1 SC If $n = 6$, but otherwise correct allow M1A0M1A0 (ans $r = -0.574$, must see wking)
	(v)	No effect oe	B1 [1]	Stay the same oe Allow just "No"	Ignore all else

(Q3, Jan 2013)

31	(i)	$\Sigma d^2 = n$ seen or implied $1 - \frac{6 \times \text{anything}}{n(n^2-1)} = \frac{63}{65}$ or $\frac{6 \times \text{anything}}{n(n^2-1)} = \frac{2}{65}$ $\frac{6}{(n^2-1)} = \frac{2}{65}$ or eg $390 = 2(n^2 - 1)$ $n = 14$ NOT $n = \pm 14$	M1 M1 A1 depM2 A1 [4]	eg $1 - \frac{6 \times \Sigma d^2}{n(n^2-1)}$ or $1 - \frac{6 \times n^2}{n(n^2-1)}$ or $1 - \frac{6 \times 1^n}{n(n^2-1)}$ or $1 - \frac{6 \times 6^2}{n(n^2-1)} = \frac{63}{65}$ Any <u>correct</u> eqn after cancelling n or take out factor of n ; can be implied by $n = 14$ But A0 if $n = 14$ clearly follows from incorrect working If no working or unclear working, but $n = 14$, M1M1A1A1	Trial method: $\Sigma d^2 = 14$ M1 $1 - \frac{6 \times 14}{14(14^2-1)}$ oe M1 $= \frac{63}{65}$ A1 (0.969 : A0) $\Rightarrow n = 14$ A1 Conclusion needed
	(ii) (a)	$r = 1 \Rightarrow$ st line, hence true (or $r_s = 1$) oe Explanation essential Must state or imply "true"	B1 [1]	$r = 1 \Rightarrow y$ incr as x incr, so $r_s = 1$ oe Allow "True because perfect corr'n" or "True because $r = 1$ means pts ranked in order so $r_s = 1$ " " $r = 1$ means the ranks will agree" " $r = 1$ means all d 's are 0, hence $r_s = 1 - 0 = 1$ "	NOT " r incr so ranks incr" NOT " $r_s = r$ for ranks so true" NOT "True because strong corr'n"
	(ii) (b)	Diag, ≥ 3 pts, not on st line but with $x_{n+1} > x_n$ & $y_{n+1} > y_n$, Zig zag line or curve, moving up & right so r_s can still be 1 eg "expon'l curve gives $r \neq 1$ but $r_s = 1$ " B1B1	B1 B1dep [2]	Ignore explan if correct diag given Ignore any st line drawn Allow numerical example for which $r \neq 1$ but $r_s = 1$. If expl'n contradicts diag, mark diag For 2 nd B1 must state or imply "false"	

(Q7, Jan 2013)