A Level Statistics

AQA Past Exam Questions

Solutions

TOPIC: Cor[illegible]ients

The calculator can be used to find the value of the PMCC and SRCC for all questions, you do not need to calculate from scratch using the formulae. Because of this, some questions have a lot of marks available for calculating the value of r so this may not be representative of the marks available in the new course

Candidates may use any calculator allowed by Pearson regulations. Calculators must not have retrievable mathematical formulae stored in them.

Instructions

• Use **black** ink or ball-point pen.

• If pencil is used for diagrams/sketches/graphs it must be dark (HB or B). Coloured pencils and highlighter pens must not be used.

• **Fill in the boxes** at the top of this page with your name, centre number and candidate number.

• Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.

• Answer the questions ***on paper***

• You should show sufficient working to make your methods clear. Answers without working may not gain full credit.

• Unless otherwise stated, statistical tests should be carried out at the 5% significance level.

• When a calculator is used, the answer should be given to three significant figures unless otherwise stated.

Information

• ***You may use the*** booklet 'Statistical Formulae and Tables'

• There are **8** questions in this question paper. The total mark for this paper is ***165***

• The marks for **each** question are shown in brackets – use this as a guide as to how much time to spend on each question.

Advice

• Read each question carefully before you start to answer it.

• Try to answer every question.

• Check your answers if you have time at the end.

• If you change your mind about an answer, cross it out and put your new answer and any working underneath.

• Check your answers if you have time at the end.

AQA_JUNE_2012_2

2				
(a)	Probably correct	B1		CAO; accept minimum of PC or Pc or pC or pc
(b)	Definitely incorrect	B1		CAO; accept minimum of DI or Di or dI or di
(c)	Probably incorrect	B1	3	CAO; accept minimum of PI or Pi or pI or pi
	Notes: Ignore reasoning in all parts, unless it includes 2 of the 4 statements in which case ⇒ B0 If answers not labelled, then assume above order			Definitely wrong, etc ⇒ B0 Likely correct, etc ⇒ B0

AQA_JAN_2013_4

4(a)				
(i)	r = **–0.326 to –0.325** r = **–0.33 to –0.32** r = **–0.4 to –0.2** r = **0.2 to 0.4**	B3 (B2) (B1) (B1)		AWFW (–0.32569) AWFW AWFW AWFW
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ $\sum y^2$ & $\sum xy$ **or** Attempt at S_{xx} S_{yy} & S_{xy}	(M1)		756 50004 738 48200 & **45652** (all 5 attempted) 2376 2813 & **–842** (all 3 attempted)
	Attempt at substitution into **correct** corresponding formula for r	(m1)		
	r = **–0.326 to –0.325**	(A1)	**3**	AWFW
(ii)	**Some/little/slight/(fairly/quite) weak/ (fairly/quite) moderate** **negative** (linear) **correlation**/relationship/ association/link (*but not 'trend'*) between	Bdep1		Dependent on **–0.4 ≤ *r* ≤ –0.2** OE; must **qualify strength** and **state negative** Ignore extra words unless contradict Bdep0 for 'low', 'small', 'poor', 'unlikely', 'medium', 'average', or adjective 'very'
	marks/percentages in the two examination papers	B1	**2**	Context; providing **–1 < *r* < 1**

AQA_JUNE_2012_1

1				
(a)	$r = \frac{S_{xy}}{\sqrt{S_{xx} \times S_{yy}}} = \frac{-0.410}{\sqrt{2.030 \times 1.498}} = \underline{\mathbf{-0.235}}$	M1		Correct substitution into **correct** formula May be implied by a **correct** answer
		A1	2	AWRT (–0.235115)
(b)				Dependent on **–0.235 or –0.24** OE; must qualify strength **and** state negative Ignore extra words unless contradict Not 'no', 'low', 'small', 'unlikely' or 'trend'
	Some / (very) weak / (very) little / (very)slight negative correlation/relationship/association/link	Adep1		
	between **width and thickness** of lengths of steel	B1	2	Context; do **not** allow 'cms' or 'mms'
SC	r = (+)0.235 ⇒ M1 A0 Adep0 B1 max			

AQA_JAN_2008_2

2(a)	$r = \frac{416.3}{\sqrt{1280.55 \times 281.8}} =$	M1		Allow no $\sqrt{}$
	0.69 to 0.7(0)	A1	2	AWFW (0.693) (0.00115)
(b)	(Quite or fairly) **weak / some / moderate** (quite or fairly) **strong positive** **correlation** (relationship / association)	A1		OE; must qualify strength and indicate positive A0 for poor / reasonable / average / medium / good A0 for very weak / very strong etc
	between			
	head & body length and **tail length** *Ignore subsequent alternative comments only if A1 B1 already scored*	B1	2	Context; accept 'body and tail' or even 'head and tail'
	OR			
	Some evidence that mice with large head & body lengths also have long tails	(A1) (B1)		OE; must qualify strength and indicate positive in context
(c)	0.69 to 0.7(0) **OR** Answer to (a)	B1√	1	$0 < r < 1$
(d)	Existence of: **Non-linear** relationship **Outliers** **More than one** relationship	B1		Any one; OE Not reasons identifiable from context (eg spurious)
	Sensible related sketch	B1	2	
	SC: Check on calculation ⇒ B1 B0			

AQA_JUNE_2013_1

1(a)(i)	Mean = **62.2 to 62.3**	B1		AWFW (62.25)
	SD = **17.4 to 17.6 or 16.7 to 16.9**	B1	2	AWFW (17.519 or 16.774)
(ii)	Mean = **16.77 to 16.84**	BF1		AWFW (16.806) F on (a)(i) only providing **45 < mean < 65**
	SD = **9.66 to 9.78 or 9.27 to 9.39**	BF2	3	AWFW (9.733 or 9.319) F on (a)(i) only providing **10 < SD < 20**
(b)	r_{xy} = **0.997**	B1		CAO Award on value only; ignore any explanation or working $r_{xy} = r_{uv}$ with no value stated ⇒ B0
	***r* not affected by change(s) in/different units** **or** ***r* not affected by linear scaling** **or** **Scaling/coding/transformation/change/ conversion** to *u* and *v* is **linear**	B1	2	Accept 'Formula' or 'It' for *r* and reference to '**linear**' is **not** necessary Accept 'Formula' or 'It' for *r* but reference to '**linear**' is necessary OE; but reference to '**linear**' is necessary

AQA_JUNE_2017_5

5 (a)(i)	r = **–0.254 to –0.255** r = **–0.25 to –0.26** r = **–0.2 to –0.3**	B3 (B2) (B1)		AWFW (–0.25467) AWFW AWFW
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ $\sum y^2$ & $\sum xy$ **or** Attempt at S_{xx} S_{yy} & S_{xy} Attempt at substitution into **correct** corresponding formula for r r = **–0.254 to –0.255**	(M1) (m1) (A1)	**3**	552 27579.6 139.2 1658.22 & **6324.64** (all 5 attempted) 2187.6 43.5 & **–78.56** (all 3 attempted) AWFW
(ii)	**Weak/little negative** (linear) correlation	Bdep1		Dependent on **–0.3 ≤ r ≤ –0.2**
Notes	**1** Statements **must** include the words "weak or little **and** negative" **together with** "correlation" **or** "association" **or** "relationship"; ignore additional comments unless clearly contradictory **2** Use of the following additional terms (in conjunction with weak or little); "fairly or quite or very" ⇒ Bdep1 **3** Use of any of the following terms (even in conjunction with weak or little): "low or small or slight or poor or some or mild or reasonably or relatively or pretty" ⇒ Bdep0			
	between			
	(actual) **fuel consumption** and **mileage mark-up** of new **CARS**	B1		Context; providing **–1 < r < 1**
Notes	**1** "As fuel consumption of cars increases so does mileage mark-up" (OE) ⇒ Bdep0 B1 **2** "As fuel consumption/x increases so does mileage mark-up/y" (OE) ⇒ Bdep0 B0			
			2	
(b) (i)	$r = \dfrac{80.56}{\sqrt{916.8 \times 15.46}}$ = **0.676 to 0.677**	M1 A1	**2**	AWFW (0.67667)
(ii)	For petrol-engine cars or A1 to F1: **moderate** or **some positive correlation** between (actual) **fuel consumption** and **mileage mark-up** of new cars	B1 Bdep1 B1		Clear **consistent** distinction Dependent on **0.6 ≤ r ≤ 0.7** Context; (providing **–1 < r < 1**)
	For diesel-engine cars or A2 to F2: **Strong negative correlation** between (actual) **fuel consumption** and **mileage mark-up** of new cars	(B1) B1 (B1)		Only if not scored above for petrol-engine cars Only if not scored above for petrol-engine cars
Notes	**1** Only accept "moderate or some and strong" with no additional terms **2** Only accept "positive (linear) correlation" and "negative (linear) correlation"			
			4	

AQA_JAN_2007_3

3(a)	0.5 ≤ Value ≤ 0.95 Positive value < 1 (and > 0)	B2 (B1)		Value is actually 0.8
(b)	–0.2 ≤ Value ≤ +0.2	B1		Value is actually 0.0
(c)	–0.95 ≤ Value ≤ –0.5 Negative value > –1 (and < 0)	B2 (B1)	5	Value is actually –0.7

AQA_JUNE_2007_1

1(a)	$r = -0.526$ to -0.525 or $r = -0.53$ to -0.52 or $r = -0.6$ to -0.4	B3 (B2) (B1)		AWFW AWFW; ignore sign AWFW; ignore sign
	OR			
	Attempt at $\sum x$, $\sum x^2$, $\sum y$, $\sum y^2$ and $\sum xy$ or Attempt at S_{xx}, S_{yy} and S_{xy}	 (M1)		 260, 6970, 143, 2083 and 3671 210, 38.1 and –47
	Attempt at a correct formula for r	(m1)		
	$r = -0.526$ to -0.525	(A1)	3	AWFW
(b)	Weak/some/moderate negative correlation (relationship/association)	B1		OE; must qualify strength and indicate negative B0 for strong/poor/reasonable/average B0 if $r > 0$ or $r < -1$ B0 if contradictory statements
	between			
	length and (maximum) diameter	B1		Context
	Ignore subsequent comments (as below) only if B1 B1 already scored			
	OR			
	Some evidence that large lengths are associated with small diameters	(B1) (B1)		OE; must qualify strength and indicate negative
	OR			
	Longer melons tend to have smaller diameters / be thinner	(B1) (B1)	2	OE; must qualify strength and indicate negative

1(a)(i)	$r = 0.6$ to 0.98	B1		AWFW (≈ 0.8) If answers are not labelled, assume order is (a)(i) then (a)(ii)
(ii)	$r = -0.5$ to -0.02 Accept answers as ranges if and only if contained entirely within given ranges	B1	2	AWFW (≈ -0.3) Eg: (a)(i) 0.7 to 0.9 ⇒ B1 (a)(ii) −0.6 to −0.4 ⇒ B0
(b)(i)	$r = 0.757$ $r = 0.75$ to 0.77 $r = 0.65$ to 0.85 **or** Attempt at Σx Σx^2 Σy Σy^2 and Σxy **or** Attempt at S_{xx} S_{yy} and S_{xy} Attempt at substitution into correct corresponding formula for r $r = 0.757$	B3 (B2) (B1) (M1) (m1) (A1)	3	AWRT (0.75708) AWFW AWFW 271.5 6142.97 1911.9 304650.01 and 43259.17 (all 5 attempted) 0.2825 36.5425 and 2.4325 (all 3 attempted) AWRT
(ii)	Strong/fairly strong/moderate positive (linear) correlation/relationship/ association/link (but not 'trend') between Circumference/size and weight of (cricket) balls	Bdep1 B1	 2	Dependent on $0.65 < r < 0.85$ Or equivalent; must qualify strength and indicate positive Bdep0 for very strong/high/average/ medium/some etc. Context; providing $0 < r < 1$

AQA_JAN_2009_2

2 (a)(i)	r = 0.022 to 0.023 r = 0.02 to 0.03 r = –0.1 to 0.1 **OR** Attempt at $\sum x$ $\sum x^2$ $\sum y$ $\sum y^2$ & $\sum xy$ **or** Attempt at S_{xx} S_{yy} & S_{xy} Attempt at **correct** formula for r r = 0.022 to 0.023	B3 (B2) (B1) (M1) (m1) (A1)	3	AWFW (0.022557) AWFW AWFW 118.8 1619.36 31.5 114.43 & 416.13 (all 5 attempted) 51.2 4.18 & 0.33 (all 3 attempted) AWFW
(ii)	(Almost/virtually) **no/zero** (linear) **correlation** (relationship/association/link) between **length** and (maximum) **diameter** of carrots	B1 B1	2	Or equivalent qualification of **NO** strength; do not follow-through from (i) B0 for very weak/weak/some/ little/slight/positive/hardly any/etc unless correct qualification also stated Context; providing $-1 < r < 1$
(b)	**Unlikely**/wrong/incorrect/invalid Would expect a **positive value** **or** Would expect **weight to increase with length** **or** Would imply **shorter carrots are heavier**	B1 B1	2	Or equivalent Or equivalent reason

3 (a)(i)	$r =$ **0.748** $r =$ **0.74 to 0.76** $r =$ **0.7 to 0.8**	B3 (B2) (B1)		AWRT (0.74802) AWFW AWFW
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ $\sum y^2$ & $\sum xy$ **or** Attempt at S_{xx} S_{yy} & S_{xy} Attempt at substitution into correct corresponding formula for r $r =$ **0.748**	(M1) (m1) (A1)	**3**	364 10916 406 13688 & **11803** (all 5 attempted) 1452 1914 & **1247** (all 3 attempted) AWRT
(ii)	**Moderate/(fairly/quite) strong positive** (linear) correlation between **marks** on (the two) papers	Bdep1 B1	**2**	Dependent on **0.7** $\leq r \leq$ **0.8** OE; must **qualify strength** and state **positive** OE; providing $-1 < r < +1$
Notes	**1** Only accept phrases stated; ignore additional comments unless contradictory **2** Use of: "very/extremely/relatively strong or high or big or good or some or medium or average" ⇒ Bdep0 **3** Accept "relationship/association/link" but not "trend" instead of "correlation" **4** Do **not** accept "between papers" without further reference to marks			
(b) (i)	Group U: $r = \dfrac{34.57}{\sqrt{279.71 \times 112.86}}$ $=$ **0.19 to 0.2**	M1 A1	**2**	Correct **numerical** form; can be implied by a **correct** answer AWFW (0.19457)
(ii)	Group T **Some**/(fairly/quite/very) **weak/little/slight**/ (almost) **no/hardly any** (positive) correlation Group U **Some**/(fairly/quite/very) **weak/little/slight**/ (almost) **no/hardly any** (positive) correlation	B1 Bdep1	**2**	OE; must **qualify strength** Dependent on **0.19** $\leq r_U \leq$ **0.2** OE; must **qualify strength**
Notes	**1** Only accept phrases listed; ignore additional comments unless contradictory **2** Use of: "low or small or poor or bad or unlikely or relatively" ⇒ B0 **3** Accept "relationship/association/link" but not "trend" instead of "correlation" **4** "For each group" ⇒ B1 Bdep1 **5** "For both groups" ⇒ Bdep2 **6** "No reference to groups (OE)" ⇒ B0			
SC	**1** "Correlation in (a)(ii) is spurious (OE)" ⇒ B1			
(iii)	(Both mean) **marks** for Group T are (much) **larger** than those for Group U so extra **tuition** appears beneficial/effective	B1 Bdep1	**2**	OE Ignore comments about r_T and r_U OE; dependent on B1
SC	**1** "Group T candidates may have been more motivated so would have performed better even without extra tuition (OE)" ⇒ B0 B1			

7				
(a)	**Ryan:** Value indicates that as **volume increases** then **weight decreases**	B1		Or equivalent in context
	Sunil: Value indicates **no correlation/relationship/ association/link** between **volume and weight**	B1	2	Or equivalent in context
	SC: If B0 B0: Would expect **weight** to **increase** with **volume** **or** Would expect **strong**(er) **positive** correlation between **weight** and **volume**	(B1)		Or equivalent in context
(b)	**Ryan & Sunil:** r is not affected by units/(linear) scaling	B1		Or equivalent
	Tim: r is not affected by sample size **or** $2 \times 0.612 > 1 \Rightarrow$ impossibility	B1	2	Either; or equivalent
(c) **(i)**	r = **0.541 to 0.543** r = **0.54 to 0.55** r = **0.5 to 0.6**	B3 (B2) (B1)	3	AWFW (0.54186) AWFW AWFW
	OR			
	Attempt at $\sum v$ $\sum v^2$ $\sum w$ $\sum w^2$ & $\sum vw$ **or** Attempt at S_{vv} S_{ww} & S_{vw}	(M1)		216 6633.16 136 2376.84 & **3795.5** (all 5 attempted) Accept notation of x and y 801.16 64.84 & **123.5** (all 3 attempted)
	Attempt at substitution into **correct** corresponding formula for r	(m1)		
	r = **0.541 to 0.543**	(A1)		AWFW
(ii)	(Quite or fairly) **weak/some/moderate** **positive** (linear) **correlation**/relationship/ association/link (*but not 'trend'*)	Bdep1		Dependent on **$0.5 \leq r \leq 0.6$** Or equivalent; must **qualify strength** and **state positive** Bdep0 for very strong/strong/high/ good/average/medium/reasonable/ poor/very weak/little/etc
	between **volumes** and **weights** of suitcases	B1	2	Context; providing **$0 < r < 1$**

1 (a)	r = **0.608** = **0.6 to 0.62** = **0.5 to 0.7**	B3 (B2) (B1)		AWRT (0.60810) AWFW AWFW
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ $\sum y^2$ & $\sum xy$ **or** Attempt at S_{xx} S_{yy} & S_{xy}	(M1)		20.25 41.0455 11.30 12.7862 & **22.8983** (all 5 attempted) 0.03925 0.0172 & **0.0158** (all 3 attempted)
	Attempt at substitution into **correct** corresponding formula for r	(m1)		
	r = **0.608**	(A1)	**3**	AWRT
(b)	**Some/moderate positive** (linear) **correlation**/relationship/association	Bdep1		Dependent on **$0.5 \leq r \leq 0.7$** Must **qualify strength** and **state positive**
Notes	**1** Only accept phrase stated; ignore additional comments unless contradictory **2** Any mention of "strong or weak" ⇒ Bdep0 **3** Use of: "quite/fairly/relatively/reasonably moderate" ⇒ Bdep0 **4** Use of: "high or big or good or low or small or poor or medium or average" ⇒ Bdep0			
	between **trunk** and **tail lengths** of male African **elephants**	B1	**2**	Context; providing **$-1 < r < 1$**
Notes	**1** "As trunk lengths of elephants increase so do tail lengths" (OE) Bdep0 B1 **2** "As trunks/x increase so do lengths/y" (OE) Bdep0 B0			

AQA_JUNE_2010_1

1(a)	r = **0.915**	B3		AWRT (0.91504)
	r = **0.91 to 0.92**	(B2)		AWFW
	r = **0.88 to 0.95**	(B1)		AWFW
	OR			
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ $\sum y^2$ and $\sum xy$			12510 15835890 1180 146616 and **1510062** (all 5 attempted)
	or			
	Attempt at S_{xx} S_{yy} and S_{xy}	(M1)		185880 7376 and **33882** (all 3 attempted)
	Attempt at substitution into **correct** corresponding formula for r	(m1)		
	r = **0.915**	(A1)	3	AWRT
(b)	**Very strong / strong / fairly strong positive** (linear) **correlation** / relationship / association / link (*but not 'trend'*)	B1dep		Dependent on **0.88 < r < 0.95** Or equivalent; must qualify strength and indicate positive B0dep for (almost) perfect / high / average / medium / some / etc
	between			
	weight and **(**engine**) power/bhp** of (hatchback) cars	B1	2	Context; providing **0 < r < 1**
	Examples:			
	The more weight/heavier the more/greater power ⇒ B0dep B1			No mention of strength
	Strong correlation and as weight/kg increases so does engine power / bhp ⇒ B0dep B1			Mention of strength but implied suggestion of positive not sufficient

AQA_JUNE_2018_1

1(a)				
(i)	SD1: r = **–0.99 to –1(.00)**	B1		AWFW (–1.00000)
(ii)	SD2: r = **0.75 to 0.95**	B1	**2**	AWFW (0.89935)
(b)				
(i)	SD3: Data/relationship/graph is **non-linear/curved/parabolic**	B1		OE; two relationships/correlations
(ii)	SD4: No correlation if **outlier** ignored Correlation caused only by **outlier**	B1	**2**	OE; must reference 'outlier' or 'anomaly'
(c)				
(i)	**Possibly correct**	B1		CAO; ignore reasoning/explanation
(ii)	**Probably incorrect**	B1		CAO; ignore reasoning/explanation
(iii)	**Definitely incorrect**	B1	**3**	CAO; ignore reasoning/explanation