A Level Statistics

AQA Past Exam Questions

TOPIC: Numerical M

** The new calculator does a lot more than the old calculator

Many of the marks awarded in these questions will be reduced for the new spec dues to the advances in technology **

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 ***95***

• 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_2018_2

Q	Solution	Marks	Total	Comments
2 (a)	Mid-points: 1 3 5 7 9 12.5 17.5 25	B1		CAO; ≥5 correct or can be implied by mean = 10.0 to 10.8
	Mean = **10.6**	B1		CAO $(\sum x = 1060)$
	Sd(n) = **5.81 to 5.82**	B2		AWFW (5.812912) $(\sum x^2 = 14615)$
	or Sd(n–1) = **5.84 to 5.85**			AWFW (5.842201)
	or Sd(n) **or** Sd(n–1) = **5.6 to 6.0**	(B1)	4	AWFW
Notes	**1** Where no method is shown for mean and standard deviation, then simply mark numerical values stated **2** If an incorrect method for mean is followed by a numerically correct value ⇒ B1 B1 **3** If an incorrect method for standard deviation is followed by a numerically correct value ⇒ 2 solutions so B2 becomes B1 or (B1) becomes (B0)			
(b)	Mean = 1.85 + 1.3 × [mean in (a)]	m1		**Dep on** mean(a) = 10.0 to 10.8 **or** mean(b) = 15.37 to 15.89
	= **15.63 or 1563**	A1		CAO; units (£/p) can be assumed
	Standard deviation = 1.3 × [sd in (a)]	m1		**Dep on** sd(a) = 5.6 to 8.2
	= **7.55 or 7.56 or 7.59 or 7.60** **or** = **755 or 756 or 759 or 760**	A1	4	CAO; units (£/p) can be assumed (7.556792 or 7.594861)
		Total	**8**	

AQA_JUNE_2017_1

Q	Solution	Marks	Total	Comments
1 (a)	Median **and** Interquartile Range **or** Semi-Interquartile Range	B1		**Names** seen **correctly** somewhere in (a) Do **not** accept Q_2, m, IQR, $SIQR$, etc
(i)	Median (Q_2, m) = **31**	B1		CAO
(ii)	IQR = **34** **or** $SIQR$ = **17**	B2	4	CAO; either
SC	**1** If B0 in (ii), then award B1 for **use of** 47 (Q_3) or 13 (Q_1); eg 42 – 13 = 29 ⇒ B1			
(b)	Mean = **33**	B1		CAO $(\sum x = 495)$
	Sd(n) = **20.4 to 20.5**	B2		AWFW (20.46460) $(\sum x^2 = 22617)$
	or Sd(n–1) = **21.1 to 21.2**			AWFW (21.18288)
	or Sd(n) **or** Sd(n–1) = **20 to 22**	(B1)	3	AWFW
Notes	**1** Value of variance stated as 418.8 or 448.7 ⇒ B0 **2** Value of standard deviation stated as √418.8 or √448.7 ⇒ B0 **3** If, and only if, B0 B0, then award M1 for **seen** attempt at (490 to 500) ÷ 15			
		Total	**7**	

AQA_JUNE_2016_2

Q	Solution	Marks	Total	Comments
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 ≤ *r* ≤ 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			
		Total	**5**	

AQA_JUNE_2015_1

Q	Solution	Marks	Total	Comments
1 (a)	Mode = **10**	B1		CAO; ignore any reference to 9 unless stated as the/a mode
	Median = **11**	B1		CAO; providing not based on shown incorrect working
	UQ = **14** LQ = **10**	B1		Either CAO; ignore notation Can be implied from IQR = 4 with no working or from IQR = 4 not from incorrect working
	IQR = **4**	B1	**4**	CAO
Notes	**1** If values are not identified, then assume that order of values is mode, median, IQR **2** Ordering of days (1, 1, 2, 3, 3, 4, 5, 7, 9) ⇒ mode = 3, median = 3, IQR = 6 – 1.5 = 4.5 ⇒ no marks			
(b)	Mean = **11.8**	B2		CAO $(\sum f = 35$ and $\sum fx = 413)$
	Mean = **11.7 to 11.9**	(B1)	**2**	AWFW
Notes	**1** Using only x-values gives mean = 11.22 ⇒ B0 **2** Using only f-values gives mean = 3.889 ⇒ B0 **3** If, and only if, B0, then award M1 for **seen** attempt at $\sum fx \div 35$ or for **seen** attempt at $413 \div 35$			
		Total	**6**	

AQA_JUNE_2014_1

Q	Solution	Marks	Total	Comments
1	**No MR or MC in this question**			
(a)	Ordered data: 3.3 3.6 3.7 3.8 3.9 4.0 4.1 4.5 4.6 4.7 4.8 4.9 5.0 5.1 5.2	M1		*May be near printed values* If seen, then ≥5 correctly ordered If not seen, then can be implied from ≥1 of M, UQ, LQ or IQR correct
	Median = **4.5**	A1		CAO
	UQ = **4.9** LQ = **3.8**	A1		Either CAO; ignore notation Can be implied by IQR = 1.1
	IQR = **1.1**	A1		CAO
			4	
Notes	**1** If values are not ordered, then M = 5.2, UQ = 3.3 and LQ = 4.5 so IQR = (–)1.2 ⇒ M0 **2** If answers are not identified, then assume that order of values is median, IQR			
(b)	Range = 5.2 – 3.3 = **1.9**	B1	**1**	CAO
Note	**1** If values are not ordered, then Range = 0.2 ⇒ B0			
(c)	All values are different/each value occurs once/ there is no mode	B1	**1**	OE
		Total	**6**	

AQA_JUNE_2013_1a

Q	Solution	Marks	Total	Comments
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**

AQA_JUNE_2010_2

Q	Solution	Marks	Total	Comments
2	–18 –11 1 15 7 –1 17 –16 18 –3 0 9			
(a)(i)	Mean, $\bar{d}$ = **1.5**	B1		CAO $\sum d = 18$
	Standard deviation, σ_d or s_d = **11.7 to 12.3**	B1	2	Ignore notation and units (11.737 or 12.259) AWFW $\sum d^2 = 1680$
(ii)	Mean, $\bar{x} = 50 + \bar{d}$ = **51.5**	B1F		F on (a)(i) or correct
	x: 32 39 51 65 57 49 67 4 68 47 50 59			$\sum x = 618$ $\sum x^2 = 33480$
	Standard deviation, σ_x or s_x = **11.7 to 12.3**	B1F	2	Ignore notation and units F on (a)(i) providing > 0 or correct
(b)	[Values, mean or sd in (a)(i) or (a)(ii)] $\times \frac{1.22}{100}$ or 1.22	M1		Award if use seen or implied by ≥ 1 Subsequent correct or (correct × 100) answer
	Mean = **0.628 to 0.63**	A1		AWFW (0.6283)
	Standard deviation = **0.14 to 0.151**	A1	3	AWFW (0.1432 or 0.1496)
	Special Cases: **At least one** answer correct with no stated units or incorrect stated units ⇒ M1 A1 A1 max			
	At least one answer × 100 with its units stated as 'cents' ⇒ M1 A1 A1 max			'cents' attached to **≥ 1** answer × 100
	At least one answer × 100 with no units stated or units stated as euros / pence / £ ⇒ M1 only			
	Total		**7**	

AQA_JUNE_2008_4

Q	Solution	Marks	Total	Comments
4(a)	Ordering: 0 0 13 28 35 40 47 51 63 77 a	M1		May be implied by 40 and/or 63 and 13
	Median (6^{th}) = 40	B1		CAO
	IQR = $Q_3(9^{th}) - Q_1(3^{rd})$			
	= 63 – 13	(B1)		Identification of 63 and 13
	= 50	B2	4	CAO
(b)(i)	*Mode*: Zero is not representative / sensible reason			
	Wide range of (known) values Small number of values mostly different	B1		Or equivalent
(ii)	*Range*: Largest value, a, is unknown Cannot be calculated	B1	2	Or equivalent
	Total		**6**	

AQA_JUNE_2012_2

Q	Solution	Marks	Total	Comments
2 (a)(i)	Mode = **23**	B1	1	CAO
(ii)	Median (88^{th} value) = **22**	B1		CAO
	Upper quartile (132^{nd} value) = **23**	B1		CAO; either
	Lower quartile (44^{th} value) = **20**			May be implied by IQR = 3
	Interquartile range = **3**	B1	3	CAO; do **not** award if **seen** to be not based on 23 and 20
(b)	Mean = **22.3**	B2		CAO; but only award B1 (22.3) if incorrect mid-points or Σfx **seen**
	Mean = **21 to 23**	(B1)		AWFW (Σfx = 3902.5)
	Standard deviation = **6.37 or 6.39**	B2		AWRT (s = 6.391 σ = 6.372)
	Standard deviation = **5 to 7**	(B1)	4	AWFW (Σfx^2 = 94132.25)
SC	Only if B0 B0 or B1 B0 then award as follows but only up to a **maximum total part mark of 2** **1** At least 2 correct mid-points 4.5, 14.5, 27, 32, 37, 44.5, 54 seen ⇒ M1 **2** Clear use of $\Sigma fx/(175$ or $174)$ ⇒ M1			
(c)	Mean = (c's mean from (b)) + $\frac{280}{175}$ = 22.3 + 1.6	M1		Adding (1.6 or equivalent) CAO to (c's mean from (b)) **or** to (c's new mean)
	Mean = **23.9**	AF1	2	F on (c's mean from (b)) **or** on (c's new mean)
	Total		**10**	

AQA_JUNE_2009_5

Q	Solution	Marks	Total	Comments
5(a) (i)	Median (50) = **3**	B1		CAO
	If not identified, then assume order is median then IQR			Do not award marks if correct answers are based on shown incorrect method; eg accept use of 99/2, etc but not 276/2, etc
	IQR (75 – 25) = 4 – 2 = **2**	B2		CAO; but 25th value ⇒ IQR = 2 ⇒ B0
	Special Cases:			
	Identification that LQ = 2 and UQ = 4	(B1)		Both CAO
	Statement of ≥ 4 cumulative frequencies *F*: 14 49 74 87 96 98 99	(M1)	3	Can award if no marks scored in (i) even if then applied to continuous data
(ii)	Mean = $\frac{\sum fx}{\sum f} = \frac{275}{99}$ = 2.77 to 2.78	B1		AWFW (2.778)
	If not identified, assume order is $\bar{x}$ then s			Treat rounding to integers as ISW
	SD $\left(\sum fx^2 = 933\right)$ = 1.3(0) to 1.32	B2		AWFW (1.307 & 1.314)
	Special Case:			
	Evidence of $\frac{\sum fx}{99}$	(M1)	3	Can award if no marks scored in (ii)
(b)(i)	$\text{Mean}_{163} = \frac{99 \times \text{Mean}_{99}}{163}$ or $\frac{\sum fx \text{ from(a)(ii)}}{163}$	M1		Or equivalent; may be implied by an answer within range
	= 1.68 to 1.69	A1	2	AWFW (1.687)
(ii)	Increase	B1	1	CAO; or equivalent (1.696) Ignore any working (1.702)
(iii)	Data is (positively/negatively) skewed / not symmetric / bimodal / not bell-shaped from frequency distribution / given table	B1		Or equivalent
	or [C's mean in (b)(i)] – 2 × [C's SD in (a)(ii)] < 0 or [C's mean in (b)(i)] – 2 × [1.69 to 1.71] < 0			(–1.75 to –0.90)
	Thus claim appears **not valid**	B1 dep	2	Or equivalent Dependent upon previous B1
	Total		**11**	

Q	Solution	Marks	Total	Comments
1 (a)(i)	Mode = **253**	B1	1	CAO
(ii)	Median = **252**	B1		CAO
	Upper quartile = **253** Lower quartile = **250**	B1		CAO; either May be implied by IQR = 3
	Interquartile range = **3**	B1	3	CAO; do not award if **seen** to be not based on 253 and 250
(b)(i)	Range = 271 – 227 = **44**	B1	1	CAO; do not award if **seen** to be not based on 271 and 227
(ii)	Mean, $\bar{x}$ = **251 to 251.4** *Award B1 if divisor **seen** not to be 85 but answer in range*	B2		AWFW $\sum fx = 21352$ $\bar{x} = 251.2$
	Note: If B0 then can award M1 for attempt at $\sum fx \div 85$ **seen**			*Ignore notation and condone incorrect midpoints (eg upper or lower limits used)*
	Standard deviation, s or σ = **4.21 to 4.28** *Award B1 if divisor **seen** not to be 84 or 85 but answer in range*	B2	4	AWFW $\sum fx^2 = 5365134$ $\sigma = 4.217$ $s = 4.242$
(c)	Interquartile range (IQR)	B1		Named
	Not affected by unknown/large/small/extreme/ outlying/227 & 271 values	Bdep1	2	Or equivalent Dependent on previous B1 Only negative comments on other measures ⇒ Bdep0
	OR			*More than one named ⇒ B0 Bdep0* *Range ⇒ B0 Bdep0*
	Standard deviation (s or σ)	(B1)		Named
	Uses all data values	(Bdep1)		Or equivalent Dependent on previous (B1) Only negative comments on other measures ⇒ Bdep0
	Total		**11**	

AQA_JUNE_2007_4

Q	Solution	Marks	Total	Comments
4(a)(i)	Mode = 2	B1		CAO
	Range = 15	B1	2	CAO
(ii)	CF: 4 17 41 58 73 84 89 95 x: 0 1 2 3 4 9 14 15			
	Median (48^{th}) = 3	B2		CAO; B0 if shown method is incorrect
	Interquartile Range ($72^{nd} - 24^{th}$) = 4 – 2 = 2	B2		CAO Allow B1 for identification of 4 and 2 B0 if shown method is incorrect
	If neither correct but CF attempted and matched correctly with ≥ 5 x–values	(M1) (A1)	4	Allow for median = $2 + \frac{x}{17}$
(iii)	Mean $(\bar{x})$ = 4.2	B2		CAO $\sum fx = 399$
	Standard Deviation (s_n, s_{n-1}) = 3.88 to 3.91	B2		$\sum fx^2 = 3111$ AWFW (3.887 or 3.907)
	If neither correct but mid-points of 7 and 12 seen and use of mean $(\bar{x}) = \frac{\sum fx}{95}$	(B1) (M1)	4	Allow for $4.1 \le \bar{x} \le 4.3$
(b)(i)	Unknown values (16) have no effect on median and IQR **or** median and IQR are exact values but $\bar{x}$ and s are estimates	B1	1	
(ii)	Use all available data or Enable further analyses	B1	1	
	Total		**12**	