



AS

Statistics

SS02

Mark scheme

6380

June 2016

Version 1.0: Final Mark Scheme

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk.

Key to mark scheme abbreviations

M	mark is for method
m or dM	mark is dependent on one or more M marks and is for method
A	mark is dependent on M or m marks and is for accuracy
B	mark is independent of M or m marks and is for method and accuracy
E	mark is for explanation
✓ or ft or F	follow through from previous incorrect result
CAO	correct answer only
CSO	correct solution only
AWFW	anything which falls within
AWRT	anything which rounds to
ACF	any correct form
AG	answer given
SC	special case
OE	or equivalent
A2,1	2 or 1 (or 0) accuracy marks
-x EE	deduct x marks for each error
NMS	no method shown
PI	possibly implied
SCA	substantially correct approach
c	candidate
sf	significant figure(s)
dp	decimal place(s)

No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded.

Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

Otherwise we require evidence of a correct method for any marks to be awarded.

Q1	Solution	Marks	Total	Comments
(a)	Median for females is 165cm Median for males is 178cm	B1	2	For both values or 13cm. NOT “mean” For comparing medians
	On average males are (13cm) taller OE	E1dep		
(b)	Range of females is 39cm Range of males is 38cm		2	CAO AWLW 7.5 to 8.5
	Or: IQR of females is 8cm IQR of males is $182 - 174 = 8\text{cm}$ So spread is similar or the same.	B1 E1		
(c)	Male distribution is fairly symmetric (or slight positive skew) Female distribution is more (negatively) skewed.	B1	2	AWLW 7.5 to 8.5. For <u>either</u> pair of values For <u>either</u> interpretation
		B1		
			6	

Examples for 1(c)

- Male symmetric, female not symmetric 2 marks
- Male symmetric, female skew 2 marks
- Male positive skew, female negative skew 2 marks
- Both symmetric 1 mark
- Both skewed (but type not specified) 1 mark

Q2	Solution	Marks	Total	Comments												
(a)(i)	$0.21 + 0.10 + 0.20$ $= 0.51$ ($= 51\% = \frac{51}{100}$)	B1	1	Answer in any of these three forms												
(ii)	$0.12^2 + 0.19^2 + 0.18^2 + 0.21^2 + 0.1^2 + 0.2^2$ $= 0.177$ ($= 17.7\% = \frac{177}{1000}$)	M1 A1														
(b)(i)	New table <table border="1" style="margin-left: 20px;"> <tr> <td>0.50</td> <td>1</td> <td>1.50</td> <td>2</td> <td>3</td> <td>5</td> </tr> <tr> <td>0.12</td> <td>0.19</td> <td>0.18</td> <td>0.21</td> <td>0.10</td> <td>0.20</td> </tr> </table>	0.50	1	1.50	2	3	5	0.12	0.19	0.18	0.21	0.10	0.20	B1	2	May be implied by next line or correct answer
0.50	1	1.50	2	3	5											
0.12	0.19	0.18	0.21	0.10	0.20											
	Mean = $0.50 \times 0.12 + 1 \times 0.19 \dots + 5 \times 0.20$ $= 2.24$	M1 A1														
	Special Cases: No working but correct answer B3 Wrong working but correct answer B2															
	$0.50^2 \times 0.12 + 1^2 \times 0.19 \dots + 5^2 \times 0.20 - '2.24'^2$ $= 7.365 - '2.24'^2$ $= 2.3474$ and $\sqrt{2.3474} = 1.53$	M1 A1	5	Complete method (their 2.24) AG												
(ii)	'2.24' \pm 1.53 = 0.71, 3.77 $0.19 + 0.18 + 0.21 + 0.10 = 0.68$	M1 A1														
			2	Their mean – both values required CAO. Or B2 for answer alone												
			10													

Q3	Solution	Marks	Total	Comments
(a)	Because the figures are rounded to the nearest thousand	E1	1	Accept “Rounding error”
(b)	$2958000000 \div 10427000$ (= 283.686...) = £284	M1 A1		2
(c)	$(36838 - 31694) \div 36838 \times 100$ = 14.0%	M1 A1	2	
(d)(i)	$10748 \div 17507 \times 360$ = 221°	M1 A1		2
(d)(ii)	Use of $58507 \div 17507$ (= 3.34192...) Use of $\sqrt{(58507 \div 17507)}$ (= 1.828...) Multiplied by 5 = 9.14 cm	M1 m1 A1	3	
				10
4(a)	Throughout part (a)			Unsupported correct answer scores full marks.
(i)	Using Po(6), $P(\leq 4) - P(\leq 3)$ or $e^{-6} \times 6^4/4!$ = 0.1339 (= 0.134 to 3 s.f.)	M1 A1	2	AWRT 0.134
(ii)	Using Po(2) 0.6767	M1 A1		2
(iii)	Using Po(10), $1 - P(\leq 7) = 1 - 0.2202 = 0.7798$	M1 A1	2	
(iv)	Using Po(11), $P(\leq 14) - P(\leq 5)$ = $0.8540 - 0.0375 = 0.8165$	M1 m1 A1		3
(b)	The rate of accidents over a period of a few months may not be the same as the annual rate	E1	1	
				10

Q5	Solution	Marks	Total	Comments
(a)	$H_0: \mu = 5.8$ $H_1: \mu < 5.8$	B1	8	For both. 'Population mean' can be used instead of μ
	$\bar{x} = 452.8 \div 80 = 5.66$ $s^2 = (33.552 \div 79) = 0.4247$ so $s = 0.6517$	B1		CAO
	$z = \frac{(5.66 - 5.8)}{0.65/\sqrt{80}}$ $= -1.92$ or -1.93	B1 M1 m1 A1		For either AWRT 0.652 For use of $\sqrt{80}$ For rest of formula (ignore sign) AWFW -1.92 to -1.94
	Critical value $= -1.2816$ (or $t_{99} = -1.29$)	B1		AWRT -1.28 (or -1.29)
	-1.92 or $-1.93 < -1.2816$ (or -1.29) so reject H_0 . Significant evidence that blood cholesterol level is less than 5.8 supporting Monica's belief.	A1dep		AG. Comparison must be stated or diagram shown. Dep on all except first B1
	Alternative 1 Where $\sigma^2 = 33.552 \div 80 = 0.4194$ so $\sigma = 0.6476$ has been used followed by $\sqrt{80}$ or $\sqrt{79}$, mark as above, but s^2 followed by use of $\sqrt{79}$ can only score B1, B1, B1, M0, m0, A0, B1, A0			Third B1 is for AWRT 0.648
	Alternative 2 If p -value approach used. B1, B1, B1, M1, m1, A1 as above Then p -value of approx. 0.027 A1 Comparison with 0.1 A1			
	(b) $1.88 < 1.92 < 2.05$ so $2 < \alpha < 3$ Or p -value of approx. 0.027	M1		Accept 1.88 or 2.05 (+ or -) for M1 AWLW 0.025 to 0.030
	Can use $\alpha = 3$ (but not 2)	A1		CAO B1 for answer alone.
	(c) (Rejected H_0 when true so) Type I error.	B1		
		11		

Q6	Solution	Marks	Total	Comments
(a)	Eg. Only those with a strong opinion would be likely to complete the questionnaire. Or. Head of household might complete the questionnaire but not reflect the views of all members of the household. Or. Does not take size of household into account.	E1	1	Or similar valid reason
(b)(i)	Number the residents 0000 to 4749 (or 0001 to 4750) Starting at a random position pick a 4-digit random number from the table Ignore (0000 &) anything over 4749 (4750) and any repeats. Repeat until the sample contains 80 numbers and select the corresponding residents	B1 B1 B1		For the numbering to a correct total Use of 4 digits Both high numbers and repeats
	Special case: Allow the marks for these steps applied to three separate registers for the three villages, but then the fourth B1 needs to explain proportionate division of the 80 in the sample between the villages, (10, 29, 41)	B1dep	4	Both 80 and corresponding. Dep on at least one previous B1.
(ii)	Because it is random, the various categories may be over- or under-represented.	E1	1	Or equivalent – maybe one example
(iii)	Because the register is by household, a systematic sample should represent the villages <u>in the correct proportions</u> , but there is no reason why it should represent the genders, or other features, correctly. Or since 4750 does not divide exactly by 80, some more likely to be chosen than others.	E1 E1	2	For it addressing the villages For it not addressing the genders or for recognising the division problem

Q6cont	Solution	Marks	Total	Comments																								
(c)	<p>Multiplying each category by $\frac{80}{4750}$</p> <p>Giving</p> <table border="1" data-bbox="296 517 691 669"> <thead> <tr> <th></th> <th>M</th> <th>F</th> </tr> </thead> <tbody> <tr> <td>Lower</td> <td>4.28</td> <td>5.51</td> </tr> <tr> <td>Middle</td> <td>14.21</td> <td>15.11</td> </tr> <tr> <td>Upper</td> <td>19.96</td> <td>20.93</td> </tr> </tbody> </table> <p>Then</p> <table border="1" data-bbox="271 757 663 902"> <thead> <tr> <th></th> <th>M</th> <th>F</th> </tr> </thead> <tbody> <tr> <td>Lower</td> <td>4</td> <td>6</td> </tr> <tr> <td>Middle</td> <td>14</td> <td>15</td> </tr> <tr> <td>Upper</td> <td>20</td> <td>21</td> </tr> </tbody> </table> <p>Interview any 4 male residents in Lower Wedlock, any 6 female residents in Lower Wedlock, any 14 male residents in Middle Wedlock etc.</p> <p>Special case: Only specifying L:M:U = 10:29:41 or M:F = 38:42 B1 only.</p>		M	F	Lower	4.28	5.51	Middle	14.21	15.11	Upper	19.96	20.93		M	F	Lower	4	6	Middle	14	15	Upper	20	21	<p>M1</p> <p>A1</p> <p>A2,1</p> <p>E1</p>	<p>5</p> <p>13</p>	<p>Specifying correct arithmetic (might be division by 59.375)</p> <p>Correct with decimal (at least 3 s.f.) Possibly implied by integer table. Allow one slip</p> <p>2 marks completely correct, 1 for correct apart from single error.</p> <p>Convincing completion of method.</p>
	M	F																										
Lower	4.28	5.51																										
Middle	14.21	15.11																										
Upper	19.96	20.93																										
	M	F																										
Lower	4	6																										
Middle	14	15																										
Upper	20	21																										

Q7	Solution	Marks	Total	Comments
(a)	$(260 + 319 + 294) \div 3$ $= 291$	M1 A1	 2	M1 for correct 3 added and divided by 3 CAO
(b)	Accurately plotted (allow 1 slip) Reasonable trend line	B1 B1	 2	Within a circle radius a half square (M1, 380-400) to (W31, 200-220)
(c)(i)	Random variation (about a downward trend)	B1		Accept “short term”
(ii)	Seasonal variation (about a downward trend)	B1	2	
(d)(i)	$[(323 - 385) + (302 - 344) + (260 - 305)] \div 3$	M1		For complete correct method, using <u>three</u> subtractions, Monday or Friday
(ii)	$= -50$ Similarly for Friday	A1		-55 to -45 SC B1 for one of or both (i) and (ii) correct but no working.
	$[(381 - 358) + (336 - 318) + (294 - 278)] \div 3$ $= (+)19$	A1	3	15 to 25
(e)	Anything 230 to 245 + (d)(ii) (in range 15 to 25) $= 250$ to 260	M1 m1 A1	 3	Their graph reading their (d)(ii) (even if from 2 values) AWFW 245 to 265
(f)	Monday 22 is $215 > 200$ so not then “225” – “50” = 175 So Monday 29	E1 E1 B1		Anything between 200 and 230 Anything between 200 and 150 Allow unsupported for just B1
	Alternative: Must be a Monday Require Monday with trend < 250 First is Monday 29 th	E1 E1 B1	 3	245 to 255
			15	

Figure 3

