

A-LEVEL

Statistics

Statistics 1B – SS1B

Mark scheme

6380
June 2014

Version/Stage: Final

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.

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 Median = <u>4.5</u> UQ = <u>4.9</u> LQ = <u>3.8</u> IQR = <u>1.1</u>	M1 A1 A1 A1	4	<i>May be near printed values</i> If seen, then ≥ 5 correctly ordered If not seen, then can be implied from ≥ 1 of M, UQ, LQ or IQR correct CAO Either CAO; ignore notation Can be implied by IQR = 1.1 CAO
Notes	1 If values are not ordered, then M = 5.2, UQ = 3.3 and LQ = 4.5 so IQR = (-)1.2 \Rightarrow M0 2 If answers are not identified, then assume that order of values is median, IQR			
(b)	Range = 5.2 - 3.3 = <u>1.9</u>	B1	1	CAO
Note	1 If values are not ordered, then Range = 0.2 \Rightarrow B0			
(c)	All values are different/each value occurs once/ there is no mode	B1	1	OE
		Total	6	

Q	Solution	Marks	Total	Comments
2	No MR or MC in this question			Accept %age equivalents in (a)(i) to (iii)
(a)	<u>Time, $X \sim N(7.5, 1.6^2)$</u>			
(i)	$P(X < 10) = P\left(Z < \frac{10 - 7.5}{1.6}\right)$ $= P(Z < 1.5625) = \underline{\mathbf{0.94}}$	M1 A1	(2)	Standardising 10 with 7.5 and 1.6 but allow (7.5 – 10); $z^2 \Rightarrow$ M0 AWRT (0.94091)
(ii)	$P(X > 6) = P(Z > -0.9375) = P(Z < 0.9375)$ $= \underline{\mathbf{0.82 \text{ to } 0.83}}$	M1 A1	(2)	Correct area change; 0.9375 or correct standardising are not required Can be implied by final answer > 0.5 AWFW (0.82575)
(iii)	$P(5 < X < 10) =$ $P(Z < 1.5625) - P(Z < -1.5625) =$ $(i) - [1 - (i)] \quad \text{or} \quad 1 - 2 \times [1 - (i)]$ $= [2 \times (i)] - 1$ $= 2 \times 0.94091 - 1 = \underline{\mathbf{0.88}}$	M1 A1	(2)	OE; any correct difference in areas using (a)(i) or $P(5 < X < 10)$ Can be implied by a correct final answer AWRT (0.88182)
			6	
(b)	$80\% (0.8) \Rightarrow z = \underline{\mathbf{0.84}}$ $P(Y < 15) = P\left(Z < \frac{15 - \mu}{2.4 \text{ or } 1.6}\right)$ $\left(\frac{15 - \mu}{2.4}\right) = 0.84(16) \text{ or } 1.28(16)$ $\mu = \underline{\mathbf{12.95 \text{ to } 13}}$	B1 M1 m1 A1	4	AWRT; ignore sign (0.8416) Standardising 15 with μ and (2.4 or 1.6) but allow $(\mu - 15)$ Equating expression with $\sigma = 2.4$ to either z-value (<i>ignore sign</i>) Can be implied by a correct answer AWFW (12.9802) Must be consistent signs throughout
		Total	10	

Q	Solution	Marks	Total	Comments
3	No MR or MC in this question			
(a)	b (gradient/slope) = <u>0.85</u> b (gradient/slope) = <u>0.8 to 0.9</u> a (intercept) = <u>94.6 to 94.8</u> a (intercept) = <u>93 to 97</u>	B2 (B1) B2 (B1)		AWRT (0.85055) AFWW AFWW (94.69602) AFWW
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ & $\sum xy$ or Attempt at S_{xx} & S_{yy} Attempt at correct formula for b $b = \underline{0.85}$ (AWRT) $a = \underline{94.6 to 94.8}$ (AWFW)	(M1) (m1) (A1 A1)	4	254 6924 1163 & 29942 (all 4 attempted) ($\sum y^2 = 135693$) 472.4 & 401.8 (both attempted) ($S_{yy} = 436.1$) ($\bar{x} = 25.4$ & $\bar{y} = 116.3$)
Notes	<p>1 Treat rounding of correct answers as ISW</p> <p>2 Written form of equation is not required</p> <p>3 Award 4 marks for $y = (94.6 \text{ to } 94.8) + 0.85$ or for $(94.6 \text{ to } 94.8) + 0.85x$</p> <p>4 Values of a and b interchanged and equation $y = ax + b$ stated in (b) \Rightarrow max of 4 marks</p> <p>5 Values of a and b interchanged and equation $y = a + bx$ stated in (b) \Rightarrow 0 marks</p> <p>6 Values are not identified or simply $b/a = \#$ and $a/b = \#$, then $0.8 \text{ to } 0.9 \Rightarrow$ B1 and $93 \text{ to } 97 \Rightarrow$ B1 but accept, for example, as identification, [$b = \#, a = \#$ with $y = a + bx$ but no substitution for b & a] or [$\text{slope/gradient}(b) = \#, \text{intercept}(a) = \#$]</p> <p>7 Answers in fractions can score at most M1 m1</p> <p>8 Some/all of marks can be scored in (b) & (d), even if some/all of marks are lost in (a), but marks lost in (a) cannot be recouped by subsequent working in (b) or (d)</p>			
(b)	$y_{30} = \underline{120 \text{ to } 120.5}$ $y_{30} = \underline{117 \text{ to } 123}$	B2 (B1)	2	AFWW (120.21253) AFWW
Note	1 If, and only if, B0, then award M1 for seen use of $y = a + b \times 30$			
(c)(i)	Extrapolation BMI is outside/above range 45 is outside/above range of BMI or x	B1		OE; accept references to sample/data but not to population
(ii)	Extrapolation Age is outside/above range 50 is outside/above range of age	B1		OE; accept references to sample/data but not to population
Notes	1 Extrapolation only stated in each of (i) & (ii) \Rightarrow B1 B0			
	2 Two debateable answers \Rightarrow B1 max			
(d)	$r_{20} = 117 - (a + b \times 20) = \underline{5.3}$ $= \underline{5 \text{ to } 6}$	B2 (B1)	2	AWRT; do not ignore sign (5.29297) AFWW; ignore sign
Note	1 If, and only if, B0, then award M1 for seen use of $\pm[117 - (a + b \times 20)]$			
(e)	As 2.71/(mean) value is small (in comparison to y -values), estimate is likely to be (quite/fairly/very/extremely) accurate	B1		OE; justification & conclusion
			1	
			11	

Q	Solution	Marks	Total	Comments
4	No MR or MC in this question			
Notes	1 Percentage answers must be penalised by 1 accuracy mark at first correct answer only if no indication of percentage shown 2 Ratio answers (eg 4:5) are only acceptable in (a) and must be penalised by 1 accuracy mark at first correct answer			
(a)(i)	$P(\geq 1) = 0.70 + 0.55 - 0.45 =$ $\underline{\underline{0.8 \text{ or } 4/5 \text{ or } 80\%}}$	M1 A1	(2)	OE; eg 0.25 + 0.45 + 0.1 CAO
(ii)	$P(=1) = (i) - 0.45 = 0.25 + 0.1$ $\underline{\underline{0.35 \text{ or } 35/100 \text{ or } 7/20 \text{ or } 35\%}}$	AF1	(1)	F on (i) $0 < p < 1$
Note	1 If answers to (i) & (ii) are correct but reversed, then award M1 A0 AF0			
(b)	$P(A) \times P(M) = \underline{\underline{0.70 \times 0.55 \text{ or } 0.385}}$ $\underline{\underline{0.385 \neq 0.45 \text{ or } < 0.45}}$	B1 B1	2	OE Must compare to 0.45 OE and compare 'like with like'
Notes	1 $P(M A) = \underline{\underline{0.45/0.70}} \neq P(M A') = \underline{\underline{0.10/0.30}} \neq P(M) = \underline{\underline{0.55}} \Rightarrow$ B1 for any 2 (OE) values, B1 for comparison 2 $P(A M) = \underline{\underline{0.45/0.55}} \neq P(A M') = \underline{\underline{0.25/0.45}} \neq P(A) = \underline{\underline{0.70}} \Rightarrow$ B1 for any 2 (OE) values, B1 for comparison			
(c)(i)	$P(AMBN) = (0.45 \text{ or } 0.385 \text{ or } 0.70 \times 0.55)$ $\times 0.85 \times 0.65$ $= \underline{\underline{0.248 \text{ to } 0.25 \text{ or } 24.8\% \text{ to } 25\%}}$	M1 A1	2	Can be implied by a correct answer Ignore any integer multipliers (eg 4) AWFW (0.248625)
Notes	1 Use of 0.385 gives an answer of 0.2127125 (0.212 to 0.213 AFWF) \Rightarrow M1 A0 2 The 3 correct terms identified but not multiplied (eg added) \Rightarrow M0 A0			
(ii)	$P(A'M'B'N')$ $= P(A'M') \times P(B'N') = p \times P(B'N')$ $p = \underline{\underline{0.2}}$ $p \times (0.15 \times 0.35)$ $= \underline{\underline{0.01 \text{ to } 0.011 \text{ or } 1\% \text{ to } 1.1\%}}$	B1 M1 A1	3	CAO; can be implied from working or from a correct answer $0 < p < 1$ Can be implied by a correct answer Ignore any integer multipliers (eg 4) AWFW (0.0105)
Notes	1 Use of $p = 0.3 \times 0.45 = 0.135$ gives answer of 0.0070875 (0.007 AWR) \Rightarrow B0 M1 A0 2 The 3 correct terms identified but not multiplied (eg added) \Rightarrow B1 M0 A0			
		Total	10	

Q	Solution	Marks	Total	Comments
5 (a) (i)	No MR or MC in this question			
	$r = \underline{\underline{0.848 \text{ to } 0.849}}$ $r = \underline{\underline{0.84 \text{ to } 0.86}}$ $r = \underline{\underline{0.8 \text{ to } 0.9}}$	B3 (B2) (B1)		AWFW AWFW AWFW (0.84856)
	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 $r = \underline{\underline{0.848 \text{ to } 0.849}}$	(M1) (m1) (A1)		696 46896 1128 129832 & 76001 (all 5 attempted) 6528 23800 & 10577 (all 3 attempted) AWFW
(ii)	(Fairly/quite) strong positive (linear) correlation between Shop X (daily) takings and Shop Y (daily) takings of two shops or (daily) takings of (two) shops	Bdep1 B1		Dependent on $0.8 \leq r < 0.9$ OE; must qualify strength and state positive Context OE; providing $-1 < r_{xy} < 1$
Notes	1 Only accept phrase stated; ignore additional comments unless contradictory 2 Use of: “very/extremely/relatively strong or high or big or good or moderate or medium or average” \Rightarrow Bdep0 3 Accept “relationship/association/link” but not “trend” instead of “correlation” 4 Do not accept “£x” and “£y” without further identification			
(b)	Scatter diagram 4 points correct & labelled 3 or 2 points correct & labelled	B2 (B1)		Deduct 1 mark if not labelled
(c)	Days D & I Day D: more shoppers or increased takings Day I: fewer shoppers or reduced takings	B1 B1 B1		OE OE
Notes	1 D stated with valid reason & I stated with valid reason \Rightarrow B3 2 I & D stated with valid matching reasons \Rightarrow B1 B1 B1 3 D & I stated with no (matching) reasons \Rightarrow B1 B0 B0 4 I & D stated with no (matching) reasons \Rightarrow B0 B0 B0			
(d)(i)	$r = \frac{407.5}{\sqrt{1292.5 \times 3850.1}} =$	M1		
(ii)	Some/(fairly/quite/very) weak or little or slight (almost) no/hardly any (positive) correlation	A1 Bdep1		AWFW (0.18267) Dependent on $0.1 \leq r < 0.2$ 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” \Rightarrow B0 3 Accept “relationship/association/link” but not “trend” instead of “correlation”			
		Total	13	

Q	Solution	Marks	Total	Comments																		
6	No MR or MC in this question			Accept percentage equivalents in (a) & (b)																		
(a)	Use of B(26, 0.06) or B(50, 0.15) $P(M = 2) = \binom{26}{2} (0.06)^2 (0.94)^{24}$ $= \underline{\underline{0.265}}$	M1 M1 A1	3	Indicated by an expression or by any one probability in (a) or (b) Correct expression Can be implied by a correct answer Ignore extra terms AWRT (0.26501)																		
(b) (i)	$P(I < 10) = \underline{\underline{0.791}}$	B1	(1)	AWRT (0.7911)																		
(ii)	$P(I > 5) = \underline{\underline{1 - (0.2194 \text{ or } 0.1121)}}$ $= \underline{\underline{0.78 \text{ to } 0.781}}$	M1 A1	(2)	Requires “1 – probability” Accept 3 dp rounding Can be implied by (0.78 to 0.781) but not by (0.888) AWFW (0.7806)																		
SC	For calculation of individual terms: award B2 for 0.78 to 0.781 AFWF; award B1 for 0.888 AWRT																					
(iii)	$P(6 < I < 12) = \underline{\underline{0.9372 \text{ or } 0.9699}}$ (p_1) MINUS $\underline{\underline{0.3613 \text{ or } 0.2194}}$ (p_2) $= \underline{\underline{0.575 \text{ to } 0.577}}$	M1 M1 A1	(3)	Accept 3 dp rounding May be implied by a correct answer Accept 3 dp rounding May be implied by a correct answer AWFW (0.5759)																		
Notes	1 First M1 is for ($+p_1$) in calculation 2 Second M1 is for ($-p_2$) in calculation 3 ($1 - p_2$) - ($1 - p_1$) \Rightarrow M1 M1 (A1) 4 B(50, 0.15) probabilities shown for at least 3 values within $5 \leq X \leq 12 \Rightarrow$ M2 May be implied by a correct answer Ans = <u>0.575 to 0.577</u> \Rightarrow A1																					
	<table border="1"> <thead> <tr> <th>x</th> <th>5</th> <th>6</th> <th>7</th> <th>8</th> <th>9</th> <th>10</th> <th>11</th> <th>12</th> </tr> </thead> <tbody> <tr> <td>P(X = x)</td> <td>0.1073</td> <td>0.1419</td> <td>0.1575</td> <td>0.1493</td> <td>0.1230</td> <td>0.0890</td> <td>0.0571</td> <td>0.0327/8</td> </tr> </tbody> </table>	x	5	6	7	8	9	10	11	12	P(X = x)	0.1073	0.1419	0.1575	0.1493	0.1230	0.0890	0.0571	0.0327/8			
x	5	6	7	8	9	10	11	12														
P(X = x)	0.1073	0.1419	0.1575	0.1493	0.1230	0.0890	0.0571	0.0327/8														
			6																			
(c)	Chain (or Farokh's): Mean = $50 \times 0.15 = \underline{\underline{7.5}}$ Var = $50 \times 0.15 \times 0.85 = \underline{\underline{6.37 \text{ to } 6.38}}$ or SD = $\underline{\underline{2.52 \text{ to } 2.53}}$ (Farokh's) mean < Chain's mean or 4.33 < C's mean (Farokh's) Var/SD < Chain's Var/SD or 3.94 < C's Variance Farokh's store (performance) is better than that of the supermarket chain as a whole	B1 B1 B1 B1 Bdep1	5	CAO (6.375) AWFW Not available for incorrect labelling Not available for incorrect labelling (1.98 to 1.99) < C's SD Dependent on previous four B1 marks																		
SC	A correct comparison of 433 with 750 or (0.086 to 0.087) with 0.15 scores B1 B0 B1 B0 Bdep0																					
			Total	14																		

Q	Solution	Marks	Total	Comments	
7 (a)	No MR or MC in this question				
	Mid-points (x): 37.5 42.5 47.5 52.5 57.5 62.5 67.5 72.5 77.5 82.5 87.5 92.5 97.5 Mean = 62.9 SD = 12.3 to 12.4	M1 A1 B2		4	May be near printed table If seen, then ≥ 5 correct If not seen, then can be implied from mean of 62.9 or 67.5 or from 10065 AWRT (62.90625) AFWF (12.3234 or 12.3621)
Notes	1 $\sum fx = 10065$ and $\sum fx^2 = 657450$ 2 Using LCB-values or UCB-values and f-values gives Mean = 65.0 or 70.0 and SD = 12.3 to 12.4 \Rightarrow M0 A0 B2 3 Using only x-values gives Mean = 67.5 and SD = 18.7 to 19.5 \Rightarrow M1 A0 B0 4 Using only f-values gives Mean = 12.3 and SD = 8.6 to 9.0 \Rightarrow M0 A0 B0 5 If, and only if, M0 A0 B0, then award M1 for seen attempt at $\sum f(LCB \text{ to } UCB) \div 160$				
(b)(i)	98% (0.98) $\Rightarrow z = \mathbf{2.32 \text{ to } 2.33}$ CI for μ is $\bar{x} \pm z \times \frac{s \text{ or } \sigma}{\sqrt{n \text{ or } (n-1)}}$ (C's-mean) $\pm (2.05 \text{ to } 2.33) \times \frac{(C's-SD)}{\sqrt{160 \text{ or } 159}}$ Thus $62.9 \pm (2.32 \text{ to } 2.33) \times \frac{(12.3 \text{ to } 12.4)}{\sqrt{160 \text{ or } 159}}$ Hence 62.9 \pm (2.2 to 2.4) or (60.5 to 60.7, 65.1 to 65.3)	B1 M1 AF1 A1 Adep1		5	AFWF (2.3263) Used; must $\div \sqrt{n}$ with $n > 1$ Evaluation of only one CL \Rightarrow M0 F on (a) AWRT/AFWF (± 2.2735) Dependent on previous A1 AFWF
	Notes	1 Use of t-value of (2.34 to 2.35) gives $\pm 2.3 \Rightarrow$ B1 M1 AF1 A1 A1 2 A correct answer with no working (ignore (a)) \Rightarrow B1 M1 AF1 A1 A1			
(ii)	Clear correct comparison of 61.7 with CI eg 61.7 is within CI or LCL < 61.7 Disagree with claim or reason to doubt claim	BF1 Bdep1		2	F on CI providing it contains 61.7 Must be an interval but quoting values for limits is not required OE; dependent on BF1
	Notes	1 Statement must clearly indicate that "61.7 is within the CI" OE 2 "It/mean/value/etc" is within CI \Rightarrow BF0 3 Statements of the form "61.7 is within 98% of the data" \Rightarrow BF0 4 Statements such as "Claim unlikely/unreasonable/unsupported/incorrect/false/impossible/invalid" \Rightarrow Bdep1 providing BF1			
		Total	11		