A-LEVEL
Statistics

Statistics 1B – SS1B
Mark scheme

6380
June 2015

Version/Stage: 1.0 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.

General Notes for SS1B

GN1   There is no allowance for misreads (MR) or miscopies (MC) unless specifically stated in a question

GN2   In general, a correct answer (to accuracy required) without working scores full marks but an incorrect answer (or an answer not to required accuracy) scores no marks

GN3   Where percentage equivalent answers are permitted in a question, penalise by **one accuracy mark** at the first **correct** answer but only if no indication of percentage (eg %) is shown

GN4   In probability questions, do **not** award **accuracy** marks for answers in the form of a ratio or odds (eg 7/20 as 7:20 or 7:13)

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

Q	Solution	Marks	Total	Comments
2 **(a)(i)**				**Accept percentage equivalent answers in (a) but see GN3**
	$P(X < 90) = P\left(Z < \dfrac{90-91}{0.8}\right)$	M1		Standardising 90 with 91 and 0.8; allow $(91-90)$
	$= P(Z < -1.25) = 1 - P(Z < -1.25)$	m1		**Correct** area change Can be implied by a **correct** answer **or** by an **answer < 0.5**
	$= (1 - 0.89435)$ $= \underline{\mathbf{0.105 \text{ to } 0.106}}$	A1	**(3)**	AWFW (0.10565)
(ii)	$P(X \neq 90) = \underline{\mathbf{1 \text{ or one or unity or } 100\%}}$	B1	**(1)**	CAO; accept nothing else but ignore zeros after decimal point (eg 1.00) Ignore additional words providing that they are not contradictory (eg certain so = 1)
Note	1 $P(X \neq 90) = P(Z \neq 0) \Rightarrow$ B0 unless followed by 1 OE			
(iii)	$P(91 < X < 92.5) = P(0 < Z < 1.875)$ $= (0.969 \text{ to } 0.972) - 0.5$ **or** $= 0.5 - (0.028 \text{ to } 0.031)$	B1		AWFW/CAO OE; can be implied by a **correct** final answer CAO/AWFW
	$= \underline{\mathbf{0.47}}$	B1	**(2)**	AWRT (0.46960)
			6	
(b)	$1\% \ (0.01) \Rightarrow z = \underline{\mathbf{-2.33 \text{ to } -2.32}}$	B1		AWFW; seen anywhere, ignore sign (–2.3263)
	$P(Y < 150) = P\left(Z < \dfrac{150-153}{\sigma}\right)$	M1		Standardising 150 with 153 and σ/s; allow $(153-150)$
	$\dfrac{\pm(150-153)}{\sigma} = \begin{pmatrix} \pm 1.28 \text{ AWRT} \\ \text{or} \\ \pm 2.32 \text{ to } \pm 2.33 \text{ AWFW} \end{pmatrix}$	m1		(–1.2816) Can be implied by a **correct** answer (–2.3263)
	$\sigma = \underline{\mathbf{1.3}}$	A1	**4**	AWRT (1.28960)
Note	1 Award A0 if the signs are not consistent throughout, so, for example, $(150-153)/+2.3263$ gives $\sigma = 1.3 \Rightarrow$ B1, M1, m1, A0			
		Total	**10**	

Q	Solution	Marks	Total	Comments
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 $\sum x \quad \sum x^2 \quad \sum y \quad \sum y^2 \quad \& \quad \sum xy$ **or** Attempt at $S_{xx} \quad S_{yy} \quad \& \quad S_{xy}$ 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 $0.7 \le r \le 0.8$ 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" $\Rightarrow$ 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: $\qquad r = \dfrac{34.57}{\sqrt{279.71 \times 112.86}}$ $= $ **0.19 to 0.2**	M1 A1	 2	Correct **numerical** form; can be implied by a **correct** answer AWFW (0.19457)
(ii)	<u>Group T</u> **Some**/(fairly/quite/very) **weak/little/slight/** (almost) **no/hardly any** (positive) correlation <u>Group U</u> **Some**/(fairly/quite/very) **weak/little/slight/** (almost) **no/hardly any** (positive) correlation	B1 Bdep1	 2	OE; must **qualify stren**gth Dependent on $0.19 \le r_U \le 0.2$ OE; must **qualify stren**gth
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" **4** "For each group" $\Rightarrow$ B1 Bdep1 **5** "For both groups" $\Rightarrow$ Bdep2 **6** "No reference to groups (OE)" $\Rightarrow$ B0			
SC	**1** "Correlation in (a)(ii) is spurious (OE)" $\Rightarrow$ 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)" $\Rightarrow$ B0 B1			
		Total	**11**	

Q	Solution	Marks	Total	Comments
4 **(a)(i)**	<table><tr><td></td><td>**M**</td><td>**M′**</td><td>**Total**</td></tr><tr><td>**E**</td><td>0.16</td><td>**0.12**</td><td>0.28</td></tr><tr><td>**E′**</td><td>**0.24**</td><td>**0.48**</td><td>**0.72**</td></tr><tr><td>**Total**</td><td>**0.40**</td><td>0.60</td><td>1.00</td></tr></table>	B1 B1 B1 **3**		Accept percentage equivalent answers in (a)(ii) & (a)(iii) but see GN3 0.12; CAO 0.4(0) and 0.72; CAO 0.24 and 0.48; CAO
(ii)	P(Buys exactly 1) = 0.12 + [0.24 or P($E′ \cap M$) from (i)] = **0.36**	M1 A1 **2**		 CAO
(iii)	P($M \cap E$) = **0.16** which is **greater than/not equal to 0** **or** P($M \cup E$) = 1 − 0.48 = **0.52** but P(M) + P(E) = 0.40 + 0.28 = **0.68**	B2 (B2) **2**		**Correct** comparison of 0.16 with 0 **Correct** comparison of 0.52 with 0.68
	Part (a)	**Total**	**7**	

Q	Solution	Marks	Total	Comments
4	**Continued**			
	Part (a)	**Total**	**7**	
(b)				**Accept percentage equivalent answers in (b) & (c)(ii) but see GN3**

	S	*S′*	Total
T	0.1700	0.1125	0.2825
T′	0.6800	0.0375	0.7175
Total	0.8500	0.1500	1.0000

(No marks for this table; it is simply here to help marking)

Q	Solution	Marks	Total	Comments
(i)	P(4 papers) $=$ P($M \cap E \cap S \cap T$) $=$			
	$0.16 \times (0.85 \times 0.20)$ **or** 0.16×0.17	M1		All correct Can be implied by a **correct** answer
	$= \underline{\textbf{0.027}}$	A1	**2**	AWRT (0.0272)
(ii)	P(0 papers) $=$ P($M′ \cap E′ \cap S′ \cap T′$) $=$			
	$0.48 \times (\textbf{0.15} \times \textbf{0.25})$ **or** $0.48 \times \textbf{0.0375}$	M1		Seen Can be implied by a **correct** answer
	$= \underline{\textbf{0.018}}$	A1	**2**	CAO (0.018)
(c) **(i)**	Chris (only) buys a **Friday morning** (newspaper) and a **Saturday** (morning) newspaper	B1 B1	**2**	Ignore additional comments about what he also does not buy
SCs	**1** "Chris does not buy either a Friday evening or a Sunday (morning) newspaper" (OE) $\Rightarrow$ B1 **2** Statements of the form "(Friday morning) × (Saturday morning)" (OE) $\Rightarrow$ B1 **3** Statements involving "probability and/or intersection" $\Rightarrow$ B1 max			
(ii)	P($M \cap E′ \cap S \cap T′$) $=$			
	$0.24 \times (\textbf{0.85} \times \textbf{0.80})$ **or** $0.24 \times \textbf{0.68}$	M1		Seen Can be implied by a **correct** answer
	$= \underline{\textbf{0.163}}$	A1	**2**	AWRT (0.1632)
Note	**1** $(0.40 \times 0.72 \times 0.85 \times 0.80) = 0.19584 \Rightarrow$ M0 A0			
		Total	**15**	

Q	Solution	Marks	Total	Comments
5 **(a)**	Scatter diagram **4 or 3** points correct	B1	1	(within tolerances on template)
(b) **(i)**	b (gradient/slope) = **10.0** b (gradient/slope) = **9.75 to 10.25**	B2 (B1)		AWRT (10.00503) AWFW
	a (intercept) = **67.6 to 67.7** a (intercept) = **50 to 90**	B2 (B1)		AWFW (67.65292) AWFW
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ & $\sum xy$ **or** Attempt at S_{xx} & S_{xy}	(M1)		690 49598 7580 & **542910** (all 4 attempted) $\left(\sum y^2 = 5995000\right)$ 1988 & **19890** (both attempted) $(S_{yy} = 249360)$
	Attempt at substitution into correct corresponding formula for b	(m1)		
	b = **10.0** (AWRT) a = **67.6 to 67.7** (AWFW)	(A1 A1)	(4)	$(\bar{x} = 69 \ \& \ \bar{y} = 758)$
Notes	**1** Treat rounding of correct, but **not** of incorrect, answers as ISW **2** Written form of equation is **not** required **3** Award 4 marks for $y = (67.6 \text{ to } 67.7) + 10x$ **or** for $(67.6 \text{ to } 67.7) + 10x$ **4** Values of a and b interchanged and equation $y = ax + b$ **used** for drawing line $\Rightarrow$ max of 4 marks **5** Values of a and b interchanged and equation $y = a + bx$ used for drawing line $\Rightarrow$ 0 marks **6** Values are **not** identified or simply $b/a = \#$ and $a/b = \#$, then 9.75 to 10.25 $\Rightarrow$ B1 and 50 to 90 $\Rightarrow$ B1 but accept, for example, as identification, $[b = \#, a = \#$ with $y = a + bx$ but no substitution for b & $a]$ **or** [slope/gradient$(b) = \#$, intercept$(a) = \#$] **7** Answers in fractions can score at most M1 m1 **8** Some/all of marks can be scored in (b)(ii), (b)(iii) & (c), even if some/all of marks are lost in (b)(i), but marks lost in (b)(i) **cannot** be recouped by subsequent working in (b)(ii), (b)(iii) or (c)			
	Scatter diagram **line** correct	B2	(2)	Within tolerance on template at least from $x = 50$ to $x = 80$
Notes	**1** If, and only if, B0, then award M1 for **seen correct** use of an equation for at least two points in range $x = 35$ to $x = 100$ **2** If, and only if, B0, then award M0 for points or line marked on scatter diagram without supportive working			
			6	
(ii)	b: **each/every customer** generates on average **£10** in **takings**	B1 BF1	2	F on b providing $9.75 \leq b \leq 10.25$
Notes	**1** To score any marks, an explanation must indicate change in x affecting change in y, **not** change in y affecting change in x **2** As x increases then y increases by 10 (OE; context **not** required) $\Rightarrow$ B1 BF0 **3** Reference **only** to correlation $\Rightarrow$ B0 BF0			
(iii)	a: takings when no customers cannot be > 0 **or** when $x = 0$ then $y = 0$ **or** never no customers/x never 0/x always > 0 **or** $x = 0$ is outside range/extrapolation	B1	1	OE
(c)	$y(50)$ = **£570**	B1	1	CAO; £ **not** required (£567.90) From calculation/graph/guesswork
		Total	**11**	

Q	Solution	Marks	Total	Comments
6	**Accept 3 dp rounding of probabilities from tables in (b)**			**Accept percentage equivalent answers in (a) & (b) but see GN3**
(a)	Use of B(24, 0.22) **or** B(40, 0.45)	M1		Indicated by an expression **or** by any one **correct** probability in **(a) or (b)**
	$P(C = 2) = \binom{24}{2}(0.22)^2(0.78)^{22}$	M1		**Fully correct** expression Can be implied by a **correct** answer Ignore extra terms
	$= \underline{\mathbf{0.056 \text{ to } 0.057}}$	A1	**3**	AWFW (0.05647)
(b) **(i)**	$P(DC < 20) \quad\quad = \underline{\mathbf{0.684 \text{ to } 0.685}}$	B1	**(1)**	AWFW (0.6844)
(ii)	$P(DC > 15) = 1 - (\mathbf{0.2142 \text{ or } 0.1326})$	M1		Requires '1 – (either value)'
	$= \underline{\mathbf{0.785 \text{ to } 0.786}}$	A1	**(2)**	AWFW (0.7858)
Note	**1** For stated answers: award **B2** for 0.785 to 0.786 (AWFW); **B1** for 0.867 to 0.868 (AWFW)			
(iii)	$P(12 \le DC \le 24) = \mathbf{0.9804 \text{ or } 0.9595}$ (p_1)	M1		Can be implied by a **correct** answer
	MINUS $\mathbf{0.0179 \text{ or } 0.0386}$ (p_2)	M1		Can be implied by a **correct** answer
	$= \underline{\mathbf{0.96 \text{ to } 0.963}}$	A1	**(3)**	AWFW (0.9625)
Notes	**1 First M1** is for $(+p_1)$ in a subtraction **2 Second M1** is for $(-p_2)$ in a subtraction $\quad\quad\quad\quad\quad\quad\quad$ **3** $(1-p_2)-(1-p_1) \Rightarrow$ M1 M1 (A1) **4** For stated answers: award **B3** for 0.96 to 0.963 (AWFW); **B2** for 0.94 (AWRT); **B1** for 0.92 (AWRT)			
			6	
(c)	$p = 1 - 0.22 - 0.45 = \underline{\mathbf{0.33}}$	B1		CAO; can be implied
	Mean $(\mu \text{ or } \bar{x}) = 200 \times 0.33 = \underline{\mathbf{66}}$	B1		CAO
	Variance $(\sigma^2 \text{ or } s^2) = 200 \times 0.33 \times 0.67$			
	$= \underline{\mathbf{44 \text{ to } 44.3}}$	B1	**3**	AWFW (44.22)
Notes	**1** If answers are not identified, then assume that order of values is (p), mean, variance **2** When 44 to 44.3 is labelled as Sd$(\sigma \text{ or } s) \Rightarrow$ B0			
SC	**1** If mean is calculated from $200p$ with $p \ne 0.33$ but $0 < p < 1 \Rightarrow$ B0 M1 B0			
		Total	**12**	

Q	Solution	Marks	Total	Comments
7 **(a)**	Sd of $\bar{A}$ $\quad= $ **0.43/√10 or 0.135 to 0.137** **or** Var of $\bar{A}$ $\quad=$ **0.43²/10 or 0.0184 to 0.0186**	B1		CAO/AWFW $\quad\quad$ (0.13598) Can be implied in what follows CAO/AWFW $\quad\quad$ (0.01849)
	$P\left(\bar{A} > 1.25\right) = P\left(Z > \dfrac{1.25 - 1.16}{0.43 \Big/ \sqrt{10}}\right)$	M1		Standardising 1.25 with 1.16 and **(0.43/√10) OE**; allow (1.16 – 1.25)
	$= P(Z > 0.6619) = 1 - P(Z < 0.6619)$	m1		Correct area change Can be implied by a **correct** answer **or** by an **answer < 0.5**
	$= 1 - 0.74597 \quad\quad\quad = $ **0.253 to 0.255**	A1	**4**	AWFW $\quad\quad$ (0.25403)
(b) **(i)**	$96\% \ (0.96) \ \Rightarrow \ z = $ **2.05 to 2.06** **or** $\quad\quad\quad\quad\quad\quad \Rightarrow \ t = $ **2.12 to 2.13**	B1		AWFW $\quad\quad$ (2.0537) AWFW $\quad\quad$ (2.1247)
	CI for μ is $0.86 \pm \begin{pmatrix} 2.05 \ \text{to} \ 2.06 \\ 2.12 \ \text{to} \ 2.13 \\ 1.75 \ \text{or} \ 1.80 \end{pmatrix} \times \dfrac{(0.65 \ \text{to} \ 0.66)}{\sqrt{40 \ \text{or} \ 39}}$	M2,1 (–1 ee)		Ignore any notation (1.75 & 1.80) are AWRT $0.65 \times \sqrt{\dfrac{40}{39}} \ = 0.65828$ No $\sqrt{n} \ \Rightarrow \ $ M0
	Hence $\quad\quad\quad$ **0.86 ± (0.21 to 0.23)** **or** $\quad\quad$ **(0.63 to 0.65, 1.07 to 1.09)**	Adep1	**4**	CAO ± AWFW Dependent on award of M2 AWFW
Notes	**1** An incorrect expression for CI followed by a numerically correct CI $\Rightarrow$ 2 solutions $\Rightarrow$ ((0 or 1) + 4)/2 $\Rightarrow$ 2 marks **2** Evaluation of only one CL $\Rightarrow$ (B1) M0 Adep0 **3** Accept answers in grams			
(ii)	**Clear correct comparison** of **1.16** with **CI** eg 1.16 is above CI **or** UCL < 1.16	BF1		F on CI providing it does **not** contain 1.16 Must have found an **interval** in (i) but quoting values for CI or CLs is **not** required
	Agree with claim or accept claim **or** Weight of apples is (likely to be) greater than that of pears	Bdep1	**2**	OE; dependent on BF1
Notes	**1** Statement must clearly indicate that "1.16 is above/outside/not within the CI" OE **2** Statements of the form "It/mean/value/etc is above/outside/not within the CI" $\Rightarrow$ BF0 **3** Statements of the form "1.16 is above/outside/not within 96% of the data/values/weights" $\Rightarrow$ BF0 **4** Statements such as "Claim is likely/reasonable/supported/correct/true/possible/valid" $\Rightarrow$ Bdep1 providing BF1			
			10	