A-LEVEL
Statistics

Statistics 1B – SS1B
Mark scheme

6380
June 2014

Version/Stage: Final

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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	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	**4**	CAO
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**	

Q	Solution	Marks	Total	Comments
2	**No MR or MC in this question**			**Accept %age equivalents in (a)(i) to (iii)**
(a)	Time, $X \sim N(7.5,\ 1.6^2)$			
(i)	$P(X < 10) = P\left(Z < \frac{10 - 7.5}{1.6}\right)$	M1		Standardising 10 with 7.5 and 1.6 but allow $(7.5 - 10)$; $z^2 \Rightarrow$ M0
	$= P(Z < 1.5625) =$ **0.94**	A1	**(2)**	AWRT (0.94091)
(ii)	$P(X > 6) = P(Z > -0.9375) = P(Z < 0.9375)$	M1		**Correct** area change; 0.9375 or correct standardising are **not** required Can be implied by final **answer > 0.5**
	= **0.82 to 0.83**	A1	**(2)**	AWFW (0.82575)
(iii)	$P(5 < X < 10) =$ $P(Z < 1.5625) - P(Z < -1.5625) =$			
	(i) – [1 – (i)] **or** 1 – 2 × [1 – (i)] = [2 × (i)] – 1	M1		OE; any **correct** difference in areas using (a)(i) or $P(5 < X < 10)$ Can be implied by a **correct** final answer
	= 2 × 0.94091 – 1 = = **0.88**	A1	**(2)**	AWRT (0.88182)
			6	
(b)	80% (0.8) $\Rightarrow$ z = **0.84**	B1		AWRT; ignore sign (0.8416)
	$P(Y < 15) = P\left(Z < \frac{15 - \mu}{2.4 \text{ or } 1.6}\right)$	M1		Standardising 15 with μ and (2.4 or 1.6) but allow $(\mu - 15)$
	$\left(\frac{15 - \mu}{2.4}\right) = 0.84(16)$ or $1.28(16)$	m1		Equating expression with σ = **2.4** to either ***z*-value** (*ignore sign*) Can be implied by a **correct** answer
	μ = **12.95 to 13**	A1	**4**	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) = **0.85** b (gradient/slope) = **0.8 to 0.9** a (intercept) = **94.6 to 94.8** a (intercept) = **93 to 97**	B2 (B1) B2 (B1)		AWRT (0.85055) AWFW AWFW (94.69602) AWFW
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ & $\sum xy$ **or** Attempt at S_{xx} & S_{xy} Attempt at **correct** formula for b b = **0.85** (AWRT) a = **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	**1** Treat rounding of correct answers as ISW **2** Written form of equation is **not** required **3** Award 4 marks for y = (94.6 to 94.8) + 0.85 or for (94.6 to 94.8) + 0.85x **4** Values of a and b interchanged and equation $y = ax + b$ stated in (b) ⇒ max of 4 marks **5** Values of a and b interchanged and equation $y = a + bx$ stated in (b) ⇒ 0 marks **6** Values are **not** identified or simply b/a = # and a/b = #, then 0.8 to 0.9 ⇒ B1 and 93 to 97 ⇒ 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) & (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)			
(b)	y_{30} = **120 to 120.5** y_{30} = **117 to 123**	B2 (B1)	**2**	AWFW (120.21253) AWFW
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	**2**	OE; accept references to sample/data but not to population
Notes	**1** Extrapolation only stated in each of (i) & (ii) ⇒ B1 B0 **2** Two debateable answers ⇒ B1 max			
(d)	r_{20} = 117 – (a + b×20) = **5.3** = **5 to 6**	B2 (B1)	**2**	AWRT; do not ignore sign (5.29297) AWFW; ignore sign
Note	**1** If, and only if, B0, then award M1 for seen use of ±[117 – (a + b×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	**1**	OE; justification & conclusion
			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)	$P(\geq 1) = 0.70 + 0.55 - 0.45 =$	M1		OE; eg $0.25 + 0.45 + 0.1$
	0.8 or 4/5 or 80%	A1	**(2)**	CAO
(ii)	$P(=1) =$ (i) $- 0.45 = 0.25 + 0.1$			
	0.35 or 35/100 or 7/20 or 35%	AF1	**(1)**	F on (i) $0 < p < 1$
			3	
Note	**1** If answers to (i) & (ii) are correct but reversed, then award M1 A0 AF0			
(b)	$P(A) \times P(M) =$ **0.70 × 0.55 or 0.385**	B1		OE
	0.385 ≠ 0.45 or < 0.45	B1	**2**	Must compare to 0.45 OE **and** compare 'like with like'
Notes	**1** $P(M \mid A) =$ **0.45/0.70** $\neq P(M \mid A') =$ **0.10/0.30** $\neq P(M) =$ **0.55** $\Rightarrow$ B1 for any 2 (OE) values, B1 for comparison **2** $P(A \mid M) =$ **0.45/0.55** $\neq P(A \mid M') =$ **0.25/0.45** $\neq P(A) =$ **0.70** $\Rightarrow$ B1 for any 2 (OE) values, B1 for comparison			
(c)(i)	$P(AMBN) = (0.45$ **or** 0.385 **or** $0.70 \times 0.55) \times 0.85 \times 0.65$	M1		Can be implied by a **correct** answer Ignore any integer multipliers (eg 4)
	= **0.248 to 0.25 or 24.8% to 25%**	A1	**2**	AWFW (0.248625)
Notes	**1** Use of 0.385 gives an answer of 0.2127125 (0.212 to 0.213 AWFW) $\Rightarrow$ M1 A0 **2** The **3 correct terms** identified but not multiplied (eg added) $\Rightarrow$ M0 A0			
(ii)	$P(A'M'B'N') = P(A'M') \times P(B'N') = p \times P(B'N')$			
	$p =$ **0.2**	B1		CAO; can be implied from working or from a **correct** answer
	$p \times (0.15 \times 0.35)$	M1		$0 < p < 1$ Can be implied by a **correct** answer Ignore any integer multipliers (eg 4)
	= **0.01 to 0.011 or 1% to 1.1%**	A1	**3**	AWFW (0.0105)
Notes	**1** Use of $p = 0.3 \times 0.45 = 0.135$ gives answer of 0.0070875 (0.007 AWRT) $\Rightarrow$ 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	**No MR or MC in this question**			
(a)				
(i)	r = **0.848 to 0.849**	B3		AWFW (0.84856)
	r = **0.84 to 0.86**	(B2)		AWFW
	r = **0.8 to 0.9**	(B1)		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)		696 46896 1128 129832 & **76001** (all 5 attempted) 6528 23800 & **10577** (all 3 attempted)
	Attempt at substitution into **correct** corresponding formula for r	(m1)		
	r = **0.848 to 0.849**	(A1)	**3**	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	**2**	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" ⇒ 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)	**2**	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	**3**	 OE OE
Notes	**1** D stated with valid reason & I stated with valid reason ⇒ B3 **2** I & D stated with valid matching reasons ⇒ B1 B1 B1 **3** D & I stated with no (matching) reasons ⇒ B1 B0 B0 **4** I & D stated with no (matching) reasons ⇒ B0 B0 B0			
(d)(i)	$r = \dfrac{407.5}{\sqrt{1292.5 \times 3850.1}}$ =	M1		
	0.182 to 0.183	A1		AWFW (0.18267)
(ii)	**Some/**(fairly/quite/very) **weak or little or slight** (almost) **no/hardly any** (positive) correlation	Bdep1	**3**	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" ⇒ 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)	M1		Indicated by an expression **or** by any one probability in **(a) or (b)**
	$P(M = 2) = \binom{26}{2}(0.06)^2(0.94)^{24}$	M1		Correct expression Can be implied by a **correct** answer Ignore extra terms
	= **0.265**	A1	**3**	AWRT (0.26501)
(b) (i)	P(I < 10) = **0.791**	B1	**(1)**	AWRT (0.7911)
(ii)	P(I > 5) = **1 – (0.2194 or 0.1121)**	M1		Requires "1 – probability" Accept 3 dp rounding Can be implied by (0.78 to 0.781) but **not** by (0.888)
	= **0.78 to 0.781**	A1	**(2)**	AWFW (0.7806)
SC	For calculation of individual terms: award B2 for 0.78 to 0.781 AWFW; award B1 for 0.888 AWRT			
(iii)	P(6 < I < 12) = **0.9372 or 0.9699** (p_1)	M1		Accept 3 dp rounding May be implied by a **correct** answer
	MINUS 0.3613 or 0.2194 (p_2)	M1		Accept 3 dp rounding May be implied by a **correct** answer
	= **0.575 to 0.577**	A1	**(3)**	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 $5 \le X \le 12 \Rightarrow$ M2 May be implied by a **correct** answer Ans = **0.575 to 0.577** $\Rightarrow$ A1			

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 × 0.15 = **7.5**	B1		CAO (6.375)
	Var = 50 × 0.15 × 0.85 = **6.37 to 6.38**			
	or SD = **2.52 to 2.53**	B1		AWFW
	(Farokh's) mean < Chain's mean	B1		Not available for incorrect labelling
	or 4.33 < C's mean			
	(Farokh's) Var/SD < Chain's Var/SD	B1		Not available for incorrect labelling
	or 3.94 < C's Variance			(1.98 to 1.99) < C's SD
	Farokh's store (performance) is **better** than that of the supermarket chain as a whole	Bdep1		Dependent on previous four B1 marks
			5	
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	**No MR or MC in this question**			
(a)	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	M1		*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
	Mean = **62.9**	A1		AWRT (62.90625)
	SD = **12.3 to 12.4**	B2	**4**	AWFW (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 ⇒ M0 A0 B2 **3** Using only *x*-values gives Mean = 67.5 and SD = 18.7 to 19.5 ⇒ M1 A0 B0 **4** Using only *f*-values gives Mean = 12.3 and SD = 8.6 to 9.0 ⇒ 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) ⇒ z = **2.32 to 2.33**	B1		AWFW (2.3263)
	CI for μ is $\bar{x} \pm z \times \frac{s \text{ or } \sigma}{\sqrt{n \text{ or } (n-1)}}$	M1		Used; must $\div\sqrt{n}$ with $n > 1$ Evaluation of only one CL ⇒ M0
	$(\text{C's-mean}) \pm (2.05 \text{ to } 2.33) \times \frac{(\text{C's-SD})}{\sqrt{160 \text{ or } 159}}$	AF1		F on (a)
	Thus $62.9 \pm (2.32 \text{ to } 2.33) \times \frac{(12.3 \text{ to } 12.4)}{\sqrt{160 \text{ or } 159}}$	A1		
	Hence **62.9 ± (2.2 to 2.4)** **or** **(60.5 to 60.7, 65.1 to 65.3)**	Adep1	**5**	AWRT/AWFW (±2.2735) Dependent on previous A1 AWFW
Notes	**1** Use of *t*-value of (2.34 to 2.35) gives ±2.3 ⇒ B1 M1 AF1 A1 A1 **2** A **correct** answer with no working (ignore (a)) ⇒ B1 M1 AF1 A1 A1			
(ii)	**Clear correct comparison** of **61.7** with **CI** eg 61.7 is within CI **or** LCL < 61.7	BF1		F on CI providing it **contain**s 61.7 Must be an **interval** but quoting values for limits is **not** required
	Disagree with claim **or** reason to doubt claim	Bdep1	**2**	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 ⇒ BF0 **3** Statements of the form "61.7 is within 98% of the data" ⇒ BF0 **4** Statements such as "Claim unlikely/unreasonable/unsupported/incorrect/false/impossible/invalid" ⇒ Bdep1 providing BF1			
		Total	**11**	