GCE 2005

January Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Mathematics/Statistics

MS/SS1B

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Key to mark scheme and abbreviations used in marking

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

$\surd$ or ft or F	follow through from previous incorrect result	MC	mis-copy
CAO	correct answer only	MR	mis-read
CSO	correct solution only	RA	required accuracy
AWFW	anything which falls within	FW	further work
AWRT	anything which rounds to	ISW	ignore subsequent work
ACF	any correct form	FIW	from incorrect work
AG	answer given	BOD	given benefit of doubt
SC	special case	WR	work replaced by candidate
OE	OE	FB	formulae book
A2,1	2 or 1 (or 0) accuracy marks	NOS	not on scheme
$-x$ EE	deduct x marks for each error	G	graph
NMS	no method shown	c	candidate
PI	possibly implied	sf	significant figure(s)
SCA	substantially correct approach	dp	decimal place(s)

MS/SS1B

Q	Solution	Marks	Total	Comments
1(a)	The takings appear to increase slightly as the air temperature increases	B1		OE
	Weak positive (linear) correlation between air temperature and takings			Comments on ranges of values of x and $y \Rightarrow$ B0
	One (or two) unusual results	B1	2	OE
(b)	Monday 10	B1	1	CAO; accept point (4, 312)
(c)	$r = 0.817$ to 0.818	B3	3	AWFW for attempts at Σx, $\Sigma x^2 \times 5$ or $S_{xx} \times 3$ M1 for attempted use of correct formula for r M1 for answer A1 If Monday 4 identified in (b), then: $r = 0.0156$ to 0.0157 scores M2 If no Monday removed, then: $r = 0.318$ to 0.319 scores M1
(d)	Temperature at another time Number of other/competing stalls Month/time of year Rainfall/snow Publicity	E1	1	Or a sensible alternative Number of customers $\Rightarrow$ E0 Weather $\Rightarrow$ E0 Population of town $\Rightarrow$ E0
	Total		**7**	

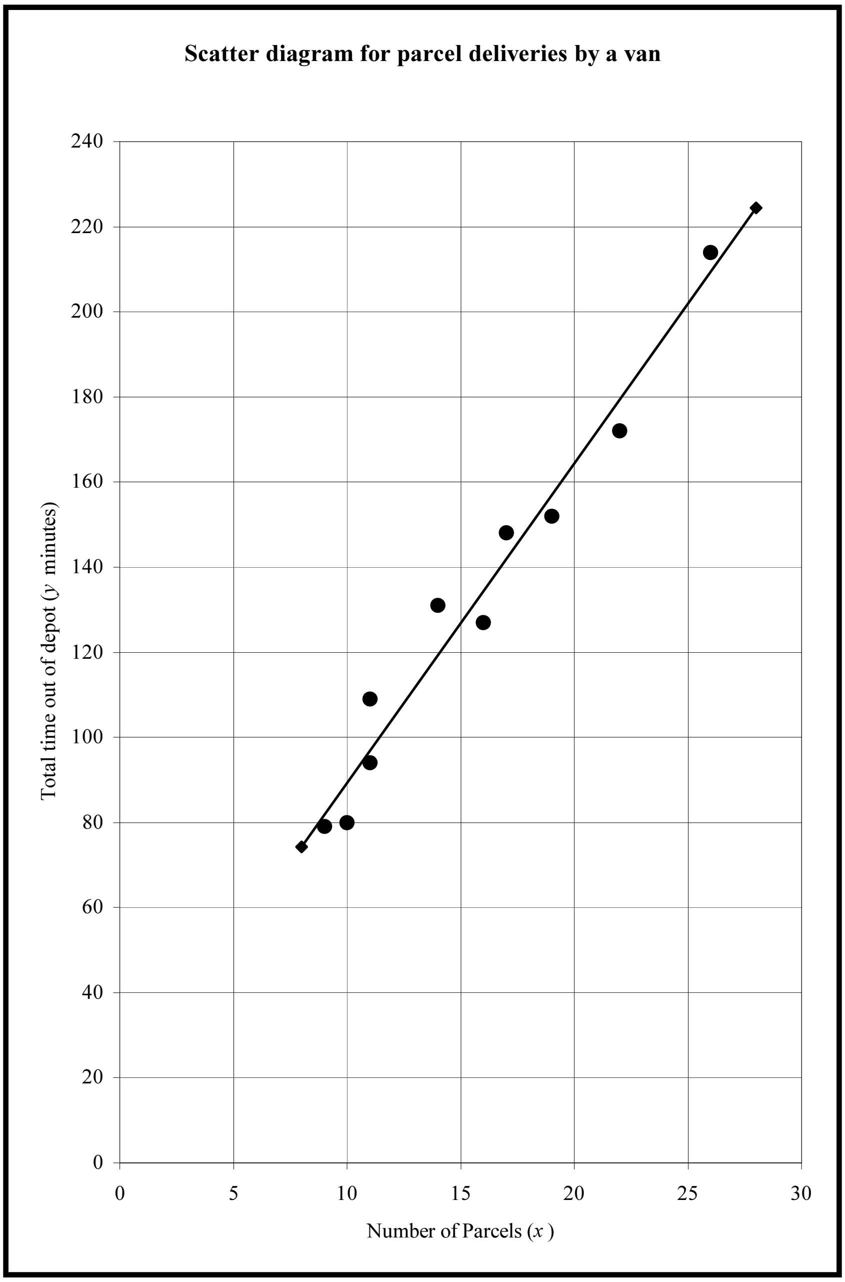
MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
2(a)	Volume ~ N(μ , 3.5^2)			
	Mean, $\bar{x} = \dfrac{1830}{12} = 152.5$	B1		CAO ($s_{n-1} = 3.778$, $s_n = 3.617$)
	98% $\Rightarrow$ $z = 2.3263$	B1		AWFW 2.32 to 2.33
	CI for μ is $\bar{x} \pm z \times \dfrac{(\sigma \text{ or } s)}{\sqrt{n}}$	M1		Use of Must have $\left(\div\sqrt{n}\right)$ with $n > 1$
	Thus $152.5 \pm 2.3263 \times \dfrac{3.5}{\sqrt{12}}$	A1√		ft on $\bar{x}$ and z only
	(150.1 to 150.2, 154.8 to 154.9)	A1	5	AWFW
(b)	Evidence, from CI, that mean volume is (above) 150 ml	B1√		ft on CI in part (a); must be clear comparison of mean of 150 with CI
	In sample, some cans have volumes less than 150 ml	B1		Or reference to range of can volumes in sample
	Thus claim of 150 ml is not justified	B1dep	3	Dependent upon making some comment about mean volume and some comment about individual can volume or range of can volumes
(c)	Volume is normally distributed	E1	1	Accept 'population' or 'X' but not 'it' or '$\bar{X}$' etc ie must be clear statement sample too small $\Rightarrow$ E0
	Total		**9**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
3(a)	Scatter Diagram 8, 9 or 10 points plotted	B2	2	5, 6 or 7 points plotted B1
(b)	$b = 7.49$ to 7.51 $a = 14.1$ to 14.6 Regression Line (implied) ≥ 2 points calculated or use of point $(\bar{x}, \bar{y})$ eg $x = 0$ $y = 14.3$ & $x = 25$ $y = 201.9$ straight line drawn	B2 B2 M1 A1	6	AWFW; accept 7.5 AWFW for attempts at Σx, $\Sigma x^2 \times 4$ or $S_{xx} \times 2$ M1 M1 for attempted use of correct formula for b A1 for answers
(c)(i)	$y_{15} = 126$ to 128 Reliable as 15 is within (observed) range	B1 E1		AWFW OE accept points close to line
(ii)	$y_{35} = 276$ to 278 Not reliable as 35 is outside (observed) range	B1 E1	4	AWFW OE accept $y > 4$ hrs so break needed point off graph $\Rightarrow$ E0
(d)	a: time to travel to and from area from/to depot b: (average) time to deliver a/one parcel (within area)	E1 E1	2	OE Both correct but reversed $\Rightarrow$ E1 OE Proportional to packages $\Rightarrow$ E0
	Total		**14**	

Question 3 (a) & (b)



MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
4(a)(i)	$X \sim \mathrm{N}(\mu, 4^2)$			
	$\mu = 106$			
	$\mathrm{P}(X < 110) = \mathrm{P}\left(Z < \dfrac{110-106}{4}\right)$	M1		Standardising (109.5, 110 or 110.5) with 106 and ($\sqrt{4}$, 4 or 4^2) and/or $(106 - x)$
	$= \mathrm{P}(Z < 1)$	A1		CAO; ignore sign
	$= 0.841$	A1	3	AWRT (0.84134)
(ii)	P(underweight) = $\mathrm{P}(X < 100)$	M1		Use of AWFW 99 to 100
	$= \mathrm{P}(Z < -1.5) = 1 - \Phi(1.5)$	m1		Area change
	$= 1 - 0.93319 = 0.0668$ to 0.067	A1	3	AWFW (0.06681)
(b)	2% $\Rightarrow$ $z = -2.0537$	B1		AWFW 2.05 to 2.06; ignore sign
	$z = \dfrac{100-\mu}{4}$	M1		Standardising AWFW 99 to 100 with μ and 4
	Thus $\dfrac{100-\mu}{4} = -2.0537$	m1		Equating z-term to z-value; not using 0.02, 0.98 or $\lvert 1-z \rvert$
	Thus $\mu = 108.2$ to 108.3	A1	4	AWFW
(c) (i)	$\mu = 108.5$			
	Mean, $\mu = 108.5$	B1		CAO
	Variance, $\dfrac{\sigma^2}{n} = \dfrac{4^2}{10} = 1.6$	B1	2	CAO; OE
(ii)	$\mathrm{P}(\bar{X} > 110) = \mathrm{P}\left(Z > \dfrac{110-108.5}{\sqrt{1.6}}\right)$	M1		Standardising (109.5, 110 or 110.5) with [μ from (i)] and $\left[\sqrt{\dfrac{\sigma^2}{10}}\ \text{or}\ \dfrac{\sigma^2}{10}\ \text{from (i)}\right]$ and/or $(\mu - x)$
	$= \mathrm{P}(Z > 1.19) = 1 - \Phi(1.19)$	m1		Area change
	$= 0.117$ to 0.119	A1	3	AWFW (0.11784)
	Total		**15**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
5(a)(i)	$p = 0.4$			
	Attempted use of B(7, 0.4) in (a)	M1		
	$P(X \le 2) = 0.419$ to 0.421	B1		AWFW (0.4199)
(ii)	$P(X > 1 \text{ and } X < 5) = P(2 \le X \le 4)$			
	$= P(X \le 4)$	M1		Identification of **at least** 2, 3 and 4
	$- P(X \le 1)$	M1		Identification of **exactly** 2, 3 and 4
	$= 0.9037 - 0.1586 = 0.744$ to 0.746	A1	5	AWFW (0.7451)
(b)	$P(Y = 7) = \binom{n}{7}(0.4)^7(0.6)^{n-7}$	M1		Correct expression for B(7; n, 0.4) with $n \ne 7$
	$= \binom{28}{7}(0.4)^7(0.6)^{21}$	A1		Fully correct expression may be implied
	$= 0.0425$ to 0.0427	A1	3	AWFW (0.042556)
(c)	Mean = $np = 2.8$	B1		CAO
	SD = $\sqrt{np(1-p)} = \sqrt{1.68}$			
	= 1.29 to 1.31	B1	2	AWFW
(d) (i)	Mean = 2.8	B1		CAO $\Sigma fx = 140$
	SD = 2.24 to 2.27	B2		AWFW $\Sigma fx^2 = 644$
	$s_{n-1}^2 = 5.14$ to 5.15 and $s_{n-1}^2 = 5.04$			Substitution of values into correct formula for variance or SD or
			3	SD = 5.03 to 5.15 AWFW M1
(ii)	Means are the same	B1$\surd$		ft on (c) and (d)(i)
	SDs differ greatly	B1$\surd$		ft on (c) and (d)(i); but must be s with σ or s^2 with σ^2
	Thus answers do not support Aaron's belief	B1	3	Dependent on B1 above CAO
	Total		**16**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
6(a)(i)	M A S T			
	M 38 369 303 **710**			
	F 26 275 643 **944**			
	T **64** **644** **946** **1654**			
	P(F) = 944/1654 (= 0.571)	M1	1	Use of
(ii)	P($F \cap A$) = 275/1654 (= 0.166)	M1	1	Use of
(iii)	$\text{P}(F \cup A) = \dfrac{944+369}{1654}$	M1		Use of; OE
	= 1313/1654 or 0.793 to 0.795	A1	2	CAO/AWFW (0.7938)
(iv)	$\text{P}(F \mid A) = \dfrac{\text{their (ii)}}{644/1654}$	M1		Use of
	= 275/644 or 0.426 to 0.428	A1	2	CAO/AWFW (0.4270)
(b)(i)	$\text{P}(MMM) = \dfrac{710 \times 709 \times 708}{1654 \times 1653 \times 1652}$	M1		Use of (without replacement)
	= 0.0788 to 0.0791	A1	2	AWFW (no fraction) (0.07891)
(ii)		M1		Use of one combination of *MFF* (without replacement)
	$\text{P}(MFF) = \dfrac{710 \times 944 \times 943 \times 3}{1654 \times 1653 \times 1652}$	M1		Use of multiplier of 3
	= 0.419 to 0.421	A1	3	AWFW (no fraction) (0.4198)
(c)(i)	Female (and) Academic	B1	1	CAO
(ii)	Male	B1		Not female $\Rightarrow$ B0
	OR			'OR' must be clearly stated or implied
	Academic (or both)	B1	2	Addition of 'not both' $\Rightarrow$ B0
	Total		**14**	
	TOTAL		**75**	