GCE 2005

January Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Mathematics/Statistics

MS/SS1A/W

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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

√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)

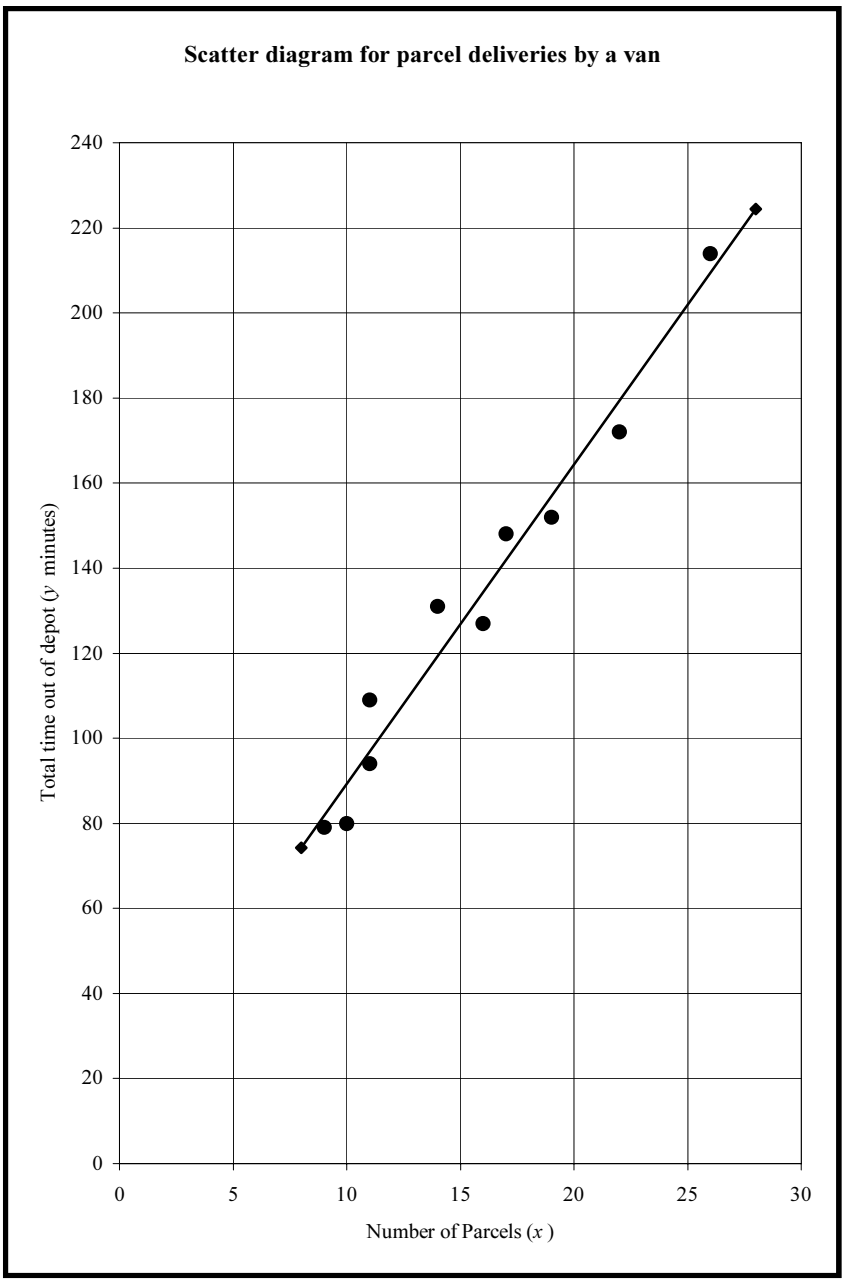
MS/SS1A/W

Q	Solution	Marks	Total	Comments
1(a)	The takings appear to increase slightly as the air temperature increases Weak positive (linear) correlation between air temperature and takings One (or two) unusual results	B1 B1	2	OE Comments on ranges of values of x and y $\Rightarrow$ B0 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**	
2	Mean = 3.75 Standard deviation = 1.84 to 1.87	B1 B2	3	CAO $\Sigma fx = 150$ AWFW $\Sigma fx^2 = 698$ s^2_{n-1} = 3.47 to 3.48 and s^2_n = 3.38 to 3.39 Substitution of values into correct formula for variance or SD or SD = 3.38 to 3.48 AWFW M1
	Total		**3**	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
3(a)(i)	$X \sim \mathrm{N}(\mu, 4^2)$ $\mu = 106$ $\mathrm{P}(X < 110) = \mathrm{P}\left(Z < \frac{110-106}{4}\right)$	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
	$z = \frac{100-\mu}{4}$	M1		Standardising AWFW 99 to 100 with μ and 4
	Thus $\frac{100-\mu}{4} = -2.0537$	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
	Total		**10**	
4(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	B2		AWFW; accept 7.5
	$a = 14.1$ to 14.6	B2		AWFW
				for attempts at Σx, $\Sigma x^2 \times 4$ or $S_{xx} \times 2$ M1
	Regression Line (implied) ≥ 2 points calculated	M1		for attempted use of correct formula for b M1
	or use of point $(\bar{x}, \bar{y})$ eg $x = 0$ $y = 14.3$ & $x = 25$ $y = 201.9$			A1 for answers
	straight line drawn	A1	6	
(c)	a: time to travel to and from area from/to depot	E1		OE Both correct but reversed ⇒ E1
	b: (average) time to deliver a/one parcel (within area)	E1	2	OE Proportional to packages ⇒ E0
	Total		**10**	

Question 4 (a) & (b)



MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
5(a)	$n = 40 \quad \underline{\bar{x}} = 72 \quad s = 32$			
	99% $\Rightarrow z = 2.5758$	B1		AWFW 2.57 to 2.58
	CI for μ is $\bar{x} \pm z \times \dfrac{(s \text{ or } \sigma)}{\sqrt{n \text{ or } (n-1)}}$	M1		Use of Must have $\left(\div\sqrt{n}\right)$ with $n > 1$
	Thus $72 \pm 2.5758 \times \dfrac{32}{\sqrt{40 \text{ or } 39}}$	A1√		ft on z only
	(58.8 to 59.1, 84.9 to 85.2)	A1	4	AWFW
(b)	$Y \sim (53, 42^2)$			
(i)	Large value of standard deviation, relative to mean,	E1		OE
	suggests negative times are likely	E1	2	OE
(ii)	Due to large sample size OR			$n > 30$ either
	by Central Limit Theorem	E1	1	CLT
(iii)	$\bar{Y}$ has mean, $\mu = 53$	B1		CAO
	and variance, $\dfrac{\sigma^2}{n} = \dfrac{42^2}{60} = 29.4$	B1		CAO; SD = AWFW 5.42 to 5.43
	$\mathrm{P}\left(\bar{Y} < 60\right) = \mathrm{P}\left(Z < \dfrac{60-53}{\sqrt{29.4}}\right)$	M1		Standardising (AWFW 59 to 60) with 53 and $\left(\sqrt{\dfrac{42^2}{n}} \text{ or } \dfrac{42^2}{n};\ n > 1\right)$ and/or $(53 - x)$
	$= \mathrm{P}(Z < 1.29) = 0.899$ to 0.903	A1	4	AWFW (0.90165)
	Total		**11**	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
6(a)(i)	$p = 0.5$			
	Attempted use of B(14, 0.5) in (a)(i) or (ii)	M1		
	$P(X \leq 10) = 0.971$ to 0.972	B1		AWFW (0.9713)
(ii)	$P(X > 5 \text{ and } X < 10) = P(6 \leq X \leq 9)$			
	$= P(X \leq 9)$	M1		Identification of **at least** 6, 7, 8 and 9
	$- P(X \leq 5)$	M1		Identification of **exactly** 6, 7, 8 and 9
	$= 0.9102 - 0.2120 = 0.698$ to 0.699	A1	5	AWFW (0.6982)
(b)	$P(Y = 7) = \binom{n}{7}(0.4)^7(0.6)^{n-7}$	M1		Correct expression for B(7; *n*, 0.4) with $n \neq 7$
	$= \binom{28}{7}(0.4)^7(0.6)^{21}$	A1		Fully correct expression may be implied
	$= 0.0425$ to 0.0427	A1	3	AWFW (0.042556)
(c)	Different numbers of days in different months	E1	1	Accept '*n* not fixed' OE
		Total	**9**	
7(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)	$P(F \mid A) = \dfrac{\text{their (ii)}}{644/1654}$	M1		Use of
	$= 275/644$ or 0.426 to 0.428	A1	2	CAO/AWFW (0.4270)
(b)	$P(MFF) = \dfrac{710 \times 944 \times 943 \times 3}{1654 \times 1653 \times 1652}$	M1		Use of **one** combination of *MFF* (without replacement)
		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 ⇒ B0
	OR			'OR' must be clearly stated or implied
	Academic (or both)	B1	2	Addition of 'not both' ⇒ B0
	Total		**10**	
	TOTAL		**60**	