

# GCE 2005

## *January Series*



ASSESSMENT and  
QUALIFICATIONS  
ALLIANCE

# Mark Scheme

## Mathematics/Statistics

MS/SS1A/W

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Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

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*Dr Michael Cresswell Director General*

## 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)

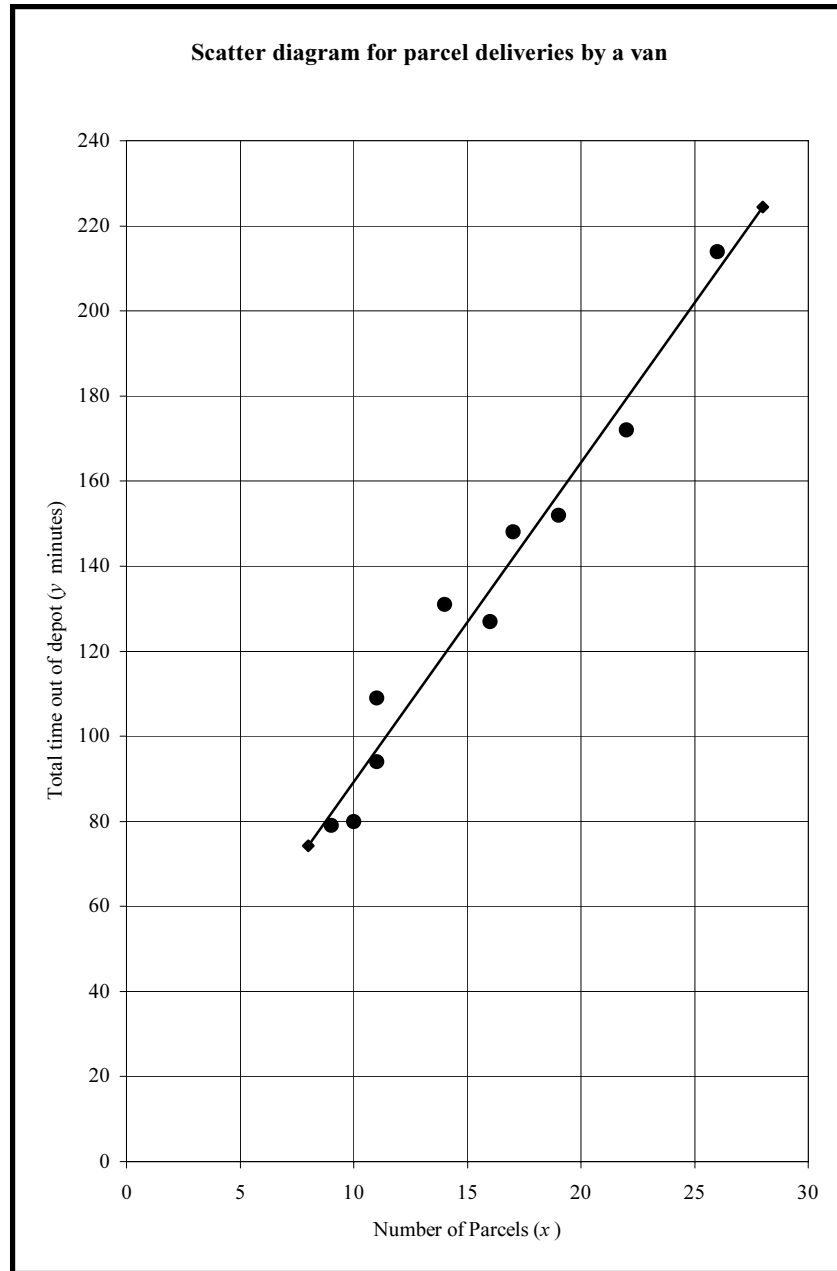
**MS/SS1A/W**

<b>Q</b>	<b>Solution</b>	<b>Marks</b>	<b>Total</b>	<b>Comments</b>
<b>1(a)</b>	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>(b)</b>	Monday 10	B1	1	CAO; accept point (4, 312)
<b>(c)</b>	$r = 0.817$ to $0.818$	B3	3	AWFW for attempts at $\Sigma x$ , $\Sigma x^2 \times 5$ 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
<b>(d)</b>	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
<b>Total</b>			<b>7</b>	
<b>2</b>	Mean = 3.75 Standard deviation = 1.84 to 1.87	B1 B2	 3	CAO $\Sigma fx = 150$ AWFW $\Sigma fx^2 = 698$ $s_{n-1}^2 = 3.47$ to $3.48$ and $s_n^2 = 3.38$ to $3.39$ Substitution of values into correct formula for variance or SD or SD = 3.38 to 3.48 AFWW M1
<b>Total</b>			<b>3</b>	

**MS/SS1A/W (cont)**

Q	Solution	Marks	Total	Comments
<b>3(a)(i)</b>	$X \sim N(\mu, 4^2)$			
	$\mu = 106$			
	$P(X < 110) = P\left(Z < \frac{110-106}{4}\right)$	M1		Standardising (109.5, 110 or 110.5) with 106 and ( $\sqrt{4}$ , 4 or $4^2$ ) and/or $(106 - x)$
	$= P(Z < 1)$	A1		CAO; ignore sign
	$= 0.841$	A1	3	AWRT (0.84134)
<b>(ii)</b>	$P(\text{underweight}) = P(X < 100)$	M1		Use of AFWW 99 to 100
	$= P(Z < -1.5) = 1 - \Phi(1.5)$	m1		Area change
	$= 1 - 0.93319 = 0.0668$ to 0.067	A1	3	AWFW (0.06681)
<b>(b)</b>	2% $\Rightarrow z = -2.0537$	B1		AWFW 2.05 to 2.06; ignore sign
	$z = \frac{100 - \mu}{4}$	M1		Standardising AFWW 99 to 100 with $\mu$ and 4
	Thus $\frac{100 - \mu}{4} = -2.0537$	m1		Equating z-term to z-value; not using 0.02, 0.98 or $ 1 - z $
	Thus $\mu = 108.2$ to 108.3	A1	4	AWFW
	<b>Total</b>		<b>10</b>	
<b>4(a)</b>	Scatter Diagram 8, 9 or 10 points plotted	B2	2	5, 6 or 7 points plotted B1
	<b>(b)</b> $b = 7.49$ to 7.51 $a = 14.1$ to 14.6	B2 B2		AWFW; accept 7.5 AWFW
	Regression Line (implied) $\geq 2$ points calculated	M1		for attempts at $\Sigma x$ , $\Sigma x^2 \times 4$ or $S_{xx} \times 2$ M1 for attempted use of correct formula for $b$ M1
	or use of point $(\bar{x}, \bar{y})$ eg $x = 0$ $y = 14.3$ & $x = 25$ $y = 201.9$ straight line drawn	A1	6	A1 for answers
<b>(c)</b>	$a$ : time to travel to and from area from/to depot	E1		OE Both correct but reversed $\Rightarrow$ E1
	$b$ : (average) time to deliver $a$ /one parcel (within area)	E1	2	OE Proportional to packages $\Rightarrow$ E0
	<b>Total</b>		<b>10</b>	

Question 4 (a) & (b)



**MS/SS1A/W (cont)**

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

**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		AWFW (0.9713)																				
	$P(X \leq 10) = 0.971$ to 0.972	B1																						
(ii)	$P(X > 5 \text{ and } X < 10) = P(6 \leq X \leq 9)$ $= P(X \leq 9)$ $- P(X \leq 5)$ $= 0.9102 - 0.2120 = 0.698$ to 0.699	M1 M1 A1	5	Identification of <b>at least</b> 6, 7, 8 and 9 Identification of <b>exactly</b> 6, 7, 8 and 9 AWFW (0.6982)																				
	(b)	$P(Y = 7) = \binom{n}{7}(0.4)^7(0.6)^{n-7}$ $= \binom{28}{7}(0.4)^7(0.6)^{21}$ $= 0.0425$ to 0.0427			M1 A1 A1	3	Correct expression for B(7; n, 0.4) with $n \neq 7$ Fully correct expression may be implied AWFW (0.042556)																	
		(c)			Different numbers of days in different months			E1	1	Accept 'n not fixed' OE														
		<b>Total</b>	<b>9</b>																					
7(a)(i)	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th><i>M</i></th> <th><i>A</i></th> <th><i>S</i></th> <th><i>T</i></th> </tr> </thead> <tbody> <tr> <td><i>M</i></td> <td>38</td> <td>369</td> <td>303</td> <td><b>710</b></td> </tr> <tr> <td><i>F</i></td> <td>26</td> <td>275</td> <td>643</td> <td><b>944</b></td> </tr> <tr> <td><b><i>T</i></b></td> <td><b>64</b></td> <td><b>644</b></td> <td><b>946</b></td> <td><b>1654</b></td> </tr> </tbody> </table>		<i>M</i>	<i>A</i>	<i>S</i>	<i>T</i>	<i>M</i>	38	369	303	<b>710</b>	<i>F</i>	26	275	643	<b>944</b>	<b><i>T</i></b>	<b>64</b>	<b>644</b>	<b>946</b>	<b>1654</b>			
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	$P(F) = 944/1654$ (= 0.571)	M1	1	Use of																				
(ii)	$P(F \cap A) = 275/1654$ (= 0.166)	M1	1	Use of																				
(iii)	$P(F   A) = \frac{\text{their (ii)}}{644/1654}$ $= 275/644$ or 0.426 to 0.428	M1 A1	2	Use of CAO/AWFW (0.4270)																				
	(b)	$P(MFF) = \frac{710 \times 944 \times 943 \times 3}{1654 \times 1653 \times 1652}$ $= 0.419$ to 0.421			M1 M1 A1	3	Use of <b>one</b> combination of <i>MFF</i> (without replacement) Use of multiplier of 3 AWFW (no fraction) (0.4198)																	
(c) (i)	Female (and) Academic	B1	1	CAO																				
(ii)	Male	B1		Not female $\Rightarrow$ B0																				
	OR Academic (or both)	B1	2	'OR' must be clearly stated or implied Addition of 'not both' $\Rightarrow$ B0																				
		<b>Total</b>	<b>10</b>																					
		<b>TOTAL</b>	<b>60</b>																					