GCE 2004
November Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Mathematics A
(MAS1/W)

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Key to Mark Scheme

M ..... mark is for ..... method
m ..... 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
AWFW ..... anything which falls within
AWRT ..... anything which rounds to
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)

Abbreviations used in Marking

MC – *x* ..... deducted *x* marks for mis-copy
MR – *x* ..... deducted *x* marks for mis-read
ISW ..... ignored subsequent working
BOD ..... given benefit of doubt
WR ..... work replaced by candidate
FB ..... formulae booklet

Application of Mark Scheme

No method shown:
Correct answer without working ..... mark as in scheme
Incorrect answer without working ..... zero marks unless specified otherwise

More than one method/choice of solution:

2 or more complete attempts, neither/none crossed out	mark both/all fully and award the mean mark rounded down
1 complete and 1 partial attempt, neither crossed out	award credit for the complete solution only

Crossed out work — do not mark unless it has not been replaced

Alternative solution using a correct or partially correct method — award method and accuracy marks as appropriate

MAS1/W

Q	Solution	Marks	Total	Comments
1(a)(i)	Any sensible statement that indicates: not random	B1		
	Any sensible statement that indicates: not representative	B1	2	
(ii)	Sampling frame is not defined Strata are not defined Random selection is not possible Any sensible alternatives	B2,1	2	
(b)	Number members from (000)0 to 7884 or (000)1 to 7885	B1		or equivalent
	Obtain 100 (consecutive) 4-digit random numbers	B1		
	Reject repeated numbers or numbers above 7884/7885 $\left[\&(000)0\right]$	B1	3	Either; or equivalent
	Total		**7**	
2(a)	Profit = Sales – Cost + Refund	M1		Use of at least (Sales – Cost)
	$\therefore P = 2.20S - (20\times 1.00)$	A1		$2.2S - 20$; or equivalent
	$+(20-S)\times 0.20$	A1	3	$4 - 0.2S$; or equivalent
	$=2S - 16$			AG
(b)	$\mathrm{E}(P) = 2\times \mathrm{E}(S) - 16 = £14.00$	B1		CAO, accept 14 (ignore units)
	$\mathrm{Var}(P) = 2^2 \times \mathrm{Var}(S)$	M1		$\mathrm{Var}(aX-b) = a^2 \times \mathrm{Var}(X)$ with $a>1$
	$= £^2 16.00$	A1		CAO; accept 16 (ignore units)
	$\mathrm{SD}(P) = \sqrt{\mathrm{Var}(P)} = \sqrt{16} = £4.00$	m1	4	use of $\sqrt{\mathrm{Var}(P)}$
	Total		**7**	

MAS1/W (cont)

Q	Solution	Marks	Total	Comments
3(a)	Area = 1	M1		Use of
	$\text{Area} = \frac{4\times 2c}{2} + (2\times 2c) + \frac{12\times 2c}{2}$	M1		Attempt at area of (2 triangles + rectangle) or equivalent
	$= 20c$	A1	3	CAO
	$\therefore 20c = 1 \Rightarrow c = 0.05$			AG
(b)(i)	$\mathrm{P}(X > 4) = \mathrm{P}(4 < X < 6) + \mathrm{P}(X > 6)$	M1		Attempt at area of (rectangle + triangle)
	or $= 1 - \mathrm{P}(X < 4)$			or (1 – triangle) or equivalent
	$= 4c + 12c = 1 - 4c = 0.8$	A1	2	CAO; or equivalent
(ii)	$\mathrm{P}(4 < X < 12) = \mathrm{P}(X < 12) - \mathrm{P}(X < 4)$	M1		use of; or equivalent
	$= \{(1-3c) \text{ or } (4c + 4c + 9c)\} - (4c)$			
	$= (1-7c)$ or $13c$	A1		either
	$= 1 - 0.35 = 0.65$	A1	3	CAO; or equivalent
(iii)	$\mathrm{P}(X < 12 \mid X > 4) = \frac{\mathrm{P}(4 < X < 12)}{\mathrm{P}(X > 4)}$	M1 A1		Attempt at conditional probability Correct expression
	$= \frac{\text{(ii)}}{\text{(i)}} = \frac{0.65}{0.80}$	m1		
	$= \frac{13}{16} = 0.8125$	A1	4	CAO or AWFW 0.812 to 0.813
				NB Area > 4 is 16c so for conditional (M1) distribution, c = 0.0625 (A1) Area < 12 is 13c for this distribution (ml) Thus probability $= 13 \times 0.0625 = 0.8125$ (A1)
(c)	Some delays greater than 18 minutes Some appointments early PDF unlikely to be linear	E1	1	
	Total		**13**	

MAS1/W (cont)

Q	Solution	Marks	Total	Comments
4(a)	$n = 18 \quad p = 0.15$			
	$P(Car = 2) =$	M1		binomial used in (a) or (b)
	$\binom{18}{2}(0.15)^2(0.85)^{16}$	A1		correct expression
	$= 0.255$ to 0.256	A1	3	AWFW (0.2556)
(b)	$n = 50 \quad p = 0.15$			
	$P(5 < Car < 10) =$			
	$P(Car \leq 9)$	M1		Use of ≤ 9 or (6, 7, 8, 9)
	$- P(Car \leq 5)$	M1		Use of $-$ & ≤ 5 or (4 correct terms added)
	$= 0.7911 - 0.2194 = 0.571$ to 0.572	A1	3	AWFW (0.5717)
(c)	$n = 900 \quad p = 0.15$			
	$\mu = 900 \times 0.15 = 135$	B1		CAO
	$\sigma^2 = 900 \times 0.15 \times 0.85 = 114$ to 115	B1		114.75 ($\sigma = 10.65$ to 10.75 AWFW)
	$P(Car \leq 150) = P(Car < 150.5)$	B1		$+0.5$
	$= P\left(Z < \frac{150.5 - 135}{\sqrt{114.75}}\right)$	M1		standardising (149.5, 150, 150.5) using their μ & their $\sqrt{\sigma^2}$ or correct values
	$= P(Z < 1.45) = \Phi(1.45)$			
	$= 0.926$ to 0.927	A1	5	AWFW (0.92647)
(d)	p not 0.15 (value for cars, not all vehicles)			
	Vehicles not independent	E1	1	
	Total		**12**	

MAS1/W (cont)

Q	Solution	Marks	Total	Comments
5(a)	$\hat{\mu} = \bar{x} = \frac{1}{n}\sum x = \frac{1040}{100} = 10.4$	B1		CAO
	$\hat{\sigma}^2 = s^2 = \frac{1}{n-1}\left(\sum x^2 - \frac{\left(\sum x\right)^2}{n}\right)$	M1		use of; or use of $\frac{n}{n-1}v$ or v
	$= \frac{1}{99}\left(11102.11 - \frac{1040^2}{100}\right) = 2.89$	A1	3	CAO ($v = 2.8611$) $\left(\sqrt{v} = 1.69148\right)$
(b)	CI : $\bar{x} \pm z \times \frac{s}{\sqrt{n}}$	M1		Use of with $n > 1$
	$99\% \Rightarrow z = 2.5758$	B1		AWFW 2.57 to 2.58
	$\therefore\ 10.4 \pm 2.5758 \times \frac{1.7}{\sqrt{100}}$	A1√		√ on (a) providing $\bar{x} \neq 1040$, & on z, not on n
	$\therefore\ 10.4 \pm 0.44$			
	i.e. (9.96, 10.8)	A1dep	4	AWRT; dependent on ÷ by 99 in part (a) unless subsequently corrected
(c)	Length, $X \sim$ Normal	E1	1	
(d)	Require to subtract 0.2 from each CL	M1		subtract/add 0.2 from/to each CL
	$\therefore$ (9.76, 10.6)	A1√	2	√ on (b); AWRT
	Total		**10**	

MAS1/W (cont)

Q	Solution	Marks	Total	Comments
6(a)(i)	$\text{Mean} = \mu = 4c$	B1		CAO
	$\text{Variance} = \sigma^2 = 3c^2$	B1	2	CAO
(ii)	$\text{E}(X^2) = \text{Var}(X) + (\text{E}(X))^2$	M1		use of or equivalent
	$= 3c^2 + (4c)^2$	A1√	2	
	$= 19c^2$			AG
(b)	$19c^2 = 171$			
	$\therefore \quad c = 3$	B1	1	CAO
(c)(i)	$\text{P}\left(X > \frac{\mu}{2} + \frac{\sigma}{\sqrt{3}}\right) = \text{P}(X > 6 + 3)$			
	$= \text{P}(X > 9)$	B1		CAO
	$= \frac{7c-9}{6c}$ or $1 - \frac{9-c}{6c}$	M1		attempt at correct area
	$= \frac{2}{3} = 0.67$	A1	3	CAO/AWRT
(ii)	$\text{P}(X < d) = 0.25$			
	$\text{P}(X < d) = \frac{d-c}{6c} = \frac{d-3}{18}$	M1		attempt at correct area **and** substitution of their value of c
	$\therefore \quad \frac{d-3}{18} = 0.25$	m1		Equating their expression in d to 0.25
	$\therefore \quad d = 7.5$	A1	3	CAO
	Total		**11**	
	Total		**60**	