

GCE

Mathematics

Advanced GCE 4735

Mark Scheme for June 2010

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1(i)	Var(2A - 3B) = 4Var(A) + 9Var(B) - 12Cov(A,B)	M1		Correct formula. Allow one
	40 00 -4 400 /4 5			error
	\Rightarrow 18 = 36 + 54 - 12Cov(A,B)	A1	2	Substitute relevant values
/::\	\Rightarrow Cov(A, B) = 6	A1 B1 ft	3	CAO
(ii)	Since $Cov(A, B) \neq 0$, A and B are not independent	ВП	1	Must have a reason. ft Cov≠ 0
			(4)	3017 3
2(i)	$G'(t) = 8te^{4t^2}/e^4$	M1A1		M1 for ct^2/e^4
	E(X) = G'(1)			
	= 8	A1	3	
(ii)	EITHER: $G(t) = e^{-4}(1 + 4t^2 +)$	M1A1		Expand in powers of t
(,	$P(X=2) = \text{coefficient of } t^2 = 4e^{-4} \text{ or } 4/e^4 \text{ or } 0.0733$	A1	3	Expand in powers of t
	OR $G''(t) = (8+64t^2)e^{4t^2-4}$	M1A1	I	M1 for reasonable attempt
	$P(X=2) = \frac{1}{2}G''(0) = 4e^{-4} \text{ or } 4/e^{4} \text{ or } 0.0733$	A1	1	at M"(<i>t</i>)
	, , , , , , , , , , , , , , , , , , , ,	' ' '	(6)	
3(i)	Number of different rankings ¹¹ C ₅	M1	. ,	Number of selections of 5
				from 11
	=462	A1		
	For $R \le 17$: $1+2+3+4+5 = 15$			
	1+2+3+4+6=16 1+2+3+5+6=17			
	1+2+3+4+7=17	B2		B1 for 2 or 3 correct
	$P(R \le 17) = 4/462 = 2/231$ AG	A1	5	
(ii)	<i>W</i> = 17	M1		
	$P(W \le 17) = \frac{2}{231}$			
	Smallest SL = $\frac{400}{231}$ %	A1ft	2	Allow $\frac{4}{231}$; ft $\frac{2}{231}$, but must
			(7)	be exact
4(i)	EITHER: (a) $M'(t) = n(1 - 2t)^{-\frac{1}{2}n - 1}$	M1 A	1	Correct form for M1
	$E(Y) = M'(0) = n$ $M''(A) = n(n+2)(1 - 24)^{-\frac{1}{2}n-2}$	A1		Et aimilar M//t
	$M''(t) = n(n+2)(1-2t)^{-1/2n-2}$ $Var(Y) = n(n+2) - n^2 = 2n$	M1 A1	5	Ft similar M'(<i>t</i>) M"(0) – (M'(0)) ²
	OR: $M(t) = 1 + nt + \frac{1}{2}n(n+2)t^2$	M1A1		$ \mathbf{v} (\mathbf{O}) = (\mathbf{v} (\mathbf{O}))$
	E(Y) = n	A1	17.1	
	$Var(Y) = n(n+2) - n^2 = 2n$	A1	5	
(ii)	$MGF = (1 - 2t)^{-30}$	B1	<u>-</u>	From [(1 – 2 <i>t</i>) ^{-1/2}] ⁶⁰
	χ^2 distribution with 60 d.f.	B1	2	
(iii)	E(S) = 60, Var(S) = 120	B1ft		From (i)
	Using CLT, Probability =1 – Φ(10/√120)	M1	2	Correct tail: allow cc
	= 0.181	A1	3 (10)	
		<u> </u>	(10)	

5(i)	Assumes salaries symmetrically	B1	In context
3(1)	distributed	וטו	III COINEAL
	H_0 : $m(\text{edian}) = 19.5$, H_1 : $m(\text{edian}) \neq 19.5$	B1	For both; not μ ; accept words
	P = 867 (or 408)		, , ,
	Using normal approximation	M1	
	$\mu = \frac{1}{4} \times 50 \times 51 \ (= 637.5)$	A1	
	$\sigma^2 = 50 \times 51 \times 101/24 (= 10731.25)$	A1	
	$z = (a - 637.5)/\sqrt{10731.25}$	M1	a=866.5, 867, 867.5 (or 408.5,
	Use $a = 866.5$ = 2.211, or 2.215 or 2.220 (– from 408)	A1 A1	408, 407.5)
	Compare their z with 1.96 and reject H_0	M1	407.5)
	There is sufficient evidence at the 5% SL	IVII	Or <i>p</i> -value rounding to 0.026 or
	that the median salary differs from £19	A1 ft	0.027
	500	10	Compare with 0.05 or equivalent
			ft z Or find critical region
(ii)	Use sign test when salary distribution is	B1 1	
	skewed	(4.4)	
6(i)	N	(11)	
0(1)	0 1 2	B1	
	0 0 c 2c	M1	Calculate 9 probs in terms of c
	R 1 2c 3c 4c		·
	2 4c 5c 6c		
	Total 27 <i>c</i> = 1	A 4	
	$c = \frac{1}{27}$	A1 3	
(ii)	9c/27c	M1	Marginal probability
	$=\frac{1}{3}$	A1 ft	AEF; ft c
		2	, , , , , ,
(iii)	P(N + R > 2)	M1	
, ,	$= 15c/27c = \frac{5}{9}$	A1 ft	AEF; ft c
		2	7.21 , 10
		_	
(iv)	$P(R=2) = \frac{15}{27}$	M1	Using conditional probabilities
	$P(N \mid R=2)$: $p_0 = \frac{4}{15}$, $p_1 = \frac{1}{3}$, $p_2 = \frac{2}{5}$	A1 ft	One value; ft values in (i)
	$E(N R=2) = 1 \times \frac{1}{3} + 2 \times \frac{2}{5}$	A1 ft	All values
	$=\frac{17}{15}$	A1	Or 1.13
	15	4	
(v)	Eg P($N = 0$ and $R = 0$) = 0	M1	Or from conditional probs
	$P(N=0) \times P(R=0) = \frac{6}{27} \times \frac{3}{27} \neq 0$	1411	M0 from <i>N</i> =1 with <i>R</i> =1 or 2
	So N and R are not independent	A1	All correct
	•	2	
		(13)	

7(i)	$\int_0^{2\theta} \frac{x^{n+1}}{2\theta^2} dx = \left[\frac{x^{n+2}}{2(n+2)\theta^2} \right]$	M1		Correct integral
	$ \int_0^{\infty} \frac{1}{2\theta^2} dx = \left[\frac{1}{2(n+2)\theta^2} \right] $ $ = 2^{n+1} \theta^n / (n+2) $	A1		AEF
	,		_	
	$E(X) = 4\theta/3$	B1 ft	3 	B0 if not 'deduced'
<i>(</i>)	$Var(X) = 2\theta^{2} - (4\theta/3)^{2} = 2\theta^{2}/9$ $Var(X^{2}) = E(X^{4}) - (E(X))^{2}$ $= 16\theta^{4}/3 - 4\theta^{4} = 4\theta^{4}/3$	M1A1ft		 ft (i) with no <i>n</i>
(ii)	$= 16\theta^4/3 - 4\theta^4 = 4\theta^4/3$	M1A1ft	4	, ,
	$E(\sum X_i) = 3 \times 4\theta/3$	M1		ft (i) with no <i>n</i>
(iii)	$= 4\theta$ $T_1 = \frac{1}{4} \sum X_i$	A1 ft A1 ft		 ft with no <i>n</i>
("")	$E(\sum X_i^2) = 3 \times 2\theta^2$ $= 6\theta^2$	M1 A1 ft		ft with no n or θ
	$T_2 = (\sum X_i^2)/27$	A1 ft	6	ft with no n ft with no n or θ
		M1		
(iv)	$Var(T_2) = 1/27^2 \times 3 \times Var(X^2)$ = $4\theta^4/729$	A1	2	
	.07720	(15)		
				CAO
8(i)	$P(L \cap M) = P(L M)P(M) = 0.12$ and		М1	
	$P(L) = P(M \cap L) / P(M \mid L) = 0.12/0.4 = 0.3$	A1		
	P(X', M') P(X - M')			
	$P(L' \cup M') = P \left[(L \cap M)' \right]$			
	$=1-P(L\cap M)$ = 1 - 0.2 × 0.6 = 0.88	B1	3	
(ii)	$P(N L \cap M) = 0.3$	M1		
	$\Rightarrow P(N \cap L \cap M) = 0.3 \times 0.12$	A1		
	$=0.036$ $P(L' \cup M' \cup N') = 1 - 0.036 = 0.964$	A1	3 [6]	

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