

November 2003

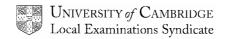
GCE A AND AS LEVEL

MARK SCHEME

MAXIMUM MARK: 50

SYLLABUS/COMPONENT: 9709/07, 8719/07

MATHEMATICS AND HIGHER MATHEMATICS Paper 7 (Probability and Statistics 2)



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	1.9	M1	For equality or inequality involving width or
1	$\frac{1.9}{\sqrt{n}} \times 1.96 < 1$		equivalent and term in $1/\sqrt{n}$ and a z-value
	n > 13.9 (13.87)	A1	For correct inequality
	n=14	M1 A1	For solving a relevant equation For correct answer cwo
		[4]	Por correct answer cwo
2	$\lambda = 4.5$	M1	For using Poisson approximation any mean
	(2 2 4)	B1 M1	For correct mean used For calculating P(2, 3, 4) their mean
	$P(X=2, 3, 4) = e^{-4.5} \left(\frac{4.5^2}{2!} + \frac{4.5^3}{3!} + \frac{4.5^4}{4!} \right)$	A1	For correct numerical expression
	= 0.471	A1	For correct answer
		[5]	NB Use of Normal can score B1 M1 SR Correct Bin scores M1 A1 A1 only
		[~]	-
3	SU ~ N(19,12)	B1	For correct mean and variance. Can be
	$P(T-SU > 0) \text{ or } P(T-S > 5) = 1 - \Phi\left(\frac{0-1}{\sqrt{21}}\right)$	M1	implied if using P(T-S>5) in next part For consideration of P(T – SU > 0)
		M1	For summing their two variances
	$=\Phi(0.2182)$	M1	For normalising and finding correct area
	= 0.586	A 1	from their values
		A1 [5]	For correct answer
		[~]	
4	(i) $\lambda = \frac{20}{80} = 0.25$	B1	For $\lambda = 0.25$
	$P(X \ge 3) = 1 - P(X \le 2)$	M1	For calculating a relevant Poisson prob(any
	$= 1 - e^{-0.25} (1 + 0.25 + \frac{0.25^2}{2})$	M1	λ) For calculating expression for P ($X \ge 3$) their λ
	_	M1	
	= 0.00216	A1	For correct answer
		[4]	
	-k		
	(ii) $e^{\frac{-k}{80}} = 0.9$	M1	For using $\lambda = -t/80$ in an expression for P(0)
	$\frac{-k}{80} = -0.10536$	M1	For equating their expression to 0.9
	80	M1	For solving the associated equation
	k = 8.43	A1	For correct answer cwo
		[4]	
5	(i) $P(\overline{X} > 1800) = 1 - \Phi\left(\frac{1800 - 1850}{117 / \sqrt{26}}\right)$	B1	For $117/\sqrt{26}$ (or equiv)
	$=\Phi(2.179)$	M1	For standardising and use of tables
	= 0.985	A1	For correct answer cwo
		[3]	
		[~]	
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(ii) H_0 : $\mu = 1850$	B1	Both hypotheses correct
H_1 : $\mu \neq 1850$ $1833 - 1850$		
Test statistic = $\frac{1833 - 1850}{117/\sqrt{26}}$	M1	Standardising attempt including standard error
= -0.7409	A1	Correct test statistic (+/-)
Critical value $z = \pm 1.645$	M1	Comparing with $z = \pm 1.645$, + with + or – with – (or equiv area comparison) ft 1 tail test $z=1.282$
Accept H ₀ , no significant change	A1ft [5]	For correct conclusion on their test statistic and their z. No contradictions.
6 (i) (a) Rejecting H₀ when it is true(b) Accepting H₀ when it is false	B1 B1 [2]	Or equivalent
(ii) (a) P(NNNN) under $H_0 = (0.94)^5$ = 0.7339 P(Type I error) = 1 - 0.7339 = 0.266	M1* A1 M1* A1ft dep*	For evaluating P(NNNN) under H ₀ For correct answer (could be implied) For identifying the Type I error outcome For correct final answer SR If M0M0 allow B1 for Bin(5,0.94)used
	[4]	
(b) P(NNNN) under $H_1 = (0.7)^5$ = 0.168 P(Type II) error = 0.168	M1 M1 A1	For Bin(5,0.7) used For P(NNNN) under H ₁ For correct final answer
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7 (i) $\int_{0}^{\infty} ke^{-3x} dx = 1$	M1	For attempting to integrate from 0 to ∞ and putting the integral = 1
$0 - \frac{-k}{3} = 1 \Rightarrow k = 3$	A1	For obtaining given answer correctly
	[2]	
(ii) $\int_{0}^{q_1} 3e^{-3x} dx = 0.25$	M1	For equating $\int 3e^{-3x} dx$ to 0.25 (no limits
$ \begin{bmatrix} -e^{-3x} \end{bmatrix}_0^{q1} = 0.25 \\ -e^{-3q1} + 1 = 0.25 $	M1	needed) For attempting to integrate and substituting (sensible) limits and rearranging
$0.75 = e^{-3q1}$ $q_1 = 0.0959$	A1	For correct answer
	[3]	

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(iii) Mean = $\int_{0}^{\infty} 3xe^{-3x} dx$ $= \left[-xe^{-3x} \right]_{0}^{\infty} - \int_{0}^{\infty} -e^{-3x} dx$	B1 M1	For correct statement for mean For attempting to integrate $3xe^{-3x}$ (no limits needed) For $-xe^{-3x}$ or $-xe^{-3x}/3$
$= \left[\frac{e^{-3x}}{-3}\right]_0^{\infty}$	M1 A1	For attempt $\int -e^{-3x} dx$ (their integral) For $0+\left[\frac{e^{-3x}}{-3}\right]_0^{\infty}$
= 0.333 or 1/3	A1 [6]	For correct answer