CAMBRIDGE
INTERNATIONAL EXAMINATIONS

June 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)

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

1 (i) 2.5 1.25	B1 B1	**2**	For correct mean. For correct variance
(ii) 5 5	B1ft B1ft	**2**	For correct mean. For correct variance
2 $H_0 : p = 0.6$ $H_1 : p > 0.6$	B1		For correct H_0 and H_1
$P(X \geq 10) = {}_{12}C_{10}0.6^{10}0.4^2 + {}_{12}C_{11}0.6^{11}0.4^1 + 0.6^{12}$ = 0.0834	M1* M1*dep A1		For one Bin term (n = 12, p = 0.6) For attempt X = 10, 11, 12 or equiv. For correct answer (or correct individual terms and dig showing 0.1)
Reject H_0, i.e. accept claim at 10% level	B1ft	**5**	For correct conclusion
S.R. Use of Normal scores 4/5 max $z = \frac{9.5 - 7.2}{\sqrt{2.88}}$ (or equiv. Using N(0.6, 0.24/12)) = 1.3552	B1 M1		For correct H_0 and H_1 Use of N(7.2, 2.88) or N(0.6, 0.24/12) and standardising with or without cc
Pr(>9.5) = 1 – 0.9123 = 0.0877 Reject H_0, i.e. accept claim at 10% level	A1 B1ft		For correct answer or 1.3552 and 1.282 seen For correct conclusion
3 (i) $31 \pm 2.326 \times \frac{3}{\sqrt{20}}$	B1		For correct mean
= (29.4, 32.6)	M1		Calculation of correct form $\bar{x} \pm z \times \frac{s}{\sqrt{n}}$ (must have $\sqrt{n}$ in denominator)
	B1		z = 2.326
	A1	**4**	Correct answer
(ii) 30% is inside interval Accept claim (at 2% level)	ftB1* ftB1*dep	**2**	S.R. Solutions not using (i) score B1ft only for correct working and conclusion
4 (i) $P(X > 1.5) = \left[x - \frac{x^2}{4}\right]_{1.5}^{2}$	M1		For substituting 2 and 1.5 in their $\int f(x)dx$ (or area method ½ their base x their height)
or $1 - \left[x - \frac{x^2}{4}\right]_{.0}^{1.5}$			
= 0.0625	A1	**2**	For correct answer

(ii)	E(X) = $\int_0^2 (x - \frac{1}{2}x^2)dx = \left[\frac{x^2}{2} - \frac{x^3}{6}\right]_0^2$	M1		For evaluating their $\int xf(x)dx$
	= 2/3	A1	**2**	For correct answer
(iii)	$m - \frac{m^2}{4} = 0.5$	M1		For equating their $\int f(x)dx$ to 0.5
		M1		For solving the related quadratic
	$m = 0.586$ (2-$\sqrt{2}$)	A1	**3**	For correct answer
5 **(i)**	P(X < 1.7) = $\Phi\left(\frac{1.7-2.1}{0.9/\sqrt{20}}\right)$	B1		For identifying prob Type I error
		M1		For standardising
	= 1 - Φ (1.9876)	A1		For correct standardising and correct area
	= 0.0234	A1	**4**	For correct final answer
(ii)	P(Type II error) = P(X > 1.7)	B1		For identifying prob for Type II error
	= 1 - $\Phi\left(\frac{1.7-1.5}{0.9/\sqrt{20}}\right)$	M1		For standardising using 1.5 and their 1.7
		A1		For correct standardising and correct area
	= 1 - Φ (0.9938) = 0.160	A1	**4**	For correct final answer
6 **(i)**	λ = 1.25	M1		For attempting to find new λ and using it
	P(X < 4) = $e^{-1.25}\left(1 + 1.25 + \frac{1.25^2}{2} + \frac{1.25^3}{6}\right)$	M1		For summing P((0,) 1, 2, 3) or P(0, 1, 2, 3, 4) using a Poisson expression
	= 0.962	A1	**3**	For correct answer
(ii)	X ~N(182.5, 182.5)	B1		For correct mean and variance
	P(> 200 breakdowns) = 1 - $\Phi\left(\frac{200.5-182.5}{\sqrt{182.5}}\right)$	M1		For standardising process with or without continuity correction
	= 1 - Φ (1.332)	A1ft		For correct standardising and correct tail
	= 0.0915 (0.0914)	A1	**4**	For correct answer
(iii)	λ = 5 for phone calls λ = 6.25 for total	B1		
	P(X = 4) = $e^{-6.25}\left(\frac{6.25^4}{4!}\right)$	M1		For summing their two λ s and using a Poisson expression OR alt. method using sep. distributions 5 terms req.
	= 0.123	A1	**3**	For correct answer

7	**(i)** 20 of A ~A* ~N(401, 20 x 0.15^2) ~N(401, 0.45)	B1		For correct mean for either
	20 of B ~B* ~N(401, 1.458)	B1		For variance 20 x 0.15^2 or 20 x 0.27^2
	$A^* - B^*$ ~N(0, 1.908)	M1		For adding their two variances
	P($A^* - B^* > 2$)			
	$= 1 - \Phi\left(\frac{2-0}{\sqrt{1.908}}\right)$	M1		For consideration of their $A^* - B^* > 2$
	$= 1 - \Phi(1.4479)$	M1		For standardising and finding correct area
	$= 0.0738$	A1	**6**	For correct answer
	OR $\overline{A}$ ~N(20.05, 0.15^2/20), $\overline{B}$ ~N(20.05, 0.27^2/20)	B1		For correct mean for either
		B1		For variance $0.15^2/20$ or $0.27^2/20$
	$\overline{A} - \overline{B}$ ~N(0, 0.00477)	M1		For adding their variances
	P($\overline{A} - \overline{B} > 0.1$)	M1		For consideration of their $\overline{A} - \overline{B} > 0.1$
	$= 1 - \Phi\left(\frac{0.1-0}{\sqrt{0.00477}}\right)$	M1		For standardising and finding correct area
	$= 0.0738$	A1	**6**	For correct answer
	(ii) $1.96 = \frac{20.07 - 20.05}{(0.15/\sqrt{n})}$	M1		For an equation of correct form on RHS involving $\sqrt{n}$
		B1		For 1.96 used
		M1		For solving an equation of correct form (any z)
	$n = 216$	A1	**4**	For correct answer