

**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)**



Page 1	Mark Scheme	Syllabus	Paper
	A AND AS LEVEL – JUNE 2003	9709	7

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

Page 2	Mark Scheme	Syllabus	Paper
	A AND AS LEVEL – JUNE 2003	9709	7

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

Page 3	Mark Scheme	Syllabus	Paper
	A AND AS LEVEL – JUNE 2003	9709	7

7 (i)	20 of $A \sim A^*$	B1		For correct mean for either
	$\sim N(401, 20 \times 0.15^2)$			
	$\sim N(401, 0.45)$			
	20 of $B \sim B^* \sim N(401, 1.458)$	B1		For variance $20 \times 0.15^2$ or $20 \times 0.27^2$
	$A^* - B^* \sim N(0, 1.908)$	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 $\bar{A} \sim N(20.05, 0.15^2/20),$	B1		For correct mean for either
$\bar{B} \sim N(20.05, 0.27^2/20)$	B1		For variance $0.15^2/20$ or $0.27^2/20$	
$\bar{A} - \bar{B} \sim N(0, 0.00477)$	M1		For adding their variances	
$P(\bar{A} - \bar{B} > 0.1)$	M1		For consideration of their $\bar{A} - \bar{B} > 0.1$	
$= 1 - \Phi\left(\frac{0.1-0}{\sqrt{0.00477}}\right)$	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	