

**June 2004**

**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  
International Examinations**

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<b>1 (i)</b> $H_0: \mu = 15$ or $p = 0.25$ $H_1: \mu > 15$ or $p > 0.25$	B1	<b>1</b>	For $H_0$ and $H_1$ correct
<b>(ii)</b> Test statistic $z = \pm \frac{21.5 - 15}{\sqrt{60 \times 0.25 \times 0.75}} = 1.938$ OR test statistic $z = \pm \frac{\frac{22}{60} - \frac{0.5}{60} - \frac{15}{60}}{\sqrt{\frac{0.25 \times 0.75}{60}}} = 1.938$ CV $z = 1.645$ In CR Claim justified	M1  A1  M1 A1ft	     <b>4</b>	For attempt at standardising with or without cc, must have $\sqrt{\quad}$ something with 60 in on the denom  For 1.94 (1.938)  For comparing with 1.645 or 1.96 if 2-tailed, signs consistent, or comparing areas to 5% For correct answer(ft only for correct one-tail test)
<b>2 (i)</b> Mean = $3.5 + 2.9 + 3.1 = 9.5$ Var = $0.3^2 + 0.25^2 + 0.35^2 (=0.275)$ St dev = 0.524	B1 M1 A1	  <b>3</b>	9.5 as final answer For summing three squared deviations For correct answer
<b>(ii)</b> $z = \frac{9 - 9.5}{\sqrt{\frac{\text{their var}}{4}}} = -1.907$ or $z = \frac{36 - 38}{\sqrt{(4 \times \text{their var})}} = -1.907$ $\Phi(1.907) = 0.9717 = 0.972$	M1 M1 A1	  <b>3</b>	For standardising, no cc For $\sqrt{\frac{\text{their var}}{4}}$ or $\sqrt{(4 \times \text{their var})}$ in denom - no 'mixed' methods. For correct answer
<b>3 (i)</b> $E(2X - 3Y) = 2E(X) - 3E(Y) = 16 - 18 = -2$	M1 A1	<b>2</b>	For multiplying by 2 and 3 resp and subt For correct answer
<b>(ii)</b> Var $(2X - 3Y) = 4\text{Var}(X) + 9\text{Var}(Y)$ $= 19.2 + 54$ $= 73.2$	B1 M1 M1 A1	   <b>4</b>	For use of var $(Y) = 6$ For squaring 3 and 2 For adding variances (and nothing else) For correct final answer
<b>4 (i)</b> $\bar{x} = 375.3$ $\sigma^2_{n-1} = 8.29$	B1 M1 A1	  <b>3</b>	For correct mean (3.s.f) For legit method involving $n-1$ , can be implied For correct answer
<b>(ii)</b> $p = 0.19$ or equiv. $0.19 \pm 2.055 \times \sqrt{\frac{0.19 \times 0.81}{200}}$ $0.133 < p < 0.247$	B1 M1 B1 A1	   <b>4</b>	For correct $p$ For correct form $p \pm z \times \sqrt{\frac{pq}{n}}$ either/both sides For $z = 2.054$ or $2.055$ For correct answer

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<p><b>5 (i)</b> <math>\frac{c-54}{3.1/\sqrt{10}} = -1.282</math></p> <p><math>c = 54 - 1.282 \times \frac{3.1}{\sqrt{10}} = 52.74</math></p>	<p>B1 M1</p> <p>A1</p> <p>A1 <b>4</b></p>	<p>For + or – 1.282 seen</p> <p>For equality/inequality with their <math>z (\pm)</math> (must have used tables), no <math>\sqrt{10}</math> needed (c can be numerical)</p> <p>For correct expression (c can be numerical, but signs must be consistent)</p> <p>For correct GIVEN answer. No errors seen.</p>
<p><b>(ii)</b> <math>P(\bar{x} &gt; 52.74) = 1 - \Phi\left(\frac{52.74 - 51.5}{3.1/\sqrt{10}}\right)</math></p> <p><math>= 1 - \Phi(1.265) = 1 - 0.8971</math></p> <p><math>= 0.103</math> or <math>0.102</math></p>	<p>B1</p> <p>M1</p> <p>A1</p> <p>A1 <b>4</b></p>	<p>For identifying the outcome for a type II error</p> <p>For standardising, no <math>\sqrt{10}</math> needed</p> <p>For <math>\pm 1.265</math> (accept 1.26-1.27)</p> <p>For correct answer</p>
<p><b>6 (i)</b> <math>P(5) = e^{-6} \times \frac{6^5}{5!} = 0.161</math></p>	<p>M1</p> <p>A1 <b>2</b></p>	<p>For an attempted Poisson <math>P(5)</math> calculation, any mean</p> <p>For correct answer</p>
<p><b>(ii)</b> <math>P(X \geq 2) = 1 - \{P(0) + P(1)\}</math></p> <p><math>= 1 - e^{-1.6}(1 + 1.6)</math></p> <p><math>= 0.475</math></p>	<p>B1</p> <p>M1</p> <p>A1 <b>3</b></p>	<p>For <math>\mu = 1.6</math>, evaluated in a Poisson prob</p> <p>For <math>1 - P(0) - P(1)</math> or <math>1 - P(0) - P(1) - P(2)</math></p> <p>For correct answer</p>
<p><b>(iii)</b></p> <p><math>P(1 \text{ then } 4 \mid 5) = \frac{(e^{-3} \times 3) \times (e^{-3} \times \frac{3^4}{4!})}{e^{-6} \times \frac{6^5}{5!}}</math></p> <p><math>= 0.156</math> or <math>5/32</math></p>	<p>M1</p> <p>M1</p> <p>A1 <b>3</b></p>	<p>For multiplying <math>P(1)</math> by <math>P(4)</math> any (consistent) mean</p> <p>For dividing by <math>P(5)</math> any mean</p> <p>For correct answer</p>
<p><b>7 (i)</b> <math>c \int_0^5 t(25 - t^2) dt = 1</math></p> <p><math>c \left[ \frac{25t^2}{2} - \frac{t^4}{4} \right]_0^5 = 1</math></p> <p><math>c \left[ \frac{625}{2} - \frac{625}{4} \right] = 1 \Rightarrow c = \frac{4}{625}</math></p>	<p>M1</p> <p>A1</p> <p>A1 <b>3</b></p>	<p>For equating to 1 and a sensible attempt to integrate</p> <p>For correct integration and correct limits</p> <p>For given answer correctly obtained</p>
<p><b>(ii)</b> <math>\int_2^4 ct(25 - t^2) dt = \left[ \frac{25ct^2}{2} - \frac{ct^4}{4} \right]_2^4 = c[136] - c[46]</math></p> <p><math>= \frac{72}{125} \quad (0.576)</math></p>	<p>M1*</p> <p>M1*dep</p> <p>A1 <b>3</b></p>	<p>For attempting to integrate <math>f(t)</math> between 2 and 4 (or attempt 2 and 4)</p> <p>For subtracting their value when <math>t = 2</math> from their value when <math>t = 4</math></p> <p>For correct answer</p>
<p><b>(iii)</b> <math>\int_0^5 ct^2(25 - t^2) dt = \left[ \frac{4}{625} \times \frac{25t^3}{3} - \frac{4}{625} \times \frac{t^5}{5} \right]_0^5</math></p> <p><math>= \frac{8}{3}</math></p>	<p>M1*</p> <p>A1</p> <p>M1*dep</p> <p>A1 <b>4</b></p>	<p>For attempting to integrate <math>tf(t)</math>, no limits needed</p> <p>For correct integrand can have <math>c</math> (or their <math>c</math>)</p> <p>For subtracting their value when <math>t=0</math> from their value when <math>t=5</math></p> <p>For correct answer</p>