

June 2005
6686 Statistics S4
Mark Scheme

edexcel 

FINAL

Publication

Question Number	Scheme	Marks
1.	<p>(a) $P(X > 19.023) = 0.025$ or $P(X < 19.023) = 0.975$ both</p> <p>$P(X > 2.088) = 0.990$ or $P(X < 2.088) = 0.010$</p> <p>$\therefore P(2.088 < X < 19.023) = 0.990 - 0.025$ or $0.975 - 0.010$</p> <p style="text-align: center;">$= \underline{0.965}$</p> <p>(b) Upper Critical value of $F_{12,5} = 4.68$</p> <p>lower Critical value of $F_{12,5} = \frac{1}{F_{5,12}}$</p> <p style="text-align: right;">$= \frac{1}{3.11} = 0.3215...$ Answer 0.322</p>	<p>B1</p> <p>M1</p> <p>A1 (3)</p> <p>B1</p> <p>M1</p> <p>A1 (3)</p>
2.	<p>(a) $H_0: \sigma_1^2 = \sigma_2^2$; $H_1: \sigma_1^2 \neq \sigma_2^2$ both</p> <p>$\frac{s_1^2}{s_2^2} = \frac{14^2}{8^2} = \underline{3.0625}$ or $\frac{8^2}{14^2} = 0.32653...$ Answer 3.06 or 0.327</p> <p>C.V $F_{12,7} = 3.57$ cv: $F_{7,12} = \frac{1}{3.57} = 0.28011$</p> <p>Since 3.0625 is not in the Critical Region there is insufficient evidence to reject H_0. There is insufficient evidence of a difference in the variances of the lengths of the fence posts.</p> <p>(b) The distribution of the population of lengths of fence posts is normally distributed.</p>	<p>B1</p> <p>M1 A1</p> <p>B1</p> <p>A1 ✓ (5)</p> <p>B1 (1)</p>

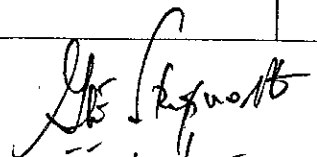
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3.	<p>Let x represent weight of flour.</p> <p>$\sum x = 8055 \therefore \bar{x} = \underline{1006.875}$ AWRT 1006.9</p> <p>$\sum x^2 = 8110611 \therefore s^2 = \frac{1}{7} \left\{ 8110611 - \frac{8055^2}{8} \right\} = 33.26785\dots$ AWRT 33.7</p> <p style="border: 1px solid black; border-radius: 50%; padding: 5px; display: inline-block;">Allow from Calculator</p> <p>$\therefore s = 5.767828\dots$ or AWRT 5.77</p> <p>$H_0: \mu = 1010; H_1: \mu < 1010$ both</p> <p>CV: $t = 1.895$ BI</p> <p>$t = \frac{ 1006.875 - 1010 }{5.767828\dots/\sqrt{8}} = \pm 1.5324$ Unf $\frac{\bar{x} - \mu}{s/\sqrt{n}}$</p> <p style="text-align: right;">AWRT -1.53 AI</p> <p>Since -1.53 is not in the critical region ($t < -1.895$) consistent</p> <p>there is insufficient evidence to reject H_0 and thus AI ✓ (4)</p> <p>the mean weight of flour delivered by the machine is 1010g.</p>	<p>BI</p> <p>MI</p> <p>AI</p> <p>BI</p> <p>BI</p> <p>MI</p> <p>AI</p> <p>AI ✓ (4)</p>

<p>4.</p>	<p>(a) The data were not collected in pairs.</p> <p>(b) Use data from twin lambs.</p> <p>(c) Age, weight, gender Any Two sensible factors.</p> <p>(d) $d = B - A$ $d: 2, 1.2, 1, 1.8, -1, 2.2, 2, -1.2, 1.1, 2.8$ $\Sigma d = 11.9; \Sigma d^2 = 30.01$ $\therefore \bar{d} = 1.19; s^2 = 1.761 (s = 1.327)$ $H_0: \delta = 0; H_1: \delta \neq 0$ Allow μ_D for δ both</p> $t = \frac{1.19 - 0}{\sqrt{\frac{1.761}{10}}} = 2.83574\dots$ <p>$n = 9; CV: t = 2.262$</p> <p>Since 2.8357... is in the critical region ($t > 2.262$) there is evidence to reject H_0. The (mean) weight gained by the lambs is different for each diet.</p> <p>(e) Diet B - it has the higher mean</p>	<p>B1 (1)</p> <p>B1 (1)</p> <p>B1; B1 (2)</p> <p>M1</p> <p>A1; A1</p> <p>B1</p> <p>M1</p> <p>A1</p> <p>B1</p> <p>A1 (8)</p> <p>B1 (1)</p>
	<p>(d) Using non-paired t-test. $H_0: \mu_A = \mu_B; H_1: \mu_A \neq \mu_B$</p> $t = \frac{\mu_A - \mu_B}{\sqrt{s_p^2 (\frac{1}{10} + \frac{1}{10})}} = -2.30$ <p>$CV: t = 2.101$</p> <p>Conclusion: Mean weights gained is different</p> <p>$\mu_A = 5.6 \mu_B = 6.79 S_p^2 = 1.342722\dots$</p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>B1 (4)</p>

5.	<p>(a) A Type I error occurs when H_0 is rejected when in fact it is true.</p> <p>(b) The size of a test is the probability of a Type I error</p> <p>(c) $X \sim B(8, 0.25)$ can be implied</p> <p>Size = $P(X > 6) = 1 - P(X \leq 6 n=8, p=0.25)$</p> $= 1 - 0.9996$ $= \underline{0.0004}$ <p>(d) Power = $P(X > 6 p > p, n=8)$</p> $= P(X=7) + P(X=8)$ $= \frac{8!}{7!1!} p^7(1-p) + p^8$ $= 8p^7 - 8p^8 + p^8$ $\approx \underline{8p^7 - 7p^8} \approx$ <p>(e) Power when $p=0.3 = 8 \times 0.3^7 - 7 \times 0.3^8$</p> $= \underline{0.00129}$ Answer 0.0013 <p>(f) $P(\text{Type II error}) = 1 - \text{Power}(0.3)$</p> $= \underline{0.99870 \dots}$ <p>(g) <u>Increase</u> the number of trials <u>Increase</u> the critical region</p>	<p>B1 (1)</p> <p>B1 (1)</p> <p>B1</p> <p>M1</p> <p>A1 (3)</p> <p>M1</p> <p>A1</p> <p>A1 (3)</p> <p>B1 (1)</p> <p>M1</p> <p>A1 (2)</p> <p>B1</p> <p>B1 (2)</p>

<p>6.</p>	<p>(a) Confidence interval is given by</p> $\bar{x} \pm t_{19} \times \frac{s}{\sqrt{n}}$ <p>ie:- $207.1 \pm 2.539 \times \sqrt{\frac{3.2}{20}}$</p> <p>ie:- 207.1 ± 1.0156</p> <p>ie:- <u>$(206.084, 208.1156)$</u></p> <p>(b) $S_p^2 = \frac{19 \times 3.2 + 9 \times 10.2173}{28}$</p> <p>$= \underline{5.45557\dots}$</p> <p>Confidence interval is given by</p> $\bar{x}_B - \bar{x}_G \pm t_{28} \times \sqrt{5.45557 \left(\frac{1}{20} + \frac{1}{10} \right)}$ <p>ie:- $(207.1 - 204.62) \pm 1.701 \sqrt{5.45557 \left(\frac{1}{20} + \frac{1}{10} \right)}$</p> <p>ie:- 2.48 ± 1.53875</p> <p>ie:- <u>$(0.94125, 4.01875)$</u></p>	<p>2.539</p> <p>Using $\bar{x} \pm t \times \frac{s}{\sqrt{n}}$</p> <p>All correct</p> <p>AWRT (206, 208)</p> <p>BI</p> <p>MI</p> <p>AI</p> <p>AI (4)</p> <p>10.2173</p> <p>AWRT 10.2</p> <p>AWRT 5.46</p> <p>BI</p> <p>MI</p> <p>AI</p> <p>1.701</p> <p>Using $\bar{x} - \bar{y} \pm t \sqrt{s \left(\frac{1}{n_x} + \frac{1}{n_y} \right)}$</p> <p>All correct</p> <p>AWRT 0.941; 4.02</p> <p>BI</p> <p>MI</p> <p>AI</p> <p>AI; AI (8)</p>

<p>7.</p>	<p>(a) $E(X) = np$, $E(Y) = mp$ both; can be implied</p> $E(p_1) = \frac{aE(X)}{n} + \frac{bE(Y)}{m} = p; \Rightarrow \frac{anp}{n} + \frac{bmp}{m} = p$ $\nRightarrow \underline{a+b=1} \quad \nexists$ <p>(b) $E(p_2) = \frac{1}{n+m} \{E(X) + E(Y)\}$</p> $= \frac{1}{n+m} \{np + mp\}$ $= \frac{1}{n+m} \cdot p(n+m) = p \Rightarrow \underline{p_2 \text{ is unbiased}}$ <p>(c) $\text{Var}(X) = np(1-p)$; $\text{Var}(Y) = mp(1-p)$ both; can be implied</p> $\text{Var}(p_1) = \frac{a^2 \text{Var}(X)}{n^2} + \frac{b^2 \text{Var}(Y)}{m^2}$ Use of $\text{Var}(ax) = a^2 \text{Var}(X)$ $= \frac{a^2 np(1-p)}{n^2} + \frac{b^2 mp(1-p)}{m^2}$ $= \underline{p(1-p) \left\{ \frac{a^2}{n} + \frac{b^2}{m} \right\}}$ <p>(d) $\text{Var}(p_2) = \frac{1}{(n+m)^2} \{np(1-p) + mp(1-p)\}$</p> $= \frac{p(1-p)}{n+m}$ <p>(e) $\text{Var}(p_1) = 0.044p(1-p)$; $\text{Var}(p_2) = 0.0333p(1-p)$</p> <p>Use p_2; $\text{Var}(p_2) < \text{Var}(p_1)$</p>	<p>B1 M1 A1 A1 (4)</p> <p>M1 A1 A1 (3)</p> <p>B1 M1 A1 (3)</p> <p>M1 A1 A1 (3)</p> <p>B1; B1 B1; B1 (4) dep</p>
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