GCE

Edexcel GCE

Mathematics

Statistics 4 (6686)

June 2008

Mark Scheme (Final)

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Mathematics

June 2008
6686 Statistics S4
Mark Scheme

Question Number	Scheme	Marks
1 a	$E(\theta_1) = \frac{E(X_3)+E(X_4)+E(X_5)}{3}$ $= \frac{3\mu}{3}$ $= \mu$ $\quad$ Bias $= 0$ $\quad$ allow unbiased	B1
	$E(\theta_2) = \frac{E(X_{10}) - E(X_1)}{3}$ $= 1/3(\mu - \mu)$ $= 0$ $\quad$ Bias $= -\mu$ $\quad$ allow $\pm\mu$	B1,B1
	$E(\theta_3) = \frac{3E(X_1)+2E(X_2)+E(X_{10})}{6}$ $= \frac{3\mu+2\mu+\mu}{6}$ $= \mu$ $\quad$ Bias $= 0$ $\quad$ allow unbiased	B1 (4)
b	$Var(\theta_1) = \frac{1}{9}\{(Var\ X_2) + Var(X_3) + Var(X_4)\}$	M1
	$= \frac{1}{9}\{\sigma^2+\sigma^2+\sigma^2\}$	
	$= \frac{1}{3}\sigma^2$	A1
	$Var(\theta_2) = \frac{2}{9}\sigma^2$	B1
	$Var(\theta_3) = \frac{1}{36}\{9\sigma^2+4\sigma^2+\sigma^2\}$	M1
	$= \frac{7}{18}\sigma^2$	A1 (5)
ci)	θ_1 is the better estimator. It has a lower var. and no bias	B1 depB1
ii)	θ_2 is the worst estimator. It is biased	B1 depB1 (4)

Question Number	Scheme	Marks
2 a	$H_1 : \sigma_A^2 = \sigma_B^2$ $H_0 : \sigma_A^2 \neq \sigma_B^2$	B1
	$S_A^2 = 22.5$ $s_B^2 = 21.6$ awrt	M1 A1A1
	$\frac{s_1^2}{s_2^2} = 1.04$	M1 A1
	$F_{(8, 6)} = 4.15$	B1
	1.04 < 4.15 do not reject H_0. The variances are the same.	B1 (8)
b	Assume the samples are selected at random, (independent)	B1 (1)
c	$s^2_p = \frac{8(22.5)+6(21.62)}{14} = 22.12$ awrt 22.1	M1 A1
	$H_0 : \mu_A = \mu_B$ $H_1 : \mu_A \neq \mu_B$	B1
	$t = \frac{40.667 - 39.57}{\sqrt{22.12}\sqrt{\frac{1}{9}+\frac{1}{7}}}$	M1
	= 0.462 0.42 – 0.47	A1
	Critical value = $t_{14}(2.5\%) = 2.145$	B1
	0.462 < 2.145 No evidence to reject H_0. The means are the same	B1 (7)
d	Music has no effect on performance	B1 (1)

Question Number	Scheme	Marks
3	Differences 2.1 -0.7 2.6 -1.7 3.3 1.6 1.7 1.2 1.6 2.4 $\bar{d}$ = 1.41 $H_0 : \mu_d = 0$ $H_1 : \mu_d > 0$ $s = \sqrt{\frac{40.65 - 10 \times 1.41^2}{9}}$ = 1.5191… $t = \frac{1.41}{\left(\frac{1.519...}{\sqrt{10}}\right)}$ = 2.935… awrt 2.94 /2.93 t_9 (1%) = 2.821 2.935.. > 2.821 Evidence to reject H_0. There has been an increase in the mean weight of the mice.	M1 M1 B1 M1 M1 A1 B1 B1ft (8)

2 sample test can score
M0 M0
B1 for $H_0 : \mu_A = \mu_B$ $H_1 : \mu_A < \mu_B$

M1 $\frac{9 \times 24.5 + 9 \times 17.16}{18}$
M0 A0
B1 2.552
B1 ft

ie 4/8

Question Number	Scheme	Marks
4a	$\bar{x}$ = 668.125 s = 84.428	M1 M1
	$T_7(5\%)$ = 1.895	B1
	Confidence limits = $668.125 \pm \frac{1.895 \times 84.428}{\sqrt{8}}$	M1
	= 611.6 and 724.7	A1A1
	Confidence interval = (612, 725)	(6)
b	Normal distribution	B1 (1)
c	£650 is within the confidence interval. No need to worry.	B1 √ B1 √ (2)

Question Number	Scheme	Marks
5 a	Confidence interval = $\left(\frac{15\times 0.003}{27.488}, \frac{15\times 0.003}{6.262}\right)$ = (0.00164, 0.00719)	M1 B1B1 A1 A1 (5)
b	0.07^2 =0.0049 0.0049 is within the 95% confidence interval. There is no evidence to reject the idea that the standard deviation of the volumes is not 0.07 or The machine is working well.	M1 A1 A1 (3)

Question Number	Scheme Marks	
6 a	H_0 $p = 0.35$ $H_1 : p \neq 0.35$	B1 B1 (2)
b	Let X = Number cured then $X \sim B(20, 0.35)$	B1
	α = P(Type I error) = P($x \leq 3$) +P($x \geq 11$) given p= 0.35 = 0.0444 + 0.0532 = 0.0976	M1 A1 (3)
c	β = P(Type II error) = P($4 \leq x \leq 10$)	M1
	p 0.2 0.3 0.4 0.5 β 0.5880 **0.8758** 0.8565 **0.5868**	A1A1 (3)
d	Power = 1 – B 0.4120 0.1435	M1 A1 (2)
e	Not a good procedure. Better further away from 0.35 or This is not a very powerful test (power = 1 - β)	B1 B1dep (2)

Question Number	Scheme	Marks
7 a	$H_0 : \mu = 230 \quad H_1 : \mu < 230$	B1
	$\nu = 9$	
	From table critical value $= \pm 1.833$	B1√
	$\bar{x} = 228.3 \quad S = 17.858$	B1 B1
	$t = \dfrac{\bar{x} - \mu}{\dfrac{s}{\sqrt{n}}}$	M1
	$= \pm \dfrac{228.3 - 230}{\dfrac{17.858}{\sqrt{10}}} = \pm 0.301$	A1
	$\pm 0.301 > \pm 1.833$. No evidence to reject H_0. Mean is 230 N/mm^2	B1 (7)
b	Since the tensile strength is the same and the price is cheaper recommend use new supplier.	B1 (1)