edexcel

June 2005
6688 Statistics S6
Mark Scheme

Question Number	Scheme	Marks
1.	H_0 : $Median_m - Median_s = 0$; H_1 : $Median_m - Median_s > 0$	B1
	8 + & 2 –	M1 A1
	N=10 $P(\le 2 \mid p = 0.5, n = 10) = 0.0547 > 0.05$	M1 A1
	$\therefore$ Insufficient evidence to reject H_0. Students do not carry out calculations more accurately when listening to music.	A1√ **(6)**
2.	H_0 : Median = 20; H_1 : Median ≠ 20	B1
	x - median: +10, -8, -5, +1, +7, -3, -4, -6, +2 Rank: 9, 8, 5, 1, 7, 3, 4, 6, 2	M1 M1 A1
	$S^+ = 19$ ($S^- = 26$)	A1
	$n = 9 \Rightarrow$ CR : $S \le 5$	B1
	Since 19 is not in the critical region there is insufficient evidence to reject H_0. The claim is justified on this evidence.	A1√ **(7)**
3.	H_0 : Median time of girls = Median time of boys H_1 : Median time of girls ≠ Median time of boys both	**B1**
	$n_1 = 25$, $n_2 = 25$ $T \approx N\left(\frac{25(25+25+1)}{2}, \frac{25\times 25(25+25+1)}{12}\right) \approx N(637.5, 2656.25)$	M1 A1 A1
	$Z = \frac{704 - 637.5}{\sqrt{2656.25}} = 1.29$ Accept 704 ± 0.5	M1 A1
	Since 1.29 is not in the critical region ($z > 1.96$) there is no evidence to suggest that boys are quicker at French translation than girls.	A1 √ **(7)**

4.

$$\text{C.F.} = \frac{(48.13 + 43.13 + 46.50 + 53.65)^2}{24} = \frac{(191.41)^2}{24}$$

$$\therefore \text{SST} = 1543.9043 - \frac{(191.41)^2}{24} = 17.3298$$ M1 A1

$$\text{SSA} = \frac{1}{6}\{48.13^2 + 43.13^2 + 46.50^2 + 53.65^2\} - \frac{(191.41^2)}{24} = 9.6365$$ M1 A1

Source	df	s.s	mss	Ratio
Between areas	3	9.6365	3.2122	8.35
Residual	20	7.6933	0.3847	
Total	23	17.3298		

df B1
Residual B1
Ratio M1 A1

$H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4$; H_1 : Not all means are equal B1

(Assume $\alpha = 0.05$) $F_{3,20} = 3.10$ (4.94 for 1%) B1

Since 8.35 is in the critical region there is evidence that there is a difference in the mean yields between areas. A1√ **(11)**

5. (a)

$$\hat{\varphi} = \frac{32}{10 \times 50} = 0.064$$ B1 **(1)**

(b)

$$\text{UWL} = 0.064 + 1.96 \times \sqrt{\frac{0.064 \times 0.936}{59}} = 0.1318\ldots$$ M1 B1 A1

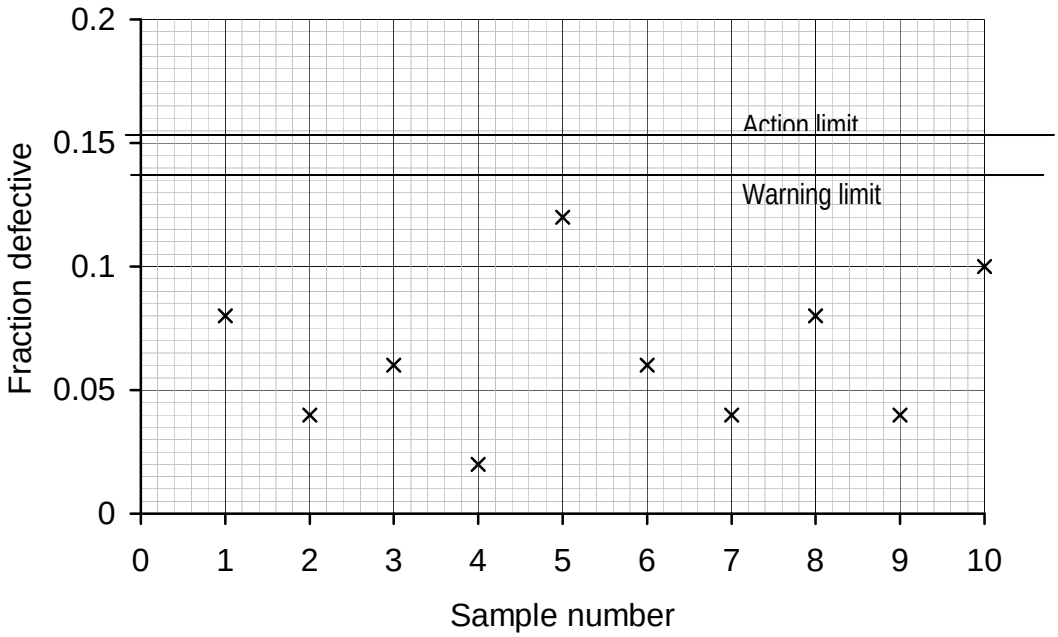
$$\text{UAL} = 0.064 + 2.5758 \times \sqrt{\frac{0.064 \times 0.936}{50}} = 0.153156\ldots$$ B1 A1 **(5)**

Graph (Limits and scales) B2 **(2)**

(c) Target value is zero; Company not concerned if $\hat{p}$ tends to zero. B1 B1 **(2)**

(d) Graph (Points) B2 **(2)**

(e) All points below warning limit so production is in control. B1 **(1)**



Scales & labels B1, Limits B1 2

Points B2 2

6 (a) Randomised Block Design — B1 **(1)**

(b)

B1

$$SSO = \frac{1}{4}\left\{302^2 + 297^2 + 287^2\right\} - \frac{886^2}{12} = 29.17$$

B1

$$SSM = \frac{1}{3}\left\{179^2 + 250^2 + 271^2 + 186^2\right\} - \frac{886^2}{12} = 2109.67$$

Source	df	s.s.	MSS	Ratio
Operators	2	29.17	14.59	0.75
Machines	3	2109.67	703.22	36.12
Residual	6	116.83	19.47	
Total	11	2255.67		

B1 df
B1 Residual
M1 A1 A1 Ratios

(i) $H_0 : \mu_A = \mu_B = \mu_C = \mu_D$; H_1 : Not all means are equal

B1

$\alpha = 0.05$ (say) $F_6^3(0.05) = 4.76$ ($F_6^3(0.01) = 9.78$)

B1 B1

Since 36.12 is in the critical region there is evidence of differences between machines

A1√

(ii) $H_0 : \mu_1 = \mu_2 = \mu_3$; H_1 : Not all means are equal

B1

$\alpha = 0.05$ (say) $F_6^2(0.05) = 5.14$ ($F_6^2(0.01) = 10.90$)

B1

Since 0.75 is not in the critical region there is insufficient evidence to reject H_0. There are no differences in the mean quality of the operators.

A1√ **(14)**

Question Number	Scheme	Marks
7. (a)	$S_{xy} = 6493576 - \frac{14061 \times 9297}{20} = -42679.85$	B1
	$\therefore \quad \hat{\beta} = \frac{-42679.85}{13998.95} = -3.048789\ldots$ -3.05	M1 A1
	$\therefore \quad \hat{\alpha} = \frac{9297}{20} - (-3.048789...) \times \frac{14061}{20} = 2608.303167\ldots$ 2608.30	M1 A1
	$\therefore \quad y = 2608.30 - 3.05x$	**(5)**
(b)	RSS $= 164592.55 - \frac{(-42679.85)^2}{13998.95} = 34470.67686$	M1 A1
	$\therefore$ 95% CI is given by	
	$-3.048789\ldots \pm 2.101 \times \sqrt{\frac{34470.67686}{18 \times 13998.95}}$	M1 B1 A1
	i.e. –3.83 & -2.27	A1 **(6)**
(c)	-3.00 is in the CI $\therefore$ Assumption is justified.	B1 B1 **(2)**
(d)	$\varepsilon_i \sim N(0, \sigma^2)$	B1
	Plot residuals $(y - \hat{y})$ against x	B1
	Residuals randomly scattered about x axis $\Rightarrow$ model justified	B1 **(3)**