RECOGNISING ACHIEVEMENT

GCE

Statistics (MEI)

Advanced Subsidiary GCE **G243**

Statistics 3 (Z3)

Mark Scheme for June 2010

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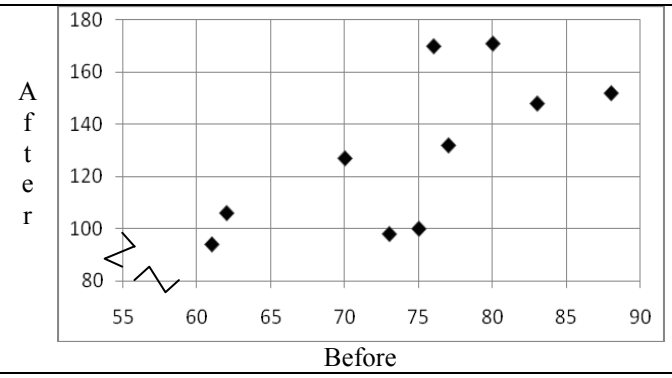
Question 1

(i)		G1 for axes including labels G1 for correct zero or broken scales G1 for all points (allow 1 error)	**3**
(ii)	r = 0.6919	M1 A1	**2**
(iii)	H_0: $\rho = 0$ H_1: $\rho > 0$ (one-tailed test) where ρ is the correlation coefficient for the underlying bivariate population For $n = 10$, 1% critical value = 0.7155 Not significant It does not appear that there is correlation between pulse rate before exercise and pulse rate after exercise.	B1 B1 B1 A1 E1 E1	**6**
(iv)	Bivariate Normality Vaguely elliptical scatter diagram	E1 E1	**2**
(v)	A test based on Spearman's rank correlation coefficient. H_0: No association between pulse rate before exercise and pulse rate after exercise.	E1 E1	**2**
			15

Question 2

(i)	H_0: $\mu_A = \mu_B$ H_1: $\mu_A \neq \mu_B$ Where μ_A, μ_B denote the population mean weights for carrots supplied by the two suppliers $\bar{x}_A = \frac{10313}{100} = 103.13 \qquad \bar{x}_B = \frac{9672}{95} = 101.81$ $s_A^2 = \frac{1}{99}\left(1072660 - \frac{10313^2}{100}\right) = \frac{9080.31}{99} = 91.72$ $s_B^2 = \frac{1}{94}\left(986540 - \frac{9672^2}{95}\right) = \frac{1828.59}{94} = 19.45$ 2–sample test based on N(0,1) Test statistic is $\frac{103.13 - 101.81}{\sqrt{\frac{91.72}{100} + \frac{19.45}{95}}} = \frac{1.32}{\sqrt{1.1220}} = \frac{1.32}{1.0592} = 1.246$ 2–tailed 1% point of N(0,1) is 2.576 Not significant No reason to suppose that mean weights are different.	B1 B1 B1 B1 M1 A1 M1 M1 A1 B1 E1 E1	**12**
(ii)	Because the samples are large and so it is reasonable to use the sample variances as the population variances.	E1 E1	**2**
(iii)	EITHER: Because they have a much lower standard deviation. OR: Because they are less variable.	E1	**1**
			15

Question 3

(i)	H_0: the medians of the two populations are the same H_1: the medians of the two populations are different Wilcoxon rank sum test (or Mann-Whitney form thereof) Ranks are Tankers 1,2,3,4,7,8,9,11,14,18,20,22,24 General Cargo 5,6,10,12,13,15,16,17,19,21,23,25,26,27,28 Rank sum for smaller sample (tankers) is 143 Refer to (13,15) table 2–tail 5% critical value is 145 [or 54 for M–W] Significant There is sufficient evidence to suggest that the median speeds are different	B1 Allow 1 for medians B1 need population for second mark M1 M1 Combined ranking A1 FT if M1 earned B1 (M–W stat = 0+0+0+0+2+2+2+3+5+8+9+10+11=52) M1 A1 E1 E1	**10**
(ii)	Unpaired *t* test –allow 2–sample *t* test The variances must be equal	E1 for unpaired E1 for *t* test E1	**3**
(iii)	No Because the data are not paired.	E1 for no E1 for explanation	**2**
		TOTAL	**15**

Question 4

(i)	The population consists of all of the concrete in all of the lorries arriving at the project site.	E1 all of the concrete E1 in all of the lorries	**2**
(ii)	The day chosen may not be representative of all days There may be some variation in compressive strength during the day, so selecting the first lorry may not give a representative sample This is much better than the other two methods and should produce a fairly representative sample	E1 E1 E1	**3**
(iii)	Allocate numbers 1 to n to the deliveries. Use random number tables or a random number generator to choose 15 random numbers. If any repeats appear, choose further random numbers to replace them.	E1 E1 E1	**3**
(iv)	H_0: $\mu_A = \mu_B$ H_1: $\mu_A \neq \mu_B$ Where μ_A, μ_B denote the population mean compressive strengths for Companies A and B Assumption required is Normality of <u>both populations</u> Pooled $s^2 = \frac{8\times 0.2482^2 + 5\times 0.2459^2}{13} = \frac{0.79516}{13} = 0.06116$ Test statistic = $\frac{4.21-4.295}{\sqrt{0.06116}\sqrt{\frac{1}{9}+\frac{1}{6}}} = \frac{-0.085}{0.1303} = -0.652$ Refer to t_{13} 2–tail 5% point is 2.160 Not significant There is insufficient evidence to show that the population means are different	B1 B1 B1 M1 for attempt at pooling A1 M1 for numerator M1 for $\sqrt{0.06116}$ M1 for $\sqrt{\frac{1}{9}+\frac{1}{6}}$ A1 (allow +0.652 if doing B – A) FT from here if all M marks earned M1 A1 E1 E1	**13**
(v)	Because each day one lorry from each company is sampled and there is expected to be day to day variation in the compressive strength which will be eliminated by pairing.	E1 E1	**2**
(vi)	Refer to t_9 2–tailed 5% point is 2.262 Significant It appears that the population means are different.	M1 A1 E1 E1	**4**
		TOTAL	**27**

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

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Facsimile: 01223 552627
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