Mark Scheme

Hypothesis testing

Pearson Edexcel GCE

In Mathematics (9MA0)

Paper 31 Statistics

Question	Scheme	Marks
1	When $n = 10$ at 5% significance level $\mathrm{P}(X \leq 0) = 0.3487$ therefore any observed outcome would give the same conclusion.	**B1** **B1**
		(2 Marks)

Question	Scheme	Marks
2	Since $r = 0.63$ is greater than the critical value, we reject the null hypothesis [that $\rho = 0$]. There is sufficient evidence at the 5% significance level to conclude that there is a positive linear correlation between the number of hours students spend studying and their exam scores.	**B1** **B1**
		(2 Marks)

Question	Scheme	Marks
3	$\mathrm{H}_0: p = 0.3$ $\mathrm{H}_1: p > 0.3$ $X \sim \mathrm{B}(35, 0.3)$ $\mathrm{P}(X \geq 15) = 1 - \mathrm{P}(X \leq 14)$ $\mathrm{P}(X \geq 15) = 1 - 0.9269$ $\mathrm{P}(X \geq 15) = 0.0731$ $0.0731 > 0.05$ do not reject H_0, there is insufficient evidence to suggest $p > 0.3$	**B1** **M1** **A1** **A1ft**
		(4 Marks)

Question	Scheme	Marks
4	$\mathrm{H}_0: \rho = 0$ $\mathrm{H}_1: \rho \neq 0$ Critical value for two tail test at 5% significance level for $n = 30$ is 0.3610 $r = 0.57$ Since $0.57 > 0.3610$ reject H_0 There is sufficient evidence to suggest there is a correlation between height and weight of the players.	**B1** **B1** **M1** **A1ft**
		(4 Marks)

Question	Scheme	Marks
5a	Parts are either **faulty or not** so the **outcomes are mutually exclusive.** Each part is tested **independently,** the chance of any part being faulty is not affected by any other part. other acceptable reasons are: "because p is constant" and "because there is a fixed sample size (number of trials) of 40".	**B1** **B1**
		(2)
5b	Testing to destruction would mean there are no parts to sell. Do not accept reasons based on time or cost constraints.	**B1**
		(1)
5c	$H_0: p = 0.05$ $H_1: p > 0.05$ $X \sim B(40, 0.05)$ $P(X \geq 5) = 1 - P(X \leq 4)$ $P(X \geq 5) = 1 - 0.9520$ $P(X \geq 5) = 0.0480$ $0.0480 < 0.05$ Reject H_0, there is sufficient evidence to take the machine out of production.	**B1** **M1** **A1** **M1** **A1ft**
		(5)
		(8 Marks)

Question	Scheme	Marks
6	$H_0: p = 0.2$ $H_1: p > 0.2$ $X \sim B(50, 0.2)$ $P(X \geq 16) = 1 - P(X \leq 15)$ $P(X \geq 16) = 1 - 0.9692$ $P(X \geq 16) = 0.0308$ 16 or more adults with the allergy would be sufficient evidence to suggest the pollution level has increased.	**B1** **M1** **M1** **A1** **A1**
		(5 Marks)

Question	Scheme	Marks
7a	W = weight of adult gym member P(W < 88) = 0.6484	**B1**
		(1)
7b	$H_0: \mu = 86.4$ $H_1: \mu \neq 86.4$ T = weight of adult non gym member $\bar{T}$~N(86.4,$\frac{4.2^2}{30}$) $P(\bar{T} > 88) = 0.0185$ 0.0185 < 0.0250 Reject H_0 There is sufficient evidence to support the instructor's claim Alternative: for 1st A1 for finding critical value 87.9 (and the comparison 88 > 87.9 for the M1)	**B1** **M1** **A1** **M1** **A1**
		(5)
7c	$2 \times 0.01846 \ldots . = 0.036927 \ldots$ $2 \times 0.0185 = 0.0370$	**B1ft**
		(1)
		(7 Marks)

Question	Scheme	Marks
8	$H_0: \mu = 32.6$ $H_1: \mu \neq 32.6$ Makes adjustment for sample using $\frac{\sigma}{\sqrt{n}} = \frac{4.9}{\sqrt{40}} = 0.7748$ Finds probability 0.0467 Compares probabilities. Since $0.0467 > 0.0250$ Do not reject H_0 There is not sufficient evidence to suggest the mean time has changed. Alternative: for 1st A1 for finding critical value 31.08 (and the comparison 31.3 > 31.08 for the M1)	**B1** **M1** **A1** **M1dep** **M1** **A1ft**
		(6 Marks)

Question	Scheme	Marks
9	$H_0: \mu = 86$ $H_1: \mu < 86$	**B1**
	Makes adjustment for sample using $\frac{\sigma}{\sqrt{n}} = \frac{16}{\sqrt{80}} = 1.79$	**M1**
	Finds probability 0.0127	**A1**
	Compares probabilities. Since 0.0127 < 0.0500 reject H_0	**M1dep**
	There is sufficient evidence to suggest mean time spent responding to emails is less than 86 minutes.	**M1**
	Alternative: for 1st A1 for finding critical value 83.06 (and the comparison 82 < 83.06 for the M1)	**A1ft**
		(6 Marks)

Question	Scheme	Marks
10	$H_0: \mu = 2.5$ $H_1: \mu < 2.5$	**B1**
	Makes adjustment for sample using $\frac{\sigma}{\sqrt{n}} = \frac{0.06}{\sqrt{30}} = 0.0110$	**M1**
	Finds Probability 0.0031	**A1**
	Compares probabilities 0.0031 < 0.0100 reject H_0	**M1dep**
	There is sufficient evidence to suggest Lucas' suspicion is correct, the mean amount of tea in the sachets is less than 2.5g.	**M1**
	Alternative: for 1st A1 for finding critical value 2.4745 (and the comparison 2.47 < 2.4745 for the M1)	**A1ft**
		(6 Marks)