GCE MARKING SCHEME

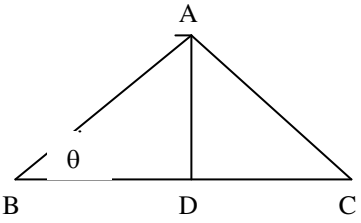
MATHEMATICS - C1-C4 & FP1-FP3
AS/Advanced

SUMMER 2012

S2

Ques	Solution	Mark	Notes
1(a)	$E(X^2) = \text{Var}(X) + [E(X)]^2$	**M1**	Award M1 for **using** formula
	$= 27$	**A1**	
	Similarly, $E(Y^2) = 39$	**A1**	
(b)			
	$\text{E}(U) = \text{E}(X)\text{E}(Y)$	**M1**	
	$= 30$	**A1**	
	$E(X^2Y^2) = E(X^2)E(Y^2) = 27 \times 39$	**B1**	FT their $E(X^2), E(Y^2)$ but not their $E(X), E(Y)$
	$\text{Var}(U) = E(X^2Y^2) - [E(XY)]^2$	**M1**	Award M1 for **using** formula
	$= 27 \times 39 - 30^2 = 153$	**A1**	
2(a)(i)	$z = \dfrac{4.5 - 4.4}{0.2} = 0.5$	**M1A1**	
	$\text{P}(X > 4.5) = 0.3085$	**A1**	
(ii)	95^{th} percentile $= \mu + 1.645\sigma$	**M1**	Award only for $\mu + z\sigma$
	$= 4.73$	**A1**	
(b)(i)	$\text{E}(2Y - X) = 0.8$	**B1**	
	$\text{Var}(2Y - X) = 4\text{Var}(Y) + \text{Var}(X)$	**M1**	
	$= 0.13$	**A1**	
(ii)	$z = \dfrac{0 - 0.8}{\sqrt{0.13}} = -2.22$ (Accept $\pm$)	**M1A1**	FT their values from (b)(i)
	We require $\text{P}(2Y - X < 0)$	**M1**	
	Prob = 0.0132	**A1**	
(iii)			
	Let total weight = S		
	$\text{E}(S) = 2 \times 4.4 + 3 \times 2.6 = 16.6$	**B1**	
	$\text{Var}(S) = 2 \times 0.04 + 3 \times 0.0225 = 0.1475$	**M1A1**	
	$z = \dfrac{16 - 16.6}{\sqrt{0.1475}} = -1.56$	**m1A1**	
	Prob = 0.9406	**A1**	
3(a)	$\bar{x} = \dfrac{69.9}{75}$ (= 0.932)	**B1**	
	SE of $\bar{X} = \dfrac{0.1}{\sqrt{75}}$ (= 0.011547…)	**B1**	
	90% conf limits are		
	$0.932 \pm 1.645 \times 0.011547\ldots$	**M1A1**	M1 correct form, A1 correct z.
	giving [0.913, 0.951]	**A1**	SE must have $\sqrt{75}$ in denom for M1.
(b)			
	If the method for finding the confidence interval is repeated a large number of times, then 90% of the intervals obtained will contain μ (or equivalent)	**B1**	Award B0 for any solution which suggests that the calculated interval contains μ with a probability of 0.9

4(a)	The total number of errors, X, is Poi(8) $P(X < 5) = 1 - 0.9004 = 0.0996$	**B1** **M1A1**	Award M1A0 for use of adjacent row/column
(b)(i)	$H_0 : \mu = 0.8; H_1 : \mu < 0.8$	**B1**	
(ii)	Under H_0, number of errors is Poi(64) ≈ N(64,64). $z = \dfrac{60.5 - 64}{8}$ $= -0.4375$	**B1** **M1A1** **A1**	Award M1A0A1A1 for incorrect or no continuity correction No c/c gives $z = -0.5$, $p = 0.31$ Incorrect c/c gives $z = -0.5625$, $p = 0.29$
	p-value = 0.33 Insufficient evidence to reject H_0 /Accept H_0	**A1** **A1**	FT their p-value
5(a)	$H_0 : \mu_D = \mu_F; H_1 : \mu_D \neq \mu_F$	**B1**	
(b)	$\bar{x}_D = \dfrac{890.4}{6} (= 148.4); \bar{x}_F = \dfrac{879}{6} (= 146.5)$ si	**B1B1**	
	SE of difference of means= $\sqrt{\dfrac{1.5^2}{6} + \dfrac{1.5^2}{6}}$ (0.866..)	**M1A1**	
	Test statistic = $\dfrac{148.4 - 146.5}{0.866..}$ $= 2.19$	**M1A1** **A1**	FT arithmetic slip in evaluating means
	Prob from tables = 0.01426	**A1**	
	p-value = 0.02852	**A1**	FT from previous line
	Strong evidence that there is a difference in mean distances for the two players. OR **Strong** evidence that David's mean is larger than Frank's mean.	**A1**	FT on their p-value

6(a)			
	Drop a perpendicular from A to BC.	**M1**	Accept any valid method
	$X = 2\text{BD} = 2\text{AB}\cos\theta = 4\cos\theta$	**A1**	Must be convincing
(b)(i)	The probability density function of θ is		
	$f(\theta) = \frac{2}{\pi}$ (for $0 < \theta < \pi/2$) si	**B1**	
	$\text{E}(X) = \int_0^{\pi/2} \frac{2}{\pi} \times 4\cos\theta \,\text{d}\theta$	**M1**	Limits not required, award M1 for $\int K \times 4\cos\theta \,\text{d}\theta, K \neq 1$
	$= \frac{8}{\pi}\left[\sin\theta\right]_0^{\pi/2}$	**A1**	Limits required here
	$= 8/\pi$ cao	**A1**	
(ii)	$\text{P}(X \leq 3) = \text{P}(\cos\theta \leq 0.75)$	**M1**	
	$= \text{P}(\theta \geq 0.723)$	**A1**	An answer of 0.46 is given M1A0M1A0
	$= \frac{\pi/2 - 0.723}{\pi/2}$	**M1**	
	$= 0.54$	**A1**	
7(a)	Let X denote the number of white flowers produced.		
	If bag is Type B, X is B(120,0.7) ≈ N(84,25.2)	**M1A1**	
	P(label A) = P(X < 70)		Award M1A0A1A1 for incorrect or no c/c.
	$z = \frac{69.5 - 84}{\sqrt{25.2}}$	**M1A1**	70.5 → $z = -2.69$, $p = 0.00357$
	$= -2.89$ (Accept ±)	**A1**	70 → $z = -2.79$, $p = 0.00264$
	Prob = 0.00193	**A1**	69→ $z = -2.99$, $p = 0.00139$
(b)			68.5 → $z = -3.09$, $p = 0.001$
	If bag is of Type A, X is B(120,0.5) ≈ N(60,30)	**M1A1**	
	P(label B) = P(X ≥ 70)		Award M1A0A1A1 for incorrect or no c/c.
	$z = \frac{69.5 - 60}{\sqrt{30}}$	**M1A1**	70.5 → $z = 1.92$, $p = 0.02743$
	$= 1.73$ (Accept ±)	**A1**	70 → $z = 1.83$, $p = 0.03362$
	Prob = 0.0418	**A1**	69 → $z = 1.64$, $p = 0.0505$
			68.5 → $z = 1.55$, $p = 0.06057$