MS3
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WELSH JOINT EDUCATION COMMITTEE
CYD-BWYLLGOR ADDYSG CYMRU

General Certificate of Education
Advanced Subsidiary/Advanced

Tystysgrif Addysg Gyffredinol
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MARKING SCHEMES

SUMMER 2006

MATHEMATICS
C1-C4 and FP1-FP3

WJEC
CBAC

MATHEMATICS S2

1. $\bar{x} = \dfrac{62 \cdot 6}{10}$ (= 6·26) B1

SE of $\bar{x} = \dfrac{0 \cdot 1}{\sqrt{10}}$ (= 0·0316) B1

95% conf limits are

$6 \cdot 26 \pm 1.96 \times 0 \cdot 0316$ M1A1

[M1 correct form, A1 1·96]

giving [6·20,6·32] A1

Yes because 6·3 is within the interval. B1

2. Variance = $\dfrac{(b-a)^2}{12} = 3$ M1A1

$(b-a)^2 = 36$ A1

$b - a = 6$ AG

Mean = $\dfrac{a+b}{2} = 10$ M1

$b + a = 20$ A1

Solving, $a = 7$, $b = 13$. M1A1

3. *(a)* (i) $z_1 = \dfrac{34-30}{2} = 2\,;\, z_2 = \dfrac{28-30}{2} = -1$ M1A1

Prob = 0·97725 – 0·15866 or 0·8413 – 0·02275 B1B1

= 0·819 (cao) B1

(ii) Reqd weight = 25 + 2·326 × 1·8 M1A1

= 29·2 A1

[M1 for $25 \pm z\sigma$]

(b) X - Y is N(5,7·24) B1B1

We require P(X - Y > 0)

$z = \dfrac{5}{\sqrt{7 \cdot 24}} = (\pm)1.86$ M1A1

Prob = 0.969 (cao) A1

4. *(a)* Prob of 1 crash on a computer $= 0 \cdot 8 \times e^{-0.8}$ M1

= 0·3595 A1

Prob of 1 crash on each of 5 computers $= 0 \cdot 3595^5$ M1

= 0·006 A1

(b) Distribution of Total is Po(4). B1

P(Total = 5) $= e^{-4} . \dfrac{4^5}{5!}$ M1A1

= 0·156 (cao) A1

5. *(a)* $H_0 : \mu = 2 \cdot 4$ versus $H_1 : \mu > 2 \cdot 4$ (Accept μ = 12] B1

In 5 days, number of passengers Y is Poi(12) under H_0. si B1
[M1A0 for normal approx]

p-value = P($Y \geq 18$) = 0·0630 M1 A1
We cannot conclude that the mean has increased. B1

(b) Under H_0 the number of passengers in 100 days is Po(240) ≈ N(240,240)
B1B1

$$z = \frac{279 \cdot 5 - 240}{\sqrt{240}}$$ M1A1

= 2·55 A1
Either p-value = 0·00539 or CV = 2·326 A1
[No cc gives z = 2·58, p = 0·00494, wrong cc gives z = 2·61, p = 0·00453]
We conclude at the 1% level that the mean has increased. B1

6. *(a)* (i) X is B(50,p) (si) B1
Sig level = P($X \leq 14 \,|\, p = 0 \cdot 4$) M1
= 0·0540 (cao) A1
(ii) We require
P($X \geq 15 \,|\, p = 0 \cdot 3$) = 0·5532 M1A1

(b) Under H_0, X is now B(500,0·4) ≈ N(200,120) B1B1

$$z = \frac{185 \cdot 5 - 200}{\sqrt{120}}$$ M1A1

= −1·32 A1
p-value = 0·0934 A1

[No cc gives z = −1·37, p = 0·0853, wrong cc gives z = −1·41, p = 0·0793]
Insufficient evidence to support the agent's belief. (oe). B1

7. *(a)* $H_0 : \mu_A = \mu_B$ versus $H_1 : \mu_A \neq \mu_B$ B1

(b) $\bar{x}_A = \frac{501}{6} = 83 \cdot 5$ B1

$\bar{x}_B = \frac{489}{6} = 81 \cdot 5$ B1

The appropriate test statistic is

$$\text{TS} = \frac{\bar{x} - \bar{y}}{\sigma\sqrt{\frac{1}{m} + \frac{1}{n}}}$$ M1

$$= \frac{83 \cdot 5 - 81 \cdot 5}{1.5\sqrt{\frac{1}{6} + \frac{1}{6}}}$$ 1A1

= 2.31 (cao) A1
Prob from tables = 0·01044 A1
p-value = 0·021 B1
(i) Accept H_0 (or the fuel consumptions are the same) at 1% SL B1
(ii) Accept H_1 (or the fuel consumptions are not the same) at 5% SL B1

8. *(a)* The **mean** of a **large** (random) sample from any distribution is (approximately) **normally** distributed. B1

(b) $\mathrm{E}(\overline{X}) = 3.5, \mathrm{Var}(\overline{X}) = \dfrac{35}{600}$ (si) B1B1

$$z = \frac{3 - 3 \cdot 5}{\sqrt{35/600}} = -2 \cdot 07$$ M1A1

Prob = 0·981 A1