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### 1(i)
Total has Poisson distribution with mean
\[ \lambda = 0.21 \times 5 + 0.24 \times 5 = 2.25 \]
\[ P(\geq 2) = 1 - e^{-\lambda} (1+\lambda) = 0.657 \]
- **M1** With \( \times 5 \)
- **A1** \( \lambda \) or 1+\( \lambda \) in brackets (their \( \lambda \))
- **M1** Or interpolation from tables

### (ii)
**EITHER:** Each length is a random sample
**OR:** Flaws occur independently on the reels
- **B1** In context
- **1** Accept randomly

### 2
\( H_0: \mu = (or \geq) 170, \ H_1: \mu < 170 \)
\( \bar{x} = 167.5 \)
\( s^2 = 5.9 \)
**EITHER:** (\( \alpha \)) \( (167.5 - 170)/\sqrt{(5.9/6)} = -2.52(1) \)
- **B1** For both hypotheses; accept words
- **B1** SR 2-tail test: B0B1B1M1A1M1A0
- **B1** Max 5/7

**OR:** (\( \beta \)) \( 170 - t\sqrt{(5.9/6)} = 168.0 \)
- **M1** Standardise 167.5; + or – for M; /6 seen
- **A1** Explicitly Allow 2.571

**Compare 167.5 with CV and reject \( H_0 \)**
- **M1** Finding critical value or region.
- **A1** With \( t \) = 2.015 or 2.571
- **M1** Explicitly. Allow correct use of \( |t| \)
- **A1** M0 if \( z \) used
- **SR:** B1 if no explicit comparison but conclusion “correct”

### 3(i)
\( H_0: \) There is no association between the area in which a shopper lives and the day they shop
\( (H_1: \) All alternatives) \)
\( \chi^2 = (4.3-0.5)^2(27.3^{-1} + 37.7^{-1} + 14.7^{-1} + 20.3^{-1}) = 2.606 \)
- **B1** SR difference in proportions
- **B1** B1 define and evaluate \( p_1 \) and \( p_2 \) with \( H_0 \)
- **B1** B1 for \( p = 0.42 \)
- **M1** M1A1 for \( z = \pm 1.827 \) or 1.835(no pe)
- **A1** M1A0 Max 5/8

**Compare with 2.706**
- **M1 ft** At least one E value correct (M1)
- **A1** All correct(A1)
- **A1** At least one \( \chi^2 \), no or wrong cc, (M1FtE)
- **M1** All correct (A1); 2.606 or 2.61 (A1)
- **A1** Or use calculator (\( p = 0.106 \)) SR: B1
- **8** if no explicit comparison, as Q2
- **SR:** If \( H_0 \) association, lose 1st B1 and last M1A1

### (ii)
**Conclusion the same since critical value > 2.706**
(and test statistic unchanged)
- **B1** OR from \( z = \pm 2.17 \), SR

| [9] |
4(i) \[ s^2 = \frac{(1183.65-246.62/70)/69}{1.645} \]
\[ (3.10, 3.94) \]
Use \[ x \pm z \frac{s}{\sqrt{70}} \] or \[ x \pm z \frac{s}{\sqrt{70}} / 69 \]
A1 A1 A1 A0 if interval not indicated
M1 M1 M1 M1
AEF Allow without ft or with \( s^2 \); with 70 Their \( s \)

(ii) \[ 4(0.9)^2(0.1) + 0.9^3 = 0.9477 \]
M1 A1 A1 5

(iii) \[ 4734 \text{ Mark Scheme June 2010} \]

5(i) \[ e^{-2.25} - e^{-4} \times 150 = 13.1 \]
\[ \text{Last: } 150 - \text{sum}=2.7 \]
M1 A1 A1 A1 ft 4

(ii) \( H_0: \text{Data fits the model, } H_1: \text{Data does not fit} \)
Combine last two cells
\[ \chi^2 = \frac{7.8^2/33.2 + 11.6^2/61.6 + 7.4^2/39.4 + 11.2^2/15.8}{13.3(46)} \]
Compare with 9.348 (or 11.14), reject \( H_0 \)
In range 13.2 to 13.5
M1*Dep A1 A1 A1 *Dep + 6

(iii) Anxiety scores; have normal distributions; common variance; independent samples
\( H_0: \mu_E = \mu_C, \quad H_1: \mu_E < \mu_C \)
\[ s^2 = \frac{(1923.56+1147.58)/29}{1.615} = -1.699 \]
\[ t_{\text{crit}} = -1.699 \]
Compare -1.615 with -1.699 and do not reject \( H_0 \)
\( t \approx (32.16 - 38.21)/\sqrt{[105.9(18-1+13-1)]} \]
M1 A1 A1 A1 ft 10

(ii) Sample sizes are too small (to appeal to CLT)
B1 1

6(i) \[ t = \frac{32.16 - 38.21}{\sqrt{105.9(18-1+13-1)}} \]
\[ t = -1.615 \]
\[ t_{\text{crit}} = -1.699 \]
Compare -1.615 with -1.699 and do not reject \( H_0 \)
There is insufficient evidence at the 5% significance level to show that anxiety is reduced by listening to relaxation tapes
M1 A1 A1 A1 ft

(ii) Sample sizes are too small (to appeal to CLT)
B1 1
7(i) Use $\sum F + \sum M \sim N(\mu, \sigma^2)$

$\mu = 1104.9$
$\sigma^2 = 6 \times 9.32 + 9 \times 8.52$
$= 1169.2$
$P(> 1150) = 1 - \Phi([1150 - 1104.9]/\sqrt{1169.2})$
$= 0.0937$

Sum of indep normal variables is normal

M1 A1 M1 A1

Standardise, correct tail. M0 $\sigma/\sqrt{15}$
Accept .094

(ii)

If unknown M, prob $\frac{1}{6}$, 6F and 9M as before.
If unknown W, prob $\frac{1}{7}$, 7W and 8M

Having $N(1093.3, 1183.4)$

$P(> 1150) = 1 - \Phi(1.648) = 0.0497$
$P = \frac{1}{2} \times 0.0936 + \frac{1}{2} \times 0.0497$
$= 0.07165$

Considering two cases

B1 B1 Mean and variance

A1

M1 Use of $\frac{1}{7}$

A1 ART 0.072

8(i)

$X = \frac{1}{2} S^2$

$F(s) = \int_{1}^{s} \frac{8}{3s^3} ds = \left[ -\frac{4}{3s^2} \right]_{1}^{s}$

$= \frac{1}{s} (1 - 1/s^2)$

$G(x) = P(X \leq x) = P(S \leq 2\sqrt{x})$

$= F(2\sqrt{x})$

$= \frac{4}{3} - \frac{1}{3x}$

$g(x) = \begin{cases} 
\frac{1}{3x^2}, & 0 \leq x \leq 1, \\
0, & \text{otherwise.}
\end{cases}$

B1 M1

Ignore range here

A1 M1 SR: B1 for $G(x) = F(2\sqrt{x})$ without justification and with correct result ft $F$

A1 ft

For $G'(a)$

B1 For range

(ii)

EITHER: $G(m) = \frac{1}{2}$

$\Rightarrow \frac{4}{3} - \frac{1}{3m} = \frac{1}{2}$

$\Rightarrow m = \frac{2}{3}$

M1 ft $G(x)$ in (i)

A1 ft CAO

A1

Allow wrong $\frac{1}{3}$

A1 Allow wrong $\frac{1}{3}$

A1 CAO

3 [10]
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