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Reg # FA22-BCE-028

## Assignment # 2

### Question 1

$$\text{Univariate Chi Square Test score} = \sum_{i=1}^n \frac{(x_i - \bar{e})^2}{\bar{e}}$$

L:-

Values: 7, 3, 2, 6

Total:  $7+3+2+6=18$

Expected value:

$$E = \frac{18}{4} = 4.5$$

$$\text{For 7: } \frac{(7-4.5)^2}{4.5} = 1.39$$

$$\text{For 3: } \frac{(3-4.5)^2}{4.5} = 0.5$$

$$\text{For 2: } \frac{(2-4.5)^2}{4.5} = 1.39$$

$$\text{For 6: } \frac{(6-4.5)^2}{4.5} = 0.5$$

Chi square:  $1.39 + 0.5 + 1.39 + 0.5$

$$\chi^2 = 3.78$$

N:-

Values: 11, 19, 21, 27

Total:  $11+19+21+27=78$

Expected value:

$$E = \frac{78}{4} = 19.5$$

M:-

Values: 1, 5, 9, 2

Total:  $1+5+9+2=17$

Expected value:

$$E = \frac{17}{4} = 4.25$$

$$\text{For 1: } \frac{(1-4.25)^2}{4.25} = 2.48$$

$$\text{For 5: } \frac{(5-4.25)^2}{4.25} = 0.13$$

$$\text{For 9: } \frac{(9-4.25)^2}{4.25} = 5.31$$

$$\text{For 2: } \frac{(2-4.25)^2}{4.25} = 1.19$$

Chi square:  $2.48 + 0.13 + 5.31 + 1.19$

$$\chi^2_m = 9.11$$

O:-

Values: 2, 1, 3, 5

Total:  $2+1+3+5=11$

Expected value:

$$E = \frac{11}{4} = 2.75$$



$$\text{For 11: } \frac{(11-19.5)^2}{19.5} = 3.71$$

$$\text{For 19: } \frac{(19-19.5)^2}{19.5} = 0.01$$

$$\text{For 21: } \frac{(21-19.5)^2}{19.5} = 0.12$$

$$\text{For 27: } \frac{(27-19.5)^2}{19.5} = 2.88$$

$$\begin{aligned} \chi^2_N &= 3.71 + 0.01 + 0.12 + 2.88 \\ &= 6.72 \end{aligned}$$

T:-

Values : 23, 43, 17, 41

$$\text{Total : } 23 + 43 + 17 + 41 = 124$$

Expected Value:

$$E = \frac{124}{4} = 31$$

$$\text{For 23: } \frac{(23-31)^2}{31} = 2.06$$

$$\text{For 43: } \frac{(43-31)^2}{31} = 4.65$$

$$\text{For 17: } \frac{(17-31)^2}{31} = 6.32$$

$$\text{For 41: } \frac{(41-31)^2}{31} = 3.23$$

$$\begin{aligned} \chi^2_T &= 2.06 + 4.65 + 6.32 + 3.23 \\ &= 16.26 \end{aligned}$$

$$\text{For 2: } \frac{(2-2.75)^2}{2.75} = 0.2$$

$$\text{For 1: } \frac{(1-2.75)^2}{2.75} = 1.11$$

$$\text{For 3: } \frac{(3-2.75)^2}{2.75} = 0.02$$

$$\text{For 5: } \frac{(5-2.75)^2}{2.75} = 1.84$$

$$\begin{aligned} \chi^2_o &= 0.2 + 1.11 + 0.02 + 1.84 \\ &= 4.18 \end{aligned}$$



## Question 2

**L:**

Values: 7, 3, 2, 6

$$\text{Mean: } \frac{7+3+2+6}{4} = 4.5$$

Squared deviations:

$$\bullet (7-4.5)^2 = 6.25$$

$$\bullet (3-4.5)^2 = 2.25$$

$$\bullet (2-4.5)^2 = 6.25$$

$$\bullet (6-4.5)^2 = 2.25$$

$$\text{Sum: } 6.25 + 2.25 + 6.25 + 2.25 = 17$$

$$\text{Variance: } s^2 = \frac{17}{4-1} = \frac{17}{3} = 5.67$$

$$s = \sqrt{s^2} = \sqrt{5.67} = 2.38$$

**N:**

Values: 11, 19, 21, 27

$$\text{Mean: } \frac{11+19+21+27}{4} = 19.5$$

Squared deviations:

$$\bullet (11-19.5)^2 = 72.25$$

$$\bullet (19-19.5)^2 = 0.25$$

$$\bullet (21-19.5)^2 = 2.25$$

$$\bullet (27-19.5)^2 = 56.25$$

$$\text{Sum: } 72.25 + 0.25 + 2.25 + 56.25 = 131$$

$$\text{Variance: } s^2 = \frac{131}{3} = 43.67$$

$$s = \sqrt{s^2} = \sqrt{43.67} = 6.61$$

**M:**

Values: 1, 5, 9, 2

$$\text{Mean: } \frac{1+5+9+2}{4} = 4.25$$

Squared deviations:

$$\bullet (1-4.25)^2 = 10.56$$

$$\bullet (5-4.25)^2 = 0.56$$

$$\bullet (9-4.25)^2 = 22.56$$

$$\bullet (2-4.25)^2 = 5.06$$

$$\text{Sum: } 10.56 + 0.56 + 22.56 + 5.06 = 38.75$$

$$\text{Variance: } s^2 = \frac{38.75}{3} = 12.92$$

$$s = \sqrt{s^2} = \sqrt{12.92} = 3.59$$

**O:**

Values: 2, 1, 3, 5

$$\text{Mean: } \frac{2+1+3+5}{4} = 2.75$$

Squared deviations:

$$\bullet (2-2.75)^2 = 0.5625$$

$$\bullet (1-2.75)^2 = 3.0625$$

$$\bullet (3-2.75)^2 = 0.0625$$

$$\bullet (5-2.75)^2 = 5.0625$$

$$\text{Sum: } 0.5625 + 3.0625 + 0.0625 + 5.0625 = 8.75$$

$$\text{Variance: } s^2 = \frac{8.75}{3} = 2.92$$

$$s = \sqrt{s^2} = \sqrt{2.92} = 1.71$$



T:

Values: 23, 43, 17, 41

$$\text{Mean: } \frac{23+43+17+41}{4} = 31$$

Squared deviations:

$$\bullet (23 - 31)^2 = 64$$

$$\bullet (43 - 31)^2 = 144$$

$$\bullet (17 - 31)^2 = 196$$

$$\bullet (41 - 31)^2 = 100$$

$$\text{Sum: } 64 + 144 + 196 + 100 = 504$$

$$\text{Variance: } s^2 = \frac{504}{3} = 168$$

$$s = \sqrt{s^2} = \sqrt{168} = 12.96$$