21BCE7371

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APPLIED STATISTICS ASSIGNMENT-1

Ans 1

$\bar{x} = 216$ (Sample mean)

$\mu = 200$ (population mean)

$n = 26$

$s = 8$

$$t_{cal} = \frac{(\bar{x} - \mu)}{(s/\sqrt{n})} \quad \text{or} \quad \frac{(\bar{x} - \mu)}{s/\sqrt{n}}$$

$$t_{cal} = \frac{(216 - 200)}{(8/\sqrt{26})} = \frac{16 \times \sqrt{26}}{8} = 10.19$$

$DOF = (n-1) = (26-1) = 25$

$\alpha = 0.05$ (Right Tail Test)

$t_{val} = t_{25, 0.05} = 1.708$

H_0 (Null Hypothesis) :- Avg. monthly values are same ($\mu = 200$)

H_1 (Alternate Hypothesis) :- Avg. monthly sales are greater after the campaign than before. ($\mu > 200$)

$\therefore$ $t_{cal} > t_{val}$

$\therefore$ H_1 is selected (It is true)

$\therefore$ we conclude that avg. monthly sales of a company after the campaign are slightly higher than before the campaign. Therefore, we can say that Advertisement Campaign has helped in promoting the sales of the particular Brand of Toothpaste.

Ans-2

$n = 10$

72, 82, 96, 85, 84, 75, 76, 93, 94, 93

$$\bar{x} = \frac{72+82+96+85+84+75+76+93+94+93}{10}$$

$$\bar{x} = \frac{850}{10} = 85$$

$$s = \sqrt{\frac{1}{(n-1)}(x_i - \bar{x})^2}$$

$$s = \sqrt{\frac{1}{(10-1)}\left((72-85)^2+(82-85)^2+(96-85)^2+(85-85)^2 + (84-85)^2+(75-85)^2+(76-85)^2+(93-85)^2 + (94-85)^2+(93-85)^2\right)}$$

$$s = \sqrt{\frac{1}{9}\left((13)^2+(3)^2+(11)^2+(0)^2+(1)^2+(10)^2+(9)^2+(8)^2 + (9)^2+(8)^2\right)}$$

$$s = \sqrt{\frac{169+9+121+100+1+81+64+81+64}{9}}$$

$$s = \sqrt{\frac{690}{9}} = \sqrt{76.6} = 8.75$$

$$t_{cal} = \frac{(\bar{x} - \mu)}{(s/\sqrt{n})}$$

$\mu = 90$, $n = 10$, $s = 8.75$, $\bar{x} = 85$

Null hypothesis (H_0) :- Avg score is 90. ($\mu_1 = \mu_2$) ($\mu = 90$)

Alternate hypothesis (H_1) :- Avg is not 90. ($\mu_1 \neq \mu_2$) ($\mu \neq 90$)

$$t_{cal} = \frac{(85-90)}{8.75/\sqrt{10}} = \frac{-5\times\sqrt{10}}{8.75} = -1.80$$

$$|t_{cal}| = 1.80$$

$t_{val} = t_{\alpha, DOF}$

$DOF = (n-1) = (10-1) = 9$ {Two Tail Test}

$\alpha = 0.05$, $\alpha/2 = \frac{0.05}{2} = 0.025$

$t_{val} = t_{9,\frac{0.05}{2}} = 2.26$

$|t_{val}| > |t_{cal}|$

$\therefore$ H_0 is Accepted

$\therefore$ Class Avg score is 90.

Ans-3

TYPE	NO. OF BATTERIES	AVG. LIFE	S
A	14	94	16
B	13	86	20

H_0 (Null Hypothesis) :- $\mu_x = \mu_y$ (No significant difference)

H_1 (Alternate Hypothesis) :- $\mu_x \neq \mu_y$ (Significant difference)

$n_1 = 14$, $\bar{x}_1 = 94$, $S_1 = 16$

$n_2 = 13$, $\bar{x}_2 = 86$, $S_2 = 20$

$\alpha = 5\%$

$$T_{cal} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} \quad \text{OR} \quad \frac{\bar{x}_1 - \bar{x}_2}{S\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

If, $S = \sqrt{\frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{(n_1+n_2-2)}}$

$$S = \sqrt{\frac{(14-1)(16)^2 + (13-1)(20)^2}{(14+13-2)}}$$

$$S = \sqrt{\frac{13\times(16)^2 + (12)(20)^2}{25}} = \sqrt{325.12} = \underline{18.03}$$

$$T_{cal} = \frac{94-86}{18.03\sqrt{\left(\frac{1}{14}+\frac{1}{13}\right)}} = \frac{8}{\sqrt{48.23}} = \frac{8}{6.94} = \underline{1.15}$$

DOF $= n_1 + n_2 - 2 = 13 + 14 - 2 = 25$

$\alpha = 0.05$, $\alpha/2 = 0.025$ {Two Tail Test}

$t_{val} = t_{25, 0.025} = 2.060$

$|t_{val}| > |t_{cal}|$ $\therefore$ H_0 is Accepted

So therefore no significant difference between Avg life of 2 Batteries.

Ans-4 4 : 3 : 9 $\Rightarrow$ Stripes : spots : Both

50 $\rightarrow$ Stripes, 41 $\rightarrow$ spots, 85 $\rightarrow$ Both (OBSERVED)

Total $= 50 + 41 + 85 = \underline{176}$

(Expected f) $E_1 = \frac{4}{16} \times 176 = \frac{176}{4} = \underline{44}$ (STRIPES)

$E_2 = \frac{3}{16} \times 176 = \underline{33}$ (SPOTS)

$E_3 = \frac{9}{16} \times 176 = \underline{99}$ (BOTH)

$$\chi^2_{cal} = \frac{\sum (O_i - E_i)^2}{E_i}$$

	OBSERVED (O_i)	EXPECTED (E_i)	$\frac{(O_i - E_i)^2}{E_i}$
STRIPES	50	44	$(50-44)^2/44 = 36/44 = 0.81$
SPOTS	41	33	$(41-33)^2/33 = 64/33 = 1.93$
BOTH	85	99	$(85-99)^2/99 = 14^2/99 = 1.97$
			$0.81 + 1.93 + 1.97$
			$= \boxed{4.71}$

$n = 3$, $K = n-1$, $DOF = n-1 = 3-1 = \underline{2}$

$\chi^2_{tab} = \chi^2_{2, 0.05} = \underline{5.99}$

H_0 (Null Hypothesis) :- Outcomes follow the Predicted Ratio.

H_1 (Alternate Hypothesis) :- They do not follow Predicted Ratio.

$$|\chi^2_{cal}| < |\chi^2_{tab}|$$

$\therefore$ H_0 is Accepted

So, we conclude that there outcomes follow the Predicted Ratio.

Ans-5 $n = 20$, $S = 23-2$

H_0 (Null Hypothesis) :- $S = 25$

H_1 (Alternate Hypothesis) :- $S < 25$

$$t_{cal} = \frac{(n-1)s^2}{\sigma^2}$$

$$t_{cal} = \frac{(20-1)(23-2)^2}{(25)^2} = 19 \times \frac{538.24}{625} = 16.36$$

$$t_{val} = t_{19,0.05} = 1.729$$

$$|t_{cal}| > |t_{val}|$$

$\therefore$ H_1 is Accepted

$\therefore$ we can say that S.D of weights of fireman is less than 25 at 0.05 level of significance