UNIVERSITY OF KARACHI

Probability and Statistical Methods

BSCS-306

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Semester No: **2nd**

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ASSIGNMENT 09

HYPOTHESIS TESTING : II

QUESTION : 01

DATA:-

$n_1 = 12$ $\quad n_2 = 12$

$\bar{x}_1 = 37900$ $\quad \bar{x}_2 = 39800$

$S_1 = 5100$ $\quad S_2 = 4900$

$\alpha = 0.05$, $\alpha/2 = 0.025$

$H_0 : \mu_1 = \mu_2 = 0$

$H_A : \mu_2 \neq \mu_2 \neq 0$

SOLUTION:-

Since $n < 30$ and equal variances.

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

$$= \sqrt{\frac{(12 - 1)(5100)^2 + (12 - 1)(4900)^2}{(12 - 1) + (12 - 1)}}$$

$$S_p = 5000.1$$

$$t_{cal} = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{S_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

$$t_{cal} = \frac{(37900 - 39800) - (0)}{5000.1 \sqrt{\frac{1}{12} + \frac{1}{12}}} = -0.930$$

t_{tab} =

$\nu = n_1 + n_2 - 2$

$= 12 + 12 - 2$

$\nu = 22$

P-value approach

$= 2P(t < -0.930)$

$= 2(0.15)$

$= 0.3$

$t_{tab}(0.05, 22)$

$t_{tab} = 1.71$

P value $> \alpha$

$0.3 > 0.025$

Now,

$t_{cal} < t_{tab}$

$-0.930 < 1.71$

Since the P-value is greater than the level of significance so we can not reject H_0. Hence there is insufficient evidence to suggest difference in the average wear of 2 brands of tires.

QUESTION : 02

DATA :-

$n_1 = 12$ $\quad n_2 = 10$

$\bar{x}_1 = 85$ $\quad \bar{x}_2 = 81$

$S_1 = 4$ $\quad S_2 = 5$

$\alpha = 0.05$, $\alpha/2 = 0.025$

$H_0 : \mu_1 - \mu_2 = 2$

$H_A : \mu_1 - \mu_2 > 2$

SOLUTION :-

Given that variances are equal and $n < 30$

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

$$= \sqrt{\frac{(12-1)(4)^2 + (10-1)(5)^2}{(12-1)(10-1)}}$$

$$S_p = 4.477$$

$$t_{cal} = \frac{(\bar{x}_1 - x_2) - (\mu_1 - \mu_2)}{S_p \sqrt{1/n_1 + 1/n_2}}$$

$$= \frac{(85-81) - 2}{4.477 \sqrt{1/12 + 1/10}} = 1.043$$

P_value approach :

$P(t > 1.043)$

$0.16 > 0.025$

Since the P-value is greater than $\alpha/2$ so we'll accept H_0.

Question : 03

DATA:-

$\alpha = 5\%$, $\alpha/2 = 0.025$

$n = 15$

$\bar{x} = 9.84$

$S = 18.47$

$H_0 : \mu_1 = \mu_2$

$H_a : \mu_1 \neq \mu_2$

Solution:-

$$t_{cal} = \frac{\bar{x} - d_0}{S/\sqrt{n}}$$

$$= \frac{9.84 - 0}{18.47/\sqrt{15}}$$

$$t_{cal} = 2.06$$

P value approach

$2P(t > 2.06)$

$2(0.03)$

$0.06 > 0.025$

Since P value is greater than the level of significance. Therefore we can't reject the Null hypothesis.

QUESTION : 04

DATA :-

$n = 15$

Subject	d_i
1	-67
2	-33
3	150
4	128
5	190
6	2
7	-56
8	119
9	-8
10	-1
11	79
12	153
13	34
14	107
15	15

$\bar{d} = 54.13$

$SD = 83.002$

$\alpha = 0.05$, $\alpha/2 = 0.025$

$H_0 : \mu_1 = \mu_2$

$H_a : \mu_1 \neq \mu_2$

SOLUTION.-

$$t_{cal} = \frac{\bar{d} - d_0}{SD/\sqrt{n}}$$

$$= \frac{54.13 - 0}{83.002/\sqrt{15}} = 2.52$$

P value approach :-

$2P(t > 2.52)$

$2(0.015)$

$0.03 > 0.025$

Since the P value is greater than the $\alpha/2$ hence we can not reject H_0 in favour of H_a.

QUESTION : 05

DATA:-

$n_1 = 5$ $\quad$ $n_2 = 7$

$\bar{x}_1 = 97.4$ $\quad$ $\bar{x}_2 = 110$

$s_1 = 8.87$ $\quad$ $s_2 = 30.22$

$\alpha = 0.01$

$H_0 : \mu_2 - \mu_1 = 10$

$H_A : \mu_2 - \mu_1 < 10$

SOLUTION:-

Since the variances are unequal

$$v = \frac{\left(s_1^2/n_1 + s_2^2/n_2\right)^2}{\frac{\left(s_1^2/n_1\right)^2}{n_1 - 1} + \frac{\left(s_2^2/n_2\right)^2}{n_2 - 1}}$$

$$= \frac{\left\{(8.87)^2/5 + (30.22)^2/7\right\}^2}{\frac{\left\{(8.87)^2/5\right\}^2}{5-1} + \frac{\left\{(30.22)^2/7\right\}^2}{7-1}}$$

$$= 7.37 \approx 7$$

P value approach:

$P(t < 1.86)$

$0.05 < 0.1$

Since the P value is less than α so we reject the H_0 in favour of H_A.

QUESTION : 06

DATA :-

$\sigma^2 = 0.03$ $\quad H_0 = \sigma^2 = 0.03$

$n = 10$ $\quad H_A = \sigma^2 \neq 0.03$

$\bar{x} = 10.06$

$s = 0.2458$

$\alpha = 0.05$, $\alpha/2 = 0.025$

SOLUTION :-

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

$$= \frac{(10-1)(0.24)^2}{0.03}$$

$$\chi^2_{cal.} = 18.12$$

P value approach :

$2P(\chi^2 > 18.12)$

$2(0.025)$

$0.05 > 0.025$

The P value is greater than the level of significance hence we can not reject H_0 in favour of H_A.

QUESTION :07

DATA:-

$n = 12$

$\alpha = 0.01$

$s = 1.75$

$H_0 = \sigma^2 = 1.96$

$H_A: \sigma^2 > 1.96$

SOLUTION:-

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

$$= \frac{(12-1)(1.75)^2}{1.96}$$

$$\chi^2 = 18.75$$

P value approach

$P(\chi^2 > 18.75)$

$0.05 > 0.01$

Since the P value is greater than of α so we can't reject H_0.

QUESTION : 08

DATA:-

$n_1 = 20$, $n_2 = 20$

$V_1 = 19$ $V_2 = 19$

$S_1 = 281.06$ $S_2 = 119.394$

$\alpha = 0.02$, $\alpha/2 = 0.01$

$H_0 : \sigma_1^2 = \sigma_2^2$

$H_A : \sigma_1^2 \neq \sigma_2^2$

SOLUTION:-

$$F_{cal} = \frac{S_1^2}{S_2^2}$$

$$= \frac{(281.066)^2}{(119.394)^2}$$

$$F_{cal} = 5.5$$
$$= 5.54$$

$$F_{tab} = f_{(19,19)} = 2.49$$

Since $F_{cal} > F_{tab}$, we reject H_0 in favour of H_A.