

Applied Multivariate Statistics

Course Code: STAT331

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Assignment III

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Question 1

First, we need the average of all 4 measurements for each person. Control group ($n = 5$)

$$\begin{aligned}\text{Participant 1: } & \frac{73 + 72 + 74 + 77}{4} = 74.00, \\ \text{Participant 2: } & \frac{71 + 71 + 77 + 74}{4} = 73.25, \\ \text{Participant 3: } & \frac{71 + 74 + 71 + 71}{4} = 71.75, \\ \text{Participant 4: } & \frac{73 + 66 + 67 + 70}{4} = 69.00, \\ \text{Participant 5: } & \frac{69 + 73 + 69 + 68}{4} = 69.75.\end{aligned}$$

$$\bar{x}_{\text{control}} = \frac{74.00 + 73.25 + 71.75 + 69.00 + 69.75}{5} = 71.55.$$

Yoga group ($n = 5$)

$$\begin{aligned}\text{Participant 6: } & \frac{74 + 69 + 70 + 66}{4} = 69.75, \\ \text{Participant 7: } & \frac{68 + 70 + 67 + 71}{4} = 69.00, \\ \text{Participant 8: } & \frac{68 + 69 + 68 + 76}{4} = 70.25, \\ \text{Participant 9: } & \frac{70 + 67 + 72 + 66}{4} = 68.75, \\ \text{Participant 10: } & \frac{71 + 64 + 66 + 71}{4} = 68.00.\end{aligned}$$

$$\bar{x}_{\text{yoga}} = \frac{69.75 + 69.00 + 70.25 + 68.75 + 68.00}{5} = 69.15.$$

Just by observing the means of the 2 groups, it looks like yoga group indeed has lower average pulse rate than the control group. However, there is a possibility that this difference has arisen just by chance.

Null Hypothesis (H_0): Regularly practising yoga does not reduce pulse rate.

Alternative Hypothesis (H_1): Regularly practising yoga does reduce pulse rate.

Since the sample size is very small (5 participants for each group), and the variance of the population is not known, we can use the student's t-test.

Since Variance rule is:

$$\text{Var}(X - Y) = \text{Var}(X) + \text{Var}(Y)$$

So the standard error of the difference is:

$$SE_D = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

Group 1 (yoga):

$$s_1 = 0.8768, \quad n_1 = 5$$

Group 2 (control):

$$s_2 = 2.1607, \quad n_2 = 5$$

Therefore,

$$\frac{s_1^2}{n_1} = \frac{0.8768^2}{5} = \frac{0.7688}{5} = 0.1538$$

$$\frac{s_2^2}{n_2} = \frac{2.1607^2}{5} = \frac{4.6696}{5} = 0.9339$$

so,

$$0.1538 + 0.9339 = 1.0877$$

so,

$$SE_D = \sqrt{1.0877} = 1.0429$$

$$SE_D = 1.0429$$

To find the t-statistic, we need the difference in sample mean which is:

$$D = \bar{x}_{\text{yoga}} - \bar{x}_{\text{control}} = 69.15 - 71.55 = -2.40$$

The t-statistic is:

$$T_n = \frac{X_n - \mu}{\sigma_{b_n}/\sqrt{n}}$$

and

$$SE_D = \sigma_{b_n}/\sqrt{n}$$

$$t = \frac{-2.40}{1.0429}$$

So the t-statistic is:

$$t = -2.301$$

From python code, we got the p value as 0.0235.

$$0.0235 > 0.01$$

So:

$$\text{Retain } H_0$$

There is not enough evidence at the 1% level to conclude that yoga reduces pulse rate.

Question 2

From the 50 observations:

$$\bar{x} = 5.63 \text{ g/day}, \quad sd = 2.334, \quad n = 50$$

Degrees of freedom:

$$df = n - 1 = 49$$

Using Python:

The test statistic is

$$t = 1.928$$

For $t = 1.928$ with $df = 49$, the two-sided p-value is

$$p = 0.0597$$

At $\alpha = 0.05$

$$p = 0.0597 > 0.05$$

We will retain H_0 . At the 5% level, the evidence is not strong enough to conclude that the mean salt intake differs from 5 g.

At $\alpha = 0.01$

$$p = 0.0597 > 0.01$$

We will retain H_0 . At the 1% level, there is no strong evidence to conclude that the mean differs from 5 g.

0.1 Question 3

