

Introduction to Statistical Methods
(S1-23_AIMLCZC418) – Assignment 2
AIML Section- 2

Each question carries 2.5 Marks (2.5 x 4 = 10 Marks)

Duration: 23rd February 2024 – 10th March 2024

Questions:

1. A psychological study was conducted to compare the reaction times of men and women to a stimulus. Independent random samples of 100 men and 100 women were employed in the experiment. The results are shown in the table below. Do the data present sufficient evidence to indicate a difference between true mean reaction times for men and women? (Use $\alpha = 0.05$)

Men	Women
$n_1=100$	$n_2=100$
$\bar{X}_1 = 2.70$	$\bar{X}_2 = 2.54$
$s_1^2 = 0.36$	$s_2^2 = 0.40$

Solution:

$$H_0: \mu_1 = \mu_2$$

$$H_1: \mu_1 \neq \mu_2$$

$$\alpha = .05$$

Since the variances are known, we obtain

$$z = \frac{2.70 - 2.54 - 0}{\sqrt{\frac{0.36}{100} + \frac{0.40}{100}}} = 1.84$$

Now, $1.84 < 1.96$, we accept H_0

2. A population of cats is known to have 160 heart beats per minute. When 13 cats were each fed on a fixed quantity of drug and data taken on their beats, the mean 148 with standard deviation 27.5. Find if there is change in heart beat due to the drug. (Table value at 5% level of significance is 1.782 for 12 d.f.)

Solution: $n=13, \bar{x} = 148, \sigma = 27.5, \mu = 160$.

t-statistic:

$$t = \frac{\bar{x} - \mu}{\sigma / \sqrt{n-1}}$$

$$t = 1.511 < 1.782$$

$$H_0: \mu = \mu_0$$

$$H_1: \mu \neq \mu_0$$

H_0 is Accepted.
No change.

i.e There is no change in the heartbeat due to the drug.

3. Assume that air ticket reservation from Delhi to Gulf is uniformly distributed during all days in winter season. To determine whether it is uniform we selected a random sample reservation list for 10 days. The following information is drawn from the list.

S. No	1	2	3	4	5	6	7	8	9	10
No. of Reservations	65	80	100	98	75	80	82	70	60	90

Test the validity of the assumption using Chi - square test. Take LOS as 5 %.

Solution:

H_0 : Air tickets reservations uniformly distributed
 H_1 : not uniformly distributed
 Total no of observations = 800 for 10 days.
 Expected reservation per day = $\frac{800}{10} = 80$

O	E	$(O_i - E_i)$	$(O_i - E_i)^2$	$\frac{(O_i - E_i)^2}{E_i}$
65	80	-15	225	2.8125
80	80	0	0	0
100	80	20	400	5
98	80	18	324	4.05
75	80	-5	25	0.3125
80	80	0	0	0
82	80	2	4	0.05
70	80	-10	100	1.25
60	80	-20	400	5
90	80	10	100	1.25

$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i} = 19.725$
 $\chi^2_{cal} = 19.725$
 LOS = 5% at $n-1 = 10-1 = 9$ df is 16.9.
 $\chi^2_{cal} > \chi^2_{table}$
 we reject H_0 .

4. Three sets of five mice were randomly selected to be placed in a standard maze but with different colour doors. The response is the time required to complete the maze as seen below. Perform the appropriate analysis to test if there is an effect due to door colour. (Use $\alpha = 0.01$)

Colour	Time			
Red	9	11	10	9

Green	20	21	23	17
Black	6	5	8	14

Solution:

Step 1: Hypotheses

$$H_0: \mu_{Red} = \mu_{Green} = \mu_{Black}$$

H_a : at least one inequality

Step 2: Significance Level

$$\alpha = 0.01$$

Step 3: Critical Value and Rejection Region

$$F(2, 9) = 8.02$$

Step 4: Calculation:

Data Summary				
Groups	N	Mean	Std. Dev.	Std. Error
Group 1	4	9.75	0.9574	0.4787
Group 2	4	20.25	2.5	1.25
Group 3	4	8.25	4.0311	2.0156

ANOVA Summary					
Source	Degrees of Freedom	Sum of Squares	Mean Square	F-Stat	P-Value
	DF	SS	MS		
Between Groups	2	342	171	21.9077	0.0003
Within Groups	9	70.2491	7.8055		
Total:	11	412.2491			

Step 5: Since $21.9 > 8.02$, we shall reject the Null hypothesis.

Step 6: At $\alpha = 0.01$ level of significance, there exists enough evidence to conclude that there is an effect due to door colour.