**Hypothesis Test**

**Exercises**

**EXERCISE 1**

The blood uric acid value is evaluated in a random sample of 40 subjects drawn from a population. The sample mean is $\overbar{x}$ = 5.55mg/dl. If the standard deviation is $s$ = 1.1, what is the 95% confidence interval of the mean?

**EXERCISE 2**

Blood glucose level in women in menopause follows a Gaussian distribution.

A sample of 100 women in menopause were enrolled in the North of Italy. They showed a mean blood glucose $\overbar{x}$ = 86.3 mg/dL, with a standard deviation $s$ = 28.2 mg/dL.

Another sample of 100 women were enrolled in the South of Italy. Their mean blood glucose was $\overbar{x}$ = 96.7 mg/dL and standard deviation $s$ = 23.5 mg/dL.

Verify if women in the South had blood glucose levels different from women in the North $(α$ = 5%) by:

1. using a two-sample t-test
2. indicating the 95% confidence interval for the mean difference in blood glucose levels between women based in the North and women based in the South of Italy

**EXERCISE 3**

The following table shows the mean and the standard deviation of weight loss (g) by sweating during an insulin-induced hypoglycemic crisis in a sample of 12 treated patients with placebo and 11 patients treated with propanol.

|  |  |  |  |
| --- | --- | --- | --- |
| **GROUP** | **n** | $\overbar{x}$(g) | $s $(g) |
| **Placebo** | 12 | 120 | 10 |
| **Propanol** | 11 | 70 | 8 |

1. Define the hypothesis system to test the hypothesis that the mean weight loss does not differ between the two groups ($α$ = 0.05) vs an appropriate one-sided alternative hypothesis assuming a Gaussian distribution of the weight loss
2. Calculate the confidence interval of the difference between the two means.

**EXERCISE 4**

25 children whose parents have type II diabetes and 25 whose parents do not have diabetes were sampled. The former had a mean fasting blood sugar level of 86.1 mg/dl, while the others had a mean fasting blood sugar level of 82.2 mg/dl. The standard deviations of the two samples are 2.09 mg/dl and 2.49 mg/dl, respectively.

Check with one tail t-test whether the parents' illness modifies the average blood sugar level of the children ($α$ = 0.05).

**EXERCISE 5**

The hypnotic effect of a new drug, F2, is tested compared to the same effect of an already known drug, F1, on a group of 8 volunteers. First, F1 was administered and then F2, before the following night. The results, evaluated in terms of additional number of hours of sleep compared to an already known average value per subject, are as follows:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Patient ID** | **F1** | **F2** | **ẟi = F2-F1** | **(ẟi- ẟ)2** |
| 1 | +0.4 | +0.6 |  |  |
| 2 | +0.3 | +0.5 |  |  |
| 3 | +0.9 | +0.7 |  |  |
| 4 | +0.4 | +0.6 |  |  |
| 5 | +1 | +0.9 |  |  |
| 6 | +1 | +1.1 |  |  |
| 7 | +1 | +1.5 |  |  |
| 8 | +1 | +2.1 |  |  |

1. Test if the effect of the two drugs is the same ($α$ = 0.05)
2. Calculate the confidence interval for the difference between the two effects in terms of hours of sleep

**EXERCISE 6**

The distribution according to sex and age in classes of a sample of people who have had a heart attack results to be the following:

|  |  |
| --- | --- |
| **Age** | **Sex** |
| **Male** | **Female** |
| (35, 45] | 2 | 1 |
| (45, 55] | 8 | 3 |
| (55, 65] | 14 | 10 |
| (65, 85] | 17 | 23 |
| Total | 41 | 37 |

It can be stated that the mean age of males with heart attack is significantly different from that of females ($α$ = 0.05)?

**EXERCISE 7**

In a study on the incidence of migraine in individuals engaged in sports activities, a sample of 150 boys and 200 girls, aged between 16 and 20 years, is examined. It is revealed that 30 boys and 48 girls suffer from frequent migraines. Based on these data, is it possible to conclude, at a significance level of α = 0.05, that there is no significant difference between the boys and girls on the proportions of athletes affected by migraines?

Calculate the 95% confidence interval of the difference between the proportion of boys and girls affected by migraines.

**EXERCISE 8**

In a study to assess the efficacy of two different antibiotic treatment regimens for urinary tract infections in adult patients 200 patients were enrolled. 100 patients were randomly assigned to group A, for receiving the standard antibiotic treatment, or to group B, for receiving a newly developed antibiotic. At the end of the treatment, the number of patients showing clinical improvement (cure) in each group was recorded.

Group A: 75 patients cured out of 100 treated.

Group B: 85 patients cured out of 100 treated.

Examine whether there is a significant difference in the efficacy of the two treatments in curing urinary tract infections:

1. Formulate the null and alternative hypotheses for the comparison of proportions
2. Calculate the cure proportion for each group
3. Perform the appropriate hypothesis test at a significance level of 5%. State the critical value and make a decision on rejecting or not rejecting the null hypothesis
4. Interpret the results of the hypothesis test: what conclusions can be drawn from the study?

**EXERCISE 9**

In a study for assessing whether there are significant differences in the frequency of postoperative complications between two different surgical procedures for laparoscopic cholecystectomy 300 patients were enrolled and randomly assigned to procedure A (traditional technique) or procedure B (innovative technique). The following data were collected:

Procedure A: 25 patients developed complications.

Procedure B: 15 patients developed complications.

Determine if the innovative technique (Procedure B) is associated with a significantly lower frequency of postoperative complications compared to the traditional technique (Procedure A).

1. Formulate the null and alternative hypotheses for the comparison of proportions
2. Calculate the proportion of patients with complications for each surgical procedure
3. Perform the appropriate hypothesis test at a significance level of 5%. State the critical value and make a decision on rejecting or not rejecting the null hypothesis
4. Interpret the results of the hypothesis test: what conclusions can be drawn from the study?