Assignment 9 – Stats

For the inferential statistics questions listed below, you can use any of the 2 approaches to come to the conclusion (either P value method or critical value method).

Q1. A company claims that their new battery lasts longer than their previous model, which has a mean lifespan of 100 hours in previous model. A sample of 25 new batteries is tested, yielding a mean lifespan of 105 hours with a standard deviation of 10 hours. At a 5% significance level, can we conclude that the new battery lasts longer?

Formulate the null and alternative hypotheses, choose an appropriate test, and conduct the test to reach a conclusion.

Q2. A researcher wants to estimate the average time spent on social media by high school students. A sample of 50 students is selected, and the mean time spent is found to be 3.5 hours with a standard deviation of 0.8 hours. Construct a 95% confidence interval for the true mean time spent on social media by all high school students.

Calculate the confidence interval and interpret the results.

Q3. A survey is conducted to examine whether there is an association between gender (male/female) and preference for a new product (like/dislike). The data is summarized in the table below. Conduct a Chi-square test of independence to determine if there is a significant association between gender and product preference.

State the null and alternative hypotheses, calculate the Chi-square statistic, and interpret the results.

|  |  |  |
| --- | --- | --- |
|  | Like | Dislike |
| Male | 20 | 30 |
| Female | 25 | 25 |

Q4. A group of students takes a math test before and after attending a 4-week tutoring session. The test scores before and after the session are recorded. Conduct a appropriate test to determine if the tutoring session has significantly improved the students' test scores.

Formulate the null and alternative hypotheses, choose an appropriate test, and conduct the test to reach a conclusion.

|  |  |  |
| --- | --- | --- |
| **Student** | **Before** | **After** |
| 1 | 60 | 75 |
| 2 | 72 | 80 |
| 3 | 63 | 78 |
| 4 | 80 | 82 |
| 5 | 69 | 76 |

Q5. A botanist is studying the effect of three different fertilizers on the growth of a particular plant species. The plants are divided into three groups, each receiving a different type of fertilizer (Fertilizer A, Fertilizer B, Fertilizer C). After 8 weeks, the height of the plants in each group is measured in centimeters.

Perform a ANOVA to determine if there is a significant difference in the average plant height between the three fertilizers. Report the F-statistic, p-value, and your conclusion.

|  |  |  |  |
| --- | --- | --- | --- |
| Fertilizer | Fertilizer A | Fertilizer B | Fertilizer C |
| Plant 1 | 24 | 30 | 22 |
| Plant 2 | 26 | 32 | 20 |
| Plant 3 | 28 | 29 | 23 |
| Plant 4 | 22 | 31 | 21 |
| Plant 5 | 25 | 33 | 24 |

Q6. You have a bag containing 4 red balls, 3 blue balls, and 3 green balls. You randomly draw two balls from the bag, without replacement.

**Task:**

1. What is the probability that both balls are red?
2. What is the probability that the first ball is red and the second ball is blue?
3. If you know the first ball drawn was red, what is the probability that the second ball drawn is also red? Use conditional probability.

Q7. Explain Bayes theorem in detail with some example.