Assignment 4 (Week 7 - 8)

STAT 2601 - Business Statistics (2024 Fall)
School of Mathematics and Statistics, Carleton University

Due Date and Time: Wednesday 13 November 2024, before 10:00 am
Total Marks: 39

Q1: [8] Immigration Canada claims that more than 60% of Canadians support increased immigration levels. To test this claim at a significance level of 0.01, a recent survey was conducted. The results indicated that out of $3,000$ Canadian residents surveyed, $1,980$ respondents expressed their support for increased immigration levels.

1. Formulate the null and alternative hypotheses to test the claim. [1]

2. Calculate the test statistic and p-value. [2.5]

3. Write the decision rule and your decision (reject or fail to reject the null hypothesis) using p-value approach and justify your answer. Explain the managerial decision in the context of public support for immigration in Canada. [3]

4. What assumptions and conditions are required for the validity of this test? [1.5]

Q2: **[14]** A marketing analyst wants to assess the effectiveness of advertising promotions on two social media platforms: Twitter and Facebook. In a study involving two separate advertising campaigns for the same product, a sample of 17 customers who engaged with the Twitter ads reported an average purchase amount of \$128, with a standard deviation of \$15. Meanwhile, a sample of 15 customers who interacted with the Facebook ads had an average purchase amount of \$117, with a standard deviation of \$18. Assume that the purchase amounts are normally distributed for both social media platforms.

1. Can we assume that the variances of the purchase amounts for customers using Twitter are equal to those for customers using Facebook? Explain. [1]

2. Construct and interpret a 90% confidence interval for the difference in average purchase amounts between customers. [6]

3. Test if there is sufficient evidence to suggest that advertising promotions on Twitter lead to a higher average purchase amount among customers compared to those on Facebook using critical value method at 10% level of significance. Write hypotheses, critical value, decision rule, test statistic, decision with justification and managerial statement in the business context. [4.5]

4. What is the p-value for this test? Write your decision rule and decision using p-value approach. [2.5]

Q3: [9] A business researcher wants to compare customer satisfaction regarding pricing between two popular online shopping platforms: AliExpress and Temu. A survey was conducted where 420 customers who shopped on AliExpress and 480 customers who shopped on Temu were asked if they were satisfied with their shopping experience in terms of pricing. The results showed that 210 customers from AliExpress reported being satisfied, while 260 customers from Temu reported satisfaction. Let p_1 be the population proportion of satisfied customers on AliExpress and p_2 is the population proportion of satisfied customers on Temu.

1. Formulate the null and alternative hypotheses for this scenario. [1]

2. Using a significance level of 0.05, conduct a hypothesis test comparing the two population proportions. Calculate the test statistic and p-value and determine whether to reject or fail to reject the null hypothesis. [8]

Q4: [8] Use the following two methods **Excel** to solve this question

Excel Instructions

- **Method 1**
  - Create a new column represents the difference between the paired observations (sample1 − sample2).
  - Count the number of pairs, n, using `=COUNT(range)` where the range corresponds to your differences column.
  - Calculate the mean (`=AVERAGE(range)`) and standard deviation (`=STDEV.S(range)`) of the differences.
  - Calculate the Test Statistic, t-statistic, for two dependent means (matched pairs).
  - Calculate the P-Value `=T.DIST.2T(ABS(t-statistic), n-1)`.
- **Method 2**
- **File** > **Option** > **Add-ins** > **Option** > **Manage:** Excel Add-ins - Go > add **Analysis ToolPak**
- **Data** > **Data Analysis** > **t-Test: Paired Two Sample for Means**.
- Input the All-Season MPG values in **Variable 1 Range** and Winter MPG values in **Variable 2 Range**.
- Set **Hypothesized Mean Difference:** 0 and **Alpha:** 0.05.

A given car dealership wants to compare the fuel efficiency of cars equipped with winter tires versus all-season tires over different years. A study was conducted using a sample of 12 Toyota cars, measuring their mileage per gallon (MPG) in two scenarios: once with winter tires and once with all-season tires. The data collected over the years is as follows:

Mileage with All-Season Tires (MPG) :	20,	22,	18,	24,	27,	28,	24,	21,	22,	20,	18,	26
Mileage with Winter Tires (MPG) :	21,	25,	20,	24,	29,	28,	25,	20,	21,	22,	19,	28

Use a significance level of 0.05 to conduct a paired t-test and decide whether to reject or fail to reject the null hypothesis that there is no difference in fuel efficiency between cars equipped with winter tires and those with all-season tires. Report all results from both methods.