MANB 1123 ASSIGNMENT #2
(HYPOTHESIS TESTING)

RULES:

1. This assignment should be conducted in group. Each group should only consist of TWO members.
2. Assignment should be done in complete (answer all the questions given) and neat.
3. You may use any statistical packages/tools as you prefer to get the result.
4. Submission should follow the date given and should be in hardcopy.

TASK 1: HYPOTHESIS TEST FOR SINGLE MEANS

Question 1: (allowed for 1 group)

At a recent meeting, the manager of a national call center for a major Internet bank made the statement that the average past-due amount for customers who have been called previously about their bills is now no larger than $20.00. Other bank managers at the meeting suggested that this statement may be in error and that it might be worthwhile to conduct a test to see if there is statistical support for the call center manager's statement. The file called **Bank Call Center** contains data for a random sample of 67 customers from the call center population. Assuming that the population standard deviation for past due amounts is known to be $60.00, what should be concluded based on the sample data? Test using α = 0.10.

Question 2: (allowed for 1 group)

The Center on Budget and Policy Priorities reported that average out-of-pocket medical expenses for prescription drugs for privately insured adults with incomes over 200% of the poverty level was $173 in 2002. Suppose an investigation was conducted in 2009 to determine whether the increased availability of generic drugs, Internet prescription drug purchases, and cost controls have reduced out-of-pocket drug expenses. The investigation randomly sampled 196 privately insured adults with incomes over 200% of the poverty level, and the respondents' 2009 out-of-pocket medical expenses for prescription drugs were recorded. These data are in the file **Drug Expenses**. Based on the sample data, can it be concluded that 2009 out-of-pocket prescription drug expenses are lower than the 2002 average reported by the Center on Budget and Policy Priorities? Use a level of significance of 0.01 to conduct the hypothesis test.

Question 3: (allowed for 1 group)

The makers of Mini-Oats Cereal have an automated packaging machine that can be set at any targeted fill level between 12 and 32 ounces. Every box of cereal is not expected to contain exactly the targeted weight, but the average of all boxes filled should. At the end of every shift (eight hours), 16 boxes are selected at random and the mean and standard deviation of the sample are computed. Based on these sample results, the production control manager determines whether the filling machine needs to be readjusted or whether it remains all right to operate. Use α = 0.05.

a. Establish the appropriate null and alternative hypotheses to be tested for boxes that are supposed to have an average of 24 ounces.

b. At the end of a particular shift during which the machine was filling 24-ounce boxes of Mini Oats, the sample mean of 16 boxes was 24.32 ounces, with a standard deviation of 0.70 ounce. Assist the production control manager in determining if the machine is achieving its targeted average.
c. Why do you suppose the production control manager would prefer to make this hypothesis test a two-tailed test? Discuss.
d. Conduct the test using a *p*-value.

Question 4: (allowed for 1 group)

The director of a state agency believes that the average starting salary for clerical employees in the state is less than $30,000 per year. To test her hypothesis, she has collected a simple random sample of 100 starting clerical salaries from across the state and found that the sample mean is $29,750.

a. State the appropriate null and alternative hypotheses.
b. Assuming the population standard deviation is known to be $2,500 and the significance level for the test is to be 0.05, what is the critical value (stated in dollars)?
c. Referring to your answer in part b, what conclusion should be reached with respect to the null hypothesis?
d. Referring to your answer in part c, which of the two statistical errors might have been made in this case? Explain.

TASK 2: HYPOTHESIS TEST FOR A PROPORTION

Question 1: (allowed for 1 group)

The practice of "phishing," or using the Internet to pilfer personal information, has become an increasing concern, not only for individual computer users but also for online retailers and financial institutions. *The Wall Street Journal* reported 28% of people who bank online have cut back on their Internet use. The North Central Educators Credit Union instituted an extensive online security and educational program six months ago in an effort to combat phishing before the problem became extreme. The credit union's managers are certain that while Internet use may be down, the rate for their customers is much less than 28%. However, they believe that if more than 10% of their customers have cut back on their Internet banking transactions, they will be required to take more stringent action to lower this percentage. The credit union's Information Technology department analyzed 200 randomly selected accounts and determined that 24 indicated they had cut back on their Internet banking transactions.

a. State the appropriate null and alternative hypotheses for this situation.
b. Using α = 0.05 and the *p*-value approach, indicate whether the sample data support the managers' contention.

Question 2: (allowed for 1 group)

Cell phones are becoming an integral part of our daily lives. Commissioned by Motorola, a new behavioral study took researchers to nine cities worldwide from New York to London. Using a combination of personal interviews, field studies, and observation, the study identified a variety of behaviors that demonstrate the dramatic impact cell phones are having on the way people interact. The study found cell phones give people a newfound personal power, enabling unprecedented mobility and allowing them to conduct their business on the go. Interesting enough, gender differences can be found in phone use. Women see their cell phone as a means of expression and social communication, whereas males tend to use it as an interactive toy. A cell phone industry spokesman stated that half of all cell phones in use are registered to females.

a. State the appropriate null and alternative hypotheses for testing the industry claim.
b. Based on a random sample of cell phone owners shown in the data file called **Cell Phone Survey**, test the null hypothesis. (Use $\alpha = 0.05$.)

Question 3: (allowed for 1 group)

A large number of complaints have been received in the past six months regarding airlines losing fliers' baggage. The airlines claim the problem is nowhere near as great as the newspaper articles have indicated. In fact, one airline spokesman claimed that less than 1% of all bags fail to arrive at the destination with the passenger. To test this claim, 800 bags were randomly selected at various airports in the United States when they were checked with this airline. Of these, 6 failed to reach the destination when the passenger (owner) arrived.

a. Is this sufficient evidence to support the airline spokesman's claim? Test using a significance level of 0.05. Discuss.
b. Estimate the proportion of bags that fail to arrive at the proper destination using a technique for which 95% confidence applies.

Question 4: (allowed for 1 group)

A survey by the Pew Internet & American Life Project found that 21% of workers with an e-mail account at work say they are getting more spam than a year ago. Suppose a large multinational company, after implementing a policy to combat spam, asked 198 randomly selected employees with e-mail accounts at work whether they are receiving more spam today than they did a year ago. The results of the survey are in the file **Spam**. At the 0.025 level of significance, can the company conclude that the percentage of its employees receiving more spam than a year ago is smaller than that found by the Pew study?

TASK 3: CASE STUDY (ANSWER ALL QUESTIONS)

Following his graduation from college, Tony Smith wanted to continue to live and work in Oxford. However, the community was small and there were not a lot of readily available opportunities for a new college graduate. Fortunately, Tony had some experience working in the food service industry gained in the summers and throughout high school at his uncle's restaurant in Buffalo. When Tony decided to leverage his experience into a small delivery and take-out restaurant located close to the university, he

thought he had hit on a great idea. Tony would offer a limited fare consisting of the Buffalo wings his uncle had perfected at his restaurant. Tony called his restaurant Wings of Fire. Although success came slowly, the uniqueness of Tony's offering coupled with the growth of the university community made Wings of Fire a success. Tony's business was pretty simple. Tony purchased wings locally. The wings were then seasoned and prepared in Tony's restaurant. Once an order was received, Tony cooked the wings, which were then delivered or picked up by the customer. Tony's establishment was small and there was no place for customers to dine in the restaurant. However, his wings proved so popular that over time Tony hired several employees, including three delivery drivers. Business was steady and predictable during the week, with the biggest days being home-football Saturdays.

A little over a year ago, Oxford really began to grow and expand. Tony noticed that his business was beginning to suffer when other fast-food delivery restaurants opened around campus. Some of these restaurants were offering guarantees such as "30 minutes or it's free." Tony's Wings of Fire now had to compete with fish tacos, specialty pizzas, and gourmet burgers. Most of these new restaurants, however, were dine-in establishments that provided carry-out and delivery as a customer convenience. However, Tony was certain that he would need to offer a delivery guarantee to remain competitive with the newer establishments. Tony was certain that a delivery guarantee of "30 minutes or it's free" could easily be accomplished every day except on football Saturdays. Tony thought that if he could offer a 30 minute guarantee on his busiest day, he would be able to hold onto and perhaps even recover market share from the competition. However, before he was willing to commit to such a guarantee, Tony wanted to ensure that it was possible to meet the 30-minute promise. Tony knew it would be no problem for customers to pick up orders within 30 minutes of phoning them in. However, he was less confident about delivering orders to customers in 30 minutes or less. Not only would the wings need to be cooked and packaged, but the delivery time might be affected by the availability of drivers. Tony decided that he needed to analyze the opportunity further. As a part of his analysis, Tony decided to take a random sample of deliveries over five different football weekends. Cooking time and packaging time were not considered in his analysis because wings were not cooked for individual orders. Rather, large numbers of wings were cooked at a single time and then packaged in boxes of 12. Tony therefore decided to focus his analysis on the time required to deliver cooked and packaged wings. He collected information on the amount of time an order had to wait for a driver (the pick-up time) as well as the amount of time required to transport the wings to the customer (the drive time). The sampled information is in the file **Wings of Fire**. Tony is not willing to offer the guarantee on football Saturdays unless he can be reasonably sure that the total time to deliver a customer's order is less than 30 minutes, on average. Tony would also like to have an estimate of the actual time required to deliver a customer's order on football Saturdays. Finally, Tony would like to know how likely it is that the total time to make a delivery would take more than 30 minutes. Based on the sampled data, should Tony offer the guarantee? What percent of the Saturday deliveries would result in a customer receiving a free order? What recommendations might help Tony improve his Saturday delivery times?

Required Tasks:

a. Use the sample information to compute a measure of performance that Tony can use to analyze his delivery performance.
b. State a hypothesis test that would help Tony decide to offer the delivery guarantee or not.
c. Calculate sample statistics and formally test the hypothesis stated in (b).
d. Estimate the probability of an order taking longer than 30 minutes.
e. Summarize your findings and make a recommendation in a short report.

TASK 4: HYPOTHESIS TEST FOR TWO POPULATION MEAN

Question 1: (allowed for 1 group)

Airlines were severely affected by the oil price increases of 2008. Even Southwest lost money, the first time ever, during that time. Many airlines began charging for services that had previously been free, such as baggage and meals. One national airline had as an objective getting an additional $5 to $10 per trip from its customers. Surveys could be used to determine the success of the company's actions. The file entitled **AirRevenue** contains results of samples gathered before and after the company implemented its changes.

a. Produce a 95% confidence interval for the difference in the average fares paid by passengers before and after the change in policy. Based on the confidence interval, is it possible that revenue per passenger increased by at least $10? Explain your response.
b. Conduct a test of hypothesis to answer the question posed in part a. Use a significance level of 0.025.
c. Did you reach the same conclusion in both parts (a) and (b)? Is this a coincidence or will it always be so? Explain your response.

Question 2: (allowed for 1 group)

The United Way raises money for community charity activities. Recently, in one community, the fundraising committee was concerned about whether there is a difference in the proportion of employees who give to United Way depending on whether the employer is a private business or a government agency. A random sample of people who had been contacted about contributing last year was selected. Of those contacted, 70 worked for a private business and 50 worked for a government agency. For the 70 private-sector employees, the mean contribution was $230.25 with a standard deviation equal to $55.52. For the 50 government employees in the sample the mean and standard deviation were $309.45 and $61.75, respectively.

a. Based on these sample data and α = 0.05, what should be concluded? Be sure to show the decision rule.
b. Construct a 95% confidence interval for the difference between the mean contributions of private business and government agency employees who contribute to United Way. Do the hypothesis test and the confidence interval produce compatible results? Explain and give reasons for your answer.

Question 3: (allowed for 1 group)

A treadmill manufacturer has developed a new machine with softer tread and better fans than its current model. The manufacturer believes these new features will enable runners to run for longer times than they can on its current machines. To determine whether the desired result is achieved, the manufacturer randomly sampled 35 runners. Each runner was measured for one week on the current machine and for one week on the new machine. The weekly total number of minutes for each runner on the two types of machines was collected. The results are contained in the file **Treadmill**. At the 0.02

level of significance, can the treadmill manufacturer conclude that the new machine has the desired result?

Question 4: (allowed for 1 group)

Although not all students have debt after graduating from college, more than half do. The College Board's *2008 Trends in Student Aid* addresses, among other topics, the difference in the average college debt accumulated by undergraduate Bachelor of Arts degree recipients by type of college for the 2006–2007 academic years. Samples might have been used to determine this difference in which the private, for profit colleges' average was $38,300 and the public college average was $11,800. Suppose the respective standard deviations were $2,050 and $2,084. The sample sizes were 75 and 205, respectively.

a. Examine the sample standard deviations. What do these suggest is the relationship between the two population standard deviations? Support your assertion.
b. Conduct a hypothesis test to determine if the average college debt for Bachelor of Arts degree recipients is at least $25,000 more for graduates from private colleges than from public colleges. Use α = 0.05significance level and a *p*-value approach for this hypothesis test.

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