Statistics - Assignment 4

Finish this assignment and submit it on the E3 system, <u>as a single PDF file</u> (a file with context or photos should be good), by 2024/05/23 23:59. Please be as detailed as possible in your response (Mandarin or English). 可以打字或是手寫拍照貼到pdf上繳交。

Round off to the 3rd decimal place

1. **Interviewing candidates for a job**. The costs associated with conducting interviews for a job opening have skyrocketed over the years. According to a Harris Interactive survey, **211 of 502** senior human resources executives at U.S. companies believe that their hiring managers are interviewing too many people to find qualified candidates for the job (Business Wire, June 8, 2006).
   a. Describe the population of interest in this study.
   b. Identify the population parameter of interest, p.
   c. Is the sample size large enough to provide a reliable estimate of p?
   d. Find and interpret an interval estimate for the true proportion of senior human resources executives who believe that their hiring managers interview too many candidates during a job search. Use a confidence level of 98%.
   e. If you had constructed a 90% confidence interval, would it be wider or narrower?

2. **Salmonella poisoning from eating an ice cream bar.** Recently, a case of salmonella (bacterial) poisoning was traced to a particular brand of ice cream bar, and the manufacturer removed the bars from the market. Despite this response, many consumers refused to purchase any brand of ice cream bars for some period of time after the event (McClave, personal consulting). One manufacturer conducted a survey of consumers 6 months after the outbreak. A **sample of 244 ice cream bar** consumers was contacted, and **23 respondents** indicated that they would not purchase ice cream bars because of the potential for food poisoning.
   a. What is the point estimate of the true fraction of the entire market who refuse to purchase bars 6 months after the outbreak?
   b. Is the sample size large enough to use the normal approximation for the sampling distribution of the estimator of the binomial probability? Justify your response.
   c. Construct a 95% confidence interval for the true proportion of the market who still refuses to purchase ice cream bars 6 months after the event.

d. Interpret both the point estimate and confidence interval in terms of this application.

3. **"Out of control" production process**. When companies employ control charts to monitor the quality of their products, a series of small samples is typically used to determine if the process is "in control" during the period of time in which each sample is selected. Suppose a concrete-block manufacturer samples **nine blocks per hour** and tests the breaking strength of each. During 1 hour's test, the **mean and standard deviation are 985.6 pounds per square inch (psi) and 22.9 psi,** respectively. The process is to be considered "out of control" if the true mean strength differs from **1,000 psi.** The manufacturer wants to be reasonably certain (**99% confidence**) that the process is really out of control before shutting down the process and trying to determine the problem. What is your recommendation?

4. **Producing machine bearings.** To determine whether a metal lathe that produces machine bearings is properly adjusted, a random **sample of 25** bearings is collected and the diameter of each is measured.
   a. If the **standard deviation** of the diameters of the bearings measured over a long period of time is **.001 inch**, what is the approximate probability **that the mean diameter x of the sample of 25 bearings will lie within ±.0001 inch** of the population mean diameter of the bearings?
   b. If the population of diameters has an extremely **skewed distribution**, how will your approximation in part **a** be affected?

5. **Improving the productivity of chickens**. Farmers have discovered that the more domestic chickens peck at objects placed in their environment, the healthier and more productive the chickens seem to be. White string has been found to be a particularly attractive pecking stimulus. In one experiment, **72 chickens** were exposed to a string stimulus. Instead of white string, blue-colored string was used. The number of pecks each chicken took at the blue string over a specified time interval was recorded. Summary statistics for the 72 chickens were **x = 1.13 pecks, s = 2.21 pecks** (Applied Animal Behaviour Science, October 2000).
   a. Estimate the population mean number of pecks made by chickens pecking at blue string using a 99% confidence interval. Interpret the result.
   b. Previous research has shown that m = 7.5 pecks if chickens are exposed to white string. Based on the results, part a, is there evidence that chickens are more apt to peck at white string than blue string? Explain.

6. To instill customer loyalty, airlines, hotels, rental car companies, and credit card companies (among others) have initiated frequency marketing programs that reward their regular customers. A large fast-food restaurant chain wished to explore the profitability of such a program. They randomly selected **12 of their 1,200 restaurants** nationwide and instituted a frequency program that rewarded customers with a $5.00 gift certificate after every 10 meals purchased at full price. They ran the trial program for 3 months. The restaurants not in the sample had an average increase in profits of **$1,050 over the previous 3 months**, whereas the restaurants in the sample had the following changes in profit.

$2,232.90	$ 545.47	$3,440.70	$1,809.10
$6,552.70	$4,798.70	$2,965.00	$2,610.70
$3,381.30	$1,591.40	$2,376.20	$-2,191.00$

Note that the last number is negative, representing a decrease in profits.
   a. Specify the appropriate null and alternative hypotheses for determining whether the mean profit change for restaurants with frequency programs was significantly greater (in a statistical sense) than $1,050
   b. Conduct the test of part a using = .05. Does it appear that the frequency program would be profitable for the company if adopted nationwide?

7. The Lincoln Tunnel (under the Hudson River) connects suburban New Jersey to midtown Manhattan. On Mondays at 8:30 .., the mean number of cars waiting in line to pay the Lincoln Tunnel toll is **1,220**. Because of the substantial wait during rush hour, the Port Authority of New York and New Jersey is considering raising the amount of the toll between 7:30 and 8:30 .. to encourage more drivers to use the tunnel at an earlier or later time. Suppose the Port Authority experiments with peak-hour pricing for 6 months, increasing the toll from $4 to $7 during the rush hour peak. On **10 different workdays** at 8:30 .. aerial photographs of the tunnel queues are taken and the number of vehicles counted. The results follow:

1,260	1,052	1,201	942	1,062	999	931	849	867	735

Analyze the data for the purpose of determining whether peak-hour pricing succeeded in reducing the average number of vehicles attempting to use the Lincoln Tunnel during the peak rush hour.