Homework 8

Problem 1 (by hand + Minitab output – hypotheses testing + calculating power)

Minitab:STAT – Basic STAT- 1sample z – Summarized data(put sample size, mean , standard deviation)

Test mean =25 , Options :Confidence level 99.0, alternative :greater than Ok

Power: STAT – Power and Sample size- 1 sample z- Specify : sample size , differences = μ- new value of μ, standard deviation,

Options: alternative Hypothesis : greater than and put desired significance level.

Imagine an automobile company looking for additives that might increase gas mileage. As a pilot study , they send 30 cars fueled with a new additive on a road trip from Boston to Los Angeles. Without the additive, those cars are known to average 25.0mpg with a standard deviation of 2.4 mpg. Suppose it turns out that the thirty cars averaged 26.3 mpg with the additive.

a) What should the company conclude? Is the additive effective? Let $\alpha=0.01$. Use three methods : the p-value , the critical value approach and the confidence Interval method.
b) Find the power of the test when μ is actually
   (i) 25.750 (by hand + Minitab)
   (ii) 26.8 (Minitab only)
   (iii) 28 (Minitab only)
   What effect does increasing the distance between the true value of μ and hypothesized value $\mu=25$
c) Find the power of the test when μ is actually 25.750 and n=100. What effect does increasing the sample size have on the power of the test? (Minitab only)
d) Find the power of the test when μ is actually 25.750 and n=30. What effect does increasing the sample size have on the power of the test? Use $\alpha=0.05$(Minitab only) and $\alpha=0.1$(Minitab only)
e) What would be the effect on power when μ is actually 25.750 (n=30, $\alpha=0.01$) if σ could be reduced from 2.4 mpg to 1.2 mpg? (Minitab only)

Problem 2 **(by hand + Minitab output – hypotheses testing + calculating power)**

The public relations officer for a particular city claims the average monthly cost for childcare outside the home for a single child is $700. A potential resident is interested in whether the claim is correct. She obtains a random sample of 64 records and computes the average monthly cost of this type of childcare to be $689 with a standard deviation of $40.

a) Perform the appropriate test of hypothesis for the potential resident using $\alpha=0.01$
b) Find the p-value for the test in the previous question.
c) What effect, if any, would there be on the conclusion of the test of hypothesis if you changed α to 0.05?
d) Find the power of the test when μ is actually $685 and $\alpha=0.05$.

e) Describe what a type I error would be . Describe what a type II error would be.

9.14 Flextime Many companies are becoming involved in *flextime*, in which a worker schedules his or her own work hours or compresses work weeks. A company that was contemplating the installation of a flextime schedule estimated that it needed a minimum mean of 7 hours per day per assembly worker in order to operate effectively. Each of a random sample of 80 of the company's assemblers was asked to submit a tentative flextime schedule. If the mean number of hours per day for Monday was 6.7 hours and the standard deviation was 2.7 hours, do the data provide sufficient evidence to indicate that the mean number of hours worked per day on Mondays, for all of the company's assemblers, will be less than 7 hours? Test using $\alpha = .05$.

<u>Problem 3 (9.14) (by hand + Minitab output)</u>. Use three methods : the p-value , the critical value approach and the confidence interval method

Find the power of the test when μ is actually 6.8 hours.

Problems 9.20 – by hand , Problems 9.22, 9.48 and - 9.77 –by hand + Minitab output

9.20 Suppose you wish to detect a difference between μ_1 and μ_2 (either $\mu_1 > \mu_2$ or $\mu_1 < \mu_2$) and, instead of running a two-tailed test using $\alpha = .05$, you use the following test procedure. You wait until you have collected the sample data and have calculated $\bar{x}_1$ and $\bar{x}_2$. If $\bar{x}_1$ is larger than $\bar{x}_2$, you choose the alternative hypothesis $H_a: \mu_1 > \mu_2$ and run a one-tailed test placing $\alpha_1 = .05$ in the upper tail of the z distribution. If, on the other hand, $\bar{x}_2$ is larger than $\bar{x}_1$, you reverse the procedure and run a one-tailed test, placing $\alpha_2 = .05$ in the lower tail of the z distribution. If you use this procedure and if μ_1 actually equals μ_2, what is the probability α that you will conclude that μ_1 is not equal to μ_2 (i.e., what is the probability α that you will incorrectly reject H_0 when H_0 is true)? This exercise demonstrates why statistical tests should be formulated *prior* to observing the data.

9.22 Healthy Eating Americans are becoming more conscious about the importance of good nutrition, and some researchers believe we may be altering our diets to include less red meat and more fruits and vegetables. To test the theory that the consumption of red meat has decreased over the last 10 years, a researcher decides to select hospital nutrition records for 400 subjects surveyed 10 years ago and to compare their average amount of beef consumed per year to amounts consumed by an equal number of subjects interviewed this year. The data are given in the table.

	Ten Years Ago	This Year
Sample mean	73	63
Sample standard deviation	25	28

a. Do the data present sufficient evidence to indicate that per-capita beef consumption has decreased in the last 10 years? Test at the 1% level of significance.

b. Find a 99% lower confidence bound for the difference in the average per-capita beef consumptions for the two groups. (This calculation was done as part of Exercise 8.76.) Does your confidence bound confirm your conclusions in part a? Explain. What additional information does the confidence bound give you?

9.48

In the last few years , many research studies have shown that the purported benefits of hormone replacement therapy (HRT) do not exist, and in fact ,that hormone replacement therapy actually increases the risk of several serious diseases. A four –year experiment involving 4532 women , reported in The Press Enterprise, was conducted at 39 medical centers. Half of the women took placebos and half took Prempo, a widely prescribed type of hormone replacement therapy. There were 40 cases of dementia in the hormone group and 21 in the placebo group. Is there sufficient evidence to indicate that the risk of dementia is higher for patients using Prempo?

Test at the 1% level of significance.

9.77 9/11 Conspiracy Some Americans believe that the entire 9/11 catastrophe was planned and executed by federal officials in order to provide the United States with a pretext for going to war in the Middle East and as a means of consolidating and extending the power of the then-current administration. This group of Americans is larger than you think. A Scripps-Howard poll of $n = 1010$ adults in August of 2006 found that 36% of American consider such a scenario very or somewhat likely![23] In a follow-up poll, a random sample of $n = 100$ adult Americans found that 26 of those sampled agreed that the conspiracy theory was either likely or somewhat likely. Does this sample contradict the reported 36% figure? Test at the $\alpha = .05$ level of significance.

Multiple choice question

A quality control officer tests bottles of shampoo to see if the filling machines are putting the proper amount in each bottle. They do not want to shut down production unless there is strong evidence indicating that the machines are not functioning properly. After testing a sample of bottles, the quality control officer decides to leave the filling machines operating. Actually, however, the filling machines are not operating properly. Which type of error, if any, did the quality control officer commit?

a. This is a Type I error.
b. This is a Type II error.
c. This is a correct decision.
d. Need more information to answer this question

The p-value of a test is the:

a. smallest α at which the null hypothesis can be rejected
b. largest α at which the null hypothesis can be rejected
c. smallest α at which the null hypothesis cannot be rejected
d. largest α at which the null hypothesis cannot be rejected

If we reject the null hypothesis, we conclude that:

a. there is not enough statistical evidence to infer that the alternative hypothesis is true
b. there is enough statistical evidence to infer that the alternative hypothesis is true
c. there is enough statistical evidence to infer that the null hypothesis is true
d. the test is statistically insignificant at whatever level of significance the test was conducted at

If we do not reject the null hypothesis, we conclude that:

a. there is not enough statistical evidence to infer that the alternative hypothesis is true
b. there is enough statistical evidence to infer that the alternative hypothesis is true
c. there is enough statistical evidence to infer that the null hypothesis is true
d. the test is statistically insignificant at whatever level of significance the test was conducted at

If a hypothesis is rejected at the 0.05 level of significance, it:

a. must be rejected at any level
b. must be rejected at the 0.02 level
c. must not be rejected at the 0.02 level
d. may be rejected or not rejected at the 0.02 level

If the hypothesis test is conducted using $\alpha = .025$, this means that:

a. there is a 2.5% chance that the null hypothesis is true
b. there is a maximum 2.5% chance that a false null hypothesis will be rejected
c. there is a maximum 2.5% chance that a true null hypothesis will be rejected
d. there is 2.5% chance of committing a Type I error and 97.5% chance of committing a Type II error