Math 160, REVIEW SHEET, Exam 3
Chapter 7.2 – 7.4, 8.2 – 8.5, 9.2, 9.3
Vanden Eynden **On the exam, you will need to SHOW ALL WORK to earn credit**

1. What are the two main types of inferential statistics we have learned in this class? Briefly describe them.

2. A Gallup Youth Survey in 2001 found that of 501 randomly selected teenagers in the U.S., 271 of them said they got along "very well" with their parents. Use this information to construct a 95% confidence interval estimate of the percentage of **all** U.S. teenagers that get along "very well" with their parents.

3. A random sample of students is to be taken to try and estimate the percentage of college students who spend, on average, more than $250 on books each semester. The publisher that is financing the study would like to estimate with 90% confidence and a margin of error of 4%. The last time a similar study was conducted suggested that 72% of college students spent, on average, more than $250 per semester. How many college students should be sampled this time?

4. A telephone company claims that private customers pay on average $17.10 per month for long-distance phone calls. A random sample of 35 customers' bills during a given month produced a sample mean of $22.10 spent on long-distance calls, and a sample standard deviation of $6.71.

   a. Calculate a 95% confidence interval for the average monthly long-distance phone bill.

   b. Can we be 95% confident that the claims made by the company are **in**valid?

5. It's usually suggested that people get 8 hours of sleep each night. It is thought that the amount people actually get is lower than suggested. A sample of 65 people living in America was asked how much sleep they got the night before. The average for the sample was 6.55 hours, and the standard deviation of sleep times is assumed to be $\sigma = 1.68$ hours.

a. Use this information to estimate μ with 90% confidence.

b. In words, what is the confidence interval in part (a) attempting to estimate?

6. A random sample of lightbulbs is to be taken so that the owner of the company can estimate the average life of his lightbulbs. How many lightbulbs should he sample so that he can estimate the mean life with 99% confidence and a margin of error of 5 hours? Assume that it is known that the standard deviation for lightbulb lifetimes is 10 hours.

7. A random sample of quiz scores yielded the results: 77, 81, 88, 65, 74, 71, 79, 84, 69, 90, and 93.

a. Create a 95% confidence interval to estimate the average quiz score for the entire class.

b. Based on the small sample size in part (a), what assumption did we make about the *population distribution* of quiz scores?

In any of the problems below involving <u>hypothesis testing</u> make sure to

1) **state the claim in symbols,**
2) **state the null and alternate hypotheses,**
3) **calculate the appropriate test statistic,**
4) **find the corresponding P-value and compare it to α (significance level),**
5) **decide to either "Reject the Null" or "Fail to Reject the Null", and**
6) **state your final conclusion in a sentence, making sure to address the original claim.**

8. A survey of 150 executives showed that 44% of them say that "little to no knowledge of the company" is the most common mistake made by candidates during ob interviews. Use a 0.05 significance level to test the claim that less than half of all executives identify that error as being the most common job interviewing error.

   a. State the claim in symbols.

   b. State the null and alternate hypotheses in symbols. Will this be a one or two tailed test?

   c. Do we use a z-score or t-score? Calculate the test statistic.

   d. What is the P-value?

   e. What is your conclusion and why? Make sure your conclusion addresses the original claim.

9. In general, under what conditions do you "Reject the Null" ?

10. Based on past data, it is known that 21% of married people make claims on insurance policies. There has long been a debate about the claim that single drivers are different than married drivers. In a random sample of 1000 single drivers, 240 had made an auto insurance claim in the last 3 years. Based on the sample information, is there evidence at the 0.05 significance level to suggest that the proportion of single people who make claims is different than the proportion of married people who make claims?

11. What is the effect on the P-value when a hypothesis test is changed from a one-tailed test to a two-tailed test?

12. It has been reported that the average credit card debt for college seniors is $3262. The student government association at San Diego State feels that their seniors have a debt much less than this, so it conducts a study of 50 randomly selected seniors and finds the sample has an average debt of $2995. Assume that σ = $1100. Use a 0.05 significance level to test their claim.
[Do we use a z-score or t-score? Why?]

13. Listed below are the heights (in inches) of the 19 U.S. Presidents who served from 1900 to the present.

67	70	71.5	71	72	70	71.5	74	69	
70.5	72	75.5	71.5	69.5	73	74	74	72	74

The mean height of all men is 69.0 inches. Assuming that men's heights are normally distributed, use a 0.01 significance level to test the claim that U.S. Presidents are taller than the typical man.
[Do we use a z-score or t-score? Why?]

14. Do smoking bans at workplaces help people quit smoking altogether?

Group A: 843 smokers were randomly selected from hospitals that <u>did have the ban in place</u>.
56 of them quit within a year of the ban.

Group B: 703 smokers were selected from hospitals <u>with no ban</u>.
27 of them quit during the year.

Construct a 95% confidence interval estimate of the difference between the percentage of Group A and Group B who quit smoking during the year. Do smoking bans seem to help employees quit smoking?

15. What does it mean when a confidence interval estimating the difference $\mu_1 - \mu_2$ contains 0?

16. Researchers investigated whether children diagnosed with ADHD (Attention Deficit Hyperactivity Disorder) had a smaller average brain size than children without this condition. The data from the study is summarized below. All cerebral volumes were measured in milliliters.

WITH ADHD	**WITHOUT ADHD**
Average Cerebral Volume: 1059.4	Average Cerebral Volume: 1104.5
Standard deviation: 117.5	Standard Deviation: 111.3
Sample size: 152	Sample size: 139

Using the summary statistics above, test to see if there is significant evidence to suggest that the average brain size for children with ADHD is lower than the average brain size of those without ADHD.
Use a 0.05 level of significance.

Answer Key: The Section # each problem relates to is given in [brackets].

1. Confidence intervals and hypothesis testing.
2. [7.2] (0.497, 0.585)
3. [7.2] 341 students
4. [7.4] a. ($19.80, $24.40) b. yes. $17.10 is not within the 95% confidence interval.
5. [7.3] a. (6.21, 6.89) b. The mean number of hours of sleep each night for all Americans.
6. [7.3] 27 lightbulbs
7. [7.4] a. (73.1, 85.2) b. We assume that it's normal (since n < 30).
8. [8.3] Claim: $p < .50$, $H_0 : p = 0.5,\ \ H_1 : p < 0.5$, z-score, $z = -1.47$, P-value = .0708 (which is > 0.05), Fail to reject the null. There is not enough evidence to support the claim that less than half of all executives identify that error as being the most common job interviewing error.
9. [8.2] We "Reject the Null" when the P-value $\leq \alpha$, the significance level (ie. 0.05 or 0.01)
10. [8.3] Claim: $p \neq .21$, $H_0 : p = .21,\ \ H_1 : p \neq .21$, *2-tailed test* , z-score, $z = 2.33$, P-value = 2(.0099) = .0198 (which is < 0.05), Reject the null. There is sufficient sample evidence to support the claim that the proportion of single people who make insurance claims is different than the proportion of married people who make insurance claims.
11. [8.2] In a two-tailed test, the P-value from a one-tailed test is multiplied by 2.
12. [8.4] Claim: $\mu < 3262$, $H_0 : \mu = 3262,\ \ H_1 : \mu < 3262$, z-score (since σ is given), $z = -1.72$, P-value = .0427 (which is < 0.05), Reject the null. There is sufficient sample evidence to support the claim that San Diego State seniors have a mean CC debt less than $3262.
13. [8.5] Claim: $\mu > 69.0$, $H_0 : \mu = 69.0,\ \ H_1 : \mu > 69.0$, t-score (since σ is not given, but we can calculate s), $t = 5.56$, P-value = 0+ (which is < 0.05), Reject the null. There is sufficient sample evidence to support the claim that U.S. Presidents are taller than the typical (average) man.
14. [9.2] 95% Confidence interval: $$(.0664 - .0384) \pm 1.96\sqrt{\frac{(.0664)(.9336)}{843} + \frac{(.0384)(.9616)}{703}}$$

   $0.0280 \pm 1.96\sqrt{.00012606}$

   $0.0280 \pm 1.96(.0112)$ So: $0.0280 \pm .0220$

   CI: $0.006 < p_1 - p_2 < 0.05$

   Since the CI does not contain 0, there seems to be some evidence that smoking bans help employees quit smoking. The CI tells us we are 95% confident that the true difference between the proportions is between 1% and 5%.
15. [9.3] When a confidence interval estimating the difference $\mu_1 - \mu_2$ contains 0, then the confidence interval suggests that it is very possible that the two population means are equal. It suggests that there is not a significant different between the two means.
16. [9.3] Claim: $\mu_{ADHD} < \mu_{NO}$, $H_0 : \mu_{ADHD} = \mu_{NO},\ \ H_1 : \mu_{ADHD} < \mu_{NO}$, Area in One Tail, $t = -3.36$ (use t = 3.36), df = 138 (use 100), P-value < .005 (which is < 0.05), Reject the null. There is evidence to suggest that the average brain size for children with ADHD is lower than the average brain size of those without ADHD.

Formula Sheet for Chapters 7, 8 & 9

$$\hat{p} \pm z_{\alpha/2}\sqrt{\frac{\hat{p}\hat{q}}{n}}$$

$$n = \frac{\left[z_{\alpha/2}\right]^2 \hat{p}\,\hat{q}}{E^2}$$

$$\overline{x} \pm z_{\alpha/2}\frac{\sigma}{\sqrt{n}}$$

$$n = \left[\frac{z_{\alpha/2}\cdot\sigma}{E}\right]^2$$

$$\overline{x} \pm t_{\alpha/2}\frac{s}{\sqrt{n}}$$

$$z = \frac{\hat{p}-p}{\sqrt{\frac{pq}{n}}}$$

$$z = \frac{\overline{x}-\mu}{\frac{\sigma}{\sqrt{n}}}$$

$$t = \frac{\overline{x}-\mu}{\frac{s}{\sqrt{n}}} \text{ , df } = n-1$$

$$z = \frac{\hat{p}_1-\hat{p}_2}{\sqrt{\frac{\overline{p}\,\overline{q}}{n_1}+\frac{\overline{p}\,\overline{q}}{n_2}}} = \frac{\hat{p}_1-\hat{p}_2}{\sqrt{\overline{p}\,\overline{q}\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}}$$

where $\hat{p}_1 = \frac{x_1}{n_1}$, $\hat{p}_2 = \frac{x_2}{n_2}$, $\overline{p} = \frac{x_1+x_2}{n_1+n_2}$, $\overline{q} = 1-\overline{p}$

$$\left(\hat{p}_1-\hat{p}_2\right) \pm z_{\alpha/2}\sqrt{\frac{\hat{p}_1\hat{q}_1}{n_1}+\frac{\hat{p}_2\hat{q}_2}{n_2}}$$

$$t = \frac{\overline{x}_1-\overline{x}_2}{\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}}$$, df = smaller of $n_1 - 1$ or $n_2 - 1$

$$\left(\overline{x}_1-\overline{x}_2\right) \pm t_{\alpha/2}\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}$$