Math 263 - Section 5
Exam #3

Instructors Name: Ryan Smith
Students Name (please print): _____

By signing my name below, I agree that I am following all rules and regulations set forth by the Code of Academic Integrity. Furthermore, I agree that I am following all rules set by my instructor and by the course policy for this exam.

Signature: _____

Date:_____

You should work alone and show all of your work on all the problems.

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Points						

Multiple Choice

You do not have to show any work in this section.

1. A one-sample t test of $H_0 : \mu = 125$, against $H_a : \mu > 125$ is carried out based on sample data from a Normal population. The SRS of size $n = 15$ produced a mean $\overline{x} = 132.8$ and $s = 12.6$. What is the value of the appropriate test statistics?

   (a) $z = 2.40$

   (b) $t = 2.32$

   (c) $\boxed{t = 2.40}$

   (d) $z = 2.32$

   (e) $t = 1.76$

2. Which of the following best describes the statement of the central limit theorem? This is **NOT ASKING** which statements are true, it is asking for which single option best describes the central limit theorem.

   (a) When drawing a SRS of size n from any population with mean μ and finite standard deviatio

   (b) The success count X of the binomial distribution $B(n, p)$ is approximately equal to $N(np, \sqrt{np(1-p)})$.

   (c) When drawing a SRS of size n from a normally distributed population with distribution $N(\mu, \sigma)$, the distribution of the average $\overline{x}$ is exactly $N(\mu, \sigma/\sqrt{n})$.

   (d) The sample proportion $\hat{p}$ of the binomial distribution $B(n, p)$ is approximately equal to $N(p, \sqrt{p(1-p)/n})$.

   (e) None of the above.

3. A study asked a group of 60 people how many miles they drive every day. They found that the average person drove 11.2 miles, with a margin of error of 3.0 miles for a 95% confidence. Assuming that the data is normally distributed, estimate the confidence interval **for 99.7% confidence**.

   (a) 99.7% confident that the average person drives between 8.2 and 14.2 miles per day.

   (b) 99.7% confident that the average person drives between 9.7 and 12.7 miles per day.

   (c) 99.7% confident that the average person drives between 6.7 and 15.7 miles per day.

   (d) Impossible to estimate without more information.

   (e) None of the above.

4. A group of researchers are testing a new compound on a group of mice to see if it has any effect on their lifespans. Population 1 is a control group, population 2 is the treatment group.

   (a) Identify the hypotheses being tested:

      i. $H_0 : \mu_1 < \mu_2$, $H_a : \mu_1 = \mu_2$
      ii. $H_0 : \mu_1 = \mu_2$, $H_a : \mu_1 < \mu_2$
      iii. $H_0 : \mu_1 \neq \mu_2$, $H_a : \mu_1 = \mu_2$
      iv. $H_0 : \mu_1 = \mu_2$, $H_a : \mu_1 \neq \mu_2$
      v. None of the above

   (b) If the P value is 0.03, what can the researchers conclude?

      i. They can reject the null hypothesis with a confidence level of 0.05.
      ii. They can reject the alternative hypothesis with a confidence level of 0.05.
      iii. They cannot reject the null hypothesis with a confidence level of 0.05, but they cannot accept the alternative hypothesis with a confidence level of 0.05.
      iv. None of the above.

5. A simple random sample of 120 vet clinics in the Midwest reveals that the vast majority of them only treat small pets (dogs, cats, rabbits, etc.) and no large animals (cows, horses, etc.). Of the 120 clinics sampled, 88 responded that they only treat small animals at their clinic.

   (a) What is the value of the standard error of $\hat{p}$?

      i. 0.02
      ii. $\boxed{0.04}$
      iii. 0.03
      iv. 0.05
      v. None of the above

   (b) What is a 90% confidence interval for p, the population proportion of vet clinics that do treat large animals?

      i. $(0.163, 0.371)$
      ii. $\boxed{(0.200, 0.333)}$
      iii. $(0.188, 0.346)$
      iv. $(0.667, 0.800)$[1]
      v. None of the above

6. Researchers in Australia are comparing a population of kangaroos to the national average to see if they can jump further. They measure the maximum jump of 15 kangaroos and compare it to the national average to get a t-value of $t = 2.71$. What is the P value of their hypothesis?

   (a) 0.0169
   (b) $\boxed{0.0085}$
   (c) 0.0081
   (d) 0.0067
   (e) 0.0034
   (f) None of the above

[1]This answer is wrong because it is measuring the proportion which **do not** treat large animals. Since this would be the right answer for students who misread the question but solved the rest of the problem correctly, some partial credit was awarded for this answer.

Free Response

You must show your work for this section. You do **not** need to show how you used your calculator to compute specific numbers, but your work must make sense.

7. A polling organization wants to test whether a lower proportion of poor people vote in midterm elections than in presidential elections. In the 2008 presidential election they randomly surveyed 840 poor voters and found that 134 of them voted. In the 2010 midterm election they randomly surveyed 710 poor voters and found that 92 voted. Use this information to answer the following questions:

   (a) Find the sample proportions $\hat{p_1}$ and $\hat{p_2}$:

   $$\hat{p}_1 = \frac{134}{840} \approx 0.160 \qquad \hat{p}_2 = \frac{92}{710} \approx 0.130$$

   (b) Find $\hat{p}$:

   $$\hat{p} = \frac{134 + 92}{840 + 710} = \frac{226}{1550} \approx 0.146$$

   (c) Recall that $D = \hat{p}_1 - \hat{p}_2$. ~~Use the previous part to~~ Find the standard error SE_D.

   $$SE_D = \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}} \approx 0.0178$$

   (d) Give a 95% confidence estimate for the difference in poor voter participation from presidential elections to midterm elections.

   The correct z^* value to use for a 95% confidence is 1.96, so the margin of error is $m = z^* SE_D \approx 0.0350$. So we estimate with 95% confidence that the difference in voter participation is in the interval $(-0.005, 0.065)$, ie we are 95% confident that there is a -0.5% to 6.5% decrease in the rate of poor voting from presidential elections to midterm elections. (The slightly negative value means it would be possible - albeit unlikely - that the rate was actually high in the midterm elections).

8. A random survey was conducted to determine if the unemployment rate is lower among people with college degrees than people without college degrees. The results are summarized in the table below:

	No degree	College degree
Unemployed	16	12
Employed	94	118

(a) State the null hypothesis.

There is no relationship between having a college degree and being employed.

(b) What are the expected values? You do not have to show work on this part.

	No degree	College degree
Unemployed	12.8	15.2
Employed	97.2	114.8

9. The national rate of leukemia is 7.8 cases per 100,000, with a standard deviation of 2.2 cases. In a particular town there are 13.1 cases per 100,000 people. Is this statistically significantly higher than the national average at a significance level $\alpha = 0.01$?

Let μ be the true rate of leukemia in this particular town. Our hypotheses are:

$$H_0 : \mu = 7.8$$

$$H_a : \mu > 7.8$$

We write down a test statistic and compute $P = P(Z \geq z)$ for the one sided alternative.

$$z = \frac{\mu - x_0}{\sigma} = \frac{13.1 - 7.8}{2.2} \approx 2.41$$

and $P(Z \geq 2.41) \approx 0.0080$. Since $P < 0.01$ the difference is statistically significance at a level of 0.01.

10. When you are trying to use statistics to solve a problem, what is the difference between $\sigma_{\overline{x}}$ and $SE_{\overline{x}}$? **Do not just repeat the definitions**, explain what these two ideas mean and how they are different.

$\sigma_{\overline{x}}$ is the standard deviation of the average of n samples drawn from a normally distributed population with a known standard deviation σ. $SE_{\overline{x}}$ is the standard error of a measurement of n samples drawn from a population with unknown standard deviation. $\sigma_{\overline{x}}$ is a theoretical number, whereas $SE_{\overline{x}}$ is a random variable which we can measure (if you don't want to use the words 'random variable' in your answer, another way to describe this would be to say that the standard error depends on which particular sample you drew, and different samples will produce different values for the standard error, whereas the standard deviation is unchanging). The standard error approximates the standard deviation, and can be used in some formulas that require $\sigma_{\overline{x}}$ (though care should be taken to remember that the standard error is not normally distributed).