1. Don’t EVEN open this until you are told to do so.

2. There are 20 multiple-choice questions on this exam, each worth 5 points. There is partial credit. Please mark your answers clearly on the scantron. Multiple marks will be counted wrong.

3. You will have 60 minutes to finish this exam.

4. If you are caught cheating or helping someone to cheat on this exam, you both will receive a grade of zero on the exam. You must work alone.

5. This exam is worth 100 points, and will constitute 20% of your final grade.

6. Good luck!
1. If you know that a hypothesis test is statistically significant, you also know
   A. the p-value is greater than $\alpha$.
   B. the null hypothesis is rejected.
   C. the alternative hypothesis is proven true.
   D. All of the above are correct.
   E. Only two of A, B and C are correct.

2. In which of the following is the sample proportion, $p$, NOT approximately normally distributed?
   A. $n = 30, \pi = 0.75$
   B. $n = 50, \pi = 0.80$
   C. $n = 25, \pi = 0.50$
   D. $n = 30, \pi = 0.40$
   E. $p$ would be approximately normally in all of the situations above.

3. Why do we need the distribution of our sample statistic to be normally distributed?
   A. We don’t have to have them be normally distributed. We just need to know what the distribution is.
   B. so we can find probabilities and percentiles
   C. so we can create confidence intervals
   D. All of the above
   E. Only two of the above.

4. What are the correct $z$-scores (critical values) to use for a 48% confidence interval for the true population proportion, $\pi$?
   A. 0.48 and 0.52
   B. $\pm 0.48$
   C. $\pm 0.6844$
   D. $\pm 0.05$
   E. $\pm 0.64$

5. Which of the following is the best interpretation of the $p$-value for $H_0 : \mu = 50$ vs. $H_A : \mu < 50$ with $\bar{x} = 48$ and the $p$-value = 0.001.
   A. 0.1% of the time we will reject the null hypothesis.
   B. 0.1% of the time we will get a sample mean, $\bar{x} = 48$ or more, when the true mean, $\mu = 50$.
   C. 0.1% of the time we will get a sample mean, $\bar{x} = 50$ or more, when the true mean, $\mu = 48$.
   D. 0.1% of the time we will get a sample mean, $\bar{x} = 48$ or less, when the true mean, $\mu = 50$.
   E. 0.1% of the time we will get a sample mean, $\bar{x} = 50$ or less, when the true mean, $\mu = 48$.

6. Suppose the sample size in the previous problem was 30 ($p$-value = 0.001). If the sample size had been 50 instead (and the sample mean and standard deviation stayed the same), which of the following would be true?
   A. The sample would be more normal.
   B. The $p$-value would be more normal.
   C. The $p$-value would be larger.
   D. Two of the above are true.
   E. None of the above would be true.

7. Suppose you’re testing $H_0 : \mu = 5$ vs. $H_A : \mu > 5$, you get a sample mean, $\bar{x} = 4$, from a sample of size 25 and you know the population is normal with a standard deviation is 2. What is the correct $p$-value for this test?
   A. You can’t determine it without a computer program (output).
   B. 0.9938
   C. 0.0062
   D. between 0.01 and 0.005 since it’s a $t$-test
   E. 0.6915

8. Let $X \sim N(18, 7^2)$ and $\bar{X}_4$ is the sample mean from a sample of size 4. Which of the following is true?
   A. $P(X > 18) > P(\bar{X}_4 > 18)$
   B. $P(X > 20) > P(\bar{X}_4 > 20)$
   C. $P(X < 20) > P(\bar{X}_4 < 20)$
   D. $P(X < 11) = 2 \times P(\bar{X}_4 < 11)$
   E. None of the above are true statements.
9. What is the purpose of confidence intervals?
   A. They give us a range of plausible values for our sample statistic.
   B. They give us an idea of the size of the effect (e.g., difference between μ₀ and \( \bar{x} \)).
   C. They help us determine whether a statistically significant result has any practical significance.
   D. All of the above are true.
   E. Only two of the above are true.

10. When is 30 not a large enough sample for the sample statistic to be approximately normally distributed?
   A. when the sample has at least one large outlier
   B. when the population sampled is highly skewed
   C. when the population proportion is 70% or more
   D. All of the above are correct answers to the question.
   E. Only 2 of the first 3 are correct answers to the question.

11. If I know that the p-value = 0.043 for the test
    \( H_0 : \mu = 10 \) vs. \( H_A : \mu \neq 10 \), then
    A. I can conclude that the true mean is not 10 at the 5 and 10% significance levels.
    B. I can say the results are statistically significant for any significance level.
    C. I know that 10 would fall in the 90 and 95% confidence intervals created from the same data.
    D. All of the above are true.
    E. Only two of A, B and C are true.

12. Which of the following would give us the MOST power in a hypothesis test?
    A. \( \alpha = 0.01 \) and \( n = 100 \)
    B. \( \alpha = 0.05 \) and \( n = 100 \)
    C. \( \alpha = 0.01 \) and \( n = 50 \)
    D. \( \alpha = 0.10 \) and \( n = 50 \)
    E. \( \alpha = 0.10 \) and \( n = 100 \)

13. What is the 70th percentile of the distribution of sample proportions, \( p \sim N(0.8, 0.04^2) \)?
    A. 0.56, 70% of 0.8
    B. 0.828, 0.8 + 0.70 * 0.04
    C. 0.821, 0.8 + 0.525 * 0.04
    D. 0.830, 0.8 + 0.758 * 0.04
    E. 0.028, 0.70 * 0.04

14. A fast food franchiser is considering building a restaurant in a certain location. Based on financial analyses, a site is acceptable only if the number of pedestrians passing the location averages more than 100 per hour. The number of pedestrians observed for each of forty hours was recorded and had a standard deviation of 12. Which type of statistical test should we employ to decide if the site is acceptable?
    A. Case 10 since this test reduces the variability.
    B. Case 3 since the sample size is large (> 30) and we are testing one mean.
    C. Case 8 since we can assume that the variances are both 12².
    D. Case 9 since we are not told that the variances are equal.
    E. Case 1 since the population standard deviation is known and we are testing one mean.

15. Suppose these three confidence intervals for the population mean, \( \mu \), are the only information you have for testing
    \( H_0 : \mu = 220 \) vs. \( H_A : \mu \neq 220 \). What is the range of the p-value for this test?
    A. p-value > 0.10
    B. 0.10 > p-value > 0.05
    C. 0.05 > p-value > 0.01
    D. p-value < 0.01
    E. It’s impossible to tell without the test.

16. The 95% confidence interval for \( \mu \) in the previous problem is (158.1, 212.5). Which of the following is the best interpretation of this interval?
    A. 95% of the time an interval like this (using the same calculations, sampling method and population) will contain 220.
    B. 95% of the time an interval like this (using the same calculations, sampling method and population) will contain \( \mu \), the true population mean.
    C. The probability of this interval containing the true mean, \( \mu \), is 95%.
    D. 95% of the time an interval like this (using the same calculations, sampling method and population) will contain the values from 158.1 to 212.5.
    E. Two of the above are true.
17. How large of a sample do you need to make the standard deviation of the sample mean, $\overline{X}$, a fourth the size of the population standard deviation?

A. 4 times the size of the population  
B. 16 times the size of the population  
C. 16  
D. 4  
E. 2 times the size of the population

18. Suppose $\overline{X}_{49} - \overline{Y}_{64} \sim N(-8, 12.26^2)$. How likely is $\overline{Y}_{64}$ to be greater than $\overline{X}_{49}$?

A. 0.6525  
B. 0.39  
C. 0.7422  
D. 0.2578  
E. 0.3475

19. Which of the following best describes the Central Limit Theorem?

A. As long as we take a large enough random sample from a population with a finite mean and standard deviation, the distribution of the sample will be approximately normally distributed.  
B. As long as we take a large enough random sample from a population with a finite mean and standard deviation, the distribution of the sample mean will be approximately normally distributed.  
C. As long as we take a large enough random sample from a population with a finite mean and standard deviation, the distribution of the population mean will be approximately normally distributed.  
D. As long as we take a large enough random sample from a population with a finite mean and standard deviation, the mean of the sample means will be the mean of the population.  
E. You must have a computer (output) to know what the $p$-value is.

20. Which of the following is TRUE?

A. The smaller the $p$-value, the stronger the evidence against the null hypothesis.  
B. The smaller the $p$-value, the more likely the result has practical significance.  
C. The smaller the $p$-value, the wider a confidence interval from the same data.  
D. All of the above are true.  
E. None of the above are true.

21. If you’re testing $H_0 : \mu_1 = \mu_2$ vs. $H_A : \mu_1 \neq \mu_2$ and the first sample size is $n_1 = 20$ and the second is $n_2 = 12$, both from normal populations, what is the correct $p$-value if the test statistic is 2.05?

A. 0.10 > $p$-value > 0.05  
B. 0.05 > $p$-value > 0.04  
C. 0.05 > $p$-value > 0.025  
D. 0.025 > $p$-value > 0.02  
E. You must have a computer (output) to know what the $p$-value is.