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

2. Be sure to write your instructor’s name in the space provided and your name beneath.

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

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

5. 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.

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

7. Good luck!
1. The sampling distribution of a statistic is
   A. the probability that we obtain the statistic in repeated random samples.
   B. the mechanism that determines whether randomization was effective.
   C. the distribution of values of a statistic in all possible samples of the same size from the same population.
   D. the extent to which the sample results differ systematically from the truth (the population parameter).
   E. the probability that we obtain a particular value for a statistic in repeated samples.

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<th>n</th>
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2. Three confidence intervals based on the same data are given above. What is the correct range of the p-value for testing $H_0 : \mu = 15.75$ vs. $H_A : \mu \neq 15.75$?
   A. $p$-value $> 0.10$
   B. $0.10 > p$-value $> 0.05$
   C. $0.05 > p$-value $> 0.01$
   D. $0.01 > p$-value
   E. The sample mean is 11, not 11.8, so we can’t use this information.

3. The area between $-2.3$ and $1.6$ on the standard normal curve, $Z \sim N(0, 1^2)$ is
   A. 0.7
   B. 0.9345
   C. 0.9559
   D. 0.0655
   E. 0.9452

4. A researcher wishes to determine if students are able to complete a maze, on paper, more quickly while listening to classical music. Suppose the time (in secs) to complete the maze without classical music follows a normal distribution with mean 40 and standard deviation 4, so he tests $H_0 : \mu = 40$ vs. $H_A : \mu < 40$. Assuming that the standard deviation is the same with music, he takes a sample of 10,000 students, he gets a mean of 40.2. What should he conclude?
   A. The sample contradicts his alternative hypothesis, so the true mean must be the same, with or without music.
   B. The sample contradicts his alternative hypothesis, so the true mean with music must be more than without music.
   C. The sample contradicts his alternative hypothesis, so the true mean with music must be less than without music.
   D. The sample contradicts his alternative hypothesis, so there’s no way he can prove the true mean with music is less than without music with this sample.
   E. There is really no practical difference between 40 secs and 40.2, so he can’t prove anything.

5. A noted psychic was tested for ESP. The psychic was presented with 200 cards face down and asked to determine if each card was one of five symbols: a star, cross, circle, square or three wavy lines. The psychic was correct in 50 cases. Let $\pi$ be the true probability that the psychic correctly identifies the symbol on the card in a random trial. Suppose you wished to see if there was evidence that the psychic is doing better than just guessing, which is 1 out of 5 correct. Which set of hypotheses would you have tested?
   A. $H_0 : \pi = 0.25$ vs. $H_A : \pi > 0.25$
   B. $H_0 : \pi = 0.20$ vs. $H_A : \pi > 0.20$
   C. $H_0 : \mu = 50$ vs. $H_A : \mu > 50$
   D. $H_0 : \pi = 0.20$ vs. $H_A : \pi \neq 0.20$
   E. $H_0 : \mu = 40$ vs. $H_A : \mu > 40$

6. What does ‘a 10% chance of rain today’ really mean, i.e., what does it mean to say the probability of rain today is 0.10?
   A. It means that it will rain in 10% of the area with that forecast.
   B. It means that it will rain 10% of the time today.
   C. It means that it will rain 10% of the time for days like today.
   D. It means that 10% of the total rain for the year will fall today.
   E. No, no, no! It ALWAYS rains when you have to go to class, like on test days.
7. Which of the following is true about probability?
   A. Every probability must be positive, but less than 1 (100%).
   B. The probability that an event will occur is the sample proportion of times the event will occur out of several repetitions of the experiment.
   C. Just because we know the exact probability that an event will occur doesn’t mean we know what will happen next.
   D. All of the above are true.
   E. Only two of the above are true.

8. Which of the following is the strongest indicator that our sample data is not normal?
   A. The mean and median are almost the same value, but not exactly.
   B. The histogram of our sample data is slightly skewed.
   C. The sample standard deviation is quite large.
   D. The stemplot of our sample data has a very large outlier.
   E. Any of the above would indicate that our data is not normal.

9. When testing a statistical hypothesis, we fail to reject \( H_0 \) at the 5% level if
   A. \( H_0 \) is true.
   B. we fail to reject at the 1% level.
   C. the sample would happen less than 5% of the time when \( H_0 \) was true.
   D. All of the above are true.
   E. Only two of the above are true.

10. The distribution of actual weights of 8 oz. chocolate bars produced by a certain machine is normal with a mean of 8.1 oz. and a standard deviation of 0.1 oz., so \( X \sim N(8.1, 0.1^2) \). What weight should be put on the chocolate bar wrappers so that only 1% (0.0100) of the bars are underweight?
    A. 8.1 oz.
    B. 8.333 oz.
    C. 8.233 oz.
    D. 7.77 oz.
    E. 7.87 oz.

11. What is the expected average weight for a box of 24 chocolate bars? Use the distribution in the previous problem.
    A. 8 oz.
    B. 192 oz.
    C. 8.1 oz.
    D. 194.4 oz.
    E. 24 oz.

12. Still using the same population, \( X \sim N(8.1, 0.1^2) \), how likely are you to get a chocolate bar weighing at least 8.25 oz.?
    A. 0.0668
    B. at least once in every 3 bars
    C. 0% of the time, never
    D. 100% of the time
    E. 0.9332

13. Which of the following is FALSE?
    A. A p-value is the smallest significance level at which \( H_0 \) can be rejected.
    B. A p-value is a measure of the strength of the evidence against the null hypothesis.
    C. A p-value is the probability that the null hypothesis is rejected.
    D. A p-value can be used to perform a test of hypotheses at any significance level.
    E. All of the above are true.

14. Suppose the Battalion interviewed a random sample of students and asked them if they feel there is adequate student parking on campus. 20 of the 25 interviewed said “no way!” Which of the following is true?
    A. If the true proportion, \( \pi = 0.80 \), we could NOT use the normal approximation for the sample proportion, \( p \).
    B. If the true proportion, \( \pi = 0.80 \), we could use the normal approximation for the sample proportion, \( p \).
    C. The sample is biased since we know there is not enough parking.
    D. Both A. and C. are correct.
    E. Both B. and C. are correct.
15. Suppose the sample proportion of 100 students who think there is insufficient parking is normally distributed, $p \sim N(0.8, 0.04^2)$. How often would we get a sample proportion of 75% or less?

A. about 89%
B. never, since it’s more than 12 sd’s from the mean
C. about half of the time since 75% is close to 80%
D. about 75% of the time
E. about 11% of the time

16. Let’s say we wanted to test whether the true proportion was really over 75%, $H_0 : \pi = 0.75$ vs. $H_A : \pi > 0.75$. Which of the following would be a Type I error?

A. We claim the true proportion is 75% when it’s actually 80%.
B. We claim the true proportion is 80% when it’s actually 75%.
C. We claim the true proportion is more than 75% when it’s actually 75%.
D. We claim the true proportion is 75% when it’s actually more than 75%.
E. We claim the true proportion is 80% when it’s actually more than 80%.

17. The power of a test is

A. the probability that $H_0$ is rejected.
B. the probability that $H_0$ is false.
C. how often we correctly reject $H_0$.
D. a measure of how strong the evidence against $H_0$ is.
E. how often we make the correct decision.

18. Suppose I created a 95% confidence interval for the true class average on this test and got (68.9, 81.1). Which of the following statements are valid for this data?

A. At least 95% of the class will pass since the entire interval is above 60.
B. The sample mean for this sample is 75.
C. The probability that anyone in the class gets between a 69 and 81 is about 95%.
D. All of the above are true.
E. Only two of the above are true.

19. For categorical data, we can use the count, $X$, or the sample proportion, $p$. Why do we prefer to use $p$ rather than $X$?

A. It’s easier to calculate.
B. It’s mean is $\pi$.
C. It varies less than $X$.
D. It doesn’t matter since we can estimate the true proportion, $\pi$, with either.
E. None of the above are correct.

20. Why is the $p$-value for a test of hypotheses more informative than just stating whether we reject or fail to reject the null?

A. It gets smaller if we increase the sample size.
B. It tells us exactly how much evidence we have against the null.
C. It is a probability, not a decision.
D. It uses all of the information where the decision only looks at the $\alpha$-level.
E. It’s not; they give the same information.

21. BONUS: (Remember HW#3!!!) A simple random sample of 50 students at Johns Hopkins University found that 60% of those sampled felt that drinking was a problem among college students. Another SRS of 50 students from Ohio State found that 65% felt drinking was a problem. There are about 2000 students at JHU and 40,000 at OSU. Which of the following is true?

A. The sample from JHU has much less sampling variability than that from OSU since the population is so much smaller.
B. The sample from JHU has much more sampling variability than that from OSU since the population is so much smaller.
C. The sample from JHU has much less sampling variability than that from OSU since less students think that drinking is a problem.
D. The sample from JHU has about the same sampling variability than that from OSU since the samples are the same size.
E. The sample from JHU has about the same sampling variability than that from OSU since opinions are about the same.