Math 247: Test 3 100 points (3 pts per problem)

Instructions:

- Fill out the provided form with your answers. (or write down the problem numbers and fill in your answers. You do NOT have to handcopy the test or print it out!
- I encourage you to work with other people in the class (virtually, of course…social distance!) but please do not ask anyone to solve the problems for you.
- **You are allowed to (and will need to) use StatCrunch.**
- Your answer sheet is due on Tuesday, 4/21/20, by midnight. Instructions on how to send it are on the website page with the test link.
- ***Suggestion****: Save your work for these problems so you can refer to it later to ask questions about the answers or scoring!*

1. Given IQ scores are approximately normally distributed with a mean of 100 and standard deviation of 15, the proportion of people with IQs above 130 is:

   a. 95% b. 68% c. 5% d. 2.5%

2. The ACT test results from 2010 has scores that are normally distributed, with a mean of 18 and standard deviation of 6. Determine the proportion of students with a score of 33 or higher.

   a. 0.0062 b. 0.0109 c. 0.0124 d. 0.0217

3. A random sample of 20 ACT scores from 2010 is listed below. Use StatCrunch to calculate the sample mean and standard deviation. Then choose the correct mean, SD values below.

   29, 26, 13, 23, 23, 25, 17, 22, 17, 19, 12, 26, 30, 30, 18, 14, 12, 26, 17, 18

   a. 20.50, 5.79 b. 20.50, 5.94 c. 20.85, 5.79 d. 20.85, 5.94

4. Using the data in the previous question, calculate number of scores (in that data set) that are two or more sample standard deviations from the sample mean.

   a. none of the scores b. 1 of the data values c. 2 of the data values d. 3 of the data values

5. The distribution of heights of American women aged 18 to 24 is approximately normally distributed with a mean of 65.5 inches and standard deviation of 2.5 inches. Calculate the *z*-score for a woman six feet tall.

   a. 2.60 b. 4.11 c. 1.04 d. 1.33

6. The Vitamin C content of a particular brand of vitamin supplement pills is normally distributed with mean 490 mg and standard deviation 12 mg. What is the probability that a randomly selected pill contains at least 500 mg of Vitamin C?

   a) 0.7967 b) 0.8333 c) 0.0525 d) 0.1123 e) 0.2033

7. Molly earned a score of 940 on a national achievement test. The mean test score was 850 with a standard deviation of 100. What is the percentile is Molly's test score at? (Assume that test scores are normally distributed.)

   (a) 18^{th} percentile (b) 82^{nd} percentile (c) 2.563e-18 (d) 60^{th} percentile (e) -12^{th} percentile

8. When asked questions concerning personal hygiene, people commonly lie. This is an example of:

a. sampling bias b. confounding c. non-response bias d. response bias

9. Failing to reject the null hypothesis when it is false is:

a. alpha b. Type I error c. beta d. Type II error

10. A parameter is:

a. a sample characteristic b. a population characteristic

11. The P-value for a right-tailed test is P-value = 0.042. Which of the following is INCORRECT?

a) The P-value for a two-tailed test based on the same sample would be P-value = 0.084
b) The P-value for a left-tailed test based on the same sample would be P-value = 0.042
c) The z-score test statistic is approximately z=1.73
d) We would reject H0 at alpha =0.05, but not at alpha =0.01
e) We would not reject H0 at alpha=0.1

12. A manufacturer of balloons claims that *p*, the proportion of its balloons that burst when inflated to a diameter of up to 12 inches, is no more than 0.05. Some customers have complained that the balloons are bursting more frequently. If the customers want to conduct an experiment to test the manufacturer's claim, which of the following hypotheses would be appropriate?

(a) Ho: $p \neq 0.05$, Ha: $p = 0.05$
(b) Ho: $p = 0.05$, Ha: $p > 0.05$
(c) Ho: $p = 0.05$, Ha: $p \neq 0.05$
(d) Ho: $p = 0.05$, Ha: $p < 0.05$
(e) Ho: $p < 0.05$, Ha: $p = 0.05$

13. Amanda read a report saying that 49% of teachers in the United States were members of a labor union. She wants to test whether this is different for teachers in her state, so she is going to take a random sample of these teachers and see what percent of them are members of a union. Let p represent the proportion of teachers in her state that are members of a union.
Which of the following is an appropriate set of hypotheses for her significance test?

(a) Ho: $p \neq 0.49$, Ha: $p = 0.49$
(b) Ho: $p = 0.49$, Ha: $p > 0.49$
(c) Ho: $p = 0.49$, Ha: $p \neq 0.49$
(d) Ho: $p = 0.49$, Ha: $p < 0.49$
(e) Ho: $p < 0.49$, Ha: $p = 0.49$

14. A consulting statistician reported the results from a learning experiment to a psychologist. The report stated that on one particular phase of the experiment a statistical test result yielded a p-value of 0.24. Based on this p-value, which of the following conclusions should the psychologist make?

(A) The test was statistically significant because a p-value of 0.24 is greater than a significance level of 0.05.
(B) The test was statistically significant because p = 1 – 0.24 = 0.76 and this is greater than a significance level of 0.05.
(C) The test was not statistically significant because 2 times 0.24 = 0.48 and that is less than 0.5.
(D) The test was not statistically significant because, if the null hypothesis is true, one could expect to get a test statistic at least as extreme as that observed 24% of the time.
(E) The test was not statistically significant because, if the null hypothesis is true, one could expect to get a test statistic at least as extreme as that observed 76% of the time.

15. . Suppose that public opinion in a large city is 35 percent against increasing taxes to support the public school system. If a random sample of 500 people from this city are interviewed, what is the approximate probability that more than 200 of these people will be against increasing taxes? Which of the following set-ups would answer the question?

(a) $P\left(z > \frac{0.40 - 0.65}{\sqrt{\frac{(0.65)(0.35)}{500}}}\right)$ (b) $P\left(z > \frac{0.40 - 0.35}{\sqrt{\frac{(0.40)(0.60)}{500}}}\right)$ (c) $P\left(z > \frac{0.40 - 0.35}{\sqrt{\frac{(0.35)(0.65)}{500}}}\right)$

16. As lab partners, Carlos and Ben collected data for a significance test. Both calculated the same *z*-test statistic, but Carlos found the results were significant at the $\alpha = 0.05$ level while Ben found that the results were not. When checking their results, the partners found that the only difference in their work was that Ben used a two-sided test, while Carlos used a one-sided test. Which of the following could have been their test statistic?

(a) −1.980 (b) −1.690 (c) 1.340 (d) 1.690 (e) 1.780

17. A national achievement test is administered annually to 3rd graders. The test has a mean score of 100 and a standard deviation of 15. If Jewel's z-score is 1.20, what was her score on the test?

(a) 82 (b) 88 (c) 100 (d) 112 (e) 118

18. A major metropolitan newspaper selected a simple random sample of 1,600 readers from their list of 100,000 subscribers. They asked whether the paper should increase its coverage of local news. Forty percent of the sample wanted more local news. What is the 99% confidence interval for the proportion of readers who would like more coverage of local news?

(a) 0.30 to 0.50 (b) 0.32 to 0.48 (c) 0.35 to 0.45 (d) 0.37 to 0.43 (e) 0.39 to 0.41

19. A researcher conducted a two-tailed hypothesis test on a set of data and obtained a P-value of .44. If the researcher had conducted a one-tailed test on the same set of data, what would the P-value have been?

(a) .88 (b) .11 (c) .22 (d) 1 (e) 0

20. In hypothesis testing, which of the following statements is always true?

I. The P-value is greater than the significance level.
II. The P-value is the parameter in the null hypothesis.
III. The P-value is a test statistic.
IV. The P-value is a probability.

(a) Only I is true (b) Only II is true (c) Only III is true (d) Only IV is true

21. The Acme Car Company claims that at most 8% of its new cars have a manufacturing defect. A quality control inspector randomly selects 300 new cars and finds that 33 have a defect. Should she reject the 8% claim? Assume that the significance level is 0.05.

(a) Yes, because the P-value is 0.016. (b) Yes, because the P-value is 0.028.

(c) No, because the P-value is 0.16. (d) No, because the P-value is 0.28.

22. A political pollster plans to ask a random sample of 500 voters whether or not they support the incumbent candidate. The pollster will take the results of the sample and construct a 90 percent confidence interval for the true proportion of all voters who support the candidate.

Which of the following is a correct interpretation of the 90% confidence level?
Choose all answers that apply:

(a) There is a 10% chance the pollster will get an "oddball" sample that will create a confidence interval that does NOT include the true proportion of voters who support the candidate.

(b) About 90 percent of people who support the candidate will respond to the poll.

(c) If the pollster repeats this process many times, then about 90 percent of the intervals produced will capture the true proportion of voters who support the candidate.

23. Ezekiel wants to use a one-sample z-confidence interval to estimate the proportion of seniors at his school who have a smartphone. He takes an SRS of 20 of the 100 total seniors and finds that 12 of those sampled have a smartphone.

Which conditions for constructing this confidence interval did Ezekiel's sample NOT meet?
Choose all answers that apply:

(a) The data is a random sample from the population of interest.
(b) The sample is large enough.
(c) The population is sufficiently large.

24. Alena wants to estimate what proportion of computers produced at a factory have a certain defect. A random sample of 200 computers shows that 12 computers have the defect.

Based on this sample, which of the following is the 95%percent confidence interval for the proportion of computers that have the defect?

(A) $12 \pm 1.96\sqrt{\frac{12(188)}{200}}$

(B) $12 \pm 2.576\sqrt{\frac{12(188)}{200}}$

(C) $0.06 \pm 1.96\sqrt{\frac{0.06(0.94)}{200}}$

(D) $0.06 \pm 2.576\sqrt{\frac{0.06(0.94)}{200}}$

25. Gallup is a company that carries out daily opinion polls on a variety of topics. In a recent daily poll of 1,000 randomly selected US adults, 334 said they were engaged at work.

Based on this sample, which of the following is a 90% confidence interval for the proportion of all US adults who would say they are engaged at work?

(a) (0.296, 0.372) (b) (0.305, 0.363) (c) (0.309, 0.359) (d) (0.315,0.353)

26. Ahmad saw a report that claimed percent of US adults think a third major political party is needed. He was curious how students at his large university felt on the topic, so he asked the same question to a random sample of 100 students and made a 95% confidence interval to estimate the proportion of students who agreed that a third major political party was needed. His resulting interval was (0.599, 0.781) Assume that the conditions were all met.

Based on his interval, which is of the following would be a reasonable inference.

(a) Fewer that 57% of all students at his university think a third major party is needed.
(b) More than 57% of all students at his university think a third major party is needed.
(c) Exactly 57% of all students at his university think a third major party is needed.
(d) 95% of all students at his university think a third major party is needed.

27. Ahmad's (see #26) sister, Diedra, was curious how students at her large high school would answer the same question, so she asked it to a random sample of 100 students at her school. She also made a 95% confidence interval to estimate the proportion of students at her school who would agree that a third party is needed. Her interval was (0.557, 0.743). Assume that the conditions for inference were all met.

Based on her interval, which is of the following would be a reasonable inference.

(a) Fewer that 57% of all students at his university think a third major party is needed.
(b) More than 57% of all students at his university think a third major party is needed.
(c) Exactly 57% of all students at his university think a third major party is needed.
(d) We can't exclude 57% as a possibility but can't infer that this is the exact value.

28. The creators of the video game also want players to have a chance at earning a rare item when they defeat a challenging enemy. The creators attempt to program the game so that the rare item is awarded randomly with a 15% probability after the enemy is defeated. To see if the rare item is being awarded as intended, the creators defeated the enemy in a series of 100 attempts (they're willing to treat this as a random sample). After each attempt, they recorded whether or not the rare item was awarded. They used the results to build a 95% confidence interval for p, the proportion of attempts that will be rewarded with the rare item, of 0.12 ± 0.060. **What does this interval suggest?**

(a) The rare item most likely isn't being awarded at the intended rate of 15%.
(b) The rare item is being awarded at the intended rate of exactly 15%.
(c) It's plausible that the rare item is being awarded at the intended rate of 15% percent.

Problems 29 and 30 pertain to this information:

Alessandra designed an experiment where subjects tasted water from four different cups and attempted to identify which cup contained bottled water. Each subject was given three cups that contained regular tap water and one cup that contained bottled water (the order was randomized). She wanted to test if the subjects could do better than simply guessing when identifying the bottled water.

Her hypotheses were $H0{:}p=0.25$ $Ha{:}p>0.25$ (where p is the true likelihood of these subjects identifying the bottled water, 1 in 4 chance).

She randomly chose 60 people to participate in this experiment, and found 20 of the 60 subjects correctly identified the bottle water. Find the P-value using this information and use it to answer the questions below.

29. **What conclusion should be made using a significance level α=0.05 ?**
(a) Fail to reject the null.
(b) Reject the null, accept the alternative.
(c) Accept the null

30. **In context, what does this conclusion say?**

(a) The evidence suggests that, in general, people can do better than guessing when identifying the bottled water.
(b) We don't have enough evidence to say that people, in general, can do better than guessing when identifying the bottled water.
(c) The evidence suggests that these subjects were simply guessing when identifying the bottled water.

Problems 31 and 32 pertain to this information:

Donated blood is tested for infectious diseases and other contaminants. Since most donated blood is safe, workers save time and money by testing batches of donated blood rather than testing individual samples. Workers perform a test to check if a certain toxin is present, and the entire batch is discarded if the toxin is detected. This is similar to using a null and an alternative hypothesis to determine whether to discard the batch. The hypotheses being tested could be stated as:

*H*0: The batch does not contain the toxin.
*H*a: The batch contains the toxin.

31. **Under which of the following conditions would the testers commit a Type II error?**

(a) The batch does not actually contain the toxin, and they conclude it does not.
(b) The batch does not actually contain the toxin, and they conclude it does.
(c) The batch actually contains the toxin, and they conclude it does.
(d) The batch actually contains the toxin, and they conclude it does not.

32. **What would be the consequence of a Type I error in this context?**

(a) The batch is discarded when it actually contains the toxin.
(b) The batch is discarded when it actually doesn't contain the toxin.
(c) The batch is kept when it actually contains the toxin.
(d) The batch is kept when it actually doesn't contain the toxin.

33. A campaign manager for a political candidate released a series of advertisements criticizing the opposing candidate in an upcoming election. The opposing candidate previously had the support of 45% of voters, so the manager wants to test
$H0$: p=0.45 versus Ha: $p < 0.45$ where p is the proportion of voters that support the opposing candidate.
After running the advertisements, the campaign manager obtained a random sample of 500 voters and found that 200 of those sampled supported the opposing candidate.
Which of the following represents the P-value for their test?

(a) $P\left(z < \frac{0.4-0.45}{\sqrt{\frac{0.45(0.55)}{500}}}\right)$

(b) $P\left(z > \frac{0.4-0.45}{\sqrt{\frac{0.45(0.55)}{500}}}\right)$

(c) $P\left(z > \frac{0.4-0.45}{\sqrt{\frac{0.4(0.6)}{500}}}\right)$