MAT 1450

Name:____ W. Cheng

Review for Exam 3

1. A medical researcher treats 400 subjects with high cholesterol with a new drug. The average decrease in cholesterol level is $\bar{x}$ = 90 after two months of taking the drug. Assume that the decrease in cholesterol after two months of taking the drug follows a Normal distribution, with unknown mean μ and standard deviation σ = 30.

   a. Find the 95% confidence interval for μ
   b. Which of the following would produce a confidence interval with a smaller margin of error than the 95% confidence interval you computed above?
      i. Give the drug to only 100 subjects rather than 400, since 100 people are easier to manage and control.
      ii. Give the drug to 500 subjects rather than 400.
      iii. Compute a 99% confidence interval rather than a 95% confidence interval. The increase in confidence indicates that we have a better interval.
      iv. None of the above

Use the following to answer questions 2 and 3.

2. You measure the lifetime of a random sample of 64 tires of a certain brand. The sample mean is $\bar{x}$ = 50 months. Suppose that the lifetimes for tires of this brand follow a normal distribution, with unknown mean μ and standard deviation σ = 5 months. A 95% confidence interval for μ is

3. Suppose I had measured the lifetimes of a random sample of 100 tires rather than 64. Which of the following statements is true?

   a. The margin of error for our 95% confidence interval would increase.
   b. The margin of error for our 95% confidence interval would decrease.
   c. The margin of error for our 95% confidence interval would stay the same since the level of confidence has not changed.
   d. σ would decrease.

4. To assess the accuracy of a laboratory scale, a standard weight known to weigh 1 gram is repeatedly weighed a total of *n* times, and the mean $\bar{x}$ of the weighings is computed. Suppose the scale readings are Normally distributed, with unknown mean *m* and standard deviation σ = 0.01 g. How large should *n* be, so that a 95% confidence interval for *m* has a margin of error of ± 0.0001?

   a. 100 b.196 c. 10,000 d. 38,416

5. In their advertisements, the manufacturers of a certain brand of breakfast cereal would like to claim that eating their oatmeal for breakfast daily will produce a mean decrease in cholesterol of more than 10 points in one month for people with cholesterol levels over 200. In order to determine if this is a valid claim, they hire an independent testing agency, which then selects 25 people with a cholesterol level over 200 to eat their cereal for breakfast daily for a month. The agency should be testing the null hypothesis H_0: $\mu = 10$ and the alternative hypothesis

   a. H_a: $\mu < 10$.
   b. H_a: $\mu > 10$.
   c. H_a: $\mu \neq 10$.
   d. H_a: $\mu \neq 10 \pm \frac{\sigma}{\sqrt{n}}$.

6. Suppose we are testing the null hypothesis H_0: $\mu = 20$ and the alternative H_a: $\mu \neq 20$, for a normal population with $\sigma = 5$. A random sample of 25 observations are drawn from the population, and we find the sample mean of these observations is $\bar{x} = 17.6$. The P-value is closest to

   a. 0.0668.
   b. 0.0082.
   c. 0.0164.
   d. 0.1336.

7. Based on the P-value calculated above, what's the conclusion?

Use the following information to answer Questions 8–12.

The Survey of Study Habits and Attitudes (SSHA) is a psychological test that measures the motivation, attitudes, and study habits of college students. Scores range from 0 to 200 and follow (approximately) a Normal distribution, with mean of 110 and standard deviation $\sigma = 20$. You suspect that incoming freshman have a mean μ, which is different from 110 because they are often excited yet anxious about entering college. To verify your suspicion, you test the hypotheses

H_0: $\mu = 110$, H_a: $\mu \neq 110$. You give the SSHA to 50 students who are incoming freshman and find their mean score.

8. The P-value of the test of the null hypothesis is

   a. the probability, assuming the null hypothesis is true, that the test statistic will take a value at least as extreme as that actually observed.
   b. the probability, assuming the null hypothesis is false, that the test statistic will take a value at least as extreme as that actually observed.
   c. the probability the null hypothesis is true.
   d. the probability the null hypothesis is false.

9. If you observe a sample mean of $\bar{x} = 115.35$, what is the corresponding P-value?

   a. 0.0588
   b. 0.0294
   c. 0.7871
   d. None of the above

10. Does the P-value support the suspicion that the incoming freshmen have a different mean score than 110 if the level of significance is 0.05?

11. Suppose you observed the same sample mean $\bar{x} = 115.35$, but based on a sample of 100 students. What would the corresponding P-value be?

a. 0.0037
b. 0.0074
c. 0.9926
d. None of the above

12. Does the P-value support the suspicion that the incoming freshmen have a different mean score than 110 if the level of significance is 0.05?

13. Suppose the time that it takes a certain large bank to approve a home loan is Normally distributed with mean (in days) μ and standard deviation $\sigma = 1$. The bank advertises that it approve loans in 5 days, on average, but measurements on a random sample of 500 loan applications to this bank gave a mean approval time of $\bar{x} = 5.3$ days. Is this evidence that the mean time to approval is actually longer than advertised? To answer this, test the hypotheses

$$H_0\text{: } \mu = 5, H_a\text{: } \mu > 5$$

at significance level $\alpha = 0.01$. You conclude that

a. H_0 should be rejected.
b. H_0 should not be rejected.
c. H_a should be rejected.
d. there is a 5% chance that the null

14. A radio show conducts a phone-in survey each morning. Listeners are asked to call in with a response to the question of the day. One morning in 2011, listeners were asked if they supported or opposed term limits for members of Congress. Remarkably, 88% of listeners that called in favored term limits. We may safely conclude that

a. there is overwhelming approval for Congressional term limits among Americans generally.
b. it is unlikely that if all Americans were asked their opinion, the results would differ from that obtained in the poll.
c. there is strong evidence that the majority of Americans believe that there should be Congressional term limits.
d. nothing, except that a great majority of those with strong enough feelings on the issue to call in are in favor of Congressional term limits. We cannot generalize any of this survey's results to any larger population.

15. A Type I error is

a. rejecting the null hypothesis when it is true.
b. accepting the null hypothesis when it is false.
c. incorrectly specifying the null hypothesis.
d. incorrectly specifying the alternative hypothesis.

Use the following to answer Questions 16–18.

An SRS of 18 recent birth records at the local hospital was selected. In the sample, the average birth weight was 119.6 ounces and the standard deviation was 6.5 ounces. Assume that in the population of all babies born in this hospital, the birth weights follow a Normal distribution, with mean μ.

16. The standard error of the mean is

a. 6.50.
b. 1.53.
c. 0.36.
d. 0.02.

17. We are interested in a 95% confidence interval for the population mean birth weight. The margin of error associated with the confidence interval is

a. 6.50 ounces.
b. 3.23 ounces.
c. 3.003 ounces.
d. 0.76 ounces.

18. A 95% confidence interval for the population mean birth weight based on these data is

a. 119.6 $\pm$ 3.23 ounces.
b. 119.6 $\pm$ 3.00 ounces.
c. 119.6 $\pm$ 0.76 ounces.
d. 119.6 $\pm$ 6.50 ounces.

Use the following to answer Questions 19–24

A special diet is intended to reduce systolic blood pressure. If the diet is effective, the target is to have the average systolic blood pressure of this group be below 150. After six months on the diet, an SRS of 28 patients with high blood pressure had an average cholesterol of $\bar{x}$ = 143, with standard deviation s = 21. Is this sufficient evidence that the diet is effective in meeting the target? Assume the distribution of the cholesterol for patients in this group is approximately Normal with mean μ.

19. The appropriate hypotheses are

a. H_0: $\mu = 150$, H_a: $\mu > 150$.
b. H_0: $\mu = 150$, H_a: $\mu < 150$.
c. H_0: $\mu = 143$, H_a: $\mu < 143$.
d. H_0: $\mu = 150$, H_a: $\mu \neq 150$.

20. The appropriate degrees of freedom for this test are

a. 27.
b. 28.
c. 20.
d. 149.

21. Based on the data, the value of the one-sample t statistic is

a. 0.33.
b. 1.76.
c. –1.76.
d. –0.33.

22. The P-value for the one-sample t test is

a. larger than 0.10.
b. between 0.10 and 0.05.
c. between 0.025 and 0.05.
d. below 0.025.

23. Suppose the mean and standard deviation obtained were based on a sample of 10 patients, rather than 28. The P-value would be

a. larger.
b. smaller.
c. unchanged, because the difference between $\bar{x}$ and the hypothesized value $\mu = 150$ is unchanged.
d. unchanged, because the variability measured by the standard deviation stays the same.

24. A 95% confidence interval for the average blood pressure of all similar patients who have been on the diet for 6 months is

a. 143 ± 21.
b. 143 ± 7.78.
c. 143 ± 8.14.
d. 143 ± 1.54.

Use the following to answer Questions 25–26.

We wish to see if, on average, traffic is moving at the posted speed limit of 65 miles per hour along a certain stretch of Interstate 70. On each of four randomly selected days, a randomly selected car is timed and the speed of the car is recorded. The observed speeds are 70, 65, 70, and 75 miles per hour. Assuming that speeds are Normally distributed with mean μ, we test whether, on average, traffic is moving at 65 miles per hour, by testing the hypotheses

$$H_0: \mu = 65, H_a: \mu \neq 65.$$

25. Based on the data, the value of the one-sample t statistic is

a. 5.
b. 4.90.
c. 2.45.
d. 1.23.

26. Based on these data,

a. we would reject H_0 at significance level 0.10 but not at 0.05.
b. we would reject H_0 at significance level 0.05 but not at 0.025.
c. we would reject H_0 at significance level 0.025 but not at 0.01.
d. we would reject H_0 at significance level 0.01.

Key:
1a) 90 ± 2.94 1b) ii 2)48.775 to 51.225 months 3)b 4)d 5)b I say C 6)c
7)Reject H_0 if level of significance is 0.05; Not reject H_0 if level of significance is 0.01
8)a 9)a 10)No 11)b 12)yes 13)a 14)d 15)a 16)b 17)b 18)a 19)b 20)a
21)c 22)c 23)a 24)c 25)c 26)a

MAT 1450

Name: Key W. Cheng

Review for Exam 3

1. A medical researcher treats 400 subjects with high cholesterol with a new drug. The average decrease in cholesterol level is $\bar{x}$ = 90 after two months of taking the drug. Assume that the decrease in cholesterol after two months of taking the drug follows a Normal distribution, with unknown mean μ and standard deviation σ = 30.

   z-test on mean error: 2.94

   a. Find the 95% confidence interval for μ $\sigma_{\bar{x}} = 1.5$ $z = 1.96$ $(87.06, 92.94)$
   b. Which of the following would produce a confidence interval with a smaller margin of error than the 95% confidence interval you computed above?
      i. Give the drug to only 100 subjects rather than 400, since 100 people are easier to manage and control. No
      ii. Give the drug to 500 subjects rather than 400. Yes
      iii. Compute a 99% confidence interval rather than a 95% confidence interval. The increase in confidence indicates that we have a better interval. NO
      iv. None of the above

Use the following to answer questions 2 and 3.

2. You measure the lifetime of a random sample of 64 tires of a certain brand. The sample mean is $\bar{x}$ = 50 months. Suppose that the lifetimes for tires of this brand follow a normal distribution, with unknown mean μ and standard deviation σ = 5 months. A 95% confidence interval for μ is

   z-test on mean $z = 1.96$ $\sigma_{\bar{x}} = .625$ error = 1.22

   $(48.78, 51.22)$

3. Suppose I had measured the lifetimes of a random sample of 100 tires rather than 64. Which of the following statements is true?
   a. The margin of error for our 95% confidence interval would increase. NO
   b. The margin of error for our 95% confidence interval would decrease. Yes
   c. The margin of error for our 95% confidence interval would stay the same since the level of confidence has not changed. NO
   d. σ would decrease. NO

4. To assess the accuracy of a laboratory scale, a standard weight known to weigh 1 gram is repeatedly weighed a total of *n* times, and the mean $\bar{x}$ of the weighings is computed. Suppose the scale readings are Normally distributed, with unknown mean *m* and standard deviation σ = 0.01 g. How large should *n* be, so that a 95% confidence interval for *m* has a margin of error of ± 0.0001?

   a. 100 b. 196 c. 10,000 d. 38,416

   $\text{stat} \pm \underbrace{z(\text{SD of Stat})}_{\text{error}}$

   $\text{error} = z(\text{St. of } \bar{x}) \longrightarrow \frac{\sigma}{\sqrt{n}}$

   $.0001 = 1.96\left(\frac{.01}{\sqrt{n}}\right)$

   $\frac{.0001}{1} = \frac{.0196}{\sqrt{n}}$

   $196 = \sqrt{n}$ $\boxed{38416}$

5. In their advertisements, the manufacturers of a certain brand of breakfast cereal would like to claim that eating their oatmeal for breakfast daily will produce a mean decrease in cholesterol of more than 10 points in one month for people with cholesterol levels over 200. In order to determine if this is a valid claim, they hire an independent testing agency, which then selects 25 people with a cholesterol level over 200 to eat their cereal for breakfast daily for a month. The agency should be testing the null hypothesis H_0: $\mu = 10$ and the alternative hypothesis

a. H_a: $\mu < 10$.
b. H_a: $\mu > 10$.
c. H_a: $\mu \neq 10$.
d. H_a: $\mu \neq 10 \pm \frac{\sigma}{\sqrt{n}}$.

6. Suppose we are testing the null hypothesis H_0: $\mu = 20$ and the alternative H_a: $\mu \neq 20$, for a normal population with $\sigma = 5$. A random sample of 25 observations are drawn from the population, and we find the sample mean of these observations is $\bar{x} = 17.6$. The P-value is closest to

a. 0.0668.
b. 0.0082.
c. 0.0164.
d. 0.1336.

Z-Test on Mean $\sigma_{\bar{x}} = 1$ $Z = -2.4$

P-value: .016

7. Based on the P-value calculated above, what's the conclusion? $\alpha = .05$ Reject Ho because $.0164 < .05$

Use the following information to answer Questions 8–12.

The Survey of Study Habits and Attitudes (SSHA) is a psychological test that measures the motivation, attitudes, and study habits of college students. Scores range from 0 to 200 and follow (approximately) a Normal distribution, with mean of 110 and standard deviation $\sigma = 20$. You suspect that incoming freshman have a mean μ, which is different from 110 because they are often excited yet anxious about entering college. To verify your suspicion, you test the hypotheses

H_0: $\mu = 110$, H_a: $\mu \neq 110$. You give the SSHA to 50 students who are incoming freshman and find their mean score.

8. The P-value of the test of the null hypothesis is

a. the probability, assuming the null hypothesis is true, that the test statistic will take a value at least as extreme as that actually observed.
b. the probability, assuming the null hypothesis is false, that the test statistic will take a value at least as extreme as that actually observed.
c. the probability the null hypothesis is true.
d. the probability the null hypothesis is false.

9. If you observe a sample mean of $\bar{x} = 115.35$, what is the corresponding P-value?

a. 0.0588
b. 0.0294
c. 0.7871
d. None of the above

Z-Test on Mean

$\sigma_{\bar{x}} = 2.82$

$Z = 1.89$ $p = .06$

10. Does the P-value support the suspicion that the incoming freshmen have a different mean score than 110 if the level of significance is 0.05?

Fail to Reject Ho

$.06 > .05$

11. Suppose you observed the same sample mean $\bar{x} = 115.35$, but based on a sample of 100 students. What would the corresponding *P*-value be?

a. 0.0037
b. 0.0074
c. 0.9926
d. None of the above

12. Does the P-value support the suspicion that the incoming freshmen have a different mean score than 110 if the level of significance is 0.05? Yes Reject Ho .0074 < .05

13. Suppose the time that it takes a certain large bank to approve a home loan is Normally distributed with mean (in days) μ and standard deviation $\sigma = 1$. The bank advertises that it approve loans in 5 days, on average, but measurements on a random sample of 500 loan applications to this bank gave a mean approval time of $\bar{x} = 5.3$ days. Is this evidence that the mean time to approval is actually longer than advertised? To answer this, test the hypotheses z-test on Mean

$$H_0: \mu = 5, H_a: \mu > 5$$

at significance level $\alpha = 0.01$. You conclude that

a. H_0 should be rejected.
b. H_0 should not be rejected.
c. H_a should be rejected.
d. there is a 5% chance that the null

$\sigma_{\bar{x}} = .045$
$z = 6.71$
P-value: $9.9 \times 10^{-12} < .01$

14. A radio show conducts a phone-in survey each morning. Listeners are asked to call in with a response to the question of the day. One morning in 2011, listeners were asked if they supported or opposed term limits for members of Congress. Remarkably, 88% of listeners that called in favored term limits. We may safely conclude that

a. there is overwhelming approval for Congressional term limits among Americans generally.
b. it is unlikely that if all Americans were asked their opinion, the results would differ from that obtained in the poll.
c. there is strong evidence that the majority of Americans believe that there should be Congressional term limits.
d. nothing, except that a great majority of those with strong enough feelings on the issue to call in are in favor of Congressional term limits. We cannot generalize any of this survey's results to any larger population.

15. A Type I error is

a. rejecting the null hypothesis when it is true.
b. accepting the null hypothesis when it is false.
c. incorrectly specifying the null hypothesis.
d. incorrectly specifying the alternative hypothesis.

I : null is true, find false (reject)
II : null is false, fail to reject

Use the following to answer Questions 16–18.

An SRS of 18 recent birth records at the local hospital was selected. In the sample, the average birth weight was 119.6 ounces and the standard deviation was 6.5 ounces. Assume that in the population of all babies born in this hospital, the birth weights follow a Normal distribution, with mean μ.

16. The standard error of the mean is $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{S_x}{\sqrt{n}} = \frac{6.5}{\sqrt{18}}$

a. 6.50.
b. 1.53.
c. 0.36.
d. 0.02.

17. We are interested in a 95% confidence interval for the population mean birth weight. The margin of error associated with the confidence interval is

$\sigma_{\bar{x}} = 1.55$ T = 2.1 error = 3.23

a. 6.50 ounces.
b. 3.23 ounces.
c. 3.003 ounces.
d. 0.76 ounces.

(116.36, 122.83)

18. A 95% confidence interval for the population mean birth weight based on these data is
a. 119.6 ± 3.23 ounces.
b. 119.6 ± 3.00 ounces.
c. 119.6 ± 0.76 ounces.
d. 119.6 ± 6.50 ounces.

Use the following to answer Questions 19–24

A special diet is intended to reduce systolic blood pressure. If the diet is effective, the target is to have the average systolic blood pressure of this group be below 150. After six months on the diet, an SRS of 28 patients with high blood pressure had an average cholesterol of $\bar{x}$ = 143, with standard deviation s = 21. Is this sufficient evidence that the diet is effective in meeting the target? Assume the distribution of the cholesterol for patients in this group is approximately Normal with mean μ.

19. The appropriate hypotheses are
a. H_0: $\mu = 150$, H_a: $\mu > 150$.
b. H_0: $\mu = 150$, H_a: $\mu < 150$.
c. H_0: $\mu = 143$, H_a: $\mu < 143$.
d. H_0: $\mu = 150$, H_a: $\mu \neq 150$.

20. The appropriate degrees of freedom for this test are $n - 1$
a. 27.
b. 28.
c. 20.
d. 149.

21. Based on the data, the value of the one-sample t statistic is
a. 0.33.
b. 1.76.
c. –1.76.
d. –0.33.

22. The P-value for the one-sample t test is p-value = .045
a. larger than 0.10.
b. between 0.10 and 0.05.
c. between 0.025 and 0.05.
d. below 0.025.

23. Suppose the mean and standard deviation obtained were based on a sample of 10 patients, rather than 28. The P-value would be
a. larger.
b. smaller.
c. unchanged, because the difference between $\bar{x}$ and the hypothesized value μ = 150 is unchanged.
d. unchanged, because the variability measured by the standard deviation stays the same.

24. A 95% confidence interval for the average blood pressure of all similar patients who have been on the diet for 6 months is

a. 143 ± 21.
b. 143 ± 7.78.
c. 143 ± 8.14.
d. 143 ± 1.54.

Use the following to answer Questions 25–26.

We wish to see if, on average, traffic is moving at the posted speed limit of 65 miles per hour along a certain stretch of Interstate 70. On each of four randomly selected days, a randomly selected car is timed and the speed of the car is recorded. The observed speeds are 70, 65, 70, and 75 miles per hour. Assuming that speeds are Normally distributed with mean μ, we test whether, on average, traffic is moving at 65 miles per hour, by testing the hypotheses

H_0: $\mu = 65$, H_a: $\mu \neq 65$.

$n=4$
$\bar{x}=70$
$s_x=4.08$
$\sigma_{\bar{x}}=2.04$
$T=2.45$ p-value $=.09$

25. Based on the data, the value of the one-sample t statistic is

a. 5.
b. 4.90.
c. 2.45.
d. 1.23.

26. Based on these data,

a. we would reject H_0 at significance level 0.10 but not at 0.05.
b. we would reject H_0 at significance level 0.05 but not at 0.025.
c. we would reject H_0 at significance level 0.025 but not at 0.01.
d. we would reject H_0 at significance level 0.01.

Key:
1a) 90 ± 2.94 1b) ii 2)48.775 to 51.225 months 3)b 4)d 5)b 6)c
7)Reject H_0 if level of significance is 0.05; Not reject H_0 if level of significance is 0.01
8)a 9)a 10)No 11)b 12)yes 13)a 14)d 15)a 16)b 17)b 18)a 19)b 20)a
21)c 22)c 23)a 24)c 25)c 26)a