Math 52 – Elementary Statistics
Review Chapter 7
Note:
1. Clearly indicate which formulas you use for the problems
2. For testing a claim be sure to indicate the
   a. The hypotheses.
   b. The test statistic
   c. The critical values and regions indicated on a z-dist, t-dist, or chi-square dist.
   (draw a picture!)
   d. Whether we accept or reject the null hypothesis
   e. A conclusion written with respect to the original problem.
   f. Be able to find p-values.

Section 7.2
1. Which of the following is not a valid statement for the null and alternative hypotheses.
   a. $H_0: \mu = 32.1$ versus $H_1: \mu > 32.1$
   b. $H_0: \mu = 32.1$ versus $H_1: \mu > 32.1$
   c. $H_0: \mu = 32.1$ versus $H_1: \mu < 32.1$
   d. $H_0: \mu \geq 32.1$ versus $H_1: \mu \leq 32.1$
   e. None of these.

2. The drug Ziac is used to treat hypertension. In a clinical test, 3.2% of 221 Ziac users experienced dizziness (based on data from Lederle Laboratories). Further tests must be conducted for adverse reactions that occur in at least 5% of treated subjects. Using a 0.01 level of significance, test the claim that fewer than 5% of all Ziac users experienced dizziness. What are the null and alternative hypotheses for this test?
   a. $H_o: p < .05$
   b. $H_o: p = .05$
   c. $H_o: p > .05$
   d. $H_0: p = .05$
   e. None of these.

3. A Type I error is which of the following:
   a. Reject $H_o$ but $H_o$ is in fact true
   b. Reject $H_o$ but $H_o$ is false
   c. Accept $H_o$ and $H_o$ is in fact true
   d. Accept $H_o$ but $H_o$ is in fact false
   e. None of these.

---

Section 7.3
1. Auto insurance companies are beginning to consider raising rates for those who use telephones while driving. The National Consumers Group claims that the problem really isn’t too serious because only 10% of drivers use telephones. The insurance industry conducts a study and finds that among 500 randomly selected drivers, 90 use telephones (based on data from Prevention magazine). At the 0.01 level of significance, test the consumer group’s claim that only 10% of drivers use telephones.
Section 7.4

1. If the z-test statistic for a two-tailed test is \( z = 2.19 \), what is the p-value for this score.
   a. .4857  b. .9714  c. .0143  d. .0286  e. None of these.

2. When 200 convicted embezzlers were randomly selected, the mean length of prison sentence was found to be 22.1 months. The standard deviation for the population is known to be 8.6 months (based on data from the U.S. Department of Justice). Kim Patterson is running for political office on a platform of tougher treatment of convicted criminals. Test her claim that prison terms for convicted embezzlers have a mean of less than 2 years. Use a 0.05 significance level. What is a type II error in this case?

3. A journal article reported that a null hypothesis of \( \mu = 100 \) was rejected (in favor of \( \mu \neq 100 \)) because the p-value was less than 0.01. The sample size was given as 75, and the sample mean was given as 104.165. Find the largest possible standard deviation. (you can round your answer to 2 decimal places)

Section 7.5

1. The skid properties of a snow tire have been tested, and a mean skid distance of 154ft. has been established for standardized conditions. A new, more expensive tire is developed, but tests on a sample of 17 cars yield a mean skid distance of 148ft. with a standard deviation of 12ft. Because the cost involved, the new tires will be purchased only if it can be shown at the .005 significance level that they skid less than the current tires. Based on the sample, Test the claim that the new tires skid less than the old tires, will the new tires be purchased? At this same significance level, what is the maximum skid distance possible for the 17 cars that would cause us to reject the null hypothesis. (that is, what is the longest skid distance that would be in the rejection region) What would be a type I error in this case? A Type II error?

2. The following data are the weights in mg of a certain brand of aspirin: 480, 495, 505, 509, 520, 515, 508, 510. The manufacturer thinks the machine needs to be recalibrated, the mean weight of the aspirin is stated to be 500mg, the manufacturer thinks the mean weight is different. Test the claim that the mean weight is different from 500mg at the 0.01 level of significance. What would be a type I error in this case? What is a type II error in this case? Which error is “better” to make in this case?

Section 7.6

1. If \( H_1: \sigma^2 < 3.4 \), \( n = 20 \) and \( \alpha = 0.05 \), the critical value(s) is(are)
   a. 10.117  b. 8.907  c. 8.907, 32.852  d. 10.117, 30.144  e. None of these.

2. Shown below are birth weights (in kilograms) of male babies born to mothers on a special vitamin supplement (based on data from the New York Department of Health). Test the claim that this sample comes from a population with a standard deviation equal to 0.470 kg, which is the standard deviation for male birth weights in general. Does the vitamin supplement appear to affect the variation among birth weights? Use a .05 significance level. You may assume that the data came from a normally distributed population.

   | 3.73 | 4.37 | 3.73 | 4.33 | 3.39 | 3.68 | 4.68 | 3.52 | 3.02 |
   | 4.09 | 2.47 | 4.13 | 4.47 | 3.22 | 3.43 | 2.54 |     |     |
### Answers Section 7.2

1. Which of the following is **not** a valid statement for the null and alternative hypotheses.
   d. $H_0: \mu \geq 32.1$ versus $H_1: \mu \leq 32.1$

2. The drug Ziac is used to treat hypertension. In a clinical test, 3.2% of 221 Ziac users experienced dizziness (based on data from Lederle Laboratories). Further tests must be conducted for adverse reactions that occur in at least 5% of treated subjects. Using 0.01 level of significance, test the claim that fewer than 5% of all Ziac users experienced dizziness. What are the null and alternative hypotheses for this test?
   d. $H_0: p = 0.05$
   d. $H_1: p < 0.05$

3. A Type I error is which of the following:
   a. Reject $H_0$ but $H_0$ is in fact true

### Answers Section 7.3

1. Auto insurance companies are beginning to consider raising rates for those who use telephones while driving. The National Consumers Group claims that the problem really isn’t too serious because only 10% of drivers use telephones. The insurance industry conducts a study and finds that among 500 randomly selected drivers, 90 use telephones (based on data from Prevention magazine). At the 0.01 level of significance, test the consumer group’s claim that only 10% of drivers use telephones.
   Hypothesis:
   $H_0: p = 0.10$ (claim)
   $H_1: p \neq 0.10$
   Test Statistic: $z = \frac{90 - 0.1}{\sqrt{\frac{0.1(0.9)}{500}}} = 5.96$
   Critical value: $z = -2.575, 2.575$ (be able to draw a picture of the acceptance/rejection regions)
   (the p-value would be between less than 2(.0001) = .0004, it is actually .00000000248)
   Conclusion: Reject $H_0$. The evidence does not support the claim that only 10% of drivers use telephones while driving.

### Answers Section 7.4

1. If the z-test statistic for a two-tailed test is $z = 2.19$, what is the p-value for this score.
   d. $0.0286$

2. When 200 convicted embezzlers were randomly selected, the mean length of prison sentence was found to be 22.1 months. The standard deviation for the population is known to be 8.6 months (based on data from the U.S. Department of Justice) Kim Patterson is running for political office on a platform of tougher treatment of convicted criminals. Test her claim that prison terms for convicted embezzlers have a mean of less than 2 years. Use a 0.05 significance level. What is a type II error in this case?
Hypothesis:
H₀: µ = 24 months
H₁: µ < 24 months (claim)

Test Statistic \[ z = \frac{22.1 - 24}{8.6/\sqrt{200}} = -3.12 \]

Critical value: \( z = -1.645 \) (be able to draw a picture of the acceptance/rejection region)
(the p-value would be less than .0001, it is actually, \( p = .0008908 \))

Conclusion: Reject H₀. The evidence supports the claim that the length of prison sentenced for embezzlers is less than 2 years (or 24 months)
Type II error would be if we accept H₀, that the mean is greater than 24 months when in fact it is less than 24 months. (Accept H₀ when H₀ is false)

3. A journal article reported that a null hypothesis of \( µ = 100 \) was rejected (in favor of \( µ ≠ 100 \)) because the p-value was less than 0.01. The sample size was given as 75, and the sample mean was given as 104.165. Find the largest possible standard deviation.
(you can round your answer to 2 decimal places)
\[ z = 2.575 = \frac{104.165 - 100}{s} \] so \( s = 14.00775 \), so \( s = 14 \)

Answers Section 7.5

1. The skid properties of a snow tire have been tested, and a mean skid distance of 154ft. has been established for standardized conditions. A new, more expensive tire is developed, but tests on a sample of 17 cars yield a mean skid distance of 148ft. with a standard deviation of 12ft. Because the cost involved, the new tires will be purchased only if it can be shown at the .005 significance level that they skid less than the current tires. Based on the sample, test the claim that the new tires will skid less than the old tires, will the new tires be purchased? At this same significance level, what is the maximum skid distance possible for the 17 cars that would cause us to reject the null hypothesis (that is, what is the longest skid distance that would be in the rejection region). What would be a type I error in this case? A Type II error?

Hypothesis:
H₀: \( µ = 154 \)
H₁: \( µ < 154 \) (claim)

Test Statistic \[ t = \frac{148 - 154}{12/\sqrt{17}} = -2.06 \]

Critical value: \( t = -2.921 \) (be able to draw a picture of the acceptance/rejection region)
(the p-value would be between .025 and .05, it is actually, \( p = .02794 \))

Conclusion: Accept H₀. The evidence suggests that the mean skid is greater than or equal to 154 feet, this suggests we should stay with the old tires. The evidence does not support the claim that the new tires skid less than the old and it would be wise to stay with the old tires.
The maximum skid for a group of 17 cars that would still cause us to reject $H_0$ would be found by solving
\[
\frac{\bar{x} - 154}{12/\sqrt{17}} = -2.921 \quad \text{for } \bar{x}.
\]
You should get $\bar{x} = 145.4986413$, we would reject $H_0$ for this exact value and anything smaller.

Type I error would be if we reject $H_0$ when $H_0$ is in fact true, so here it would mean that we get the new tires because we think that they have a mean skid length that is less than 154 ft., but in fact the mean is really 154 or greater (so we would be spending more money for tires that may not be worth the cost).

A Type II error would be if we accept $H_0$ when $H_0$ is in fact false, so this would mean that we stay with the old tires but in fact the new more expensive tire is much better and worth the extra money.

2. The following data are the weights in mg of a certain brand of aspirin: 480, 495, 505, 509, 520, 515, 508, 510. The manufacturer thinks the machine needs to be recalibrated, the mean weight of the aspirin is stated to be 500 mg, the manufacturer thinks the mean weight is different. Test the claim that the mean weight is different from 500 mg at the 0.01 level of significance. What would be a type I error in this case? What is a type II error in this case? Which error is “better” to make in this case?

Hypothesis:

$H_0$: $\mu = 500$

$H_1$: $\mu \neq 500$ (claim)

Test Statistic

\[ t = \frac{505.25 - 500}{12.532814^{0.5}} = 1.18 \]

Critical value: $t = -3.500, 3.500$ (be able to draw a picture of the acceptance/rejection region)

(the p-value would be between .20 and .40, it is actually, $p = .2747$)

Conclusion: Accept $H_0$. The evidence does not support the claim that the mean is something other than 500 mg, it does appear to be 500 mg.

Type I error would be if we decided that the aspirin had a mean other than 500 mg, when in fact it really was 500 mg. (so reject $H_0$ when $H_0$ is actually true)

Type II error would be if we decided that the aspirin did have a mean of 500 mg but in fact it was something other than 500 mg. (accept $H_0$ when $H_0$ is false)

Which is worse, well is it better to over or under medicate? Probably safer to under-medicate.

Answers Section 7.6

1. If $H_1: \sigma^2 < 3.4$, $n = 20$ and $\alpha = 0.05$, the critical value(s) is(are) a. 10.117
2. Shown below are birth weights (in kilograms) of male babies born to mothers on a special vitamin supplement (based on data from the New York Department of Health). Test the claim that this sample comes from a population with a standard deviation equal to 0.470 kg, which is the standard deviation for male birth weights in general. Does the vitamin supplement appear to affect the variation among birth weights? Use a .05 significance level. You may assume that the data came from a normally distributed population.

3.73 4.37 3.73 4.33 3.39 3.68 4.68 3.52 3.02
4.09 2.47 4.13 4.47 3.22 3.43 2.54

Hypothesis:
\[ H_0: \sigma = 0.470 \text{ (claim) } \]
\[ H_1: \sigma \neq 0.470 \]

Test Statistic
\[ \chi^2 = \frac{(16 - 1)(.6573177821)^2}{.47^2} = 29.339 \]

Critical value: \[ \chi^2 = 6.262, 27.488 \] (be able to draw a picture of the rejection/acceptance rejection)

Conclusion: Reject \( H_0 \). The evidence does not support the claim, the standard deviation for male birth weights is something other than .47,