

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 001

**Name:** \_\_\_\_\_

This take-home exam is due **Monday, April 29** at the beginning of class.

You may use any notes, textbook, or online tools; however, you may not request help from any other human. If you believe a question is ambiguous, unanswerable, or erroneous, please let me know.

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1. As an ornithologist, you wish to determine the average body mass of *Vireo griseus*. You randomly capture 34 adults of *Vireo griseus*, resulting in a sample mean of 9.9 grams and a sample standard deviation of 0.903 grams. You decide to report a 99% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 7 students who have each taken two quizzes. Perform a two-tail test with significance level 0.04 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6	student7
quiz 1:	50.4	78.9	88.6	59.2	87.7	74	62.8
quiz 2:	49.2	81	92.5	60.6	87.6	79.6	66.8

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 7 cases and a control group with 7 cases. You decide to run a hypothesis test with a significance level of 0.1. Your data is below. Please use 10 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
30	42
54	33
46	24
57	36
61	46
57	65
63	42

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 940 individuals was taken. In that sample, 65.4% were special. Determine a 99.5% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is cold. She also wants to guarantee that the margin of error of a 90% confidence interval will be less than 0.002 (which is 0.2 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.



6. An experiment is run with a treatment group of size 143 and a control group of size 179. The results are summarized in the table below.

	treatment	control
happy	88	131
not happy	55	48

Using a significance level of 0.04, determine whether the treatment causes an effect on the proportion of cases that are happy.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 002

**Name:** \_\_\_\_\_

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1. As an ornithologist, you wish to determine the average body mass of *Icterus spurius*. You randomly capture 32 adults of *Icterus spurius*, resulting in a sample mean of 21.99 grams and a sample standard deviation of 1.96 grams. You decide to report a 99.5% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 7 students who have each taken two quizzes. Perform a two-tail test with significance level 0.1 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6	student7
quiz 1:	53	70.5	71.9	68.1	59.5	88.3	52.6
quiz 2:	47.9	66	69.4	64.9	46.7	89.3	54.4

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 7 cases and a control group with 7 cases. You decide to run a hypothesis test with a significance level of 0.05. Your data is below. Please use 6 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
530	720
510	620
530	550
480	490
510	590
520	700
530	530

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 4900 individuals was taken. In that sample, 15.2% were purple. Determine a 95% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.



5. Your boss wants to know what proportion of a very large population is broken. She also wants to guarantee that the margin of error of a 99.5% confidence interval will be less than 0.007 (which is 0.7 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 24 and a control group of size 21. The results are summarized in the table below.

	treatment	control
folksy	14	8
not folksy	10	13

Using a significance level of 0.2, determine whether the treatment causes an effect on the proportion of cases that are folksy.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 003

**Name:** \_\_\_\_\_

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1. As an ornithologist, you wish to determine the average body mass of *Dendroica coronata*. You randomly capture 13 adults of *Dendroica coronata*, resulting in a sample mean of 11.8 grams and a sample standard deviation of 0.962 grams. You decide to report a 90% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 5 students who have each taken two quizzes. Perform a two-tail test with significance level 0.04 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5
quiz 1:	76.8	78.8	62	55.1	58
quiz 2:	72.8	69.2	56.4	55.3	48.4

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 7 cases and a control group with 7 cases. You decide to run a hypothesis test with a significance level of 0.05. Your data is below. Please use 10 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
107	78
96	84
78	83
81	82
113	83
96	87
86	84

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?



4. From a very large population, a random sample of 12000 individuals was taken. In that sample, 24.9% were bitter. Determine a 98% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is glowing. She also wants to guarantee that the margin of error of a 95% confidence interval will be less than 0.007 (which is 0.7 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 251 and a control group of size 287. The results are summarized in the table below.

	treatment	control
sorry	30	19
not sorry	221	268

Using a significance level of 0.04, determine whether the treatment causes an effect on the proportion of cases that are sorry.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 004

**Name:** \_\_\_\_\_

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1. As an ornithologist, you wish to determine the average body mass of *Vermivora peregrina*. You randomly capture 28 adults of *Vermivora peregrina*, resulting in a sample mean of 12.78 grams and a sample standard deviation of 1.01 grams. You decide to report a 95% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 6 students who have each taken two quizzes. Perform a two-tail test with significance level 0.05 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6
quiz 1:	50.4	83.1	71.6	75.1	63.4	80.9
quiz 2:	46.1	84.4	68.6	64.9	62	75.4

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?



3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 7 cases and a control group with 7 cases. You decide to run a hypothesis test with a significance level of 0.01. Your data is below. Please use 9 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
2.88	2.01
3.04	3.15
2.89	2.19
2.78	2.12
2.7	2.57
2.73	2.04
3.06	2.14

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 41000 individuals was taken. In that sample, 67.2% were floating. Determine a 99.5% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is angry. She also wants to guarantee that the margin of error of a 90% confidence interval will be less than 0.02 (which is 2 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 71 and a control group of size 44. The results are summarized in the table below.

	treatment	control
reclusive	29	30
not reclusive	42	14

Using a significance level of 0.01, determine whether the treatment causes an effect on the proportion of cases that are reclusive.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 005

**Name:** \_\_\_\_\_

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1. As an ornithologist, you wish to determine the average body mass of *Passerina cyanea*. You randomly capture 35 adults of *Passerina cyanea*, resulting in a sample mean of 15.25 grams and a sample standard deviation of 1.93 grams. You decide to report a 99% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.



2. A teacher has 6 students who have each taken two quizzes. Perform a two-tail test with significance level 0.1 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6
quiz 1:	63.5	74.3	62.7	56	70.4	85.9
quiz 2:	63	77.6	65.3	56.1	70.5	87.3

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 7 cases and a control group with 7 cases. You decide to run a hypothesis test with a significance level of 0.01. Your data is below. Please use 7 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
89	92
86	104
83	106
87	87
83	118
84	95
86	94

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 5200 individuals was taken. In that sample, 62.5% were blue. Determine a 98% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is angry. She also wants to guarantee that the margin of error of a 99% confidence interval will be less than 0.02 (which is 2 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 247 and a control group of size 225. The results are summarized in the table below.

	treatment	control
reclusive	122	80
not reclusive	125	145

Using a significance level of 0.005, determine whether the treatment causes an effect on the proportion of cases that are reclusive.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 006

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1. As an ornithologist, you wish to determine the average body mass of *Agelaius Phoeniceus*. You randomly capture 24 adults of *Agelaius Phoeniceus*, resulting in a sample mean of 46.27 grams and a sample standard deviation of 6.72 grams. You decide to report a 99% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 6 students who have each taken two quizzes. Perform a two-tail test with significance level 0.04 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6
quiz 1:	86.1	54.2	60.5	59.8	57	69.8
quiz 2:	87.9	50.4	54.6	52.7	55.6	63

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 7 cases and a control group with 7 cases. You decide to run a hypothesis test with a significance level of 0.01. Your data is below. Please use 11 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
108	124
60	130
92	125
101	103
90	76
82	134
78	132

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 6500 individuals was taken. In that sample, 94.3% were angry. Determine a 96% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is shiny. She also wants to guarantee that the margin of error of a 95% confidence interval will be less than 0.005 (which is 0.5 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 181 and a control group of size 205. The results are summarized in the table below.

	treatment	control
special	134	173
not special	47	32

Using a significance level of 0.02, determine whether the treatment causes an effect on the proportion of cases that are special.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 007

**Name:** \_\_\_\_\_

This take-home exam is due **Monday, April 29** at the beginning of class.

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1. As an ornithologist, you wish to determine the average body mass of *Wilsonia citrina*. You randomly capture 31 adults of *Wilsonia citrina*, resulting in a sample mean of 9.99 grams and a sample standard deviation of 1.88 grams. You decide to report a 95% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 5 students who have each taken two quizzes. Perform a two-tail test with significance level 0.1 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5
quiz 1:	82.6	51	68.8	62.7	63.4
quiz 2:	88.1	62.4	73	59.4	68.5

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 5 cases and a control group with 5 cases. You decide to run a hypothesis test with a significance level of 0.1. Your data is below. Please use 6 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
740	610
1030	990
1280	700
950	940
1010	820

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 5400 individuals was taken. In that sample, 59.8% were asleep. Determine a 90% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is special. She also wants to guarantee that the margin of error of a 99% confidence interval will be less than 0.02 (which is 2 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 19 and a control group of size 41. The results are summarized in the table below.

	treatment	control
happy	5	19
not happy	14	22

Using a significance level of 0.2, determine whether the treatment causes an effect on the proportion of cases that are happy.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 008

**Name:** \_\_\_\_\_

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1. As an ornithologist, you wish to determine the average body mass of *Seiurus aurocapillus*. You randomly capture 23 adults of *Seiurus aurocapillus*, resulting in a sample mean of 23.17 grams and a sample standard deviation of 1.4 grams. You decide to report a 99.5% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 6 students who have each taken two quizzes. Perform a two-tail test with significance level 0.02 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6
quiz 1:	66.5	64	74.6	81.8	69.9	69.5
quiz 2:	65.6	68.5	77.3	84.2	74.6	75.7

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 6 cases and a control group with 6 cases. You decide to run a hypothesis test with a significance level of 0.05. Your data is below. Please use 7 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
580	400
490	510
570	500
550	530
490	330
480	240

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 1200 individuals was taken. In that sample, 46.3% were glowing. Determine a 95% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is messy. She also wants to guarantee that the margin of error of a 99% confidence interval will be less than 0.009 (which is 0.9 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 132 and a control group of size 176. The results are summarized in the table below.

	treatment	control
sick	55	55
not sick	77	121

Using a significance level of 0.1, determine whether the treatment causes an effect on the proportion of cases that are sick.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?



# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 009

**Name:** \_\_\_\_\_

This take-home exam is due **Monday, April 29** at the beginning of class.

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1. As an ornithologist, you wish to determine the average body mass of *Icterus spurius*. You randomly capture 26 adults of *Icterus spurius*, resulting in a sample mean of 21.92 grams and a sample standard deviation of 2.05 grams. You decide to report a 98% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 5 students who have each taken two quizzes. Perform a two-tail test with significance level 0.1 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5
quiz 1:	83.2	85.9	57	61.5	56.3
quiz 2:	80.5	90.1	61.9	64.9	61.1

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 7 cases and a control group with 7 cases. You decide to run a hypothesis test with a significance level of 0.01. Your data is below. Please use 10 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
700	490
720	600
720	660
650	500
700	690
720	630
670	550

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 46000 individuals was taken. In that sample, 24.5% were blue. Determine a 95% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is shiny. She also wants to guarantee that the margin of error of a 96% confidence interval will be less than 0.01 (which is 1 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.



6. An experiment is run with a treatment group of size 258 and a control group of size 216. The results are summarized in the table below.

	treatment	control
green	45	28
not green	213	188

Using a significance level of 0.2, determine whether the treatment causes an effect on the proportion of cases that are green.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 010

**Name:** \_\_\_\_\_

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1. As an ornithologist, you wish to determine the average body mass of *Dendroica pensylvanica*. You randomly capture 28 adults of *Dendroica pensylvanica*, resulting in a sample mean of 12.77 grams and a sample standard deviation of 1.26 grams. You decide to report a 80% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 6 students who have each taken two quizzes. Perform a two-tail test with significance level 0.02 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6
quiz 1:	54.8	54.9	73.8	71.4	80.4	55
quiz 2:	49.4	52	68.5	64.8	74.7	56.5

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 5 cases and a control group with 5 cases. You decide to run a hypothesis test with a significance level of 0.1. Your data is below. Please use 5 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
85	83
94	79
80	82
126	82
91	74

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 49000 individuals was taken. In that sample, 98.9% were bitter. Determine a 80% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.



5. Your boss wants to know what proportion of a very large population is sweet. She also wants to guarantee that the margin of error of a 80% confidence interval will be less than 0.002 (which is 0.2 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 254 and a control group of size 259. The results are summarized in the table below.

	treatment	control
sick	155	190
not sick	99	69

Using a significance level of 0.005, determine whether the treatment causes an effect on the proportion of cases that are sick.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 011

**Name:** \_\_\_\_\_

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1. As an ornithologist, you wish to determine the average body mass of *Seiurus noveboracensis*. You randomly capture 31 adults of *Seiurus noveboracensis*, resulting in a sample mean of 19.63 grams and a sample standard deviation of 3.26 grams. You decide to report a 98% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 6 students who have each taken two quizzes. Perform a two-tail test with significance level 0.04 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6
quiz 1:	61.6	62.3	84.1	73.6	69.8	83.4
quiz 2:	67.9	60.5	89.3	78.7	74.6	84.2

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 6 cases and a control group with 6 cases. You decide to run a hypothesis test with a significance level of 0.1. Your data is below. Please use 8 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
2.93	4.41
3.5	3.44
2.57	3.12
2.6	2.72
3.03	3.7
3.03	3.75

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?



4. From a very large population, a random sample of 570 individuals was taken. In that sample, 47% were special. Determine a 95% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is bitter. She also wants to guarantee that the margin of error of a 99.5% confidence interval will be less than 0.008 (which is 0.8 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 72 and a control group of size 70. The results are summarized in the table below.

	treatment	control
green	40	22
not green	32	48

Using a significance level of 0.005, determine whether the treatment causes an effect on the proportion of cases that are green.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 012

**Name:** \_\_\_\_\_

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1. As an ornithologist, you wish to determine the average body mass of *Vireo philadelphicus*. You randomly capture 35 adults of *Vireo philadelphicus*, resulting in a sample mean of 13.36 grams and a sample standard deviation of 1.92 grams. You decide to report a 90% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 6 students who have each taken two quizzes. Perform a two-tail test with significance level 0.05 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6
quiz 1:	84.6	82.4	89.8	63.3	64.8	50.4
quiz 2:	90.1	81.8	89.6	67.9	69.4	53.5

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?



3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 6 cases and a control group with 6 cases. You decide to run a hypothesis test with a significance level of 0.02. Your data is below. Please use 9 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
12.6	11.6
15.6	11.5
14.8	11
16.3	12.5
12.4	11.2
11.6	8.1

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 8500 individuals was taken. In that sample, 93.4% were messy. Determine a 99% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is happy. She also wants to guarantee that the margin of error of a 99% confidence interval will be less than 0.03 (which is 3 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 138 and a control group of size 186. The results are summarized in the table below.

	treatment	control
sick	128	151
not sick	10	35

Using a significance level of 0.005, determine whether the treatment causes an effect on the proportion of cases that are sick.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 013

**Name:** \_\_\_\_\_

This take-home exam is due **Monday, April 29** at the beginning of class.

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1. As an ornithologist, you wish to determine the average body mass of *Hylocichla mustelina*. You randomly capture 27 adults of *Hylocichla mustelina*, resulting in a sample mean of 55.53 grams and a sample standard deviation of 7.22 grams. You decide to report a 80% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.



2. A teacher has 6 students who have each taken two quizzes. Perform a two-tail test with significance level 0.1 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6
quiz 1:	57.3	66.2	58.3	55.3	59.6	71.5
quiz 2:	54.1	64.6	53.1	55.6	60.1	69.8

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 7 cases and a control group with 7 cases. You decide to run a hypothesis test with a significance level of 0.05. Your data is below. Please use 7 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
270	410
360	420
270	450
500	420
370	420
350	390
320	380

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 910 individuals was taken. In that sample, 58.4% were bitter. Determine a 96% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is floating. She also wants to guarantee that the margin of error of a 95% confidence interval will be less than 0.05 (which is 5 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 243 and a control group of size 195. The results are summarized in the table below.

	treatment	control
angry	31	43
not angry	212	152

Using a significance level of 0.02, determine whether the treatment causes an effect on the proportion of cases that are angry.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 014

**Name:** \_\_\_\_\_

This take-home exam is due **Monday, April 29** at the beginning of class.

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1. As an ornithologist, you wish to determine the average body mass of *Oporornis formosus*. You randomly capture 22 adults of *Oporornis formosus*, resulting in a sample mean of 15.92 grams and a sample standard deviation of 3.01 grams. You decide to report a 90% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 5 students who have each taken two quizzes. Perform a two-tail test with significance level 0.05 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5
quiz 1:	66.3	53.5	64.2	70.3	60.3
quiz 2:	68.6	61	68.6	69.9	66.7

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 5 cases and a control group with 5 cases. You decide to run a hypothesis test with a significance level of 0.04. Your data is below. Please use 7 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
600	540
550	510
580	520
680	550
570	560

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 850 individuals was taken. In that sample, 76% were tasty. Determine a 90% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is frigid. She also wants to guarantee that the margin of error of a 96% confidence interval will be less than 0.008 (which is 0.8 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 233 and a control group of size 213. The results are summarized in the table below.

	treatment	control
omnivorous	206	201
not omnivorous	27	12

Using a significance level of 0.04, determine whether the treatment causes an effect on the proportion of cases that are omnivorous.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 015

**Name:** \_\_\_\_\_

This take-home exam is due **Monday, April 29** at the beginning of class.

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1. As an ornithologist, you wish to determine the average body mass of *Dendroica castanea*. You randomly capture 35 adults of *Dendroica castanea*, resulting in a sample mean of 15.03 grams and a sample standard deviation of 1.41 grams. You decide to report a 90% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 6 students who have each taken two quizzes. Perform a two-tail test with significance level 0.1 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6
quiz 1:	85	83.7	73.3	76.2	51.4	60.6
quiz 2:	85.5	84.1	71.2	70.4	49.4	58.6

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 7 cases and a control group with 7 cases. You decide to run a hypothesis test with a significance level of 0.1. Your data is below. Please use 9 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
4.3	6
7.3	3
6.1	4.1
6.3	5.6
6.4	6.9
7.7	5.7
7.3	5.8

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 97000 individuals was taken. In that sample, 80.8% were messy. Determine a 95% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is cold. She also wants to guarantee that the margin of error of a 99.5% confidence interval will be less than 0.04 (which is 4 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 111 and a control group of size 106. The results are summarized in the table below.

	treatment	control
special	64	75
not special	47	31

Using a significance level of 0.1, determine whether the treatment causes an effect on the proportion of cases that are special.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 016

**Name:** \_\_\_\_\_

This take-home exam is due **Monday, April 29** at the beginning of class.

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1. As an ornithologist, you wish to determine the average body mass of *Vireo philadelphicus*. You randomly capture 35 adults of *Vireo philadelphicus*, resulting in a sample mean of 13.45 grams and a sample standard deviation of 1.63 grams. You decide to report a 80% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 7 students who have each taken two quizzes. Perform a two-tail test with significance level 0.1 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6	student7
quiz 1:	63.7	89.5	86.2	59.4	55.3	57.8	52.2
quiz 2:	58.2	89.3	81.7	57.7	55.5	49.8	54.6

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 6 cases and a control group with 6 cases. You decide to run a hypothesis test with a significance level of 0.01. Your data is below. Please use 7 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
3.8	2.8
4.3	3.9
4.3	2.6
3.8	2.6
3.9	2.7
4.3	3.8

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 670 individuals was taken. In that sample, 38.8% were messy. Determine a 99% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is green. She also wants to guarantee that the margin of error of a 98% confidence interval will be less than 0.003 (which is 0.3 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 136 and a control group of size 151. The results are summarized in the table below.

	treatment	control
folksy	44	34
not folksy	92	117

Using a significance level of 0.1, determine whether the treatment causes an effect on the proportion of cases that are folksy.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?



# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 017

**Name:** \_\_\_\_\_

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1. As an ornithologist, you wish to determine the average body mass of *Vireo griseus*. You randomly capture 33 adults of *Vireo griseus*, resulting in a sample mean of 10.13 grams and a sample standard deviation of 0.848 grams. You decide to report a 99.5% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 7 students who have each taken two quizzes. Perform a two-tail test with significance level 0.05 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6	student7
quiz 1:	55	57.2	68	87.8	78.3	75.9	58.2
quiz 2:	48.7	59.3	60.8	85.3	78.1	72.7	52.2

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 6 cases and a control group with 6 cases. You decide to run a hypothesis test with a significance level of 0.01. Your data is below. Please use 8 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
5.4	7.4
3.3	6.4
6.8	8.5
6.8	8.3
4.5	7.4
6.2	7.7

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 480 individuals was taken. In that sample, 24.8% were asleep. Determine a 96% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is cold. She also wants to guarantee that the margin of error of a 80% confidence interval will be less than 0.001 (which is 0.1 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.



6. An experiment is run with a treatment group of size 200 and a control group of size 150. The results are summarized in the table below.

	treatment	control
angry	9	20
not angry	191	130

Using a significance level of 0.005, determine whether the treatment causes an effect on the proportion of cases that are angry.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 018

**Name:** \_\_\_\_\_

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1. As an ornithologist, you wish to determine the average body mass of *Helmitheros vermivorus*. You randomly capture 19 adults of *Helmitheros vermivorus*, resulting in a sample mean of 16.11 grams and a sample standard deviation of 2.43 grams. You decide to report a 99.5% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 7 students who have each taken two quizzes. Perform a two-tail test with significance level 0.01 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6	student7
quiz 1:	56.1	72.1	80	75.5	83	59.2	81
quiz 2:	64.8	70.2	87.9	82.9	85.3	68.2	89.9

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 7 cases and a control group with 7 cases. You decide to run a hypothesis test with a significance level of 0.05. Your data is below. Please use 11 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
165	137
172	253
126	206
144	242
172	202
212	179
149	196

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 70000 individuals was taken. In that sample, 60% were sweet. Determine a 95% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.



5. Your boss wants to know what proportion of a very large population is happy. She also wants to guarantee that the margin of error of a 99% confidence interval will be less than 0.01 (which is 1 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 290 and a control group of size 304. The results are summarized in the table below.

	treatment	control
preoccupied	260	288
not preoccupied	30	16

Using a significance level of 0.04, determine whether the treatment causes an effect on the proportion of cases that are preoccupied.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 019

**Name:** \_\_\_\_\_

This take-home exam is due **Monday, April 29** at the beginning of class.

You may use any notes, textbook, or online tools; however, you may not request help from any other human. If you believe a question is ambiguous, unanswerable, or erroneous, please let me know.

You will show your work on the pages with questions. When you are sure of your answers, you will put those answers in the boxes on the first few pages.

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1. As an ornithologist, you wish to determine the average body mass of *Chaetura pelagica*. You randomly capture 22 adults of *Chaetura pelagica*, resulting in a sample mean of 30.52 grams and a sample standard deviation of 1.36 grams. You decide to report a 95% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 6 students who have each taken two quizzes. Perform a two-tail test with significance level 0.1 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6
quiz 1:	64.9	62.5	63.8	64.5	73.4	59.4
quiz 2:	65.3	59.9	64.3	60.7	72.2	55.5

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 5 cases and a control group with 5 cases. You decide to run a hypothesis test with a significance level of 0.04. Your data is below. Please use 4 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
139	199
137	220
126	152
138	160
133	158

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?



4. From a very large population, a random sample of 440 individuals was taken. In that sample, 78.2% were super. Determine a 98% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is cold. She also wants to guarantee that the margin of error of a 99% confidence interval will be less than 0.02 (which is 2 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 222 and a control group of size 217. The results are summarized in the table below.

	treatment	control
reclusive	37	58
not reclusive	185	159

Using a significance level of 0.02, determine whether the treatment causes an effect on the proportion of cases that are reclusive.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 020

**Name:** \_\_\_\_\_

This take-home exam is due **Monday, April 29** at the beginning of class.

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1. As an ornithologist, you wish to determine the average body mass of *Ammodramus maritimus*. You randomly capture 17 adults of *Ammodramus maritimus*, resulting in a sample mean of 22.18 grams and a sample standard deviation of 1.75 grams. You decide to report a 90% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 5 students who have each taken two quizzes. Perform a two-tail test with significance level 0.05 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5
quiz 1:	83.5	70.6	71.3	86.4	72.3
quiz 2:	82.7	73.4	74	90.1	77

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?



3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 6 cases and a control group with 6 cases. You decide to run a hypothesis test with a significance level of 0.1. Your data is below. Please use 9 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
820	460
430	650
630	530
510	580
830	360
770	510

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 7700 individuals was taken. In that sample, 28.4% were glowing. Determine a 95% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is angry. She also wants to guarantee that the margin of error of a 99% confidence interval will be less than 0.01 (which is 1 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 72 and a control group of size 98. The results are summarized in the table below.

	treatment	control
green	55	64
not green	17	34

Using a significance level of 0.2, determine whether the treatment causes an effect on the proportion of cases that are green.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 021

**Name:** \_\_\_\_\_

This take-home exam is due **Monday, April 29** at the beginning of class.

You may use any notes, textbook, or online tools; however, you may not request help from any other human. If you believe a question is ambiguous, unanswerable, or erroneous, please let me know.

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1. As an ornithologist, you wish to determine the average body mass of *Piranga rubra*. You randomly capture 34 adults of *Piranga rubra*, resulting in a sample mean of 36.74 grams and a sample standard deviation of 6.13 grams. You decide to report a 95% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.



2. A teacher has 7 students who have each taken two quizzes. Perform a two-tail test with significance level 0.01 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6	student7
quiz 1:	87.8	57.4	88.4	83.3	76.5	69.9	56.1
quiz 2:	86.2	50.8	83.4	80	76.7	60.9	52.1

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 7 cases and a control group with 7 cases. You decide to run a hypothesis test with a significance level of 0.01. Your data is below. Please use 10 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
2.5	1.68
1.59	1.46
2.12	1.13
2.87	1.76
1.51	1.27
1.78	1.29
2.45	1.29

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 18000 individuals was taken. In that sample, 93.3% were blue. Determine a 98% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is broken. She also wants to guarantee that the margin of error of a 99% confidence interval will be less than 0.02 (which is 2 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 51 and a control group of size 60. The results are summarized in the table below.

	treatment	control
reclusive	9	18
not reclusive	42	42

Using a significance level of 0.2, determine whether the treatment causes an effect on the proportion of cases that are reclusive.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 022

**Name:** \_\_\_\_\_

This take-home exam is due **Monday, April 29** at the beginning of class.

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1. As an ornithologist, you wish to determine the average body mass of *Catharus ustulatus*. You randomly capture 28 adults of *Catharus ustulatus*, resulting in a sample mean of 32.55 grams and a sample standard deviation of 7.85 grams. You decide to report a 90% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 7 students who have each taken two quizzes. Perform a two-tail test with significance level 0.1 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6	student7
quiz 1:	69.6	76.4	87.1	64.4	89.6	63.4	56.2
quiz 2:	69.1	73.7	81.4	64.5	87.9	60.7	57.8

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 7 cases and a control group with 7 cases. You decide to run a hypothesis test with a significance level of 0.04. Your data is below. Please use 11 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
6.6	6.9
6.3	5.2
7.2	6.6
7.3	6
7.9	5.4
6.7	4.5
7	7

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 6000 individuals was taken. In that sample, 36.1% were shiny. Determine a 95% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is purple. She also wants to guarantee that the margin of error of a 99.5% confidence interval will be less than 0.05 (which is 5 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 222 and a control group of size 241. The results are summarized in the table below.

	treatment	control
reclusive	72	105
not reclusive	150	136

Using a significance level of 0.02, determine whether the treatment causes an effect on the proportion of cases that are reclusive.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 023

**Name:** \_\_\_\_\_

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1. As an ornithologist, you wish to determine the average body mass of *Vermivora peregrina*. You randomly capture 16 adults of *Vermivora peregrina*, resulting in a sample mean of 12.76 grams and a sample standard deviation of 1.06 grams. You decide to report a 90% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 7 students who have each taken two quizzes. Perform a two-tail test with significance level 0.005 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6	student7
quiz 1:	67.2	52	89.3	74	81.7	50.6	79.2
quiz 2:	77.4	51.5	102	90.2	89	62.1	84.9

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 5 cases and a control group with 5 cases. You decide to run a hypothesis test with a significance level of 0.1. Your data is below. Please use 6 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
1.64	1.54
1.57	1.82
1.43	1.78
1.37	1.78
1.44	1.41

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 8300 individuals was taken. In that sample, 53.6% were tasty. Determine a 98% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is messy. She also wants to guarantee that the margin of error of a 99.5% confidence interval will be less than 0.004 (which is 0.4 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 93 and a control group of size 113. The results are summarized in the table below.

	treatment	control
sick	60	55
not sick	33	58

Using a significance level of 0.04, determine whether the treatment causes an effect on the proportion of cases that are sick.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 024

**Name:** \_\_\_\_\_

This take-home exam is due **Monday, April 29** at the beginning of class.

You may use any notes, textbook, or online tools; however, you may not request help from any other human. If you believe a question is ambiguous, unanswerable, or erroneous, please let me know.

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1. As an ornithologist, you wish to determine the average body mass of *Icterus spurius*. You randomly capture 18 adults of *Icterus spurius*, resulting in a sample mean of 23.05 grams and a sample standard deviation of 1.98 grams. You decide to report a 80% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 7 students who have each taken two quizzes. Perform a two-tail test with significance level 0.05 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6	student7
quiz 1:	66.3	67	76.1	82.8	60	59.7	52.3
quiz 2:	63.4	65.5	75.1	79.7	62.2	58	48.6

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 6 cases and a control group with 6 cases. You decide to run a hypothesis test with a significance level of 0.05. Your data is below. Please use 7 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
530	750
510	510
490	720
550	580
530	720
520	1050

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 440 individuals was taken. In that sample, 76.1% were floating. Determine a 96% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is bitter. She also wants to guarantee that the margin of error of a 96% confidence interval will be less than 0.007 (which is 0.7 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 272 and a control group of size 306. The results are summarized in the table below.

	treatment	control
cold	33	17
not cold	239	289

Using a significance level of 0.01, determine whether the treatment causes an effect on the proportion of cases that are cold.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?



# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 025

**Name:** \_\_\_\_\_

This take-home exam is due **Monday, April 29** at the beginning of class.

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1. As an ornithologist, you wish to determine the average body mass of *Catharus ustulatus*. You randomly capture 17 adults of *Catharus ustulatus*, resulting in a sample mean of 34.37 grams and a sample standard deviation of 5.66 grams. You decide to report a 98% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 5 students who have each taken two quizzes. Perform a two-tail test with significance level 0.1 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5
quiz 1:	86.9	78.4	69.9	50.3	60
quiz 2:	90.4	89.2	75.4	48.2	62.8

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 5 cases and a control group with 5 cases. You decide to run a hypothesis test with a significance level of 0.02. Your data is below. Please use 4 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
4.4	5
3.5	5.4
4.1	5.2
4.5	5.3
2.2	5.2

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 82000 individuals was taken. In that sample, 10.3% were tasty. Determine a 96% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is blue. She also wants to guarantee that the margin of error of a 90% confidence interval will be less than 0.009 (which is 0.9 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.



6. An experiment is run with a treatment group of size 70 and a control group of size 28. The results are summarized in the table below.

	treatment	control
angry	52	14
not angry	18	14

Using a significance level of 0.02, determine whether the treatment causes an effect on the proportion of cases that are angry.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 026

**Name:** \_\_\_\_\_

This take-home exam is due **Monday, April 29** at the beginning of class.

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1. As an ornithologist, you wish to determine the average body mass of *Denrdoica magnolia*. You randomly capture 15 adults of *Denrdoica magnolia*, resulting in a sample mean of 9.96 grams and a sample standard deviation of 1.4 grams. You decide to report a 96% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 7 students who have each taken two quizzes. Perform a two-tail test with significance level 0.02 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6	student7
quiz 1:	73.5	87.9	54.6	82	81.5	85.5	58.7
quiz 2:	72.8	84.7	50.8	79.9	74.2	86	55.5

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 5 cases and a control group with 5 cases. You decide to run a hypothesis test with a significance level of 0.05. Your data is below. Please use 5 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
5.3	4.9
5.4	4.8
6.1	4.6
5.3	5.4
5.5	5.2

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 31000 individuals was taken. In that sample, 63.6% were asleep. Determine a 95% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.



5. Your boss wants to know what proportion of a very large population is asleep. She also wants to guarantee that the margin of error of a 96% confidence interval will be less than 0.04 (which is 4 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 198 and a control group of size 169. The results are summarized in the table below.

	treatment	control
sick	73	42
not sick	125	127

Using a significance level of 0.02, determine whether the treatment causes an effect on the proportion of cases that are sick.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 027

**Name:** \_\_\_\_\_

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1. As an ornithologist, you wish to determine the average body mass of *Dumetella carolinensis*. You randomly capture 14 adults of *Dumetella carolinensis*, resulting in a sample mean of 38.31 grams and a sample standard deviation of 4.3 grams. You decide to report a 99.5% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 7 students who have each taken two quizzes. Perform a two-tail test with significance level 0.01 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6	student7
quiz 1:	62.6	64.7	65.1	53.7	61.9	84.6	64.2
quiz 2:	72.5	74.1	68.2	67.7	60.5	95.1	79.1

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 6 cases and a control group with 6 cases. You decide to run a hypothesis test with a significance level of 0.04. Your data is below. Please use 6 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
8.9	7.6
9.2	9.2
9	6.9
8.7	6.4
8.5	8.6
9.2	8.1

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?



4. From a very large population, a random sample of 2000 individuals was taken. In that sample, 69.1% were messy. Determine a 99% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is cold. She also wants to guarantee that the margin of error of a 96% confidence interval will be less than 0.06 (which is 6 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 48 and a control group of size 87. The results are summarized in the table below.

	treatment	control
angry	38	52
not angry	10	35

Using a significance level of 0.04, determine whether the treatment causes an effect on the proportion of cases that are angry.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 028

**Name:** \_\_\_\_\_

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1. As an ornithologist, you wish to determine the average body mass of *Catharus guttatus*. You randomly capture 27 adults of *Catharus guttatus*, resulting in a sample mean of 29.12 grams and a sample standard deviation of 1.3 grams. You decide to report a 99.5% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 6 students who have each taken two quizzes. Perform a two-tail test with significance level 0.05 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6
quiz 1:	77.1	76.9	67.2	53.4	56.3	71.3
quiz 2:	68.2	74	65.4	44.3	51.6	73.2

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?



3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 6 cases and a control group with 6 cases. You decide to run a hypothesis test with a significance level of 0.05. Your data is below. Please use 6 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
29.5	20.5
29.3	22.2
25.7	28.8
27.7	26.8
26.3	22.5
29.3	26.7

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 55000 individuals was taken. In that sample, 70.7% were shiny. Determine a 95% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is asleep. She also wants to guarantee that the margin of error of a 96% confidence interval will be less than 0.007 (which is 0.7 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 82 and a control group of size 117. The results are summarized in the table below.

	treatment	control
sick	62	63
not sick	20	54

Using a significance level of 0.005, determine whether the treatment causes an effect on the proportion of cases that are sick.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 029

**Name:** \_\_\_\_\_

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1. As an ornithologist, you wish to determine the average body mass of *Dendroica castanea*. You randomly capture 33 adults of *Dendroica castanea*, resulting in a sample mean of 14.77 grams and a sample standard deviation of 1.26 grams. You decide to report a 98% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.



2. A teacher has 7 students who have each taken two quizzes. Perform a two-tail test with significance level 0.04 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6	student7
quiz 1:	72.8	89.7	60.8	54.9	84.1	71.8	61.4
quiz 2:	75.6	97.1	59.3	58.6	89.1	74.8	61.6

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 5 cases and a control group with 5 cases. You decide to run a hypothesis test with a significance level of 0.02. Your data is below. Please use 5 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
2.84	3.24
2.55	3.34
2.14	2.99
2.47	2.77
2.82	3.08

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 390 individuals was taken. In that sample, 51.5% were floating. Determine a 99.5% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is messy. She also wants to guarantee that the margin of error of a 90% confidence interval will be less than 0.02 (which is 2 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 40 and a control group of size 34. The results are summarized in the table below.

	treatment	control
preoccupied	24	8
not preoccupied	16	26

Using a significance level of 0.005, determine whether the treatment causes an effect on the proportion of cases that are preoccupied.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

# Bunker Hill Community College

Third Statistics Exam 2019-04-25

Exam ID 030

**Name:** \_\_\_\_\_

This take-home exam is due **Monday, April 29** at the beginning of class.

You may use any notes, textbook, or online tools; however, you may not request help from any other human. If you believe a question is ambiguous, unanswerable, or erroneous, please let me know.

You will show your work on the pages with questions. When you are sure of your answers, you will put those answers in the boxes on the first few pages.

Unless you have an objection to doing so, please copy the honor-code text below and sign.

*I understand that outside help is NOT allowed on this exam. On my honor, the work herein is my own.*

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**Signature:** \_\_\_\_\_

1. (a)
- (b)
2. (a)
- (b)
- (c)
- (d)
- (e)
- (f)
- (g)
3. (a)
- (b)
- (c)
- (d)
- (e)
- (f)
- (g)
4. (a)
- (b)
5.
6. (a)

(b)

(c)

(d)

(e)

(f)

(g)



1. As an ornithologist, you wish to determine the average body mass of *Dendroica castanea*. You randomly capture 31 adults of *Dendroica castanea*, resulting in a sample mean of 15.24 grams and a sample standard deviation of 1.11 grams. You decide to report a 95% confidence interval.
  - (a) Determine the lower bound of the confidence interval.
  - (b) Determine the upper bound of the confidence interval.

2. A teacher has 7 students who have each taken two quizzes. Perform a two-tail test with significance level 0.05 to determine whether students' performance changed on average.

	student1	student2	student3	student4	student5	student6	student7
quiz 1:	89.4	55.1	81.6	87.4	69.5	86	76.5
quiz 2:	88	49.7	72.5	80.1	72.7	84	65.6

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

3. You are interested in whether a treatment causes an effect on a continuously measurable attribute. You use a treatment group with 6 cases and a control group with 6 cases. You decide to run a hypothesis test with a significance level of 0.1. Your data is below. Please use 6 for the degrees of freedom (calculated with the Welch-Satterthwaite equation).

treatment	control
3.44	4.07
3.77	1.78
3.11	2.51
3.31	2.54
3.28	1.43
2.53	2.16

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?

4. From a very large population, a random sample of 2400 individuals was taken. In that sample, 14.2% were tasty. Determine a 95% confidence interval of the population proportion.
- (a) Find the lower bound of the confidence interval.
  - (b) Find the upper bound of the confidence interval.

5. Your boss wants to know what proportion of a very large population is bitter. She also wants to guarantee that the margin of error of a 95% confidence interval will be less than 0.02 (which is 2 percentage points). How large of a sample is needed? Please round up, using only 2 significant digits.

6. An experiment is run with a treatment group of size 42 and a control group of size 77. The results are summarized in the table below.

	treatment	control
omnivorous	18	20
not omnivorous	24	57

Using a significance level of 0.1, determine whether the treatment causes an effect on the proportion of cases that are omnivorous.

- (a) State the null hypothesis.
- (b) State the alternative hypothesis.
- (c) Evaluate the critical value. (The critical value is either  $z^*$  or  $t^*$ . Determine its value.)
- (d) Determine the standard error of the relevant sampling distribution.
- (e) Evaluate the absolute value of the test statistic. (The test statistic is either  $z_{\text{obs}}$  or  $t_{\text{obs}}$ . Determine its absolute value.)
- (f) If possible, evaluate the  $p$ -value. Otherwise, describe an interval containing the  $p$ -value.
- (g) Do we reject or retain the null?