**Statistician: Ryan Andersen Version: B**

**Directions**

The final exam will consist of several application-type questions related to the following topics we’ve covered this semester – univariate EDA (quantitative & categorical), bivariate EDA (quantitative & categorical), linear regression, one-sample t-test, two-sample t-test, and chi-square. On the final exam, you will be asked to answer each question from results that you have prepared prior to the exam using R.

The dataset that you will examine is introduced below including actual questions that will be on the exam. You should load these data into R (from the class website) and create output that can be used to answer each question. Your R input and output should be printed and brought to the exam to be used to answer the exam questions.

The R output document that you bring to the exam must meet the following strict criteria:

* The document must be produced by you and you alone!! You may not ask anyone but me (including the tutors) for specific help on using R. If you have questions, I will be available in my office or via e-mail.
* The document can only contain R commands related to expressions, assignments, functions, or objects; R output; or R created graphics. You may not type or write ***any other*** material on the document (including labeling figures, tables, output, or sections). You may not type any “notes” (i.e., non-R-related expressions, assignments, functions or objects) as “R code.” The document should contain no code that results in errors.

Failure to follow all of these criteria will result in a 0 for the final exam (29% of your overall grade)!!

**Data Set -- BatMorph**

The Hawaiian hoary bat, *Lasiurus cinereus semotus*, is an endemic subspecies of the North American hoary bat; the mainland subspecies is *L. c. cinereus*. Researchers in Hawaii and on the mainland recorded a variety of morphological (body) characteristics on bats collected from three different types of habitat. Specifics of the variables recorded are documented in the **Batmorph.txt** data file (open the data file outside of R to read comments at the top). You should prepare results for each of these items …

1. Univariate EDA for canine, wingspan, and habitat.

2. Bivariate EDA for bodymass and wingspan, and skull length and wingspan.

3. Linear regression results (equation results and r2) for predicting the height of the coronoid process from the height of the canine tooth.

4. Results for testing the following research hypotheses (use 5% level for each)

a. The mean height of the canine tooth is different between the two subspecies of bats.

b. The distribution of individuals into the three habitats differs between the two subspecies.

c. The mean body mass of the *L. c. cinereus* subspecies is greater than 35 g.

**Version: B Statistician: Ryan Andersen**

**Directions:**

You may have a pencil, a calculator, and your R output document for the **BatMorph.txt** file on your desk. All other materials should be fully stored out of sight and your computer should be turned off.

Do not write anything on your document of results except to add labels – e.g., “Output #1” or “Figure 1” – for referring to when answering the questions below. When you are finished with the exam, you should staple this sheet, your handwritten answers, and your document of R results together, in that order.

You should answer all questions below with as much information as necessary to fully answer the question. All answers should be completed by using and referring to specific R output. Some questions require further calculations for which you are allowed to use your calculator. You are not allowed to make any further calculations in R. Your answers should be legibly handwritten on the sheets of paper provided, clearly labeled with the question number, and, *when marked by an asterisk*, written with complete sentences.

# **11 Steps for any Significance Test**

1. **[1]** state the rejection criterion (),

2. **[2]** state the null and alternative hypotheses to be tested – define the parameter,

3. **[1]** determine which hypothesis test to use – thoroughly explain why,

4. **[1]** collect the data (address type of study and randomization),

5. **[2]** check all necessary assumptions – explain how you tested the validity,

6. **[1]** calculate the appropriate statistic(s),

7. **[2]** calculate the appropriate test statistic,

8. **[2]** calculate the p‑value,

9. **[1]** state rejection decision,

10. **[2]\*** summarize your findings in terms of the problem, and

11. **[2]\* If reject H0,** compute a **100(1-)%** *confidence region* for the parameter.

**Questions:**

1. **[3pts]** Identify what type of variable each of the following is: bodymass, wingspan, and hab.

2. **[5pts]\*** Perform a thorough EDA for the wingspan of bats.

3. **[2pts]\*** Perform a thorough EDA for the habitat variable.

4. **[5pts]\*** Perform a thorough EDA for the relationship between skull length and wingspan.

5. **[2pts]\*** Interpret the slope of the linear regression that you performed.

6. **[2pts]** Predict the height of the coronoid process if the height of the canine tooth equals the median height of the canine tooth.

7. **[2pts]** What proportion of the total variability in the coronoid process is explained by knowing the height of the canine tooth?

8. **[15pts]** Test that distribution of individuals into the three habitats differs between the two subspecies.

9. **[15 or 17 pts]** Test that the mean height of the canine tooth is different between the two subspecies of bats.

10. **[8 pts]\*** Describe the importance of statistics (as a field of study or a collection of methods). Among other things make sure you describe the two major goals of statistics, identify at least three major concepts or ideas of statistics, and identify how some of the “tools” you have learned this semester illustrate or are related to why you think statistics is important.

**Statistician: Stephanie Anderson Version: B**

**Directions**

The final exam will consist of several application-type questions related to the following topics we’ve covered this semester – univariate EDA (quantitative & categorical), bivariate EDA (quantitative & categorical), linear regression, one-sample t-test, two-sample t-test, and chi-square. On the final exam, you will be asked to answer each question from results that you have prepared prior to the exam using R.

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**Data Set -- BatMorph**

The Hawaiian hoary bat, *Lasiurus cinereus semotus*, is an endemic subspecies of the North American hoary bat; the mainland subspecies is *L. c. cinereus*. Researchers in Hawaii and on the mainland recorded a variety of morphological (body) characteristics on bats collected from three different types of habitat. Specifics of the variables recorded are documented in the **Batmorph.txt** data file (open the data file outside of R to read comments at the top). You should prepare results for each of these items …

1. Univariate EDA for canine, wingspan, and habitat.

2. Bivariate EDA for bodymass and wingspan, and skull length and wingspan.

3. Linear regression results (equation results and r2) for predicting the height of the coronoid process from the height of the canine tooth.

4. Results for testing the following research hypotheses (use 5% level for each)

a. The mean height of the canine tooth is different between the two subspecies of bats.

b. The distribution of individuals into the three habitats differs between the two subspecies.

c. The mean body mass of the *L. c. cinereus* subspecies is greater than 35 g.

**Version: B Statistician: Stephanie Anderson**

**Directions:**

You may have a pencil, a calculator, and your R output document for the **BatMorph.txt** file on your desk. All other materials should be fully stored out of sight and your computer should be turned off.

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You should answer all questions below with as much information as necessary to fully answer the question. All answers should be completed by using and referring to specific R output. Some questions require further calculations for which you are allowed to use your calculator. You are not allowed to make any further calculations in R. Your answers should be legibly handwritten on the sheets of paper provided, clearly labeled with the question number, and, *when marked by an asterisk*, written with complete sentences.

# **11 Steps for any Significance Test**

1. **[1]** state the rejection criterion (),

2. **[2]** state the null and alternative hypotheses to be tested – define the parameter,

3. **[1]** determine which hypothesis test to use – thoroughly explain why,

4. **[1]** collect the data (address type of study and randomization),

5. **[2]** check all necessary assumptions – explain how you tested the validity,

6. **[1]** calculate the appropriate statistic(s),

7. **[2]** calculate the appropriate test statistic,

8. **[2]** calculate the p‑value,

9. **[1]** state rejection decision,

10. **[2]\*** summarize your findings in terms of the problem, and

11. **[2]\* If reject H0,** compute a **100(1-)%** *confidence region* for the parameter.

**Questions:**

1. **[3pts]** Identify what type of variable each of the following is: bodymass, wingspan, and hab.

2. **[5pts]\*** Perform a thorough EDA for the wingspan of bats.

3. **[2pts]\*** Perform a thorough EDA for the habitat variable.

4. **[5pts]\*** Perform a thorough EDA for the relationship between skull length and wingspan.

5. **[2pts]\*** Interpret the slope of the linear regression that you performed.

6. **[2pts]** Predict the height of the coronoid process if the height of the canine tooth equals the median height of the canine tooth.

7. **[2pts]** What proportion of the total variability in the coronoid process is explained by knowing the height of the canine tooth?

8. **[15pts]** Test that distribution of individuals into the three habitats differs between the two subspecies.

9. **[15 or 17 pts]** Test that the mean height of the canine tooth is different between the two subspecies of bats.

10. **[8 pts]\*** Describe the importance of statistics (as a field of study or a collection of methods). Among other things make sure you describe the two major goals of statistics, identify at least three major concepts or ideas of statistics, and identify how some of the “tools” you have learned this semester illustrate or are related to why you think statistics is important.

**Statistician: Jay Bongey Version: B**

**Directions**

The final exam will consist of several application-type questions related to the following topics we’ve covered this semester – univariate EDA (quantitative & categorical), bivariate EDA (quantitative & categorical), linear regression, one-sample t-test, two-sample t-test, and chi-square. On the final exam, you will be asked to answer each question from results that you have prepared prior to the exam using R.

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Failure to follow all of these criteria will result in a 0 for the final exam (29% of your overall grade)!!

**Data Set -- BatMorph**

The Hawaiian hoary bat, *Lasiurus cinereus semotus*, is an endemic subspecies of the North American hoary bat; the mainland subspecies is *L. c. cinereus*. Researchers in Hawaii and on the mainland recorded a variety of morphological (body) characteristics on bats collected from three different types of habitat. Specifics of the variables recorded are documented in the **Batmorph.txt** data file (open the data file outside of R to read comments at the top). You should prepare results for each of these items …

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3. Linear regression results (equation results and r2) for predicting the height of the coronoid process from the height of the canine tooth.

4. Results for testing the following research hypotheses (use 5% level for each)

a. The mean height of the canine tooth is different between the two subspecies of bats.

b. The distribution of individuals into the three habitats differs between the two subspecies.

c. The mean body mass of the *L. c. cinereus* subspecies is greater than 35 g.

**Version: B Statistician: Jay Bongey**

**Directions:**

You may have a pencil, a calculator, and your R output document for the **BatMorph.txt** file on your desk. All other materials should be fully stored out of sight and your computer should be turned off.

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# **11 Steps for any Significance Test**

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8. **[2]** calculate the p‑value,

9. **[1]** state rejection decision,

10. **[2]\*** summarize your findings in terms of the problem, and

11. **[2]\* If reject H0,** compute a **100(1-)%** *confidence region* for the parameter.

**Questions:**

1. **[3pts]** Identify what type of variable each of the following is: bodymass, wingspan, and hab.

2. **[5pts]\*** Perform a thorough EDA for the wingspan of bats.

3. **[2pts]\*** Perform a thorough EDA for the habitat variable.

4. **[5pts]\*** Perform a thorough EDA for the relationship between skull length and wingspan.

5. **[2pts]\*** Interpret the slope of the linear regression that you performed.

6. **[2pts]** Predict the height of the coronoid process if the height of the canine tooth equals the median height of the canine tooth.

7. **[2pts]** What proportion of the total variability in the coronoid process is explained by knowing the height of the canine tooth?

8. **[15pts]** Test that distribution of individuals into the three habitats differs between the two subspecies.

9. **[15 or 17 pts]** Test that the mean height of the canine tooth is different between the two subspecies of bats.

10. **[8 pts]\*** Describe the importance of statistics (as a field of study or a collection of methods). Among other things make sure you describe the two major goals of statistics, identify at least three major concepts or ideas of statistics, and identify how some of the “tools” you have learned this semester illustrate or are related to why you think statistics is important.

**Statistician: Devon Brock-Montgomery Version: B**

**Directions**

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**Data Set -- BatMorph**

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4. Results for testing the following research hypotheses (use 5% level for each)

a. The mean height of the canine tooth is different between the two subspecies of bats.

b. The distribution of individuals into the three habitats differs between the two subspecies.

c. The mean body mass of the *L. c. cinereus* subspecies is greater than 35 g.

**Version: B Statistician: Devon Brock-Montgomery**

**Directions:**

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# **11 Steps for any Significance Test**

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9. **[1]** state rejection decision,

10. **[2]\*** summarize your findings in terms of the problem, and

11. **[2]\* If reject H0,** compute a **100(1-)%** *confidence region* for the parameter.

**Questions:**

1. **[3pts]** Identify what type of variable each of the following is: bodymass, wingspan, and hab.

2. **[5pts]\*** Perform a thorough EDA for the wingspan of bats.

3. **[2pts]\*** Perform a thorough EDA for the habitat variable.

4. **[5pts]\*** Perform a thorough EDA for the relationship between skull length and wingspan.

5. **[2pts]\*** Interpret the slope of the linear regression that you performed.

6. **[2pts]** Predict the height of the coronoid process if the height of the canine tooth equals the median height of the canine tooth.

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8. **[15pts]** Test that distribution of individuals into the three habitats differs between the two subspecies.

9. **[15 or 17 pts]** Test that the mean height of the canine tooth is different between the two subspecies of bats.

10. **[8 pts]\*** Describe the importance of statistics (as a field of study or a collection of methods). Among other things make sure you describe the two major goals of statistics, identify at least three major concepts or ideas of statistics, and identify how some of the “tools” you have learned this semester illustrate or are related to why you think statistics is important.

**Statistician: Emily Donaldson Version: B**

**Directions**

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**Data Set -- BatMorph**

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4. Results for testing the following research hypotheses (use 5% level for each)

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c. The mean body mass of the *L. c. cinereus* subspecies is greater than 35 g.

**Version: B Statistician: Emily Donaldson**

**Directions:**

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**Questions:**

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8. **[15pts]** Test that distribution of individuals into the three habitats differs between the two subspecies.

9. **[15 or 17 pts]** Test that the mean height of the canine tooth is different between the two subspecies of bats.

10. **[8 pts]\*** Describe the importance of statistics (as a field of study or a collection of methods). Among other things make sure you describe the two major goals of statistics, identify at least three major concepts or ideas of statistics, and identify how some of the “tools” you have learned this semester illustrate or are related to why you think statistics is important.

**Statistician: Michaela Fisher Version: B**

**Directions**

The final exam will consist of several application-type questions related to the following topics we’ve covered this semester – univariate EDA (quantitative & categorical), bivariate EDA (quantitative & categorical), linear regression, one-sample t-test, two-sample t-test, and chi-square. On the final exam, you will be asked to answer each question from results that you have prepared prior to the exam using R.

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**Data Set -- BatMorph**

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4. Results for testing the following research hypotheses (use 5% level for each)

a. The mean height of the canine tooth is different between the two subspecies of bats.

b. The distribution of individuals into the three habitats differs between the two subspecies.

c. The mean body mass of the *L. c. cinereus* subspecies is greater than 35 g.

**Version: B Statistician: Michaela Fisher**

**Directions:**

You may have a pencil, a calculator, and your R output document for the **BatMorph.txt** file on your desk. All other materials should be fully stored out of sight and your computer should be turned off.

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# **11 Steps for any Significance Test**

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5. **[2]** check all necessary assumptions – explain how you tested the validity,

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8. **[2]** calculate the p‑value,

9. **[1]** state rejection decision,

10. **[2]\*** summarize your findings in terms of the problem, and

11. **[2]\* If reject H0,** compute a **100(1-)%** *confidence region* for the parameter.

**Questions:**

1. **[3pts]** Identify what type of variable each of the following is: bodymass, wingspan, and hab.

2. **[5pts]\*** Perform a thorough EDA for the wingspan of bats.

3. **[2pts]\*** Perform a thorough EDA for the habitat variable.

4. **[5pts]\*** Perform a thorough EDA for the relationship between skull length and wingspan.

5. **[2pts]\*** Interpret the slope of the linear regression that you performed.

6. **[2pts]** Predict the height of the coronoid process if the height of the canine tooth equals the median height of the canine tooth.

7. **[2pts]** What proportion of the total variability in the coronoid process is explained by knowing the height of the canine tooth?

8. **[15pts]** Test that distribution of individuals into the three habitats differs between the two subspecies.

9. **[15 or 17 pts]** Test that the mean height of the canine tooth is different between the two subspecies of bats.

10. **[8 pts]\*** Describe the importance of statistics (as a field of study or a collection of methods). Among other things make sure you describe the two major goals of statistics, identify at least three major concepts or ideas of statistics, and identify how some of the “tools” you have learned this semester illustrate or are related to why you think statistics is important.

**Statistician: John Graetz Version: B**

**Directions**

The final exam will consist of several application-type questions related to the following topics we’ve covered this semester – univariate EDA (quantitative & categorical), bivariate EDA (quantitative & categorical), linear regression, one-sample t-test, two-sample t-test, and chi-square. On the final exam, you will be asked to answer each question from results that you have prepared prior to the exam using R.

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Failure to follow all of these criteria will result in a 0 for the final exam (29% of your overall grade)!!

**Data Set -- BatMorph**

The Hawaiian hoary bat, *Lasiurus cinereus semotus*, is an endemic subspecies of the North American hoary bat; the mainland subspecies is *L. c. cinereus*. Researchers in Hawaii and on the mainland recorded a variety of morphological (body) characteristics on bats collected from three different types of habitat. Specifics of the variables recorded are documented in the **Batmorph.txt** data file (open the data file outside of R to read comments at the top). You should prepare results for each of these items …

1. Univariate EDA for canine, wingspan, and habitat.

2. Bivariate EDA for bodymass and wingspan, and skull length and wingspan.

3. Linear regression results (equation results and r2) for predicting the height of the coronoid process from the height of the canine tooth.

4. Results for testing the following research hypotheses (use 5% level for each)

a. The mean height of the canine tooth is different between the two subspecies of bats.

b. The distribution of individuals into the three habitats differs between the two subspecies.

c. The mean body mass of the *L. c. cinereus* subspecies is greater than 35 g.

**Version: B Statistician: John Graetz**

**Directions:**

You may have a pencil, a calculator, and your R output document for the **BatMorph.txt** file on your desk. All other materials should be fully stored out of sight and your computer should be turned off.

Do not write anything on your document of results except to add labels – e.g., “Output #1” or “Figure 1” – for referring to when answering the questions below. When you are finished with the exam, you should staple this sheet, your handwritten answers, and your document of R results together, in that order.

You should answer all questions below with as much information as necessary to fully answer the question. All answers should be completed by using and referring to specific R output. Some questions require further calculations for which you are allowed to use your calculator. You are not allowed to make any further calculations in R. Your answers should be legibly handwritten on the sheets of paper provided, clearly labeled with the question number, and, *when marked by an asterisk*, written with complete sentences.

# **11 Steps for any Significance Test**

1. **[1]** state the rejection criterion (),

2. **[2]** state the null and alternative hypotheses to be tested – define the parameter,

3. **[1]** determine which hypothesis test to use – thoroughly explain why,

4. **[1]** collect the data (address type of study and randomization),

5. **[2]** check all necessary assumptions – explain how you tested the validity,

6. **[1]** calculate the appropriate statistic(s),

7. **[2]** calculate the appropriate test statistic,

8. **[2]** calculate the p‑value,

9. **[1]** state rejection decision,

10. **[2]\*** summarize your findings in terms of the problem, and

11. **[2]\* If reject H0,** compute a **100(1-)%** *confidence region* for the parameter.

**Questions:**

1. **[3pts]** Identify what type of variable each of the following is: bodymass, wingspan, and hab.

2. **[5pts]\*** Perform a thorough EDA for the wingspan of bats.

3. **[2pts]\*** Perform a thorough EDA for the habitat variable.

4. **[5pts]\*** Perform a thorough EDA for the relationship between skull length and wingspan.

5. **[2pts]\*** Interpret the slope of the linear regression that you performed.

6. **[2pts]** Predict the height of the coronoid process if the height of the canine tooth equals the median height of the canine tooth.

7. **[2pts]** What proportion of the total variability in the coronoid process is explained by knowing the height of the canine tooth?

8. **[15pts]** Test that distribution of individuals into the three habitats differs between the two subspecies.

9. **[15 or 17 pts]** Test that the mean height of the canine tooth is different between the two subspecies of bats.

10. **[8 pts]\*** Describe the importance of statistics (as a field of study or a collection of methods). Among other things make sure you describe the two major goals of statistics, identify at least three major concepts or ideas of statistics, and identify how some of the “tools” you have learned this semester illustrate or are related to why you think statistics is important.

**Statistician: Eva Hagen Version: B**

**Directions**

The final exam will consist of several application-type questions related to the following topics we’ve covered this semester – univariate EDA (quantitative & categorical), bivariate EDA (quantitative & categorical), linear regression, one-sample t-test, two-sample t-test, and chi-square. On the final exam, you will be asked to answer each question from results that you have prepared prior to the exam using R.

The dataset that you will examine is introduced below including actual questions that will be on the exam. You should load these data into R (from the class website) and create output that can be used to answer each question. Your R input and output should be printed and brought to the exam to be used to answer the exam questions.

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**Data Set -- BatMorph**

The Hawaiian hoary bat, *Lasiurus cinereus semotus*, is an endemic subspecies of the North American hoary bat; the mainland subspecies is *L. c. cinereus*. Researchers in Hawaii and on the mainland recorded a variety of morphological (body) characteristics on bats collected from three different types of habitat. Specifics of the variables recorded are documented in the **Batmorph.txt** data file (open the data file outside of R to read comments at the top). You should prepare results for each of these items …

1. Univariate EDA for canine, wingspan, and habitat.

2. Bivariate EDA for bodymass and wingspan, and skull length and wingspan.

3. Linear regression results (equation results and r2) for predicting the height of the coronoid process from the height of the canine tooth.

4. Results for testing the following research hypotheses (use 5% level for each)

a. The mean height of the canine tooth is different between the two subspecies of bats.

b. The distribution of individuals into the three habitats differs between the two subspecies.

c. The mean body mass of the *L. c. cinereus* subspecies is greater than 35 g.

**Version: B Statistician: Eva Hagen**

**Directions:**

You may have a pencil, a calculator, and your R output document for the **BatMorph.txt** file on your desk. All other materials should be fully stored out of sight and your computer should be turned off.

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# **11 Steps for any Significance Test**

1. **[1]** state the rejection criterion (),

2. **[2]** state the null and alternative hypotheses to be tested – define the parameter,

3. **[1]** determine which hypothesis test to use – thoroughly explain why,

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9. **[1]** state rejection decision,

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11. **[2]\* If reject H0,** compute a **100(1-)%** *confidence region* for the parameter.

**Questions:**

1. **[3pts]** Identify what type of variable each of the following is: bodymass, wingspan, and hab.

2. **[5pts]\*** Perform a thorough EDA for the wingspan of bats.

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5. **[2pts]\*** Interpret the slope of the linear regression that you performed.

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8. **[15pts]** Test that distribution of individuals into the three habitats differs between the two subspecies.

9. **[15 or 17 pts]** Test that the mean height of the canine tooth is different between the two subspecies of bats.

10. **[8 pts]\*** Describe the importance of statistics (as a field of study or a collection of methods). Among other things make sure you describe the two major goals of statistics, identify at least three major concepts or ideas of statistics, and identify how some of the “tools” you have learned this semester illustrate or are related to why you think statistics is important.

**Statistician: Nicole Hayes Version: B**

**Directions**

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**Data Set -- BatMorph**

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4. Results for testing the following research hypotheses (use 5% level for each)

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c. The mean body mass of the *L. c. cinereus* subspecies is greater than 35 g.

**Version: B Statistician: Nicole Hayes**

**Directions:**

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**Questions:**

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**Statistician: Meghan Vondriska Version: B**

**Directions**

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**Version: B Statistician: Meghan Vondriska**

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