Is everything bigger in Texas? Rock Pocket Mice (*Chaetodipus intermedius*)

*Learning Objectives:*
By the end of this module students will be able to:

1. Understand how to structure data
2. Form hypotheses using observations of museum specimens
3. Measure morphological traits to answer questions about intraspecies variation
4. Choose between a t-test and a correlation to help assess a hypothesis-driven question
5. Assess validity of research (including sample size, multiple measures, and biases)
6. Communicate scientific findings

*Vocabulary:*

*Categorical variable* – Quantitative variables that fall into distinct groups based on a characteristic, such as color or phylum

*Correlation* – Statistical measure of how much two variables are linearly related

*Intraspecific variation* – *variation within a species*

*Numerical variable* – Values that describe a quantity as a number. These can either be continuous (how wide is the skull?) or discrete (how many specimens are in the jar?)

*P-value* – Probability that results of a hypothesis test were due to random chance. In ecology, a p-value of 0.05 is used most often. This means that if the p-value from your statistical test is less than 0.05, your results are statistically significant (we would say there is less than a 5% chance that our results occurred due to random chance). If the p-value from your statistical test is greater than 0.05, no statistically significant differences were found

*T-test* – Statistical test that measures the means and spread of data between two groups to determine if there is a difference between the groups (here we use a 2-sample t-test; there are other types of t-tests that you may use in other studies)

*Introduction:*

All Texans know that “Everything is bigger in Texas”. Texas is the second largest state in the U.S., second only to Alaska. Our hair is bigger, our cows are bigger and our parks are bigger (Big Bend National Park). But truly, is everything bigger in Texas?
*Chaetodipus intermedius* (The Rock Pocket Mouse) is a small nocturnal rodent native to the deserts of the southwest (Utah, Arizona, New Mexico and *western* Texas) and Mexico (west Sonoran and Chihuahuan Desert). Most notably, they are tightly associated with rocky substrate, especially where boulders are large and jumbled in rock canyons. Well known research sites include the Afton Lava Flows and in El Paso, they are most likely found in the Franklin Mountains. In rocky canyons, they tend to avoid open patches and wash zones.

This fossorial species is most active in the summertime, increasing in activity with rising temperatures. As temperatures cool in the fall, so does the species, which shortly goes into torpor in the winter. As a heteromyid, this species forages for mostly seeds under bushes and stores food in burrows. The name “pocket mouse” refers to its use of cheek pouches for hoarding food.

Many studies have focused on the wide coloration of *C. intermedius* (See further reading), which ranges from light gray to black. Born naked, offspring receive their coat color in 2-3 weeks, starting with a gray color that matures in approximately 2 months.

**But are they bigger in Texas? Will museums hold the answer?**

Museum specimens have data associated with them, such as location, date collected, and information obtained from the collector. Physical specimens, such as mammal skins, are preserved in a uniform way to allow researchers to study physical attributes long after the specimen has been collected. They also continue to provide genetic resources that can’t be obtained through digitized data. However, images of specimens do enable a lot of remote research. These images often have very high resolution, are taken at the same distance from each physical specimen, have a scale, and have a standardized viewpoint. These traits allow researchers to measure many things on specimens without having to travel long distances, struggle with small features or handle fragile parts. Many of these images are available online through biodiversity databases, such as Arctos, GBIF, or iDigBio and can enable researchers to return to specimens for many different questions. Using both physical specimens and images together facilitates access and research of all kinds.

**Activities**

Today, you will be answering a question together as a class: *Are rock pocket mice in Texas bigger than rock pocket mice in New Mexico in all aspects?*

Your assignment is to answer all of the *questions in italics* in this worksheet (this will include writing, drawing, and recording data); the questions are numbered “Q1-Q10.”

The skin collection of *Chaetodipus intermedius* from Texas and New Mexico has been provided to you in person or digitally. If you have been provided the skin collection to work with, please be gentle. You are working with real research materials that have been used by past scientists and will be used by scientists after you! You will also have been provided enlarged images of the skull collection from multiple views (dorsal, ventral and lateral view of the left side). Note that these skull images are several times larger than the actual specimen. You can also find these images on the Arctos database. Read the instructions below. Write your answers on the worksheet provided in the lab.
Pre-lab Activity: Making observations

Brainstorm (5 minutes):

Q1. Look at the specimens and/or images and make as many observations as possible. Don’t worry about technical vocabulary or limiting yourself. Hint: what differences can you see between multiple specimens? Write your observations below:

Activity 1: Formulating your own question

There are a number of ways to answer today’s overarching class question, but you will decide as a lab pair (or group of 3) how to do so. Namely, what will you measure to determine if a trait on the mice in Texas are larger than in New Mexico?

1. With your lab partner, discuss some observations that you’ve made during your brainstorm about the variation in the specimens you’ve seen.
2. Decide on two variables/traits you will use and measure. (You can measure anything!) Examples of research questions: Are skulls wider in Texas? Are skulls longer in Texas? Are eyeballs larger in Texas? Are tails longer in Texas?

Q2. Name the traits (measurements) you want to take, and answer the following. Give these traits to your instructor so that they can enter them into the data sheet:

Trait 1 Name:________________________________________________________________________
Trait 1 Definition:____________________________________________________________________
Circle one: Is this variable Categorical or Numerical?

Trait 2 Name:________________________________________________________________________
Trait 2 Definition:

Circle one: Is this variable Categorical or Numerical?

3. Diagram/draw your measurement technique. If it’s a linear measurement, draw a line denoting how you will measure the trait on the diagram and describe the trait in words (i.e. from the widest tip of the cheek bone to the nose) You can draw on the following diagrams, or create your own if you are using the taxidermy skins.

Figure 1.—Cranial elements of *Chaetodipus intermedius* illustrating the 12 skull measurements taken. A, skull, lateral view; B, skull, dorsal view; C, skull, ventral view; D, mandible, lateral view. Numbers correspond to the characters listed in Table 1.

Figure from Weckerly & Best, 1985
4. Based on your question and the type of variables you’ve decided to measure, what type of statistical test will you perform?

*Q4. Circle the type of statistical test you’d like to complete*  
- T-test  
- Correlation

5. On the graphs below, draw the possible hypothetical results that you might have. Keep in mind that t-test results can be displayed as bar graphs or boxplots; correlation results can be displayed as lines. Three hypotheses are given for you. **Label the axes with your traits.**

The exact numbers don’t matter. Instead, focus on the relative magnitude of different groups. You don’t need to include units of measurement, but you do need to label your axes. Remember, you are comparing Texas vs. New Mexico.

- $H_{a1}$: Everything is bigger in Texas  
- $H_{a2}$: Everything is smaller in Texas  
- $H_0$: There is very little difference

![Graphs](#)

**Activity 2: Data collection**

6. Refer to the data entry sheet to find catalog numbers belonging to Texas and New Mexico specimens. Remember! In order to answer the question, you will need some specimens of both and may have to work with your classmates to share samples and data. It is sometimes helpful to use a written handout for data collection. On the data entry handout, write the catalog number of what specimens you intend to measure and then measure the specimens with your traits of interest.

**NOTES FOR SKULL MEASUREMENTS:** Mouse skulls are extremely fragile, so UTEP Biodiversity Collections has photographed each skull and included a ruler for scale. Your TA will demonstrate how to convert measurements on the photographed ruler to real measurements.

Once you have finished collecting the data on your worksheet, first find your catalog number (they should be in sequential order) in the google sheet and type in your data in the appropriate columns. Links to each catalog record have been provided if you would like further information.
Activity 3: Statistical analysis: an amazing dashboard that will make a graph, do your statistics, and give you p-value! (TA will demonstrate)

7. With your group, go to your designated Results Dashboard in the Google sheet (Rename your dashboard tab to a team name or your names).
8. Type in your hypothesis
9. Choose the appropriate test in the drop down menu
10. Choose the variables you are testing
11. Based on what you learned, determine if you reject the null hypothesis
12. Select the appropriate value next to “Reject null” (yes or no)
13. Take a look at the graphs that are generated and answer the following:

Activity 4: Results

14. Write down the following to prepare for a brief (2-4 minute) presentation to the class about your results! Your TA will project your data dashboard for your reference.

Q8. State hypothesis:

Q9. State what statistical test you used and why:

Q10. Describe your graph:

Q11. Conclude with acceptance/rejection of hypothesis (include discussion of p-value):

Q12. Do you think you collected enough data to answer your question?

Q13. How confident are you about your results? Why?
Activity 5: Discussion questions (to be completed in class based on everyone’s data)

Q14. According to your data, and the class data, are Rock Pocket Mice bigger in Texas? Why or Why not?

Q15: Come up with 2 more hypotheses you could answer using the Rock Pocket Mouse specimens:

a. Hypothesis that can be answered using a t-test:

b. Hypothesis that can be answered using a correlation or regression:

Assessments
Your lab assignment/homework is to answer all of the questions in italics above. Write your answers in the worksheet in lab.

References and Resources:


Wyatt, M. R. (2020). *Using 2D Dental Geometric Morphometrics to Identify Modern Chaetodipus and Perognathus Specimens (Rodentia, Heteromyidae).* https://scholarsbank.uoregon.edu/xmlui/handle/1794/25411

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Data Collection Sheet

Note: Remember to measure in millimeters. Physical specimens can be directly measured with a ruler or calipers. Images (photos of skulls) are NOT TO SCALE. Remember to multiply your physical ruler/caliper measurement by 0.24 to convert to actual millimeters.

Names: ____________________________________________

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