

# Mini Cases on Choosing Appropriate Statistical Tests for Ecological Data

by

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## Instructions

As scientists, we use statistics to quantify the significance of our results—to determine whether the patterns we observe are the result of a certain stimulus or are merely an artifact of chance. There are a variety of different experimental designs and types of data that we use to study the world around us, and different data require different statistical tests. This activity is designed to provide you with an opportunity to select and apply the appropriate statistical test to a given data set. We will focus on the application and use of four statistical tests: t-test, one-way ANOVA, linear regression, and Chi-square test.

You will work in groups of 3–4 students. Your group will receive a data set related to a habitat use study for eastern cottontail rabbits and a description of why the data were collected. After reviewing these, you and your group will:

1. Write a hypothesis set, both a null and alternative hypothesis, based on the research question provided in the scenario.
2. Determine the appropriate statistical test to evaluate the significance of the results and test your hypotheses.
  - a. *Ask yourself:* What kind of data do I have? Am I comparing groups or evaluating a relationship?
3. Explain why this test is appropriate by describing the evaluation accomplished by using this test.
4. Use the statistical test your group selected to analyze the data set and test your hypothesis.
5. Discuss how to interpret the test results. Are additional tests needed to test your hypothesis? If so, what test would you use?
6. Evaluate the variance calculated in the test and interpret this number.
7. Create a four-slide PowerPoint presentation that includes: a brief description of the data set and research question; your hypotheses; the statistical test you selected to test your hypotheses; your test results and interpretation; a figure depicting your data; and whether you reject or fail to reject the null hypothesis.

## Data Set #1

You have noticed that the field site for your cottontail rabbit research is experiencing declines in understory plant species richness. You suspect that the declines are caused by the spread of an invasive plant, Asian honeysuckle, and consider promoting a more rigorous honeysuckle removal program. To evaluate whether honeysuckle density is affecting understory richness, you set up an experiment where you record plant species richness as a function of honeysuckle density (stems per meter<sup>2</sup>) throughout the property. Using a random sampling design and geographical information system (GIS) to identify sampling points, you measure understory species richness and honeysuckle density resulting in the following **data set**:

Honeysuckle density	Species Richness
23	5
2	15
27	2
31	1
5	10
8	8
36	1
21	3
5	11
12	5

## Data Set #2

To investigate habitat use by cottontail rabbits at your field site, you estimate understory plant species richness. You decide to evaluate canopy cover as a variable that could possibly influence understory richness. You measure and record canopy cover and understory plant species richness at 10 randomly chosen survey sites resulting in the following data set:

Canopy Cover (%)	Species Richness
21	5
33	15
92	2
65	1
31	10
43	8
94	1
76	3
69	11
48	5

### Data Set #3

While investigating habitat use by cottontail rabbits, you decide to evaluate the impact of rabbit browsing on tree sapling growth. To accomplish this, you set up seven exclusion areas (“no predator”) using rabbit-proof fencing and seven non-exclusion areas of equal size with no fencing (“predator”). After two years you compare the mean tree sapling height (cm) from the “no predator” and “predator” treatments.

No Predator	Predator
218.3	52.07
224.8	25.91
244.09	39.88
230.1	46.8
211.33	35.7
250.2	64.2
234.95	59.4

## Data Set #4

A portion of your field site for the study of habitat use by cottontail rabbits in Indiana is also part of a prairie restoration project. In prairies there are a variety of disturbance regimes and management practices used to promote diversity of grasses and prevent the growth of trees and shrubs. Some areas of this field site are managed using controlled burns, grazing by livestock, or both burning regimes and grazing. To evaluate rabbit habitat and grass diversity, you determine the total number of grass species present within areas of prairie experiencing no management, burns, grazing, and both controlled burn and grazing, using seven randomly selected survey sites per area.

No Management	Burn	Grazing	Burn and Grazing
2	9	6	10
3	10	7	14
1	6	11	12
2	8	9	15
4	8	10	8
1	11	8	13
5	7	5	11

## Data Set #5

Habitat use of wildlife is often related directly, at least in part, to diet choice. You are interested in winter food preferences of cottontail rabbits at your field site in Indiana. You calculate the frequency of occurrence of five major food types in diet based on microhistological fecal analysis to determine if rabbits show a preference for a specific food that could be managed to either increase or control cottontail populations.

Diet Item	Frequency of Occurrence
Woody plants	45
Grasses	38
Other herbaceous plants (not grasses)	10
Agricultural plant materials (corn, etc.)	5
Arthropods	2
Total:	100