financialalgebra

# 9.3 Two-Way Tables
## Student Activity Packet
UNIT: PAYING FOR COLLEGE & STATISTICAL ANALYSIS

**Name:**

**IN THIS LESSON, YOU WILL:**

- Identify different types of data, including categorical, numerical, discrete, and continuous.
- Summarize categorical data using two-way tables
- Interpret data in relative frequency tables in context, including identifying associations.
- Analyze real-world data about education and employment

## INTRO

**ANALYZE: Prom Decisions**

The senior class at Evergreen High School is planning their prom! The prom planning committee decides to survey the class on their top options. They ask each senior whether they would prefer to hold prom at Sunset Lodge or the Aquarium and whether they prefer a Under the Sea or Starry Night theme.

Some of the survey results are:

- The survey included 92 different students.
- 20 students said they'd prefer Starry Night at the Aquarium.
- 43 students said they'd prefer Sunset Lodge over the Aquarium.
- 47 students said they'd prefer Under the Sea over Starry Night.
- 18 students said they'd prefer Under the Sea at Sunset Lodge.

Use the above information to answer the following questions. Show all reasoning.

1. **How many students prefer the Aquarium over Sunset Lodge?**

2. **How many students said they prefer both Under the Sea and the Aquarium?**

3. **How many students said they prefer both Starry Night and Sunset Lodge?**

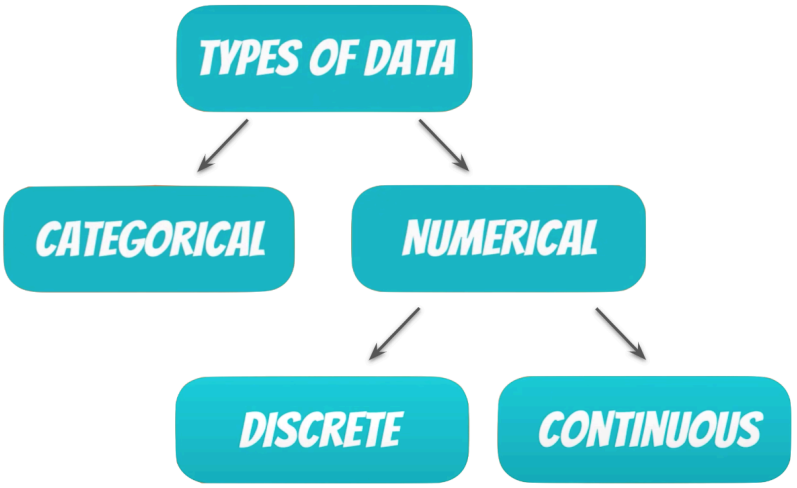
## LEARN IT

**VIDEO: Types of Data: Categorical vs Numerical Data**

In the INTRO, you looked at a survey that gathered **categorical data** about prom options. Watch the video

to learn about the different types of data. Then, answer the questions

1. **Annotate the diagram with a definition or example for each type of data: categorical, numerical, discrete, and continuous.**




2. **Read each survey question below and determine what type of data would be collected in response. For each question, circle categorical, discrete, or continuous.**

| | | | | |
|---|---|---|---|---|
| a. | How tall are you? | Categorical | Discrete | Continuous |
| b. | What is your favorite color? | Categorical | Discrete | Continuous |
| c. | How many pets do you have? | Categorical | Discrete | Continuous |
| d. | Rate your experience on a scale of 1 to 10. | Categorical | Discrete | Continuous |

3. **Think back to the survey from the INTRO. What two categories did the prom committee collect data on? These are called the categorical variables.**

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**VIDEO: Two-Way Tables**

We can organize data on two categorical variables by using a **two-way table**. A two-way table uses rows to represent one categorical variable and columns to represent the second categorical variable. Each cell of the table tells us how many data points fall into that particular intersection and totals are often included at the end of each row and column. Watch the video walkthrough and answer the questions.

1. **Complete the two-way table using the data from the Intro.**

   Some of the survey results are:
   - The survey included 92 different students.
   - 20 students said they'd prefer Starry Night at the Aquarium.
   - 43 students said they'd prefer Sunset Lodge over the Aquarium.

- 47 students said they'd prefer Under the Sea over Starry Night.
- 18 students said they'd prefer Under the Sea at Sunset Lodge.

| | Sunset Lodge | The Aquarium | Total |
|---|---|---|---|
| **Starry Night** | | | |
| **Under the Sea** | | | |
| **Total** | | | |

2. **Which options do you think the prom committee should choose? Explain your reasoning.**

## PRACTICE IT

**High School Graduates: 6 Months Later**
You've finally made it - you've graduated from high school! But what comes next? Let's look at some data to see what recent high school graduates are doing

The table below shows observational data about the education and employment of recent high school graduates. It is based on the nationally representative sample from the Current Population Survey. Study the table and answer the questions below.

| | Enrolled in 4-year college | Enrolled in 2-year college | Not enrolled in school | Total |
|---|---|---|---|---|
| **Employed** | 285 | 228 | 547 | 1060 |
| **Unemployed** (looking for work) | 34 | 14 | 151 | 199 |
| **Not in labor force** (not looking for work) | 863 | 265 | 345 | 1473 |
| **Total** | 1,182 | 507 | 1,043 | 2732 |

Source

1. **What was the population for this table?**

2. **How many people were included in the sample studied?**

3. **What are the two categorical variables being studied in this table?**

4. **How many people surveyed are enrolled at a 4-year college?**

5. **If you wanted to know the total number of high school graduates who were in the labor force, which boxes would you add together?**
   Note: the labor force includes both people who are employed and people who are unemployed and looking for work.

6. **Write one question that you could answer using the information in this table.**

## LEARN IT

**Relative Frequency Table**
The table below shows the same data about recent high school graduates. However, it is organized differently to show the percentage of people who gave each response, instead of the number.

This is called a **relative frequency table**. It is a type of two-way table that shows percentages rather than counts. It is helpful for seeing if there is an association between two variables.

| | Enrolled in 4-year college | Enrolled in 2-year college | Not enrolled in school |
|---|---|---|---|
| **Employed** | $\frac{285}{2732} = 10\%$ | $\frac{228}{2732} = 8\%$ | $\frac{547}{2732} = 20\%$ |
| **Unemployed** (looking for work) | $\frac{34}{2732} = 1\%$ | $\frac{14}{2732} = 1\%$ | $\frac{151}{2732} = 6\%$ |
| **Not in labor force** (not looking for work) | $\frac{863}{2732} = 32\%$ | $\frac{265}{2732} = 10\%$ | $\frac{345}{2732} = 13\%$ |

1. **The denominator used to calculate each percentage is 2732. What does that represent?**

2. **Out of all recent high school graduates, what percentage are enrolled in a 4-year college and employed?**

3. **Find the cell with the value 6%. What is that cell telling you?**

4. **What percentage of recent high school graduates are enrolled in a 4-year college?**

5. **If 3 million students graduate from high school in 2025 and these trends stay the same, how many graduates would you expect to attend 2-year college after graduation?**

## EXPLORE IT

**Playing with Percentages**

The table above tells you the percentage of ALL the recent high school graduates who gave each answer. But what if you want to focus on only high school graduates who are enrolled in 2-year colleges? Or only high school graduates who are employed?

Using the same data set, let's calculate a couple of percentages that will tell us more about those graduates.

1. **1060 recent graduates said they were currently employed. 228 recent graduates said they were both currently employed AND enrolled in 2-year college. Out of recent graduates who are employed, what percentage were enrolled in 2-year college?**

2. **507 recent graduates said they were currently enrolled in 2-year college. 228 recent graduates said they were both currently employed AND enrolled in 2-year college. Out of recent graduates who are enrolled in 2-year college, what percentage were employed?**

3. **In the relative frequency table above, you saw another percentage describing the same group of 228 graduates: 8% of all recent graduates said they were both currently employed AND enrolled in 2-year college. Why are these three percentages different?**

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**Represented Another Way**

Mahlet wanted to find out if educational enrollment was associated with employment. Using the same data set about recent high school graduates, she built a different relative frequency table to compare the percentage of people who were employed, unemployed, or not in the labor force across each educational group.

**Mahlet's Table: Employment by Educational Enrollment**

| | Enrolled in 4-year college | Enrolled in 2-year college | Not enrolled in school |
|---|---|---|---|
| **Employed** | $\frac{285}{1182} = 24\%$ | $\frac{228}{507} = 45\%$ | $\frac{547}{1043} = 52\%$ |

| | | | |
|---|---|---|---|
| **Unemployed** (looking for work) | $\frac{34}{1182} = 3\%$ | $\frac{14}{507} = 3\%$ | $\frac{151}{1043} = 14\%$ |
| **Not in labor force** (not looking for work) | $\frac{863}{1182} = 73\%$ | $\frac{265}{507} = 52\%$ | $\frac{345}{1043} = 33\%$ |
| **Total** | $\frac{1182}{1182} = 100\%$ | $\frac{507}{507} = 100\%$ | $\frac{1043}{1043} = 100\%$ |

1. **How is Mahlet's table different than the other tables we've seen for this data set?**

2. **Out of all recent high school graduates enrolled in a 4-year college, 73% are not in the labor force. Make an inference - why do you think that percentage is so high?**

3. **Out of recent high school graduates who are not enrolled in school, what percentage are employed?**

## LEARN IT

**Associations Between Variables**
You've learned about correlation in previous lessons; when we talk about two-way tables, we use the term association to mean something similar.

**Association** refers to a relationship between two variables: when one variable changes, so does the other one. **Correlation** is a type of association that tells us more about the shape and strength of the relationship.

We can use relative frequency tables to determine whether two variables have an association. One of the easiest ways to know if there is an association is to work backwards: check if the variables have NO association. If there's no association, the relative frequency values should be very similar across each column or row.

**Part 1: No Association**
The table below is an example of two variables with no association; it shows the percentage of American children with health insurance by age. You can see that the percentage of children with health insurance stays approximately the same in each age group.

| | Has Health Insurance | No Health Insurance |
|---|---|---|
| **<3 years old** | 94% | 6% |
| **3-5 years old** | 95% | 5% |
| **6-11 years old** | 95% | 5% |
| **12-18 years old** | 94% | 6% |

Source

1. **Hypothesize: why is there no association between age and having health insurance for children?**

2. **How might the table be different if there was an association - if children were less likely to have health insurance as they got older?**

**Part 2: Association**

The table below shows the percentage of American adults with health insurance by education level. Study the table and answer the questions.

| | Has Health Insurance | No Health Insurance |
|---|---|---|
| **No high school diploma** | 68% | 32% |
| **High school graduate** | 84% | 16% |
| **Some college, no degree** | 89% | 11% |
| **Associate's degree** | 91% | 9% |
| **Bachelor's degree** | 94% | 6% |
| **Graduate degree or higher** | 97% | 4% |

Source

3. **Find the cell in the table with the value 91%. What is this cell telling you?**

4. **Based on this observational data, Owen concludes that there is an association between education level and having health insurance. What evidence from the table supports that conclusion?**

5. **Imagine a law passed tomorrow that required everyone to complete at least an associate's degree. Do you think that would that cause more Americans to have health insurance? Why or why not?**

6. **Make an inference: What is one other variable that you think could be related to either education and/or health insurance?**

7. **Review Mahlet's relative frequency table from the previous activity. Is there an association between educational enrollment and employment for recent high school graduates? Explain your reasoning.**

Mahlet's Table: Employment by Educational Enrollment

| | **Enrolled in 4-year college** | **Enrolled in 2-year college** | **Not enrolled in school** |
|---|---|---|---|
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| **Total** | $\frac{1182}{1182} = 100\%$ | $\frac{507}{507} = 100\%$ | $\frac{1043}{1043} = 100\%$ |

## APPLY IT

Follow your teacher's directions to complete the Application Problems.