**Instructional Days:** 12-14

**Topic Description:** Bar plots and the differences between categorical and continuous data are explored. Mosaic plots are introduced as a vehicle for comparing categorical data and looking for trends in data.

**Objectives:**

The students will be able to:

* Read and interpret a bar plot.
* Create bar plots.
* Differentiate between categorical and continuous data.
* Compare two categorical sources with mosaic plots.
* Look for trends by analyzing various plots.

**Outline of the Lesson:**

* Journal Entry (5 minutes)
* Birth Month Bar Plot (15 minutes)
* Experiment with bar plot commands (30 minutes)
* Public Agenda Bar Plot Activity (45 minutes)
* Journal Entry (5 minutes)
* Public Agenda data and mosaic plots (60 minutes)
* Wrap up Question (5 minutes)

**Student Activities:**

* Complete journal entry.
* Participate in Birth Month Bar Plot discussion.
* Experiment with bar plot commands.
* Complete Public Agenda Bar Plot Activity.
* Complete journal entry.
* Respond to questions during guided discussion.
* Complete questions in Public Agenda Data and Mosaic Plots Activity.
* Provide responses to the wrap up question and participate in discussion.

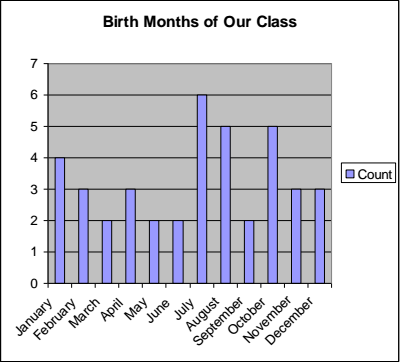
**Teaching/Learning Strategies:**

* Journal Entry: If everyone were going to be put in a different group based on the MONTH in which they were born, how many groups would there be? Which group do you think would have the most people?
* Birth Month Bar Plot
  + Tell students that you are going to create a bar plot (also called a bar graph or bar chart) of everyone’s birth month to answer the journal question.
  + Have students help you create the skeleton of a bar plot like Sample Birth Month Bar Plot. You should end up with a similar chart, but without any counts (bars).
  + Ask each student what their birth month is. Increase the height of the corresponding bar by one until the entire class has responded.
  + The bar plot should be used for categorical data only.
  + Categorical data is expressed in terms of specific category values or labels (e.g., days of the week, answers to a multiple choice survey).
  + Explain to the students that if we tried to do a bar plot of every student’s exact height (example of 68.901 inches), we would most likely end up with a bar plot with a bar for every student each with a height of one. This type of data is quantitative (e.g., decimal numbers).
* Public Agenda Data and Bar Plots
  + Explain that the survey data file holds data collected by a private research group called Public Agenda (www.publicagenda.org). It is a survey of high school students and their parents designed to see if both groups have the same view of what's working (or not) with our schools. The people in the survey were identified by random selection from a list of all high school students in the United States. Respondents were asked over 100 questions—the file that will be used is a small subset.
  + Have students load the survey data file. Ask questions such as: How many different students are represented? (1293) How many different questions were asked of a student. (Survey contains four (4) of the over 100 questions.)
  + Ask: What are the variables?
    - **"year"** is their year in school
    - **"effort"** describes how hard they are working at doing well in school
    - **"homework"** describes their view of the amount of homework they are getting, and
    - **"grades"** records how well they said they are doing in school
  + Look at the Variable View in the data viewer. Here you see the type of each variable and possible values that are assigned to each variable. Factor is the type for categorical variables.
  + Demonstrate how to use the plot tool to create a bar plot. Point out that a bar plot is a graphical representation of the table and each bar should correspond to the count in the table.
  + Have students complete Public Agenda Bar Plot Activity individually.
  + Lead a discussion of the answers to Public Agenda Bar Plot Activity.
    - Each of the responses should generate a discussion beyond the simple solutions.
* Journal Entry: Do you think there is a relationship between grades and effort? If so, what type of relationship do you think grades and effort might have?
* Public Agenda Data and Mosaic Plots
  + Reload the survey data file, if necessary.
  + Demo looking at two variables at once with mosaic plots and guide a discussion with students.
    - Note that in the previous section bar plots about grades and effort were looked at separately.
    - A good question to ask is “are the two related?”
      * Discuss the journal entry.
    - Create a contingency table with data to show the relationship between the answers to the two questions.
      * The table will appear in the Console window. Ask students to explain what the items in the table mean. For example, there are 311 students that earned an A and are trying their best to do well in school. To represent this graphically, we can use a mosaic plot.
  + Demo how to create a mosaic plot to graphically compare the 2 categorical variables grade and effort.
  + How to interpret the mosaic plot:
    - The wider the columns, the more responses there are in that category.
      * Point out that the labels may not line up correctly.
    - Allow students time to respond individually to questions such as the following before discussing them as a group.
      * What grade is the most common?
      * What grade is the least common?
      * Does that reflect the numbers in the table?
    - Within each column, the taller the row, the more responses there are in that category.
    - Allow students time to respond individually to questions such as the following before discussing them as a group.
      * Within those students with A’s, are most of them trying their best or could they try harder?
      * Within those students with B’s, are most of them trying their best or could they try harder?
      * All the sizes are proportional to the numbers in the tables. So if twice as many respond a certain way, then the height would be twice as tall in the mosaic plot.
      * Looking at the mosaic plot as a whole, is there a trend? What story does it tell?
  + Have students complete the Public Agenda Data and Mosaic Plots Activity individually.
  + Discuss student responses and ask probing questions that will lead to discussion of the data.
* Wrap up question: Which items used when tagging events with phones are categorical?
  + Ask students to provide a response. Discuss their responses to make sure they understand the difference between categorical and quantitative data.

**Resources:**

* Sample Birth Month Bar Plot
* Public Agenda Bar Plot Activity
* Public Agenda Data and Mosaic Plots Activity
* Deducer Quick Start Guide

**Sample Birth Month Bar Plot**

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**Public Agenda Bar Plot Activity**

1. Create a bar plot for effort.

* Copy the plot to a document.
* How does the effort of the students that responded compare?

2. Create a bar plot for homework.

* Copy the plot to a document.
* How much homework did most students respond that they have?
* How do you think that compares with students at your school?
* If you think responses about homework are different from those at your school, why do you think students in this survey might have responded as they did? How could you test your assumption?

3. Create a bar plot for grades.

* Copy the plot to a document.
* What grade is most common?
* How do you think that compares with students at your school?
* If you think grades are different from those at your school, why do you think students in this survey might have responded as they did? How could you test your assumption?

**Public Agenda Data and Mosaic Plots Activity**

1. Create a contingency table with effort as the row and grade as the column.

* How does this table compare to the one with grade as the row and effort as the column?

2. Create a mosaic plot with (effort, grades)

* What do you see in this plot?
* Compare your plot to the one done previously. Does it tell a different story? Justify your answer with features of the plot.

3. Try making mosaic plots with three different combinations of the available variables: year, effort, homework, grades. Choose one of these other plots, describe what you see, and explain what story it tells.