



### Math Objectives

- Students will represent bivariate categorical data with bar charts and split bar charts.
- Students will examine and describe patterns in bivariate categorical data by displaying frequencies in a two-way table.
- Students will use relative frequencies to identify a possible association between the two variables.

### Vocabulary

- bivariate data
- categorical data
- split bar chart
- two-way tables

### About the Lesson

- This lesson involves using given bivariate and multivariate categorical data to display bar charts and construct two-way tables.
- As a result, students will:
  - Construct bar charts and split bar charts for categorical data.
  - Build tables and two-way tables by gathering information in the charts.
  - Find any patterns of association in the charts or tables.

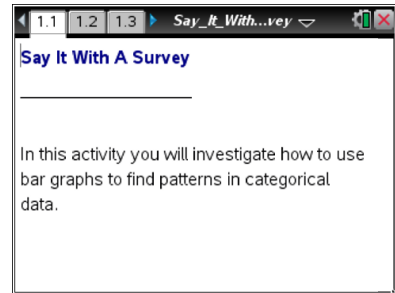


### TI-Nspire™ Navigator™

- Send out the *Say\_It\_With\_A\_Survey.tns* file.
- Monitor student progress using Class Capture.
- Use Live Presenter to spotlight student answers.

### Activity Materials

- Compatible TI Technologies: TI-Nspire™ CX Handhelds, TI-Nspire™ Apps for iPad®, TI-Nspire™ Software



### Tech Tips:

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at <http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials>

### Lesson Files:

#### *Student Activity*

- Say\_It\_With\_A\_Survey\_Student.pdf
- Say\_It\_With\_A\_Survey\_Student.doc

#### *TI-Nspire document*

- Say\_It\_With\_A\_Survey.tns

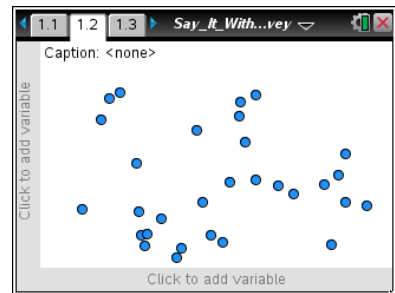


### Discussion Points and Possible Answers

**Teacher Tip:** This TI-Nspire document contains responses from 30 students. The categorical variables included are gender, music, phone\_type, and tv\_source. The variable, **siblings**, is the only numeric variable. This data are displayed in a table found on the last page of this document.

#### Move to page 1.2.

This TI-Nspire document contains data from 30 middle grades students. The survey asked each student to provide information about their music preference and how many siblings they have. The document also includes information about their television source at home, the telephones used at home, and their gender.



1. What kinds of music do the students surveyed prefer? To find out, you will construct a bar chart to show the music preferences of the survey students. Follow these directions:
  - Select the bottom of the page where the horizontal axis should be placed, and select the categorical variable **music**.
  - Select **MENU > Plot Type > Bar Chart** to change to a bar chart.
  - Select the bars to reveal the values.

**Tech Tip:** Use `tab` to quickly move to the x and y axes and select the variable.

**Tech Tip:** Tap and choose **Plot Type > Bar Chart** to display a bar chart. Students may need to back-out to the main Tools menu.

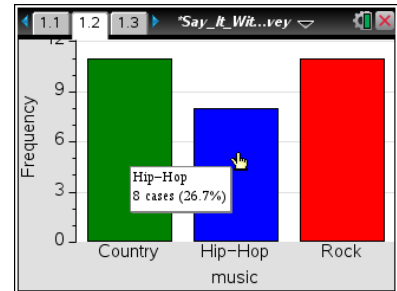
**Tech Tip:** Display the table found at the end of these Teacher Notes. Let your students know that the variables are stored in the document as lists, so students can plot them on the coordinate axes. Initially, the axes are not shown on the Data & Statistics page. When students select the bottom of the page where a horizontal axis should be placed, they will see the choice of stored independent variables. After they select the variables, they can create a bar chart. Have students move the cursor over the bars to display the frequencies and percents.



2. Use the bar chart to complete the table below. How many students favor country, hip-hop, or rock? Explain what you find.

**Sample Answer:** The students seem to like Country and Rock slightly more than Hip-Hop.

Country	Hip-Hop	Rock	Total
11	8	11	30



#### TI-Nspire Navigator Opportunity: *Quick Poll*

See Note 1 at the end of this lesson.

3. Can we find out if there are different music preferences for boys and girls? To do that, construct a split bar chart for music preferences split by gender. Use these directions:

- Select **MENU > Plot Properties > Split Categories by Variable**.
- Select the variable **gender**.
- Move your cursor over the bars in the bar chart to see the frequency values and percents.

- a. What do you notice in the split bar chart?

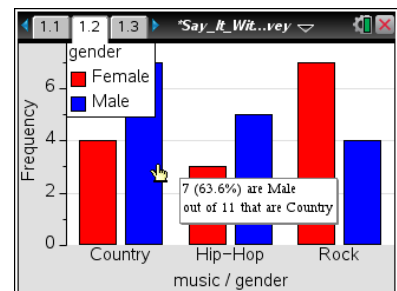
**Sample Answer:** More males like Country than females. More males like Hip-Hop than females, and more females like Rock than males.



**Tech Tip:** Select  > **Plot Properties > Split Categories by Variable**. Students may need to back-out to the main Tools  menu.

- b. What does this split bar chart tell you that the regular bar chart didn't show? Explain.

**Sample Answer:** The split bar chart shows the three preferences divided into male and female so we can compare those as well.



#### TI-Nspire Navigator Opportunity: *Class Capture*

See Note 2 at the end of this lesson.



4. a. Use the bar chart to complete the two-way table below.

Music / Gender	Country	Hip-Hop	Rock	Totals
Female	4	3	7	14
Male	7	5	4	16
Totals	11	8	11	30

- b. Describe what you find for each preference.

**Sample Answer:** The results are shown in the table. Nearly twice as many males prefer Country than females. With Hip-Hop, the preferences are nearly the same. Nearly twice as many females prefer Rock music than males.

**Teacher Tip:** Let students know that two-way tables and split bar charts allow easy comparisons of bivariate categorical data. Relative sizes of the bars and the frequency values allow you to see patterns in the data that are not easily found when the data is presented in total.

5. Examine the table and bar chart to make relative comparisons of some of the entries. Based on the split bar charts and two-way table:
- a. Of those preferring “Country,” how many are males and how many are females? List the values for males and females and then express your answer as a ratio.

**Answer:** 7 males and 4 females; 7:4

- b. Of those preferring “Hip-Hop”, how many are males and how many are females? List the values for males and females and then express your answer as a ratio.

**Answer:** 5 males and 3 females; 5:3

- c. Of those preferring “Rock”, how many are males and how many are females? List the values for males and females and then express your answer as a ratio.

**Answer:** 4 males and 7 females; 4:7

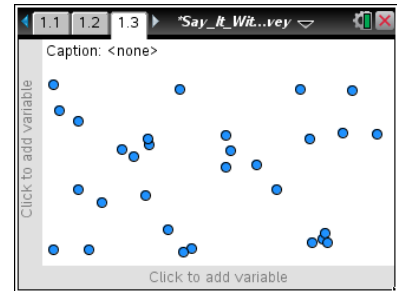


#### TI-Nspire Navigator Opportunity: *Quick Poll*

See Note 1 at the end of this lesson.

Move to page 1.3.

- 6. The survey data include the number of siblings each student has reported. These data will allow us to answer questions related to families of various sizes. You will now construct a bar chart to show the number of siblings reported in the survey:




**Tech Tip:** Numeric values are plotted in histograms and box plots.

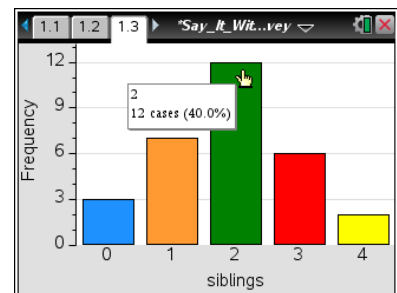
There are times when it might make sense to treat number values as categories. In order to change numeric data into categorical data you need to select **MENU > Plot Properties > Force Categorical X** to force the numerical values to become categorical. After doing this, you can make a bar chart with numerical data that is now treated as categorical data.



**Tech Tip:** Select  > **Plot Properties > Force Categorical X**.

Students may need to back-out to the main Tools  menu.

- Select the bottom of the page where the horizontal axis should be placed, and select the categorical variable **siblings**.
- Follow this sequence to change the numerical data to categorical: **MENU > Plot Properties > Force Categorical X**.
- Next, select **MENU > Plot Type > Bar Chart** to change to a bar chart.



- 7. a. Use the bar chart to complete the table below.

Zero Siblings	One Sibling	Two Siblings	Three Siblings	Four Siblings	Total
3	7	12	6	2	30

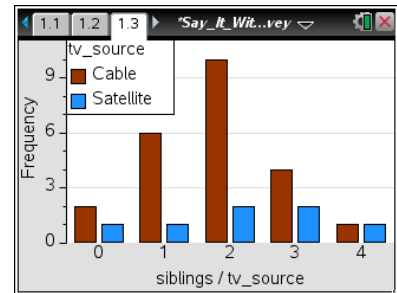


b. Describe the shape of the distribution and the range of data.

**Sample Answer:** The distribution is mound-shaped and ranges from 0 to 4.

8. This survey might provide answers to various questions. For instance, one question might be: Is there a relationship between family size (the number of siblings) and the source for a television signal?

Now you will construct a split bar chart for the number of siblings students have based on the television source:



- Select **MENU > Plot Properties > Split Categories by Variable**.
- Select the variable **tv\_source**.
- Move your cursor over the bars in the bar chart to see the frequency values and percents.



**Tech Tip:** Select  > **Plot Properties > Split Categories by Variable**. Students may need to back-out to the main Tools  menu.



**TI-Nspire Navigator Opportunity: Class Capture**

See Note 2 at the end of this lesson.

9. a. Use the bar chart to complete the two-way table below.

Siblings / Television Source	Zero Siblings	One Sibling	Two Siblings	Three Siblings	Four Siblings	Totals
Cable	2	6	10	4	1	23
Satellite	1	1	2	2	1	7
Totals	3	7	12	6	2	30

b. What do the split bar chart and the data in the table tell you?

**Sample Answer:** The data in the table and the split bar chart tell us that cable is used as the television signal source most often. The only case where the cable and satellite users are equal is in families with 4 siblings (5 total children), but this may not be an accurate representation of television sources in 4 sibling households because the sample of 4 sibling households is so low in this survey.



**Teacher Tip:** When the frequency value for a cell in a two-way table is low, you have to be careful with relative comparisons. A change of just a few values can really change a relative comparison. Also, note that some of the ratios can be expressed more than one way. Encourage a discussion about the different ways a ratio can be expressed to make a connection to proportional reasoning.

10. Examine the table and bar chart to make relative comparisons using ratios of some of the entries.

a. What patterns stand out in the two-way table or split bar chart? Explain.

**Sample Answer:** For the students with two siblings, cable was selected 10 to 2 (5 to 1) over satellite. For students with one sibling, cable was selected 6 to 1 over satellite. For students with three siblings, cable was selected 4 to 2 (2 to 1) over satellite. These ratios would change greatly if slight changes were made to the cells with low frequencies.

b. Is there a consistent choice of television source for all family sizes? Explain.

**Sample Answer:** No. It is not clear what the relative sizes would be for families with a single child or with five children because the frequencies are low, but it is apparent that cable has been chosen over satellite for other family sizes.



**TI-Nspire Navigator Opportunity: Quick Poll**

See Note 1 at the end of this lesson.



**TI-Nspire Navigator Opportunity: Quick Poll**

See Note 3 at the end of this lesson.

11. Record at least three survey questions you plan to ask in the space below.

**Sample Answer:** Answers will vary. Some questions might include: What type of mobile phone do students use? How far away from school do students live? What mode of transportation do students use to get to school?

**Teacher Tip:** Students need to select categories of questions that are appropriate, interesting, and have a limited number of responses. Students should ask questions that generate interest in data gathering and topics that their age group considers important. Students should be cautioned not



to ask questions that have several responses. When there are several such options, the cells of the two-way table will likely have low frequency values. Discuss several options for questions with your students.

12. After your teacher approves your survey questions, your task is to administer the survey and create your own TI-Nspire document with bar charts and split bar charts. Follow these steps:

- Add a **new problem** to the existing document.
- Enter the responses from your survey into a spreadsheet. Make sure to label each spreadsheet column.
- Add a Data & Statistics pages to display bar graphs and split bar graphs, and then create these charts.
- Record the information from your bar charts into tables on separate sheets of paper for presentation to the rest of the class.
- Describe and analyze what you find in your bar charts and tables in paragraph form.
- Record the information in your split bar charts into two-way tables for presentation.
- Describe and analyze what you find in your split bar charts and two-way tables in paragraph form.



**Tech Tip:** To add a new problem, select **Add >** **Problem >** **Lists & Spreadsheet.**

## Wrap Up

Upon completion of the lesson, the teacher should ensure that students are able to understand:

- How to construct a split bar chart given two lists of categorical data.
- How to construct a two-way table from a split bar chart.
- How to confirm that the representations provide some matching ordered pairs.

## Assessment

Students will collect categorical data and numerical data through a survey. Let students construct split bar charts and two-way tables. Use *Class Capture* and *Live Presenter* to provide opportunities for students to share their findings.



## TI-Nspire Navigator

### Note 1

#### Quick Poll

Use open-response questions in Quick Poll to collect students' answers to questions about relative comparisons using information in tables or charts for class discussion.





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### Note 2

#### Class Capture

Use Class Capture to show student bar charts and split-bar charts to monitor student progress.

### Note 3

#### Quick Poll

Use open-response questions in Quick Poll to collect students' ideas about potential survey topics that are appropriate, interesting, and with a limited number of responses.



## Say It With A Survey Data

	<b>Gender</b>	<b>Television Source</b>	<b>Phone Type</b>	<b>Favorite Music</b>	<b>Siblings</b>
1	Male	Cable	Cell	Country	1
2	Male	Cable	Landline	Country	0
3	Male	Cable	Both	Rock	3
4	Male	Cable	Both	Rock	2
5	Female	Cable	Landline	Country	1
6	Male	Cable	Both	Hip-Hop	3
7	Female	Cable	Cell	Country	2
8	Female	Cable	Cell	Rock	2
9	Male	Cable	Cell	Country	2
10	Male	Cable	Landline	Hip-Hop	3
11	Female	Cable	Cell	Rock	4
12	Female	Satellite	Cell	Hip-Hop	1
13	Female	Cable	Landline	Rock	2
14	Female	Satellite	Landline	Rock	3
15	Female	Cable	Both	Country	2
16	Male	Cable	Cell	Hip-Hop	1
17	Female	Satellite	Cell	Rock	4
18	Male	Cable	Both	Hip-Hop	2
19	Male	Satellite	Both	Hip-Hop	2
20	Female	Satellite	Both	Country	3
21	Male	Cable	Cell	Rock	2
22	Male	Cable	Both	Country	1
23	Female	Satellite	Both	Hip-Hop	0
24	Male	Cable	Both	Country	2
25	Female	Satellite	Cell	Rock	2
26	Male	Cable	Both	Country	2
27	Female	Cable	Landline	Rock	3
28	Female	Cable	Both	Hip-Hop	1
29	Male	Cable	Both	Country	0
30	Male	Cable	Cell	Rock	1