Hung Up on Histograms? Hang On to Explore the Hilly Terrain of Histograms!		
Description	**Instructor Notes**	**Slides/Handouts/Files**

Explore data representation with histograms on the TI-73 Explorer using numerical data. Distinguish between appropriate and inappropriate representations for data based on essential features of histograms. Explain how conventions in constructing histograms may be manipulated to highlight certain features of the data while obscuring other features of the data. Determine which statistics (range, mode, median, mean) may be appropriately applied to describing data represented in histograms.
 	
Key Questions to Explore:
  1. What are essential features of histograms?
  2. What conventions help to make sense of data in histograms?
  3. What conventions of
	1. Noticing features of histograms:
	  a. Show four different histograms (i.e., using discrete numerical data and continuous numerical data).
	  b. Have students examine these histograms to identify similarities and differences.
	  c. The focus of this discussion should reflect the features of histograms (e.g., bars are used to represent the data, each bar represents an interval on a given scale, the length of each bar tells how much or how many of something, bars are usually equal width); and features of the data (e.g., a range of data values with frequencies, if it matters the size of the intervals, if it matters that bars could be arranged in a different order)
	2. Collect data from students (e.g., number of letters in your name; height in centimeters). Be sure to ask at least two survey questions to collect some data that is discrete numerical data and some data that is continuous numerical data. One way to collect data is for each student to have a separate sticky note for each survey question. Each student writes her/his answer to each question on a separate sticky note.
	3. Organize the data from the class. Gather the sticky notes from each student according to each question and sort the responses for each question, or have students post their sticky notes with responses for one of the questions on the wall/board for the class to sort. Decide what information indicates the intervals, and what information indicates the frequencies for each interval.
	4. Have students enter the data in lists on the TI-73 Explorer.
	5. Set up the following plots (remember to check and adjust the WINDOW):
	  a. histogram plot with discrete (integer) numerical data and Xscl of 1
	  b. histogram plot with integer numerical data and Xscl of 0.5
	  c. histogram plot with integer numerical data and Xscl of 5
		• Sample Histograms to Compare – may be used to compare similarities and differences in the first step of this activity.
		• Conventions for Histograms – may be used by the instructor as background information on key ideas for data analysis with histograms.
		• Descriptive Statistics and Histograms – may be used by the instructor as background information on key ideas for using statistics appropriately with histograms.
		• Student Sheet –Hung Up on Histograms? Hang On to Explore the Hilly Terrain of Histograms!
		• Instructions for entering data in lists on TI-73 Explorer (See the

histograms are not necessary to make sense of the data? 4. When is it appropriate to use a histogram to display data? 5. What does the TI-73 Explorer assume about the data for making a histogram? 6. What does the TI-73 Explorer allow (correct and incorrect), and what do you need to know to set up a meaningful plot for a histogram?	d. histogram plot with continuous data and Xscl of 1 e. histogram plot with continuous data and Xscl of 0.5 f. histogram plot with continuous data and Xscl of 5 6. Discuss each plot for conventions used in displaying data with histograms (e.g., what each bar represents, what the length of each bar represents, data values included in each interval, the effect of the size of the interval on the visual image of the data represented in the histogram). 7. Discuss how the TI-73 Explorer deals with each convention, implicitly or explicitly. Discuss the implications for manipulating the view of the data by exploring different sizes of the interval, and when the TI-73 Explorer shows an error message for the plot because the size of the interval is too small relative to the data values and limits of the pixels of the screen display). Analyze and interpret the data represented in each histogram. 8. Calculate the descriptive statistics for each set of data represented in the histograms (range, mode, median, mean). 9. Discuss how the statistics make sense for the data represented and have students explain how the statistics describe the data represented.	manual for the TI-73 with Graph Explorer Software, Chapter 5: Lists) • Instructions for setting up plots for histograms on TI-73 Explorer (See the manual for the TI-73 with Graph Explorer Software, Chapter 6: Statistical Plots)

Participant Discussion Questions and Sample Responses

1. *Examine these histograms.* **[Examples are provided in the *Sample Histograms to Compare* document.]**

• *What do the bars represent?* **[Each bar represents an interval on the scale.]**

• *What do the lengths of the bars represent?* **[The length of a bar represents the frequency of data values within each interval.]**

• *What does each histogram show about the data?* **[List statements that can be concluded about the data represented in each histogram. Some examples are provided in the *Conventions for Histograms* and *Descriptive Statistics and Histograms* documents.]**

• *What features of the data are highlighted or shown in the histogram?* **[It is typically easy to see how many or how much of each interval; it is relatively easy to compare the frequencies; the histogram can provide a visual image for how spread out the data might be, or if the data are clumped together.]**

• *What features of the data are not shown or hidden in the histogram?* **[What portion of all the data represented is a certain numerical value; when representing numerical data (such as how many people own a certain number of calculators) keeping track of what the numbers mean might be confusing.]**

- *Is there a reason for the intervals to be a particular size? What is helpful about having the intervals this size? Would it matter if the intervals were a different size? How would different-sized intervals change the interpretation of the data represented?* **[Several examples are provided in the *Conventions for Histograms* document; each set of data (discrete numerical data, and continuous numerical data) is represented in multiple plots with different-sized intervals for each plot of the data.]**
- *How are these histograms similar, and how are they different, from each other?* **[All use bars to compare frequencies of data values; all have equal width bars/intervals; the size of the interval may be changed to change the shape of the graph, but the data values are not changed.]**
- *Which histograms show discrete numerical data?* **[For example: How many calculators does each person own?]**
- *Which histograms show continuous numerical data?* **[For example: How many centimeters tall are you?]**
2. *Collecting data: sample survey questions are provided in the Conventions for Histograms document, or you may design your own survey questions. Be sure to include at least one survey question that results in categorical data and at least one survey question that results in numerical data.*
3. *Organizing the data collected by students:*
- *How can we sort this data to make sense of it?*
- *What kind of data was collected for this survey question (e.g., numerical data as discrete counts or integers, or continuous data)?*
- *What size interval makes sense for the data values?*
- *How might the data be grouped or organized to determine the frequencies of data values within each interval?*
4. *Enter data in lists on the TI-73 Explorer.*
5. *Set up the plots for histograms of the data.*
6. *Examine the histograms of the data on the TI-73 Explorer.*
- *What do the bars represent?*
- *What do the lengths of each bar represent?*
- *Explain how it would change the visual effect of the histogram for analyzing or interpreting the data if the size of the intervals was changed.*
7. *Histograms have several conventions (features that are agreed upon by mathematicians and statisticians) for what the bars represent, what the lengths of each bar represent, the width of the intervals, and which values on the x-axis are included within an interval. Answer the questions below by using the TI-73 Explorer to manipulate the data for your histograms in the following ways, and compare the new histograms with the original histogram:*
    a) Change the size of the interval so that the histogram has no gaps (all intervals within the range of the data have a frequency of at least one.
    b) Change the size of the interval so that there are only two bars that include all of the data.
    c) Change the size of the interval so that the histogram looks like a bar graph with equal spaces between the bars (if possible).

d) Change the size of the interval to be too small so that an error message appears.

- *Why are certain conventions helpful when displaying data in histograms?*
- *What conventions about histograms does the TI-73 Explorer automatically use to display the data?*
- *Which conventions of histograms does the TI-73 Explorer allow to be manipulated?*

8. *Calculate the descriptive statistics of range, mode, median, and mean for the data represented in each histogram.*

9. *Consider the statistics you calculated and the related histogram:*

  - *How does the histogram visually help to see each of these statistics?*
  - *Which statistics are relatively easy to "see" in the histogram? Explain.*
  - *Which statistics are not easily made visible in the histogram? Explain.*
  - *How might the size of the interval be manipulated to help visualize these statistics? Which representations are helpful for analyzing and interpreting the data?*
  - What happens when the interval is devised so that the data is split into two intervals around the median value of the data? What do you have to think about in order to determine the WINDOW that will produce this histogram of the data?
  - What other ways can you partition the data into intervals? What does the resulting histogram show or reveal (or hide) about the data?

Questions for prospective and practicing teachers

based on the National Council of Teachers of Mathematics Content and Process Standards for Grades 6-8

Data Analysis and Probability

- *Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them*

  What topics or information might be interesting to your students for designing questions to collect data?

  How might you support students to develop and refine their own questions to pursue for collecting data?

  What methods will students use to collect and organize the data?

  - *select, create, and use appropriate graphical representations of data*

    How might you support students' thinking so that they are able to determine what are appropriate graphical representations of the data they collected?

    What role will technology have in the creation of representations of data collected (e.g., graphing hand-held; spreadsheet software; etc.)?

    How might students use graphical representations to analyze the data collected?

- *Select and use appropriate statistical methods to analyze data*

  How might you support students in determining which statistics are meaningful for analyzing the data they collected?

  What methods of calculating appropriate statistics are meaningful to your students?

  - *find, use, and interpret measures of center and spread*

    What tools or materials might be helpful for students when finding appropriate statistics for data collected?

    How might you support students' interpretation of the statistics used to describe the data they collected?

    How might graphical representation of the data help students to make sense of the statistics that describe the data?

Representation

- *Create and use representations to organize, record, and communicate mathematical ideas*

  What will students need to know to use technology appropriately in creating meaningful representations of the data they collected?

  How might students use appropriate graphical representations to communicate analysis of the data to answer the original question posed for collecting the data?