# TAKE IT TO THE MAT

A NEWSLETTER ADDRESSING THE FINER POINTS OF MATHEMATICS INSTRUCTION

Southern Nevada Regional Professional Development Program
April/May 2004 — Elementary School Edition
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*Stem-and-leaf plots* are a means to chart data based on place value. They work well with small data sets—50 or less pieces of data—and serve to both organize data as well as graph it. In the last issue of *Take It to the MAT*, we learned how to create a stem-and-leaf plot. This time, in our final double issue for the 2004–2005 school year, we'll look at its brother—the *histogram*.

| Number of Steps |
|---|
| 36 |
| 44 |
| 23 |
| 18 |
| 16 |
| 54 |
| 59 |
| 52 |
| 43 |
| 9 |
| 35 |
| 49 |
| 38 |
| 23 |
| 53 |

Look closely at the data table and its accompanying stem-and-leaf plot. (See the March 2004 issue for more details.) The stems represent tens of steps, the leaves represent ones. Each line of the plot is a group or interval of ten possible observations. The "1" stem contains all data between 10 and 19. The "5" stem contains leaves of all data between 50 and 59.

| Stems \| Leaves |
|---|
| 0 \| 9 |
| 1 \| 68 |
| 2 \| 33 |
| 3 \| 568 |
| 4 \| 349 |
| 5 \| 2349 |

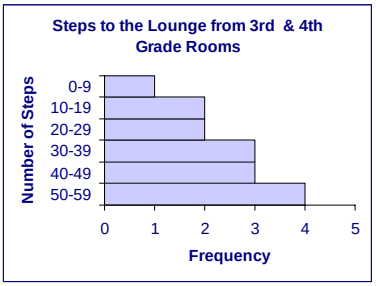
Key: 4|3 means 43 Steps

What if we didn't really care about the exact values for some reason? Maybe just knowing that a room is between 50 and 59 steps from the lounge is sufficient—tens are important but ones are not. Perhaps the data set is so large that making a stem-and-leaf plot is cumbersome. (Can you imagine making a stem-and-leaf plot with 100 observations?)

If the actual observations in each of the intervals 0–9, 10–19, etc. don't matter, but only the numbers of observations do, then we could simply replace the leaves with bars. The lengths of the bars are equivalent to the number of observations in each interval. The result is called a *histogram* and is shown at right.

| Stems \| Leaves |
|---|
| 0 \| 9 |
| 1 \| 68 |
| 2 \| 33 |
| 3 \| 568 |
| 4 \| 349 |
| 5 \| 2349 |

Key: 4|3 means 43 Steps

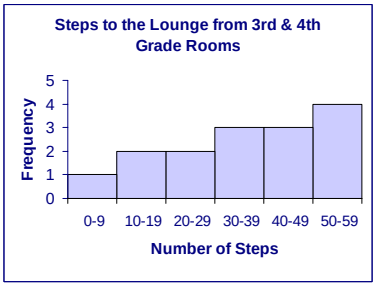



The histogram is a form of bar graph where the heights of the bars show the number of observations in an *interval* or group of numerical values. The intervals can be ten units wide, as they are here, or any other value the creator desires. The width of the interval will depend on how spread out the data is and how many data are present. There's no hard and fast rule, but it's best to pick something easy to read; ten is better then nine, five is better than six.

| Number of Steps | Frequency |
|---|---|
| 0–9 | 1 |
| 10–19 | 2 |
| 20–29 | 2 |
| 30–39 | 3 |
| 40–49 | 3 |
| 50–59 | 4 |

When one has large data sets, it's often best to create a frequency table before constructing the graph. It's not a requirement, but organizing the data will give one an idea how tall the bars will have to be and how much space to allow. A frequency table for our small set of data is shown.

Histograms, like bar graphs, can be drawn with their bars oriented horizontally or vertically. The histogram at right displays vertical orientation. Students should be able to create, read, and interpret graphs of either orientation.



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Let's now turn our attention to a little larger data set. The distances for the six 5th-grade rooms have been added to the list, shown in italics. We will organize it into a frequency table, a stem-and-leaf plot, and a histogram in order to compare the various methods.

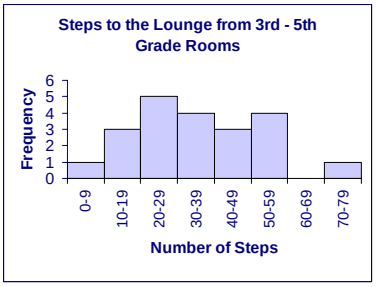
| Number of Steps |
|---|
| 36 |
| 44 |
| 23 |
| 18 |
| 16 |
| 54 |
| 59 |
| 52 |
| 43 |
| 9 |
| 35 |
| 49 |
| 38 |
| 23 |
| 53 |
| *24* |
| *26* |
| *11* |
| *20* |
| *30* |
| *75* |

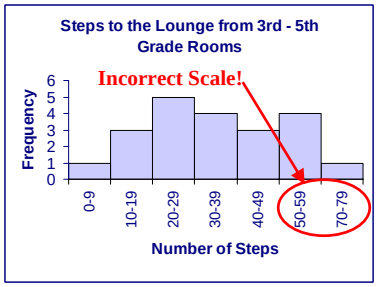
First, we'll make a frequency table grouping the data by tens. Notice that we have that one room that is 75 steps from the lounge! There are also no 3rd, 4th, or 5th grade rooms at a distance between 60 and 69 steps. Do we need to include that category in our table? Yes, we do. It's important to know where data *aren't* in addition to where they *are*.

| Number of Steps | Frequency |
|---|---|
| 0–9 | 1 |
| 10–19 | 3 |
| 20–29 | 5 |
| 30–39 | 4 |
| 40–49 | 3 |
| 50–59 | 4 |
| 60–69 | 0 |
| 70–79 | 1 |

From the frequency table, we will make our histogram. The heights of the bars are equivalent to the frequencies in each category. Notice the gap between the fifties bar and the seventies bar. That gap shows that we have no observations in the sixties.

Students often ask the question, "Does one draw a bar for the sixties?" Well, no, one doesn't draw a bar, but that space for the sixties must still be there. The horizontal scale of the graph is a number line, and we can't cut out pieces in the middle of a number line. Another way to look at it is that there is a bar there, it just has a height of zero.




If we wanted to make a nice build-as-you-go graph from the data, a stem-and-leaf plot would be useful. We will not go through the detail of making the graphs—we have been there and done that. What needs to be addressed is what to do if there are no observations in a particular stem. Is the stem included? The short answer to that is YES. It is incorrect to leave out a stem in the middle of the list of stems, just as it is incorrect not to leave the gap in the histogram for a category with frequency zero.

| Stems | Leaves |
|---|---|
| 0 | 9 |
| 1 | 168 |
| 2 | 03346 |
| 3 | 0568 |
| 4 | 349 |
| 5 | 2349 |
| 6 | |
| 7 | 5 |

Key: 4|3 means 43 Steps