



Linear Transformations Lab

Open the file “LinearTransformationsLab.xls”

A. **Shifting**, or “how adding constants affects data.”

The first sheet on the spreadsheet contains the number of houses built in 2002 in each African nation in which Habitat for Humanity has a chapter. In cells A28-A31, enter the words “Median,” “Mean,” “Variance,” and “Standard Deviation,” then in cells B28-B31 enter formulas that will give those values. **Note: use the spreadsheet commands VARP and STDEV for the population variance and standard deviation.** Obtain the **deviations** for each nation in column C (note: since the mean is in cell B28, you may simply type “=B3-B\$28” in cell C3, then drag-fill-down thru C25; the dollar sign before the 28 makes the spreadsheet always refer to row 28 in the formula).

Now, “make a donation to Habitat” allowing a fixed number of homes to be built in each country this year (you choose the number, but give the same number to each country). Type “2003” in cell E2, then in E3 type “=B3+[your number].” Drag-fill-down thru E25. Next, simply highlight the formulas you typed in cells B28-B31, then copy and paste them into cells E28-E31 (so that, in fact, they are calculating the stats for the new housing totals). What do you notice about the changes in the statistics? Obtain the deviations for new home totals in column F, and compare to the deviations in column C.

What do you know about the work of Habitat for Humanity? Does Habitat have a chapter in your area? Who benefits from the work of Habitat? Is the work of Habitat detrimental to society?

B. **Rescaling**, or “how multiplying data affects statistics.”

The second sheet in the spreadsheet (entitled “Sweatshops”) contains hourly wages for sweatshops in different countries. Prepare cells for median, mean, variance, standard deviation, and deviations of the data as you did in part A above.

A typical sweatshop worker might work 102 hours per week. Convert the hourly wages to weekly wages and place them in column F (you may type “=C3*102” in cell F3, then drag-fill-down thru F21; type “Weekly Wage” in cell F2). Prepare cells for the same statistical information you obtained for the hourly wages. What do you notice about the changes in the statistics? Do you observe the same patterns as with shifting? Think about how variance and standard deviation are related if you have trouble figuring out a pattern to how the variance changed...

The data on sweatshops may be out of date. More and more companies who have been accused of using sweatshop labor have changed their labor practices. How would it make you feel to know that some of the clothes you wear were made by someone who earned the median weekly wage you computed, after working over 14 hours per day, every day?

C. **Linear Transformations**, or “Gee, this isn’t so hard after all!”

The third sheet contains average daily high temperatures (in °Celsius) in three different cities. Choose one of the cities; you may work with rows as given, or you can copy the data over into a column. Convert the temperatures to Fahrenheit and place them in a separate row or column (formula: $F = 1.8 * C + 32$). Note that this formula involves both a shift and a rescaling. What would you expect to happen to the statistical measures? Find out! Once again, obtain listings (labeled) for mean, median, variance, standard deviation, and deviations of the original and transformed data. Do you get what you expected?

For the city you chose, find a little about the economy and government. Name a few problems that the citizens of the city might face.

D. **Extension (optional):** A fifth grader had to measure the lengths of several cubes. Her measurements appear on the “Extensions” sheet. As you did for parts A, B, and C, compute mean, median, deviations, variance, and standard deviation for the lengths. Now, devise a formula for the **VOLUMES** of the cubes; put that in column E of your spreadsheet, and investigate how the statistical measures performed under this NON-LINEAR transformation. → *Aren’t linear transformations NICE?*

Submit your spreadsheets (actually, all one spreadsheet, with 3 or 4 different sheets) electronically. **On each sheet of the spreadsheet**, in the yellow text box discuss how each of the five measures (mean, median, deviations, variance, standard deviation) changed (or not!) under the transformations. In the green text box, comment on the social issues and questions raised.