Standardizing Scores

Purpose:
Participants will determine the z-score of a data set.

Overview:
In pairs, participants will input data into the lists of their graphing calculator. They will determine the z-scores of one data set and explain the meaning of these scores.

TExES Mathematics 4-8 Competencies. The beginning teacher:

IV.012.B Applies concepts of center, spread, shape, and skewness to describe a data distribution.

IV.012.C Supports arguments, makes predictions, and draws conclusions using summary statistics and graphs to analyze and interpret one-variable data.

IV.012.D Demonstrates an understanding of measures of central tendency (e.g., mean, median, mode) and dispersion (e.g., range, interquartile range, variance, standard deviation).

IV.012.E Analyzes connections among concepts of center and spread, data clusters and gaps, data outliers, and measures of central tendency and dispersion.

TEKS Mathematics Objectives. The student is expected to:

5.13.B Describe characteristics of data presented in tables and graphs including the shape and spread of the data and the middle number.

6.10.B Use median, mode, and range to describe data.

7.12.A Describe a set of data using mean, median, mode, and range.

7.12.B Choose among mean, median, mode, or range to describe a set of data and justify the choice for a particular situation.

Terms.
mean, first quartile, third quartile, spread of data, variance, standard deviation, range, interquartile range

Materials.
For instructor:

- Transparencies
- Overhead graphing calculator and LCD panel

For each participant:

- Data Sheet
- Activity Sheet
- Graphing calculator

Transparencies.

- *Standardizing Scores*

Activity Sheet(s).

- *Standardizing Scores*

Procedure:

Steps	Questions/Math Notes
1. Have participants enter the data either by hand or by linking two calculators and sending the lists from the calculator which has the data to the other calculator. Ask participants to work in pairs and to check one another's input of data.	Let L1 = Region Number, L2 = Total Number of Students Enrolled in that Region during 1987-88, and L3 = Total Number of Students Enrolled in that Region during 1997-98. Do not enter the 4th column of data.
2. Once the data for L1, L2, and L3 are entered into all calculators, have participants compute the total student enrollment change from 1987-88 to 1997-98 in L4. Once L4 has been calculated, have participants exchange calculators with their partner and check the L4 column for correctness. If L4 is correct, then most likely all the data is correct.	Calculating the total student enrollment change from 1987-88 to 1997-98 in L4 can be done by placing the cursor on L4 and typing L3 – L2. Then press ENTER.
3. Ask participants to calculate the mean and standard deviation of L3.	*What is the mean of L3?* (The mean = 194,575.65 students) *What is the standard deviation of L3?* (The standard deviation = 199,690)
4. Ask participants to standardize the L3 data and store the results in L4. Calculator keystrokes are as follows: highlight L4, (L3 –, 2nd LIST, MATH, 3: mean(L3)), ÷, 2nd LIST, MATH, 7:stdDev(L3), ENTER. Alternate calculator keystrokes are: highlight L4, (L3 –, VARS, 5: Statistics, 2: mean,), ÷, VARS, 5: Statistics, 3:Sx, ENTER.	*How do we standardize the data?* (We calculate the z-score of each data entry. The formula for doing this is as follows: z-score = (X – mean)/ standard deviation) *What is the z-score for data point 1 (42,388)?* (The z-score is -0.7621.) *What is the z-score for data point 20 (828,262)?* (The z-score is 3.1733.)

5. Ask participants to compute the sum of the z-scores listed in L4.	*How do we calculate the sum of the z-scores listed in L4?* (Use the following keystrokes: 2^{nd} QUIT, 2^{nd} LIST, MATH, 5: sum(L4), ENTER or highlight L5, 2^{nd} LIST, OPS, 6: cumSum(L4), ENTER. Then scroll down to the 20^{th} data point and view the cumSum which is zero.)
6. Ask participants to discuss with their table partners the meaning of the standardized scores.	*What do the z-scores tell us?* (The z-score for data point 1 (Region IX) is - 0.7621. This tells us that Region IX's student population in 1997-98 was approximately ¾ of a standard deviation below the mean for all the regions.) (The z-score for data point 20 (Region IV) is 3.1733. This tells us that Region IV's student population in 1997-98 was approximately 3 standard deviations above the mean for all the regions.)

Solutions to Activity Sheet:

1. *What is the mean of L3?* The mean = 194,575.65 students
   What is the standard deviation of L3? The standard deviation = 199,690

2. *How do we standardize the data?*
   We calculate the z-score of each data entry. The formula for doing this is as follows:
   z-score = (X – mean)/ standard deviation

   Calculator keystrokes are as follows:
   highlight L4, (L3 –, 2^{nd} LIST, MATH, 3: mean(L3)), ÷, 2^{nd} LIST, MATH, 7:stdDev(L3), ENTER.

   Alternate calculator keystrokes are as follows:
   highlight L4, (L3 –, VARS, 5: Statistics, 2: mean,), ÷, VARS, 5: Statistics, 3:Sx, ENTER.

   What is the z-score for data point 1 (42,388)? The z-score is -0.7621.
   What is the z-score for data point 20 (828,262)? The z-score is 3.1733.

3. *How do we calculate the sum of the z-scores listed in L4?*
   Use the following keystrokes: 2^{nd} QUIT, 2^{nd} LIST, MATH, 5: sum(L4), ENTER
   or
   highlight L5, 2^{nd} LIST, OPS, 6: cumSum(L4), ENTER. Then scroll down to the 20^{th} data point and view the cumSum which is zero.

   What is the sum of the z-scores listed in L4? The sum is zero.

4. *What do the z-scores tell us?*

   Sample responses are given below:
   The z-score for data point 1 (Region IX) is -0.7621. This tells us that Region IX's student population in 1997-98 was approximately ¾ of a standard deviation below the mean for all the regions.

   The z-score for data point 20 (Region IV) is 3.1733. This tells us that Region IV's student population in 1997-98 was approximately 3 standard deviations above the mean for all the regions.