Grade level: secondary
Subject: mathematics
Time required: 45 to 60 minutes

TI-*nspire*™

TI-Nspire Activity: *Readability of Magazine Advertisements*

By: Rebekah Boyd

Activity Overview

Market researchers use the number of sentences per advertisement as a measure of readability for magazine ads. Using statistical information, students will discover what advertisers believe is the best number of sentences per advertisement.

After collecting data from magazine advertisements, students will explore the concepts of variance, standard deviation and the Empirical Rule.

Concepts

- ➢ *Mean*
- ➢ *Variance*
- ➢ *Standard Deviation*
- ➢ *Empirical Rule*

Teacher Preparation

- ❖ *Collect a minimum of 30 advertisements from magazines.*
- ❖ *Determine what makes a sentence. My rule of thumb is a period.*
- ❖ *The teacher file has a possible data set and complete solution.*
- ❖ *Using Connect-2-Class, transfer the file **varandstanddevstudent.tns** to students.*

Associated Materials

- • *StandardDeviationVariation.doc*
- • *StandardDeviationVariationstudent.doc*
- • *varianceandstandarddeviation.tns*
- • *varandstanddevstudent.tns*

Grade level: secondary
Subject: mathematics
Time required: 45 to 60 minutes

TN Curriculum Standards

Algebra 1 Standards
- ➤ *3102.5.2 Develop a meaning for and identify outliers in a data set and verify.*
- ➤ *3102.5.4 Explore quartiles, deciles, and percentiles of a distribution.*
- ➤ *3102.5.5 Construct and interpret various forms of data representations, (including line graphs, bar graphs, circle graphs, histograms, scatter-plots, box-and-whiskers, stem-and-leaf, and frequency tables).*
- ➤ *SPI 3102.5.1 Interpret displays of data to answer questions about the data set(s) (e.g., identify pattern, trends, and/or outliers in a data set).*

Algebra 2 Standards
- ➤ *3103.5.2 Organize and display data using appropriate methods (including spreadsheets and technology tools) to detect patterns and departures from patterns.*
- ➤ *3103.5.5 Calculate measures of central tendency and spread (variance and standard deviation).*
- ➤ *3103.5.8 Know the Empirical Rule for one, two and three standard deviations for a normal distribution.*
- ➤ *SPI 3103.5.1 Compute, compare and explain summary statistics for distributions of data including measures of center and spread.*
- ➤ *SPI 3103.5.2 Compare data sets using graphs and summary statistics.*

Statistics
- ➤ *select and use a method such as a survey or an experiment to collect data*
- ➤ *construct and interpret charts, tables, and graphs that display univariate and bivariate data;*
- ➤ *calculate and apply measures of central tendency and dispersion in order to make inferences about a data set;*
- ➤ *analyze the affects of data transformations on measures of central tendency and variability*
- ➤ *demonstrate an understanding of confidence intervals.*
- ➤ *demonstrate an understanding of the Central Limit Theorem;*

Grade level: secondary
Subject: mathematics
Time required: 45 to 60 minutes

TI-*nspire*™

Part 1: Defining Deviation

This first part of the activity is to define deviation. Students have a challenge understanding what it means to "deviate" from the norm. To deviate means "the difference between an observed value and the expected value of a variable or function". To find standard deviation, we need to first consider how the collected data deviates from the mean.

*Giving each student an advertisement, have them count the number of sentences that appear. On the first spreadsheet, label column A **sentence** and record the data for number of sentences found in the ads.*

To go from the notes page to the list and spreadsheet page, press ⏎ctrl⏎ ⏎tab⏎.

*Students will then need to find the mean of the list **sentence** and store it as the variable mu. This is a good time to remind students that the mean is the "average: expected value" and is found by "total sum of all the numbers in a data set, divided by the number of data points."*
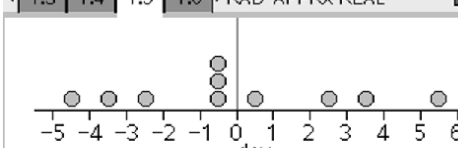
*The next step is to find out how much each data point varies or deviates from the calculated mean. Name column B "**dev**" for deviation. In the formula bar insert: **dev:=sentence-mu**.*

*Create a dot plot with **dev** as the x-value and create a dot plot with **sentence** as the x-value. On the second dot plot, plot the mean value that was found.*
Discuss with the students how the data deviates from the set mean. Students can click on each data point in dev and see which exact data point relates to the deviated point and how much it deviates from the mean.

Grade level: secondary
Subject: mathematics
Time required: 45 to 60 minutes
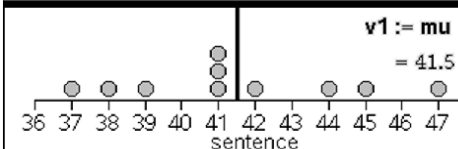
TI-*nspire*™

Part 2: Defining and Evaluating Variance

Variance is a measure of the average distance between each of a set of data points and their mean value and is equal to the sum of the squares of the deviation from the mean value. The larger the variance, the larger the distance of the individual cases from the group mean.

*Name column C **Dev2** and type $=dev^2$ in the formula bar. Create a scatter plot of **Sentence** versus **dev2**. Noting the shape of the scatter plot is a parabola.*

Using the regression ability, calculate the quadratic regression equation that matches the data.

($\overset{\text{menu}}{}$, 4. Analyze 6. Regression, 5. Show Quadratic)
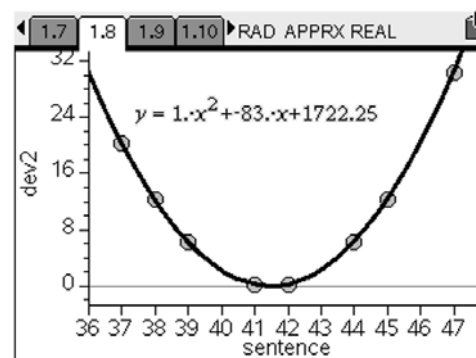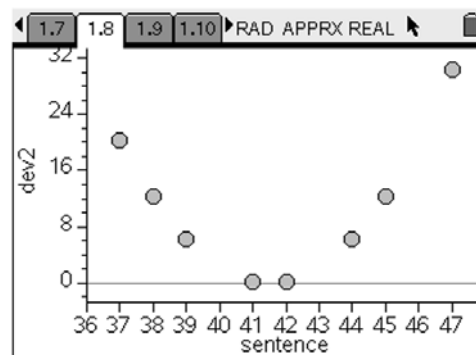
Discuss with the students how the advertisements with the number of sentences that are farther from the mean have a higher square of deviation.

*The population variance is the average of the deviation squared. Calculate the variance of the data. Store as **var**.*

$$\text{var} := \frac{sum(\mathbf{d}ev2)}{count(\mathbf{s}entence)}$$

Grade level: secondary
Subject: mathematics
Time required: 45 to 60 minutes

TI-*nspire*™

Part 3: Define and Calculating Standard Deviation

Standard Deviation is a statistic that tells you how tightly all the various examples are clustered around the mean in a set of data: a measure of how spread out your data is.

When the examples are pretty tightly bunched together and the bell-shaped curve is steep, the standard deviation is small.
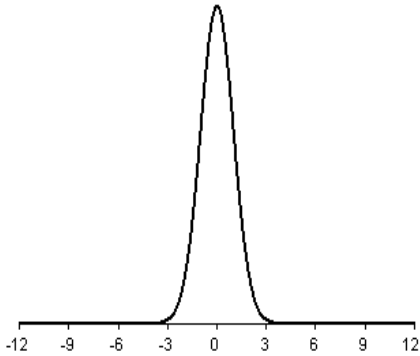
When the examples are spread apart and the bell curve is relatively flat, that tells you have a relatively large standard deviation.
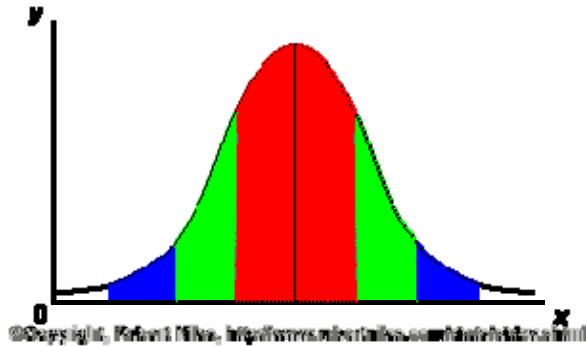
Grade level: secondary
Subject: mathematics
Time required: 45 to 60 minutes
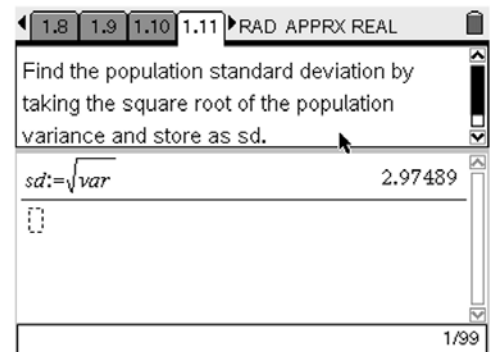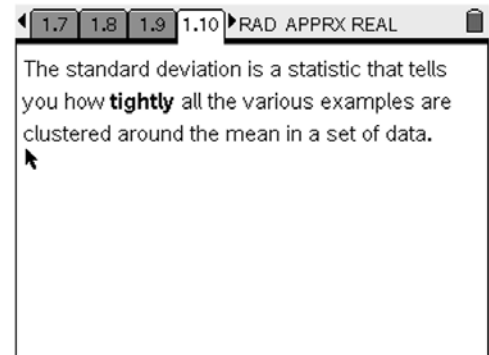
Part 4: Empirical Rule
Empirical Rule: a symmetric bell-shaped distribution has:
68% of the data falls within 1 standard deviation of the mean
95% of the data falls within 2 standard deviations of the mean
99.7% of the data falls within 3 standard deviations of the mean

To explore the Empirical Rule, students need to understand what it means to be within 1, 2, or 3 standard deviations. Students will be creating a dot plot of the data and plot values of 1 standard deviation above and 1 standard deviation below the mean.

Discuss how many of the data points are within 1 standard deviations.

Back on page 1.13 plot the values for 2 standard deviations above and below the mean.

Discuss how many of the data points are within 2 standard deviations.

Grade level: secondary
Subject: mathematics
Time required: 45 to 60 minutes

TI-*nspire*™

Part 5: Using the built-in formulas

The population standard deviation is found by
stDevPoP(list**).**

The population variation is found by
varPoP(list**).**

The sample standard deviation is found by
stDevSamp(list**).**

The sample variation is found by
varSamp(list**).**

The Sample Deviation formula is easily found in the menu.
((menu)*, 5. Statistics, 3. List Math, 7. Sample Standard Deviation)*

The Sample Variance formula is found:
((menu)*, 5. Statistics, 3. List Math, 8. Sample Variance)*

The Population Deviation formula is easily found in the menu.
((menu)*, 5. Statistics, 3. List Math, 9 Population Standard Deviation)*

The Sample Variance formula is found:
((menu)*, 5. Statistics, 3. List Math, A. Population Variance)*