Percentiles

ID: 9539

Time required
25 minutes

Activity Overview

*In this activity, students use the area to the left of a value in a normal distribution to find its percentile. Then they reverse the process and find the value for a given percentile. In doing so, students learn how to use **normCdf** and **invNorm** commands.*

Topic: The Normal Distribution

- *Determine the x^{th} percentile for a normally distributed variable given its mean and standard deviation.*

Teacher Preparation and Notes

- *This activity is designed to be used for students studying Statistics and Probability.*
- *Students should already be familiar with the normal distribution and its characteristics, specifically the 68-95-99.7rule (i.e., the empirical rule).*
- *Percentiles divide data into 100 equal parts. For the sake of simplicity, round all percentiles to the nearest whole percent.*
- *This activity is intended to be mainly **teacher-led**, with breaks for individual student work. The material on the following pages can be presented to the class and used for discussion. The teacher should lead students through the Nspire commands while they follow using their handhelds.*

Associated Materials

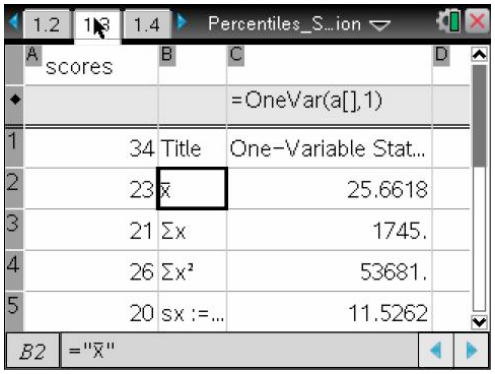
- *Percentiles_Student.doc*
- *Percentiles.tns*
- *Percentiles_Soln.tns*

Suggested Related Activities

Statistics Nspired Action/Consequence Documents: z-scores, Normal Curve Family, Histograms

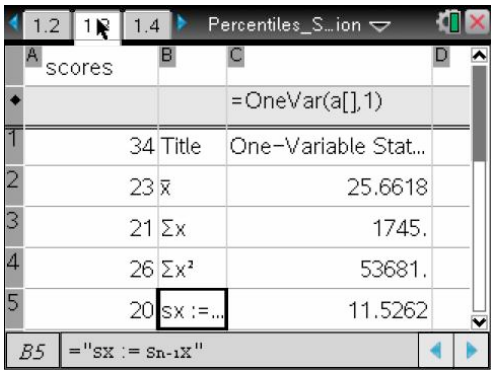
Problem 1 – Finding the Percentile Given the Score

Students are to find the mean and standard deviation of the 68 scores listed on page 1.3 using the **One-Variable Statistics** command. They should press OK for one list and choose **scores** for X1 List, and **b[ ]** for the result location.

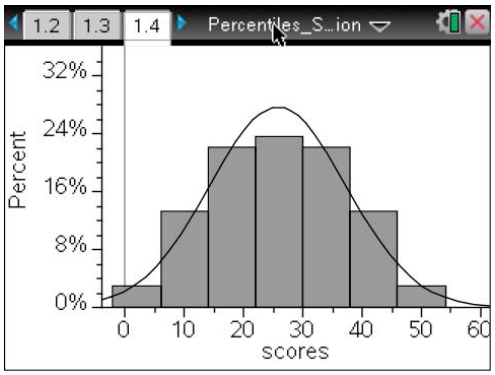


The mean, $\bar{x}$, is 25.6618, and the standard deviation, sx, is 11.5262. (Note that **sx** is used instead of σ**x** because the scores are a sample and not the entire population.)

Note: The mean and standard deviation can also be found by entering **=mean(scores)** and **=stDevSamp(scores)**, respectively, in different cells.



Students make a histogram of the data on page 1.4. They need to move the cursor to the middle of the horizontal axis, click to add variable, and select **scores** for the horizontal variable. Change the dot plot to a histogram by pressing **MENU > Plot Type > Histogram**. To change the vertical scale to percent, press **MENU > Plot Properties > Histogram Scale > Percent**. To change the bin width to have eight bins, press **MENU > Plot Properties > Histogram Properties > Bin Settings.** Choose bin width 8 and alignment 6 for the upper end of the first bin.

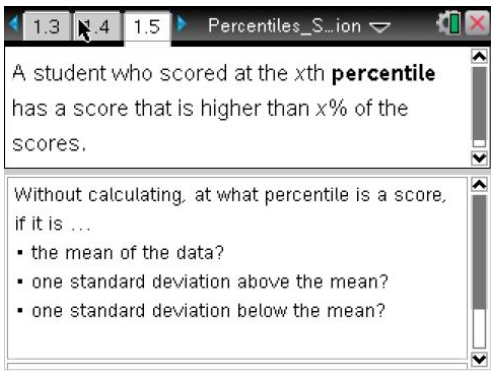


Students should determine whether the data are normally distributed. If desired, they can plot the normal distribution curve by pressing **MENU > Analyze > Show Normal PDF**.

Tell students to assume that all the scores on the test, not just this sample of 68, are distributed approximately normally with a mean of 25.6618 and a standard deviation of 11.5262.

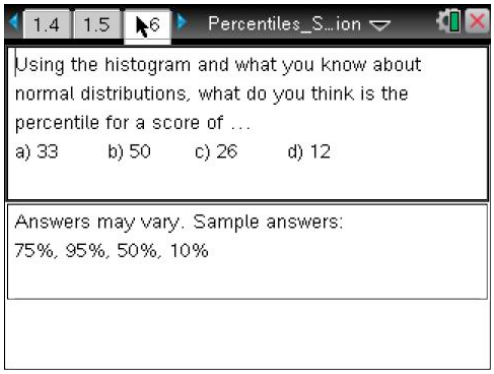
Define and discuss *percentile*. Stress that the percentile gives the proportion of the scores to the *left* of that score.

To test students' understanding have them answer the questions on page 1.5. (50%, 84%, 16%).

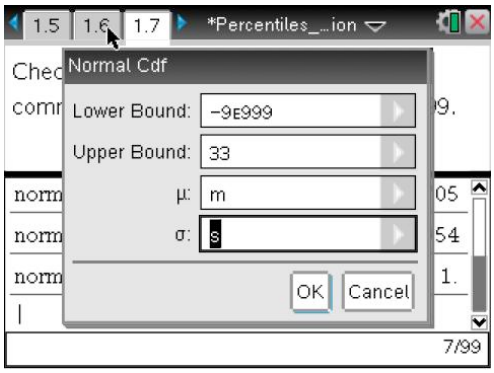


Review the characteristics of a normal distribution and the 68-95-99.7 rule. Students are to determine what they think are the percentiles for the scores shown on page 1.6. Discuss with students how they determined their answers.

Students can record their guesses on the worksheet or on the question page of the .tns file so they compare how they did when they find the actual percentiles.



To check the guesses, students can use the **normCdf** command on page 1.7. Because *One-Variable Statistics* were calculated in question 3, students can recall the values by typing **stat.,** and a popup list will appear. Students should store the mean as **m** and the standard deviation as **s** by typing **Define m: =stat.** and select $\bar{x}$ for mean, and **sx** for standard deviation.



They can choose **MENU > Statistics > Distributions > Normal Cdf** and then enter information into the boxes or type the command with the following parameters:

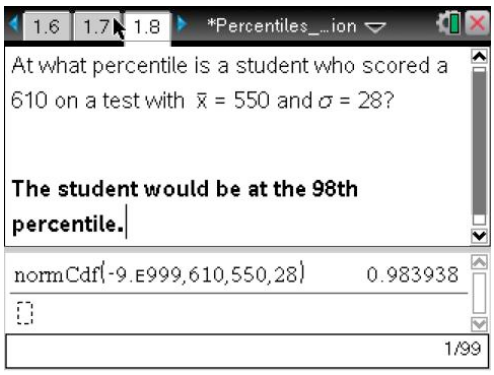
normCdf(lower bd, upper bd, mean, std dev)

(Again the mean and standard deviation can be accessed by typing **stat.** and choosing from the list.)

In either case, the lower bound is negative infinity, which should be entered as **–9E999**. The symbol E can be selected by pressing EE .

When students record their answers, they should round to the nearest whole percent: 74%, 98%, 51%, and 12%.

Have students work independently to answer the questions on pages 1.8 and 1.9. Students should assume the distributions are normal.



Problem 2 – Finding the Score Given the Percentile

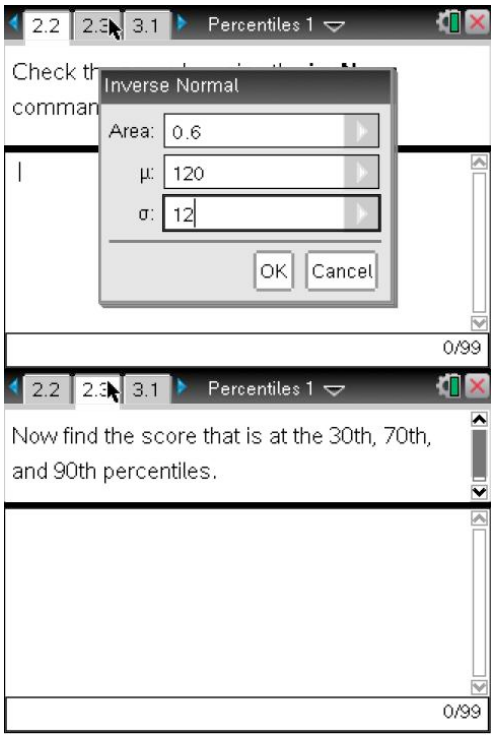
To reverse the process and estimate a score given its percentile, students must use the I**nverse Normal** command from the Distributions menu. This command has the format:

invNorm(percentile, mean, standard dev)

Area in the pop up box refers to the area to the left of the given score, marked by the percentile.

Before having students find the **invNorm**, have them guess what it will be and explain how they determined it.

Let students work independently on page 2.3. Again, encourage them to guess each value before they find it.



Problem 3 – Practice

Problem 3 consists of three practice problems. Let students work through these questions on their own, and then review the answers.

Page 3.1: normCdf(–9E999, 465, 380, 42) = 0.978505

normCdf(–9E999, 88, 65, 10) = 0.989276

Juan is in the higher percentile.

Page 3.2: invNorm(0.86, 200, 35) = 237.811

Ty's score is about 237.

Page 3.3: invNorm(0.95, 325, 35) = 382.57

Shaung has to get a score of at least 382.