



About the Lesson

In this activity, students estimate and find a given area under a normal curve. First, they find areas under the curve and to the left of given values. Then, they use subtraction to find the difference between the areas. Students will use both the **normalcdf** command and the **ShadeNorm** command. They continue the activity to find probabilities for which the corresponding area is greater than a given value, and then they conclude the activity by finding areas between z-scores. As a result, students will:

- Express a normally distributed random variable X , of mean μ and standard deviation σ , in terms of a normally distributed random variable Z with mean 0 and $\sigma = 1$.
- Determine the probability that a normally distributed random variable given its mean and standard deviation.

Vocabulary

- standard normal distribution
- z-score

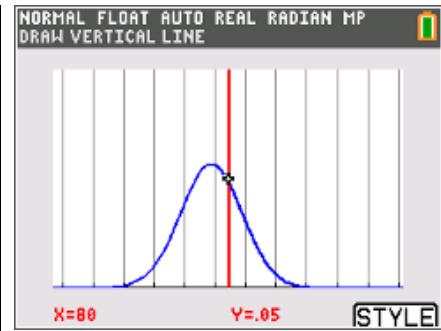
Teacher Preparation and Notes

- As students finish Problem 1, discuss that because the total area is equal to 1, the proportions can also be used as probabilities. The probability that a randomly chosen score is between 60 and 80 is about 70.5%.

Activity Materials

- Compatible TI Technologies:
 - TI-84 Plus*
 - TI-84 Plus Silver Edition*
 - TI-84 Plus C Silver Edition
 - TI-84 Plus CE

* with the latest operating system (2.55MP) featuring MathPrint™ functionality.



Tech Tips:

- This activity includes screen captures taken from the TI-84 Plus CE. It is also appropriate for use with the rest of the TI-84 Plus family. Slight variations to these directions may be required if using other calculator models.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at <http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials>
- Any required calculator files can be distributed to students via handheld-to-handheld transfer.

Lesson Files:

- AreasInIntervals_Student.doc
- AreasInIntervals_Student.pdf



Problem 1 – Finding the Area between Two Given Scores

1. Estimate the proportion of scores that fall below 80; that is, the area under the curve and to the left of the vertical line. Explain how you chose your answer.

Sample Answer: Sample: 60%. I chose 60% because half the curve is below the mean of 76. 80 is a little bit greater than 76 and 60% is a little bit greater than 50%.

2. What is the actual proportion of scores that are less than 80? Round to the nearest thousandth.

Answer: 0.716

3. Estimate the proportion of scores that fall below 60. Explain how you chose your answer.

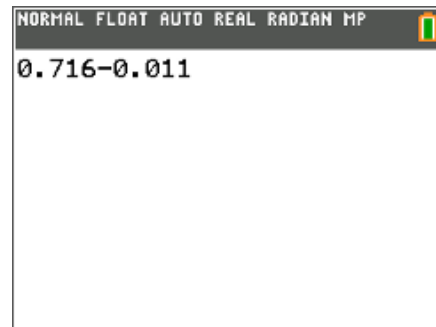
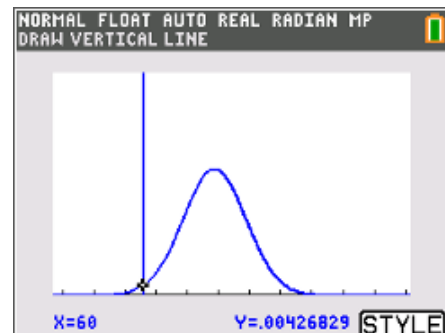
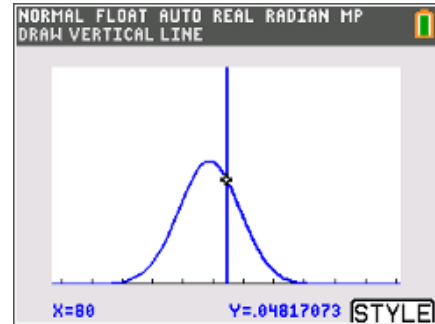
Sample Answer: About 1%, almost all of the area under the curve is above this line. Because 60 is more than two standard deviations below the mean, guesses should be less than 0.025. (95% of scores are within two standard deviations, leaving 5% for both tails, or 2.5% in each tail.)

4. Find the actual proportion by using either **normalcdf** or **ShadeNorm**. Round to the nearest thousandth.

Answer: 0.011

5. Subtract the area that is below 60 from the area that is below 80.

Answer: 0.705





Problem 2 – Finding the Area Greater than a Given Value

6. How can you use the **normalcdf** command to find the probability that a randomly chosen token weighs more than 4.9 grams if **normalcdf** gives the area to the left of a value, rather than to the right of a value?

Answer: Find the area to the left and then subtract from 1 because the total area is always 1.

7. Use **normalcdf** to find $P(\text{weight} > 4.9 \text{ g})$. Round to the nearest thousandth.

Answer: 0.266

8. Estimate $P(\text{weight} > 4.75)$. Explain how you chose your answer.

Sample Answer: Sample: 90%. I chose 90% because 4.75 is more than one standard deviation below the mean. Because about 34% of the data is between the mean and one standard deviation below the mean, 84% of the data must be above the value that is one standard deviation below the mean. 90% is greater than 84%.

9. Use **normalcdf** to find $P(\text{weight} > 4.75 \text{ g})$. Round to the nearest thousandth.

Answer: 0.894

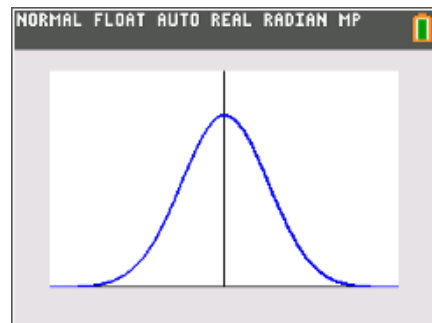
Problem 3 – Using the Standard Normal Distribution

10. What is the student's z-score?

Answer: -0.8

11. Use what you know about normal curves to explain why the value is negative and why the absolute value of the score is less than one.

Answer: The z-score is negative because 88 is less than the mean. The absolute value is less than one because it is within one standard deviation of the mean.



```
normalcdf(-1E99, -.8, 0, 1)
```



12. What are these areas? Round to the nearest thousandth.

Answer: Both are 0.212.

13. A student has a z-score of 2.8. What was their score on the test? Tell how you found the answer.

Answer: 142; Sample: I substituted 2.8 for z in the formula and solved for x.

14. What are these areas? Round to the nearest thousandth.

Answer: Both are 0.997.

15. Find $P(-1.5 < z < 2.3)$. Round to the nearest thousandth.

Answer: 0.922

16. In what range of test scores does $P(-1.5 < z < 2.3)$ correspond with?

Answer: 77.5 and 134.5