## Problem 1 – Finding the Area between Two Given Scores

On a certain test, the scores are normally distributed with a mean of 76 and a standard deviation of 7.

Graph the normal distribution by pressing ⌷y=⌷ and entering **normalpdf(X, 76, 7)**. The **normalpdf** command is in the DISTR menu which is accessed by pressing ⌷2nd⌷⌷var⌷.

After entering the values, select **Paste** to transfer the information to the **Y=** screen.

Press ⌷window⌷ and set the values equal to the following.

Xmin = 40, Xmax = 120, Xscl = 7, Ymin = 0,
Ymax = 0.1, Yscl = 0

Draw the vertical line *x* = 80 by pressing ⌷2nd⌷⌷prgm⌷ and choosing **Vertical**. Use the arrow keys to place the line as needed.

You may wish to change the default color, blue, of the vertical line to some other color like red to contrast it with the default color of the Y1 graph. To change the color, press ⌷graph⌷.
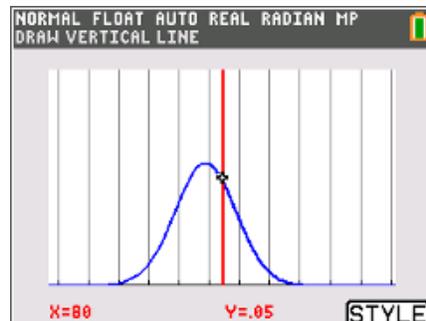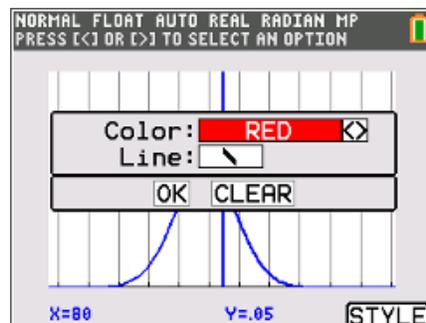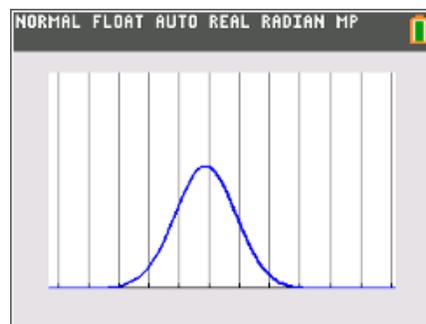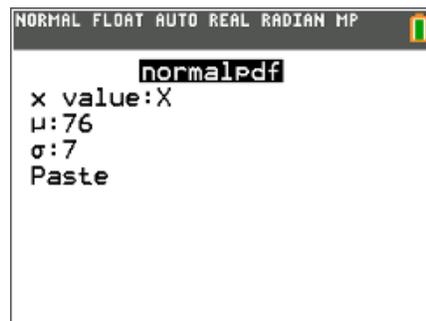
1. Estimate the proportion of scores that fall below 80; that is, the area under the curve and to the left of the vertical line. Explain how you chose your answer.

Press [2nd] [mode] to quit. Check your estimate by choosing **normalcdf** from the DISTR menu. Enter the lower bound, the upper bound, the mean, and the standard deviation.

The lower bound is negative infinity: use $-1 \times 10^{99}$, entered as –1E99. To type E, press [2nd] [ , ].

```
NORMAL FLOAT AUTO REAL RADIAN MP
       normalcdf
lower:-1E99
upper:80
μ:76
σ:7
Paste
```
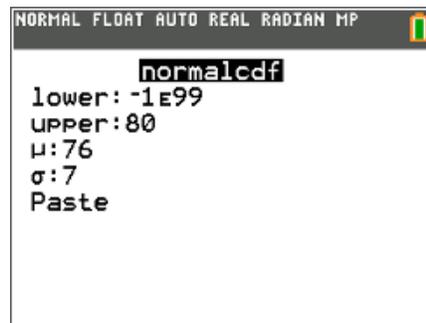
**2.** What is the actual proportion of scores that are less than 80? Round to the nearest thousandth.

See the area shaded on the curve by pressing [2nd][var], arrowing over to the **DRAW** menu, choosing **ShadeNorm(** and entering the lower bound, upper bound, mean, and standard deviation as before. Then selecting Draw.

Press [2nd][prgm] and choose **ClrDraw** to remove the shading from under the normal curve. Press DRAW again to draw a vertical line at about $x = 60$.

```
NORMAL FLOAT AUTO REAL RADIAN MP
DRAW VERTICAL LINE



X=60                Y=.00426829 STYLE
```
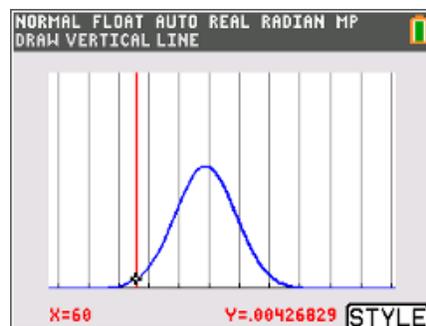
**3.** Estimate the proportion of scores that fall below 60. Explain how you chose your answer.

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

```
NORMAL FLOAT AUTO REAL RADIAN MP




Area=.011135
low=-1E99        up=60
```
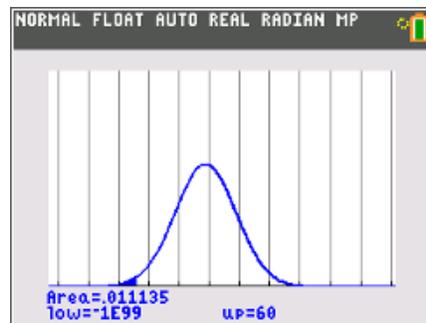
**5.** Subtract the area that is below 60 from the area that is below 80.

Confirm that this is the proportion of scores that fall between 60 and 80 by using the **normalcdf** command with 60 as the lower bound and 80 as the upper bound.

**Problem 2 – Finding the Area Greater than a Given Value**

The weights of game tokens are normally distributed with a mean of 4.85 grams and a standard deviation of 0.08 gram.

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?

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

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

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

**Problem 3 – Using the Standard Normal Distribution**

The standard normal distribution has a mean of 0 and a standard deviation of 1. Change **Y1** to graph the standard normal distribution. Set your window settings as follows:
Xmin = –4, Xmax = 4, Xscl = 1, Ymin = 0,
Ymax = 0.5, Yscl = 0

```
NORMAL FLOAT AUTO REAL RADIAN MP

Plot1  Plot2  Plot3
∎\Y1▤normalpdf(X,0,1)
∎\Y2=
∎\Y3=
∎\Y4=
∎\Y5=
∎\Y6=
∎\Y7=
∎\Y8=
∎\Y9=
```
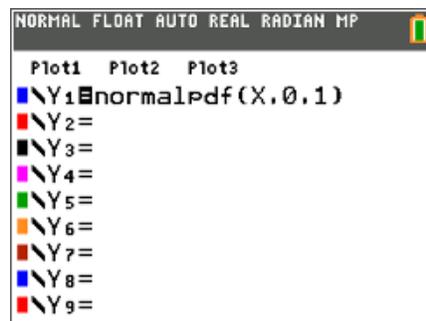
A *z*-score gives the number of standard deviations above or below the mean of a standard normal distribution:

$$z = \frac{x - \mu}{\sigma}$$
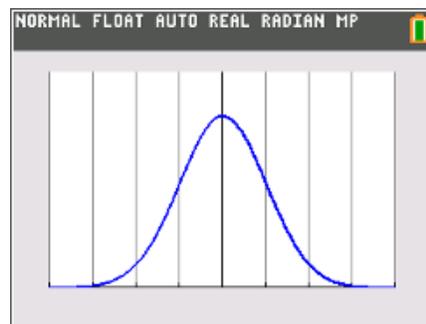
The scores on an IQ test are normally distributed with a mean of 100 and a standard deviation of 15. A student scored an 88.

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

**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.

Check that the *z*-score you found above is correct by finding the area to the left of it for a normal distribution with a mean of 0 and a standard deviation of 1 and then finding the area to the left of 88 for a normal distribution with a mean of 100 and a standard deviation of 15.

```
NORMAL FLOAT AUTO REAL RADIAN MP
normalcdf(-1E99,-.8,0,1)
```
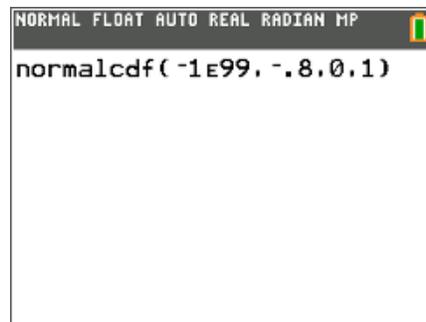
**12.** What are these areas? Round to the nearest thousandth.

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

Check that the *z*-score you found above is correct by comparing the probabilities that a *z*-score is less than 2.8 and that a test score is less than the score you found.

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

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

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