

Technology Note: Investigating the Normal Distribution on a TI-83/4 Graphing Calculator

We can graph a normal curve for a probability distribution on the TI-83/4. Press [$y =$]. To create a normal distribution, we will draw an idealized curve using something called a density function. The command is called a probability density function and it is found by pressing [2nd] [DISTR] [1]. Enter an X to represent the random variable, followed by the mean and the standard deviation. For this example, choose a mean of 5 and a standard deviation of 1.

```

DISTR DRAW
1:normalpdf(
2:normalcdf(
3:invNorm(
4:invT(
5:tpdf(
6:tcdf(
7:χ²pdf(
    
```

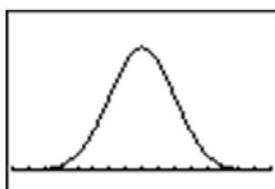
```

Plot1 Plot2 Plot3
\Y1:normalpdf(X,
5,1)
\Y2=
\Y3=
\Y4=
\Y5=
\Y6=
    
```

Adjust your window to match the following settings and press [GRAPH]

```

WINDOW
Xmin=1
Xmax=9
Xscl=.5
Ymin=-.05
Ymax=.5
Yscl=1
Xres=1
    
```



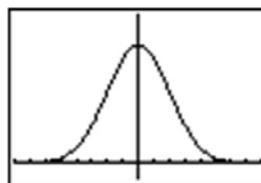
Choose [2nd] [QUIT] to go to the home screen. We can draw a vertical line at the mean to show it is in the center of the distribution by pressing [2nd] [DRAW] and choosing VERTICAL. Enter the mean (5) and press [ENTER]

```

DRAW POINTS STO
1:ClrDraw
2:Line(
3:Horizontal
4:Vertical
5:Tangent(
6:DrawF
7:Shade(
    
```

```

Vertical 5
    
```



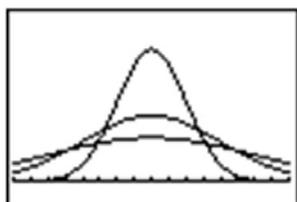
Remember that even though the graph appears to touch the x axis it is actually just very close to it.

In your [$y =$] Menu, make the following change to your normalpdf:

```

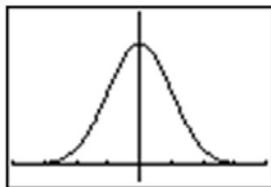
Plot1 Plot2 Plot3
\Y1:normalpdf(X,
5,(1,2,3))
\Y2=
\Y3=
\Y4=
\Y5=
\Y6=
    
```

This will graph 3 different normal distributions with various standard deviations to make it easy to see the change in spread.



Notice that vertical lines are drawn at points that are exactly one standard deviation to the left and right of the mean. We have consistently described standard deviation as a measure of the "typical" distance away from the mean. How much of the data is actually within one standard deviation of the mean? To answer this question, think about the space, or area under the curve. The entire data set, or 100% of it, is contained by the whole curve. What percentage would you estimate is between the two lines? To help estimate the answer, we can use a graphing calculator. Graph a standard normal distribution over an appropriate window.

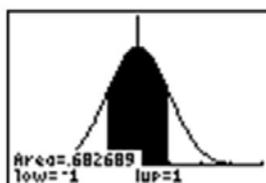
```
Plot1 Plot2 Plot3
\Y1 normalpdf(X,
0, 1)
\Y2 =
\Y3 =
\Y4 =
\Y5 =
\Y6 =
```



Now press [2nd] [DISTR] and choose DRAW ShadeNorm. Insert -1, 1 after the ShadeNorm command and it will shade the area within one standard deviation of the mean.

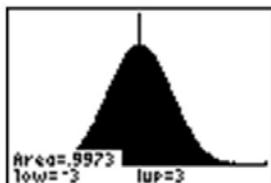
```
DISTR 0:1/4
1:ShadeNorm(
2:Shade_t(
3:ShadeX^2(
4:ShadeF(
```

```
ShadeNorm(-1, 1)
```



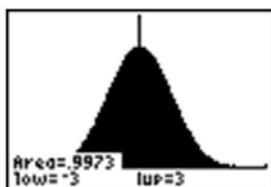
The calculator also gives a very accurate estimate of the area. We can see from this that approximately 68% of the area is within one standard deviation of the mean. If we venture two standard deviations away from the mean, how much of the data should we expect to capture? Make the changes to the ShadeNorm command to find out.

```
ShadeNorm(-2, 2)
```



Notice from the shading, that almost all of the distribution is shaded and the percentage of data is close to 95%. If you were to venture 3 standard deviations from the mean, 99.7%, or virtually all of the data is captured, which tells us that very little of the data in a normal distribution is more than 3 standard deviations from the mean.

```
ShadeNorm(-3, 3)
```



Notice that the shading of the calculator actually makes it look like the entire distribution is shaded because of the limitations of the screen resolution, but as we have already discovered, there is still some area under the curve further out than that. These three approximate percentages, 68, 95, and 99.7 are extremely important and is called the *empirical rule*.

The empirical rule states that the percentages of data in a normal distribution within 1, 2, and 3 standard deviations of the mean, are approximately 68, 95, and 99.7 respectively.