***Technology Note The Normal CDF Command.***

Your graphing calculator has already been programmed to calculate probabilities for a normal density curve using what is called a cumulative density function or cdf. This is found in the distributions menu above the VARS key.

```
DISTR DRAW
1:normalpdf(
2:normalcdf(
3:invNorm(
4:invT(
5:tpdf(
6:tcdf(
7↓X²pdf(
```

Press **[2nd] [VARS], [2]** to select the normalcdf (command. normalcdf (lower bound, upper bound, mean, standard deviation)

The command has been programmed so that if you do not specify a mean and standard deviation, it will default to the standard normal curve with $\mu = 0$ $\sigma = 1$.

For example, entering normalcdf (-1, 1) will specify the area within one standard deviation of the mean, which we already know to be approximately 68%.
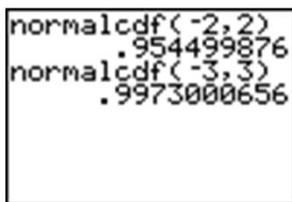
```
normalcdf(-1,1)
        .6826894809
▮
```
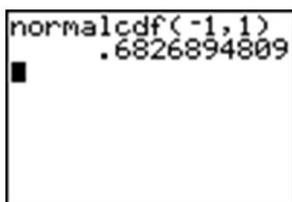
Try to verify the other values from the empirical rule.

Summary:

Normalpdf $(x, 0.1)$ gives values of the probability density function. It gives the value of the probability (vertical distance to the graph) at any value of x. This is the function we graphed in Lesson 5.1

Normalcdf (a, b, μ, σ) gives values of the cumulative normal density function $N(\mu, \sigma)$ It gives the probability of an event occurring between $x = a$ and $x = b$ (area under the probability density function curve and between two vertical lines) where the normal distribution has mean μ and standard deviation σ. If μ and σ are not specified it is assumed that $\mu = 0$ and $\sigma = 1$.

```
normalcdf(-2,2)
        .954499876
normalcdf(-3,3)
        .9973000656
```

Example: Find the probability that $x < -1.58$.

The calculator command must have both an upper and lower bound. Technically though, the density curve does not have a lower bound as it continues infinitely in both directions. We do know however, that a very small percentage of the data is below 3 standard deviations to the left of the mean. Use -3 as the lower bound and see what answer you get.

```
normalcdf( -3, -1.
58)
       .0557034698
```

The answer is accurate to the nearest 1%, but you must remember that there really still is some data, no matter how little, that we are leaving out if we stop at 3. In fact, if you look at Table 1, you will see that about 0.0013 has been left out. Try going out to -4 and -5.

```
normalcdf( -4, -1.
58)
        .057021751
normalcdf( -5, -1.
58)
       .0570531499
```

Notice that if we use -5, the answer is as accurate as the one in the table. Since we cannot really capture "all" the data, entering a sufficiently small value should be enough for any reasonable degree of accuracy. A quick and easy way to handle this is to enter -99999 (or "a bunch of nines"). It really doesn't matter exactly how many nines you enter. The difference between five and six nines will be beyond the accuracy that even your calculator can display.

```
normalcdf( -99999
, -1.58)
         .057053437
normalcdf( -99999
9, -1.58)
         .057053437
```

Example: Find the probability for $x \geq -0.528$.

Right away we are at an advantage using the calculator because we do not have to round off the z score. Enter a normalcdf command from -0.528 to "bunches of nines". This upper bound represents a ridiculously large upper bound that would insure a probability of missing data being so small that it is virtually undetectable.

```
normalcdf( -.528,
9999999)
        .7012503533
```

Remember that our answer from the table was slightly too small, so when we subtracted it from 1 it became too large. The calculator answer of about .70125 is a more accurate approximation than the table value.