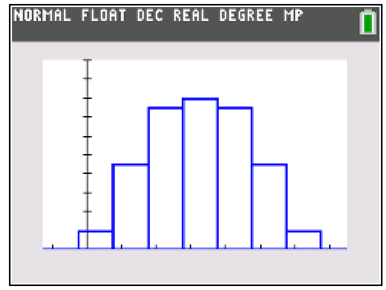
Percentiles
Student Activity

Name ______________
Class ______________

The goal of this activity is for students to use the area to the left of a value in a normal distribution to find its percentile. The process will then be reversed to find the value for a given percentile. In doing so, students will learn how to use the **Normal CDF** and **Inverse Normal** commands on the handheld.



For this activity, students should be familiar with the normal distribution and its characteristics, specifically the empirical rule (68-95-99.7 rule). Percentiles divide data into 100 equal parts. For the sake of simplicity, round all percentiles to the nearest whole percent.

Problem 1 – Find the Percentile Given the Score

A sample of 68 scores from a standardized test are listed below. Input the scores into L_1 on your handheld.

34, 23, 21, 26, 20, 31, 9, 7, 32, 11, 15, 52, 20, 9, 28, 13, 14, 14, 13, 28, 26, 8, 25, 4, 15, 29, 12, 32, 17, 15, 9, 24, 44, 28, 33, 31, 44, 36, 33, 49, 22, 22, 28, 38, 19, 24, 17, 37, 30, 45, 17, 21, 15, 19, 37, 26, 39, 43, 23, 4, 31, 38, 36, 39, 41, 29, 36, 35

(a) Calculate the mean and standard deviation using the **1-Variable Statistics** command from the **stat, Calc** menu.

(b) Create a histogram on your handheld. Describe the distribution. Use the following window settings: Xmin = -10, Xmax = 60, Xscl = 8, Ymin = 0, Ymax = 20, Yscl = 2

(c) Sketch your graph below.

(d) Without calculating, and assuming the scores are normally distributed, find the percentile of the score if it is…
(note that pressing trace and moving your cursor left and right will give you how many scores are in each bin. Divide this number by the total number of scores, 68, to find the percentage in each bin)

(i) the mean.

(ii) one standard deviation above the mean.

(iii) one standard deviation below the mean.

(e) Using the histogram and what you know about normal distributions, fill in the following table with your guess of the percentile for each score and the actual percentile for each score. Use the **2nd, vars (distr), normalcdf(** command to find the actual percentile for the scores in the table.

	33	**50**	**26**	**12**
Guesses				
Actual				

Problem 1 Practice

(a) Assuming that the scores for the class were normally distributed and given that a student scored a 610 on a test with $\bar{x} = 550$ and $\sigma = 28$, find the percentile.

(b) Assuming that the scores for the class were normally distributed and given that a student scored a 17 on a test with $\bar{x} = 20$ and $\sigma = 2.5$, find the percentile.

Problem 2 – Finding the Score Given the Percentile

The scores on a test are normally distributed with a mean of 120 and a standard deviation of 12, or using the notation $N(120, 12^2)$. To reverse the process and find a score given its percentile, use the **invNorm(** command from the **2nd, vars (distr)** menu. When the input screen appears, enter:

area, mean, standard deviation, LEFT

The area on the input screen refers to the area to the left of the given score, marked by the percentile.
**Remember that the normal distribution notation is $N(\mu, \sigma^2)$, where σ^2 represents the variance.

(a) Estimate what you think the lowest score a student needs to be at least the 60th percentile. Explain your answer.

(b) Verify your estimate from part (a) using the **invNorm(** command. Also use this command to help find the scores for the following percentiles:

	60th	**30th**	**70th**	**90th**
Guesses				
Actual				

Problem 3 – Practice

(a) Helen took a test where $N(380, 42^2)$ and scored 465. Juan took a test where $N(65, 10^2)$ and scored 88. Determine which student is at the higher percentile.

(b) Ty scored lower than 14% of the rest of the students on a test with $N(200,\ 35^2)$. Estimate Ty's score.

(c) Find the score Shuang must get to be in the top 5% of the students taking a test with $N(325,\ 35^2)$.

Further IB Applications

It is known through the company website that 43% of gecko heat lamp bulbs have a life of less than 60 hours and 89% have a life less than 65 hours. It can be assumed that heat lamp bulb life is modelled by the normal distribution $N(\mu, \sigma^2)$.

(a) Find the value of μ and the value of σ.

(b) Find the probability that a randomly selected bulb will have a life of at least 55 hours.

(c) Find the percentile for the bulb with 58 hours of life.