# 8.5 and 8.6: The Normal Distribution

Continuous random variables can take on any value.

Let t = time in seconds to run a race

Let w = weight of kitten in kg

Let L = length of a week-old bean plant

Let X = value where pointer lands.

$0 \leq X < 1$ and $P(0 \leq X < 1) = 1$

What is $P(X = \frac{1}{2})$?

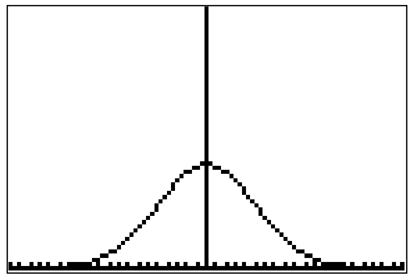
What is $P(0 \leq X < \frac{1}{4})$?

What is $P(0.75 \leq X \leq 0.80)$?

How can we represent this graphically?

When we graph the probability distribution for a continuous variable we find a probability density function.

Many natural and social phenomena produce a continuous distribution with a bell-shaped curve.

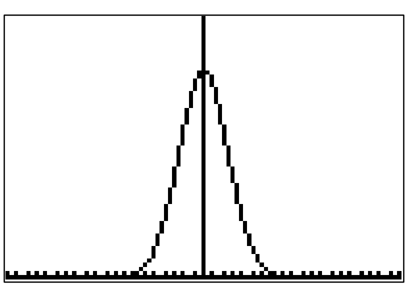


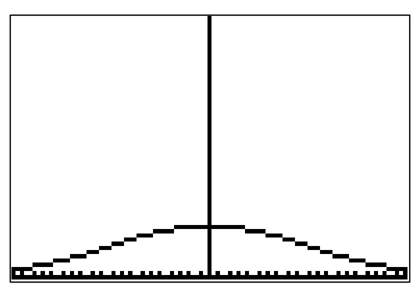
Every bell-shaped (NORMAL) curve has the following properties:

- Its peak occurs directly above the mean, μ
- The curve is symmetric about a vertical line through μThe curve never touches the x-axis. It extends indefinitely in both directions.
- The area between the curve and the x-axis is always 1 (total probability is 1).

The shape of the curve is completely determined by μ and σ,

$$P(x)=\frac{1}{\sqrt{2\pi\sigma}}e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

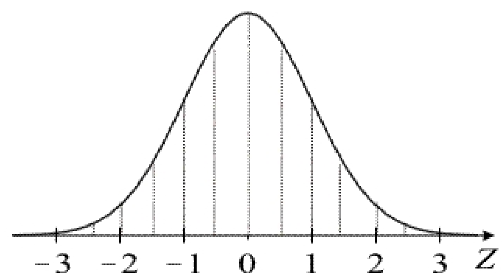




A continuous probability distribution is represented by a probability density function, $f$. The area between the graph of $f$ and the $x$-axis from $x = a$ to $x = b$ gives the probability that the random variable $X$ is between $a$ and $b$.

The standard normal curve has $\mu = 0$ and $\sigma = 1$. $Z$ is used to represent the standard normal curve instead of $X$ in this special case.

On the normal curve to the right, shade the area where $-0.5 < Z < 0.5$.

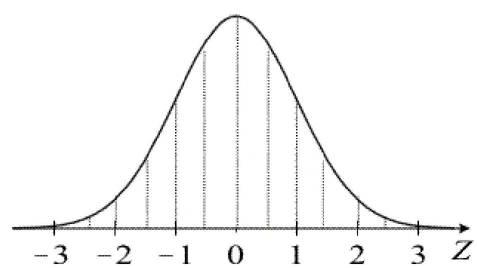



The normalcdf function on your calculator is used to evaluate probabilities involving normal curves.

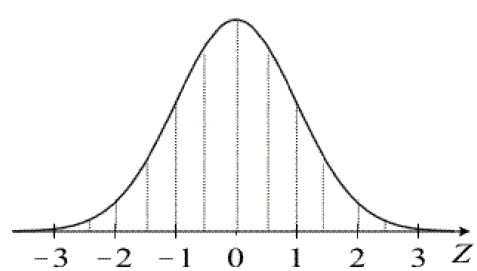
$$P(a < X < b) = \textbf{normalcdf(a, b, }\mu, \sigma\textbf{)}$$

$P(-0.5 < Z < 0.5)$ = normalcdf(–0.5, 0.5, 0, 1) = ___________

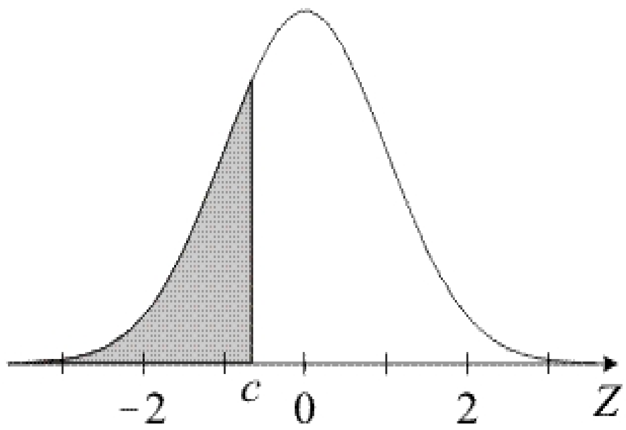
What is $P(Z > 1.5)$?




What is $P(Z < 2)$?



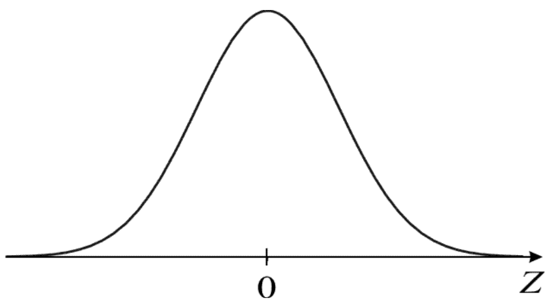
In the drawing on the right, the shaded region has an area of 0.25. To find the value of $c$, the calculator has a function to "invert the normal curve" called **invNorm**.




**invNorm(area to LEFT of unknown value, $\mu$, $\sigma$)**

$c =$ ____________.

Find the value of $b$ such that $P(Z > b) = 0.10$.




Find the value of $a$ such that $P(-a < Z < a) = 0.60$.