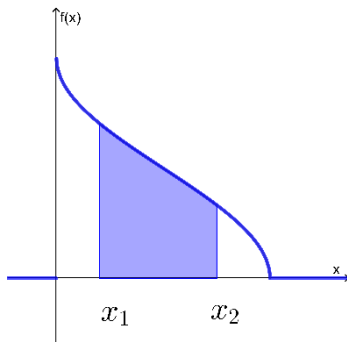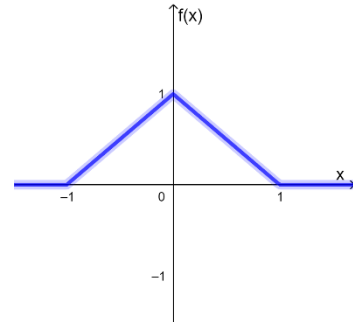# Continuous Random Variables

Continuous Random Variables are often represented as functions.

These can often be piecewise functions. Notice that the function should be defined for all values of x

$$f(x) = \begin{cases} x+1 & -1 \le x < 0 \\ \text{-}x+1 & 0 \le x < 1 \\ 0 & \text{otherwise} \end{cases}$$
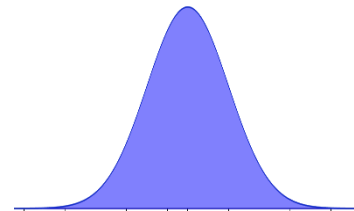

Probability calculations are made from finding the area under the graph
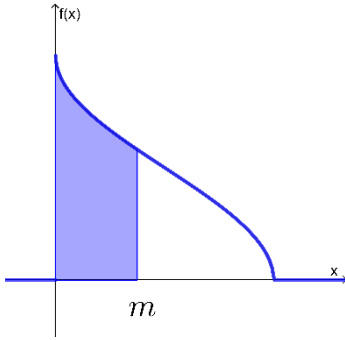
$$P(x_1 \le X < x_2) = \int_{x_1}^{x_2} f(x)dx$$

Since, all the probabilities add to 1,
then the total area under the graph = 1

$$\int_{-\infty}^{\infty} f(x)dx = 1$$

$$\text{Mean} = E(X) = \int_{-\infty}^{\infty} xf(x)dx$$

$$Variance = E(X)^2 - [E(X)]^2$$

$$= \int_{-\infty}^{\infty} x^2 f(x)dx - \left[\int_{-\infty}^{\infty} xf(x)dx\right]^2$$

Median, m is the value that divides the area of the function in two equal parts. It can be found by solving:

$$\int_{-\infty}^{m} f(x)dx = 0.5$$

Mode is the value at which the probability density function reaches a local maximum