Today:

- We will cover probability concepts as we work through the material from Section 5.1.
- We will first look at the properties of a Normal Distribution
- Then use our previously defined standardized variable, the $z$-score to transform any Normal Distribution into The Standard Normal Distribution.
- We will learn how to find the area under the standard normal curve.
- Next time we tie the area under normal curves to percentages (or probabilities).

A variable is said to be normally distributed or have a normal distribution if its distribution has the shape of a normal curve - a special bell-shaped curve.

The variables we will now consider are continuous random variables.

**Properties of a Normal Distribution**

**GUIDELINES**

**Properties of a Normal Distribution**

A normal distribution is a continuous probability distribution for a random variable $x$. The graph of a normal distribution is called the normal curve, which has all of the following properties:

1. The mean, median, and mode are equal.
2. The normal curve is bell-shaped and is symmetric about the mean.
3. The total area under the curve is equal to one.
4. The normal curve approaches, but never touches, the $x$-axis.
5. Between $\mu - \sigma$ and $\mu + \sigma$ the graph is concave down and elsewhere the graph is concave up. The points at which the graph changes concavity are called inflection points.

Remarks

- A normal distribution can have any mean and any positive standard deviation
- The two parameters, $\mu$ and $\sigma$ completely determine the shape of the normal curve.
- The equation of the normal curve is $y = \frac{1}{\sigma \sqrt{2\pi}} e^{-\frac{(x - \mu)^2}{2\sigma^2}}$
The Standard Normal Distribution

**DEFINITION**
The **standard normal distribution** is a normal distribution with a:  
- mean of 0,  
- standard deviation of 1.

![The Standard Normal Distribution](image)

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**Properties of the Standard Normal Distribution**

1. The cumulative area is close to 0 for $z$-scores close to $z = -3.5$.
2. The cumulative area increases as the $z$-score increases.
3. The cumulative area for $z = 0$ is $\frac{1}{2}$.
4. The cumulative area is close to 1 for $z$-scores close to $z = 3.5$.

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**GUIDELINES**

**Finding Areas under The Standard Normal Curve**

1. Sketch the standard normal curve, and shade the appropriate region under the curve.
2. Find the area based on the appropriate case below.
   
   (a) To find the area to the left of $z$, find the area corresponding to $z$ in the Standard Normal Table.
   
   (b) To find the area to the right of $z$, first find the area corresponding to $z$ in the Standard Normal Table, then subtract that area from 1.
   
   (c) To find the area between two $z$-scores, find the area corresponding to each $z$-score in the Standard Normal Table. Then subtract the smaller from the larger.

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**Remarks**

- It is important that you recognize the difference between $x$ and $z$.
  
The random variable $x$ is sometimes called the **raw score** and represents values in a nonstandard normal distribution. The variable $z$ represents values in the standard normal distribution.

- The area under the standard normal curve to the left of a $z$-score gives the probability that $z$ is less than that $z$-score.