Normal Distribution

Colby Community College

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A little while later more and more start to pop.

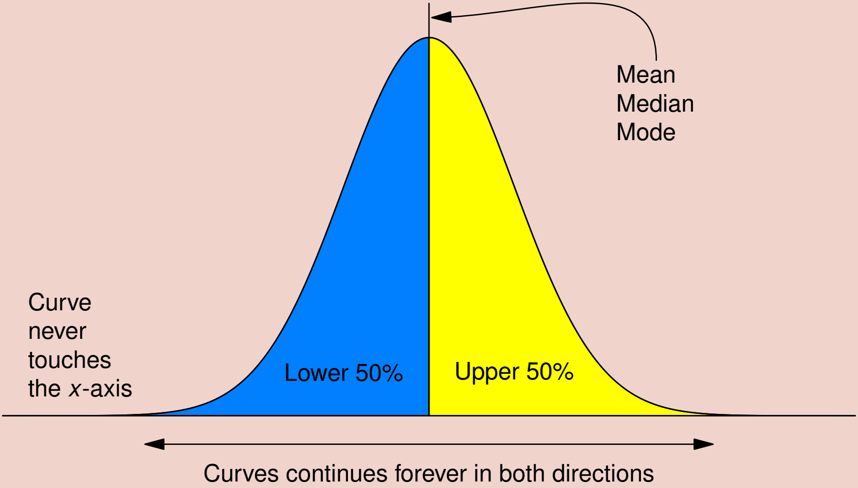
This goes one for a minute or so, and the popping gradually tappers off.

Most of the popping happens in that brief, noisy moment.

This demonstrates a typical pattern that is part of many phenomena.

Definition

A **normal distribution** is a perfectly symmetric, bell-shaped distribution. It is also referred to as a **normal curve** or a **bell curve**.



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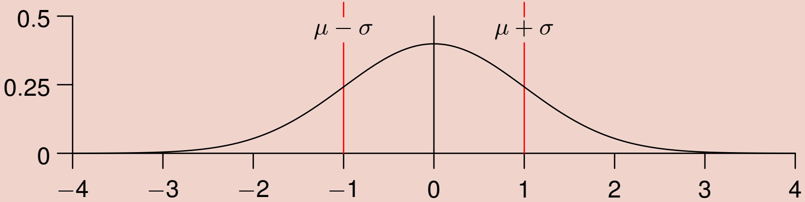
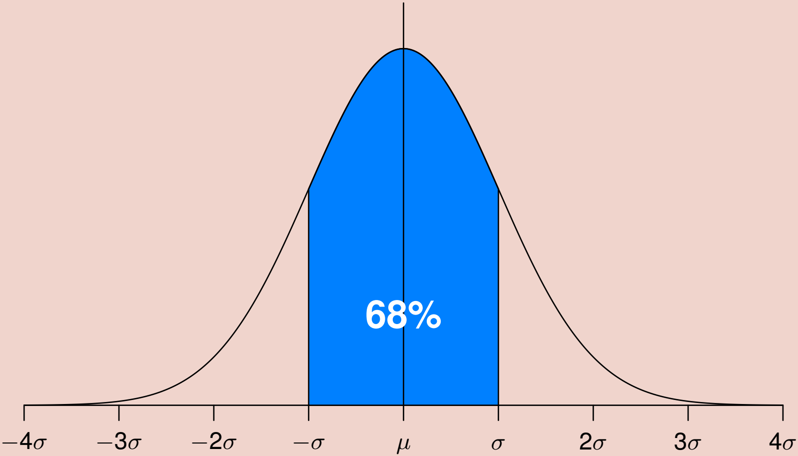
When $\mu = 0$ and $\sigma = 1$, the curve is called the **standard normal distribution.** The total area under the curve is exactly equal to 1.



Definition

The **empirical rule**, or **68-95-99.7 rule**, states approximately how much of the area is contained when stepping one, two, or three standard deviations from the mean.

One standard deviation from the mean.



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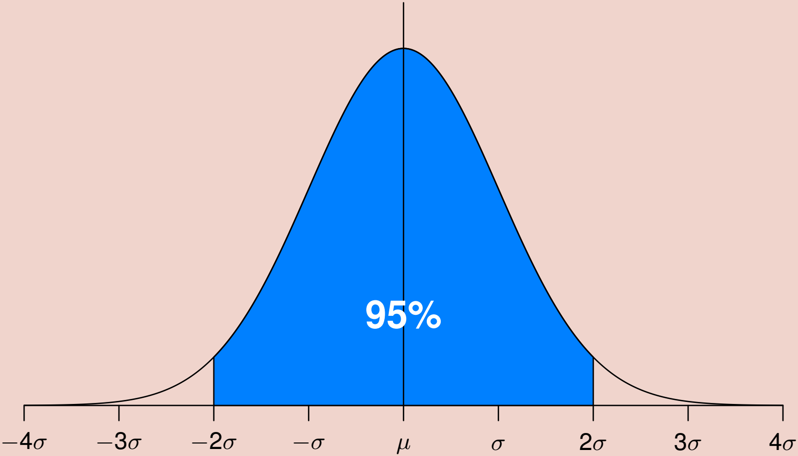

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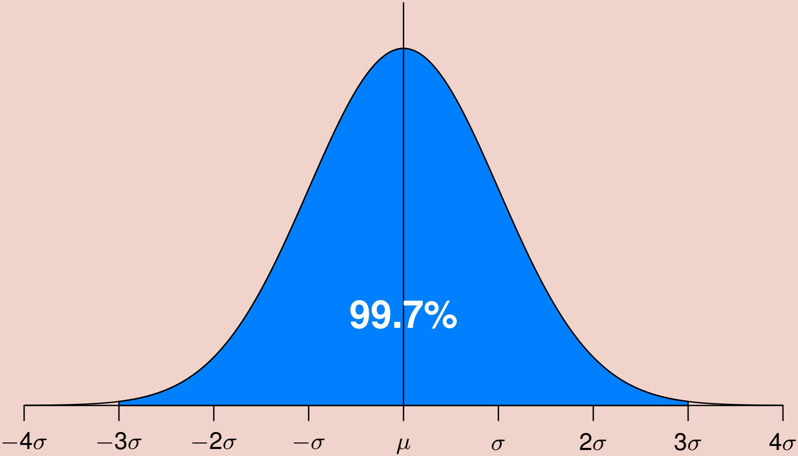

Definition

A ***z*-score** is a measure of the number of standard deviations a particular data point is away from the mean.

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$$z = \frac{x-\mu}{\sigma} \;\Rightarrow\; z\sigma = x - \mu \;\Rightarrow\; x = z\sigma + \mu = (-1.3)(8) + 70 = 59.6$$

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Since the curve is symmetric, we know that 13.5% of the students scored between 89 and 96, as well as 13.5% between 68 and 75

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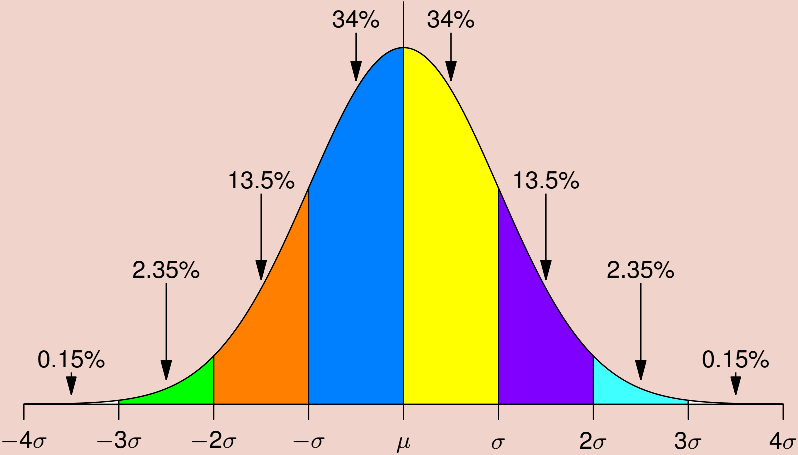
For each standard deviation.



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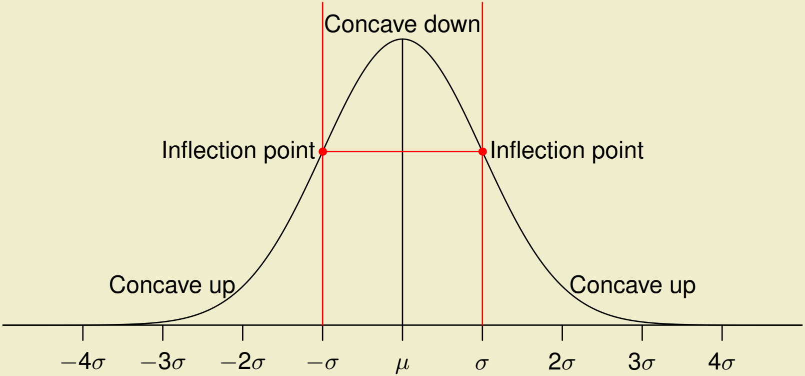
A normal density curve always has two inflection points, each one standard deviation from the mean.



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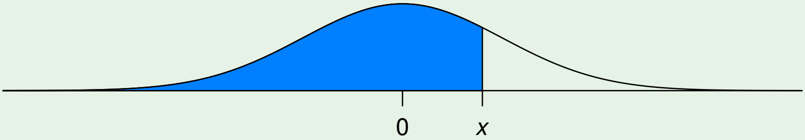

The area of the shaded region is the probability that a z score is less than or equal to x, $P(z \leq x)$.

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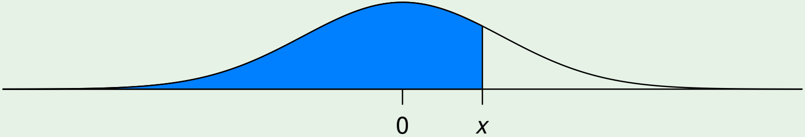

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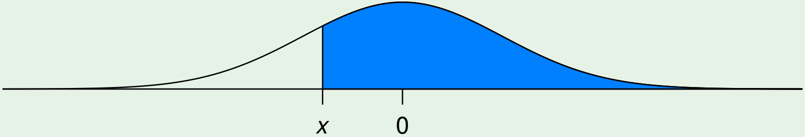

The area of the shaded region is the probability that a z score is greater than or equal to x, $P(z \geq x)$.

Can also be calculated as $1 - P(z \leq x)$.

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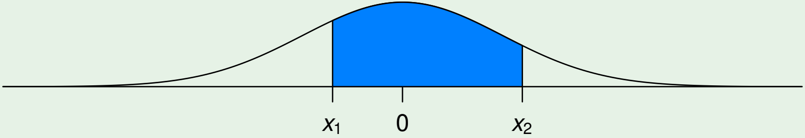

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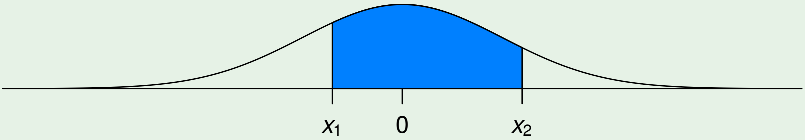

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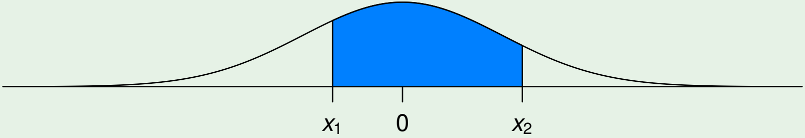

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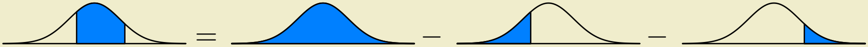
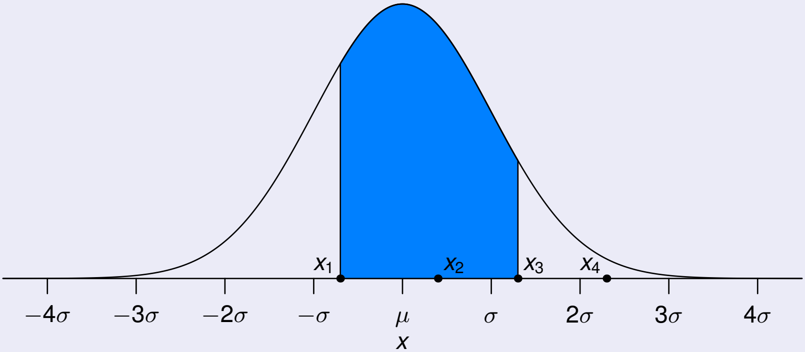


$$P(x_1 \le z \le x_2) = 1 - P(z \le x_1) - P(z \ge x_2)$$

Procedure for Finding Areas with a Nonstandard Normal Distribution

1. Sketch a normal curve, label the mean and any specific x values, and then shade the region representing the desired probability.
2.
3.



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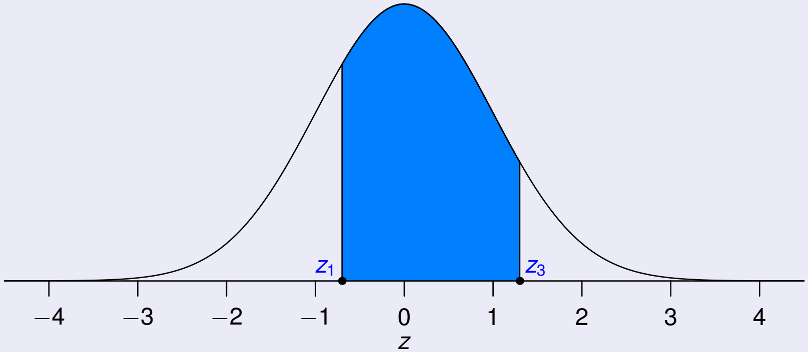

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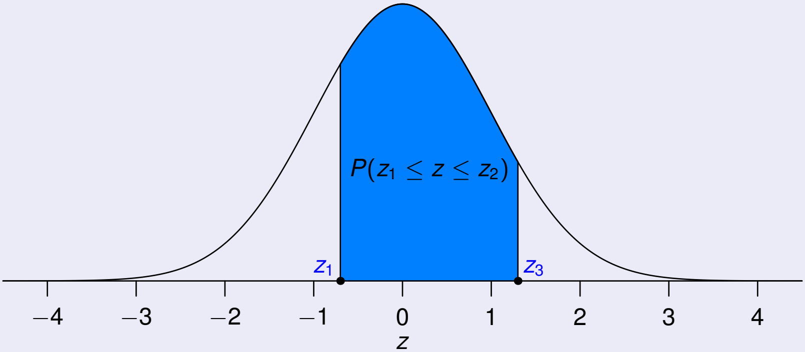
3. Use technology to find the area of the shaded region.



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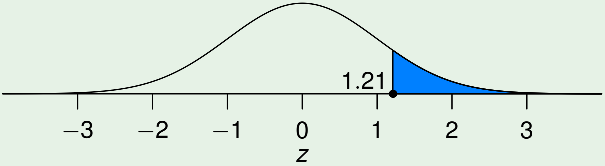

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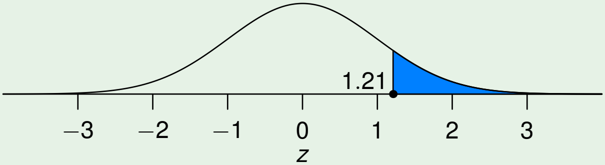

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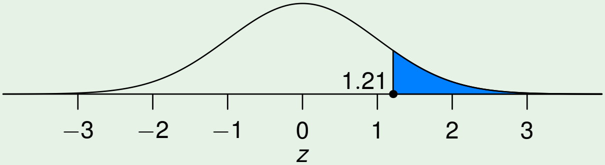

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So, about 11.23% of men are taller than the shower head.

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The U.S. Air Force requires that pilots have heights between 64 and 77 in. The heights of men are normally distributed with a mean of 68.6 in. and a standard deviation of 2.8 in.

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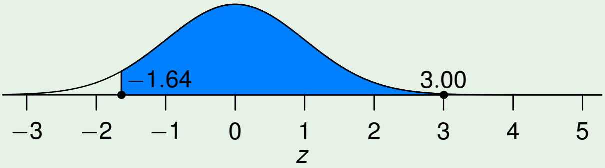

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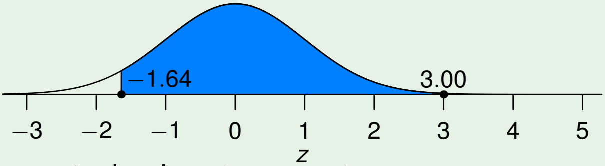

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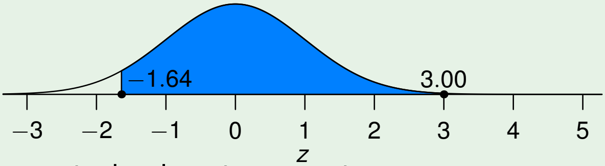

We can then use technology to compute:

$$P(-1.64 \le z \le 3.00) \approx 0.9484 \quad \text{(rounded)}$$

So, we see that about 94.84% of men meet the requirements.

Example 10

The U.S. Air Force requires that pilots have heights between 64 and 77 in. The heights of women are normally distributed with a mean of 63.7 in. and a standard deviation of 2.9 in.

Let's find the percentage of women meet that requirement.

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Let's find the percentage of women meet that requirement.

We start by finding the z-values of the height requirements.

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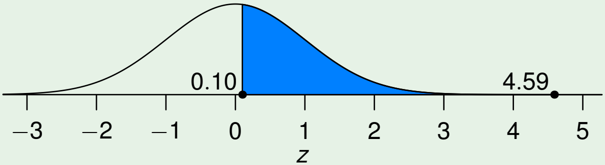

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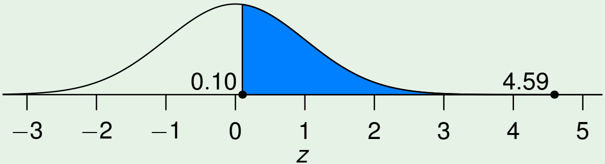

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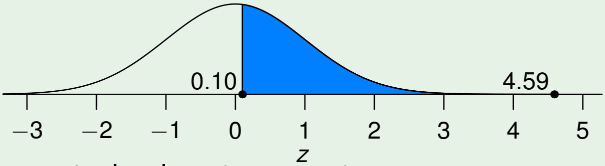

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So, we see that only about 46% of women meet the requirements.

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4. Use your sketch to verify that the solution makes sense.