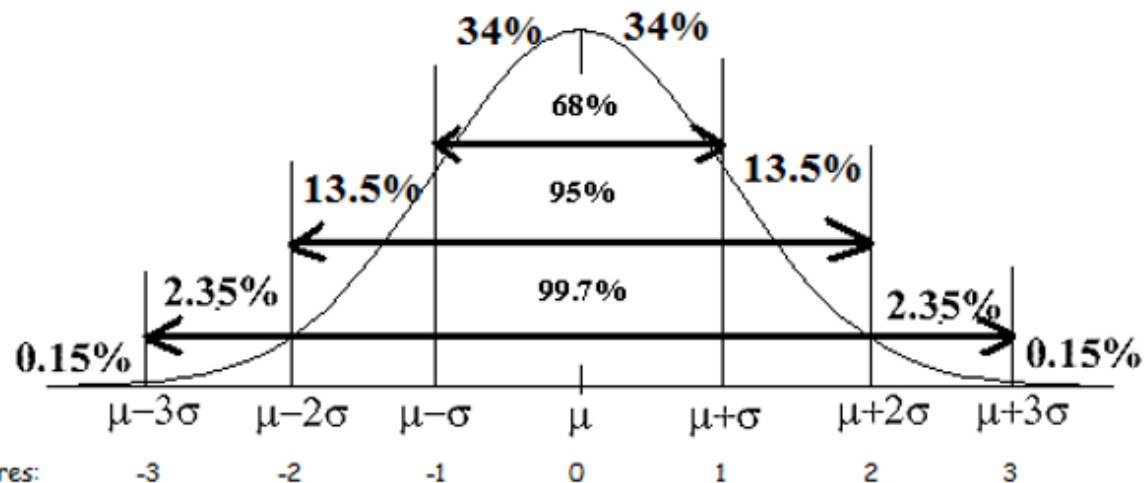# Lesson 13.2: Normal Curves

A **Normal distribution** is described by a Normal density curve. Any particular Normal distribution is **completely specified** by two numbers: its mean μ and standard deviation σ. The mean of a Normal distribution is at the **center** of the **symmetric** Normal curve. The standard deviation is the **distance** from the center to the change of **curvature points** on either side. We abbreviate the Normal distribution with mean μ and standard deviation σ as **$N(\mu, \sigma)$**.

μ = "mu"
mean

σ = "sigma"
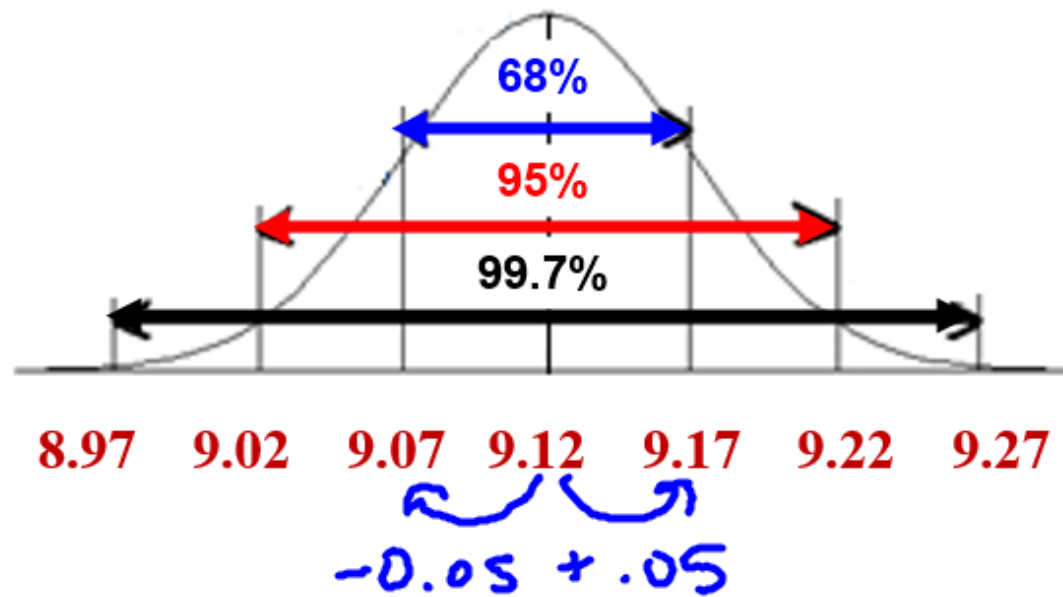standard deviation

68-95-99.7 Rule

	$\mu-3\sigma$	$\mu-2\sigma$	$\mu-\sigma$	μ	$\mu+\sigma$	$\mu+2\sigma$	$\mu+3\sigma$
z-scores:	-3	-2	-1	0	1	2	3

34% 34%
68%
13.5%   13.5%
95%
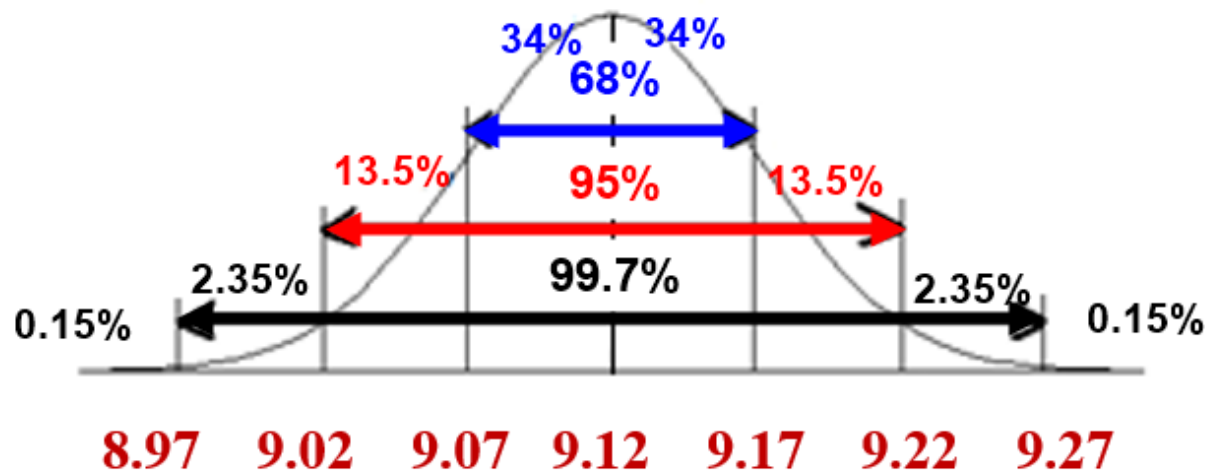2.35%   99.7%   2.35%
0.15%   0.15%

The **standard Normal distribution** is the Normal distribution with **mean 0** and **standard deviation 1**. If a variable x has any Normal distribution $N(\mu, \sigma)$ with mean μ and standard deviation σ, then the **standardized variable** $z = \frac{x-\mu}{\sigma}$ has the standard Normal distribution $N(0, 1)$.

The **standard Normal table** is a table of **areas** under the standard Normal curve. The **table entry** for each value z is the **area** under the curve to the **left** of z.
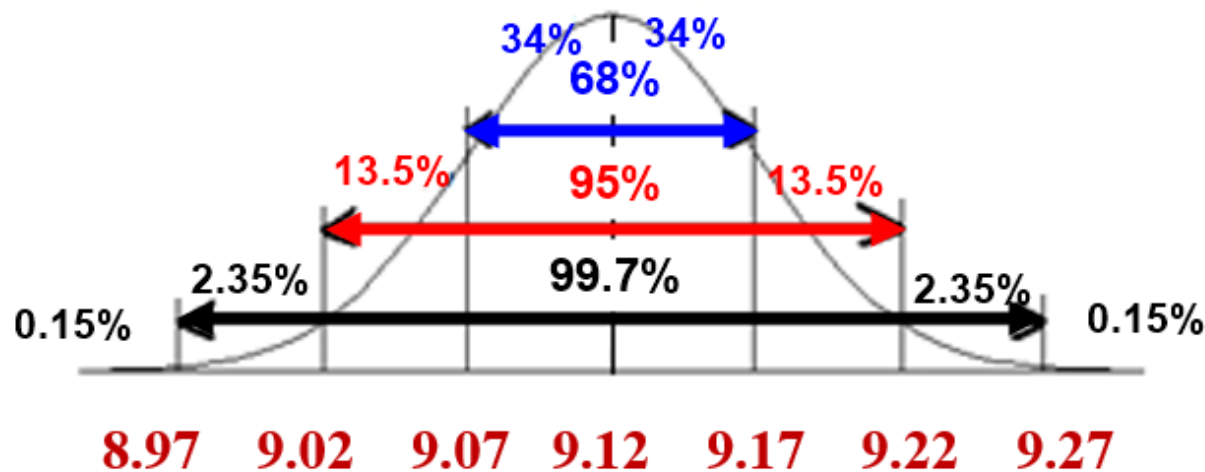
The distribution of weights of 9-ounce bags of a particular brand of potato chips is approximately Normal with mean $\mu = 9.12$ ounces and standard deviation $\sigma = 0.05$ ounce. On the sketch below label the mean, as well as the points 1, 2, and 3 standard deviations away from the mean on the horizontal axis.
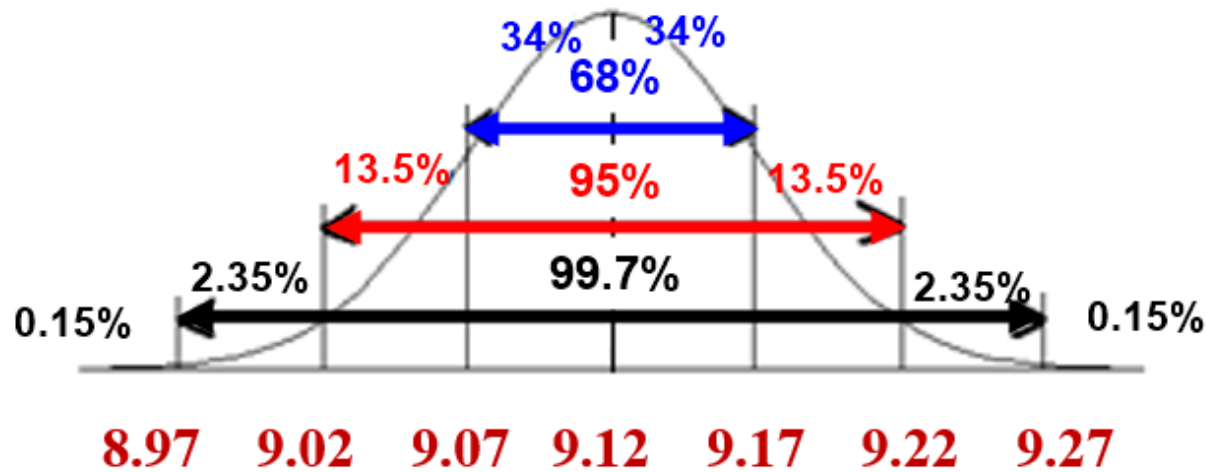
68%

95%

99.7%

8.97   9.02   9.07 9.12   9.17   9.22   9.27

$-0.05 \quad +.05$

The normal distribution curve shows percentages: 34% and 34% (68%), 13.5% and 13.5% (95%), 2.35% and 2.35% (99.7%), 0.15% and 0.15%, with values along the bottom: 8.97, 9.02, 9.07, 9.12, 9.17, 9.22, 9.27

a- Identify the interval(s) that contain the given approximate areas under the curve.

95%	47.5%
9.02 to 9.22	13.5 + 34 = 47.5% 9.02 to 9.12 9.12 to 9.22

34% | 34%
68%
13.5% | 95% | 13.5%
2.35% | 99.7% | 2.35%
0.15% | 0.15%

8.97   9.02   9.07   9.12   9.17   9.22   9.27

a- Identify the interval(s) that contain the given approximate areas under the curve.

16%	97.35%
.15 + 2.35 + 13.5 = 16%	95 + 2.35 = 97.35
Below 9.07	9.02 to 9.27
Above 9.17	8.97 to 9.22

34%   34%
68%
13.5%   95%   13.5%
2.35%   99.7%   2.35%
0.15%   0.15%

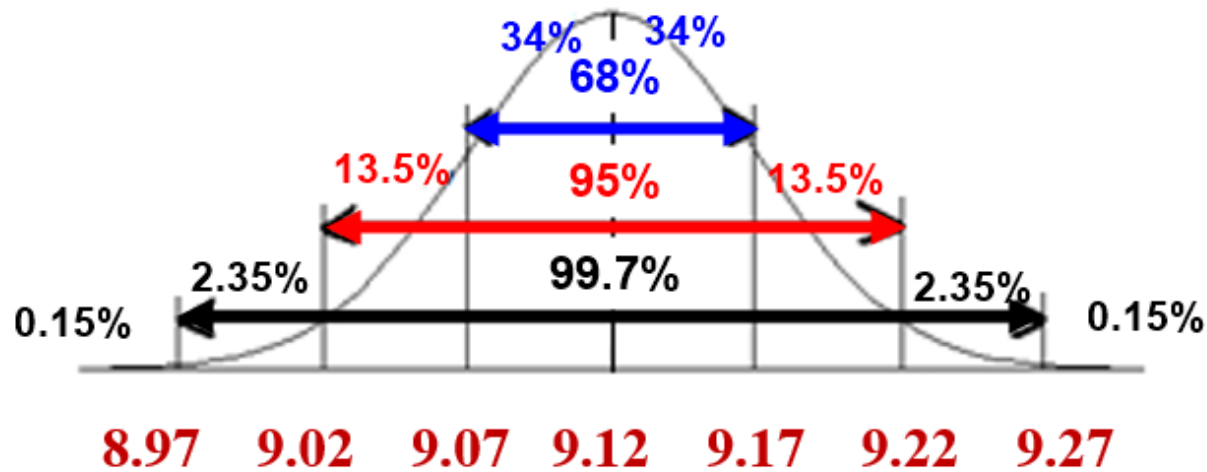8.97   9.02   9.07   9.12   9.17   9.22   9.27

a- What percentage of potato chip bags weigh less than 9.02 ounces?

$$2.35 + 0.15 = \boxed{2.5\%}$$

b- What percentage of potato chip bags weigh more than 9.07 ounces?

$$34 + 34 + 13.5 + 2.35 + 0.15$$

$$= \boxed{84\%}$$

34% | 34%
68%
13.5% 95% 13.5%
2.35% 99.7% 2.35%
0.15% 0.15%

8.97 9.02 9.07 9.12 9.17 9.22 9.27

c- What percentage of potato chip bags weigh between 8.97 and 9.22 ounces?

$$2.35 + 13.5 + 34 + 34 + 13.5$$

$$= 97.35\%$$

The mean height of 18-24-year-old males in the United States is about 70.1 inches with a standard deviation of 2.7 inches. The mean height of 18-24-year-old females is about 64.8 inches, with a standard deviation of 2.5 inches.

$x = 72.5$

a-   What percentage of men are under 6 feet tall? Find the appropriate z-score to answer this question as well as the percentage requested.

$$Z = \frac{X - \mu}{\sigma}$$

$$Z = \frac{(72 - 70.1)}{2.7} = 0.70$$

$\mu = 70.1$

$\sigma = 2.7$

$X = 72$

$$\boxed{75.80\%}$$

Less than: Keep % the same

More Than: 100 - %

Between: Subtract the two
$$\%'s$$

The mean height of 18-24-year-old males in the United States is about 70.1 inches with a standard deviation of 2.7 inches. The mean height of 18-24-year-old females is about 64.8 inches, with a standard deviation of 2.5 inches.

71"

d- The average height of WNBA players is 5'11". How many women are taller than that? Find the appropriate z-score to answer this question as well as the percentage requested.

$$Z = \frac{x - \mu}{\sigma}$$

$$Z = \frac{(71 - 64.8)}{2.5} \approx 2.48$$

$X = 71$

$\mu = 64.8$

$\sigma = 2.5$

Table: 99.34%

Taller!

$100 - 99.34\% = 0.66\%$

The mean height of 18-24-year-old males in the United States is about 70.1 inches with a standard deviation of 2.7 inches. The mean height of 18-24-year-old females is about 64.8 inches, with a standard deviation of 2.5 inches.

e- To work as a flight attendant for United Airlines, you must be between (5'2") 62" and 6' tall. What percent of men of this age meet the height requirement? 72 Find the appropriate z-score to answer this question as well as the percentage requested.

$$X = 62$$
$$M = 70.1$$
$$\sigma = 2.7$$
$$Z = \frac{62 - 70.1}{2.7} \approx -3$$
$$.13\%$$

$$X = 72$$
$$M = 70.1$$
$$\sigma = 2.7$$
$$Z = \frac{72 - 70.1}{2.7} \approx 0.70$$
$$75.8\%$$

$$75.8 - 0.13 = \boxed{75.67\%}$$