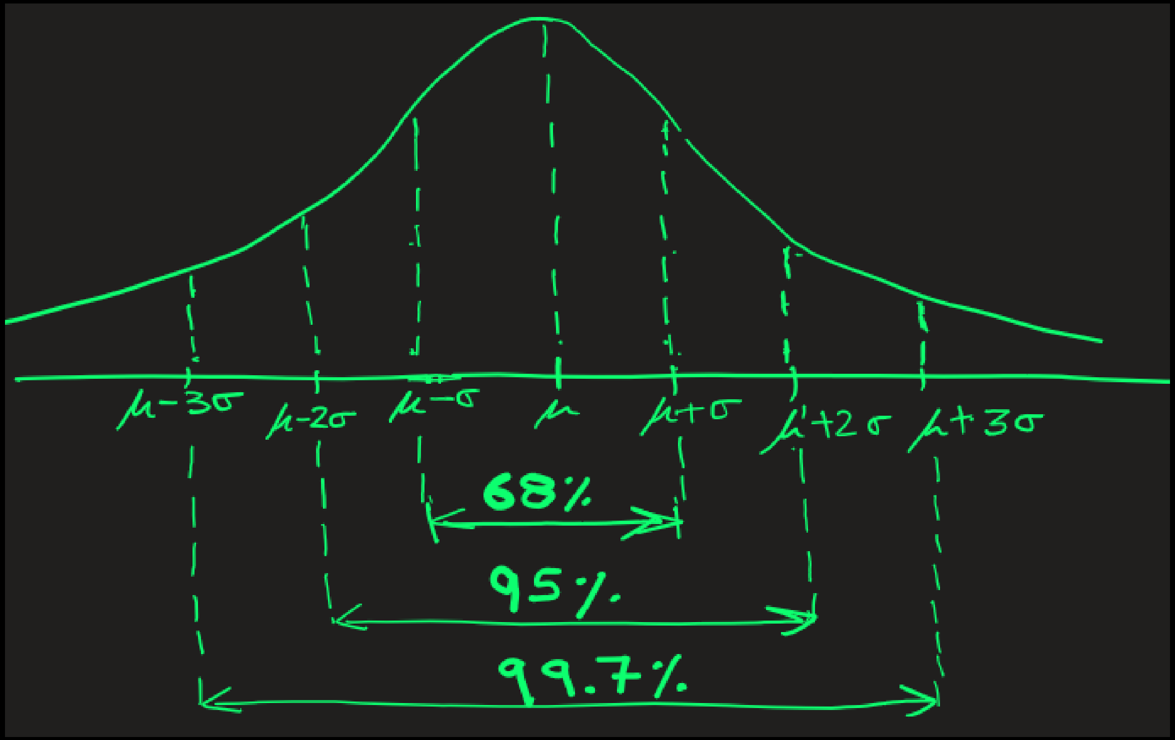
Empirical Rule: 68 – 95 – 99.7

Empirical Rule describes how data is distributed in a **normal distribution AKA Gaussian distribution** — *bell-shaped curve*.

This is the rule devised by nature which is almost universally true.

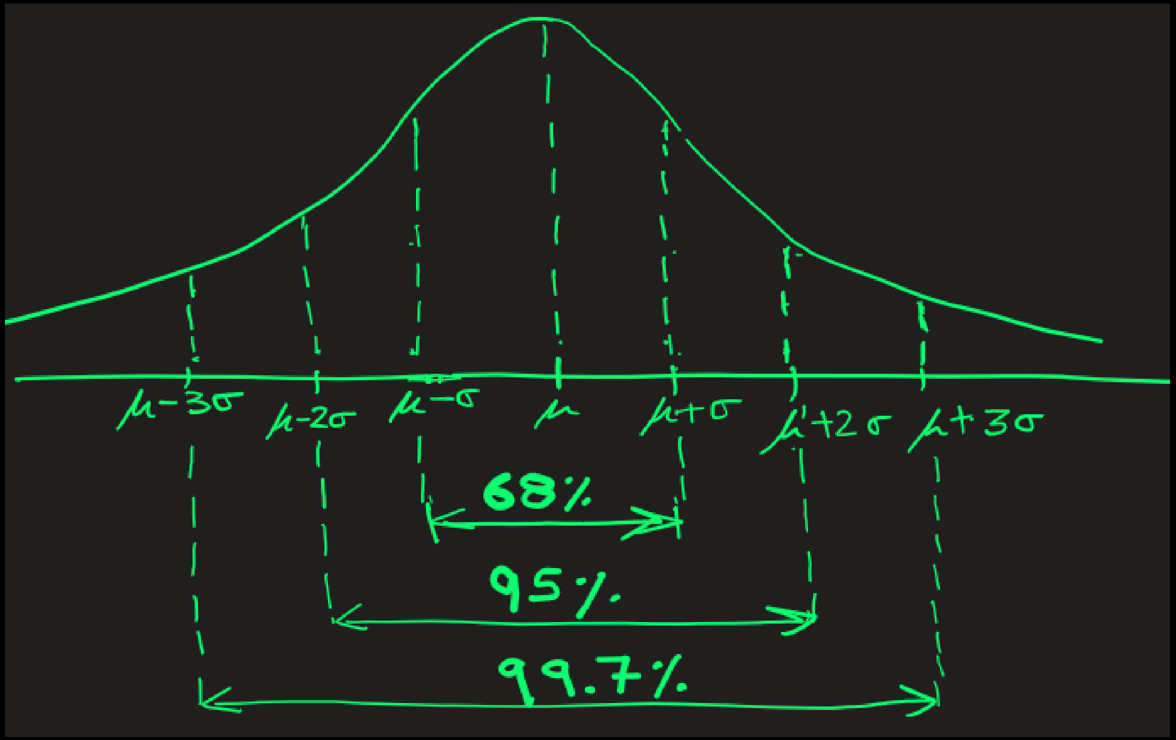


Empirical Rule: 68 – 95 – 99.7

About 68% of data lies within **1 standard deviation (σ)** of the mean (μ). → Between **μ – σ and μ + σ**.

About 95% of data lies within **2 standard deviations** of the mean. → Between **μ – 2σ and μ + 2σ**.

About 99.7% of data lies within **3 standard deviations** of the mean. → Between **μ – 3σ and μ + 3σ**.



68 – 95 – 99.7

The curve is **symmetrical:** The left side is mirroring right.

What does this symmetry mean?

The implication:

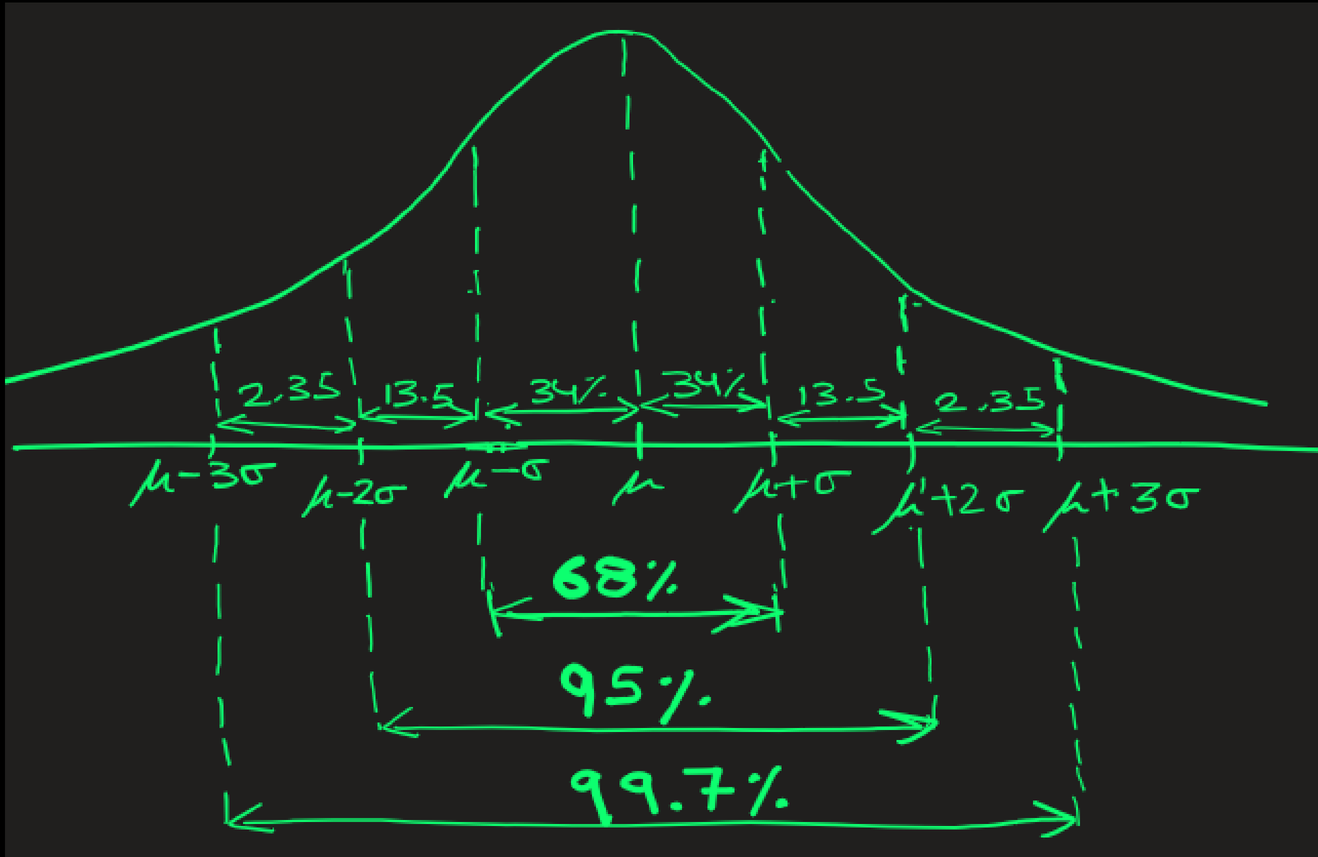
68/2 = 34% of data lies in between **μ – σ and μ**

68/2 = 34% of data lies in between **μ and μ + σ**

(95 – 68)/2 = 13.5% of data lies in between **μ – 2σ and μ – σ**

(95 – 68)/2 = 13.5% of data lies in between **μ + σ and μ + 2σ**

And so on…..



68 – 95 – 99.7

EXAMPLE: Let's say exam scores of students from all schools are normally distributed with **mean (μ) = 70** and **standard deviation (σ) = 10**.

It essentially means that

68% of students scored between **μ – σ and μ + σ**

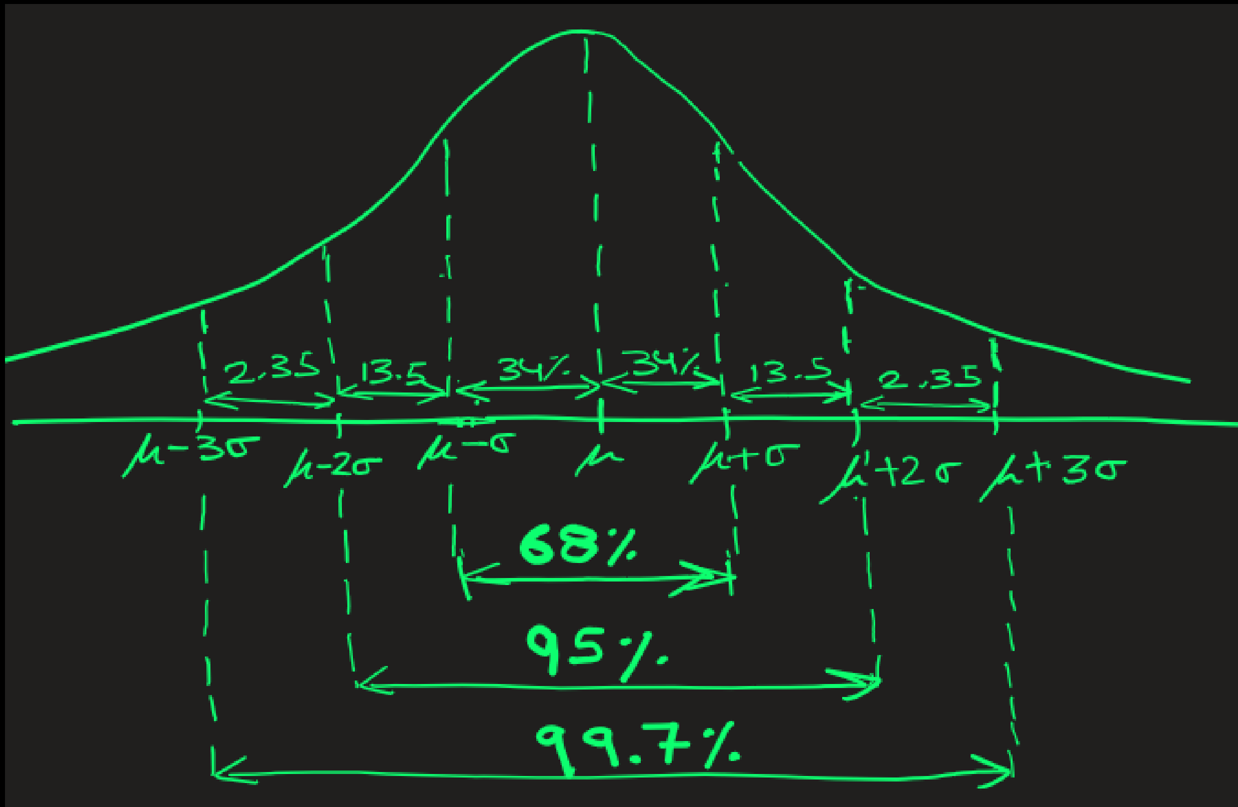
-> 68% of students scored between **60 and 80**

95% of students scored between **μ – 2σ and μ + 2σ**

-> 95% of students scored between **50 and 90**

99.7% of students scored between **μ – 3σ and μ + 3σ**

-> 99.7% of students scored between **40 and 100**



68 – 95 – 99.7

PROBLEM: Suppose the heights of adult men in a city are **normally distributed** with mean (μ) = **175 cm** and standard deviation (σ) = **5 cm.**

1) Using empirical rule determine the range around mean that includes 68% of men height
2) Using empirical rule determine the range around mean that includes 95% of men height

Answer:

1)

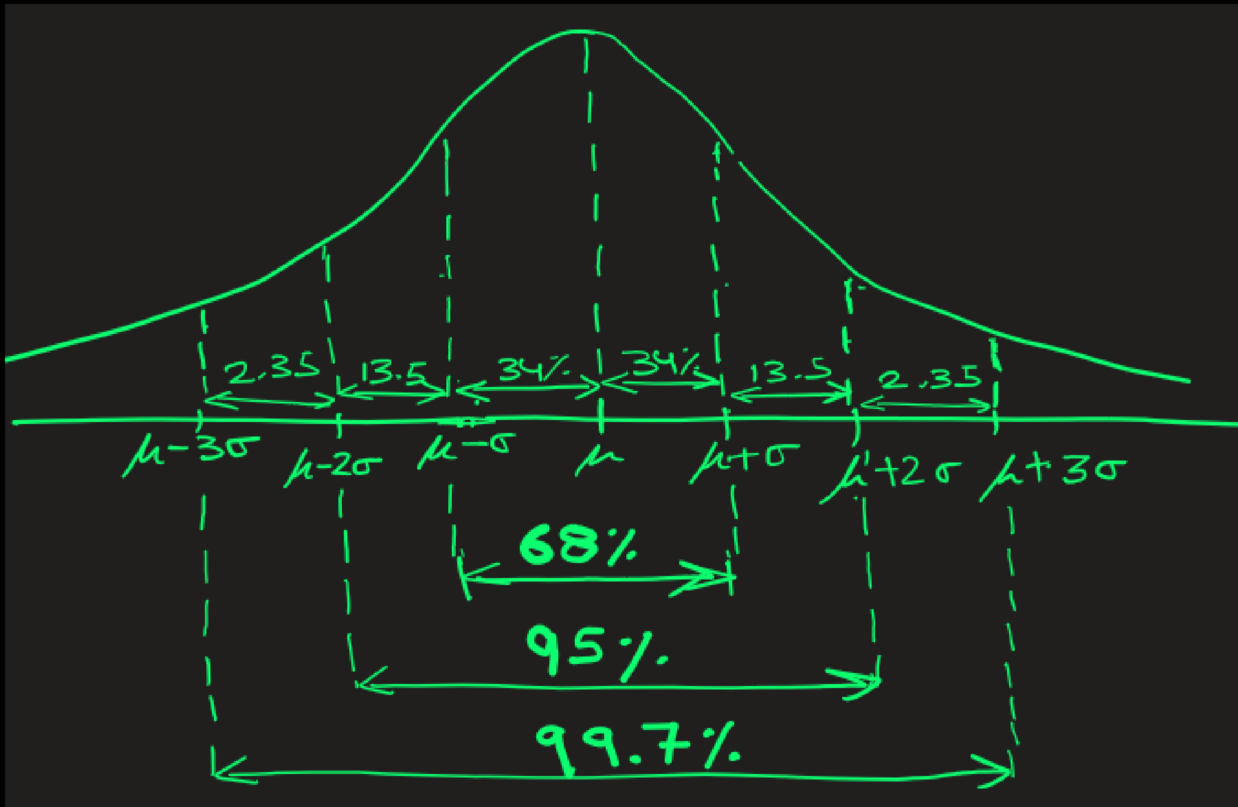
68% of men's height is in between **μ – σ and μ + σ**

68% of men's height is in between **170 and 180 cm**

2)

95% of men's height is in between **μ – 2σ and μ + 2σ**

95% of men's height is in between **165 and 185 cm**



68 – 95 – 99.7

PROBLEM: Suppose the heights of adult men in a city are **normally distributed** with mean (μ) = **175 cm** and standard deviation (σ) = **5 cm.**

1) Using empirical rule determine the percentage of people whose height is between 175 and 180 cm
2) Using empirical rule determine the percentage of people whose height is between 170 and 185 cm

Answer:

1)

175 cm to 180 cm :

By looking at graph , 68 / 2 = 34%

2)

170 cm to 185 cm :

By looking at graph , 68% + 13.5% = 81.5%