

Regents Park Publishers

Business Statistics



T1LM3

Excel Tutorials



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Axioms

Axioms

An **Axiom** is a mathematical statement that is **assumed** to be true.

- a self-evident truth that requires no proof
- a universally accepted principle or rule
- a proposition that is assumed without proof for the sake of studying the consequences that follow from it
- Formulas that we use are based on axioms

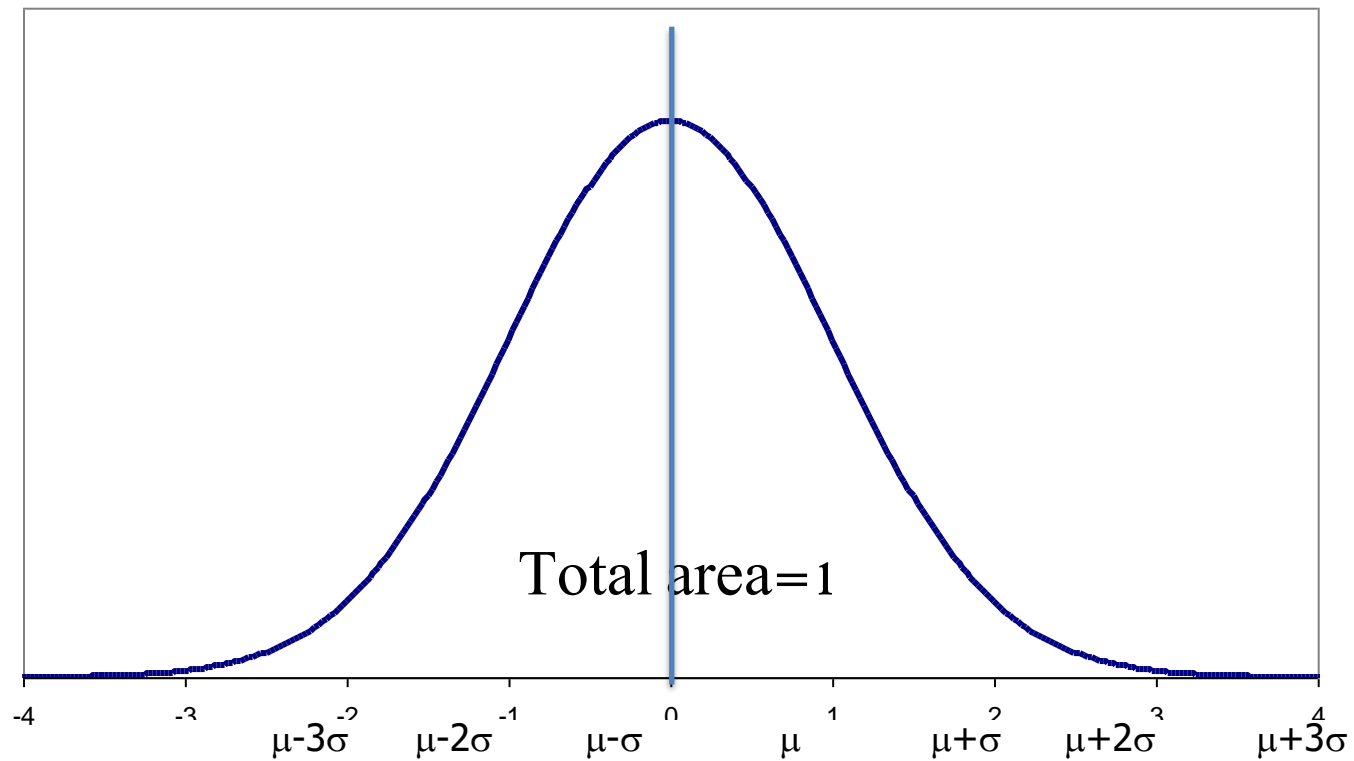


Normal Probability Distribution

Introduction

- The Normal (or Gaussian) distribution is probably the most used (and abused) distribution in statistics.
- Normal random variables are **continuous** (they can take any value on the real line) so the Normal distribution is an example of a **continuous probability distribution**.

The Normal Distribution



The graph of the normal distribution is called the normal (or bell) curve.

The Normal Distribution

- The mean, median, and mode are the same.
- The normal curve is symmetric about its mean.
- The total area under the normal curve is one.
- The normal curve approaches, but never touches, the x-axis.

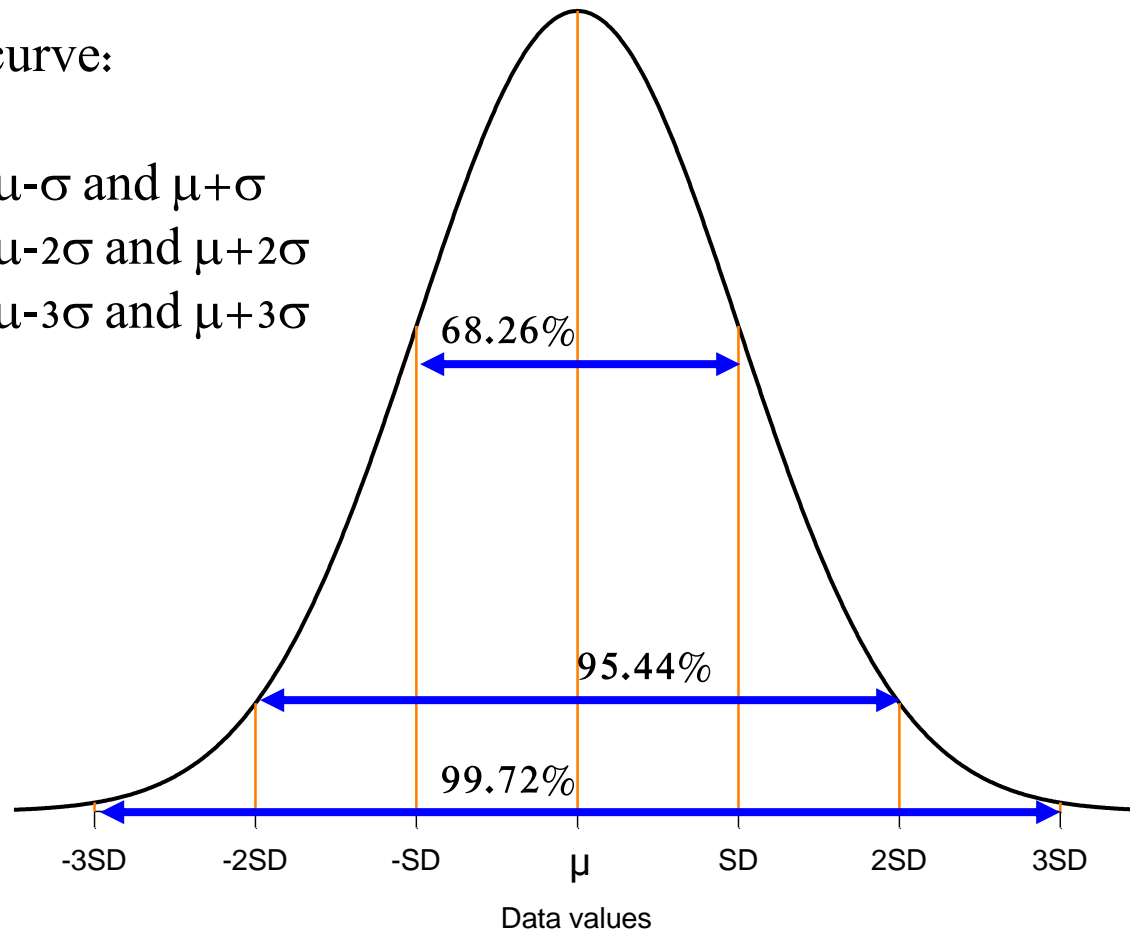
The Empirical Rule

The areas under the curve:

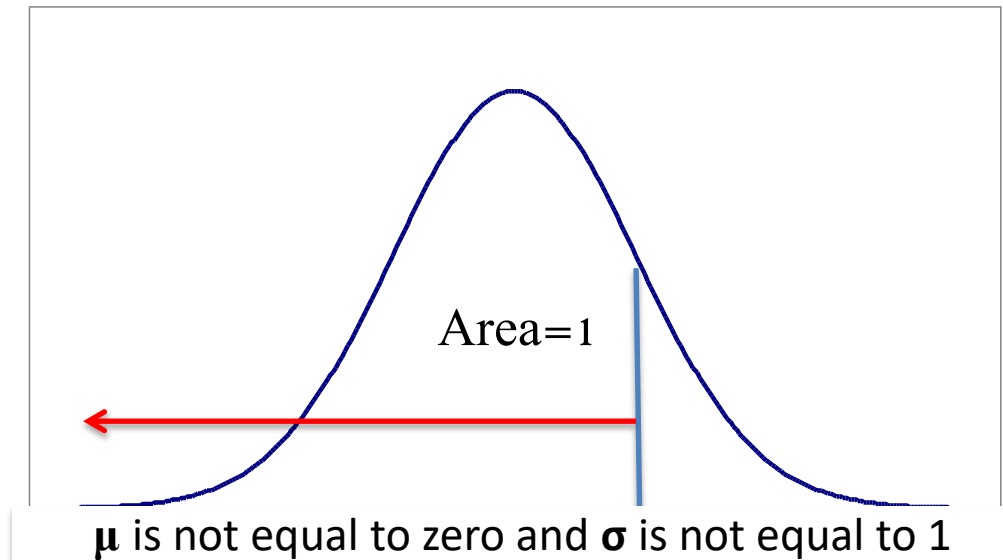
68.26% lies between $\mu - \sigma$ and $\mu + \sigma$

95.44% lies between $\mu - 2\sigma$ and $\mu + 2\sigma$

99.72% lies between $\mu - 3\sigma$ and $\mu + 3\sigma$

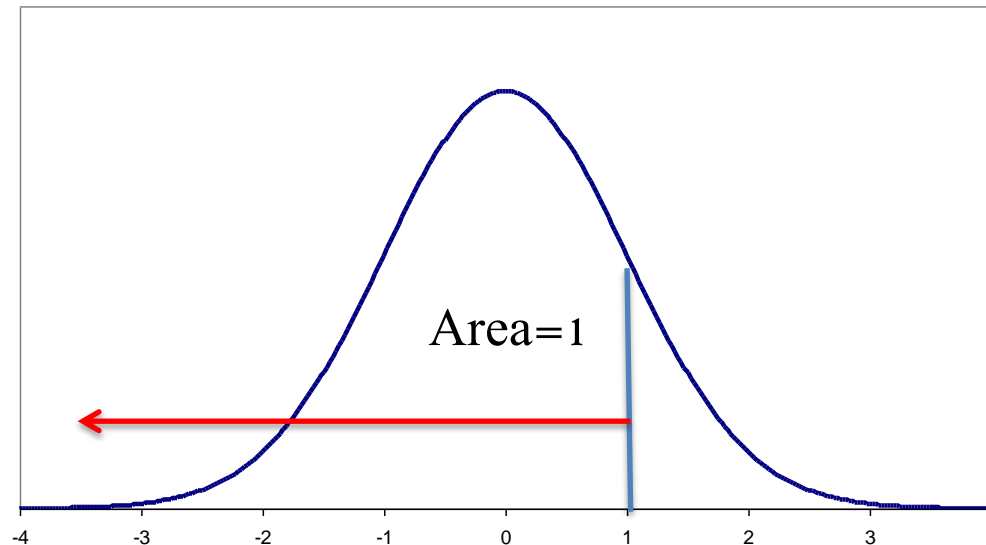


Excel Function (Not Standardized)



The area under the normal distribution
from x to $-\infty$ can be computed using the EXCEL function
NORMDIST

Excel Function (Standardized)



The area under the **standard** normal distribution from x to $-\infty$ can be computed using the EXCEL function **NORMSDIST**

Examples 1-3

Non-Standardized

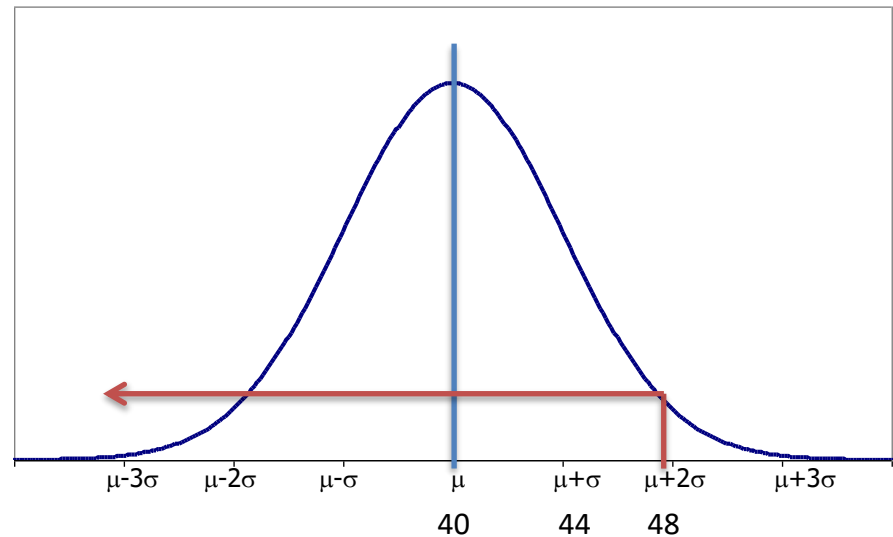
Example 1

- The mean length of a fish is **40cm** and the standard deviation is **4 cm**. What is the probability that the length of a randomly selected fish is less than **48cm**?

- 48cm** is **two** standard deviations above the mean so the area to the left of 48cm is

NORMDIST (48,40,4,1)

= 0.9772



Example-2

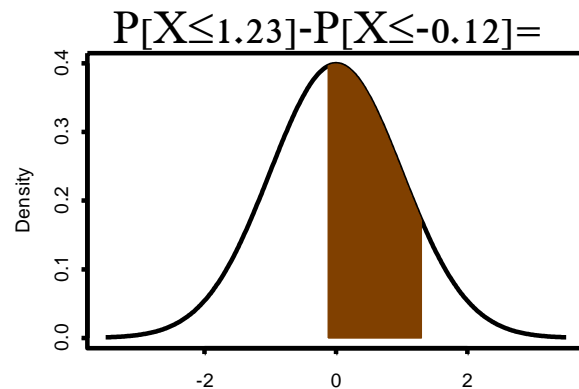
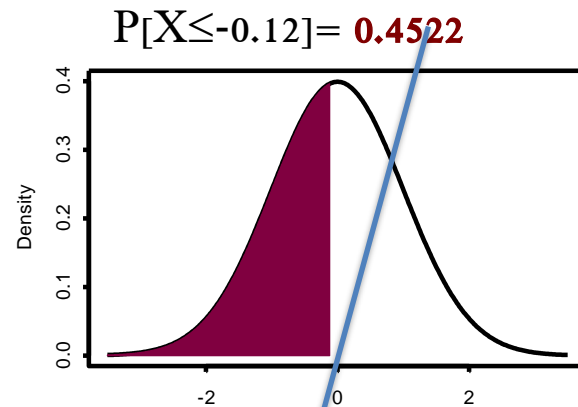
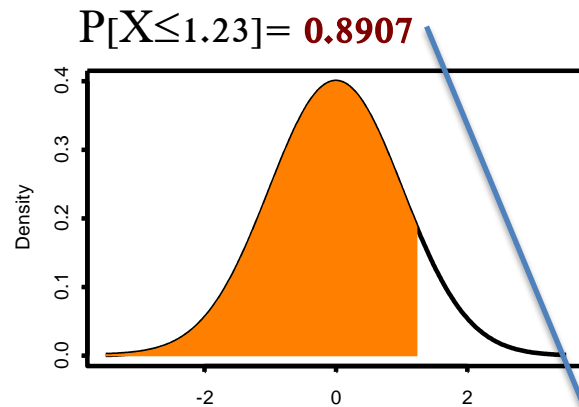
- Find the area under the normal distribution curve between -0.12 and 1.23.

– In EXCEL:

- $\text{NORMDIST}(1.23,0,1,1) - \text{NORMDIST}(-0.12,0,1,1)$

$\text{NORMDIST}(x,\mu,\sigma,1)$

Example-2



$0.8907 - 0.4522 = 0.4384$



Standardized Normal Probability Distribution

The Standard Normal Distribution

The normal distribution with a mean of 0 and a standard deviation of 1 is called the

Standard Normal Distribution

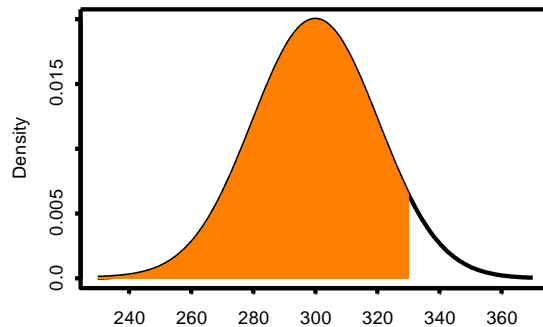
- The standard normal distribution and the z-score:

$$z = \frac{\text{value} - \text{mean}}{\text{standard deviation}} = \frac{x - \mu}{\sigma}$$

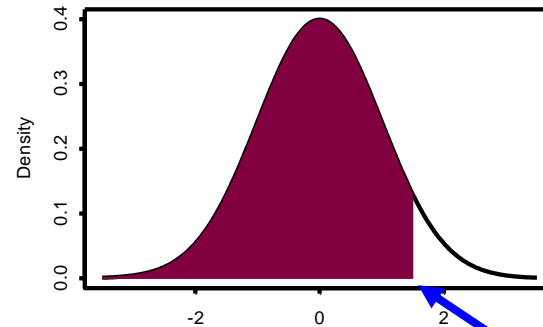
Standardization

- We can transform any normal distribution into a standard normal distribution by subtracting the mean and dividing by the standard deviation.

$\mu=300; \sigma=20; X=330$



$\mu=0; \sigma=1; Z=1.5$



Area=0.933 in both cases

$$Z = (X-300)/20$$

Standardization

- To find the probability that $X \leq Y$ if X is normally distributed with mean μ and standard deviation σ .
 - Compute the z-score: $z = (y - \mu) / \sigma$
 - Calculate the area under the normal curve between $-\infty$ and z
 - We could calculate this area directly using **EXCEL**:
Formulas to More Functions to Statistical to:

Standardize

Examples 4-6

Standardized

Example 4

The average swimming speed of a fish population is **2 m/s**. (standard deviation **0.5**). You select a fish at random.

What is the probability that:

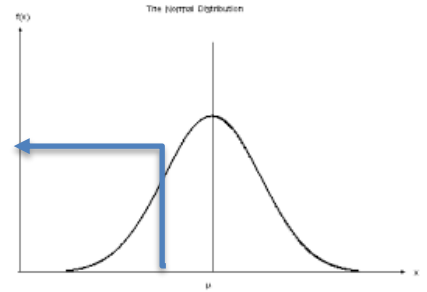
Its swimming speed is less than 1 m/s

Example - 4

The average swimming speed of a fish population is:

$$\mu = 2 \text{ m/s}$$

$$\sigma = 0.5$$



you select a fish at random, what is the probability that it's swimming speed is **less** than

$$x = 1 \text{ m/s}$$

$$= P(z < (1-2)/0.5)) = P(z < (-1/0.5)) = P(z < -2)$$

$$\text{NORMSDIST}(-2,1) = \mathbf{0.0228}$$

Example 5

- The average swimming speed of a fish population is **2 m/s**. (standard deviation **0.5**). You select a fish at random.

What is the probability that:

Its swimming speed is greater than 2.5 m/s

Example-5

The average swimming speed of a fish:

population is $\mu = 2 \text{ m/s}$

standard deviation $\sigma = 0.5$

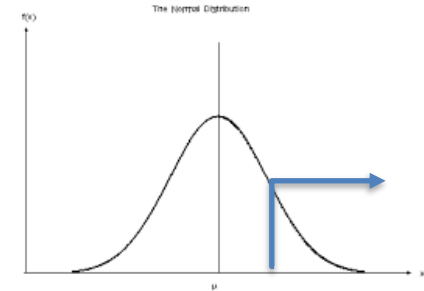
You select a fish at random.

What is the probability that its swimming speed is **greater** than $x = 2.5 \text{ m/s}$.

$$= P(z > (2.5-2)/0.5)) = P(z > 1) = 1 - P(z \leq 1)$$

$$\text{NORMSDIST}(1,1) = 0.8413$$

$$1 - 0.8413 = 0.1586$$



Example 6

- The average swimming speed of a fish population is **2 m/s**. (standard deviation **0.5**). You select a fish at random. What is the probability that:

Its swimming speed is between 2 and 3 m/s

Example - 6

The average swimming speed of a fish population is:

$$\mu = 2 \text{ m/s}$$

$$\sigma = 0.5$$

You select a fish at random. What is the probability that:

- Its swimming speed is **between** 2 and 3 m/s.

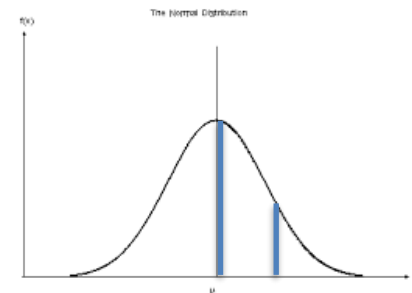
$$P((2-2)/0.5) = P(z = 0)$$

$$P((3-2)/0.5) = P(z = 2)$$

$$= P(0 \leq z \leq 2) = P(z \leq 2) - P(z \leq 0)$$

$$= \text{NORMSDIST}(2,1) - \text{NORMSDIST}(0,1)$$

$$= 0.9773 - 0.5 = 0.4773$$



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T₁LM₃



End