Regents Park Publishers

Data Analytics

T1LM 7

V.2

Excel Tutorials

Content

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

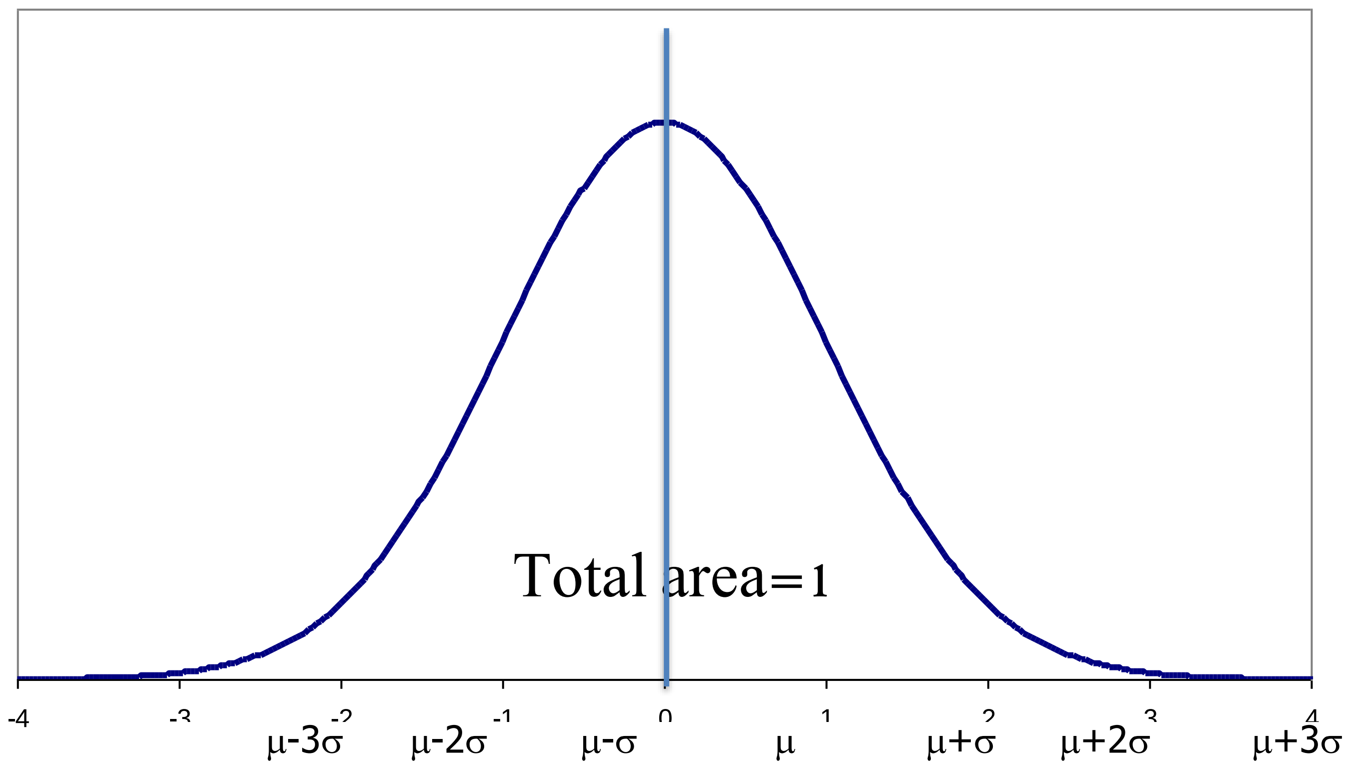
Normal Probability Distribution

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.

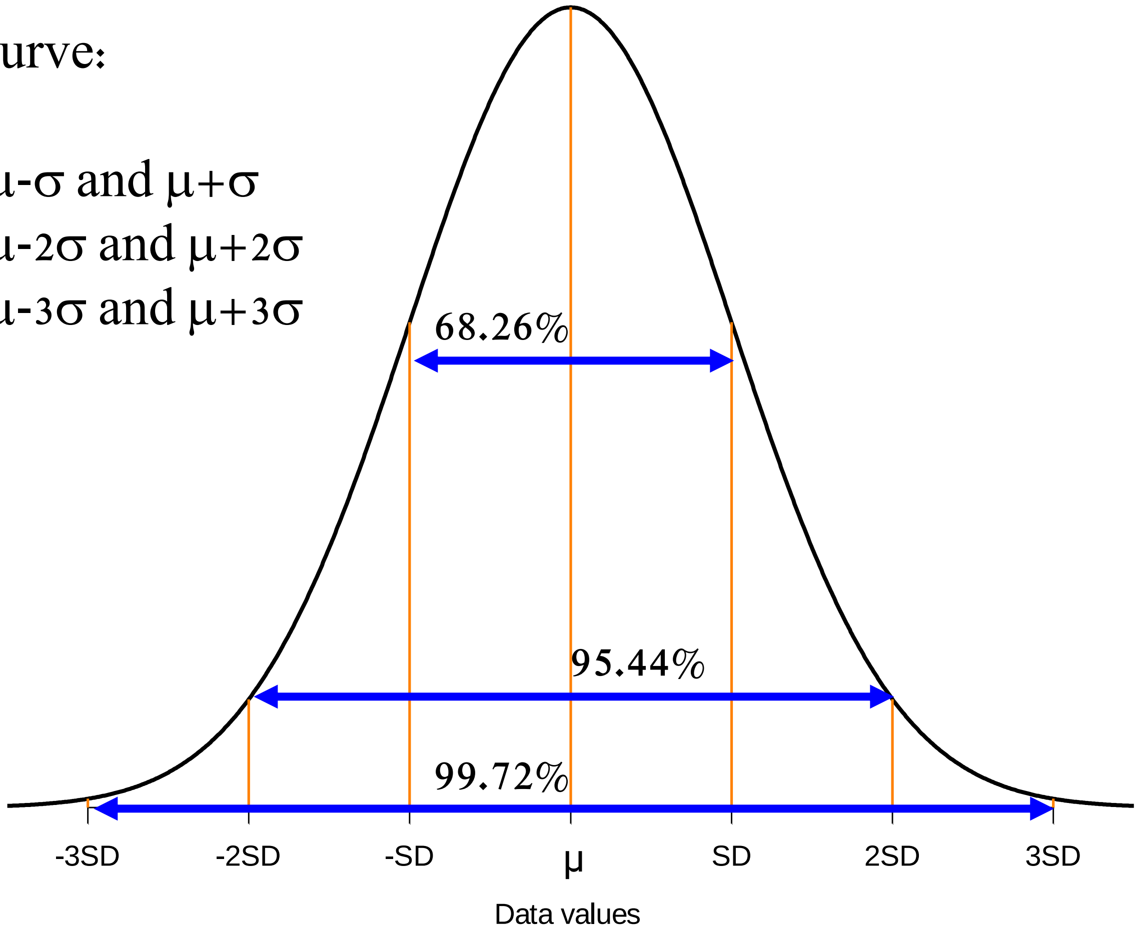
Normal Distributions and Probability

The areas under the curve:

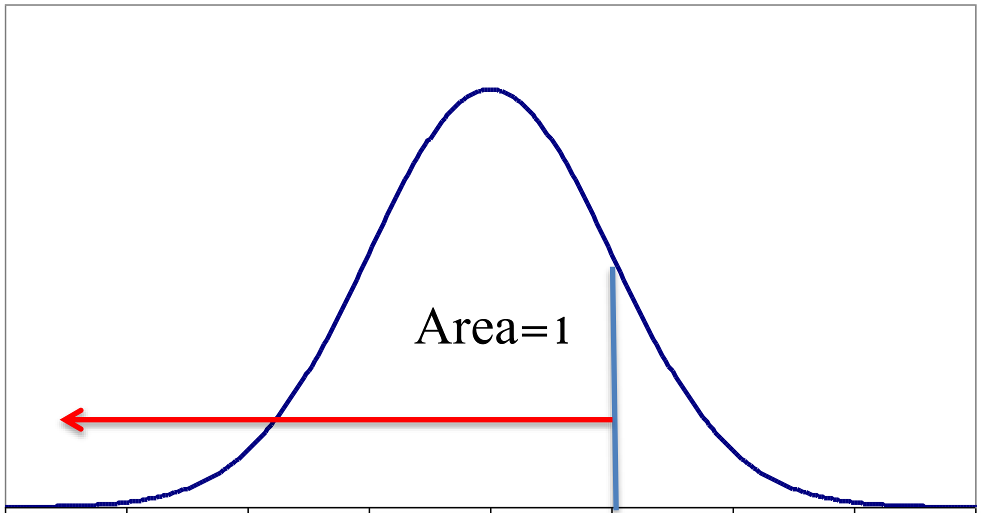
68.26% lies between $\mu-\sigma$ and $\mu+\sigma$

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

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



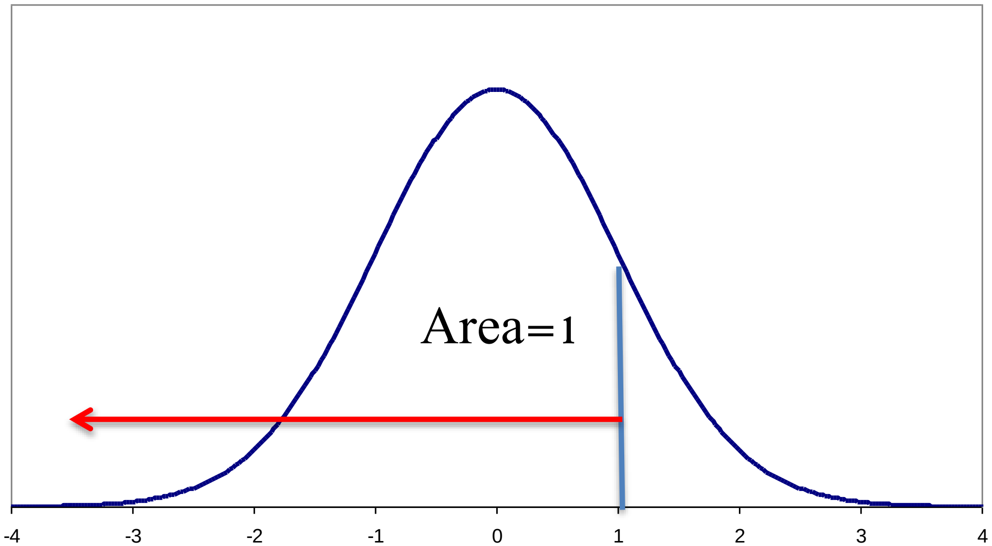
Excel Function
(Non- Standardized)



μ is not equal to zero and **σ** is not equal to 1

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

Excel Function
(Standardized)



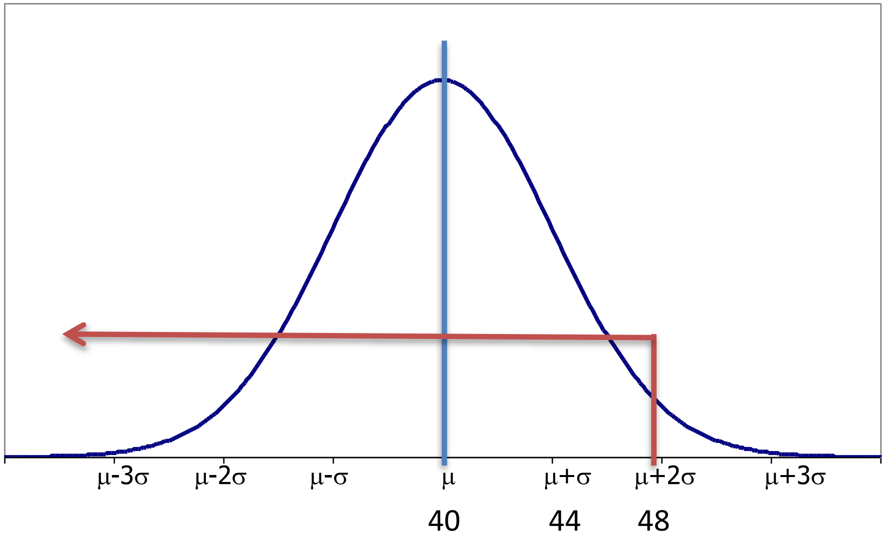
The area under the standard normal distribution from x to -∞ can be computed using the EXCEL function **NORMSDIST**

Examples 1-3

Example 1 (Non-Standardized)

- 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 (Non-Standarized)

- Find the area under the normal distribution curve between -0.12 and 1.23.
- Let's assume:

μ= 0

σ= 1

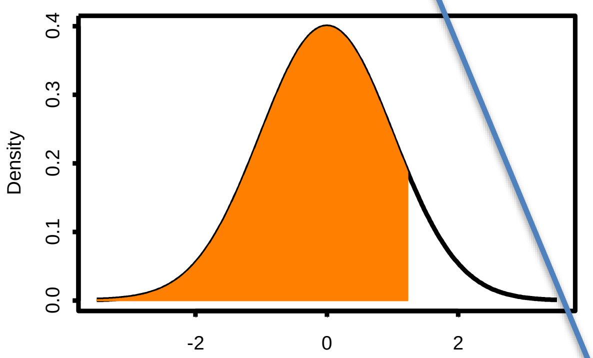
Continuous Distribution =1

- In EXCEL:
  - NORMDIST(1.23,0,1,1)-NORMDIST(-0.12,0,1,1)

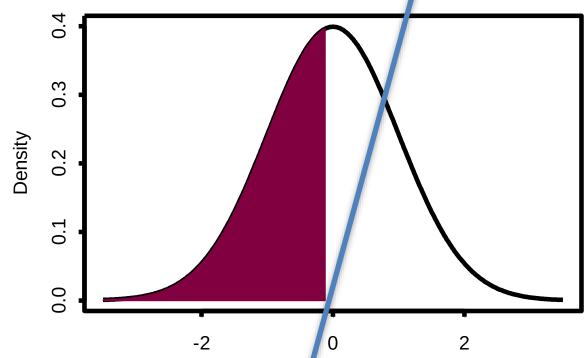
NORMDIST(x,μ,σ,1)

Example-2

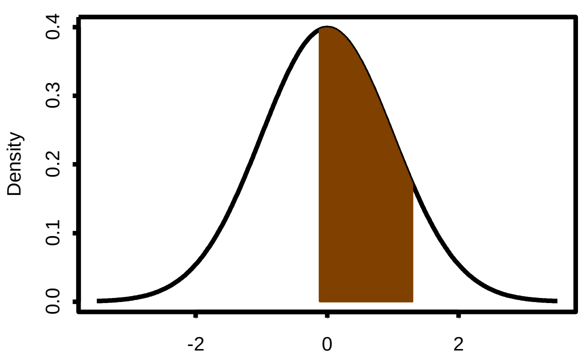
P[X≤1.23]= **0.8907**



P[X≤-0.12]= **0.4522**



P[X≤1.23]-P[X≤-0.12]=



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

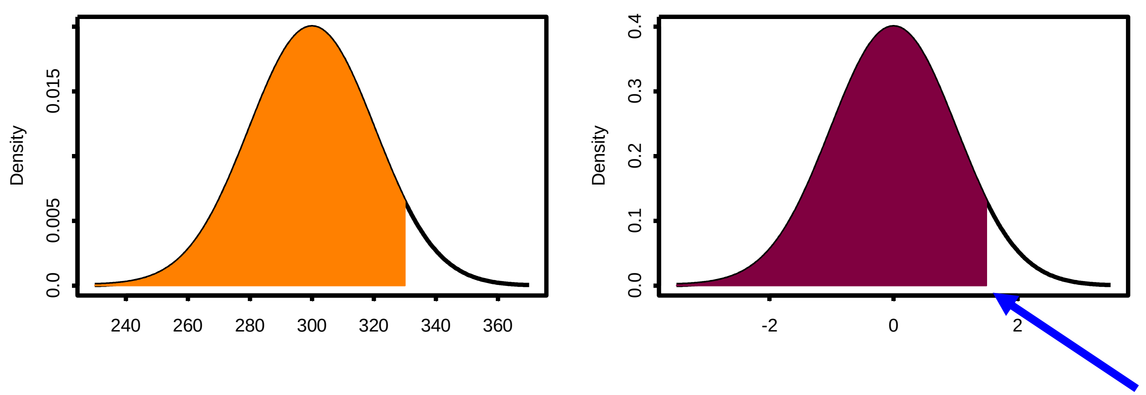
- The standard normal distribution (population) and the z-score:

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

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 the EXCEL function: Standardize

    Excel Path: Formulas to More Functions to Statistical to **Standardize**

Examples 4-6

Examples 4-6 (Standardized)

- 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.
  - Its swimming speed is greater than 2.5 m/s.
  - Its swimming speed is between 2 and 3 m/s.

Example -4 (Standardized)

- 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:

  - It's swimming speed is less than 1 m/s.
    $= P(z < (1-2)/.5) = P(z < -2)$

NORMSDIST (-2,1) = 0.0228

Examples-5 (Standardized)

- 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:
  - Is swimming speed is greater than 2.5 m/s.

$= P(z > (2.5-2)/.5) = P(z > 1) = 1 - P(z \leq 1)$

NORMSDIST (1,1) = 0.8413

1- 0.8413 = 0.1586

Example-6 (Standardized)

- 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.

  - P (2-2)/0.5) = P (z = 0)
  - P (3-2)/0.5) = P (z = 2)

= $P(0 \le z \le 2) = P(z \le \mathbf{2}) - P(z \le \mathbf{0})$

= NORMSDIST(2,1) – NORMSDIST(0,1)

= 0.9773 – 0.5 = 0. 4773

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End