NORMAL PROBABILITY DISTRIBUTION

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INTRODUCTION

The normal or Gaussian Probability Distribution is most popular and important because of its unique mathematical properties which facilitate its application to practically any physical problem in the real world. It constitutes the basis for the development of many of the statistical methods.

The normal probability distribution was discovered by Abraham De Moivre in 1733 as a way of approximating the binomial probability distribution when the number of trials in a given experiment is very large. In 1774, Laplace studied the mathematical properties of the normal probability distribution. Through a historical error, the discovery of the normal distribution was attributed to Gauss who first referred to it in a paper in 1809. In the nineteenth century, many scientists noted that measurement errors in a given experiment followed a pattern (the normal curve of errors) that was closely approximated by this probability distribution.

NORMAL PROBABILITY DISTRIBUTION

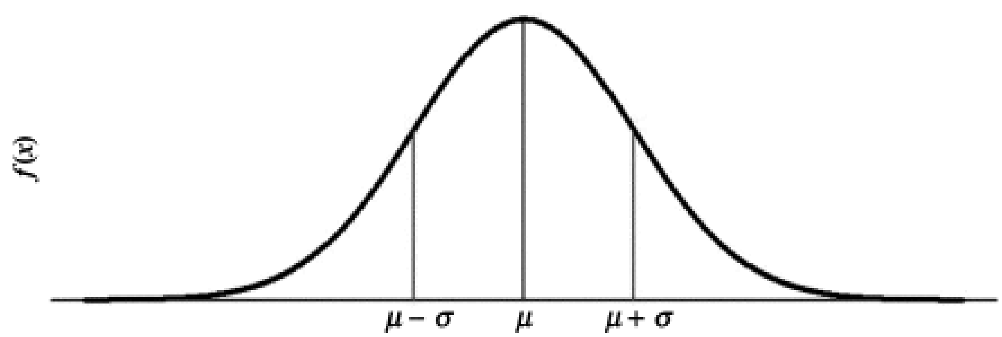
A continuous random variable X is normally distributed or follows a normal probability distribution if its probability distribution is given by the following function:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}},$$

$$-\infty < x < \infty, -\infty < \mu < \infty, 0 < \sigma^2 < \infty.$$

The universally accepted notation X~Nμσ2 is read as “the continuous random variable ***X*** is normally distributed with a population mean ***μ*** and population variance σ^2. Of course in real world problems we do not know the true population parameters, but we estimate them from the sample mean and sample variance. However, first, we must fully understand the normal probability distribution.

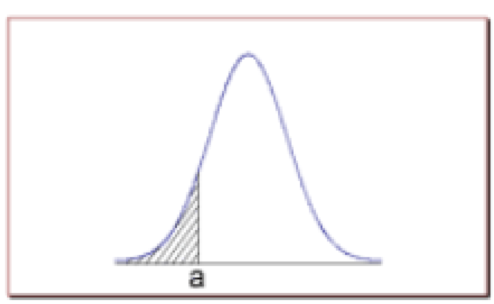
The graph of the normal probability distribution is a "**bell-shaped**" curve, as shown in Figure 7.3. The constants $\boldsymbol{\mu}$ and $\boldsymbol{\sigma}^2$ are the parameters; namely, "$\boldsymbol{\mu}$" is the population true mean (or expected value) of the subject phenomenon characterized by the continuous random variable, ***X***, and "$\boldsymbol{\sigma}^2$" is the population true variance characterized by the continuous random variable, ***X***. Hence, "$\boldsymbol{\sigma}$" the population standard deviation characterized by the continuous random variable ***X***; and the points located at $\mu-\sigma$ and $\mu+\sigma$ are the points of inflection; that is, where the graph changes from cupping up to cupping down.



The area under the bell-shaped curve is so disposed that it represents probability; that is, the total area under the curve is equal to one. The random variable ***X*** can assume values anywhere from minus infinity to plus infinity, but in practice we very seldom encounter problems in which random variables have such a wide range. The **normal curve graph of the normal probability distribution**) is **symmetric** with respect to the mean $\boldsymbol{\mu}$ as the **central position**. That is, the area between $\boldsymbol{\mu}$ and $\boldsymbol{\kappa}$ units to the left of $\boldsymbol{\mu}$ is equal to the area between $\boldsymbol{\mu}$ and $\boldsymbol{\kappa}$ units to the right of $\boldsymbol{\mu}$.

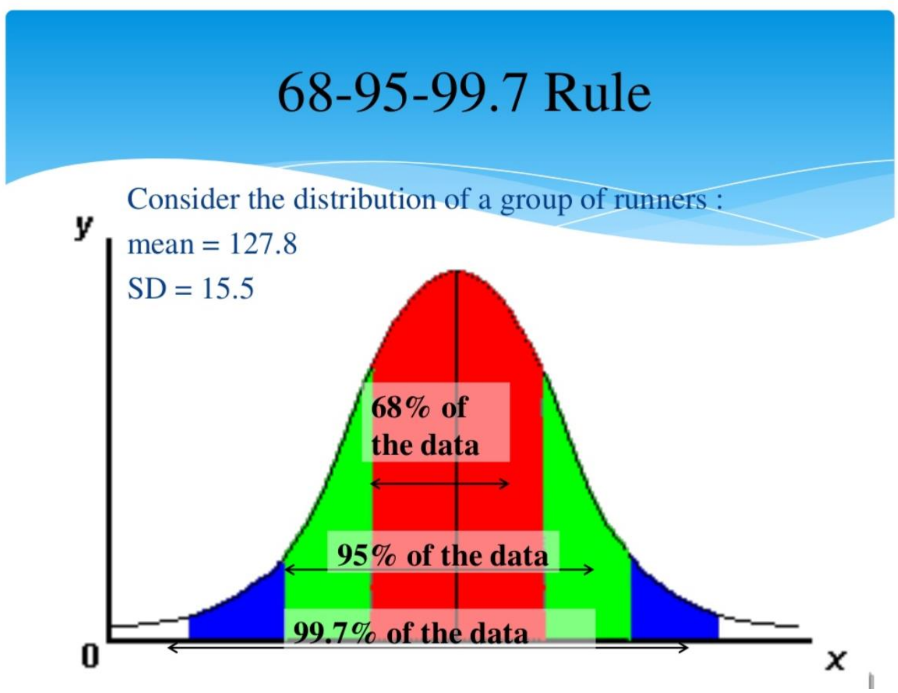
THE BELL-SHAPED CURVE

The Bell-shaped Curve is commonly called the normal curve and is mathematically referred to as the Gaussian probability distribution. Unlike Bernoulli trials which are based on discrete counts, the normal distribution is used to determine the probability of a continuous random variable.



The normal distribution is a continuous probability distribution. This has several implications for probability.

- The total area under the normal curve is equal to 1.
- The probability that a normal random variable X equals any value is 0.
- The probability that X is greater than a equals the area under the normal curve bounded by a and plus infinity (as indicated by the non-shaded area in the figure).
- The probability that X is less than a equals the area under the normal curve bounded by a and minus infinity (as indicated by the shaded area in the figure).
- The mean, mode and median are all equal.
- The curve is symmetric at the center (i.e. around the mean, μ).
- Exactly half of the values are to the left of center and exactly half the values are to the right.



APPLICATIONS IN BIOSTATITICS

The normal distribution is one of the important continuous distributions in statistics and due to the fact that it is positively skewed and effect of variety of forces working independently on the variability of lognormal distribution is multiplicative, it has many applications in Biological and Medical Sciences.

It can have varies applications.

For example, the distribution of incubation period of infectious diseases; distributions of chemicals and organisms in the environment; distributions of sensitivity to fungicides in populations and distribution of population size; the distribution of times to the appearance of lung cancer in cigarette smokers, etc., have been shown to be log-normally distributed. In this paper, an attempt has been made to discuss detailed applications of lognormal distributions in different areas of Biological and Medical Sciences based on the data collected from Eritrea and other countries and it has been observed that lognormal distributions is a better fit.

REFERENCES:

https://statisticsbyjim.com/basics/normal-distribution/
https://stattrek.com/probability-distributions/normal.aspx
https://www.intmath.com/counting-probability/14-normal-probability-distribution.php
https://www.sciencedirect.com/topics/mathematics/normal-probability-distribution
https://www.sciencedirect.com/science/article/pii/B9780128029671000012
https://www.statisticshowto.com/probability-and-statistics/normal-distributions/
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0021403
https://academic.oup.com/bioscience/article/51/5/341/243981
https://www.hilarispublisher.com/proceedings/lognormal-distribution-and-its-applications-in-biological-and-medical-sciences-4628.html
https://www.slideshare.net/abhishmanyu/the-standard-normal-curve-its-application-in-biomedical-sciences
https://www.slideshare.net/BalaVidyadhar/normal-curve-in-biostatistics-data-inference-and-applications