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RESEARCH PAPER

Profile of Carl Friedrich Gauss & History of Normal (Gaussian) Distribution

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ABSTRACT

The importance of the normal distribution as a model of quantitative phenomenon in the natural and behavioral sciences is due to the central limit theorem. Many physiological measurements and physical phenomenon (Like noise) can be approximated well by the normal distribution. While the mechanisms underlying these phenomenons are often unknown, the use of the normal model can be theoretically justified by assuming that many small, independent effects are additively contributing to each observation.

Key words: *Profile, Carl Friedrich Gauss, Gaussian*

NORMAL (GAUSSIAN) DISTRIBUTION:

Carl Fridrich Gauss (1777-1855)
(Painted by Christian Albrecht Jensen)

Born	:	30th April 1777
Died	:	23rd February 1855 (aged-77)
Residence	:	Kingdom of Hanover
Nationality	:	German
Fields	:	Mathematician and Physicist

The Normal Distribution, also called the Gaussian distribution, is an important family of continuous probability Distributions, applicable in many fields. Each member of the family may be defined by two parameters, locations and scale: the mean (average μ) and variance standard derivation squared σ^2, respectively. The standard normal distribution is the normal distribution with a mean of zero and a variance of one. Carl Friedrich Gauss became associated with this set of distributions when he analyzed astronomical data using them and defined the equation of its probability density function. It is often called the bell curve because the graph of its probability density resembles a bell.

The normal distribution also arises in many areas of statistics. For example, the sampling distribution of the sample mean is approximately normal, even if the distribution of the population from which the sample is taken is not normal. In addition, the normal distribution maximizes information entropy among all distributions with know mean and variance, which makes it the natural choice of underlying distribution for data summarized in terms of sample mean and variance. The normal distribution is the most widely used family of distribution in statistics and many statistical tests are based on the assumption of normality. In probability theory, normal distributions arise as the limiting distributions of several continuous and discrete families of distributions.

HISTORY OF NORMAL DISTRIBUTION

The normal distribution was first introduced by Abraham de Moivre in an article in 1733, which was reprinted in the second edition of his The Doctrine of Chances, 1738 in the context of approximating certain binomial distribution for large n. His result was extended by Lapalace in his book Analytical Theory of Probabilities (1812), and is now called the theorem of de Moivre-Lapalace.

Lapalace used the normal distribution in the analysis of errors of experiments. The important method of least squares was introduced by Legendre in 1805. Gauss, who claimed to have used the method since 1794, justified it rigorously in 1809 by assuming a normal distribution of the errors. The name 'bell curve' goes back to Jouffret who first used the term 'bell surface' in 1972 for a bivariate normal with independent components, The name 'normal distribution' was coined in independently by Charles S. Peirce, Francis Galton and Wilhelm Lexis around 1875. This terminology unfortunately encourages the fallacy that many or all other probability distributions are not "normal".

CHARACTERIZATION

There are various ways to characterize a probability distribution. The most visual is the probability density faction (PDF). Equivalent ways are the cumulative distribution function the moments, the comulants, the characteristics function, the cumulant-generating function, and Maxwell's theorem.
To indicate that a real - valued random variable X is normally distributed with mean (i and variance $a^2 > 0$, we write

$$X \sim N(\mu\sigma^2)$$

PROBABILITY DENSITY FUNCTION

The continuous probability density function of the normal distribution is the *Gaussian function*

$$f\ \mu,\sigma^2(x) = \frac{1}{\sigma\sqrt{2\pi}}\ e^{-\frac{(x-\mu)^2+}{2\sigma^2}} = \frac{1}{\sigma}\varphi\left(\frac{(x-\mu)}{\sigma}\right), x \in \mathbb{R}$$

Where <j >0 is the standard deviation, the real parameter u is the expected value, and

$$f(x) = f\,0,1(r) = \frac{1}{\sqrt{2\pi}}\,e^{-\frac{x^2}{2}},\ x \in \mathbb{R},$$

is the density function of the "standard" normal distribution ,i.e, the normal distribution with $\mu = 0$ and $\sigma = 1$.
As a Gaussian function with the denominator of the exponent equal to 2, the standard normal density function is an eigan function of the Fourier transform.
Some notable qualities of the probability density function:

1. The density function is symmetric about its mean value μ.
2. The mean p is also its mode and median.
3. The inflection points of the curve occur at one standard deviation away from the mean.

STANDARD DEVIATION AND CONFIDENCE INTERVALS

About 68% of values drawn from a normal distribution are within one standard deviation $\sigma > 0$ away from the mean μ; about 95% of the values are within two standard deviations and about 99.7% lie within three standard deviations. This is known as the "68.95.99.7 rule" or the 'empirical rule'.
To be more precise, the area under the bell curve between $\mu - n\sigma$ and $\mu + n\sigma$ in terms of the cumulative normal distribution function is given by

$$F_{\mu\sigma^2}(\mu + n\sigma) - F_{\mu\sigma^2}(\mu - n\sigma)$$
$$= F(n) - F(-n) = 2F(n) - 1 = \mathrm{erf}(n/\sqrt{2},)$$

Where Erf is the error function. To 12 decimal places, the values for the 1-, 2-, up to 6-sigma points are-

Table 1: Value of Erf $(n/\sqrt{2})$

N	Erf $(n/\sqrt{2})$
1	0.682689492137
2	0..954499736104
3	0.997300203937
4	0.999936657516
5	0.999999426697
6	0.999999998027

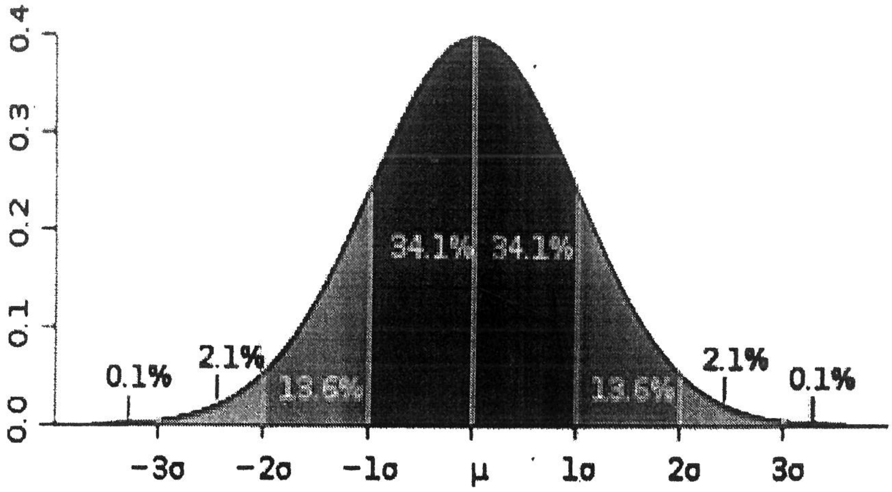

Fig. 1: Showing Six-Sigma points

The next table gives the reverse relation of sigma multiples corresponding to a few often used values for the area under the bell curve. These values are useful to determine (asymptotic) confidence intervals of the specified levels for normally distributed (or asymptotically normal) estimators.

Table 2: Reverse relation of sigma multiples corresponding to a few often used values for the area under the bell curve

0.99	2.57583
0.995	2.80703
0.998	3.09023
0.999	3.29052

Where the value on the left of the table is the proportion of values that will fall within a given interval and n is a multiple of the standard deviation that specifies the width of the interval.

REFERENCES

1. Behara Ravi S. (1995): Customer satisfaction measurement and analysis using Six Sigma, Internationa; Journal of Quality and Reliability Management,MCB University Press, 12(3): 4.
2. Behara Ravi S., Fontenot Gwen F. *and* Gresham Alicia (April 1994): Customer satisfaction measurement and analysis using Six Sigma Journal of Management 3(7).
3. Hahn, *et al.*, (1999): The Impact of Six Sigma Improvement- a glimpse into the future of Statistics. The American Statistician, 53(3): 208-215.
4. Harry, Mikel J. (1998): Six sigma: a breakthrough strategy for profitability Quality Progress. May 1998.
5. Linderman K., Schroeder R.G., Zaheer S. and Choo A.S. (2003): Six Sigma: A goal-theretic Perspective, Journal of Operations Management, Elsavier Science, 21: 193-203.
6. Spiring F.A. (1993): The inverted normal loss function. Canadian Journal of Statistics, 24: 321-330.
7. Walton M. (1986): The Deming Management Mode, Dodd, Mead and Co., New York, NY.

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