

Elementary Statistics And Probability Tutorials And Problems

Probability

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Probability is a branch of mathematics and statistics concerning events and numerical descriptions of how likely they are to occur. The probability of an event is a number between 0 and 1; the larger the probability, the more likely an event is to occur. This number is often expressed as a percentage (%), ranging from 0% to 100%. A simple example is the tossing of a fair (unbiased) coin. Since the coin is fair, the two outcomes ("heads" and "tails") are both equally probable; the probability of "heads" equals the probability of "tails"; and since no other outcomes are possible, the probability of either "heads" or "tails" is 1/2 (which could also be written as 0.5 or 50%).

These concepts have been given an axiomatic mathematical formalization in probability theory, which is used widely in...

Bayesian inference

estimate posterior probabilities. Bayesian inference is an important technique in statistics, and especially in mathematical statistics. Bayesian updating

Bayesian inference (BAY-zee-ən or BAY-zhən) is a method of statistical inference in which Bayes' theorem is used to calculate a probability of a hypothesis, given prior evidence, and update it as more information becomes available. Fundamentally, Bayesian inference uses a prior distribution to estimate posterior probabilities. Bayesian inference is an important technique in statistics, and especially in mathematical statistics. Bayesian updating is particularly important in the dynamic analysis of a sequence of data. Bayesian inference has found application in a wide range of activities, including science, engineering, philosophy, medicine, sport, and law. In the philosophy of decision theory, Bayesian inference is closely related to subjective probability, often called "Bayesian probability..."

Binomial distribution

In probability theory and statistics, the binomial distribution with parameters n and p is the discrete probability distribution of the number of successes

In probability theory and statistics, the binomial distribution with parameters n and p is the discrete probability distribution of the number of successes in a sequence of n independent experiments, each asking a yes–no question, and each with its own Boolean-valued outcome: success (with probability p) or failure (with probability $q = 1 - p$). A single success/failure experiment is also called a Bernoulli trial or Bernoulli experiment, and a sequence of outcomes is called a Bernoulli process; for a single trial, i.e., $n = 1$, the binomial distribution is a Bernoulli distribution. The binomial distribution is the basis for the binomial test of statistical significance.

The binomial distribution is frequently used to model the number of successes in a sample of size n drawn with replacement from...

Random walk

walk, and the transition probabilities depend on the location of the state because on margin and corner states the movement is limited. An elementary example

In mathematics, a random walk, sometimes known as a drunkard's walk, is a stochastic process that describes a path that consists of a succession of random steps on some mathematical space.

An elementary example of a random walk is the random walk on the integer number line

Z

$\{\mathbb{Z}\}$

which starts at 0, and at each step moves +1 or −1 with equal probability. Other examples include the path traced by a molecule as it travels in a liquid or a gas (see Brownian motion), the search path of a foraging animal, or the price of a fluctuating stock and the financial status of a gambler. Random walks have applications to engineering and many scientific fields including ecology, psychology, computer science, physics, chemistry...

Markov chain

In probability theory and statistics, a Markov chain or Markov process is a stochastic process describing a sequence of possible events in which the probability

In probability theory and statistics, a Markov chain or Markov process is a stochastic process describing a sequence of possible events in which the probability of each event depends only on the state attained in the previous event. Informally, this may be thought of as, "What happens next depends only on the state of affairs now." A countably infinite sequence, in which the chain moves state at discrete time steps, gives a discrete-time Markov chain (DTMC). A continuous-time process is called a continuous-time Markov chain (CTMC). Markov processes are named in honor of the Russian mathematician Andrey Markov.

Markov chains have many applications as statistical models of real-world processes. They provide the basis for general stochastic simulation methods known as Markov chain Monte Carlo...

Central limit theorem

applicable to many problems involving other types of distributions. This theorem has seen many changes during the formal development of probability theory. Previous

In probability theory, the central limit theorem (CLT) states that, under appropriate conditions, the distribution of a normalized version of the sample mean converges to a standard normal distribution. This holds even if the original variables themselves are not normally distributed. There are several versions of the CLT, each applying in the context of different conditions.

The theorem is a key concept in probability theory because it implies that probabilistic and statistical methods that work for normal distributions can be applicable to many problems involving other types of distributions.

This theorem has seen many changes during the formal development of probability theory. Previous versions of the theorem date back to 1811, but in its modern form it was only precisely stated as late...

Stochastic simulation

probabilities. Realizations of these random variables are generated and inserted into a model of the system. Outputs of the model are recorded, and then

A stochastic simulation is a simulation of a system that has variables that can change stochastically (randomly) with individual probabilities.

Realizations of these random variables are generated and inserted into a model of the system. Outputs of the model are recorded, and then the process is repeated with a new set of random values. These steps are repeated until a sufficient amount of data is gathered. In the end, the distribution of the outputs shows the most probable estimates as well as a frame of expectations regarding what ranges of values the variables are more or less likely to fall in.

Often random variables inserted into the model are created on a computer with a random number generator (RNG). The U(0,1) uniform distribution outputs of the random number generator are then transformed...

Chi-squared distribution

In probability theory and statistics, the χ^2 -distribution with k degrees of freedom is the distribution

In probability theory and statistics, the

χ

2

χ^2

-distribution with

k

k

degrees of freedom is the distribution of a sum of the squares of

k

k

independent standard normal random variables.

The chi-squared distribution

χ

k

2

χ_k^2

is a special case of the gamma distribution and the univariate Wishart distribution. Specifically if

X

$\sim$

χ^2

Polynomial regression

Regression, A PHP regression class. Devore, Jay L. (1995). Probability and Statistics for Engineering and the Sciences (4th ed.). US: Brooks/Cole Publishing Company

In statistics, polynomial regression is a form of regression analysis in which the relationship between the independent variable x and the dependent variable y is modeled as a polynomial in x .

Polynomial regression fits a nonlinear relationship between the value of x and the corresponding conditional mean of y , denoted $E(y | x)$. Although polynomial regression fits a nonlinear model to the data, as a statistical estimation problem it is linear, in the sense that the regression function $E(y | x)$ is linear in the unknown parameters that are estimated from the data. Thus, polynomial regression is a special case of linear regression.

The explanatory (independent) variables resulting from the polynomial expansion of the "baseline" variables are known as higher-degree terms. Such variables are also...

Beta distribution

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In probability theory and statistics, the beta distribution is a family of continuous probability distributions defined on the interval $[0, 1]$ or $(0, 1)$ in terms of two positive parameters, denoted by alpha (α) and beta (β), that appear as exponents of the variable and its complement to 1, respectively, and control the shape of the distribution.

The beta distribution has been applied to model the behavior of random variables limited to intervals of finite length in a wide variety of disciplines. The beta distribution is a suitable model for the random behavior of percentages and proportions.

In Bayesian inference, the beta distribution is the conjugate prior probability distribution for the Bernoulli, binomial, negative binomial, and geometric distributions.

The formulation of the beta distribution...

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