Discretization Of Processes Stochastic Modelling And Applied Probability

Probability distributions are closely linked to random variables. A random variable is a function that assigns a value to each outcome of a probabilistic experiment; it induces a probability distribution on the set of values it can take. For example, the result of a coin toss can be represented by a random variable X that equals 1 for heads and 0 for tails. If the coin is fair, this distribution assigns probability 1/2 to X = 1 and probability 1/2 to X = 0. Viewed as a probability measure, the distribution of X assigns $\mathbb{P}(X \in A)$ to each set $A \subseteq \{0,1\}$; for a fair coin, $\mathbb{P}(X \in \{1\}) = \mathbb{P}(X \in \{0\}) = 1/2$, $\mathbb{P}(X \in \{0,1\}) = 1$, and $\mathbb{P}(X \in \emptyset) = 0$. 43ba847661 == Principles == 43ba847661

Stochastic calculus It allows a consistent theory of integration to be defined for integrals of stochastic processes with respect to stochastic processes. integration to be defined for integrals of stochastic processes with respect to stochastic processes. This field was created and started by the Japanese mathematician Kiyosi Itô during World War II. This field was created and started by the Japanese mathematician Stochastic calculus is a branch of mathematics that operates on stochastic processes 43ba847661

A left stochastic matrix is a square matrix of nonnegative real numbers, with each column summing to 1 (so it is also called a column stochastic matrix). 43ba847661 The main flavours of stochastic calculus are the Itô calculus and its variational relative the Malliavin calculus. For technical reasons the Itô integral is the most useful for general classes of processes, but the related Stratonovich integral is frequently useful in problem formulation (particularly in engineering disciplines). The Stratonovich integral can readily be expressed... 43ba847661 In statistical theory, the probability distributions of continuous variables can be expressed in terms of probability density functions. 43ba847661 A doubly stochastic matrix is a square matrix of nonnegative real numbers with each row and column summing to 1. 43ba847661 Methods of calculus are often used in problems in which the variables are continuous, for example in continuous optimization problems. 43ba847661 == Etymology == 43ba847661 Stochasticity is used in

many different fields, including actuarial science, image processing, signal processing, computer science, information theory, telecommunications, chemistry, ecology, neuroscience, physics, and cryptography. It is also used in finance, medicine, linguistics, music, media, colour theory, botany, manufacturing and geomorphology. 43ba847661 For example, a variable over a non-empty range of the real numbers is continuous if it can take on any value in that range. 43ba847661 == Background == 43ba847661 The name comes from its connection to Markov chains, a concept developed by the Russian mathematician Andrey Markov. The "Markov" in "Markov decision process" refers to the underlying structure of state transitions that still follow the Markov property. The process is called a... 43ba847661 SDEs have a random differential that is in the most basic case random white noise calculated as the distributional derivative of a Brownian motion or more generally a semimartingale. However, other types of random behaviour are possible, such as jump processes like Lévy processes or semimartingales with jumps. 43ba847661 Stochastic differential equations originated in the theory of Brownian motion, in the work of Albert Einstein and Marian Smoluchowski in 1905, although Louis... 43ba847661

Stochastic These terms are often used interchangeably. Stochasticity and randomness are technically distinct concepts: Stochasticity is the property of being well-described by a random probability distribution. Stochasticity is the property of being well-described by a random probability distribution. Stochasticity and randomness are technically distinct concepts: stochasticity refers to a modeling approach, while randomness describes phenomena. In probability theory, the formal concept of a stochastic process is also referred to as a random process 43ba847661

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, which are used for simulating sampling from complex probability distributions, and have found application in areas including Bayesian statistics, biology, chemistry, economics, finance, information theory, physics, signal processing, and speech processing. 43ba847661 A substochastic matrix is a real square matrix whose row sums are all 43ba847661

Stochastic process Stochastic processes are widely used as mathematical models of In probability theory and related fields a stochastic () or random process is a mathematical object usually defined as a family of random variables in a probability space, where the index of the family

often has the interpretation of time. Stochastic processes have applications in many disciplines such as biology, chemistry, ecology, neuroscience, physics, image processing, signal processing, control theory, information theory, computer science, and telecommunications. Furthermore, seemingly random changes in financial markets have motivated the extensive use of stochastic processes in finance. probability space, where the index of the family often has the interpretation of time. Stochastic processes are widely used as mathematical models of systems and phenomena that appear to vary in a random manner. Examples include the growth of a bacterial population, an electrical current fluctuating due to thermal noise, or the movement of a gas molecule 43ba847661

A continuous variable is a variable such that there are possible values between any two values. 43ba847661 A right stochastic matrix is a square matrix of nonnegative real numbers, with each row summing to 1 (so it is also called a row stochastic matrix). 43ba847661 Applications and real-world phenomena have repeatedly motivated mathematicians to propose new stochastic processes. Two classic examples are the Wiener process (also called the Brownian motion process) and the Poisson process. Louis Bachelier used the Wiener process to model price changes on the Paris Bourse, while A. K. Erlang... 43ba847661 == Continuous variable == 43ba847661 Originating from operations research in the 1950s, MDPs have since gained recognition in a variety of fields, including ecology, economics, healthcare, telecommunications and reinforcement learning. Reinforcement learning utilizes the MDP framework to model the interaction between a learning agent and its environment. In this framework, the interaction is characterized by states, actions, and rewards. The MDP framework is designed to provide a simplified representation of key elements of artificial intelligence challenges. This modeling framework incorporates the understanding of cause and effect, the management of uncertainty and nondeterminism, and the pursuit of explicit goals. 43ba847661

Stochastic control The system designer assumes, in a Bayesian probability-driven fashion, that random noise with known probability distribution affects the evolution and observation of the state variables. The context may be either discrete time or continuous time. Stochastic control or stochastic optimal control is a sub field of control theory that deals with the existence of uncertainty either in observations or Stochastic control or stochastic optimal control is a sub field of control theory that deals with the existence of uncertainty either in observations or in the noise that drives the evolution of the system. Stochastic control aims to design the time path of the controlled variables that performs the

desired control task with minimum cost, somehow defined, despite the presence of this noise 43ba847661

Probability distribution In probability theory and statistics, a probability distribution describes how probabilities are assigned to the possible results of a random phenomenon—more In probability theory and statistics, a probability distribution describes how probabilities are assigned to the possible results of a random phenomenon—more precisely, to events, which are sets of possible outcomes of a probabilistic experiment. Formally, it is a probability measure: a function that assigns probabilities to events in a way that satisfies the axioms of probability. Informally, a probability distribution tells us how likely different results are 43ba847661

Stochastic differential equations are in general neither differential equations nor random differential equations. Random differential equations are conjugate to stochastic differential equations. Stochastic differential equations can also be extended to differential manifolds. 43ba847661

Stochastic matrix The stochastic matrix was first developed by Andrey Markov at the beginning of the 20th century, and has found use throughout a wide variety of scientific fields, including probability theory, statistics, mathematical finance and linear algebra, as well as computer science and population genetics. Each of its entries is a nonnegative real number representing a probability. (2003). Applied Probability and Queues. It is also called a probability matrix, transition matrix, substitution matrix, or Markov matrix. "Markov Chains". the stochastic matrix to continuous time Asmussen, S. Stochastic Modelling and Applied Probability In mathematics, a stochastic matrix is a square matrix used to describe the transitions of a Markov chain. R. There are several different definitions and types of stochastic matrices: 43ba847661

The best-known stochastic process to which stochastic calculus is applied is the Wiener process (named in honor of Norbert Wiener), which is used for modeling Brownian motion as described by Louis Bachelier in 1900 and by Albert Einstein in 1905 and other physical diffusion processes in space of particles subject to random forces. Since the 1970s, the Wiener process has been widely applied in financial mathematics and economics to model the evolution in time of stock prices and bond interest rates. 43ba847661 In continuous-time dynamics, the variable time is treated... 43ba847661

Continuous or discrete variable In some contexts, a variable can be discrete in some ranges of the number line and continuous in others. If it can take on a value such that there is a non-infinitesimal gap on each side of it containing no values that the variable can take on, then it is discrete around that value. If it can take on two real values and all the values between them, the variable is continuous in that interval. In statistics, continuous and discrete variables are distinct statistical data types which are described with different probability distributions. measure Discrete modelling Discrete series representation Discrete space Discrete spectrum Discrete time and continuous time Discretization Interpolation In mathematics and statistics, a quantitative variable may be continuous or discrete 43ba847661

An extremely well-studied formulation in stochastic control is that of linear quadratic Gaussian control. Here the model is linear, the objective function is the expected value of a quadratic form, and the disturbances are purely additive. A basic result for discrete-time centralized systems with only additive uncertainty is the certainty equivalence property: that the optimal control solution in this case is the same as would be obtained in the absence of the additive disturbances. This property is applicable to all centralized... 43ba847661

Stochastic differential equation SDEs have many applications throughout pure mathematics and are used to model various behaviours of stochastic models such as prices of listed company shares, random growth models or physical systems that are subjected to thermal fluctuations. SDEs have many applications throughout pure mathematics and are used to model various behaviours of stochastic models such as A stochastic differential equation (SDE) is a differential equation in which one or more of the terms is a stochastic process, resulting in a solution which is also a stochastic process. also a stochastic process 43ba847661

Markov decision process Springer. P. It is a type of stochastic decision process, and is often solved using the methods of stochastic dynamic programming. Continuous-Time Markov Decision Processes. ISBN 978-3-642-02546-4. A Markov decision process (MDP) is a mathematical model for sequential decision making when outcomes are uncertain. Meyn, S. Stochastic Modelling and Applied Probability. (2009). Hernández-Lerma, O 43ba847661

The adjectives Markovian and Markov are used to describe something that is related to a Markov process. 43ba847661 The word stochastic in English was originally used as an adjective with the definition "pertaining to conjecturing", and stemming from a Greek word meaning "to aim at a

mark, guess", and the Oxford English Dictionary gives the year 1662 as its earliest occurrence. In his work on probability Ars Conjectandi, originally published in Latin in 1713, Jakob Bernoulli used the phrase "Ars Conjectandi sive Stochastice", which has been translated... 43ba847661 == Certainty equivalence == 43ba847661

Markov chain Markov processes are named in honor of the Russian mathematician Andrey Markov. A continuous-time process is called a continuous-time Markov chain (CTMC). A countably infinite sequence, in which the chain moves state at discrete time steps, gives a discrete-time Markov chain (DTMC). 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 43ba847661

In practice, probability distributions are often described by functions such as cumulative distribution... 43ba847661

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