Stochastic processes and SDE’s

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1. **INTRODUCTION**

Stochastic processes and Stochastic Differential Equations (SDEs) form a rich and important area in mathematical modeling, particularly in the fields of finance, physics, and biology. This research paper will provide an overview of stochastic processes, delve into the fundamentals of Stochastic Differential Equations, and explore their applications in various domains.

1. **STOCHASTIC PROCESSES**

**2.1) Definition and Characteristics**

A stochastic process is a collection of random variables evolving over time. It can be represented as ***X*(*t*)**, where ***t*** is time. Stochastic processes are characterized by their probabilistic nature, incorporating uncertainty and randomness into models.

**2.2) Types of Stochastic Processes**

1. **Markov Processes**: A Markov process is memoryless, meaning that the future behavior of the process depends only on its present state, not on how it arrived at that state.
2. **Wiener Process (Brownian Motion):** The Wiener process is a continuous-time stochastic process that is widely used to model random motion. Brownian motion is a specific example of a Wiener process.
3. **Stochastic Differential Equations (SDEs)**

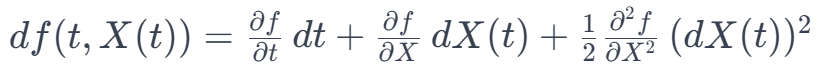
Stochastic Differential Equations are differential equations involving stochastic processes. They are used to model systems that include both deterministic and random components. The general form of an SDE is given by:

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**3.1) Itô's Lemma**

Itô's Lemma is a fundamental result in the calculus of stochastic processes. It provides a formula for computing the differential of a function of a stochastic process involving an SDE.



1. **Conclusion**

Stochastic processes and Stochastic Differential Equations are powerful tools for modeling systems with inherent randomness. Their applications span various disciplines, making them essential in understanding and predicting complex phenomena. This research paper has provided a brief overview, but the richness of the subject invites further exploration into specific models, numerical methods for solving SDEs, and advanced applications in modern research.