Ep - 8 Probabilistic Distributions

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Random Variables

A random variable is a mathematical function that maps the outcomes of a random experiment to real numbers. It assigns a numeric value to each possible outcome of a random process, allowing us to quantify and analyse uncertainty and probabilistic events. Random variables can be discrete or continuous, depending on the nature of the outcomes.

There are two main types of random variables:

1. **Discrete Random Variable**: A discrete random variable represents outcomes that can be counted and are distinct. It takes on a *finite* or *countably infinite* set of values. Examples include the number of heads in multiple coin tosses, the roll of a die, or the count of emails received in a given hour.
2. **Continuous Random Variable**: A continuous random variable represents outcomes that are measured, often on a *continuous scale*. It can take on any value within a given range. Examples include the height of a person, the time it takes to complete a task, or the temperature at a specific time.

Tldr

A random variable is a set of possible values from a random experiment.

Distribution Functions

Probability distribution functions describe how the probabilities of a random variable's values are spread across its possible outcomes. These functions provide a comprehensive summary of the probabilities associated with each value of the random variable. There are two main types of distribution functions:

Probability Mass Function (PMF):

- PMF is used for *discrete random variables*, which have countable outcomes.
- It assigns probabilities to each specific outcome.
- The sum of probabilities across all possible outcomes is equal to 1.

Probability Density Function (PDF):

- PDF is used for *continuous random variables*, which have an uncountable range of values.
- It provides a function that describes the likelihood of the random variable taking on a value within a given range.
- Unlike the PMF, the probability associated with any individual value is typically zero.

Cumulative Distribution Function (CDF):

- CDF is a fundamental concept in probability and statistics.
- It's a function that provides information about the cumulative probability that a random variable takes on a value less than or equal to a specified value.
- In other words, the CDF of a random variable *gives the probability that the random variable is less than or equal to a certain value*.

Mathematically, the CDF of a random variable X is often denoted as $F(x)$ and is defined as:

$$F(x) = P(X \leq x)$$

In this equation, F(x) represents the CDF of the random variable X, and P(X ≤ x) represents the probability that X is less than or equal to a specific value x.

The CDF is a useful tool for understanding the distribution of random variables and can help calculate various probabilities and percentiles associated with the variable.

> **Tldr**
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> CDF gives probability of an event up till that point/value.

Probabilistic Distributions

Probabilistic distributions, also known as probability distributions, are mathematical functions that describe the likelihood of different outcomes for random variables. They play a fundamental role in probability theory, statistics, and data analysis. These distributions model the uncertainty or randomness in various real-world phenomena.

[Main Idea Behind Probability Distributions]

Some Important Distributions

1. Normal Distribution

2. Student's t Distribution
3. Log Normal Distribution
4. Pareto Distribution
5. Uniform Distribution
6. Bernoulli Distribution
7. Binomial Distribution