**Probability**

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**PROBABILITY**

# Curriculum for studying Statistics

## Things to know before studying Probability

1. Set Theory: Basic concepts of sets, union, intersection, and complement.
2. Mathematical Notation: Familiarize yourself with common Probability notation, including sigma-algebras, random variables, and events.

## Basic/Easy Level Topics

1. Probability Fundamentals: Understand the concept of Probability, sample spaces, events, and the axioms of Probability.
2. Combinatorics: Study permutations, combinations, and the binomial coefficient.
3. Conditional Probability: Learn how to compute probabilities based on given information.
4. Probability Distributions: Understand discrete and continuous Probability distributions, including the binomial, geometric, uniform, and normal distributions.
5. Expected Value and Variance: Learn to compute the expected value and variance of random variables.
6. Law of Large Numbers: Understand the convergence of sample means to population means with increasing sample sizes.

## Moderate Level Topics

1. Joint and Conditional Distributions: Study joint Probability distributions, conditional Probability distributions, and independence.
2. Central Limit Theorem: Understand the fundamental theorem in Probability theory, which states that the sum of a large number of independent and identically distributed random variables tends toward a normal distribution.
3. Markov Chains: Explore the theory of discrete-time Markov chains, including transition probabilities, steady-state probabilities, and absorbing states.
4. Bayes' Theorem: Learn the fundamental theorem of Bayesian Probability, which relates conditional probabilities to prior and posterior probabilities.
5. Random Variables and Transformation: Study functions of random variables, moments, and moment-generating functions.
6. Limit Theorems: Familiarize yourself with the Weak Law of Large Numbers, Strong Law of Large Numbers, and the Central Limit Theorem.

## Expert Level Topics

1. Stochastic Processes: Dive deeper into the theory of stochastic processes, including Poisson processes, Brownian motion, and martingales.
2. Estimation Theory: Study maximum likelihood estimation, confidence intervals, and hypothesis testing.
3. Bayesian Inference: Explore advanced topics in Bayesian inference, including conjugate priors, hierarchical models, and Bayesian model selection.
4. Advanced Probability Distributions: Learn about multivariate distributions, such as the multivariate normal distribution, and their properties.
5. Monte Carlo Methods: Understand Monte Carlo simulation techniques, including importance sampling, Markov Chain Monte Carlo (MCMC), and the Metropolis-Hastings algorithm.

Remember, this curriculum is designed to provide a solid foundation in Probability theory with practical relevance. After completing Probability and Statistics, you can move on to studying machine learning, where Probability concepts play a crucial role in understanding algorithms and modeling uncertainty.