# Data Science Notes by Sarowar Ahmed

## 📊 Chapter: Bayesian Statistics

## 📊 Topic: Prior and Posterior Distributions

🔎 Hello, GitHub community! Today, let's embark on a journey into the realm of Bayesian statistics, focusing on the concepts of prior and posterior distributions. Don't worry if these terms sound unfamiliar; I'll guide you through them with clarity and simplicity, using real-world examples and intuitive explanations. Let's dive in!

🌟 Understanding Prior and Posterior Distributions:

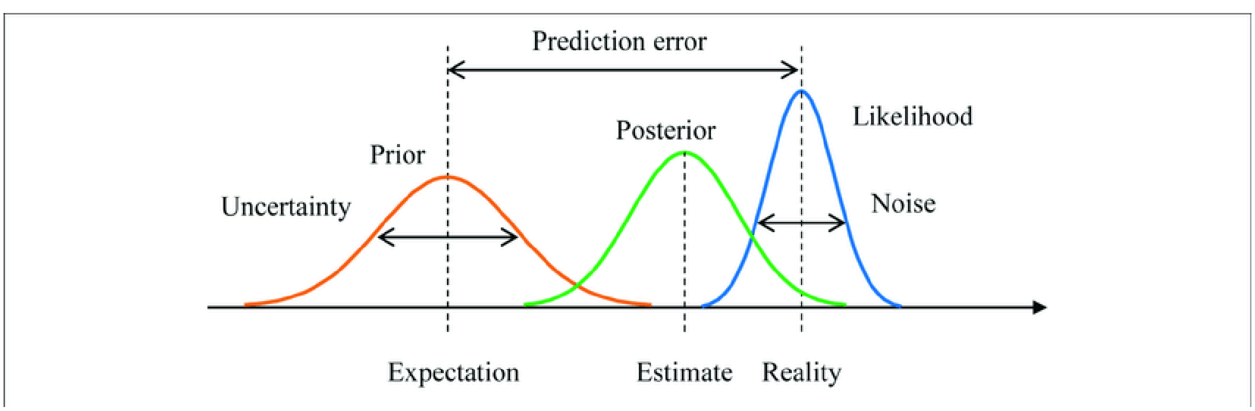
▪ In Bayesian statistics, we start with an initial belief about the distribution of parameters (prior distribution), which we update based on observed data to obtain a revised distribution (posterior distribution). Think of it as refining our understanding as we gather more evidence.

📐 Formulae:

▪ Prior Distribution (P(θ)):
The prior distribution represents our initial belief about the parameters of interest before observing any data. It encapsulates what we know or assume about the parameters. Mathematically, it is represented as a probability density function (PDF).

▪ Posterior Distribution (P(θ|X)):
The posterior distribution reflects our updated belief about the parameters after observing the data X. It combines the prior distribution with the likelihood of the observed data. Again, it is represented as a PDF.

🖼️ Visual Representation:




🌍 Real-Life Example:

▪ Scenario: Suppose we want to estimate the success rate of a new medication. Our prior belief is that the success rate could be anywhere between 0.2 and 0.8, following a uniform distribution.

▪ Question: After conducting a clinical trial with 100 patients and observing 60 successes, what is our updated belief about the success rate?
Using Bayesian Statistics:

▪ Prior Distribution: $P(\theta) \sim \text{Uniform}(0.2,0.8)$
▪ Likelihood: Binomial distribution with $n=100$ trials and $k=60$ successes.
▪ Posterior Distribution: Combining the prior and likelihood using Bayes' theorem.

🔢 Mathematical Example:

▪ Given the above scenario, let's say our posterior distribution follows a beta distribution with parameters $\alpha=61$ and $\beta=41$. This means our updated belief about the success rate is best represented by a beta distribution with these parameters.

🚀 Why This Matters:

▪ Understanding prior and posterior distributions allows us to incorporate prior knowledge and update our beliefs in light of new evidence, leading to more informed decision-making in various fields, including medicine, finance, and engineering.

Got any questions about Prior and Posterior Distributions!? Feel free to ask me via Linkedin! Let's keep learning together.

My LinkedIn Date: 01/05/2024