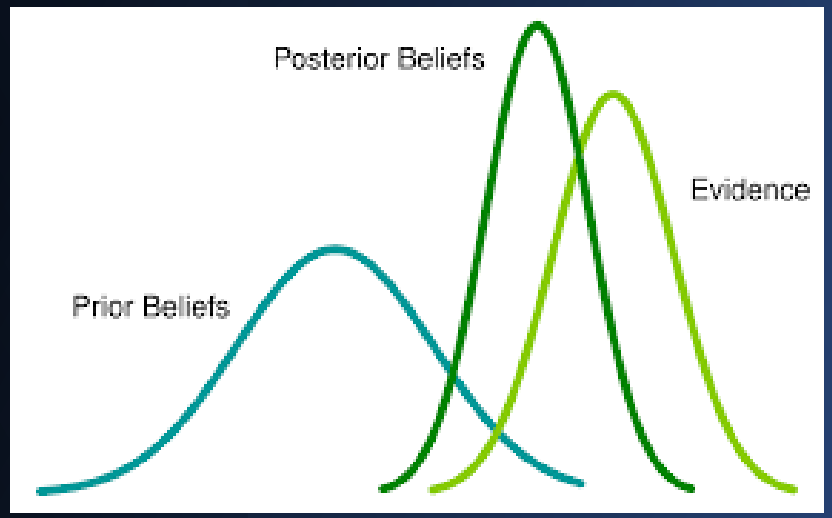
Bayesian Inference

The objective of the Bayesian inference is to determine, based on a priori knowledge, the degree of certainty one can have in a particular work hypothesis.

This a priori knowledge, derived from real-world observations and provided by experts, is used to calculate this certainty.

In this respect, Bayesian inference differs from the traditional statistical approach, which is mainly based on observations during experiment plans.



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Let’s roll the dice

Let's take a simple, unrealistic but quite illustrative example. Suppose a statistician wants to calculate the probability of getting 6 points if he rolls a die.

A traditional statistician will make several rolls and calculate how often he gets 6 points from the experiment and deduce the probability of this happening.

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A Bayesian statistician will surround himself with people who specialise in making dice, who will tell him, for example, that because the dots are actually hollowed out of the faces, there is less material on the faces with more dots, which affects the likelihood of each face ending up on top after a roll of the die in proportion to the amount of less material and therefore to the number of points*.

Based on this information, the Bayesian statistician will deduce the probability of obtaining 6 points when rolling a die.

*This example is completely imaginary and should not be taken as true.

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The Bayesian approach is based on the idea of conditional probabilities. If we know the probabilities of an event A and an event B occurring (P(A) and P(B)), as well as the probability of event B occurring if event A has already occurred (P(B|A)), then we can calculate the probability of A occurring if B has already occurred (P(A|B)) thanks to the formula on the right

$$P(A|B) = \frac{P(B|A) \times P(A)}{P(B)}$$

Real life example of the use of Bayesian inference

A clinical sign is suggestive of food A or food B poisoning. We know the probability that this sign is due to the ingestion of A and the probability that it is due to the ingestion of B.

It is known that the clinical sign is unreliable in X% of cases of intoxication with A and unreliable in Y% of cases of intoxication with B.

With this information and using a series of calculations based on Bayesian logic, the doctor will know whether to prioritize treatment in the case of ingestion of A or treatment in the case of ingestion of B and will be able to adjust the treatment according to the results of the biological monitoring tests.

In such cases, clinical tests are not relevant and Bayesian inference is a quick aid to decision making

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Nota Bene

This document has been written to popularize the concept of Bayesian inference to a wide audience and does not give an exhaustive account of all its richness and complexity. It cannot therefore be considered as exhaustive or rigorously accurate.

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