**The Bayesian Method**

In Bayesian statistics, we

* create a statistical model to link data to parameters
* formulate prior information about parameters
* combine the two source of information using Bayes’ theorem
* use the resulting posterior distribution to derive inferences about parameters.

The first step is common to all formulations of statistics, including the frequentist approach. The reminder is uniquely Bayesian. A key feature of Bayesian statistics is the third step, in which Bayes’ theorem synthesizes the two separate sources of information- see figure 1 for the schematic representation of this process. The result of combining the prior information and data in this way is the posterior distribution (O’Hagan, 2003).

Data

Prior

Posterior

r

**Figure 1:** Synthesis of Information by Bayes’ Theorem

**Bayes’ Theorem**

The Bayesian statistical approach is based on updating information using Bayes’ law, it provides the mathematical tool that combines prior knowledge with data to produce posterior distribution. It expresses the conditional probability of an event ‘A’ occurring, given that the event ‘B’ has occurred. In terms of unconditional probabilities the formula is:

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where .

In terms of probability density function, it takes the form:



Where  is the probability model, for the observed data *x* given the unknown parameter ,  is the prior for , while  is the posterior distribution. The same formula, written in terms of likelihood function is:

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Bayes’ theorem enables the Bayesian statistician to express the probability of a hypothesis both unconditional (prior probability) and give some evidence (its posterior probability), whereas other statisticians will only talk of probability of a hypothesis in restricted circumstances.