



Bayesian Probability

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Predicting Likelihood of Future Events

Bayesian probability is the process of using probability to try to predict the likelihood of certain events occurring in the future.

Unlike traditional probability, which uses a frequency to try to estimate probability, Bayesian probability is generally expressed as a percentage. In its most basic form, it is the measure of confidence, or belief, that a person holds in a proposition.

Using Bayesian probability allows a researcher to judge the amount of confidence that they have in a particular result. Frequency probability, via the traditional null hypothesis restricts the researcher to yes and no answers.

Bayesian methods are becoming another tool for assessing the viability of a research hypothesis.

To use Bayesian probability, a researcher starts with a set of initial beliefs, and tries to adjust them, usually through experimentation and research. The original set of beliefs is then altered to accommodate the new information. This process sacrifices a little objectivity for flexibility, helping researchers to circumvent the need for a tortuous research design.

A drug company does not want to know whether a drug works or not, but assess if it works better than existing treatments, giving a baseline for comparison. Drugs companies often 'tinker' with the molecular structure of drugs, and do not want to design a new program each time. The researchers will constantly reassess their Bayesian probability, or degree of belief, allowing them to concentrate upon promising drugs and cutting short failing treatments. This reduces the risk to patients, the timescale and the expense.

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Bayesian Probability in Use

One simple example of Bayesian probability ^[1] in action is rolling a die: Traditional frequency theory dictates that, if you throw the dice six times, you should roll a six once. Of course, there may be variations, but it will average out over time. This is where Bayesian probability differs.

Imagine a Bayesian specialist observing a game of dice in a casino. It is more than likely that he will begin with the same 1 in 6 chance, or 16.67%. As the night wears on, he notices that the dice is turning up sixes more than expected, and adjusts his belief. He begins to suspect that the dice is loaded, so leaves, keeping his money in his pocket.

Sticking with the gambling theme, consider a professional poker player taking part in a game. Standard probability would state, assuming that all the players are of equal ability and have a good 'poker face,' that the game revolves around the frequencies and chances of certain cards appearing.

However, our player has researched and studied the styles of his opposition over the years. She knows that one is likely to bluff a lot; another player is cautious, and he will not place large bets unless he has a good chance of a strong hand. The other is prone to making rash bets and going all in. Armed with this information, she can use Bayesian probability to reassess the likelihood of her own hand being strong, and having a chance of taking the pot.

A similar, although more complex process is used to predict the weather, based upon previous events and occurrences, and is right much more often than not. Weather is a chaotic system, and these are notoriously difficult to predict by frequency probability.

Any regular computer user regularly makes use of Bayesian probability. Spam filters on e-mail accounts make use of the Bayes theorem, and do a pretty good job. Whilst they do not intercept every single spam e-mail, and may wrongly assign legitimate messages to the trash folder, they are certainly better than having hundreds of junk messages waiting in the inbox every time the account is opened. Every time the program makes an incorrect assumption, which is flagged by the recipient, the new information feeds back into the model and facilitates a more accurate answer the next time.

This summarizes Bayesian probability very well - it is an extremely useful tool, more often

right than wrong, but it is only ever a guide. Many areas of science are adapting to this reworking of an old theory, and it promises to fit alongside the traditional methods very well.

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Links

[1] http://en.wikipedia.org/wiki/Bayesian_probability