**Application of Bayesian Statistics**

Bayesian methods are gaining popularity in many areas such as clinical trials, genomics, marketing, environmental science, and other fields where prediction and decision making must follow from statistical analysis. Bayesian methods are highly computational, they are also gaining wider acceptance as technology makes analyses possible that were not feasible in the recent past. Bayesian methods have become the primary tools for expert system that acknowledge uncertainty. Bayesian statistics is the hot topic today in numerous fields in which statistics is applied. Bayesian approach has a range of applications in different fields such as Artificial Intelligence, medicine, finance and insurance, industry, architecture and physics. Below are described a number of the most prominent utilization of Bayesian Statistics and Bayesian Networks in these areas.

**Banking and Finance**

Bayesian techniques have wide-ranging uses within the financial sector. By its intrinsic nature, Bayes’ Theorem lends itself perfectly to use within risk management. It is therefore commonly exploited within hedging and within asset and portfolio management. Banks and credit card companies are using Bayesian methods to determine whether or not to grant customers credit and to what limit. The key is that Bayesian statistics (as opposed to classical statistics) allow us to assess the probability of almost any chosen event (not just those generated by random processes). This reflects the probabilistic and chance nature of everyday life. This is the essence of the progression seen with the introduction of Bayesian techniques. It is for these reasons that Bayes’ Theorem has been so effective within banking - where the constant objective is that of assessing risk, and making forecasts, predictions and inferences based on this assessment. Risk assessment is inherently subjective and a central idea within Bayesian statistics is that of subjective probability.

**Security and Fraud Detection**

Bayesian methods have also changed the face of computer network security and the detection of credit card fraud. Companies would monitor the spending on the card, and anomalous behavior can be seen as a possible sign of fraud. Bayes’ Theorem is crucial in assessing the likelihood of fraud given the spending patterns. The Bayesian process means that patterns of behavior are sought rather than individual anomalies - the sort that could lead to incorrect results.

**Artificial Intelligence**

Since the late 1980’s, Bayesian Networks have been central to the development and hopes of Artificial Intelligence. The theory of Bayesian Networks has enabled the production of expert systems, which attempt to combine a wealth of previous experimental data and in-built expert analysis to determine a most likely cause or an optimal solution to a problem.

Today Microsoft is pioneers of the use of Bayesian Networks in their software applications. Indeed, Microsoft has an entire research group devoted to Decision Theory and Adaptive Learning, based on Bayesian Networks. They have attempted to incorporate Bayesian learning into a number of their products, perhaps the most famous example being the “paperclip”, Microsoft’s Office Assistant. This uses Bayesian methods to determine what help topics might be appropriate to the user, given the operation they are performing, the “object” they are interacting with, etc., in order to provide a more user-friendly and intelligent response. (Unfortunately, the Bayesian methods which were also used to determine how often the Office Assistant should pop up were considered to be too cautious, and so a different, non-Bayesian algorithm was implemented which causes the paperclip to appear more frequently). Microsoft also have a free web service, offering advice on solving printer problems, again the advice being determined by Bayesian techniques applied to past data. Similar approaches can be used in voice recognition systems or in applications linked to computer vision etc.

**Medicine**

In medicine, Bayes’ Theorem has assisted in diagnosis - identifying a patient’s ailments as a particular disorder - and in prognosis - forecasting the natural course of disease. It is also integral to some models being used to determine optimal treatments for various disorders for individual patients.

**Software Systems**

Bayesian Statistics have been used in a diverse range of other software systems. Bayesian systems are also being used in the continuing fight against spam, the unsolicited marketing and other junk email that deluges most companies email systems. An open source anti-spam email filter, called POP File, can be downloaded from the internet, which makes use of a simple Bayesian component that “learns” how to recognize spam and differentiate it from non-spam. This is achieved by training the software – telling it which of the emails you receive are acceptable, and which are spam. The software analyses the words in the message, and builds up a model of the “spaminess” of the word. After training, the system can then accurately predict which messages it believes to be spam. In practice this system has been found capable of spotting 99% of all spam emails.

The US Navy have developed real-time software for determining the performance of various ship self-defence weapon systems against varying types and ranges of incoming attack weapons. Traditional techniques to solve the problem had been unsuccessful, but an approach that involved the use of Bayesian Networks led to a solution that was both effective and efficient .