Statistics article review essay sample

The statistics article " Data Analysis: Frequently Bayesian" by Glen Cowan provides detailed overview of Bayesian and frequentists learning stressing the role of subjectivity, important problems associated with this method, why and when to use it in statistics field. The article is well-organized and well-supported as the author uses persuasive arguments and logical conclusion to defend his position that a well-established mathematics of probability still remains a thorny position. The author is trying to asses whether this hypothesis is valid claiming that all experiments are entailed with uncertain and random aspects.

Cowan specifies that in the filed of mathematics the probability rules are not merely manipulating numbers. Probability is defined as quantifying randomness. However, it is rather difficult to provide exact definition of probability. The result is a number of schools of statistical inference which are concerned with probability. The schools are Bayesian and frequentist and they have different views on probability and the role of subjectivity. Frequentists argue that probability is " something associated with the outcome of an observation that is at least in principle repeatable, such as the number of nuclei that decay in a certain time".

In other words, probability is viewed as limiting frequency. Subjective measure is used to describe the degree of belief. Bayesian School of statistics promotes the idea that subjective probability should be used to quantify the degree of belief in different models. The theorem can be presented as $P\{Qx) \propto P\{xQ)P(Q)$, where H is parameter representing the hypothesis, whereas value x represents observational outcome.

Further, on the right-hand side the quantity P{xO) is the probability how to get x for a given Q. Cowan stresses that Bayesian statistics tends to interpret data through referring to prior judgment. They argue that prior probability is relatively flat. On the left-hand side the theorem represents the posterior probability – the probability after seeing the outcome of the experiment or observation. The author argues that Bayesian theorem " tells experimenters how to learn from their measurements; the figure presents a couple of graphical examples". (p. 83) Nevertheless, Bayesian theorem requires an input – a prior degree of belief about the hypothesis.

No golden rule is provided for the prior probabilities as Bayesian analysis is based on symmetry arguments and physical intuition. When parameters are set, the theorem provides original interpretation how to choose probability and how they will change in the light of changing data. The same numerical results are obtained by Bayesians and frequentists in case of vague initial judgments and large data sample. Nevertheless, subtle differences will be observable. When dealing with small data sample, the differences between approaches will be both numerical and philosophical.

Bayesian statistics is not without difficulties. For example, one of the difficulties originates from requirement to use prior probabilities. When measuring particle mass the temptation to profess ignorance is rather high. One more problem is associated with specification of the ignorance for continuous parameter. For example, Cowan notes that " a constant probability for one parameter would imply a nonconstant probability for the other". (p. 83) Uniform prior probabilities are used because they ensure

convenient point of reference, not simply because they are real prior judgments.

When probabilities reflecting the prior input are written down, the difficulties related to non-informative priors are diminished. Individuals have different views on how to incorporate and how to deal with judgments and, therefore, prior probabilities are applied to the entire scientific community. Thus, Bayesian method should show how the posterior probabilities are changing under reasonable variation of prior probabilities. Cowan concludes that scientists should value both Bayesian and frequentists as these approaches answer related questions. Bayesian method is used if the parts of the problem require assignment of probabilities.