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Kittisak Kulvichit

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The right answer to the wrong question

Kittisak Kulvichit*

All research starts with uncertainties and we hope that at the end they will be less. Those uncertainties are from two sources of errors, ie. systematic error and random error. Statistical analysis will help us lessen and quantify the uncertainty caused by random error. Unfortunately doctors usually misunderstand how and to what extent those cryptic statistical values allow them to express their uncertainties.

The classical approach, also known as the frequentist approach, is based on the idea that the parameter that we are trying to estimate has a fixed but unknown value. The infamous "p value" obtained from this approach is the probability of having observed such data, or more extreme data, when, in fact, there is no difference. For example, if we conduct research to see if drug A would reduce blood pressure better than the conventional drug B. We find that on average drug A can reduce the blood pressure 4 mmHg more than drug B with the p value of 0.03. We can say that if drug A is the same as drug B, there is (only) 3 percent chance of finding such data (4 mmHg difference) or more extreme data (5, 6, 7 ...... mmHg differences). As a result we deduce that the premise, that drug A is the same as drug B, must be wrong. However, this probability is not what most clinicians want to know. What they want to know is the probability that drug A is better than B given the data, not the probability of finding the data given drug A and drug B being the same. The former is what Bayesian statistical inference offers.

The Bayesian approach is based on the idea that the parameter we are trying to estimate has a probability distribution. Before conducting research, we express our knowledge and uncertainty about the parameter in form of a distribution, ie. prior distribution. After we collect more data from the study, the prior distribution will be modified by the data and becomes the posterior distribution. Using the posterior distribution, a doctor can then say "There is a 95% chance that drug A can reduce the blood pressure somewhere between 2 to 6 mmHg more than drug B". The two main reasons why the Bayesian approach has not been widely adopted in medical science are the skepticism of the effect of subjective prior distribution on the posterior distribution and the complexity of computation. No matter which statistical approach, Frequentist or Bayesian, we use, there will always be an element of subjectivity. The Bayesian approach, nevertheless, brings it into the spotlight. As for the computation, the invention of the Markov Chain Monte Carlo (MCMC) simulation has revolutionized the application of Bayesian statistics. The BUGS (Bayesian inference Using Gibbs Sampling)

* Department of Ophthalmology, Faculty of Medicine, Chulalongkorn University

project, which is a joint programme of the Medical Research Council's Biostatistics Unit in Cambridge and the Department of Epidemiology and Public Health of Imperial College at St.Mary's Hospital in London, has provided software, at no cost, for Bayesian analysis using MCMC method. [1] It is now a matter of time before the Bayesian approach becomes the standard approach embraced by the biomedical community. Are we ready for the right answer to the right question?

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