

Operationalizing the Concept of Probability in Legal-Social Science Research

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Statistics has been called the science of uncertainty. Central to this science is the concept of probability. Operationalizing probability, however, has provided statisticians with many difficulties over the years, and to this day no complete agreement has been reached on this extremely important issue.

Still, the term probability has been profitably used, both in theoretical statistics and in many sciences where statistics is applied. The concept has been slow in reaching the legal profession, but Simon and Mahan show that the concept can be used there as well.

Before commenting directly on their paper, I want to identify the two main ways in which the term probability is currently used. On the one hand probability is taken to be a relative frequency. For example, in coin tossing, to find the probability of a coin coming up heads I toss the coin n times and observe that x of those tosses produce heads. The relative frequency of heads is x/n , and when n increases to infinity this relative frequency equals the probability of heads. Overlooking the fact that we never have time to repeat the tossing experiment infinitely many times, a key requirement here is that we have the kind of experiment that can be repeated. Otherwise we cannot obtain a relative frequency.

Any given legal trial, however, is presumably a unique “experiment” which cannot be repeated. According to the relative frequency way of operationalizing the probability concept, it is therefore not possible to consider the probability of a defendant being guilty. Still, Simon and Mahan seem to treat probability as

a relative frequency when in the example in Figure 1 they say "a five out of ten chance or probability." This statement leads me to a relative frequency of five over ten. One would have to interpret this as saying that if the defendant is tried for this particular offense ten times, five times he is truly guilty, and five times he is truly not guilty. But this last sentence makes no sense.

The defendant is either guilty or not guilty. Presumably, he usually knows which of these two is the correct conclusion. But while the defendant may know the truth, we remain uncertain about whether or not he is guilty, and it is this uncertainty that Simon and Mahan want to measure. Uncertainty about unique events is present in many areas, and the inability of the relative frequency interpretation of probability to deal with unique events has led to the second major interpretation of probability. Here probability is taken as a personal measure of uncertainty, and it is in this sense that we must interpret the probabilities used by Simon and Mahan. Numbers between zero and one measure varying degrees of uncertainty as to the defendant's guilt. The probability of the defendant being guilty equals zero if we are absolutely certain he is not guilty, and the probability equals one if we are absolutely certain he is guilty.

The branch of statistics that makes use of probabilities to measure personal uncertainty is known as Bayesian statistics. Bayesian statisticians have given considerable attention to the problem of how to measure personal uncertainties, and future research in assessing probabilities of guilt might benefit from a better operationalization of probabilities than the one used by Simon and Mahan. The operationalization used by Bayesian statisticians often is cast as a hypothetical betting situation where the subject is asked how much he is willing to bet on the opportunity of winning a dollar if the event he is betting on turns out to be true. As an example, a subject would think the probability of a defendant being guilty was .8 if the subject were willing to pay as much as eighty cents for a note entitling him to one dollar if it turns out that the defendant is truly guilty.

Considering how important the probability estimates are to Simon and Mahan, one might wish that they had given more discussion of their method of obtaining the probabilities and that they had tried methods that Bayesian statisticians have to offer. Since probabilities are usually given as numbers between zero and one or as percentages, it is distracting in their paper to have probabilities reported on a scale from zero to ten.

It is difficult to imagine any defendant ever hearing probability statements made in court about his assumed guilt, and one would expect the legal system to continue using the dichotomy of guilty/not guilty. But pursuing the type of research reported by Simon and Mahan should increase our knowledge of the process that ends in such a determination by a judge or a jury.

Moreover, future legal-social science research using statistical ideas ought to go beyond obtaining probabilities. Psychologists and others have investigated how people arrive at their subjective probability estimates. The estimates are

obtained through experiments of various kinds, and research of this type could have much to offer for anyone making use of probabilities in legal research. For a particularly well-written account of this and other topics, see Raiffa (1968).

Formal theory of probability and statistics represents another body of knowledge that should not be overlooked in this connection. Declaring a defendant guilty or not guilty has a direct correspondence in statistical hypothesis testing. One hypothesis, denoted H_1 , states that the defendant is not guilty, and the other hypothesis, denoted H_2 , states that he is guilty. Since either H_1 or H_2 is true, an error is made if the court declares the wrong hypothesis to be true. If H_1 is true and the court decides on H_2 , one kind of error is made, and if the court decides on H_1 while H_2 really is true, another kind of error is made. The cost to the defendant and society differs with the two kinds of error, the severity of the offense, the severity of the sentence, and the like. Cost functions, as used in statistical theory, could provide another stimulus for the kind of research reported by Simon and Mahan.

The authors have made a valuable start investigating an important and difficult legal-social problem, and one can only hope that they will explore the matter still further in future research.

REFERENCE

- RAIFFA, H. (1968) *Decision Analysis: Introductory Lectures on Choice Under Uncertainty*. Reading, Mass.: Addison-Wesley.