LEARNING STATISTICS BASED UPON MULTIPLE THEORIES OF PROBABILITY

Chong Ho Yu and Anna Yu
Azusa Pacific University, Azusa, California, USA
AnnaMarieYu1@gmail.com

INTRODUCTION

Probabilistic inference is the foundation of statistics. Hypothesis testing – a fundamental process that underlies the science of statistics – is based on the probabilistic inference of obtaining a given statistic in the long run, given that the null hypothesis is true. Despite the utility of learning diverse perspectives and theories on probability, many students learn the subject of probability within a single and unified framework (the frequency approach). As a result, statistics learners often learn to blindly follow mechanistic principles (e.g. alpha ≤ 0.05). Students' failure to learn that probability is a complex, multitheoretical subject often interferes with their conceptual comprehension of the wider subject of statistics and their openness to different interpretations.

STATISTICS IS BUILT UPON MULTIPLE THEORIES OF PROBABILITY

These authors subscribe to the notion that statistics is more about philosophy and logical reasoning (Onwuegbuzie & Wilson, 2003) than it is about mathematics. It is our conviction that statistics classes should include multitheoretical perspectives on probability, rather than just the traditional frequency perspective (Galavotti, 2005). Recommended theories for inclusion in introductory statistics courses include the classical theory, the frequency approach, the Bayesian probability model (Berry, 1996), the notion of propensity (Gillies, 2012), and many others. Research indicates that students are averse to abstract, overly-formal methods of teaching probability (Freudenthal, 1973; Garfield & Ahlgren, 1988). Therefore, we encourage the teaching of probability theories through the usage of real-world examples, to stimulate in-class engagement and discussion (i.e. If a student has received five 'A's in a row, what is the probability that this student will receive an 'A' on his or her next assignment?; If a couple has already gotten married, what is the probability that this couple will decide to get a divorce?) Psychological fallacies that hinder us from making correct probabilistic inferences will also be discussed (e.g. above-average fallacy, unreliability of eye-witness testimony, conjunction fallacy).

CONCLUSION

Although students in introductory statistics classes are traditionally taught the subject of probability within a uniform, frequency approach, this subject should not be taught in a straightforward, singular manner. Rather, it should be taught within the context of relevant factors such as independence of chance, regression toward the mean, Bayesian conditional probability, propensity, and direct inference. Based on our teaching experience this philosophical and psychological approach would help students overcome common fallacies and difficulties in learning probabilistic inferences.

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