

TEACHING FUNDAMENTAL STATISTICAL CONCEPTS USING SIMULATION: EXPERIENCES WITH THIS APPROACH IN SOUTH AFRICA AND AUSTRALIA

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WHY ADOPT SIMULATION AS A TEACHING TOOL?

It is argued that introducing fundamental statistical concepts via expounding theory followed up with statistical recipes, can be seen as not only ineffective, but also elitist. It represents a mechanistic framework for students to achieve passing (or even excellent) grades, who, in reality, understand very little. Very few students are likely to have anything except the most superficial grasp of the material. Moreover, by effectively catering primarily to educationally advantaged students, it is a method that is also elitist. A society such as that in South Africa has an urgent imperative to find teaching approaches which promote access to effective learning for all.

ELUSIVE FUNDAMENTAL STATISTICAL CONCEPTS

The key statistical concepts in a standard introductory statistics syllabus that students typically find hard to grasp include:

- Random variation
- Distributions (empirical vs. theoretical)
- The sample mean as a random variable
- The effect of sample size
- The Central Limit Theorem
- Statistical significance and statistical power

A SUITE OF SIMULATIONS IN VBA FOR THE EXCEL ENVIRONMENT

The simulation programs are written in VBA, to be executed in a spreadsheet environment likely to be familiar to most students. The Uniform, Binomial, Normal (via CLT), Poisson and Exponential distributions are simulated via everyday experimental situations that students are able to interact with. The programs simulate situations modeled as repetitions of random experiments and generate distributions of key random variables, displayed graphically. Each program allows the number of repetitions and parameters of the experiment to be varied by the user.

TEACHING EXPERIENCES

South Africa

The simulation tool was introduced as a new form of teaching statistics to first year students at the University of Cape Town (UCT). A teaching team of seven teachers taught five streams in daily classes of around 300 each. The teaching team came to the strong view that the insights gained using this approach could not have been attained using traditional “static” data set illustrations. Importantly, it was felt that the simulations provided a space in which students could ask “what if” questions and debate material which is typically presented to first year students as incontrovertible and consequently not likely to stimulate debate. Results of a survey designed to evaluate the approach highlighted the benefits of using visual approaches, in particular for learners experiencing language challenges.

Australia

One of the authors had the opportunity to introduce the simulation teaching approach at Murdoch University in Perth, Western Australia. The experience indicated strong support for this approach as opposed to the erstwhile approaches using ‘static’ data sets. Interestingly, the conclusions of the author were similar to those in South Africa, even though the students were from backgrounds that were generally more affluent than those at UCT, levels of inequality were much lower and the students largely had the advantage of being taught in their own first language.