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The pedagogical importance of statistical simulation methods

Statistical theory and methods are employed in virtually every academic discipline when data needs to be analyzed. Indeed, required courses in statistics are currently the norm in most quantitative fields. The advantages of using computer technology to achieve fast and accurate statistical results, and their need in statistical education, are both well established. However, the pedagogical uses of statistical simulation methods do not, at present, hold a firm foundation in post-secondary statistical curriculum, especially at the introductory level. The advantages of employing such methods are crucial for the modern user of statistical methodology, and can be appropriated on many different levels. First, simulation techniques are very useful in presenting key statistical concepts. For example, the Central Limit Theorem, probability density functions, asymptotic consistency, and even confidence limits all become far more intelligible when the student is shown how these results actually operate in practice.

Secondly, it is certainly the case that there are many real-world problems that simply cannot be solved using conventional theoretical models. For example, deriving standard errors for various estimators using re-sampling methods (such as the Bootstrap or Monte Carlo methods) are necessary in a wide variety of applications, especially for the more complicated multivariate problems.

Finally, it is quite easy to implement simulation methods in class or on assignments, and these methods are typically present in all of the main statistical software packages (e.g. SAS, S-PLUS, MINITAB, SPSS, etc.).