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Simulation of the sampling distribution of the mean can mislead.

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Summary: Although the use of simulation to teach the sampling distribution of the mean is meant to provide students with sound conceptual understanding, it may lead them astray. We discuss a misunderstanding that can be introduced or reinforced when students who intuitively understand that “bigger samples are better” conduct a simulation to explore the effect of sample size on the properties of the sampling distribution of the mean. From observing the patterns in a typical series of simulated sampling distributions constructed with increasing sample sizes, students reasonably – but incorrectly – conclude that, as the sample size, n , increases, the mean of the (exact) sampling distribution tends to get closer to the population mean and its variance tends to get closer to σ^2/n , where σ^2 is the population variance. We show that the patterns students observe are a consequence of the fact that both the variability in the mean and the variability in the variance of simulated sampling distributions constructed from the means of N random samples are inversely related, not only to N , but also to the size of each sample, n . Further, asking students to increase the number of repetitions, N , in the simulation does not change the patterns.

Classification: K70 K90

Keywords: stochastics; sampling distribution of the mean; simulation; sampling variability; variance of means; variance of variances; central limit theorem; estimated mean; estimated standard deviation
<http://ww2.amstat.org/publications/jse/v22n3/watkins.pdf>