Applet #1 Activities: Instructor Guide

Learners studying introductory statistics usually find concepts relating to the sampling distribution of a statistic difficult to understand. One reason for this is that how a statistic varies over multiple samples is not easy to convey in a textbook or traditional lecture. A variety of methods have been proposed for aiding learning about sampling distributions, one being on–line simulation–based tools, or *applets*, that permit visualisation of multiple samples from a distribution and how their statistics vary. Research suggests that how students engage with such applets can impact the learning obtained, as without structure to their interactions with a visualisation tool learners may miss important concepts.

Prof. Mike Whitlock (in the Department of Zoology, University of British Columbia) has developed a suite of applets for use in introductory courses. The first of these, "Sampling Means from a Normal Distribution", allows the learner to explore how the sample mean behaves when sampling from a Normal distribution. The accompanying activity aims to assist the learner in their engagement with the applet, helping to focus attention on key learning goals. The activity may be used as an in–class activity (say as part of a lab–based tutorial) or outside class as a homework assignment. The activity has been trialed on over two hundred students at the University of British Columbia. There follows an instructor guide to the activity.

The applet includes a tutorial, and the learner is obliged to work through that before commencing the activity. The first part requires the learner to reflect on what they learned from the tutorial and write down what are perceived as important points. If nothing else, this ensures the learner works through the tutorial and pays some attention.

The second part obliges the learner to modify the parameter values and the sample size before observing multiple simulations. The idea is that armed with the prior knowledge that about 99% of a Normal distribution lies three standard deviations from its mean the learner will be able to deduce a ball–park figure for the standard deviation of the sample mean. The learner is asked to provide a reasoning behind their estimate, mindful that the actual value could be computed from the result $(\sigma/\sqrt{n})$ stated in the tutorial.

The third part is a repeat of the second but with different parameter values. The learner may observe how changes in parameters can affect the sampling distribution, but really the aim is to reinforce the thinking that was expected in part 2. The final part exists mainly to ensure the learner

appreciates how the standard deviation of the sample means depends on the parameter values and sample size, and also to familiarise the learner with the notation commonly used in this context.