Making Sense of Inference: From Common Core to AP Statistics

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I. What's the scoop? *Inference for Sampling*

<u>Goal:</u> To estimate the true proportion *p* of red beads in the container with a point estimate and a margin of error.

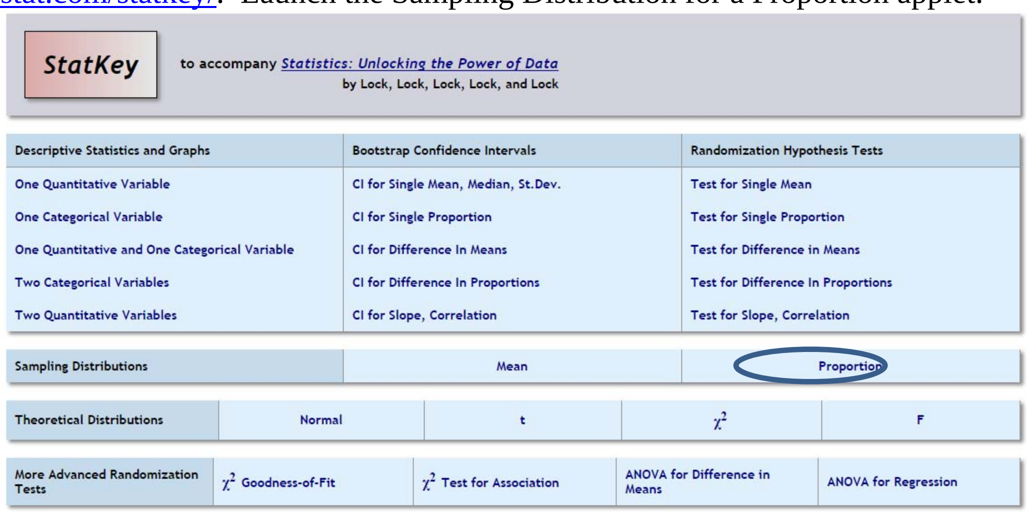
- We'll start by taking a random sample of beads from the container.

- What is our "best guess" at the value of *p* based on the data? This is our *point estimate*.

Suppose that our estimate is exactly correct and that _____% of the beads in the container are red. (This assumption seems unlikely to be true, but just play along for now!) How far would the sample proportion tend to be from the "true" population proportion of _____ in random samples of size ____? To find out, let's simulate.

- First, let's seed our random number generators! Type the 7 digits in your cell phone number, STO to MATH/PRB/rand, and press ENTER.
- Let's assume that the true population proportion is ______.
- Use the randInt command to generate _____ values between 1 and 100 and store them in L1/list1. Let values from 1 to ____ represent getting a red bead. Find the proportion of beads in your simulated sample that are red.
- Record your value of the sample proportion $\hat{p}$ on the poster in front of the room.
- Repeat the process if needed.

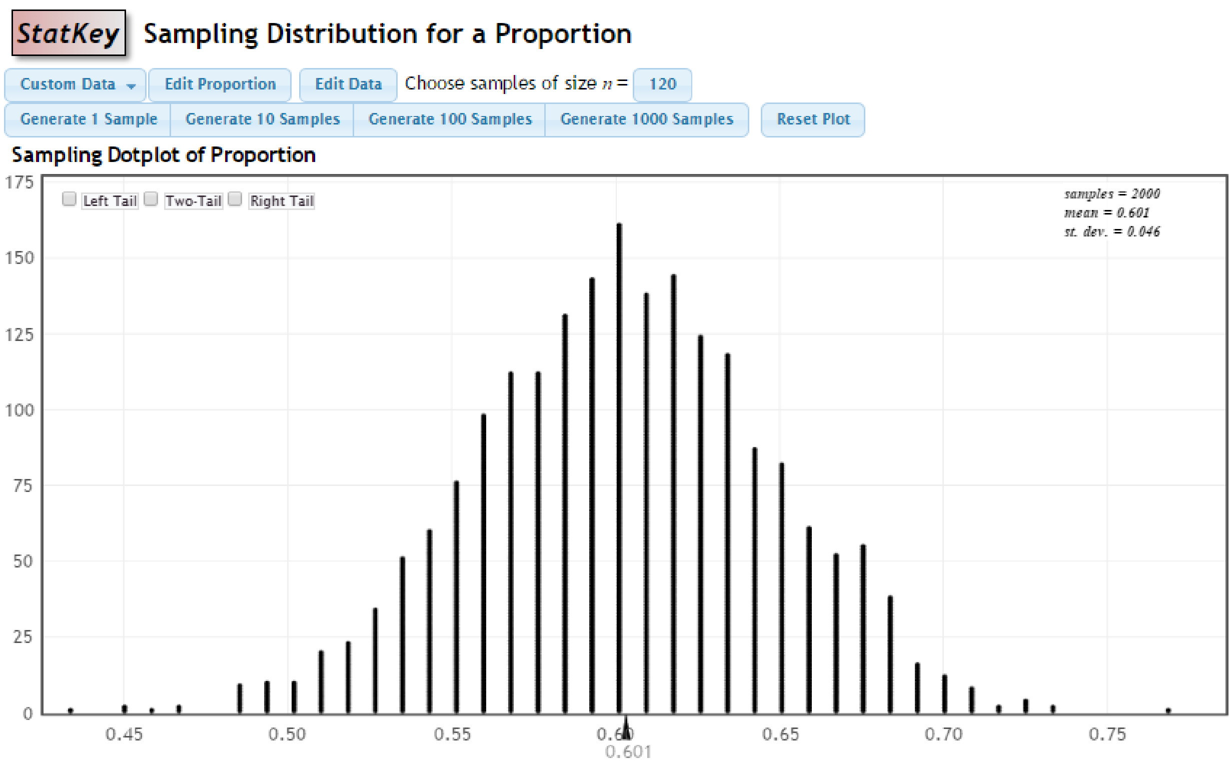
What if the true proportion of red beads in the container is really *p* = _____? This time, let's use a **computer applet** to perform the simulation. Open your device's browser and go to http://lock5stat.com/statkey/. Launch the Sampling Distribution for a Proportion applet.



- Click on Edit Proportion and enter ______.
- Change the sample size to *n* = ______.
- Click on Generate 1 Sample. Repeat several times.
- Now click on Generate 1000 Samples.

- Click on edit proportion and enter a different value for *p*. What do you notice?

3. How close does the sample result tend to be to the true population value in random samples of this size? In other words, what's the *margin of error* for our estimate?



Scope of inference

		Were subjects randomly selected?	
		YES	**NO**
Were subjects randomly assigned?	**YES**	The researcher: —may infer cause and effect; *and* —may generalize findings to the population.	The researcher: —may infer cause and effect; *but* —may *not* generalize findings to the population.
	NO	The researcher: —may *not* infer cause and effect; *but* —may generalize findings to the population.	The researcher: —may *not* infer cause and effect; *and* —may *not* generalize findings to the population.

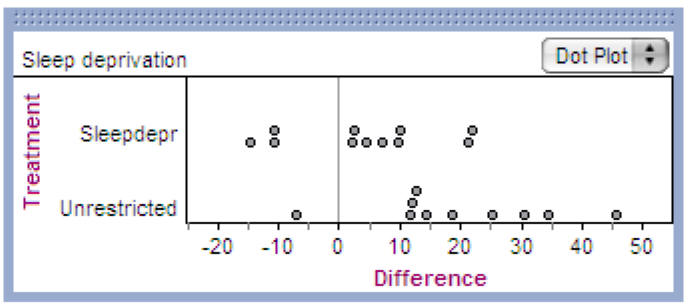
II. Does sleep deprivation linger? *Inference for experiments*

(from Rossman, Cobb, Chance, and Holcomb's NSF project shared at JMM 2008 in San Diego)

Researchers have established that sleep deprivation has a harmful effect on visual learning. But do these effects linger for several days, or can a person "make up" for sleep deprivation by getting a full night's sleep on subsequent nights? A recent study (Stickgold, James, and Hobson, 2000) investigated this question by randomly assigning 21 subjects (volunteers between the ages of 18 and 25) to one of two groups: one group was deprived of sleep on the night following training and pre-testing with a visual discrimination task, and the other group was permitted unrestricted sleep on that first night. Both groups were then allowed as much sleep as they wanted on the following two nights. All subjects were then re-tested on the third day. Subjects' performance on the test was recorded as the minimum time (in milliseconds) between stimuli appearing on a computer screen for which they could accurately report what they had seen on the screen. The sorted data and dotplots presented here are the improvements in those reporting times between the pre-test and post-test (a negative value indicates a decrease in performance):

Sleep deprivation (n = 11): -14.7, -10.7, -10.7, 2.2, 2.4, 4.5, 7.2, 9.6, 10.0, 21.3, 21.8

Unrestricted sleep (n = 10): -7.0, 11.6, 12.1, 12.6, 14.5, 18.6, 25.2, 30.5, 34.5, 45.6



Compare the improvement scores for the two groups. Does it appear that subjects who got unrestricted sleep on the first night tended to have higher improvement scores than subjects who were sleep deprived on the first night?

Question: Is it plausible (believable) that there's really no harmful effect of sleep deprivation, and random chance alone produced the observed differences between these two groups?

Simulation of the random assignment

- If no difference in treatment effects, then values will be the same as in the original study.
- Write each of the 21 data values on a separate card.
- Place all of the cards (subjects) in a bag.
- How large a difference in group means with different random assignments?
- Mix your cards and deal two groups—one with 10 cards (unrestricted sleep) and one with 11 cards (sleep deprived).
- Calculate the difference in mean time improvement for the two groups (unrestricted – sleep).
- Record the difference in means on a sticky note.
- Repeat the process as instructed to perform more repetitions of the simulation.