

Sampling Distributions

Course

Introduction to Biostatistics

Big Idea

Each student will obtain and calculate the mean for eight different simple random samples of size 4 from a population of exam grades. The class will construct a histogram of sample means to illustrate a sampling distribution. The teacher will demonstrate a sampling distribution from the same population using sample size $n=2$. Students will consider the sampling distributions of sample means and the population distribution in light of the purpose of statistics, i.e., to make inferences about the population from sample data.

Note about the Central Limit Theorem

The Central Limit Theorem will be discussed in the next lesson. It is not practical to use this lesson to illustrate the Central Limit Theorem because students would have to calculate the means of multiple samples with $n=25$ or more. The more difficult concept here is the sampling distribution itself. This activity lays a strong foundation for students to understand the Central Limit Theorem by illustrating what a sampling distribution is. I then use computer simulations to illustrate the Central Limit Theorem.

Objectives

Students will be able to...

1. Generate a sampling distribution and construct a histogram of sample means.
2. Differentiate between population distribution and sampling distribution.
3. Compare and contrast the various distributions and draw conclusions about how sample data can be used to make inferences about the population.

Rationale for Students

Students will be interested in this lesson because it is highly visual and interactive and involves data they see on a regular basis. Students will benefit from this lesson as a necessary step for understanding a crucial theorem in statistics, i.e., The Central Limit Theorem.

Materials

- Computer, projector, and screen
- 35 copies of the activity worksheet

Anticipatory Set (5 minutes)

(Recall)

- The population distribution describes how individuals vary in the population.
- A normal distribution is a continuous distribution that is bell shaped and symmetric
- Illustrate that samples are taken from a population (usually too large to evaluate as a whole) for the purpose of calculating statistics that can be used to make inferences about the unknown population parameters, e.g. population mean and standard deviation.

Procedure (35 minutes)

1. Construct a sampling distribution from a large number of samples.
 - a. Each student obtains eight simple random samples (SRS) and calculates the means (worksheet).
 - b. Students construct a histogram on the board; each student marks his or her eight sample means.
2. Define sampling distribution and contrast it with population distribution.
 - a. The sampling distribution describes how sample means vary in repeated sampling.
 - b. A sampling distribution is the distribution of a statistic, such as the mean, drawn from a population and calculated for all possible combinations of samples of a particular size, n .
3. Demonstrate using smaller samples, $n=2$, from the same population, $N = 10$.
4. Compare and contrast the population distribution and two sampling distributions.
5. Discuss the implications of the similarities with respect to the purpose of statistics.
6. Define the sampling distribution of the sample means:

If the individual observations are normally distributed, $N(\mu, \sigma)$, then the distribution of sample means, with samples of size n , is normally distributed with mean equal to μ and standard deviation, called the standard error of the mean, equal to σ/\sqrt{n} , $N(\mu, \sigma/\sqrt{n})$.

Closing (5 minutes)

Student evaluations (exit slip)

- Describe an aspect of the lesson that you found interesting or practical.
- Describe an aspect of the lesson that left you confused or questioning something that I left unanswered.
- Was there any part of the lesson that was especially good?
- Was there any part of the lesson that I could have handled better?