Tree Sampling

Nº. 75

INTERMEDIATE/SENIOR

Math

LESSON SUMMARY

Students will use a woodlot inventory as the context for learning about continuous one-variable data and standard deviation

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Activity Information

Grade Level:	Intermediate/Senior
Estimated duration:	One 90 minute class
Materials:	Blackboard/smartboard, student handouts
Setting:	Indoors
Key Vocabulary:	Sampling, standard deviation, forestry, inventory, hectare, precision
MDM4U (Grade 12 Data Management):	Probability Distributions Unit – 2.2 ("recognize standard deviation as measure of the spread of a distribution…") 2.3 ("describe challenges associated with determining a continuous frequency distribution…")
Mathematical Processes:	Selecting Tools and Computational Strategies, Connecting, Problem Solving

Teacher Background

In forestry, determining the population of specific species in a given area can be of vital importance. For example, having information about the abundance of a variety of tree species can better allow the landowner to make informed decisions about woodlot management (such as timber extraction). In order to make accurate counts, many foresters use sampling techniques to make estimates about population sizes.

In this lesson plan, students will use a woodlot inventory as the context for learning about continuous one-variable data and standard deviation. A brief introduction to simple random sampling can serve as a primer to future deeper considerations in the area of sampling (such as systematic sampling, and considering biases). Students will be expected to analyze data from a simulated tree inventory and assess the validity of their findings.

Activity

Step 1 Have a class discussion about the importance counting trees or other plants in forestry.

Ask them to brainstorm: What use does this information have? How can we determine the number of trees without counting each one?

Introduce the concept of sampling. Ask students to move conceptually from the idea of sampling to the practicalities of it. You can use the general rule that you should sample at least 2.5% of the total area being assessed (Forester's rule of thumb), and bring up the concept of circles versus squares for sampling areas, and how we could use these in the forest (pegged rope for circles, compass for squares). Also discuss how to prevent biasing sample areas (could stick to simple random sampling for now).

Step 2 Introduce the concept of a hectare (100 m x 100 m), and have them determine what radius a circle must be to give 1 hectare sampling area (answer: about 56.4 m). You could talk about feasibility of sampling 1 hectare versus sampling 1/10 or 1/25 of a hectare. Have them find the radii of these smaller sampling circles.

Step 3 Use simulated counts to estimate the total number of trees in the entire woodlot. You could do this portion as a class with students following along in their handouts. Have students participate on the blackboard for the various steps.

Step 4 Introduce standard variation as a measure of the variation in the data. In other words, how precise our measurements are. Measures the average deviation of each data point from the mean, and is closely related to variance. Explain the 68/95 rule. With the class, calculate the SD for this data set.

Step 5 Expand the students' data set by introducing Set B. Allow them to run through the calculations on their own as practice. Have them determine whether 68 % of the data falls within +/- 1 SD, and 95% for 2 SD.

Extension

This lesson plan could be enriched by having the students do some sampling in any locally available woods. This could be limited to relatively small areas and without discernment between tree species. The difficulty of managing students who are sampling different plots may be large.

This lesson could also be refocused toward using Microsoft Excel. This would allow the students to handle a larger data set, and practice their ability to perform mathematical calculations on this software program.

NAME: _____

Tree Sampling – Student Handout

In the field of Forestry, it is often important to know the population size of various trees or other plant species in a certain area. Today we will investigate the concepts of sampling and standard deviation in the context of a Forester's efforts to create an inventory of the land.

Brainstorm: What value is there in knowing how many of each species exist in a forested area?

Brainstorm: How can we determine the number of trees in a large area without counting each one?

Define and write notes for the following terms:

Sampling –

Hectare -

Tree Sampling – Student Handout

Sample question: You have recently acquired a 20 hectare property, of which 18 hectares are covered in forest. You want to create an inventory of the tree species within the forest, and choose to start by determining the number of sugar maples within. You take 8 samples, each covering 1/25 of a hectare. Your sugar maple counts for the samples are:

5, 11, 8, 13, 7, 7, 10, 16

How many sugar maple trees do you estimate are in your entire property?

In order to assess how precise our estimate is, we must determine the standard deviation of the answer. Standard deviation measures the average deviation from the mean for each data point.

Σ(Σ– Σ)2n

Σis their average, and n is the number of data points. Σmeans 'the sum of'.
Determine the standard deviation of your estimate. Create a table to help you find the deviation.

Determine the standard deviation of your estimate. Create a table to help you find the deviation.

Sample question expanded: You've decided that your earlier estimate could be improved upon. You now decide to sample another 8 locations, expanding your total to 16 samples. Your newest sugar maple counts are:

7, 8, 9, 12, 11, 12, 4, 7

What is your new estimate for the number of sugar maple trees on the property? Find its standard deviation, and comment on the difference between your findings in this question versus the original. Determine what proportion of your data falls within 1 standard deviation, and within two standard deviations. Does this match the 68/95 rule?