Greening you math program;
Real mathematics that can be used in your classroom

The mathematics from algebra, geometry, and trigonometry will be used to study problems that arise in working with natural resources such as forest and wildlife management. The program is intended for high school mathematics teachers who are interested in showing their students some applications of mathematics to the real world. All lessons will include hands on activities, many of them with an outdoor component, as well as notes that can be used to help the teachers do similar activities with students in their own classes.

The following is a rough schedule for the weekend. All times are only approximate, and additional topics may be included depending on the time and interest of the students.

Saturday, April 6, 2013

9:00 - 9:30; Welcome and introduction. We will begin with a description of the activities that will occur during the weekend, some of the mathematics that will be used, and introduction to such tools as the Biltmore stick, diameter tape and angle gauge, as well as some terminology such as DBH, basal area, cord and stand density.

9:30 - 1:00; How to use a Biltmore stick and the mathematical derivation of the formula used to place the marks on the Biltmore stick. After working out the necessary mathematics, students will then make a custom Biltmore stick designed for their own arm length. Students will then go into the forest and measure the DBH of several trees using both their own Biltmore stick and a diameter tape. After returning to the classroom, students will see if there is any statistical difference between their two sets of measurements (using a paired t-test; students will be shown how to do this on the TI85 calculator). Possible reasons for preferring the Biltmore stick to the diameter tape will be discussed. After a discussion of how to compute basal area, and how to estimate total basal area per acre (using fixed radius plots), students will return to the forest, select plots and take the necessary measurements. They will then return to the classroom and make the necessary calculations.

2:00 - 5:30; Students will be shown how to use an angle gauge and 10 factor wedge prism. We will then work out the mathematics to develop the formulas necessary to make a 10 factor angle gauge. Students will then make a simple angle gauge using a coin and a piece of string. (The choice of coin will depend on the arm length of the student.) Students will then go into the forest and estimate the basal area per acre using their angle gauge. Student estimates can be compared with the estimates obtained by other students, estimates obtained using the Biltmore stick with the fixed radius plots that were obtained in the morning.

There will also be some discussion of how to measure heights of trees, and the Biltmore sticks will be modified to include the marks necessary for doing this. Students will then return to the forest and use various methods to estimate the heights of trees. The data they collect can then be used to estimate volumes of trees. (Depending on time and interest, there are a number of different formulas that could be discussed, some of which give a very nice application of calculus.)

Sunday, April 7, 2013

9:00 - 11:00; We will begin with a discussion of population estimation. First we will discuss the Capture/Recapture procedure. Following a discussion of the mathematics involved, students will use the procedure to estimate the number of beans in a container, as well as discussion (and demonstration) of how this can be simulated using Excel. This will be followed by discussion of the catch per effort method. After working out the mathematics, we will do a simulation using beans. The procedure involves using linear regression, and students will see how to do this on the TI calculator.

11:00 - 1:00; We will begin with a discussion of how to find the area of a plot of land from the legal description. This will include discussion of the double meridian distance method and why the method works. Students will then use the method to compute the areas of some plots of land from the actual legal description. Additional topics from land surveying will be discussed.

2:00 - 3:30; We will discuss how the law of cosines can be used to estimate distances that cannot be measured directly (such as the distance between two points on opposite sides of a lake. Students will then go into the field and try to use the method to compute the distance between two posts. They can then compare their results with the known distance.

3:30 - 5:30; Additional topics depending on time and interest. One possibility would be a discussion of the mathematics to estimate properties of downed woody debris using an angle gauge similar to that used to estimate basal area per acre. A second possibility is a discussion of the SAK (sex, age, kill) method used by the Wisconsin DNR to estimate deer populations.