Oregon State University

College of Forestry

FOR 524 - Forest Biometrics (CRN # 36264), 2010

Time and Place:	Lectures: T, R 12:00 – 13:10, Peavy 224
Instructors:	Temesgen Hailemariam, Associate Prof. in Forest Biometrics and Measurements, Peavy 233, Tel. 737-8549
	Don L Stevens, Jr., Prof. in Statistics, Department of Statistics, Kidder 8, 737-2239
Office hours:	T, 2:30 -4:30 PM or by appointment

Course Description and rationale

FOR 524 (3) is an advanced course in forest biometrics for graduate students in Forest Management, Forest Engineering, Forest Sciences, and Natural Resources majors. The course focuses on principles of statistical sampling, alternative estimators of population parameters, the precision of such estimates, and the basis for inference in survey sampling. The scope includes equal and unequal probability sampling techniques; inference in the presence of missing data; methods used to adjust edge effect bias and handle non-sampling errors.

To manage forest resources sustainably, practitioners must know the quality and quantity of resources and their changes over time. Forest biometrics provides information that supports forest management decisions at tree, stand, and forest levels. Although the general topic of the course focuses on quantitative analysis of forest vegetation, we will spend considerable time and effort on measuring other forest resources (e.g., wildlife habitat resources and riparian zones). Certainly, the theories and methods discussed in this course apply to other renewable resources.

Prerequisite

FOR 321, ST 511 or equivalent courses - a familiarity with the precepts and vernacular of probability sampling or statistics is presumed.

Course Structure and Organization

FOR 524 is a lecture-lab course with two 70-minute lectures per week and one 2-hour biweekly lab. The course will be both theoretical and practical, with major emphasis on application of sampling techniques to support natural resource management. To provide students with an overview of recent research, readings are derived from the current literature, and a list of recommended reading will be provided.

Expected Learning Outcomes

Upon completion of this course, students should be able to:

1. Describe the importance of statistical sampling and analysis in natural resource management,
2. Describe several of the "well known" sampling methods, and conditions and situations where each is appropriate,
3. Design and evaluate efficient forest inventory and sampling strategy based on knowledge of a population and variable of interest, and
4. Analyze data collected from common sample survey designs and interpret resulting information.

Tentative Course Topics and Schedule

Week	Topic
1	Basics of probability sampling and sampling distributions Simple Random Sampling
2	Systematic Sampling and Stratified Sampling Sample Size Estimation and Allocation
3	Unequal probability sampling: Hansen-Hurwitz and Horvitz-Thompson estimators Sampling on continuous domains
4	Spatial sampling Structuring a sample through space & time
5	Theory and Applications of Cluster Sampling Fixed Area/Variable Radius Plot sampling
6	*Mid-Term Exam* Ratio/Regression Estimation Double (Two-phase) sampling
7	Multi-stage Sampling 3-P Sampling Theory and Applications

8 *Topics as time permits*

Line Intersect Sampling

Boundary overlap and edge effects

9 Large scale forest inventory and monitoring

Missing data in forestry - Weighting and Imputation methods

10 Summary and wrap-up

Student-lead presentations

Textbooks:
Recommended:

1) Thompson, S. K. 2002. Sampling. 2nd edition. John Wiley & Sons, NY. 367 p.
2) Lohr, S.L. 1999. Sampling: Design and Analysis. Duxbury, Pacific Grove, CA. 494 p.
3) Shiver, B.D. and B.E. Borders. 1996. Sampling Techniques for Forest Resource Inventory. John Wiley & Sons, NY. 356 p.
4) Schreuder, H.T., T. G. Gregoire, and G. B. Wood. 19993. Sampling Methods for Multiresource Forest Inventory. John Wiley & Sons, NY. 446 p.
5) Gregoire, T. G. and H. T. Valentine. Sampling Strategies for Natural Resources and the Environment. Chapman & Hall/CRC. 474 p.
6) Cochran, W.G. 1977. Sampling Techniques, 3rd ed. John Wiley & Sons, NY. 428 p.

Grading

Grading will be based on five biweekly assignments, a project, a midterm, and a final exam. To complete assignments and projects, you are encouraged to use spreadsheet and/or statistical software packages. Although for survey sampling I advocate the use of SAS, students can choose any statistical packages (e.g., SPSS, Systat, S+ or R (www.r-project.org)) available to them. All assignments will have the same weight and will be graded on a percentile bases. The relative weights of the course components are:

Assignments	30%
Project and presentation	30%
Mid-Term Exam	10%
Final Exam	30%

Assignments must be completed and submitted by the specified due dates.

Rules of Conduct

The honor system at OSU will be in effect at all times. Details on university guidelines for student conduct can be found at:
http://catalog.oregonstate.edu/ChapterDetail.aspx?key=75#Section2883

FOR 524 Class Project

The purpose of the final research project is to give you some experience in 1) using the knowledge that you have gained from the course, 2) synthesizing the current body of literature, and 3) conducting analysis (e.g., design effect, Monte Carlo analysis, imputation, estimation) that informs your own research. Each student will select a research question that requires analysis or synthesis of a selected method and write a research paper presenting the results. The project can be one of the following types:

1. The description of a sampling design, including all the steps as given in the introduction of this course, for a new survey that you plan to conduct.

2. The description of a sampling design not covered in the course, or the description of an extension of a design covered in the course.

3. Analysis of existing sample data and a discussion about how the sampling design might be improved for future use.

4. Selected analysis technique - Monte Carlo analysis, simulation or imputation.

The project should be not more than seven pages (typewritten, double-spaced, single sided). A preliminary presentation of your project will be required in the last week of classes (25 to 30 minutes). The comments made in class will be used to improve your research paper. The final project write-up must be in report format, complete with a title page, introduction, methods, results, and conclusion. The final report for your project will be due on March 12, at 5:00 PM, 2010.

Additional class project topics include:

1. Sampling for rare items or occurrences
2. Adaptive (cluster) sampling designs
3. Theory and applications of sampling with partial replacement
4. Forest inventory updating techniques
5. Sampling with airborne lasers for regional or small area estimation
6. Regeneration and residue surveys, forest floor sampling/fuel loading
7. Plot/boundary overlap (edge effect bias)
8. Sampling in riparian zones
9. Randomized branch sampling and importance sampling, and related Monte Carlo methods
10. Imputation and classification techniques
11. Re-sampling methods - jackknifing/boot strapping techniques
12. Sampling methods to estimate tree-level attributes (e.g., biomass, taper)

13. Design and implementation of forest inventory/wildlife habitat analysis
14. Post-stratification and weight adjustment
15. Theory and applications of sequential sampling
16. Model-assisted sampling
17. Stand growth estimators and critical height sampling
18. Sampling spatial population, distance sampling.
19. Sample size considerations for multi-level surveys in forestry
20. Sampling to examine map accuracy and/or spatial variability, etc