FOREST AND RANGELAND STEWARDSHIP
COLORADO STATE UNIVERSITY

NR421: Natural Resource Sampling

COURSE SYLLABUS

Department of Forest and Rangeland Stewardship
Warner College of Natural Resources

	Instructor	Teaching Assistants	
Name:	Wade Tinkham	Matthew Creasy &	Neal Swayze
Office:	Forestry 126e	Forestry 126a	Forestry 126a
E-Mail:	Wade.Tinkham@colostate.edu	Matthew.Creasy@colostate.edu	Neal.Swayze@colostate.edu
Office Hours:	MW 8-8:50 am or by appointment	Wed 10-noon or by appointment	

Term:	Spring 2019	**Lecture Meeting Hours:**	9-9:50 or 10-10:50
Lecture Days:	MWF	**Lecture Location:**	Military Sciences 201

Course Overview

This course provides an overview of the theory, principals, and process involved in collecting, processing, and interpreting sampling data of natural resources. This is intended to provide an understanding of the sampling designs and statistical approaches commonly implemented within natural resource management. It primarily focuses on the statistics and theory of natural resources and management sampling, including topics such as simple random sampling, stratified random sampling, systematic sampling, cluster sampling, and multiphase sampling. A major objective of the course is not only for students to learn the basics of sampling design but instill the importance of appropriate designs and what they mean for the standard error of the mean. The course will reinforce these principals through a term project, were students will develop, implement, analyze, and report on a natural resource survey.

Course Goals and Objectives

This course should enable students with the following skills and knowledge:

1. Students should be able to *rephrase* the importance of the Law of Large Numbers and Central Limit Theorem to probability based sampling.
2. Students should be able to *interpret* how steps within the Survey Process fit together and how this is utilized in broader natural resource monitoring.
3. Students should be able to *discuss* and *justify* different approaches to determining sample size.
4. Students should be able to *describe* the structure and limitations of common sampling designs (i.e. simple random sampling, stratified random sampling, cluster sampling, and unequal probability sampling).
5. Students should be able to *evaluate* and *justify* the use of different types of multiphase sampling.
6. Students will *demonstrate* the ability to analyze datasets collected using common sampling designs.
7. Students should be able to *articulate* the results of a natural resource survey through written and visual presentation.

Course Prerequisites

ST301 (Introduction to Statistics) or equivalent and NR220 (Natural Resources Ecology and Measurements)

Required Texts and Materials

- Text: Scheaffer, Mendenhall, Ott, and Gerow. 2011 Elementary Survey Sampling (6th or 7th editions will suffice). Durbury Press.
- Scientific Calculator

Library & Research Help

The CSU Libraries Help Desk provides basic research and technical assistance either in person at Morgan Library or by phone at 970-491-1841. Virtual assistance is also available via the Libraries' Ask Us chat and email services (http://lib.colostate.edu/help/ask-us). Jocelyn Boice is the librarian supporting the Forest and Rangeland Stewardship Department and this course. Contact her for in-depth assistance at: jocelyn.boice@colostate.edu or 970-491-3882.

Important Dates to Remember

Project Proposal:	Fri, Mar. 8, 2019 by 5:00 pm
Exam 1:	Wed, Mar. 13, 2019
Spring Break:	Sat, Mar. 16, 2019 – Sun, Mar. 24, 2019
Project Update Memo:	Fri, Apr. 12, 2019 by 5:00 pm
Exam 2:	Wed, Apr. 24, 2019
Project Poster:	Tue, Apr. 30, 2019 by midnight
Project Report:	Fri, May 3, 2019 by 5:00 pm
Final Examination:	Sect 1 - Tue, May 14, 2019, 7:30 am – 9:30 am
	Sect 2 - Thur, May 16, 2019, 4:10 pm – 6:10 pm

A complete schedule is available at the end of the syllabus and on the Canvas homepage.

Assignments

Assignments consist of numerical interpretation, data analysis, and critical thought exercises. Students are encouraged to work together, but all work handed in must be your own. You are required to report your final answers on the homework sheet and show all work on a separate sheet in an organized and as neat a fashion as possible, *Credit will only be awarded if students show their work and doing so allows for partial credit.* Part of showing your work will include turning in two copies of any work performed in Excel, one with the values displayed and another with the formulas displayed. Without this formulas page we will not be able to provide partial credit. Be sure to double check your answer for proper units and to determine if your answer is reasonable, failing to label units will result in a 50% deduction on the question.

Each assignment will be available on the course website and should be handed in by the assigned time on Canvas. The lowest graded assignments will be dropped from your final grade (*we all have bad weeks*). Written answers are encouraged to be typed and turned in on a separate piece of paper. Any typed answers must use Times New Roman 12 pt font, 1 inch margins, and at least 1.5 line spacing.

Project and Poster Presentation

The course will develop the skills needed for students to complete an independent sampling practicum. This practicum will require students to perform a preliminary evaluation from a site visit or previously collected data in order to determine the most feasible, rigorous, and statistically viable approach of sampling the population they define with appropriate management objectives in mind. This will be formalized in a sampling proposal that should include information on the number, type, and protocols that will be used to locate and collect sample units. You must justify the techniques that you use in terms of both efficiency and statistical rigor. Then students will conduct their proposed inventory and generate a memo to update the client on their progress and any issues that arise. This will be followed up by a formal report that summarizes the current conditions of the population in question and makes suggestions as to appropriate management actions to achieve the relevant management objectives. The finalized survey will be analyzed and presented as both a term paper and poster. A large component of this project will be evaluated based on your ability to use technical writing to convey statistical concepts.

Exams

The two mid-term exams will be a combination of short answer, multiple choice, True/False, and matching, with 2-4 simplified quantitative questions. These are designed to assess your understanding of key course concepts and your critical thinking ability.

Basis for Final Grade

Assessment	Percent of Final Grade
Assignments (8/9)	400
Exams (2)	250
Project Proposal	50
Project Memo	50
Project Poster	50
Project Report	100
Final Exam	100
	1000

Letter grade assignment will be based on: A: 900-1000, B: 800-899, C: 70-799, D: 60-699, F: < 600 points.

Course Policies

Late Work Policy

All late assignments will receive a **20% deduction** in credit for one week, after which the late assignment will not be accepted for credit. Students must notify the instructors at least 1 week before missing an assignment, report, quiz, or exam, or they will not be allowed to make it up.

Extra Credit Policy

Extra credit will be available through in class example questions and questions related to assigned readings. You may earn a maximum of **50 points extra credit**, but it will only count toward your overall course grade if you earn a passing grade in the course. Meaning you can use it to improve your grade but not to simply pass the class, this is because you must first demonstrate a certain level of mastery of the material.

Final Exam Policy

Final examination week is part of the regular semester. Student attendance shall be consistent with University policy.

If a student has three or more final examinations (not classes) scheduled for the same day or if conflicts of examination times occur, the student may negotiate a time change with the instructors involved. If the parties involved cannot find a mutually agreeable time, the Registrar's Office indicates which courses must be changed. **Note:** The Registrar's Office must be notified at least one week prior to Final Examination Week to allow instructors time to make appropriate accommodations. It is the student's responsibility to initiate negotiations.

Any student who has a conflict with the examination schedule must inform the instructor as soon as possible before the examination. If an agreement cannot be reached between the instructor and student as to the appropriateness of a make-up examination the student should appeal to the department head.
http://www.registrar.colostate.edu/final-exams

Professionalism Policy

Per university policy and classroom etiquette; mobile phones and electronic devices **must be silenced** during all classroom and lab sessions. Those not heeding this rule will be asked to leave the classroom/lab immediately so as to not disrupt the learning environment. Please arrive on time for all class meetings. Students who habitually disturb the class by talking, arriving late, *etc*., and have been warned may suffer a reduction in their final class grade. When emailing the instructor or TA, please do so in a professional manner by including a salutation, complete sentences, and your full name, CSU ID, and the course number in your email.

Academic Integrity

The Department of Forest and Rangeland Stewardship takes academic integrity seriously. At minimum, academic integrity means that no one will use another's work as their own. The CSU writing center defines plagiarism this way:

Plagiarism is the unauthorized or unacknowledged use of another person's academic or scholarly work. Done on purpose, it is cheating. Done accidentally, it is no less serious. Regardless of how it occurs, plagiarism is a theft of intellectual property and a violation of an ironclad rule demanding "credit be given where credit is due."

Source: (Writing Guides: Understanding Plagiarism. http://writing.colostate.edu/guides/guide.cfm?guideid=17)

If you plagiarize in your work you could lose credit for the plagiarized work, fail the assignment, or fail the course. Each instance of plagiarism, classroom cheating, and other types of academic dishonesty will be addressed according to the principles published in the CSU General Catalog (under "Academic Integrity/Misconduct: http://catalog.colostate.edu/general-catalog/policies/students-responsibilities/ .)

Of course, academic integrity means more than just avoiding plagiarism. It also involves doing your own reading and studying. It includes regular class attendance, careful consideration of all class materials, and engagement with the class and your fellow students. Academic integrity lies at the core of our common goal: to create an intellectually honest and rigorous community. Because academic integrity, and the personal and social integrity of which academic integrity is an integral part, is so central to our mission as students, teachers, scholars, and citizens, we will ask to you sign the CSU Honor Pledge as part of completing all of our major assignments. While you will not be required to sign the honor pledge, we will ask each of you to write and sign the following statement on your papers and exams:

> "I have not given, received, or used any unauthorized assistance."

Grades of "Incomplete"
Per university policy, an instructor may assign temporary grade of Incomplete to a student who demonstrates that he or she could not complete the requirements of the course due to circumstances beyond the student's control and not reasonably foreseeable. A student must be passing a course at the time that an Incomplete is requested unless the instructor determines that there are extenuating circumstances to assign an Incomplete to a student who is not passing the course. When an instructor assigns an Incomplete, he or she shall specify in writing using the Department Incomplete Grade Form the requirements the student shall fulfill to complete the course as well as the reasons for granting an Incomplete when the student is not passing the course. The instructor shall retain a copy of this statement in his or her grade records and provide copies to the student and the department head or his or her designee. (Section I.6 of the Academic Faculty and Administrative Professional Manual)

Disability Access
Colorado State University is committed to providing reasonable accommodations for all persons with disabilities. Students with disabilities who need accommodations must first contact Resources for Disabled Students before requesting accommodations from the professor. Resources for Disabled Students (RDS; http://rds.colostate.edu/home) is located in room 100 of the General Services Building. Their phone is (970) 491-6385 (V/TDD). Students who need accommodations in this course must contact the professor at the beginning of the semester to discuss needed accommodations.

Attendance Policy
Students must inform the instructors prior to any anticipated absence and take the initiative to make up missed work in a timely fashion. In the event of a conflict in regard to this policy, individuals may appeal using established University procedures. University-sanctioned activities include competitions, events and professional meetings in which students are officially representing the institution. Appropriate sanctioned activities include:

a. Intercollegiate athletics;
b. Collegiate club sports and competitions;
c. Conferences and workshops recognized by the University not related to academics;
d. Commitments on behalf of the University (ASCSU, band, etc.); and
e. Professional activities recognized by the University related to academics.

Department heads or their designated representatives must approve sanctioned professional and departmental activities. Other sanctioned activities must be approved by the appropriate program director on record with the Division of Student Affairs offices or the Department of Athletics.

Religious Accommodation
Participation in official University activities, e.g., an out-of-town athletic event, or special religious observances may provide a legitimate reason for an excused absence. The student is responsible for discussing this with the instructor at the beginning of the semester.

Title IX Information
CSU's Student Sexual Harassment and Violence policy, following national guidance from the Office of Civil Rights, requires that faculty follow CSU policy as a "mandatory reporter" of any personal disclosure of sexual harassment, abuse, and/or violence related experiences or incidents shared with the faculty member in person, via email, and/or in classroom papers or homework exercises. These disclosures include but are not limited to reports of personal relational abuse, relational/domestic violence, and stalking. While faculty are often able to help students locate appropriate channels of assistance on campus (e.g., see the CSU Health Network link below), disclosure by the student to the faculty member requires that the faculty member inform appropriate CSU channels to help ensure that the student's safety and welfare is being addressed, even if the student requests that the disclosure not be shared.

For counseling support and assistance, please see the CSU Health Network, which includes a variety of counseling services that can be accessed at: http://www.health.colostate.edu/. And, the Sexual Assault Victim Assistance Team is a confidential resource for students that does not have a reporting requirement and that can be of great help to students who have experienced sexual assault. The web address is http://www.wgac.colostate.edu/need-help-support.
Source: http://oeo.colostate.edu/title-ix-sexual-assault

Non-Discrimination Statement

Colorado State University does not discriminate on the basis of race, age, creed, color, religion, national origin or ancestry, sex, gender, disability, veteran status, genetic information, sexual orientation, gender identity or expression, or pregnancy. The University complies with the Civil Rights Act of 1964, as amended, related Executive Orders 11246 and 11375, Title IX of the Education Amendments Act of 1972, Sections 503 and 504 of the Rehabilitation Act of 1973, Section 402 of the Vietnam Era Veterans' Readjustment Assistance Act of 1974, as amended, the Age Discrimination in Employment Act of 1967, as amended, The Pregnancy Discrimination Act of 1978, Americans with Disabilities Act of 1990, the Civil Rights Act of 1991, the ADA Amendments Act of 2008, the Genetic Information Nondiscrimination Act of 2008, and all civil rights laws of the State of Colorado. Accordingly, equal opportunity of employment and admission shall be extended to all persons. The University shall promote equal opportunity and treatment in employment through a positive and continuing affirmative action program for ethnic minorities, women, persons with disabilities, and veterans. The Office of Equal Opportunity is located in 101 Student Services. Source: http://oeo.colostate.edu/non-discrimination-statement

Sample Designs and Related Topics

I. Characteristics of Biological Populations
- Small scale vs. large-scale patterns
- Mobile vs. stationary populations

II. Sampling Biological Populations
- Decision making process (Objective of survey sampling)
- Characterizing a Population Using Sample Data
- Graphical (Spatial vs. Non-spatial)
- Numerical (Spatial vs. Non-spatial)
- Central Limit Theorem

III. Statistical Distributions
- Binomial distribution
- Poisson distribution
- Normal distribution
- t-distribution

IV. Statistical Inferences (Parametric and nonparametric)
- Comparison of sample means
- Comparison of sample variances

V. Sampling Units

VI. Simple Random Sampling

VII. Spatial Patterns of Biological Populations

VIII. Stratified Random Sampling

IX. Systematic Sampling

XI. Multiphase Sampling
- Ratio estimators
- Regression estimators

X. Cluster Sampling

XII. Monitoring

Course Schedule *All dates are tentative depending on the pace of the class.*

	Lecture Topics	Readings	Important Dates
Week 1 (Jan. 22-25)	Course Overview & Numbers in Natural Resources		
Week 2 (Jan. 28-Feb. 1)	Foundations of Natural Resource Sampling Monitoring Made Sensible	Chapter 2 & 3 *Statistics for Practical People*	
Week 3 (Feb. 4-8)	Statistics Demystified Review of Sample Types	*Distributions, Standard Deviations, & Confidence*	
Week 4 (Feb. 11-15)	Simple Random Sampling	Chapter 4	Assignment 1 Due Feb 11
Week 5 (Feb. 18-22)	Sample Size Estimation		
Week 6 (Feb. 25-Mar. 1)	Systematic Sampling	Chapter 7 Chapman - "Plot Spacing"	Assignment 2 Due Feb 25
Week 7 (Mar. 4-8)	Stratified Sampling	Chapter 5	Assignment 3 Due Mar 4 Project Proposal Due Mar 8
Week 8 (Mar. 11-15)	**Exam 1** (Wednesday)		Assignment 4 Due Mar 15
(Mar. 18-22)	**Spring Break**		
Week 9 (Mar. 25-29)	Exam 1 critique Double Sampling	Chapter 6	
Week 10 (Apr. 1-5)	Double Sampling continued	Chapter 6 Iles – "BigBAF Sampling"	Assignment 5 Due Apr 1
Week 11 (Apr. 8-12)	Cluster Sampling	Chapter 8	Assignment 6 Due Apr 8 Project Memo Due Apr 12
Week 12 (Apr. 15-19)	Cluster Sampling continued Monitoring		Assignment 7 Due Apr 17
Week 13 (Apr. 22-26)	Exam Review **Exam 2** (Wednesday) Developing Objectives		Assignment 8 Due Apr 26
Week 14 (Apr. 29-May 3)	(Possible Guest Lecture) Poster Presentations		Project Poster Due Apr 30 Project Report Due May 3 Extra Credit Assign. Due May 3
Week 15 (May 6-10)	Other Things and Stuff		Assignment 9 Due May 8
Week 16 (May 13-17)	**Final Exam –**	**Section 1 – May 14th 7:30 am – 9:30 am** **Section 2 – May 16th 4:10 am – 6:10 am**	

All assignments are due at the start of class unless otherwise stated on Canvas.