MATHEMATICS AND STATISTICS (Div III)

STATISTICS

Chair: Professor Richard De Veaux

Associate Chair for Math: Professor Mihai Stoiciu


On leave fall/spring: P. Harris, B. Klingenberg, S. Loepp, R. Morrison, C. Silva, L. Tupper, D. Turek

On leave fall only: L. Goldmakher, S. Johnson, C. Topaz

MAJOR IN STATISTICS

The major in Statistics is designed to meet three goals: to introduce some of the central ideas of information and data science, to develop problem-solving ability by teaching students to combine creative thinking with rigorous reasoning, and to develop interdisciplinary skills by applying statistics to an application area of interest.

REQUIREMENTS (10 courses plus colloquium)

The major in Statistics consists of ten courses plus a colloquium requirement. The major includes courses in mathematics, computer science and statistics. Students interested in continuing their study of statistics in graduate school should strongly consider taking Math 350/351 in addition to the other requirements.

Mathematics (2 courses)

- MATH 150 or 151 Multivariable Calculus or equivalent high school course
- MATH 250 Linear Algebra

Except in unusual circumstances, students planning to major in statistics should complete the calculus sequence (MATH 130, 140, 150/151) before the spring of the sophomore year, at the latest. MATH 150 is a prerequisite for STAT 201 and MATH 250 is a prerequisite for STAT 346.

Computer Science (1 course)

CSCI 134 Intro to Computer Science or CSCI 135 Diving into the Deluge of Data or CSCI 136 Data Structures and Advanced Programming or some other course in the Computer Science Department with prior approval of the Math/Stat department.

Core Courses (4 courses)

- STAT 201 Statistics and Data Analysis or STAT 202 Introduction to Statistical Modeling
- STAT 346 Regression and Forecasting
- STAT 341 Probability
- STAT 360 Inferential Statistics

Continuation (2 courses)

Any two courses among the 300 or 400 level courses in the department with a STAT prefix.

Capstone Course (1 course)

The capstone course is a 400-level STAT course taken in the senior year. Although the specific methodological emphasis of the course may vary from year to year, an in-depth project with both a written report and an oral presentation is typically part of the capstone course.

Colloquium Requirement

Participation in the Department Colloquium, in which each senior major presents a talk on a mathematical or statistical topic of their choice. Each major must also attend at least 20 colloquia, and up to 5 attendances may be counted in their junior year. Students engaged in study away may petition the department in advance to count up to 5 suitable colloquia attendances from their study away program.

PLACEMENT

Students with an AP Stat score of 5 or 4 are placed in the advanced introductory course Stat 202.

NOTES
Substitutions, Study Abroad, and Transfer Credit: In some cases, and with prior permission of the Mathematics and Statistics Department, appropriate courses from other institutions may be substituted for the application and continuation requirements, but at least eight courses must be taken from the Department of Mathematics and Statistics at Williams.

These can, with prior permission, include courses taken away. Students with transfer credit should contact the department about special arrangements.

Double Counting: No course may count towards two different majors.

Early Senior Capstone Course: In exceptional circumstances, with the prior permission of the department, a student may be allowed to satisfy the Senior Capstone Course requirement in the junior year, provided that the student has completed at least three 300-level statistics courses before enrolling in the capstone course.

Planning Courses: Core courses are normally offered every year. Other 300 and 400 level statistics courses are offered on an irregular basis. Students should check with the department before planning far into the future.

Course Admission: Courses are normally open to all students meeting the prerequisites, subject to any course caps. Students with questions about the level at which courses are conducted are invited to consult department faculty.

FAQ

Students MUST contact departments/programs BEFORE assuming study away credit will be granted toward the major or concentration.

Can your department or program typically pre-approve courses for major/concentration credit?

Yes, in many cases, though students should be sure to contact the department.

What criteria will typically be used/required to determine whether a student may receive major/concentration credit for a course taken while on study away?

Course title and description, and complete syllabus including readings/assignments.

Does your department/program place restrictions on the number of major/concentration credits that a student might earn through study away?

No.

Does your department/program place restrictions on the types of courses that can be awarded credit towards your major?

Yes. They have to be approved MATH/STAT courses.

Are there specific major requirements that cannot be fulfilled while on study away?

Yes. Colloquium requirement, Senior Seminar requirement.

Are there specific major requirements in your department/program that students should be particularly aware of when weighing study away options? (Some examples might include a required course that is always taught in one semester, laboratory requirements.)

Yes. The highly cumulative structure of the major.

Give examples in which students thought or assumed that courses taken away would count toward the major or concentration and then learned they wouldn’t:

None to date.

THE DEGREE WITH HONORS IN STATISTICS

The degree with honors in Statistics is awarded to the student who has demonstrated outstanding intellectual achievement in a program of study which extends beyond the requirements of the major. The principal considerations for recommending a student for the degree with honors will be: Mastery of core material and skills, breadth and, particularly, depth of knowledge beyond the core material, ability to pursue independent study of statistics, originality in methods of investigation, and, where appropriate, creativity in research.

An honors program normally consists of two semesters (STAT 493 and 494) and a winter study (WSP 031) of independent research, culminating in a thesis and a presentation. One of STAT 493 or STAT 494 can count as a continuation course, but not both. Neither counts as the 400-level senior capstone course.

An honors program in actuarial studies requires significant achievement on four appropriate examinations of the Society of Actuaries.

Highest honors will be reserved for the rare student who has displayed exceptional ability, achievement or originality. Such a student usually will have written a thesis or pursued actuarial honors. In all cases, the award of honors and highest honors is the decision of the Department.
STAT 101  (F)(S)  Elementary Statistics and Data Analysis  (QFR)
It is impossible to be an informed citizen in the world today without an understanding of data and information. Whether opinion polls, unemployment rates, salary differences between men and women, the efficacy of vaccines or consumer webdata, we need to be able to separate the signal from the noise. We will learn the statistical methods used to analyze and interpret data from a wide variety of sources. The goal of the course is to help reach conclusions and make informed decisions based on data.

Requirements/Evaluation: quizzes and exams
Prerequisites: MATH 102 (or demonstrated proficiency on a diagnostic test)
Enrollment Limit: 50
Expected Class Size: 40
Grading: no pass/fail option, no fifth course option
Unit Notes: students with calculus background and social science interest should consider STAT 161; students with MATH 150 should enroll in STAT 201; students with a 5 on AP Stats should enroll in STAT 202; students with a 4 on AP Stat should consult the department
Distributions: (D3)  (QFR)
Attributes: BIGP Recommended Courses  COGS Related Courses  PHLH Statistics Courses

Fall 2019
LEC Section: 01  TF 2:35 pm - 3:50 pm  Elizabeth M. Upton

Spring 2020
LEC Section: 01  TR 9:55 am - 11:10 am  Elizabeth M. Upton
LEC Section: 02  TR 11:20 am - 12:35 pm  Elizabeth M. Upton

STAT 161  (F)(S)  Introductory Statistics for Social Science  (QFR)
This course will cover the basics of modern statistical analysis with a view toward applications in the social sciences and sciences. Topics include exploratory data analysis, elements of probability theory, basic statistical inference, and introduction to statistical modeling. The course focuses on the application of statistics tools to solve problems, to make decisions, and the use of statistical thinking to understand the world.

Prerequisites: MATH 130 (or equivalent); not open to students who have completed STAT 101 or equivalent
Enrollment Limit: 40
Enrollment Preferences: Economics majors, sophomores
Expected Class Size: 40
Grading: no pass/fail option, no fifth course option
Unit Notes: students with MATH 150 should consider STAT 201; students with a 5 on AP Stats should enroll in STAT 202; students with a 4 on AP Stats should consult the department; students without any calculus background should consider STAT 101
Distributions: (D3)  (QFR)
Quantative/Formal Reasoning Notes: It is a quantitative course.
Attributes: PHLH Statistics Courses

Fall 2019
LEC Section: 01  TR 8:30 am - 9:45 am  Anna M. Plantinga

Spring 2020
LEC Section: 01  TF 1:10 pm - 2:25 pm  Anna M. Plantinga
LEC Section: 02  TF 2:35 pm - 3:50 pm  Anna M. Plantinga

STAT 201  (F)(S)  Statistics and Data Analysis  (QFR)
Statistics can be viewed as the art and science of turning data into information. Real world decision-making, whether in business or science is often based on data and the perceived information it contains. Sherlock Holmes, when prematurely asked the merits of a case by Dr. Watson, snapped back, “Data, data, data! I can’t make bricks without clay.” In this course, we will study the basic methods by which statisticians attempt to extract
information from data. These will include many of the standard tools of statistical inference such as hypothesis testing, confidence intervals, and linear regression as well as exploratory and graphical data analysis techniques. This is an accelerated introductory statistics course that involves computational programming and incorporates modern statistical techniques.

Requirements/Evaluation: quizzes and exams
Prerequisites: MATH 150 or equivalent; not open to students who have completed STAT 101 or STAT 161 or equivalent
Enrollment Limit: 40
Expected Class Size: 40
Grading: yes pass/fail option, yes fifth course option
Unit Notes: students with a 5 on AP Stats should enroll in STAT 202; students with a 4 on AP Stats should consult the department; students with MATH 130/140 background should consider STAT 161; students with no calc. should consider STAT 101
Distributions: (D3) (QFR)
Attributes: BIGP Recommended Courses COGS Related Courses EVST Methods Courses PHLH Statistics Courses

Fall 2019
LEC Section: 01 TR 9:55 am - 11:10 am Shaoyang Ning
LEC Section: 02 TR 11:20 am - 12:35 pm Shaoyang Ning

Spring 2020
LEC Section: 01 TR 8:30 am - 9:45 am Stewart D. Johnson
LEC Section: 02 TR 9:55 am - 11:10 am Stewart D. Johnson

STAT 202 (F)(S) Introduction to Statistical Modeling (QFR)
Data come from a variety of sources sometimes from planned experiments or designed surveys, but also arise by much less organized means. In this course we'll explore the kinds of models and predictions that we can make from both kinds of data as well as design aspects of collecting data. We'll focus on model building, especially multiple regression, and talk about its potential as well as its limits to answer questions about the world. We'll emphasize applications over theory and analyze real data sets throughout the course.

Requirements/Evaluation: homework, exams and projects
Prerequisites: AP Statistics 5 or STAT 101; 161 or 201 or permission of instructor
Enrollment Limit: 25
Expected Class Size: 20
Grading: no pass/fail option, no fifth course option
Unit Notes: students with a 4 on the AP Stats exam should contact the department for proper placement
Distributions: (D3) (QFR)
Attributes: EVST Methods Courses PHLH Statistics Courses

Fall 2019
LEC Section: 01 MWF 9:00 am - 9:50 am Xizhen Cai
LEC Section: 02 MWF 10:00 am - 10:50 am Xizhen Cai

Spring 2020
LEC Section: 01 MWF 11:00 am - 11:50 am Xizhen Cai

STAT 341 (F)(S) Probability (QFR)
Cross-listings: MATH 341 STAT 341
Secondary Cross-listing
While probability began with a study of games, it has grown to become a discipline with numerous applications throughout mathematics and the sciences. Drawing on gaming examples for motivation, this course will present axiomatic and mathematical aspects of probability. Included will be
discussions of random variables, expectation, independence, laws of large numbers, and the Central Limit Theorem. Many interesting and important applications will also be presented, potentially including some from coding theory, number theory and nuclear physics.

Requirements/Evaluation: homework, classwork, and exams
Prerequisites: MATH 250 or permission of the instructor
Enrollment Limit: 40
Expected Class Size: 20
Grading: yes pass/fail option, yes fifth course option
Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:
MATH 341 (D3) STAT 341 (D3)

Fall 2019
LEC Section: 01  MWF 11:00 am - 11:50 am  Steven J. Miller

Spring 2020
LEC Section: 01  TF 2:35 pm - 3:50 pm  Mihai Stoiciu

STAT 342 (F) Introduction to Stochastic Processes (QFR)
Stochastic processes are mathematical models for random phenomena evolving in time or space. Examples include the number of people in a queue at time t or the accumulated claims paid by an insurance company in an interval of time t. This course introduces the basic concepts and techniques of stochastic processes used to construct models for a variety of problems of practical interest. The theory of Markov chains will guide our discussion as we cover topics such as martingales, random walks, Poisson process, birth and death processes, and Brownian motion.

Requirements/Evaluation: weekly homework, classwork, and exams
Prerequisites: STAT 341
Enrollment Limit: 30
Enrollment Preferences: senior Statistics majors
Expected Class Size: 15
Grading: yes pass/fail option, yes fifth course option
Distributions: (D3) (QFR)
Quantative/Formal Reasoning Notes: This is a statistics class with a focus on mathematical skills and translating real world phenomena into mathematical descriptions.

Fall 2019
LEC Section: 01  TF 1:10 pm - 2:25 pm  Elizabeth M. Upton

STAT 344 (F) Statistical Design of Experiments (QFR)
What does statistics have to do with designing and carrying out experiments? The answer is, surprisingly perhaps, a great deal. In this course, we will study how to design experiments with the fewest number of observations possible that are still capable of understanding which factors influence the results. After reviewing basic statistical theory and two sample comparisons, we cover one and two-way ANOVA and (fractional) factorial designs extensively. The culmination of the course will be a project where each student designs, carries out, analyzes, and presents an experiment of interest to him or her. Throughout the course, we will use both the statistics program R and the package JMP to carry out the statistical analyses.

Requirements/Evaluation: problem sets, midterm, final exam, project
Prerequisites: STAT 201, 202, or equivalent
Enrollment Limit: 20
Enrollment Preferences: Statistics majors, seniors
Expected Class Size: 15
Grading: no pass/fail option, no fifth course option
Distributions: (D3) (QFR)
Attributes: COGS Related Courses
Not offered current academic year

STAT 346 (F)(S) Regression and Forecasting (QFR)
This course focuses on the building of empirical models through data in order to predict, explain, and interpret scientific phenomena. Regression modeling is the standard method for analyzing continuous response data and their relationship with explanatory variables. This course provides both theoretical and practical training in statistical modeling with particular emphasis on simple linear and multiple regression, using R to develop and diagnose models. The course covers the theory of multiple regression and diagnostics from a linear algebra perspective with emphasis on the practical application of the methods to real data sets. The data sets will be taken from a wide variety of disciplines.

Requirements/Evaluation: exams, homework, and a project
Prerequisites: STAT 201 or 202, and MATH 150 and 250; or permission of instructor
Enrollment Limit: 22
Expected Class Size: 15
Grading: no pass/fail option, no fifth course option
Distributions: (D3) (QFR)
Attributes: EVST Methods Courses

Fall 2019
LEC Section: 01 MWF 8:30 am - 9:45 am Richard D. De Veaux

Spring 2020
LEC Section: 01 MWF 8:30 am - 9:45 am Xizhen Cai

STAT 355 (S) Multivariate Statistical Analysis (QFR)
To better understand complex processes, we study how variables are related to one another, and how they work in combination. Therefore, we want to make inferences about more than one variable at time? Elementary statistical methods might not apply. In this course, we study the tools and the intuition that are necessary to analyze and describe such data sets. Topics covered will include data visualization techniques for high dimensional data sets, parametric and non-parametric techniques to estimate joint distributions, techniques for combining variables, as well as classification and clustering algorithms.

Requirements/Evaluation: homework and exams
Prerequisites: MATH 250, and STAT 346 or permission of instructor
Enrollment Limit: 25
Expected Class Size: 10
Grading: yes pass/fail option, yes fifth course option
Distributions: (D3) (QFR)
Attributes: EVST Methods Courses
Not offered current academic year

STAT 356 (S) Time Series Analysis (QFR)
Time series--data collected over time--crop up in applications from economics to engineering to transit. But because the observations are generally not independent, we need special methods to investigate them. This course will include exploratory methods and modeling for time series, including smoothing, ARIMA and state space models, and a foray into the frequency domain. We will emphasize applications to a variety of real data.

Class Format: lecture
Requirements/Evaluation: evaluation will be based primarily on projects, homework, and exams
Prerequisites: STAT 346 (may be taken concurrently) or permission of instructor
Enrollment Limit: 30
Expected Class Size: 20
Grading: yes pass/fail option, yes fifth course option
Distributions: (D3) (QFR)
Not offered current academic year

STAT 359 (S) Statistical Computing (QFR)
This course introduces a variety of computational and data-centric topics of applied statistics, which are broadly useful for acquiring, manipulating, visualizing, and analyzing data. We begin with the R language, which will be used extensively throughout the course. Then we'll introduce a variety of other useful tools, including the UNIX environment, scripting analyses using bash, databases and the SQL language, alternative data formats, techniques for visualizing high-dimensional data, and text manipulation using regular expressions. We'll also cover some modern statistical techniques along the way, which are made possible thanks to advances in computational power. This course is strongly computer oriented, and assignments will be project-based.
Requirements/Evaluation: based primarily on projects, homework, and exams
Prerequisites: STAT 201 or 202 and CSCI 134, 135, or 136
Enrollment Limit: 30
Enrollment Preferences: juniors and seniors, Statistics majors
Expected Class Size: 15
Grading: yes pass/fail option, yes fifth course option
Distributions: (D3) (QFR)
Not offered current academic year

STAT 360 (S) Statistical Inference (QFR)
How do we estimate unknown parameters and express the uncertainty we have in our estimate? Is there an estimator that works best? Many topics from introductory statistics such as random variables, the central limit theorem, point and interval estimation and hypotheses testing will be revisited and put on a more rigorous mathematical footing. The focus is on maximum likelihood estimators and their properties. Bayesian and computer intensive resampling techniques (e.g., the bootstrap) will also be considered.
Class Format: lecture
Requirements/Evaluation: evaluation will be based on problem sets and exams
Prerequisites: MATH 250, STAT 201 or 202, STAT 341
Enrollment Limit: 30
Enrollment Preferences: Statistics majors
Expected Class Size: 30
Grading: no pass/fail option, yes fifth course option
Distributions: (D3) (QFR)

Spring 2020
LEC Section: 01 MR 2:35 pm - 3:50 pm Shaoyang Ning

STAT 362 (F) Design of Experiments (QFR)
How do you get informative research results? By doing the right experiment in the first place. We'll look at the techniques used to plan experiments that are both efficient and statistically sound, the analysis of the resulting data, and the conclusions we can draw from that analysis. Using a framework of optimal design, we'll examine the theory both of classical designs and of alternatives when those designs aren't appropriate. On the applied side, we'll make extensive use of R to work with real-world data.
Requirements/Evaluation: based primarily on projects, homework, and exams
Prerequisites: STAT 346
Enrollment Limit: 30
Enrollment Preferences: seniors/juniors and Statistics majors
Expected Class Size: 20
Grading: no pass/fail option, no fifth course option
Distributions: (D3) (QFR)

Not offered current academic year

STAT 365 (F) Bayesian Statistics (QFR)
The Bayesian approach to statistical inference represents a reversal of traditional (or frequentist) inference, in which data are viewed as being fixed and model parameters as unknown quantities. Interest and application of Bayesian methods have exploded in recent decades, being facilitated by recent advances in computational power. We begin with an introduction to Bayes' Theorem, the theoretical underpinning of Bayesian statistics which dates back to the 1700's, and the concepts of prior and posterior distributions, conjugacy, and closed-form Bayesian inference. Building on this, we introduce modern computational approaches to Bayesian inference, including Markov chain Monte Carlo (MCMC), Metropolis-Hastings sampling, and the theory underlying these simple and powerful methods. Students will become comfortable with modern software tools for MCMC using a variety of applied hierarchical modeling examples, and will use R for all statistical computing.

Requirements/Evaluation: homework and exams
Prerequisites: STAT 201 and MATH 150 and 250, or permission of instructor
Enrollment Limit: 30
Enrollment Preferences: juniors and seniors, Statistics majors
Expected Class Size: 10
Grading: yes pass/fail option, yes fifth course option
Distributions: (D3) (QFR)

Not offered current academic year

STAT 368 (S) Modern Nonparametric Statistics (QFR)
Many statistical procedures and tools are based on a set of assumptions, such as normality or other parametric models. But, what if some or all of these assumptions are not valid and the adopted models are miss-specified? This question leads to an active and fascinating field in modern statistics called nonparametric statistics, where few assumptions are made on data's distribution or the model structure to ensure great model flexibility and robustness. In this course, we start with a brief overview of classic rank-based tests (Wilcoxon, K-S test), and focus primarily on modern nonparametric inferential techniques, such as nonparametric density estimation, nonparametric regression, selection of smoothing parameter (cross-validation), bootstrap, randomization-based inference, clustering, and nonparametric Bayes. Throughout the semester we will examine these new methodologies and apply them on simulated and real datasets using R.

Class Format: lecture
Requirements/Evaluation: primarily on performance on exams, homework, and a project
Prerequisites: STAT 201 and STAT 346, or permission of instructor.
Enrollment Limit: 30
Enrollment Preferences: senior Statistics majors
Expected Class Size: 15
Grading: yes pass/fail option, yes fifth course option
Distributions: (D3) (QFR)
Quantitative/Formal Reasoning Notes: This is a statistics class with a focus on mathematical, computational, and data analysis skills as well as appropriate practical application of analysis methods.

Spring 2020
LEC Section: 01 TR 11:20 am - 12:35 pm Shaoyang Ning

STAT 372 (S) Longitudinal Data Analysis: Modeling Change over Time (QFR)
This course explores modern statistical methods for drawing scientific inferences from longitudinal data, i.e., data collected repeatedly on experimental units over time. The independence assumption made for most classical statistical methods does not hold with this data structure because we have multiple measurements on each individual. Topics will include linear and generalized linear models for correlated data, including marginal and random effect models, as well as computational issues and methods for fitting these models. We will consider many applications in the social and biological sciences.

**Requirements/Evaluation:** performance on exams, homework, and a project

**Prerequisites:** STAT 201 and STAT 346

**Enrollment Limit:** 30

**Enrollment Preferences:** junior and senior Statistics majors

**Expected Class Size:** 20

**Grading:** no pass/fail option, no fifth course option

**Distributions:** (D3) (QFR)

**Attributes:** PHLH Statistics Courses

Not offered current academic year

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**STAT 397 (F) Independent Study: Statistics**

Directed independent study in Statistics.

**Prerequisites:** permission of department

**Grading:** yes pass/fail option, yes fifth course option

**Distributions:** (D3)

Fall 2019

IND Section: 01  TBA  Richard D. De Veaux

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**STAT 398 (S) Independent Study: Statistics**

Directed independent study in Statistics.

**Class Format:** independent study

**Prerequisites:** permission of department

**Grading:** yes pass/fail option, yes fifth course option

**Distributions:** (D3)

Spring 2020

IND Section: 01  TBA  Richard D. De Veaux

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**STAT 410 (F) Statistical Genetics (QFR)**

Genetic studies explore patterns of genetic variation in populations and the effect of genes on diseases or traits. This course provides an introduction to statistical and computational methods for genetic studies. Topics will include Mendelian traits (such as single nucleotide polymorphisms), genome-wide association studies, pathway-based analysis, and methods for population genetics. Students will be introduced to some of the major computational tools for genetic analysis, including PLINK and R/Bioconductor. The necessary background in genetics and biology will be provided alongside the statistical and computational methods.

**Requirements/Evaluation:** project work, homework, exams, and contribution to discussion

**Prerequisites:** STAT 346 and STAT 360, or permission of instructor

**Enrollment Limit:** 14

**Enrollment Preferences:** Statistics majors, juniors and seniors

**Expected Class Size:** 10
Grading: no pass/fail option, no fifth course option
Distributions: (D3) (QFR)

Quantitative/Formal Reasoning Notes: This is a statistics class with a focus on mathematical, computational, and data analysis skills as well as appropriate practical application of analysis methods.

Attributes: BIGP Related Courses  PHLH Statistics Courses

Fall 2019
LEC Section: 01  TR 11:20 am - 12:35 pm  Anna M. Plantinga

STAT 440  (F)  Categorical Data Analysis  (QFR)
This course focuses on methods for analyzing categorical response data. In contrast to continuous data, categorical data consist of observations classified into two or more categories. Traditional tools of statistical data analysis are not designed to handle such data and pose inappropriate assumptions. We will develop methods specifically designed to address the discrete nature of the observations and consider many applications in the social and biological sciences as well as in medicine, engineering and economics. All methods can be viewed as extensions of traditional regression models and ANOVA.

Requirements/Evaluation: performance on exams, homework, and a project
Prerequisites: STAT 346 and STAT 360
Enrollment Limit: 14
Enrollment Preferences: seniors and Statistics Majors
Expected Class Size: 12
Grading: yes pass/fail option, yes fifth course option
Distributions: (D3) (QFR)
Attributes: PHLH Statistics Courses

Not offered current academic year

Spring 2020
LEC Section: 01  MWF 8:30 am - 9:45 am  Richard D. De Veaux

STAT 458  (F)  Spatio-Temporal Data  (QFR)
Everything happens somewhere and sometime. But the study of data collected over multiple times and locations requires special methods, due to the dependence structure that relates different observations. In this course, we'll look at exploring, analyzing, and modeling this kind of information--introducing standard methods for purely time-series and purely spatial data, and moving on to methods that incorporate space and time
together. Topics will include autocovariance structures, empirical orthogonal functions, and an introduction to Bayesian hierarchical modeling. We'll use R to apply these techniques to real-world datasets.

**Requirements/Evaluation:** project work, homework, exams, and contribution to discussion

**Prerequisites:** STAT 346, or permission of instructor

**Enrollment Limit:** 14

**Enrollment Preferences:** Seniors and Statistics majors

**Expected Class Size:** 10

**Grading:** no pass/fail option, no fifth course option

**Distributions:** (D3) (QFR)

**Quantitative/Formal Reasoning Notes:** This is an intensive statistics course, involving theoretical and mathematical reasoning as well as the application of mathematical ideas to data using software.

**Not offered current academic year**

**STAT 493  (F) Senior Thesis: Statistics**
Each student carries out an individual research project under the direction of a faculty member that culminates in a thesis. See description under *The Degree with Honors in Statistics.*

**Grading:** yes pass/fail option, yes fifth course option

**Distributions:** (D3)

Fall 2019

HON Section: 01  TBA  Richard D. De Veaux

**STAT 494  (S) Senior Thesis: Statistics**
Each student carries out an individual research project under the direction of a faculty member that culminates in a thesis. See description under *The Degree with Honors in Statistics.*

**Class Format:** independent study

**Grading:** yes pass/fail option, yes fifth course option

**Distributions:** (D3)

Spring 2020

HON Section: 01  TBA  Richard D. De Veaux

**STAT 497  (F) Independent Study: Statistics**
Directed independent study in Statistics.

**Prerequisites:** permission of department

**Grading:** yes pass/fail option, yes fifth course option

**Distributions:** (D3)

Fall 2019

IND Section: 01  TBA  Richard D. De Veaux

**STAT 498  (S) Independent Study: Statistics**
Directed independent study in Statistics.

**Class Format:** independent study

**Prerequisites:** permission of department
STAT 499 (F)(S) Statistics Colloquium
Statistics senior colloquium. Meets every week for an hour both fall and spring. Senior statistics majors must participate. This colloquium is in addition to the regular four semester-courses taken by all students.

Requirements/Evaluation: delivering a passing talk and participation throughout the year
Prerequisites: Statistics majors must take the colloquium in their senior year
Enrollment Limit: none
Enrollment Preferences: none
Expected Class Size: 25
Grading: non-graded
Distributions: (D3)

Winter Study -----------------------------------------------------------------------------------------------

STAT 10 (W) Interactive Data Visualization
Data visualization is an important means of detecting patterns in data and communicating results to the public. However, if designed poorly, data visualizations can also be ineffective or misleading. Tools for interactive data visualization have become increasingly popular in recent years, giving viewers more autonomy in data exploration. In this course, we will learn techniques for effective data visualization and use these criteria to evaluate visualizations (both static and interactive) in academic publications and in the news. This class will meet about 8 hours per week for lecture and discussion. In addition to participating in class discussions, students will be expected to keep a daily journal, complete short R programming exercises, and create a final project using interactive data visualization tools such as R Shiny.

Requirements/Evaluation: class participation, daily journal, final project and presentation
Prerequisites: some experience in R programming
Enrollment Limit: 15
Enrollment Preferences: preference will be given based on a one-paragraph explanation of the student's interest in the course
Grading: pass/fail only

Winter 2020
LEC Section: 01 MWF 10:00 am - 11:50 am Anna M. Plantinga

STAT 11 (W) Introduction to Statistical Analysis of Network Data
Networks are everywhere in our connected world, from social networks like facebook and twitter, to information networks like citation and coauthors, from biological network like neural and ecological networks, to technological networks like internet connection or power grids. In recent years, there has been an explosion of network data. How do we learn and represent information from these data? In this course, you will see examples from different types of networks. We will learn how to organize, visualize and describe network data using proper tools. Additionally, since things are connected in networks, we will also explore statistical methods to overcome this challenge with dependent data. Tentatively course work includes 2-3
class meetings per weeks for lectures and assignments. Students are also expected to read related materials and finish a final project.

Requirements/Evaluation: final project or presentation

Prerequisites: STAT 201 or equivalent

Enrollment Limit: 10

Enrollment Preferences: students with more statistics background and experience with R have priority

Grading: pass/fail only

Winter 2020

LEC Section: 01    MWF 10:00 am - 11:50 am     Xizhen  Cai

STAT 20 (W) The History, Geography and Economics of the Wines of France

The history of wine making in France is long, dating back to the Greeks and later the Romans. Of course, geography and climate play an essential and important role in grape growing. The first areas to be planted were the areas around present day Marseille, (Massalia in Ancient Greece) in Provence, and the areas just north farther up the Rhône river valley. We will briefly survey the history of wine in France from the Romans through the middle ages, the influence of monasteries on wine production, the impact of the French revolution and the evolution of the modern classification system in the 19th century, which is still in place today. We will look at temperature data and study the relationship between temperature change and quality. We will discuss the impact of wine “scorers” such as Robert Parker as his influence on the economics of the French wine market. Finally, we will discuss the role of wine in French cuisine and the importance of wine to French culture. SELECTED REFERENCES [1] Climate, hydrology, land use, and environmental degradation in the lower Rhone Valley during the Roman period, SE Van der Leeuw - Comptes Rendu, Geosciences, 2005, Elsevier [2] The red and the white : a history of wine in France and Italy in the nineteenth century / by Leo A. Loubère ; drawings by Mark Blanton and Philip Loubère Albany : State University of New York Press, 1978 [3] Climate Change and Global Wine Quality, Jones, G. V. White, M. A. Cooper, O. R. Stororghann, K.,Climatic Change, 2005, VOL 73; NUMBER 3, pages 319-343. [4] Wine Growers’ Syndicalism in the Languedoc: Continuity and Change, Jean Phillipe Martin, Sociologia Ruralis, 36,3,1996. [5] The Table Comes First: Family, France, and the Meaning of Food, Adam Gopnik, Knopf, 2011 (Possible required book). [6] Wine and War: The French, the Nazis, and the Battle for France's Greatest Treasure, D. Kladstrup and P. Kaldstrup , Broadway Books, 2002.

Requirements/Evaluation: 10-page paper

Prerequisites: none

Enrollment Limit: 12

Enrollment Preferences: based on short essay

Grading: pass/fail only

Materials/Lab Fee: $450 and approximately $15 for books

Winter 2020

LEC Section: 01    MWF 3:30 pm - 6:00 pm     Richard D. De Veaux

STAT 30 (W) Senior Project: Statistics

To be taken by candidates for honors in Statistics other than by thesis route.

Class Format: senior project

Grading: pass/fail only

Winter 2020

HON Section: 01    TBA     Richard D. De Veaux

STAT 31 (W) Senior Honors Thesis

Statistics senior honors thesis.

Class Format: thesis
Grading: pass/fail only

Winter 2020

HON Section: 01 TBA Richard D. De Veaux

STAT 99 (W) Indep Study: Statistics

Open to upperclass students. Students interested in doing an independent project (99) during Winter Study must make prior arrangements with a faculty sponsor. The student and professor then complete the independent study proposal form available online. The deadline is typically in late September. Proposals are reviewed by the pertinent department and the Winter Study Committee. Students will be notified if their proposal is approved prior to the Winter Study registration period.

Class Format: independent study

Grading: pass/fail only

Winter 2020

IND Section: 01 TBA Richard D. De Veaux