STATISTICS DEPARTMENT

In the Department of Statistics

Chair, *Associate Professor James Scott*

Professor Liam O'Brien; Associate Professor James Scott; Assistant Professors Jerzy Wieczorek and Bret Zeldow; Visiting Assistant Professor Costel-Gabriel Bontea

The statistics major is designed to equip students with the analytical tools and capacities to interact with real-world data in a research environment while also accommodating students who seek a more theoretical foundation in the field. It is designed to pair with fields of study in which data plays a central role. This major equips students with the fundamental skills necessary to understand not only how to display and analyze data, but how to design studies and experiments and collect data.

Requirements for the Major in Statistics

Completion of each of the following with a grade of C- or better: Mathematics 122 or 160 or 165, 253, 381; a Computer Science course; Mathematics 274 or Computer Science 2XX or Statistics 3XX; Statistics 212, 321, 482, and two additional statistics electives numbered 300 or above.

Requirements for the Minor in Statistics

Completion of each of the following with a grade of C- or better: Mathematics 122 or 160 or 165, and 253; Statistics 212 and 321; and two more statistics courses numbered 300 or above. (The Psychology 214/215 or Economics 293/393 course sequences may be substituted for Statistics 212.)

A minor in data science is described in the "Data Science" section of the catalogue.

The point scale for retention of the minors applies to all courses in the minors. No requirement for the minors may be taken satisfactory/unsatisfactory.

Course Offerings

[SC110] Statistical Thinking Statistics is the science of learning from data; it provides tools for understanding data and arguments based on data in many diverse fields. Students will learn to describe data in basic terms and to verbalize interpretations of it. Topics include graphical and numerical methods for summarizing data, methods of data collection, basic study design, introductory probability, confidence intervals, and statistical inference. Does not count toward any major or minor. *Four credit hours.* **Q.**

SC212fs Introduction to Statistics and Data Science An exploration of statistical methods relevant to a broad array of scientific disciplines. Students will learn to properly collect data through sound experimental design and to present and interpret data in a meaningful way, making use of statistical computing packages. Topics include descriptive statistics, design of experiments, randomization, contingency tables, measures of association for categorical variables, confidence intervals, one- and two-sample tests of hypotheses for means and proportions, analysis of variance, correlation/regression, and nonparametrics. *Prerequisite:* Sophomore standing or above. *Four credit hours.* **Q, W2.** BONTEA, WIECZOREK, ZELDOW

SC306f Topics in Epidemiology The purposes of epidemiological research are to discover the causes of disease, to advance and evaluate methods of disease prevention, and to aid in planning and evaluating the effectiveness of public health programs. Students will learn about the historical development of epidemiology, a cornerstone of public health practice. Through the use of statistical methods and software, they will explore the analytic methods commonly used to investigate the occurrence of disease. Topics include descriptive and analytic epidemiology; measures of disease occurrence and association; observational and experimental study designs; and interaction, confounding, and bias. *Prerequisite:* Statistics 212. *Four credit hours.* SCOTT

[SC308] Topics in Psychometrics and Multivariate Statistics Psychometrics is concerned with the development and evaluation of psychological instruments such as tests and questionnaires. Students will learn about the fundamental concepts central to measurements derived from these tools. The establishment and assessment of the validity and reliability of research instruments, as well as the construction of scales and indices, will be discussed. Data reduction techniques and an introduction to testing theory will also be covered. Statistical software will be used throughout. *Prerequisite:* Statistics 212 and Mathematics 253 (may be taken concurrently). *Four credit hours.*

[SC310] Applied Longitudinal Analysis Longitudinal data occur when the same response is measured repeatedly through time. Students in this course will learn the fundamental properties of the structure of longitudinal data, as well as standard regression and mixed modeling strategies to analyze them. The types of estimation, and implications for using them, will also be discussed. Statistical software will be used throughout the course. *Prerequisite:* Statistics 212 and Mathematics 253 (may be taken concurrently). *Four credit hours.*

SC321fs Statistical Modeling Students will expand on their inferential statistical background and explore methods of modeling data through linear and nonlinear regression analysis. Through the use of statistical software, they will learn how to identify possible models based on data visualization techniques, to validate assumptions required by such models, and to describe their limitations. Topics include multiple linear regression, multicollinearity, logistic regression, models for analyzing temporal data, model-building strategies, transformations, model validation. *Prerequisite:* Statistics 212. *Four credit hours.* SCOTT, WIECZOREK

SC323s Statistical Surveys, Censuses, and Society Revolves around the role of sampling and surveys in the context of U.S. society. We will examine the evolution of census- and survey-taking in the U.S. in the context of its economic, social, and political uses, eventually leading to discussions about the accuracy and relevance of survey responses, especially in light of various kinds of sampling and nonsampling errors. We will also explore links to sampling methods useful for studying wildlife, forests, and other non-human populations. Students will be required to design, implement, and analyze a survey using rigorous, well-motivated methods. Previously offered as Statistics 397 (Fall 2019). *Prerequisite:* Statistics 212. *Four credit hours.* WIECZOREK

SC324s Statistical Learning in Data Science Statistical methods used in data science allow computers to make inferences and predictions about target variables. This course will provide students exposure to the common statistical methods and models used in this setting. Although the emphasis is on applications, the statistical and mathematical foundations for these data science techniques will also be covered. Topics will include linear modeling and classification techniques, cross validation, bootstrapping, non-linear modeling, tree-based methods, and data reduction strategies. Unsupervised learning techniques will also be covered as time allows. *Prerequisite:* Statistics 212 and Mathematics 253 (may be taken concurrently). *Four credit hours.* SCOTT

SC326f Statistical Graphics and Principles of Visualization An effective statistical graphic is a powerful tool for analyzing data and communicating insights. From tabular to geospatial and network datasets, students will learn to create and interpret visualizations that show the raw data, statistical models of that data, and the statistical precision of those summaries. Students will also apply principles of human visual processing and data science workflows to ensure their statistical graphics are effective and reproducible. With the help of the tidyverse, ggplot2, rmarkdown, and shiny R packages, students will create static and interactive graphics, culminating in an interactive data dashboard. Previously offered as Statistics 398 (Spring 2021). *Prerequisite:* Statistics 212. *Four credit hours.* WIECZOREK

SC327f Bayesian Statistics An introduction to Bayesian statistics. We will cover topics such as Bayes Theorem, prior and posterior distributions, linear regression, hierarchical models, and statistical inference using Bayesian methods. We will also make extensive use of R to implement these methods. *Prerequisite:* Mathematics 381. *Four credit hours.* ZELDOW

SC381fs Probability Listed as Mathematics 381. *Four credit hours.* RANDLES

SC482s Topics in Statistical Inference Building on their background in probability theory, students explore inferential methods in statistics and learn how to evaluate different estimation techniques and hypothesis-testing methods. Students learn techniques for modeling the response of a continuous random variable using information from several variables using regression modeling. Topics include maximum likelihood and other methods estimation, sample properties of estimators, including sufficiency, consistency, and relative efficiency, Rao-Blackwell theorem, tests of hypotheses, confidence, and resampling techniques. *Prerequisite:* Mathematics 381. *Four credit hours.* ZELDOW

SC491f, 492s Independent Study *One to four credit hours.*