

# STATISTICS (STAT)

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## **STAT-140 Introduction to the Ideas and Applications of Statistics**

*Fall and Spring. Credits: 4*

This course provides an overview of statistical methods, their conceptual underpinnings, and their use in various settings taken from current news, as well as from the physical, biological, and social sciences. Topics will include exploring distributions and relationships, planning for data production, sampling distributions, basic ideas of inference (confidence intervals and hypothesis tests), inference for distributions, and inference for relationships, including chi-square methods for two-way tables and regression.

*Applies to requirement(s): Math Sciences*

*I. Imtiyas, B. Pittman-Polletta*

*Advisory: 2 years of high school algebra*

## **STAT-242 Intermediate Statistics**

*Fall and Spring. Credits: 4*

In this course, students will learn how to analyze data arising from a broad array of observational and experimental studies. Topics covered will include exploratory graphics, description techniques, the fitting and assessment of statistical models, hypothesis testing, and communication of results. Specific topics may include multiple regression, ANOVA, and non-linear regression. Statistical software will be used.

*Applies to requirement(s): Math Sciences*

*I. Beaudry, L. Lyman*

*Prereq: STAT-140 or equivalent.*

## **STAT-244 Intermediate Topics in Statistics**

### **STAT-244MP Intermediate Topics in Statistics: 'Survey Sampling'**

*Not Scheduled for This Year. Credits: 4*

In this course, students will explore statistical techniques for designing and analyzing complex survey designs. Sample surveys are used to obtain data on demography, health, and development; to measure attitudes and beliefs; to estimate natural resources; to evaluate the impact of social programs; along with many other uses. The proper design and analysis of these surveys is crucial to their utility. We will cover topics including survey design, estimation, poststratification, imputation, and survey error. We will also apply these methods by frequently using real (and often messy) survey data through assignments and projects. The analysis of the data will be performed through R programming. Background should include estimation, confidence intervals and hypothesis testing.

*Applies to requirement(s): Math Sciences*

*I. Beaudry*

*Prereq: STAT-140.*

*Notes: No prior knowledge of the statistical software R is required.*

### **STAT-244NF Intermediate Topics in Statistics: 'Infectious Disease Modeling'**

*Not Scheduled for This Year. Credits: 4*

Infectious disease has plagued humanity since time immemorial. Statistical models serve a critical role in improving understanding of the progression and proliferation of infection in a population, as well as the impact of interventions in stopping the spread of disease. In this course, we will explore regression and compartmental model-based approaches, which will be motivated by some of the most impactful epidemics and pandemics in recent history, including HIV/AIDS, Ebola, Zika, and COVID-19. R statistical software will be used.

*Applies to requirement(s): Math Sciences*

*M. Ozanne*

*Prereq: STAT-140.*

### **STAT-244NP Intermediate Topics in Statistics: 'Nonparametric Statistics'**

*Not Scheduled for This Year. Credits: 4*

The methods taught in traditional statistics courses are based on assumptions that are often not satisfied by real data sets. In this course we will learn about approaches that require fewer assumptions, known as nonparametric methods. After taking this course, students will be able to examine assumptions for different approaches to statistical inference, compare nonparametric statistical tests such as sign and Wilcoxon tests to their parametric equivalents, and implement non-parametric approaches using R. In addition, the course will incorporate computational techniques for statistical analysis, including simulation, permutation tests, and bootstrapping.

*Applies to requirement(s): Math Sciences*

*The department*

*Prereq: STAT-140.*

*Advisory: Students should have experience with the programming language R.*

### **STAT-244SC Intermediate Topics in Statistics: 'Computational Statistics'**

*Spring. Credits: 4*

Computation is now an essential component of several modern statistical methods. This course will introduce students to computationally intensive techniques in statistics and explore the role of computation as a tool for discovery. Specifically, it will emphasize simulation-based, rather than calculus-based, approaches in statistical theory. Topics may include sampling algorithms, numerical analysis, and missing data. All data analysis in the course will be performed using R software. Research applications will be emphasized through assignments and student-defined projects.

*Applies to requirement(s): Math Sciences*

*L. Lyman*

*Prereq: STAT-140.*

*Advisory: Students should have experience with the programming language R.*

### **STAT-295 Independent Study**

*Fall and Spring. Credits: 1 - 4*

*The department*

*Instructor permission required.*

*Advisory: The permission of the department is required for independent work to count toward the major or minor.*

**STAT-331 Design of Experiments***Not Scheduled for This Year. Credits: 4*

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 use R to explore real-world experimental data from science, industry, and everyday life; and we'll discuss key principles for working with expert (and not-so-expert) collaborators to help them set up the experiments they need.

*Applies to requirement(s): Math Sciences**The department**Prereq: STAT-242.***STAT-340 Applied Regression Methods***Fall and Spring. Credits: 4*

This course includes methods for choosing, fitting, evaluating, and comparing statistical models; introduces statistical inference; and analyzes data sets taken from research projects in the natural, physical, and social sciences.

*Applies to requirement(s): Math Sciences**I. Imtiyas**Prereq: MATH-211 and STAT-242.***STAT-343 Mathematical Statistics***Spring. Credits: 4*

This course is an introduction to the mathematical theory of statistics and to the application of that theory to the real world. Topics include probability, random variables, special distributions, introduction to estimation of parameters, and hypothesis testing.

*Applies to requirement(s): Math Sciences**I. Beaudry**Prereq: MATH-102 and MATH-342.***STAT-344 Seminar in Statistics and Scientific Research****STAT-344ND Seminar in Statistics and Scientific Research: 'Analysis of Neural Data'***Spring. Credits: 4*

Neuroscience addresses big questions about the mind by studying the structure and function of the brain – questions like: How do we remember, learn, and make decisions? Why do we feel emotions and experience consciousness? What causes mental illness? This increasingly means analyzing datasets that are large, complex, high dimensional, and time varying. Neural data analysis employs a unique set of concepts and approaches drawing on statistics, mathematics, physics, and computer science. In this course, we will apply these techniques to real neural datasets through hands-on activities and a final independent project. Possible topics include statistical modeling of neuronal spiking data; analysis of high-dimensional data with spatial structure (e.g., EEG, fMRI); and techniques in time series analysis (e.g., autoregressive modeling, time-frequency decomposition, network connectivity, causality).

*Crosslisted as: NEURO-309ND**Applies to requirement(s): Math Sciences**B. Pittman-Polletta**Prereq: STAT-242.*

*Advisory: Students who have completed courses in allied fields on research methods (e.g., PSYCH-204 and NEURO-221) or computational and mathematical techniques (e.g., COMSC-335 and PHYS-205) may also be qualified. Contact the instructor to discuss.*

**STAT-344TM Seminar in Statistics and Scientific Research: 'Time Series Analysis'***Not Scheduled for This Year. Credits: 4*

Time series – data collected across time – show up in a vast range of application areas, from climate to economics to music. But they can have special behaviors, like seasonality, memory, and directionality, that require some special treatment! We'll look at tools for describing, modeling, and predicting time series behavior. Topics include decomposition, ARIMA, exponential smoothing, dynamic regression, and a foray into the frequency domain. We'll apply these concepts using real datasets in R.

*Applies to requirement(s): Math Sciences**L. Tupper**Prereq: STAT-242 and MATH-211.*

*Advisory: Previous or concurrent registration in STAT-340 (or other multiple regression experience) is recommended.*

**STAT-351 Bayesian Statistics***Fall. Credits: 4*

Bayesian statistics refers to a statistical paradigm that has its roots in Bayes' theorem, where prior belief and data can be combined to update our understanding of a particular problem in what is known as the posterior. In this class, you can expect to combine your knowledge of probability and statistics to develop and apply Bayesian thinking to statistical modeling. Possible topics include conjugate families, posterior simulation, regression and classification, and hierarchical modeling. R statistical software will be used.

*Applies to requirement(s): Math Sciences**M. Ozanne**Prereq: MATH-342 and STAT-242.*

*Advisory: Students may substitute another 200-level Statistics course for STAT-242 with instructor permission.*

**STAT-395 Independent Study***Fall and Spring. Credits: 1 - 8**The department**Instructor permission required.*

*Advisory: The permission of the department is required for independent work to count toward the major or minor.*