

# STATISTICS (STAT)

## Course Descriptions

### STAT 263 Introduction to Statistics 3 Credit Hours

This algebra-based introduction to statistics is designed to provide students from various majors with a foundational understanding of statistical concepts and techniques. The course uses practical application of statistical methods to real-world scenarios across different disciplines. Key topics include data visualization, descriptive statistics, sampling, elementary probability, statistical inference, and simple linear regression. This course uses technology, such as statistical software, to analyze data and draw meaningful conclusions. Students will develop the skills to critically evaluate data-driven studies, make informed decisions, and apply statistical methods in their academic, professional, and everyday life. This course does not count for the Statistics minor nor the Statistics major. Students who have already taken Calculus I should not take this course, instead they should take STAT 301 or STAT 325, both of which use R and count for the Statistics minor and major. (F, W, S).

### STAT 301 Biostatistics I 4 Credit Hours

This course focuses on statistical techniques and applications for biological and life sciences, as well as the relevant mathematical aspects of these statistical techniques. Topics include samples and populations, quantitative vs. categorical data, clinical vs. epidemiological studies, comparative displays and analysis, probability, Bayes' Theorem, point estimation, confidence intervals, hypothesis tests, ANOVA, and linear regression. Study design is emphasized: clinical trials in experimental settings, case-control, cohort studies in epidemiological settings, and review of some case studies from the literature. This course includes learning statistical software in labs with a biological focus. Students will be expected to write short lab reports. Students can receive credit for only one of STAT 301 and STAT 325. (F, W, S).

**Prerequisite(s):** MATH 113 or MATH 115

### STAT 305 Introduction to Data Science for All 3 Credit Hours

With the growing availability of data, companies, governments, and nonprofits alike are striving to convert this data into insightful knowledge. This course will provide students with the fundamental skills in the statistical software called R needed to handle such data. The course will focus on three broad areas: computation, inferential thinking, and real-world applications. We will also discuss data collection, data cleaning, and exploratory data analysis. Students will connect data to underlying phenomena and think critically about the conclusions of data analyses. Students will also learn how to write short programs that automate data analysis processes. Students will gain an applied understanding of various analytical methods, including data visualization, linear regression, and classification or clustering. Most of the material will be taught using real-world data. (F, W).

### STAT 325 Applied Statistics I 4 Credit Hours

This course studies the principles and applications of statistics. Topics include descriptive statistics, random variables, probability distributions, sampling distributions, the central limit theorem, confidence intervals, hypothesis testing for means and variances, and the use of normal, chi-square, F, and t distributions in statistical problems. Other topics are selected from regression and correlation, the design of experiments, and analysis of variance. A minimum grade of C- is required in the prerequisite. Students can receive credit for only one of STAT 301 and STAT 325. (F).

**Prerequisite(s):** MATH 113 or MATH 115

### STAT 327 Statistical Computing 3 Credit Hours

This course focuses on computational techniques that are crucial for statistics applications. Using the statistical packages R and SAS, the course teaches students about importing and storing data, manipulating and visualizing data, debugging and re-sampling, as well as simulation methods including bootstrap and Monte Carlo methods. A minimum grade of C- is required in the prerequisite course(s). (YR).

**Prerequisite(s):** STAT 325 or (STAT 301 and STAT 305)

### STAT 330 Introduction to Survey Sampling 3 Credit Hours

An introduction to survey sampling techniques assuming only a limited knowledge of higher-level mathematics. Topics include: simple and stratified random sampling, estimation, systematic sampling, simple and two stage cluster sampling, and population size estimation. (F, AY).

**Prerequisite(s):** STAT 301 or STAT 325 or MATH 425 or IMSE 317 or ME 364

### STAT 390 Topics in Applied Statistics 3 Credit Hours

A course designed to offer selected topics in applied statistics. The specific topic or topics will be announced together with the prerequisites when offered. Course may be repeated for credit when specific topics differ. (OC)

**Restriction(s):**

Can enroll if Level is Undergraduate

### STAT 430 Applied Regression Analysis 3 Credit Hours

Topics include single variable linear regression, multiple linear regression and polynomial regression. Model checking techniques based on the analysis of residuals will be emphasized. Remedies to model inadequacies, such as transformations, will also be covered along with basic time series analysis and forecasting using moving averages and autoregressive models with prediction errors. Statistical packages will be used. A minimum grade of C- is required in the prerequisite course(s). Students are encouraged to take MATH 227 before STAT 430. Students cannot receive credit for both STAT 430 and STAT 530. (F, W).

**Prerequisite(s):** STAT 325 or MATH 425 or IMSE 317 or ME 364 or (STAT 301 and STAT 305)

### STAT 431 Machine Learning and Computational Statistics 4 Credit Hours

Computational models trained with high dimensional data are increasingly important in industry and many academic disciplines. We will cover a wide range of topics in machine learning and statistical programming that enhance learning from data. Topics include an introduction to statistical learning, a review of simple and multiple linear regression, logistic regression, classification with linear and quadratic discriminant analysis and naïve Bayes, variable selection, shrinkage methods, dimension reduction methods, decision trees, deep learning (neural networks), and clustering methods. Students cannot receive credit for both STAT 431 and STAT 531. (W).

**Prerequisite(s):** STAT 325 or MATH 325 or IMSE 317 or ME 364 or (STAT 301 and STAT 305)

### STAT 440 Design and Analysis of Experiments 3 Credit Hours

An introduction to the basic methods of designed experimentation. Fixed and random effects models together with the analysis of variance techniques will be developed. Specialized designs including randomized blocks, latin squares, nested, full, and fractional factorials will be studied. The statistical computer package R will be used. In addition to the course prerequisite, students are strongly encouraged to complete STAT 305 prior to enrolling in STAT 440 for a more comprehensive understanding. Students cannot receive credit for both STAT 440 and STAT 540. (W, AY).

**Prerequisite(s):** STAT 301 or STAT 325 or MATH 425 or IMSE 317

**STAT 455 Environmental Statistics 3 Credit Hours**

The primary objective of the course is to teach students majoring in the environmental and biological sciences how to make data-driven decisions with statistics. This course aims to nurture the importance of statistical methods to enhance the understanding of issues related to environmental sciences. A one-semester course cannot be exhaustive in depth and width of literature but the aim of this course is to create interest and encourage students to delve more into the subject. This course does not count for the Statistics minor nor the Statistics major. Students who have already taken Calculus I should not take this course, instead they should take STAT 301 or STAT 325, both of which use R and count for the Statistics minor and major. Students cannot receive credit for both STAT 455 and STAT 555. (AY).

**Restriction(s):**

Can enroll if Level is Undergraduate

**STAT 460 Time Series Analysis 3 Credit Hours**

An introduction to time series, including trend effects and seasonality, while assuming only a limited knowledge of higher-level mathematics. Topics include: linear Gaussian processes, stationarity, autocovariance, and autocorrelation; autoregressive (AR), moving average (MA), and mixed (ARMA) models for stationary processes; likelihood in a simple case such as AR(1); ARIMA processes, differencing, seasonal ARIMA as models for non-stationary processes; the role of sample autocorrelation, partial autocorrelation, and correlograms in model choice; inference for model parameters; forecasting: dynamic linear models and the Kalman filter. Students cannot receive credit for both STAT 460 and STAT 560. (F, AY).

**Prerequisite(s):** STAT 430

**STAT 490 Topics in Applied Statistics 3 Credit Hours**

\*An asterisk denotes that a course may be taken concurrently.

Frequency of Offering

The following abbreviations are used to denote the frequency of offering: (F) fall term; (W) winter term; (S) summer term; (F, W) fall and winter terms; (YR) once a year; (AY) alternating years; (OC) offered occasionally