This course satisfies the General Education Criteria for: 

**Quantitative Reasoning I**

**STAT 107   Data Science Discovery   credit: 4 Hours.**

Data Science Discovery is the intersection of statistics, computation, and real-world relevance. As a project-driven course, students perform hands-on-analysis of real-world datasets to analyze and discover the impact of the data. Throughout each experience, students reflect on the social issues surrounding data analysis such as privacy and design. Same as CS 107 and IS 107. 

This course satisfies the General Education Criteria for: Quantitative Reasoning I

**STAT 199   Undergraduate Open Seminar   credit: 1 to 5 Hours.**

See course schedule for topics. Approved for Letter and S/U grading. May be repeated if topics vary.

**STAT 200   Statistical Analysis   credit: 3 Hours.**

Survey of statistical concepts, data analysis, designed and observational studies and statistical models. Statistical computing using a statistical package such as R or a spreadsheet. Topics to be covered include data summary and visualization, study design, elementary probability, categorical data, comparative experiments, multiple linear regression, analysis of variance, statistical inferences and model diagnostics. May be taken as a first statistics course for quantitatively oriented students, or as a second course to follow a basic concepts course. Credit is not given for both STAT 200 and STAT 212.

This course satisfies the General Education Criteria for: Quantitative Reasoning I

**STAT 207   Data Science Exploration   credit: 4 Hours.**

Explores the data science pipeline from hypothesis formulation, to data collection and management, to analysis and reporting. Topics include data collection, preprocessing and checking for missing data, data summary and visualization, random sampling and probability models, estimating parameters, uncertainty quantification, hypothesis testing, multiple linear and logistic regression modeling, classification, and machine learning approaches for high dimensional data analysis. Students will learn how to implement the methods using Python programming and Git version control. Prerequisite: STAT 107 or consent of instructor.

This course satisfies the General Education Criteria for: Quantitative Reasoning II

**STAT 212   Biostatistics   credit: 3 Hours.**

Application of statistical reasoning and statistical methodology to biology. Topics include descriptive statistics, graphical methods, experimental design, probability, statistical inference and regression. In addition, techniques of statistical computing are covered. Credit is not given for both STAT 212 and STAT 200. This course satisfies the General Education Criteria for: Quantitative Reasoning I

**STAT 361   Probability & Statistics for Computer Science   credit: 3 Hours.**

Same as CS 361. See CS 361.

**STAT 385   Statistics Programming Methods   credit: 3 Hours.**

Statisticians must be savvy in programming methods useful to the wide variety of analysis that they will be expected to perform. This course provides the foundation for writing and packaging statistical algorithms through the creation of functions and object oriented programming. Fundamental programming techniques and considerations will be emphasized. Students will also create dynamic reports that encapsulate their implemented algorithms. Students must have access to a computer on which they can install software. Prerequisite: STAT 200 or STAT 212.

**STAT 390   Individual Study   credit: 1 or 2 Hours.**

May be repeated to a maximum of 8 hours. Prerequisite: Consent of instructor.

**STAT 391   Honors Individual Study   credit: 1 or 2 Hours.**

May be repeated to a maximum of 8 hours. Prerequisite: Consent of instructor.

**STAT 400   Statistics and Probability I   credit: 4 Hours.**

Introduction to mathematical statistics that develops probability as needed; includes the calculus of probability, random variables, expectation, distribution functions, central limit theorem, point estimation, confidence intervals, and hypothesis testing. Offers a basic one-term introduction to statistics and also prepares students for STAT 410 and STAT 425. Same as MATH 463. 4 undergraduate hours. 4 graduate hours. Prerequisite: MATH 231. Concurrent Enrollment in MATH 241 is required. Not intended for first-time freshmen.

**STAT 408   Actuarial Statistics I   credit: 4 Hours.**

Examines elementary theory of probability, including independence, conditional probability, and Bayes' theorem; combinations and permutations; random variables, expectations, and probability distributions; joint and conditional distributions; functions of random variables; sampling; central limit theorem. Same as ASRM 401. 4 undergraduate hours. 4 graduate hours. Credit is not given for both STAT 408 and either MATH 461 or STAT 400. Prerequisite: MATH 241 or equivalent.

**STAT 409   Actuarial Statistics II   credit: 4 Hours.**

Continuation of STAT 408. Examines parametric point and interval estimation, including maximum likelihood estimation, sufficiency, completeness, and Bayesian estimation; hypothesis testing; linear models; regression and correlation. Same as ASRM 402. 4 undergraduate hours. 4 graduate hours. Credit is not given for both STAT 409 and STAT 410. Prerequisite: STAT 408.
STAT 410  Statistics and Probability II  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/410/)
Continuation of STAT 400. Includes moment-generating functions, transformations of random variables, normal sampling theory, sufficiency, best estimators, maximum likelihood estimators, confidence intervals, most powerful tests, unbiased tests, and chi-square tests. Same as MATH 464. 3 undergraduate hours. 4 graduate hours. Credit is not given for both STAT 410 and STAT 409. Prerequisite: MATH 241 and STAT 400.

STAT 420  Methods of Applied Statistics  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/420/)
Systematic, calculus-based coverage of the more widely used methods of applied statistics, including simple and multiple regression, correlation, analysis of variance and covariance, multiple comparisons, goodness of fit tests, contingency tables, nonparametric procedures, and power of tests; emphasizes when and why various tests are appropriate and how they are used. Same as ASRM 450. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 408 or STAT 400; MATH 231 or equivalent; knowledge of basic matrix manipulations; or consent of instructor.

STAT 424  Analysis of Variance  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/424/)
Estimation and hypotheses testing in linear models; one-, two-, and higher-way layouts; incomplete layouts; analysis of covariance; and random effects models and mixed models. 3 undergraduate hours. 4 graduate hours. Prerequisite: Credit or concurrent registration in MATH 415 and STAT 410.

STAT 425  Statistical Modeling I  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/425/)
This is the foundation for advanced statistical modeling with a focus on multiple strategies for analyzing data. The course explores linear regression, least squares estimates, F-tests, analysis of residuals, regression diagnostics, transformations, model building, generalized and weighted least squares, PCA, A/B testing, randomization tests, ANOVA, random effects, mixed effects, and longitudinal data. Statistical computing is an integral part of the course. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 400; MATH 257 or MATH 415. Concurrent Enrollment in STAT 410 is preferred.

STAT 426  Statistical Modeling II  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/426/)
This is a continuation in the study of advanced statistical modeling techniques with a focus on categorical data. The course explores logistic regression, generalized linear models, goodness-of-fit, link functions, count regression, log-linear models, probability models for contingency tables, and ordinal response models. Statistical computing is an integral part of the course. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 410; STAT 425.

STAT 427  Statistical Consulting  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/427/)
Students, working in groups under the supervision of the instructor, consult with faculty and graduate students through the Statistical Consulting Service; readings from literature on consulting. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 425 or consent of instructor.

STAT 428  Statistical Computing  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/428/)
Examines statistical packages, numerical analysis for linear and nonlinear models, graphics, and random number generation and Monte Carlo methods. Same as CSE 428. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 410 or equivalent; knowledge of a programming language.

STAT 429  Time Series Analysis  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/429/)
Studies theory and data analysis for time series; examines autoregressive moving average model building and statistical techniques; and discusses spectral model building and statistical analysis using windowed periodograms and Fast Fourier Transformations. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 410.

STAT 430  Topics in Applied Statistics  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/430/)
Formulation and analysis of mathematical models for random phenomena; extensive involvement with the analysis of real data; and instruction in statistical and computing techniques as needed. 3 undergraduate hours. 4 graduate hours. May be repeated in the same or separate terms if topics vary. Prerequisite: STAT 410; STAT 425. Some topics may require additional prerequisites. Read the section text for each topic.

STAT 431  Applied Bayesian Analysis  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/431/)
Introduction to the concepts and methodology of Bayesian statistics, for students with fundamental knowledge of mathematical statistics. Topics include Bayes’ rule, prior and posterior distributions, conjugacy, Bayesian point estimates and intervals, Bayesian hypothesis testing, noninformative priors, practical Markov chain Monte Carlo, hierarchical models and model graphs, and more advanced topics as time permits. Implementations in R and specialized simulation software. Same as ASRM 453. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 410 and knowledge of R.

STAT 432  Basics of Statistical Learning  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/432/)
Topics in supervised and unsupervised learning are covered, including logistic regression, support vector machines, classification trees and nonparametric regression. Model building and feature selection are discussed for these techniques, with a focus on regularization methods, such as lasso and ridge regression, as well as methods for model selection and assessment using cross validation. Cluster analysis and principal components analysis are introduced as examples of unsupervised learning. Same as ASRM 451. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 400, and either STAT 420 or STAT 425.

STAT 433  Stochastic Processes  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/433/)
A stochastic process is a random process that represents the evolution of some system over time. Topics may include discrete-time and continuous-time Markov chains, birth-and-death chains, branching chains, stationary distributions, random walks, Markov pure jump processes, birth-and-death processes, renewal processes, Poisson process, queues, second order processes, Brownian motion (Wiener process), and Ito's lemma. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 400 required, STAT 410 preferred, and MATH 225 (or equivalent knowledge of Linear Algebra) highly recommended.

STAT 434  Survival Analysis  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/434/)
Introduction to the analysis of time-to-event outcomes. Topics center around three main procedures: the Kaplan-Meier estimator, the logrank test, and Cox regression. Emphasis on big-picture concepts, basic methodological understanding, and practical implementation in R. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 410, STAT 420, and knowledge of R at the level of STAT 420.

Information listed in this catalog is current as of 09/2021
STAT 440  Statistical Data Management  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/440/)
The critical elements of data storage, data cleaning, and data extractions that ultimately lead to data analysis are presented. Includes basic theory and methods of databases, auditing and querying databases, as well as data management and data preparation using standard large-scale statistical software. Students will gain competency in the skills required in storing, cleaning, and managing data, all of which are required prior to data analysis. Same as CSE 440. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 400 or STAT 409.

STAT 443  Professional Statistics  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/443/)
This project-based course emphasizes written, visual, and oral communication of statistical results and conclusions. An introduction to statistical consulting is also provided. Additional topics include introductions to statistical methodologies in industry and aspects of careers in statistics. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 420 or consent of instructor.

STAT 447  Data Science Programming Methods  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/447/)
The field of data science is revolutionizing science and industries. Work across many fields is becoming more data driven, affecting available jobs and required skills. Increasing amounts of data, along with novel ways of analyzing them, lead the economy as well as society and daily life to become more data-dependent. This course aims to provide the principal foundations to working with data at scale. We will cover shell programming, git version control, SQL basics, a lot of R, and some more advanced topics such as Docker and some C++. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 410.

STAT 448  Advanced Data Analysis  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/448/)
Several of the most widely used techniques of data analysis are discussed with an emphasis on statistical computing. Topics include linear regression, analysis of variance, generalized linear models, and analysis of categorical data. In addition, an introduction to data mining is provided considering classification, model building, decision trees, and cluster analysis. Same as CSE 448. 4 undergraduate hours. 4 graduate hours. Prerequisite: STAT 400 or STAT 409, and credit for or concurrent registration in STAT 410.

STAT 458  Math Modeling in Life Sciences  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/458/)
Same as ANSC 448 and IB 487. See ANSC 448.

STAT 480  Data Science Foundations  credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/480/)
Examines the methods of data management and analysis for "big data", characterized by high volume, variety, velocity, and veracity. Attention will be focused on advanced statistical analysis and visualization in data science applications employing parallel processing, storage and distribution techniques necessary for analysis of massive data sets. Data mining techniques, machine learning methods, and streaming technologies will be utilized for real-time analysis. Students must have access to a computer on which they can install software. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 425 and familiarity with high-level language (e.g. Python, Java, C, F#), and command line programming.

STAT 510  Mathematical Statistics  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/510/)
Distributions, transformations, order-statistics, exponential families, sufficiency, delta-method, Edgeworth expansions; uniformly minimum variance unbiased estimators, Rao-Blackwell theorem, Cramer-Rao lower bound, information inequality; equivariance. Prerequisite: STAT 410.

STAT 511  Advanced Mathematical Statistics  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/511/)
Provides an advanced introduction to rigorous mathematical foundations of statistical inference, covering topics such as distribution theory, point estimation theory, interval estimation, theory of hypothesis testing, and decision theory. 4 graduate hours. No professional credit. Prerequisite: Familiarity with probability theory and statistics at the level of STAT 410. For Graduate Students Only.

STAT 525  Computational Statistics  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/525/)
Various topics, such as ridge regression; robust regression; jackknife, bootstrap, cross-validation and resampling plans; E-M algorithm; projection pursuit; all with a strong computational flavor. Same as CSE 525. May be repeated if topics vary. Prerequisite: STAT 425, STAT 426, and STAT 511; or consent of instructor.

STAT 527  Advanced Regression Analysis  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/527/)
An advanced introduction to regression analysis with applications to analysing data from disciplines such as biostatistics and economics. The course will introduce classical as well as modern regression methods and goes into the depths of those techniques to understand the motivation, justification, implementation of those methods. An emphasis will be given to understand the statistical properties of those methods along with their practical advantages and limitations. Both theoretical and applied aspects of regression analysis will be discussed. 4 graduate hours. No professional credit. Prerequisite: STAT 410, STAT 510 (concurrent enrollment is sufficient), and knowledge of R. For Graduate Students Only.

STAT 528  Advanced Regression Analysis II  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/528/)
An advanced (graduate-level) introduction to generalized linear models and categorical data analysis with applications to analyzing data from disciplines such as biostatistics, economics, evolutionary biology, and medicine. The course will introduce classical techniques as well as modern methods. A strong emphasis will be placed on statistical properties of presented methods as well as data analysis practice and critical statistical thinking. Practical advantages, limitations, and comparisons of methods will be discussed. 4 graduate hours. No professional credit. Prerequisite: STAT 510, STAT 527. Restricted to graduate students only.

STAT 530  Bioinformatics  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/530/)
Same as ANSC 543, CHBE 571, and MCB 571. See CHBE 571.
STAT 425  data analysis. 4 graduate hours. No professional credit. Prerequisite: provided in class and statistical software will be used to illustrate the for aggregated data and point processes. Real data examples will be edge research advances for geostatistics, and statistical methods and spatio-temporal data. Covers both fundamental theories and cutting-

Theory and methods for analyzing univariate and multivariate spatial and spatio-temporal data. Covers both fundamental theories and cutting-edge research advances for geostatistics, and statistical methods for aggregated data and point processes. Real data examples will be provided in class and statistical software will be used to illustrate the data analysis. 4 graduate hours. No professional credit. Prerequisite: STAT 425 or equivalent.

STAT 546  Machine Learning in Data Science  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/546/) Trains students to analyze large complex data using advanced statistical learning methods and algorithms. The main topics in the course include: data exploration and interpretation in data science; large data processing; regularization methods; optimization tools; deep learning; recommender systems; network and graphical models; text mining; and imaging analyses. Students will gain practical skills of data mining and knowledge discovery in various applications such as business, political science, biology and medicine. 4 graduate hours. No professional credit. Prerequisite: STAT 510 or STAT 410 (students must have taken either STAT 510 or STAT 410) and STAT 425.

STAT 551  Theory of Probability I  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/551/) Same as MATH 561. See MATH 561.

STAT 552  Theory of Probability II  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/552/) Same as MATH 562. See MATH 562.

STAT 553  Probability and Measure I  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/553/) Measures and probabilities; integration and expectation; convergence theorems and inequalities for integrals and expectations; independence; convergence in probability; almost surely, and mean; Three Series Theorem; laws of large numbers. Prerequisite: MATH 447 or consent of instructor.

STAT 554  Probability and Measure II  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/554/) Measure extensions, Lebesgue-Stieltjes measure, Kolmogorov consistency theorem; conditional expectation, conditional probability, martingales; distribution functions and characteristic functions; convergence in distribution; Central Limit Theorem; Brownian Motion. Credit is not given for both STAT 554 and either MATH 561 or MATH 562.

STAT 555  Applied Stochastic Processes  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/555/) Same as MATH 564. See MATH 564.

STAT 556  Advanced Time Series Analysis  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/556/) This is a graduate-level course on time series analysis, with an emphasis on nonlinear and multivariate time series. Topics include: linear time series, nonlinear time series, continuous-time models, multivariate and high-dimensional models. Students will learn how to build adequate models, perform statistical estimation and inference, conduct prediction, and related topics. Students will also learn some basic mathematical tools (such as Markov chains, martingales, stochastic calculus, concentration inequalities, etc.) for theoretically analyzing large-sample properties of general nonlinear random processes. 4 graduate hours. No professional credit.

STAT 558  Risk Modeling and Analysis  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/558/) Same as MATH 563. See MATH 563.

STAT 571  Multivariate Analysis  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/571/) Inference in multivariate statistical populations emphasizing the multivariate normal distribution; derivation of tests, estimates, and sampling distributions; and examples from the natural and social sciences. Prerequisite: STAT 410 and MATH 415, or consent of instructor.
STAT 575  Large Sample Theory  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/575/)
Limiting distribution of maximum likelihood estimators, likelihood ratio test statistics, U-statistics, M-, L-, and R-estimators, nonparametric test statistics, Von Mises differentiable statistical functions; asymptotic relative efficiencies; asymptotic expansions. Same as ECON 578.
Prerequisite: STAT 511 and either MATH 561 or STAT 554.

STAT 576  Empirical Process Theory and Weak Convergence  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/576/)
A graduate-level introduction to Empirical Process Theory with applications to statistical M estimation, nonparametric regression, and high dimensional statistics. Empirical Process Theory deals with two fundamental questions: the uniform law of large numbers, and the uniform central limit theorems, both of which will be covered. This course provides rigorous training in empirical process for students with a strong background in mathematical statistics. Topics covered are useful for conducting modern theoretical research in statistics and probability. 4 graduate hours. No professional credit. Prerequisite: STAT 511, STAT 575, STAT 553. Restricted to graduate students only.

STAT 578  Topics in Statistics  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/578/)
May be repeated if topics vary. Prerequisite: Consent of instructor.

STAT 587  Hierarchical Linear Models  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/587/)
Same as PSYC 587 and EPSY 587. See EPSY 587.

STAT 588  Covar Struct and Factor Models  credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/STAT/588/)
Same as EPSY 588, PSYC 588, and SOC 588. See PSYC 588.

STAT 590  Individual Study and Research  credit: 0 to 8 Hours. (https://courses.illinois.edu/schedule/terms/STAT/590/)
Directed reading and research. Approved for letter and S/U grading. May be repeated with approval. Prerequisite: Consent of instructor.

STAT 593  STAT Internship  credit: 0 to 8 Hours. (https://courses.illinois.edu/schedule/terms/STAT/593/)
Supervised, off-campus experience in a field in which statistical science plays an important role. Approved for letter and S/U grading. Prerequisite: STAT 425 and consent of instructor.

STAT 595  Preparing Future Faculty  credit: 2 Hours. (https://courses.illinois.edu/schedule/terms/STAT/595/)
Prepares Ph.D. students who are interested in an academic career to develop a successful academic career path, and to prepare graduate students for their future roles as teachers, and researchers. The course will focus on profession, job search, research, teaching and service. The course will involve guest panels, small and large group presentations and interactive Q&A with student participation.

STAT 599  Thesis Research  credit: 0 to 16 Hours. (https://courses.illinois.edu/schedule/terms/STAT/599/)
Approved for S/U grading only. May be repeated. Prerequisite: Consent of instructor.