STATISTICS (STAT)

STAT Class Schedule (https://courses.illinois.edu/schedule/DEFAULT/DEFAULT/STAT)

Courses

STAT 100  Statistics credit: 3 Hours.
First course in probability and statistics at a precalculus level; emphasizes basic concepts, including descriptive statistics, elementary probability, estimation, and hypothesis testing in both nonparametric and normal models. Credit is not given for both STAT 100 and any one of the following: ECON 202, PSYC 235, or SOC 485. Prerequisite: MATH 112. This course satisfies the General Education Criteria for: Quantitative Reasoning I

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 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. Same as MATH 463. 4 undergraduate hours. 4 graduate hours. Prerequisite: MATH 241 or equivalent.

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.
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: STAT 400; or STAT 100 and MATH 461.

STAT 420  Methods of Applied Statistics credit: 3 or 4 Hours.
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.
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  Applied Regression and Design credit: 3 or 4 Hours.
Explores linear regression, least squares estimates, F-tests, analysis of residuals, regression diagnostics, transformations, model building, factorial designs, randomized complete block designs, Latin squares, split plot designs. Computer work is an integral part of the course. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 410.

STAT 426  Sampling and Categorical Data credit: 3 or 4 Hours.
Sampling: simple random, stratified, systematic, cluster, and multistage sampling. Categorical data: multiway contingency tables, maximum likelihood estimation, goodness-of-fit tests, model selection, logistic regression. Computer work is an integral part of the course. 3 undergraduate hours. 4 graduate hours. Prerequisite: STAT 410.
STAT 427  Statistical Consulting  credit: 3 or 4 Hours.
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.
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.
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.
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 with approval. Prerequisite: STAT 410 or STAT 420; or consent of instructor.

STAT 431  Applied Bayesian Analysis  credit: 3 or 4 Hours.
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.
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.
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 Itō’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.
Introduction to the analysis of time-to-event outcomes. Topics center around three main procedures: the Kaplan-Meier estimator, the log-rank 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.

STAT 440  Statistical Data Management  credit: 3 or 4 Hours.
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.
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 448  Advanced Data Analysis  credit: 4 Hours.
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.
Same as ANSC 448 and IB 487. See ANSC 448.

STAT 466  Image and Neuroimage Analysis  credit: 3 or 4 Hours.
Same as PSYC 466. See PSYC 466.

STAT 480  Data Science Foundations  credit: 3 or 4 Hours.
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 484  Ethical Practice of Statistics  credit: 3 or 4 Hours.
Same as PSYC 484. See PSYC 484.

STAT 510  Mathematical Statistics I  credit: 4 Hours.
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.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
<th>Prerequisites and Details</th>
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<tbody>
<tr>
<td>STAT 511</td>
<td>Mathematical Statistics II</td>
<td>4</td>
<td>Bayes estimates, minimaxity, admissibility, maximum likelihood estimation, consistency, asymptotic efficiency; testing and confidence intervals; Neyman-Pearson lemma, uniformly most powerful tests; likelihood ratio tests and large-sample approximation; nonparametrics. Prerequisite: STAT 510.</td>
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<tr>
<td>STAT 525</td>
<td>Computational Statistics</td>
<td>4</td>
<td>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.</td>
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<tr>
<td>STAT 530</td>
<td>Bioinformatics</td>
<td>4</td>
<td>Same as ANSC 543, CHBE 571, and MCB 571. See CHBE 571.</td>
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<tr>
<td>STAT 534</td>
<td>Advanced Survival Analysis</td>
<td>4</td>
<td>Introduction to the analysis of time-to-event outcomes. Topics include censoring, discrete survival, parametric models, nonparametric one- and K-sample methods, Cox regression, regression diagnostics, time-dependent covariates, and multivariate survival outcomes. Emphasis on key underlying concepts. Counting process-based theoretical justification and practical implementation will also be discussed. 4 graduate hours. No professional credit. Prerequisite: STAT 410, STAT 425, and knowledge of R.</td>
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<tr>
<td>STAT 538</td>
<td>Clinical Trials Methodology</td>
<td>4</td>
<td>The topics of the course focus on clinical trials designs and inferential techniques that are commonly used in the pharmaceutical industry. Topics include fixed sample designs for normal and survival data, two-sided group sequential design, Pocock's and O'Brien-Fleming boundaries, general theory of group sequential design, alpha and beta spending functions, one-sided designs with early stopping to accept the null hypothesis, non-inferiority designs, and inferential techniques. Computing in SAS will be emphasized. 4 graduate hours. No professional credit. Prerequisite: STAT 410, STAT 425, and familiarity with SAS.</td>
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<tr>
<td>STAT 542</td>
<td>Statistical Learning</td>
<td>4</td>
<td>Modern techniques of predictive modeling, classification, and clustering are discussed. Examples of these are linear regression, nonparametric regression, kernel methods, regularization, cluster analysis, classification trees, neural networks, boosting, discrimination, support vector machines, and model selection. Applications are discussed as well as computation and theory. Same as CSE 542. Prerequisite: STAT 410 and STAT 425.</td>
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<tr>
<td>STAT 543</td>
<td>Appl. Multivariate Statistics</td>
<td>4</td>
<td>Same as CPSC 543. See CPSC 543.</td>
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<tr>
<td>STAT 545</td>
<td>Spatial Statistics</td>
<td>4</td>
<td>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.</td>
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<tr>
<td>STAT 551</td>
<td>Theory of Probability I</td>
<td>4</td>
<td>Same as MATH 561. See MATH 561.</td>
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<tr>
<td>STAT 552</td>
<td>Theory of Probability II</td>
<td>4</td>
<td>Same as MATH 562. See MATH 562.</td>
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<tr>
<td>STAT 553</td>
<td>Probability and Measure I</td>
<td>4</td>
<td>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.</td>
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<tr>
<td>STAT 554</td>
<td>Probability and Measure II</td>
<td>4</td>
<td>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.</td>
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<tr>
<td>STAT 555</td>
<td>Applied Stochastic Processes</td>
<td>4</td>
<td>Same as MATH 564. See MATH 564.</td>
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<td>STAT 558</td>
<td>Risk Modeling and Analysis</td>
<td>4</td>
<td>Same as MATH 563. See MATH 563.</td>
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<tr>
<td>STAT 571</td>
<td>Multivariate Analysis</td>
<td>4</td>
<td>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.</td>
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<tr>
<td>STAT 575</td>
<td>Large Sample Theory</td>
<td>4</td>
<td>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.</td>
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<tr>
<td>STAT 578</td>
<td>Topics in Statistics</td>
<td>4</td>
<td>May be repeated if topics vary. Prerequisite: Consent of instructor.</td>
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<tr>
<td>STAT 587</td>
<td>Hierarchical Linear Models</td>
<td>4</td>
<td>Same as PSYC 587 and EPSY 587. See EPSY 587.</td>
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<tr>
<td>STAT 588</td>
<td>Covar Struct and Factor Models</td>
<td>4</td>
<td>Same as EPSY 588, PSYC 585, and SOC 588. See PSYC 588.</td>
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<tr>
<td>STAT 590</td>
<td>Individual Study and Research</td>
<td>0 to 8</td>
<td>Directed reading and research. Approved for letter and S/U grading. May be repeated with approval. Prerequisite: Consent of instructor.</td>
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<tr>
<td>STAT 593</td>
<td>STAT Internship</td>
<td>0 to 8</td>
<td>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.</td>
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<tr>
<td>STAT 595</td>
<td>Preparing Future Faculty</td>
<td>2</td>
<td>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&amp;A with student participation.</td>
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<tr>
<td>STAT 599</td>
<td>Thesis Research</td>
<td>0 to 16</td>
<td>Approved for S/U grading only. May be repeated. Prerequisite: Consent of instructor.</td>
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