# Statistics Courses (Statistics and Actuarial Science) (STAT)

This is a list of all statistics courses. For more information, see Statistics and Actuarial Science.

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**STAT:1000 First-Year Seminar**  
Small discussion class taught by a faculty member; topics chosen by instructor; may include outside activities (e.g., films, lectures, performances, readings, visits to research facilities). Requirements: first- or second-semester standing.

**STAT:1010 Statistics and Society**  
Statistical ideas and their relevance to public policy, business, humanities, and the social, health, and physical sciences; focus on critical approach to statistical evidence. Requirements: one year of high school algebra or MATH:0100. GE: Quantitative or Formal Reasoning.

**STAT:1020 Elementary Statistics and Inference**  
Graphing techniques for presenting data, descriptive statistics, correlation, regression, prediction; logic of statistical inference, elementary probability models, estimation and tests of significance. Requirements: one year of high school algebra or MATH:0100. GE: Quantitative or Formal Reasoning.

**STAT:1030 Statistics for Business**  
Descriptive statistics, graphical presentation, elementary probability, estimation and testing, regression, correlation; statistical computer packages. GE: Quantitative or Formal Reasoning.

**STAT:2010 Statistical Methods and Computing**  
Methods of data description and analysis using SAS; descriptive statistics, graphical presentation, estimation, hypothesis testing, sample size, power; emphasis on learning statistical methods and concepts through hands-on experience with real data. Recommendations: undergraduate standing. GE: Quantitative or Formal Reasoning.

**STAT:2020 Probability and Statistics for the Engineering and Physical Sciences**  
Probability, random variables, important discrete and continuous distributions, joint distributions, transformations of random variables, descriptive statistics, point and interval estimation, tests of hypotheses, regression. Prerequisites: MATH:1560 or MATH:1860.

**STAT:3100 Introduction to Mathematical Statistics I**  
Descriptive statistics, probability, discrete and continuous distributions, sampling, sampling distributions. Prerequisites: MATH:1860 or MATH:1560. Same as IGPI:3100.

**STAT:3101 Introduction to Mathematical Statistics II**  
Estimation, testing statistical hypotheses, linear models, multivariate distributions, nonparametric methods. Prerequisites: STAT:3100. Same as IGPI:3101.

**STAT:3120 Probability and Statistics**  
Models, discrete and continuous random variables and their distributions, estimation of parameters, testing statistical hypotheses. Prerequisites: MATH:1560 or MATH:1860. Same as IGPI:3120.

**STAT:3200 Applied Linear Regression**  
Regression analysis with focus on applications; model formulation, checking, selection; interpretation and presentation of analysis results; simple and multiple linear regression; logistic regression; ANOVA; hands-on data analysis with computer software. Prerequisites: STAT:2020 or STAT:2010. Same as IE:3760, IGPI:3200.

**STAT:3210 Experimental Design and Analysis**  
Single- and multifactor experiments; analysis of variance; multiple comparisons; contrasts; diagnostics; fixed, random, and mixed effects models; designs with blocking and/or nesting; two-level factorials and fractions thereof; use of statistical computing packages. Prerequisites: STAT:3200.

**STAT:3510 Biostatistics**  
Statistical concepts and methods for the biological sciences; descriptive statistics, elementary probability, sampling distributions, confidence intervals, parametric and nonparametric methods, one-way ANOVA, correlation and regression, categorical data. Requirements: MATH:0100 or MATH:1005 or ALEKS score of 30 or higher. Same as IGPI:3510.

**STAT:3620 Quality Control**  
Basic techniques of statistical quality control; application of control charts for process control variables; design of inspection plans and industrial experimentation; modern management aspects of quality assurance systems. Offered fall semesters. Prerequisites: STAT:2020 or (STAT:3100 and STAT:3101 and STAT:3200). Same as CEE:3142, IE:3600.

**STAT:4100 Mathematical Statistics I**  
Probability, conditional probability, random variables, distribution and density functions, joint and conditional distributions, various families of discrete and continuous distributions, mgf technique for sums, convergence in distribution, convergence in probability, central limit theorem. Prerequisites: MATH:2850 and MATH:2700. Same as IGPI:4100.

**STAT:4101 Mathematical Statistics II**  
Transformations, order statistics, point estimation, sufficient statistics, Rao-Blackwell Theorem, delta method, confidence intervals, likelihood ratio tests, applications. Prerequisites: STAT:4100. Same as IGPI:4101.

**STAT:4143 Introduction to Statistical Methods**  
Analysis, interpretation of research data; descriptive statistics; introduction to probability, sampling theory, statistical inference (binomial, normal distribution, t-distribution models); linear correlation, regression. Same as PSQF:4143.

**STAT:4200 Statistical Methods and Computing**  
Methods of data description and analysis using SAS; descriptive statistics, graphical presentation, estimation, hypothesis testing, sample size, power; emphasis on learning statistical methods and concepts through hands-on experience with real data. Recommendations: graduate standing in non-statistics or less quantitative major. Same as IGPI:4200.

**STAT:4510 Regression, Time Series, and Forecasting**  
Regression analysis, forecasting, time series methods; use of statistical computing packages. Prerequisites: STAT:3101 with a minimum grade of C+. 
STAT:4520 Bayesian Statistics 3 s.h.
Bayesian statistical analysis, with focus on applications; Bayesian and frequentist methods compared; Bayesian model specification, choice of priors, computational methods; hands-on Bayesian data analysis using appropriate software; interpretation and presentation of analysis results. Prerequisites: STAT:3200 and (STAT:3101 or STAT:4101 or STAT:3120). Same as IGPI:4522, PSQF:4520.

STAT:4540 Statistical Learning 3 s.h.
Introduction to supervised and unsupervised statistical learning, with a focus on regression, classification, and clustering; methods will be applied to real data using appropriate software; supervised learning topics include linear and nonlinear (e.g., logistic) regression, linear discriminant analysis, cross-validation, bootstrapping, model selection, and regularization methods (e.g., ridge and lasso); generalized additive and spline models, tree-based methods, random forests and boosting, and support-vector machines; unsupervised learning topics include principal components and clustering. Requirements: an introductory statistics course and a regression course. Recommendations: prior exposure to programming and/or software, such as R, SAS, and Matlab. Same as IGPI:4540.

STAT:4560 Statistics for Risk Modeling 3 s.h.
Theory and applications of general linear models, generalized linear models, and regression-based time series models; emphasis on parameter estimation, variable selection, and diagnostic checking for these models and their use for statistical inference and prediction; demonstration of practical implementations of these models with real data in actuarial and financial contexts. Prerequisites: STAT:4101 with a minimum grade of C+ or STAT:5101 with a minimum grade of C+. Requirements: knowledge of computer programming.

STAT:4580 Data Visualization and Data Technologies 3 s.h.
Introduction to common techniques for visualizing univariate and multivariate data, data summaries, and modeling results; students learn to create and interpret these visualizations, and assess effectiveness of different visualizations based on an understanding of human perception and statistical thinking; data technologies for obtaining and preparing data for visualization and further analysis. Requirements: an introductory statistics course and a regression course. Recommendations: prior exposure to basic use of statistical programming software (e.g., R or SAS) as obtained from a regression course strongly recommended. Same as IGPI:4580.

STAT:4740 Large Data Analysis 3 s.h.
Current areas that deal with problem of Big Data; techniques from computer science, mathematics, statistics; high performance and parallel computing, matrix techniques, cluster analysis, visualization; variety of applications including Google PageRank, seismology, Netflix-type problems, weather forecasting; fusion of data with simulation; projects. Prerequisites: CS:1210 with a minimum grade of C- or ENGR:2730 with a minimum grade of C-) and (MATH:3800 or CS:3700) and (STAT:3200 or IE:3760 or IGPI:3200). Same as CS:4740, IGPI:4740, MATH:4740.

STAT:4880 Data Science Creative Component 1 s.h.
Independent project under a faculty advisor’s supervision; emphasis on communication of ideas learned in student’s data science course work or internship.

STAT:4890 Data Science Practicum 2 s.h.
On- or off-campus internship or group-based consulting project that provides experience in a real-world setting and introduces ethical and confidentiality issues related to data collection, storage, and sharing.

STAT:5090 ALPHA Seminar 1 s.h.
Resources available to students, program requirements, tips for academic success, professional statistical organizations, library and career center resources, statistical computing, scientific document preparation, history of statistics. Requirements: graduate standing in statistics.

STAT:5100 Statistical Inference I 3 s.h.
Review of probability, distribution theory (multiple random variables, moment-generating functions, transformations, conditional distributions), sampling distributions, order statistics, convergence concepts, generating random samples. Prerequisites: MATH:2850 and STAT:3101.

STAT:5101 Statistical Inference II 3 s.h.
Continuation of STAT:5100; principles of data reduction, point estimation theory (MLE, Bayes, UMVU), hypothesis testing, interval estimation, decision theory, asymptotic evaluations. Prerequisites: STAT:5100.

STAT:5120 Mathematical Methods for Statistics 3 s.h.
Real numbers, point set theory, limit points, limits, metric spaces, continuity, sequences and series, Taylor series (multivariate), uniform convergence, Riemann-Stieltjes integrals. Requirements: statistics graduate standing.

STAT:5200 Applied Statistics I 4 s.h.
Introduction to computing environments and statistical packages, descriptive statistics, basic inferential methods (confidence intervals, chi-square tests); linear models (regression and ANOVA models—specification and assumptions, fitting, diagnostics, selection, testing, interpretation). Prerequisites: STAT:5101, Corequisites: STAT:4100 or STAT:5100. Requirements: facility with matrix algebra. Same as IGPI:5199.

STAT:5201 Applied Statistics II 3 s.h.
Design of experiments and analysis of designed experiments; models for fixed and random effects; mixed models; design and analysis of complex plans; sample-size methods. Prerequisites: STAT:5200. Recommendations: prior exposure to SAS software.

STAT:5400 Computing in Statistics 3 s.h.
R; database management; graphical techniques; importing graphics into word-processing documents (e.g., LaTeX); creating reports in LaTeX; SAS; simulation methods (Monte Carlo studies, bootstrap, etc.). Prerequisites: CS:1210 and STAT:3200 and (STAT:3120 or STAT:3101 or STAT:4101). Corequisites: STAT:5100 and STAT:5200 if not already completed. Same as IGPI:5400.

STAT:5610 Regression Modeling and ANOVA in the Health Sciences 3 s.h.
Continuation of BIOS:4120; correlation, simple and multiple linear regression, confounding, interactions, model selection, single and multiple factor ANOVA (analysis of variance) models, contrasts, multiple comparisons, nested and block designs, and an introduction to mixed models; designed for non-biostatistics majors. Offered spring semesters and summer sessions. Prerequisites: BIOS:4120. Same as BIOS:5120, IGPI:5120.
STAT:5810 Research Data Management 3 s.h.
Introduction to data management techniques and problems encountered in gathering and processing data from biomedical investigations; introduction to SAS, techniques taught in SAS; designed for non-biostatistics majors. Offered fall and spring semesters. Recommendations: prior programming experience with C, C++, Python, Java, or other. Same as BIOS:5310, IGPI:5310.

STAT:6220 Statistical Consulting 3 s.h.
Realistic supervised data analysis experiences, including statistical packages, statistical graphics, writing statistical reports, dealing with complex or messy data. Offered spring semesters. Prerequisites: (STAT:3200 and STAT:3210) or (STAT:5201 and STAT:5200). Requirements: for undergraduate majors—major g.p.a. of 3.00 or above, and grades of B or higher in STAT:3200 and STAT:3210.

STAT:6300 Probability and Stochastic Processes I 3 s.h.
Conditional expectations; Markov chains, including random walks and gambler's ruin; classification of states; stationary distributions; branching processes; Poisson processes; Brownian motion. Prerequisites: STAT:4100.

STAT:6301 Probability and Stochastic Processes II 3 s.h.
Markov chains with continuous state space, Martingales, random walks, Brownian motion and other continuous-time Markov chains, simulation methods. Prerequisites: STAT:6300.

STAT:6510 Applied Generalized Regression 3 s.h.
Applications of semiparametric models, generalized linear models, nonlinear normal errors models, correlated response models; use of statistical packages, especially R and SAS. Requirements: introductory statistics and applied linear models. Same as IGPI:6511.

STAT:6513 Intermediate Statistical Methods 4 s.h.

STAT:6514 Correlation and Regression 4 s.h.
Correlation techniques; selected bivariate procedures, multiple, partial, curvilinear correlation; multiple linear regression; sampling theory applied to regression analysis and correlation coefficients; simple causal models. Requirements: for PSQF:6244—PSQF:6243; for STAT:6514—STAT:6513. Same as PSQF:6244.

STAT:6516 Design of Experiments 4 s.h.

STAT:6530 Environmental and Spatial Statistics 3 s.h.
Methods for sampling environmental populations, sampling design, trend detection and estimation, geostatistics, kriging, variogram estimation, lattice data analysis, analysis of spatial point patterns. Prerequisites: STAT:4101 and STAT:3200. Same as IGPI:6530.

STAT:6540 Applied Multivariate Analysis 3 s.h.

STAT:6547 Nonparametric Statistical Methods 3 s.h.
Selected nonparametric methods; one- and two-sample location tests and estimation methods, measures of association, analyses of variance; emphasis on relationships to classical parametric procedures. Same as PSQF:6247.

STAT:6550 Introductory Longitudinal Data Analysis 3 s.h.
Introduction to statistical models and estimation methods for outcome variables (normal and non-normal) clustered or measured repeatedly in time or space; focus on applications and computer software methods for ANOVA based methods, hierarchical linear models, linear mixed models, correlated regression models, generalized estimating equations, and generalized linear mixed models. Offered fall semesters. Prerequisites: BIOS:5120 or STAT:3200. Same as BIOS:6310, IGPI:6310.

STAT:6560 Applied Time Series Analysis 3 s.h.
General stationary, nonstationary models, autocovariance functions; stationary, nonstationary autoregressive integrated moving average models; identification, estimation, forecasting in linear models; use of statistical computer packages. Offered spring semesters. Prerequisites: (STAT:5200 or STAT:3200) and STAT:3101.

STAT:6970 Topics in Statistics 3 s.h.


STAT:7100 Advanced Inference I 3 s.h.
Concepts of convergence, asymptotic methods including the delta method, sufficiency, asymptotic efficiency, Fisher information and information bounds for estimation, maximum likelihood estimation, the EM-algorithm, Bayes estimation, decision theory. Prerequisites: STAT:5101 and STAT:5120.

STAT:7101 Advanced Inference II 3 s.h.
Hypothesis testing, asymptotics of the likelihood ratio test, asymptotic efficiency, statistical functionals, robustness, bootstrap and jackknife, estimation with dependent data. Prerequisites: STAT:7100.


STAT:7200 Linear Models 4 s.h.
Linear spaces and selected topics in matrix algebra, multivariate normal distribution and distributions of quadratic forms, full rank and non-full rank linear models, estimability, least squares and best linear unbiased estimation, interval estimation, hypothesis testing, random and mixed models, best linear unbiased prediction, variance component estimation. Prerequisites: STAT:5101 and STAT:5200 and STAT:5201.


STAT:7300 Foundations of Probability I 3 s.h.
Probability theory, with emphasis on constructing rigorous proofs; measure spaces, measurable functions, random variables and induced measures, distribution functions, Lebesgue integral, product measure and independence, Borel Cantelli lemma, modes of convergence. Prerequisites: STAT:5120.
STAT:7301 Foundations of Probability II 3 s.h.
Laws of large numbers, characteristic functions and properties, central limit theorem, Radon-Nikodym derivatives, conditional expected value and martingales. Prerequisites: STAT:7300.

STAT:7390 Seminar: Probability arr.

STAT:7400 Computer Intensive Statistics 3 s.h.
Computer arithmetic; random variate generation; numerical optimization; numerical linear algebra; smoothing techniques; bootstrap methods; cross-validation; MCMC; EM and related algorithms; other topics per student/instructor interests. Prerequisites: (BIOS:5710 or STAT:5200) and STAT:3101. Requirements: proficiency in Fortran or C or C++ or Java. Same as IGPI:7400.

STAT:7510 Analysis of Categorical Data 3 s.h.
Models for discrete data, distribution theory, maximum likelihood and weighted least squares estimation for categorical data, tests of fit, models selection. Offered spring semesters. Prerequisites: (BIOS:5720 or STAT:5200) and (STAT:5101 or STAT:4101). Same as BIOS:7410.

STAT:7520 Bayesian Analysis 3 s.h.

STAT:7560 Time Series Analysis 3 s.h.
Stationary time series, ARIMA models, spectral representation, linear prediction inference for the spectrum, multivariate time series, state space models and processes, nonlinear time series. Prerequisites: STAT:4101 and (STAT:3200 or STAT:6560).

STAT:7570 Survival Data Analysis 3 s.h.
Types of censoring and truncation; survival function estimation; parametric inference using exponential, Weibull, and accelerated failure time models; nonparametric tests; sample size calculation; Cox regression with stratification and time-dependent covariates; regression diagnostics; competing risks; topics may include analysis of correlated survival data and/or recurrent events; designed for biostatistics and statistics majors. Offered fall semesters. Prerequisites: BIOS:5720 and ((STAT:4100 and STAT:4101) or (STAT:5100 and STAT:5101)). Same as BIOS:7210, IGPI:7210.

STAT:7990 Reading Research arr.