Statistics (STATS)

COURSES

STATS 1308. ELEMENTARY STATISTICAL ANALYSIS. 3 Hours.
Topics may include collection, analysis, presentation, and interpretation of data. Analysis includes descriptive statistics, probability, relationships between variables and graphs, elementary statistical models, hypothesis testing, inference, estimation, correlation, regression and confidence intervals. The use of mathematical software and calculators is required. See course syllabus for details.

STATS 3302. MULTIVARIATE STATISTICAL METHODS. 3 Hours.
Topics in multivariate data analysis with applications in various areas of interest, including multiple regression, analysis of experimental designs, covariate adjustment, non-linear regression and the use of standard multivariate statistical packages. Offered as MATH 3302 and STATS 3302; credit will be granted in only one department. Prerequisite: C or better in MATH 3313 or STATS 3313 or MATH 3316 or STATS 3316 or MATH 3351 or BIOL 3351 or consent of the instructor.

STATS 3313. INTRODUCTION TO PROBABILITY. 3 Hours.
Basic concepts in probability, random variables, probability distributions, functions of random variables, moment generating functions, central limit theorem and its role in statistics, joint probability functions and joint probability density functions, joint cumulative distribution functions, conditional and marginal probability distributions, covariance and correlation coefficients, transformation and order statistics. Offered as MATH 3313 and STATS 3313; credit will be granted in only one department. Prerequisite: C or better in MATH 2326, or student group.

STATS 3316. STATISTICAL INFERENCE. 3 Hours.
A comprehensive study of basic data analysis, focused on reasoning process of statistical investigations from asking question and collecting data to analyzing data and drawing inferences. Topics include exploratory data analysis, sampling, sampling distribution, estimation, hypothesis tests, regression, and ANOVA, with an emphasis on applications of these techniques using statistical software. Offered as MATH 3316 and STATS 3316; credit will be granted in only one department. Prerequisite: C or better in 6 hours from the following: MATH 1302, MATH 1308, MATH 1322, MATH 1323, MATH 1330, MATH 1331, MATH 1332, MATH 1402, MATH 1421, MATH 1426, MATH 2425, MATH 2326, MATH 3300, MATH 3307, MATH 3314, MATH 3319, or MATH 3330; HONR-SC 1426, HONR-SC 2425, or student group.

STATS 4311. STOCHASTIC MODELS AND SIMULATION. 3 Hours.
A study of processes, whose outcomes are governed by chance, through a combination of lectures and computer lab sessions. Experiments include random number generation, coin tossing and other games of chance, random walks, Markov Chains, Poisson processes, birth-death processes, branching processes, and Brownian Motion. A foundation for modeling random phenomena in sciences, engineering and business. Prerequisite: C or better in MATH 2326 and knowledge of basic probability (MATH 3313/STATS 3313 or MATH 3351/BIOL 3351 or equivalent), or consent of instructor, or student group.

STATS 4313. MATHEMATICAL STATISTICS. 3 Hours.
A continuation of MATH 3313. Random sampling and sampling distributions, estimation of unknown parameters and main properties of estimators, confidence intervals for unknown parameters, testing of hypotheses. Prerequisite: C or better in MATH 3313 or STATS 3313.

STATS 5305. STATISTICAL METHODS. 3 Hours.
Topics include descriptive statistics, numeracy, and report writing; basic principles of experimental design and analysis; regression analysis; data analysis using the SAS package. Prerequisite: consent of the instructor.

STATS 5312. MATHEMATICAL STATISTICS I. 3 Hours.
Random variables and their expectations, some special distributions, moment generating functions, transformations of bivariate random variables, sampling distribution of statistics, Central Limit Theorem, confidence intervals, maximum likelihood estimation, introduction to hypothesis testing, maximum likelihood tests. Prerequisite: MATH 3335 or consent of instructor.

STATS 5313. MATHEMATICAL STATISTICS II. 3 Hours.
Multivariate distributions, consistency and limiting distributions, Rao-Cramer lower bound and efficiency, sufficiency and completeness, most powerful tests, uniformly most powerful tests, likelihood ratio test, the sequential probability ratio test, minimax and classification procedures. Prerequisite: MATH 5312/STATS 5312.

STATS 5314. EXPERIMENTAL DESIGN. 3 Hours.
This course covers the classical theory and methods of experimental design, including randomization, blocking, one-way and factorial treatment structures, confounding, statistical models, analysis of variance tables and multiple comparisons procedures. Prerequisite: MATH 5305/STATS 5305 or MATH 5355/STATS 5355 or permission of instructor.

STATS 5353. APPLIED LINEAR MODELS. 3 Hours.
The course covers, at an operational level, three topics: 1) the univariate linear model, including a self-contained review of the relevant distribution theory, basic inference methods, several parameterizations for experimental design and covariate-adjustment models and applications, and power calculation; 2) the multivariate linear model, including basic inference (e.g. the four forms of test criteria and simultaneous methods), applications to repeated measures experiments and power calculation; and 3) the univariate mixed model, including a discussion of the likelihood function and its maximization, approximate likelihood inference, and applications to complex experimental designs, missing data, unbalanced data, time series observations, variance component estimation, random effects estimation, power calculation and a comparison of the mixed model's capabilities relative to those of the classical multivariate model. Knowledge of the SAS package is required. Prerequisite: MATH 5358/STATS 5358 (Regression Analysis) or equivalent.

STATS 5354. CATEGORICAL DATA ANALYSIS. 3 Hours.
This course covers classical methods for analyzing categorical data from a variety of response/factor structures (univariate or multivariate responses, with or without multivariate factors), based on several different statistical rationales (weighted least squares, maximum likelihood and randomization-based). Included are logistic regression, multiple logit analysis, mean scores analysis, observer agreement analysis, association measures, methods for complex experimental designs with categorical responses and Poisson regression. The classical log-linear model for the association structure of multivariate responses is briefly reviewed. Randomization-based inference (e.g. Mantel-Haenzel) is discussed as well. The necessary distribution theory (multinomial, asymptotics of weighted least squares and maximum likelihood) are discussed at an operational level. Knowledge of the SAS package is required. Prerequisite: MATH 5358, or MATH 5305, or IE 5318 or by consent of instructor.

STATS 5355. STATISTICAL THEORY FOR RESEARCH WORKERS. 3 Hours.
Designed for graduate students not majoring in mathematics. Topics include basic probability theory, distributions of random variables, point estimation, interval estimation, testing hypotheses, regression, and an introduction to analysis of variance. Graduate credit not given to math majors. Prerequisite: calculus MATH 1426/MATH 2425/MATH 2326 or permission of instructor.

STATS 5356. APPLIED MULTIVARIATE STATISTICAL ANALYSIS. 3 Hours.
Statistical analysis for data collected in several variables, topics including sampling from multivariate normal distribution, Hotelling's T'2, multivariate analysis of variance, discriminant analysis, principal components, and factor analysis. Prerequisite: MATH 5312/STATS 5312 or consent of instructor.

STATS 5357. SAMPLE SURVEYS. 3 Hours.
A comprehensive account of sampling theory and methods, illustrations to show methodology and practice, simple random sampling, stratified random sample, ratio estimates, regression estimates, systematic sampling, cluster sampling, and nonsampling errors. Prerequisite: MATH 5312/STATS 5312 or consent of instructor.

STATS 5358. REGRESSION ANALYSIS. 3 Hours.
A comprehensive course including multiple linear regression, non-linear regression and logistic regression. Emphasis is on modeling, inference, diagnostics and application to real data sets. The course begins by developing a toolbox of methods via a sequence of guided homework assignments. It culminates with projects based on consulting-level data analysis problems involving stratification, covariate adjustment and messy data sets. Some knowledge of the SAS package is required. Prerequisites: MATH 5312/STATS 5312 or MATH 5305/STATS 5305 with a B or better or permission of the instructor.

STATS 5359. SURVIVAL ANALYSIS. 3 Hours.
This course covers analysis of lifetime data with applications in engineering and biomedical research. Topics may include survival function, hazard function, cumulative hazard function, parametric distributions to model lifetime data, censoring, Kaplan-Meier estimator, testing for survival times for two or more groups, Cox proportional hazards model (both fixed and time dependent covariate), parametric regression models, regression diagnostics, accelerated failure time models, sample size determination, extensive use of R statistical software. Prerequisites: MATH 5305/STATS 5305 or MATH 5312/STATS 5312 or permission of instructor.

STATS 6353. GENERALIZED LINEAR MODELS. 3 Hours.
This course covers modern methods for analyzing Bernoulli, multinomial and count data. It begins with a development of generalized linear model theory, including the exponential family, link function and maximum likelihood. Second is a discussion of the case of models for independent observations. Next is a discussion of models for repeated measures, based on quasi-likelihood methods. These include models (such as Markov chains) for categorical time series. Next is a treatment of models with random effects. Finally is a discussion of methods for handling missing data. Knowledge of the SAS package is required. Prerequisites: MATH 5358/STATS 5358 (Regression Analysis) and preferably MATH 5313/STATS 5313. (Students without 5313 can still succeed but must deal with the slightly higher mathematical level of this course.).

STATS 6356. TIME SERIES ANALYSIS. 3 Hours.
This course covers classical methods of time series analysis, for both the time and frequency domains. For covariance stationary series, these include ARIMA modeling and spectral analysis. For nonstationary series, they include methods for detrending and filtering. Also included is a treatment of multivariate series, as well as a discussion of the Kalman filter state-space model. Knowledge of the SAS package is required. Prerequisites: MATH 5358/STATS 5358 (Regression Analysis) and MATH 5313/STATS 5313.

STATS 6357. NONPARAMETRIC STATISTICS. 3 Hours.
This is a survey of classical nonparametric methods for inference in standard observational settings (one-sample, two-sample, k-samples and the univariate linear model), and includes a development of U-statistics, rank statistics and their asymptotic distribution theory. The mathematical level is fairly high. Prerequisite: MATH 5313/STATS 5313.

STATS 6390. BAYESIAN DATA ANALYSIS. 3 Hours.
Introduces the Bayesian framework to statistical inference and describes effective approaches for Bayesian modeling and computation. Prerequisite: Mathematical Statistic; statistical computing.