STAT - STATISTICS AND PROBABILITY

STAT400 Applied Probability and Statistics I (3 Credits)
Random variables, standard distributions, moments, law of large numbers and central limit theorem. Sampling methods, estimation of parameters, testing of hypotheses.
Prerequisite: 1 course with a minimum grade of C- from (MATH131, MATH141); or students who have taken courses with comparable content may contact the department.
Cross-listed with: DATA400.
Credit Only Granted for: DATA400, ENEE324, or STAT400.
Additional Information: Not acceptable toward graduate degrees in MATH/STAT/AMSC.

STAT401 Applied Probability and Statistics II (3 Credits)
Point estimation - unbiased and consistent estimators. Interval estimation. Minimum variance and maximum likelihood estimators. Testing of hypotheses. Regression, correlation and analysis of variance. Sampling distributions. Elements of non-parametric methods.
Prerequisite: 1 course with a minimum grade of C- from (STAT400, STAT410).
Additional Information: Not acceptable toward graduate degrees in MATH/STAT/AMSC.

STAT410 Introduction to Probability Theory (3 Credits)
Probability and its properties. Random variables and distribution functions in one and several dimensions. Moments. Characteristic functions. Limit theorems.
Prerequisite: 1 course with a minimum grade of C- from (MATH240, MATH461, MATH341); and 1 course with a minimum grade of C- from (MATH340, MATH241).
Cross-listed with: SURV410.
Credit Only Granted for: STAT410 or SURV410.

STAT420 Theory and Methods of Statistics (3 Credits)
Point estimation, sufficiency, completeness, Cramer-Rao inequality, maximum likelihood. Confidence intervals for parameters of normal distribution. Hypothesis testing, most powerful tests, likelihood ratio tests. Chi-square tests, analysis of variance, regression, correlation. Nonparametric methods.
Prerequisite: 1 course with a minimum grade of C- from (SURV410, STAT410); and a minimum grade of C- from (MATH410).
Cross-listed with: SURV420.
Credit Only Granted for: STAT420 or SURV420.

STAT422 Probability Models (3 Credits)
Random variables, Joint Distributions, Hierarchical Models, Random Samples, Algorithms for generating samples, Markov Chains, Poisson Processes, Stochastic Processes, Simulations.
Prerequisite: Minimum grade of C- in STAT400 or STAT410.
Credit Only Granted for: STAT498J or STAT422.
Formerly: STAT498J.

STAT426 Introduction to Data Science and Machine Learning (3 Credits)
An introductory course to the recent developments in the fields of data science and machine learning. Emphasis will be given to mathematical and statistical understanding of commonly used methods and processes.
Prerequisite: Minimum grade of C- in MATH241 or MATH340; and minimum grade of C- in MATH240, MATH461 or MATH341; and minimum grade of C- in STAT400 or STAT410; students who have taken courses with content comparable to STAT400/410 may request permission of the instructor.
Credit Only Granted for: STAT426 or CMSC320.

STAT430 Introduction to Statistical Computing with SAS (3 Credits)
Descriptive and inferential statistics. SAS software: numerical and graphical data summaries; merging, sorting and splitting data sets. Least squares, regression, graphics and informal diagnostics, interpreting results. Categorical data, lifetime data, time series. Applications to engineering, life science, business and social science.
Prerequisite: 1 course with a minimum grade of C- from (STAT400, STAT410); and must have completed or be concurrently enrolled in STAT401 or STAT420; students who do not meet the STAT401 or STAT420 requirement but who have taken a statistics course may contact the math department to confirm eligibility.

STAT440 Sampling Theory (3 Credits)
Simple random sampling. Sampling for proportions. Estimation of sample size. Sampling with varying probabilities. Sampling: stratified, systematic, cluster, double, sequential, incomplete.
Prerequisite: 1 course with a minimum grade of C- from (STAT401, STAT420).
Credit Only Granted for: STAT440 or SURV440.

STAT464 Introduction to Biostatistics (3 Credits)
Probabilistic models. Sampling. Some applications of probability in genetics. Experimental designs. Estimation of effects of treatments. Comparative experiments. Fisher-Irwin test. Wilcoxon tests for paired comparisons.
Prerequisite: 1 course with a minimum grade of C- from (MATH120, MATH136, or MATH140);.
Restriction: Junior standing or higher.
Credit Only Granted for: BIOE372 or STAT464.
Additional Information: Not acceptable toward degrees in MATH/STAT.

STAT470 Actuarial Mathematics (3 Credits)
Major mathematical ideas involved in calculation of life insurance premiums, including compound interest and present valuation of future income streams; probability distribution and expected values derived from life tables; the interpolation of probability distributions from values estimated at one-year multiples; the 'Law of Large Numbers' describing the regular probabilistic behavior of large populations of independent individuals; and the detailed calculation of expected present values arising in insurance problems.
Prerequisite: 1 course with a minimum grade of C- from (STAT400 or STAT410); and 1 course with a minimum grade of C- from (MATH340, MATH241).
Recommended: STAT400.

STAT498 Selected Topics in Statistics (1-6 Credits)
Topics of special interest to advanced undergraduate students will be offered occasionally under the general guidance of the MATH/STAT major committee. Students register for reading in statistics under this number.
Restriction: Permission of CMNS-Mathematics department.
Repeatable to: 16 credits.

STAT600 Probability Theory I (3 Credits)
Probability space; distribution functions and densities; Poissson limit theoreom; de Moivre-Laplace theorem; measure-theoretic definition of expectation; classification of measures on R; convergence of random variables; Radon-Nikodym theorem;LP spaces; conditional probabilities; independence of events, sigma-algebras and random variables; Bayes' theo rem; pi-systems and Dynkin systems; discrete Markov chains; random walks; gambler's ruin problem; Markov chains on a general phase space; Borel-cantelli lemmas; Kolmogorov inequality; three series theorem; laws of large numbers.
Prerequisite: STAT410.

STAT601 Probability Theory II (3 Credits)
Weak convergence of measures; characteristic functions; Central Limit Theorem and local limit theorem; stable laws; Kolmogorov consistency theorem (without proof); conditional expectations and martingales; optimal stopping theorem; convergence of martingales; Brownian motion; Markov processes and families; stochastic integral and Ito formula.
Prerequisite: STAT600.

STAT650 Applied Stochastic Processes (3 Credits)
Basic concepts of stochastic processes. Markov processes (discrete and continuous parameters), Random walks, Poisson processes, Birth and death processes. Renewal processes and basic limit theorems. Discrete time martingales, stopping times, optional sampling theorem. Applications from theories of stochastic epidemics, survival analysis and others.
Prerequisite: STAT410; or students who have taken courses with comparable content may contact the department.

STAT658 Advanced Applied Stochastic Processes II (3 Credits)
Advanced topics in applied stochastic processes, rotating among the headings of queueing theory, population proceses, and regenerative phenomena. Course includes disucssion of stochastic models and fields of application, Markov process theory including calculation and characterization of stationary distributions and diffusion approximations, renewal theory and Wiener-Hopf factorization theory.
Prerequisite: STAT650; and must have completed a graduate course in analysis. Or permission of instructor.
Recommended: STAT601 and STAT600.
Repeatable to: 6 credits if content differs.

STAT689 Research Interactions in Statistics (1-3 Credits)
The students participate in a vertically integrated (undergraduate, graduate and/or postdoctoral, faculty) research group. Format varies, but includes regular meetings, readings and presentations of material. See graduate program's online syllabus or contact the graduate program director for more information.
Restriction: Permission of instructor.
Repeatable to: 6 credits if content differs.

STAT698 Selected Topics in Probability (1-4 Credits)

STAT700 Mathematical Statistics I (3 Credits)
Sampling distributions including noncentral chi-squared, t, F. Exponential families, completeness. Sufficiency, factorization, likelihood ratio. Decision theory, Bayesian methods, minimax principle. Point estimation. Lehmann-Scheffe and Cramer-Rao theorems. Set estimation.
Prerequisite: STAT410; or students who have taken courses with comparable content may contact the department.

STAT701 Mathematical Statistics II (3 Credits)
Testing hypotheses: parametric methods. Neyman-Pearson lemma. Uniformly most powerful tests. Unbiased tests. Locally optimal tests. Large sample theory, asymptotically best procedures. Nonparametric methods, Wilcoxon, Fisher-Yates, median tests. Linear models, analysis of variance, regression and correlation. Sequential analysis.
Prerequisite: STAT700; or students who have taken courses with comparable content may contact the department.

STAT702 Survival Analysis (3 Credits)
Concepts/definitions of survival functions, hazard rate or hazard function, cumulative hazard functions, mean residual life, inversion formulas; Parametric models: exponential distribution, Weibull distribution; Censored/incomplete data and real data examples; right censored data, doubly censored data, interval censored data, truncated data; Nonparametric maximal likelihood estimator for the lifetime distribution under different types of censoring (e.g., Kaplan-Meier estimator), self-consistency estimators, the EM algorithm, applications of the empirical likelihood; Semiparametric models: accelerated lifetime model, proportional hazard model, the Cox model; Goodness of fit tests and diagnostic methods for model checking.
Prerequisite: STAT410 and STAT420; or students who have taken courses with comparable content may contact the department; or permission of instructor.

STAT705 Computational Statistics (3 Credits)
Modern methods of computational statistics and their application to both practical problems and research. S-Plus and SAS programming with emphasis on S-Plus. S-Plus objects and functions, and SAS procedures. Topics include data management and graphics, Monte Carlo and simulation, bootstrapping, numerical optimization in statistics, linear and generalized linear models, nonparametric regression, time series analysis.
Prerequisite: STAT700 or STAT420.
Recommended: Have some programming experience (any language).
Credit Only Granted for: STAT705 or STAT798C.
Formerly: STAT798C.

STAT707 Bayesian Statistics (3 Credits)
The essentials of Bayesian statistics with some advanced topics. Basic statistical decision theory. Bayesian paradigm. Prior and posterior distributions. Conjugate family. Hierarchical models. Bayesian linear regression. Bayes factors. Markov chain Monte Carlo. Metropolis-Hastings algorithm. Gibbs sampler. Bernstein von-Mise theorem. Posterior consistency. Potential advanced topics include variational Bayes, empirical Bayes, Bayesian inference of high-dimensional data and Bayesian non-parametric inference.
Prerequisite: STAT700; or permission of instructor .
Credit Only Granted for: STAT700 or STAT818B.
Formerly: STAT818B.

STAT712 Statistical Learning Theory (3 Credits)
Covers statistical machine learning and empirical process theory. The topics to be covered include: basics of statistical decision theory; concentration inequalities; supervised and unsupervised learning; empirical risk minimization; complexity-regularized estimation; generalization bounds for learning algorithms; VC dimension and Rademacher complexities; minimax lower bounds; online learning and optimization. Additionally, we will explore applications of these theories in areas like variational Bayes, high-dimensional statistics, generative model estimation, and various machine learning problems.
Prerequisite: STAT700, STAT701, STAT740, and STAT741.

STAT730 Time Series Analysis (3 Credits)
The methodology of probabilistic description and statistical analysis of (primarily stationary) random sequences and processes. Correlation functions, Gaussian processes, Hilbert-space methods including Wold decomposition and spectral representation, periodogram and estimation of spectral densities, parameter estimation and model identification for ARMA processes, linear filtering, Kalman-Bucy filtering, sampling theorems for continuous-time series, multivariate time series.
Prerequisite: STAT700; and must have completed a graduate course in analysis. Or permission of instructor.
Recommended: STAT701 and STAT650.

STAT740 Linear Statistical Models I (3 Credits)
Least squares, general linear models, estimability and Gauss-Markov theorem. Simple and multiple linear regression, analysis of residuals and diagnostics, polynomial models, variable selection. Qualitative predictors, one and two way analysis of variance, multiple comparisons, analysis of covariance. Nonlinear least squares. High-level statistical computer software will be used for data analysis throughout the course.
Prerequisite: STAT700 or STAT420.

STAT741 Linear Statistical Models II (3 Credits)
Continuation of STAT 740. Multiway layouts, incomplete designs, Latin squares, complete and fractional factorial designs, crossed and nested models. Balanced random effects models, mixed models, repeated measures.General mixed model, computational algorithms, ML and REML estimates. Generalized linear models, logistic and loglinear regression.
Prerequisite: STAT740.

STAT750 Multivariate Analysis (3 Credits)
Multivariate normal, Wishart's and Hotelling's distributions. Tests of hypotheses, estimation. Generalized distance, discriminant analysis. Regression and correlation. Multivariate analysis of variance; distribution of test criteria. Principal components, canonical correlations and factor analysis.
Prerequisite: STAT700 or STAT420.

STAT760 Statistics Practicum (3 Credits)
A semester long applied statistical project or statistical consulting project (a minimum 10 hours per week or 120 hours in total), in an internship of collaborative research-laboratory setting working on a substantive applied quantitative project with significant statistical content.
Prerequisite: Must have completed one year of graduate study in Mathematical Statistics.
Restriction: Permission of the Department of Mathematics .
Additional Information: Students must have project proposal approved by Statistics Director and Statistics Consulting Center Director.

STAT770 Analysis of Categorical Data (3 Credits)
Loglinear and logistic models. Single classification, two-way classification; contingency tables; tests of homogeneity and independence models, measures of association, distribution theory. Bayesian methods. Incomplete contingency tables. Square contingency tables - symmetry. Extensions to higher dimensional contingency tables.
Prerequisite: STAT430 and STAT420; or permission of CMNS-Mathematics department.

STAT798 Selected Topics in Statistics (1-4 Credits)

STAT799 Master's Thesis Research (1-6 Credits)

STAT808 Selected Topics in Probability (1-3 Credits)
Advanced topics of current interest.
Restriction: Permission of instructor.
Repeatable to: 18 credits.

STAT818 Selected Topics in Statistics (1-3 Credits)
Advanced topics of current interest.
Restriction: Permission of instructor.
Repeatable to: 18 credits.

STAT898 Pre-Candidacy Research (1-8 Credits)

STAT899 Doctoral Dissertation Research (1-8 Credits)