STATISTICS

STAT-1301 (3) Statistical Analysis I (3 hrs Lecture) This course introduces students in the natural, physical, social and human sciences to elementary statistical analysis and its applications. Topics include: descriptive statistics; probability theory; discrete random variables and their expected values and variances; normal distribution and applications; sampling distributions; estimation of parameters; and statistical inference for one population.
Restrictions: Students may not hold credit for this course and STAT-1401 | STAT-1501.
Requisite Courses: Pre-Calculus Math 40S or Applied Math 40S [prerequisite(s)].

STAT-1302 (3) Statistical Analysis II (3 hrs Lecture) This course is an extension of STAT-1301(3). Topics include: review of statistical inference for one population; statistical inference for two populations; chi-square tests; analysis of variance; goodness-of-fit tests and contingency tables; linear regression and correlation; and non-parametric procedures.
Restrictions: Students may not hold credit for this course and PSYC-2101 | STAT-1201 | STAT-1601 | STAT-2001.
Requisite Courses: STAT-1301, STAT-1401, or STAT-1501 [prerequisite(s)].

STAT-1401 (3) Statistics I for Business and Economics (3 hrs Lecture) This course introduces students in business and economics to statistical analysis and applications. Students learn to graph and analyze data using Excel. Topics include descriptive statistics, basic probability including counting techniques, discrete random variables and their expected values and variances, the normal probability distribution and its applications, sampling distributions, hypothesis testing and estimation of parameters.
Restrictions: Students may not hold credit for this course and STAT-1301 | STAT-1501.
Requisite Courses: Pre-Calculus Mathematics 40S or Applied Mathematics 40S [prerequisite(s)].

STAT-1501 (3) Elementary Biological Statistics I (3 hrs Lecture) This course provides students in the biological and health sciences with an introduction to data analysis and statistical inference. Topics include: descriptive statistics; probability concepts; Bayes' Theorem; screening tests; discrete probability distributions; uniform and normal distributions; sampling distributions; and statistical inference for one population. Applications are drawn from biology, chemistry and other sciences.
Restrictions: Students may not hold credit for this course and STAT-1301 | STAT-1401.
Requisite Courses: Pre-Calculus Mathematics 40S or Applied Mathematics 40S [prerequisite(s)].

STAT-2001 (3) Elementary Biological Statistics II (3 hrs Lecture) This course is an extension of STAT-1501 (3). Topics include: a review of statistical inference for one population; statistical inference for two populations; analysis of variance for completely randomized and randomized block designs, including contrasts and multiple comparisons; analysis of qualitative data based on the chi-square distribution, including goodness-of-fit tests; relative risk and odds ratios; regression and correlation analyses; and nonparametric procedures. Applications are drawn from biology, chemistry and other sciences.
Restrictions: Students may not hold credit for this course and PSYC-2101 | STAT-1201 | STAT-1302 | STAT-1601.
Requisite Courses: STAT-1301, STAT-1401, or STAT-1501 [prerequisite(s)].

STAT-2102 (3) Business and Management Statistics (3 hrs Lecture) This course surveys quantitative management science techniques used in both the private sector and government. The contents include classical decision-making, utility for money, statistical and Bayesian decision-making, decision trees, index numbers and their properties, elementary quality control, and decomposition of time series and seasonal and cyclical analysis. Emphasis will be on having students communicate effectively through essays and term projects.
Requisite Courses: STAT-1302 or STAT-2001 [prerequisite(s)].

STAT-2103 (3) Intermediate Biological Statistics (3 hrs Lecture) This course provides students with the underlying concepts and techniques for applying biometrical procedures to problems arising in biological and medical research. Topics include basic experimental designs and models for one-factor analysis of variance, multiple comparison procedures, data transformations, introductory multiple linear regression analysis, analysis of count data, Poisson index of dispersion, inference about the Poisson parameter, analysis of proportions, analysis of covariance with one factor and one covariate, and biological assay (analysis of quantal response, probit and/or logit transformations, parallel line assays and slope-ratio assays. Logistic regression with one regressor variable may also be covered.
Requisite Courses: STAT-1302 or STAT-2001 [prerequisite(s)].

STAT-2104 (3) Nonparametric Statistics (3 hrs Lecture) This course considers statistical methods for analysing data when the distribution of the population is unknown and/or the measurement is on a nominal, ordinal, or interval scale. The contents include inference based on the binomial distribution, the Mann-Whitney-Wilcoxon test, the Wilcoxon signed rank test, measures of association for ranked data, the Kruskal-Wallis and Friedman tests, and elements of contingency table analysis.
Requisite Courses: STAT-1302, or the former STAT-1201, or both STAT-1501 and STAT-2001 or the former STAT-1601 [prerequisite(s)].

STAT-2301 (3) Survey Sampling I (3 hrs Lecture) This course emphasizes practical aspects of conducting sample surveys. Some of the sample survey designs that are examined include simple random sampling, stratified random sampling, systematic sampling and cluster sampling. The course also deals with Horvitz-Thompson estimator as well as ratio and regression type estimators. The statistical software R is used throughout the course and applications

to real-life data are an integral part of the course.
Note: This course is of interest not only to Statistics majors but also to students of Business, Economics, Sociology, Environmental Sciences and other social sciences.
Requisite Courses: STAT-1302 or STAT-2001 [prerequisite(s)].

STAT-2413 (3) Introduction to Mathematical Finance (3 hrs Lecture) This course gives an introduction to the mathematics of finance, an area of applied mathematics concerned with financial markets. Topics include present value analysis; geometric Brownian motion and its suitability as a model of stock prices; option pricing; the Arbitrage Theorem; derivations of the Black-Scholes formula; and portfolio selection. The approach emphasizes underlying mathematical tools and their derivation.
Restrictions: Students may not hold credit for this course and MATH-2413.
Requisite Courses: MATH-1201, either STAT-1301, STAT-1401 or STAT-1501, and either MATH-1103, MATH-1101, or MATH-1102 [prerequisite(s)].

STAT-2612 (3) Mathematical Statistics I (3 hrs Lecture) This course provides students with a firm foundation in probability theory, which is necessary for a complete understanding of advanced statistics. Topics include combinatorial methods, probability, random variables, probability distributions and densities, joint and conditional distributions, mathematical expectation, special discrete probability distributions, and the continuous uniform and exponential distributions. Exam, term tests and assignments are utilized for student evaluation.
Cross-listed: MATH-2612.
Restrictions: Students may not hold credit for this course and MATH-2612 | MATH-3611 | STAT-3611.
Requisite Courses: STAT-1302 or STAT-2001 [prerequisite(s)]; MATH-2105(3) (must be taken previously or at the same time as this course).

STAT-2702 (3) Statistics for Epidemiology (3 hrs Lecture) This course provides a comprehensive introduction to the basic concepts, principles, and methods of studying disease occurrence in human populations. It covers the applications of epidemiology in public health practice and preventive medicine. Topics include: definitions, measures of disease frequency and effect, measures of risk, diagnostic and screening tests, epidemiological study designs, causality, interaction, bias, confounding, and internal and external validity. The class may be interspersed with special selected topics.
Restrictions: Students may not hold credit for this course and STAT-3701.
Requisite Courses: STAT-1302 or STAT-2001 [prerequisite(s)].

STAT-2903 (3) Statistical Computing I (3 hrs Lecture | 1.5 hrs Lab) This course introduces the use of modern statistical computer packages for data management and data analysis. Topics include introduction to statistical programming language R, pseudo random number generation, simulation of discrete and continuous random variables, test of one and two sample means and proportions, linear regression, analysis of contingency tables, non-parametric statistics and ANOVA.
Requisite Courses: STAT-1302 or STAT-2001 [prerequisite(s)]; STAT-2903L (lab) (must be taken concurrently).

STAT-3102 (3) Applied Multivariate Methods (3 hrs Lecture) This course introduces students to the concepts and procedures of multivariate statistical analysis. Analysis and interpretation of multivariate data are emphasized. Topics include: matrix algebra, random vectors from two populations, multivariate analysis of variance, discriminant analysis, cluster analysis, and one of the following topics: factor analysis, canonical correlation analysis, correspondence analysis. *R* statistical software is used to facilitate most analyses.
Requisite Courses: MATH-1201 and either STAT-1302 or STAT-2001 [prerequisite(s)].

STAT-3103 (3) Applied Regression Analysis (3 hrs Lecture) This course provides students with the skills necessary to perform regression analyses and to interpret statistical issues related to regression applications in many areas, especially in health sciences. Topics include linear and nonlinear regression models, residual diagnostics, multicollinearity, model selection, transformations and weighted least squares, measures of influence and generalized linear models with a focus on logistic and Poisson regression. The statistical software R or SAS is used throughout the course and applications to real-life data are an integral part of the course.
Requisite Courses: STAT-1302 or STAT-2001, and MATH-1201 [prerequisite(s)].

STAT-3104 (3) Analysis of Variance and Covariance (3 hrs Lecture) This course provides students with insight into the practice of statistical research. Emphasis is placed upon the development of various analysis of variance (ANOVA) models for single-factor and multi-factor studies. Topics are chosen from design and analysis of completely randomized, randomized block, Latin square designs and the analysis of covariance (ANCOVA). Random, fixed and mixed effects models as well as sample size determination, power analysis, diagnostics and remedial measures are discussed. Split-plot, nested, partially nested and repeated measure designs may be presented.
Requisite Courses: STAT-1302 or STAT-2001 [prerequisite(s)].

STAT-3105 (3) Time Series and Forecasting (3 hrs Lecture) The course deals with the general problem of analysing data which is ordered over time, for the purpose of forecasting and statistical prediction. Such data do not represent an independent sample and thus can not be analyzed using other statistical methods. Topics include: trend analysis, smoothing by moving averages, seasonal indices; forecasting using exponential smoothing and Box-Jenkins models.
Restrictions: Instructor Permission Required. Students may not hold credit for this course and STAT-2601.
Requisite Courses: STAT-3103 [prerequisite(s)].

STAT-3302 (3) Survey Sampling II (3 hrs Lecture) Statistical agencies have long collected data of interest to

governments to inform the development of public policy through surveys. This course emphasizes some key theoretical and practical aspects of survey methodology. Some important unequal probability sampling designs such as probability proportional to size sampling and multi-stage sampling are studied. The Horvitz-Thompson, generalized regression and calibration estimators and their properties are investigated. This course also covers practical methods for dealing with missing survey data, such as imputation. *R* statistical software is used to facilitate some analyses.
Requisite Courses: STAT-2301 with a minimum grade of C, and STAT-2612|MATH-2612 (or the former STAT-3611|MATH-3611) [prerequisite(s)].

STAT-3412 (3) Introduction to Operations Research (3 hrs Lecture) This course provides a practical introduction to the formulation and solution of some economics and industrial problems using Operations Research models. It emphasizes model-building and problem-solving using computer packages. Topics covered are chosen from linear programming, transportation, assignment and transshipment problems, network models, integer programming, nonlinear programming, decision making, inventory models, and queuing theory.
Cross-listed: MATH-3412(3).
Restrictions: Students may not hold credit for this course and MATH-3412.
Requisite Courses: MATH-1201 or MATH-2201 or ECON-3201 or permission of the instructor [prerequisite(s)].

STAT-3501 (3) Simulation (3 hrs Lecture | Lab) This course is designed to show students how a computer can be utilized to model phenomena with stochastic elements and how analysis can be carried out in the context of a simulation study. Topics will be drawn from the following: generating an arbitrary random variable; the discrete event simulation approach; variance reduction techniques; statistical validation techniques; bootstrapping and other resampling methods; statistical analysis of simulated data; and simulation languages.
Requisite Courses: STAT-2612 or MATH-2612 (or the former MATH-3611 or STAT-3611) and STAT-2903 or permission of the instructor [prerequisite(s)].

STAT-3612 (3) Mathematical Statistics II (3 hrs Lecture) This course studies the continuous probability distributions and their general properties, distributions of functions of random variables, sampling distributions, including t and F and introduction to estimation and theory of hypotheses testing.
Cross-listed: MATH-3612(3).
Restrictions: Students may not hold credit for this course and MATH-3612.
Requisite Courses: STAT-2612|MATH-2612 (or the former STAT-3611|MATH-3611) [prerequisite(s)]; MATH-2106 (must be taken previously or at the same time as this course).

STAT-3904 (3) Statistical Computing II (3 hrs Lecture) This course introduces modern techniques of statistical computing for practical analysis of data using the statistical software R. Topics include random number generation, an introduction to resampling methods, classical and Bayesian inference and Monte Carlo methods, methods of finding roots, numerical integration methods, expectation-maximization, and Markov chain Monte Carlo. All statistical principles are illustrated using simulated and real-life data sets.
Requisite Courses: STAT-2903 or STAT-3103 [prerequisite(s)]; STAT-3612 or MATH-3612 (must be taken previously or at the same time as this course).

STAT-4102 (3) Survival Analysis (3 hrs Lecture | Lab) This course introduces the core concepts and methods for analyzing time-to-event (survival) data obtained from various epidemiological and medical applications. Topics include: an introduction to survival analysis; right censoring and left truncation; life tables, non-parametric estimators (e.g., Kaplan-Meier); Log-rank test; parametric methods for analyzing survival data (e.g., exponential model, Weibull model); semi parametric methods (e.g., Cox proportional hazards model).
Requisite Courses: STAT-2612 or MATH-2612 (or the former STAT-3611 or MATH-3611 or STAT-3201 or STAT-2701) [prerequisite(s)].

STAT-4103 (3) Statistical Learning (3 hrs Lecture) This course deals with a variety of topics in statistical learning and their implementation in R. Topics include introduction to statistical learning methods; review of linear regression; use of LASSO and ridge regression techniques to identify useful explanatory variables; understanding the practical difference between predictive outcomes from parametric and non parametric methods; implementation of several ensemble learning methods; clustering methods and dimension reduction; employing reasonable programming practices with basic R syntax and functions; report writing for projects using standard software. Students who major in Data Science are encouraged to take ACS-4953 prior taking this course.
Requisite Courses: STAT-3103 [prerequisite(s)].

STAT-4202 (3) Statistical Inference (3 hrs Lecture) This course expands on Mathematical Statistics II. Topics include the following: Theory of point and interval estimations; completeness and minimal sufficiency, Rao-Blackwell theorem; theory of tests and hypotheses; likelihood ratio tests; unbiased and invariant tests; sequential probability ratio tests; and Bayesian Inference.
Requisite Courses: STAT-3612 or MATH-3612 or permission of the instructor [prerequisite(s)].

STAT-4401 (3) Probability Theory (3 hrs Lecture) This course is a continuation of Mathematical Statistics I (STAT-3611 (formerly STAT-3201 or Applied Probability STAT-2701)) and is intended to give students a firm foundation in probability theory. Topics include random walks, characteristic functions and central limit theorem concepts of convergence, laws of large numbers, and martingales and stochastic differential equations.
Requisite Courses: STAT-2612 or MATH-2612 (or the former STAT-3611/MATH-3611) or permission of the instructor [prerequisite(s)].

STAT-4501 (3) Spatial Statistics (3 hrs Lecture | 1.25 hrs

Lab) This course considers the theory and application of statistical techniques for analysis of spatial (geographic) data. Topics include: characteristics of spatial data, types of maps and issues in mapping, spatial analysis of areal units (Moran's I statistic and extensions), point pattern analysis (centrography, measures of density, distance and dispersion), spatial statistics for fields (spacial interpolation, semivariogram and kriging) location quotient, Gini index and Lorenz curve. Use of R statistical software and some spreadsheet software is required. Examples are drawn from demography, developmental practice geography, epidemiology, environmental science, and biology.
Requisite Courses: STAT-1302 or STAT-2001 or GEOG-2309 or the former STAT-1201 or STAT-1601 [prerequisite(s)]; STAT-4501L (lab) (must be taken concurrently).

STAT-4601 (3) Statistical Design of Experiments (3 hrs Lecture) This course explores basic principles of statistical experimental design including randomization; replication; blocking; confounding; nested versus crossed factors; split-plot designs; fixed, random and mixed models; and the contrast between designed experiments and observational studies. It investigates factorial and fractional factorial designs with an emphasis on 2k factorial designs and 2k-p fractional factorial designs. Other potential topics include robust parameter design, 3k-p fractional factorial designs, balanced incomplete block designs, mixture experiments, and response surface methodology.
Requisite Courses: STAT-3104 [prerequisite(s)].