SOUTH ASIAN LANGUAGES

See Linguistics and Oriental and African Languages.

SPANISH

See Romance Languages.

STATISTICS AND PROBABILITY STT

College of Natural Science

Introductory courses are further classified as follows:

315, 316—sequence for undergraduate students of Business Administration.

201—survey course.

421, 422, 423—minimal sequence for students planning to use statistical methods in their research.

441, 442, 443—minimal sequence in theory of statistics. Qualified students should take the 861, 862, 863 sequence instead.

861, 862, 863—sequence for students preparing to do advanced work in statistics.

881, 882, 883—sequence in analytic probability theory and stochastic processes at graduate mathematics level.

201. *Statistical Methods*

Fall, Winter, Spring, Summer. 4(4-0) MTH 108 or 111. Primarily for students in psychology, sociology, anthropology, political science, economics, agriculture, and forestry. Credit may not be earned in more than one of the following: 201, 315, 421.

Descriptive statistics, elementary probability and combinatorics. The binomial distribution. Random variables, their expectations and variances. Central Limit Theorem, estimation and inference. Simple tests based on the binomial, normal, t, chi-square and F distributions.

315. *Introduction to Probability*

(121.) Fall, Winter, Spring, Summer. 4(5-0) MTH 111. Credit may not be earned in more than one of the following: 201, 315, 421.

Set and algebra of sets. Chance experiments, outcomes and events. Probabilities of events. Conditional probability, independent trials, Bayes' theorem. Introduction to statistical inference relevant to business decision problems.

316. *Fundamentals of Statistical Inference*

Fall, Winter, Spring, Summer. 4(5-0) 315. Primarily for students in the College of Business. Interdepartmental with the Marketing and Transportation Administration Department.

Description of sample data, applications of probability theory, sampling, estimation, tests of hypotheses.

317. *Quantitative Business Research Methods*

Fall, Winter, Spring, Summer. 4(3-2) 316. Interdepartmental with and administered by the Marketing and Transportation Administration Department.

Application of statistical techniques to business decision-making. Topics covered include applications of linear regression and correlation, analysis of variance, selected non-parametric tests, time series, and index numbers.

341. *Probability for Teachers*

Spring. 4(4-0) MTH 301 or approval of department.

Primarily for majors in mathematical education. Probability theory will be studied as a mathematical structure. Although some examples of the use of the theory will be discussed (as the use of some theorems is discussed in a course in plane geometry) the major emphasis will be on understanding the structure of probability theory.

351. *Introduction to Statistics*

Spring. 4(4-0) MTH 214.

Probability models, discrete random variables, the binomial, hyper-geometric and Poisson distributions, statistical inference based on the binomial distribution, continuous random variables, test of hypothesis and confidence intervals based on the normal distribution.

421. *Statistics I*

Fall, Winter, Spring, Summer. 4(4-0) MTH 108. Credit may not be earned in more than one of the following: 201, 315, 421. This course and 422, 423 form a one year sequence in statistics for those without a calculus background; 421 provides an introduction to a few of the main ideas of probability and statistics. The course sequences 441-2-3 and 861-2-3 form one year sequences in statistics for those with a calculus background. Those expecting to use statistics in their graduate research should complete one of the full year sequences.

Descriptive statistics, elementary probability and combinatorics. The binomial distribution. Random variables, their expectations and variances. The Central Limit Theorem, Estimation and inference. Simple tests based on the binomial, normal, t, chi-square and F distributions.

422. *Statistics II*

Fall, Winter, Spring, Summer. 3(3-0) 421.

Nonparametric tests: sign test, Wilcoxon's rank sum test, Spearman's rank correlation test, run tests. Multiple regression analysis. Least squares estimation and tests for simple linear hypotheses.

423. *Statistics III*

Fall, Winter, Spring, Summer. 3(3-0) 422.

Application of multiple regression analysis to analysis of variance problems. Design of experiments including randomized block designs. Latin squares, factorial designs, and balanced incomplete block designs.

441. *Probability and Statistics I: Probability*

Fall, Winter, Spring, Summer. 4(4-0) MTH 215.

Mathematical probability as a basis for the theory of statistics. Discrete and continuous probability models, conditional probability and independence, random variables, central limit theorem, sampling distributions.

442. *Probability and Statistics II: Inference*

Winter, Spring. 4(4-0) 441; MTH 334 or concurrently.

Estimation, confidence intervals, test of hypotheses, linear hypotheses.

443. *Probability and Statistics III: Inference*

Fall, Spring. 4(4-0) 442.

Multiple linear regression, analysis of variance, goodness of fit tests, certain non-parametric tests.

490. *Statistical Problems*

Fall, Winter, Spring. 1 to 6 credits. Approval of department.

Individualized study adapted to the preparation and interests of the student.

825. *Sample Surveys*

Fall. 3(3-0) 423 or 442 or 862.

Application of statistical sampling theory to survey designs involving simple random, stratified, and systematic samples; sub-sampling, double sampling; ratio and regression estimates; other topics.

826. *Nonparametric Statistics*

Spring. 4(4-0) 442 or 862.

Current tests of hypotheses which may be made without specification of the underlying distribution. Rank tests and tests based on permutation of observations. Tolerance and confidence sets. Large-sample distributions. Applications to research in the social and natural sciences.

833. *Mathematical Programming*

Spring. 3(3-0) EC 800, or 812A, MTH 334. Interdepartmental with the Agricultural Economics and Economics Departments and administered by the Agricultural Economics Department.

Linear programming. Theory of linear economic models. Topics in nonlinear programming.

841. *Linear Statistical Models*

Fall. 4(4-0) 443 or 863.

Use of linear statistical models. Curve fitting, simple and multiple regression analysis, multiple and partial correlation coefficients, the analysis of variance, simultaneous confidence intervals, more complex experimental designs.

852. *Methods in Operations Research I*

Winter. 3(3-0) 441 or 861.

Optimization techniques and probability models with a wide variety of applications: linear programming, including special problems; network analysis, including PERT; dynamic programming; game theory; queuing theory. Acquaintance with matrices advisable.

853. *Methods in Operations Research II*

Spring. 3(3-0) 852.

Continuation of 852. Inventory theory; Markov chains with applications; simulation as adjunct to mathematical models; advanced topics in linear programming; non-linear programming.

861. *Theory of Probability and Statistics I*

Fall. 4(4-0) MTH 424 or 427 or concurrently.

Discrete probability models, random variable expectation, combinatorial analysis, conditional probability and independence, generating functions, some special discrete distributions, continuous probability models.

862. *Theory of Probability and Statistics II*

Winter. 4(4-0) 861; MTH 425 or 428 or concurrently.

Continuous probability models, density transformations, some special continuous distributions, limit laws. Introduction to statistical inference, estimation of parameters, hypothesis testing.

863. *Theory of Probability and Statistics III*

Spring. 4(4-0) 862; MTH 334, 426 or 429 or concurrently.

Continuation of hypotheses testing, sufficiency, Rao-Blackwellization, some non-parametric methods, linear models.

864. *Stochastic Models in Biology*

Fall. 3(3-0) 441 or 861.

Stochastic processes. Selected topics from growth processes, epidemic theory, prey-predator models, mathematical genetics.

865. *Theory of Experimental Designs*

Fall. 4(4-0) 863 and MTH 831 or approval of department.

Experimentation: Cochran's theorem; review of sampling theory; simple designs and statistical analyses; factorial designs and confounding and the group theoretic aspects of these designs; geometrical problems of construction of sets of Latin and Graeco-Latin squares.

871. *Statistical Decision Theory I*

Fall. 4(4-0) 863; MTH 821 or concurrently.

The general statistical decision problem. Concepts of loss function, risk, admissibility, completeness, minimax and Bayes procedures and reductions due to sufficiency and invariance. The minimax and complete class theorems. Some distributions and sufficient statistics.

872. *Statistical Decision Theory II*

Winter. 4(4-0) 871; MTH 822 or concurrently.

Exponential families, complete sufficient statistics. Invariant statistical decision problems. Estimation of parameters and testing statistical hypotheses.

873. *Statistical Decision Theory III*

Spring. 4(4-0) 872; MTH 927 or concurrently; or approval of department.

Continuation of hypotheses testing, the two-sample problem, confidence sets, and the general linear hypothesis. Multiple decision problems.

876. *Statistical Inference in Economics I*

Fall. 3(3-0) 443 or 863; EC 812A or 801; or approval of department. Interdepartmental with the Agricultural Economics and the Economics Departments and administered by the Economics Department.

Review and extension of single-equation regression models. Properties of least-squares estimators under alternative specifications. Problems of analyzing nonexperimental data. Errors in variable, autoregressive and heteroscedastic models.

877. *Statistical Inference in Economics II*

Winter. 3(3-0) EC 876 or approval of department. Interdepartmental with the Agricultural Economics and Economics Departments and administered by the Economics Department.

Specification interpretation and estimation of simultaneous equation models. Nonlinear models. Bayesian approach to estimation problems. Recent developments in econometrics.

878. *Statistical Inference in Economics III*

Spring. 3(3-0) EC 877 or approval of department. Interdepartmental with the Agricultural Economics and Economics Departments and administered by the Economics Department.

Validation and application of dynamic econometric models. Bayesian approach to estimation problems. Recent developments in econometric methods and in applied econometric research.

881. *Probability and Stochastic Processes I*

Fall. 3(3-0) MTH 821 or concurrently.

Discrete probability models, dependence and independence, random variables and expectation. Exponential and uniform densities. Special densities and mixtures. Multivariate densities. Probability distributions in R^r.

882. *Probability and Stochastic Processes II*

Winter. 3(3-0) MTH 822 or concurrently.

Laws of large numbers, applications in analysis. Basic limit theorems. Markov processes and semi-groups. Renewal theory. Random walks in R^1.

883. *Probability and Stochastic Processes III*

Spring. 3(3-0) MTH 823 or concurrently.

Laplace transforms, Tauberian theorems, resolvents. Applications of Laplace transforms. Characteristic functions. Application of Fourier methods to random walks. Harmonic analysis.

886. *Stochastic Processes and Technological Applications*

Winter. 3(3-0) 441 or 861.

Discrete stochastic processes. Markov chains, birth and death processes, branching processes. Selected technological applications.

887. *Stochastic Models in the Physical Sciences*

Spring. 3(3-0) 886 or approval of department.

Selected models from the physical sciences. These may include topics from the theory of queues, the theory of dams, and branching processes in cosmic ray theory.

890. *Statistical Problems*

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

899. *Research*

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

927. *Theory of Measure and Integration*

Spring. 4(4-0) MTH 861. Interdepartmental with and administered by the Mathematics Department.

Introduction to the theory of integration over abstract spaces. Topics include: measure spaces; measurable and integrable functions; modes of convergence, theorems of Egoroff, Lusin, Riesz-Fischer, Lebesgue; absolute continuity, and the Radon-Nikodym theorem; product measures and Fubini's theorem. Applications to some of the classical theories of integration and summability.

937. *Systems Simulation*

Fall. 4(4-0) MGT 836, STT 423, MTH 228. Interdepartmental with and administered by the Management Department.

The concept of a model, model building, characteristics of simulation models. Techniques of computer simulation. Simulation models in research and management planning/control. Validation and experimental design. Special purpose languages.

948. *Mathematical Programming For Business*

Spring. 4(4-0) MGT 836, MTH 334, 426, STT 863. Interdepartmental with and administered by the Management Department.

Large mathematical programs with special structure. Duality and decomposition in mathematical programming. Basic theory of dynamic programming; multistage decision processes and the principle of optimality. Risk, uncertainty, and introduction to stochastic and adaptive control processes.

949. *Advanced Applied Stochastic Processes*

Winter. 4(4-0) MGT 836, 937. Interdepartmental with and administered by the Management Department.

Selected topics from the following areas: Semi-Markov, Markov-renewal and regenerative process models; Markov and semi-Markov decision processes; decision theory, applications from production, inventory, reliability, queuing, and gaming theory.

971. *Advanced Theory of Statistics I*

Fall. 4(4-0) 873; 981 or concurrently.

Continuation of 873; more general treatment of topics using measure theory and measure-theoretic probability.

972. *Advanced Theory of Statistics II*

Winter. 4(4-0) 971; 982 or concurrently.

Statistical convergence theorems. Variables and distributions in n-space. Asymptotic and exact sampling distributions. Tests of significance.

973. *Advanced Theory of Statistics III*

Spring. 4(4-0) 972.

Continuation of 972.

981. *Advanced Theory of Probability I*

Fall. 4(4-0) 863; MTH 927 or approval of department.

Measures on infinite product spaces and Kolmogorov' consistency theorem. Distributions and characteristic functions. Independence. Series of independent random variables.

982. *Advanced Theory of Probability II*

Winter. 4(4-0) 981 or approval of department.

Central limit problem: the classical limit problem, the bounded variances case, and limit laws for infinitely divisible random variables. Conditional probabilities and expectations. Martingales with discrete time.

983. *Advanced Theory of Probability III*

Spring. 4(4-0) 982 or approval of department.

Ergodic theory; individual and L_p ergodic theorems. Second order processes, weakly and strongly stationary processes. Foundations; separability and measurability of processes; properties of sample functions. Continuous time martingales. Processes with independent increments.

995. *Advanced Topics in Statistics*

Fall, Winter, Spring. Variable credit.

999. *Research*

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

STUDIO ART

See Art.