fruits, forestry, highway-airfield engineering, county and township planning, urban development and wildlife. Preparation of land use reports based upon soil maps of assigned areas.

480. Soil Geography and Land Use of the World

Spring. 4(4-0) 210 or approval of department.

Survey of the great soil groups and their use throughout the world, their location, significant characteristics, how they are and can be utilized, and the relation of each to food and population increase.

488. The Impact of Animal Resource Management Upon the World's Developing Nations

Winter. 3(4-0)

For course description, see **Interdisciplinary Courses.**

810. Advanced Studies in Soil Science

Fall, Winter, Spring, Summer. 1 to 5 credits. May re-enroll for a maximum of 6 credits. Approval of department.

Areas of study include chemistry, fertility, geography, management, microbiology, micropedology, organic soils, physics, physical chemistry, and soils of the tropics.

820. Seminar

Fall, Winter, Spring. 1(1-0) May re-enroll for a maximum of 3 credits.

825. Clay Mineralogy

(945.) Winter. 4(3-4) 840, 850 or approval of department. Interdepartmental with and administered by the Geology Department.

Structures and properties of clays; their origins, occurrence, and utilization. Methods of studying clays including x-ray diffraction, differential thermal analysis, infrared absorption and other chemical and physical techniques.

840. Soil Physics

Fall. 5(3-6) 430; CEM 162 or approval of department.

Physical properties of soil (texture, structure, consistency, aeration, water, temperature, etc.), their quantitative measurement, and relation to plant growth, and agronomic and engineering practices.

850. Soil Chemistry

Winter. 5(3-6) 430; CEM 162, 383; or approval of department.

Chemistry of mineral weathering and soil formation, ion activities, ionic exchange and equilibrium reactions, soil pH, specific elements and their chemical analysis, and availability of nutrients to plants.

860. Soil Biochemistry

Spring of even-numbered years. 4 credits. 850; MPH 442.

Biochemical transformations of mineral nutrients and of natural and exotic organic materials in soils, considered in relation to chemical, physical and ecological systems in the complex soil environment.

870. Origin and Classification of Soils

Winter. 4(3-2) 470, 840, or approval of department.

Genesis, morphology and classification of major soils of the world. Relationships among soils in natural and cultural landscapes. How soil properties affect their use, management and conservation. Land classifications for various purposes.

880. Soils and Land Use in Tropical and Subtropical Regions

Spring. 3(3-0) Approval of department. Interdepartmental with Agriculture.

Problem oriented studies of soils and land use in the tropics and subtropics in relation to their genesis, morphology, taxonomy, and management.

899. Research

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

930. Soil Fertility

Spring. 4(4-0) 850 or approval of department.

Fundamental concepts in soil fertility and nutrient uptake by plants; history and development of field plot and greenhouse techniques; research methods in soil fertility; and origin, utilization and management of organic soils.

999. Research

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

SOUTH ASIAN LANGUAGES

See Linguistics and Oriental and African Languages.

SPANISH

See Romance Languages.

STATISTICS AND PROBABILITY STT

College of Natural Science

Courses are classified as follows:

Courses with the last two digits more than 40 require minimum prerequisites of MTH 215.

Courses with the last two digits less than 40 require fewer mathematics prerequisites.

Introductory courses are further classified as follows:

123, 315—sequence for Business Administration students.

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.

123. Statistics in Business Decision-Making

Fall, Winter, Spring. 4(2-2) 315.

Statistical inference and decision-making under uncertainty. Summarization of information and statistical tests. Statistical decision rules and their evaluation in terms of expected cost. Risk.

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 combinatories. 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 includng 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, tests 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. Probability and Statistics I: Discrete Probability

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

Combinatorial analysis, discrete probability spaces, conditional probability and independence, Bernoulli trials, random variables, expectations, generating functions, laws of large numbers.

862. Probability and Statistics II: Continuous Probability

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

Distribution functions, density, moment generating function, multivariate distributions, transformations, various important special distributions, central limit theorem.

863. Probability and Statistics III: Inference

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

Introduction to methods of estimation and testing hypotheses based on probability.

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.

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.

SURGERY* SUR

College of Human Medicine

608. *Surgery Clerkship*

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 43 credits. H M 602.

An introduction to the surgical patient, stressing surgical diagnosis, pre-operative evaluation and post-operative care. Objectives are designed to help the student attain acceptable levels of surgical competence for physicians.

609. *Otolaryngology Clerkship*

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. H M 602.

Common otolaryngologic disorders, emergencies, including diagnosis and treatment, and judgments concerning proper management by primary physicians.

610. *Plastic Clerkship*

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. H M 602.

Principles of wound healing and tissue repair. Indications and applications of plastic procedures.

611. *Urology Clerkship*

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. H M 602.

Demonstration of clinical manifestations of genito-urinary disease, investigative methods and techniques of diagnosis and management, familiarity with urologic emergencies and performance of basic urologic skills.

612. *Rectal Surgery*

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. H M 602.

Data collection, physical examination, and problem formulation relating to colon and rectal disease. Involvement in special techniques, examinations, and surgical procedures is an important aspect of the experience.

613. *Orthopedic Clerkship*

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. H M 602.

Diagnostic and management information and skills, including emergencies, in common orthopedic problems.

614. *Neurosurgery Clerkship*

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. H M 602.

A hospital-based experience to provide the student with familiarity with the field and understanding of the contribution of neurosurgery in medicine generally.

615. *Opthalmalogy Clerkship*

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. H M 602.

Development of skills and knowledge in opthalmoscopy, neuro-opthalmalogy, visual function, and management of problems such as glaucoma, the red eye, and trauma.

616. *Thoracic Surgery Clerkship*

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. H M 602.

Problem-solving in thoracic medicine and surgery, also stressing pulmonary physiology, use of diagnostic tools and tests, and indications for surgical procedures.

617. *Emergency Medicine Clerkship*

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. H M 602.

Exposure to acute problems of wide variety is provided by this experience. Evaluation, management and disposition of patients is seen in the framework of the continuing patient care system.

SYSTEMS SCIENCE

See Electrical Engineering and Systems Science.

TELEVISION AND RADIO T R

College of Communication Arts

100. *Foundations of Broadcasting*

(271.) Fall, Spring, Summer. 3(3-0)

Origin, development, nature, and function of radio and television in modern society.

201. *Fundamentals of Radio Broadcasting*

(272.) Fall, Winter, Spring, Summer. 4(2-4) 100. Sophomore television-radio majors.

Basic orientation to the radio studio, with laboratory experiences in production, writing, and performance.

202. *Fundamentals of Television Broadcasting*

(352.) Fall, Winter, Spring. 4(2-4) 201.

Basic orientation to the television studio, with laboratory experiences in production, writing, and performance.

280. *History of the Motion Picture*

Fall, Winter. 4(2-4) Sophomores.

Development of the motion picture from its beginning to the present, emphasizing social background and cultural values. Screening of significant films from various periods and countries.

333. *Television Directing*

(433.) Fall, Winter, Spring, Summer. 4(2-4) 202 and approval of department.

Television producing and directing methods with assigned experiences in the television studios.

335. *Television and Radio Audience Studies*

Winter, Summer. 3(3-0) Juniors.

Analysis and evaluation of broadcast audience measurement services and other feedback systems. Broadcast audience characteristics, attitudes and behavior.

350. *Advanced Radio Production*

(450.) Spring. 4(2-4) 201 and approval of department.

Planning, coordinating and producing the radio program. Emphasis on documentary and studio productions utilizing original ideas and methods.

351. *Television Studio Production*

Fall, Spring. 4(2-4) Junior majors, 202 and approval of department.

Advanced television crew operations. Writing and production of programs directed by students in 451.

386. *Broadcast Promotion*

Winter, Spring. 4(4-0) 202 and Juniors.

Purpose, creation and production of promotional ideas and material in broadcasting. Introduces the student to the promotional facet of broadcasting, relating it to increasing sales, audience size and improving public relations.

390. *Cinema I*

Fall. 3(3-0) 280 or approval of department.

Survey of the film production process: concepts, techniques, procedures, problems, tools. Emphasis on production as the execution of film design.

401. *Television and Radio Station Management*

(485.) Fall, Spring. 4(4-0) Seniors and 15 credits in television and radio courses.

Problems of station management in budgetng, programming, sales, government regulation and community relations.

402. *Television and Radio Station Programming*

(486.) Winter, Spring. 4(4-0) Seniors and 15 credits in television and radio courses.

Objectives and methods of planning television and radio programs. Evaluation of individual program formats and their relation to various types of audiences and markets. Laws and regulations affecting programming.

*Established February, 1971.