

**Descriptions — Soil Science
of
Courses**

210. Fundamentals of Soil Science
Fall, Winter. 5 credits.

Principles of the origin and development of soils. Relationship of properties to utilization and soil fertility to plant composition and animal health. Emphasis is placed on changing soils to serve man.

331. Soil Management
Winter. 4(4-0) 210.

Management of soils, drainage and irrigation, organic matter, tillage, rotation, conservation practices, soil reaction, lime, fertilizers, and micronutrients. Soil management vs. soil conservation. Special study in general crops, horticultural crops, greenhouse crops, turf and organic soils.

390. Soil Conservation and Land Use
Spring. 3(3-0) 210.

Soil resources of the United States and methods and plans for soil conservation including control of erosion. Interpretation of soil survey maps and land evaluation for farm crops, fruits, forestry, engineering and wildlife. Soil judging.

410. Special Soil Problems
Fall, Winter, Spring, Summer. 1 to 3 credits. May re-enroll for a maximum of 6 credits. Approval of department.

Independent study topics include: Special soil problems, fertility, geography, classification, conservation, soil management, organic soils and turfgrass soils.

420. Seminar
Winter. 1(1-0) May re-enroll for a maximum of 4 credits. Interdepartmental and administered jointly with Crop Science.

424. Forest Soils
Spring. 4(3-3) 210; FOR 220. Interdepartmental with and administered by the Forestry Department.

Interrelationships of forest site and the growth of forests. Classification and productivity of forest soils. Effects of silvicultural and forest management practices on the soil. Two-day field trip required.

430. Soil Fertility and Fertilizers
Spring. 5(4-1) 210.

Assessment of the fertility of soils and alteration of fertility by the use of fertilizers, lime, manure, and cropping systems. The role of colloids in ion fixation and exchange. Soil and tissue tests. The history, technology, and use of fertilizers.

442. Soil Microbiology
Spring. 4(3-2) MPH 200; 301 or 401. Interdepartmental with and administered by the Microbiology and Public Health Department.

Major groups of microorganisms of importance in soils are studied with emphasis on ecological, biochemical, and physical aspects.

470. Soil Classification and Mapping
Fall, Spring; Summer of odd-numbered years. 4(0-3) 210 or approval of department.

Classification of soils. Interpretation of profiles in relation to land utilization for farm crops, 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 North America
Spring. 3(2-1) 210 or approval of department.

Properties, geography and dominant land use of the major soils of North America.

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

Areas of work to include: advanced studies in soil science, chemistry, classification, conservation, fertility, geography, management, microbiology and biochemistry, micronutrients, micropedology, mineralogy, organic soils and physics.

820. Seminar
Winter, Spring. 1(1-0) May re-enroll for a maximum of 3 credits. Interdepartmental and administered jointly with Crop Science.

Studies and presentation of research in crop and soil sciences.

825. Clay Mineralogy
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.

830. Soil Fertility and Plant Nutrition
(930.) Winter of even-numbered years. 3(3-0) 430 or approval of department.

Fundamental concepts in soil fertility and mineral nutrition of plants; fate of nutrients applied to soils, nutrient uptake, translocation and utilization by plants; principles of laboratory, greenhouse and field research methods.

835. Organic Soils
Spring. 2(2-0) Approval of department.

Information pertinent to organic soils formation, classification, water control, conservation, plant nutrients, soil testing, commercial utilization, special crops, road construction, and real estate development will be presented. Field trip included.

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. Fertility and Management of Tropical and Subtropical Soils
Winter. 3(3-0) Approval of department.

Fertility and management of tropical and subtropical soils, the use of soil testing techniques with field studies to evaluate the fertility status and develop cropping systems for optimum production.

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

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

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 infer-
ence 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 Market-
ing and Transportation Administration Depart-
ment.

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 Admin-
istration Department.

Application of statistical techniques to business
decision-making. Topics covered include ap-
plications of linear regression and correlation,
analysis of variance, selected nonparametric
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 mathe-
matical 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 dis-
tributions, statistical inference based on the
binomial distribution, continuous random vari-
ables, test of hypothesis and confidence inter-
vals 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 back-
ground; 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. Ran-
dom 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 hy-
potheses.

423. Statistics III

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

Application of multiple regression analysis to
analysis of variance problems. Design of ex-
periments 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 hy-
potheses, 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.

460. Theory of Games

Winter of odd-numbered years. 3(3-0)
MTH 215, 334.

Zero-sum, two-person games. Extensive and
normal forms, convexity, von Neuman minimax
theorem and extensions. Methods of solving
games. Applications.

490. Statistical Problems

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

Individualized study adapted to the prepara-
tion 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, strati-
fied, 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 distribu-
tion. Rank tests and tests based on permutation
of observations. Tolerance and confidence sets.
Large-sample distributions. Applications to re-
search in the social and natural sciences.

833. Mathematical Programming

Spring. 3(3-0) EC 800, or 812A,
MTH 334. Interdepartmental with the Agri-
cultural 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, mul-
tiple 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 pro-
gramming, including special problems; network
analysis, including PERT; dynamic program-
ming; game theory; queuing theory. Acquaint-
ance 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 func-
tions, some special discrete distributions, con-
tinuous probability models.

**862. Theory of Probability and
Statistics II**

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

Continuous probability models, density trans-
formations, some special continuous distribu-
tions, 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 nonparametric meth-
ods, 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 of even-numbered years. 3(3-0)
873 or approval of instructor.

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. Theory of Probability and
Statistics I**

Fall. 3(3-0) 863; MTH 821 or con-
currently.

Probability spaces. Distribution functions.
Characteristic functions. Law of large numbers,
Glivenko-Cantelli theorem, central limit theorem.
Some special distributions including multivariate
normal. Convergences for sequences of random
variables.

**872. Theory of Probability and
Statistics II**

Winter. 3(3-0) 871; MTH 822 or
concurrently.

Basic concepts of decision theory. Most power-
ful tests. Standard statistical methods for use
in the binomial, Poisson and normal situation;
sequential and nonparametric methods; linear
models.

Descriptions — Statistics and Probability of Courses

873. Theory of Probability and Statistics III

Spring. 3(3-0) 872; MTH 927 or concurrently; or approval of department. Asymptotic distributions of some statistics. Cramer-Rao inequality. Asymptotic properties of maximum likelihood methods.

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^n .

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. 3(3-0) MTH 822. Interdepartmental with and administered by the Department of Mathematics.

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. 3(3-0) 873, MTH 927, 981 or concurrently.

General decision theory. Concepts of loss, risk, admissibility, completeness, minimax and Bayes solutions. Sufficiency, equivariance and their associated reductions. Monotone likelihood ratio and exponential families. Optimality properties of tests.

972. Advanced Theory of Statistics II

Winter. 3(3-0) 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. 3(3-0) 972.

Continuation of 972.

981. Advanced Theory of Probability I

Fall. 3(3-0) 863; MTH 927 or approval of department.

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

982. Advanced Theory of Probability II

Winter. 3(3-0) 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. 3(3-0) 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.

990. Problems in Statistics and Probability

Fall, Winter, Spring, Summer. 1 to 4 credits. May re-enroll for a maximum of 10 credits. 873.

Seminar or individual study on an advanced topic in statistics.

995. Topics in Statistics and Probability

Fall, Winter, Spring. Variable credit.

Nonparametric statistics, multivariate statistical analysis, statistical time series analysis, Bayesian statistics, reliability theory, stochastic approximation, design of experiments, sets of decision problems, stochastic processes, sequential analysis, other topics.

999. Research

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

STUDIO ART

See Art.

SURGERY*

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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.

*Established February, 1971.