MASTER OF SCIENCE
STATISTICS & OPERATIONS RESEARCH

INTRODUCTION

The Department of Statistics and Operations Research (College of Science) offers a Master of Science program in **Statistics and Operations Research**. Both part-time and full-time students are admitted to this program. Research requirements include both thesis and non-thesis options. Current research interests of the faculty include: Non-Parametric Statistics, Linear Models, Stochastic Processes, Probability Theory, Distribution Theory, Multivariate analysis, Demography, Quality Control, Sampling, Simulation, Queuing Theory, Inventory Models, and Mathematical Programming.

According to the University Council decision dated 4/2/2007, Thesis students admitted with effect from September 2007 are exempted from the comprehensive examination.

PROGRAM REQUIREMENTS (non-thesis option in parenthesis)

31 (34) TOTAL COURSE CREDITS

1 SEMINAR (1 credit each)

0480-509 Seminar in Probability Theory
0480-529 Seminar in Statistics
0480-569 Seminar in Operations Research

9 (12) COMPULSORY (3 credits each)

0480-501 Probability Theory
0480-502 Theory of Statistics I
0480-550 Stochastic Processes
0480-593 Project (non-thesis option only).

6(12) ELECTIVES (3 credits each)

0480-503 Theory of Statistics II
0480-504 Multivariate Statistical Analysis
0480-505 Mathematical Statistics
0480-506 Topics in Probability Theory and Stochastic Processes
0480-510 Non-Parametric Statistics
0480-511 Bayesian Analysis
0480-512 Statistical Theory of Reliability
0480-513 Topics in Statistics

0480-520 Applied Statistics
0480-521 Time Series Analysis
0480-522 Linear Statistical Models I
0480-523 Linear Statistical Models II
0480-551 General Systems Theory
0480-552 Optimization of Continuous System
0480-553 Optimization of Discrete Systems
0480-554 Queues and Inventories
0480-560 Modeling of Systems
0480-561 Operations Research in Public Sectors
0480-562 Operations Research Project
0480-563 Simulation
0480-564 Dynamic Programming
0480-565 Topics in Operations Research

6 (9) The remaining credit hours may be elected from any 500 level graduate courses offered by the Department of Statistics and Operations Research or the Department of Mathematics. Students may also substitute up to 6 credit hours from the elective undergraduate statistics or mathematics courses (400-level) with the approval of the Program Committee.

9 COMPULSORY

0480-597	Thesis	(0)
0480-598	Thesis	(0)
2000-599	Thesis	(9)

COURSE DESCRIPTION

0480-501: PROBABILITY THEORY
CR: 3
{Pre 1989/1990 was offered as 0410-540}
Measure-theoretic probability, random variables, univariate and multivariate distribution functions, expectation, characteristic functions, independence, the zero-one-law, the continuity theorem, modes of convergence. Sums of independent random variables, laws of large numbers, central limit theorems, conditional expectation.

0480-502: THEORY OF STATISTICS I
CR: 3 PR: 0480-501
{Pre 1989/1990 was offered as 0410-541}
Criteria and methods of estimation: minimum variance unbiased estimators, properties. General Procedures: Bayes estimation, minimax estimation, fiducial probability, principle of invariance estimation of parameters, maximum likelihood estimators, method of scoring, hypotheses testing, non parametric estimation.

0480-503: THEORY OF STATISTICS II
CR: 3 PR: 0480-502
{Pre 1989/1990 was offered as 0410-542}
Asymptotic theory, Cramer-Rao type inequalities, asymptotic properties of maximum likelihood estimate, sequential analysis, estimation and hypothesis testing, decision theory and problem of identification.

0480-504: MULTIVARIATE STATISTICAL ANALYSIS
CR: 3 PR: Consent of the Department
{Pre 1989/1990 was offered as 0410-543}
The multivariate normal, inferences about mean and covarianced matrix, Wishart distribution, Hotelling T-square, multivariate analysis of variance, classification techniques, principal components, factor analysis.

0480-505: MATHEMATICAL STATISTICS
CR: 3 PR: 0480-502
{Pre 1989/1990 was offered as 0410-545}
General decision problem, concepts of loss, risk and utility, minimax and Bayes procedures, invariance principle, monotone likelihood ratios and exponential families, optimality properties.

0480-506: TOPICS IN PROBABILITY THEORY AND STOCHASTIC PROCESSES
CR: 3
{Pre 1989/1990 was offered as 0410-556}
Special topics not covered in other courses.
May be repeated for credit under different subtitles.

0480-509: SEMINAR IN PROBABILITY THEORY
CR: 1
{Pre 1989/1990 was offered as 0410-559}

0480-510: NON-PARAMETRIC STATISTICS
CR: 3 PR: Consent of the Department
{Pre 1989/1990 was offered as 0410-547}
Order statistics, tests based on runs, goodness of fit tests, the signed test and signed rank test, the general two sample problem, linear rank statistics and the general two sample problem, linear rank tests for the location and scale parameters.

0480-511: BAYESIAN ANALYSIS
CR: 3 PR: Consent of the Department
{Pre 1989/1990 was offered as 0410-551}
Theories of probability: comparative, subjective, frequentist and quantitative probability. Decision theory: loss, utility and decision functions, no data problems. Distributions: prior, likelihood, posterior, fiducial and predictive. Methods of constructing prior distributions: personal, non-informative, Jeffry's prior, conjugate prior and maximum posterior distributions. Bayesian-statistical inference: point and interval estimation, testing, non-parametric procedures and analysis of contingency tables. Robustness of Bayes methods.

0480-512: STATISTICAL THEORY OF RELIABILITY
CR: 3 PR: Consent of the Department
{Pre 1989/1990 was offered as 0410-552}
Structural properties of coherent Systems. Reliability of coherent systems. Parametric families of distributions of direct importance in reliability theory. Classes of life distributions based on notions of aging. Concepts helpful in the study of maintenance policies. Implementing coherent structure theory for complex systems.

0480-513: TOPICS IN STATISTICS
CR: 3 PR: Consent of the Department
{Pre 1989/1990 was offered as 0410-557}
Special topics not covered in other courses.
May be repeated for credit under different subtitles.

0480-520: APPLIED STATISTICS
CR: 3 PR: Consent of the Department
{Pre 1989/1990 was offered as 0410-546}
Planning collection of data, sample selection, estimation in sample surveys, balance of cost and error, orthogonal and non-orthogonal designs, factor experiments in both complete and incomplete replicates, groups of experiments.

0480-521: TIME SERIES ANALYSIS
CR: 3 PR: Consent of the Department
{Pre 1989/1990 was offered as 0410-548}
Stationary and non-stationary models, auto-covariance and auto correlation functions, spectral density, linear models, identification, estimation and forecasting, estimation of spectral densities, analysis of time series data.

0480-522: LINEAR STATISTICAL MODELS I
CR: 3 PR: Consent of the Department
{Pre 1989/1990 was offered as 0410-549}
Distribution of quadratic forms, non-central t, chi-square, non-normal cases, regression models, polynomial and trigonometric models.

0480-523: LINEAR STATISTICAL MODELS II
CR: 3PR: Consent of the Department
{Pre 1989/1990 was offered as 0410-550}
Experimental design models, one-factor and two-factors, incomplete block models and tests for interaction, components-of-variance models.

0480-529: SEMINAR IN STATISTICS
CR: 1
{Pre 1989/1990 was offered as 0410-558}

0480-550: STOCHASTIC PROCESSES
CR: 3 PR: Consent of the Department
{Pre 1989/1990 was offered as 0410-544}
Markov chains, random walk, run problems, birth and death processes, Processes with independent increments, Poission and Gaussian Processes, applications, models in science, engineering and social sciences.

0480-551: GENERAL SYSTEMS THEORY
CR: 3
{Pre 1989/1990 was offered as 0410-584}
Definition and classification of systems, goal seeking behaviour and memory characteristics of systems, methods of systems description, interdependence analysis, entropic content of systems and the law of requisite variety and systems design and analysis.

0480-552: OPTIMIZATION OF CONTINUOUS SYSTEMS
CR: 3 PR: Consent of the Department
{Pre 1989/1990 was offered as 0410-586}
The optimization problem, the simplex method for linearizable models, duality in optimization, quadratic and convex mathematical programming, dynamic linear models, Markovian decision processes.

0480-553: OPTIMIZATION OF DISCRETE SYSTEMS
CR: 3 PR: Consent of the Department
{Pre 1989/1990 was offered as 0410-587}
Integer programming and combinatorial models, network models, dynamic programming and sequential analysis.

0480-554: QUEUES AND INVENTORIES
CR: 3 PR: Consent of the Department
{Pre 1989/1990 was offered as 0410-588}
Persuasiveness of waiting lines and inventories, structure and analysis of queues and inventories, optimal control of waiting lines and inventories.

0480-560: MODELING OF SYSTEMS
CR: 3 PR: Consent of the Department
{Pre 1989/1990 was offered as 0410-585}
The need for and pitfalls of modeling, the decision-making context, responsibility for and objectives of decisions, structure and analysis of decisions, modeling of decision-making situations, non-linear dynamic stochastic models and their approximation, problems of model validation.

0480-561: OPERATIONS RESEARCH IN PUBLIC SECTORS
CR: 3
{Pre 1989/1990 was offered as 0410-589}
Modeling the operations of public sectors and the problem of measures of performance, control, and implementations, paradigon examples from health-care, education, and municipalities.

0480-562: OPERATIONS RESEARCH PROJECT
CR: 3
{Pre 1989/1990 was offered as 0410-590}
Phases of the operations research study. The student with the instructor identify a real-life significant problem and conduct on it a full operations research study.

0480-563: SIMULATION
CR: 3
{Pre 1989/1990 was offered as 0410-591}
The need for computer simulation of processes, building a simulation model generating phenomena, design of simulation experiments, application of simulation, computer languages.

0480-564: DYNAMIC PROGRAMMING
CR: 3
{Pre 1989/1990 was offered as 0410-594}
Deterministic and stochastic dynamic programming: Theory and applications. Dynamic programming algorithm. Optimal route problem. Optimal discounting and nondiscounting over time with single and multi-period decision epochs. Linear programming formulations. Stochastic scheduling. Bandit processes. Network flow. Markov decision processes.

0480-565: TOPICS IN OPERATIONS RESEARCH
CR: 3
{Pre 1989/1990 was offered as 0410-596}
Special topics not covered in other courses.
May be repeated for credit under different subtitles.

0480-569: SEMINAR IN OPERATIONS RESEARCH
CR: 1
{Pre 1989/1990 was offered as 0410-595}

0480-593: PROJECT
CR: 3

0480-597: THESIS
CR: 0

0480-598: THESIS
CR: 0

2000-599: THESIS
CR: 9