Ph.D. Concentration in Supply Chain and Operations Management
The University of Texas at Austin McCombs School of Business

Course Requirements

The economics department also offers a math refresher course to prepare students for the different mathematical concepts required for micro/macro economics. This informal course is conducted in the first three weeks of August.

Background course requirements
- Applied Probability
- Real Analysis

Core methodology courses
- Linear Programming
- Applied Stochastic Processes
- Microeconomics I
- One of the following:
  - Introduction to Research Methods
  - Mathematical Statistics

Core contextual (SCM and OM) courses
At least three courses in the Theory of OM/SCM series dealing with optimization models, economic models, stochastic models/inventory theory, and product development

Supporting methodological courses
At least three advanced graduate courses from the following fields:
- Optimization: network optimization, nonlinear programming, integer programming, stochastic programming;
- Stochastic processes: queueing theory, advanced stochastic processes, simulation
- Economics: microeconomics, econometrics, game theory
- Statistics

Minor field
At least three courses in a field other than doctoral courses in OM/SCM to provide the grounding needed in basic business disciplines

Brief Description of the Relevant Courses

Real Analysis
- Sequence and series
- Functions on intervals
- Riemann integral
- Metric and function spaces

Linear Programming
- Problem formulation, LP models and applications
- Review of linear algebra, piecewise linear problems
- Simplex algorithms: primal, dual, revised simplex, upper bounded variables
- LP duality, theorems of the alternative for systems of linear inequalities
- Sensitivity analysis, parametric programming and economic interpretation of duality
- Interior point methods and decomposition techniques

Microeconomics I
- Preference relations and choice rule
- Classical demand theory: utility maximization, duality, welfare evaluation
- Aggregate demand and aggregate wealth
- Choice under uncertainty: expected utility theory, lotteries and risk aversion, state dependent utility
- Introduction to game theory
Applied Probability
- Review of basic probability: combinatorial analysis, conditional probability, stochastic independence, and discrete and continuous random variables
- Probability distribution functions, parametric families of distributions, jointly distributed random variables, Multivariate normal distribution
- Expectation, generating functions, covariance, correlation
- Distributions of functions of random variables, order statistics
- Multivariate random variables, multivariate normal distribution
- Limiting distributions
- Poisson process, Markov chains, introduction to the theory of queues

Applied Stochastic Processes
- Introduction to stochastic modeling: manufacturing, telecommunication, computer performance
- Discrete time Markov chains: transient and limiting behavior, ergodic theorem, reversibility
- Continuous time Markov chains: recurrence, transience, ergodicity, CTMCs with costs and rewards
- Poisson process: exponential distribution, non-homogeneous Poisson process, Compound Poisson process
- Renewal process: renewal function, Balckwell’s renewal theorem, key renewal theorem, regenerative process

Stochastic Optimization
- Stochastic programming with recourse
- Some applications: capacity expansion planning, financial planning, vehicle allocation, hydroelectric scheduling, capacitated facility location, network interdiction / design
- Optimality: expected-value, probability threshold, Markowitz, expected utility
- Bounds on the value of information and the value of the stochastic solution
- Decomposition algorithms: Dantzig-Wolfe, Benders, L-shaped method, cutting plane algorithms
- Approximation and bounding technique
- Monte Carlo sampling-based algorithms

Non-Linear Programming
- Theory: Understand the derivation and uses of the Kuhn-Tucker first order necessary conditions for optimality, second order optimality conditions, saddle points, and the Lagrangian dual problem
- Algorithms: Understand the derivation and comparative advantages of the following classes of algorithms:
  - Generalized Reduced Gradient
  - Successive Quadratic Programming
  - Successive Linear Programming
  - Penalty and Barrier Methods, Exact and Inexact
  - Interior Point Methods

Mathematical Statistics
- Properties of statistics (e.g. sufficiency, completeness, invariance)
- Point estimation (methods and properties)
- Hypothesis testing (methods and properties)
- Interval estimation (methods and properties)
- Non-parametric statistics
- Basic analysis of variance
- Linear regression

Microeconomic II
- General Equilibrium Theory
- Financial Economics
- Externalities and Public Goods
- Market Power
- Information Economics
- Social Choice and Mechanism Design

Queueing Theory
- Classical Queueing Theory: Markovian models, G/G/1 queue, open and closed Jackson networks, Kelly Networks
- The Modern Theory of Multi-class Queueing Networks: open multi-class network, fluid networks, stability of queueing and fluid network, Dai’s Theorem, stability analysis via Lyapunov functions

For more information, please email romeohd@mccombs.utexas.edu or call 512-471-3322.