

Syllabus

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Department of Mathematical and Statistical Sciences Marquette University

Syllabus
Spring 2024

Course: MSSC 6020 Statistical Simulation

Time: TuTh 5:00 pm - 6:15 pm

Location: Cudahy 137 (in-person)

Office Hours: TuTh 4:00 pm – 5:00 Cudahy 313 & by arrangement.

Instructor: Daniel B. Rowe, Ph.D. daniel.rowe@marquette.edu

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Course Description From The University Bulletin

MSSC 6020. Statistical Simulation. 3 cr. hrs.

Elements of statistical simulation and modeling with applications. Generation of random variables, simulating statistical models, Monte Carlo method, Markov chains, birth-and-death processes, queues, variance reduction, Markov chain Monte Carlo (MCMC) methods and applications, bootstrapping, validation and analysis of simulated data. Prereq: MSSC 6010 and programming competency in a high-level language.

I am not the prerequisite enforcer!

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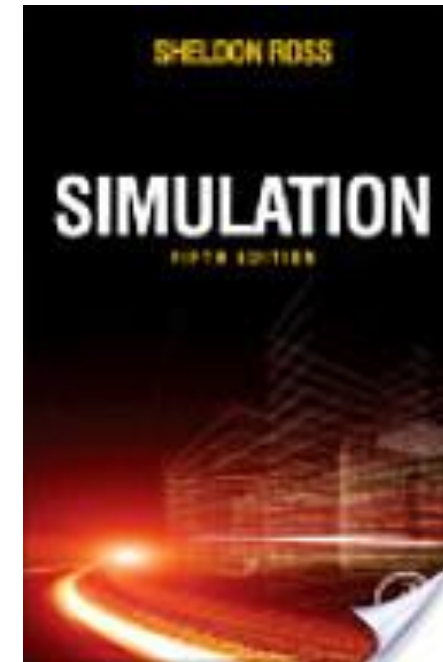
Office: Cudahy Hall 313

E-mail: daniel.rowe@marquette.edu

Text: Ross, Sheldon. (2012).

Simulation, Fifth edition, Academic Press.

ISBN: 0124159710



Grading: A midterm (IC & TH) on Th March 7 TH due Sunday Mar 10 at midnight, weekly homework/class participation, and a final (TH) due on Tuesday May 7, at midnight.

Homework/Participation (30%), Midterm (30%), Final (40%).

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~~Chapter 2: Elements of Probability~~

Covered by prerequisite.

~~Sample Space and Events, Axioms of Probability, Random Variables, Expectation, Discrete RVs, Continuous RVs, Conditional Expectation and Variance~~

Numerical Integration

Chapter 3: Random Numbers

Number Generation, Random Numbers to Evaluate Integrals

Chapter 4: Generating Discrete RVs

Inverse Transform, Poisson RV, Binomial RV, Acceptance-Rejection, Composition Approach, Alias Method, Random Vectors

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Transformation of Variables

Continuous Distributions, PDF, CDF, Transformation of Variable, Uniform, Normal Distribution

Chapter 5: Generating Continuous RVs

Inverse Transform, Rejection Polar Method for Normal RVs, Poisson Processes, Nonhomogeneous Poisson Processes, ~~2D Poisson Process~~.

Bivariate Transformation of Variables

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Chapter 6: Multivariate Normal and Copulas

Multivariate Normal, Generating Multivariate Normal RVs, ~~Copulas,~~
~~Generating Variables from Copula Models~~

Wishart Distribution

Line Fitting and Univariate Multiple Regression

Multivariate Multiple Regression

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~~Chapter 7: Discrete Event Simulation~~

~~Discrete Events, Queueing Systems, Inventory Model, Insurance Risk Model, Repair Problem, Stock Option~~

Chapter 8: Analysis of Simulated Data

Sample Mean and Variance, Interval Estimates of Mean, Bootstrapping for Mean Square Error

Chapter 9: Variance Reduction Techniques

~~Antithetic Variables, Control Variates, Variance Reduction by Conditioning, Stratified Sampling, Importance Sampling, Common Random Numbers, Exotic Option~~

Confidence Intervals for Variance

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The Correlation Coefficient

Bayesian Statistics

Chapter 10: Additional Variance Reduction Techniques

~~Conditional Bernoulli Sampling, Normalized Importance Sampling,
Latin Hyper Cube Sampling~~

Chapter 11: Statistical Validation Techniques

Goodness of Fit Tests, Two Sample Problem, ~~Validating Assumptions of a
Nonhomogeneous Poisson Process~~

Chapter 12: Markov Chain Monte Carlo Methods

Markov Chains, Hastings-Metropolis Algorithm, Gibbs Sampler, ~~Markov Chains and
Queueing Loss, Simulated Annealing, Sampling Importance Resampling~~

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Numerical Flavor

All slides are a summary of the material and do not contain all detail. Book is ultimate authority.

Familiarize yourself with Matlab.

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Questions?