

Course: MSCS 6020 (Statistical) Simulation, Spring 2020 **Office Hours:** TuTh 4:00-5:00pm, 6:15-6:45pm
Time: TuTh 5:00-6:15 Cudahy Hall 114 **Office:** CU 313
Instructor: Daniel B. Rowe, Ph.D. **E-mail:** daniel.rowe@marquette.edu

Texts: Ross, Sheldon (2012). *Simulation*, Fifth edition, Academic Press. ISBN: 0124159710
Grading: A midterm (take-home) on March 5, homework/participation, and a final project (report and presentation) on Tuesday May 5, 5:45 pm – 7:45 pm. Homework/Participation (30%, $\geq 3 \rightarrow 100\%$, $= 2 \rightarrow 90\%$, $= 1 \rightarrow 80\%$, $= 0 \rightarrow 70\%$), Mid-Term Exam (30%), and a Final (40%).
Note: This course is heavily computational with extensive Matlab use.

~~Chapter 2: Elements of Probability (Skip)~~

~~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

Transformation of Variables

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

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

~~Chapter 7: Discrete Event Simulation~~

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

Multivariate Multiple Regression

Chapter 8: Analysis of Simulated Data

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

Introductory Neural Nets for Multivariate Multiple Linear and Logistic Regression

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 the Variance

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~~

Other topics as needed.