

Fall 2022

CE 5310

RISK AND RELIABILITY ANALYSIS OF ENGINEERING SYSTEMS

Instructor: Dr. Carlos Ferregut

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Office Hours: You can stop by the office any time. If I am free, I will talk to you; or if you prefer you can make an appointment through Mrs. Concha Ruiz. If you contact me by email, I will try to reply to you by the end of the day.

Text Book: See list of reference books.

Course Objectives: Familiarize the student with the process of modeling engineering problems containing uncertainties in the control (design) variables; and train the student in the application of analytical and numerical methods to quantify the effect that those uncertainties have on the performance of an engineering system. The student will also become familiar with the principles of design and decision making under uncertain conditions.

COURSE OUTLINE

1. Review of Basic Probability Concepts
 - 1.1 Data analysis
 - 1.2 Set theory
 - 1.3 Probability distribution of a random variable
 - 1.4 Parameter estimation from data
 - 1.5 Empirical determination of distribution models
 - 1.6 Probability distributions of multiple random variables
 - 1.7 Functions of random variables
 - 1.8 Rosenblueth's point mass distribution and applications
2. Monte Carlo Simulation Techniques
 - 2.1 Random numbers with standard uniform distribution
 - 2.2 Continuous random variables (Normal, Exponential, Lognormal, etc.)
 - 2.3 Functions of random variables
3. Extreme Value Statistics
 - 3.1 Probability distribution of extremes
 - 3.2 The three asymptotic forms

3.3 Estimation of extremal parameters

- 4. Reliability and reliability-based design
 - 4.1 Analysis and assessment of reliability
 - 4.2 First order second moment formulation FORM
- 5. Systems Reliability

Grading Policy:

Homework: 40% - Homework will be individual work. Homework is due by the date indicated in the instructions.

Term Project: 60% - This will be a team project on an application of your choice. Teams will consist of one graduate student and one undergraduate student.

Reference Books

Alfredo H-S Ang and Wilson H. Tang, Probability Concepts in Engineering: Emphasis on Applications to Civil and Environmental Engineering, 2nd Edition, John Wiley & Sons, 2007.
(NOTE: I like the first edition better, but it is out of print)

Probability Concepts in Engineering Planning and Design, Volume II, Decision, Risk and Probability
Alfredo H-S Ang and Wilson H. Tang
John Wiley & Sons
1984

Structural Reliability Theory and Its Applications
Palle Thoft-Christensen and Michael J. Baker
Springer-Verlag
Berlin Heidelberg, New York
1982.

Reliability Based Design in Engineering
Milton E. Harr.
Dover Publications, Inc.
Mineola, New York
1987.

Methods of Structural Safety
H. Madsen, S. Krenk, N.C. Lind
Dover (originally published by Prentice-Hall)

Probability, Statistics and Decision for Civil Engineers
Jack R. Benjamin and C. Allin Cornell
Dover

Probability and Statistics for Engineering and the Science
Jay L. Devore
Duxbury Press

Probability, Reliability and Statistical Methods in Engineering and Design
Achintya Haldar and Sankaran Mahadevan
John Wiley and Sons, Inc
2000

Structural Reliability Analysis and Prediction
Robert E. Melchers
John Wiley
Second or third editions

Reliability of Structures
Andrzej S. Nowak & Kevin R. Collins
CRC Press