Course Syllabus

CIVE 203 - Engineering Systems and Decision Analysis

SPRING 2018

Course Instructor:

Mazdak Arabi

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Office Hours: M 11:00 a – noon; W 1:00 p – 2:00 p

Course GTAs:

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Saddam Waheed

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Office Hours: T 9:00 - 10:00 a

Course Website:

canvas.colostate.edu

Course Times and Locations:

Lab	Date	Location
Lecture	T – TH 11:00 – 11:50 a	Scott Bioengineering 101
Lab 1	M 1:00 – 2:40 p	Engr. C205
Lab 2	T 8:00 – 9:40 a.m	Engr. C205
Lab 3	M 3:00 – 4:40 p.m.	Engr. C205
Lab 4	TH 8:00 – 9:40 a	Engr. C205
Lab 5	M 12:00 – 1:40 p.m.	Engr. B205

Exams and Grading:

The course will include two midterm exams and a comprehensive final examination. Grading will be based on the following components:

Laboratory exercises	10%
Homework (other than lab)	20%
Final Project	10%
Midterm Examination (2)	30%
Final Examination	30%

- The laboratories are an essential part of the course as is the lecture material. Students must have a passing grade (>=60%) on the laboratory exercises and on the midterm and final examinations to receive a passing grade for the course. Any deviation from this policy is only at the discretion of the instructor.
- This course will use the +/- Grading system.
- All exams are given during the lecture period.
- Final exam is given during the scheduled final exam period.
- Final exam is comprehensive and covers the entire course.
- Make-up exams are given only for extreme cases.
- One 8.5 by 11 in crib sheet is allowed for each exam.

Homework:

- Assigned weekly on Canvas, some submitted on paper, some submitted as MATLAB files.
- Show your work and clearly identify your answers.
- Must be your own work (every cell, every line of code, and every word of text must be written individually).
- Providing your homework solution to someone is not allowed, but discussion with others is permitted.
- Homework submissions are due before class, late submissions are not accepted.

- Solutions are posted on Canvas after due date.
- In the case where assignments are submitted on-line via Canvas, it is the responsibility of the student to be sure that all attachments to the submission are provided. Students will not receive credit for any submission that is missing the required attachments.

Project:

- A project will be assigned on Canvas.
- The project analysis and report must be your own work (every cell, every line of code, and every word of text must be written individually).
- Providing your project solution to someone is not allowed, but discussion with others is permitted.
- Submit all project files including the final report on Canvas by deadline.
  Late projects can be emailed to instructor for partial credit:
  < 24 hrs late (maximum of 2/3 credit)
  24-48 hrs late (maximum of 1/3 credit)
  > 48 hrs late (no credit)

Course Description:

In dealing with real world problems, engineers make decisions about design, implementation, and operation of a system of interest. The decision making process requires an understanding of import system variables and processes, and the interactions between system components. In this context, uncertainties are unavoidable. The role of probability and statistics is quite pervasive in engineering; it ranges from the description of basic information to the development of models for design and decision making. This course covers basic statistical and probability concepts and methods that are useful for making decisions under uncertain conditions. The course materials are organized as follows:

- Exploratory data analysis
- Fundamentals of probability
- Random variables: distributions, functions, and moments
- Hypothesis testing and confidence intervals
- Building empirical models: Simple Linear Regression

The laboratory exercises aim to enhance students' capacity to implement statistical and probability methods. To this end, the MATLAB software is used.

Prerequisite: CIVE 202, Numerical Modeling & Risk Analysis.

Course Format:

Two lectures and one 2-hour laboratory per week, with the laboratory used for a mix of laboratory, computer use and team projects.

Course Objectives:

At the end of the course, the successful student should be able to:

- Apply basic statistical and probability models for data analysis as applied to civil and environmental engineering systems.

- Estimate parameters of various probability distributions for discrete and continuous random variables.
- Compute exceedance and nonexceedance probabilities as well as quantiles of random variables.
- Demonstrate the proper application of confidence limits and hypothesis testing to examples from civil and environmental engineering systems.
- Demonstrate the proper application of simple linear or multiple regression for building empirical models of engineering and scientific data.
- Enhance the capacity to solve real world problems.
- Write technical programing scripts in MATLAB.
- Enhance their oral and written communication and presentation skills.

Prerequisite Knowledge and Skills:

The student starting CIVE 203 is expected to have an understanding of basic concepts of simulation and modeling, basic statistical concepts and measures, and a basic understanding of mathematical programming and code development (e.g., VBA).

Required Textbook:

Montgomery, D.C., G.C. Runger and N.F. Hubele, **Engineering Statistics-Fifth Edition**, John Wiley $ Sons, Inc., ISBN-13: 978-0-470-63147-8. 2011.

Recommended Textbook:

Ang, A. and W. Tang, **Probability Concepts in Engineering- Second Edition**, John Wiley $ Sons, Inc., ISBN-13: 978-0-471-72064-5.

General Class Policies:

You are expected to:

- Attend regularly: It is recommended that you attend each class because important information will be covered in class that will help you with the laboratory assignments, homework, and exams. Remember that not everything is in the lecture handouts. Also, if changes in exam procedure, exam date, exam coverage, assignments, etc. are announced in class you are responsible for knowing this information.
- Access Canvas regularly: The Canvas course site will be updated regularly with Power Point handouts and other materials presented in class. The class schedule and due dates for assignments will be regularly posted and updated. It is your responsibility to be aware of this information. Anything that is posted on Canvas and covered in class is likely to be subject to questions on the midterm and final.
- Respect the lecture time: Coming late to class or leaving early from class causes a disturbance to others. Please try not to enter or leave the room while the class is in progress, except in the case it is absolutely necessary. If you must leave the classroom please do so as quietly as possible.
- Turn off or silence your cell phones before the start of class.
- Respect assignment deadlines: Assignments will typically be submitted via Canvas and the system will not accept submissions after the deadline. Unless you have discussed an emergency situation with your instructor late assignments will not be accepted. It is highly encouraged that you submit your assignment prior to the deadline to avoid any last minute problems.

- Be honest: CSU Policies and Guiding Principles will be strictly enforced. For details, please visit: http://www.catalog.colostate.edu/index.asp?url=catalog_04-06/policies.

All CSU students are responsible for knowing and adhering to the academic integrity policies of this institution. Violations of this policy may include: cheating, plagiarism, aiding academic dishonesty, fabrication, lying, bribery, and threatening behavior. Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion).

Specifically in CIVE 203, homework assignments (unless otherwise noted on the assignment) will be individual assignments. While you may certainly discuss the approach to solving the assignments with your classmates, all submissions and associated software coding must be individually done and unique (every line of code and every word of text must be written individually)**.** Likewise projects must be unique and not use any coding developed by other students in this or previous offerings of this course.

Tentative Schedule:

Topic	**Date**	**Reading Assignment**	**Lab**
Introduction, review of class policy, instructions about Canvas; Role of statistics in engineering: emphasis on civil and environmental applications	16-Jan	Montgomery, Chapter 1	None
Data summary and presentation: descriptive statistics, data processing, plotting data, empirical cumulative distribution function	18-Jan	Montgomery, Chapter 2	
Fundamentals of probability: review of basic concepts, mathematics of probability	23-Jan	Hand out- Ang and Tang, Chapter 2	Getting Started: - Introduction to the MATLAB environment - Data types: Scalar, vector, and arrays - Saving your work - Publishing your work
Fundamentals of probability: conditional probability	25-Jan **HW1**	Hand out- Ang and Tang, Chapter 2	
Fundamentals of probability: examples	30-Jan	Hand out- Ang and Tang, Chapter 2	Solving Problems with MATLAB: - Elementary Math Functions - Using Built-in Functions - Using the Help feature - Display function
Random variables and probability distributions: definitions, type of random variables, experimental (empirical) cumulative distribution function, probability distribution of a random variable	1-Feb **HW2**	Montgomery, Chapter 3: 57-66	

			- Formatted outputs
Continuous random variables: probability density function, cumulative distribution function, mean and variance	6-Feb	Montgomery, Chapter 3: 66-74	Plotting: - 2-dimensional plots - Subplots - Editing plots - Saving your plots
Important continuous distributions: Normal distribution	8-Feb **HW3**	Montgomery, Chapter 3: 74-84	
Important continuous distributions: Normal distribution examples	13-Feb		Working with Matrices: - Manipulating matrices - Matrix operations - Solutions of systems of linear equations - Elementwise operations
Important continuous distributions: Lognormal, Exponential, Gamma, and Uniform distributions	15-Feb **HW4**	Montgomery, Chapter 3: 84-92	
Continuous random variables examples, Probability plots	20-Feb	Montgomery, Chapter 3: 92-97	Statistical Toolbox: - Descriptive statistics - Statistical visualization o Histogram o Boxplot o CDF plot
Midterm Exam 1	22-Feb		
Discrete random variables: probability mass function, cumulative distribution function, mean and variance	27-Feb	Montgomery, Chapter 3: 97-102	Probability distributions - Generating random numbers - Fitting continuous distributions o Normal distribution o Lognormal distribution - Cumulative distribution function
Important discrete distributions: Binomial, Geometric, Negative Binomial, and Poisson distributions	1-Mar **HW5**	Montgomery, Chapter 3: 102-119	

			- Quantile estimation - Probability plots
Random variables: discrete random variables examples	5-Mar		User-Defined Functions: - Creating Function M-Files - Anonymous functions - Function functions - Subfunctions
More than one variable and independence	8-Mar **HW6**	Montgomery, Chapter 3: 123-129	
Spring Break (10 – 18 March)			
Functions of random variables: linear and nonlinear functions	20-Mar	Montgomery, Chapter 3: 129-136	Logical Functions: - Relational and logical operators - Flowcharts and pseudocode - Logical functions - Selection structures - Debugging
	22-Mar **HW7**	Montgomery, Chapter 3: 136-140	
Statistical inference and point estimation	27-Mar	Montgomery, Chapter 4: 148-156	Repetition Structures: - For loops - While loops - Break and Continue
Hypothesis testing	29-Mar **HW8**	Montgomery, Chapter 4: 156-169	
Inferences on the mean of a population with known variance	3-Apr	Montgomery, Chapter 4: 169-186	Repetition Structures: - Nested loops - Improving efficiency of loops
Midterm Exam 2	5-Apr		
Inferences on the mean of a population with unknown variance	10-Apr	Montgomery, Chapter 4: 186-199	Numerical Techniques: - Interpolation - Numerical integral - Numerical differentiation
Inferences on the variance of a normal population	12-Apr **HW9**	Montgomery, Chapter 4: 199-205	
Testing for Goodness of Fit	17-Apr	Montgomery, Chapter 4: 219-221	Model development:

Building empirical models: simple linear regression, least square parameter estimation	19-Apr **HW10**	Montgomery, Chapter 6: 298-312	- Linear curve fitting - Nonlinear curve fitting
Simple linear regression: testing hypotheses	24-Apr	Montgomery, Chapter 6: 312-315	Optimization Toolbox: - Working with solvers - Minimizers - Equation solvers
Simple linear regression: confidence and prediction intervals	26-Apr **HW11**	Montgomery, Chapter 6: 315-319	
Model adequacy and correlation analysis	1-May	Montgomery, Chapter 6: 319-326	
Other aspects of regression: transformations	3-May **HW12**		
Final Exam	9-May		6:20 - 8:20 p