Data Analysis & Decision Making 22:960:575 Spring 2020 Saturday 9:00-12:00	**Michael N. Katehakis** 1070 1 WP Home page Office Hours: after class, and by appointment

COURSE DESCRIPTION

A data model describes how structured data is represented in a business environment. Data modeling is a natural consequence of the prevalence of management information systems (MIS) in the real world. Together they form what in our days has become known as a Data Analytics system that provides management tools to evaluate performance and make decisions. The course aims to introduce the fundamentals of data models tools and methods and related topics. Business applications of the topics covered will be highlighted. The emphasis will be on modeling and evaluating uncertainty, understanding the nature of decision-making, using data and limited information efficiently, simulating complex systems, and optimally allocating resources.

COURSE MATERIALS

◇ *Data, Models, and Decisions: The Fundamentals of Management Science* by Dimitris Bertsimas and Robert Freund. Charlestown, MA: Dynamic Ideas, 2004. ISBN: 9780975914601. Book Site

From the authors' description: This text uses data analysis techniques (statistics, simulation, probabilistic modeling and optimization), but only as tools to facilitate problem solving. The book embraces the following dictum as its premise: "The final test of any theory is its capacity to solve the problems which originated it. This book is used in the core MBA program at MIT's, Sloan School of Management for the class titled: "Data, Models and Decisions". It is used in over ten universities in both core and elective classes, including Stanford University, Chicago's graduate school of Business, Babson College, among several others. The book contains many real business cases from the authors consulting experience.'

◇ *Other Resources:* I will provide additional at: reading materials during the course.
◇ Start with: Review of Probability.

LEARNING GOALS AND OBJECTIVES

The aim is to develop decision-making skills. It is impossible to teach one all there is to know about data analysis techniques in a semester; hence the objective is to enable you to become *intelligent users of data analysis techniques.* This will necessitate some use of formulas and computer manipulations of data. However, the goal is not that you will become experts on equations and computer software, but rather to give you a perspective on how data models and techniques are used in practice. Hence, much of the material will be presented in a setting of practical business situations. decisions. The focus is on ways of modeling and structural ideas about, decision problems.

Specific goals: There will be an introduction to the concepts and applications of those basic ideas that are considered to be most important for the practical analysis of management, listed below.

1. Random Events, Probabilities and Probability Distributions.

2. Monte Carlo simulation.

3. Normal, Binomial, and Poisson Distributions.

4. Sampling and Sampling Distributions.

5. Estimation & Confidence Intervals.

6. Hypothesis Testing.

7. Regression Analysis.

8. Additional Forecasting Methods.

9. Optimization models.

10. Decision Theory.

Students develop these skills and knowledge through the following course activities and assignments: Lectures, Homework Assignments, and Exams.

PREREQUISITES

a) Basic undergraduate statistics courses or 22:135:572 Stat for Mgrs.
b) Calculus with a grade of B or better; or 22:135:571 Calc for Mgrs.

ACADEMIC INTEGRITY
Students are responsible for understanding the RU Academic Integrity Policy. Students must sign the RU Honor Pledge. See business.rutgers.edu/ai for more details.

ATTENDANCE AND PREPARATION POLICY
Expect me to attend all class sessions. I expect the same of you. If I am to be absent, my department chair or I will send you notice via email and Blackboard as far in advance as possible. If you are to be absent, report your absence in advance at https://sims.rutgers.edu/ssra/.

If your absence is due to religious observance, a Rutgers-approved activity, illness, or family emergency/death and you seek makeup work, also send an email with full details and supporting documentation within 3 days of your absence. For weather emergencies, consult the campus home page. If the campus is open, class will be held. Expect me to arrive on time for each class session. I expect the same of you. Expect me to remain for the entirety of each class session. I expect the same of you. Expect me to prepare properly for each class session. I expect the same of you. Complete all background reading and assignments. You cannot learn if you are not prepared. The minimum expectation is that for each 3-hour class session, you have prepared by studying for at least twice as many hours. Expect me to participate fully in each class session. I expect the same of you. Stay focused and involved. You cannot learn if you are not paying attention.

CLASSROOM CONDUCT
The course will be largely taught using computer presentation. Class-related material (lecture notes, messages, etc.) will be posted on the class site. Additional visual material and demos may be shown in some classes. *Most of your work will take place outside the classroom, as you study, and apply the material to which you are introduced in class.*

Homework Assignments are designed to help you learn the material discussed in class. In addition doing a thorough job on the homework assignments is the best preparation for the quiz and the final examination. There are three types of assignments: read, prepare, and hand in.

- **Read:** When the assignment is to read some material, this reading is an important introduction to the topics to be discussed in class. I will make the assumption that you have done the reading before class and have understood much (but not necessarily all) of it. When the assignment is to read a problem, that problem will often be used in class to introduce new concepts.

- **Prepare:** Fully analyze the problem. Be ready to discuss it in class, with the numbers computed, etc. I will call on people, so please be ready.

- **Hand In:** The same as prepare, but you must turn in your analysis. All written assignments must be handed in at the beginning of class on the day they are due, and so you will probably want to make a copy of your assignment for reference during class. All written assignments will be graded. These assignments should be submitted in typed form using a word processor. Please write your name, RUID and email on all homework submitted. Team work on this homework is not allowed. Unless a documented reason is produced for unusual circumstances, late submissions will not be accepted more than a week late.

Case write-ups should consist of a summary of no more than two pages of single-sided text, The summary should not contain any calculations. In it you should clearly present your recommendations and proposals. Supporting documents (calculations, charts, figures, etc.) may be appended to the summary. Case write-ups should represent only the work of a single student. You may discuss the case with other students in your team, the teaching assistants, or the professor of the course, but the memo and the analysis should represent only your own work.

Term Project: A Data Models related topic is part of the course. For the project work only, students may team up into groups of 3 or so.

Your class participation will be evaluated subjectively, but will rely upon measures of punctuality, attendance, familiarity with the required readings, relevance and insight reflected in classroom questions, and commentary. Your class participation will be judged by what you add to the class environment, regardless of your technical background. Although several lectures will be didactic, we will rely heavily upon interactive discussion within the class. Students will be expected to be familiar with the readings, even though they might not understand all of the material in advance. In general, questions and comments are encouraged. Comments should be limited to the important aspects of earlier points made, and reflect knowledge of the readings. You may called on to answer questions about the homework or classroom discussion. Your classroom participation evaluation is based on the extent to which you contribute to the learning environment. However, correcting a mistake of the professor and asking what appear to be "dumb questions" about what is being covered are positive contributions. In the case of so-called "dumb questions," very often half of the class will have the same questions in mind and are relieved to have them asked.

Other requirements are: On-time arrival to classes, with uninterrupted attendance for the duration.
Maintenance of a professional atmosphere - use respectful comments and humor.
Refraining from distracting or disrespectful activities, e.g., avoiding side conversations.
Courtesy towards all participants in the classroom.

EXAM DATES AND POLICIES
There are 2 exams in this course:

Midterm Exam: in class, open book, date: March 28, 2020.

Final Exam: in class, open book, date: May 2, 2020.

During exams, the following rules apply: If you have a disability that influences testing procedures, provide me an official letter from the Office of Disability Services at the start of the semester. No cell phones or other electronics are allowed in the testing room. You must show a valid Rutgers photo ID to enter the room and to turn in the exam. Alternate seating; do not sit next to another student or in your usual seat. Use the bathroom prior to the exam start; bathroom breaks, if essential, will be escorted. Your exam will not be accepted unless you sign the Honor Pledge.

GRADING Your grade[1] will be based on a final exam, a quiz, case write-ups, homework assignments, and class participation, as follows:

⋄ Final exam (3-hour exam) 40%.
⋄ Case write-ups and homework assignments 20%
⋄ Quiz (2-hour test held in class) 25% on 3/18 in class
⋄ Class participation and conduct 15%

COURSE SCHEDULE[2]

⋄ Weeks 1-3: BASIC CONCEPTS
Sections 2.1 through 2.11 & 2.13 of chapter 2

- Random Variables

Discrete Distributions: Bernoulli, Binomial, Poisson, Uniform, Geometric.

- Laws of Large Numbers
- Simulation Modeling
Sections 4.1 and 4.2 of chapter 4

∗ Simulation: Simple Example
∗ The Binomial Model and its Simulation
∗ Simulation of an Inventory System

⋄ Week 4: CONTINUOUS DISTRIBUTIONS
Sections 3.1 through 3.8

- Normal, Exponential Distribution, t_n, χ_n^2
- Defining the Poisson Process
- American Options
- Capital Asset Pricing Model

⋄ Weeks 5-6: STATISTICAL SAMPLING
Section 4.4 through 4.6 of chapter 4

---

[1]Your final grade is not subject to negotiation. If you feel I have made an error, submit your written argument to me within one week of receiving your final grade. Clarify the precise error I made and provide all due supporting documentation. If I have made an error, I will gladly correct it. But I will adjust grades only if I have made an error.

[2]Tentative.

- – Estimators

- – Confidence Intervals

- – Test of Hypothesis

- – Bayes Estimation

◇ Weeks 9-10: REGRESSION MODELS: CONCEPTS AND PRACTICE
Sections 6.1 through 6.7 of chapter 6

- – Linear Models

- – Analysis of Correlation

- – Ridge regression

- – Lasso method

◇ Weeks 11-13: OPTIMIZATION.
Sections 7.1-7.6 of chapter 7

- – Linear Optimization

- – Binary Optimization

- – Non-Linear Optimization

SUPPORT SERVICES

If you need accommodation for a disability, obtain a Letter of Accommodation from the Office of Disability Services. The Office of Disability Services at Rutgers, The State University of New Jersey, provides student-centered and student-inclusive programming in compliance with the Americans with Disabilities Act of 1990, the Americans with Disabilities Act Amendments of 2008, Section 504 of the Rehabilitation Act of 1973, Section 508 of the Rehabilitation Act of 1998, and the New Jersey Law Against Discrimination. https://ods.rutgers.edu

If you are a military veteran or are on active military duty, you can obtain support through the Office of Veteran and Military Programs and Services. http://veterans.rutgers.edu/

If you are in need of mental health services, please use our readily available services. [Select for inclusion in syllabus based on course location] [Rutgers University-Newark Counseling Center: http://counseling.newark.rutgers.edu/] [Rutgers Counseling and Psychological Services ? New Brunswick: http://rhscaps.rutgers.edu/]

If you are in need of physical health services, please use our readily available services. [Select for inclusion in syllabus based on course location] [Rutgers Health Services ? Newark: http://health.newark.rutgers.edu/] [Rutgers Health Services ? New Brunswick: http://health.rutgers.edu/]

If you are in need of legal services, please use our readily available services: http://rusls.rutgers.edu/