STA 4821 STOCHASTIC MODELS FOR COMPUTER SCIENCE (Fall 2018)

CATALOG DESCRIPTION: Prerequisite: MAC 2312 (Differential and Integral Calculus II). Basic principles of probability and statistics for modeling and experimentation in computer science. Topics from probability and statistics include basic concepts, conditional probability, random variables, distribution and density functions, stochastic processes, the central limit theorem, and simulation; applications include computer system performance evaluation, fault-tolerant computing, software reliability, telecommunications traffic analysis.

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PREREQUISITE: MAC 2312, especially the relationship between the derivative and the definite integral (the Fundamental Theorem of Calculus). Ability to evaluate integrals numerically, using a calculator or other software.

TEXTBOOK: Ross, S.M., A FIRST COURSE IN PROBABILITY, 6th Ed., Prentice-Hall 2002, ISBN 0-13-033851-6. (Any edition is acceptable.) A copy of the 6th edition and its solutions manual will be kept on Reserve in the library.

REFERENCES:
Tijms, H., PROBABILITY: A LIVELY INTRODUCTION, Cambridge 2017, ISBN 978-1-108-40784-7 (paperback) .

Bertsekas, D.P. and J.N. Tsitsiklis, INTRODUCTION TO PROBABILITY, 2nd Ed., Athena Scientific 2008, ISBN 978-1-886529-23-6. www.athenasc.com/probbook.html.

Ghahramani, S., FUNDAMENTALS OF PROBABILITY, 3rd Ed., Pearson Prentice Hall 2005, ISBN 0-13-145340-8.

Videos, STA 4821 recorded Fall 2003 (and other courses):
https://www.youtube.com/channel/UCJbnVTvSB6gEt4kgOLOMQMA/playlists

TOPICS: 1. Events, sample space, axioms of probability.
2. Conditional probability, independence.
3. Random variables.
4. Distribution and density functions; mean and variance; convolution.
5. Uniform, binomial, exponential, normal, and other distributions.
6. The Poisson process.
7. Simulation, the inverse transform method.
8. Laws of large numbers, the central limit theorem.
9. Sampling statistics, confidence intervals.
10. Queues, reliability, or other applications.

OBJECTIVES: To provide certain technical skills that are important in computer science and engineering applications; to provide a feeling and appreciation of statistical concepts and reasoning in everyday life; and to show, in passing, that the subject is interesting, enlightening, and sometimes surprising. To examine the relationship between theory (mathematical model) and experiment (simulation).

Topics 1-9 provide the theoretical background for the application of probabilistic and statistical reasoning. Homework assignments compare theory and simulation. Topic 10 provides an in-depth discussion of the application of these concepts to a realistic engineering model. Overall, the Topics promote “An ability to identify, formulate, and solve complex computing/engineering problems by applying principles of computing, engineering, science, and mathematics” (ABET).

RULES: There will be two exams, a midterm and a final. Exams will be in class, open book. Homework problems will be assigned, but only specifically designated assignments will be graded. Students are allowed to "consult" (to be defined in class) on homework problems. Grades will be based on the exams and the graded homeworks.

NOTE: In homework problems, all "theory" answers recorded in the summary table must be supported by calculations; and all "simulation" results recorded in the table must be supported by actual code and output. It will be taken as evidence of cheating if any theory result recorded in the table does not correspond to the accompanying calculation; or if the simulation code, its printed output, and the output values recorded in the table are not consistent; or if simulation code with (incorrect) parameter values from a previous semester is used.