National Taiwan University of Science and Technology

2021 Summer Program

STAT 400 Probability Theory

Course Outline

Course Code: STAT 400

Instructor: Professor Vadim Olshevsky

Home Institution: University of Connecticut

Office Hours: TBA and By Appointment

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Credit: 4

Course Description: Introducing probability and statistical inference. The course has a prerequisite of differential and integral calculus. We will use the textbook "A first course in Probability" by Sheldon Roth, 9^{th} edition.

Course Objectives: **A student who satisfactorily completes this course will be able to:**

- understand the basic rules of probability conditional probability. and expectation
- apply Bayes' theorem on changing conditional probabilities with new evidence;
- understand the difference between discrete and continuous random variables;
- work easily with several common distributions, discrete and continuous;
- understand the central limit theorem;
- understand the difference between point estimates and inference by confidence intervals, the strengths and limits of both;
- engage in critical evaluation of statistical evidence, and experimental design.

Required Textbooks: A first course in Probability" **by Sheldon Roth, 9th editi**on, 2014, Pearson, ISBN: 9780321794772.

Homework: We will use Pearson My Lab web site for daily homework assignments.

Grading & Evaluation		**Grade**	**Range**
Attendance and participation:	10%	A	90-100
Homework:	30%	B	80-89
Midterm:	30%	C	70-79
Final:	30%	D	60-69
		F	0-59

Course Schedule:

Week1

Chapter 1. Axioms of probability, sampling, review of counting, infinitely many outcomes.

Probabilities defined on events, Conditional probabilities

Independent events, Bayes' formula.

Chapter 2. Random variables, Discrete random variables (Bernoulli, Binomial, Geometric, Poisson).

Continuous random variables. Expectation of a random variable.

Week2

Jointly distributed random variables, Moment generating functions.

Limit theorems, stochastic processes.

Chapter 3. Conditional probability and conditional expectation. Discrete and continuous cases.

Computing probabilities and expectations by conditioning.

Week3

Chapter 4. Chapman-Kolmogorov equations. Classification of states. Limiting probabilities.

Markov chains. Monte Carlo methods. Markov Decision processes.

Chapter 5. Exponential distributions.

The Poisson process.

Week4

Chapter 6. Continuous-time Markov chains. The transition probability function.

Limiting probabilities. Time reversibility.

Chapter 7. Renewal Theory and applications.

Final exam.

Student responsibilities/expectations: The main course material will be presented through lectures. Students are advised to keep pace with the course material as it is being presented. Consequently, students should endeavor to attend all class meetings and discussion sessions, be early for class, and spend sufficient time working on assigned homework problems. If for any reason a student misses a class, he/she should endeavor to obtain the notes and learn the missed material before the next class meeting. Students should not hesitate to ask questions or seek additional assistance to ensure that they are staying on pace with the class. Students will be expected to come to class prepared and ready to participate actively. Please, turn off your cell phones and put aside any unrelated material before class begins. Students should exhibit a sense of responsibility and respect towards fellow students.

Examinations: There will be two midterm exams plus one cumulative final exam. The exams will contain problems to solve and definitions, brief explanations of concepts, and simple proofs.