University of International Business and Economics

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International Summer School

STAT 205 Probability Theory

Term: June 13th – July 14th, 2022
Instructor: Shen Fan
Home Institution: China University of Petroleum
Email: fans@cup.edu.cn
Class Hours: Monday through Thursday, 120 minutes each day (2,400 minutes in total)
Office Hours: TBD
Discussion Session: 2 hours each week

Total Contact Hours: 64 contact hours (45 minutes each, 48 hours in total)
Credit: 4 units

Course Description:

This course introduces students to probability. Topics include probability spaces, conditional probability, independence, univariate random variables, multivariate random variables, random vectors, expectation, law of large numbers, central limit theorem.

Course Goals:

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;
- ✧ know what expectation and variance mean and be able to compute them;
- ✧ understand the central limit theorem.

Required Textbook:

S. Ross, A First Course in Probability, 10th Edition, Pearson, ISBN-13: 9780134753119.

Attendance policy:

Summer school is very intense and to be successful, students need to attend every class. Occasionally, due to illness or other unavoidable circumstance, a student may need to miss a class. A medical certificate is required to be excused. Any absence may impact on the student's grade. Arriving late or leaving early will count as a partial absence. If a student is missing less than a point for a better grade, the better grade will be given, provided the student had no unexcused absences during the course.

Grading Policy:

Grading will be determined by a combination of class attendance and participation, and the results of your exams.

Homework	30%.
Midterm Exam	30%.
Final Exam	40%.

Grading Scale:

Assignments and examinations will be graded according to the following grade scale:

A	90-100	**C+**	72-74
A-	85-89	**C**	68-71
B+	82-84	**C-**	64-67
B	78-81	**D**	60-63
B-	75-77	**F**	below 60

Class Rules:

All academic work should be done with the high level of honesty and integrity. Academic misconduct of any kind may result in a grade penalty or the assignment of a failing grade.

Course Schedule:

Week One（June.13-16 13:10-15:10）
Monday: Chapter one, combinatorial analysis, the basic principle of counting, permutations, combinations, Multinomial Coefficients, The Number of Integer Solutions of Equations.
Tuesday: Chapter two, axioms of probability, sample space and events, axioms of probability, some simple propositions, sample spaces having equally likely outcomes, probability as a continuous set function, probability as a measure of belief.
Wednesday: Chapter three, conditional probability, Bayes formula.
Thursday: independent events, $\mathrm{P}(\cdot\,|\mathrm{F})$ is a Probability.

Week Two（June.20-23 13:10-15:10）
Monday: Chapter four, random variables, discrete random Variables, expected value, expectation of a function of a random variable, variance.
Tuesday: The Bernoulli and binomial random variables, the Poisson random variable, other Discrete Probability Distributions, expected value of sums of random variables, properties of the cumulative distribution function.
Wednesday: Chapter five, continuous random variables, expectation and variance of continuous random variables, the uniform random variable, normal random variables.
Thursday: exponential random variables, other continuous distributions, the distribution of a function of a random variable.

Week Three （June.27-30 13:10-15:10）
Monday: Midterm Examination 30%.
Tuesday: Chapter six, jointly distributed random variables, joint distribution functions, independent random variables, sums of independent random variables.
Wednesday: conditional distributions: discrete case, conditional distributions: continuous case, order statistics, joint probability distribution of functions of random variables, exchangeable random variables.
Thursday: Chapter seven, properties of expectation, expectation of sums of random variables, moments of the number of events that occur, covariance, variance of sums, and correlations.

Week Four（July.4-7 13:10-15:10）
Monday: Conditional expectation, conditional expectation and prediction, moment generating functions.
Tuesday: Additional properties of normal random variables, general definition of expectation.
Wednesday: Chapter eight, Chebyshev's inequality and the weak law of large numbers, the central limit theorem, the strong law of large numbers.
Thursday: Other inequalities and a Poisson limit result, bounding the error probability when approximating a sum of independent Bernoulli random variables by a Poisson random variable, the Lorenz curve.

Week Five（July.11-14 13:10-15:10）
Monday: Brief introduction to chapter nine.
Tuesday: Brief introduction to chapter ten.
Wednesday: Review.
Thursday: final, 40%.