Syllabus of Probability Theory and Mathematical Statistics A*

Course Name/Title： Probability Theory and Mathematical Statistics A*

Course code： 63915

Course Type： General Course, Compulsory Course

Total Teaching Hours： 48

Course Credit： 3

Ⅰ Course Objective

This course is offered to students who have successfully completed Linear Algebra and Calculus. The purpose of the Probability and Statistics course is to develop the ability to think clearly, logically and critically within mathematical and non-mathematical situations. Students will acquire an understanding of probability and statistics through mathematical formulas, and the organization/examination of data. Students will apply probability and statistics concepts through class activities and projects.

Probability and Statistics is an introduction to basic statistical concepts and techniques. Topics include descriptive statistics, probability theory, binomial distribution, normal distribution, sampling theory, hypothesis testing, confidence limits and ANOVA. Probability is the study of randomness and uncertainty. Statistics is the branch of mathematics that provides methods for organizing data, summarizing data and using information in the data to draw various conclusions. Learning probability and statistics concepts will enable the student to maximize his/her knowledge in uncertain situations by using and evaluating existing data or by collecting and analyzing his/her relevant data.

Ⅱ Course Content

Chapter 1. Random Events and Probability

Topics: Sample space and events, Probability, The axioms of probability, Some Elementary theorems, Conditional probability, Bayes theorem, Independence events

Core learning outcomes:

1. Understand the concept of sample space and events.
2. Understand the concepts of frequency and probability and their relationships.
3. Understand the concept of classical probability and geometric probability.
4. Understand the concept of conditional probability and its computational formulation.
5. Understand the concept of independence events.

Chapter 2. Random Variable and Its Distributions

Topics: Random variables, Discrete and continuous Distribution, Distribution function, Two points distribution, Binomial distributions, Poison distributions, Normal distribution, Probability density

Core learning outcomes:

1. Understand the concept of Random variables.
2. Master the common discrete variables: Two points distribution, Binomial distribution, Poisson distribution, Geometric and Hyper-geometric distribution.

3. Understand the Poisson theorem and binomial theorem.

4. Understand the inherent characteristics of continuous random variable and the probability significance of the derivative of its distribution function.

5. Understand the concept and the properties of probability density of continuous random variable. And master a few common density function with continuous random variable, such as uniform distribution, exponential distribution and normal distribution.

Chapter 3. Multidimensional Random Variables and their Distribution

Topics: Two-dimensional continuous random variable, Multi-dimensional random variable, Distribution function of two-dimensional continuous random variable, Probability density of two-dimensional continuous random variable, Conditional distribution.

Core learning outcomes:

1. Understand the concept of multi-dimensional random variable, and can describe random events with multi-dimensional random variable.

2. Understand the inherent characteristics of two-dimensional continuous random variable and the probability significance of the derivative of its distribution function.

3. Understand the concept and the properties of probability density of two-dimensional continuous random variable.

4. Understand the meaning of the conditional distribution.

5. Master the method to compute the function of two-dimensional random variable.

Chapter 4. Numerical Characteristics of Random Variables

Topics: mathematical expectation, variance, moment, covariance, correlation coefficient, covariance matrix, characteristic function

Core learning outcomes:

1. Understand the definition and the property of mathematical expectation and variance of random variables. And remember the mathematical expectation and variance of several common functions.

2. Understand the concept and the computational methods of moment, covariance and correlation coefficient.

3. Understand the concept of covariance matrix.

4. Understand the concept of characteristic function and its basic properties.

Chapter 5. Law of Large Numbers and The Central Limit Theorem

Topics: Law of Large Numbers, the Central Limit Theorem

Core learning outcomes:

1. Understand Chebychev inequality, law of averages and law of large numbers.

2. Understand the central limit theorem for Bernoulli trials, binomial distributions again, the normal distribution and the general central limit theorem.

Chapter 6. The Basis of Mathematical Statistics

Topics: Introduction to Statistics, Role of Statistics in Engineering, Histogram, Illustrative examples

Core learning outcomes:

1. Understand the concept of overall, individual and statistics.
2. Master the method to draw histogram.
3. Master how to compute sample mean, sample variance and sample Moment, and understand the concept of empirical distribution function.

Chapter 7. Parameter Estimation
Topics: point estimates of parameters, moment estimation method, maximum likelihood estimation method, interval estimation.
Core learning outcomes:

1. Understand the concept of point estimates of parameters
2. Compute estimator of parameter with moment estimation.
3. Compute estimator of parameter with maximum likelihood estimation method.
4. Understand the concept of interval estimation.
5. Compute the confidence interval of mean and variance for a single normal population.
6. Compute the confidence interval of mean and variance for the two normal populations.

Chapter 8. Hypothesis Testing
Topics: Hypothesis Testing, Type I Error, Type II Error and Power
Core learning outcomes:

1.Understand the fundamentals of Hypothesis Testing.

2.Understand the hypothesis test of mean and variance for single and two normal populations.

III Practice Plan and Requirement

Teaching method / Teaching hours / Contents	Theoretical teaching	Exercise class	Discussion Class	subtotal
1. Random Events and Probability	4	1	1	6 hours
2. Random Variable and Its Distributions	6	2	1	9 hours
3. Multidimensional Random Variables and their Distribution	5	1		6 hours
4. Numerical Characteristics of Random Variables	4	1	1	6 hours

5. Law of Large Numbers and The Central Limit Theorem	2	1		3 hours
6. The Basis of Mathematical Statistics	4	1	1	6 hours
7. Parameter Estimation	6	2	1	9 hours
8. Hypothesis Testing	3			3 hours
total	34	9	5	48 hours

Ⅳ Suggestions for Teaching

In the teaching process must pay attention to the rigor and completeness of the theory of teaching, the basic concepts of the course, the basic theory and the basic method must be in-depth explanation, so that students can form a new way of thinking as soon as possible. Pay attention to the fun of the classroom, cultivate students' interest in learning, improve students' learning initiative. In the course of teaching should also pay attention to contact practice, so that the teaching content is more diverse and richer, so as to exercise the students' thinking ability and practical ability.

Using multimedia teaching methods to improve teaching efficiency and quality. Multimedia teaching methods intuitive and easy to understand, illustrated, lively characteristics, so that active classroom atmosphere, increase classroom teaching capacity, not only to stimulate students' interest in learning, but also on the teaching efficiency and quality play a very good role in promoting. The use of interactive heuristic teaching, students to develop independent thinking and self-learning ability. In the teaching process, the interaction with the students should be student-oriented, all teaching activities should be conducive to student learning, master the principles of learning methods.

Ⅴ Suggestions for Course Learning

1. Extra-class Work

Extra-class exercises are important elements in the progress to guide students and check the teaching effect. In the meanwhile, exercises are the benchmarks of curriculum requirements. It should focus on the teaching requirements which emphasize basic training and lower the need of tricks to choose appropriate exercises. Extra-class work should be able to cultivate students' capacity to analyze and solve problems, consolidate knowledge. It should be also practical enough to be able to arouse students' interests. The teachers could either use exercises from the teaching materials or compile by themselves, usually once every two class hours. Besides, special small papers, reading notes, extracurricular reading and so on are all helpful.

2. Autonomous Learning

It is important to improve students' ability to learn and acquire knowledge independently, so teachers should appropriately assign students to learn by themselves. To help students study by themselves, professional books in the department library which was only open to teachers should allow students to access, besides of the college library. It would help student develop individually and cultivate innovative ideas.

3. Extracurricular Guide

Extracurricular guide asks teachers to answer students' questions out of class, and requires second classroom. In principle, there should be one hour for question and answer every two or three class hours. The teacher could arrange the night study to tutor students' problems, collect common issues for class.

Ⅵ Assessment

(Assessment content and methods must correlate with course objectives.)

Assessment Methods or Approaches	Assessment Requirements	Assessment Weighting	Evaluation of Course Objectives
classroom performance	attendance and so on	10%	
conventional assignments	15	30%	
final exam	Close-book	60%	

Note: 1. Assessment methods or approaches mainly include classroom performance, conventional assignments, unit tests, mid-term exam, final exam, big assignments, course paper, project design and works, etc.

2. Assessment requirements include frequencies of assignments, assessment methods (open-book, close-book), and project design requirements, etc.

3. Assessment Weighting refers to the percentage that assessment methods or approaches take up in the total score.

Ⅶ Textbooks and References

1.Textbook

Jay L. Devore, Probability and Statistics for Engineering and the Sciences(English language reprint edition), China Machine Press, 2005.

2.Reference

Ronald E. Walpole et al. Probability & Statistics for Engineers & Scientists(English language reprint edition), Tsinghua University Press, 2004.

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