Probability THEORY& statistics

Course Syllabus

1. General Information

Course name: Probability Theory & Statistics

Course code: BAS1226

Number of credits: 2

2. Objectives

- Knowledge: Providing students with the background necessary to understand probability theory and mathematical statistics. Helping students to obtain methods and tools to study, research and solve problems in the fields of electronics, telecommunications and information technology, including the following topics:

- Probability Theory: Random experiments, events, probability of events, random variables, multiple random variables, the characteristics of random variables and multiple random variables,…
- Statistics: Sampling theory, estimation theory andhypothesis testing.

- Skills: Students can apply mathematical tools from probability theory and statistics to study related problems in electronics, telecommunications & information technology, specifically:

- Applying probability theory and statistics to study other subjects.
- Applying probability theory and statistics to solve practical problems of electronics, telecommunications & information technology.

- Attitude:

- Make theeffort to the lessons and prepare for these ones before attending class.
- Complete all homeworks and assignments.

3. Abstract

The course has two parts that are relatively independent in structure but closely related in contents:

- Probability theory: Studying the rules of random phenomena: events, probability of events, random variables, multiple random variables, the characteristics of random variables and multiple random variables, the law of large numbers and the central limit theorem.
- Statistics: Sampling theory, estimation theory and hypothesis testing.

4. Teaching and learning methods

Lectures: 24 h

Project & practice: 6 h

Individual reading: 0 h

5. Prerequisites

Calculus 1&Calculus 2

6. Learning Outcomes

On successful completion of the course, students will be able to:

1. understand the basic terms in probability theory and statistics;

2. obtain methods and tools to study, research and solve problems in the fields of electronics, telecommunications and information technology;

3. apply mathematical tools from probability theory and statistics to study related problems in electronics, telecommunications & information technology.

7. Assessment Criteria

Learning outcomes Upon successful completion of the course, a learner will	**Assessment criteria for pass**
LO1: Understand the basic terminology in probability theory and statistics.	- Basic probability concepts - Random variables, multiple random variables - Discrete, continuous probability distributions - Convergence in probability and convergence in distribution - Law of large numbers, the central limit theorem - Point estimation, interval estimation - Hypothesis testing
LO2: Apply mathematical tools from probability theory and statistics to study related problems in electronics, telecommunications and information technology.	- Analyse practical problems - Analyse mathematical models - Critical and analytical thinking - Solving practical problems

8. Outlines

Chapter 1: Events and the notion of probability

1.1. Sample space and events

1.2. Basic probability concepts and rules of probability

1.3. Joint and conditional probabilities

1.4. Total probability theorem and Bayes' rule

1.5. Independent events

1.6. Bernoulli trials

Chapter 2: Random variables

2.1. Concept of random variables and probability distribution functions

2.2. Discrete random variables and probability mass functions

2.3. Continuous random variables and probability density functions

2.4. The characteristics of random variables: Expectation, variance and standard deviation

2.5. Some probability distributions

2.5.1. Bernoulli distribution

2.5.2. Binomial distribution

2.5.3. Poisson distribution

2.5.4. Uniform distribution

2.5.5. Exponential distribution

2.5.6. Normal (or Gaussian) distribution

Chapter 3: Multiple random variables

3.1. Concept of multiple random variables, joint distribution functions, marginal distribution functions

3.2. Multiple discrete random variables

3.2.1. Joint probability mass functions

3.2.2. Marginal probability mass functions

3.3. Multiple continuous random variables

3.3.1. Joint probability density functions

3.3.2. Marginal probability density functions

3.4. Independent random variables

3.5. The characteristics of multiple random variables

3.5.1. Expectation and variance

3.5.2. Covariance and correlation coefficient

3.6. Conditional distributions, conditional probability mass functions, conditional probability density functions, conditional expectation and conditional variance

3.7. The law of large numbers and the central limit theorem

Chapter 4: Sampling theory

4.1. On the necessity of sampling

4.2. Random sampling

4.2.1. Concept of random sampling

4.2.2. Random sampling model

4.2.3. Representation the experimental value of the random sampling by table and chart

4.3. Statistics andcharacteristic statistics of random sampling

4.3.1. Concept of statistics

4.3.2. Sample mean

4.3.3. Sample variance and sample standard deviation

4.3.4. Sample frequency

4.3.5. Calculate the concrete value ofsample mean and sample variance

4.4. Statistical distribution laws of random sampling

4.5.1. Case 1: The original variance hasnormal distribution

4.5.2. Case 2: The original variance has binomial distribution

Chapter 5: Estimation theory and hypothesis testing

5.1. Parameter estimation

5.1.1. Point estimation: unbiased estimators, efficient estimators, consistent estimators

5.1.2. Interval estimation:

- General concepts of interval estimation
- Interval estimation of the mean of a normal distribution
- Interval estimationof the mean of a bernoulli distribution

5.2. Hypothesis testing

5.2.1. General concepts of the Neyman–Pearson theory of hypothesis testing

- Hypothesis testing: Null hypothesis, alternative hypothesis
- The critical region and types of errors in hypothesis testing

5.2.2.Decision testing:

- Testing the expectation of a normal distribution
- Testing the parameter of a Bernoulli distribution

9. Required Textbooks

1. L. B. Long; *Probability Theory and Statistics*;The Information and Communications Publishing House, 2008.
2. D. P. Bertsekas; J. N. Tsitsiklis; *Introduction to Probability*; Athena Scientitis, 2000.

10. Suggested Textbooks

1. Peyton Z. Peebles, Jr.; Probability, Random variabbles, and Random signal principles; McGraw-Hill, Inc. 1987.

2. H.P. Hsu; Theory and Problems of Probability, Random Variables, and Random Processes; Schaum's Outline series. Copyright © 1997 by The McGraw-Hill Companies.

11. Grading Policy

Attendance:	10%
Average of mini midterm tests:	10%
Assignments:	10%
Final exam:	70%

Lecturer **Head of Department of Mathematics**

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