TKU211211

Probability and Random Variables

Probabilitas dan Variable acak

BASIC INFORMATION

Course Credit	2 / 100 minutes per Week
Course Type	Required
Course Classification	Basic Science
Prerequisites	-

STUDENT AND LEARNING OUTCOMES

Covered Student Outcomes

Fundamental and Engineering Knowledge (KP.1)

Learning Outcomes

LO1 Students are able to explain probability theory including conditional probability theory and solve basic problems in probability science using the theory of opportunity.

LO2 Students are able to understand the concept of both discrete and continuous random variable, understand and calculate probability distribution, probability density function, mathematical expectation and variance of a random variable as well as to derive a probability model of a random variable.

LO3 Students are able to recognize and understand the various distribution of random discrete and continuous variables that appear in the real world, apply the distributions, and use the tables of each existing distribution.

LO4 Students are able to apply the concept of probability distribution function and probability density function for multivariate random variables and compute statistical measures including covariance and correlation.

COURSE DESCRIPTION

In this course, the students learn about the theoretical concept of probability models for engineering applications.

TOPICS

1. Introduction to Probability and Statistic

1.1 Introduction to Descriptive Statistic and Inferential Statistics

1.2 Introduction to Sampling Process

1.3 Sample Mean and Sample Median

1.4 Variability Measure

1.5 Continuous and Discrete Data

1.6 Data Representation

2. Probability Theory

2.1 Sample Space

2.2 Event and Set Theory

2.3 Counting Sample Points (Tree Diagram, Permutation, Combination).

2.4 Probability of Events

2.5 Additive Rule

2.6 Conditional Probability, Product Rule, and Independence

2.7 Bayes Rule

3. Concept of Random Variables: Discrete Random Variables

3.1 Definition and Concept of Random Variable

3.2 Probability Distribution Function (Probability Mass Function)

3.3 Cumulative Distribution Function

3.4 Mathematical Expectation (Theoretical Mean)

3.5 Theoretical Variance and Standard Deviation

3.6 Introduction to Mean and Variance of Linear Combination of Random Variables

3.7 Family of Discrete Random Variables

3.7.1 Bernoulli Distribution

3.7.2 Discrete Uniform Distribution

3.7.3 Binomial Distribution

3.7.4 Poisson Distribution and Poisson Process'

3.7.5 Optional: Geometry, Hypergeometry, Negative Binomial, Multinomial Distribution

3.8 Probability Model of Derived Random Variables

4. Concept of Random Variables: Continuous Random Variables

4.1 Introduction to Continuous Random Variables

4.2 Cumulative Distribution Function

4.3 Probability Density Function

4.4 Mathematical Expectation (Theoretical Mean)

4.5 Theoretical Variance and Standard Deviation

4.6 Introduction to Mean and Variance of Linear Combination of Random Variables

4.7 Family of Continuous Random Variables

4.7.1 Continuous Uniform Distribution

4.7.2 Normal (Gaussian Distribution)

4.7.3 Chi Square Distribution

4.7.4 Optional: Exponential Distribution

4.8 Probability Model of Derived Random Variables

5. A Pair of Random Variables

5.1 Joint Cumulative Distribution Function

5.2 Joint Probability Mass Function

5.3 Marginal Probability Mass Function

5.4 Conditional Probability Mass Function

5.5 Joint Probability Density Function

5.6 Marginal Probability Density Function

5.7 Conditional Probability Density Function

5.8 Statistical Independence

5.9 Covariance and Correlation

6. Random Vectors (Multiple Random Variables)

6.1 Distribution Model for N Random Variables

6.2 Statistical Independence

6.3 N Random Variables with Identical Distribution

6.4 Expected Values, Correlation Matrices and Covariance Matrices

7. Linear Combination of Random Variables

7.1 Probability Distribution Model of Linear Combination of Multiple Random Variables

7.2 Combination of Identical Random Variables

7.3 Combination of Independent Random Variables

7.4 Central Limit Theorem

REFERENCES

[1] Probability and Statistics for Engineers and Scientists, Walpole and Myers, 2012, Ninth Edition, Prentice Halls

[2] Probability and Stochastic Processes: A Friendly Introduction for Electrical and Computer Engineers, Yates and Goodman, 2005, Second Edition, John & Wiley

[3] Probability, Random Variables, and Stochastic Processes, A. Papoulis and S. U. Pillai, 2002, Fourth Edition, Mc Graw Hill