

# Mathematical Statistics

Syllabus Number 4B206

Basic Major Subjects

Elective 2 credit

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## 1. Course Description

The goal is to master the elements of mathematical statistics. In particular, we aim to understand descriptive statistics, basic probability theories, concepts of probability distributions, various discrete probability distributions and concepts of continuous probability distributions, various distributions and inferences and tests for the first step for the inference statistics. This subject corresponds to the diploma policies DP1.

## 2. Course Objectives

Mathematical statistics are fundamental knowledge essential to understand or to estimate the data collected from various fields. The students will understand the fundamentals of mathematical statistics and will be able to calculate basic statistical calculation actually.

## 3. Grading Policy

Passing the two reports is just the requirement of qualifications of the final examination. The overall grade of this course will be decided based on the final examination. If the result of the final examination is 60 or more, you will pass.

If you have ability to pass the two reports and to answer questions in a written exam similar to the two reports, you can pass this course easily.

For feedback, submitted reports will be corrected.

## 4. Textbook and Reference

### Textbook

Keishi Baba Probability and statistics campus seminar ver.6, ISBN:978-4-86615-161-8.

Mathema Publishing

The slides shown in the class and the exercises will be open to LMS.

### Reference

Department of Statistics, College of Arts and Sciences, the University of Tokyo. Basic statistics I, Introduction of the statistics, ISBN: 978-4130420655. University of Tokyo Press

Sonoko Ishimura Yasashiku manaberu toukeigaku, ISBN: 978-4320018082. Kyoritsu Shuppan

Heiji Kodera Meikai enshu: mathematical statistics, ISBN:978-4-320-01381-0 Kyoritsu Shuppan

## 5. Requirements(Assignments)

For preparations of each class, students must read and organize the contents, and must go through the example questions in the relevant part of the textbook (about 1.0 hour).

For reviews of each class, students must do the corresponding exercises on the textbook and reports (about 2.0 hour).

If you have any questions about the exercises, you should read the relevant part of the textbook carefully to solve the problems. If there is something that you can not understand, you should refer to the reference books.

## 6. Note

This course handles the fundamental aspects of probability. Therefore, if you are not good at probability, you should review the probability at senior high school carefully. Furthermore, calculus will be applied in the latter half of this course. Therefore, you should review calculus carefully. During studying this course, you should analyze actual data with spread sheet software.

LMS will be used for this course.

## 7. Schedule

- [1] Introduction and descriptive statistics (1) case of one variable: After the digest of this course, statistics such as average, variance, etc. will be explained. The relevant part of the textbook is Sec. 6.1.
- [2] Descriptive statistics (2) correlation relation of two variables: Correlation relation in the statistics and its calculation will be explained. The relevant part of the textbook is correlation coefficient of Sec. 6.2.
- [3] Descriptive statistics (3) regression of two variables: Regression and its calculation will be explained. The relevant part of the textbook is regression of Sec. 6.2.
- [4] Basic theory of probability (1) number of cases and definition of probability: Reviewing probability at senior high school and the advanced concepts of probability will be explained. The relevant parts of the textbook are Sec. 1.1 and 1.2.
- [5] Probability distribution (1) what is discrete probability?: Reviewing probability at senior high school and the advanced concepts of discrete probability, expectation, variance, etc. will be explained. The relevant parts of the textbook are random variables, expectation and variance of Sec. 1.3.
- [6] Probability distribution (2) various discrete probability: discrete probabilities such as binomial distribution and Poisson distribution will be explained. The relevant parts of the textbook are binomial distribution of Sec. 1.3, and Sec. 4.1.
- [7] Basic theory of probability (2) Bayes theorem and independence of events: The concept of a posteriori probability through Bayes theorem and independence of events will be explained. The relevant parts of the textbook are Bayes theorem and independence of events of Sec. 1.2.

- [8] Probability distribution (3) what is continuous probability?: The advanced concepts of continuous probability from discrete probability, and how to calculate its expectation and variance using integrals will be explained. The relevant part of the textbook is Sec. 2.1.
- [9] Probability distribution (4) change of variables and probability distributions with two variables for continuous probability: a change of variables and probability distributions with two variables for continuous probability will be explained. The relevant parts of the textbook are a change of variables of Sec. 2.2 and Chapter 3.
- [10] Probability distribution (5) continuous probability distribution and normal distribution: Reviewing continuous probability, normal distribution, and central limit theorem relating to normal distribution will be explained. The relevant parts of the textbook are Secs. 2.1, 4.2, and 4.3.
- [11] Probability distribution (6) various distributions (for inferences and tests): Various distributions such as chi-squared distribution, t distribution, F distribution, etc., will be explained. The relevant parts of the textbook are exponential distribution of Sec. 2.2, Chapter 5.
- [12] Inferences (1) population and sample: The concept of population and sample, which are important for the inference statistics, unbiased estimators, etc. will be explained. The relevant part of the textbook is exponential distribution of Sec. 7.1.
- [13] Inferences (2) point estimation and interval estimation: Point estimation and interval estimation will be explained as the introduction of the inference statistics. The relevant part of the textbook is Chapter 7, especially 7.2.
- [14] Tests (1) concept of tests: The concept of tests to decide statistically will be explained as the introduction of the inference statistics. The relevant part of the textbook is Chapter 8.
- [15] Tests (2) tests when population variance is unknown and tests for difference between two population means : Practically useful tests when population variance is unknown and tests for difference between two population means will be explained. The relevant part of the textbook is Chapter 8, especially 8.2.