Course Syllabus

Mathematical Statistics II (2023 Spring)

Instructor: Chung-Han Hsieh (ch.hsieh@mx.nthu.edu.tw)

Course Description & Audience: Mathematical Statistics II, as a continuation of Mathematical Statistics I, concentrates on decision theory, estimation theory, confidence intervals, and hypothesis testing. Our aim is to lay a solid foundation for students to explore various areas such as data analysis, economics, statistical signal processing, machine learning, financial mathematics in the future. Many of the results will be delivered in a definition-theorem-proof manner. Hence, to succeed in this course, some mathematical maturity is expected.

Part 1: Review of Basic Probability Theory

- Discrete and Continuous Random Variables
- Multivariate Probability Distributions
- Functions of Random Variables
- Sampling Distributions and Central Limit Theorem

Part 2: Basic Statistical Inference Theory

- Point Estimations
- Properties of Point Estimators
- Unbiasedness, Consistency, Efficiency
- Sufficiency and Data Reduction
- Method of Moments
- Method of Maximum Likelihood
- Confidence Intervals
- Introduction to Hypothesis Testing Theory
- Neyman-Pearson Lemma
- Likelihood Ratio Tests

Part 3: Other Statistical Tools

- Least Square Methods (if time permitted)
- Nonparametric and Robust Statistics (if time permitted)
- Bayesian Statistics (if time permitted)

Prerequisites: A student planning to take this course should have some background in calculus, linear algebra, basic probability theory, and statistics. Familiarity with some numerical software such as Matlab or Python is also *required*. If in doubt about background, the student should consult with the instructor.

Time and Place: Lectures are at T7T8T9, in Room 206 TSMC Building. Office hours for the instructor are at 12:00–13:00 Monday, in Room 608 TSMC Building. Meetings are also possible at other times by appointment.

Course Materials: Students will be provided with handout material to support the lectures. The material will be mainly drawn from some recommended textbooks/references listed below.

1. G. Casella and R. L. Berger, *Statistical Inference*, Cengage Learning, 2001.
2. R. Hogg, J. McKean, A. Craig, *Introduction to Mathematical Statistics*, Pearson, 2018.
3. D. Wackerly, W. Mendenhall, and R. L. Scheaffer, *Mathematical Statistics with Applications*, Thomoson Brooks/Cole, 2008.
4. J. A. Rice, *Mathematical Statistics and Data Analysis*, Cengage Learning, 2006.

Teaching Method: Lecture

Homework: Approximately weekly. You are encouraged to join with other students in discussing the course work, including homework. However, *work that you hand in must have been prepared by you alone.*

Grading: The grade will be based on midterm test (30%) and homework (30%) and a final (40%). The instructor may exercise discretion up to 10% in each of the grading categories.