Instructor: Professor Yih-Fang Huang
Prerequisites: Stochastic Processes, Linear Systems.

COURSE OUTLINE

This course is intended for first or second year graduate students and for industry practitioners. The objective of this course is to present essential fundamental concepts of statistical inference with applications to signal processing and communication systems. However, these concepts are applicable to a wide variety of areas. The coverage should provide an easy-to-access reference to the essential concepts and tools of mathematical statistics.

The first part of the course offers a succinct overview of elements of mathematical statistics, including Fisher statistics and Bayesian statistics. Fisher estimation methods like Maximum Likelihood estimation, and Bayesian estimation such as conditional mean estimation (i.e., the minimum mean-squared error estimation) and maximum a posteriori (MAP) estimation will be presented along with some of their important properties. If time permits, we shall also present linear minimum mean-squared error estimation (orthogonality principle) that includes Wiener filters and Kalman filters.

The second part of the course will start with a discussion of the concept of sufficient statistics, presented with an introduction of the exponential family of distributions and its properties. It will then address optimality theory of estimation, minimum variance unbiased estimates, information inequality, performance bounds such as the Cramér-Rao lower bound, Rao-Blackwell Theorem and Lehmann-Scheffé Theorem. A brief introduction to confidence intervals and binary hypothesis testing with applications to signal processing and communication systems will be included.

References