

Statistical Communication Theory

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Course Description: This course intends to supply theoretical background regarding statistical decision theory and mathematical statistics at graduate level, which is useful in modern communication theory, information theory, pattern recognition, machine learning, and many advanced research such as biomedical applications and cognition. Graduate/Undergraduate students who are interested in probability and probabilistic models are welcome.

Prerequisites: Probability, Signal and Systems (preferred), Principles of Communications (preferred), Advanced Calculus (preferred but not required), Detection and Estimation (preferred but not required)

Contents:

- 1 Mathematical Background
 - 1.1 Probability and Measure
 - 1.2 Sequence of Random Variables
 - 1.3 Random Process
 - 1.4 Markov Chain
- 2 Introduction to Mathematical Statistics
- 3 Statistical Decision Theory
- 4 Game theory
- 5 Hypothesis Testing
- 6 Signal Detection
- 7 Parameter Estimation
- 8 Signal Estimation
- 9 Digital Transmission Theory
 - 9.1 Continuous-time Detection and Estimation
 - 9.2 Optimal Receiver
 - 9.3 Inner Receiver Design
 - 9.4 Multiuser Detection
- 10 Biological Applications*
 - 10.1 DNA Sequencing
 - 10.2 Evolutionary Models
- 11 Markov Decision Process

- 12 Statistical Inference
- 13 Statistical Learning
 - 13.1 Supervised Learning
 - 13.2 Unsupervised Learning
- 14 Information Theory and Statistics*
- 15 Prediction Algorithms*
- 16 Cognitive Psychology*
 - 16.1 Reasoning Systems
 - 16.2 Belief and Propagation Networks

*Optional if time allows

Textbooks: Class note and selected papers

Grades:

Mid-Term	40%
Final	40%
Term-Project	20%

References:

- [1] J.O. Berger, *Statistical Decision Theory*, 1985.
- [2] V. Poor, *Introduction to Signal Detection and Estimation*,
- [3] D.J.C. MacKay, *Information Theory, Interference, and Learning Algorithms*, Cambridge University Press, 2003.
- [4] T. Hastie, R. Tibshirani, J. Friedman, *The Elements of Statistical Learning*, Springer, 2001.
- [5] M.L. Puterman, *Markov Decision Processes*, Wiley, 1994.
- [6] N. Cesa-Bianchi, G. Lugosi, *Prediction, Learning, and Games*, Cambridge University Press, 2006.
- [7] P.J. Bickel, K.A. Doksum, *Mathematical Statistics Vol. I Basic Ideas and Selected Topics*, 2nd edition, Pearson Education, 2007.