

FSRM/MSDS 581
Probability and Statistical Inference
Fall 2020

- Instructors:** Sijian Wang, Ph.D.
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Office hour: 10-11am & 8-9pm EST on Thursday
Office hour Zoom link: same as the lecture Zoom link
- TA:** Ms. Yimeng Shi,
Email: ys565@rutgers.edu
Office hour: 10-11am EST on Monday & 9-10pm EST on Tuesday
Office hour Zoom link:
<https://rutgers.zoom.us/j/96850045984?pwd=RTFxNjJKbloxN090cUV0Qjhoc09wQT09>
Password: FSRM581
- Prerequisite:** Level IV Statistics (e.g. Statistics 960:401 or 960:484)
It should be emphasized that this course will cover a great deal of material at a rapid pace and will involve a lot of mathematics. Students who have had difficulty in previous mathematics, probability and statistics courses may find that this course requires a considerable amount of time and effort and should plan accordingly.
- Textbooks:** *All of Statistics: A Concise Course in Statistical Inference*, by Larry A. Wasserman

[Supplemental Text] *Pattern Recognition and Machine Learning*, by Christopher M. Bishop.
- Lectures:** Wednesday 6:40-9:30pm EST
Lecture Zoom link:
<https://rutgers.zoom.us/j/97731421584?pwd=WlNPSW9pam9vSDhvaDJpUnFtRUtEdz09>
Meeting ID: 977 3142 1584 Password: 949525
All lectures will be recorded and made available.
- Grading:** Homework: 30%; Midterm: 30%; Final: 40%.

Homework: Homework will be assigned and collected on Canvas. **Late homework will NOT be accepted. DO NOT COPY from other sources.** Computer generated output without detailed explanations and remarks will NOT receive any credit.

Course outline (tentative):

0. Introduction

1. Probability, Conditional probability, Independence
2. Random variables and distributions.
3. Expectation and variance, Conditional expectation
4. Decision theory. Minimizing expected loss, loss functions, classification, prediction.
Bayes rules and Bayesian inference.
5. Probability inequalities: Chebyshev's inequality, Chernoff inequality and the law of large numbers.
6. Moment generating functions and the central limit theorem. Relationship to statistical inference.
7. Point and interval estimation. Methods for constructing estimators: Method-of-moments and maximum likelihood. Asymptotic results: Consistency and asymptotic normality.
8. Hypothesis testing, multiple testing and false discovery rates. Type I and type II error, power. Familywise error rate and false discovery rate. Benjamini-Hochberg procedure.
9. Linear methods for regression and classification. Regression: Least-squares, bias-variance decomposition, Bayesian linear regression, Classification, Linear discriminant.
10. (if time permits) Non-linear methods for regression and classification. Kernel density estimators and nearest-neighbor classifiers.