STA 5106
Computational Methods in Statistics I

Department of Statistics

Florida State University

Class 25
December 3, 2019

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Review of STA 5106

Chapter 2 Numerical Linear Algebra

- Multiple Linear Regression
  - Least Square solution
  - Orthogonal Transformation
  - Rotation and Reflection
  - Householder Transformation (Qualify exam)

- Principal Component Analysis (unsupervised method)
  - Singular Value Decomposition
  - Principal Component Analysis (Qualify exam)

- Linear Discriminant Analysis (supervised method)
  - Generalized Eigenvalue Solution

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Chapter 3 Non-Linear Statistical Methods

- Non-linear Optimization
  - Maximum Likelihood Estimation
  - Root Finding
  - Order of Convergence
  - Simple Iterations
  - Newton-Raphson Method (Qualify exam)
  - Convexity and Concavity

- EM Algorithm
  - Derivation of the EM Algorithm (Qualify exam)
  - EM for Multinomial Example (Qualify exam)
  - EM for Gaussian Mixture Model (Quality exam)

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Chapter 9 Statistical Pattern Recognition

- Classification
  - Feature Vector and Dimension Reduction
  - Metric Distance in Feature Space
  - Training Data and Test Data
  - Nearest Neighbor (NN) Classifier
  - k-Nearest Neighbor (kNN) Classifier

- Clustering
  - K-Means Clustering
  - Minimization of Sum of Squared Errors

Chapter 5
Simulating Probability Distributions

- Simulating Uniform Random Variable
  - Uniform Pseudorandom Numbers
  - Congruential Generators

- Simulating Other Random Random Variables
  - Discrete Random Variables (e.g. Poisson, Geometric, Binomial)
    - Inverse transform method
    - Acceptance/rejection method
  - Continuous Random Variables (e.g. Exponential, Gamma, Normal)
    - Inverse transform method
    - Acceptance/rejection method

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Chapter 6 Monte Carlo Method

- Classical Monte Carlo Method
  - Unbiased Estimator and Variance Convergent to 0
  - Variance Reduction Techniques
    - By Conditioning
    - By Control Variates

- Importance Sampling: Change of sampling function for
  - Easy sampling
  - Variance reduction

- Tilted Sampling
  - One special case of the importance sampling
  - Tail probability estimation

Special Topics

- ## Locally Linear Embedding
  - Nonlinear dimension reduction
  - Effective with nonlinear low-dimensional structure

- ## Dynamic Programming
  - Optimization on Long Sequence with Markovian Structure
  - Brute-force Computation is not feasible
  - Final Project

- ## Function Alignment

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Extra Office Hours

- No class this Thursday.

- Extra help will be provided for the final project and bonus project.

- Time: this Thursday (12/5) afternoon (2-5pm).

- Location: 106B OSB.