Course Outline

1. Document Information

Degree Program	Computer Science
Course Number	CS 480
Course Title	Computational Statistics II
Semester Hours	3
Course Coordinator	Xiaolan Huang
Revision Term	Spring 2020
Latest Revision	Spring 2020

2. Catalog Description

This course utilizes computational and graphical approaches to solve statistical problems. A comprehensive coverage on modern and classical methods of statistical computing will be given. Case studies in various disciplines such as science, engineering, and education will be discussed. Various topics such as numerical integration and simulation, optimization and maximum likelihood estimation, density estimation and smoothing as well as re-sampling will be presented. Students will be able to create graphical and numerical display based on their data analysis results using R programming language.

3. Textbooks

- James, G. (2017). An Introduction to Statistical Learning with Applications in R. Springer, 8th edition. ISBN: 9781461471370, eBook ISBN: 9781461471387.

4. References

5. Course Learning Outcomes

- Develop analytical and computational skills for statistical inference.
- Write software in R language to implement statistical procedures.
- Implement a combination of statistical toolkits for analyzing real data sets.

6. Assessment of the Contribution to Student Outcomes

Outcome	1	2	3	4	5	6
Assessed	X	X				X

7. Prerequisites by Topic

MATH 250 and CS 306 or CS 330 with a grade of C or better or graduate standing.

8. Major Topics Covered in the Course

1. Overview and review (3 lectures)
   a. Course introduction
   b. Probability and statistics review
2. Introduction to R (2 lectures)
   a. Overview of R, Vectors, matrices and data frames
   b. R lab
3. Data manipulation in R (3 lectures)
   a. Data manipulation and summarization and visualization
   b. Basic graphics
4. Visualization of Multivariate data (4 lectures)
   a. Surface plots and 3D scatter plots
   b. Contour plots
   c. Other 2D representations of data
5. Simulations (5 lectures)
   a. Generating random variables
   b. Markov Chain
6. Probability density estimation (4 lectures)
   a. Univariate density estimation
   b. Kernel density estimation
7. Monte Carlo integration and methods in inference (6 lectures)
   a. Monte Carlo integration
   b. Variance reduction
   c. Monte Carlo method for estimation
   d. Monte Carlo method for hypothesis test
8. Numerical optimization and maximum likelihood estimation (4 lectures)
9. Resampling methods (4 lectures)
10. Presentation and discussion (5 lectures)