

Course Outline

1. Document Information

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|---------------------------|----------------------------|
| Degree Program | Computer Science |
| Course Number | CS 280 |
| Course Title | Computational Statistics I |
| Semester Hours | 3 |
| Course Coordinator | Chun-Hsi Huang |
| Revision Term | Spring 2020 |
| Latest Revision | Spring 2020 |

2. Catalog Description

This course provides a basic introduction to probability and statistics as well as related computational approaches. Topics include basic probability models, combinatorics, random variables, discrete and continuous probability distributions, statistical estimation and hypotheses testing, confidence intervals and linear regression. Some selected computational approaches for statistical problems such as simulation of random variables from probability distributions, the visualization of multivariate data, Monte Carlo integration and methods in inference will also be discussed. The R language will be used for programming assignments.

3. Textbooks

- Blitzstein, Joseph K. (2014). Introduction to Probability. Chapman and Hall (CRC), ISBN:9781466575578.

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 108 with a grade of C or better

8. Major Topics Covered in the Course

1. Course overview {1 class}
2. Distribution with numbers {3 classes}
 - a. Mean, median quartiles
 - b. Standard deviation
3. Normal distribution {2 classes}
4. Probability {5 classes}
 - a. Probability models and rules
 - b. Discrete probability models
 - c. Continuous probability models
5. Estimation {4 classes}
 - a. Degree of freedom
 - b. Confidence interval
6. Hypothesis test {6 classes}
 - a. P value and significance testing
 - b. Type I and Type II error
 - c. One and two-tail tests
 - d. Results interpretation
7. Linear Regression {4 classes}
8. Analysis of Variance {3 classes}
 - a. Analysis of variance design
 - b. ANOVA test
9. Introduction to R {2 classes}
 - a. Overview of R, Vectors, matrices and data frames
 - b. Data manipulation and summarization and visualization
 - c. Basic graphics

10. Visualization of Multivariate data {4 classes}
 - a. Surface plots and 3D scatter plots
 - b. Contour plots
 - c. Other 2D representations of data
11. Simulation {3 classes}
 - a. Generating random variables
12. Monte Carlo integration and methods in inference {3 classes}
 - a. Monte Carlo integration
 - b. Monte Carlo method for estimation
 - c. Monte Carlo method for hypothesis test