

SYLLABUS

MATH 20011 – Decision Making Under Uncertainty

(3 Credit Hours)

Catalog Information: An introductory course on applied statistics. The course provides a hands-on approach to understanding, quantification and decision-making under various forms of uncertainty. The main topics include visualization of uncertainty, probabilistic quantification of uncertainty, Bayesian and non-Bayesian ways of decision-making under uncertainty. Class activities incorporate active learning elements, including in-classroom computation with professional-grade software for statistical analysis and simulation.

Prerequisite: MATH 12002 with a minimum C grade

Recommended Texts: *OpenIntro Statistics*, David Diez, Mine Çetinkaya-Rundel and Christopher Barr, CreateSpace, 4th Edition, 2019.

Recommended Course Format: Every week, there are in-class lectures on Monday and Wednesday. There is also a lab on Friday, which aims to give you hands-on experience with data analysis using the R statistical language.

Suggested Schedule (MWF schedule based off calendar Fall 2022, Courtesy by Tsung-Heng Tsai)

Week 01: Introduction to Data

- Data basics
- Populations and samples
- Sampling strategies

Lab: Introduction to R, RStudio, Rmarkdown

Week 02: Introduction to Data

- Observational studies
- Experiments

Lab: Fundamentals of R

Labor Day: No class

Week 03: Summarizing Data

- Examining numerical data
- Considering categorical data

Lab: Fundamentals of R, continued

Week 04: Summarizing Data

- Data visualization
- Exploratory data analysis

Lab: Data visualization in R

Week 05: Probability

- Probability
- Conditional probability

Lab: Data transformation in R

Week 06: Probability

- Random variables
- Distributions of random variables

Lab: Simulations of random events

In Class Closed-book Midterm exam on Monday

Week 07: Useful Distributions

- Normal distribution
- Binomial distribution

Fall break: No class

Week 08: Useful Distributions

- Geometric distribution
- Negative binomial distribution

Lab: Distributions in R

Week 9: Foundations for Statistical Inference

- Point estimation
- Sampling variability

Lab: Sampling distributions

Week 10: Foundations for Statistical Inference

- Confidence interval
- Hypothesis testing

Lab: Confidence intervals

Week 11: Inference for Categorical Data

- Inference for a single proportion
- Difference of two proportions

Veterans Day: No class

Week 12: Inference for Numerical Data

- One-sample means with the t distribution

Lab: Inference for categorical and numerical data

Week 13: Inference for Numerical Data

- Paired data
- Difference of two means

Thanksgiving Break: No class

Week 14: Introduction to Linear Regression

- Fitting regression models
- Regression diagnostics
- Inference for linear regression

Lab: Fitting regression models

Week 15: Multiple Linear Regression

- Introduction to multiple linear regression
- Association, correlation and causation

Lab: Interpreting regression models

Week 16: Final Exam Week

Final project due on Monday