Math 20011-002: Decision Making Under Uncertainty

Tsung-Heng Tsai

Fall 2021

E-mail: ttsai1@kent.edu
Office Hours: MWF 2:00-3:00 p.m. (*online*)
Office: MSB 372

Web: tsunghengtsai.github.io/dm-F21
Class Hours: MWF 1:10-2:00 p.m.
Class Room: *online*

Course Description

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-class computation with professional-grade software for statistical analysis and simulation.

Prerequisites

You should have completed Math 12002 with a C or better. Please contact instructor if you would like to take the course, but do not satisfy the prerequisite.

Recommended Textbook

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

The textbook is freely available online. If you prefer a paperback version you can buy it at low cost (around $20) on Amazon.

Course Format

The course is offered remotely during August 26, 2021 through December 12, 2021. Every week, there are recorded video lectures for classes on Monday and Wednesday. The videos and notes will be available on Blackboard. The instructor will hold online meetings through Blackboard Collaborate Ultra at class hours, to answer questions and/or discuss extra examples. There is also a lab on Friday, which aims to give you hands-on experience with data analysis using the R statistical language.

Course Policy

Important policy for this course is detailed below.

Grading

Grades will be calculated as follows:

- Homework assignments: 70%
- Final project: 30%

The final letter grades will follow the usual scale: A=90-100; B=80-89; C=70-79; D=60-69; F=0-59. Plus and minus grades will be given at discretion of the instructor.

Homework

There will be approximately 8 homework assignments that will be posted on Blackboard. Solutions must be uploaded to Blackboard as a **PDF** file. Please make sure your work is clearly presented. Assignments are due at the beginning of class hour on the specified date. In general, **NO** late submissions will be accepted. In case of truly exceptional situations (e.g., family emergencies or illness), the instructor may make exceptions and allow late submission. The lowest homework score will be dropped at the end of the semester.

Final Project

There will be a final project, where you will apply the methods you learn from the course to analyze a dataset. More details about the final project will be posted and discussed later in the semester.

Re-grades

All re-grading requests should be made in writing, within one week after receiving a grade. The request should state the specific question that needs to be re-graded, as well as a short explanation of why re-grading is necessary. The new grade may be lower than the original grade.

Academic Integrity

University policy 3-01.8 deals with the problem of academic dishonesty, cheating, and plagiarism. None of these will be tolerated in this class. The sanctions provided in this policy will be used to deal with any violations. If you have any questions, please read the policy at http://www.kent.edu/policyreg/administrative-policy-regarding-student-cheating-and-plagiarism and/or ask.

Accommodations for Students with Disabilities

Kent State University is committed to inclusive and accessible education experiences for all students. University Policy 3342-3-01.3 requires that students with disabilities be provided reasonable accommodations to ensure equal access to course content. Students with disabilities are encouraged to connect with Student Accessibility Services as early as possible to establish accommodations. If you anticipate or experience academic barriers based on a disability (including mental health, chronic medical conditions, or injuries), please let me know immediately.

Student Accessibility Services (SAS) Contact Information:

- Location: University Library, Suite 100
- Email: sas@kent.edu
- Phone: 330-672-3391; VP 330-968-0490
- Web: www.kent.edu/sas

Registration Requirement

The official registration deadline for this course is September 1, 2021. University policy requires all students to be officially registered in each class they are attending. Students who are not officially registered for a course by published deadlines should not be attending classes and will not receive credit or a grade for the course. Each student must confirm enrollment by checking his/her class schedule (using Student Tools in FlashLine) prior to the deadline indicated. Registration errors must be corrected prior to the deadline.

Withdrawal

The last day to drop without a grade of "W" is September 8, 2021. The last day to withdraw this course is November 3, 2021. Other important Registrar dates can be found at http://www.kent.edu/registrar/registrar-dates-term.

Tentative Schedule

The schedule is subject to change and will be updated at the course website (tsunghengtsai.github.io/dm-F21), so please check it regularly.

Week 01, 08/23 - 08/27: Syllabus

Class begins on August 27.

Week 02, 08/30 - 09/03: Introduction to Data

Topics:

- Data basics
- Populations and samples
- Sampling strategies

Lab: Introduction to R, RStudio, Rmarkdown

Week 03, 09/06 - 09/10: Introduction to Data

Topics:

- Observational studies
- Experiments

Lab: Fundamentals of R

Labor Day. No class on September 6

Week 04, 09/13 - 09/17: Summarizing Data

Topics:

- Examining numerical data
- Considering categorical data

Lab: Descriptive statistics in R

Week 05, 09/20 - 09/24: Summarizing Data

Topics:

- Data visualization
- Exploratory data analysis

Lab: Data visualization in R

Week 06, 09/27 - 10/01: Probability

Topics:

- Probability
- Conditional probability

Lab: Exploratory data analysis in R

Week 07, 10/04 - 10/08: Probability

Topics:

- Random variables
- Distributions of random variables

Lab: Simulations of random events

Week 08, 10/11 - 10/15: Useful Distributions

Topics:

- Normal distribution
- Binomial distribution

Fall Break. No class on October 15

Week 09, 10/18 - 10/22: Useful Distributions

Topics:

- Geometric distribution
- Negative binomial distribution

Lab: Distributions in R

Week 10, 10/25 - 10/29: Foundations for Statistical Inference

Topics:

- Point estimation
- Sampling variability

Lab: Sampling distributions

Week 11, 11/01 - 11/05: Foundations for Statistical Inference

Topics:

- Confidence interval
- Hypothesis testing

Lab: Confidence intervals

Week 12, 11/08 - 11/12: Inference for Categorical Data

Topics:

- Inference for a single proportion
- Difference of two proportions

Lab: Inference for categorical data

Week 13, 11/15 - 11/19: Inference for Numerical Data

Topics:

- One-sample means with the t distribution

Lab: Central limit theorem for means

Week 14, 11/22 - 11/26: Inference for Numerical Data

Topics:

- Paired data
- Difference of two means

Thanksgiving Break. No class on November 24 and 26, 2021

Week 15, 11/29 - 12/03: Introduction to Linear Regression

Topics:

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

Lab: Fitting regression models

Week 16, 12/06 - 12/10: Multiple Linear Regression

Topics:

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

Lab: Interpreting regression models

Week 17, 12/13 - 12/17: Final Exam Week

Final project due 11:59 p.m. on December 13, 2021