Math 20011-003: Decision Making Under Uncertainty

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Class Hours: MWF 1:10-2:00 p.m.

Class Room: MSB 228

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 during August 25, 2022 through December 11, 2022. 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. Lecture notes and lab materials will be available on Canvas.

Course Policy

Important policy for this course is detailed below.

Grading

Grades will be calculated as follows:

- Homework assignments: 30%
- Midterm exam: 30%
- Final project: 40%

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 6 homework assignments that will be posted on Canvas. Solutions must be uploaded to Canvas 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.

Midterm Exam

There will be an in-class midterm exam on **October 3, 2022**. The exam will be closed-book. Each student should work on the exam independently.

Final Project

There will be a final project due on **December 12, 2022**, 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.

Accessibility

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
- Web: www.kent.edu/sas

Diversity

Kent State University is committed to the creation and maintenance of equitable and inclusive learning spaces. This course is a learning environment where all will be treated with respect and dignity, and where all individuals will have an equitable opportunity to succeed. The diversity that each student brings to this course is viewed as a strength and a benefit. Dimensions of diversity and their intersections include but are not limited to: race, ethnicity, national origin, primary language, age, gender identity and expression, sexual orientation, religious affiliation, mental and physical abilities, socio-economic status, family/caregiver status, and veteran status.

Registration Requirement

The official registration deadline for this course is **August 31, 2022**. 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 7, 2022**. The last day to withdraw this course is **November 2, 2022**. Other important Registrar dates can be found at http://www.kent.edu/registrar/registrar-dates-term.

Tentative Schedule

The schedule is subject to change.

Week 01, 08/22 - 08/26: Syllabus

Class begins on August 26.

Week 02, 08/29 - 09/02: Introduction to Data

Topics:

- Data basics
- Populations and samples
- Sampling strategies

Lab: Introduction to R, RStudio, Rmarkdown

Week 03, 09/05 - 09/09: Introduction to Data

Topics:

- Observational studies
- Experiments

Lab: Fundamentals of R

Labor Day. No class on September 5

Week 04, 09/12 - 09/16: Summarizing Data

Topics:

- Examining numerical data
- Considering categorical data

Lab: Fundamentals of R, continued

Week 05, 09/19 - 09/23: Summarizing Data

Topics:

- Data visualization
- Exploratory data analysis

Lab: Data visualization in R

Week 06, 09/26 - 09/30: Probability

Topics:

- Probability
- Conditional probability

Lab: Data transformation in R

Week 07, 10/03 - 10/07: Probability

Topics:

- Random variables
- Distributions of random variables

Lab: Simulations of random events

Midterm exam on October 3

Week 08, 10/10 - 10/14: Useful Distributions

Topics:

- Normal distribution
- Binomial distribution

Fall Break. No class on October 14

Week 09, 10/17 - 10/21: Useful Distributions

Topics:

- Geometric distribution
- Negative binomial distribution

Lab: Distributions in R

Week 10, 10/24 - 10/28: Foundations for Statistical Inference

Topics:

- Point estimation
- Sampling variability

Lab: Sampling distributions

Week 11, 10/31 - 11/04: Foundations for Statistical Inference

Topics:

- Confidence interval
- Hypothesis testing

Lab: Confidence intervals

Week 12, 11/07 - 11/11: Inference for Categorical Data

Topics:

- Inference for a single proportion
- Difference of two proportions

Veterans Day Observed. No class on November 11

Week 13, 11/14 - 11/18: Inference for Numerical Data

Topics:

- One-sample means with the t distribution

Lab: Inference for categorical and numerical data

Week 14, 11/21 - 11/25: Inference for Numerical Data

Topics:

- Paired data
- Difference of two means

Thanksgiving Break. No class on November 23 and 25

Week 15, 11/28 - 12/02: Introduction to Linear Regression

Topics:

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

Lab: Fitting regression models

Week 16, 12/05 - 12/09: Multiple Linear Regression

Topics:

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

Lab: Interpreting regression models

Week 17, 12/12 - 12/16: Final Exam Week

Final project due 11:59 p.m. on December 12, 2022