Syllabus for the Mathematics of Politics, Democracy and Social Choice

AS.110.303

Course Materials

The course will require internet access for Zoom office hours and accessing the course website and spreadsheets. Additionally, there is a textbook ***required*** for this course (see below).

Course Schedule

The course is thirteen weeks broken up into the following content

Week	Topic	Book Chapters
Week 1	Definitions (anon, monotone, neutral) Majority, May's Theorem	Ch 1
Week 2	Preference Ballots, Plurality, Borda Count, Plurality with Elim,	Ch 2 - 3
Week 3	Pairwise Comp; Fairness Crit; Arrow's Theorem;	Ch 4, Ch 5
Week 4	Strategic Voting and the Gibbard-Satterwaite Theorem	Ch 6
Week 5	Essay 1	
Week 6	Weighted Voting Systems & Banzhaf;	Ch 7 & 8
Week 7	Shapely-Shubik & Basic Combinatorics	Ch 7 & 8
Week 8	Electoral College;	Ch 9 Skip Ch 10
Week 9	Essay 2	
Week 10	Apportionment; Hamilton + 3 Paradox; Jefferson Method	Ch 11
Week 11	Divisor Methods (Adams, Websters, HH) Balinski-Young	Ch 11
Week 12	Gerrymandering	Ch 12
Week 13	Essay 3	

Online Lectures

Prerecorded lectures will be posted for the week in each module. These will explore the material of the textbook and beyond and are a good source of definitions and terms used in the course. There will be live synchronous sessions throughout the semester through zoom, with dates posted in the course. During these live synchronous components, homework problems and exam review will take place. Links to the recordings of each live online sessions will be posted in Blackboard and emailed to the class.

For more information regarding Zoom, please see the Zoom Student Quick Start Guide.

Course Description

This course is designed for students of all backgrounds to provide a mathematical introduction to social choice theory, weighted voting systems, apportionment methods, and gerrymandering. In the search for ideal ways to make certain kinds of political decisions, a lot of wasted effort could be averted if mathematics could determine that finding such an ideal were actually possible in the first place. The course will analyze data from recent US elections as well as provide historical context to modern discussions in politics, culminating in a mathematical analysis of the US Electoral College. Case studies, future implications, and comparisons to other governing bodies outside the US will be used to apply the theory of the course. Students will use Microsoft Excel to analyze data sets. There are no mathematical prerequisites for this course.

Course Goals

This course will prepare you to understand the opportunities, challenges and limitations of any political democratic system. By teaching you mastery in the techniques, theory, and applications of algebra, combinatorics and probability to economic and social systems this course will serve as a stepping stone to navigating real world issues in US and foreign politics.

Course Objectives

By the conclusion of this course, you are expected to have gained the ability to

- Understand different criteria for fairness in social choice systems as well as limitations imposed by Arrow's impossibility theorem.
- Define and identify weighted voting systems and evaluate their fairness using multiple methods
- Evaluate the fairness of the US electoral college as a weighted voting system
- Define apportionment and solve apportionment problems using different methods
- Understand the limitations of apportionment methods with the Balinski-Young theorem.
- Understand some of the complexities of Gerrymandering

Textbook

The Textbook for this course is *The Mathematics of Voting and Elections: A Hands-On Approach*, Hodge and Klima: 9781470442873

Weekly readings will be assigned from the textbook. It will be the primary source for definitions and terms throughout the course.

Student Coursework Requirements:

Homework:
Homework will be assigned each week in problem sets. The highest of the attempts is counted as the grade. Your lowest homework grade will be dropped.

Essays:
There will be two mid-term essays and a final essay. Essay prompts will appear inside the relevant course module in blackboard. The final essay will also have a cumulative quiz component.

Quizzes:
There will be a short (20 minute) online quiz each week. There are two attempts at the quiz and the questions are pulled randomly during each attempt. The higher of the two attempts counts for the grade. Your lowest quiz grade will be dropped.

Discussion Forums:
Each week you are to post your initial response to the discussion by Thursday night and respond to at least two classmates by end of day Sunday.

Grading

Your final grade for the class will be given as a weighted average as follows.

Homeworks: 15% (lowest dropped)

Essay 1: 20%

Essay 2: 20%

Essay 3: 20%

Quizzes: 15% (lowest dropped)

Discussion Forums: 10%

The letter grades are assigned as follows based on your final weighted average:

A: 90-100

B: 80 - 89

C: 70 - 79

D: 63 - 69

F: < 63

"+" and "-" will be determined at the end of the semester.

Students with disabilities

Students with documented disabilities or other special needs who require accommodation must register with Student Disability Services. After that, remind the instructor of the specific needs at least one week prior to each exam; the instructor must be provided with the official letter stating all the needs from Student Disability Services.

There may be a student in this class who requires the services of a note taker. This is an opportunity to share notes through the Student Disability Services Office. If you are interested in performing this service, please register as a notetaker with Student Disability Services.

Academic Integrity

Academic Misconduct Policy
All students are required to read, know, and comply with the Johns Hopkins University Krieger School of Arts and Sciences (KSAS) / Whiting School of Engineering (WSE) Procedures for Handling Allegations of Misconduct by Full-Time and Part-Time Graduate Students.
This policy prohibits academic misconduct, including but not limited to the following: cheating or facilitating cheating; plagiarism; reuse of assignments; unauthorized collaboration; alteration of graded assignments; and unfair competition. You may request a paper copy of this policy at this by contacting jhep@jhu.edu.

JHU ethics statement

"Undergraduate students enrolled in the Krieger School of Arts and Sciences or the Whiting School of Engineering at the Johns Hopkins University assume a duty to conduct themselves in a manner appropriate to the University's mission as an institution of higher learning. Students are obliged to refrain from acts which they know, or under circumstances have reason to know, violate the academic integrity of the University. [The JHU Code of Ethics]"

Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition.