Math 89, Section 1, Spring 2020
The Mathematics of Voting
01/07/2020

Class times: MWF 9:05 – 9:55 am
Class location: Dey Hall 209
Office hours: M 3:30 – 4:30, W 3:30 – 4:30, Th 4:00 – 5:00, and by appointment. Note: See Piazza for updates to office hours.

Instructor: Linda Green
Email: greenl@email.unc.edu
Office: Phillips 338
Course website: Sakai

Materials:
Textbook: *The Mathematics of Voting and Elections: A Hands-on Approach* by Jonathan Hodge and Richard Kilma (2nd edition)
Piazza: Please use Piazza instead of email to ask questions about homework problems and logistics. Other students and the instructor can answer them there for the benefit of all students. See details below.
Gradescope: Please use Gradescope to submit homework. See details below.
Other: Supplementary articles, assignments, and other resources are posted on Sakai.

Placement and Prerequisites:
Math 89 is a First Year Seminar, intended for first year students with no prior college experience. There are no prerequisites for this class.

Course Description:
What properties should a fair election have and are these properties achievable in theory and in practice? How can mathematics and statistics be used to expose election fraud and gerrymandering? What might voting systems look like if they were designed by mathematicians? Students will address these questions as they compare different election systems, evaluate their strengths, weaknesses, and abuses, and design improvements to current structures. Topics will include ranked voting, approval voting, exit polls, election fraud, and gerrymandering. The course will include some data analysis, but no prior experience is needed.

Course Objectives:
- Evaluate different methods of quantifying the level of gerrymandering. Implement algorithms to draw districts in a systematic way and evaluate the effect of these algorithms on gerrymandering.
- Compare different ranked voting systems and evaluate their strengths and weaknesses in different settings.
- Explain Arrow's Impossibility Theorem and its implications on designing election systems.
- Explore other topics relevant to election systems.

Course Topics may include:
1. Gerrymandering
2. Ranked voting systems
3. Arrow's Impossibility Theorem
4. Approval voting
5. Strategic Voting
6. Weighted Voting Systems
7. Power indices
8. Electoral College
9. Referendums and Separability
10. Apportionment
11. Polls
12. Election Fraud

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Participation: Participation is a major component of a first year seminar. Students are expected to come to class prepared, to participate wholeheartedly in group work and class discussions, and to contribute ideas and information to the Sakai wiki on a regular basis.

Homework: Homework will be posted on Sakai after every class. Students are encouraged to work together on homework, but each student must hand in a separate assignment, written up in their own words, crediting help from other students as applicable.

Homework will be due approximately once a week, with due dates posted on Gradescope and / or Sakai and announced in class. Homework should be submitted via Gradescope at www.gradescope.com. If you are not added automatically to Gradescope, you can create an account yourself using your unc email address and the Entry Code MP385N.

Homework will be graded based on the following criteria:

- Completeness: All assigned work should be included. Please consult Sakai for a current list of assigned work and point values. Entries should address topics at a depth commensurate with your mathematical background and prior knowledge of the topic.
- Exposition: If you are presenting the answer to a question, state or paraphrase the question. If you are giving an argument, explain what the point is before you launch into it. If you are giving instructions, have a friend test them for you. Explain things clearly, at a level that a peer in the class could understand.
- Accuracy: Some homework questions will have correct answers. Stated facts should be correct, and conjectures should be labeled accordingly.

Quizzes: There will be quizzes given in class approximately once every two weeks. Quiz dates and topics will be posted on Sakai and announced in class. Your lowest quiz grade will be dropped. There will be no make-up quizzes. The only exception is in the case of university sponsored sports trips or academic trips, when arrangements must be made in advance, or in the case of illness or family emergency with intervention from the Dean of Students Office.

Final Project: The final project will allow students to delve more deeply into a theoretical topic or an application of their choice. Students can work individually or in groups of 2, 3, or 4. Possible topics will be listed on Sakai, but you do not need to limit yourself to topics on the list. The final project should include a presentation to the class and a written component. Final projects will be presented during the final exam period on Monday, May. 4 from 8:00 – 11:00 am.

Piazza: Instead of emailing the instructor directly with questions about homework or logistics, please post your questions on Piazza. Other students and the instructor can answer them there for the benefit of all students. If you were not already automatically added to Piazza, you can also register yourself here: piazza.com/unc/spring2020/math89 .

Grading:
All grades will be assigned according to a 10-point scale. That is, 93-100 is an A, 90-92 is an A-, 87-89 is a B+, 83-86 is a B, 80-82 is a B-, 77-79 is a C+, 73-76 is a C, 70-72 is a C-, 67-69 is a D+, 60-66 is a D, and below 60 is an F. Your course grade will be determined as follows:

Participation:	**10%**
Homework:	**35%**
Quizzes:	**30%**
Final Project:	**25%**

Late work: Late homework assignments will be accepted with a penalty of 10% per calendar day that they are late. Additional late work will not be accepted.

Honor Code:
It is expected that each student in this class will conduct themself within the guidelines of the UNC Honor System, described at http://studentconduct.unc.edu/students.

In this class, quizzes must be done individually and are closed book and closed notes unless otherwise noted. It is an instance of cheating to give or receive help on a quiz, except from the instructor. On homework assignments, students are encouraged to work together in pairs or small groups, provided that all participants are contributing and the collaboration benefits the learning of all involved. Simply copying or trading answers is an instance of cheating. On most in-class assignments, students are encouraged to work together. If you are not sure if collaboration is permitted, please ask!

Please cite your sources. An informal citation (e.g. website URL or textbook name) is sufficient for most assignments. More formal citations and a bibliography are required for the final project. If another student contributes substantial work, please credit that student by describing their contribution, for example: "_____ and I worked on this problem together," or "_____ gave me the idea of using the ratio of circumference to maximum diameter."

Students who observe a violation of the honor code should report it to the instructor. The instructor will report any suspected honor code violations to the Honor Court.

Disclaimer: The instructor reserves the right to make changes to the syllabus, including due dates. These changes will be announced in class or on Sakai.