

**Tufts University**  
**Department of Mathematics**

**Math 19 Section 1**

**Spring 2018**

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**Office Hours:** Mondays 3 - 4 pm, Wednesdays noon - 1 pm, and by appointment.

**Class meetings:** E+ block (Mon and Wed 10:30 - 11:45). Note this course is not coordinated with other sections of Math 19, so you cannot attend other time blocks.

**Text:** Mathematics of Social Choice by Christoph Borgers. The text is on reserve in Tisch, and an ebook is also available. We will cover many chapters in the text, and also some small topics not in the text.

**Course Website:** We are NOT using Trunk for this course. Solutions and other resources can be found on <http://courses.math.tufts.edu/math19/garant>

**Homework** ...is assigned for each class meeting, and should be done before the next class. It may be collected. Answers to many problems are in Appendix D of the text and on the course website. You can ask questions about the homework during office hours and via email.

**Quizzes:** ...will typically happen at the beginning of every class, so you need to get to class on time. Homework problems can appear on quizzes. The quizzes are not sufficient preparation for exams.

**Class Attendance** ...is extremely important! You are responsible for all announcements and content during class meetings. Your grade for any quizzes during a class you miss will be a zero (there are no makeups). If you do miss a class, you should get the notes from one or two classmates, read the pertinent section of the text, and do the homework before seeing me for questions, and before the next class meeting.

**Technology Use:** For all of our benefit, please **turn off any cell phones** or alarms during class. Laptops can also be distracting to others, so please speak with me before using one in class.

**Exams:** You must be present for the exams on **2/28** and **5/4**. The Math Department policies can be found at <http://math.tufts.edu/courses>, under the heading *Exam Policy*.

**Honesty:** I have no tolerance regarding cheating on exams or quizzes. I consider cheating to be an egregious violation of the trust of all your classmates as well as myself. Your signature is required on exams to indicate that you have neither given nor received assistance on the exam. Anyone found violating this pledge will receive an F in the course, and will be reported to the Dean of Students.

**Calculators** ...will not be allowed for quizzes nor for exams.

**Grading:** Your three lowest quiz grades will be dropped, and the remaining averaged. Your quiz and two exam scores are weighted equally to create your course average. Your course average is converted to a letter grade as follows: A+ (98 and above), A (93 and above), A- (90-92), B+ (87-89), B (83-86), B- (80-82), C+ (77-79), C (73-76), C- (70-72), D+ (67-69), D (63-66), D- (60-62), F (below 60).

**Learning Objectives** include 1a,c,d,e, and 2a,b from the list of Mathematics undergraduate learning objectives, viewable at <http://ase.tufts.edu/faculty/committees/objectives/math.htm>

**Student Accessibility Services:** To request accommodation due to a documented disability, register with Student Accessibility Services at the beginning of the semester. Call the Student Services Desk (617-627-2000) to arrange an appointment with Kirsten Behling.

<b>Important</b>	<b>2/1</b>	Last day to add a course	<b>4/5</b>	Last day to drop (without a W)
<b>Dates</b>	<b>2/19</b>	No class (President's Day)	<b>4/16</b>	No class (Patriot's Day)
	<b>2/22</b>	Class meets (Monday Schedule)	<b>4/30</b>	Last class
	<b>3/19, 3/21</b>	No class (Spring Break)	<b>4/30</b>	Last day to drop (with a W)

**Schedule of Topics, Reading, and Homework:** on next page (changes may be announced in class)

## Compensation and Fair Division (Text Parts II and III)

Date	Lecture Topic	Reading (for after class)	Problems (for after class)
1/22	Fair, Envy-Free Compensation	Ch. 13 (p.95 - p.100); Logic Video	p.103/ 1, 2, 5, 6 (inequalities on p. 100)
1/24	Equitable, Pareto-optimal Compensation	Ch. 13 (p.100 - p.103), Ch 14 (p.105 - p.109)	p. 111/ 2, 4, 5; Compensation Applet Worksheet (don't use Chrome for applet... Firefox works)
1/29	More Pareto-optimal, Equitable Compensation	Ch. 14 (p.110 - p.111)	p. 111/1, 3, note: for both 1 and 3, show both methods of computing payouts produce the same result (so compute $\frac{w}{s}(a)$ , and $(\frac{w}{m} \cdot \frac{a}{n})$ for A, and then do similar computations for each of the other players); Compensation Handout 1-6
1/31	I Cut You Choose	Ch. 16	p. 126/2; Fair Division Handout 1, 2
2/5	Equal Div; Pareto-optimal & Equitable is fair	Ch. 16	p. 126/ 1, 3, 4, 6
2/7	Selfridge/Conway	Ch. 20	p. 145/ 1 (typo: B trims to make it as valuable as the <b>left</b> piece), 2, 3, 4; Fair Division Handout 6, 7
2/12	Steinhaus Method	Ch. 17	p. 131/ 1 (typo: B's value of 1 <sup>st</sup> piece should be .2, not .3), 2, 3, 4, 5; p. 141/ 1 - 3; Fair Division Handout 3, 4, 5
2/14	Adjusted Winner setup	Ch. 21 (p. 149 - 151)	p. 145/ 5; p. 154/ 1, 2; Prove Steinhaus is fair, then do the handout of student proofs that Steinhaus is fair
2/21	Adjusted Winner method	Ch. 22, Ch 23	p. 161/ 1, 2ab; Fair Division Handout 8; Start Non-comprehensive review problems
2/22	Apportionment	Website: Apportionment	Apportionment Handout; Finish Non-comprehensive review problems; optional: apportionment problems from reading on website p. 146/ 19, 20, 21
2/26	Review		
2/28	<b>Exam 1</b>	10:30 - 11:45	in our classroom

## Voting (Text Part I)

Date	Lecture Topic	Reading (for after class)	Problems (for after class)
3/5	Basic Methods, Condorcet	Ch. 1; Borda Video	p. 9/ 1 - 7, start considering extra credit vote option (see handout on p.9 in packet, or website for detailed instructions)
3/7	Sequential, Fairness Criteria	Ch. 2, Paulos article; Majority/Condorcet video	p. 15/ 1, 2, 3, 7, 8, 9, 10. Also, you will hand in the following homework on 3/14: from Paulos article find winner(s) of election with revised numbers (36, 28, 18, 9, 9) using Plurality, Borda, Pairwise, Runoff, Elimination, and Coombs, and draw graph. Do each method completely, writing all steps since quiz on 11/1 will ask for details.
3/12	Spoilers	Ch. 3, LePore article; No Spoiler video	p. 21/ 1, 2, 3, 4; Voting Handout 1, 2; Paulos: show Cain and Perry are spoilers using Borda, Romney is a spoiler using Runoff and Elimination, and Cain is a spoiler using Plurality.
3/14	Smith Set	Ch. 4 (p. 23 - 24, and 4.9 on p. 27 to end)	p. 30/ 1, 2, 3, 4, 5; Prove Pairwise is unanimity fair, then do the handout of student proof that pairwise is UF
3/26	Smith fairness, a posteriori SF (out of order with text)	Ch. 5 (p. 31 - 32)	p. 30/ 2, 6, 7, 8; p. 35/ 3, 6; Voting Handout 3a-d, 9a,c,e; submit poll question if doing optional extra credit vote
3/28	No Weak Spoiler, a priori SF	Ch. 5 (p.33 - 35)	p. 35/ 1, 2, 7, 8, 9; Voting Handout 8, 9b
4/2	Schulze's Beatpath	Ch. 6 (omit Prop 6.3 proof on p. 40); Monotonicity video	p. 41/ 1, 2, 3, 5 (typo: Prop 6.3 should be Prop 6.5), 6; Voting Handout 8, 9f
4/4	Monotonicity I	Ch. 7 (p. 43 - mid p. 45)	p. 52/1, 2 (add parts c: plurality, d: pairwise, e: a priori Smith fair plurality), 3; Voting Handout 7
4/9	Monotonicity II	Ch. 7	Voting Handout 3e, 4, 5, 6; show runoff violates monotonicity for preference schedule in monotonicity video
4/11	IIC , Pareto Efficiency	Ch. 9	p. 69/ 1, 2, 4 ; Criteria Handout 1-7; Recent Voting in NE handout
4/18	Ranking, Impossibility Theorems, Weighted Voting	Optional: Muller-Satterthwaite video	One shot (not recursive) rankings for p. 81/ 1, 2, 4a, 7; One shot elimination ranking for example 11.2 on p. 77; Voting Handout 10, 11a-11g, 11m-11q, 12-14, Weighted Voting Handout 1,2,3 and corresponding parts of 13
4/23	Banzhaf Power	Website: Banzhaf	Weighted Voting Handout 4, 5, 8, 9, 10, 11b - 11e, 12, more 13
4/25	More on Banzhaf	Website: Banzhaf	Weighted Voting Handout 6, 7, more 13; Nassau handout
4/30	Review		Article on why Jill Stein shouldn't advocate runoff voting
5/4	<b>Final Exam</b>	8:30 - 10:30 am	(room to be determined)