

# Mathematics of Social Choice

## Course Number and Title:

**MA 108-ZN**

Mathematics of Social  
Choice

**Credit:** 3 credit hours

## Class Meeting Times:

**Tues/Thurs 2:30-3:15**  
**HHB Rm 221**

**Prerequisite:** There is no specific mathematical prerequisite. Students should have a high school degree meeting the mathematics requirements of the Alabama curriculum.

## Resources

Materials and assignments for this course will be located on the Canvas Learning Management system.

Mathematics of Social Choice by Christoph Borgers is an optional resource that you may want to purchase.

## Instructor Info

**Tami Puchta** (Puck\* ta)

Office: Room 4039, UH

Email: [tpuchta@uab.edu](mailto:tpuchta@uab.edu)

**Office hours: Wed. 1:00-**

**3:00** or other times by appointment. Zoom hours available.

## Course Description and Objectives:

You make decisions daily. Most are insignificant such as what to eat or where to study while others are of more consequence such as how much insurance is enough. Groups make decisions as well. Who will be mayor and how will they be selected? Should a company allow employees to work from home? How can an inheritance be divided fairly? The organizing principle of the course is that mathematics underlies many of our social choices and can assist in deciding what to do and determining what is fair. For most people, the value of mathematics lies in applications. While our society depends upon a great deal of technical mathematics that is mastered by a minority of the population, this course takes the view that there are many useful applications of mathematics that require only an understanding and computational familiarity with elementary mathematics. In this course, you will construct models of problem situations, translate verbal descriptions into mathematical form, use quantitative evidence as a basis for reasoning, argument, and drawing conclusions, and communicate your results to an audience appropriately.

## Learning Outcomes:

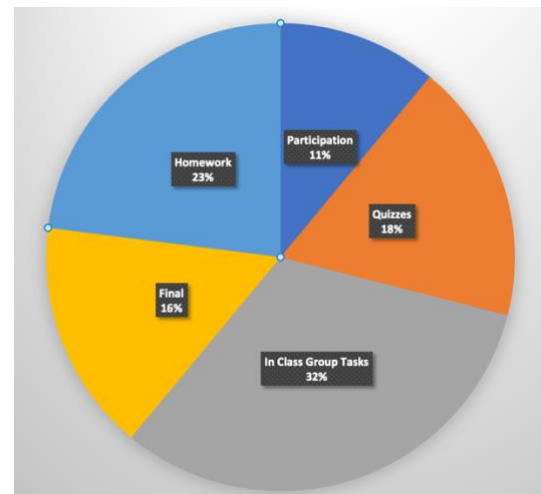
**Upon successful completion of this course, students will be able to articulate an understanding of, solve problems related to, and make informed decisions regarding:**

- principles of fair division, including both equal and unequal entitlements (QL1)
- methods of dividing both divisible and indivisible resources fairly (QL 2)
- voting methods, the principles of fairness that one might want a voting method to satisfy, and the paradoxes of trying to satisfy all the desirable principles (QL 1)
- apportionment methods, the principles of fairness that one might want an apportionment method to satisfy, and the paradoxes of trying to satisfy all the desirable principles. Interestingly, one paradox is known as the "Alabama Paradox." (QL 2)
- cost-sharing rules and the mathematically articulable value of different game positions (QL 2)
- the evaluation of data, as well as commonly seen misleading displays of data (QL 3)

## Course Requirements:

You earn your grade in the course as shown in the tables below. Each grade component is described in the paragraphs that follow. Points accumulated will be recorded in Canvas within one week of the completion of the assignment or activity. Due dates will be listed in the Canvas calendar.

Grade Element	Points
Homework	140
Quizzes	112
Participation	70
Group Tasks	196
Tests/Final	100
<b>Total</b>	<b>618</b>



### Canvas Homework (23% of grade)

Homework is due each Friday for the entire semester. Each assignment is worth 8 points. You are strongly encouraged to begin homework before the due date as some of the information available on homework assignments will be useful in class assignments. You have access to textbook resources through homework. Homework assignments typically include videos which may be especially beneficial to in-class assignments. Homework assignments may be submitted after the due date for half credit.

**Canvas Quizzes (18% of grade):** Canvas quizzes are due on Fridays of the assigned week. Typically, quizzes are fairly brief. The purpose of this quiz is to solidify work from homework and in class. Each quiz counts 8 points. Quizzes may be submitted late for half credit, please note that they are no longer available after the close date.

**In-class Group Tasks (32% of grade):** This is an inquiry-based course. Therefore, nearly all assignments will begin in class with you working with other students in a group. Groups are randomly assigned each week. Although you work in groups to complete in-class assignments, each person turns in their own paper to be graded. You are responsible for learning the material, and you will be expected to perform on your own, particularly on quizzes and the final exam. Assignments are due on a weekly basis and will be collected in class. You will have the opportunity to present your work or that of your group in class as part of participation in processing. Assignments for this course are designed to engage you in interesting tasks related to the math of social choices in ways that develop the essential learning objectives of this course.

**Late Assignment Policy:** Assignments no more than one class meeting late will be subject to a 10% grade penalty. Assignments more than one class meeting late are subject to greater penalty at the discretion of the instructor.

**Participation (11% of grade):** You are expected to participate actively, particularly in small group work, in-class group activities, and class discussions. **Mere presence does not constitute ACTIVE participation.** Participation points are awarded as in the following table. Note that it is possible to earn MORE than 70 points total for the semester since we will have

about 14 weeks of class. Points earned beyond 70 are extra credit. Students who participate fully generally enjoy the class more and increase their learning.

Level of Participation	Points
Be present in class	1
Make minimal contribution to class discussion or group task	2
Contribute significantly to class discussion or group task	4
Make substantially correct presentation to the class	5
Make correct presentation to the class	6

**Final Exam/Tests (16% of grade):** The final examination will consist of several problems like the major problems and applications of the course, but not repeating problems from the course. You select a small number of problems to complete from a longer list.

**Make-Up Policy.** There are no make-up quizzes or presentations for absences resulting in decreased participation or quiz credit. If you miss a class for a verifiable emergency, illness, necessary medical appointment, medical isolation, or on UAB official business, the instructor will work with you to find a reasonable accommodation

**Final Grades are assigned as follows:**

Points Earned	Course Grade
557 points or more	A
495-556 points	B
433-494 points	C
371-432 points	D
Below 360 points	F

There are many resources available to you both through the math department and through other UAB resources designed to ensure your success. You can reach me through email or office hours. The Math Lab is open Monday – Friday for student assistance. You can simply show up and ask for help.

Below is a link to additional UAB academic resources. Please ask me if you have questions about whom to contact.

<https://www.uab.edu/students/academics>

## Course Expectations:

What I can expect from you:	What you can expect from me:
It is important for your academic success that you <b>attend each class and arrive on time</b> . Life events sometimes prevent class attendance, but if you must miss more than 3 classes, you may want to consider withdrawing from the course.	I will be prepared for class and arrive at least 10 minutes before class. I will make any changes regarding class meetings well in advance except in the event of an emergency.
<b>Participate fully</b> when you are in class. You will learn more and the content will be more interesting to you if you do.	I will actively support and encourage your learning. I will be engaged with students throughout class either in whole class discussions or group tasks.
Have a <b>positive and productive disposition</b> toward yourself, your classmates, and learning mathematics. Because we work in groups on a regular basis, it is essential that you be respectful of others during interactions regardless of whether the interactions are in class or online.	I will respect your views even when they are different than mine. I will respond in a positive manner to your genuine effort regardless of whether you are correct mathematically.
<b>Assignments</b> are carefully designed to help you learn the big ideas from this course. Obviously, missing multiple assignments will impact what you take from this course as well as likely have a negative impact on your grade.	I will grade assignments and assessments in a fair, transparent, and timely manner.
<b>Seek help</b> if needed and before you get too far behind or feel lost.	You can contact me through email and I will respond within 24 hours except perhaps on weekends. You may also see me during office hours.

Adapted from [https://digitallearning.ucsd.edu/\\_files/learner-centered-syllabus-guide.pdf](https://digitallearning.ucsd.edu/_files/learner-centered-syllabus-guide.pdf)

## Course Materials:

### Rules for Group Work

1. Each member takes responsibility for his/her own learning.
2. Each member of the group is willing to help every other group member who asks for help.
3. Groups may ask the teacher for help only when all group members have the same question.
4. There is always a further challenge.

These rules apply during all small group discussions. Whole group discussions require adherence to the standard rule of classroom engagement: Speak and listen respectfully.

## Scoring Rubric for Group Tasks (14 points)

	<b>Conceptual Understanding:</b> <i>Interpreting the concepts of the task and translating them into mathematics (Identifying the “core” of the problem)</i>	<b>Evidence of Problem Solving:</b> <i>Using task-appropriate tools and problem-solving strategies. (Strategies/thinking must be made visible.)</i>	<b>Explanation:</b> <i>Using language, supporting math, and visuals when appropriate, to make a clear case for conclusions. (The explanation is logical &amp; flows smoothly.)</i>	<b>Accuracy:</b> <i>Providing a wholly justified solution for the task at hand.</i>
<b>4</b>			Explanation is coherent, and the ideas involved follow logically from previously stated ones.	The solution is completely justified, with no gaps in the argument.
<b>3</b>	Student’s work has demonstrated that he/she has fully identified the major concepts of the task.	The student’s work has demonstrated the strategic use of all task-appropriate tools and problem-solving methods.	Explanation is not sufficiently rigorous, or something may not immediately follow from what is written.	The solution has one or two minor gaps in justification.
<b>2</b>	Some, but not all, of the major concepts needed were evident.	Not all tools needed for the task are used or the tools are not used in a manner appropriate for solving the problem.	Explanation has multiple gaps or multiple steps need to be inferred.	The solution has major gaps in the justification.
<b>1</b>	Does not achieve minimal requirements for 1 point	Does not achieve minimal requirements for 1 point	Does not achieve minimal requirements for 1 point	Does not achieve minimal requirements for 1 point
<b>0</b>	Not included	Not included	Not included	Not included

## UAB Policies

### Add/Drop and Course Withdrawal

- **Drop/Add:** Deadlines for adding, dropping, or withdrawing from a course and for paying tuition are published in the [Academic Calendar](#) available online. Review the [Institutional Refund Policy](#) for information on refunds for dropped courses.
- **Withdrawal:** To avoid academic penalty, a student must withdraw from a course by the withdrawal deadline shown in the academic calendar and receive a grade of W (withdrawn). Failure to attend class does not constitute a formal drop or withdrawal.

### Academic Misconduct

The University of Alabama at Birmingham expects all members of its academic community to function according to the highest ethical and professional standards.

Academic dishonesty and misconduct includes, but is not limited to, acts of abetting, cheating, plagiarism, copying homework, fabrication, and misrepresentation. Students are expected to honor the [UAB Academic Integrity Code](#).

### **DSS Accessibility Statement**

UAB is committed to providing an accessible learning experience for all students. If you are a student with a disability that qualifies under Americans with Disabilities Act (ADA) and Section 504 of the Rehabilitation Act, and you require accommodations, please contact Disability Support Services for information on accommodations, registration and procedures. Requests for reasonable accommodations involve an interactive process and consist of a collaborative effort among the student, DSS, faculty and staff. If you are registered with Disability Support Services, please contact DSS to discuss accommodations that may be necessary in this course. If you have a disability but have not contacted Disability Support Services, please call (205) **934-4205**, visit [their website](#), or their office located in Hill Student Center Suite 409.

### **Non-harassment, hostile work/class environment**

The UAB College of Arts and Sciences expects students to treat fellow students, their Course Instructors, other UAB faculty, and staff as adults and with respect. No form of hostile environment or harassment will be tolerated by any student or employee. In this class, we will only use constructive criticism and will work to build a community of life-long learners.

### **Title IX Statement**

UAB is committed to providing an environment that is free from sexual misconduct, which includes gender-based assault, harassment, exploitation, dating and domestic violence, stalking, as well as discrimination based on sex, sexual orientation, gender identity, and gender expression. If you have experienced any of the aforementioned conduct we encourage you to report the incident. For more information about Title IX, policy, reporting, protections, resources and supports, please visit <http://www.uab.edu/titleix> for UAB's Title IX Policy, UAB's Equal Opportunity, AntiHarassment Policy and Duty to Report and Non-Retaliation Policy.

**Blazer Core – Quantitative Literacy** Courses in quantitative literacy provide students with central conceptual knowledge of numbers, formulas, data, and probabilities, and encourage students to apply this knowledge to address real-world problems.

(QL 1) Identify and utilize tools of quantitative reasoning to solve problems that impact academic understanding and public life.

(QL 2) Critically analyze and evaluate how quantitative information, including statistical information, is derived, reported, and applied.

(QL 3) Analyze and evaluate how information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words) is used to describe, predict, or model natural or social processes.

## Course Calendar MA108 Tuesday/Thursday

Spring 2024		
Week 1	Fair Division & Apportionment	<p>Each class will begin with a short lecture or review of current material followed by in-class tasks which are completed in groups. Group tasks can be made up for partial credit if the absence is included in one of the following categories:</p> <ul style="list-style-type: none"> <li>• Documented illness</li> <li>• DSS accommodation</li> <li>• Official UAB function with a written excuse</li> <li>• Jury duty</li> <li>• Military duty</li> <li>• Emergency situations (at the discretion of the instructor)</li> </ul> <p>Questions about homework assignments should be asked at the beginning of class.</p> <p>Unit Tests will be completed in class on designated days. See the Canvas homepage for all assignment due dates.</p>
Week 2		
Week 3		
Week 4		
Week 5	Voting Methods	
Week 6		
Week 7	Displaying Data	
Week 8		
Week 9		
Week 10	Game Theory	
Week 11		
Week 12		
Week 13		
Week 14		
<b>Final</b>	You will choose 4 problems from a list of 8 to submit. You may use any personal notes that you have created for this class.	