4 - Voting Methods and Ranking Systems

Content Area: **Mathematics**
Course(s):
Time Period: **Marking Period 2**
Length: **5 weeks**
Status: **Published**

Summary of Voting Methods and Ranking Systems

Social Choice Mathematics is a field of study that develops mathematical reasoning in the context of decision making; it is a field that acknowledges the presence of personal feelings in the world of math and illustrates the significant role played by human emotions and how they interact with numbers. This unit recognizes the subjective nature of knowledge and the common misconception that mathematics always produces a definite answer. Students will explore the five most common voting systems used to determine the winner of an election. In addition, students will investigate the mechanics of ratings and rankings to learn how to make comparisons among competing choices when multiple factors are involved and those factors are not equally weighted.

Revision Date: July 2026

Essential Questions for Voting Methods and Ranking Systems

- What is the best way to transform a collection of individual preferences into a societal preference?
- How does the winner selection method chosen impact the outcome of the election?
- How should one design and collect ballots in order to learn about voter preferences?
- What is the difference between ratings and rankings, and how are their mechanics mathematically justified?
- In what ways can ranking systems be manipulated to produce different outcomes?

Enduring Understandings for Voting Methods and Ranking Systems

- There are multiple forms of winner selection methods which may be used in an election.
- A variety of mathematically justifiable voting systems can actually lead to different results.
- Ranking systems, although they contain mathematical components, can be manipulated to produce different outcomes based upon the selected categories and the weights assigned to each category.

Objectives for Voting Methods and Ranking Systems

Students Will Know:

- Five different voting systems commonly used in elections around the world, including the plurality method, plurality with a runoff, plurality with elimination, Borda counts, and

Condorcet's method of pairwise comparisons.
- The outcome of an election often depends on the winner selection method used.
- There is no guarantee that different methods will yield the same result.
- Ranking systems are subjective, according to the weights assigned to each category.

Objectives for Voting Methods and Ranking Systems

Students Will Be Skilled At:

- Designing an election ballot to maximize information gathered about voters' preferences.
- Organizing voters' ballots into a reduced preference schedule.
- Determining the winner of an election using plurality methods.
- Determining the winner of an election using point-based Borda counts.
- Determining the winner of an election using pairwise comparisons.
- Calculating mathematically-justifiable ratings within each category of a ranking system, and then combining such ratings with the category weights to produce an overall ranking list of competing choices.

Learning Plan for Voting Methods and Ranking Systems

The instructor will present content and clarify concepts, and respond to students' questions. The students will be expected to read the assigned material, as well as the supplementary resources found online. The topics in this unit of social choice mathematics lend themselves to many forms of project-based learning and assessments. To start, the instructor will introduce five different winner selection methods and explain their corresponding advantages and disadvantages. The various voting systems will be presented in the context of real-life examples, and students will engage in guided note-taking activities to learn the mechanics of each method. Classroom time will be used for students to collaborate on exercises that develop and reinforce their understanding of the five methods, and the instructor will facilitate whole group discussions about the academic field. Additionally, students will work with real data in small groups to deconstruct published ranking systems, as well as construct their own lists of rankings in contexts of their choice.

Evidence/Performance Tasks for Voting Methods and Ranking Systems

Both topics of voting and ranking systems will culminate with students designing their own elections and rankings, making extensive use of original data. Students' original projects will serve as both formative and summative assessments due to the requirement that students will necessarily meet with the instructor at designated checkpoints along the way. Additionally, students may have the option to verbally articulate their understanding of key concepts or elaborate on their written work. In this unit, students will be evaluated on their project work and the presentation of their findings to their peers. Throughout the unit, formative assessments will include classroom activities and discussions, with immediate feedback from the instructor. Short written quizzes, in the form of entrance and exit tickets, will be frequently administered and reviewed during class time in order to identify students' misconceptions and/or struggles with comprehension.

Materials for Voting Methods and Ranking Systems

Core instructional materials: Core Book List including district approved textbook: *Mathematical Ideas, 14th ed*. Miller, Heeran, Hornsby, and Heeran. Pearson (2020).

Supplemental instructional materials: Lecture notes and classroom activities designed by instructor. Internet resources, including instructional videos on YouTube, Khan Academy, and teacher-recommended math education websites.

Standards for Voting Methods and Ranking Systems

Through collaborative learning about various discrete mathematics applications, students will embrace each other's differing points of view and logical reasoning. Through group and class discussions, students will reinforce their knowledge of voting systems in addition to learning from each other's unique analyses which incorporates elements of the following:

NJ Diversity and Inclusion Law:
In accordance with New Jersey's Chapter 32 Diversity and Inclusion Law, this unit includes instructional materials that highlight and promote diversity learning, including: economic diversity, equity, inclusion, tolerance, and belonging in connection with gender and sexual orientation, race and ethnicity, disabilities, and religious tolerance.

	Modeling Standards:
P.4	Demonstrate creativity and innovation.
9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
P.6	Model integrity, ethical leadership and effective management.
9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
P.7	Plan education and career paths aligned to personal goals.
P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
	Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.
MA.N-Q.A	Reason quantitatively and use units to solve problems.
P.9	Work productively in teams while using cultural/global competence.
9.4.12.CT.3	Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).
MA.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
LA.K-12.NJSLSA.L4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.

LA.K-12.NJSLSA.L5	Demonstrate understanding of word relationships and nuances in word meanings.
LA.K-12.NJSLSA.L6	Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.
6.1.13	Postwar United States: Civil Rights and Social Change (1945 to early 1970s) Social and political systems throughout time have promoted and denied civic virtues and democratic principles.
6.1.12.CivicsDP.13.a	Analyze the effectiveness of national legislation, policies, and Supreme Court decisions in promoting civil liberties and equal opportunities (i.e., the Civil Rights Act, the Voting Rights Act, the Equal Rights Amendment, Title VII, Title IX, Affirmative Action, Brown v. Board of Education, and Roe v. Wade).
6.2.3	Age of Revolutions: Political and Industrial Revolutions, Imperialism, Reform and Global Impact (1750–1914) Democratic principles concerning universal human rights, concepts of equality, and the commitment to human freedom are commonly expressed in fundamental documents, values, laws, and practices.

Suggested Accommodations and Modifications

Link to Google Doc with list of accommodations and modifications:

https://docs.google.com/spreadsheets/d/1pRh--nhM8IFIomBxghCfN1PrwPPFT7n_y6BvOpAt6nQ/edit#gid=1426178898