Grade(s):	**11 & 12**
Discipline/Course:	**Mathematics**
Course Title:	**Modern Mathematics - A**
Prerequisite(s):	Algebra 2
Course Description: *Program of Studies*	Modern Mathematics is a fourth-year launch course that differs from the courses that precede it in that the mathematics is focused on discrete topics instead of continuous functions. This post-Algebra II course is heavily based in modeling with mathematics and includes topics like elections and weighted voting, graph theory, game theory, and apportionment. Students engage in problem-based learning where problems are ill defined and may have varying outcomes. In this course, reasoning and modeling are primary drivers of instruction.
Course Essential Questions:	**Where is mathematics used?** **What is the mathematics connection to history, art, computer science, etc?**
Course Enduring Understandings:	● A quantity can be represented numerically in various ways. ● Problem solving depends upon choosing wise ways. ● There are multiple algorithms for finding a solution.
Duration:	Semester
Course Materials/Resources:	Excursions in modern mathematics (9th), Peter Tannenbaum, Pearson

***Note: Topics listed in the units may evolve over time based on adaptations to implementation. However, the overall content of the entire course will not change**

FAIRFIELD PUBLIC SCHOOLS

Academic Expectations The Fairfield Public Schools describe a variety of cross curricular expectations that all students should exemplify during their time within the schooling experience. This page gives examples of what the practice standards look like at the specified grade level. Students are expected to:		
Standards	Explanations	Example
1. Exploring and Understanding	When students engage in problem solving situations, they should be able to understand the problem, determine relevant information, and ask relevant additional questions.	Students should be able to answer the following questions when approaching a problem: 1. Do you understand all the words used in stating the problem? 2. What are you asked to find or show? 3. Can you restate the problem in your own words? 4. Can you think of a picture or diagram that might help you understand the problem?
2. Synthesizing and Evaluating	Engaging in a problem solving situation, students should be able to analyze the most efficient approach, and reflect on the process used to solve the problem.	Students should be able to answer the following questions when analyzing how to approach a problem, and also reflect on the result: 1. Is there enough information to enable you to find a solution? If not, what additional information is needed? 2. Are there multiple ways to complete the task? Which approach do you think is most efficient, and why? 3. Do you know a related problem? Look at the unknown and try to think of a familiar problem having the same or similar unknown. Can you use it? 4. Was your strategy effective? What worked? What didn't? 5. Was there another approach that could have been more efficient? 6. Is your answer reasonable? How do you know? 7. Was your presentation approach effective? If not, what would you change? 8. How did the communication tools allow you to get the message across to the intended audience?

3. Creating and Constructing	Engaged in a problem solving situation, students should implement a plan.	Students should be able to answer the following question to implementing their plan to solve a problem: 1. What strategy will you use to complete the task?
4. Conveying Ideas	Students should be able to use correct mathematical language, logically display their work for the desired problem.	Students should be able to answer the following questions to convey their mathematical thinking to solve a problem: 1. How will you present your information to your intended audience? 2. Does your response illustrate the correct terms and work to the problem?
5. Using Communicatio n Tools	Students should be able to choose the correct tools to illustrate their mathematical work to solve a specific problem.	Students should be able to answer the following question to use specific communication tools to solve a problem: 1. If applicable, what communication tools will you use to convey your ideas and solution?
6. Collaborating Strategically	Students should be able to work collaboratively to solve problems.	Students should be able to answer the following question to collaboratively solve problems: 1. In what ways did you work together to help solve the desired problem?

Unit Number and Title:	**Unit 1: The Mathematics of Elections and Power (The Paradoxes of Democracy & Weighted Voting)**
Resource(s):	Textbook: Chapter 1, Chapter 2
Learning Goals	
Standard(s):	CC Standards: CC 2.4 HS B.1:Summarize, represent, and interpret data on a single count or measurement variable - Use data displays in problem solving settings and/or make predictions CC.2.HS.C.1: Use the concept and notation of functions to interpret and apply them in terms of their context. - Analyze and/or use patterns or relations - Analyze a set of data for the existence of a pattern and represent the pattern algebraically and/or graphically. Compare and/or order any real numbers. CC 2.2.HS.D.2: Write expressions in equivalent forms to solve problems
Essential Question(s):	● What is meant by a fair election? ● Is any method of voting fair? ● How can a method of voting be used to favor an outcome in an election? ● How does the method of voting in the United States compare to methods used elsewhere? ● What are the shortcomings of each method? ● How can the voter be satisfied in the face of the Impossibility Theorem?
Enduring	● Choosing the best voting method for your situation.

Understanding(s):	
Learning Goal(s): *Students will be able to use their learning to:*	1. Use preference ballots 2. Create a preference schedule from the total number of ballots for any given election. 3. Determine the winner of an election using any method: Plurality, Majority, Borda Count, Pairwise Comparison, Plurality with Elimination (Runoff and Sequential Runoff), and Approval. 4. Compare and contrast the different voting procedures 5. Recognize and discuss the implications of Arrow's impossibility theorem.

Unit Number and Title:	**Unit 2: The Mathematics of Sharing: Fair Division Games**
Resource(s):	Testbook: Chapter 3
Learning Goals	
Standard(s):	- N/A
Essential Question(s):	● What is fair division? ● What is the difference between discrete and continuous schemes in fair division? ● What methods can be used in each scheme? ● How can a person be satisfied that the outcome of a method is fair?
Enduring Understanding(s):	● Voting results may vary depending on voting methodology.
Learning Goal(s): *Students will be able to use their learning to:*	1. Define player, game, goods and scheme type (continuous, discrete or mixed). 2. Define what is meant by fair division 3. Investigate and describe situations using continuous division, or infinitely divisible sets using the following Fair Division schemes: divider/chooser, lone divider, lone chooser, and last diminisher 4. Investigate and describe situations involving discrete division using methods of sealed bids and method of markers 5. Compare and contrast the differences between the two types of fair division schemes 6. Solve fair division problems that consist of *n* individuals or players who must partition some set of goods, *s,* into *n* disjoint sets.

Unit Number and Title:	**Unit 3: The Mathematics of Apportionment: Making The Rounds**
Resource(s):	Textbook: Chapter 4
Learning Goals	
Standard(s):	N/A
Essential Question(s):	● Why were different apportionment methods applied in the United States? ● What are the benefits and shortcomings of the various methods? ● What method is used currently?
Enduring Understanding(s):	● Sharing is not always fair.\ ● Sharing on a large scale (apportioning) is always flawed.
Learning Goal(s): *Students will be able to use their learning to:*	1. Relate apportionment to fair division and define the players and the goods. 2. Calculate the standard divisor using the total population and the total number of seats available to apportion. 3. Determine each player's (state's) standard quota based on the standard divisor. 4. Find the lower and upper quotas based on the standard quota 5. Understand and apply the apportionment methods: Hamilton, Jefferson, Adams, Webster and Huntington-Hill 6. Compare and contrast each of the different methods and the benefits of using each one. 7. Apply each of the methods of apportionments to specific problems to determine the allocation of goods