

Finite: Linear Mathematics

ESTABLISHED GOALS:

Competencies:

- Students will demonstrate the ability to solve equations, inequalities and systems by analyzing structure and applying the properties of equality and rational expressions.
- Students will demonstrate the ability to apply functions to solve problems in a variety of contexts by interpreting and analyzing multiple representations of functions.
- Students will demonstrate the ability to apply matrices to solve problems in a variety of contexts
- Students will demonstrate the ability to use mathematics to model real world problems by building and analyzing the appropriate expression, equation, or function.
- Students will demonstrate the ability to analyze and summarize text and integrate knowledge to make meaning of discipline-specific materials.
- Students will demonstrate the ability to produce coherent and supported writing in order to communicate effectively for a range of discipline-specific tasks, purposes, and audiences.
- Students will demonstrate the ability to speak purposefully and effectively by strategically making decisions about content, language use, and discourse style.

Content Standards:

- A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- A.CED.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.
- HSN.VM.C.6 (+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.
- HSN.VM.C.7 (+) Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.
- HSN.VM.C.8 (+) Add, subtract, and multiply matrices of appropriate dimensions.
- HSN.VM.C.9 (+) Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.
- HSN.VM.C.10 (+) Understand that the zero and identity matrices

Transfer

*Students will be able to independently use their learning to **maximize or minimize a problem's solution given a set of restrictions.***

Meaning

ENDURING UNDERSTANDINGS

Students will understand that...

- a best solution can be found by analyzing how constraints affect a problem.
- a constant rate of change always results in a direct correlation between quantities.

ESSENTIAL QUESTIONS

- How can we make the best decisions given a restrictive situation?

Acquisition

Students will know...

- the price that a commodity sells for is related to the quantity available
- how the slopes of parallel and perpendicular lines relate to each other
- systems with no solution can always be detected by the presence of a matrix row of the form $[0 \ 0 \ \dots \ 0 | a]$, where a is a nonzero number
- in order to add or subtract matrices, they must have the same dimensions
- in order to multiply matrices, the columns of the first must be the same as the rows of the second
- multiplication of matrices is not commutative
- $I_n \cdot A = A \cdot I_n = A$
- not all square matrices have inverses
- an input-output matrix summarized the interdependence among the industries of the economy
- Fundamental Theorem of Linear Programming
- Some linear programming problems have infinitely many solutions
- A linear programming problem requires

Students will be skilled at...

- graphing linear equations inequalities from y-intercept form
- using a graphing calculator to graph and analyze linear equations, inequalities, & systems
- graphing systems of linear equations and inequalities
- applying the method of least squares
- using a graphing calculator to obtain the least square line
- performing a break-even analysis
- solve systems of equations using the Gauss-Jordan elimination method
- using a graphing calculator to solve systems using matrices
- pivoting a matrix around a given nonzero entry
- adding, multiplying, and subtracting matrices by hand and with a graphing calculator
- performing scalar multiplication
- finding the inverse of a matrix using Gauss-Jordan and with a calculator
- solving a matrix equation
- using a matrix inverse to solve a system of equations
- performing input-output analysis using matrix

play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse. • A.REI.6 Solve systems of linear equations exactly and approximately, focusing on pairs of linear equations in two variables. • A.REI.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes. • A.REI.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). • F-IF.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x. The graph of f is the graph of the equation $y = f(x)$. • F-IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. • F-IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. • F-IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. • F-IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. • F-IF.C.7a Graph linear functions and show intercepts. • F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context. • MP2 Reason abstractly and quantitatively. • MP4 Model with mathematics. • MP5 Use appropriate tools strategically. • MP7 Look for and make use of structure. • MP8 Look for and express regularity in repeated reasoning.	<i>maximizing or minimizing the value of a linear function subject to restrictions given by linear inequalities</i> • <i>the particular solution derived from a simplex tableau is a maximum if and only if the bottom row contains no negative numbers to the left of the vertical bar</i> • <i>Fundamental Theorem of Duality</i> <u>vocabulary:</u> <i>linear depreciation, feasible set, law of supply and demand, cost curve, marginal cost of production, fixed cost, depreciation, least square error, break-even point, diagonal form of a system, elementary row operations, matrix, pivoting; row, column, & square matrices; entries, coefficient matrix, scalar product, identity matrix, inverse of a matrix, final demand, production amounts, linear programming, optimal point, feasible set objective function, standard form of a linear programming problem, slack variable, simplex tableau, Group I & Group II variables, sensitivity analysis, range of feasibility, shadow price, transpose</i>	<i>arithmetic</i> • <i>solving optimization problems</i> • <i>solving linear programming problems in standard form</i> • <i>using lack variables</i> • <i>reformulating problems as a systems of linear equations</i> • <i>applying Simplex Methods I & II</i> • <i>performing sensitivity analysis</i>
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● RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. ● RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 9-10 texts and topics</i>. ● RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.	● <i>reason effectively</i> ● <i>use systems thinking</i> ● <i>solve problems</i> ● <i>access and evaluate information</i> ● <i>use and manage information</i> ● <i>be self-directed learners</i>
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<i>Evaluative Criteria</i>	<i>Assessment Evidence</i>
	PERFORMANCE TASK(S):
	OTHER EVIDENCE:

<i>Summary of Key Learning Events and Instruction</i>		
<i>Science Integration</i>	<i>College, Career, and Civic Life Integration</i>	<i>Technology Integration</i>
<i>District Materials</i>	<i>Distance Learning/Field Trips</i>	<i>Technology Resources</i>