Finite: Linear Mathematics

ESTABLISHED GOALS:

Competencies:

- *Students will demonstrate perseverance and strategic thinking by identifying the underlying meaning of a problem, planning a logical solution pathway, working through challenges, and verifying the reasonableness of their answers.*
- *Students will demonstrate the ability to decontextualize (represent symbols) and contextualize (understand the meaning of quantities) by converting real-world situations into mathematical symbols for manipulation, and interpreting symbolic results back into practical contexts.*
- *Students will demonstrate application skills by using mathematical concepts and symbols to represent, analyze, and solve problems arising in everyday life, society, and the workplace.*
- *Students will demonstrate accuracy and clarity using correct mathematical terminology, specifying units of measure, and calculating with the degree of precision appropriate for the problem context.*
- *Students will demonstrate structural awareness by discerning patterns and functional relationships within complex mathematical concepts to simplify and solve problems.*
- *Students will demonstrate the ability to notice repetitive calculations or patterns, evaluate the reasonableness of results, and formulate general methods, formulas, or shortcuts while maintaining oversight of the process.*
- *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*
  ], *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*
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- *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.	*maximizing or minimizing the value of a linear function subject to restrictions given by linear inequalities* ● *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* ● *Fundamental Theorem of Duality* *<u>vocabulary:</u> 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*	*arithmetic* ● *solving optimization problems* ● *solving linear programming problems in standard form* ● *using lack variables* ● *reformulating problems as a systems of linear equations* ● *applying Simplex Methods I &II* ● *performing sensitivity analysis*

Content Area Literacy Standards	***21st Century Skills***

• 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 *grades 9-10 texts and topics*. • 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.	• *reason effectively* • *use systems thinking* • *solve problems* • *access and evaluate information* • *use and manage information* • *be self-directed learners*

Evaluative Criteria	***Assessment Evidence***
	PERFORMANCE TASK(S):
	OTHER EVIDENCE:

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