Mathematical Models with Applications

Unit 1: Investing in You

Texas Essential Knowledge and Skills (TEKS)

The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:
M1.A apply mathematics to problems arising in everyday life, society, and the workplace;
M1.B use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;
M1.C select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;
M1.D communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;
M1.E create and use representations to organize, record, and communicate mathematical ideas;
M1.F analyze mathematical relationships to connect and communicate mathematical ideas; and
M1.G display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

The student uses mathematical processes with graphical and numerical techniques to study patterns and analyze data related to personal finance. The student is expected to:
M.2A use rates and linear functions to solve problems involving personal finance and budgeting, including compensations and deductions;
M.2B solve problems involving personal taxes; and
M.2C analyze data to make decisions about banking, including options for online banking, checking accounts, overdraft protection, processing fees, and debit card/ATM fees.

The student uses mathematical processes with algebraic formulas, graphs, and amortization modeling to solve problems involving credit. The student is expected to:
M.3A use formulas to generate tables to display series of payments for loan amortizations resulting from financed purchases;
M.3B analyze personal credit options in retail purchasing and compare relative advantages and disadvantages of each option;
M.3C use technology to create amortization models to investigate home financing and compare buying a home to renting a home; and
M.3D use technology to create amortization models to investigate automobile financing and compare buying a vehicle to leasing a vehicle.

The student uses mathematical processes with algebraic formulas, numerical techniques, and graphs to solve problems related to financial planning. The student is expected to:
M.4A analyze and compare coverage options and rates in insurance;
M.4B investigate and compare investment options, including stocks, bonds, annuities, certificates of deposit, and retirement plans; and
M.4C analyze types of savings options involving simple and compound interest and compare relative advantages of these options.

Unit Big Ideas/Learning Targets

- I can use rates and linear functions to solve problems involving personal finance and budgeting. I can determine reasonableness of my solutions and justify my thinking.
- I can solve problems involving personal taxes. I can determine reasonableness of my solutions and justify my thinking.
- I can analyze data to make decisions about banking and justify my thinking.
- I can use formulas to generate tables to display series of payments for loan amortizations from financed purchases in order to make and justify decisions.
- I can use technology to create amortization models to investigate home and automobile financing. I can compare buying a home to renting a home or buying a vehicle to leasing a vehicle in order to make and justify decisions.
- I can analyze personal credit options in retail purchasing and compare relative advantages and disadvantages of each option in order to make and justify decisions.
- I can analyze and compare coverage options and rates in insurance in order to make and justify decisions.
- I can investigate and compare investment options in order to make and justify decisions.
- I can analyze types of savings options involving simple and compound interest and compare relative advantages of these options in order to make and justify decisions.

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Unit 2: On the Move

Texas Essential Knowledge and Skills (TEKS)

Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:
M1.A apply mathematics to problems arising in everyday life, society, and the workplace;
M1.B use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;
M1.C select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;
M1.D communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;
M1.E create and use representations to organize, record, and communicate mathematical ideas;
M1.F analyze mathematical relationships to connect and communicate mathematical ideas; and
M1.G display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

The student applies mathematical processes with algebraic techniques to study patterns and analyze data as it applies to science. The student is expected to:
M.5A use proportionality and inverse variation to describe physical laws such as Hooke's Law, Newton's Second Law of Motion, and Boyle's Law;
M.5B use exponential models available through technology to model growth and decay in areas, including radioactive decay; and
M.5C use quadratic functions to model motion.

Unit Big Ideas/Learning Targets

- I can use quadratic functions to model motion in order to analyze and solve problems.
- I can use proportionality and inverse variation to describe physical laws in order to analyze and solve problems.
- I can use exponential models with technology to model growth and decay in areas in order to analyze and solve problems.

Mathematical Models with Applications

Unit 3: Draw It, Build It, Play It

Texas Essential Knowledge and Skills (TEKS)

Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:
M1.A apply mathematics to problems arising in everyday life, society, and the workplace;
M1.B use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;
M1.C select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;
M1.D communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;
M1.E create and use representations to organize, record, and communicate mathematical ideas;
M1.F analyze mathematical relationships to connect and communicate mathematical ideas; and
M1.G display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

The student applies mathematical processes with algebra and geometry to study patterns and analyze data as it applies to architecture and engineering. The student is expected to:
M.6A use similarity, geometric transformations, symmetry, and perspective drawings to describe mathematical patterns and structure in architecture;
M.6B use scale factors with two-dimensional and three-dimensional objects to demonstrate proportional and non-proportional changes in surface area and volume as applied to fields;
M.6C use the Pythagorean Theorem and special right-triangle relationships to calculate distances; and
M.6D use trigonometric ratios to calculate distances and angle measures as applied to fields.

The student uses mathematical processes with algebra and geometry to study patterns and analyze data as it applies to fine arts. The student is expected to:
M.7A use trigonometric ratios and functions available through technology to model periodic behavior in art and music;
M.7B use similarity, geometric transformations, symmetry, and perspective drawings to describe mathematical patterns and structure in art and photography;
M.7C use geometric transformations, proportions, and periodic motion to describe mathematical patterns and structure in music; and
M.7D use scale factors with two-dimensional and three-dimensional objects to demonstrate proportional and non-proportional changes in surface area and volume as applied to fields.

Unit Big Ideas/Learning Targets

- I can use similarity, geometric transformations, symmetry, and perspective drawings to describe mathematical patterns and structure in architecture.
- I can use scale factors with two-dimensional objects to demonstrate proportional and non-proportional changes as applied to architecture and engineering to make sense of the world around me.

- I can use scale factors with three-dimensional objects to demonstrate proportional and non-proportional changes in surface area and volume as applied to architecture and engineering to make sense of the world around me.
- I can use scale factors with three-dimensional objects to demonstrate proportional and non-proportional changes in surface area and volume as applied to architecture and engineering to make sense of the world around me.
- I can use trigonometric ratios to calculate distances and angle measures as applied to architecture and engineering to make sense of the world around me.
- I can use trigonometric ratios and functions available through technology to model periodic behavior in art and music to make sense of the world around me.
- I can use geometric transformations, proportions, and periodic motion to describe mathematical patterns and structure in music to make sense of the world around me.
- I can use similarity, geometric transformations, symmetry, and perspective drawings to describe mathematical patterns and structure in art and photography to make sense of the world around me.
- I can use scale factors with two-dimensional and three-dimensional objects to demonstrate proportional and non-proportional changes involving surface area and volume in the fields of art and photography.

Mathematical Models with Applications

Unit 4: Chances Are

Texas Essential Knowledge and Skills (TEKS)

Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:
M1.A apply mathematics to problems arising in everyday life, society, and the workplace;
M1.B use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;
M1.C select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;
M1.D communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;
M1.E create and use representations to organize, record, and communicate mathematical ideas;
M1.F analyze mathematical relationships to connect and communicate mathematical ideas; and
M1.G display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

The student applies mathematical processes with algebra and geometry to study patterns and analyze data as it applies to architecture and engineering. The student is expected to:
M.6A use similarity, geometric transformations, symmetry, and perspective drawings to describe mathematical patterns and structure in architecture;
M.6B use scale factors with two-dimensional and three-dimensional objects to demonstrate proportional and non-proportional changes in surface area and volume as applied to fields;
M.6C use the Pythagorean Theorem and special right-triangle relationships to calculate distances; and
M.6D use trigonometric ratios to calculate distances and angle measures as applied to fields.

The student uses mathematical processes with algebra and geometry to study patterns and analyze data as it applies to fine arts. The student is expected to:
M.7A use trigonometric ratios and functions available through technology to model periodic behavior in art and music;
M.7B use similarity, geometric transformations, symmetry, and perspective drawings to describe mathematical patterns and structure in art and photography;
M.7C use geometric transformations, proportions, and periodic motion to describe mathematical patterns and structure in music; and
M.7D use scale factors with two-dimensional and three-dimensional objects to demonstrate proportional and non-proportional changes in surface area and volume as applied to fields.

Unit Big Ideas/Learning Targets

- I can analyze problems using a mathematical modeling cycle to determine the number of ways an event may occur by using combinations, permutations, and the Fundamental Counting Principle.
- I can compare theoretical to empirical probabilities and report the conclusions and the reasoning behind the conclusions.
- I can conduct experiments to determine the reasonableness of a binomial or geometric theoretical model.

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Unit 5: Survey Says…

Texas Essential Knowledge and Skills (TEKS)

Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:
M1.A apply mathematics to problems arising in everyday life, society, and the workplace;
M1.B use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;
M1.C select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;
M1.D communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;
M1.E create and use representations to organize, record, and communicate mathematical ideas;
M1.F analyze mathematical relationships to connect and communicate mathematical ideas; and
M1.G display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

The student applies mathematical processes and mathematical models to analyze data as it applies to social sciences. The student is expected to:
M.9A interpret information from various graphs, including line graphs, bar graphs, circle graphs, histograms, scatterplots, dot plots, stem-and-leaf plots, and box and whisker plots, to draw conclusions from the data and determine the strengths and weaknesses of conclusions;
M.9B analyze numerical data using measures of central tendency (mean, median, and mode) and variability (range, interquartile range or IQR, and standard deviation) in order to make inferences with normal distributions;
M.9C distinguish the purposes and differences among types of research, including surveys, experiments, and observational studies;
M.9D use data from a sample to estimate population mean or population proportion;
M.9E analyze marketing claims based on graphs and statistics from electronic and print media and justify the validity of stated or implied conclusions; and
M.9F use regression methods available through technology to model linear and exponential functions, interpret correlations, and make predictions.

The student applies mathematical processes to design a study and use graphical, numerical, and analytical techniques to communicate the results of the study. The student is expected to:
M.10A formulate a meaningful question, determine the data needed to answer the question, gather the appropriate data, analyze the data, and draw reasonable conclusions; and
M.10B communicate methods used, analyses conducted, and conclusions drawn for a data-analysis project through the use of one or more of the following: a written report, a visual display, an oral report, or a multi-media presentation.

Unit Big Ideas/Learning Targets

- I can interpret information from various graphs to draw conclusions and determine the strength and weaknesses of the conclusions made. I can justify and report the reasoning behind the conclusions.
- I can use measures of central tendency (mean, median, and mode) and variability (range, IQR, and standard deviation) to analyze and make inferences about data with normal distributions.
- I can distinguish the purposes and differences among types of research to report on the conclusions and the reasoning behind the conclusions of the research.
- I can use data from a sample to estimate population mean or population proportion, report the conclusions and explain the reasoning behind the conclusions of the data.
- I can analyze marketing claims based on graphs and statistics from electronic and print media and justify the validity of stated or implied conclusions.
- I can use regression methods available through technology to model linear and exponential functions, interpret correlations, and make predictions.
- I can design a study and use graphical, numerical, and analytical techniques to communicate the results of the study.