Mathematical Reasoning for Decision Making | MR

Applications and modeling using mathematics are the primary foci of this course. Throughout the course, students explore mathematical content in the context of applications to the real-world. Topics will build upon previous knowledge requiring students to reason, solve, and represent mathematical concepts in multiple ways to encourage the use of math to answer problems students will encounter in life. This course is best intended for students who are planning to attend a College of Applied Technology, military service, or enter the workforce immediately following graduation.

Mathematical Reasoning for Decision Making includes the following domains and clusters:

Number and Quantity

Financial Mathematics

- Use financial mathematics to make personal financial decisions.
- Use financial mathematics to make business decisions.

Algebra

Linear Programming

- Use linear programming techniques to solve real-world problems.
- Solve real-world optimization problems.

Data Analysis, Statistics, and Probability

Organize and Interpret Data

- Analyze data from multiple viewpoints and perspectives.

Normal Probability Distribution

- Work with the normal distribution in real-world situations.
- Work with confidence intervals in real-world situations.

Geometry

Geometric Measurement and Dimension

- Understand the role of precision in measurement.
- Accurately use standard and non-standard units in measurement.

Mathematical Modeling

Mathematical Modeling is a Standard for Mathematical Practice (MP4) and a Conceptual Category. Specific modeling standards appear throughout the high school standards indicated with a star (★). Where an entire domain is marked with a star, each standard in that domain is a modeling standard.

Standards for Mathematical Practice

Being successful in mathematics requires the development of approaches, practices, and habits of mind that need to be in place as one strives to develop mathematical fluency, procedural skills, and conceptual understanding. The Standards for Mathematical Practice are meant to address these areas of expertise that teachers should seek to develop in their students. These approaches, practices, and habits of mind can be summarized as "processes and proficiencies" that successful mathematicians have as a part of their work in mathematics. Additional explanations are included in the main introduction of these standards.

Standards for Mathematical Practice
1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.

Literacy Standards for Mathematics

Communication in mathematics employs literacy skills in reading, vocabulary, speaking and listening, and writing. Mathematically proficient students communicate using precise terminology and multiple representations including graphs, tables, charts, and diagrams. By describing and contextualizing mathematics, students create arguments and support conclusions. They evaluate and critique the reasoning of others, analyze, and reflect on their own thought processes. Mathematically proficient students have the capacity to engage fully with mathematics in context by posing questions, choosing appropriate problem-solving approaches, and justifying solutions. Further explanations are included in the main introduction.

Literacy Skills for Mathematical Proficiency
1. Use multiple reading strategies. 2. Understand and use correct mathematical vocabulary. 3. Discuss and articulate mathematical ideas. 4. Write mathematical arguments.

Number and Quantity

Financial Mathematics (N.NQ)★

Cluster Headings	Content Standards
A. Use financial mathematics to make personal financial decisions.	**MR.N.NQ.A.1** Define common terms associated with finance (such as interest, compound interest, annuities, retirement funds, amortizations, future value, and present value) and know how each term is related to personal finance. **MR.N.NQ.A.2** Calculate compound interest within the context of personal finance (such as credit card debt, home/car purchase, personal loans, and amortization schedules) and use the results to make decisions (for example, determine which home financing option is best). **MR.N.NQ.A.3** Calculate net pay using gross pay (weekly, biweekly, monthly, or annual) and both fixed and variable deductions (such as withholding tax, Social Security tax, insurance costs, retirement investments and other contributory benefits). **MR.N.NQ.A.4** Access and use published data (such as cost of city or state utilities, housing, city or state taxes, meals, and other costs of living) to estimate and compare monthly living expenses based on location, identified needs, and personal preferences or desired lifestyles. **MR.N.NQ.A.5** Access and use published data (such as average life expectancy based on location and/or health issues, investment data, retirement funds, and annuity data) to calculate and compare retirement investments (such as total savings and monthly payouts) based on projected income. **MR.N.NQ.A.6** Access and use published data to create depreciation schedules and analyze the depreciation of various assets (such as cars, business equipment, and store fixtures). **MR.N.NQ.A.7** Access and use published data to calculate income tax based on projected gross annual income, returns on investments, tax deductions and tax credits, and other factors that affect calculations. **MR.N.NQ.A.8** Develop a personal mid-term (three to five years) financial plan based on anticipated income, projected living expenses, projected retirement or other savings, and other factors that affect personal finances.
B. Use financial mathematics to make business decisions.	**MR.N.NQ.B.9** Compare the components of a small business plan to the components of a personal financial plan (i.e., identify components that are common to both plans and components that are unique to a small business plan). **MR.N.NQ.B.10** Define common terms associated with business finance (such as assets, liabilities, revenue, expenses, net profit, net loss, profit margin, and return on investment) and know how each term is related to business finance. **MR.N.NQ.B.11** Access and use published data to develop a three-year financial plan for starting and running a small business (including projected income and projected fixed and variable costs such as licenses, rent and utilities, city and state taxes, cost of goods sold, etc.).

Algebra

Linear Programming (A.LP)★

Cluster Headings	Content Standards
A. Use linear programming techniques to solve real-world problems.	**MR.A.LP.A.1** Read, interpret, and solve linear programming problems graphically and by computational methods.
B. Solve real-world optimization problems.	**MR.A.LP.B.2** Use linear programming to solve optimization problems (for example, optimizing profit for a small business). **MR.A.LP.B.3** Interpret the meaning of the maximum or minimum value in terms of the objective function.

Data Analysis, Statistics, and Probability

Organize and Interpret Data (D.ID)★

Cluster Headings	Content Standards
A. Analyze data from multiple viewpoints and perspectives.	**MR.D.ID.A.1** Organize, analyze, and interpret data for problem solving (for example, compare data related to costs of living; analyze survey data; provide a circle graph that demonstrates the percentages of income that support various expenses). **MR.D.ID.A.2** Determine whether a set of data supports a given assertion (for example, whether a data set collected on Tennessee residents can be generalized to support an assertion about all Americans; whether a data set supports, or is large enough to support, the validity of a claim). **MR.D.ID.A.3** Develop facility with representations of a data set and explain why some representations are more accurate or relevant than others in a given context. **MR.D.ID.A.4** Interpret and use measures of central tendency and spread to solve problems and make informed decisions. **MR.D.ID.A.5** Calculate expected value in real-world situations (such as lottery return on investment, expected value of each possession in sports, and expected payoff in a game of chance). **MR.D.ID.A.6** Evaluate and compare two investments or strategies where one investment or strategy is safer but has lower expected value. Include large and small investments and situations with serious consequences. **MR.D.ID.A.7** Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values. Evaluate strategies and make decisions based on expected values (for example, whether a team should pursue a higher-scoring option with a smaller probability of success or a lower-scoring option with a higher probability of success; whether a homeowner should file a small insurance claim given the probability that the monthly cost of insurance will rise as a result).

Normal Probability Distribution (D.ND)★

Cluster Headings	Content Standards
A. Work with the normal distribution in real-world situations.	**MR.D.ND.A.1** Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.
B. Work with the confidence intervals in real-world situations.	**MR.D.ND.B.2** Understand and interpret confidence levels and confidence intervals (for example, use the weights of randomly sampled boxes of cereal compared to the expected tolerances to determine whether the machinery is operating properly).

Geometry and Measurement

Geometric Measurement (G.GMD)★

Cluster Headings	Content Standards
A. Understand the role of precision in measurement.	**MR.G.GMD.A.1** Use standard units (metric and non-metric) to accurately measure objects to within 0.1 of the unit used. **MR.G.GMD.A.2** Use precise measurements (within 0.1 of the unit used) to calculate area, surface area, and volume/capacity (emphasize common two-and three-dimensional shapes). **MR.G.GMD.A.3** Understand and explain the effects that an error in measurement will have on a calculation that uses the erroneous measurement (for example, whether an error of 0.1 unit in length affects the calculated vs. actual measurement of the volume of an object, and whether that error is compounded by errors in other measurements used in the calculation).
B. Accurately use standard and non-standard units in measurement.	**MR.G.GMD.B.4** Use standard units of measure to develop accurately estimated measurements of commonly available non-standard instruments of measurement (for example, establish the length of hand span in inches or centimeters; length of arm span or stride length in feet or yards; the area of a floor tile in square inches or square feet; the volume of a gallon of milk or a water bottle or a soda can in cubic inches or cubic centimeters, etc.). **MR.G.GMD.B.5** Understand and explain the consequences of relying on non-standard units of measure (for example, explain why paper clip length or pencil length are not standard units of measure and how failing to use mutually agreed-upon units can lead to erroneous assumptions, calculations, or conclusions). **MR.G.GMD.B.6** Use the established dimensions of common non-standard measuring instruments to estimate other measurements using standard units to a given tolerance (for example, use stride length to estimate the length of a hallway to within 10% of the actual length in feet; use the estimated volume of a finger in cubic centimeters to estimate the amount of liquid in a glass).

B. Accurately use standard and non-standard units in measurement.	**MR.G.GMD.B.7** Estimate the area, surface area, volume, or capacity of an object using the established dimensions of common non-standard measuring instruments to determine measurements in standard units with and without using technology (for example, use the number of floor tiles along a wall to estimate the area of the floor of a room and use the height of a person to estimate the height of the room, then find the volume of the room based on those estimations; use the size of a milk jug to estimate the number of gallons in a tank of water). **MR.G.GMD.B.8** Estimate the amount of error in a calculation that is based on using established dimensions of common non-standard measuring instruments (for example, if a person's stride length is 30 inches plus/minus 2 inches, and the person uses stride length to measure the length and width of a plot of land, determine the estimated error in calculating the area of the plot of land). **MR.G.GMD.B.9** Understand and use unit conversions in estimations involving both standard and non-standard units (for example, determine how many boxes of flooring will be needed to cover a floor of given dimensions if 10% waste is assumed; how many gallons of paint will be needed to paint a room of a given size; how many bags of fertilizer will be needed to fertilize a yard of a given size). **MR.G.GMD.B.10** Discuss the various examples and consequences of innumeracy; consider poor estimation, improper experimental design, inappropriate comparisons, and scientific notation comparisons.