Introduction to Mathematical Applications

Adopted 2024

Introduction to Mathematical Applications

Number and Quantity

1. Mathematics as a language. I.NQ.1
    1. Demonstrate reasoning skills in developing, explaining, and justifying sound mathematical arguments and analyzing the soundness of mathematical arguments of others. M.IMA.1
    2. Communicate with and about mathematics orally and in writing as part of independent and collaborative work, including making accurate and clear presentations of solutions to problems. M.IMA.2
    3. Use units to understand problems and to guide the solutions of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. M.IMA.3
2. Mathematics and Measurement I.NQ.2
    4. Select and correctly use an appropriate tool (e.g., tape measure, ruler, compass, level, micrometer, scale, protractor, thermometer, speedometer, odometer, pressure gauge, measuring squares, multimeter) to measure and/or calculate lengths, distances, directions, masses, temperatures, rates of change (e.g., slope, speed), areas, volumes, voltages, currents, and resistances. M.IMA.4
    5. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. M.IMA.5
    6. Solve real-world problems requiring conversion of units using dimensional analysis for measurements in English and metric systems. Solve problems involving multiple units of measurement (e.g., converting between currencies, calculating dosages of medicine, trip planning from miles to kilometers). M.IMA.6
    7. Distinguish between proportional and non-proportional situations, apply proportional reasoning when appropriate, solve for an unknown quantity in proportional situations; apply scale factors to perform indirect measurements using maps, blueprints, concentrations, dosages, and densities. M.IMA.7

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3. The Real Number System. I.NQ.3

    8. Perform operations and convert quantities between fractions, decimals, and percents using positive and negative numbers, fractions, absolute value, decimals, percentages, and scientific notation (e.g., given the cost of a project, determine what percentage of the budget were salaries; percent of increase/decrease). M.IMA.8

    9. Solve real-world problems in a variety of contexts by representing quantities in equivalent forms (fractions, decimals, and percentages) to investigate and describe quantitative relationships. Compare the size of numbers in different forms arising in authentic real-world contexts, such as growth expressed as a fraction versus as a percentage. Interpret the meaning of numbers in different forms, such as scientific notation and the meaning of a fraction or percentage greater than 100 and its validity in a given context. Recognize incorrect or deceptive uses of fractions, decimals, or percentages. M.IMA.9

Algebra – Seeing Structure in Expressions

1. Understand the connections between proportional relationships, lines, and linear equations. I.IS.1

    10. Graph proportional relationships, interpreting the unit rates as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed (e.g., labor cost per time, material cost per job). M.IMA.10

    11. Solve application problems using direct and inverse variation equations (e.g., determine the mechanical advantage of gears, Ohm's Law). M.IMA.11

2. Create equations that describe numbers or relationships. I.IS.2

    12. Analyze real-world problem situations and use variables to construct and solve equations involving one or more unknown or variable quantities to answer questions about the situations, such as creating spreadsheet formulas to calculate prices based on percentage mark-up or solving formulas for specified values. Demonstrate understanding of the meaning of a solution. Identify when there is insufficient information given to solve a problem. M.IMA.12

    13. Analyze real-world problem situations and use variables to construct and solve equations and inequalities in one variable, representing linear, exponential, and simple rational functions (e.g., using spreadsheet functions, determine sale price of items). M.IMA.13

    14. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales (e.g., profit vs. number of units, cost vs. number of units, resistance vs. current). M.IMA.14

    15. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations (e.g., rearrange Ohm's law V = IR to highlight resistance R). M.IMA.15

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3. Solve systems of equations. I.IS.3

    16. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables (e.g., childcare facility – sq. footage to number of children; solving electrical current in a circuit with multiple paths, break-even point). M.IMA.16

Functions – Interpreting Functions

1. Understand the concept of a function and use function notation. I.F.1

    17. Use multiple representations of functions to recognize 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. Develop function notation utilizing the definition of a function to represent situations both algebraically and graphically. M.IMA.17

2. Analyze functions using different representations. I.F.2

    18. Interpret the parameters in a linear function in terms of a context. M.IMA.18

    19. Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. M.IMA.19

    20. Describe qualitatively the functional relationship between two quantities by analyzing a graph. M.IMA.20

3. Build a function that models a relationship between two quantities. I.F.3

    21. Represent application problems as linear equations. Write a function that describes a relationship between two quantities (e.g., level of education versus pay; rate of speed versus fuel consumption; caloric intake versus expenditure). M.IMA.21

    22. Recognize that the graph of a linear or exponential equation in two variables is the set of all its solutions plotted in the coordinate plane. M.IMA.22

Geometry/Trigonometry

1. Visualize relationships between two dimensional and three-dimensional objects and apply geometric concepts in modeling situations. I.GT.1

    23. Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects (e.g., three-view drawings and blueprints). M.IMA.23

    24. Use two- and three-dimensional shapes and circles, their measures, and their properties to describe objects. M.IMA.24

        a. Apply concepts of density based on area and volume in modeling situations. M.IMA.24.A

        b. Apply geometric methods to solve design problems to satisfy given constraints (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with topographic grid systems based on ratios). M.IMA.24.B

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2. Use geometric theorems and formulas to solve problems. I.GT.2

    25. Explore theorems about triangles to solve real-world application problems. M.IMA.25

    26. Understand and apply the Pythagorean Theorem for solving real-world problems (e.g., checking accuracy on gate construction, conduit bending, roof pitch). M.IMA.26

    27. Solve application problems by calculating area and surface area for two-dimensional objects (e.g., calculate the cost of installing flooring in a building and painting the interior and exterior of a building based on square footage). M.IMA.27

    28. Solve application problems by calculating volume for three-dimensional objects using formulas for cylinders, pyramids, prisms, cones, and spheres (e.g., compute amount of cement needed for a sidewalk, amount of water in a fire hose, amount of air in ductwork). M.IMA.28

    29. Solve application problems by calculating circumference, area, radius, diameter, area of sector, arc length of a circle with appropriate unit labels (e.g., develop a circular watering system). M.IMA.29

Modeling

1. Concrete geometric representation (physical modeling) I.M.1

    30. Create and use two- and three-dimensional representations of authentic situations using paper techniques or dynamic geometric environments for computer-aided design and other applications. M.IMA.30

    31. Gather data, conduct investigations, and apply mathematical concepts and models to solve problems (e.g., designing and building a house or a car). M.IMA.31

2. Summarize, represent, and interpret data on two quantitative variables. I.M.2

    32. Collect numerical bivariate data; represent data on two quantitative variables on a scatter plot; determine whether or not a relationship exists; if so, describe how the variables are related and select a function to model the data, justify the selection and use the model to make predictions (e.g., cost of the materials for a construction project, cost of the labor for a project, cost and value of a vehicle based on depreciation). M.IMA.32

    33. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. Interpret the rate of change and the constant term of a linear model in the context of the data. M.IMA.33

    34. Identify positive and negative correlations (e.g., vehicle depreciation). Use technology to compute and interpret the correlation coefficient of a linear fit. M.IMA.34

Statistics and Probability: Interpreting Categorical & Quantitative Data

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1. Summarize, represent, and interpret data on a single count or measurement variable. I.SP.1

    35. Select applicable representations to display data on the real number line (e.g., dot plots, histograms, and box plots). M.IMA.35

    36. Analyze and interpret tables, charts, and graphs (e.g., interpret a body mass index (BMI) chart). M.IMA.36

    37. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation only as a tool to describe spread and not to explicitly find standard deviation) of two or more different data sets. M.IMA.37

    38. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). M.IMA.38

    39. Distinguish between correlation and causation. M.IMA.39

Finance Mathematics

1. Understanding financial models. I.FM.1

    40. Determine, represent, and analyze mathematical models for loan amortization and the effects of different payments and/or finance terms (e.g., business loans, auto, mortgage, and/or credit card). M.IMA.40

    41. Determine, represent, and analyze mathematical models for investments involving simple and compound interest with and without additional deposits (e.g., savings accounts, bonds, and/or certificates of deposit). M.IMA.41

2. Personal use of finance. I.FM.2

    42. Research, develop, and analyze personal budgets based on given parameters (e.g., fixed and discretionary expenses, insurance, gross vs. net pay, types of income, wage, salary, commission, career choice, geographic region, retirement, and/or investment planning). M.IMA.42

    43. Research and analyze taxes including payroll, sales, personal property, real estate, and income tax returns. M.IMA.43