Mathematics – Quantitative Reasoning

Adopted 2024

Logical Reasoning

1. Mathematics as a language. MQR.L.1
    1. Demonstrate reasoning skills in developing, explaining, and justifying sound mathematical arguments and analyze the soundness of mathematical arguments of others. M.QR.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.QR.2
2. Tools for problem solving. MQR.L.2
    3. Gather data, conduct investigations, and apply mathematical concepts and models to solve problems in mathematics and other disciplines. M.QR.3

Algebraic Modeling

1. Understand ratio concepts and use ratio reasoning to solve problems. MQR.A.1
    4. Use ratio and rate reasoning to solve real-world and mathematical problems. M.QR.4
        a. Make tables of equivalent ratios relating quantities with whole number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios. M.QR.4.A
        b. Solve unit rate problems including those involving unit pricing and constant speed (e.g., if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?). M.QR.4.B
        c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent. M.QR.4.C
        d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities. M.QR.4.D
2. Work with integer exponents, scientific notation, and radicals. MQR.A.2
    5. Know and apply the properties of integer exponents to generate equivalent numerical expressions. M.QR.5
    6. Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology. M.QR.6
    7. Rewrite expressions involving radicals and rational exponents using the properties of exponents. M.QR.7
3. Reason quantitatively and use units to solve problems. MQR.A.3
    8. Define appropriate quantities for the purpose of descriptive modeling. M.QR.8
4. Represent and solve equations and inequalities graphically. MQR.A.4
    9. Recognize that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane. M.QR.9
5. Explain volume formulas and use them to solve problems. MQR.A.5
    10. Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. M.QR.10
6. Understand financial models. MQR.A.6
    11. 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.QR.11
    12. 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.QR.12

13. Research and analyze taxes including payroll, sales, personal property, real estate, and income tax returns. M.QR.13

7. Reason quantitatively and use units to solve problems. MQR.A.7

14. Use units to understand problems and to guide the solution 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.QR.14

15. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. M.QR.15

8. Create equations that describe numbers or relationships. MQR.A.8

16. Create equations and inequalities in one variable, representing linear, quadratic, simple rational, and exponential relationships, and use them to solve problems. M.QR.16

17. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. M.QR.17

9. Construct and compare linear, quadratic, and exponential models and solve problems. MQR.A.9

18. Construct linear and exponential functions, including arithmetic and geometric sequences to model situations, given a graph, a description of a relationship, or given input-output pairs (include reading these from a table). M.QR.18

10. Build a function that models a relationship between two quantities. MQR.A.10

19. Write a function that describes a relationship between two quantities. M.QR.19

a. Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model. M.QR.19.A

b. Compose functions. For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time. M.QR.19.B

11. Interpret linear models. MQR.A.11

20. Interpret the rate of change and the constant term of a linear model in the context of the data. Use technology to compute and interpret the correlation coefficient of a linear fit. M.QR.20

Descriptive Statistics

1. Summarize, represent, and interpret data on two categorical and quantitative variables. MQR.DS.1

    21. Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data. M.QR.21

2. Summarize, represent, and interpret data on a single count or measurement variable. MQR.DS.2

    22. Select applicable representations to display data on the real number line (e.g., dot plots, histograms, and box plots). M.QR.22

    23. 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.QR.23

    24. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). M.QR.24

3. Perform statistical analysis. MQR.DS.3

    25. Create data displays for given data sets to investigate, compare, and estimate center, shape, spread, and unusual features. M.QR.25

4. Communicate statistical information. MQR.DS.4

    26. Report results of statistical studies to a particular audience, including selecting an appropriate presentation format, creating graphical data displays, and interpreting results in terms of the question studied. M.QR.26

    27. Communicate statistical results in both oral and written formats using appropriate statistical and nontechnical language. M.QR.27

Probability

1. Analyze information using probability and counting. MQR.P.1

    28. Use the Fundamental Counting Principle, permutations and combinations to determine all possible outcomes for an event; determine probability and odds of a simple event; explain the significance of the Law of Large Numbers. M.QR.28

    29. Determine and interpret conditional probabilities and probabilities of compound events by constructing and analyzing representations, including tree diagrams, Venn diagrams, two-way frequency tables, and area models, to make decisions in problem situations. M.QR.29

2. Use probability to evaluate outcomes and manage uncertainty. MQR.P.2

    30. Use probabilities to make and justify decisions about risks in everyday life. M.QR.30

    31. Calculate expected value to analyze mathematical fairness, payoff, and rise. M.QR.31

3. Understand independence and conditional probability and use them to interpret data. MQR.P.3

    32. Describe events as subsets of a sample space using characteristics of the outcomes or as unions, intersections, or complements of other events. M.QR.32

    33. Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities. Use this characterization to determine if they are independent. M.QR.33

    34. Recognize the conditional probability of A given B as P(A and B)/P(B), and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B. M.QR.34

    35. Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. M.QR.35

    36. Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. M.QR.36

4. Use the rules of probability to compute probabilities of compound events in a uniform probability model. MQR.P.4

    37. Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A and interpret the answer in terms of the model. M.QR.37

    38. Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B) and interpret the answer in terms of the model. M.QR.38

    39. Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B) and interpret the answer in terms of the model. M.QR.39

40. Use permutations and combinations to compute probabilities of compound events and solve problems. M.QR.40

5. Use probability to evaluate outcomes of decisions. MQR.P.5

41. Use probabilities to make fair decisions. M.QR.41

42. Analyze decisions and strategies using probability concepts. M.QR.42