Advanced Mathematical Modeling

Adopted 2024

Advanced Mathematical Modeling

Developing College and Career Skills

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

Finance

1. Understand financial models. AM.F.1
    4. 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.AMM.4
    5. 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.AMM.5
    6. Determine, represent, and analyze mathematical models for inflation and the Consumer Price Index using concepts of rate of change and percentage growth. M.AMM.6
2. Personal use of finance. AM.F.2
    7. Research 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.AMM.7
    8. Research and analyze taxes including payroll, sales, personal property, real estate, and income tax returns. M.AMM.8

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*r*obability

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

    9. 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.AMM.9

    10. 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.AMM.10

2. Manage uncertainty. AM.P.2

    11. Use probabilities to make and justify decisions about risks in everyday life. M.AMM.11

    12. Calculate expected value to analyze mathematical fairness, payoff and risk. M.AMM.12

Statistics

1. Critique statistics. AM.S.1

    13. Identify limitations or lack of information in studies reporting statistical information, especially when studies are reported in condensed form. M.AMM.13

    14. Interpret and compare the results of polls, given a margin of error. M.AMM.14

    15. Identify uses and misuses of statistical analyses in studies reporting statistics or using statistics to justify particular conclusions, including assertions of cause and effect versus correlation. M.AMM.15

    16. Describe strengths and weaknesses of sampling techniques, data and graphical displays and interpretations of summary statistics, and other results appearing in a study, including reports published in the media. M.AMM.16

2. Perform statistical analysis. AM.S.2

    17. Identify the population of interest, select an appropriate sampling technique, and collect data. M.AMM.17

    18. Identify the variables to be used in a study. M.AMM.18

    19. Determine possible sources of statistical bias in a study and how such bias may affect the ability to generalize the results. M.AMM.19

    20. Create data displays for given data sets to investigate, compare, and estimate center, shape, spread, and unusual features. M.AMM.20

    21. Determine possible sources of variability of data, both those that can be controlled and those that cannot be controlled. M.AMM.21

3. Communicate statistical information. AM.S.3

    22. 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.AMM.22

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    23. Communicate statistical results in both oral and written formats using appropriate statistical and nontechnical language. M.AMM.23

Modeling

1. Manage numerical data. AM.M.1

    24. Solve problems involving large quantities that are not easily measured. M.AMM.24

    25. Use arrays to efficiently manage large collections of data and add, subtract, and multiply matrices to solve applied problems. M.AMM.25

2. Model data and change with functions. AM.M.2

    26. Determine or analyze an appropriate model for problem situations - including linear, quadratic, power, exponential, logarithmic and logistic functions (e.g., stopping distance, period of a pendulum, population growth, Richter Scale, and/or Fujita Tornado Scale). M.AMM.26

    27. Determine or analyze an appropriate cyclical model for problem situations that can be modeled with trigonometric functions (e.g., predator-prey models, tide heights, diurnal cycle, and/or music). M.AMM.27

    28. Determine or analyze an appropriate piecewise model for problem situations (e.g., postal rates, phase change graphs, sales tax, and/or utility usage rates). M.AMM.28

    29. Solve problems using recursion or iteration (e.g., fractals, compound interest, population growth or decline, and/or radioactive decay). M.AMM.29

    30. Collect numerical bivariate data; use the data to create a scatter plot; determine whether or not a relationship exists; if so, select a function to model the data, justify the selection and use the model to make predictions. M.AMM.30

Networks

1. Network for decision making. AM.N.1

    31. Solve problems involving scheduling or routing situations that can be represented by a vertex-edge graph; find critical paths, Euler paths, Hamiltonian paths, and minimal spanning trees (e.g., Konigsberg bridge problem, mail vs. Fed Ex delivery routes, Kolam drawings of India, traveling salesman problem, and/or map coloring). M.AMM.31

    32. Construct, analyze, and interpret flow charts in order to develop and describe problem solving procedures. M.AMM.32

Social Decision Making

1. Make decisions using ranking and voting. AM.SD.1

    33. Apply and analyze various ranking algorithms to determine an appropriate method for a given situation (e.g., fair division, apportionment, and/or search engine results). M.AMM.33

    34. Analyze various voting and selection processes to determine an appropriate method for a given situation (e.g., preferential vs. non-preferential methods, and/or weighted voting). M.AMM.34

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Geometry

1. Concrete geometric representation (physical modeling). AM.G.1
    35. 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.AMM.35
    36. Solve geometric problems involving inaccessible distances. M.AMM.36
2. Abstract geometric representation (matrix modeling). AM.G.2
    37. Use vectors to represent and solve applied problems. M.AMM.37
    38. Use matrices to represent geometric transformations and solve applied problems. M.AMM.38