Alabama Mathematics

Grades 9-12: Mathematical Modeling

Adopted 2019

Mathematical Modeling

Modeling

A. Mathematical modeling and statistical problem-solving are extensive, cyclical processes that can be used to answer significant real-world problems. MM.M.A

1. Use the full Mathematical Modeling Cycle or Statistical Problem-Solving Cycle to answer a real-world problem of particular student interest, incorporating standards from across the course. MM.M.A.1

Financial Planning and Management

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A. Mathematical models involving growth and decay are useful in solving real-world problems involving borrowing and investing; spreadsheets are a frequently-used and powerful tool to assist with modeling financial situations. MM.FPM.A

2. Use elements of the Mathematical Modeling Cycle to solve real-world problems involving finances. MM.FPM.A.2
3. Organize and display financial information using arithmetic sequences to represent simple interest and straight-line depreciation. MM.FPM.A.3
4. Organize and display financial information using geometric sequences to represent compound interest and proportional depreciation, including periodic (yearly, monthly, weekly) and continuous compounding. MM.FPM.A.4
   a. Explain the relationship between annual percentage yield (APY) and annual percentage rate (APR) as values for r in the formulas A=P(1+r)t and A=Pert. MM.FPM.A.4.A
5. Compare simple and compound interest, and straight-line and proportional depreciation. MM.FPM.A.5
6. Investigate growth and reduction of credit card debt using spreadsheets, including variables such as beginning balance, payment structures, credits, interest rates, new purchases, finance charges, and fees. MM.FPM.A.6
7. Compare and contrast housing finance options including renting, leasing to purchase, purchasing with a mortgage, and purchasing with cash. MM.FPM.A.7
   a. Research and evaluate various mortgage products available to consumers. MM.FPM.A.7.A
   b. Compare monthly mortgage payments for different terms, interest rates, and down payments. MM.FPM.A.7.B
   c. Analyze the financial consequence of buying a home (mortgage payments vs. potentially increasing resale value) versus investing the money saved when renting, assuming that renting is the less expensive option. MM.FPM.A.7.C
8. Investigate the advantages and disadvantages of various means of paying for an automobile, including leasing, purchasing by cash, and purchasing by loan. MM.FPM.A.8

Design in Three Dimensions

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A. Two- and three-dimensional representations, coordinates systems, geometric transformations, and scale models are useful tools in planning, designing, and constructing solutions to real-world problems. MM.D3D.A

9. Use the Mathematical Modeling Cycle to solve real-world problems involving the design of three-dimensional objects. MM.D3D.A.9
10. Construct a two-dimensional visual representation of a three-dimensional object or structure. MM.D3D.A.10
    a. Determine the level of precision and the appropriate tools for taking the measurements in constructing a two-dimensional visual representation of a three-dimensional object or structure. MM.D3D.A.10.A
    b. Create an elevation drawing to represent a given solid structure, using technology where appropriate. MM.D3D.A.10.B
    c. Determine which measurements cannot be taken directly and must be calculated based on other measurements when constructing a two-dimensional visual representation of a three-dimensional object or structure. MM.D3D.A.10.C
    d. Determine an appropriate means to visually represent an object or structure, such as drawings on paper or graphics on computer screens. MM.D3D.A.10.D
11. Plot coordinates on a three-dimensional Cartesian coordinate system and use relationships between coordinates to solve design problems. MM.D3D.A.11
    a. Describe the features of a three-dimensional Cartesian coordinate system and use them to graph points. MM.D3D.A.11.A
    b. Graph a point in space as the vertex of a right prism drawn in the appropriate octant with edges along the x, y, and z axes. MM.D3D.A.11.B
    c. Find the distance between two objects in space given the coordinates of each. MM.D3D.A.11.C
    d. Find the midpoint between two objects in space given the coordinates of each. MM.D3D.A.11.D
12. Use technology and other tools to explore the results of simple transformations using three-dimensional coordinates, including translations in the x, y, and/or z directions; rotations of 90°, 180°, or 270° about the x, y, and z axes; reflections over the xy, yz, and xy planes; and dilations from the origin. MM.D3D.A.12
13. Create a scale model of a complex three-dimensional structure based on observed measurements and indirect measurements, using translations, reflections, rotations, and dilations of its components. MM.D3D.A.13

Creating Functions to Model Change in the Environment and Society

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B. Functions can be used to represent general trends in conditions that change over time and to predict future conditions based on present observations. MM.D3D.B

14. Use elements of the Mathematical Modeling Cycle to make predictions based on measurements that change over time, including motion, growth, decay, and cycling. MM.D3D.B.14

15. Use regression with statistical graphing technology to determine an equation that best fits a set of bivariate data, including nonlinear patterns. MM.D3D.B.15

    a. Create a scatter plot with a sufficient number of data points to predict a pattern. MM.D3D.B.15.A

    b. Describe the overall relationship between two quantitative variables (increase, decrease, linearity, concavity, extrema, inflection) or pattern of change. MM.D3D.B.15.B

    c. Make a prediction based upon patterns. MM.D3D.B.15.C

16. Create a linear representation of non-linear data and interpret solutions, using technology and the process of linearization with logarithms. MM.D3D.B.16

Modeling to Interpret Statistical Studies

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C. Statistical studies allow a conclusion to be drawn about a population that is too large to survey completely or about cause and effect in an experiment. MM.D3D.C

17. Use the Statistical Problem Solving Cycle to answer real-world questions. MM.D3D.C.17

18. Construct a probability distribution based on empirical observations of a variable. MM.D3D.C.18

    a. Estimate the probability of each value for a random variable based on empirical observations or simulations, using technology. MM.D3D.C.18.A

    b. Represent a probability distribution by a relative frequency histogram and/or a cumulative relative frequency graph. MM.D3D.C.18.B

    c. Find the mean, standard deviation, median, and interquartile range of a probability distribution and make long-term predictions about future possibilities. Determine which measures are most appropriate based upon the shape of the distribution. MM.D3D.C.18.C

19. Construct a sampling distribution for a random event or random sample. MM.D3D.C.19

    a. Use the binomial theorem to construct the sampling distribution for the number of successes in a binary event or the number of positive responses to a yes/no question in a random sample. MM.D3D.C.19.A

    b. Use the normal approximation of a proportion from a random event or sample when conditions are met. MM.D3D.C.19.B

    c. Use the central limit theorem to construct a normal sampling distribution for the sample mean when conditions are met. MM.D3D.C.19.C

    d. Find the long-term probability of a given range of outcomes from a random event or random sample. MM.D3D.C.19.D

20. Perform inference procedures based on the results of samples and experiments. MM.D3D.C.20

    a. Use a point estimator and margin of error to construct a confidence interval for a proportion or mean. MM.D3D.C.20.A

    b. Interpret a confidence interval in context and use it to make strategic decisions. MM.D3D.C.20.B

    c. Perform a significance test for null and alternative hypotheses. MM.D3D.C.20.C

    d. Interpret the significance level of a test in the context of error probabilities, and use the results to make strategic decisions. MM.D3D.C.20.D

21. Critique the validity of reported conclusions from statistical studies in terms of bias and random error probabilities. MM.D3D.C.21

22. Conduct a randomized study on a topic of student interest (sample or experiment) and draw conclusions based upon the results. MM.D3D.C.22