

Advanced Topics and Modeling in Mathematics

Functions **FN**

Interpreting Functions: Students extend previous knowledge of functions beyond linear and quadratic.

- 1 Interpret key features of graphs and tables in terms of two quantities, which extend to function families beyond linear and quadratic, that model a relationship between the quantities in a contextual application and/or student-generated data. **AT.FN.1**
- 2 Interpret the parameters of functions beyond the level of linear and quadratic in terms of a given context. **AT.FN.2**

Graphing Functions: Students analyze functions using graphing.

- 3 Graph functions expressed symbolically and show key features of the graph using technology. **AT.FN.3**
 - 1 Functions include exponential, logarithmic, and trigonometric functions. **AT.FN.3.1**
- 4 Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions, with or without the appropriate technology. Contextual situations may include: **AT.FN.4**
 - 1 Cube root (e.g., minimizing packaging on cubic boxes, geostationary satellites) **AT.FN.4.1**
 - 2 Piecewise (e.g., postage stamp function, teacher salary, GPS for distance) **AT.FN.4.2**
 - 3 Square root (distance via Pythagorean Theorem) **AT.FN.4.3**
- 5 Graph polynomial functions, identifying zeros when suitable factorizations are available and showing end behavior, with or without the appropriate technology. **AT.FN.5**
- 6 Graph rational functions, identifying zeros and asymptotes (vertical, horizontal, and/or oblique) when suitable factorizations are available and showing end behavior, with or without the appropriate technology. **AT.FN.6**
- 7 Graph exponential and logarithmic functions, showing intercepts and end behavior. **AT.FN.7**
- 8 Graph trigonometric functions showing period, midline, and amplitude. **AT.FN.8**

Vectors & Matrices **VM**

Vectors: Students represent and model vector quantities and perform operations on vectors.

- 1 Recognize that vector quantities have both magnitude and direction and can be represented by directed line segments. [AT.VM.1](#)
- 2 Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point. [AT.VM.2](#)
- 3 Solve problems involving velocity and other quantities that can be represented by vectors. [AT.VM.3](#)
- 4 Add and subtract vectors graphically and algebraically. [AT.VM.4](#)
- 5 Given two vectors in magnitude and direction form, determine the magnitude and direction of the sum. [AT.VM.5](#)
- 6 Multiply a vector by a scalar graphically and analytically; reverse their direction when possible. [AT.VM.6](#)
- 7 Compute the magnitude and direction of a vector by multiplying a vector by a scalar. [AT.VM.7](#)

Matrices: Students perform operations on matrices and use matrices in applications.

- 8 Use matrices to represent, list, describe and manipulate data with technology. [AT.VM.8](#)
- 9 Multiply a matrix by a scalar. [AT.VM.9](#)
- 10 Add and subtract matrices. [AT.VM.10](#)
- 11 Multiply matrices, understanding that matrix multiplication for square matrices is not commutative. [AT.VM.11](#)
- 12 Represent a system of linear equations as a single matrix equation in a vector variable. [AT.VM.12](#)
- 13 Find and use the inverse of a matrix to solve systems of linear equations; solve 3×3 or greater systems of equations with technology. [AT.VM.13](#)

Statistics & Probability

Expected Value: Students calculate and use expected values to solve problems.

- 1 Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions. [AT.SP.1](#)
- 2 Calculate the expected value for a random variable and describe the expected value as the mean of the probability distribution in context. [AT.SP.2](#)
- 3 Create a probability distribution using theoretical probabilities; calculate the expected value. [AT.SP.3](#)
- 4 Create a probability distribution using experimental or observational data; calculate the expected value. [AT.SP.4](#)

Decisions Using Probability: Students use probability to evaluate outcomes of decisions.

- 5 Analyze the costs and benefits of possible outcomes of making a decision by assigning probabilities to particular payoff values; calculate expected values. **AT.SP.5**
- 7 Analyze decisions and strategies using probability concepts. **AT.SP.7**