Mathematics Standards for High School — Discrete Mathematics A and Discrete Mathematics B

Discrete Mathematics is a rigorous fourth-year launch course that differs from the courses that precede it in that the mathematics is focused in discrete topics instead of continuous functions. This post-Algebra II course is heavily based in modeling with mathematics and includes topics like elections and weighted voting, graph theory, game theory, and apportionment. Students engage in problem-based learning where problems are ill-defined and may have varying outcomes. In this course, reasoning and modeling are primary drivers of instruction.

Discrete Mathematics includes only a few CCR standards across all six conceptual categories (Number and Quantity, Algebra, Functions, Geometry, Modeling, and Statistics and Probability), which includes those that are designated as Modeling standards, as indicated with the star symbol ★. Number and Quantity, Statistics and Probability, and Modeling are the foci of the course, differing from the algebra and function foci of preceding courses.

Discrete Mathematics Overview – Conceptual Categories, Domains, and Clusters

Number and Quantity

Vector and Matrix Quantities

C. Perform operations on matrices and use matrices in applications

Algebra

Creating Equations

A. Create equations that describe numbers or relationships

Functions

Building Functions

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

Geometry

Modeling with Geometry

A. Apply geometric concepts in modeling situations

Statistics and Probability

Making Inferences and Justifying Conclusions

A. Understand and evaluate random processes underlying statistical experiments

Conditional Probability and the Rules of Probability

B. Use the rules of probability to compute probabilities of compound events in a uniform probability model

Using Probability to Make Decisions

A. Calculate expected values and use them to solve problems
B. Use probability to evaluate outcomes of decisions

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Number and Quantity

Vector and Matrix Quantities	N—VM
C. Perform operations on matrices and use matrices in applications. 6. (+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network. 7. (+) Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled. 8. (+) Add, subtract, and multiply matrices of appropriate dimensions.**Use complex numbers in polynomial identities and equations.** 5. (+) Work with 2 × 2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area.	

Algebra

Creating Equations★	A—CED
A. Create equations that describe numbers or relationships 3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*	

Functions

Building Functions	F—BF
A. Build a function that models a relationship between two quantities 1. Write a function that describes a relationship between two quantities.★ a. Determine an explicit expression, a recursive process, or steps for calculation from a context. 2. Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.★	

Geometry

Modeling with Geometry	G—MG
A. Apply geometric concepts in modeling situations 3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).★	

Statistics and Probability

Making Inferences and Justifying Conclusions	S—IC
A. Understand and evaluate random processes underlying statistical experiments 2. Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?*	
Conditional Probability and the Rules of Probability	**S—CP**
B. Use the rules of probability to compute probabilities of compound events in a uniform probability model 9. (+) Use permutations and combinations to compute probabilities of compound events and solve problems.	
Using Probability to Make Decisions	**S—MD**
A. Calculate expected values and use them 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. 3. (+) Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. *For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.* 4. (+) Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. *For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?* **B. Use probability to evaluate outcomes of decisions** 5. (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values. a. Find the expected payoff for a game of chance. *For example, find the expected winnings from a state lottery ticket or a game at a fast food restaurant.* b. Evaluate and compare strategies on the basis of expected values. *For example, compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.* 6. (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator). 7. (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).	