Discrete Mathematics

The following standards outline the content of a one-year course in Discrete Mathematics. If a one-semester course is desired, the standards with a dagger (†) would apply.

Discrete mathematics may be described as the study of mathematical properties of sets and systems that have a countable (discrete) number of elements. With the advent of modern technology, discrete (discontinuous) models have become as important as continuous models. In this course, the main focus is problem solving in a discrete setting. Techniques that are not considered in the current traditional courses of algebra, geometry, and calculus will be utilized. As students solve problems, they will analyze and determine whether a solution exists (existence problems), investigate how many solutions exist (counting problems), and focus on finding the best solution (optimization problems). Connections will be made to other disciplines. The importance of discrete mathematics has been influenced by computers.

Graphing utilities (calculators, computers, and other technology tools) will be used to assist in teaching and learning. Graphing utilities facilitate visualizing, analyzing, and understanding algebraic and statistical behaviors and provide a powerful tool for solving and verifying solutions.

Graphs

DM.1† The student will model problems, using vertex-edge graphs. The concepts of valence, connectedness, paths, planarity, and directed graphs will be investigated.

DM.2† The student will solve problems through investigation and application of circuits, cycles, Euler paths, Euler circuits, Hamilton paths, and Hamilton circuits. Optimal solutions will be sought using existing algorithms and student-created algorithms.

DM.3† The student will apply graphs to conflict-resolution problems, such as map coloring, scheduling, matching, and optimization.

DM.4 The student will apply algorithms relating to trees, networks, and paths. Appropriate technology will be used to determine the number of possible solutions and generate solutions when a feasible number exists.

Election Theory and Fair Division

DM.5† The student will analyze and describe the issue of fair division in discrete and continuous cases.

DM.6† The student will investigate and describe weighted voting and the results of various election methods. These may include approval and preference voting as well as plurality, majority, runoff, sequential runoff, Borda count, and Condorcet winners.

DM.7 The student will identify apportionment inconsistencies that apply to issues such as salary caps in sports and allocation of representatives to Congress. Historical and current methods will be compared.

Computer Mathematics

DM.8 The student will describe and apply sorting algorithms and coding algorithms used in sorting, processing, and communicating information.

DM.9† The student will select, justify, and apply an appropriate technique to solve a logic problem.

Recursion and Optimization

DM.10 The student will use algorithms to schedule tasks in order to determine a minimum project time. The algorithms will include critical path analysis, the list-processing algorithm, and student-created algorithms.

DM.11 The student will solve linear programming problems.

DM.12 The student will use the recursive process and difference equations with the aid of appropriate technology to generate

a) compound interest;
b) sequences and series;
c) fractals;
d) population growth models; and
e) the Fibonacci sequence.

DM.13 The student will apply the formulas of combinatorics in the areas of

a) the Fundamental (Basic) Counting Principle;
b) knapsack and bin-packing problems;
c) permutations and combinations; and
d) the pigeonhole principle.