Texas Mathematics

Discrete Mathematics

Adopted 2013

Mathematical process standards

1. The student uses mathematical processes to acquire and demonstrate mathematical understanding DMPS.9-12.1

(A) apply mathematics to problems arising in everyday life, society, and the workplace DMPS.9-12.1.A

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution DMPS.9-12.1.B

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems DMPS.9-12.1.C

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate DMPS.9-12.1.D

(E) create and use representations to organize, record, and communicate mathematical ideas DMPS.9-12.1.E

(F) analyze mathematical relationships to connect and communicate mathematical ideas DMPS.9-12.1.F

(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication DMPS.9-12.1.G

Graph theory

2. The student applies the concept of graphs to determine possible solutions to real-world problems DMPS.9-12.2

(A) explain the concept of graphs DMPS.9-12.2.A

(B) use graph models for simple problems in management science DMPS.9-12.2.B

(C) determine the valences of the vertices of a graph DMPS.9-12.2.C

(D) identify Euler circuits in a graph DMPS.9-12.2.D

(E) solve route inspection problems by Eulerizing a graph DMPS.9-12.2.E

	(F) determine solutions modeled by edge traversal in a graph DMPS.9-12.2.F
	(G) compare the results of solving the traveling salesman problem (TSP) using the nearest neighbor algorithm and using a greedy algorithm DMPS.9-12.2.G
	(H) distinguish between real-world problems modeled by Euler circuits and those modeled by Hamiltonian circuits DMPS.9-12.2.H
	(I) distinguish between algorithms that yield optimal solutions and those that give nearly optimal solutions DMPS.9-12.2.I
	(J) find minimum-cost spanning trees using Kruskal's algorithm DMPS.9-12.2.J
	(K) use the critical path method to determine the earliest possible completion time for a collection of tasks DMPS.9-12.2.K
	(L) explain the difference between a graph and a directed graph DMPS.9-12.2.L
Planning and scheduling	**3.** The student uses heuristic algorithms to solve real-world problems DMPS.9-12.3
	(A) use the list processing algorithm to schedule tasks on identical processors DMPS.9-12.3.A
	(B) recognize situations appropriate for modeling or scheduling problems DMPS.9-12.3.B
	(C) determine whether a schedule is optimal using the critical path method together with the list processing algorithm DMPS.9-12.3.C
	(D) identify situations appropriate for modeling by bin packing DMPS.9-12.3.D
	(E) use any of six heuristic algorithms to solve bin packing problems DMPS.9-12.3.E
	(F) solve independent task scheduling problems using the list processing algorithm DMPS.9-12.3.F
	(G) explain the relationship between scheduling problems and bin packing problems DMPS.9-12.3.G
Group decision making	**4.** The student uses mathematical processes to apply decision-making schemes. The student analyzes the effects of multiple types of weighted voting and applies multiple voting concepts to real-world situations DMPS.9-12.4
	(A) describe the concept of a preference schedule and how to use it DMPS.9-12.4.A
	(B) explain how particular decision-making schemes work DMPS.9-12.4.B
	(C) determine the outcome for various voting methods, given the voters' preferences DMPS.9-12.4.C

(D) explain how different voting schemes or the order of voting can lead to different results DMPS.9-12.4.D

(E) describe the impact of various strategies on the results of the decision-making process DMPS.9-12.4.E

(F) explain the impact of Arrow's Impossibility Theorem DMPS.9-12.4.F

(G) relate the meaning of approval voting DMPS.9-12.4.G

(H) explain the need for weighted voting and how it works DMPS.9-12.4.H

(I) identify voting concepts such as Borda count, Condorcet winner, dummy voter, and coalition DMPS.9-12.4.I

(J) compute the Banzhaf power index and explain its significance DMPS.9-12.4.J

Fair division

5. The student applies the adjusted winner procedure and Knaster inheritance procedure to real-world situations DMPS.9-12.5

(A) use the adjusted winner procedure to determine a fair allocation of property DMPS.9-12.5.A

(B) use the adjusted winner procedure to resolve a dispute DMPS.9-12.5.B

(C) explain how to reach a fair division using the Knaster inheritance procedure DMPS.9-12.5.C

(D) solve fair division problems with three or more players using the Knaster inheritance procedure DMPS.9-12.5.D

(E) explain the conditions under which the trimming procedure can be applied to indivisible goods DMPS.9-12.5.E

(F) identify situations appropriate for the techniques of fair division DMPS.9-12.5.F

(G) compare the advantages of the divider and the chooser in the divider-chooser method DMPS.9-12.5.G

(H) discuss the rules and strategies of the divider-chooser method DMPS.9-12.5.H

(I) resolve cake-division problems for three players using the last-diminisher method DMPS.9-12.5.I

(J) analyze the relative importance of the three desirable properties of fair division: equitability, envy-freeness, and Pareto optimality DMPS.9-12.5.J

(K) identify fair division procedures that exhibit envy-freeness DMPS.9-12.5.K

Game (or competition) theory

6. **The student uses knowledge of basic game theory concepts to calculate optimal strategies. The student analyzes situations and identifies the use of gaming strategies** DMPS.9-12.6

- **(A) recognize competitive game situations** DMPS.9-12.6.A
- **(B) represent a game with a matrix** DMPS.9-12.6.B
- **(C) identify basic game theory concepts and vocabulary** DMPS.9-12.6.C
- **(D) determine the optimal pure strategies and value of a game with a saddle point by means of the minimax technique** DMPS.9-12.6.D
- **(E) explain the concept of and need for a mixed strategy** DMPS.9-12.6.E
- **(F) compute the optimal mixed strategy and the expected value for a player in a game who has only two pure strategies** DMPS.9-12.6.F
- **(G) model simple two-by-two, bimatrix games of partial conflict** DMPS.9-12.6.G
- **(H) identify the nature and implications of the game called "Prisoners' Dilemma"** DMPS.9-12.6.H
- **(I) explain the game known as "chicken"** DMPS.9-12.6.I
- **(J) identify examples that illustrate the prevalence of Prisoners' Dilemma and chicken in our society** DMPS.9-12.6.J
- **(K) determine when a pair of strategies for two players is in equilibrium** DMPS.9-12.6.K

Theory of moves

7. **The student analyzes the theory of moves (TOM). The student uses the TOM and game theory to analyze conflicts** DMPS.9-12.7

- **(A) compare and contrast TOM and game theory** DMPS.9-12.7.A
- **(B) explain the rules of TOM** DMPS.9-12.7.B
- **(C) describe what is meant by a cyclic game** DMPS.9-12.7.C
- **(D) use a game tree to analyze a two-person game** DMPS.9-12.7.D
- **(E) determine the effect of approaching Prisoners' Dilemma and chicken from the standpoint of TOM and contrast that to the effect of approaching them from the standpoint of game theory** DMPS.9-12.7.E
- **(F) describe the use of TOM in a larger, more complicated game** DMPS.9-12.7.F

(G) **model a conflict from literature or from a real-life situation as a two-by-two strict ordinal game and compare the results predicted by game theory and by TOM** DMPS.9-12.7.G