**Advanced Mathematics Decision Making**

**Unit 07: Networks and Graphs**

**Georgia Performance Standards:**

**MAMDMA2.** Students will use a variety of network models to organize data in quantitative situations, make informed decisions, and solve problems.

  a.) Solve problems represented by a vertex-edge graph, and find critical paths, Euler paths, and minimal spanning trees.
  b.) Construct, analyze, and interpret flow charts to develop an algorithm to describe processes such as quality control procedures.
  c.) Investigate the scheduling of projects using PERT.
  d.) Consider problems that can be resolved by coloring graphs.

**Key Terms:**

- **Student Activity Sheets 1 – 5**
  - circuit, edge, Euler circuit, graph, Hamiltonian circuit, path, vertex

- **Student Activity Sheets 6 – 8**
  - connectivity, efficient network, graphs with vertices and edges, minimal spanning, tree, minimally connected, spanning tree, tree, weight, weighted graph

- **Student Activity Sheets 9 – 10**
  - adjacency, chromatic number, edge, graph, planar, sameness, vertex

- **Student Activity Sheets 11 – 12**
  - activity graph, complex process, flow chart, project time

**Essential Questions:**

- How do we go about planning a path of travel?
- Using the placement rules for dominoes, can a set be placed in a line? Can they loop back to the start?
- How do we determine the best route for snow plow operates handling multiple cities?
- What is the best route for us to take if we want to travel the world?
- What possible paths can a Knight take during a game of chess?
- How can we plan an inner office network path?
- How can we design a railroad system between various cities?
- What are the advantages of having an algorithm to find minimal spanning trees?
- Why are different colors used in a map?
- How do we begin to color a map so as to use the minimal number of colors?
- How long does it take to prepare for a project?
- As a project manager, how do you decide how long a project will take and who should work on what?
### Activities:
- Activity V.A (Sheet 01): Euler Circuits and Paths
- Activity V.A (Sheet 02): Dominoes (Optional)
- Activity V.A (Sheet 03): Weighted Graphs
- Activity V.A (Sheet 04): Hamilton Circuits and Paths
- Activity V.A (Sheet 05): Knight’s Tour (Optional)
- Activity V.B (Sheet 06): High-Speed Internet
- Activity V.B (Sheet 07): Minimal Spanning Trees
- Activity V.B (Sheet 08): Kruskal’s Algorithm
- Activity V.C (Sheet 09): Map Coloring
- Activity V.C (Sheet 10): Coloring Maps and Scheduling
- Activity V.D (Sheet 11): Activity Graphs
- Activity V.D (Sheet 12): Building a Robot

### Assessment:
- Formative Assessment 07a (Sections A – B)
- Formative Assessment 07b (Sections C – D)

### Objectives:
1. Students use graphs and the definitions of circuits and paths to study a situation like the Königsberg Bridge problem to determine if certain conditions can be satisfied. They use theorems and algorithms to solve such problems. Students create graph structures to use in determining the best methods for scheduling tasks and making assignments. These structures are a bit more complicated and generally more applicable.

2. Students represent situations with tree diagrams and then look at ways of determining the spanning trees that solve questions arising from the situation. Some algorithms for finding spanning trees are presented and used without proof.

3. Students consider problems that can be resolved by coloring graphs. They create graphs from a description of a situation and then determine if the graphs can be colored in specific ways using theorems and algorithms.

4. Students study the scheduling of projects using the Program Evaluation and Review Technique. They work with information about a project, including tasks and their time constraints along with interrelationships between and among tasks. Optionally, freely available PERT software is employed to determine the scheduling pattern for the project.

### Resources:
Advanced Mathematical Decision Making (A.K.A. Advanced Quantitative Reasoning); 2010 Edition; A project of the Charles A. Dana Center at The University of Texas at Austin and the Texas Association of Supervisors of Mathematics