

Georgia Department of Education  
***Common Core Georgia Performance Standards  
Mathematics of Industry and Government***

***Mathematics Common Core Georgia Performance Standards***

**K-12 Mathematics Introduction**

The Georgia Mathematics Curriculum focuses on actively engaging the students in the development of mathematical understanding by using manipulatives and a variety of representations, working independently and cooperatively to solve problems, estimating and computing efficiently, and conducting investigations and recording findings. There is a shift towards applying mathematical concepts and skills in the context of authentic problems and for the student to understand concepts rather than merely follow a sequence of procedures. In mathematics classrooms, students will learn to think critically in a mathematical way with an understanding that there are many different ways to a solution and sometimes more than one right answer in applied mathematics. Mathematics is the economy of information. The central idea of all mathematics is to discover how knowing some things well, via reasoning, permit students to know much else—without having to commit the information to memory as a separate fact. It is the connections, the reasoned, logical connections that make mathematics manageable. As a result, implementation of Mathematics Common Core Georgia Performance Standards places a greater emphasis on problem solving, reasoning, representation, connections, and communication.

***Common Core Georgia Performance Standards  
Mathematics of Industry and Government***

This is a course designed to follow the completion of Mathematics III or Accelerated Mathematics II. Modeled after operations research courses, Mathematics of Industry and Government allows students to explore decision making in a variety of industries such as: Airline - scheduling planes and crews, pricing tickets, taking reservations, and planning the size of the fleet; Pharmaceutical - R& D management; Logistics companies - routing and planning; Lumber and wood products - managing forests and cutting timber; Local government - deployment of emergency services, and Policy studies and regulation - environmental pollution, air traffic safety, AIDS, and criminal justice policy. Students learn to focus on the development of mathematical models that can be used to model, improve, predict, and optimize real-world systems. These mathematical models include both deterministic models such as mathematical programming, routing or network flows and probabilistic models such as queuing, and simulation. (*Prerequisite: Successful completion of Mathematics III or Accelerated Mathematics II*)

Instruction and assessment should include the appropriate use of manipulatives and technology. Topics should be represented in multiple ways, such as concrete/pictorial, verbal/written, numeric/data-based, graphical, and symbolic. Concepts should be introduced and used, where appropriate, in the context of realistic phenomena.

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**DETERMINISTIC DECISION MAKING**

Students will explore decision making through linear programming, optimal locations, and optimal paths.

**MMIGDD1. Students will use advanced linear programming to make decisions.**

- a. Distinguish among continuous, integer, and binary contexts.
- b. Model a contextual problem with three or more variables.
- c. Solve problems with three or more variables using technology.
- d. Interpret the results.
- e. Examine cause and effect of contextual changes.

**MMIGDD2. Students will determine optimal locations and use them to make appropriate decisions.**

- a. Find the optimal median location in a one-dimensional context.
- b. Find the optimal median location in a rectilinear context.
- c. Find the optimal location given three equally weighted, non-collinear points.
- d. Find the optimal location in a set covering context.

**MMIGDD3. Students will determine optimal paths and use them to make appropriate decisions.**

- a. Relate context to a network representation.
- b. Apply appropriate recursive algorithms for minimum spanning tree, shortest path, and critical path management.
- c. Examine alternate decisions in response to contextual changes.

**PROBABILISTIC DECISION MAKING**

Students will use normal and other (e.g. binomial, geometric, and Poisson) distributions as well as simulations to make appropriate decisions.

**MMIGPD1. Students will use properties of normal distributions to make decisions about optimization and efficiency.**

- a. Calculate theoretical and empirical probabilities using standardized and non-standardized data.
- b. Analyze and interpret the probabilities in terms of context.
- c. Consider contextual factors and investigate issues within the decision-making process.
- d. Apply techniques to quality control settings.

**MMIGPD2. Students will use properties of other distributions (e.g. binomial, geometric, Poisson) to make decisions about optimization and efficiency.**

- a. Calculate theoretical and empirical probabilities using standardized and non-standardized data.
- b. Analyze and interpret the probabilities in terms of context.

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- c. Consider contextual factors and investigate issues within the decision-making process.

**MMIGPD3. Students will use other probabilistic models to make decisions.**

- a. Use program evaluation review technique (PERT) to investigate completion times of a project.
- b. Develop and apply transition matrices to make predictions using Markov Chains.
- c. Apply queuing theory.
- d. Consider contextual factors and investigate issues within the decision making process.

**MMIGPD4. Students will use computer simulations to make decisions.**

- a. Use technology to simulate a real-world situation.
- b. Analyze, evaluate, and interpret results.
- c. Examine alternate decisions in response to contextual changes.

**Terms/Symbols:**

Linear programming, continuous, integer, binary, optimization, optimal, median location, set covering, network, recursive, minimum spanning trees, shortest path, critical path, normal distribution, binomial distribution, geometric distribution, Poisson distribution, probabilistic models, PERT, Markov Chains, queuing, simulation.

**PROCESS STANDARDS**

The following process standards are essential to mastering each of the mathematics content standards. They emphasize critical dimensions of the mathematical proficiency that all students need.

**MMIGP1. Students will solve problems (using appropriate technology).**

- a. Build new mathematical knowledge through problem solving.
- b. Solve problems that arise in mathematics and in other contexts.
- c. Apply and adapt a variety of appropriate strategies to solve problems.
- d. Monitor and reflect on the process of mathematical problem solving.

**MMIGP2. Students will reason and evaluate mathematical arguments.**

- a. Recognize reasoning and proof as fundamental aspects of mathematics.
- b. Make and investigate mathematical conjecture.
- c. Develop and evaluate mathematical arguments and proofs.
- d. Select and use various types of reasoning and methods of proof.

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**MMIGP3. Students will communicate mathematically.**

- a. Organize and consolidate their mathematical thinking through communication.
- b. Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.
- c. Analyze and evaluate the mathematical thinking and strategies of others.
- d. Use the language of mathematics to express mathematical ideas precisely.

**MMIGP4. Students will make connections among mathematical ideas and to other disciplines.**

- a. Recognize and use connections among mathematical ideas.
- b. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
- c. Recognize and apply mathematics in contexts outside of mathematics.

**MMIGP5. Students will represent mathematics in multiple ways.**

- a. Create and use representations to organize, record, and communicate mathematical ideas.
- b. Select, apply, and translate among mathematical representations to solve problems.
- c. Use representations to model and interpret physical, social, and mathematical phenomena.

**Reading Standard Comment**

After the elementary years, students are seriously engaged in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal learning. Students encounter a variety of informational as well as fictional texts, and they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas *in context*.

Beginning with the middle grades years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

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**MRC. Students will enhance reading in all curriculum areas by:**

- a. Reading in all curriculum areas
  - Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas
  - Read both informational and fictional texts in a variety of genres and modes of discourse
  - Read technical texts related to various subject areas
- b. Discussing books
  - Discuss messages and themes from books in all subject areas.
  - Respond to a variety of texts in multiple modes of discourse.
  - Relate messages and themes from one subject area to messages and themes in another area.
  - Evaluate the merit of texts in every subject discipline.
  - Examine author's purpose in writing.
  - Recognize the features of disciplinary texts.
- c. Building vocabulary knowledge
  - Demonstrate an understanding of contextual vocabulary in various subjects.
  - Use content vocabulary in writing and speaking.
  - Explore understanding of new words found in subject area texts.
- d. Establishing context
  - Explore life experiences related to subject area content.
  - Discuss in both writing and speaking how certain words are subject area related.
  - Determine strategies for finding content and contextual meaning for unknown words.