Reasoning With Functions II

Course Outcomes

Dana Center Mathematics PATHWAYS

About *Reasoning With Functions II*

Reasoning With Functions II is designed for students who have completed *Reasoning With Functions I,* or college algebra, and plan on taking calculus courses or pursuing science, technology, engineering, or mathematics coursework that requires a thorough knowledge of functions and algebraic reasoning.

Course structure and contact hours

Reasoning With Functions II aligns with Math 2412 *Pre-Calculus Math* in the Texas Academic Course Guide Manual. It provides students the opportunity to use multiple representations and explicit covariational reasoning to investigate and explore quantities, their relationships, and how these relationships change. Students use their knowledge of functions to model and solve problems involving algebraic and transcendental functions and equations. Students also develop the algebraic tools necessary to model and solve problems using trigonometric functions and their properties.

Active and collaborative learning form the basis for each lesson, while independent learning and strong study habits are fostered through out-of-class assignments. The curriculum adheres to the DCMP Curriculum Design Standards and presents students with meaningful problems that arise from a variety of science, technology, engineering, or mathematical contexts. After completing this course, students will be prepared to take first-semester Calculus.

Reasoning With Functions II is designed to be taught as a one-semester course with four student contact hours per week or in a quarter system with an equivalent number of contact hours.

Structure of the curriculum

The curriculum is designed in 25-minute learning episodes, which may be pieced together to conform to any class length. These short bursts of active learning, combined with whole-class discussion and summary, can produce increased memory retention.[1]

[1] Sources: Buzan, T. (1989). Master your memory (Birmingham: Typesetters); Buzan, T. (1989). Use your head (London: BBC Books); Sousa, D. (2011). How the brain learns, 4th ed. (Thousand Oaks, CA: Corwin); Gazzaniga, M., Ivry, R. B., & Mangun, G. R. (2002). Cognitive neuroscience: The biology of the mind, 2nd ed. (New York: W. W. Norton); Stephane, M., Ince, N., Kuskowski, M., Leuthold, A., Tewfik, A., Nelson, K., McClannahan, K., Fletcher, C., & Tadipatri, V. (2010). Neural oscillations associated with the primary and recency effects of verbal working memory. Neuroscience Letters, 473, 172–177; Thomas, E. (1972). The variation of memory with time for information appearing during a lecture. Studies in Adult Education, 57–62.

Readiness competencies

Students enrolling in *Reasoning With Functions II* should be able to do the following:

- Create and interpret mathematical models within a variety of contexts.
- Communicate effectively with function notation.
- Use multiple representations of functions to interpret and describe how two quantities change together, justify the presence of a relationship, identify constraints, distinguish between dependent and independent variables, identify domains and ranges, and draw diagrams of dynamic situations.
- Compute, describe, and interpret rates of change embedded in multiple function representations.
- Analyze linear, polynomial, exponential, power, rational, and logarithmic functions as well as their inverses and compositions.
- Demonstrate procedural fluency in applying factoring techniques to simplify expressions and locate roots, interpreting and evaluating expressions involving variables, solving mathematical equations, and reading and applying formulas.
- Take charge of their own learning through good classroom habits, time management, and persistence. Participate in the classroom community through written and oral communication.

Learning goals

The following five learning goals apply to all DCMP mathematics courses, with the complexity of problem-solving skills and use of strategies increasing as students advance through the pathways.

For each course, we define the ways that the learning goals are applied and the expectations for mastery. The bullets below each of the five learning goals specify the ways each learning goal is applied in the *Reasoning With Functions II* course.

Each DCMP course is designed so that students meet the goals across the courses in a given pathway. Within a course, the learning goals are addressed across the course's content-based learning outcomes.

Communication Goal: Students will be able to interpret and communicate quantitative information and mathematical and statistical concepts using language appropriate to the context and intended audience.

In the *Reasoning With Functions II* course, students will...

- Communicate effectively about function processes using function notation.
- Describe the behavior of functions on entire intervals.
- Describe dynamic scenarios orally and in written form using appropriate mathematical language.

- Communicate their conclusions both orally and in written form and support their conclusions by providing appropriate mathematical justifications.

Problem Solving Goal: Students will be able to make sense of problems, develop strategies to find solutions, and persevere in solving them.

In the *Reasoning With Functions II* course, students will...

- Identify a variety of strategies to solve a problem, persist in applying a strategy, and reflect on the outcome of that strategy.
- Solve complex problems in a variety of contexts related to science, technology, engineering, or mathematics.

Reasoning Goal: Students will be able to reason, model, and draw conclusions or make decisions with mathematical, statistical, and quantitative information.

In the *Reasoning With Functions II* course, students will...

- Apply covariational reasoning skills in various contexts and representations and draw appropriate conclusions.
- Apply dynamic reasoning to create appropriate models and use these models to make decisions.
- Create mathematical models in a variety of meaningful mathematical applications and use these models to make decisions.

Evaluation Goal: Students will be able to critique and evaluate quantitative arguments that utilize mathematical, statistical, and quantitative information.

In the *Reasoning With Functions II* course, students will...

- Identify constraints and limitations for mathematical models in a variety of contexts and representations.
- Critically reflect on the reasonableness of their solutions.

Technology Goal: Students will be able to use appropriate technology in a given context.

In the *Reasoning With Functions II* course, students will...

- Use technology effectively and appropriately to analyze multiple representations of functions.

Content learning outcomes

The learning outcomes for *Reasoning With Functions II* are organized around three topics:

- Geometric Reasoning
- Trigonometry
- Functions

Geometric Reasoning

Outcome: Students will apply geometric reasoning to model and solve problems involving length, area, and volume.

Students will be able to:

G.1 Use geometric formulas for length, area, and volume of common shapes.
For example: Apply the Pythagorean Theorem and determine the distance between points in the plane. Compute circumference and area of circles. Compute perimeter and area of triangles and rectangles. Calculate the volume of spheres, rectangular solids, cones, and cylinders.

G.2 Use proportional reasoning to describe and identify geometric quantities.
For example: Determine the arc length of a sector. Find missing lengths or angles in similar triangles.

Trigonometry

Outcome: Students model and solve meaningful problems using trigonometric functions and their properties.

Students will be able to:

T.1 Use the basic trigonometric functions to model and solve meaningful problems.
For example: Convert between degrees and radians. Interpret sine and cosine as coordinates on a (unit) circle. Understand definitions of tangent, cotangent, secant, and cosecant. Apply right triangle trigonometry and recognize when a trigonometric function appropriately represents the relationship between two quantitative variables.

T.2 Prove and use trigonometric identities.
For example: Use the Pythagorean identity (and its variations), double and half angle identities, and angle addition and subtraction formulas to convert and simplify trigonometric expressions.

T.3 Identify important properties of trigonometric functions.
For example: Identify amplitude, period, frequency, phase shift (domain shift), and vertical and horizontal shifts and stretches.

T.4 Solve for missing lengths or angles of oblique triangles.
For example: Apply the Law of Sines and Cosines.

T.5 Use and describe inverse trigonometric functions.
For example: Use a calculator and principal angle to evaluate inverse trigonometric functions and solve equations using properties of inverse trigonometric functions.

Functions

Outcome: Students use and apply knowledge of functions to model and solve meaningful problems.

Students will be able to:

F.1 Model and solve meaningful problems involving algebraic and transcendental functions and equations.
For example: Create models using algebraic and graphical problem solving techniques and properties of functions.