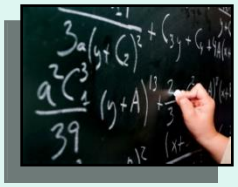
Connecticut Core Curricula for High Schools

Algebra 1, Geometry, Algebra 2







Today’s Presenters

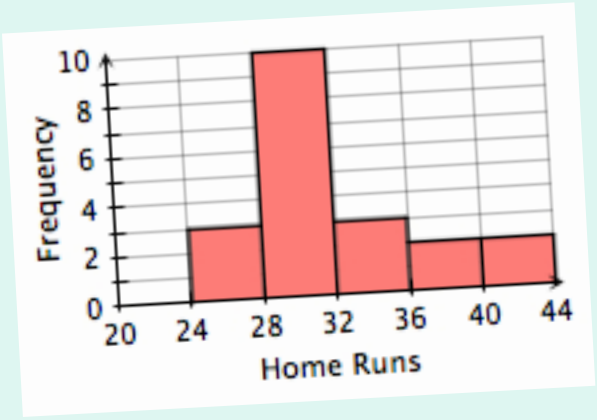
Why did the state of Connecticut undertake to write a "model" curriculum for Algebra I?

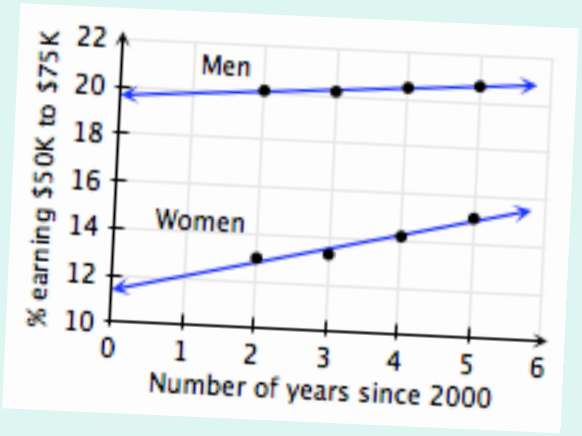
- P.A.10-111
  - Secondary School Reform (passed in 2010, amended in 2011)
- CCSSM
  - Common Core State Standards for Mathematics (adopted in 2010)

High School Requirements
starting with class of 2021*

- 25 credits for graduation
- 8 in STEM areas with at least 4 in mathematics (including **Algebra I, Geometry**, **Algebra II** and/or Probability/Statistics)
- Model curricula to be developed for 8 courses including **Algebra I**
- Common final examinations for **Algebra I, Geometry**, Biology, English 2, American History

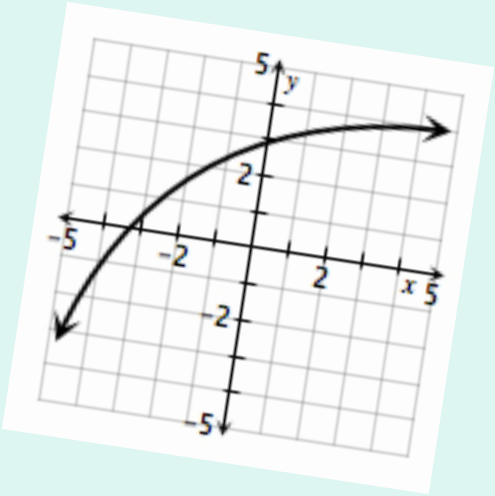
*pushed back several times

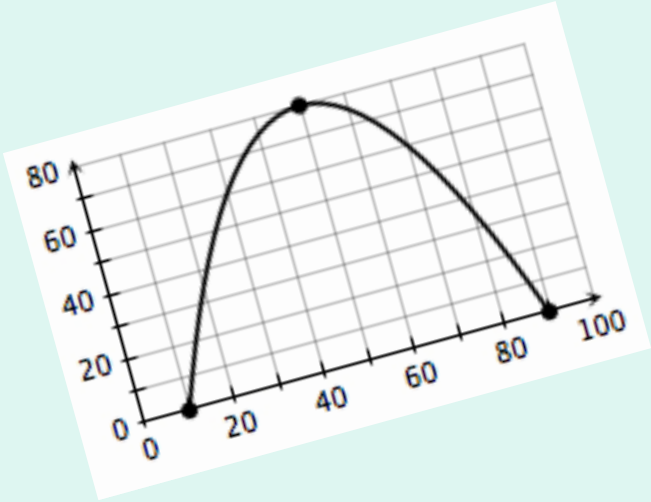




First "model curriculum" to be developed was Algebra I

(Geometry and Algebra II are now complete!)





Connecticut Algebra One Partners 2009

- Associated Teachers of Mathematics in Connecticut (ATOMIC)
- Connecticut Academy for Education in Mathematics, Science & Technology, Inc.
- Connecticut Council of Leaders of Mathematics (CCLM)
- Mathematics Basic Skills Council of Connecticut (MBSCC)
- Mathematical Association of Two-Year Colleges of CT (MatyCONN)
- Project to Increase Mastery of Mathematics and Science (PIMMS)

Algebra I Curriculum Components

- Guiding Principles-framed the work
- Big Ideas About Algebra-critical concepts
- Course-level Expectations/now aligned with CCSS
- Structure based on Units/Investigations/Activities
- Formative and Summative Assessments
- End-of-Course Test

Common Core State Standards

- Emphasis on Focus, Coherence, Conceptual Understanding
- HS standards for “College and Career Readiness”
- Most HS standards identified as “core” with additional standards for “STEM”
- Eighth grade curriculum will place major emphasis on algebra and geometry
- Connecticut Core Algebra I Curriculum is well aligned with these standards.

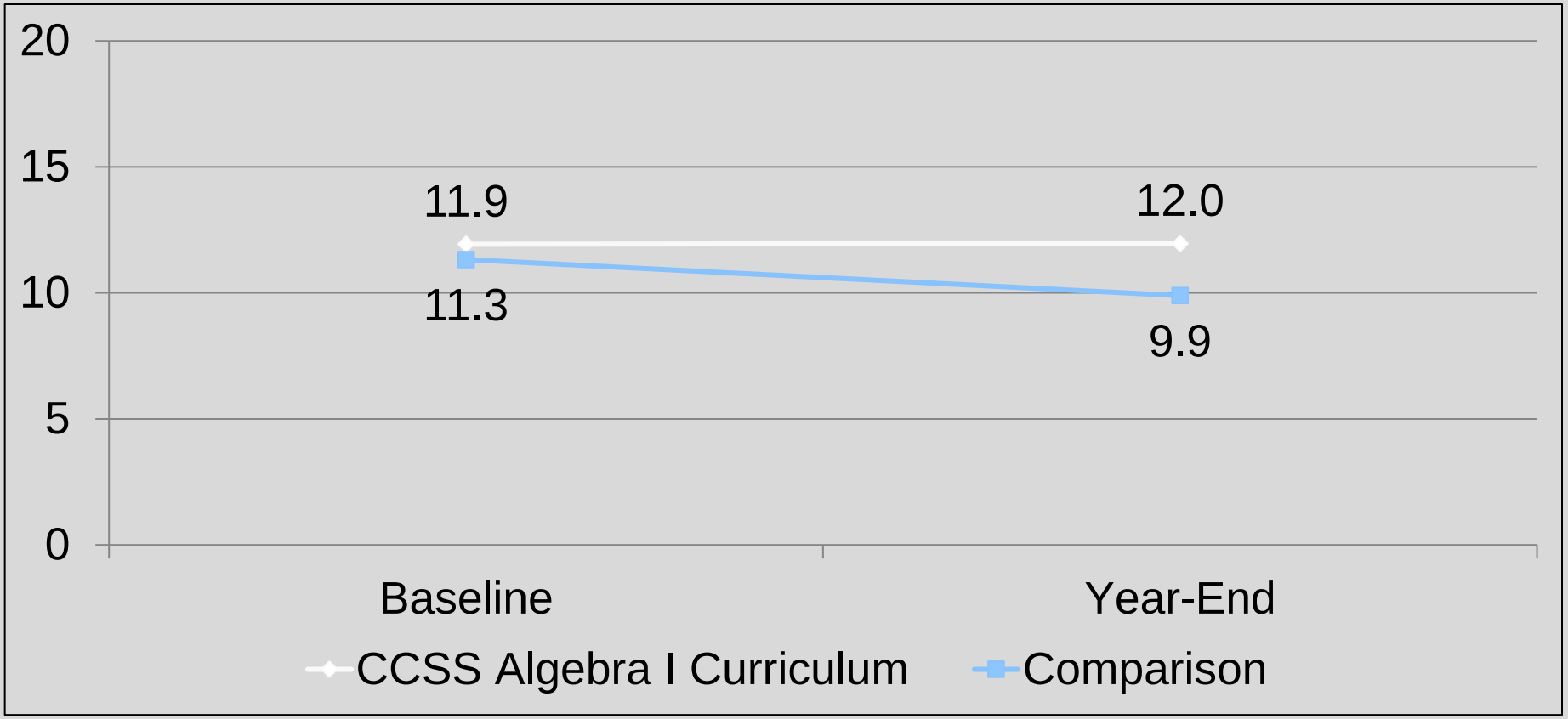
CCSS Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Pilot Study – 2010-13

- Year 1: Field test with 24 Teachers in 7 school districts.
- Year 2: An additional 28 Teachers in 10 districts joined.
- Curriculum was improved on the basis of feedback from Year 1 and Year 2.
- Year 3: Comparative study, conducted by Education Development Center (EDC)

Baseline and Year-End Math Assessment Scores by Group



Conclusions from EDC Study

- Curriculum implementation and PD attendance varied among teachers.
- Teachers faced challenges with accessibility of curriculum for diverse students.
- Intervention teachers had significant positive changes in pedagogical preparedness and maintained their use of CCSS practices throughout the year.
- Students in intervention group were predicted to score 1.3 points (6.5%) higher than those in comparison group.
- There was a positive impact of the curriculum for both middle and high school students, although middle schoolers had higher baseline and year-end scores than high schoolers.
- Students taught by teachers who implemented more of the curriculum were predicted to have higher scores.

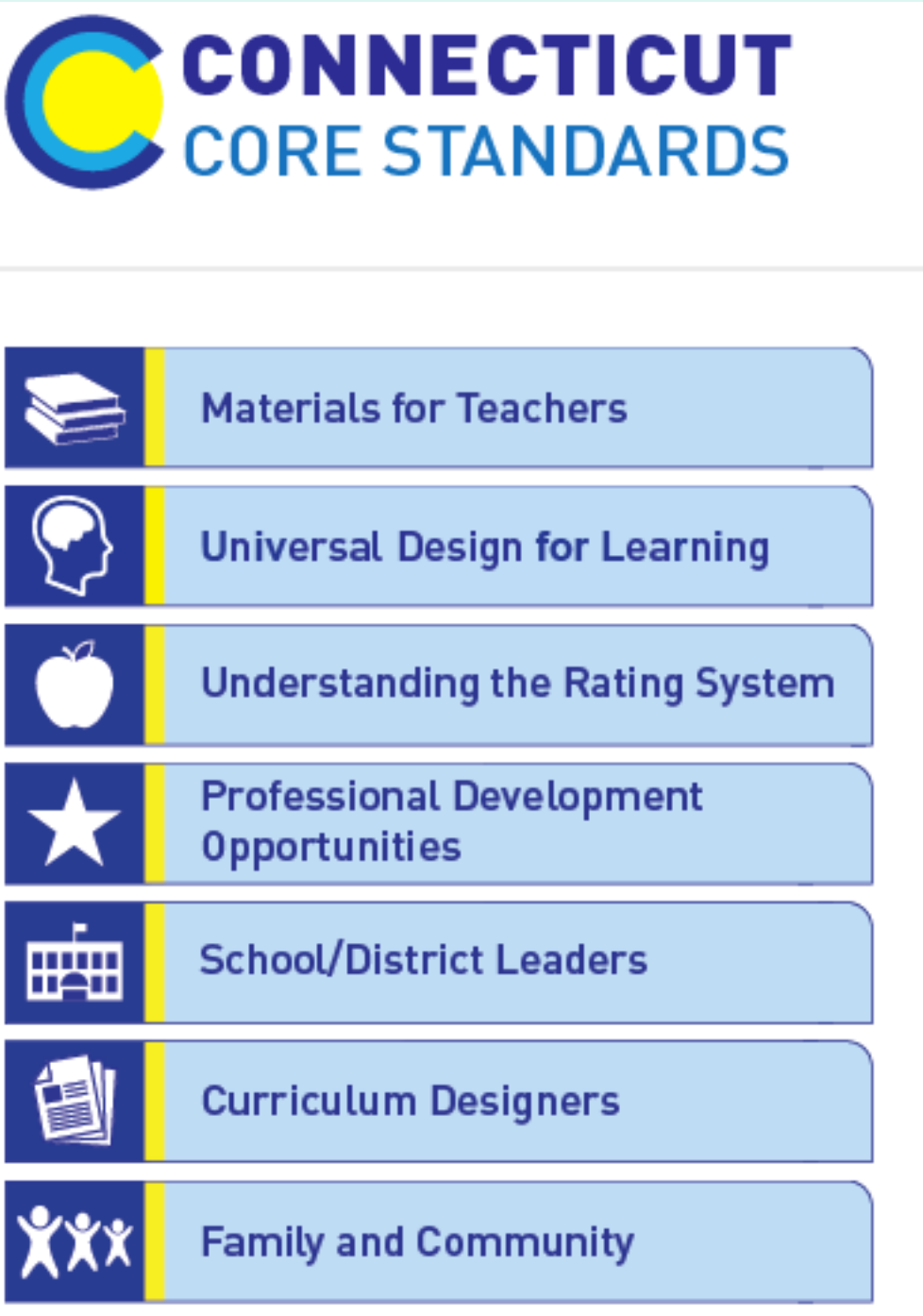
Development of Geometry and Algebra 2

- Partnership between Connecticut State Department of Education and Central Connecticut State University
- Author team included faculty who helped develop and refine Algebra 1 curriculum; each responsible for one or more units
- Writing started in January 2015
- Activity writers included high school teachers
- Version 1.0 was completed by June 30, 2015 and revised several times over the summer.
- Curricula was ready for adoption for 2015-16 school year with version 3.0 incorporating further changes and corrections.

Connecticut Core Curricula are accessible on line.

CTCORESTANDARDS.org

This is a public web site so there are no assessments or answer keys.



Algebra 1 Unit 1 Patterns

- Inv 1 Representing Patterns
- Inv 2 Patterns with Integers
- Inv 3 Arithmetic Sequences
- Inv 4 Geometric Sequences
- Inv 5 Patterns with Fractals

Unit 2 Equations and Inequalities

- Inv 1 Understanding Algebraic Equations
- Inv 2 One-Step and Two-Step Linear Equations
- Inv 3 Combining Like Terms to Solve Equations
- Inv 4 Solving Equations Using the Distributive Property
- Inv 5 Formulas and Literal Equations
- Inv 6 Linear Inequalities

Unit 3 Functions

- Inv 1 Relations and Functions
- Inv 2 What is a Function?
- Inv 3 Function Notation and Evaluating Functions
- Inv 4 Multiple Representations and Applications of Functions

Unit 4 Linear Functions

- Inv 1 What makes a Function Linear?
- Inv 2 Recognizing Linear Functions from Words, Tables and Graphs
- Inv 3 Calculating and Interpreting Slope
- Inv 4 Effects of Changing Parameters of an Equation in Slope-Intercept Form
- Inv 5 Forms of linear Equations: Slope Intercept and Standard
- Inv 6 The Point-Slope Form of Linear Equations

Unit 5 Scatter Plots and Trend Lines

- Inv 1 One Variable Data
- Inv 2 Introduction to Scatter plots and Trend Lines
- Inv 3 Technology and Linear Regression
- Inv 4 Exploration of Data Sets
- Inv 5 Exploring the Influence of Outliers on Trend Lines
- Inv 6 Piecewise Functions

Unit 6 Systems of Equations

- Inv 1 Solving Systems of Linear Equations
- Inv 2 Solving Systems of Linear Equations using Substitution
- Inv 3 Solving Systems of Linear Equations using Elimination

Unit 7 Introduction to Exponential Functions

- Inv 1 A New Function Family-World Population Growth
- Inv 2 Exponential Growth and Exponents
- Inv 3 Exploring Parameters of Exponential Functions
- Inv 4 Modeling Exponential Data
- Inv 5 Exponential Patterns and Percent Change
- Inv 6 Exponential Functions and Climate Change

Unit 8 Quadratic Functions

- Inv 1 Introduction Quadratic Functions: Parabolas Everywhere
- Inv 2 Quadratic Functions in Vertex Form
- Inv 3 Solving Quadratic Equations Using the Square Root Property
- Inv 4 Quadratic Functions in Factored Form
- Inv 5 Factoring Quadratic Trinomials
- Inv 6 Solving Quadratic Equations by Completing the Square and the Quadratic Formula

Connecticut Core Geometry: Key Features

- Follows structure of Algebra 1: Unit/Investigation/Activity
- Transformational approach as specified in Common Core
- Use of a variety of tools: compass/staightedge, coordinates, software (including Geogebra)
- In general, students will first discover properties using drawings, manipulatives, and/or software before writing a formal proof.
- Variable scaffolding on proofs to meet needs of diverse students.

Unit 1: Transformations and Coordinates*

Investigations:

1. The Pythagorean Theorem and the Distance Formula
2. Vectors and Translations
3. Angles and Rotations
4. Reflections
5. Composition of Transformations
6. Isometries (Rigid motions) and Congruence
7. Symmetry

* Titles and order of investigations as of March 2015

Unit 2: Congruence, Constructions and Proof

Investigations:

1. Identifying Congruent Figures
2. Congruent Triangles: SAS and ASA
3. Isosceles Triangles
4. Congruent Triangles: SSS
5. Vertical Angles and Parallel Lines
6. The Construction Game
7. Proving That Constructions Work

Unit 3: Polygons

Investigations:

1. Sums of Interior Angles
2. Inequalities in Triangles
3. Proving Lines Parallel
4. Regular Polygons
5. Properties of Quadrilaterals with Synthetic Proof
6. Properties of Quadrilaterals with Coordinate Proof
7. Introduction to Tessellations

Unit 4: Similarity and Trigonometry

Investigations:

1. Properties of Dilations
2. Similarity
3. Proving that Triangles are Similar
4. Parallel Lines in Triangles
5. Similarity in Right Triangles
6. Special Right Triangles
7. Right Triangle Trigonometry

Unit 5: Circle and Other Conics

Investigations:

1. Circles in the Coordinate Plane
2. Central Angles and Arcs
3. Radii and Chords
4. Tangents to Circles
5. Angle Bisectors
6. Inscribed Angles and Cyclic Quadrilaterals
7. Parabolas
8. (+) Ellipses and Hyperbolas

Unit 6: Three Dimensional Geometry

Investigations:

1. Polygons and Polyhedra
2. Nets and Surface Area
3. Volume
4. Cross Sections and Solids of Revolution
5. Spheres
6. Geometry on the Sphere
7. Size and Shape in the Real World

Unit 7: Applications of Probability

Investigations:

1. Sample Spaces
2. Theoretical and Experimental Probability
3. Independence of Events and the Multiplication Principle
4. Conditional Probability
5. Interpreting Two-Way Frequency Tables
6. Using Probability to Make Decisions
7. Geometric Probability

Unit 8: Additional Topics

Topics for Teachers to present as special lessons or for students to explore as special projects.

1. Border Patterns
2. Further Investigation of Tessellations
3. The Golden Ratio
4. The History of Pi
5. Pythagorean Triples
6. The Fourth Dimension
7. Non-Euclidean Geometry
8. Fractals
9. Topology

... more will be added.

Beyond the Common Core: Each state is expected to tailor 15% of its curriculum to its own needs. These topics constitute our 15%.

Differentiation and Scaffolding

- All three Connecticut Core Standards Curricula are intended for all students.
- Activity Overviews include suggestions for differentiating for “learners needing more help” and for “enrichment”
- Some of the Algebra 2 activities are written in 2 forms– one with additional scaffolding
- Many complete activities and part of some are marked (+) for STEM-intending students
- Overviews in the resources provide information on activities which can be omitted or included as extras and for what reason

Functional Approach – Looking at Relationships between Variables as the Basis for Algebra

- Balance between skill development and conceptual understanding, applications, and connections
- Emphasis on how the output changes in relation to a change in input
- When developing skills avoids unnecessarily complex algebraic manipulations
- Students discover patterns, properties, formulate definitions, theorems and laws based on observation of concrete examples and then they compare theirs to the formal ones

Functional Approach – Looking at Relationships between Variables as the Basis for Algebra

- Emphasis on modeling
- Uses a compare and contrast approach between the function families studied and their various representations
- Utilizes data both from experiments in the classroom and researched
- Emphasis on recognizing patterns and the major characteristics of the function families

Alg 2 Unit 1 Functions and Inverse Functions

- Investigation 1: Systems of Linear Inequalities and Linear Programming
- Investigation 2: Relations and Functions
- Investigation 3: Types of Functions
- Investigation 4: Building New Functions From Old
- Investigation 5 (+): Composition of Functions
- Investigation 6: Inverse Functions
- Investigation 7: Root Functions
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Unit 2 Quadratic Functions

- Investigation 1: Transforming Quadratic Functions
- Investigation 2: Methods for Solving Quadratic Equations
- Investigation 3: Complex Numbers
- Investigation 4: Fundamental Theorem of Algebra
- Investigation 5: Modeling with Quadratic Functions
- Investigation 6: Radical Equations

Unit 3 Polynomial Functions

- Investigation 1: Properties of Polynomial Functions
- Investigation 2: Polynomial Operations
- Investigation 3: Factoring Polynomials
- Investigation 4: Binomial Theorem
- Investigation 5: Polynomial Applications
- Investigation 6: Exponential vs Polynomial Growth

Unit 4 Rational and Power Functions

- Investigation 1: Indirect Variation Functions
- Investigation 2: Modeling with Power Functions
- Investigation 3: Graphs of Rational Functions
- Investigation 4: Operations on Rational Expressions
- Investigation 5: Operations on Rational Equations

Unit 5 Exponential and Logarithm Families

- Investigation 1: Logarithmic Functions – Inverse of Exponentials
- Investigation 2: Natural Logarithm and Base e
- Investigation 3: Logarithmic Scales
- Investigation 4: Parameters of Exponential Functions
- Investigation 5: Curve Fitting with Exponential and Logarithmic Functions
- Investigation 6: Geometric Series
- Investigation 7: Financial Mathematics

Unit 6 Trigonometric Functions

- Investigation 1:The Unit Circle and Radian Measure
- Investigation 2: Unit Circle Definition of Trig Functions
- Investigation 3: Graphs of Trigonometric Functions
- Investigation 4: Transformations of Trig Functions
- Investigation 5: Models of Periodic Behavior

Unit 7 Inferential Statistics

- Investigation 1: Inference on Correlation and Regression
- Investigation 2: Collecting and Examining Data
- Investigation 3: Inference on Population Proportions
- Investigation 4: Inference on Population Means
- Investigation 5: Modeling Data Distributions
- Investigation 6: Inference on Categorical Data

Unit 8 Matrices

- Investigation 1: OPERATIONS WITH MATRICES
- Investigation 2: OPERATIONS WITH VECTORS
- Investigation 3: APPLICATIONS WITH VECTORS AND MATRICES
- Investigation 4: APPLICATIONS WITH 2×2 MATRICES
- Investigation 5: APPLICATIONS WITH $n \times n$ MATRICES
- Investigation 6: APPLICATIONS WITH MARKOV CHAINS AND STOCHASTIC PROCESSES

Implementing This Curriculum

- Experience from Algebra 1: first year is the most difficult and pace will be slower.
- Collaboration with other teachers at your school will be extremely helpful.
- Along the way we will discuss specific suggestions to make this task easier.
- A pacing guide is available to assist with year 1, 2 and 3 of implementation as well as 45 minute periods and block

Give us your feedback!

- Please use the 3 x 5 cards throughout the workshop to write down questions, comments, and concerns, and leave them in the box in the back of this room.
- We will try to address all questions in the course of the workshop