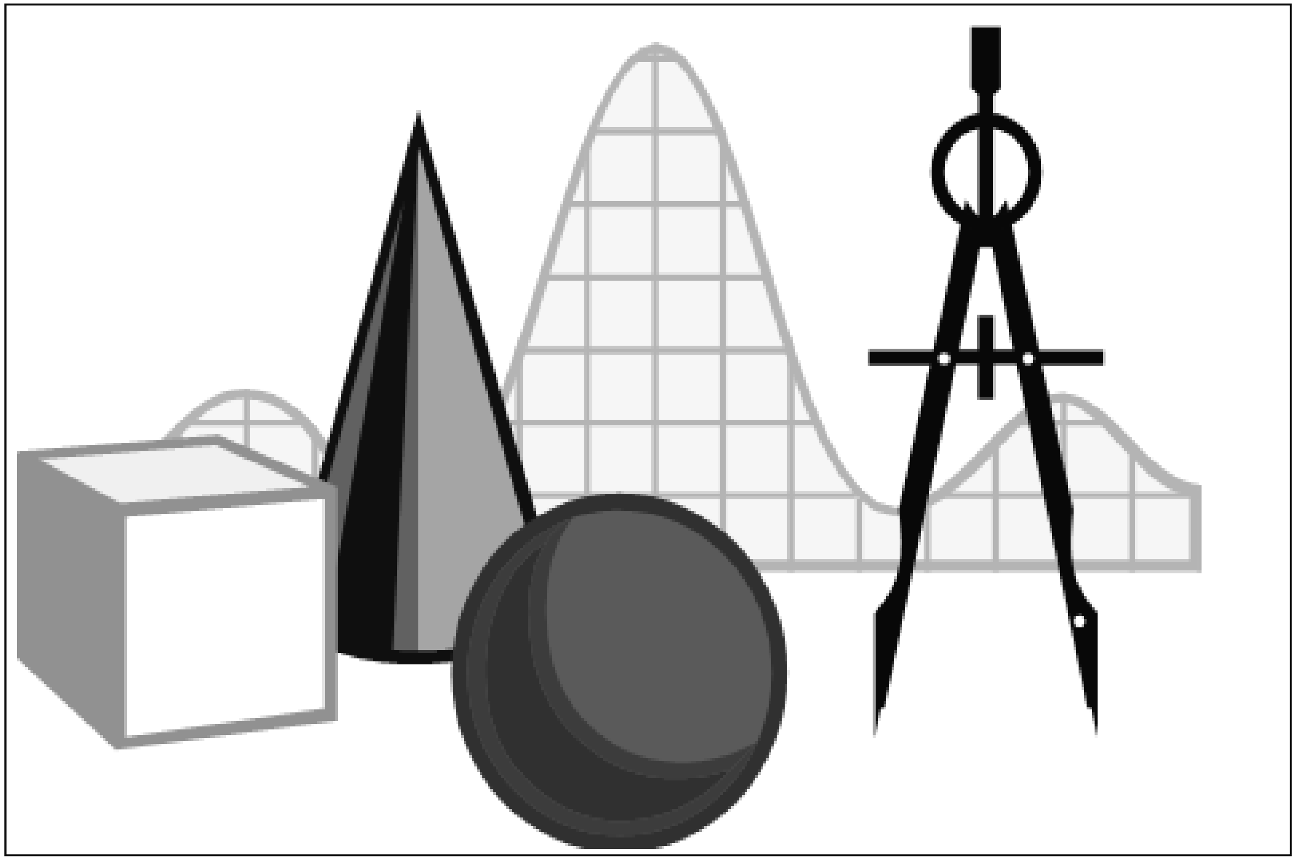

MATHEMATICAL ANALYSIS CURRICULUM GUIDE

Loudoun County Public Schools

2010-2011

Complete scope, sequence, pacing and resources are available on the CD and will be available on the LCPS Intranet.

INTRODUCTION TO LOUDOUN COUNTY'S MATHEMATICS CURRICULUM GUIDE

This CURRICULUM GUIDE is a merger of the Virginia Standards of Learning (SOL) and the Mathematics Achievement Standards for Loudoun County Public Schools. The CURRICULUM GUIDE includes excerpts from documents published by the Virginia Department of Education. Other statements, such as suggestions on the incorporation of technology and essential questions, represent the professional consensus of Loudoun's teachers concerning the implementation of these standards. In many instances the local expectations for achievement exceed state requirements. The GUIDE is the lead document for planning, assessment and curriculum work. It is a summarized reference to the entire program that remains relatively unchanged over several student generations. Other documents, called RESOURCES, are updated more frequently. These are published separately but teachers can combine them with the GUIDE for ease in lesson planning.

Mathematics Internet Safety Procedures

1. Teachers should review all Internet sites and links prior to using it in the classroom. During this review, teachers need to ensure the appropriateness of the content on the site, checking for broken links, and paying attention to any inappropriate pop-ups or solicitation of information.
2. Teachers should circulate throughout the classroom while students are on the internet checking to make sure the students are on the appropriate site and are not minimizing other inappropriate sites.
   Teachers should periodically check and update any web addresses that they have on their LCPS web pages.
3. Teachers should assure that the use of websites correlate with the objectives of lesson and provide students with the appropriate challenge.
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Mathematical Analysis Nine Weeks Overview

1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
MA.14 MA.1 MA.2 MA.3 MA.9 T.6 T.7 38 days	T.8 T.5 MA.13 MA.8 MA.10 MA.11 48 days	MA.12 MA.5 MA.6 MA.4 MA.7 MA.3 LCPSCALC1.1 LCPSCALC1.2 LCPSCALC 1.3 LCPSCALC 2.1 LCPSCALC 2.2 LCPSCALC 2.3 LCPSCALC 2.4 LCPSCALC 2.5 LCPSCALC 2.6 48 days	LCPSCALC 2.1 LCPSCALC 2.2 LCPSCALC 2.3 LCPSCALC 2.4 LCPSCALC 2.5 LCPSCALC 2.6 47 days

Number of Blocks	Topics and Essential Questions	Standard(s) of Learning Essential Knowledge and Skills Essential Understandings	Additional Instructional Resources/Comments
Quarter 1:	Matrices: • Basic matrix operations • Solving Systems of equations	**MA.14** Add, subtract, and multiply matrices and multiply matrices by a scalar. Model problems with a system of no more than three linear equations. Express a system of linear equations as a matrix equation. Solve a matrix equation. Find the inverse of a matrix. Verify the commutative and associative properties for matrix addition and multiplication. Matrices are a convenient shorthand for solving systems of equations. Matrices can model a variety of linear systems. Solutions of a linear system are values that satisfy every equation in the system. Matrices can be used to model and solve real-world problems.	**Solving may include using inverse matrices, Cramer's Rule, and/or row echelon reduction
	Functions: • Graphing—families of functions • Transformations • Domain, range, intercepts, • Odd/even, increasing/decreasing, • Maximum/minimum, continuity) • Compositions, inverse functions • Polynomial functions: end behavior, • Rational Functions: vertical,	**MA.1** Identify a polynomial function, given an equation or graph. Identify rational functions, given an equation or graph. Identify domain, range, zeros, upper and lower bounds, *y*-intercepts, symmetry, asymptotes, intervals for which the function is increasing or decreasing, points of discontinuity, end behavior, and maximum and minimum points, given a graph of a function. Sketch the graph of a polynomial function. Sketch the graph of a rational function. Investigate and verify characteristics of a polynomial or rational function, using a graphing calculator.	**Brief review of topics covered in Alg 2 (use pre-assessment tool to determine strength of previous knowledge) **Emphasize transformations **Emphasize rational functions!!!

	horizontal, oblique asymptotes, discontinuities	The graphs of polynomial and rational functions can be determined by exploring characteristics and components of the functions. **MA.2** Find the composition of functions. Find the inverse of a function algebraically and graphically. Determine the domain and range of the composite functions. Determine the domain and range of the inverse of a function. Verify the accuracy of sketches of functions, using a graphing utility. In composition of functions, a function serves as input for another function. A graph of a function and its inverse are symmetric about the line $y = x$. $\left(f \circ f^{-1}\right)(x) = \left(f^{-1} \circ f\right)(x) = x$ **MA.3** Describe continuity of a function. Investigate the continuity of absolute value, step, rational, and piece-wise-defined functions. Use transformations to sketch absolute value, step, and rational functions. Verify the accuracy of sketches of functions, using a graphing utility. Continuous and discontinuous functions can be identified by their equations or graphs.	
	Exponential and logarithmic functions: Graphing, Properties, Solving Equations, Law of Exponential Growth/Decay, Compound Interest, Logistics (?)	**MA.9** Identify exponential functions from an equation or a graph. Identify logarithmic functions from an equation or a graph. Define e, and know its approximate value. Write logarithmic equations in exponential form and vice versa. Identify common and natural logarithms. Use laws of exponents and logarithms to solve equations and simplify expressions. Model real-world problems, using exponential	**Graphing covered in Alg 2/Trig **Emphasize Solving Equations **Include Applications

		and logarithmic functions. Graph exponential and logarithmic functions, using a graphing utility, and identify asymptotes, intercepts, domain, and range. Exponential and logarithmic functions are inverse functions. Some examples of appropriate models or situations for exponential and logarithmic functions are: – Population growth; – Compound interest; – Depreciation/appreciation; – Richter scale; and – Radioactive decay.	
	Trigonometry: • Graphing trigonometric functions Phase shift • Amplitude • Period • Vertical Shift	**T.6**	**Unit Circle (T.1-T.5) covered in Alg 2/Trig. **Review graphs of six trig functions **Emphasize Phase Shift
	Inverse Trigonometric Functions: • Graphing • Domain/Range • Evaluating	**T.7**	**Pythagorean Triples, Variable Sides, Composition with Trig. Functions **Understanding calculator interpretation
	Assessment, Enrichment, and Remediation		

Number of Blocks	Topic and Essential Questions	Standard(s) of Learning Essential Knowledge and Skills Essential Understandings	Additional Instructional Resources/Comments
Quarter 2:	**Trigonometric Properties/Identities:** Sum/difference Half angle, double angle Establishing identities Solving trigonometric equations	**T.8 , T.5**	**Focus on derivations of formulas **Continue focus on establishing identities throughout **Variety of forms of Trig Equations (quadratic, etc.)
	Triangle Trigonometry Applications: • Law of Sines • Law of Cosines	**MA.13** Solve and create problems, using trigonometric functions. Solve and create problems, using the Pythagorean Theorem. Solve and create problems, using the Law of Sines and the Law of Cosines. Solve real-world problems using vectors. Real-world problems can be modeled using trigonometry and vectors.	**Review right triangle trig in a problem set (seen in Geometry) **Area of Triangles, as time permits
	Conic Sections: • Graphs • Identifying/and classifying conic sections • General and standard Form, Transformations	**MA.8** Given a translation or rotation matrix, find an equation for the transformed function or conic section. Investigate and verify graphs of transformed conic sections, using a graphing utility. Matrices can be used to represent transformations of figures in the plane.	****Starting in Fall 2011, students will have not seen this in Alg 2/Trig** **Conceptual discussion of locus of points (focus, directrix, etc.)
	Polar Coordinates and Graphs: • Graphing in the polar plane • Converting between rectangular and polar coordinates • Common polar equations	**MA.10** Recognize polar equations (rose, cardioid, limaçon, lemniscate, spiral, and circle), given the graph or the equation. Determine the effects of changes in the parameters of polar equations on the graph, using a graphing utility. Convert complex numbers from rectangular form to polar form and vice versa. Find the intersection of the graphs of two polar equations, using a graphing utility. The real number system is represented geometrically on the number line, and the	**Supplement text for graphs of polar equations

		complex number system is represented geometrically on the plane where $a + bi$ corresponds to the point (a, b) in the plane.	
	Vectors: • Basic Operations • Dot Product • Norm of a Vector • Unit Vector • Graphing • Properties • Proofs • Complex Numbers as Vector-perpendicular components	**MA.11** Use vector notation. Perform the operations of addition, subtraction, scalar multiplication, and inner (dot) product on vectors. Graph vectors and resultant vectors. Express complex numbers in vector notation. Define *unit vector*, and find the unit vector in the same direction as a given vector. Identify properties of vector addition, scalar multiplication, and dot product. Find vector components. Find the norm (magnitude) of a vector. Use vectors in simple geometric proofs. Solve real-world problems using vectors. Every vector has an equal vector that has its initial point at the origin. The magnitude and direction of a vector with the origin as the initial point are completely determined by the coordinates of its terminal point.	**Supplement as necessary **Implement Real-World problems
	Assessment, Enrichment, and Remediation	**Refer to common review	

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Number of Block	Topic and Essential Questions	Standard(s) of Learning Essential Knowledge and Skills Essential Understandings	Additional Instructional Resources/Comments
Quarter 3:	**Parametric Equations:** • Graphing • Converting to Rectangular	**MA.12** Graph parametric equations, using a graphing utility. Use parametric equations to model motion over time. Determine solutions to parametric equations, using a graphing utility. Compare and contrast traditional solution methods with parametric methods. Parametric equations are used to express two dependent variables, *x* and *y*, in terms of an independent variable (parameter), *t*. Some curves cannot be represented as a function, *f*(*x*). Parametric graphing enables the representation of these curves in terms of functions.	**Incorporate calculator ** Real-World Applications
	Sequences and Series: • Arithmetic/geometric sequences • Infinite--sums of convergent series	**MA.5** Use and interpret the notation: $\sum$, n, nth, and a_n. Given the formula, find the nth term, a_n, for an arithmetic or geometric sequence. Given the formula, find the sum, S_n, if it exists, of an arithmetic or geometric series. Model and solve problems, using sequence and series information. Distinguish between a convergent and divergent series. Discuss convergent series in relation to the concept of a limit. Examination of infinite sequences and series may lead to a limiting process. Arithmetic sequences have a common difference between any two consecutive terms.	**Review finite series (covered in Alg 2/Trig) **Introduce Idea of a Limit

		Geometric sequences have a common factor between any two consecutive terms.	
	Mathematical Induction	**MA.6** Compare inductive and deductive reasoning. Prove formulas/statements, using mathematical induction. Mathematical induction is a method of proof that depends on a recursive process. Mathematical induction allows reasoning from specific true values of the variable to general values of the variable.	**Consider including examples extending beyond equalities
	Binomial Theorem: • Pascal's Triangle • Combinations	**MA.4** Expand binomials having positive integral exponents. Use the Binomial Theorem, the formula for combinations, and Pascal's Triangle to expand binomials. The Binomial Theorem provides a formula for calculating the product $(a + b)^n$ for any positive integer n. Pascal's Triangle is a triangular array of binomial coefficients.	**One day to test (Sequences, Series, Induction, Binomial Theorem)
	Limits: • Numerically • Analytically • Graphically • Algebraically End Behavior Asymptotes One-sided Limits Definition of Continuity	**MA.7** Verify intuitive reasoning about the limit of a function, using a graphing utility. Find the limit of a function algebraically, and verify with a graphing utility. Find the limit of a function numerically, and verify with a graphing utility. Use limit notation when describing end behavior of a function. The limit of a function is the value approached by $f(x)$ as x approaches a given value or infinity. **MA.3** Continuous and discontinuous functions can be identified by their equations or graphs.	**Calculus Topics

		LCPSCalc.1.1 **Limits of functions (including one-sided limits)** • An intuitive understanding of the limiting process • Calculating limits using algebra • Estimating limits from graphs or tables of data LCPSCalc.1.2 **Asymptotic and unbounded behavior** • Understanding asymptotes in terms of graphical behavior • Describing asymptotic behavior in terms of limits involving infinity • Comparing relative magnitudes of functions and their rates of change (for example, contrasting exponential growth, polynomial growth, and logarithmic growth) LCPSCalc.1.3 **Continuity as a property of functions** • An intuitive understanding of continuity. (The function values can be made as close as desired by taking sufficiently close values of the domain.) • Understanding continuity in terms of limits • Geometric understanding of graphs of continuous functions (Intermediate Value Theorem and Extreme Value Theorem)	
	Differentiation: • Tangent line problem • Limit of the difference quotient • Definition of derivatives • Differentiation rules • Graph analysis	LCPSCalc.2.1 **Concept of the derivative** • Derivative presented graphically, numerically, and analytically • Derivative interpreted as an instantaneous rate of change • Derivative defined as the limit of the difference quotient • Relationship between differentiability and continuity	**Formal Definition (δ-ε) not required **Optional: Exponential, Logarithms, Inverse Trig. Derivative rules

		LCPSCalc.2.2 **Derivative at a point** • Slope of a curve at a point. Examples are emphasized, including points at which there are vertical tangents and points at which there are no tangents. • Tangent line to a curve at a point and local linear approximation • Instantaneous rate of change as the limit of average rate of change • Approximate rate of change from graphs and tables of values LCPSCalc.2.3 **Derivative as a function** • Corresponding characteristics of graphs of f and f' • Relationship between the increasing and decreasing behavior of f and the sign of f' • The Mean Value Theorem and its geometric interpretation • Equations involving derivatives. Verbal descriptions are translated into equations involving derivatives and vice versa. LCPSCalc.2.4 **Second derivatives** • Corresponding characteristics of the graphs of f, f', and f'' • Relationship between the concavity of f and the sign of f'' • Points of inflection as places where concavity changes LCPSCalc.2.5 **Applications of derivatives** • Analysis of curves, including the notions of monotonicity and concavity • Optimization, both absolute (global) and relative (local) extrema • Modeling rates of change, including related rates problems • Use of implicit differentiation to find the derivative of an inverse function	

		• Interpretation of the derivative as a rate of change in varied applied contexts, including velocity, speed, and acceleration • Geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential equations LCPSCalc.2.6 **Computation of derivatives** • Knowledge of derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonometric functions • Derivative rules for sums, products, and quotients of functions • Chain rule and implicit differentiation	
	Assessment, Enrichment, and Remediation		

Number of Blocks	Topic and Essential Questions	Standard(s) of Learning Essential Knowledge and Skills Essential Understandings	Additional Instructional Resources/Comments
Quarter 4:	**Differentiation, continued:** • Position • Velocity • Acceleration • Implicit differentiation • Related rates (Applications)	Continued from Quarter 3	**Real-World Applications for PVA, Related Rates **Optional: Slope Fields **Refer to AP-Style Problems
	Applications of Differentiation: • Extrema • Rolle's Theorem • Mean Value Theorem • Curve Sketching • Optimization Linearization/Differentials		**Continue to include AP-Style Problems
	Assessment, Enrichment, and Remediation	**Introduce integration and incorporate AP-style practice	

****Incorporate calculator as a tool throughout the year.**