

Mathematics Department Student Learning Outcomes Spring 2011

Mathematics Programs

BA Math, BA Math Preparation for Secondary Teaching Student Learning Objectives

- Goal 1 Ability to Use and Construct Logical Arguments
- Goal 2 Ability to Communicate Mathematics Effectively
- Goal 3 Ability to Perform Standard Mathematical Computations
- Goal 4 The ability to use technology to solve mathematical problems

BS Applied Mathematics, Concentration in Applied and Computational Mathematics, Concentration in Economics and Actuarial Science, Concentration in Statistics Student Learning Objectives

- Goal 1 Ability to Communicate Mathematics Effectively
- Goal 2 Ability to Perform Standard Mathematical Computations
- Goal 3 The ability to use technology to solve mathematical problems
- Goal 4 The ability to use mathematical models and non-exact methods to solve practical problems

Graduate Mathematics Programs Student Learning Objectives

- Goal 1: The ability to read, understand, and explicate journal articles in mathematics related to student's area of specialty.
- Goal 2: Ability to communicate mathematics effectively.

BA Math, BA Math Preparation for Secondary Teaching Student Learning Objectives

	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Math 30/30P (Calculus I)	I	I	I	I
Math 30 W		I	I	I
Math 31 (Calculus II)	I	I	I	I
Math 31 W		I	I	I
Math 32 (Calculus III)	I		I	I
Math 32 W		I	I	I
Math 42 (Discrete Math)	I	I	I	I
Math 42 W		I	I	I
Math 100W (Tech Writing)		I		
Math 104 (History of Math)		*R		
Math 108 (Intro to Proof)	I *	R	R	
Math 109 (Math Software)				R
Math 112 (Vector Calculus)		R	R	
Math 113 (Differential Geometry)	R	R	R	
Math 115 (Modern Geometry)	R	R	R	R
Math 126 (Number Theory)	R	R	R	
Math 128 A (Abstract Alg I)	R	R	R	
Math 128 B (Abs Alg II)	A	A	A	
Math 129A (Linear Alg I)	R	R	R	R

Math 129 B (Linear Alg II)	A	A	A	A
Math 131A (Analysis)	R	R	R	
Math 131B (Real Analysis)	A	A	A	
Math 132 (Adv Calc)	R			
Math 133A (Ord Diff Eq's)		R	R	R
Math 133 B (Partial Diff EQ's)		R	R	
Math 134 (Dynamical Systems)				
Math 138 (Complex Variables)	R	R	R*	
Math 142 (Combinatorics)	R	R	R	R
Math 143C/M (Numerical Analysis)		R	R	R/A*
Math 160 (Statistic for Biology)				
Math 161A (Applied Statistics I)		R	R	R
Math 161 B (Applied Statistics II)		A	A	A
Math 162 (Statistics for Bioinformatics)				
Math 163 (Probability)		R	R	R
Math 164 (Mathematical Statistics)	A	A	A	
Math 167 (Programming in SAS)				R
Math 171 (Logic for Math and CS)	R	R	R	R
Math 175 (Algebraic	A	A	A	

Topology)				
Math 177 (Linear Optimization)		R	R	R
Math 178 (Mathematical Modeling)				R
Math 179 (Graph Theory)	R	R	R	R

I - Introduced

R – Reinforced

A- Advanced

Asterisk indicates
class in which SLO
will be assessed.

**BS Applied Mathematics, Concentration in Applied and Computational Mathematics,
 Concentration in Economics and Actuarial Science, Concentration in Statistics Student
 Learning Objectives**

	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Math 30/30P (Calculus I)	I	I	I	I
Math 30 W	I	I	I	I
Math 31 (Calculus II)	I	I	I	I
Math 31 W	I	I	I	I
Math 32 (Calculus III)	I	I	I	I
Math 32 W	I	I	I	I
Math 42 (Discrete Math)	I	I	I	I
Math 42W	I	I	I	I
Math 100W (Tech Writing)	I			
Math 104 (History of Math)	R			
Math 108 (Intro to Proof)	R	R		
Math 109 (Math Software)			R	R
Math 112 (Vector Calculus)		R		
Math 113 (Differential Geometry)	R	R		
Math 115 (Modern Geometry)	R	R	R	R
Math 126 (Number Theory)	R	R		
Math 128 A (Abstract Alg I)	R	R		
Math 128 B (Abs Alg II)	A	A		
Math 129A (Linear Alg I)	R	R	R/A	R

Math 129 B (Linear Alg II)	A	A		A
Math 131A (Analysis)	R	R		
Math 131B (Real Analysis)	A	A		
Math 132 (Adv Calc)	R			
Math 133A (Ordinary Diff Eqs)		R	R	R
Math 133 B (Partial Diff Eqs)		R		
Math 134 (Dynamical Systems)				
Math 138 (Complex Variables)	R	R*		
Math 142 (Combinatorics)	R	R	R	R
Math 143C/M (Numerical Analysis)		R	R/A*	A/R
Math 160 (Statistic for Biology)				
Math 161A (Applied Statistics I)		R	R	R
Math 161 B (Applied Statistics II)	R*	A	A	A
Math 162 (Statistics for Bioinformatics)				
Math 163 (Probability)		R	R	R
Math 164 (Mathematical Statistics)	A	A		
Math 167 (Programming in SAS)			R	R
Math 171 (Logic for Math and CS)	R	R	R	R
Math 175	A	A		

(Algebraic Topology)				
Math 177 (Linear Optimization)		R	R	R
Math 178 (Mathematical Modeling)	A		R	R*
Math 179 (Graph Theory)	R	R	R	R

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Graduate Mathematics Programs Student Learning Objectives

The SLO's are introduced in upper division courses.

	<u>1</u>	<u>2</u>
Math 201 A	R	R
Math 211A	R	R
Math 213 A	R	R
Math 221A	R	R
Math 226	R	R
Math 229	R	R
Math 231A	R	R
Math 233A	R	R
Math 234	R	R
Math 235	R	R
Math 238	R	R
Math 243A	R	R
Math 261A	R	R
Math 265	R	R

Math 266	R	R
Math 267	R	R
Math 271A	R	R
Math 275	R	R
Math 279A	R	R
Math 201 B	A	A
Math 203	A	A
Math 211B	A	A
Math 213B	A	A
Math 221B	A	A
Math 231B	A	A
Math 243B	A	A
Math261B	A	A
Math 269	A	A
Math 271B	A	A
Math 279B	A	A
Math 285	A	A
Math 298	A*	A*
Math 299	A*	A*

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R – Reinforced

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Asterisk indicates class in which SLO will be assessed.

2011 Math Department Assessment Map

Undergraduate Mathematics Degrees

BA Math, BA Math Preparation for Secondary Teaching

BS Applied Math

Concentration in Applied and Computational Math

Concentration in Statistics

Concentration in Economics and Actuarial Science

Math Department Courses Typically taken by Math Majors

Math 30/30P Calculus I, Math 31 Calculus II, Math 32 Calculus III, Math 42 Discrete Math, Math 100W Technical Writing, Math 104 History of Math, 108 Introduction to Proof, Math 109 Mathematical Software, Math 112 Vector Calculus, Math 113 Differential Geometry, Math 115 Modern Geometry, Math 126 Number Theory, Math 128A Abstract Algebra I, Math 128B Abstract Algebra II, Math 129A Linear Algebra I, Math 129B Linear Algebra II, Math 131A Analysis, Math 131B Real Variables, Math 132 Advanced Calculus, Math 133A Ordinary Differential Equations, Math 133B Partial Differential Equations, Math 134 Dynamical Systems, Math 138 Complex Variables, Math 142 Combinatorics, Math 143C/M Numerical Analysis, Math 160 Statistics for Biological Sciences, 161A Applied Statistics I, Math 161B Applied Statistics II, Math 162 Statistics for Bioinformatics, Math 163 Probability, Math 164 Mathematical Statistics, Math 167 Programming in SAS, Math 171 Logic for Math and CS, Math 175 Algebraic Topology, Math 177 Linear Optimization, Math 178 Mathematical Modeling, Math 179 Graph Theory

BA Mathematics, BA Mathematics Preparation for Secondary Teaching Learning Objectives

Goal 1 Ability to Use and Construct Logical Arguments

Goal 2 Ability to Communicate Mathematics Effectively

Goal 3 Ability to Perform Standard Mathematical Computations

Goal 4 The ability to use technology to solve mathematical problems

Goal 1 Ability to Use and Construct Logical Arguments

Math majors are introduced to logic and proof techniques in Math 42 Discrete Math and they should learn to become proficient in constructing logical arguments in Math 108 Introduction to Proof. This “bridge” course was especially designed to help students make the transition from understanding logical arguments to constructing their own logical arguments. This skill is especially needed and used in the gateway courses to theoretical mathematics, especially Math 128A Abstract Algebra I, Math 129B Linear Algebra II, and Math 131A Real Analysis I, and several other more theoretical upper division courses. The assessment data on related student learning objectives is obtained by the instructors of Math 108 using embedded test questions, and is then reviewed by the undergraduate curriculum committee and the department chair.

Courses where students learn SLO #1

Introduced	Reinforced	Advanced
30/30P, 31, 32, 42, 108,	113, 115, 126, 128A, 129A, 131A, 132, 138, 142, 171, 179	128B, 129B, 131B, 164, 175

Goal 2 Ability to Communicate Mathematics Effectively

Math majors are being asked to write explanations of their solutions to problems throughout the curriculum starting with Calculus. Their writing skills are further enhanced by taking Math 100W. Their ability to communicate mathematics effectively is demonstrated fully in a variety of upper division courses when they are asked to write up projects and give oral presentations. Goal 2 is currently assessed in Math 104 History of Math for BA Math majors and in Math 161B for BS Applied Math majors. The assessment data on related student learning objectives is obtained by the instructors of these courses using embedded test questions, and is then reviewed by the undergraduate curriculum

committee and the department chair. A capstone course where all math majors are required to write up a mathematical project and present it orally would be a way of further enhancing the students' communication skills and it is being considered. New precalculus and calculus workshops were introduced in Fall 2008 in an attempt to raise the passing rates in these key gateway courses. In the workshops, students work in small groups on appropriate problems. This should also help students in achieving Goal 2.

Courses where students learn SLO #2

Introduced	Reinforced	Advanced
30/30P, 30W, 31, 31W, 32, 32W, 42, 42W, 100W	104, 108, 113, 115, 126, 128A, 129A, 131A, 132, 138, 142, 161B, 171, 179	128B, 129B, 131B, 164, 175, 178

Goal 3 Ability to Perform Standard Mathematical Computations

Throughout the math curriculum there are certain standard computational skills that students should learn, among these a) the ability to calculate limits and intervals of convergence for sequence/series, b) computing derivatives and integrals, c) as well as the ability to apply properties of algebraic and transcendental functions. Many of these skills are introduced in Calculus and further enhanced in a variety of upper division courses, including Math 138 Complex Analysis. These skills are assessed in Math 138. The assessment data on related student learning objectives is obtained by the instructors of this course using embedded test questions, and is then reviewed by the undergraduate curriculum committee and the department chair. Discussions are ongoing about which skills are important for the students to learn and how they should best be assessed. New precalculus and calculus workshops were introduced in Fall 2008 in an attempt to raise the passing rates in these key gateway courses. This should also help students in achieving Goal 3. In reality even though certain standard computational techniques are singled out in goal 3, it is also desirable for students to learn a variety of computational skills in addition, to learning these standard computational skills in depth.

Courses where students learn SLO #3

Introduced	Reinforced	Advanced
30/30P, 30W, 31, 31W, 32, 32W, 42, 42W	108, 112, 113, 115, 126, 128A, 129A, 131A, 133A, 133B, 138, 142, 143C/M, 161A, 163, 171, 177, 179	128B, 129B, 131B, 161B, 164, 175

Goal 4 The ability to use technology to solve mathematical problems.

Students are often introduced to the uses of a graphing calculator in Calculus. It is also desirable that they should be familiar with programming a computer and the various uses of mathematical software. Students are often introduced to programming in MATLAB in Math 129A. All math majors are required to take at least one programming course, either Math 109, Math 167, CS 46A, CS 49C, CS 49J, or Math 50. A new course Math 109 Mathematical Software was introduced in Fall 2008 to help students learn about mathematical software (either MATLAB or Maple). A programming project is required in Math 109. Another new course Math 167 Programming in SAS was added in Spring 2009. This course will be especially useful for Statistics majors since SAS is the mostly widely used statistical software in business and industry. There are several upper division courses where students must demonstrate their proficiency in using technology in assigned programming projects, including Math 129A, Math 143C, 143M, Math 177, Math 178, and Math 179. Goal 4 is assessed in either of our Numerical Analysis courses Math 143C or Math 143M. The assessment data on related student learning objectives is obtained by the instructors of these courses, and is then reviewed by the undergraduate curriculum committee and the department chair.

Courses where students learn SLO #4

Introduced	Reinforced	Advanced
30/30P, 30W, 31, 31W, 32, 32W, 42, 42W	109, 115, 129A, 133A, 142, 143C/M, 161A, 163, 167, 171, 177, 178, 179	143C/M, 129B, 161B,

BS Applied Mathematics, Concentration in Applied and Computational Mathematics, Concentration in Economics and Actuarial Science, Concentration in Statistics Learning Objectives

Goal 1 Ability to Communicate Mathematics Effectively

Goal 2 Ability to Perform Standard Mathematical Computations

Goal 3 The ability to use technology to solve mathematical problems

Goal 4 The ability to use mathematical models and non-exact methods to solve practical problems

Goals 1,2,3 are the same as goals 2,3,4 in the BA Mathematics programs and their assessment is described above.

Goal 4 The ability to use mathematical models and non-exact methods to solve practical problems.

Mathematical modeling is demonstrated and used throughout the mathematics curriculum, starting in Calculus, and continuing in Linear Algebra, Differential Equations, Statistics, Linear Programming, and a variety of other applied math courses. A mathematical modeling course Math 178 is required of all BS Applied and Computational Mathematics majors and this is where goal 5 is assessed. Math 178 provides students with a broad view of mathematical modeling in many different areas of mathematics. In Math 178 students are required to write up a mathematical modeling project and explain the strengths and weaknesses of their mathematical models, which helps improve their communication skills. The assessment data on related student learning objectives is obtained by the instructors of this course using embedded test questions, and is then reviewed by the undergraduate curriculum committee and the department chair.

Courses where students learn SLO #4

Introduced	Reinforced	Advanced
30/30P, 30W, 31, 31W, 32, 32W, 42, 42W	109, 115, 129A, 133A, 142, 143C/M, 161A, 163, 167, 171, 177, 178, 179	143C/M, 129B, 161B,

Math Department Courses Typically taken by Graduate Math Majors

Math 201AB Mathematics for Secondary Teachers, Math 203 CAMCOS, Math 211A Geometry of Projective Spaces, Math 211B Advanced Topics in Geometry, Math 213A Smooth Manifolds, Math 213B Riemannian Geometry, Math 221A Higher Algebra I, Math 221B Higher Algebra II, Math 226 Advanced Number Theory, Math 229 Advanced Matrix Theory, Math 231A Real Analysis I, Math 231B Real Analysis II, Math 233A Applied Mathematics I, Math 233B applied Mathematics II, Math 234 Advanced Dynamical Systems, Math 235 Wavelets, Math 238 Advanced Complex Variables, Math 243A Advanced Numerical Analysis, Math 243B Advanced Topics in Numerical Analysis, Math 261A Regression Theory, Math 261B Design and Analysis of Experiments, Math 265 Time Series, Math 266 Survival Analysis, Math 267 Statistical Computing, Math 269 Statistical Computing, Math 271A Mathematical Logic, Math 271B Advanced Mathematical Logic, Math 275 Topology, Math 279A Graph Theory, Math 279B Advanced Graph Theory, Math 285 Advanced Topics in Mathematics, Math 298 Special Study, Math 299 Master's Thesis

MA Math

MA Math Emphasis in Statistics

MA Math Concentration in Secondary Education

MS Math

MS Math Emphasis in Applied Math

MS Statistics

Graduate Mathematics Programs Learning Objectives

Goal 1: The ability to read, understand, and explicate journal articles in mathematics related to students area of specialty.

Goal 2: Ability to communicate mathematics effectively.

Goal 1: The ability to read, understand, and explicate journal articles in mathematics related to students area of specialty.

Goal 2: Ability to communicate mathematics effectively.

Math graduate students use the skills in Goal 6 and Goal 7 in writing up and presenting their masters thesis or writing project. There are also a variety of graduate courses where students write project reports and give oral presentations. Each semester we offer Math 203 CAMCOS where students work in teams on a research problem for an industry sponsor. At the end of the semester students in each CAMCOS project are required to help in the writing of a report and an oral presentation describing their research and the accomplishments of their project. Each graduate student is also required to take one two-semester sequence in some area of interest. Goals 1 and 2 are assessed at the thesis (or writing project) defense. Each student in our new MS Statistics program, which is a Professional Science Master's degree, is required to take Math 203 (either a group project or an approved individual internship). Certainly for the students in a Professional Science Masters degree communication skills are paramount. The assessment data for evaluating these goals is obtained by having the thesis defense committee for each masters' thesis/writing project fill out an evaluation form. The assessment data is then reviewed, by the graduate curriculum committee and the department chair.

Courses where students learn SLOs #1,2

Introduced	Reinforced	Advanced
Upper division mathematics courses	201A, 211A, 213A, 221A, 226, 229, 231A, 233A, 234, 235, 238, 243A, 261A, 265, 266, 267, 271A, 275, 279A,	201B, 203, 211B, 213B, 221B, 231B, 243B, 261B, 269, 271B, 279B, 285, 298, 299