Assessment of Student Learning Outcomes

University of North Texas
Department of Mathematics

Academic Program:	Bachelor of Science in Mathematics		
Graduate/Undergraduate:	Undergraduate		
Person completing this form:	Michael Monticino	**Email:**	monticno@unt.edu
Signature:		**Date:**	
Department Chair:	Neal Brand		
Signature:		**Date:**	

This document describes student learning objectives and assessment methods for the Bachelor of Science degree with a major in mathematics from the University of North Texas. Student learning outcomes are presented in section 1. Section 2 describes the method used to assess whether students are meeting the learning outcomes. How the assessment results will be used to improve student learning is described in section 3.

1. Student Learning Outcomes

Upon completion of a Bachelor of Science degree with a major in mathematics UNT, it is expected that the student will have developed the following perspectives and background.

- Cultivated the perspectives and the analytical skills required for efficient use, appreciation, and understanding of mathematics.
- Developed the ability to read, communicate, and understand mathematical ideas in a variety of settings, both verbally and in writing, making use of numerical, graphical, and symbolic viewpoints.
- Obtained a well-rounded introduction in the areas of algebra, analysis, statistical data analysis and principles of modeling uncertainty, and geometry/topology.
- Completed an in-depth experience in one or more of the following areas: algebra, analysis, geometry or topology, and/or probability and statistics.

- Be well-prepared for at least one of the following: graduate school in mathematics, science, engineering, economics, or the social sciences; professional school in business, medicine, or law; an entry-level positions in business, finance, engineering, actuarial science, government, statistics; or secondary education.

- Obtained in-depth experiences in a particular area of mathematics.

- Developed both a general knowledge of the sciences, as well as more in-depth scientific expertise in a social, physical, or biological science.

In developing these perspectives and background knowledge, it is expected that a UNT mathematical sciences major will achieve the following specific learning outcomes.

Mathematical reasoning

MR 1. Read, understand, formulate, explain, and apply mathematical statements.
MR 2. Formulate conjectures by considering examples that move from the specific to the general.
MR 3. Distinguish between valid and fallacious arguments.
MR 4. State and apply important results in key mathematical areas, with the ability to provide proof-based arguments of these and related results.
MR 5. Use a variety of techniques – such as, mathematical induction, proof by contradiction, or direct application of axioms and previously proven theorems – to prove propositions.

Applying mathematics

AM 1. Demonstrate knowledge of problem-formulation, problem solving, and modeling techniques central to applications of mathematics.
AM 2. Be able to manipulate and analyze numerical and graphical data in such a way as to draw reasonable inferences and conclusions.
AM 3. Represent functional relationships using numerical, graphical, and/or analytic/symbolic means.
AM 4. Competently use calculators, spreadsheets, high level programming languages, specialized mathematical and statistical software, and/or other appropriate technology to implement mathematical algorithms, to assist in solving mathematical problems, to assist in modeling complex systems, to assist in statistical data analysis, to help formulate and test conjectures, and/or to help represent and communicate mathematical ideas, principles, and concepts.

General skills

GS 1. Solve mathematical problems individually and cooperatively.
GS 2. Formulate strategies for solving advanced applied mathematics problems

GS 3. Formulate strategies for solving novel theoretical problems.
GS 4. Communicate, both verbally and in writing, mathematical ideas at a variety of levels from technical to intuitive.

2. Measuring Student Learning Outcomes

Learning outcomes (MR 1-5, AM 1-4, and GS 1-3) are achieved through successful completion of required and elective mathematics courses. Courses required of all mathematics majors provide opportunities for students to develop core competencies in mathematical reasoning and general mathematical skills. For example, the objective of Math 2510 and 2520 (Real Analysis 1 and 2) is to provide the training and experiences necessary for students to be able to (MR 1) understand, formulate and apply mathematical statements, (MR 2) formulate mathematical conjectures, (MR 3) distinguish between valid and fallacious arguments, (MR 4) state and apply important results in real analysis, and (MR 5) be able to use a variety of techniques to prove propositions. Elective courses provide students further opportunities to improve their mathematical reasoning skills as well as develop competencies in applying mathematics. For instance, MATH 4610 and 4650 (Probability and Statistics) give students experience in (AM 1) problem-formulation and modeling stochastic systems, (AM 2) analyzing data sets in order to draw reasonable inferences, (AM 3) training in using statistical software to analyze large datasets, and (GS 3) practice in verbal and written communication of statistical results. The learning objectives associated with each required and elective mathematics course are given below.

Assessment of how well students have met learning outcomes will be performed primarily through the review of assessment tools from individual courses. Course assessment tools include graded homework, quizzes, tests, final exams, project reports, and video recordings of in-class presentations. Course assessment tools will be collected for each student from each required and elective mathematics course taken by the student. Assessment tools will also be from at least two of the upper division science courses taken by the BS student. Specifically, by the end of each semester, instructors of required and elective mathematics courses will be required to supply at least two course assessment instruments for each mathematics major completing the course. The undergraduate advisor will also request assessment tools from selected science courses. For lab science courses, at least one lab report will be requested. If a final exam is given in a course, one of the assessment tools provided will be the final exam (applies to the mathematics and the selected science courses).

A file of course assessment tools will be maintained for each undergraduate mathematics student. Individual student files will be reviewed after a student has completed MATH 2510 and 2520 (typically at the end of the sophomore year) and upon graduation. Files will be reviewed by the Undergraduate Affairs Committee (UAC) near the end of each spring semester for students that either graduated during the previous summer and fall semesters, plan on graduating during the current spring semester, completed the MATH 2510/2520 sequence during the previous summer or fall semesters, or will be completing MATH 2520 during the current spring semester. The review will consist of an evaluation of how well students have mastered each learning outcome. The

evaluation will be based on the materials from courses associated with specific learning outcomes (given below). A written report will be produced reflecting the committee's consensus evaluation of a student's accomplishments. The committee will solicit additional input from MATH 2510 and 2520 instructors for the "mid-major" evaluation. For each learning outcome, the evaluation will give a summary evaluation (mastered, developing, not mastered) as well as a narrative citing specific examples supporting the evaluation. During a student's final semester before graduation, a representative of the Undergraduate Affairs Committee (usually the undergraduate advisor) will conduct an exit interview (attached below). The complete student file and exit interview will be used to complete the final student assessment.

Learning outcomes addressed by required and elective mathematics courses.

MATH 1710, 1720, and 2730 (Calculus 1, 2 and 3): MR 1, AM1, AM 2, AM 3, GS 1, GS 4.

MATH 2510 and 2520 (Real Analysis 1 and 2): MR 1-5, AM 3, GS 1, GS 4.

MATH 2700 (Linear Algebra and Vector Geometry): MR 1, MR 3, MR 4, AM 1, AM 4, GS 1.

MATH 2770 (Discrete Mathematical Structures): MR 1-4, AM 1-4, GS 1.

MATH 3350 (Introduction to Numerical Analysis): MR 1, MR 4, AM 1-4, GS 1, GS 4.

MATH 3310, 3410 and 3420 (Differential Equations with Applications, Differential Equations 1 and Differential Equations 2): MR 1, MR 4, AM 1-4, GS 1.

MATH 3510 and 3520 (Abstract Algebra 1 and 2): MR 1-5, AM 3, GS 1, GS 4.

MATH 3400 (Number Theory): MR 1-5, AM 3, AM 4, GS 1, GS 3, GS 4.

MATH 3740 (Vector Calculus): MR 1, MR 4, AM 1-3, GS 1.

MATH 4050 (Advanced Study of the Secondary Mathematics Curriculum): MR 1, MR 4, MR5, AM 3, GS 1, GS3.

MATH 4060 (Foundations of Geometry): MR 1-5, AM 3, GS 1, GS 3, GS 4.

MATH 4100 (Fourier Analysis): MR 1, MR 4, AM 1-4, GS 1, GS 2.

MATH 4200 (Dynamical Systems): MR 1, MR 4, AM 1-4, GS 1, GS 3.

MATH 4430 (Introduction to Graph Theory): MR 1, MR 4, AM 1-3, GS 1, GS 3.

MATH 4450 (Introduction to the Theory of Matrices): MR 1-5, AM 1, AM 3, GS 1, GS 3, GS 4.

MATH 4500 (Introduction to Topology): MR 1-5, AM 3, GS 1, GS 3, GS 4.

MATH 4520 (Introduction to Functions of a Complex Variable): MR 1, MR 4, AM 1-4, GS 1, GS 2.

MATH 4610 (Probability): MR 2, MR 4, AM 1-4, GS 1, GS 2, GS 3.

MATH 4650 (Statistics): MR 2, MR 4, AM 1-4, GS 1, GS 2, GS 4.

3. Use of Assessment Results

The Undergraduate Affairs Committee will prepare a summary report of the learning outcome assessment at the end of each spring semester. The report will provide an overview on how well students – both at mid-major and upon graduation – are meeting departmental learning objectives. Major deficiencies and successes will be highlighted. The report will include recommendations from the UAC on how to address any identified deficiencies as well as how to incorporate successful strategies into other courses. Reports will be distributed to all mathematics faculty by the start of the following fall semester. The assessment evaluation and feedback from faculty will be used by the UAC to implement changes to the undergraduate curriculum. These changes may include changing the courses required for a mathematics major, adding new courses to the curriculum, or modifying the topics taught in particular courses. Where appropriate, the department chair will manage any instructional/personnel issues identified through the evaluation process.

Individual mid-major evaluations of a student's progress in achieving learning outcomes will be shared with the student by the undergraduate advisor. The advisor will discuss with the student their progress and will encourage student feedback on the effectiveness of the teaching strategies that they have experienced. This feedback will be incorporated into the assessment report prepared by the Undergraduate Affairs Committee.

4. Results of the Use of the Assessment Results

This assessment plan is being initiated during spring semester 2004. No changes to the undergraduate program or the learning outcomes will be made before the first assessment report in spring 2004.

(DRAFT) Senior Exit Interview Questionnaire

The following information is requested so the mathematics department can better serve its majors. You are not required to provide your name, but if we have questions concerning your answers, we would like to be able to contact you later. If you have no opinion on a particular question, then do not answer it.

Name

Email Address

1. Which mathematics classes were your favorites and why?

2. Which mathematics classes were your least favorites and why?

3. Are there mathematics classes you would like to have taken that the UNT mathematics department does not currently offer?

4. Which professor(s) did you learn the most from? Why?

5. Which professor(s) did you learn the least from? Why?

6. Which professor(s) inspired you the most? How did they inspire you?

7. Which professor(s) inspired you the least? How were they uninspiring?

8. What could be done to improve a math major's experience here at UNT in terms of:
    a. Advising
    b. Communications

9. Did you work in the math lab while a student here? If so, what could be done to help math lab workers do a better job in assisting students in introductory courses?

10. Were the class schedules convenient for you, or was it difficult to schedule required classes at times you could take them?