

Mathematics Majors Learning Outcomes Assessment

The Mathematics Department will regularly assess whether the undergraduates completing a major in our department are meeting our expectations for learning mathematics. We have selected 10 of our core courses in mathematics – each required for at least one of our majors – that will each be assessed every two years using our students' final exams or final projects.

Mathematics Majors. The Mathematics department offers five (counting emphases) distinct majors – Mathematics, Mathematics with Mathematics of Computation Emphasis, Mathematics with Statistics Emphasis, Applied Mathematics, and Mathematics Teaching. Each of these majors has a distinct collection of courses required for graduation, and for each of our majors, we've selected 4-6 required courses which are considered essential for the major (or 3 courses plus a professional Praxis exam in the case of Mathematics Teaching, see below). These essential courses (plus Praxis), grouped by the majors they are linked with, are directly below.

Mathematics. MATH 2270, Math 2280, MATH 3210, and MATH 3220.

Mathematics with Mathematics of Computation Emphasis. MATH 2270, Math 3210, MATH 3220, and MATH 5620.

Mathematics with Statistics Emphasis. MATH 2270, MATH 3210, MATH 3220, and MATH 5090.

Applied Mathematics. MATH 2270, Math 2280, MATH 3210, MATH 3220, MATH 5600, and MATH 5610.

Mathematics Teaching. MATH 2270, Math 3430, MATH 4090, and Praxis Exam #5161, which is a Utah state professional licensure exam.

Timing of assessments. Each of the courses listed above will be assessed every two years, on a rotating schedule so that each Fall or Spring semester will see at least two of these courses assessed. Passing the Praxis Exam #5161 is required for graduation of all Mathematics Teaching majors, and will take place on each student's own timeline.

Method of course assessments. Our course instructors will report on the results of their classes, responding to a set of standard questions (see page 3 for a sample). If several sections of a single assessed course

are taught in a semester, then each section will take part in the assessment. For each course being assessed, our department will only record the performance of those students who are completing one of the five majors that is linked with the particular course, as indicated above.

Each January and May, the Mathematics Department Undergraduate Curriculum Committee will review the reports collected at the conclusion of the previous semester, and perhaps follow up with the instructors who created those reports. If it's determined that a piece of core material is not being learned as well as we believe our majors require, then appropriate changes will be made to our department's curriculum.

Sample Instructor Report

Math 2270-004, Fall 2019, Instructor: Smith

Linked Majors: Mathematics, Mathematics with Mathematics Computation Emphasis, Mathematics with Statistics Emphasis, Applied Mathematics, and Mathematics Teaching.

Essential course material:

1. Systems of linear equations.
2. Matrices and determinants.
3. Vector spaces, linear independence, span and bases.
4. Linear transformations.
5. Eigenvalues, eigenvectors and diagonalization.

Questions to be answered by Instructor:

1. Did this course cover each of the topics above in sufficient detail? If not, please elaborate.
2. Which topics from the essential material were tested on the students' final exams or final projects? Please provide some exam questions.
3. Which percentage of students from the linked majors for this course demonstrated reasonable knowledge of the material from this course on the final exam? How many students from linked majors were enrolled in the course?
4. Which topics from this course, if any, should we seek to improve our instruction of?

Essential Material for each assessed course

The previous page contained a sample instructor report for Math 2270. For other assessed courses, the report will be changed by replacing the essential material listed with the appropriate essential material for each course which is given below.

MATH 2270

1. Systems of linear equations.
2. Matrices and determinants.
3. Vector spaces, linear independence, span and bases.
4. Linear transformations.
5. Eigenvalues, eigenvectors and diagonalization.

MATH 2280

1. First order equations, and existence and uniqueness of solutions.
2. Linear single equations of n-th order.
3. Systems of linear equations, with applications to mechanical vibrations.
4. Qualitative analysis of the behavior of solutions to 2-by-2 systems near critical points.
5. Fourier series with an introduction to the heat, wave, and Laplace equations.

MATH 3210

1. Completeness of the system of real numbers.
2. Real sequences and series.
3. Continuous functions, uniform continuity, and uniform convergence.
4. Differentiable functions.
5. Riemann integrals.

MATH 3220

1. Sequences and series in Euclidean space.
2. Continuous functions, uniform continuity, and uniform convergence in Euclidean space.
3. Taylor formula and optimization.
4. Differentiability of functions of several variables.
5. Inverse function theorem and implicit function theorem.

6. Riemann integration in Euclidean space.

MATH 3430

1. Visual representations and manipulatives to understand polynomial operations, basic equation solving, substituting values in functions, and operations with fractions or rational functions.
2. Representing functions using words, tables, expressions, and graphs (including PAR [parallel axis representation] graphs – function diagrams), and using these representations in explaining secondary school math concepts.
3. Constant sums and constant products to explain basic features (existence and location of roots, vertex) of quadratic functions.
4. Explaining the basic properties of exponential and logarithmic functions, connecting them using generalized fact families.

MATH 4090

1. 5 Practices for Orchestrating Productive Mathematical Discussions.
2. NCTM's Principles to Actions.
3. The 8 Standards for Mathematical Practice (Common Core State Standards).
4. Common Core State Standards for Mathematical Content.
5. Mathematical Mindsets.
6. Unit plan.

MATH 5090

1. Construction of confidence intervals for IID samples from a parametric family of distributions.
2. Generalized likelihood ratio tests in hypothesis testing.
3. Computation of Type I and Type II errors for a given hypothesis test and its alternative.
4. Non-parametric tests for the equality of one-dimensional probability distributions.
5. Non-parametric tests of independence (chi-squared tests).

MATH 5600

1. Basic principles of numerical methods for solving mathematical problems (other than DEs).

2. Applying these principles to the solution of simple application problems.
3. Adapting basic methods for the solution of more complicated problems.
4. Analyzing simple numerical methods.
5. Basic principles of solving ODEs numerically.
6. Basic numerical ODE methods.
7. Analyzing basic DE methods.
8. Adapting basic DE methods to particular applications.

MATH 5610

1. Basic principles of numerical methods for solving mathematical problems (other than DEs).
2. Applying these principles to the solution of simple application problems.
3. Adapting basic methods for the solution of more complicated problems.
4. Analyzing simple numerical methods.

MATH 5620

1. Basic principles of solving ODEs numerically.
2. Basic numerical ODE methods.
3. Analyzing basic DE methods.
4. Adapting basic DE methods to particular applications.

Sequence of assessment

Each of the assessed courses listed on previous pages will be assessed once every two years. Below is a list of the first semester that each of these courses will be assessed under this system.

Fall 2020: MATH 2270 and MATH 5610.

Spring 2021: MATH 2280, MATH 5600, and MATH 5620.

Fall 2021: MATH 3210 and MATH 3430.

Spring 2022: MATH 3220, MATH 4090, and MATH 5090.