

Department of Mathematics & Statistics

Mathematics major and minor

ASSESSMENT REPORT

ACADEMIC YEAR 2020-2021

I. LOGISTICS & PROGRAM LEARNING OUTCOMES

1. Name of program(s) and degree type(s)

The Department of Mathematics and Statistics offers a bachelor's degree in Mathematics and a bachelor's degree in Data Science.

2. Names and contact information of the faculty coordinating the assessment of each program and report

a. Mathematics Aggregate Report

Emille Lawrence, Chair

edlawrence@usfca.edu

b. Data Science Report

Daniel O'Connor, Data Science Program Director

doconnor@usfca.edu

3. Mathematics Major and Minor Mission Statement

There were no changes to our mission statement since last assessment cycle. Our mission statement remains:

The USF Department of Mathematics & Statistics seeks to deliver a quality mathematics education to our majors and minors, inspiring them to appreciate, understand, and engage with clear and rigorous thinking, both in abstract and concrete settings.

4. Mathematics Major and Minor Program Learning Outcomes

1. Differentiate and integrate functions of one and several variables;
2. Use differentiation and integration to solve problems in mathematics and other disciplines;
3. Solve and understand linear systems;
4. Give direct proofs, proofs by contradiction, and proofs by induction; formulate definitions and construct counterexamples;

5. Read mathematics without supervision; write mathematics with correct style, including typesetting;
6. Apply mathematics to problems in other disciplines; and
7. Use technology to solve mathematical problems.

5. Curricular Map

**Curriculum Map for Program Learning Outcomes
and Math Courses**

	PLO - 1	PLO - 2	PLO - 3	PLO - 4	PLO - 5	PLO - 6	PLO - 7
Math 109	✓	✓			✓		
Math 110	✓	✓			✓		
Math 211	✓	✓			✓		
Math 230			✓	✓	✓	✓	
Math 235				✓	✓		
Math 310				✓	✓	✓	
Math 314				✓	✓	✓	
Math 340	✓	✓	✓			✓	✓
Math 345			✓			✓	✓
Math 350					✓	✓	
Math 355	✓	✓		✓	✓		
Math 367				✓	✓		
Math 370	✓	✓				✓	
Math 371	✓	✓				✓	
Math 372						✓	✓
Math 373						✓	✓
Math 375			✓			✓	✓
Math 380				✓	✓		
Math 422				✓	✓		
Math 435				✓	✓		
Math 453	✓			✓	✓		
Math 482				✓	✓		
Math 485				✓	✓		

6. Assessment schedule between APRs

We have assessed PLOs 1, 2, 3, 4, 5, and 6 each year since our last Academic Program Review in 2017 through a standardized exit exam. We will continue this plan until it proves to be an unsuccessful measure of assessment.

II. METHODOLOGY

7. Description of the methodology used to assess the PLO(s)

To assess the aforementioned Program Learning Outcomes, our graduating math majors took the **ETS Major Field Test for Mathematics** in April 2021. This exam is written by the Educational Testing Service, the same organization that writes the GRE and TOEFL. In the past year (June 2020 – June 2021) this exam was taken by graduating math majors at different institutions all across the United States. The total number of examinees during this time period is 1,050.

The exam has 50 multiple choice questions and covers topics most commonly offered as part of an undergraduate mathematics curriculum.

The content breakdown of the exam is as follows:

- **Calculus** (about 30%)
Both single-variable and multivariable calculus.
- **Linear & Abstract Algebra** (about 30%)
Matrices, linear transformations, eigenvalues, eigenvectors, vector spaces, systems of linear equations, elementary group/ring/field theory, elementary topics from number theory.
- **Additional Topics** (about 40%)
Complex analysis, differential equations, discrete mathematics (including graph theory and combinatorics), foundations (including logic, proofs, sets, functions and relations), geometry, point-set topology, probability and statistics, and real analysis.

The exam questions are at three cognitive levels:

- **Routine** (about 55%)
These questions cover definitions, questions with no more than a two-step reasoning process, or questions that require a standard technique that is practiced extensively in math courses at most institutions.
- **Non-routine** (about 25%)
Includes questions that require an idea that is considered insightful, questions that require several steps of reasoning, and questions that require either the use of several definitions or a new definition that the student would not be expected to know. Some questions may require bringing techniques from two or more areas to bear on one problem.
- **Applied** (about 20%)
This includes, for example, questions that are cast in real-world settings.

The relationship between this exam and our Program Learning Outcomes is as follows:

- 30% percent of the exam problems cover calculus knowledge, which corresponds to **Program Learning Outcomes 1 and 2**.
- 30% of the exam problems cover algebra knowledge, which corresponds to **Program Learning Outcomes 3 and 4**.
- 25% of the exam problems are classified as non-routine, requiring several steps of reasoning or a new definition that the student would not be expected to know, which corresponds to **Program Learning Outcomes 4 and 5**.

- 20% of the exam problems are classified as applied, requiring the student to apply math to real-world settings. This corresponds to **Program Learning Outcome 6**.

III. RESULTS & MAJOR FINDINGS

8. Description of results and significant findings from the data or assessment process

This year we had 8 mathematics majors who took the ETS Major Field Test for Mathematics, known in our department as the **Mathematics Senior Exit Exam**. There was a wide range of scores: between 14th and 84th percentiles when compared to all test takers from undergraduate institutions across the nation. However, most of our students were between the 63rd and 68th percentile. Below is a chart detailing the outcome for each student.

Student	Score out of 200	Percentile
1	165	68th
2	162	63rd
3	165	68th
4	165	68th
5	177	84th
6	141	14th
7	144	19th
8	162	63rd

Table 1. USF Math major scores on the 2021 ETS Major Field Test for Mathematics. (Scores are listed in ascending order. The scale range for the total score is 120 – 200.)

I was able to obtain data collected by ETS from senior test takers from domestic institutions from September 2017 through June 2021. The following tables summarize how our seniors compare to seniors nationwide. Table 2 compares USF scores to individual and institutional nationwide data. Table 3 is a breakdown of how our students compare to other test takers according to the question type.

	Number	Mean score	Median	Standard Deviation
Nationwide individual aggregate 2017 to 2021	4859	157.5	156	17.8
Nationwide institutional aggregate 2017 to 2021	215	155.9	155	8.3
USF 2021	8	160	163	12
USF 2019	6	172.8	175.5	20
USF 2018	13	157	153	22
USF 2017	11	159	158	22
USF 2016	12	161	154.5	20

Table 2. USF Math major scores on the 2021 ETS Major Field Test for Mathematics as compared to previous years and nationwide data.

	Calculus Questions	Algebra Questions	Applied Questions	Routine Questions	Non-routine Questions
Nationwide Aggregate 2017 to 2021	31.4	33.9	35.5	33.7	26.4
USF 2021	41	32	44	36	27
USF 2019	48	48	55	52	28
USF 2018	27	35	33	29	38
USF 2017	30	35	38	32	30
USF 2016	30	45	33	38	29

Table 3. A breakdown of performance on the ETS Major Field Test in Mathematics by question type. Numbers in table represent the mean percent correct for each question type.

The year 2019 can be seen as an outlier among the last 5 years. We only had 6 students take the exit exam that year, and two of the students did quite well with one perfect score. I will also mention that we did not administer the exit exam during 2020 due to the pandemic. The students who took the exam in 2021 performed very typically as compared to USF students from previous years. Our students also exceeded nationwide scores overall. We see a noticeable gap in the Calculus questions and the Applied questions. Our students are outperforming the rest of the country by about 10

percentage points in both categories. The difference is even greater compared to our students in previous years. I think this is a testament to our growing curriculum in applied mathematics.

These results were shared with all faculty at May 2021 department meeting. The test scores were not at all surprising to our faculty. Our best students did well, and a couple of students who have struggled over the years did poorly. Because results did not shatter well-established trends, we do not have plans to alter our assessment method.

9. Feedback from previous year's report

Last year our department submitted an alternate report in which we addressed a series of questions related to the shift to remote learning. We were given feedback related to our test administering strategies over Zoom and suggestions for team building activities over Zoom for Math Tea. Thankfully our Math Tea is back in person for AY 2021-2022, and so are the vast majority of our sections.