Mathematics Bachelor's of Science

Assessment Report 2017-18

I. SUMMARY OF ASSESSMENT

A. Program Learning Outcomes (PLO)

Students graduating with a Bachelor of Science in Mathematics will be able to:

1. Apply the definitions, techniques and theorems of abstract mathematics (ILO's #1 & #6)
2. Apply the definitions, techniques and theorems of applied mathematics (ILO's #1 & #6)
3. Apply mathematical algorithms to solve problems, both individually and in teams (ILO's #2 & #4)
4. Creatively conjecture and rigorously write, analyze and critique proofs (ILO's #1 & #6)
5. Communicate mathematics to others in written and/or oral form with precision, clarity and organization (ILO's #2 & #4)
6. Apply techniques of at least one area of mathematics in depth (ILO's #1 & #6)

B. Program Learning Outcome(S) Assessed

PLO 2: Apply the definitions, techniques and theorems of applied mathematics

PLO 4: Creatively conjecture and rigorously write, analyze and critique proofs

This is the first year that these PLO's have been assessed.

C. Summary of Assessment Process

Instrument(s): The department used final exam questions and a rubric for each PLO. The rubrics were used to score the exam questions in the areas of readability, validity and fluency.

Sampling Procedure: The courses for this year's assessment were chosen by the department when we created our five-year assessment plan. For each course assessed, a final exam question was identified as a typical problem for the course that demonstrates the PLO to be assessed. These problems were chosen by the department during one of our monthly department meetings.

Sample Characteristics: The courses selected include both required courses for all options in the major and courses specifically required for the Applied and Teaching options. The exam questions were selected carefully to ensure they included essential course content. This selection was done during one of the monthly department meetings.

Data Collection: Final exams were collected by the department assessment coordinator. Each problem was scored by the undergraduate committee for readability, validity and fluency using the rubric found in appendix A.

Data Analysis:

Courses Assessed:

MATH 3300 Analysis I and MATH 4750 Numerical Analysis

Math 3300 Analysis I, SLO 4/Mastered (24 Students)

Problem: Prove a function from R to R^2 is continuous

	Missing	Emerging	Developing	Mastering
Readability	0	13%	29%	58%
Validity	4%	17%	8%	71%
Fluency	8%	17%	42%	33%

These scores indicate 58% of the students have mastered the ability to write a readable proof using a basic definition, 71% mastered the ability to write a valid proof, and 33% of the students mastered the ability to write a proof with fluency. These scores are considerably higher than the abstract algebra scores and slightly higher than the Analysis II scores were last year. This may indicate that the Analysis I course should be recommended prior to Algebra for students for whom this is practical. The department should discuss whether there is a preferred order for students to enter the upper division major courses.

These scores indicate most of the students have developed or mastered the ability to write a readable proof about a continuous function, most of the students have developed or mastered the ability to write a valid proof and 67% of the students have developed or mastered the ability to write a proof with fluency.

Math 4750 Numerical Analysis, SLO 2/Mastered (13 students)

Problem: Gaussian Elimination with pivoting.

	Missing	Emerging	Developing	Mastering
Readability	0.00%	17%	17%	67%
Validity	0.00%	17%	25%	58%
Fluency	0%	25%	25%	50%

These scores indicate most of the students have mastered the ability to apply techniques of applied mathematics and 50% are able to write a fluent solution. These results are slightly better than last year when we re-scored a differential equations problem.

D. **Summary of Assessment Results**

Main Findings: Students perform uniformly well at the readability and validity level. The departments needs to find ways to increase performance at the fluency level.

Recommendations for Program Improvement: The department needs to work on setting and communicating to instructors and students the essential topics for each course and how to include fluency practice throughout the coursework.

Next Step(s) for Closing the Loop: The department is creating new expanded syllabi for semester courses which will include more details regarding course topics, depth of study, grading guidelines, and assessment expectations at the introductory, developing or mastery level for readability, validity and fluency in student work. Professors will be encouraged to share the assessment rubrics with their students.

Other Reflections: The work described above is a huge project. We will have guidelines ready once semesters begin but will need to continuously improve our course packets for instructors.

E. **Assessment Plans for Next Year**

New PLO's

PLO #1: Apply the definitions, techniques and theorems of mathematics
PLO #2: Use mathematics to understand, explain and/or solve problems beyond a particular course.
PLO #3: Creatively conjecture and rigorously write, analyze and critique proofs
PLO #4: Communicate mathematics effectively

Assessment Plan for 2018-19

PLO's	2018-2019
PLO 1	Use RVF rubric to assess in Math 320 Abstract Algebra I
PLO 2	Use RVF rubric to assess in Math 310 Linear Algebra Theory

Appendix A - Rubrics

CSU East Bay Mathematics

SLO 4: Creatively conjecture and rigorously write, analyze and critique proofs

SLO 1 RVF Rubric – Readability, Validity, Fluency

	Missing (0)	Emerging (1)	Developing (2)	Mastering (3)
Readability	Informal or non-mathematical language is used. There is misuse of notation/symbols.	Some improper mathematical language or notation is used.	Mostly proper mathematical language and notation is used.	Proper mathematical language and notation is used.
Validity	Significantly inaccurate or irrelevant statements in definitions, techniques and/or theorems are present. Important information is missing.	Mostly accurate statements in definitions, techniques and/or theorems are present. May include some irrelevant or unjustified statements.	Statements in definitions, techniques and/or theorems are accurate and relevant.	Statements in definitions, techniques and/or theorems are accurate and relevant and connected/deduced correctly.
Fluency	No coherent flow of ideas Listing facts without a sense of how to link them to obtain or apply a valid definition, technique or proof of a theorem.	Partially coherent and organized, but inconsistent. Appeals to intuition. Some unjustified or improperly justified statements/ conclusions in definitions, techniques or proofs of theorems are present.	A correct and essentially complete definition, solution, or proof given. Logic and flow overall sound. Some small gaps in presentation may require "benefit of the doubt."	A correct and complete definition, solution, or proof given. Elegance or mathematical maturity present.

SLO 2: Apply the definitions, techniques and theorems of applied mathematics

SLO 2 RVF Rubric – Readability, Validity, Fluency

	Missing (0)	Emerging (1)	Developing (2)	Mastering (3)
Readability	Informal or non-mathematical language is used. There is misuse of notation/symbols.	Some improper mathematical language or notation is used.	Mostly proper mathematical language and notation is used.	Proper mathematical language and notation is used.
Validity	Significantly inaccurate or irrelevant steps in algorithms are present. Important information is missing.	Mostly accurate steps in algorithms are present. May include some irrelevant or unjustified statements.	Steps in algorithms are accurate and relevant.	Steps in algorithms are accurate and relevant and connected/deduced correctly.
Fluency	No coherent flow of ideas Listing facts without a sense of how to link them to get a correct solution.	Partially coherent and organized, but inconsistent. Appeals to intuition. Some unjustified or improperly justified steps in algorithms are present.	A correct and essentially complete solution given. Logic, steps in algorithms, and flow overall sound. Some small gaps in solution may require "benefit of the doubt."	A correct, fully justified, and complete solution given. Elegance or mathematical maturity present.