ANNUAL ASSESSMENT REPORT

College	Science
Department	Mathematics
Program	BS
Reporting for Academic Year	2016-2017
Last 5-Year Review	2010-2011
Next 5-Year Review	2017-2018
Department Chair	Julie Glass
Date Submitted	10/20/17

SUMMARY OF BS ASSESSMENT

BACHELOR'S OF SCIENCE IN MATHEMATICS

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**

Summarize your assessment process briefly using the following sub-headings.
Instrument(s): The department used final exam questions and a rubric for each PLO. The rubrics were used to re-score the exam questions for readability, validity and fluency using the rubrics below included in Appendix A.

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 assessed the given PLO. 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 required courses for the Applied and Teaching options. The exam questions were selected carefully to ensure they tested material that is essential in the courses.

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 in Appendix A.

Data Analysis: Courses Assessed:
MATH 3121, 3301, 3331, 3600, 3750, 3841

Math 3121 Abstract Algebra, SLO 4/Mastered (15 Students)
Problem: Prove a function is a group homomorphism.

	Missing	Emerging	Developing	Mastering
Readability	7%	13%	53%	27%
Validity	0%	25%	25%	50%
Fluency	0%	37%	57%	6%

These scores indicate 27% of the students have mastered the ability to write a readable proof using a basic definition, 50% mastered the ability to write a valid proof, and 6% of the students mastered the ability to write a proof with fluency.

Math 3301 Real Analysis II, SLO 4/Mastered (9 students)
Problem: Prove if f: [-1,1] to [-1,1] is continuous then f has a fixed point

	Missing	Emerging	Developing	Mastering
Readability	0.00%	0%	11%	89%
Validity	0.00%	11%	44%	44%
Fluency	0.00%	33%	34%	33%

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 3331 Differential Equations, SLO 2/Mastered (13 students)
Problem: Solve a linear, first-order initial value problem.

	Missing	Emerging	Developing	Mastering
Readability	0.00%	15%	23%	62%
Validity	0.00%	15%	23%	62%
Fluency	8%	0%	54%	38%

These scores indicate most of the students have mastered the ability to apply techniques of applied mathematics although only 38% are able to write a fluent solution.

Math 3600 Number Theory, SLO 2/Mastered (7 students)
Problem: Prove congruence properties of even and odd integers

	Missing	Emerging	Developing	Mastering
Readability	0%	0%	29%	71%
Validity	0%	28%	29%	43%
Fluency	0%	28%	29%	43%

These scores indicate most of the students have mastered the ability to write a readable proof using theorems of applied mathematics, 43% have mastered the ability to write a valid proof, and 43% have mastered the ability to write a proof with fluency.

Math 3750 Numerical Analysis I, SLO 3/Mastered (27 students)
Problem: Use an $O(h^2)$ approximation of a derivative to generate an $O(h^3)$ approximation.

	Missing	Emerging	Developing	Mastering
Readability	11%	4%	15%	70%
Validity	11%	11%	33%	44%
Fluency	11%	11%	15 %	63%

These scores indicate most of the students have mastered the ability to write a readable and fluid solution to a problem in applied mathematics and 77% are developing or mastering writing a valid solution.

Math 3841 Linear Programing, SLO 2/Mastered (24 students)
Problem: Use Complementary Slackness to prove a vector is an optimal solution to maximize a linear function under given restrictions.

	Missing	Emerging	Developing	Mastering
Readability	0%	0%	17%	83%
Validity	0%	4%	8%	88%
Fluency	0%	0%	12%	88%

These scores indicate the majority of the students have mastered the ability to write a readable, valid and fluid solution to a problem applying a technique in applied mathematics

D. **Summary of Assessment Results**

Main Findings: Students perform uniformly well at the readability and validity level. The department 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 its courses and how to include fluency assessment throughout the coursework.

Next Step(s) for Closing the Loop: The department is creating new expanding syllabi for the semester courses which will include more in depth 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.

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**

We plan to assess program student learning outcomes 2 and 4 listed above. We will use two courses for this assessment: Math 330 Analysis I and Math 370 Numerical Analysis I. This is a change from our original plan, which uses nine courses. We plan to spend more time analyzing the data and planning for program improvement instead of time on redundant data collection.

APPENDIX A: SAMPLE RUBRICS

SLO 1: Apply the definitions, techniques and theorems of abstract mathematics

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 3: Apply mathematical algorithms to solve problems, both individually and in teams

SLO 3 RVF Rubric – Readability, Validity, Fluency

	Missing (0)	Emerging (1)	Developing (2)	Mastering (3)
Readability	Informal or non-	Some improper	Mostly proper	Proper

	mathematical language is used. There is misuse of notation/symbols.	mathematical language or notation is used.	mathematical language and notation is used.	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.