Mathematics Program

School of Arts & Science, University of Alaska Southeast

2022-23 Annual Report on Assessment of Program Learning Outcomes

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Format: This report adheres to the "Report Template" posted approve by the UAS Faculty Senate in September of 2023 and posted on the Provost Office website.

1. **Brief Program Overview**

   The Bachelor of Science in Mathematics provides a solid foundation in mathematics. In addition to taking the core and interdisciplinary courses, students also take part in a seminar dedicated to undergraduate research during their last two years.

   After obtaining the degree, students have opportunities in secondary education, graduate studies and direct entry into the job market. Each student is advised by faculty to achieve a specific program tailored for the student's goals. The program philosophy remains that our primary objective is to help students learn and internalize the process of creating solutions – by synthesizing information and thinking for themselves.

   UAS is an institutional member of the Intercollegiate Biomathematics Alliance (IBA), a consortium of U. S. universities that promotes and fosters research and education in biomathematics. This membership opens doors to many opportunities and resources for both students and faculty at UAS.

   In addition, UAS has the only Alaska chapter of Pi Mu Epsilon, a national honor society dedicated to the promotion of mathematics and recognition of students who successfully pursue mathematical understanding. The Alaska Alpha Chapter of Pi Mu Epsilon was installed in April of 2014 at UAS.

2. **Program Learning Outcomes (PLOs)**

   The following program learning outcomes have been identified by the Mathematics Program faculty as being relevant to measuring the potential success of UAS mathematics Bachelor of Science graduates in the workforce or in academics and are listed in the UAS Course Catalog.

   Outcome 1: Competency in Core Subject Content
   1A. Graduates will demonstrate skills in basic quantitative and analytic problem solving and competency in basic undergraduate mathematics coursework.
   1B. Graduates will demonstrate knowledge of foundational theoretical concepts essential to the study of mathematics.
   1C. Graduates will demonstrate an ability to extend and generalize foundational concepts and critically analyze and solve abstract problems in mathematics.

   Outcome 2: Skills in Analysis, Application, and Technology Utilization
   2A. Graduates will demonstrate the ability to use technology as an aid to understanding and solving mathematical problems.

2B. Graduates will demonstrate the ability to apply mathematical knowledge in new settings and situations.
2C. Graduates will demonstrate the ability to critically analyze and solve a wide variety of problems using theoretical or technological tools.

Outcome 3: Communication Skills
3A. Graduates will demonstrate the ability to read and comprehend mathematical ideas.
3B. Graduates will demonstrate the ability to communicate mathematical ideas in writing.
3C. Graduates will demonstrate the ability to communicate mathematical ideas verbally.

Outcome 4: Professionalism and Independence
4A. Graduates will produce a resume highlighting marketable mathematical skills and knowledge.
4B. Graduates will demonstrate confidence in communicating mathematical ideas verbally and in writing.
4C. Graduates will demonstrate the ability to independently pursue investigations in the mathematical sciences.

3. **Data Collection Method(s)**
   We assessed each of our graduates on these outcomes by considering the Student Individual Record file (SIR file) for each. The contents of the SIR file are outlined below:

   1. Resume
   2. Degree audit
   3. Final transcript
   4. Final capstone seminar paper
   5. Summary scorecard for the final capstone presentation
   6. First seminar paper and presentation scorecard
   7. Exit Survey
   8. Proficiency matrix for PLO competency
   9. Permanent contact information
   10. Post-graduate surveys, if applicable

   The permanent Juneau faculty members meet each spring (in early May) to review and evaluate the SIR file for each graduating mathematics major. There are three categories of assessment possible with a high and low in each category. The lowest category is "Does Not Meet Expectations" with a possible numerical score of 1 or 2. The second category is "Meets Expectations" with possible scores of 3 or 4. The last category is "Exceeds Expectations" with possible scores of 5 or 6.

4. **Data from 2022-2023 Academic Year**
   The average score for the AY23 graduates on each outcome is given in the table below along with the cumulative average score from AY17 when the program began this assessment scheme.

Outcome	AY23 Average Score	Cumulative Average Score
1A	4.666667	4.789474
1B	4.333333	4.315789
1C	4	3.736842
2A	4.210526	4.277778
2B	4	3.842105
2C	4	3.842105
3A	4.333333	4.421053
3B	4.333333	4.052632
3C	4.666667	4.052632
4A	2.666667	2.842105
4B	4.666667	4.368421
4C	4.333333	4.421053

5. Evaluation of Data

On average, our students are meeting program expectations with the exception of outcome 4A, graduates will produce a resume highlighting marketable mathematical skills and knowledge. Consequently, we have added more instruction on resume writing and job searches to our Junior/Senior Seminar course.

We are now giving more direct instruction with example resumes and explicit examples to illustrate how to incorporate transferable, but non-cognitive, skills from coursework. We've also added the course requirement that each student turn in a resume highlighting marketable mathematical skills and knowledge in each year of the seminar course (MATH S392/S492). We are giving explicit written feedback on each resume submitted so that students can revise before submitting to employers or graduate schools. Since our majors are required to take the one-credit seminar four times (twice as junior seminar and twice as senior seminar), we are seeing increased attainment for this outcome.

In the program exit surveys, 100% of the students indicate they are extremely satisfied with both the education they received in the math program and their interaction with the mathematics faculty. They all mentioned accessibility of math faculty and faculty willingness to help as program strengths. The main weakness mentioned was course availability – both number and frequency of offerings. However, all students acknowledged the reality of viability at a small school.

News on graduates: Alice Mehalek (2023) wrapped up her remarkable accomplishments at UAS, earning her second bachelor's degree, and was recognized as the *Outstanding Mathematics Graduate*. For her capstone research, Alice took inspiration from Lewis Carroll's book *Alice's Adventures in Wonderland* to mathematics, and presented a talk on her paper titled *Alice's Adventures in Quarternionland: Hamilton's Quaternions and Quaternion Algebras*. In addition to participating in the online *Polymath REU* in Summer 2022 and attending the *Graduate Research Opportunities for Women* (GROW) conference at Duke University in Fall 2022, Alice applied for and was awarded an *Undergraduate Research and Creative Activity* (*URECA*) grant for Spring 2023. For this award, she led a team of Math Club members through a fun research project on the *Mathematics of Board Games*, which

culminated in April with a talk at the *URECA Student Symposium*, and an outreach activity with the Thunder Mountain High School Math Club. Alice secured admission to the Ph.D. program in mathematics at Colorado State University in Fort Collins.

Hailey Quinto (2023) celebrated her graduation (Cum Laude) with enthusiasm and looks forward to taking a well-earned break from school. Hailey explored the Riemann Hypothesis, presenting a talk on her paper titled *Peculiar Properties of The Prime Numbers: Investigating the Riemann Zeta Function*. Hailey was part of the *Mathematics of Board Games* research team.

Our continuing majors also had an impressive year: Cassandra Suryan was awarded an *Undergraduate Research Apprenticeship* from the *Alaska Space Grant Program*. Under the guidance of Dr. Jason Amundson, Cassandra conducted a statistical analysis of ice flow and glacier change from glaciers around Greenland in order to better constrain the processes controlling tidewater glacier stability. She presented a poster on her research with Jason Amundson, titled *Testing and Analysis of a Simple Parameterization of Iceberg Calving*, at the Alaska Space Grant Program's annual meeting at UAA in April 2023. Along with Genoa Mangusso, Cassandra also received the *Ron Seater Award* for the 2023 academic year.

As part of a continuation of her Summer 2022 *Intercollegiate Biomathematics Alliance Cross-institutional Undergraduate Research Experience* (*IBA CURE*) research project, Elizabeth Bruch will be attending the *American Chemical Society's Northwest Regional Meeting*, to be held at Montana State University in Bozeman, MT. Elizabeth will present work that she has been doing with Dr. Meghan McGreal of University of North Carolina, Ashville, NC. Her research has been on computational chemistry, which involves working on the UNC supercomputer using the Gaussian program to modify, and attempt to optimize the structure of the Ni-Fe Hydrogenase enzyme.

The latest news on some recent graduates: Amy Jenson (2020) has wrapped up the first year of her PhD in Geophysics at UAF. She is continuing her research into better understanding what drives changes in ice velocities on Jakobshavn, a glacier in Southwest Greenland.

Evan Carnahan (2019) earned his MS in Computational Science, Engineering, and Mathematics from the University of Texas at Austin in 2021. For this he worked on *Multimodal data integration with non-linear glacier flow models for the Greenland Ice Sheet*, and was also a member of the UT Austin Ice Dynamics Lab team. Evan is continuing with his doctoral studies in Electrical and Computer Engineering, also at University of Texas in Austin.

Katy Price (2020) is continuing with her Ph.D. at Oregon State University; Ben Malander (2016, and of Learning Center fame) wrapped up his first year of graduate studies in mathematics at University of Wyoming, Laramie; and Charles McKenry Jr. (2018) is teaching mathematics at Yaakoosgé Daakahídi High School in Juneau.

6. Conclusions and future plans

We did not make explicit changes to the degree program. However, in response to student requests for more courses, we continue to have access to course offerings via the IBA (Intercollegiate Biomathematics Alliance) that our students can take as upper division

electives. We plan to continue offering these electives as long as we are an IBA institutional member. We are also discussing ways to add a variable credit Current Topics course option for additional upper division elective opportunities for our majors.

We also continue allowing video recording of student capstone presentations. Students still must answer questions "live" to demonstrate ability to communicate mathematics verbally. The recorded presentations give an opportunity for communicating mathematics verbally from a different perspective.