CALIFORNIA STATE UNIVERSITY EAST BAY

ACADEMIC SENATE

http://www.csueastbay.edu/senate

COMMITTEE ON ACADEMIC PLANNING AND REVIEW

ANNUAL PROGRAM REPORT

College	**CoS**
Department	**Mathematics**
Program Unit	**Mathematics**
Reporting for Academic Year	**2015-2016**
Department Chair	**Julie Glass**
Date Submitted	**6/26/2016**

1. SELF-STUDY

A. Five-year Review Planning Goals

Our last five year program review was in 2010-11. The goals listed in the plan for that review included issues regarding students, curriculum, faculty and support. The specific goals were:

1. Students: The Department will continue to try to provide a high caliber, creative undergraduate and graduate math program. The challenge is to retain high quality regular faculty and to maintain a large enough student demand in order to be able to provide these courses. The quality of these courses is also put at risk by lack of funding for graders, which has always been central to the effective delivery of our math courses. The Department also needs to continue to be responsive to the needs of entering freshmen who are taking remedial math courses. Several aspects of the remedial math program have been changed over the last five years, which has improved the student flow through these courses and increased the amount of mathematical feedback within the courses.

2. Curriculum: Continue to be responsive to the needs and requirements of local K-12 schools in the preparation of future teachers. Continue to update curriculum to provide innovative and challenging experiences for our undergrad and grad math majors. Continue to investigate ways to improve student preparation, so that meeting a prerequisite should enable a student to succeed in future courses.

3. Faculty: Hire new faculty in appropriate areas of expertise and retain the faculty that the

Department already has. Try to increase faculty support funds for travel and research.

4. Outside Reviewer's Report: Main points suggested were (1) increase number of sections of upper division math courses, and decrease their size, (2) encourage faculty cohesiveness, (3) encourage faculty research

5. Program Response to Outside Reviewer's Report: The Department would indeed like to have better physical offices for faculty, and smaller classes offered more often. Achieving all of these goals does not seem reasonable given current budget restrictions. Many faculty are focusing their efforts in STEM Education projects. This work is generally not recognized as "research" by outside reviewers, but is strongly in line with institutional and college level priorities. It has been the historical stance of the department to value and reward this type of work. In addition, this work allows for the participation of undergraduates in relevant professional development through the programming provided. Many of our students graduate and become teachers at various levels, as well as teaching for us during their time at CSU East Bay, and thus this work is supportive of their goals and those of CSU East Bay. We also recognize the importance of engaging students in more traditional research of discovery, and we have new faculty who are also working in this area. Our most recent position descriptions have included an emphasis on the ability to work with undergraduates in research. We look forward to filling our vacant positions with new faculty who can help us strengthen this aspect of our program.

B. Five-year Review Planning Goals Progress

Students

Supporting student success with graders: Consistent with the stated intention of our AY 2014-15 annual report, this year graders were provided for all regular and lecturer faculty who requested them. This grader policy was for one year while we assess the impact of the support and determine whether the budget will allow ongoing provision of graders at this level. Instructors who used graders will be surveyed about the usefulness of having graders and those who did not request graders will be surveyed as to why they chose not to make a request. In addition, we will consider surveying student graders to see if they felt the experience was beneficial in terms of solidifying their learning and building stronger relationships with their faculty.

Major enrollment: Our major enrollment at both the undergraduate and graduate level has remained fairly constant (see included data). Our course offerings have remained broad, allowing students' exposure to a variety of topics of current interest.

Student Club(s): We are part of three student clubs that have been active this past year. The Recreational Math and Computer Science Club had a series of speakers and activities that have attracted a wide range of students. The Data Science Club (co-directed by Dr. Kamalinejad) has more than 40 active students attending every 2 weeks to hear speakers and participate in events for networking and building community. Finally, the Association for Women in Mathematics Student Club (directed by Dr. Yap) has met and is making plans for future speakers and activities.

Student engagement beyond the classroom:
Dr. Kamalinejad is working with several students on 2 different research projects: Dynamical

Data Clustering (work in progress with another faculty and 3 students) and NLP for speech analysis of presidential candidates (work in progress with 3 students).

Dr. Olkin was faculty advisor on a grant examining bias against women in Computer Science with Linda Beverly (undergraduate).

Dr. Yap submitted a successful proposal for a Faculty Support Grant for Mentoring Student Researchers through the Center for Student Research for a project titled, "Student Creation of a Geometric Data Dimension Reduction Taxonomy." She will be working with 2 students, Linda Beverly (undergraduate) and Perry Aliado (graduate).

Developmental Mathematics: We continue our efforts to support student success in developmental math. These efforts include more training and oversight of our graduate student TAs in Math 805-806-807 (ChaRM) and in Math 900 and Math 950. In 2015-16 we hired a "head TA" to work with the department chair to more fully implement common elements (final exam, syllabus, grading policies) in Math 950. This effort included meeting with all Math 950 instructors to develop problems and rubrics for common final problems. We worked on grading sample problems to establish common understanding around partial credit, rigorous mathematical language, and problem selection. Feedback from TAs teaching Math 950 was very positive in that they developed more collaborative relationships and felt greater support in their instruction. We also continue to offer the ChaRM sequence with mostly volunteer support from Dr. Kevin Callahan and Dr. Julia Olkin both of whom developed the program.

Developmental mathematics is one of our areas of greatest need. A fulltime director, as is common across the CSU System, would allow more innovation, better coordination, and more professional development for our graduate student TAs. This program serves the entire university and requires more attention and support than is currently provided.

Supplemental Instruction: Supplemental instruction was implemented in 2 college algebra courses taught by Dorothy Fujimura. We have plans to implement more widely in our ChaRM classes in collaboration with Undergraduate Studies and the SCAA, with support from the Chancellor's Office initiative on extended early start.

<u>Curriculum</u>

This past year the department created and submitted a transformed curriculum for semesters. The department met in a 2 day retreat in June, 2015, and weekly throughout the academic year. At the retreat key elements of our proposed transformation were discussed and fleshed out. These elements included a more intentional integration of applications and technology across our curriculum. New courses for our majors, the departments we serve, and the general education population.

We also changed the overall structure of our program, eliminating concentrations/options so that students will be able to move more efficiently through the degree and have an opportunity to be exposed to a variety of areas of mathematics based on their interest and department expertise. We developed new program learning outcomes, curriculum maps, degree maps, and all new course and program proposals. Specifically, the major will more clearly include a set of "core" courses required for all majors and sequences and electives more clearly connected and streamlined for each option. Scheduling will be more transparent allowing for better planning and facilitating graduation. Additionally, students will complete a capstone experience modeled

on the High Impact Practice advocated by the AAC&U. The revised major was designed so that students interested in high school teaching are able to complete their BS in mathematics and their Single Subject Matter Program in Mathematics in tandem. These students will be qualified to enter a teaching credential program in mathematics without having to pass the three California Subject Examinations for Teachers (CSETs) in mathematics.

Planned content and cognitive change: The major will more clearly include the transformed outcomes and objectives described below which will be introduced, developed and mastered according to a new curriculum map. These outcomes and objectives will be clearly communicated to students via departmental syllabi and through other department guides and publicity materials.

A list of new courses was included in last year's annual CAPR report.

Individual Curricular Innovations:
Dr. Kathy Hann used the free software Geogebra and the BayCloud virtual computing lab in Math 4215 Topics in Geometry for the first time. Geogebra and the Geometer's Sketchpad were used for in class demonstrations, homework and student presentations. These software packages helped students visualize projective geometry in two and three dimensions and enable the class to create an infinite number of examples to verify properties before they were proved.

Dr. Ehsan Kamalinejad taught Statistical Learning and Data Analysis (CS6831) as a truly multidisciplinary course that attracted students from all related majors of statistics, CS and math.

Faculty

We had a successful search for a new tenure track faculty member during AY 2015-16. Dr. Jesus Oliver received his PhD from UC San Diego and served as a lecturer there for 3 years and also taught at Mesa Community College for a year. His research is in the area of partial differential equations and mathematical physics.

We anticipate the retirement of 2 tenure track faculty (Dr. Wolitzer and Dr. Ouyang) and a 1.0 lecturer (Ms. Fujimura) within the next 1-5 years. These retirements will result in a significant need for new faculty who are able to teach at the upper and graduate level.

Professional Activity Highlights
The department is very active in supporting our students who are future teachers as well as providing professional development for current teachers. Faculty are engaged in research projects to identify and measure promising practices for mathematics instructors across educational levels. Faculty are also active in traditional and interdisciplinary research that includes students and collaborations across the CSU and beyond.

Dr. Kathy Hann worked with Nada Djordjevich to study the effectiveness of the Noyce program and the CSUEB Math and Science teaching credential programs on teaching in middle and high school high needs districts. This study will conclude next year and will be written up for publication. In related work, she served on a panel titled, "Pathways to Teaching Middle School Mathematics--Models and Issues" at the CMC North Annual Mathematics Education Meeting at Asilomar. She is also a member of the CAMTE Advising Committee which meets virtually monthly and in person bi-anually to discuss and propose policy for future mathematics teachers. This committee submits formal recommendations to the California Commission on Teacher

Credentialing.

Dr. Hann also co-sponsored and developed workshops for the AAREA (African American Regional Education Alliances) 7th annual Professional Development Summit held at CSUEB. This work was a collaboration with Robyn Fisher, Co-Founder & Board Chair of AAREA, with the goal of connecting, learning, and expanding our thinking about how we can support African American students succeed on their path to college and beyond. Additional work with Robyn Fischer resulted in Fall and Spring Diversity in Teaching workshops for the Noyce Scholars.

Dr. Hann and Dr. Julia Olkin are working with Dr. Julie McNamara (TED) to lead CSU East Bay's participation in the Mathematics Teacher Education Partnership (MTEP), an initiative of APLU (Association of Public and Land Grant Universities) SMTI (Science & Mathematics Teacher Imperative) which is a national effort to assist public universities to increase the number and improve the quality and diversity of science and mathematics teachers they prepare. The partnership is aimed at transforming mathematics teacher education to prepare effective math teachers for all students. Partnerships include higher education faculty from teacher education and mathematics as well as personnel from K-12 institutions.

Dr. Ehsan Kamalinejad submitted "IsoClustering: A Generalized Framework for Local Data Clustering" for publication. He also presented at the Faculty Research Symposium at CSUEB.

Dr. Julia Olkin presented "Co-Teaching Across the Pipeline" discussing work done for the Bechtel New Generation of Educators(NGEI) grant. She also presented two week-long summer Algebra II workshop and Geometry respectively for teachers in Contra Costra County supported by the Lesher Foundation and focused on the new common core standards. She is also the PI of the Math and Science Teacher Initiative (MSTI) grant, working with several people in TED, with Kathy Hann on Noyce, and Claudia Quezada and the Community Colleges, to encourage our undergrads to consider entering our Credential Program in a STEM field.

Service to the University

The department is very active in service at the college and university level and in state and national organizations in support of K-16 education. We have representatives on the College RTP and Curriculum committees, the General Education Subcommittee of CIC, Academic Senate, COBRA, and a wide range of Semester Conversion committees. Dr. Olkin serves as co-chair of the Board of Directors of the STEM institute. Dr. Hann is a member of the California Association of Mathematics Teachers (CAMTE) Advising Committee and the Purposeful Recruitment, Exploration, and Preparation (PREP) Initiative Task Force. Dr. Yap serves as our regional section governor to the Mathematical Association of America.

Funding awarded and proposals submitted

Dr. Julie Glass is lead participant on an Irvine Foundation funded Bridging the Gap planning grant that brings together a partnership among CSUEB, Peralta Community Colleges, Oakland Unified School District and Berkeley Unified School District. The goal of the project is to support student success across the High School – Community College – University transitions. She is also a participant the funded Greater Bay Area P20 Basic Skills Consortium, a collaborative among Ohlone Community College District (lead), CSUEB, Berkeley City College, Chabot College, Diablo Valley College, Las Positas College, Mission College, Peralta Community College District, San Francisco State and San Jose State. The Greater Bay Area K20 Basic Skills Consortium (GBA K20BSC) Greater Bay Area K20 Basic Skills Consortium (GBA K20BSC) was formed to increase retention and graduation rates in two and four-year

college degree and certificate programs through newly (re)designed developmental mathematics courses and course sequences that address needs of high school and college students. Partners in this grant will design and implement improvements in mathematics requirements, coursework and support systems across multiple educational entities.

Dr. Kathy Hann continues to be the PI for the CSUEB Noyce Teaching Fellows Program and CSUEB Noyce Scholarship program. These grants provide scholarships and professional development for future math and science teachers committed to teaching in high needs schools.

In addition, she submitted for funding to support a multi-institutional research project, Effects of Recruitment Models and Program Aspects on Secondary Mathematics and Science Teacher Preparation. This project was proposed for funding to the National Science Foundation under the Noyce Track 4 solicitation is a national study of features that make teacher preparation programs effective for and attractive to high performing teacher candidates in math and science. This grant was not awarded. They plan to improve the proposal and resubmit this summer.

Dr. Ehsan Kamalinejad submitted, together with five other faculty members from CSUEB and Fresno State University, a National Science Foundation FURST, Faculty and Undergraduate Research Student Teams, grant. This grant is currently under review.

Dr. Julia Olkin was co-PI, along with Julie McNamara (TED) of the CEMPSLI TEEM grant: Teaming for Effectiveness & Equity in Mathematics. They work with traditional-K - 3rd grade teachers in Hayward to focus on capacity building for the Common Core math standards, effective teaching methods for early math instruction, and teaching methods addressing the unique needs of English Language Learners. This is a two-year grant.

New building relocation: The move to the 5th floor of SF has resulted in a more collaborative and cohesive faculty community.
.

C. Program Changes and Needs

New department: The split from computer science is complete. Becoming our own independent department has resulted in a strong sense of community and cohesion. Regular meetings for semester conversion were leveraged to also begin discussions around department policy and practice that will continue into next year.

New policies: Some significant policy decisions that will be made are: common curricular elements, especially at the lower division; evaluation of teaching; advising; placement; calculator use, etc.

New placement exam: We are implementing a new precalculus and calculus placement exam in Fall, 2015. We will use information from our pilot to refine and expand this option for students.

Needs: Our greatest needs are in the area of oversight for developmental mathematics, new tenure track faculty, and staffing. Developmental math and faculty hiring were touched on earlier in this report. As for staffing, with the split from Computer Science, we are in the process of recruiting a new ASC who will be assigned only to Math. The decision regarding a shared ASA to help support the department is pending. Math will move its non-faculty-advising to the

College of Science Advising Center.

2. SUMMARY OF ASSESSMENT

A. Program Student Learning Outcomes

Bachelor of Science in Mathematics

Students graduating with a Bachelor's of Science in Mathematics will be able to:
1. Apply the definitions, techniques and theorems of abstract mathematics
2. Apply the definitions, techniques and theorems of applied mathematics
3. Apply mathematical algorithms to solve problems, both individually and in teams
4. Creatively conjecture and rigorously write, analyze and critique proofs
5. Communicate mathematics to others in written and/or oral form with precision, clarity and organization
6. Apply techniques of at least one area of mathematics in depth

Students taking Option B or C for the Bachelor in Mathematics receive focused emphasis on particular PLOs as follows:
- The Applied Mathematics Option emphasizes PLOs #2, 3 & 6 above.
- The Mathematics Teaching Option emphasizes #1, 2, & 5 above.

Master of Science in Mathematics

Students graduating with a Master's of Science in Mathematics will be able to:
1. Apply the fundamental definitions and theorems of pure mathematics
2. Apply the fundamental definitions and theorems of applied mathematics

B. Program Student Learning Outcome(s) Assessed

Math BS

SLO 1: Apply the definitions, techniques and theorems of abstract mathematics
SLO 3: Apply mathematical algorithms to solve problems, both individually and in teams asses

Math MS
SLO 1: Apply the fundamental definitions and theorems of pure mathematics

C. Summary of Assessment Process

For each upper division and graduate course assessed, a final exam question was identified as a typical problem for the course that assessed the given SLO. Each problem was scored by the undergraduate/graduate committee for readability, validity and fluency using the rubric below. The results were organized and discussed by the undergraduate and graduate committees.

Please see the scoring rubric in Appendix A.

D. Summary of Assessment Results

Please see data summaries in Appendix B

This was our second attempt at using the RVF (readability-validity-fluency) rubrics to score authentic student work for attainment levels of PLOs. We learned/improved our process in the following ways:

a) developing a rubric to be used for a variety of courses forced/allowed us to examine common features of successful student work that is not exclusively looking for the right answer = "validity." Working with faculty across the department with different areas of expertise to identify and measure three features, readability, validity and fluency, which characterize quality and maturity in student work created opportunities for conversations about pedagogy and priority of outcomes for our students.

b) identifying appropriate problems for scoring takes some care as the dimensions of the rubric (readability, validity, flow) were not necessarily demonstrated and/or were too interdependent on some types of problems.

c) we will continue to refine the rubrics for greater ease of use and applicability.

d) we will consider sharing the rubrics with math students to further emphasize the importance of each dimension of successful student work.

e) we will consider how the different levels/scores via the rubrics may (or may not) align with I/D/M levels of attainment of PLOs. In particular, we know that not all students in a specific course are at the same point in their major. So, some students taking Math 3600, for example, might be doing so as their first advanced proof-based course while others might be completing their degree and have a higher level of maturity. We see this in the generally lower overall scores for "fluency" since this skill will likely be most developed for those students with experience in proof-intensive courses. With the move to semesters, some of the courses currently aligned with mastery will align with developing knowledge attainment.

f) we will continue to explore ways to support instructors unfamiliar with course content to score student work using the RVF rubric. This is needed as the rubric based scoring is most effective when faculty score student work from courses where they were not the instructor.

3. STATISTICAL DATA

From Academic Program Review Standard Data
(http://www.csueastbay.edu/ir/Academic%20Program%20Review.html)

Student Headcount Enrollment by Major & Race/Ethnicity			Fall 2015				
			Degree Level				TOTAL
			Bachelor	PostBacc	Master	Ed/Doc	
MATH Female	**Female**	**Black, non-Hispanic**	3		1		4
		American Indian or Alaska Native					
		Asian	6		5		11
		Hawaiian/Othern Pacific Island			2		2
		Hispanic	10		4		14
		White	7		4		11
		Multiple ethnicity	3		1		4
		Race/ethnicity unknown	2		1		3
		Nonresident aliens	1		1		2
		total	32		19		51
	Male	**Black, non-Hispanic**	4		1		5
		American Indian or Alaska Native					
		Asian	7		8		15
		Hawaiian/Othern Pacific Island					
		Hispanic	14	1	2		17
		White	9		10		19
		Multiple ethnicity	1		1		2
		Race/ethnicity unknown	6		3		9
		Nonresident aliens	1		2		3
		total	42	1	27		70
	Total	**Black, non-Hispanic**	7		2		9
		American Indian or Alaska Native					
		Asian	13		13		26
		Hawaiian/Othern Pacific Island			2		2
		Hispanic	24	1	6		31
		White	16		14		30
		Multiple ethnicity	4		2		6
		Race/ethnicity unknown	8		4		12
		Nonresident aliens	2		3		5
		total	74	1	46		121

Headcount Enrollment	Fall Quarter 2011	2012	2013	2014	2015
Math					
1. Undergraduate	73	71	81	67	74
2. Postbaccalaureate	4	1	1	0	1
3. Graduate	74	66	58	53	46
4. Total Number of Majors	151	138	140	120	121

Degrees Awarded	College Years 10-11	11-12	12-13	13-14	14-15
	Math				
1. Undergraduate	15	20	11	21	24
2. Graduate	19	24	16	26	22
3. Total Number of Majors	34	44	27	47	46

	College Years 10-11	11-12	12-13	13-14	14-15
Student Faculty Ratio	Math				
1. Tenured/Track	17.6	18.0	16.5	21.0	18.3
2. Lecturer	27.2	27.0	28.5	30.0	29.2
3. SFR By Level (All Faculty)	24.2	24.5	24.8	27.1	26.7
4. Lower Division	26.1	25.6	27.1	28.7	28.4
5. Upper Division	15.4	19.5	17.7	20.6	19.1
6. Graduate	15.2	11.3	7.3	12.8	10.3
Section Size	Math				
1. Number of Sections Offered	91.0	90.0	88.0	89.0	94.0
2. SCU taught	8951.0	8965.0	9093.0	9000.0	9934.0
3. Average Section Size	25.2	25.3	26.4	25.6	27.1
4. Average Section Size for LD	26.5	26.0	27.4	27.0	28.7
5. Average Section Size for UD	19.0	23.0	23.3	22.3	21.3
6. Average Section Size for GD	16.3	13.7	9.7	8.8	8.5
7. LD Section taught by Tenured/Track	12	12	10	12	8
8. UD Section taught by Tenured/Track	9	7	8	9	8
9. GD Section taught by Tenured/Track	4	3	5	5	6
10. LD Section taught by Lecturer	64	66	64	62	71
11. UD Section taught by Lecturer	2	2	2	2	2
12. GD Section taught by Lecturer	0	0	0	0	0

Please note that the following data could only be found for Math/CS Combined.

Math & Computer Science					
	Fall Quarter				
	2011	**2012**	**2013**	**2014**	**2015**
A. Students Headcount					
1. Undergraduate	363	386	407	422	496
2. Postbaccalaureate	8	1	2	1	1
3. Graduate	247	197	263	332	266
4. Total Number of Majors	618	584	672	755	763
	College Years				
B. Degrees Awarded	**10-11**	**11-12**	**12-13**	**13-14**	**14-15**
1. Undergraduate	69	71	74	95	96
2. Graduate	133	129	85	75	98
3. Total	202	200	159	170	194
	Fall Quarter				
	2011	**2012**	**2013**	**2014**	**2015**
C. Faculty					
Tenured/Track Headcount	Computer Science and Mathematics Combined				
1. Full-Time	25	23	21	22	19
2. Part-Time	2	1	1	2	3
3a. Total Tenure Track	27	24	22	24	22
3b. % Tenure Track	62.8%	58.5%	52.4%	57.1%	48.9%
Lecturer Headcount	Computer Science and Mathematics Combined				
4. Full-Time	1	1	2	2	4
5. Part-Time	15	16	18	16	19
6a. Total Non-Tenure Track	16	17	20	18	23
6b. % Non-Tenure Track	37.2%	41.5%	47.6%	42.9%	51.1%
7. Grand Total All Faculty	43	41	42	42	45
Instructional FTE Faculty (FTEF)	Computer Science and Mathematics Combined				
8. Tenured/Track FTEF	19.4	16.5	17.4	17.0	12.5
9. Lecturer FTEF	18.1	19.0	19.3	18.4	23.1
10. Total Instructional FTEF	37.4	35.4	36.7	35.4	35.6
Lecturer Teaching	Computer Science and Mathematics Combined				
11a. FTES Taught by Tenure/Track	307.1	288.1	314.9	356.4	260.3
11b. % of FTES Taught by Tenure/Track	38.7%	36.0%	36.2%	39.4%	28.3%
12a. FTES Taught by Lecturer	487.1	513.2	553.9	547.3	660.1
12b. % of FTES Taught by Lecturer	61.3%	64.0%	63.8%	60.6%	71.7%
13. Total FTES taught	794.2	801.3	868.7	903.7	920.4

14. Total SCU taught	11913.0	12019.0	13031.0	13556.0	13806.0
D. Student Faculty Ratios	Computer Science and Mathematics Combined				
1. Tenured/Track	15.9	17.5	18.1	21.0	20.9
2. Lecturer	27.0	27.1	28.7	29.8	28.5
3. SFR By Level (All Faculty)	21.2	22.6	23.7	25.6	25.9
4. Lower Division	25.7	25.2	26.9	28.7	28.2
5. Upper Division	16.7	19.9	20.1	22.7	21.7
6. Graduate	10.8	14.0	16.6	19.0	20.8
E. Section Size					
1. Number of Sections Offered	138.8	127.0	133.8	138.0	141.0
2. Average Section Size	22.9	24.1	25.1	25.0	25.7
3. Average Section Size for LD	26.5	26.3	27.4	27.0	28.4
4. Average Section Size for UD	18.9	22.0	23.0	24.4	22.1
5. Average Section Size for GD	13.2	15.1	17.8	19.0	18.6
6. LD Section taught by Tenured/Track	17	17	15	14	10
7. UD Section taught by Tenured/Track	30	26	29	24	22
8. GD Section taught by Tenured/Track	22	13	17	21	18
9. LD Section taught by Lecturer	66	67	67	69	79
10. UD Section taught by Lecturer	2	5	7	7	7
11. GD Section taught by Lecturer	3	3	3	4	6

Source and definitions available at: http://www.csueastbay.edu/ira/apr/summary/definitions.pdf

Appendix A Sample Scoring Rubric

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.

Appendix B Mathematics Assessment Data

Mathematics Undergraduate Assessment Results 2015-16

Courses Assessed:

MATH 3100, 3300, 3600, 3750, 3841

SLO's Assessed:

Upon completion of the Mathematics BS degree students will be able to:

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

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

Math 3100 Linear Algebra, SLO 1/Mastered (8 Students)

Problem: Prove a set is a basis for a vector space.

	Missing	Emerging	Developing	Mastering
Readability	0%	25%	37.5%	37.5%
Validity	0%	25%	50%	25%
Fluency	0%	50%	25%	25%

These scores indicate 37.5% of the students have mastered the ability to write a readable proof using a basic definition, 25% mastered the ability to write a valid proof, and 25% of the students mastered the ability to write a proof with fluency.

Math 3300 Real Analysis I, SLO 1/Developed (16 students)

Problem: Establish topological property of the real numbers.

	Missing	Emerging	Developing	Mastering
Readability	0.00%	25.00%	56.25%	18.75%
Validity	0.00%	50.00%	12.50%	37.50%
Fluency	0.00%	37.50%	37.50%	25.00%

These scores indicate most of the students have developed or mastered the ability to write a readable proof of a topological property of the real numbers, half of the students have developed or mastered the ability to write a valid proof and 62.5% of the students have developed or mastered the ability to write a proof with fluency.

Math 3600 Number Theory, SLO 1/Mastered (12 students)

Problem: Use induction to prove a property of the Fibonacci numbers.

	Missing	Emerging	Developing	Mastering
Readability	0.00%	16.67%	16.67%	66.67%
Validity	0.00%	16.67%	58.33%	25.00%
Fluency	0.00%	33.33%	66.67%	0.00%

These scores indicate most of the students have mastered the ability to write a readable and valid proof using induction, 66% have developed and no students mastered the ability to write a proof with fluency using induction.

Math 3750 Numerical Analysis I, SLO 3/Mastered (21 students)

Problem: Apply an algorithmic technique to improving an approximating formula.

	Missing	Emerging	Developing	Mastering
Readability	14.29%	23.81%	9.52%	52.38%
Validity	28.57%	9.52%	19.05%	42.86%
Fluency	19.05%	23.81%	4.76%	52.38%

These scores indicate over 52% of the students have mastered the ability to write a readable solution using an algorithm to improve an approximating formula, more than 42% have mastered the ability to write a valid solution, and more than 52% have mastered the ability to write a solution with fluency.

Math 3851 Linear Programming, SLO 3/Mastered (23 students)

Problem: Apply the Simplex Algorithm to find production level to minimize cost.

	Missing	Emerging	Developing	Mastering
Readability	0.00%	0.00%	26.09%	73.91%
Validity	0.00%	13.04%	43.48%	43.48%
Fluency	0.00%	4.35%	56.52%	39.13%

These scores indicate all of the students have developed or mastered the ability to write a readable solution using the Simplex Algorithm, more than 43% have mastered the ability to write a valid solution, and almost all have developed or mastered the ability to write a solution with fluency.

Mathematics Graduate Assessment Results 2015-16

Courses Assessed

MATH: 6339, 6340, 6119

SLO Assessed

SLO 1: Apply the fundamental definitions and theorems of pure mathematics

D = developed in this course

M = mastered in this course

Math 6339 Introduction to Complex Variables, SLO 2/D (10 students)

Problem: State theorems precisely.

	Missing	Emerging	Developing	Mastering
Readability	0.00%	10.00%	40.00%	50.00%
Validity	0.00%	20.00%	30.00%	50.00%
Fluency	10.00%	20.00%	30.00%	40.00%

These scores indicate half of the students have mastered and 40% have developed the ability to write a readable theorem statement, 80% have mastered or developed the ability to write a valid theorem statement, 30% have developed and 40% of the students have mastered the ability to write a theorem statement with fluency.

Math 6340 Complex Analysis, SLO 1/M (10 Students)

Problem: Find all Riemann Surfaces associated with a function.

	Missing	Emerging	Developing	Mastering
Readability	10%	0%	50%	40%
Validity	10%	20%	20%	50%
Fluency	10%	10%	40%	40%

These scores indicate 90% of the students have developed or mastered the ability to write a readable proof using the fundamental definitions and theorems of pure mathematics, 70% have developed or mastered the ability to write a valid proof, and 80% of the students developed or mastered the ability to write a proof with fluency.

Math 6119 Advanced Algebra SLO 1/M (12 Students)

Problem: Prove the Cartesian product of two groups is a group and that it's also abelian if both of the groups are abelian.

	Missing	Emerging	Developing	Mastering
Readability	0%	17%	50%	33%
Validity	0%	8%	50%	42%
Fluency	0%	50%	25%	25%

These scores indicate 88% of the students have developed or mastered the ability to write a readable proof using the fundamental definitions and theorems of pure mathematics, 92% have developed or mastered the ability to write a valid proof, and 50% of the students developed or mastered the ability to write a proof with fluency.