

Program Review Mathematics

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**UNIVERSITY
of HAWAI'I^o**

HILO

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I. Mission Statement and Goals

The instructional mission of the University of Hawaii – Hilo Mathematics Department is threefold.

1. The Mathematics Department provides extensive support to those departments requiring Mathematics content for their majors.
2. The major program is designed to prepare its students for successful careers in secondary education and other areas requiring a strong foundation in Mathematics, or for success at the graduate level, either in Mathematics or a related discipline. The degree is intended to familiarize students with a wide range of areas within the field of Mathematics and to instill in them an appreciation for the rigor and structure of the discipline.
3. The department services non-science majors by offering a limited selection of courses that are designed to introduce the students to the fundamental concepts that constitute classical and contemporary Mathematics.

The scholarship mission of the department is to contribute to the global body of Mathematical knowledge. The service mission of the department is to contribute professional expertise to the university, and Mathematical expertise to the University of Hawaii at Hilo (UHH), the State of Hawaii, and the national and international Mathematics communities.

II. Secondary Accreditation

Not applicable.

III. Executive Summary

At the time of our last Program Review in 2002 the Mathematics Department had just begun a major rebuilding effort with only one of its six full-time faculty members tenured. It was transitioning from a twenty-year period that could best be characterized as problematic to one with aspirations of excellence. It used the Program Review self-examination for developing a transformational vision of what it wanted to become, namely, an exemplary department characterized by excellence with a collegial and vibrant working atmosphere, mutually beneficial interaction between faculty and students, opportunities for student-faculty research that would best prepare our students for both teaching and graduate school, excellence in both teaching and research, and a well-respected department that contributes significantly to both the university and the community.

In many aspects the department has reached and even surpassed these laudable goals. It has 11 full-time faculty members: seven tenure-track, of which six are tenured, and four instructors. Each is devoted to the profession and has successfully contributed to the

department and its programs; we work well together as an efficient team. We strive to be the best department we can be - an exemplary Mathematics department in a relatively small, student-oriented four-year institution. We take pride in providing our students with high-quality learning experiences both within and outside the major. We provide our majors with personalized guidance and academic mentorship; we help our students find opportunities that would best help them realize their professional aspirations. The department represents a focal point for providing Mathematical expertise for UHH and beyond - the state of Hawaii, the Pacific Rim, and the national and international academic community.

The extensive record of professional accomplishments marks the department's excellence in all three areas: teaching, research, and service to the academic community.

Three department members were recognized for excellence in teaching during the past ten years: two with the Board of Regents Excellence in Teaching Award; one with the Frances Davis Award for Excellence in Undergraduate Teaching. The interaction between students and faculty has notably increased, with the junior faculty engaging in numerous directed readings opportunities for external activities greatly increased.

The UHH Math Club has been reinstated and re-energized, hosting a Big Island Math League Meet each year; our students now participate in the National William Lowell Putnam Competition; and department members were able to secure not one but two NSF grants, the first ever for the department, as well as an NSA supplemental grant, the first ever for UHH. This goes well beyond grant expectations within the department's last Program Review MOU.

One of the NSF grants, the HiNTS program, is designed to prepare secondary teachers; the other is for two closely-linked summer Research Experience for Undergraduates (REU). All are ongoing efforts that are achieving great results. Many UHH Math students have participated in these efforts, while other Math majors have participated in other out-of-state REU's, presenting their research results both at Math seminars and at national conferences.

These advanced activities have prepared our students well, either for teaching or for graduate school, and have enabled them to better compete at each level. Two of our most recent graduates are currently succeeding in their respective graduate programs in Economics at Boston College and Mathematics at Brandeis University, while others are actively preparing their graduate applications as they near completion of their degrees. The most fulfilling part of all this activity is a close-knit enthusiastic and energized group of Math majors that work together and encourage each other to higher and greater aspirations and achievements.

The department's scholarly and service activities have also been notable. Faculty members over the past 10 years have produced no fewer than 46 peer-reviewed articles that have appeared in well-recognized journals of high impact. They have been invited to numerous prestigious conferences, to chair sessions at national and international research

symposia, to train educators at a national event, to mentor young promising researchers at an international forum, and one to be recognized as an Outstanding International Scholar. Several members also provide quality service to the academic community at large – as referees for the National Science Foundation, as reviewers for several international editorial and advisory boards, and as lead consultants to the Department of Education (DoE). Two department members are attempting to positively impact secondary education across Hawaii by developing new high school Math curriculum for the entire state as it transitions to the national common core standards. Leading up to that responsibility, they were also awarded a grant for developing eight workshops for DoE in-service teachers to bridge the gap between what the DoE is teaching in the high school Math classes and university expectations. Campus-wide, department members have contributed valuable service to the university by serving in leadership roles on the Congress. One such member chaired the Academic Policy Committee (APC) while it was responsible for a major revision of the Tenure and Promotion (T&P) Process. Another is currently chairing the APC and charged with revising the Program Review Process, as well as playing a leadership role in our upcoming accreditation. The former APC Chair has been later appointed as T&P Referee for the entire UH System. The department has earned a reputation as a “*model department*”.

In recent years the Mathematics Department reached a record high enrollment in both service and general education courses. Due to the increased number of majors in the Natural Sciences Division and the introduction of the new College of Pharmacy, enrollment in our Calculus classes doubled. The recent changes in the UHH general education requirements yielded more than double enrollment in our 100-level courses. During the review period new developmental courses were offered that added another 90 to 120 students each semester. A successful Math Placement mechanism was introduced in 2006 for all students entering their first college-level Math class, which included an exam and mandatory advising from the Mathematics Department. The number of Math majors remains stable, around 30, with an average of 6 graduates per year. Half of our graduates pursue careers in secondary education, the other half continue their education at graduate schools or seek employment in industry. In order to better prepare our future teachers, the department revised its teaching track requirements during this past program review cycle to include one semester each of Geometry, Algebra, and Analysis.

Department Progress on Previous Program Review MOU Action Points

The department has made significant progress on most MOU action points.

1. Work with the Dean to fill the vacant tenure-track position. The department filled that position, two additional tenure-track positions, and three instructor positions.
2. Work with the administration to plan for a Mathematics-dedicated classroom... The department moved the Math tutoring lab to CH-5 and transformed CH-6 into a smart classroom. However, the administration was possibly referring to an idea of theirs to combine two K-building rooms into a 40-seat classroom. They did not pursue this idea any further than the MOU.

3. The College and University will commit to prioritizing the needs of the Mathematics Department...The administration transferred control of the Math tutoring lab to Kilohana. (See comments in the section below on Administrative Support since the last MOU.)
4. Continue to cooperate with various university programs and units on future grant opportunities. As mentioned above, the department has been awarded two NSF grants, one NSA grant, and a DoE grant during this past cycle.
5. Concentrate on a viable plan to measure the learning outcomes... The department has made considerable progress in this area. (See the section on Evidence of Student Learning.)
6. [...Math remediation...]. The department designed and implemented a developmental course, Math 103 (College Algebra), for those under-prepared students who required Calculus. An instructor was hired to teach the majority of the sections of that course and to lead the developmental effort in better identifying students early in the process who needed additional help early in the process, as well as those that could more quickly move to Math 104F. Progress on that effort fell somewhat short of expectations, but the department is currently hiring a new instructor for that position and has renewed high hopes of great success.
7. Develop a plan...to attract more Math majors... While the number of majors increased during the last few years, the department is now working on a more proactive campaign to attract more majors and minors.
8. [...encourage a Math Ohana...]. Although the department experienced a few “setbacks” in this area during the cycle, it has rebounded admirably and now works well together as a team. Credit for this should be given in part to the current chair.
9. Continue conversation with the College of Business and Economics (CoBE) to resolve issues with Math 115 (Applied Calculus). This issue was resolved when CoBE decided to add Math 104F (Pre-Calculus: Functions) as an option in lieu of Math 115. They did this without consulting the Math Department. The department is somewhat baffled by this move by CoBE, while we feel CoBE students are better served by Math 115. It would seem that the move was made based on an erroneous assumption that Math 104F is easier than Math 115, which most Math faculty view as questionable. We may wish to revisit this issue again in the interest of best servicing CoBE students.

Administrative Support since the last Program Review

The UHH administration has greatly supported the department's growth in demand for Math courses by authorizing a number of new hires, which goes beyond the hiring mentioned in the last MOU. After a number of retirements prior to the last review, the department was able to return to its previous full strength of six tenure-track faculty members by hiring two new faculty members in 2007. The following year, when it was clear that the new Pharmacy Program would impact our Calculus offerings, we were allowed to hire one more tenure-track faculty member, bringing us to our current total of seven. When it became apparent in 2003 that the Math tutoring lab was a growing and

vital support mechanism for Math students, the administration authorized a full-time instructor position with a one-course reduction to supervise the lab. After a former tenure-track faculty member specializing in Statistics resigned in 2006, at the department's request the administration authorized hiring a full-time instructor to cover most Probability and Statistics courses. They also authorized another full-time instructor in 2008 to lead the newly instituted developmental effort. Most recently, when our instructors for our Calculus labs and Developmental Program announced their retirements, the administration authorized us to fill both positions, both during a time when many programs have unfilled faculty vacancies. These decisions undoubtedly reflect the importance of the department's service to other programs and possibly to our status as a model department.

Two areas in which the administration did not rise to the level of assistance desired by the department are the Math tutoring lab and Math Placement.

The Math tutoring lab achievements were acknowledged in numerous points within the last MOU, including its significant growth and success, the critical role it played in the success of students, and the lack of space and funding due to its tremendous growth. The Math tutoring lab continued to grow exponentially after the department hired a full-time instructor who assumed leadership for the lab. The lab outgrew its venue in CH-5 and in 2006 moved into CH-6. It received new furniture as part of a UHH STEM grant; UHH's academic computing took over supplying and managing its 10 computers. It had an extremely vibrant atmosphere, seemingly by far the most popular and successful support lab on campus. In 2008 – 2009, from state legislative funding, a new overarching UHH student support office was formed and named Kilohana.

In April 2009 the Mathematics Department Chair signed an MOU with Kilohana¹, also signed by the NS division chair, CAS Dean, VCAA, and the Kilohana director. The MOU stipulated that Kilohana would assume responsibility for funding the lab, advertising and hiring tutors that were selected by the Mathematics Department, providing non-discipline tutor training, reporting and assessment, and other collaborative efforts towards the success of the lab, primarily all administrative work. The Mathematics Department would retain responsibility for the day-to-day operations, selecting tutors, discipline-specific tutor training, and a faculty-level lab supervisor to provide day-to-day supervision of the tutors. Federal Work Study and "G" funds that had been previously used to fund the lab, in the amount of \$16,500, were transferred to Kilohana, and Kilohana would work with the Math department to determine the annual budget.

At the end of the following semester, the Mathematics Department was informed that the MOU was no longer in effect, that Kilohana was taking full control of the lab and renaming it the Math Center. The reason given was that the department had failed to demonstrate that it had lowered the DWF rates. The department was not informed of this criterion beforehand. Even at this point the department had no problem with transferring control of the Math tutoring lab as long as its services remained at its remarkably high

¹ See Appendix – Math – Kilohana MOU

level, but notes that the transfer of responsibility could have been done in a more collegial manner. However, the department and the students are extremely disappointed in the resulting quality of support.

The Math Center is no longer an exciting and vibrant place. The tutors are chosen in many instances without sufficient consultation with the department resulting in tutors that lack sufficient competence, which further results in most students not seeking it out or returning to it for help. Without Mathematics Department's supervision, the tutors no longer receive their weekly instruction from a Math faculty member, which, it turns out, is critical to "filling in their educational gaps". The number of visits to the lab dropped to less than 1600 for Fall 2012, in comparison to over 3,300 in Fall 2007², a drop of more than 50% in patronage. To date, Kilohana has not produced evidence that the DWF rates have declined since they took over. In fact, according to institutional research data, the DWF rates have risen since Fall 2009 in critical courses such as Math 103, 104F, 115, and 205, the very courses the Math Center is designed to service³. Nevertheless, the department will continue to seek ways to collegially work with Kilohana towards returning the Math Center to its former glory.

Math placement has a similar riches-to-rags history. In 2005 the administration requested that the Mathematics Department implement Math placement. In 2006 it did so very efficiently and effectively, with few problems. It first required all students taking a college level Math courses for the first time to take a Compass Math placement exam. In the demographic information for the exam, it asked students for their major, the highest Math class taken in high school and the grade received, and their Math SAT scores. Immediately after completing the exam, and within the same venue, students were then required to see a Math faculty advisor who would take into account all the information to determine for which courses the student was prepared. National data has shown that high school Math classes and grades are a much better predictor of success than placement exams, but that all information taken together is best.

After advising the student was electronically authorized to enroll in an appropriate Math class(es). This worked very well primarily due to the individualized and accurate advising. In 2008 there was a problem with long lines. As a consequence, the VCAA at that time decided to do away with the advising component of the testing. In 2010, in anticipation of implementing pre-built schedules, the VCAA office asked the Mathematics Department to design their own Math placement exam that could be taken online. The number of misplaced students has anecdotally notably increased. (Increased DWF rates might be reflected here as well.) The department will continue to work with the administration to develop a more effective placement strategy that still accommodates the need for pre-built schedules.

² See Appendix – Math Tutoring Lab Report 2002 – 2008 and Math Center Data Fall 2012.

³ See Appendix – DWF rates and grade distributions for Math (excludes summer courses)

IV. Program Organization

Background

The UHH Mathematics Department supports the UHH⁴ and UH – System missions⁵ by offering a major program in Mathematics that is consistent with a public university that offers a comprehensive portfolio of distinguished undergraduate programs, complemented by select graduate and professional degrees, while at the same time providing significant support to a large number of other programs. In particular, the department services many programs that fall under the ‘island as a learning laboratory’ specification cited in the 1997-2007 UHH Strategic Priorities⁶, such as Marine Science, Astronomy, and Geology/Volcanology. It also contributes considerably to many of the goals in the current strategic plan 2011-15.

Most notably, the program is designed to provide learning experiences that prepare our students for success after graduation, as stipulated within Strategic Goal 1. The teaching and traditional tracks within the major are rigorous, particularly with respect to developing critical thinking, and prepare students for teaching careers, graduate study, or entering the work force. Our service courses supporting the sciences also instill high levels of critical thinking for those students.

We also provide a rich culture of mentorship between faculty and students, and require a service learning component for future teachers. Consistent with action plan 2.4 we have successfully integrated teaching and research, with many of our majors involved in independent studies and summer REU’s, resulting in student research presentations at the department and national levels. The department also contributes to strategic priority action 5.1 by strengthening the P-20 pipeline through training future secondary Mathematics teachers, both in terms of content and by providing hands-on training as Teaching Assistantship, helping with high school Math competitions (Big Island Math Meets), delivering in-service training for DoE Math teachers, and developing comprehensive new high school Math curriculum for the DoE’s transition to the common core standards.

Program Goals⁷

As stated in our catalog, Mathematics majors should develop:

1. A general understanding of the different areas of Mathematics and how they interrelate, and the importance of Mathematics in a scientifically oriented society.
2. Classical theorem-proving skills, which include the ability to reason mathematically and to apply the rigor necessary to construct proofs.
3. A refined understanding of the problem solving process.

⁴ <http://www.uhh.hawaii.edu/uhh/strategic/mission.html>

⁵ <http://www.hawaii.edu/ovppp/stratplan/UHstratplan.pdf>

⁶ <http://www.uhh.hawaii.edu/uhh/strategic/priorities.html>

⁷ Student learning outcomes for Math are included in section V, Evidence of Student Success.

4. The ability to independently develop and deliver all pre-college Math curricula, if the professional goal is teaching.
5. A working knowledge of technology appropriate to the field.
6. The skills necessary to
 - Read, write, translate and articulate Mathematically related material,
 - Solve problems using a variety of techniques including algebraic, numerical, and spatial reasoning through visualization (e.g. graphically), and
 - Make inferences and generalizations.

Students outside the major should develop:

1. The ability to apply the respective concepts and techniques to their major, in the case the course is required for the major.
2. An appreciation for the applicability of the respective concepts and techniques to contemporary society, in the case the course is taken to satisfy the general education requirement.

Program Components

The BA in Mathematics is offered through two tracks, the Teaching Track for students pursuing a career in secondary Math education, and the Traditional Track for students planning to continue their education in graduate programs or pursue a non-education career. Both tracks require two years of Calculus, Linear Algebra, Discrete Mathematics, and the first semester each of Analysis and Algebra⁸. The Teaching Track also includes a one-year sequence on Probability and Statistics, and courses in Geometry⁹ and service in Mathematical tutoring/teaching assistantship. The Traditional Track includes the second semesters in the classical areas of Modern Algebra, Real Analysis, and a 3 unit upper-division Mathematics elective. Students completing this track are particularly well prepared for graduate study. The credit requirement total for the Teaching Track is 39 credits and for the Traditional Track is 37.

The Math requirements for both tracks are distributed as follows:

⁸ Please see <http://www.uhh.hawaii.edu/academics/cas/natsci/Math.php> for a description of all courses.

⁹ The geometry class focuses on both Geometry and its pedagogy, to help prepare students to teach geometry at the secondary level.

Teaching Track

- MATH 205–206 Calculus I and II (8)
- MATH 231–232 Calculus III and IV (6)
- MATH 310 Discrete Mathematics (3)
- MATH 311 Introduction to Linear Algebra (3)
- MATH 421 Elementary Probability Theory (3)
- MATH 422 Elementary Mathematical Statistics (3)
- MATH 431 Real Analysis I (4)
- MATH 441 Geometry I (3)
- MATH 454 Modern Algebra I (3)
- MATH 496 Teaching Assistance and Tutoring in Mathematics (3)

Total 39 credits

Traditional Track

- MATH 205–206 Calculus I and II (8)
- MATH 231–232 Calculus III and IV (6)
- MATH 310 Discrete Mathematics (3)
- MATH 311 Introduction to Linear Algebra (3)
- MATH 431–432 Real Analysis I and II (8)
- MATH 454–455 Modern Algebra I - II (6)
- Plus 3 more semester hours of 300–400-level Mathematics courses, not including MATH 496

Total 37 credits

Comparison with other Math Programs

A perusal of other Math programs indicates that our major requirements are consistent in content with those required by other national Math programs, but that our number of required credits 37 – 39 appears less. On the one hand, it is difficult to find a true peer institution for UHH, a four-year public institution of approximately 3000 students with a limited number of graduate degrees and a large indigenous population, and one that is physically isolated by 2500 miles of ocean from the rest of the country, requiring airline travel even within the state. Fort Lewis College in Colorado, for example, has a similar student population count, is also very rural, and serves a large Native American student body. Their Mathematics Major requires 45 credits, very similar in content to ours, but also includes four capstone Math credits. The UHH Mathematics Department has conducted serious discussions lately on developing a required capstone experience for its majors. It is likely that, as a result, the number of credits required for the major will soon rise accordingly. Some private institutions with similar student body counts, such as BYU-Hawaii and Lewis and Clark University in Oregon, have very similar requirements to those at UHH. At the other end of the spectrum, CSU Monterey Bay, which has (perhaps questionably) been identified as a peer institution, requires 72 credits for its Math majors. On the other hand, the number of required credits in Mathematics is consistent with those of other UHH majors. To supplement their preparation for graduate school, students in the traditional track are highly encouraged to enroll in as many of our regular course offerings as possible such as ODE's (Ordinary Differential Equations) and Probability and Statistics, and our less frequently offered courses such as Complex Analysis and Topology, as well as the occasional topics courses as Introduction to Theory of Equations. Many students also engage in a variety of directed readings.

In terms of content and rigor, our course offerings compare favorably with those across the country. Since the last program review the department has developed detailed course outlines for each of its courses. Last year the department contacted the top 132 US universities formally inquiring as to how our Pre-Calculus, Calculus I, and Calculus II courses compared with those at their institutions, and whether or not our credits would transfer. Fifty-six schools responded (over 40%) and of those all but one indicated that our Calculus courses would transfer for full credit¹⁰. In fact, 5 of the top 10 schools responded, Harvard, MIT, Stanford, Chicago, and Duke, and each of them except Chicago, (that indicated that as a matter of principle they never accept transfer credits from any university), indicated that our Calculus courses would transfer. Perhaps surprisingly, approximately 80% of those responding also indicated they would accept the Pre-Calculus (sometimes as credit but, more importantly,) as satisfying the pre-requisite to enter Calculus I.

One student transferring to UC San Diego wrote back to tell us that, based on our course outline for Calculus, he was essentially given credit for Honors Calculus. Another student wrote back to say that our Analysis course was the single best course he had taken to prepare him for his graduate studies in Economics at Boston College. More on the rigor of some of our courses can be found within section V, Evidence of Student Success, where assessment has been conducted for Pre-Calculus, Calculus I and II, Linear Algebra, and Analysis.

Service Course Offerings – Primarily the Natural Sciences

In addition to offering courses intended primarily for the major, the Mathematics Department also services a number of other programs. Its largest service responsibility by far is to the Natural Sciences division, where all majors except the BA option for Biology require a year of Calculus. Additionally, Pharmacy requires the first semester of the Calculus. Students not prepared to enter directly into Calculus have two options, a one-semester Pre-Calculus course or a decelerated one-year Pre-Calculus sequence. Students lacking sufficient preparation for Pre-Calculus can now enroll in Math 103, College Algebra. Math courses required by natural science majors above and beyond the first-year Calculus are given in the table below.

Major	Courses Required
Computer Science	Linear Algebra
Physics	Multivariable Calculus 1-yr sequence , Differential Equations, one additional upper division Math course
Astronomy	Multivariable Calculus 1-yr sequence , Differential Equations
Chemistry	Multivariable Calculus , Differential Equations and Linear Algebra recommended

The department also offers a less rigorous Applied Calculus course (Math 115) that is required for the BA in Biology, Economics, and some degrees in the College of

¹⁰ A few mentioned slight variations in the courses but in essence they transferred, usually for equal credit.

Agriculture, Forestry, and Natural Resource Management (CAFNRM), and is an option for Business. The lower division Introduction to Probability and Statistics course (Math 121) is also required by certain degrees in CAFNRM and is also an option for Economics.

All lower division Math courses except Math 103 satisfy the quantitative reasoning general education requirement. Students majoring in areas that require at least two specific Math courses satisfy their quantitative reasoning general education requirements in this manner, while most other (non-science) students satisfy it by taking the Survey of Mathematics course and either Introduction to Probability and Statistics or a non-Math quantitative reasoning course. A small number opt for Pre-Calculus, Applied Calculus, or even Calculus.

Note: All sections of first-year Calculus include a one-hour per week technology enhanced numeric/visualization component. (See Curricular Changes below.)

Revisions to the Teaching Track

The department offers two majors, traditional and teaching track. At the time of our last program review the requirements for the teaching track majors included Calculus, Discrete Mathematics, Linear Algebra, Introductory Probability and Statistics (Math 121), Mathematical Probability and Statistics (Math 421-422), and one year-long sequence chosen from Ordinary and Partial Differential Equations, Complex Variables, Real Analysis, and Modern Algebra. Students not choosing the Real Analysis option were required to include one more upper division Math course to reach the minimum of 37 credits.

The department identified a number of deficiencies in this version of the teaching track. First, it was possible for teaching track majors to graduate without exposure to either of the two fundamental areas, Real Analysis and Modern Algebra. Second, the department did not offer a course that would help prepare future high school teachers for the inevitability of being required to teach Geometry. Finally, students were not exposed to the teaching process outside of being passive observers in their courses.

Beginning in Fall 2006, the department revised the teaching track major to address these deficiencies. The new requirements eliminated Math 121, Introductory Probability and Statistics, and replaced the option of taking a single year-long sequence with the requirements that students take the first semesters of both Real Analysis and Modern Algebra. Students are also now required to take a one-semester course in Geometry, which emphasizes teaching high school Geometry (See New Course Offering – Geometry 441-442 below).

Finally, the department now requires teaching track majors to perform three credits of teaching-related service learning. Students enrolled in Math 496, Teaching Assistance and Tutoring in Mathematics, are assigned a Math faculty mentor and satisfy their service learning through a variety of activities which include tutoring in the Math Center

(formerly the Math tutoring lab) or working as an undergraduate teaching assistant in lower division courses. The faculty mentors provide exposure to the teaching process by engaging students in all aspects of teaching, including preparing lesson plans and quizzes, monitoring student progress and offering topic specific study sessions prior to exams, teaching in the classroom, preparing and grading homework and quizzes, and discussing with the mentor problems regarding professional ethics, integrity, etc. Such hands-on activities allow graduating teaching track students to enter into the teaching certification program with more classroom experience and a higher chance of success.

Although the department has as yet not performed a formal assessment of the effectiveness of the new teaching track requirements, we are confident that today's teaching track graduates are much better prepared as a result of their more rigorous and comprehensive content and their increased exposure to the teaching practice.

Curricula Changes

A number of significant curriculum changes were implemented during the past program review cycle. These changes are singularly presented below.

New Course – Geometry, Math 441 – 442

The department developed a required one-semester course on Geometry, with emphasis on teaching Geometry at the high school level. Geometry is required of all high school students and most beginning teachers are assigned at least one such course during their first year of teaching, and yet we had no course that prepares our future teachers to teach this subject. Dr. Ivanova has an advanced degree in secondary Math education and a research specialty in Geometry, so naturally she took the lead in developing the new course.

The course provides a unique emphasis on both content and pedagogy of teaching high school Geometry. It offers a solid foundation in Euclidean Geometry in two and three dimensions, including teaching methods and pedagogy. This builds a solid knowledge and understanding of the most fundamental geometric concepts. It then allows the opportunity to lead the students into a more advanced Geometry course, Geometry 442, introducing non-Euclidean Geometries and classic Riemannian Geometry. This second course is designed for either future teachers or traditional track Math majors.

Calculus “Labs” for Math 205 and 206

In 2003 the department performed a vigorous assessment of its delivery of Calculus. The primary milestones were: determining the department's long-term Calculus teaching philosophy (i.e. traditional, reform, or compromise), identifying course objectives, choosing an appropriate text, and developing policy regarding the use and role of technology both in terms of instruction and student use. A new textbook was carefully chosen and the role of the Calculus labs re-evaluated. With an eye to the possible future use of online homework and the desire to make this transition as easy as possible on both

students and faculty, the department decided to choose all introductory textbooks from Pearson Publishing, thereby making it possible for instructors in most of its courses through Calculus IV to utilize their MyMathLab online homework suite. The reasons for choosing Pearson included their broad coverage of topics, their more mature development of online homework capabilities, and the extensive support service offered by their representative. Simultaneously, the department created its comprehensive course outlines for the Calculus, and decided to continue its configuration of three-days per week lecture and one day for numerical/visualization lab.

The one-day “lab” met in an electronic classroom and utilized MathCAD software to gain visualization and numeric approximation capabilities. Robert Garry, the instructor who was given responsibility (but little support) for developing the technology component of the class back in 2000, subsequently wrote an extensive Calculus Lab workbook and also worked with MathSoft to secure free MathCAD software for the students. While Mr. Garry’s extensive work should be praised, nagging and recurring problems surfaced. The biggest complaint from students was that there seemed to be a “disconnect” between the lecture and the lab, that it seemed “useless”. Mr. Garry repeatedly worked diligently with the department and with the individual Calculus instructors to attempt to remedy this problem. At times, lab assignments would be returned to students through the lecture, thereby tying the lab more closely to the lecture. Other instructors assigned numeric-based projects within their lecture sections and required students to utilize MathCAD when writing up the results. In anticipation of Mr. Garry’s retiring, in 2010 the department formed a committee charged with defining the intent of the lab and to formulate recommendations to the department regarding its delivery. This committee created a detailed course outline for the Calculus labs, including student learning outcomes, to accompany the course outline for the Calculus. Summarizing their results, the lab was intended to assist student learning by utilizing technology (specific technology was purposefully left up to the instructor) to provide numeric approximations and visualizations of key Calculus concepts. The lab was intended to proceed through the same conceptual topics, lagging just behind the lecture, thereby supplementing the lecture.

The committee also suggested that some Calculus instructors may wish to teach their own “labs”, thereby seamlessly threading the numeric approximation and visualization throughout their courses rather than setting aside a specific day and time each week for that purpose. Some instructors have since opted for that configuration with great success. Sadly, Mr. Garry has announced his retirement at the end of the 2012-2013 academic year. Given that we will be hiring an instructor whose primary responsibility will be to lead this aspect of the Calculus instruction, the department now recognizes that it is time once again to assess the Calculus labs, to come to agreement on what we envision for our Calculus instruction, to ensure that Mr. Garry’s replacement has clear guidance, supervision, and the full support of the department as we move forward.

Discrete Mathematics, Math 310

In Fall 2003 the department began offering Math 310 (Discrete Mathematics) to its majors. Math 310 is intended to provide the necessary foundation for understanding logic and related theorem proving techniques. It used to be taught by the Computer Science (CS) department and was required of all Math majors. Math students used to enroll in Math 310 and proceeded for the first 10 weeks together with computer science students enrolled in CS 215. At week 11 the two groups of students would separate and each would pursue its own curriculum. The department utilized Dr. Figueroa-Centeno's considerable experience in teaching this course and started offering its own course for Math majors only.

Topology, Math 314

In 2010, the department enhanced the list of elective Math courses offered to our majors by introducing a much needed course in Topology, Math 314. The newly hired in 2007 and 2008 Drs. Ruiz and Pelayo collaboratively developed the course based on topics courses in Topology they taught in Spring 2008 and Spring 2010, respectively. This course was designed to serve several purposes:

- i. provide a new transitional proof course;
- ii. introduce Math majors to topics and proof-techniques similar to those they will see in the required Real Analysis course; and
- iii. introduce topological concepts, which are many times pre-requisites for entry into graduate Math courses.

Since the creation of the Math 314 course, it was instructed once by Dr. Ruiz in Spring 2012. The department plans to offer this course every 2 years in the semester preceding Real Analysis I. The course offers a study of topological spaces and their continuous functions. Some important properties and characteristics of topologies such as compactness, Hausdorff, connectedness, metric, quotient, product, and subspace topologies are discussed. The course also provides our majors with valuable initial exposure to the Theory of Manifolds and Functional Analysis. With their extensive expertise, youthful enthusiasm, and love for Mathematics, Drs. Pelayo and Ruiz attracted a record number of majors to this challenging course.

Probability and Statistics, Math 121

Our Introductory Probability and Statistics course, Math 121, has been modified and is now technology based. Ten years ago we offered one section of the course each semester; we now offer four. The course is administered in a technology classroom where each student has a computer with access to the statistical package MINITAB. The students complete thirteen computer labs throughout the semester in which they investigate data analysis techniques as well as use Monte Carlo simulations to deepen their understanding of concepts involved in random sampling.

Developmental Mathematics, Math 103

In 2006 at the request of the administration and as part of the UHH NSF-funded STEM Grant administered by Dr. Sonia Juvik, the department designed and began offering Math 103, College Algebra. Math 103 is a developmental course intended for students who need to enroll in the Calculus but are not yet prepared to enter Pre-Calculus. Prior to offering Math 103 those students in the Calculus track with weak backgrounds were referred to the community colleges to complete their remedial work. During its first 3 – 4 years it was taught by Ms. Denise Luker, a dedicated lecturer who had excellent results. During the initial year, for example, the department asked students in Math 103 to retake the Compass Placement exam at the end of Math 103. The results that year were quite impressive. Approximately 90% of the students scored high enough to enter the next level of classes (i.e. Math 104F or 115). It should be noted, however, that over the next two years the average GPA in Math 103 dropped slightly and the DWF rates rose. In fact, in 2007-08 the DWF rate for Math 103 was almost 50%.

In 2008 the Mathematics Department hired Ms. Breyfogle as a full-time instructor, specifically to teach Math 103 and 104F, and also to lead the developmental effort for the department, to implement early intervention strategies for struggling students in both Math 103 and 104F, to implement better placement strategies for such students, and to develop assessment instruments for the same. Unfortunately, during Ms. Breyfogle's initial year, she was partially reassigned to the department's Math tutoring lab to replace Ms. Nadine Wolff, who had left the department to work in Colorado. Consequently, Ms. Breyfogle necessarily expended her time there and did not get a good start on leading the developmental effort. While she did a wonderful job teaching and began to make plans for improvements, her developmental efforts fell short of department expectations. Ms. Breyfogle unexpectedly retired at the beginning of the 2012-13 academic year and was replaced with an emergency hire. The department is currently searching for her replacement and has high hopes that with an explicit job description, supervision from the chair, and a unified vision of what the department wants, the replacement will move our developmental program to excellence. In the interim, discussions have already begun with Pearson publishing to run a pilot program next Fall that is designed to better identify specific student deficiencies and to provide those students with online practice-on-demand software. The department anticipates the new hire will play a pivotal role in directing that effort.

Trends

Math Tutoring Lab

The department's Math tutoring lab achieved recognition as the most utilized and vibrant support service on campus. During the early half of this review cycle it doubled the number of students serviced, increased its operating budget accordingly, and implemented a service learning component for future Math teachers that included weekly instructional meetings with Ms. Wolff, the lab supervisor. It outgrew its venue in CH-5, moved to the much larger room next door, and utilized STEM grant funding to refurbish.

Unfortunately, it was decided that all such student support mechanisms needed to be hosted under one organizational umbrella, called Kilohana. Thus, despite an MOU to the contrary written less than six months prior, in 2009 the department relinquished all control and contributions to the lab. The results have been unsatisfactory. The department intends to work closely with Kilohana to bring the lab, now known as the Math Center, back to its former glory. (See Future Goals at the end of this Program Review for more on Math tutoring.)

Math Center

The Math Center, housed in College Hall-5 and administered by Kilohana, offers free walk-in tutoring for most 100- and 200-level Mathematics courses at UHH. The tutors, who are mostly Mathematics majors, are recommended by Mathematics faculty and selected by the Math Center coordinator. Two of these coordinators have been recent UHH Mathematics graduates. In Spring 2012 this position was held by Ms. Zinat Rahman, who was also an adjunct member of the Mathematics Department, and since Fall 2012 it has been under the direct supervision of Kilohana. Having a coordinator with a dual appointment in the Math Center and the Mathematics Department is preferable as that situation fosters increased communication and cooperation between Mathematics faculty and Math Center tutors.

Beginning in Spring 2012, during the time of the dual appointment of Ms. Rahman, various initiatives were established to improve tutor preparation and interaction with faculty. Most notable was the Math Center Lualaba site, which provides a forum in which professors can post homework, quiz, and test information. Many tutors have commented that this site allows them to become better informed about specific course assignments and gives them opportunities to review relevant topics before interacting with students. Another initiative was the faculty-tutor mixer at the beginning of the term, which encouraged dialogue between Kilohana and the department and answered some initial logistical and pedagogical questions related to Math Center tutoring. As a result of these initiatives, Mathematics faculty were more supportive of the Math Center and encouraged their students to make use of this resource. Unfortunately, the connection between the Mathematics Department and Kilohana's Math Center continues to be tenuous at best and the future success of the Math Center seems to be in question. Math Center usage has dropped by more than half since 2007, while the lab was under the department's supervision, while the DWF rates have increased. The department looks forward to working with Kilohana to bring better services to our students. (See Future Goals at the end of this document.)

Professional Development

In 2010 Drs. Anderson and Pelayo responded to a DoE call for proposals to bridge the gap between university Math expectations and high school Math. They were awarded a grant to develop and administer a series of professional development workshops to Hawaii DoE in-service high school Math teachers. They ran four 5-hour workshops in Kona and eight 2.5-hour workshops in Hilo. Participants received PD credits and created

lesson plans based on what they had learned. Many of the participants continue to utilize what they learned and created in those workshops.

In 2011 Drs. Anderson and Pelayo, along with Dr. Barrett from Education, administered a one-day professional development workshop in Kona designed to familiarize the DoE in-service high school Math participants with the implications of the common core Math standards being adopted across the country. These workshops positioned Drs. Anderson, Pelayo, and Barrett for the necessary transition to the common core standards, resulting in the following contract.

Leading the Hawaii State Effort to Transition to the Math Common Core Standards

Recognizing that the average high school Math teacher would struggle with the transition to the new standards, Drs. Anderson, Pelayo, and Barrett developed a sample Algebra II course outline, aligned with the new standards, and presented it to the DoE. The DoE recognized its merit and asked the professors to take the lead in transitioning Hawaii high schools to the new Math standards. They were asked to expand the outline and to do the same for Algebra I and Geometry, and with the help of a team of nine teachers statewide to develop accompanying lesson plans, homework, handouts, and assessments, all tied to the new standards. This work is highly significant to the state and stands to make a positive impact. One of the teachers closely following a portion of the Algebra II outline reported that his students were much more engaged, seemed to truly understand the sophisticated concepts, and scored 10% higher on the end-of-course exam despite the fact that the exam questions were not written in the manner in which he taught. He is a long-time teacher and reported that such a difference in scores had never occurred in his department before.

Serving another College - Biostatistics, PHPP 508

In 2008 the College of Pharmacy (CoP) asked for help in developing and teaching a Biostatistics course, required for their accreditation. Dr. Bernstein developed the requested course, which was taught to all first year CoP students. The course was taught for four years by the Mathematics Department and the instructor was involved in the accreditation process, which included providing course materials for program assessment. In 2012 CoP hired a full-time faculty to teach the course.

Contributing to the Hawaiian Language Revitalization

In Fall 2012 one section of the 7-8 sections of Math 100 (Survey of Mathematics) offered each semester has been approved to be taught in Hawaiian. After the 90-year ban on the Hawaiian language as language of instruction at schools was lifted in the 1980s, there are now many students that have completed elementary and secondary education through Hawaiian language immersion schools and hence are fluent in the language; they are enthusiastic about taking Math 100 in Hawaiian. With this course, the Mathematics Department is the first after the Hawaiian Language Department at UHH to offer a

Hawaiian medium course, thereby substantially contributing to the tenuous process of Hawaiian language revitalization.

As further collaboration with the Hawaiian Language Department, graduating seniors of the Hawaiian language immersion high school (which is under the Hawaiian Language Department) are accepted into a section of Math 121 (Introduction to Statistics and Probability) above the course capacity of 25 students; the instructor, Dr. Lazarevich, sets an additional hour per week for these students as discussion section, thus easing their transition to university-level English medium courses.

V. Evidence of Program Quality

(Quantitative Data and Tables start on the next page)

Quantitative Data and Tables

Table 3.1 MATHEMATICS	Fall 2003	Fall 2004	Fall 2005	Fall 2006	Fall 2007	Fall 2008	Fall 2009	Fall 2010	Fall 2011	Fall 2012
1. Number of Majors	39	32	42	36	36	31	35	39	39	42
1a. % of College MJRs	1.6%	1.3%	1.6%	1.3%	1.3%	1.1%	1.2%	1.4%	1.3%	1.47%
1b. % of Division MJRs	5.1%	4.4%	5.4%	4.5%	4.6%	3.8%	4.1%	4.3%	4.6%	4.96%
2. SSH Generated, Fall Sem.	2,670	2,910	2,829	2,394	2,374	2,455	2,747	2,848	2,977	3,054
Lower Division	2,430	2,631	2,480	2,057	2,091	2,135	2,414	2,600	2,683	2,738
Upper Division	240	279	349	337	283	320	333	248	294	316
2a. % of College SSH	7.1%	8.3%	7.9%	6.6%	6.6%	6.8%	7.3%	7.7%	8.1%	8.20%
2b. % of Division SSH	21.4%	22.7%	22.1%	19.4%	19.5%	19.3%	20.1%	20.4%	23.7%	23.60%
3. FTE course enrollment	178.0	194.0	188.6	159.6	158.3	163.7	183.1	189.9	198.5	203.6
(SSH divided by 15)										
4. SSH generated by Majors	187	156	206	182	166	171	203	201	219	237
4a. % own majors	7.0%	5.4%	7.3%	7.6%	7.0%	7.0%	7.4%	7.1%	7.4%	7.76%
4b. % all others	93.0%	94.6%	92.7%	92.4%	93.0%	93.0%	92.6%	92.9%	92.6%	92.24%
5. Number sections offered	34	40	40	39	39	39	43	46	44	42
Lower Division	30	32	30	31	32	30	31	37	37	33
Upper Division	4	8	10	8	7	9	12	9	7	9
Fall Semester college CRN	634	663	698	688	694	725	709	741	685	718
Fall Semester division CRN	221	259	274	266	277	289	273	298	249	257
5a. % of College CRN	5.4%	6.0%	5.7%	5.7%	5.6%	5.4%	6.1%	6.2%	6.4%	5.85%
5b. % of Division CRN	15.4%	15.4%	14.6%	14.7%	14.1%	13.5%	15.8%	15.4%	17.7%	16.34%
6. Avg. class size										
Registrations/ no. classes										
LOWER DIVISION	24.4	25.3	24.5	19.9	19.8	21.6	23.8	21.8	22.8	25.18
UPPER DIVISION	20.0	20.3	14.6	18.3	14.4	13.7	14.7	12.2	19.2	18.4
7. FTE faculty--MATH	9.42	9.83	10.00	10.00	10.33	9.92	10.00	11.33	11.00	10.42
SH_TAUGHT	113	118	120	120	124	119	120	136	132	125
8. Student-faculty ratio (FTE enrollment / FTE faculty)	18.9	19.7	18.9	16.0	15.3	16.5	18.3	16.8	18.0	19.53
9. Number degrees earned	7	4	18	10	9	6	9	7	8	NA
9a. % College Degrees	1.7%	1.0%	3.6%	2.1%	1.8%	1.2%	1.8%	1.3%	1.40%	NA
9b. % Division Degrees	5.8%	4.0%	12.2%	7.1%	7.3%	3.5%	6.2%	3.9%	6.0%*	NA
10. Budget allocation										
11. Instructional Cost-- Fall										
LOWER DIVISION	\$154,632.7	\$183,595.8	\$167,902.3	\$195,886.3	\$220,909.5	\$220,492.1	\$235,626.3	\$252,185.7	\$269,439.9	
UPPER DIVISION	\$23,546.0	\$27,427.4	\$37,194.9	\$33,464.2	\$43,560.7	\$49,323.5	\$48,154.7	\$42,266.5	\$39,387.0	
12. Cost/SSH--Fall Semester										
LOWER DIVISION	\$102.4	\$58.5	\$66.7	\$86.7	\$113.5	\$93.0	\$83.9	\$100.0	\$107.0	
UPPER DIVISION	\$105.5	\$63.1	\$95.4	\$78.4	\$196.8	\$150.6	\$131.9	\$132.3	\$111.1	

Evidence of Student Success – Assessment Based

The Mathematics Department has engaged in multiple assessment efforts since the last program review, including efforts in its major program and its General Education/Service mission. As part of the 2008 campus-wide assessment effort, the Department developed student learning outcomes for its major program for both the traditional and teaching tracks, and developed a curriculum matrix that aligned those outcomes with its courses¹¹. At the same time the department developed a schedule for assessing the various outcomes throughout subsequent years, usually choosing two – three outcomes per year¹². Recent campus-wide developments have also required departments to assess institutional General Education goals. Fortunately, there is overlap in these two types of assessments. Our Calculus classes, for example, are an integral part of our major program, but are also part of the GenEd program and service numerous Natural Sciences (NS) departments and Pharmacy. Thus, in many instances, assessments for the program also gave us information regarding how well we are meeting institutional goals. The department engaged in eight assessment activities in recent years, four of which spanned more than one semester including one that spanned six semesters. These efforts are summarized in the table below. A detailed report is available in Appendix A¹³.

It is of particular interest to note that the department is striving to make assessment a more intuitive part of our work, an effort in which the department is attempting to involve a higher percentage of the faculty, and to encourage more discussion of how well we are meeting our mission. To that end, the department has updated its Assessment Plan¹⁴ and has adopted a user-friendly Annual Assessment Report Form¹⁵ that is used to identify two assessments each year and the faculty performing those assessments, and makes the reporting process and resulting discussions easier. It is the hope that such a plan and the availability of such a form will not only encourage broader participation in and spreading of the assessment load, but will also help to departmentalize assessment as a natural part of what we do.

Glossary of abbreviations:

SLO – Student Learning Outcomes (in general)

CLO – Course Learning Outcomes (SLO's from specific courses)

ILO – Institutional Learning Outcomes (Appendix A-Institutional Learning Outcomes)

PLO – (Math Department) Program Learning Outcomes (Appendix A – Curriculum Matrix)

¹¹ See Appendix A - Curriculum Matrix.

¹² See Appendix A - Math Department Major Assessment Timeline.

¹³ See Appendix A – Assessment Report

¹⁴ See Appendix A – Annual Assessment Plan

¹⁵ See Appendix A - Annual Assessment Report Form.

Summary of Assessment Efforts

All of the assessments except the one related to Analysis (Math 431-432) were direct assessments that embedded problems addressing specific learning outcomes or institutional goals directly into course exams. At least two faculty members met in each case to discuss the types of problems that should be assessed and the associated learning outcomes, and rubrics were jointly determined prior to scoring. In most instances, however, very little whole-department discussion occurred as a result of the assessments. This is a reflection of the department's somewhat indifferent "state of assessment readiness", which is currently only at an emerging level if viewed from the perspective of developing a "culture of assessment" as desired by WASC. Consequently, although the assessments were perhaps valuable to the faculty involved, who then used the results to "close the loop" and make adjustments to their teaching, the department is still struggling with implementing methods that would close the loop on a broader basis. As we implement our revised long-range Assessment Plan it appears inevitable that assessment will emerge as being inclusive across the department and, more importantly, more meaningful.

The details, results, and analysis of each assessment are located in the detailed assessment report in Appendix A. Each of the assessment efforts provided valuable information about how the department is reaching its learning outcomes' goals, particularly within certain courses. None of the assessments identified critical weaknesses, which, given our record of teaching excellence, is not entirely unexpected, except in the area of writing at the intermediate level. The quality of writing appears to have dropped over the past 10 years and an assessment was performed to verify. Some of the instructors in Math 205 and 206 have introduced short writing assignments with very specific learning objectives. Over the course of a single semester, the quality of writing appears to have notably improved. Future assessment efforts will assess these results more closely. The most useful quantitative reasoning assessments identified specific weaknesses in student understanding, usually in terms of the Analysis and Critical Thinking Institutional Goals and sometimes with respect to Program Learning Outcomes. The most detailed information of this type was gained in Math 206 and Math 311, Calculus II and Linear Algebra, respectively, which the department considers critical courses in terms of both the major and in serving Natural Sciences. The instructor(s) closed the loop in these two courses by addressing these weaknesses in various ways (see full report). The scores over multiple-semester assessments showed marked improvement in most cases.

Compilation of Assessments since the last Program Review

Timeframe	Faculty Involved	Classes Involved	SLO's Assessed
Sp 2011, Sp 2012	Diana Webb, Zorana Lazarevic, Efren Ruiz, Mitchell Anderson	Math 104F, 104G, and 104	QR ILO's (all 3 and Critical Thinking) Embedded Assessment
F 2011	Brian Wissman, Shuguang Li, Zorana Lazarevic, Mitchell Anderson	Math 205	QR ILO's (Computation) Embedded Assessment
F 2008 and F 2011	Efren Ruiz, Mitchell Anderson	Math 205	QR ILO's (Computation) Gateway Derivative Exams
F 09, Sp 10 (2), Su 11, F 11, Sp 12, Su 12, Sp 12	Mitchell Anderson, Brian Wissman	Math 206	QR ILO's (all 3 and Critical Thinking) Embedded Assessment
Sp 2012	Brian Wissman, Mitchell Anderson, Shuguang Li	Math 206	QR ILO's (all 3 & Critical Thinking), Comm ILO's (Organization & Structure, Line of Reasoning) Group Project
Sp 2012	Brian Wissman, Mitchell Anderson	Math 206	QR ILO's (all 3 and Critical Thinking) Embedded Assessment
Sp 2010, Sp 2012	Mitchell Anderson, Brian Wissman	Math 311	QR ILO's (all 3 and Critical Thinking) PLO's -- All
F 2010 – Sp 2011	Mitchell Anderson, Brian Wissman, Roberto Pelayo, Efren Ruiz	Math 431-432	QR ILO's (Analysis and Critical Thinking) PLO's – All Course Portfolio

Note: The full Assessment report is provided in Appendix A, along with several other related appendix documents.

Former Student Success

Since the last program review in 2003, the department has seen an increase in the number of declared majors and graduates. The Mathematics Department is now averaging approximately 36 majors and 9 graduates per year. In Spring 2013, we currently have 39 declared majors and anticipate 4-6 graduates this year.

Of the 70 majors that have graduated since 2003 (note: according to Alumni Database there were 91 graduates since 2003), 13 of these students have gone on to graduate school in STEM fields, with 7 out of the 13 going to graduate school in Mathematics. Fifteen of the 70 graduates are now educators either at the elementary or secondary level. Aside from servicing our majors, the faculty of the Mathematics Department has had direct and extensive contact with students in related fields, most prominently Physics, Astronomy,

and Computer Science. These are students whose Mathematics requirements are such that it is only natural that we have become mentors to many of them. Many of the students we have mentored have participated in summer internships and have gone to graduate school or have gotten jobs in their respective fields.

The Mathematics Department has implemented initiatives to increase the number of our majors going on to graduate school in Mathematics and/or careers in the Department of Education. Through grants from the National Science Foundation (see Grant Related Activities), we anticipate these numbers to increase by at least 25% in the next 5 years.

Evidence of Faculty Quality

Faculty Curriculum Vita are attached

Faculty Composition and Utility

During the past ten years the department hired three tenure-track faculty and two instructors to reach the number of total eleven full members. It is currently composed of seven tenure-track professors and four instructors. Specialty areas of the tenure-track professors and the years of service are listed below:

Name	Rank	Specialty	Year of Service
Raina "Reni" Ivanova	Professor	Geometry	11th
Mitchell Anderson	Associate Professor	Real Analysis	25th
Shuguang Li	Professor	Number Theory	14th
Ramón Figueroa-Centeno	Associate Professor	Graph Theory	11th
Brian Wissman	Associate Professor	Differential Eqns	6th
Efren Ruiz	Associate Professor	C*-Algebras	6th
Roberto Pelayo	Assistant Professor	Geom. Topology	5th
Robert Garry	Instructor	Technology/Educ.	14th
Erica Bernstein	Instructor	Harmonic Analysis	10th
Zorana Lazarevic	Instructor	Set-theor. Topology	8th
Diana Webb	Instructor	Algebra/Math Ed.	4th

All tenure-track faculty and Dr. Bernstein and Dr. Lazarevic hold a Ph.D. in Mathematics, while Mr. Garry and Ms. Webb hold a Master's Degree in Mathematics.

The tenure-track faculty members distribute their 9-credit teaching load per semester¹⁶ (usually 3 classes) between introductory and upper division courses, with a typical assignment being 2 introductory courses and 1 upper division course. Given that most

¹⁶ The Chair receives a one-course reduction per semester.

Math faculty members are capable and desire to teach a variety of upper division courses, the department attempts to be equitable and fair in assigning such duties.

The department also teaches a number of summer courses. Summer courses typically include one section each of Math 100, Pre-Calculus, Applied Calculus, Calculus I and II, and, less frequently, Linear Algebra and Ordinary Differential Equations.

Faculty Achievements in Scholarship

In the years since the last program review the number of professors in the department has almost doubled, which, given the strong and ongoing research programs of the faculty already present, has resulted in a productive decade for the department. Indeed, the faculty members have published a total of 46 papers, presenting their results at numerous national and international conferences. Moreover, several of the faculty members are very active as referees and reviewers for prestigious journals and associations. Also, a few have obtained grant funding for their research, which is rare in the field. Further details are available in the individual CV's included at the end of the review.

Grant Activity

The Mathematics faculty has consistently engaged in grant activity since its previous program review. In more recent years, though, the number of grant applications as well as the total dollar amounts requested and awarded has accelerated.

Grant activity can be categorized in terms of its intramural, state, or federal funding source. While the highest frequency of grant attempts and awards are intramural, larger amounts of funds are received from state and federal sources. Below is a summary of the department's grant activities and attempts within this trichotomy.

Intramural Funding

Almost all tenured and tenure-track Mathematics faculty have received intramural grant funding from a variety of sources, including the Research Relations fund, Faculty Development funds, CAS Dean's RTRF research funds, Seed grants, and Diversity and Equity Initiative funds. The majority of these funding requests were research or travel related; a few, however, do implement student-centered programs. Research-related intramural funds were used in Mathematical fields like Geometric Topology, Analytic Number Theory, and Analytic Geometry. Program-related intramural funds were utilized for sponsoring student travel to conferences.

State Funding

The sole source of non-intramural state funding is from the Hawaii Department of Education (DoE). Two grants were awarded from the same DoE request for proposals in 2009 using "No Child Left Behind" funds - one for providing professional development for Big Island DoE Algebra II teachers and the other establishing a K-5 Mathematics

Summer Institute. The latter grant was ultimately not accepted due to the departure of one of the Principal Investigators.

Federal Funding

Since the last program review, several Mathematics faculty members have applied for federal funding from the National Science Foundation (NSF), the National Institutes of Health (NIH), and the National Security Agency (NSA).

Mathematics faculty have applied for the following NSF grants:

- 3 Research in Undergraduate Institutions (RUI) grants
- 1 Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) grant
- 1 Research Experience for Undergraduates (REU) grant
- 1 Mentoring through Critical Transition Points (MCTP) grant
- 1 Noyce Teacher Training grant (HiNTS)

Of the above, two were awarded (one MCTP and one Noyce grant)

From the NIH, one faculty member attempted to obtain funding as an academic consultant to a Principal Investigator.

From the NSA, one grant was awarded as supplemental funding for a larger NSF MCTP grant.

The NSF PURE Math grant is **\$707,718** for UHH and equal amount for the partner institution, Sam Houston State University. The NSF HiNTS grant is **\$769,711**. The total for the NSA grant is **\$39,959**.

Observations and Trends

While intramural funding requests have remained relatively constant since the last program review, there has been a marked increase in the number of state and federal grant applications and awards. In particular, the Mathematics Department possesses the unique honor of having the only NSA grant in UHH history.

Also notable is an increase in collaborative grant activity. Such grants reflect the augmented value placed on inter-departmental and inter-disciplinary grant endeavors by state and federal funding agencies. In particular, two of the awarded state and federal grants have been inter-departmental (Mathematics and Education), and two of the awarded federal grants are joint with another institution (Sam Houston State University).

Grant Activity within the Mathematics Department also maintains a good balance between two of its majors focal areas: research and teacher training. In terms of research, two of the department's large federal grants focus on providing undergraduate research

experiences. Several attempts have also been made for more faculty-centered research in the areas of Analytic Number Theory and Differential Geometry. Teacher training and pedagogy related grants are also prevalent. The NSF Noyce grant provides scholarship for future teachers while one of the DoE grants funds professional development for in-service teachers.

Grant Review Panels

Two faculty members have served on grant review panels. A junior colleague has recently served on two NSF grant review panels. The Department Chair has served on 13 NSF panels. She has chaired a few university grant review panels, two NSF review panels, and has been an ad hoc reviewer for both NSF and academic research foundations overseas. She is a national mentor and advisor for the NSF Graduate Research Fellowship Program. Both colleagues have found this service to academia to be highly valuable and rewarding experience.

Peer Reviewers for Research Journals

Over the past ten years several faculty have been peer reviewers for selected prestigious Mathematical journals in America and Europe, as well as ad hoc reviewers of books and textbooks for major publishing companies.

VI. Future Program Goals and Resource Requirements

Future Goals

The department has achieved and surpassed its goals from the previous Program Review. The period since 2002 has been a time of steep professional growth and a striving for excellence. The department has transformed itself from one with seemingly high potential into a model department for the campus. With the enhancement of the teaching track and more offerings for those students following the traditional track, and with the variety of high quality extracurricular activities and initiatives for both, the department became a center for teaching excellence and advanced research, a hub of valuable professional teacher training for the state of Hawaii and a gravitational center for a national Summer REU serving the Pacific region. The research findings of some of our department members are recognized within both the national and international arenas. The service of some of our senior faculty to the UH System-wide Tenure and Review Process, UH Faculty Congress, UH Research Council, Accreditation, and various campus-wide committees is contributing to the improvement of the culture and academic life on campus. Our main goal now is to maintain this highest level of scholarship, teaching, and service for the years to come, while addressing the following specific goals.

Developmental

The department would like to improve its developmental program by designing and implementing a comprehensive agenda that better serves those students entering the science track. The success rate for students in Math 103 and 104F is far below what the

department deems acceptable. We need to better place these students, identify more quickly their individual strengths and weaknesses, and introduce support and intervention mechanisms that address the weaknesses on the one hand and on the other allow strengths to move students more quickly to their most appropriate level. The department is currently hiring an instructor whose responsibility it will be, under the supervision of the chair and the rest of the department, to provide new life and leadership to this critical endeavor. This endeavor needs to be assessed on a regular basis to show marked and continuous improvement. The newly developed assessment plan has been designed with this goal in mind.

Placement, Advising, and Student Support

The department would like to work with the administration and Kilohana to re-institute a more comprehensive student support system that begins with better Placement and Advising, includes intervention mechanisms as mentioned directly above, and a vibrant tutoring environment exemplified by the Math tutoring lab when it was under the supervision of the Mathematics Department. Moving to pre-built schedules required instituting a new placement mechanism and, more importantly, removed the most critical component of Math placement, personalized advising by expert Math faculty. The current mechanism for placing introductory students appears to be deficient, contributing heavily to an unacceptable number of students failing to pass Math 103, 104, 115, and 205, undoubtedly negatively impacting retention as well. Further, at-risk students seeking help at the Math Center are in many cases reporting that they are not receiving sufficient help and that they do not plan to return to seek further assistance. While the department has not attempted to collect data on this, it is apparent to the department that the Math Center is currently underperforming. Simply opening the door one can see that it obviously lacks its prior vigor and excitement, and reviewing the data shows it is currently supporting less than half the number of students previously utilizing its services. Since support is such a critical component of overall student success in Mathematics courses, the department would like to work with Kilohana to design and implement policies that will provide lasting success.

It is the department's expert view that the Math Center requires a dedicated Math faculty member as its supervisor, returning to the model of using a one-course reduction to a dedicated Math instructor. It is only in this way that the tutors can receive necessary instruction and supervision. After all, students seeking help bring to the tutors only the most difficult problems and concepts, and tutors must be able to understand and assist students from a wide variety of classes and instructors. The methods used by different Math faculty, even within a single course, can differ widely, and unless the tutor was instructed by the particular faculty member in question, may find it extremely difficult to identify the right orientation from which to provide help to the individual student seeking help. Under the previous Math tutoring lab, tutors attended a once-a-week mandatory session in which the supervisor addressed such issues, reviewing the content that appeared most difficult to tutor, and discussing tutoring strategies. Only a professional mathematician can provide this type of broad supervision, both in terms of content and pedagogy.

Calculus Instruction

The department will strive to maintain the highest level of instruction across its curriculum, moving steadily in the direction of excellence in *all* courses. The Calculus courses are currently in transition due to the retirement of Mr. Garry, its longtime instructor for the numeric/visual portion of Calculus I and II. The department is currently in the process of hiring Mr. Garry's replacement and would like to see the new instructor take a leadership role, under the supervision of the chair and the rest of the Mathematics Department, in designing and implementing a numeric/visual component of Calculus I and II. The department would like to see this component utilize current technological capabilities to provide the visual approximation component of the Calculus in as seamless a manner as possible, thoroughly enhancing the lecture sections.

Major Count

Although our major count has increased from approximately 30 to 40 majors, with 5 – 8 graduates per year, the department would like to see its major count increase for both tracks. The department has high expertise in both preparing future teachers and future mathematicians. It will leverage its teaching expertise through its teacher training program (HiNTS) and its statewide curriculum development effort to recruit and then train more future teachers, and it will leverage its research expertise through its summer REU PURE Math program to become a well-known center of excellence in preparing future mathematicians and a desirable destination for undergraduate Mathematics preparation.

Assessing the Department Mission

The department would like to better assess its multi-faceted instructional mission, including its service to non-science majors, developmental agenda, service to the natural sciences, and its two major tracks. The department has made great strides in assessment and has identified a reasonable assessment plan that will, over the next 5 – 7 years and with the help of the entire department, provide valuable information across its mission.

Current and Future Resource Requirements

Faculty

The number of students the Mathematics Department is asked to service appears higher than the department can accommodate. All of our lower division courses fill to full capacity. If the number of students continues to increase according to the popularity of the Natural Sciences and the approximate 5% per year growth of the general student body, the department anticipates the need to fill another faculty position in approximately five years.

As mentioned above, the department would like to immediately see a one-course reduction awarded to a faculty member, identified by the department, dedicated to supervising the Math Center in collaboration with Kilohana.

Operating Budget

As with most programs at UHH, securing adequate funding is a challenge that has only increased in recent years. The primary source of funding for the department is the annual operational B-Budget, which has been dwindling. These funds have historically been used primarily for operating expenses, office and instructional supplies, and faculty computers, software, and computer peripherals.

With one-time funding from Kealoha the Mathematics Department was able to renovate our (at the time) Math tutoring lab and our primary classroom CH-6. As noted above, long-term budgetary planning is essential. The little funds Summer school incentive” in the last two years could only partially help with basic supplies for the instructional needs of the department and our four lecturers. The department currently has sufficient computing equipment only because the Dean provided computing startup funds (hardware only) for the last five tenure-track faculty hires, 2002-2007. However, all of those computer systems will need to be replaced in the next two years, along with the rest of the department members’ computing needs. The B-budget is inadequate for this purpose, despite attempts to spread out the purchases. Funding will also be needed for the two new instructor hires in Spring 2013.

Facilities and Equipment

The department currently occupies 14 standard size offices (approx. 150 ft.²), three of which are used by lecturers. This allotment is adequate for the current configuration of faculty and lecturers. One larger room (approx. 1000 ft.²) was used for the Math tutoring lab. In 2009 the responsibility for that facility was assumed by Kilohana.

Classroom space in general has been marginally adequate over the past 10 years, albeit in high demand. The department’s teaching load is larger than most on campus, and yet it only has one dedicated teaching room, CH-6, with the heavy overflow taught in various other rooms in K-building and UCB. With the significant increase in the number of courses taught and the size of the department over the last few years, we are in constant need of adequate classrooms, with large white boards and modern equipment located in such a manner as to be able to access the projection screen and the white board simultaneously. Perhaps unlike other departments, apart from CH-6 we do not have designated classrooms for our classes. Consequently, scheduling classes has become more difficult than necessary. It creates constant frustration and multiple room changes with each the new course schedule.

Mathematics departments in general do not require an abundance of facilities and equipment, and our department is no exception. However, the constant problem is that

many Math classes are still being scheduled in inadequate classrooms with not enough chairs or too old chalk boards (K building), or too small white boards (UCB and MSB), or computer rooms with computer stations instead of tables for the students. In some of these rooms, the screen for the projector is located in front of the board, therefore making it impossible for the professor to use both the projector and the board. The Mathematics Department has expressed our needs for just a big white board and good working projector/computer equipment located at the side. The NS Division Chair supported the department's needs for functional classrooms and recommended usage of some rooms in the new ST building (STB) and the newly renovated W building. Beginning in Spring 2013, the department teaches a number of its courses in STB, which has very nice presentation technology and sufficient room. This is a huge help, although having dedicated classrooms would make the process much easier.

The Calculus labs are usually taught in electronic classrooms in UCB, as are all sections of Math 121 (Introductory Probability and Statistics). The computers are aging rapidly. A time frame and plan for their replacement would be helpful so that the teaching of these courses is not disrupted.

The department anticipates the need for continual upgrading of its instructional technology, particularly in CH-6, its primary classroom. The LCD projection system in CH-6 currently needs a new computer console; the computer there is one of the oldest on campus.

Library Facilities

The Mathematics Department does not require a great deal of library facilities. The library currently subscribes to the American Mathematical Monthly and the Mathematical Intelligencer, with older copies of the Intelligencer available online.¹⁷ As a necessary and sufficient resource for research articles, the department relies on MathSciNet¹⁸, which is a great improvement over past years when most journal articles had to come through inter-library loan from Manoa.

Department Chair's Evaluation

The UHH Mathematics Department has undergone a remarkable transformation since the last Program Review: new faculty have come on board, new courses have been offered, and our courses have record high enrollments. Great success did not come without a price. There were times of adjustments and learning to work together. Now the Chair is pleased to report that morale is high, the atmosphere is vibrant, and ownership and involvement is unanimous.

¹⁷ <http://library.uhh.hawaii.edu/cgi-bin/dbperl/ebSCO.pl>

¹⁸ http://library.uhh.hawaii.edu/math_index.htm

The most significant developments over the past ten years include the introduction and development of the teaching track into a major program, clear focus on servicing the Natural Sciences, and the department's ability to adjust to recent advances in technology by refining its first-year Calculus. As Calculus and Pre-Calculus play a central role in our major and those in the Natural Science, and accordingly in our mission, it is paramount that we deliver the best possible Calculus experience. Furthermore, developing several new courses has strengthened our majors' preparation for the challenges of graduate programs.

The scholarly achievements and plans of all faculty are ambitious but within their reach. The department has reached a record number of publications and grant funding awards. The senior faculty members are well sought-after experts at the state, national, and international level. Our younger colleagues, two of whom just received their Tenure and Promotion, have already made significant accomplishments and developed rigorous plans for the future.

More than ever before, the department is bubbling with activities. Below are a few of the many recent activities and commendations that bring pride to our department:

- two Board of Regents' Excellence in Teaching Awards;
- one Frances Davis Award for Excellence in Teaching at the Undergraduate Level;
- numerous student presentations at national conventions;
- faculty recognition at the international level;
- substantial NSF grants and Summer REUs;
- a re-invigorated Math Club hosting the Big Island Math League competition;
- regular end-of-the-year Mathematics Department student awards;
- creating our students' "Wall of Fame" and Motivation Corner for Math majors and minors
- participation in the national Putnam Competition Friday afternoon trainings
- professional development for in-service teachers
- working with the DoE on creating outlines and lesson plans tied to the new Common Core standards
- and so much more.

Every one of these new activities has given our math majors, our faculty, our UHH students, and our community fantastic opportunities that have greatly impacted numerous lives and careers.

The Mathematics department plays a key role in the NS Division. It initiated creating a new STEM Research Honors Certificate Program and, with the enthusiastic support from

all other Science departments, the program has recently been approved. With the STEM Honors Program, our excellent students' hard work will be recognized and rewarded. The STEM Honors Certificate will open many new doors for them and help shape their brighter future.

Our commitment to our students' success goes well beyond our classrooms. Numerous initiatives contribute to preparing our students for successful careers in Math and STEM. Among them:

- securing federal funding and hosting national undergraduate research experiences (REU's)
- participating at the National Putnam Lowell Competition
- founding our own chapter of STEM Honorary Societies (chapter of the national SACNAS)
- providing our students with exposure to national mathematics events and professional conferences
- advising them to reach a level worthy of national students' presentation awards
- helping them apply, get accepted, and excel in leading national summer REU's on the mainland
- mentor them to find their way to a prestigious international summer institute in Europe
- grooming and mentoring them for competitive submission of NSF grant proposals
- working with them and teaching them how to prepare impressive portfolios that secure their acceptance in leading graduate programs with generous scholarships (100K)
- helping them develop impeccable work ethics and professional integrity

The Mathematics Department turned into a cohesive and focused team working diligently and with enthusiasm to fulfill its former and current chair's vision for an *exemplary* department. We meet on a regular basis to discuss issues ranging from how to best serve our students to new curricula, and from research seminars to community outreach. We celebrate our successes and give a hand to a colleague's family in need. We meet socially beyond the offices, the classrooms, and conference rooms, and with our students in large and lively parties. All this is a part of a unique and pleasant small college experience for students and faculty alike. It is now common to hear comments from colleagues from the division and the college, as well from the Dean's and VCAA's offices, that the Mathematics Department has grown into a *model department*.

The Department Chair is proud to be part of this exiting period for the department- a period of outstanding accomplishments. She is confident that the department will keep the momentum and will maintain its exemplary performance at all levels for the years to come.

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## **VII. External Reviewer's Report**

### **UHH Mathematics Program: External Reviewer's Report**

**Written by Dr. Hongde Hu, Mathematics Chair and Professor, UC Monterey Bay**

**Submitted March 2, 2013.**

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#### **Introduction**

The faculty of the UHH Mathematics Department have done remarkable work to build and run an impressive mathematics Program. Their dedication, talent, and enthusiasm have drawn diverse students to the discipline, and the department has distinguished itself by undertaking an unusual effective program of value to the mathematics community over the last 10 years.

The delivery of the mathematics program is outstanding. The courses appear to be well-designed, with Student Learning Outcomes, Course Learning Outcomes, Program Learning Outcomes and Institutional Learning Outcomes built into the curriculum in sensible ways. Mathematics majors are being well served, and graduates are leaving with preparation that enables them to enter productive employment in quantitative fields or to continue study in a quantitative discipline.

The major has great potential to continue to grow and to thereby address the critical need in Hawaii for highly qualified math teachers as well as graduates for various technical fields. In my view, there is no question that this exemplary program will continue contributions significantly to the University and the mathematics community.

Given the nature of the UHH, a relatively small liberal arts (and science) institution, and the rate of growth of the mathematics program, I have suggestions on curriculum, faculty, and community outreach that I believe will help guiding the department to greater success in the future. My most immediate suggestions are to revamp the Developmental Mathematics Program and the Mathematics Center, institute an applied statistics program, and establish a plan of faculty development for both instructors and tenure track faculty in the department. Many other suggestions are also detailed.

I begin with the current state of the program and then suggest directions for future growth.

#### **The Current State of the Program**

The mathematics major is thriving. The remarkable record of professional accomplishments shows the department's excellence in all three areas: teaching, research

and service to the academic community. Further, the students I interviewed are extremely happy with the program and appear to be both prepared and motivated to be successful after graduation.

*Students* The UHH Mathematics Department produces outstanding math majors who receive prestigious fellowships to attend graduate school in top universities around the nation. The student population in the major is quite diverse. About 1/3 of the students I met were minority students and about 1/2 of the students were female. This last statistic is particularly high for mathematics programs, which historically have been male dominated. It is clear that these high percentages of minority and female students are due to several success programs, such as the UHH Math Club, STEM Research Honors Certificate Program, NSF funded the HiNTS Program and the summer Research Experience for Undergraduates (REU).

In two meetings with current students, I repeatedly heard that the strength of the department was its faculty. Students reported that faculty gave individual attention, were sensitive to student needs, volunteered to lead course/seminar offerings to facilitate timely graduation, and provided support for the transition to graduate studies, high school teaching, or industrial career pathways. The faculty attracted students to the study of mathematics, created a sense of community between students and faculty, and encouraged a sense of community between the students. Math majors seemed to fully understand the benefit of the problem solving skills and productive habits of mind that they gained in the department. The loyalty of students for the department is remarkable.

*Major curriculum* The department has established an excellent foundation for the curriculum of the major. Within the constraints imposed by a university just over 4000 students, the department has made very logical choices of offering rigorous courses to facilitate students timely graduation. The curriculum is efficient and effective. In particular, the department has very cleverly employed its research seminars and the UHH Mathematics Day to tailor projects to student interests and to thus address curricular deficiencies for students with particular learning goals. For example, to prepare for graduate school in pure mathematics, students often do a math project which the department isn't able to run a class in this standard subject. Similarly, there are many applied math projects being performed by students interested in industry or in graduate school, and also projects related to mathematics teaching and learning for those interested in the teaching profession.

*Service Curriculum* The department courses that serve other students and majors on campus are very good in terms of their current level of effectiveness. For example, the math course for computer science majors, the Pre-Calculus course and the calculus sequence, have been thoughtfully developed and/or updated. Other courses, for example, the developmental mathematics course, are in need of faculty attention. Suggestions for areas of emphasis will be given below.

*Faculty* The department have had many years of strong, competent chairs who are really interested in building up the department rather than padding their own *résumés*. Because

of the department maintaining a noncompetitive, supportive environment, faculty are generally very enthusiastic about their program. They seem to be thoughtful and excited about creating and developing both the degree and the service courses in the program. The teaching I observed showed great talent and promise. The faculty are very open to new ideas for improving and revising their teaching and their courses. The significant redesign of Math 310 and the newly developed Math 314 for the math majors provide the strong foundation for understanding logic and proof-techniques. Further, when one instructor had issues with some parts of the transition, it was a good sign that a senior faculty worked together with the instructor to work toward a course where both were happy. The department appears to be developing a culture of respect for each other.

*Community outreach* The department has also reached out to the larger community, primarily through its very active work with local mathematics teachers, such as the project on transitioning Hawaii DOE High School Mathematics to the new Common Core Standards . This level of involvement for a department of mathematics in K-12 outreach projects is unparalleled in the UH system. I believe that these local connections will raise the profile of UHH and lead more students to enroll. In particular, high school students with a potential interest in K-12 mathematics teaching will be much more likely to be sent to the UHH since their teachers will have experienced the UHH programs first-hand.

### **Suggested Directions for Future Growth**

I divide this section into three parts: (1) Service courses, (2) Courses for majors and minors, and (3) Faculty:

#### **(1) Service courses**

*Developmental Mathematics Program* Math 103, a developmental course intended for students who need to enroll in the Calculus but are not yet prepared to enter Pre-Calculus. The course catalog describes the course as being “For students who need to improve algebraic skills prior to taking Pre-calculus or Applied Calculus, or for courses in Introductory Chemistry, Physics or Statistics” but concerns about this goal being reached seem to be unanimous, though sometimes for different reasons, by the faculty from mathematics and their client quantitative disciplines. The success rate for students in Math 103 is below what the department deems acceptable. I would strongly recommend redesigning Math 103. The goal of the redesign should be to better prepare students for college-level mathematics, particularly those who are headed to quantitative disciplines like computing science, business, and natural sciences. The following issues should be addressed in the redesign:

- Rigor of the curriculum – students must have the opportunity to be well prepared for success in pre-calculus and beyond,
- Preparation of faculty – instructors and teaching assistants must have sufficient expertise in both the content and pedagogy of the developmental program, and
- Assessment of student achievement.

*The Math Center* No one in the department seems to be satisfied with the current state of the Math Center. I agree with the suggestion in the self-study that the Math Center Coordinator should have a dual appointment in the Math Center and the Mathematics Department in order to increase the communication and cooperation between the Mathematics Department and the Math Center. Under the general supervision of the Mathematics Department Chair, the Coordinator should act as the central resource where students, instructors, staff, and other interested parties may access information regarding the Developmental Mathematics Program at the UHH.

*The Math Placement* The UHH should require new students to be tested in mathematics as soon as possible after they are admitted and before enrolling at the UHH. One of very success math placement tests that has been using in the California State University System is the ENTRY LEVEL MATHEMATICS (ELM) Examination. The ELM is designed to assess and measure the level of mathematics coursework (Algebra I and II, and Geometry) of students entering the California State University. The ELM must be completed by all non-exempt entering undergraduates prior to enrollment in any course, including remedial courses. Students may be exempt from this test if they have scored well on other specified tests or have completed appropriate courses, such as a score of 550 or above on the mathematics section of the College Board SAT Reasoning Test or a College Board SAT Subject Test in Mathematics (level 1 or level 2).

*Scheduling* The department should be careful about having three hour math classes. Having two back-to-back Pre-Calculus will undoubtedly have a negative effect on the enthusiasm of even the best students.

*Statistics Education* With the high need for statistics courses that serve other students and majors at the UHH I suggest that the department faculty engage in dialogue regarding the long-term plans for developing the statistical education and expertise needed to support these programs. On far too many universities, a lack of advanced planning for statistics education has led to a duplication of course content, and a dilution of the expertise needed to support student study and research. Perhaps the Mathematics Department can take the lead in ensuring the statistical needs of the UHH community are vibrant, relevant, and truly interdisciplinary.

## **(2) Program and courses for majors and minors**

*An Applied Math/Statistics Concentration* The Mission statement for the degree includes “The major program is designed to prepare its students for successful careers in secondary education and other areas requiring a strong foundation in Mathematics, or for success at the graduate level, either in Mathematics or a related discipline”. The students seem to choose all three of these post-bachelor’s paths, but, at the moment, there are course concentrations only in “pure mathematics” and “education”, which primarily address only two of these three paths. To address the employment option better, I suggest a three course “Applied mathematics/Statistics” concentration.

## **(3) Faculty**

*Additional Faculty* With a worldwide need for statistical analysis, it will need at some

point to develop its statistics side at the UHH. In particular, I recommend that the department give serious consideration to hiring a Ph.D. statistician. With a statistician, the department can begin to form a statistics minor. If the department wants a major in statistics or actuary, there will need to be a number of statisticians hired for the programs to be credible.

*Professional development* The department currently works diligently and laudably to make sure that local K-12 teachers receive professional development. *Similarly, the university and the department should encourage professional development for its faculty, specifically its instructors and junior faculty.* From our individual conversations, it was clear that the instructors and tenure-track members are very excited about research, teaching and eager to improve their methods. This is particularly good to do early in teaching careers as it is much more difficult to change a teaching style that is repeated over too many years. There are many cost-effective ways to do this. The easiest is to develop a culture where faculty at all levels attend each other's classes (perhaps one class visit per semester) and *informally* discuss the class afterwards. For these discussions to be useful and allow faculty to exchange ideas freely, it is important that such discussions not be part of formal evaluations. Further, to prevent insularity, it is also important to support occasional trips for faculty to other universities to observe mathematics classes or to go to AMS/MAA conferences or, if they recently received their Ph.D., to be a part of Project NExT. This support should also be available for instructors who usually have less experience and background than their tenure-track colleagues and therefore need enrichment even more. Activities like this will keep the faculty thinking about fresh ways they can improve their teaching/research throughout their careers and lead to productive discussions about teaching that can improve department cohesiveness. The investment for such activities is small; the long-run pay-off can be huge.

*Summer Stipend* Since no math department supporting staff is available at the UHH and the department chair or her/his designee continues to be expected to manage the departmental issues and advising students, a summer stipend shall be needed. I hope these suggestions will help to improve what is already a thriving and successful department.

## VIII. MOU

**(Scanned and copied on the following pages.)**

**Memorandum of Understanding  
External Program Review  
Department of Mathematics  
College of Arts and Sciences  
April 2013**

Members of the Mathematics Department faculty, the Dean and Associate Dean of the College of Arts and Sciences, the Natural Sciences Division Chair, and the Vice Chancellor for Academic Affairs met on April 16, 2013 to review and discuss the Department's program review by Dr. Hongde Hu, Chair of the Mathematics Department at California State University – Monterey Bay. The group agreed upon the summary points and action plan that follow:

**Summary Facts:**

- 1) The Mathematics Department consists of seven tenure-track faculty members (Mitchell Anderson, Ramón Figueroa-Centeno-, Raina Ivanova, Shuguang Li, Roberto Pelayo, Efren Ruiz, and Brian Wissman) and four instructors (Erica Bernstein, Zorana Lazarevic, Zinat Rahman, and Aaron Tresham).
- 2) The Math Department averages (Fall 2009 – Fall 2012) 39 majors per year; 8 graduates per year; and 2,907 SSH per year. This compares to the NS Division averages of 83 majors, 14 graduates, and 1,310 SSH/year.
- 3) The Math Department has an FTE Student/FTE Faculty ratio of 18:1, and an SSH/FTE Faculty of 272, which is close to the NS Division average of 18:1 and 277 respectively.
- 4) The Math Department offers a B.A. degree.
- 5) The Math Department has a strong major curriculum that produces outstanding students, some of whom receive prestigious fellowships to attend graduate school in top universities around the nation.
- 6) The Math Department carries a heavy service load serving students and majors across the entire university. The external reviewer notes that the Math service courses (e.g., Pre-Calculus course and calculus sequence) have been thoughtfully developed and are all up-to-date.
- 7) The Math Department does a good job of reaching out to the larger community, primarily by supporting the Big Island Math League, and transitioning Hawaii DOE High School Mathematics to the new Common Core Standards.

**External Reviewer's Recommendations:**

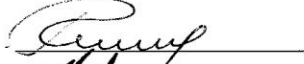
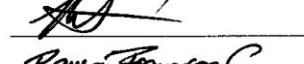
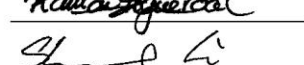

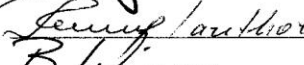
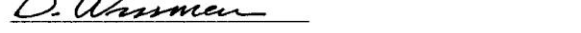

- 1) **Redesign Math 103.** The goal of the redesign should be to better prepare students for college-level mathematics, particularly those who are headed to quantitative disciplines like computing science, business, and natural sciences. The following issues should be addressed in the redesign: rigor of the curriculum – students must have the opportunity to be well prepared for success in pre-calculus and beyond, preparation of faculty – instructors must have sufficient expertise in both the content and pedagogy of the developmental program, and assessment of student achievement.
- 2) **Math Center Coordinator.** The Math Center Coordinator, currently under the auspices of the Kilohana Student Success Center, should have a dual appointment in the Math Center and the Mathematics Department in order to increase the communication and cooperation between the Mathematics Department and the Math Center. Under the general supervision of the Mathematics Department Chair, the Coordinator should act as the central resource where students, instructors, staff, and other interested parties may access information regarding the Developmental Mathematics Program at the UHH.

- 3) **Math Placement.** The Math Department, and UHH, should reconsider its current method of placing students in Math courses. One very successful math placement exam is the ENTRY LEVEL MATHEMATICS (ELM) Examination. The ELM exam is designed to assess and measure the level of mathematics coursework (Algebra I and II, and Geometry) of students entering the university. UHH might consider coupling this exam with face-to-face advising during orientation week to ensure that students are placed in the proper level of mathematics classes.
- 4) **Applied Math/Statistics Concentration.** With the high need for statistics courses that serve other students and majors at the UHH, the Math Department should engage in dialogue regarding the long-term plans for developing the statistical education concentration or track. An Applied Math/Statistics concentration could prepare Math graduates to directly enter the workforce in high-paying careers. A related recommendation is for the department to hire a Ph.D. statistician in its next hire.


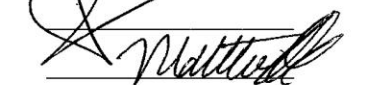

**Math Department Action Plan:**

- 1) The Math Department will engage in a comprehensive redesign of its MATH 103 course in accordance with the recommendation of the external reviewer. Newly hired instructor, Zinat Rahman, under the supervision and guidance of the department, is charged with implementing this redesign.
- 2) The Chair of the Math Department will continue to serve as a liaison between the department and Kilohana Student Success Center. With the VCAA's approval, Ms. Zinat Rahman, under the supervision of the Department Chair, will serve as Math Tutor Coordinator in the Math Center. She will have one course release (or equivalent) to perform her duties as academic advisor and coordinator for the Math tutors.
- 3) With the goal of ensuring proper placement for students, the Math department will collaborate with the VCAA to optimize the placement process into all introductory math courses.
- 4) The Math department welcomes the idea of expanding its program by developing a statistics and or applied Math concentration. This is understood to be a large undertaking and we will work with the VCAA to identify the process.
- 5) The Math Department serves the entire university and requires an upgrade of its teaching classroom in College Hall, room 6. A new teaching station is required that contains a projector, ELMO, computer station, and internet access. In addition, the chalk boards in its Kanakaole Building classroom need to be replaced with large white boards. The Dean of CAS will consult with Dr. Robert Chi about upgrading the teaching station in CH-6 and the blackboards in K-Building.
- 6) The department anticipates the need to upgrade to a new Calculus 1-2 computational platform, which may include new software and hardware. The department needs a priority scheduling commitment for the suitable electronic classrooms for our Math 121 (Intro to Statistics and Probability) courses. Math 121 is a GE requirement with high enrollment.
- 7) The Math Department expresses our appreciation for the External Reviewer's helpful recommendations and for the Dean's and VCAA's continuing support in implementing them.

**Departmental Approvals:**

Raina Ivanova, Chair   
Mitchell Anderson   
Ramón Figueroa-Centeno   
Shuguang Li   
Roberto Pelayo   
Efren Ruiz   
Brian Wissman 

**Administration Approvals:**

Ernest Kho, Natural Sciences Division Chair   
Randy Hirokawa, CAS Dean   
Matthew Platz, VCAA 

Erica Bernstein

E. Buhr

Zorana Lazarevic

Zorana Lazarevic

Zinat Rahman

Zinat Rahman

Aaron Tresham

Aaron Tresham

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