MATHEMATICS PROGRAM

EXTERNAL REVIEW REPORT

University of Arkansas at Monticello
School of Mathematical and Natural Sciences

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OVERVIEW

This report is based upon a review of the Fall 2012 Mathematics Program Review (MPR} provided by UAM and upon Mathematical Association of America's (MAA} Committee on Undergraduate Mathematics Programs (CUPM} publications and recommendations. As a native of Monticello, AR, 1986 magna cum laude graduate of the Mathematics program at UAM, and as a member of the Salem College (Winston-Salem, NC} mathematics faculty since 1993, I am very familiar with the challenges, opportunities, and issues related to an academic program that must serve many with few resources. I believe that the Mathematics Program at UAM is meeting the needs of all of its constituents and is doing so in a manner which is both reflective and effective.

l. REVIEW OF PROGRAM GOALS, OBJECTIVES AND ACTIVITIES

The program's student learning goals are appropriate for an institution of the size of UAM, especially in light of the student population that UAM has traditionally served and continues to serve. The assessment of all aspects of the Program adhere to institutional and system-wide standards of assessment, including the Review upon which this report is based.

The rural nature and low population density of its geographic proximity, coupled with its open-access admissions policy, UAM and its Mathematics Program will likely be filling this role for many years to come. With students arriving with wide-ranging preparation, the necessity for remedial courses is not only met by the Program's faculty but is also embraced by them. With approximately 65%[1] of entering freshmen requiring at least one remedial mathematics course, the Program and its faculty are taking on a role that a community college would normally assume.

The use of the ASSET examination to assess student proficiency in Intermediate Algebra prior to permitting students to enroll in college-level mathematics courses demonstrates a commitment on the part of the program to not only assess student learning but also to assist in the revision of the placement process and the improvement of the delivery of the remedial courses. At many institutions, the teaching of remedial courses is often relegated to inadequately trained graduate teaching assistants or to adjunct faculty with little or no vested interest in the individual student's success. The Program is to be commended for providing students with full- time faculty as instructors in these important, often life changing, courses.

The Program provides appropriate courses that serve the general education of each UAM student as well as mathematics majors and future mathematics educators. It is difficult to find a

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[1] MPR, p. 4.

balance between meaningful topics for those who will take only one or two courses from the Program and appropriate rigor for those who intend to major in mathematics. In its internal review, the Program clearly documents its commitment to improving instruction and student learning through regular assessment of its faculty (currently via CourseEvals®) and a review of student performance on standardized examinations such as the PRAXIS II®[2] and GRE®. These results, along with anecdotal evidence regarding public school teachers who are alumni of the program[3], indicate that the Program is well aware of the value of assessment and utilizes such assessment appropriately.

For example, the adoption of ALEKS® in remedial courses and WebAssign® in College Algebra demonstrates the attention the Program is giving to improving student learning in those courses[4]. In addition, the dividing of Multi-Dimensional Calculus and Differential Equations into two 3-semester-hour segments demonstrates that the Program is paying attention to the needs of other students it serves, particularly those planning to transfer to an engineering program or to continue to graduate school after UAM[5].

The MPR lists numerous activities which serve a variety of student populations. Student participation in service projects (such as the ACTM Regional Mathematics Contest)[6], faculty involvement in the Southeast Arkansas Math and Science Alliance[7], and the UAM Math Tutor Group[8] show that the Program is attempting to maintain high visibility and recognition, both internally and externally.

The demand for citizens with highly quantitative backgrounds is a focal point of many states', indeed the USA's, plans for the 21st Century. UAM's Mathematics Program is playing its part in these plans well by providing Southeast Arkansas's citizenry with the opportunity to enroll in mathematics courses from the remedial to the advanced. It is clear from the MPR that most significant demand for the Program's courses comes from those who plan to pursue a career as a mathematics educator in a public school system. The *Initial Placement of Graduates, 2002 - 2012,* provided as Appendix G of the MPR, shows that the majority of program graduates completed the MAT program and/or are teaching in Arkansas or one its neighboring states. Through the development and delivery of the mathematics courses which support the MAT program and the secondary education program, the Mathematics Program has adapted to meet this demand.

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[2] MPR p. 25.
[3] MPR, p. 36.
[4] MPR, p. 8.
[5] MPR, p. 8.
[6] MPR, p. 2.
[7] MPR, p. 2.
[8] MPR, p. 2.

Course enrollments are quite high in the lower-level and remedial courses, as one would expect. Enrollments in <u>Spring 2013</u> demonstrate that there is a high need for remedial courses (16 sections, range: 6 - 32 students} and that the Program faculty are certainly meeting that need. Enrollments in upper-level courses are, also as one would expect, do not enjoy the same demand, with five courses offered which satisfy major requirements and with enrollments ranging from 2 to 9 in four of those (Calculus I: 29 students}[9].

The organization Teach Arkansas [10] displays Drew County as a critical-need area and mathematics as a critical-need discipline for the entire state. UAM is playing and should continue to play a significant, impactful role in alleviating this criticality. Future generations of Arkansans, particularly Southeast Arkansans, will look to UAM as a leader in preparing mathematics educators within the surrounding communities.

The resources that the Mathematics Program requires in order to continue to meet its goals and to serve its constituents should be met by the UAM governing bodies and the University system without hesitation. Resources such as additional full-time faculty, updated computing facilities, updated classrooms that support innovative pedagogy, and lively areas for students to meet, study, engage in projects, or to engage in peer-tutoring activities are a necessity. It is important for the preparation of 21st Century teachers to include 21st Century, cutting-edge technology and facilities.

II. REVIEW OF PROGRAM CURRICULUM

The program's curriculum is certainly appropriate to meet current and future needs and to prepare students for advanced study. The required core courses for the major in mathematics are compatible with CUPM guidelines, with the inclusion of the Mathematics Seminar beingone of the most important of those requirements for the preparation of students to pursue graduate work in mathematics or an allied discipline.

Mathematics majors, regardless of their chosen career paths, must be able to communicate mathematical and quantitative information through both the spoken and written word. While many may argue with my point here, words are *the* most powerful tool of the mathematician- if I cannot explain in words what my mathematics means, then my mathematics is meaningless. Thus, I am pleased to see the Mathematics Seminar in the major requirements.

There are sufficient electives available to mathematics majors to round out their curriculum, including History of Mathematics, Number Theory, College Geometry and Discrete

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[9]   http://www.uamont.edu/classschedules/UAM_1T_004.pdf
[10] http://www.teacharkansas.org/critical-shortage-areas.html

Mathematics. The eight-semester, plan included as Appendix A of the MPR, clearly demonstrates how a student without adequate preparation could begin her/his pursuit of the mathematics major with College Algebra and Trigonometry and still complete degree requirements in four years.

The only topic I see missing from the undergraduate program is the topic of introductory analysis, which some institutions call "Advanced Calculus" or "Introduction to Real Analysis". I believe that such a course is an essential component of the undergraduate education for any student interested in pursuing graduate level work in mathematics. However, there may not be a current faculty member eligible or comfortable enough with the subject matter, so adding such a course might require a new hire.

I am pleased to see that a minor is *required* in order to pursue the major in mathematics. It is important for students of mathematics to recognize the connections that mathematics has to other disciplines, such as Chemistry, Computer Science, Economics and Physics. Mathematics, from its birth, has been an interdisciplinary entity, and the Program's students are provided with ample opportunity to experience this via the required minor.

The syllabi included with the report show the use of well-respected texts (such as Stewart's *Calculus Concepts and Contexts* and Hungerford's *Abstract Algebra),* of important technology (TI-83® and TI-84® series calculators, Maple®, MS® Excel®), and appropriate supplementary materials that are either supplied by the textbook publishers or prepared by the Program's faculty. These components along with the course topic outlines incorporated into the syllabi demonstrate that the faculty are well aware of the national trends in content, delivery, and pedagogy in undergraduate mathematics at all levels.

III. REVIEW OF ACADEMIC SUPPORT

The Mathematics Program provides suppose to students through its Math Tutor Group[11] by providing peer-tutoring opportunities to those who need it. The employment of nearly all mathematics majors as tutors functions in two ways-to benefit lower level students and to hone the skills of majors [12]. Such peer-tutoring endeavors are typical of undergraduate mathematics programs at most colleges and universities. Like most of these programs, the UAM tutoring program clearly needs a formal, physical home in a comfortable and welcoming location that is in close proximity to the Program's classrooms and faculty[13]

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[1] MPR,
[12] MPR, p. 3.
13 MPR, p. 3.

The undergraduate research project involving cluster computing is an important opportunity for students majoring in mathematics as it supports their academic growth through participation in state and regional professional meetings[14] Additional undergraduate research opportunities may be available through independent study or through the Mathematics Seminar, and such opportunities should be increased and varied by encouraging more Program faculty to sponsor such endeavors.

Recruitment and retention of mathematics majors is an issue at almost every small to medium sized college or university. The development of relationships with local high schools and faculty participation in recruiting events and follow-up to those events show that the Program is keenly aware of the need to recruit quality students into the major[15] By hosting mathematics contests[16] and Advanced Placement prep sessions[17] the faculty are doing their best to ensure that UAM's Program is visible within the region.

IV. REVIEW OF PROGRAM FACULTY

The curriculum vitae provided with the MPR as Appendix E indicate that the Program employs faculty who are credentialed and qualified to teach the courses they are charged to teach. The faculty are evaluated annually through processes mandated by the institution and its governing body, and exhibit an appropriate level of professional activity for an institution of the size and mission of UAM. All faculty participate in the

The teaching load borders on excessive, especially instructors. Those who hold the rank of Assistant Professor or higher are required to teach 12 credit hours per term (3 – 4 courses); those who hold the rank of Instructor are required to teach 15 credit hours per term[18] Instructors do not teach courses at or above the level of Calculus I.

The faculty workload table on page 14 of the MPR includes an acronym (SSCH) that I surmise has something to do with credit hours taught and student head-count. If my assumption about this acronym is correct, a review of these numbers shows that the Program's faculty are bearing a significant burden. what the numbers in the table show is that 9 full-time faculty were responsible for the mathematics education of 5966 students during the Fall 2011 and Spring 2012 semesters. Even with the use of WebAssign, ALEKS, and other web-based assignment collection and grading tools, this is a weighty responsibility. I have no doubt, based on the MPR and the reflective formative assessment and the obvious affinity for the students at all levels

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[14] MPR, p. 3.
[15] MPR, p. 23.
[16] MPR, p. 2.
[17] MPR, p. 23.
[18] MPR, p. 13.

that the Program emphasized therein, that the faculty have met this responsibility admirably. However, with an apparent average of approximately 330 students per semester per faculty member, it seems that any professional activity in which the Program's faculty engage would require amazing feats of time management.

While there are no national standards or universally adopted best practices that mandate a maximum class-size for remedial mathematics or for courses like College Algebra, Trigonometry or Calculus, my experience has been that these courses require the most one-on-one faculty-to-student interaction of all the courses offered by a mathematics department or program. To facilitate the success of these students, and to provide them with the personalized attention that they require, it would be ideal, in my opinion, to keep the enrollments in these courses capped at 16 – 20 students.

V. REVIEW OF PROGRAM RESOURCES

The MPR provided detail regarding the recent use of faculty development funds[19], access of library resources[20], and equipment purchases[21]. These resources are minimally adequate to support a program that serves so many students in such varying capacities. There should be an institutional plan to keep the mathematics classrooms and mathematics faculty equipped with the most currently available technologies and to train the faculty in those technologies so that they may impart their knowledge to future teachers. Current technology does not always need to equate to exorbitant expense. For example, the statistical computing environment R® is free, extensible, and quickly becoming the industry standard for statistical computing across many disciplines. There are options out there for minimum or no-cost reputable software, but the Program's faculty would need to be trained in the use of this software and trained in the teaching of the use of the software-that is where the bigger expenses lie, of course.

Every classroom, every faculty office, every student study space should be equipped with state-of-the-art equipment and software in order to adequately prepare students for the rapid changes in pedagogy and instructional technology. Ten computers in the only Science Center computer lab is not sufficient to support student learning, nor is outdated software[22]'

There is an expressed need in the MPR for an improved physical learning environment, in particular, a new Science Center[23]. Any efforts to improve the recruitment and retention of

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[19] MPR, p. 15.
[20] MPR, p. 16-17.
[21] MPR, p. 17.
[22] MPR, p. 39.
[23] MPR, p. 39.

highly qualified students into the mathematics and sciences must include improvements to the teaching and learning spaces for those students.

VI. REVIEW OF PROGRAM EFFECTIVENESS

The Mathematics Program at UAM has great strengths. In addition to those mentioned elsewhere in this review, the following strengths are worthy of note:

- Qualified faculty dedicated to the mission of the Program, the Division and the University and to all students admitted by UAM;
- Sufficient course offerings to support under-prepared students admitted to the University;
- Sufficient course offerings to support the major in Mathematics;
- Sufficient course offerings to support the MAT program to prepare highly-qualified secondary mathematics teachers;
- Excellent rapport and interaction with other programs within the School of Mathematics and Natural Sciences;
- Willingness of Program faculty to host or participate in outreach activities, such as mathematics contests, exam prep, and science fairs, all of which support the visibility of the Program and emphasize the dedication of its faculty.

Areas which need attention within the next 12 months are:

- A full-scale review of the student-to-faculty ratio, particularly in remedial courses, College Algebra, and Trigonometry, to determine the ideal ratio and to facilitate the hiring of new full-time faculty to teach more sections of those courses;
- Consideration of the addition of an elective course in Advanced Calculus (Introduction to Real Analysis};
- The development of a plan to improve faculty and student access to current technologies to support 21st Century teaching and learning;
- The development of a more focused Exit Interview that asks graduates to reflect upon their experiences within the Mathematics Program and the School of Mathematics and Natural Sciences, rather than about UAM in general.

Areas which need attention within the next 2 - 5 years are:

- The development of a plan for upgrading all classrooms, computing resources and learning spaces;

- The development of a plan for increasing faculty participation in regional and national conferences and other professional activity by reducing the teaching load and/or hiring additional faculty to support smaller class sizes;
- In collaboration with the admissions staff, develop a focused plan to attract and retain potential mathematics majors.

Being familiar with the Southeast Arkansas region, I realize that job opportunities for students are limited by the major industries in the area-paper production, forestry services, health care and education. However, there are some markets that UAM could serve that would take students to other regions of the state upon graduation or prepare them for graduate study in areas that are becoming more important in our technological age. Thus, below I will mention areas for *possible* program development that have not been identified elsewhere in this document:

- Consideration of requiring a computer programming course {C++® or Java®) for mathematics majors;
- Consideration of additional upper-level courses in probability and statistics {mathematical statistics, nonparametric statistics, mathematics of finance) to prepare students for a potential career as an actuary, which is one of the fastest growing careers in the country24;
- Consideration of partnerships with other programs and departments to develop interdisciplinary majors and improve student's post-graduate job placement {eg., mathematical business, mathematical biology, biostatistics).

VII. REVIEW OF INSTRUCTION BY DISTANCE TECHNOLOGY

I wholeheartedly agree with the statement in the MPR that "face-to-face course instruction is far superior to on-line or even Compressed Interactive Video {CIV) courses" and applaud the faculty in the Program for being honest about this in their report[25] Yes, such offerings are heaper for an institution, but there is no published evidence to support the claim that on-line or distance courses in mathematics are in any way comparable to or superior to the type of instruction delivered by the faculty at UAM.

VIII. REVIEW OF PROGRAM RESEARCH AND SERVICE

The Program regularly participates in formative assessment of its major, minor, courses, and faculty. The results of these are addressed elsewhere in this document. One assessment not yet

[24] http://beanactuary.com
[25] MPR, p. 18.

addressed is the Exit Interview described on pages 35 – 37 of the MPR. Graduating seniors invited to participate, though not all do. Those who participate in the Exit Interview are asked 14 questions, ranging from very broad questions about UAM to more narrow questions about their major. The summary of the responses that is included on page 36 leads me to believe that a shorter list of more focused questions would better assist the Mathematics Program in its assessment. For example, the question, "What about UAM would you change if you were chancellor for the day?" does not appear to elicit responses related to the Mathematics Program or the School of Natural Sciences and Mathematics.

IX. LOCAL REVIEW COMMENTS

The faculty in the Program are well aware of the need for more STEM graduates in the region and the state[26] They are also well aware of the importance of preparing students to become excellent mathematics teachers in the public school systems. I believe that by increasing the size of the full-time mathematics faculty to facilitate smaller class sizes in the remedial and freshman level mathematics courses, as well as to offer more courses in areas such as statistics, the Program will be well positioned to produce graduates who will be prepared for emerging 21st Century occupations.

X. REPORT SUMMARY

The faculty in the Mathematics Program clearly understand and embrace the populations that they serve. A strong, dedicated, committed group of mathematics faculty, I hope they realize their importance to the future of the region. Their reflective assessments and logical responses to those assessments are evident throughout the Mathematics Program Review and they are to be commended for carrying the great burden of serving every student admitted by the University of Arkansas, Monticello.

Without a strong Mathematics Program and a strong Mathematics faculty, the University, the city, the county and the region would be in dire straits. The University and its governing bodies should make every effort to support the Program and its growing importance to our technologically driven society.

[26] MPR, p. 37.