University of California Merced
Applied Mathematical Sciences Undergraduate Program Review Committee Report June 2010

§1. Summary

The Applied Mathematical Sciences (AMS) faculty have in just five years established the AMS Undergraduate Program as one of the best run undergraduate programs at UC Merced. The AMS faculty work exceptionally well together, and are hailed as one of the best academic units in their home School of Natural Sciences. We, the program review committee, are particularly impressed by AMS faculty's dedication to teaching and serving the students of UC Merced.

The AMS faculty are poised to raise the AMS Undergraduate Program to an even higher level of excellence over the next several years. The AMS Undergraduate Program needs a greater diversity of core course offerings, and needs the existing course offerings to be offered more frequently. The AMS faculty need to reduce parts of their administrative workload so that they can concentrate more effort on developing the AMS degree programs and serving the UC Merced students they teach. Some additional communication should be encouraged between the AMS faculty and AMS students to further facilitate the flow of information about the program and its goals. To address these needs, the AMS program will require additional resources in the near future. While we recognize the challenge of providing resources in this challenging economic environment, the AMS program is a critical component of the UC Merced plan for excellence and needs to be supported. In the concluding section, we give specific recommendations for resources that will aid the AMS faculty in their efforts to improve the program as recommended.

§2. Program Review Process

The program review process has been based upon the recommended procedures established in the UC Merced Undergraduate Program Review Guidelines. The AMS faculty completed their self review of the AMS Undergraduate Program and submitted summary documentation of their self study in March 2010. In April 2010, a review committee was formed including: (i) a member of the UC Merced Undergraduate Council who served as chair (Peter Vanderschraaf), (ii) two UC Merced faculty members who are work fields related to but other than AMS (Carlos Coimbra and Anne Kelley), and (iii) an external reviewer who is prominent in the field of AMS and is outside UC Merced (John Lowengrub). After studying the summary documentation of the self study, on May 10, 2010, this review committee met and interviewed specific individuals and groups who will contribute significantly to the future of the program under review. Specifically, the program review committee met with and interviewed (in the following order):

- Executive Vice Chancellor and Provost Keith Alley

- Faculty of the AMS Program
- Undergraduate students majoring in AMS
- Dean of Natural Sciences Maria Pallavicini
- School of Natural Sciences staff who provide significant support for the AMS Program
- Professor Arnold Kim, Chair of the AMS Program

Immediately upon completion of these meetings, the program review committee discussed the strengths and weaknesses of the AMS Undergraduate Program and recommendations for improving this program. This report summarizes these discussions.

The program review committee commends the AMS faculty for their fine work in preparing for and executing their parts of this review process, particularly in light of the fact that the AMS Undergraduate Program is being reviewed for the first time.

§2. Program Assessment

The AMS Undergraduate Program is very strong. This is particularly striking given the youth of this program, as the AMS faculty developed their first strategic plan in the Spring of 2005 and the major was first available for UC Merced students in the 2006-2007 academic year. This program both provides students with rigorous training in applied mathematics and allows them the flexibility of tailoring their undergraduate programs so that they may apply their mathematical training to natural, social and computational sciences of their specific interests. This AMS undergraduate program is unusual compared with nearly all other American undergraduate programs in applied mathematics in that UC Merced AMS students are expected to gain extensive experience in application fields. This program requires nearly as many units in application fields (19-20 units) as it requires in the upper division core AMS courses (24 units). The AMS faculty have worked hard to make the program straightforward to navigate and work hard to ensure on-time graduate rates. Indeed, their work has borne fruit with 7 students graduating in 2009 (as part of the first full graduating class of UC Merced) and 6 students likely graduating in 2010.

Under Professor Kim's excellent leadership, the program has recruited and nurtured a group of dynamic young faculty who demonstrate excellence in teaching, administration and research. The eight senate AMS faculty function very well as a group and have excellent morale. The faculty are proactive in identifying and addressing problems in the program as they arise or are anticipated to arise. We include a representative comment from one of the meetings: “Applied Math functions as a group. They get things done before they need reminding.” Morale is clearly high among the AMS faculty. We found it striking to learn that while junior faculty in the School of Natural Sciences may upon request receive formal faculty mentoring, none of the

untenured AMS faculty have opted to seek formal mentoring. We believe a large share of the credit for the fine synergy of the AMS group goes to Professor Kim.

We were struck by how consistently the AMS faculty were praised for their commitment to quality teaching and to serving their students both in and out of the classroom. Numbers fully support the comments we heard in meetings. For the nine semesters for which relevant data are available, the lowest average overall course evaluation score each semester for AMS courses is 6.13 (for Fall 05, the earliest of these nine semesters) on a scale of 0.00 to 7.00, with 7.00 denoting the highest rating.

The AMS undergraduate majors are found to be generally very happy with their program. The undergraduate AMS students we interviewed commented very positively on their interactions with faculty and lecturers. They reported they found AMS courses to be useful with the lower division courses providing a good foundation for the upper division courses. They observed that each AMS student has a good working relationship with at least one AMS professor.

The AMS program has an outstanding record of undergraduate student scholarship. The number of peer-reviewed publications that involve undergraduates substantively is exceptional for American mathematics or applied mathematics programs. Generally, it is difficult for undergraduate students to perform research in mathematics due to the large body of basic knowledge that is typically required for students to become sufficiently proficient to perform research-level contributions.

In the near future, the AMS faculty needs to work on three areas in order to bring the AMS undergraduate program to a new level of excellence for which they already aim. First, and foremost, the AMS faculty need to diversify their upper division course offerings and to offer their core upper division courses more frequently. The current backbone of the AMS undergraduate program is a core of upper division courses in differential equations and linear algebra. The AMS students would be served even better if they had available to them courses in other areas of applied mathematics such as probability, statistics and discrete mathematics. The AMS students expressed a strong desire for a greater variety of upper division AMS courses. They also stated that they would like to have the option of taking a larger share of their required course work from the AMS program itself rather than from the emphasis track disciplines. Additionally, they stated that they thought that in some cases, core AMS courses were offered too infrequently, making it both somewhat hard to complete the major requirements in four years and somewhat difficult to maintain the continuity of their learning advanced applied mathematics. Professor Kim and the rest of the AMS faculty are already well aware of the need for a greater variety of courses, and explicitly stated that they wish to add courses in stochastic processes as soon as possible.

Second, the AMS faculty need to spend significantly less time on administrative tasks so that they can focus more on their primary missions of teaching and research. In the meetings with the

School of Natural Sciences staff and with Dean Pallavicini, concerns were raised that the AMS faculty devote too large a share of their time to administrative service and to managing remedial courses. The AMS faculty themselves stressed both in their written summary of their self study and in person that managing some of the lower division AMS courses, especially Math 5 (the precalculus course) has become a serious strain for them. The management of these lower division courses, which includes supervising and mentoring a number of part time lecturers of highly variable ability and temperament, is draining far too much time that AMS faculty should be devoting towards teaching their core courses and further developing both the AMS undergraduate and graduate programs. Moreover, as the AMS faculty noted in their self study summary report, their work on assessment of their program learning outcomes forced them to divert too much time from their service to students. Even with the aid of a staff coordinator that Professor Kim managed to hire for a time on a half time basis, the AMS faculty reported that they found themselves conflicted and somewhat frustrated because their work on program assessment cost them too much time away from their other scholarly duties. Unless action is taken to reduce the AMS faculty's administrative workload, this problem will become far more acute now that the half time AMS staff coordinator has resigned and no funding for a replacement staff position is available.

Third, the AMS faculty should work on improving their channels of communication, both with students and with the programs that serve the emphasis tracks of the undergraduate major. The undergraduate AMS majors expressed concerns that the required courses in the disciplines of the emphasis tracks did not always give them the opportunity to apply in a significant manner the mathematics they were learning in their AMS core courses. They also reported that on occasion they were assigned homework that required the use of computer software for which they felt they were insufficiently proficient in using. A few AMS majors were evidently unaware at the start of the program that they have the option of designing their own emphasis track. Given the AMS faculty's stellar record of teaching and collegiality, these concerns should be regarded as minor blemishes and can be addressed with measures as simple as a handful of additional meetings between students and faculty.

§3. Recommendations

The program review committee recommends the following:

1. The AMS Program should be given more faculty positions, which are a necessary condition for enabling the AMS faculty to diversify their upper division and graduate course offerings and to complete the establishment of leading undergraduate and graduate programs. In line with this more general recommendation, we make the following more specific recommendations:

1A. The university should support without reservation the AMS Program's plan to add ladder faculty at the rate of one per year for at least the next three years, as they have specifically

proposed. Ideally the policy of adding one ladder faculty per year should continue well beyond the next three years.

1B. A formal Visiting Assistant Professor program should be established. The faculty participating in such a program could help relieve the stress on the lower division courses as well as providing research expertise to help teach upper division courses and enhance the research base of the program.

1C. A formal Visiting Professor Program for senior-level faculty should also be established. A senior faculty member can help with teaching of core and elective courses. Such a faculty member can help provide advice and guidance for the developing program, help spread the word of the strength of the fledging program at UC Merced, thus helping to recruit students, and provide students with an additional perspective on research-level mathematics.

1D. The AMS faculty should continue their efforts to add senior level faculty. Senior faculty will serve a variety of current and future needs of the AMS Program, including some relief of administrative duties for junior faculty, the mentoring of future junior faculty, and an intellectual "magnet" that will attract even better undergraduate and graduate students.

2. The Math 5 course should be maintained in its current form of small, highly interactive classes. We recommend that the AMS faculty and the School and University Administration work together to provide a solution for maintaining the high-quality and successful instruction of Math 5. Given the importance of this course to students across many disciplines, it is important that the best instruction possible be given to these students. The offering of small classes with significant student-faculty interaction is a national trend in the mathematical sciences because it provides the best environment for students to learn highly technical subject matter.

3. The reliance upon lecturers for lower division courses should be reduced. In line with the university mission, more AMS undergraduate courses at the lower division level should be taught by ladder faculty. Moreover, the management of and mentoring of part-time lecturers is proving to be a significant administrative burden for the AMS faculty and this burden should be reduced as much as possible.

4. The AMS Program should introduce a new emphasis track in mathematical analysis for the undergraduate major. This track would provide the necessary training for those students who are interested in going on to graduate studies in mathematics.

5. Better communication between AMS faculty and students and faculty from emphasis track disciplines should be established. In particular, every effort should be made to emphasize to the students early on that they may design their own emphasis tracks. The AMS faculty might consider one additional meeting a year each between AMS faculty and students and AMS faculty and representative faculty in emphasis track disciplines in order to discuss issues related to the

undergraduate major, such as diversifying course offerings by utilizing faculty across departments and modifying existing courses to better tie content across the disciplines.

6. This program should be provided a dedicated Program Coordinator. The AMS faculty have led the effort at UC Merced to use quantitative data to continually assess and revise the program. However, as they have noted, the lack of dedicated staff support has seriously impeded their ability to complete necessary program assessment while maintaining their high standards of service to the student body. Having a coordinator dedicated to this effort will enable the program to continue to move forward and help to relieve the administrative burden on the young and active faculty members. While we recognize the difficulties in allocating resources in the current economic environment, having a coordinator shared among many academic units in the School of Natural Sciences (e.g. Biology, Chemistry, Physics, ESS) does not provide a sufficient level of support to achieve excellence in program assessment.

Review Committee Members

4 June 2010_____

Carlos Coimbra, Associate Professor of Mechanical Engineering, UC Merced

4 June 2010_____

Anne Kelley, Professor of Chemistry, UC Merced

4 June 2010_____

John Lowengrub, Chancellor's Professor of Mathematics, UC Irvine

5 June 2010_____

Peter Vanderschraaf (chair), Associate Professor of Philosophy, UC Merced