

February 1, 2018

**PROFESSOR LEI NI, Chair**  
**Department of Mathematics**

SUBJECT: Undergraduate Program Review for the Department of Mathematics

Dear Professor Ni,

The Undergraduate Council discussed the Department of Mathematics 2017 Undergraduate Program Review. The Council supports the findings and recommendations of the review subcommittee and appreciates the thoughtful and proactive response from the Department. The Council's comments centered on the following:

**Advising.** The Council echoed the concerns of the review subcommittee in regards to quality of student advising. We understand that the Department plans to hire a new student affairs staff member, and we look forward to hearing about the additional staff member's impact on students' experience with advising.

**Faculty.** The Council was encouraged to hear about the Excellence Positions within the Division of Physical Sciences, which allow Departments to offer faculty positions to those who promote diversity and inclusion in the academic environment. It is UGC's hope that the Department of Mathematics will continue its efforts in actively recruiting and hiring women and underrepresented minority faculty.

The Council will conduct its follow-up review of the Department in Winter 2019. At that time, our goal is to learn about the Department's progress in implementing the recommendations of the program review subcommittee and the Undergraduate Council. The Council extends its thanks to the Department for their engagement in this process and we look forward to the continued discussion.

Sincerely,

Sam Rickless, Chair  
Undergraduate Council

Attachment

(1) Undergraduate Program Review Report and Responses for Mathematics

cc: F. Ackerman  
S. Boggs  
J. Eggers  
R. Horwitz  
J. Moore  
R. Rodriguez  
M. Sidney

**Undergraduate Program Review  
Department of Mathematics  
UCSD  
May 15-16, 2017**

**Introduction**

The Undergraduate Program Review Committee for the Department of Mathematics met on May 15 and 16, 2017. The committee had previously received material from the Chair of UGC and the Associate Vice Chancellor for Undergraduate Education (AVCUE). This material included (1) two letters dated July 5, 2016 and October 14, 2016 from the chair of UGC to the chair of the Department of Mathematics, (2) the Department's Self-Study report dated February 15, 2017, (3) supporting material, including course schedule and enrollment data, courses taught, grade distribution by courses, funding and support summary, instructor ratings from CAPE, faculty workload policies, teaching statistics for mathematics, physical sciences and the general campus, ladder-rank faculty demographics, degree requirements, degrees awarded, distribution of majors by college, data collected by the Office of the AVCUE, retention and time to degree, UCEUS results, alumni survey, UCSD Career services survey, and (4) the report of the last review of mathematics in 2008 and subsequent letters from the chairs of mathematics, the chair of UGC and the acting Dean of the Division of Physical Sciences.

The committee met on May 15th with the Associate Vice Chancellor for Academic Affairs/Dean of Undergraduate Education, with the Department Chair, Vice Chair of Undergraduate Studies, with Senate Faculty, with the Student Affairs Officers and Business Officer, with Teaching Assistants and with the undergraduates. On May 16th, the committee met with a representative from the College Deans of Academic Advising, with Department Non-Senate Faculty, once again with the Department Chair, Vice Chair of Undergraduate Studies, the Associate Vice Chancellor for Academic Affairs/Dean of Undergraduate Education, together with the Associate Divisional Dean, Assistant Dean of Undergraduate Education, and Senate Analyst.

**Description of the current operation of the department**

The department currently has 55 Academic Senate faculty, including four LSOE/LPSOE. Last year was a very successful recruitment season, so six new faculty members will be joining in the fall. There is a Department Chair (Lei Ni), an Undergraduate Vice Chair (Patrick Fitzsimmons) and a Graduate Vice Chair (Hans Wenzl). The department has an MSO (Molly Love) and 19 other staff members. Currently the math department has eight Warschawski Assistant Professors, that will grow to sixteen in next year. The Warschawski Assistant Professors have been key in helping with teaching, especially in the upper division lectures. There are 94 PhD students, about 40 MA students, and about 40 CSME Masters students, and approximately 2,350-2,400 undergraduate majors. The number of students in math majors has exploded in the last few years. The department has put on cap of 600 new majors each year as of Fall 2016. In addition, the department has screening criteria for continuing students (Math 18, 20ABCD). The

UCSD mathematics department includes statistics, while other UCs have a separate Statistics Department. For comparison, when math and statistics departments are combined, UCB has 87 faculty, UC Davis 71, UCLA 65, UCI 56, and a large postdocs program. In the period from 2012-2016, the Math department has grown in terms of undergraduate math majors from 572 to 2395 (>318% increase), but the number of faculty increased by only two - from 53 to 55. As of 2016, the ratio of undergraduate math majors to faculty is 44:1. In comparison, the next highest ratio in UC system is at UCLA at approximately 15:1.

The department provides service teaching to the whole campus, with approximately 20,000 students enrolled per year (360:1 student to math faculty ratio). Service teaching covers precalculus, calculus and probability, including 3C, 4C, 15, 18, the 10A-B-C sequence and 20 A-B-C-D-E sequence. There have been a number of course changes. Most notably, renumbering Math 20F to Math 18 (Linear Algebra) and removing Multivariable calculus as a prerequisite has enabled shorter time to degree. Math 2 (Introduction to College Math) has been added for students who lack the foundational mathematics skills necessary to fully benefit from a course in PreCalculus. As a part of the newly developed interdisciplinary major in Data Science, Math department has created Data Analysis and Inference (Math 189/289C), and optimization courses (Math 173A-B). Lastly, there is a new course on Mathematics of Modern Cryptography.

The department has eight majors. Almost all the majors have dramatically increased in the number of students. Math-Computer Science, Applied Math, Probability and Statistics majors have increased five to ten times. As a result, upper division have grown in size: many are over 100, and some even over 300. The department also offers an honors program, undergraduate colloquium and research opportunities, tutoring labs, a student-run math club, San Diego math circle (for grades 5-12), alumni contact and career seminars. It currently has two Research Training Groups funded by NSF which has undergraduate research component.

The standard faculty course load is 4 per year, with no credit for mentoring Ph.D. students. Classes are distributed among the entire ladder-rank staff. Most lower-division classes are taught by Lectures and Visitors. The department has a Faculty Teaching committee, and has recently added Warschawski Assistant Professors Teaching Committee. Members of these committees attend classes of any instructor and prepare a written report that is shared with the instructor and is filed as a peer-written supplement to CAPE reviews. Every teaching visitor is observed at least once during their first quarter at UCSD.

The staffing levels are insufficient to handle the current load of students. Department has two advising officers, each advising a portion of undergraduate and graduate students (one advises MS students, the other PhD). There are three instructional support staff. Each of the eight majors has one or two faculty advisors available. The department has leveraged as much as possible the group advising model to handle the increasing student numbers. In addition, there is a student affairs committee that meets quarterly to bring up areas of concern, work on initiatives, and enact changes.

### **Analysis of strengths and weaknesses of the department's program**

The committee was very impressed with the quality of the department's undergraduate program. Faculty, S.E. Warschawski Assistant Professors, lecturers, TAs and staff are doing an outstanding job at providing excellent education to majors, and non-majors.

The department currently offers eight majors: Pure Math, Applied Math, Scientific Computation, Probability and Statistics, Math-Applied Science, Math-Secondary Education, Math-Computer Science, Math and Economics (the latter is a joint major with Economics). It is excellent that since the last review all major programs but the major in Mathematics-Secondary Education which is a B.A, have become B.S. degrees. This better reflects the nature of the programs. More recently, the department has joined with the Computer Science and Cognitive Science departments in creating a new major on data sciences. The department also offers minors in Math and Math-Education. The students would benefit if the department could generalize and simplify requirements for the majors, and possibly remove some majors (e.g. Math-Scientific Computing). Better communication with the other departments would be very helpful to ensure that the students understand what is involved and are able to progress in their major on timely basis.

Math department's undergraduate major population has grown rapidly since the last undergraduate program review, thus dramatically changing both the size of the student body and their needs. While in the past this department has primarily focused on providing an excellent service to the campus through teaching a number of service courses, namely Math 10 and Math 20 sequences, now with the dramatic growth of math majors, there is a new demand for a larger variety of both lower and upper division math courses, in addition to a larger need to engage undergraduate students in research.

One of key strengths of this department is their commitment to education and training. Impressively, this spans from very popular outreach programs for 5-12<sup>th</sup> grade called San Diego Math Circle that include 240 students, to undergraduate math club SUMS, tutoring club, undergraduate research, honors classes, math internship course through which students can get credit for their internships, and even alumni career seminars. The dedication and effort of the professors, the visiting instructors, the graduate students and the staff is impressive and has shown great results.

Since the last review, the department has implemented a number of changes. Improvements in administration and advising were very helpful. There are two advising officers, each with graduate and undergraduate students to advise. In addition to this, each of the eight majors has one or two faculty advisors for consultation. The advising officers have moved to a group model of advising due to a large number of students in the department with mixed results. A greeter at the front desk was much appreciated by students. The Director of Instructional Support and the Student Affairs Manager have gone above and beyond the call of duty to help students and staff and to ensure that everything runs as smoothly as possible, and as a result, they are overwhelmed. It is clear that the department is still understaffed.

The department hired two more LPSOE to help address the exponential enrollment growth. The idea of expanding the postdoc and SEW program has been well received by all in the department and seems to be a good strategy to address some of the concerns related to skyrocketing enrollments. The department has added a faculty teaching committee that has been very helpful to both the new faculty, SEWs, and faculty who needed additional help. Members of this committee attend classes of an instructor and prepare a written report that is shared with the instructor and is added as supplement to CAPE reviews. Median CAPE score for department faculty is 90%, which is very high, and 81.4% for teaching visitors. The department has done a good job of better supporting their teaching visitors by ensuring that each gets a faculty member as a mentor. However, a number of comments from individuals within the department indicate that the training is not consistent enough, and that more feedback would be helpful. Across board, all teaching faculty, postdocs and SEWs liked coordinated classrooms. One of the issues raised was related to training & recruitment of TAs. Half of the TAs are not from Math department. The TA training is primarily done by a senior TA, which the committee did not feel was appropriate – at least one faculty member should be involved in the process of training TAs. Center for teaching and learning should be better leveraged as well; right now it seems to be utilized by graduate students to prepare them for TA positions, but postdocs and visiting scholars could also benefit from the center's resources.

Student affairs committee has been formed to ensure that the department addresses any areas of concern, and that it communicates with one voice to the community at large. However, there is a significant lack of communication between faculty and chair & the faculty, leading to the faculty's lack of cohesive understanding regarding undergraduate education issues. Faculty meetings have been dominated by AdHoc presentations. The department should ensure that there is a consistent time and place to discuss other issues relevant to the department's operation in order to give the faculty and the chair an opportunity to both provide feedback and to make joint decisions. The department needs to address the diversity of the faculty in the department better so that they can better serve the needs of URM students

Research continues to be an important area of strength in the Math department. Both graduate and undergraduate students spoke very highly of the research done in the department, and stated that this was one of the main reasons for coming to the department. Math department has done an amazing job of reaching into the community and should try to leverage that to attract top talent to its program. A big strength is the departments summer program that prepares new students for the school year. This needs to be more uniformly leveraged, and expanded if possible.

The department has worked very hard to provide excellent service to the university in teaching undergraduate math classes, including recently offering Math 2 which should be taken by students who are not ready for college math yet. There was a mismatch between teaching resources provided and the number of students that actually came to the Math 2 classroom last year that will hopefully be addressed by requiring students to take Math 2 class if the placement exam indicates they need to. There has been excellent collaboration with the Director of Math Testing and Placement, this should continue to be leveraged going forward.

## **Recommendations to the Department**

The committee would like to commend the department on its achievements/improvements in the domain of undergraduate education. In particular, the department has done a heroic job dealing with an enormous growth in their undergraduate student population.

1. The faculty are strongly encouraged to create a forum/space to frequently discuss, formulate, and decide various policies and issues affecting the undergraduate mission of the department. There is an evident lack of communication among faculty, faculty and staff, faculty and the department chair. This lack of communication could be costly for the department and of major consequence for the students and the staff. The faculty are encouraged to build consensus around important issues such as impaction, class size limits, grading policies.
2. The department is encouraged to think about providing a consistent space for the students to form study groups, socialize, and discuss courses. The students complained about the difficulty to meet other Math majors as this lack of space seems to prevent the students to identify and form a community. This not only significantly impacts the undergraduate experience at UCSD, but also results in a higher advising workload.
3. The department has agreed to provide an important service to the campus by providing MATH2, Introduction to College Math, for those students whose pre-college training severely lacks appropriate mathematics training. To make sure this resource is fully utilized by the students, the department has taken up the responsibility of reaching out to the students. Despite this, a majority of the students placed in MATH2 have not so. Overall, this seems to have caused a lot of confusions in the department.

In our discussions with the college advising staff, it became clear that one key problem was that the online registration system allowed the students placed in MATH2 to register in MATH3C. Furthermore, some students who were placed in MATH2 ended up realizing their major does not require calculus. We encourage the department to take a lead in communicating with other entities involved in teaching and administering MATH2.

It is important for the university to clarify the advising responsibility of colleges versus the department's role to ensure a full utilization of MATH2 course offerings. While the college advisors seemed to be very much involved, the Math faculty and staff seem less integrated in the process. We recommend the department to build a stronger line of communications with the college advisors.

While many among the faculty seem to be in support of the department's involvement in coordinating MATH2, the degree of the faculty support for the program or faculty's familiarity with important aspects are unclear. For instance, some members of the faculty stated that they were not certain as how/if the administration of the program provides or drains the teaching resources of the depart, how/if the courses would count towards graduation requirements, etc. The committee strongly urges the department to bring this issue to a departmental wide meeting/discussion/vote.

4. Many undergraduate students, particularly those majored in pure mathematics, seem thirsty for more upper division mathematics courses. But they receive little guidance as how to navigate the seeming gap between introduction to some core mathematics courses, such as

analysis, algebra, and topology, and the more advanced graduate offerings. The committee would like to encourage the department to strengthen their upper division offerings in more advanced topics.

5. The department is strongly encouraged to consider incorporating the role of undergraduate research in their undergraduate education. The stellar research record of the faculty at UCSD can uniquely enrich the undergraduate education. In fact, our research visibility is what sets us apart from teaching institutions and as such our undergraduate students must be exposed and integrated in these activities. We advise the department to increase the number of advanced topic reading groups and encourage a broader participation of the undergraduate students in various research activities of the department.
6. The department is encouraged to revamp their website and online resources for the students. Given the large body of the students who are served by the department, the current website and online resources are insufficient. This also affects the pure math majors who have a lot of flexibility in the choice of the electives. The committee recommends that the department posts on line some sample course plans for the students.
7. Some undergraduate student growth in mathematics, evidently, has been due to an increase in the number of international student admissions. The international students have a higher degree of familiarity with basic calculus topics but cannot use the AP waiver option. This seems to create some challenges to teaching the lower division classes. The committee would like to encourage the department to address this issue.
8. The review committee is extremely concerned about the quality of the advising the undergraduate students receive. The student evaluations reflect serious concerns with the staff advisors; furthermore, the extremely rare interactions with faculty advisors is alarming. Lastly, a particular staff member has consistently gotten poor comments from the students and yet no effort seems to have been made to address this issue.
9. The department needs to take a more active role in hiring underrepresented minority faculty. While the undergraduate student body includes 12% Hispanic students and very few (<1%) African American or American Indian students, there are no URM faculty in the department who could be described by any of these categories. The department did list 9 female faculty (15% of the total), with 6 ladder-rank faculty. Undergraduate female student population was 39% in 2015.
10. The review committee was encouraged by the department's comprehensive efforts to improve on their teaching preparations for non-ladder-rank and junior faculty. However, the committee felt that the reports available did not fully document the departmental efforts and/or detailed analysis needed to provide a complete picture. More specifically, the committee makes the following recommendations:
  - a. The committee finds the CAPE scatterplots and the spread of course evaluation across courses and instructors problematic. To understand and remedy the concerns regarding the CAPE scatterplots, it seems critical that the department provides further detailed analysis. For instance, it would be helpful to categorize the data based on the lower versus upper division courses, service versus major courses, instructors' experience, teaching versus research faculty, etc.
  - b. The committee would like to encourage the department to document departmental training efforts and the corresponding statistics in order to identify best practices. The committee is

concerned that while much training has been put in place, it has not been consistently leveraged. In particular, the committee hopes such data collection process to assess the effectiveness of teaching preparation and other training methods.

- c. The transfer students (from community colleges) seem to have a particularly longer time-to-degree. Collecting data on what the source of this longer time-to-degree could be extremely helpful. The department (advising staff and the chair) speculated that the soon to be in place “transfer major prep” will address the issue. Collecting data will enable the department to identify other potential sources, such as additional need for advising.

### **Recommendations to the Administration**

The campus seems to be struggling with an unplanned growth in the undergraduate student population in STEM and Computer Science. The faculty at many departments, by and large, have been caught unprepared for this growth. This has not only affected the quality of teaching that the faculty provides, but also has had unfair impact on the students’ lives and experience at UCSD and beyond. While Mathematics department has done a heroic job dealing with an enormous growth in their undergraduate student population, it is apparent to the committee that the issues facing the department, to a great degree, are issues to be addressed by the UC administration to help the department cope with this challenge. In particular, the growth of the undergraduate student body must be accompanied by the growth of the department overall.

As a research institution, it is critical for the department to grow its research profile and ladder rank faculty proportional to its undergraduate population. The existing undergraduate program and curriculum, in terms of course offering as well as availability of TAs, do not meet the needs of the increasing number of student majoring in the mathematics. There are critical needs for an increased number of FTEs who can teach upper division mathematics courses. Without such increase in the number of FTEs, the total number of PhD students cannot increase to a level appropriate for the teaching and research needs of the department. While we commend the UCSD administration in leading the way in expanding the admissions of the students who are historically under-represented and poorly prepared for STEM fields, we feel that the administration should take a more active role in helping prepare them for success.

Professor Tajana S. Rosing, Program Review Chair, Department of CSE, UCSD

Professor Tara Javidi, Department of ECE, UCSD

Professor Guofang Wei, Department of Mathematics, UCSB