The on-site visit by the external review committee occurred on April 15, 2016. This report is based on information taken from the departmental self-study (provided in advance to the external review committee members), interviews with Dean Lindquist, with Department Chair Toda, with the Department Administration, with faculty and with graduate students, as well as a tour of the Mathematics and Statistics Building.

As requested, my report emphasizes those aspects of the graduate program connected to pure mathematics.

1. Academic Unit Description, Vision and Strategic Plan

The Department of Mathematics and Statistics is a large and active unit. The department’s faculty and graduate students bear a heavy service teaching load, which impacts the education of students across campus. The size of the department’s graduate program has increased in recent years, and the current number of graduate students is a historical maximum for the department. The number of PhDs awarded annually has simultaneously increased.

The range of faculty expertise covers most major branches of pure mathematics, with concentrations in several areas with particular connections to both applied math and statistics. Faculty productivity is quite good, especially considering the heavy teaching and graduate mentoring load. The department promotes its own national visibility through annual and periodic events such as the Red Raider Mini-Symposium, the Texas Geometry and Topology Conference, and the Departmental Distinguished Lecturer Series, all of which regularly attract prominent scholars to visit the campus.

The current department administration is providing effective leadership and has a clear vision for the department’s short term and long term future which is consistent with the mission statement of the department, the strategic goals of the college, and the Tier I research status of the campus. The department is well positioned to increase its standing and the reputation of its graduate program, if provided with suitable resources and support from the college and campus administration.

2. Program Curriculum

The department offers both an MA and an MS degree in Mathematics, as well as a PhD. Additional degrees are offered in Statistics.

PhD students must complete Preliminary Exams (3 chosen from a list of 8), a Qualifying Exam and a thesis defence (typically done as a departmental colloquium). The number and type of requirements is consistent with peer and aspirational institutions. The list of graduate courses covers all major areas of pure mathematics, focusing on the existing strengths of the faculty.
The overall course load for graduate students is high, even though it has already been reduced somewhat since the previous graduate program review. When coupled with heavy teaching obligations, this large course load leaves little time for students to effectively develop their own research program and gain requisite professional experience through conference participation, short-term research visits to other institutions, and similar activities. As a result, students are at a disadvantage when competing for postdoctoral or entry-level faculty positions upon graduation.

In particular, all courses leading up to the preliminary exams are two-semester sequences. This course load puts a serious burden upon first- and second-year grad students, who are also likely to be less experienced as classroom instructors themselves. One suggestion would be to convert these two-semester courses into one-semester courses with a slightly greater number of lecture hours per week (and provide suitable incentives for faculty to teach such courses).

3. Faculty Productivity

The department currently has 42 full-time tenure stream faculty. This number is down significantly over the past few years. The campus administration’s commitment to regrow the faculty in the near future is commendable. The department administration has strategically identified key areas for upcoming hires, coordinated with the overall mission and strengths of the department.

The pure mathematics faculty has strengths in core areas such as real and complex analysis, differential geometry, algebra and algebraic geometry, topology and differential equations, as well as representation in several other fields, notably number theory and logic. The breadth of faculty expertise is impressive and strongly benefits graduate students by providing them both with a rich overview of the landscape of pure mathematics as well as with the opportunity to work together with faculty in virtually any branch of pure mathematics in which they are interested. The department may consider further expanding the breadth of its faculty by making a targeted hire in discrete mathematics and/or combinatorics, an area which does not appear to be currently represented. An effective approach would perhaps be to make a hire working at the intersection of that field with one of the department’s established research groups.

Faculty publication rates are healthy and indicative of an active research culture. An especially encouraging sign is the strong research record of the early career faculty (Assistant and Associate Professors), which bodes well for the department’s potential to increase its national scholarly profile over the long term.

Funding success has been good but not superlative. The pure mathematics faculty compete regularly for basic research funding with some success. It is worth emphasizing that competition within the national funding organizations remains extremely intense, and the difficulties in this area faced by this department are being felt across the country. Faculty members have been successful in obtaining funding from other sources including the Simons Foundation. This option should be encouraged. The department should endeavor to incentivize faculty research, for instance via differential teaching loads or via departmental recognition of research success (e.g., a Faculty Scholars program). A 2-1 teaching load for research active faculty is the norm in Tier 1 institutions.

The overall improvements to the graduate program suggested in other parts of this review will also benefit faculty productivity by improving the quality of the graduate student population, reducing the mentoring and teaching workload, etc.
The department is in the process of introducing a postdoctoral program; the first postdoctoral scholars will arrive in Fall 2016. This program is timely and well considered, and will benefit both faculty and graduate students in coming years. This program should be maintained and indeed further increased if possible. Hiring postdocs across all areas of pure mathematics represented within the faculty will provide benefit to the maximum number of research groups. The role of postdocs in graduate student training, both as role models and as liaisons between students and faculty, should not be discounted.

The level of faculty professional service is good. Editorial board memberships, peer review and refereeing, service to other departments, and so on are indicators of the national standing and reputation of many of the department’s professors.

Other markers of professional excellence include several named professorships (Horn Professors, Brooks Endowed Professor), as well as recipients of distinguished research awards and excellence in teaching awards.

4. Graduate students and graduates

Enrollment and graduation numbers for the graduate program continue to increase. Average time to degree for the PhD is slightly less than six years, and for the Masters degrees around four years. These numbers seem slightly high (more so for the masters’ degrees). Time to degree could be reduced by implementing several recommendations in this report, particularly reduced teaching and course loads, increased faculty size (thereby providing more faculty mentor options to students), and a streamlined application process (leading to higher quality incoming students).

Approximately 75-80 PhD students are enrolled, which is about twice the number of faculty. This is a good level, and in line with the overall standards for the discipline. It provides sufficient opportunity for students to explore different options for their research while not becoming an overwhelming burden for the faculty themselves.

Students reported that 9-month salaries were sufficient for that time period. However, many concerns were raised about recent changes which have impacted the department’s ability to provide summer support to graduate students. The fact that many grad students must take other (non-academic) jobs over the summer to pay their bills negatively affects time to degree as well as both the quality and quantity of grad student research. This issue is of special concern for international students. Improved outcomes for graduating PhD students will require the commitment of additional resources to provide students with sufficient funding to allow them to work consistently on their research throughout the summer months.

Teaching loads for grad students are too high. Relevant issues here include the number of courses which students are expected to teach each semester as well as the size of those courses and the fact that many teaching assignments are stand-alone courses (which require significantly more preparation and administrative maintenance). The graduate student teaching load is substantially more than the norm for Tier I research universities; raising the research profile of the department will require bringing this load down to a level comparable with peer and aspirational departments. This will necessarily require additional staffing, or a drastic rethinking of course format (e.g., extremely large lecture courses taught by faculty, with multiple TA-led discussion sections). However, a large increase in the number of graduate students without a comparable increase in faculty size could impact the ability of students to identify the right advisor and maximize their own research potential.
During the interview with graduate students, it was indicated that the level of institutional support provided to grad students for their teaching obligations (e.g., presence of a TA or grader, overall course coordinator, etc.) was not uniform. Such lack of uniformity has a disparate effect on the teaching workload and efforts should be made to standardize the level of support provided to instructors insofar as possible.

The department provides a variety of training opportunities for students, including a pedagogy course, workshops on English proficiency, and regular classroom observations. Ongoing activities coordinated by the SIAM Student Chapter also help to improve graduate student instruction.

Job placement during the most recent academic year (2014–2015) was rather good. PhD graduates took a mixture of academic jobs (tenure-track, postdoctoral, visiting/lecturer positions) at a variety of institutions as well as some non-academic jobs. Given the department’s strengths in applied mathematics and statistics, it is surprising that only a few students take jobs in industry (which may often be more attractive than some academic positions). The department could provide better training for and help to facilitate the acquisition of non-academic jobs, especially jobs in government labs, in industry, and in the financial sector. A specific recommendation to this end is made at the conclusion of this section. A similar, but less involved, recommendation would be to implement a program which brings back graduate student alumni to the department to give talks about the role which their graduate preparation played in their current work.

Serious concerns were raised about the recruitment and admission process for incoming graduate students. Inefficiencies and delays within the Graduate School have led to situations in which qualified students were lost to other institutions due to an inability of the department to make a timely admissions offer. The department’s lack of autonomy with regards to graduate student admissions is unusual and not in line with standard practice at peer and aspirational institutions. This issue negatively impacts the quality of the graduate student population, contributing to several other problems indicated elsewhere in this report. The department should be given complete control of the applications process.

**Recommendation:** The department could implement a summer industry/national labs internship program. My own department at the University of Illinois at Urbana-Champaign recently introduced such a program (Program for Interdisciplinary and Industrial Internships at Illinois, or PI4). Such a program would provide numerous benefits and would address several concerns raised elsewhere in this report. For instance, it could lead to summer funding opportunities for some graduate students, in jobs which are better coordinated with their ongoing PhD research than the type of summer jobs which students are currently taking. Successful internships in industry or outside labs may lead to job opportunities post-graduation. Finally, such a program would raise both the regional and national profile of the department and identify it as a leader in this important area. The proximity of Texas Tech to national labs such as Sandia or Los Alamos is worth noting.

5. **Facilities and Resources**

The building has significant capacity, but the department is currently unable to use all of the space effectively. The proposed plans to renovate the stacks in order to recapture additional office space should be implemented. Many of the recommendations in this review are predicated on increased staffing, and office space remains a systemic concern.

The quality of the facilities is mixed. Major rain events regularly lead to water damage in many faculty offices as well as extensive and potentially dangerous flooding in the basement. The
associated health and safety concerns are significant, and effectively addressing this concern should be a top priority of the administration.

Lack of classroom space in the building was noted by several groups during the on-site interviews. The review committee did not see this as a priority, although several faculty did note that many classrooms elsewhere on campus in which they must teach lack suitable instructional technology equipment. Addressing this concern would appear to be a matter of general campus policy. Of greater concern is the lack of a suitable colloquium room within the department’s building, which negatively impacts departmental culture and synergy and reflects poorly to distinguished outside speakers.

Office space for graduate students remains cramped. The department has been creative in its use of space but continued growth of the graduate program will soon outstrip these increasingly creative solutions. It is also important to note the opportunity cost of ongoing facilities maintenance: the department has invested significant funds during recent years to address ongoing problems with the building, renovate various spaces into new offices, and so on.

Feedback from all stakeholders indicated high levels of satisfaction with departmental support services. The department’s IT staff was particularly singled out for praise as doing an excellent job. However, concerns were raised about the Graduate School’s support services, specifically, its role in the admission of new graduate students (see Section 4 for more information and recommendations).

Finally, it must be stressed that the extensive service teaching performed by the department underlines the critical role that it plays in the university’s overall educational mission. The campus should recognize the department for this activity by funding it at a level which is, at the very least, comparable to other departments on campus. Improving the research profile and standing of the department overall, and the graduate program in particular, will require a commitment of additional resources.

6. Summary

The faculty and administration of the Mathematics and Statistics Department should be commended for their substantial efforts to improve the research profile and national standing of the department while satisfying the extensive teaching and service requirements placed upon them by virtue of their position within the university. Overall, the graduate program is functioning well, despite several systemic issues related to funding, office space and heavy teaching loads. The external committee heard testimonials about numerous positive aspects of the department: a collegial atmosphere, excellent departmental support services, strong departmental leadership, and a research active faculty with a strong junior faculty cohort. There is great potential for the department to raise its profile and national ranking in coming years. An effective synergy between the department and campus leadership, and the willingness on the part of the administration to commit new resources as necessary, are critical for the realization of that potential.

7. Recommendations

1. Reduce graduate student teaching load and standardize instructional support for grad students. At UIUC the typical graduate student teaching assignment in one semester consists of either TAing for two discussion/recitation sections of a large lecture course or teaching one stand-alone course. (The latter option is usually provided only to students who have already demonstrated teaching excellence in the discussion section format.)
2. Improve funding arrangements for grad students. Options could include a paid industry or government lab summer internship program, or higher academic year salaries.
3. Increase departmental autonomy over the graduate student application process.
4. Reduce degree requirements for graduate students by streamlining pre-Prelim courses.
5. Improve departmental space, especially quantity and quality of office space for graduate students. Address ongoing facilities maintenance problems, especially recurring problem of water damage to the building.
6. Address the departmental funding disparity. The math department currently receives less money (per instructional hour) than other departments on campus despite a significant service teaching commitment.
7. Increase the size of the faculty via effective hiring in all areas including both core disciplines of pure math as well as areas which expand the department’s research breadth. Maintain planned postdoctoral hiring program and increase the size of that program if possible.
8. Incentivize faculty research and grant funding via differential teaching loads, faculty research awards, etc.
9. Add a PhD program in Statistics.
10. Bring back graduate student alumni for talks, workshops, and panel discussions.