The on-site visit took place on April 15, 2016. The first meeting was with Dean Lindquist, followed by meetings with a group of graduate students and with Department Chair, Magda Toda. After lunch, the external reviewers were given a comprehensive tour of the Mathematics and Statistics building, followed by meetings with the graduate faculty (only one faculty asked to meet individually with the external review committee). There was a wrap-up meeting with the Department Chair, the Associate Chair, and the Graduate Studies Chair, after which the external reviewers met to summarize the main issues which came up during the visit.

The report is based on the site visit and on materials provided by the Department. As required, most of my comments relate primarily to those aspects of the graduate program that can be characterized as Applied and Computational Mathematics.

1 Vision, mission and goals. Strategic plan

No serious STEM-centered university can thrive, nationally and even more so internationally, without a strong Mathematics and Statistics component. The University and the Department’s vision of increased enrollment in the Graduate Program (GP) and of a higher overall research profile are commendable, but need to be adequately supported in terms of resources if those goals are to be achieved. While by no means unique to TTU, the challenge presented by crushing service teaching loads makes it very difficult to raise the Department’s research profile and the level and productivity of the GP in terms of degrees conferred and student placement. The Department is doing a remarkably good job under the circumstances. The new Chair is already implementing certain much needed changes. Dr. Toda has a clear vision of how to move the Department forward, and is setting realistic goals for the near future; it is paramount that she has the continuing support of the Administration.

The strategic plan laid out in previous years (in the form that was included in the printed materials provided to the external reviewers) set goals that were too ambitious (in terms of applicant numbers, enrollment of graduate students, and number of graduate degrees conferred) and therefore it is no surprise that the stated goals were not achieved. The administration needs to be more realistic when setting such goals.

2 Faculty productivity

The Department has critical mass and highly qualified researchers in several areas of Applied Mathematics, namely: mathematical biology, computational mathematics/scientific computing, and partial differential equations. The recent election of a member of the Department to Fellow of the Society for Industrial and Applied Mathematics signals recognition of achievement at the
highest level on the part of the broader Applied Mathematics community. With few exceptions, publication rates range from good to excellent, and appear to be higher than that at several of the peer institutions (some of which have lighter teaching loads).

Most of the research in computational mathematics is rather applied- and engineering-oriented, with less emphasis on traditional numerical analysis topics; this fact is reflected in the fact that faculty in this area tend to publish more in application-oriented journals than in “standard” journals devoted to computational mathematics (such as SIAM J. Numer. Anal., Numer. Math., Math. Comp., BIT, etc.), especially after the departure of Prof. R. Kirby. While this is not a problem per se, it does have the effect of somewhat reducing the odds of Department members receiving grants from certain types of NSF programs, such as the one in Computational Mathematics, which focus more on core methodological research than on applications. On the other hand, this more applied focus may increase the odds of receiving support from other sources, such as industry. Nevertheless, I believe it would be in the best interest of the Department to focus the next hire in Computational Mathematics in a direction that would restore the balance that was altered after Kirby’s departure.

Overall, the applied math faculty is also extremely active in teaching and advising graduate students, both at the MS and PhD levels.

The amount of external funding received by applied mathematics faculty is good, but not spectacular. Increasing grant productivity will require some fundamental changes, including reduced teaching loads for faculty with external grants and the introduction at the University level of internal “seed grants” like the ones present at other universities (these are 1-year grants typically averaging $25-30K that are meant to support preparatory research, often resulting in greatly increased chances of success when submitting external grant proposals).

Finally, both the professional service (in terms of editorial board memberships, conference organization, peer review, etc.) and the community service are satisfactory.

3 Graduate students and Graduates

The graduate students at Texas Tech are a diverse mix of US (mostly local) and foreign students (many from developing countries), with good demographic and especially gender diversity. As far as the graduation and retention rates go, the numbers are pretty good. Enrollment is healthy, as is the number of graduate degrees awarded annually. Time to degree, on the other hand, seems to be comparatively high, especially for students ending up with a MS degree.

Job placement needs to be further diversified: the number of graduates finding employment in industry and government labs is low compared to that of other institutions with a vibrant applied/computational math program. These are jobs that pay considerably higher salaries than the ones offered by small, teaching-oriented colleges and universities, and more students should be made aware of (and put in a position to compete for) such job opportunities. According to some of the graduate students there is room for improvement on the side of mentoring of students by faculty, especially in professional development matters.
The graduate students reported positively about support services available to them, in particular technical staff services. Quality of life for international students is good. On the other hand, there were complaints regarding such issues as available space (too many graduate students crammed in an office with a single computer), salaries (sufficient for the 9-month academic year but not enough to spread over 12 months), course loads, and teaching loads (with increasing class sizes and/or number of sessions to teach).

As a rule, students are not required to take courses outside of the Mathematics and Statistics Department, and it is unusual for thesis committees to include faculty from other departments. This is somewhat unusual for PhD students in applied/computational mathematics in a technical university. It may be advisable to explore opportunities for a more interdisciplinary approach to advising applied and computational mathematics students.

Very few students are supported by external grants during the academic year, and as a result students have few, if any, opportunities to travel to conferences and to present their work there. This puts them at a distinct disadvantage when competing with graduates of other institutions for the best jobs. Likewise, the number of applied/computational math students who find work as summer interns in major industrial or government labs is very small, making it more challenging to obtain post-doctoral employment at such places.

Graduate students at TTU are burdened by higher teaching loads and course requirements than those at any other university I'm familiar with. This is the main reason behind the long time to graduation. Together with non-tenure-track faculty, graduate students do much of the low-level service teaching. It is hard to avoid the impression that they are essentially being exploited as cheap labor by the Administration. This is clearly not in the best interest of the students: longer times to graduation and diminished research accomplishments (an almost inevitable consequence of the high teaching loads) put TTU graduates at a disadvantage when competing for jobs. This is further aggravated by the need, for many of the students, to find summer employment not related to academics, stemming from the fact that the 9-month salaries are not enough to cover living expenses for the summer months. The Department should be commended for its efforts to provide additional support to the most deserving students, but this is only going to help a small number of candidates nearing the completion of their dissertations.

Concerning course requirements and qualifying exams/prelims, it seems that students at TTU have to take perhaps too many courses not related to their chosen area of specialization. I am generally in favor of broad training for PhD students, but in view of the high teaching loads this may be putting too much of a burden on students. It is also unusual that every course (at least among those eligible for the qualifying examinations) seems to be a 2-semester course. For instance, applied mathematics students should be required to take only one semester (each) of real analysis and complex analysis, not having to choose between two semesters of real analysis or two of complex analysis. It is also unusual that students are given three chances to pass their qualifying exams; the norm is two tries.

Some students voiced a desire for greater transparency in decisions that directly affect them, including teaching assignments. More involvement by graduate student representatives in GP-related issues would go a long way to help achieving this goal.
Finally, although I focus here primarily on the Applied/Computational Mathematics component of the GP, there seems to be a strong case for starting a PhD program in Statistics, essentially at no cost to the University. There is broad support for this within the Department. Hopefully, the central Administration will be supportive as well.

4 Facilities and Resources

The status of the facilities available to the Department of Mathematics and Statistics at Texas Tech is nothing short of disgraceful. Floodings and water infiltrations (with the associated, inevitable damage) are a recurring problem accompanying every heavy downpour. Some faculty members keep buckets in their offices to deal with water infiltrations that regularly occur when it rains. The frequent floodings at the basement level are a potential hazard, given the presence of electrical and electronic equipment.

The building hosting the Department (originally designed to be a library) lacks a room for colloquia, a major drawback for any Mathematics Department. This is not because of the (mild) inconvenience of having to walk over to the nearby Chemistry Department, but because a colloquium room is integral part of the identity of every math department and a place where interactions between the speaker and department members usually take place immediately following a talk. This opportunity for exchange is currently denied to Department members, due to the need to vacate the room strictly on time at the end of a talk. Not having an adequate space for colloquia is bad for morale and is almost unheard of at Mathematics Departments in major universities. This is a much more serious problem that the need to hold many classes at nearby buildings, although complaints were heard about the lack of appropriate audio-visual equipment in some of the classrooms outside the Department.

As already mentioned, graduate student space is inadequate, with the exception of the few nice offices available to students nearing the completion of their PhDs at the top floor of the building. Creative stopgap measures have been employed in the past, but until the stack space is recuperated to productive use the problems will persist and in fact can only get worse if the program expands.

Financial resources available to the Department are clearly insufficient to fully achieve the Department’s mission and goals, especially in view of the tremendous amount of service teaching the Department provides. The Department of Mathematics and Statistics, with its teaching and corresponding tuition revenue, is probably subsidizing other components within the College, while receiving a fraction of what other Departments receive in return. (Incidentally, this seems to be a constant theme at many universities nationwide.) It is imperative that the Administration understands that it is simply impossible to achieve the desired higher research profile and level of the graduate program unless a better deal is given to the Department in return for its enormous service to the education of TTU undergraduates.

Secretarial and technical staff resources within the Department appear to be adequate and were praised by many. In contrast to this, we heard serious complaints about the inefficiency with which the Graduate School staff handles applications to the GP. It appears that several excellent applicants decided to go elsewhere for their graduate studies due to the slowness with which their
applications were processed. This is unacceptable. Decentralization of the application process is much needed: the Department should have full control of the application flow and should be able to communicate directly with applicants, as in many other universities.

5 Overall assessment

The TTU Mathematics and Statistics Department is working hard to enhance research, teaching and service in the environment of a technological university. In terms of its graduate program, the Department is doing an excellent job with limited resources and in spite of the constraints imposed by geography. For example, the course requirements and teaching loads imposed on graduate students are high while the salaries are not exactly competitive; furthermore, the physical facilities leave much to be desired. This said, recent and forthcoming changes (coming both from the University-wide administration and from the current Department leadership) are pointing in the right direction and can be expected to further strengthen the position of the Department in research and training. A positive observation is that morale does not seem to be a problem, especially among faculty, and collegiality appears to be high, which is a very good thing. A few (very few) complaints were heard about the Administration trying to micro-manage the Department, especially in terms of areas of hiring. However, in view of the information provided by the Chair concerning the current hiring plans, these concerns seem to be exaggerated.

The Department has the potential to achieve much more. This will require imaginative leadership from the Department to frame its goals and needs, in particular if it is to meet its ambitious goals for short and intermediate term growth. It will also require a sympathetic understanding from the administration concerning the resources that need to be made available to help the Department meet those goals.

6 Recommendations

The following recommendations are meant as suggestions that, if implemented, would result in a considerable strengthening of the GP in Mathematics and Statistics at TTU. Some of these should be relatively easy to carry out, at virtually no cost to the institution; others will require a redistribution of resources and a sympathetic Administration. All of them are indispensable and urgent if the goals and vision set out by the Administration and by the Department leadership are to be achieved.

1. Current academic year graduate student salaries are not competitive with those at other universities and must be brought up to the level where students can continue their studies and research during the summer instead of having to wait tables or do similar jobs unrelated to academics.

2. Student teaching loads should be gradually reduced to bring them in line with those found in other graduate programs. At my institution, for example, graduate students only teach one course per semester, with no more than 25-30 students per class. (I emphasize that if TTU is serious about improving its GP, comparison should be made not only with so-called peer institutions but also with those a notch above.) This issue is closely related to the previous one: more competitive offers to prospective students would lead to a higher number
of graduate students coming to TTU, thus making it possible to spread the teaching of service
courses among more people. This in turn will have a virtuous effect on the time to graduation,
which is currently too high.

3. The Department should get back from the University more of the revenue it generates through
teaching. The fact that the Math and Statistics Department is now getting less (per hour
taught) than pretty much any other Department, including English, is hard to understand
and unacceptable. Addressing this issue will make more resources available to alleviate the
current teaching loads for graduate students and lead to marked improvements in the GP. It
may also free resources which could be used to address the current space crunch, a major
issue which is likely to get only worse as the GP expands as planned.

4. The building hosting the Department is in deplorable conditions and in dire need of upgrades
and repairs. Recuperating the stack space should be a high priority for the University. The
lack of a Colloquium room should also be addressed at some point.

5. The recruiting process for graduate students, including the processing of student applications,
is currently plagued by inefficiencies due to the slow handling on the part of Graduate School
staff. The process needs to be entirely controlled by the Department, in coordination with
the Graduate School.

6. The Department should start a PhD program in Statistics.

7. Students seeking a PhD should be given two chances, not three, to pass any portion of the
qualifying exams.

8. The possibility of interdisciplinary thesis committees should be explored for PhD students in
Applied Mathematics and Statistics.

9. The Department should avoid hiring and retaining its own MS graduates for teaching low-level
service courses.

10. The Department should intensify its efforts to hire research and teaching postdocs. The
Administration should seriously consider starting an institutional postdoc program like those
found at many other universities. Postdocs should not be asked to teach more than three
courses per academic year.

In summary, the GP in Mathematics and Statistics at TTU faces many challenges. The Depart-
ment has strong and energetic leadership, excellent research faculty, very good collegiality, excellent
staff, and many other virtues that put it in a good position to meet such challenges and aim for
excellence, provided it has the full support of the Administration.