External Review of the Mathematics and Statistics Department at Sonoma State University

Overview

The Mathematics and Statistics Department at Sonoma State University is a remarkable group of dedicated faculty with a clear and strong vision for how they serve SSU students. Conversations with dozens of stakeholders – current and former students, tenure-track faculty and lecturers, administrators and staff – all pointed to one thing: the fantastic departmental culture that strives to support all students, staff, and faculty. That sort of culture, rare within academia and especially rare in the mathematical sciences, channels everyone's energy into supporting students from all backgrounds, meeting students where they are and supporting them in reaching their aspirations, and helping each other out. Particularly notable is the department's explicit and shared commitment to active learning and the thorough and introspective work faculty have done through the TIPS project to attend to all students, especially the Latin* students core to the "Hispanic Serving Institution" label SSU aims to live up to.

The positive, supportive, student-centered culture is something the department and institution would do well to value – and to maintain through the current budget challenges and through the coming changes in departmental personnel over the coming years. While there are important issues the department should attend to, discussed in the Recommendations section, these should be viewed within the context of the department being an extraordinary group that is doing tremendous work to support SSU students.

This document gives an overview of the process for this external review, the strengths we observed (in the self-report and through two days of interviews), the challenges facing the department, and recommendations for the department to consider over the coming months and years. The document finishes with brief bios of the external review team members to provide the reader some sense of the perspective we brought to this work.

Process

Over the course of a two day visit (May 8-9, 2025), we met with all the various stakeholders for the Mathematics and Statistics Department at Sonoma State University. We had conversations with the current and former Department Chair, the College Dean, and faculty members from each of the main disciplines including Pure and Applied Mathematics, Statistics, and Math Education, the latter including faculty from the College of Education, and community partners such as the California Math Project. Additionally we spoke with a small group of lecturers within the math department, STEM faculty collaborators, academic staff from other student supporting departments such as the McNair Scholars lead, had an engaging lunch with more than a dozen current students, and ended the first day hearing from 11 alumni who graduated within the past 15 years.

The visit concluded with a lunch shared with available tenure track faculty (including one over zoom), a closing meeting with the Associate VP for Academic Affairs.

The conversations were conducted in a relaxed atmosphere, but maintained a clear interview focus. People spoke candidly and comfortably, often building on each other's comments, yet the discussions were structured around key evaluative themes—such as curriculum design, enrollment pressures, program viability, and departmental culture.

Strengths

Here we lay out what we see as the many strengths of the department.

Department Culture. Conversations with students (current and former) and with all faculty were effusively positive. It is clear that there is a positive, supportive environment for all members of the community–which now stretches back decades. Faculty are student-centered and asset-based in all areas, from finding ways to meet students in their introductory classes where they are, to the open student hours (not "office hours") in the Darwin lobby, to the active learning approach in classes where building a sense of community is a high priority. Others noted that *"They've been really intentional about collaboration and partnership and focusing on our students and having that student first lens."*

Of particular note is the open, collaborative attitude the faculty bring to all aspects of their work. Thanks to lesson study opportunities (generated through the TIPS grant), classroom teaching is seen as far more transparent (and less siloed) than in any other department in the mathematical sciences that we know of. One lecturer noted that they have *"...a common canvas thing that has a module for each class... As we do stuff, we can drop it in and we can pull it out if we want to..."*. Not only does this type of resource sharing give instructors new to a course a head start, but also allows everyone to learn from each other in their own time frame.

Students speak not just appreciatively, but lovingly about the faculty. Specifically they note the camaraderie among faculty, whom they see eating lunch together and enjoying each others' company. They emulate that behavior, leading to a sense of mutual support among students. One alumni noted "*These days, I don't know. It's — That's just where they all hang out. They all hang out like the faculty do their office hours*" when asked about the interactions among students of different disciplines.

The open, supportive atmosphere is most obvious in the Darwin Hall lobby, where students and faculty mingle regularly, with everyone helping each other out. One person noted that it has *"essentially just been taken over by math and stats students".* Students reported getting help from their own professor, from other professors, from their learning assistants, and from other random students who happen to be there. These interactions serve multiple purposes, including inculcating students into the supportive environment and transferring informal knowledge among students and between cohorts.

While evidence (including alumni testimonials) suggests that much of this exemplary department culture has existed for decades, the recent work of the TIPS grant appears to have taken the culture to the next level. Other STEM faculty view the mathematics and statistics faculty as leaders in the move to better support all students, including the Latin* students named explicitly in the "Hispanic Serving Institution" label. Other individuals in student success staff positions stated *"They've sort of revolutionized that department. They've done just remarkable work, specifically catering to racial minority students, which I really, really appreciate. And I think it has a lot to do with the TIPS grant and their sort of vision of what it should be."*

Importantly – and unlike many departments in the mathematical sciences – we saw no evidence of splits between different factions of faculty (e.g. pure vs. applied, mathematics vs. mathematics education, mathematics vs. statistics.) Lecturers are valued equally alongside TT faculty, with respect to teaching and departmental decisions. One stated *"I've taught in a number of math departments and this one is one of the few that as a part-time person, you're treated as a colleague as opposed to like a second class sort of person."* The wider community would do well to learn from the Sonoma State department on how to not just "get along" but to productively work together for the betterment of all.

Pedagogy. The department's commitment to research-based pedagogy is clear, uniform, and public. Because all faculty teach in ways aligned with recommendations like the MAA's Instructional Practices Guide, interactive classroom experiences are the norm. Students don't even remark on the participatory nature of some classes versus others – they simply expect to be actively engaged in learning. One faculty outside the department said *"They have made math less scary... They have made it applicable to our students' daily lives".* We see this as the result of intentional steps taken by the department, including the sharing of resources (especially Dr. Morris' well-loved workbooks), the departmental statement on active learning, and the participation of faculty in larger efforts like MAA Project NExT and Inquiry Based Learning workshops.

While many individual faculty across the country implement active learning, it's notable to see an entire department embrace those pedagogies at scale. Moreover, while some concentrate more on what students **do** in the classroom, evidence suggests that departmental faculty (including lecturers) uniformly focus on how students **feel.** There was a sense of community among students in classes that is the hallmark of liberal arts colleges – but is all-to-often missing from mathematics, statistics, and STEM classes. The Signature Assignments in Introductory Statistics exemplify this by guiding students to collect and analyze data that is important to them. Bringing their lived experiences into the project helps them connect with the topic more authentically.

Curriculum & Placement. The placement and curriculum structures we observed do an excellent job of supporting students. The multiple-measures placement (mandated by the CSU system) follows research-backed guidance. Introductory mathematics and statistics courses are clearly aligned with most meta-majors, with students who need stretch classes automatically placed into courses based on their past records. The only adjustment needed is for students who intend to major in humanities fields. Those students would be better served with a general education Quantitative Reasoning course (a.k.a. Math for Liberal Arts, Math for Responsible Citizenship).

In terms of supporting students who, according to the placement process need extra help, the SSU stretch model is not as prevalent as the corequisite model employed elsewhere in the CSU system, the community college system, or across the country. However, SSU faculty have implemented it in a way that avoids the most common pitfall of prerequisite sequences: student attrition between semesters. By keeping groups of students together for the entire year (with the same professor) and adding activities that help students adjust to the rigors of college-level work, the department has found successful model – one that they have rightly trumpeted at conferences and elsewhere. One administrator pointed out that *"The stretch program has you take students who are coming in as labeled as at risk essentially by the CSU... And they have about the same completion rate as the students in the one semester who are already college ready."* Our only caution is that implementing

a stretch model effectively might not be possible at an institution with less stability (in terms of instructional staff and student enrollment.) What clearly works at Sonoma State might not work elsewhere.

The Mathematical Epidemiology Research Group (MERG) run by Dr. Ortega deserves particular attention as an effective way to give students research opportunities in the course of their undergraduate studies.

Student Supports. The department has an excellent reputation with campus groups that work to support students, including both LARC and Summer Bridge. One student support staff member mentioned how they've *"really appreciated the intentional outreach to me and my department"* Our understanding is that students benefit from those opportunities on both ends. On the student side, those in the bridge course and those supported by LARC tutors benefit from the extra attention. Additionally, departmental majors benefit from serving as tutors.

Service. Departmental faculty are seen as effective, inspiring, and innovative leaders. Importantly, the TIPS work has positioned them as leaders across STEM fields. Faculty in other disciplines clearly look up to the math and statistics faculty, and staff have said *"They're probably, for me, working with many departments on campus, the most collegial and collaborative department that I work with."* Additionally, as noted in the self-study, departmental faculty regularly take on leadership positions across the university.

Challenges

The financial uncertainty brought about by the double whammy of a substantial drop in overall enrollment and an alarming state budget gap presents tremendous challenges - that go well beyond the mathematics and statistics department. We see that larger context as playing out in a couple of specific ways for the department.

Curriculum. Smaller mathematics and statistics departments typically do not have as many degree offerings. The five current offerings (Mathematics BA, Applied Mathematics BS, Statistics BS, Applied Statistics BS and Bi-Disciplinary Mathematics BA) makes it hard for the department to consistently offer the courses students need for their various pursuits. Although the potential to collaborate with other CSUs (for instance, teaching Topology at Humboldt one spring and at Sonoma State the next) might mitigate some of those issues, some streamlining of departmental offerings would help more.

Additionally, technology has accelerated the broadening of mathematical content needed in many areas. While the department is well situated to adapt to a shift toward statistics – and is in the process of adapting to the rise of data science – other parts of the curriculum could use updating. In particular, linear algebra has risen in importance in many areas (including data science and computer science). Nationally, math department offerings have not kept pace with these changes. Like many places, SSU would benefit from updating its offerings.

As mentioned above, current introductory mathematics offerings lack support for a quantitative reasoning course that would best serve many Humanities majors.

With respect to serving students outside the major the department has a reputation for supporting students with varying degrees of preparation. However, there is room for growth with one STEM faculty sharing *"I feel like they're kind of bringing everybody up to the same level, but not helping them excel sometimes."* and *"We*

almost have to reteach some of the basic stats that we are assuming all of our students have had, but they are more like maybe meeting them, but not really helping to push them to maybe where they could be or should be." This notion that students entering upper-division courses lack fluency with statistical concepts—is not uncommon. It reflects a broader reality in many programs: core ideas from GE-level statistics often need to be revisited and recontextualized when paired with discipline-specific applications and statistical software. As more departments develop and teach their own versions of statistics, tailored to their disciplinary contexts, there's a risk that the depth of training and expertise offered by statistics faculty is undervalued—potentially weakening the cohesion and rigor of statistics education across campus.

Use of Technology. Increasingly, both research in and teaching of mathematics and statistics utilize technology. Which tech tools are used changes – sometimes quickly – and it is difficult for educational institutions to keep up. Historically the department has incorporated Mathematica into math offerings and SAS into statistics offerings. While that has changed recently with Python and R rising in importance, we don't see those changes as keeping pace with what is needed by students – a sentiment echoed by both current students and alumni.

The rise of Artificial Intelligence is quickly becoming ubiquitous and will undoubtedly change many things about our lives. We anticipate that it will change how we teach mathematics and statistics, as well as what content we choose to cover. The uncertainties about predictions regarding those changes are still far too large to chart a clear path forward, however the "ignore" disposition with AI is not viable. The tools are here, accessible, and accomplish a wide variety of tasks. The department would do well to prepare for future changes, even though the nature of those changes remains uncertain.

Staffing. Looking ahead, the department is likely to have turnover in the coming 2-5 years. This presents both an opportunity to expand (including in the direction of math for Data Science). It also presents a danger to the carefully cultivated positive, student-centered culture of the department.

Recommendations

The Department self-study already acknowledges some of these areas of improvement and upcoming challenges. Nevertheless we would like to highlight the following items for consideration. Here we list the seven recommendations. Below that we expand on each of them.

1. Steamline degree offerings.
2. Modernize courses, with special attention to the software used in courses.
3. Create an introductory Quantitative Reasoning course tailed for the Humanities.
4. Build research experiences into the curriculum for more students.
5. Intentionally build out the proposed Data Science minor/major to be integrated with other offerings.
6. Intentionally shepherd the department culture through coming faculty turnover.
7. Continue to monitor how stretch courses are equitably serving students.
8. Find creative ways to attract more future teachers.

1. Streamline degree offerings. The many different degree options (five or six, depending if you count the teaching track as a separate degree) represent a large number for the size of the institution and department. That leads to problems when enrollments are too low for some classes (even required ones) to run and faculty then spread themselves even thinner by offering those courses as independent studies. This system ends up serving neither the students (we heard some frustration about cancelled classes) or the faculty.

We could imagine collapsing the existing majors into three or four, with some options within those majors to tailor students' programs of study to their needs while not over-taxing faculty. Any such process would be tricky and potentially controversial. Keeping students' needs at the center of all such conversations would be natural given the departmental culture, and that could avoid potential pitfalls.

Some potential ideas for reducing course offerings while still meeting students needs include these:

- Find ways to creatively offer courses that serve multiple purposes. For instance, a Number Theory & Cryptography course, an Abstract Algebra course that includes perspectives appropriate for future teachers (potentially drawn from the META Math project)
- Revising the introductory Linear Algebra course (222) to simultaneously serve CS, Data Science, and Math majors.
- Engaging with other STEM disciplines to make sure courses are meeting their students' needs (e.g. upper division applied Statistics courses).
- Coordinate with other CSU campuses to jointly offer courses that are vital for a small number of students (e.g. Topology or Complex Analysis).

Importantly, given the department's track record of serving the institution, we encourage the administration not to just eliminate the degree program with the fewest current students, but instead allow the department to creatively reach the administration's goals while minimizing any negative impact on the student experience.

2. Modernize courses, with special attention to the use of computers in courses. The inertia of continuing to do the same thing in classes works against keeping courses relevant for students, and that shows in a number of places in the department's offerings. Software choices are constantly moving targets, and fields like Data Science are rapidly progressing at a faster pace than college curriculum tends to move. Open source programs like R and Python are more quickly becoming the norm in not just Statistics and Data Science programs but also in many sciences. A clear and intentional emphasis on modern programming languages such as R and Python were echoed from both Alumni, current students, and other STEM faculty, and was a recurring theme in the department self study. This is an area where the Statistics faculty have an opportunity to be seen as the experts they are in the statistical analysis and programming space, and can open doors for more interdisciplinary research opportunities (e.g. encouraging science student researchers to seek assistance from the Statistics faculty instead of their major advisors)

Some specific changes the department should consider include these:

- Specifically revise *Computing for Statistics: SAS Programming Language (Math 381)* both in name and content.
- Explore other options outside of Mathematica, in collaboration with other departments (including Physics)

- Revising Linear Algebra (222) to emphasize material appropriate for data science (e.g. singular value decomposition)
- The term “pure math” strikes some (including one reviewer and at least one department member) as exclusionary, elitist, and out-of-date. Discussions of streamlining degree options could address this using different terminology (e.g. “theoretical math”) or eliminating the distinction altogether.

Finally, we anticipate that Artificial Intelligence – both the quickly improving Large Language Models (LLMs) and the logic models that now ace tests like the International Mathematics Olympiad – will change both what content we teach and how we teach existing content. Although predicting what changes will arise is a fool’s errand, in general terms we see a refocusing on student thinking (from proxies for that thinking that AI can now complete). The department, with its focus on active learning and engaged student learning, is well positioned for this change. Still the department would do well to stay on top of the coming changes, and maybe even partner with others across the country to lead the way into this new AI-enabled world.

3. Create an introductory Quantitative Reasoning course. The math pathways movement has coalesced around a small handful of introductory courses being appropriate for different meta-majors. Two of these are well-established at SSU: a path to Calculus serves STEM and economics students, and Statistics serves social science majors and some professional programs (e.g. nursing). Increasingly we see modern Quantitative Reasoning courses as being the norm for most students intending to major in the Humanities. Such a course, with a stretch option for students needing extra support, would be a more appropriate introductory math option for many SSU students. Materials could be borrowed from a variety of sources, including the infrequently taught Math 103, 104, and 105, as well as courses across the country with titles like Quantitative Reasoning, Math for Liberal Arts, Math for Responsible Citizenship, and (where allowed) Math for Social Justice.

4. Build research experiences into the curriculum for more students. The one suggestion from both current and former students – always phrased as a suggestion more than a complaint - was to increase the real-world experiences for all students (including those in the more theoretical tracks. One successful alum from the pure math program, now working at a high-profile tech company, lamented how the switch to industry could have been smoother had his undergraduate career included a course-based applied project, a summer internship, or some other way to explore possibilities in Business, Industry and Government (BIG).

This is an area of significant recent innovation, with a variety of ways to accomplish this goal:

- Course-based research experiences (CURE models, enhancements to Signature Assignments).
- Projects done with local partners (especially non-profits) like those done in the PIC Math program.
- Summer research programs.
- Research groups (like Dr. Ortega’s MERG project.)
- Summer and semester internships.

The attitudes of the small group of alumni we interviewed suggest that departmental graduates offer an untapped resource in this area. Several specifically mentioned that their current place of work offers internships – but that networks aren’t set up for them to connect current students with those opportunities. This is an area

that the department could learn more about from other departments, one alumni had a research opportunity through the Computer Science department in connection with Lawrence Livermore labs. The prevalence of CS minors and Bi-Di majors among current students speaks to a good partnership between the departments that perhaps could be leveraged in this area as well.

5. Data Science program development. We commend the department for their work to establish a Data Science minor (with a major coming soon after that). As an inherently interdisciplinary program, Data Science can bring a lot of curricular, and ideological challenges. It is important to openly and intentionally collaborate with closely related disciplines such as Applied Mathematics, Computer Science, and Business to realize the potential of shared courses, resources and in general avoid duplication. First establishing a minor is an appropriate way to begin. In terms of the major, however, we worry that CSU bureaucracy will keep the department from moving quickly enough to adequately serve students in a rapidly-changing context where the need for data skills is increasing quickly.

While we know that the Data Science major is still in the planning stages, the lack of Calculus concerns us. In our experience, high quality data science degrees require coursework in both Calculus and Linear Algebra.

Both the BS and Minor in Data Science could help bolster enrollments in some Math courses. While careful planning of how existing Statistics courses could serve this Data Science student population is already underway, we recommend taking a closer look at courses outside of the Statistics major such as linear algebra offerings for adjustment and inclusion. Making sure Data Science degrees are deeply embedded within the fabric of the department ensures their sustainability. The extent to which a program relies on individual faculty members (as opposed to departments), like having a single philosopher interested in data science increases the fragility of the program. Having a robust set of electives from multiple other departments can increase visibility of the program and emphasize the interdisciplinary nature of the field.

6. Intentionally shepherd the department culture through coming faculty turnover. Departmental culture, especially one as inclusive and supportive as what we saw at SSU, can be fragile, especially in times of change. Times of financial difficulty, and the resulting cuts in offerings, can open up fissures between factions of faculty that were not noticeable before. Turnover, whether by retirement, voluntary departure, or involuntary exit, can have similar impacts.

Maintaining (or even improving) the existing culture will be more likely if the department engages in self-reflective discussions designed to shepherd the group through coming transitions. For instance, many students noted how seeing the department faculty having lunch together impacted their sense of the department as a welcoming place. We got a sense that many of them see those actions and emulate them in their own peer-to-peer interactions. If a faculty member chooses not to participate in such activities, are there other ways to include that faculty member – both as a way to make sure they feel included and as a way to signal to students that they are not being left out?

Importantly, the current ethos includes a sense of classes as open and public spaces - in stark contrast to the insulated, siloed view expressed by faculty at most institutions. While the transparency and willingness to learn from each other goes back to the late ‘80s, the lesson study engaged in as part of TIPS undoubtedly deepened that feeling. How will it be maintained – or even further deepened – as faculty join the department post-TIPS?

One specific action in this direction would be to revisit Retention, Tenure, and Promotion guidelines to ensure that the department's values (including support for active learning and equity) are enshrined in those policies.

7. Continue to monitor how stretch courses are serving students. Stretch courses, which extend material for a single college-level course over two semesters, and corequisite support, which add supports during a single semester, are both common ways to improve student success rates in introductory mathematics courses. One of the reviewers (Dave) has extensive experience working with higher ed institutions to implement corequisite support courses, and fully expected to recommend some version of corequisite courses for SSU.

The primary drawback of stretch courses is that the break between two academic terms represents a crack that many students fall through, negatively impacting success rates. The SSU math department has implemented stretch courses in a way to avoid this drawback. Maintaining the same professor and the same cohort of students through the two-semester stretch sequence closes that crack and it appears that few students fall through it.

Instead of recommending that the department implement corequisites, we encourage the department to continue to monitor the impacts of their stretch courses. The other common criticism of stretch courses is that they increase the time-to-degree for some students – especially STEM students in highly structured majors like physics, chemistry, and engineering. Is that the case at SSU? Some STEM faculty suggested that they have adjusted their programs accordingly. Still it is an issue worthy of attention.

(As an aside, given the success of the stretch model at SSU and the corequisite model at other CSU campuses, a study comparing the two models would be highly useful to the field. Such a research project could help the mathematical sciences community better understand what aspects of the two models are key to their success – and how institutions have managed to avoid the common pitfalls.)

8. Find creative ways to attract more future teachers. Sonoma State, like many institutions that train future teachers, has seen a substantial decrease in interest from future middle and high school mathematics teachers. While many of the causes are cultural and are well beyond the control of the department (e.g. the teaching profession is seen as much less desirable now than in the past), creative solutions could help reverse that trend, helping to meet the (substantial) needs of the local schools. While we do not know the local conditions well enough to make informed recommendations, potential strategies include these:

- Creatively use MSTI funds to generate interest in the teaching profession among first-year students.
- Partnering with SRJC to generate interest in and smooth transitions for future teachers.
- Learn from CSU campuses with thriving programs (Long Beach?) through collaborations and visits.

Reviewers:

Dr. Robin Donatello is a Statistics faculty in the Mathematics and Statistics Department at CSU, Chico, and leading the development of their Data Science programming. With a background in Biostatistics she also works as a Research Manager for the Center for Healthy Communities, a public health and nutrition education research center. Her current goals are to increase availability of pre-professional experiential learning opportunities for statistics & data science students. Personally, she is a novice homesteader, working to increase her and her families' self-sustainability, and volunteers for the Northern Valley Animal Disaster Group, a community based animal rescue team essential for evacuation and care of animals during natural disasters.

Dr. Dave Kung has worked in the intersection of mathematics and equity his entire career. He currently serves as the Executive Director of Transforming Post-Secondary Education in Mathematics (TPSE-Math). Prior to that, he served as the Director of Policy at the UT Dana Center, leading the Launch Years Initiative that works with state teams to modernize math options for students across the high school / higher ed transition. He has directed MAA Project NExT, served as a professor at St. Mary's College of Maryland, authored a variety of articles and books, produced two Great Courses lecture series, and won the MAA's highest award in college math teaching. He resides in the DC, coaching local high school teachers, as well as playing violin and running–never simultaneously.