As part of the West Virginia University Board of Governor's Rule 2.2 Program Review process, the WVU Provost's Office required that a single Program Review Self-Study Form be completed on behalf of all identified programs in the department or unit. This Program Review Self-Study Form was to be submitted to the Provost's Office by end of day on August 1, 2023. The Provost's Office reviewed the submitted Program Review Self-Study Forms in early August.

Self-Study content is unvetted by the Provost's Office. As such, the WVU Provost's Office cannot attest to the accuracy of any data, analyses, or statements provided within. Also, redactions were made where warranted for the protection of individual identities around sensitive information.

Q1.1.
BOG Program Review Self-Study Form

This is the self-study form that will be completed in support of the summer 2023 academic transformation program portfolio review.

Only one program review self-study is to be submitted per unit; all of the unit's *programs* will be covered by one self-study.

Q1.2. Select the appropriate academic unit under review.

College	Eberly College of Arts and Sciences
Department or School	Mathematical and Data Sciences

Q1.3. List all of the unit's programs.

Example:

BA Biology
BS Biology
MS Biology
PhD Biology

BA Math BS Math PhD Math

Q1.4. Name and Email of the person completing the self-study

Name	Earl Scime
Email Address	escime@wvu.edu

Q1.5. How were faculty given the opportunity to contribute to, review and provide feedback on this self-study?

Faculty who were not 100% grant funded during the review process time (since their participation is not permitted by federal regulations) were invited to review the draft response document and invited to a faculty-wide meeting on July 19th on campus to provide in-person feedback. Some key faculty were already committed to full-time, off-campus, teaching or research activities, such as running the Governor's Honor Academy program, and could not participate during the limited window of time dictated by this process. The remaining faculty welcomed this opportunity to describe the ongoing changes in the School of Mathematical and Data Sciences that have been designed to boost enrollments, decrease expenses, and improve operational efficiencies. We note that since the Self-Study questionnaire (question 6.2) was modified significantly on July 26, 2023 – nearly two weeks after the guidelines for the self-study were released by the provost's office and three working days before responses were due, there has not been enough time for the faculty to fully participate in discussions related to our response to the new format of question 6.2. The faculty provided the self-study report team with a summary that includes data-based evidence of the existence of significant research expenditures, plans that are already underway to develop new externally funded research programs, ongoing and planned efforts to significantly reduce expenses, already completed significant reductions in address personnel, and ongoing and planned efforts to increase operational efficiency. Summary of Key Findings ● Documented research expenditures by faculty in the School of Mathematical and Data Sciences exceed the $1M threshold for research expenditures in 2022 and that should have automatically exempted the mathematics doctoral program from review. ● In response to the University's financial crisis, the mathematics program has implemented reductions in operational expenses for FY24 of over $1.5M. Expense reductions implemented from 2020-2022 already saved $778,839. Thus, from 2000 to 2024, the mathematics program will have reduced annual operational expenses by more than $2.3M - significantly more than the upper limit estimate for the total annual costs of operating the combined undergraduate and graduate program in mathematics. The elimination of 4 additional FTEs in 2024-2025 as well as other program efficiencies will result in additional cost savings of more than $0.6M. Thus, from the beginning of the review period to the end of AY24-25, efficiencies and personnel reductions will have resulted in approximately $3M of cost reductions. ● By the end of academic year 2023-2024, the mathematics program will have reduced regular faculty by 5 FTE (>10% of tenure track) and eliminated 7.5 FTE additional instructors since the beginning of the review period (since 2020) - for a total reduction of 12.5 FTE. An additional 4 FTEs of tenure-track and teaching faculty have been eliminated for 2024-2025. ● The upper limit estimate of the undergraduate program cost is slightly more than 10% of the net revenue generated by mathematics ($0.7M). The upper limit estimate of the graduate program cost is 10% of the net revenue ($0.6M). ● The majority of the students in upper division mathematics courses are not mathematics majors (56% in 2022). Therefore, nearly all the courses needed to operate the undergraduate program in mathematics would still need to be taught even without an undergraduate degree in mathematics. ● The net revenue generated by the mathematics program has a significant and positive impact on the total operating budget for the university. ● Undergraduate and graduate program enrollments in mathematics are on the rebound as a result of focused and intense recruiting efforts. Yearly graduate admissions are up significantly, but very high graduation rates in the graduate program led to an overall drop in total graduate enrollments in recent years. ● Fundamental mathematics is critical to a strong research program in physics and data sciences. Our growing Data Sciences program cannot excel without a vibrant research-active mathematics program. Research-active faculty in the new Data Sciences program cannot perform research without the mathematics graduate program. Some mathematics faculty are already teaching special topics courses in the Data Sciences realm and others could help with instruction in Data Sciences as that program area does not currently have enough faculty to cover instruction in its required courses. ● Through careful stewardship of revenues acquired over the past decade, the mathematics program has a net reserve of over $1M as of July 1, 2023. These funds exist and could be used to further offset operating costs of the undergraduate and graduate program for many years to come. ● Over the past two years, the mathematics program has generated ~ 10% of all PhD degrees in STEM disciplines at WVU at a relatively modest net cost per PhD for a STEM program. This is a significant contribution to the total PhD production of WVU. Compared to our Big-12 peers, WVU's mathematics PhD production rate and graduate student to faculty FTE ratio are among the highest in the Big-12.

Q2.1. Explain how the unit and its programs contributes to WVU's mission.

This response is limited to 7500 characters, approximately 2 single spaced pages.

A robust mathematics program is the foundation of all Science, Technology, Engineering, and Mathematics (STEM) programs. Thus, mathematics plays a key role in WVU's contributing to advancing education, healthcare and prosperity, and advancing high-impact research in the state of West Virginia. Specifically in the area of education, the undergraduate program in mathematics makes a significant contribution to generating graduates in the State priority fields of middle and secondary education (https://www.wvhepc.edu/wp-content/uploads/funding_formula/2023/FundingFormulaFramework_29July2022.pdf) as nearly 22% of recent BS/BA graduates in mathematics also completed the WVU UTeach program that enables STEM graduates to graduate with certification to teach at the K-12 level. Historically, roughly 50% of our undergraduate majors have pursued K-12 teaching certifications. As demonstrated in the post-graduation employment data provided in Appendix 3, a significant fraction of recent mathematics PhD graduates have gone on to serve as faculty at colleges and universities in WV. Therefore, the WVU mathematics graduate program is a critical source of mathematics faculty for higher education throughout WV. Further evidence of the mathematics program's commitment to the land grant mission is seen in how WVU mathematics faculty lead mathematics enrichment programs that reach thousands of K-12 students across WV each year, e.g., Dual Enrollment Math courses that allow high school students to obtain college credit, the Governor's Honors Academy, Math Field Day, etc. Such programs encourage young people to pursue advanced education and are the gateway to the future for the next WV mathematician such as Katherine Johnson (WVU mathematics graduate program, 1939). The mathematics program at WVU is also the birthplace of innovative programs that have transformed society and created new industries. In the 1960's and 1970's, the mathematics program at WVU gave rise to the new field of computer science and graduated students who have gone on to build billion-dollar companies in the fields of computer science and cybersecurity (e.g., Ray Lane, Math B.S. 1968 and Addison Fischer, Math B.S (1970) and MS (1972)). The only Nobel Prize winner to be born and raised in WV, Dr. John Nash Jr., received all his degrees in mathematics and was one of the founders of an entirely new branch of economics (1994 Nobel Prize in Economics). Now in the beginning of the 21st Century, the Mathematics program at WVU has transformed itself into the School of Mathematical and Data Sciences and has given rise to a new undergraduate program in Data Sciences. Faculty in this exciting new field are heavily engaged in mathematics-related research and are now supervising and employing, as graduate research assistants, graduate students from the mathematics graduate program in their funded research programs. As a state flagship university, an R1 university, and as a member of the Big-12, WVU's peer institutions all maintain robust undergraduate and graduate programs in mathematics. By continuing to support a flourishing, cost-efficient, undergraduate and graduate programs in mathematics, WVU will provide opportunities for WV students to stay in the state and complete degrees in mathematics that lead to high-paying, high-quality jobs. Specifically in the area of advancing high-impact research, this self-study shows that the program exceeded the $1M threshold for research expenditures in 2022.

Q3.1.
Resources, Revenue, and Expenses

The purpose of this section is to ensure the accessibility and adequacy of the unit's infrastructure and resources and its financial viability.

Responses in this section are limited to 7500 characters or approximately 2 single spaced pages.

Q3.2. Has the unit experienced significant issues with any of the following during the past five years?

By "significant," we mean issues that interfere with either the unit's ability to deliver its programs to its students or the students' ability to complete those programs in a timely manner.

	Yes	No
Ability to schedule required classrooms	○	○
Access to adequate technological infrastructure	○	○

Access to adequate technological support	○	○
Access to adequate physical infrastructure (labs, performance spaces, etc.)	◉	○

Q3.3. Describe the issues the program has faced in the area(s) identified above.

While not a traditional definition of infrastructure, access to PhD students is a critical component of infrastructure for the graduate program in mathematics. Like the need for laboratory space for an experimental program in the sciences, access to graduate students is a key component of infrastructure. Without access to graduate students, the mathematics graduate program cannot flourish. The Covid-19 pandemic created a significant impediment to accessing international graduate students. Students still wanted to join the doctoral program in mathematics at WVU, but access to these students was blocked by well-intentioned university, state, and federal barriers. A large fraction of the decline in mathematics graduate enrollment from academic year (AY) AY18-19 to AY21-22 can be attributed to the loss of international students and especially international students on fellowships. Before 2020, a significant fraction of the mathematics graduate students were international students. Mathematics had many strong doctoral students from China, typically recruited by our faculty members. There were also a significant number of graduate students on fellowships from Middle Eastern countries such as Saudi Arabia, Iraq, Libya. International students are typically required to register full-time, so they contribute to the core enrollment headcount. Some specific examples are illustrative of the impact of this infrastructure issue. In fall of 2018 (F18) there were 15 fellowship students from the Middle East (students that had their own financial support for doctoral study in mathematics). These students made up 25% of the full-time graduate enrollment (of 71 total, approx. 58 full-time) and generated approximately $200,000 in graduate tuition revenue. The proportion of these students increased to 31% in F19 (still 15, of a total of 59 / 48 full-time). Almost half of them (40%) left by Fall 2020 (once the pandemic began), with only 9 remaining. Many of the students had support that prohibited them from staying in graduate programs that only provided online courses. Without in-person instruction, their financial support was cut off. By 2021, there were still 9 of these fellowship students (out of 40, 34 which were full time), but only 2 of them were still funded. The median over the period of interest was 12. By F22, only 8 students originally funded on fellowship remained (of which only 2 were still funded – the remaining 6 from Libya and Iraq were supported by the mathematics program for a while but eventually became self-supporting). Having to provide support for these formerly externally supported graduate students meant that the mathematics program could not recruit new students and maintain the size of the graduate program. The infrastructure problem is improving; however some institutional challenges remain. The level of service from the international admissions office has not yet returned to pre-pandemic levels. Confusion about student charges, visa processing, etc. have resulted in delays in onboarding new students and, in some cases, losses of incoming students. Another delay comes from incoming international students no longer being able to attend summer intensive English classes at WVU. Therefore, they have to delay their official matriculation into the mathematics graduate program until the winter semester. However, even with all these barriers we are achieving a rate of ~3 new Fellowship students entering each year. With an average tenure of 4-5 years, we expect to reach a steady state of 12-15 by F27, consistent with pre-pandemic levels. Our new student enrollment data from F2022 and F2023 is consistent with this prediction. In 2022 2 new Fellowship students (from Saudi Arabia and from Kuwait) entered the graduate program and 2 new Fellowship students (one from Saudi, one from Libya) are scheduled to arrive in F2023, with additional students who were accepted pending their completion of the Intensive English Program (IEP). At this rate of progress, recovering to pre-pandemic levels by F27 is a reasonable prediction.

Q3.4. Data have been provided on the unit's last three years of tuition revenue, expenses, and net revenue. Address any negative net revenue or any significant changes (positive or negative) to unit's net position.

Revenue by department is the actual tuition revenue, net of any discounting, paid by students taking courses in course subject codes affiliated with the department.

Expense by department is the actual unrestricted, operating expenditures by department within the functions of instruction and academic support.

Net revenue is the revenue minus the expense.

According to the SCH data provided, there was a 17.2% decrease from 2020 to 2022 in SCH generated by mathematics. However, a comparable decrease in revenue would have resulted in a 2022 revenue of $18,596,353, larger by $1,282,006 for 2022. We have learned that the explanation for the much larger decrease in revenue is that programs do not receive revenue if students are given scholarships. Since a larger fraction of students taking courses in the SMDS received scholarships in 2022, the revenue per SCH decreased by 7.5% from 2020 to 2022. We note that under this funding model, programs that are highly selective and recruit the very best students to WVU receive zero revenue if those students are on full scholarship. While not all the students taking mathematics courses were on scholarships in 2022, many of the majors in the program are. The new funding model established for WVU appears to incentivize programs to seek out and recruit mostly non-scholarship, out-of-state students to maximize revenue. We believe it is consistent with our land grant mission to continue to emphasize recruitment and retention of outstanding in-state students. An important revenue component that is buried within the total revenue is the large fraction of doctoral students that pay tuition. As noted previously, historically 25% of the graduate students pay their own tuition. We estimate that these students generate about $200,000 in tuition revenue. In other STEM disciplines, this fraction is typically zero. Mathematics is unique in that the graduate program generates significant (relative to its cost) tuition revenue. As discussed above, restrictions on in-person teaching during the pandemic resulted in an exodus from the graduate program of a large fraction of the tuition paying students. Thus, from 2020 to 2022, the total graduate tuition revenue generated decreased. However, focused recruiting efforts have led to a rebound in the population of tuition-paying graduate students. In Appendix 2 we present an analysis of SCH generation. That analysis indicates that the primary drivers of the decrease in program revenue are the decreases in enrollments in other degree programs and an increase in the fraction of students in undergraduate mathematics courses on scholarships. Because all expenses are grouped by program, the costs of faculty salaries, graduate student stipends, tutoring center costs, and operational costs for all employees and activities in mathematics, statistics, and data sciences are grouped together and reported as the expenses for the entire mathematics program. This fact becomes very important later in this self-study when we identify missing 2022 research expenditures by faculty whose salaries are mapped to mathematics and therefore should have been counted as mathematics research expenditures in 2022. This point was reiterated by Dr. Mark Gavin on July 13, 2023, during a webinar in which he stated that according to the guidelines for this review process, all expenses for a program, regardless of whether they pertained to a particular degree within that program or not, were to be considered as expenses for that program. Shown in Table 2 in Appendix 1 are the expenses attributed to the entire SMDS. Each of these numbers represents the tabulated costs of the program times a scaling factor, roughly 1.5 (the scaling factor varies a little bit each year per the data definitions). As discussed in Appendix 2, we have developed three different methods to estimate the incremental cost of operating the undergraduate and graduate degrees alongside the service course instruction provided by the mathematics program. Our analysis shows that the upper limit on the cost of operating the graduate degree in 2022 is roughly $600,000 (three methods: lower limit of $110,000, upper limit of $611,000, or elimination revenue gain of $600,000). Therefore, the financial cost of the graduate degree in mathematics is 10% of the net revenue. Our analysis shows that the upper limit on the cost of operating the undergraduate degree in 2022 is roughly $763,555 (two methods: lower limit of $349,243, upper limit of $763,555). Therefore, the financial cost of the undergraduate degree in mathematics is just over 10% of the net revenue. Both of the calculation methods for estimating the incremental cost of the undergraduate program do not include the fact that nearly half of the students in upper division mathematics courses (56%) are majors in other disciplines. Therefore, if the courses required for those students need to be taught anyway, the actual incremental cost of the undergraduate program in mathematics drops to near zero. One of the directives of this self-study was to propose ways of reducing expenses. In addition to the total instructional personnel costs, the mathematics program expenses include fixed costs that are mandated by WVU and almost none of those costs are associated with operation of the undergraduate or graduate degrees. For example, the FY20 expenses included over $275,000 in costs associated with operating a mandatory tutoring center for non-mathematics students, the FY22 budget included an over $220,000 expense for return of funds to the Eberly College as a result of budget cuts across campus, and each year of expenses includes personnel support charges of $26,000 for college IT personnel. Nonetheless, even with these mandated fixed costs, from 2020 to 2022 the program review data provided by the Provost's office shows that the mathematics program reduced (scaled) costs by $778,339. The reduction in expenses from 2020 to 2022 significantly exceeds the lower limit estimate for total expenses for the undergraduate and graduate program combined and is comparable to the upper limit estimate for either the undergraduate or graduate degree program. To improve program efficiency and reduce the costs, the mathematics program has made significant reductions for FY24 (beyond the $778,339 reduction in annual program costs already made from 2020 to 2022). As listed in Table 23 in Appendix 1, the program has eliminated all faculty telecommunication systems, eliminated all state-funded travel for non-junior faculty, eliminated all state-funded travel for students, restructured the ACCESS program to eliminate a staff position, and has targeted a 50% reduction in printing costs. The changes will result in a projected reduction in non-instructional expenses of $60,000. In terms of instructional personnel costs, the program has eliminated over 60 adjunct instructor positions and reduced course organization stipends for a savings of $400,000. We have also eliminated two full-time instructor positions, three tenure track positions, and the position of Associate Director for Data Sciences – resulting in a savings of approximately $900,000. The combined scaled savings result in a significant projected additional reduction of over $1.5M for FY24. Thus, from 2020 to 2024, the mathematics program will have reduced annual operational expenses by over $2.2M, more than the upper limit on the total annual costs of operating the undergraduate and graduate degrees. To further improve efficiency and reduce costs in AY24-25, the mathematics program will eliminate 4 additional faculty FTEs (2 tenure-track and 2 visiting teaching), 0.25 FTE of Adjunct Instruction, and the tutoring center. These changes are also summarized in Table 23 and result in an additional scaled cost savings of $623,000.

Q4.1.

Faculty Composition and Productivity

Responses should be concise but also specific and supported by evidence. Responses in this section are limited to 7500 characters or approximately 2 single spaced pages.

Specific data definitions for these metrics are available on the Academic Transformation webpage.

Q4.2. Data have been provided on the unit's faculty full-time equivalency (FTE) to the median of all majors for fall 18 to fall 22.

Address any differences in the unit's student to FTE ratio and the institution's student-to-faculty ratio of 18-to-1 per IPEDS reporting for academic year 2021-2022.

In 2023, there were 27 tenure-track faculty working directly in the mathematics undergraduate and graduate degree programs. The provided data lists 30. For teaching faculty (TAPS and instructors), there are 17. The total of those two numbers is 44, not the 48 FTE faculty shown in the data table provided by the Provost. We believe these small, but important, discrepancies come from including faculty who do not teach mathematics but are in the data sciences and statistics programs. Those faculty work in degree programs that are not being evaluated (data sciences) or are in a program without a degree (statistics). Using the total number of tenure-track faculty (27) who work in the mathematics undergraduate degree program, the ratio of total majors (including double majors so the total number of majors for 2020 is 100, for 2021 is 94, and for 2022 is 77) to faculty is 3.7, 3.5, and 2.9, respectively. For comparison, we have surveyed some of our Big-12 peers and they report an average of total undergraduate majors to tenure-track FTE ratio in their mathematics programs of 6.0 (see Table 3 in Appendix 1) from 2018 to 2022. In fact, all of the Big-12 mathematics programs that provided data are well below the 15-1 ratio target. The WVU undergraduate mathematics program is near the bottom of all the Big-12 programs but is not the smallest. Later in this self-study, we outline specific measures that are already underway (and have been since fall of 2022) to grow the undergraduate program. What is clear, however, is that the WVU ratio of math majors to faculty is well within the range of peer Research 1 universities in the Big-12. The total number of majors (primary and secondary) in the mathematics program in 2022 was 94 and that exceeds the median number of majors in a degree program at WVU of 72 by a wide margin. If only primary majors are counted, the median number of majors in the program from 2019 to 2022 was 72, exactly equal to the campus median of 72. We believe that the significant drop in singular majors to 65 for fall 2022 is correlated with the very significant drop in enrollments in Engineering over the same time and the virtual instruction that was implemented during the pandemic. Historically, a number of Engineering majors became mathematics majors after they were exposed to advanced mathematics and had positive personal interactions with supportive faculty members in their first few math courses. These personal interactions did not occur in virtual courses in 2020 and 2021 and there was a sharp drop off in students switching to a major in math in 2021. We identified this decrease in undergraduate majors as a point of concern during an internal self-review of the mathematics program in 2021 and implemented an extensive effort in AY22-23 to recruit new first-year mathematics majors by developing direct relationships with mathematics teachers in WV and surrounding states. These efforts will continue and will be adapted to focus on best practices. For example, in AY22-23, the Recruiting Committee chaired by Prof. Tsikkou organized a campaign to recruit students at the undergraduate and graduate levels. At the undergraduate level, these recruiting efforts in WV included emailing teachers at sixty-nine High Schools, four centers (Cabell Co. Career Tech Center, Ben Franklin Career and Tech Center, Putnam Career and Tech Center, Rubenstein Juvenile Detention Center), and one middle school in West Virginia. Newly developed program flyers (describing programs in mathematics and data sciences) were attached to the emails and faculty volunteered to make in-person or virtual visits to the schools. These efforts led to thirteen visits by faculty in nine different WV counties, two open houses, and two mathematics competitions. Program information was also distributed to WV teachers via the WV K-12 mathematics teachers listserv. In conversations with the WV teachers, we learned that none of them have had any exposure to the mathematics and data sciences programs at WVU through the WVU recruiters. Most were unaware of any of the STEM degree offerings at WVU. Therefore, we have developed a database of contacts for all the high schools in WV and have collaborated with the department of Physics and Astronomy to coordinate visits to every high school in WV in every county every three years. Now that the mathematics and physics programs know that WVU recruiters are not engaging with STEM teachers in WV high schools, we can focus our in-state recruiting efforts on reaching out to those teachers directly to establish relationships to increase enrollments in our programs. Because WVU draws 60% of its students from out of state, we have also invested in recruiting students from outside of WV. In AY22-23, mathematics faculty contacted teachers at thirty high schools in Pennsylvania, Maryland, and Washington, DC. Promotional literature was distributed and we have begun the process of organizing visits to those schools. These efforts will be expanded over the coming years. Additionally, and somewhat unique to the mathematics program, many of the upper division courses offered by the program are also taken by students in other majors. In fact, some of these upper division courses (course numbers >300) require multiple sections to accommodate the demand. Specifically, from Fall 2018 to Spring 2023, mathematics taught 1268 out of 2098 students in 300 and 400 level courses who were not majors, so 60% were not Math Majors. (As shown in Table 16 in Appendix 1, 56% of the students in those courses from F19 to S23 were non-majors). These students were primarily majors in data sciences, engineering, business, forensics, agriculture, chemistry, physics, biology, geology, etc. While the total number of unique primary mathematics majors in those courses in 2022 was 123, the recent 2022 yearly average of the number of unique overall students taught in those same advanced mathematics courses is 389, over 3 times the number of majors. Therefore, the need for instruction at the 300-400 level in mathematics reflects a significant, campus-wide demand for advanced mathematics instruction that goes well beyond the number of majors. In other words, even without the undergraduate program in mathematics, there is significant demand for upper division mathematics courses that are critical to other programs across the university and those courses would still have to be taught. Therefore, after meeting the demand for those courses by other degree programs, the incremental cost for operating the undergraduate degree program in mathematics is minimal. Lastly, we note that the new WVU budget model for FY25 eliminates much of the distinction between single majors and double majors by incentivizing the generation of total SCH and not singular degrees. When the FY25 budget model is implemented, programs such as mathematics and data sciences will be incentivized to recruit and retain primary, secondary, and tertiary majors along with minors nearly equally. For example, we expect that a great many students will add a minor or double major in data sciences. The data sciences degree relies heavily on upper division coursework in mathematics and will generate additional mathematics SCH. There is ample evidence that incoming students want multidisciplinary degree programs. The synergistic mathematics and data sciences undergraduate degree programs clearly address this desire of 21st century students.

Q4.3. This question is optional and required only if a unit's doctoral programs are under review.

Data have been provided on the unit's tenure-track / tenured FTE to doctoral student headcount ratio across all of the unit's doctoral programs.

Address any differences in the unit's doctoral student to tenure-track and tenured faculty FTE ratio to the institutional expectation of 2-to-1.

There are two important items of context for the discussion of the doctoral program. First, prior to AY22-23, the doctoral program required that all entering students enter as MS students. In many of the doctoral programs at WVU, all entering graduate students are admitted as doctoral students. As noted in the additional documentation at the end of this response, this problematic aspect of the doctoral program was identified in 2021 during an internal review of the doctoral program during the formation of the School of Mathematical and Data Sciences. A new admissions process that brings in all new graduate students as doctoral students was submitted for approval to the Eberly College in the fall of 2022. There is an agreement in principle to permit the mathematics program to make this change, but as yet there is no Eberly-approved plan that can be used to initialize the formal process of defining this new admissions pathway. Until that plan is developed by the Eberly College, the mathematics program is not allowed to make this change. Since the approval process timeline is the same as for creating a new program, assuming that the Eberly College moves our proposal forward by mid-August, final approval of the changes in the graduate program would likely occur in the Fall of 2024, in time for the Fall 2025 admission season. Nonetheless, for the purposes of this analysis, all the graduate students in the program are considered to be in the doctoral track as of AY22-23. Secondly, the doctoral program enrollment has historically included a large number of part-time and long-duration graduate students. A large fraction of the students in these categories were teaching instructors in the department that were pursuing their doctoral degree over many years, over a decade in some cases. With a doctoral degree, these teaching instructors would then be eligible for promotion from teaching instructor to teaching assistant professor. Other long duration students included research staff at local federal research facilities, e.g., the NASA IV&V facility, and companies. Not only did these students somewhat artificially inflate the total number of graduate students in mathematics, their long-duration enrollments significantly skewed the time-to-degree for the doctoral program. Thus, after the internal review of the doctoral program that was performed in 2021 that identified this issue, renewed emphasis was placed on moving these students along to completion in a timely fashion. As a result, over the three years of this review period, the PhD production rate for mathematics (approximately 10 per year since Fall 2021) has been excellent and the total number of enrolled graduate students has dropped rapidly as the backlog of long-term students has been reduced. We note that 68% of the current doctoral program enrollment (Fall 2023) are in their first or second year of graduate study. Thus, most of the doctoral program has been rebuilt with new students since the self-study was completed in 2021. We also note that the completion push coincided with the peak of the pandemic, which severely curtailed the ability to bring new international students to campus to begin their graduate studies in mathematics and to replace the long-term students in the pipeline. International students have been a major constituent of the mathematics graduate program and many of them brought with them financial support from their home countries (particularly students from the Middle East). Shown in Table 4 in Appendix 1 are the total number of graduate students in mathematics each fall since 2018. The data shows that enrollment is stabilizing, with enrollment in two key categories projected to increase. We expect to have 40 graduate students in Fall 2023. Also shown are the total number of PhD degrees awarded in mathematics each year. As discussed above, the PhD production levels have been exceptionally strong over the past few years (an average of 10 PhDs/year – which is nearly double that of the American Mathematical Society's published national average for medium sized public institutions of 3.9-6.8/year in mathematics). A key element in the Fall 2023 numbers is that the precipitous drop in the total number of graduate students has been arrested. While Eberly has now effectively restricted the number of graduate students in mathematics that can be supported as GTAs to less than 24 (by restricting the total dollars from any source that the department is allowed to spend on graduate students), we have been able to recruit a number of new international students that are supported by their home countries (4) and doctoral students that are now supported on research grants awarded to mathematics and data sciences faculty (3). These additional lines of support have enabled us to maintain the doctoral enrollments at about 40 for Fall 2023. The only limitation to growing the doctoral program at this time is the availability of financial support for the students. With the growth in research grant funding through partnership with the data sciences program and through targeted recruitment of international students with their own financial support, we expect to add an additional 8-9 students to the doctoral program in Fall 2024. Since the pipeline of students from the Middle East has been severely restricted, the mathematics program has focused intensely in AY22-23 on recruiting self-supported students from Africa and Eastern Europe. In the fall of 2023, we expect that 8 of our new doctoral students will be from these regions of the world. Using the number of tenure track faculty in mathematics that work with graduate students in mathematics (26), the ratio of graduate students to tenure-track FTEs is 1.72. (the same as the median for all of WV). This is somewhat under the target level of 2-to-1 but similar to the campus wide ratio. Given that we have two retirements under way within the tenure track and we have targeted an enrollment of 50 doctoral students by fall 2024, we anticipate reaching the milestone of students to tenure-track FTEs ratio of 2.0. This will return the program to the ratio achieved in fall of 2021. As part of this self-study, we performed a review of Big-12 peers (see Table 14 in Appendix 1). WVU ranks near the top in the ratio of students to FTEs (3rd of the 8 that reported data). Only two of our reporting Big-12 peers had a ratio of 2 or greater (and we note that one of them, Iowa State, has two separate PhD programs). We also learned that the largest program (UT-Austin with 52 tenure track faculty and 84 graduate students) only graduated 28 PhDs over the past two academic years (compared to 19 for WVU). Even though the total enrollment numbers have dipped over the past few years, the graduate program in mathematics has been producing PhD graduates/tenure-track faculty at a rate well above that of our Big-12 peers and has been making a significant contribution to the overall PhD production rate (roughly 10% of total WVU PhD production in STEM fields 2021, the latest year for which IPED data were available).

Q4.4. Data have been provided that show the changes to the unit's total number of faculty over the review period. Data have also been provided that show the total student headcount enrolled in all of the unit's programs over the same period of time as well as a three-year trend in student credit hour (SCH) production.

Explain the relationship between the change in the number of faculty in the unit and the change in the units total headcount enrollment and SCH production trends.

The total headcount of faculty over the review period includes the faculty in statistics, the new faculty hired for the data sciences program, and the new director of the school. Thus, the decrease in FTE headcount of 1 over the review period is obscured by adding these additional faculty positions in other programs. In fact, over the past 3 years and including AY 2023-2024, the mathematics program has hired 2 new tenure track faculty, 2 teaching instructors, and 2 teaching assistant professors. The program will have lost to retirements, and departures 6 tenure track faculty and 5 teaching instructors, for a net reduction of 5 FTE faculty (net loss of 3 out of 28 tenure track) in the mathematics program so far. In AY 2024-2025, there will be an additional reduction of 2 tenure-track FTEs due to already committed retirements and elimination of two instructors due to elimination of the postdoctoral scholar program. More importantly, in terms of program expenditures and the decrease in SCH generation, the role of adjunct instructors is a critical element. As noted elsewhere in this document, as part of our efficiency improvements for FY24, we have eliminated nearly 100% of the adjunct positions used for mathematics instruction (some adjunct instruction remains for statistics courses), eliminated an Associate Director position, and reduced expenditures. This decrease of 60 adjunct-taught courses for FY24 is not reflected in the number of FTEs associated with the mathematics program but significantly reduces the expenses attributed to the program. This reduction is equivalent to eliminating 7.5 full time positions since the beginning of the review period (2020). This calculation of 7.5 is based on the elimination of the 60 single course adjunct positions in FY2024 and then assuming an adjunct FTE teaches 8 courses per year. Thus, the combination of a reduced number of faculty FTE positions and the elimination of the adjunct instructors is consistent with the reduced instructional needs that arise from the reduced amount of SCH generation. In summary, the mathematics program has already implemented significant cost savings and an FTE reduction of 12.5 that is consistent with the decrease in SCH generation. Another 4 FTE reduction is already planned for FY25. It is important to note that some degree programs in the School of Mathematical and Data Sciences have grown in absolute SCH generation since 2020. The first Data Sciences courses were taught in 2021 and by 2022, SCH generation had grown by 300%. Since the hiring freeze has eliminated the possibility of hiring additional faculty in the Data Sciences program, mathematics faculty who have complimentary skills could also contribute to coverage of Data Sciences, particularly special topics courses for Data Sciences majors (such as the MATH 493B: Mathematics of Machine Learning taught in the spring of 2023). In other words, there is a growing need for instructors in our growing programs and some mathematics faculty could make significant contributions to those degree programs since they lack sufficient faculty to teach their required degree (major and minor) courses.

Q4.5. Data have been provided that shows the unit's research expenditures per the Higher Education Research and Development Survey (HERD).

Does this data capture all of the unit's research expenditures? If not, explain the difference here and provide evidence of additional research expenditures below.

The FY22 research expenditure data in the HERD analysis misses over $1M in 2022 research expenditures by faculty in the mathematics program. First, as part of WVU's Covid-19 response, a number of mathematics faculty were brought into new funded studies to model disease propagation in WV. These new awards were directed by the Health Sciences Center and while mathematics faculty received salary support in 2022 (shown in the Table 5 in Appendix 1), no tasks that flowed through the Eberly College were created. Second, another program with participation from mathematics faculty that does not appear in our research numbers is the NSF NOYCE (DUE1950217) Award that is through the College of Applied Human Sciences. Third, a research program led by a member of the mathematics program and funded by the NSF is directed centrally by the Provost's Office through the Center for STEM Education. That award is shown in the table below and the annual expenditures are estimated to be 1/3 of the three-year project funding since we do not have access to those expenditure data. Fourth, while large research awards in mathematics from federal agencies are rare, there are also additional private sources of mathematics support. Mathematics faculty have been quite successful in competing for these private sources of funding, but those awards flow through the WVU Foundation. The research awards made through the WVU Foundation are also shown in Table 5. The first six lines in Table 5 are the amounts of faculty summer salary, postdoc, and graduate student support that were not expended through a mathematics project code but were generated by personnel in math for work done on those projects. While these four groups of awards add approximately $200,000 to the 2022 funding of $227,792 in the data provided by the Provost (raising the research expenditures attributable to the mathematics program to ~$430,000 in 2022), that total for research expenditures still misses the research expenditures of the Director of the School of Mathematical and Data Sciences in 2022. Because the Director's salary and related expenses are included as part of the total program expenses in 2022, his research expenditures in 2022 should also be attributed to the mathematics program. His research fund program mapping was not updated when he moved to Mathematics because under the "One-WVU" philosophy, it was not considered critical to move all his active and new awards to mathematics (note that in prior years, when mathematics faculty were moved to other departments, their research funding was moved to their new departments and that created a sharp decrease in mathematics research expenditures over the past few years). However, according to the program review guidelines disseminated by the Provost's office and reiterated by Dr. Gavin in a live webinar on July 13, 2023, all the expenses and research expenditures for a program are based on an individual's Human Resources (HR) unit. The School Director is listed under mathematics in the HR system and his salary and expenses are included in the expenses of the program. Therefore, his research projects and their 2022 expenditures are listed in the second half of Table 5. As Table 5 clearly demonstrates, the total research expenditures that should be attributed to the mathematics program far exceed the $1M threshold set by the program review process. Therefore, had these research expenditures been properly attributed to the mathematics program, the PhD program in mathematics would have been exempted from review. According to the Provost's office guidelines for attribution of expenses and research expenditures to programs (not specific degrees), the mathematics program has exceeded the research expenditures threshold as defined in the self-study guidelines. While proper accounting of the research expenditures for mathematics in 2022 clearly exempts the mathematics PhD program from review, we feel that to be responsive to the spirit of the Provost's self-study process it is important to describe the ongoing efforts by the School of Mathematical and Data Sciences to grow research expenditures further in the coming years. The mathematics program was integrated into the School of Mathematics and Data Sciences in the summer of 2021 with a specific goal of developing a robust program of external funding. New hires were completed in AY21-22 and AY22-23 who either showed great promise for external funding or were brought to WVU with existing funding, e.g., Prof. Jing who brought his existing NSF CAREER award with him from his previous institution. While just in its infancy, this focus on developing extramural funding in the School of Mathematical and Data Sciences is already bearing fruit. Total new research awards for faculty in the School of Mathematical and Data Sciences are just a little less than $1M in 2023 ($927,039). These funds were obtained from the National Science Foundation and the Intel Corporation. All FY23 research awards are listed in Table 6 in Appendix 1. Proposal submission rates by faculty in the mathematics program have also significantly increased. 14 research proposals were submitted by faculty in the School in 2022-23. That was a 75% increase in proposal submission over the previous year (and a 100% increase in the proposed award dollars – from $1M to $2M). There is a new and substantive commitment to research funding in the School of Mathematical and Data Sciences. Given time to develop, the faculty in the School will continue to exceed the $1M research expenditure threshold over the next few years. We believe it is a very good sign that both new hires in Data Sciences obtained research funding (from NSF and Intel) in the first year of the Data Sciences program (and their first year as faculty). The 3rd hire in Data Sciences is already submitting research proposals before his arrival in Fall of 2023.

Q4.6. Upload evidence of research expenditures here.

Q5.1.
Student Enrollment and Graduation History

Responses in this section are limited to 7500 characters (approximately 1.5 single spaced pages).
Responses should be concise but also specific and supported by evidence.

Specific data definitions for these metrics are available on the Academic Transformation webpage.

Q5.2. Data have been provided on all of the unit's program's student enrollment trends.

That data includes:

4-year median fall enrollment (fall 18 through fall 21);
Fall 2022 change from 4-year median (in headcount and in percentage).

Units should address any programs with enrollment below the median for the program level or which has experienced a negative change in enrollment.

Undergraduate Program: The relevant trends are: 4-year median Fall enrollment (F18 - F21): 94 (not 83.5 as provided) F2022 change from 4-year median (headcount and percentage): - 20 (-21.28%) (not -18.5 (-22%) 4-year median degrees awarded (F18 - F21): 25 F2022 change from 4-year median (in headcount and in percentage). -3 (-12%) In Table 7 in Appendix 1, we provide details of the enrollments in the undergraduate program based on advising records. Undergraduate enrollment dropped sharply in F22. We attribute the bulk of this decrease to student difficulty in completing coursework and having limited interactions with their peers and professors during the pandemic (in classrooms and in extracurricular/outreach activities). Another factor was that our double/dual majors dropped from 2018 to 2022 (see Table 8) and a few math majors switched to the data science major. The low point in undergraduate math major enrollment occurred in Spring 2023 with 65 mathematics majors. There has been a slight rebound to at least 69 for the Fall 2023 semester. We anticipate a continued resurgence of major enrollment to at least the Fall 2018 enrollment by Fall 2024 and continue to improve moving forward to again place enrollment above the average for University majors and at a level it was prior to the pandemic. To achieve our enrollment targets, we have aggressively recruited during 2022-23. We visited 13 high schools in WV. We have developed a recruitment plan to visit each WV High School every three years to discuss the math and data science majors and the minors in math, data science, and statistics. Another part of our recruiting efforts involves the development of a new fund specifically targeted for recruiting. In 2018-19, we intensely recruited incoming math majors and incentivized any major that was calculus ready with a $1,000 scholarship. The result was a record freshman enrollment of 34 majors. This far exceeded the incoming classes prior to 2019 (e.g., 25, 16, 15, 15, 25, and 15 incoming math majors in the Fall 2013 through Fall 2018). We plan to work with our alumni to permanently fund this program with an endowment. The total number of BA/BS math majors that graduated in each academic year from 2018-19 to 2022-23 are listed in Table 9 in Appx. 1. Additional discussion of improvement enrollments and retention in the undergraduate degree program is provided in the response to Question 6.1 below. Graduate Program: Table 11 in Appx. 1 shows our fall enrollment in (1) our Ph.D. program only, and (2) our PhD and MS programs jointly. Both sets of numbers are important to the enrollment trends in the graduate program, especially with respect to potential future PhD enrollment after the direct admit to PhD program is approved. We compute the following statistics: 1. 4-year median fall enrollment (F18 - F21): 37 (PhD); 55.5 (PhD + MS) 2. Fall 2022 change from 4-year median (in headcount and in percentage): -13, -35% (PhD); -15.5, -28% (PhD + MS) 3. 4-year median degrees awarded (F18 -h F21): 5.5 (PhD); 6 (MS) 4. F2022 change from 4-year median (in headcount and in percentage): +5.5, +100% (PhD); +3, +50% (MS) Note that our graduate programs have experienced a significant decrease in enrollment, a matter we take very seriously. We concluded that the decline in enrollment is due to a combination of factors: 1. Increased graduation rates (30+ students in the past 2 years) as we have made a concerted effort to accelerate the progression of students who had been enrolled for many (7+) years. 2. A reduction in the number of international students with scholarship support from their home countries due to the pandemic (down by 55%). 3. A reduction in the number of students who are supported by grants. 4. A lack of organized domestic recruiting efforts in the years prior to the formation of the SMDS. Although all of these factors reduce our program enrollment headcount, we must stress that Factor 1 actually represents a significant improvement in the overall health of our graduate programs; see Table 21 and Graph 22 in Appendix 1 for a view of our enrollments by year. We acknowledge that Factors 2 through 4 are negative indicators for the health of our programs and, ultimately, our contribution to the university budget. Factor 2 is clearly related to the COVID pandemic, and our efforts to rebuild the number of international students on foreign scholarships are already showing some signs of success. In Table 17 and Graph 18 in Appendix 1, we break our graduate student enrollment down into 3 categories: part-time students, fellowship students, and core enrollment. Core enrollment represents the student population that is least likely to be affected by COVID. Table 19 and Graph 20 in Appendix 1 display analogous data for our doctoral enrollment. Our Factors 3 and 4 are areas in which we recognize a need to make changes. To address Factor 3, we have implemented incentives for faculty to apply for grants, and our records show that grant activity is increasing; moreover, we very intentionally consider the likelihood of funding success when hiring new faculty. At the graduate level, Prof. Tsikkou's graduate student recruitment campaign led to 9 events in AY 2022-23, with 4 virtual and 5 in person (Florida A&M University; Morgan State University; 2022 National Diversity in STEM Conference; 2023 Joint Mathematics Meeting; WV Council of Teachers of Mathematics Conference). As noted previously, currently, incoming math graduate students must first be admitted to our 2-year MS program or have a MS degree. After successful completion of the MS degree, students may be admitted to our 3+-year PhD program. Although WVU's math graduate programs are, in many respects, functionally equivalent to other math graduate programs, our current structure has two significant disadvantages: 1.Students in our 2-year MS program who intend to pursue our 3+-year PhD program are not included in the enrollment count for our PhD program, even though these students are functionally equivalent to first- and second-year PhD students under the typical 5+-year PhD structure. 2.Students who prefer to enter a math PhD program directly upon finishing their undergraduate degrees might not consider graduate study at WVU. Moving from our current admissions structure to the industry standard is one of our highest priorities. Doing so requires that we execute a formal Program Change, an intricate process that takes time. Although we have initiated this process, the program change is not yet official; the details are under review at the college level. Student demand for our graduate programs remains very strong. The main constraint in increasing our graduate program enrollment is a lack of stipends for graduate students. Because our R1 and Big-12 peers provide support for mathematics graduate students with a tuition waiver and a stipend funded through revenue from their service course teaching activities, to be competitive for those students we must find ways to provide a comparable level of support - through some combination of fellowships, research funding, and teaching assistant positions. One highlight of the graduate program is that we have awarded a substantial number of degrees over this reporting period, with our MS in Mathematics experiencing natural fluctuations and our PhD program producing a sustained increase in production. Our graduation data per calendar year are given in Table 12 in Appx 1.

Q5.3. Data have been provided on the unit's three-year trend in student credit hour (SCH) production.

Units should address any programs with a negative trend in SCH production.

There are three elements to the discussion of SCH production for the program in mathematics. First are the SCH generated through service course offerings. While these SCH reflect the revenue generating capacity of the program, they do not actually reflect the SCH generation due to the undergraduate or graduate degree programs. Although not a major factor in the total SCH generation, we note that the calculations of credit hours earned in mathematics provided by the Provost's office appear to include credits generated at the Bahrain campus. The trends in SCH generated in Bahrain are ignored for the purposes of discussion here. With respect to SCH production for the undergraduate degree program in mathematics, we show in the first row of Table 13 in Appendix 1 the total SCH generated for mathematics courses with course numbers > 200 for the last four years. This sum is an estimate of the SCH generation of the BS/BA program in mathematics. Relative to the average SCH production over the academic years AY19-AY22, the undergraduate program SCH production has decreased by 7.5%, which is a much smaller decline than the decline in the overall university SCH production. The 2020-2022 decrease in SCH generated for courses above 300 (which has a larger fraction of majors than all the courses above 200) is even smaller. Thus, the undergraduate program in mathematics is performing better than the university as a whole in terms of SCH generation. With respect to SCH production for the graduate program in mathematics, we show in the second row of the Table below, the total SCH generated for mathematics courses with course numbers > 400 for the last four years. This sum is a measure of the SCH generation of the graduate program in mathematics. Relative to the average SCH production over the academic years AY19-AY22, the graduate program SCH production has decreased by 11%. Again, this change is less than the decline in SCH production for the overall university. Thus, the graduate program in mathematics is performing somewhat better than the university as a whole in terms of SCH generation. As shown in the data provided by the Provost and in our calculations, the net revenue generated by the mathematics program far exceeds the costs of running the undergraduate and graduate programs combined. Even if the total SCH generated by the mathematics program continues to decrease because enrollments in other degree programs decrease, there is little chance that the costs to operate the mathematics programs will exceed the net revenue in the foreseeable future. How other units address their enrollment decreases, e.g., Engineering, is outside of the control of the mathematics program. However, the SCH production in our degree programs (as shown in Table 13 in Appendix 1) is an area in which programmatic decisions in the mathematics program can have a direct impact. As described earlier in this Self-Study, the mathematics program has undertaken a significant effort in recruiting beginning in 2022 (last year). At the undergraduate level, faculty are engaged in one-on-one interactions with high school teachers across WV and in neighboring states with the specific goal of increasing the visibility of the WVU mathematics program and recruiting new students to WVU. We have established a goal of reaching every high school in every county in WV on a three-year cycle. If the new leadership of the School continues and supports these activities, we are confident that the undergraduate program can return to pre-pandemic levels of majors if WVU survives the current financial crisis. SCH production in the graduate program has also fallen. The decrease in SCH production is directly attributable to a decrease in the number of graduate students in the mathematics program. As described earlier, this decrease is due to a number of compounding factors - increased graduation rates (a good problem to have); decreases in international student enrollment and admissions due to the pandemic; decreases in the number of GTA positions available to support graduate students due to WVU's financial crisis; and the loss of research supported graduate student stipends after the loss of a key faculty member with a very active research program. All of these issues were identified in our 2021 internal review and all are being addressed by active efforts in the School. New faculty with strong potential for extramural research funding have been recruiting and they are already getting new research awards after their first year at WVU. Intense graduate student recruiting efforts are underway and we have already demonstrated that the graduate student enrollment has stabilized and is likely to start to recover over the next few years. SCH production in the graduate program was nearly constant from AY21 to AY22 and we anticipate gradual improvement over the next few years.

Q6.1.
Assessment of Learning and Program Improvement

The Provost's Office will review the self-studies from the most recent Board of Governor's five-year program reviews for this section.

Units may provide updated information below if they so choose.

Q6.2. Provide the unit's plans or ideas to make significant changes to its operations, structure, offerings, or personnel in order to reduce its costs or improve its efficiency.

Provide any significant changes to the department's program curricula, its assessment of learning practices, or any other improvements that have been made since the department's programs completed their most recent Board of Governor's five-year review.

Undergraduate Program: Ongoing efforts to improve the undergraduate program and thereby increase retention and enrollments include regularizing our undergraduate math classes. For example, we can save on expenditures, become more efficient in course offers, and increase enrollments by offering some classes only once a year (i.e., 322 and 451), every other year during even or odd calendar years (i.e. 318, 338, 376, 381), and combining multi-section courses into one course (i.e., Math 375). We have already submitted for approval by the College revisions to our B.S. in Math degree to consolidate the AoEs to Actuarial Science, Computational Mathematical Science, Statistics, Math Education, Applied Math, and Foundations of Math. By consolidating some of the current AoEs and adding the Statistics AoE, the mathematics major will be aligned further with careers in math and statistics and make the major more attractive to students. This proposal is awaiting approval by the College. This will help us with our recruitment for both incoming and transfer students and attract double/dual majors (valuable for the new budget model in FY25). Finally, the math minor adds significant SCH and we will continue to recruit into the minor (minor enrollments are given in Table 10 in Appx 1). A key aspect of our upgrades of the undergraduate program is to understand where students struggle and improve our efforts in those areas. For example, in response to several required courses with above average DFW rates such as Real Analysis (Math 451), we now offer voluntary problem sessions in Math 451. The results of this for the Spring 2023 semester was a dramatic decrease in the DFW rate to 29% for Math 451. We are expanding these problem sessions to Math 341: Algebraic Structures and other advanced courses with higher DFW rates. We will also develop a Math 291 class focused on careers, internships, applying for REUs and other summer/academic year research opportunities to further build a sense of community in the program. For undergraduate program assessment, the annual ETS testing of math majors and the annual exit survey are the primary sources for information. As we discussed in our 2021 BoG report, based on nationally normed ETS testing results, WVU math majors consistently outperform their peers in the assessment areas of Calculus, Algebra, Routine and Non-Routine Calculations, and Applied Mathematics. These assessment results apply to all students completing BS and BA degrees. We have continued to use the detailed results of the national ETS mathematics assessment exam to identify potential areas of weakness in the preparation of our undergraduates. During the most recent review cycle, we identified deficiencies in the area of Modern Algebra. To improve in this area, we have hired two faculty members in Modern Algebra and have expanded our course offerings in this topical area. In the most recent ETS assessments, student performance in Modern Algebra has improved. Our exit survey with graduating majors points to issues in various courses that have been addressed by instructor and/or course content changes. Our last BOG report also highlighted a need to develop new minors and AoEs within the major. As we noted earlier, we have now proposed an additional consolidation of AoEs that is waiting for approval by the College. We will work with the College in AY23-24 to finalize the revisions to the AoE in order to streamline the requirements and redesign the degree to be even more career focused and attractive to students. We continue to use the results of exit surveys to identify problem courses or instructors and have reorganized teaching assignments and syllabi to address the specific concerns identified in the exit surveys. In addition to revamping our AoEs, we will continue to work with the College to update our course syllabi and prerequisites. We also updated the minors in Pure and Applied Mathematics and have added a new minor in Actuarial Sciences. Over the last two years, we have been successful in building a new sense of community in the math program by improving our mentoring and advising program and our extra-curricular activities and events around mathematics (mathematics club, Pi Mu Epsilon, Integration Bee, Junior Math Competition, Putnam Exam sessions, Math Field Day, and AMRL practice sessions). The growth of the DSCI program and major is also expected to have a significant impact in terms of academic program needs and complement the math program. For example, Linear Algebra is central to Data Science; in fall 2022 we requested approval of a new Linear Algebra introductory course whose delivery is supposed to be less theoretical and more mechanistic/applied. The goal is to provide students with the background necessary to understand basic tools of data processing - an important foundation for data science courses and various data science careers. Graduate Program: There has not been a formal assessment process for the graduate program. In the most recent BOG review (AY 21-22), we were required to provide a follow-up report that “demonstrates assessment of learning” by December 2023. The PhD program relies on an Entrance Exam (called Qualifying Exam in many other STEM PhD Programs). This is a critical milestone for PhD students, who need to pass two subjects (of four offered) within two years from entering the PhD program. A key element of our assessment strategy focuses on monitoring student performance on these exams and ensuring individual progress toward mastering the relevant subject matter. Starting with Fall 2022, we have paid increased attention to advising our first-year graduate students and encouraged them to enroll in courses that are appropriate for their background. Mathematics education (at any level) is fundamentally incremental but there are cultural and geographical differences in the pace and/or the depth of the material covered in the relevant courses; we are particularly sensitive to that since many of our graduate students are international. We have also been sensitive to the perils of first- and second-year students who may get into the wrong (often, too advanced) course, perform poorly (due largely to insufficient background) and have their progress through the program negatively (and, sometimes, irreversibly) affected. The impetus to start doing research in an advanced area of mathematics may feel very compelling even to new students; however, it is our duty to make sure that that does not adversely affect their progress through the program (which is designed to help them become well-rounded, knowledgeable and adaptable individuals). We have created a new initiative to pair students with advisors right from the beginning of their studies, as a way to provide better stewardship of our students, to detect and address potential problems early on. We also started a series of exam preparation courses in each of the four Entrance Exam subjects. Of the 11 incoming students in 2022, 9 attempted at least one entrance exam; 4 passed two exams by the end of their first year, and 2 passed one exam, (one at PhD level, one at MS level). This is a major improvement over the 2021 incoming class where none of the incoming 4 students passed two exams at PhD level to date and 2 passed one exam. This dramatic improvement in graduate student performance is just one example of the program improvements that arose from our internal review in 2021.

Q6.3. The program may provide additional evidence of program improvement here.

Additional 6.2 response.pdf
68.5KB
application/pdf

Q7.1. The unit may provide any additional context or information about the unit's programs here.

Q7.2. You may use this section to provide any additional evidence referenced in the program review.

7.1 response and Appendices.pdf
827.4KB
application/pdf

Q7.3. You may use this section to provide any additional evidence referenced in the program review.

Q7.4. You may use this section to provide any additional evidence referenced in the program review.

Q8.1.
Thank you for completing your self-study for the West Virginia University Board of Governors program review. You may now submit the survey and your self-study will be passed on to the Provost's Office for review.

Location Data

Location: [redacted]

Source: GeoIP Estimation