General Assembly Constituency Report 1

Senator Information

General Assembly Senator: Daniel Domingo Tcheurekdjian

Constituency: Natural and Mathematical Sciences

Contact Information: tcheurekdjian.1@osu.edu

Meetings and Events Attended/Hosted

Date	Organization/Event Name	Discussion Topics	Primary Contact Info for Organization/Group
10/5	Mathematics Advisory Conference	Reform of STEM General Education, Increase of sustainable development of opportunities in mathematics for undergraduates, Increase in equity-achieving initiatives.	The Mathematics Advisory Board can be contacted through official Department of Mathematics channels.
10/6	Mathematics Advisory Conference	Reform of STEM General Education, Increase of sustainable development of opportunities in mathematics for undergraduates, Increase in equity-achieving initiatives.	The Mathematics Advisory Board can be contacted through official Department of Mathematics channels.

General Assembly Constituency Report 1

Since being elected to be part of the General Assembly, what have you done to represent the student voice in the chamber and in other relevant circumstances?

In conjunction with the Department of Mathematics, and through the utilization of my role on the Mathematics Advisory Board, I hosted a two-day conference to discuss prescient issues facing the College of Arts and Sciences' Natural and Mathematical Sciences division. The agenda for October 5th is enclosed below.

Math Advisory Board
October 5–6, 2023
(all meetings in MW 724)

Thursday, October 5

Time	Meeting Topic	Comment
1:00 – 1:10	Welcome / Previous Actions	D. Baer
1:10 – 1:30	Introduction of new MAB Members	D. Baer
1:30 – 2:15	Departmental Updates Introduction of new interim chair Vice-Chair Reports	 Xiu Fowler, Hiary(?), Xing
2:15 – 2:30	Break	
2:30 – 2:50	Brief from Faculty (Data Science)	Xing & Xiu
2:50 – 3:10	Brief from Faculty (Quantum)	Penneys
3:10 – 3:30	Brief from Faculty (RTG)	Patrikis
3:30 – 3:45	Break	
3:45 – 5:00	Committee Meetings	various

General Assembly Constituency Report 1

As a result of this work, we were able to develop an actionable report, which we are now presenting to Deans at the Department and College level. The report follows.

Rebranding Mathematics at the Ohio State University

Introduction (Bench)

The success of a university all comes down to the students, thus the success of students in mathematics courses is a top priority within the department. To expand upon the values which mathematics has in everyday life and immerse students in a new mentality around math not only allows students to better connect with the material, but to also seek a deeper understanding of it. Curating better resources to further the engagement of students both in and outside of class will set students up for better success. This leads to the rebranding of our mathematics department in an initiative to revitalize mathematics and increase student engagement.

Our math department has the chance to pioneer a new outlook which would reestablish the foundational concepts that mathematics offers in everyday life. Most who decide to major in math already have a good understanding of these ideas and share a passion in sharing them with others. Rebranding math allows the department to connect back with a greater number of alumni with a chance to reignite their passions in math and support its revitalization. In turn, an effort to give a fresh perspective to an age-old subject will spur greater interest in the department. Actively working with students and getting helpful feedback to both improve and create resources will bring greater attention to the math department and all that we can offer. In an initiative to improve the extension of our resources to students, we have a greater possibility of stimulating greater interest in our programs.

1. Reestablishing the Foundational Nature of Mathematics (Bench)

In working to improve the department, we must assess who is in need of support and resources. The bulk of students who come in contact with the math department are enrolled in the core math classes that serve as prerequisites. Thus, most students taking classes within the department are not mathematics majors. Often, in the learning of mathematics, many question its necessity. In all the trigonometry and calculus, it can be easy to get lost in computation and lose grounds for the reasoning behind learning the material. Recognizing the end goal, however, and knowing what the material is helping to develop is crucial. This puts an emphasis on the difference between describing math and interpreting it. Understanding how to interpret the calculations within mathematics and giving meaning to the numbers and formulas creates a better connection

between the math and the students. Recognizing this will help in further understanding the foundational nature of mathematics as opposed to simply being a supporting subject to other areas. The department has the ability to curate a new mindset around math which emphasizes this foundational thinking. To implement these ideas, we suggest the math department should carry out the following actions:

1. **Utilization of Social Media.** In order to appeal to new students, it is crucial that we know how to communicate with our market. In the age of social media, it's safe to say that almost all students receive a majority of information from some type of social media. Most communication between the department and students occurs through email and though this may be somewhat effective, as students, we can attest to the fact that many emails get missed, especially emails which are mass sent. If we want to put a fresh perspective onto math and our department, we need to grow and adapt with our audience.
2. **Updating Course Descriptions.** Many of the current course descriptions shown on the mathematics website simply list a handful of the topics which the courses cover throughout the semester. For example, the description for MATH 2568 (Linear Algebra) is the following: "Matrix algebra, vector spaces and linear maps, bases and dimension, eigenvalues and eigenvectors, applications". Further establishing how linear algebra relates back to more tangible areas of our world would help students better connect to the material, and thus feel a more positive inclination towards math.
3. **Provide Opportunities for Application-Based Assignments.** A common sentiment amongst students is that fulfilling prerequisites in mathematics feels like climbing an endless, pointless ladder: each rung only matters because it allows you to reach the next, with no end in sight. We believe that allowing for some portion of a student's grade to be derived from the utilization of mathematics in an applied sense, instead of rote computation, would improve this perspective.

2. Increasing Interest and Enrollment in the Major

From statistics seen on the first day of the autumn 2023 Math Advisory Board meeting, the number of students majoring in math has seen a decline. Though a degree in mathematics has been shown as a top contender for high paying salaries upon receiving a four year degree, the number of students enrolled in a degree pathway within the math department is decreasing. From autumn 2015 to autumn 2020, mathematics was a top ten major within the university as a whole

(which offers more than 200 majors), consistently composing roughly 2% of the total undergraduate population. Since 2020, however, mathematics has been removed from the top ten list and electrical and computer engineering and mechanical engineering has been included. Further, the finance major has remained the number one undergraduate major since autumn 2017 and its lead has only grown over the last six years, composing about 7.22% of the undergraduate population in the current autumn semester (2023).

The changes in degree choices among students over the last 10 years exemplifies changing interests, but what remains consistent is the interest in areas with a basis in mathematics. As more students become interested in computer science, data analytics, and finance, there is no reason students should be driven away from mathematics. The five tracks which the math degree offers would support areas in finance, computer science and engineering, and electrical and computer engineering, three of the top ten majors in our current semester. Arguably undertaking a mathematics degree would better support students in these areas as the required courses would offer a greater basis in the understanding of these topics because of the mathematical foundations. From here, we must assess how the department can stand out amongst other departments within the university. This is not so much of a question as to how we attract new students, but what is the reasoning behind the loss of students directly enrolled in the math department.

1. **Negative Perceptions and Misconceptions (Tcheurekdjian and Bench)**

Mathematics is a field with enormous potential for individual expression, innovation, and development. Mathematicians work in a diversity of roles: every science engages deeply with mathematics, and as such mathematicians are in demand in every field across every discipline. This demand is not localized to academia: positions across industries in analysis, control, efficiency, and research and development highly prioritize the hiring of mathematicians.

Despite this, the Department routinely loses out on undergraduate enrollment due to a double disconnect: a disconnect between perception of the work of a mathematician and the actual potential work of a mathematician, and disconnect between that work and the coursework in mathematics most undergraduates are exposed to.

84% of surveyed undergraduate students stated that potential job prospects and opportunities to earn significant compensation were a very significant contributor to their choice of major. Conversely, only 40% of surveyed students placed mathematics in their top 10 majors in terms of economic value. Further, **no** surveyed undergraduates outside of the Department of Mathematics could accurately describe the work that a mathematician conducts. At most, people could identify two very broad categories of mathematics employment: education and academic

research, although it should be noted that the respondents' ideas surrounding the scope and composition of research in mathematics are very likely misguided. This is, in our opinion, a dramatic failure on the fronts of marketing, communication, and public engagement.

As we see a decline in mathematics majors, but a rise in computer science, engineering, and finance majors, we see that there is not a decline in the interest of mathematics, rather there is a disconnect between what majors students feel best suit their career plans and what students believe the mathematics department offers. This disconnect can be fixed through the following ways:

- **Connecting with students.** Strengthening the ties between students and the math department is outlined below, but to further explicate, being able to connect with students allows the department to better understand the intentions of students at the university both academically and in their career goals. This is especially important with students in the larger prerequisite classes, as understanding their intentions will aid in assessing how we can make the department more appealing. A flow of communication between students and the department will disclose which resources within the department should be further developed and marketed.
- **Providing better resources to students.** In order to change the negative perceptions and misconceptions of the mathematics subjects, the department must offer resources which help in portraying math in a new light. Oftentimes students will refer to resources outside of their lecture materials or notes to complete their homework or study for an exam. Most of the time, this leads to youtube videos, informational websites, and other online resources. Though the ability to seek other resources is a great skill, in our opinion, it is a great flaw that students are seeking help outside of the university. That is to say, it is a huge downfall to our department that students are being directed to other university resources as they research additional materials to aid in their studies. As one of the largest public universities in the nation, there is no reason for students to first seek aid outside of Ohio State in order to complete their learning, rather than using the resources available to them through the university. Further, curating our own resources personal to our students, we have the chance to explicate the versatile nature of mathematics through providing multiple perspectives of a subject from TA's, faculty, and even other students.
- **Explication of career options.** A greater effort to illustrate the career fields which mathematics opens the door for will allow students more insight into the benefits of graduating with a math degree rather than a more specific degree (i.e. finance, CSE, etc). If we widen the perspective of students to see the vast number of different fields which math fits into, mathematics will become more appealing to students. Changing the narrative of where mathematics can take students after graduation is integral to the rebranding of mathematics.

General Assembly Constituency Report 1

3. Strengthening the Ties Between Students and the Department (Tcheurekdjian)

Undergraduate Student Engagement Within the Major

It is our opinion that driving the creation of an inter-major community should be a top priority for the Department. Unlike other highly technical majors, mathematics students find themselves broadly compartmentalized and isolated despite the inherently complex nature of their work. This leads to higher attrition rates, decreased productivity, and increased psychological stressors. In a survey of 50 mathematics majors, 92% agreed that having a more active and involved community would improve both their productivity and their mental health.

Having demonstrated the importance of community, we identify several currently existing barriers to the creation of an undergraduate community in the Department, and highlight certain possible interventions to address them.

1. Location

Undergraduate mathematics majors do not have a dedicated community gathering space that is located close to professors and department staff. Contrast this with majors like Chemistry and Chemical Engineering, which give their majors permanent access to their building, or Physics and Astrophysics, which provides modern forum spaces for their student organizations. This leads to a high degree of decentralization within the major, and a loss of community development, opportunities for collaboration, and group learning.

Although the undergraduate math study space exists, it is not modernized, it is isolated from professors and staff, clubs cannot reasonably use it to host events, and students do not have access to the space on the weekends. This is unfortunate, as a dedicated space would be a boon to the undergraduate mathematics ecosystem. We believe that the following characteristics are essential to ensure the success of undergraduate spaces:

a. **Accessibility.** An undergraduate space should be always available for students to use. Students should be able to access the space continuously, including on the weekends and in the evenings.

b. **Resource availability.** The space should include resources (chalkboards, projectors, flexible seating, variable lighting, etc.) necessary to facilitate a diverse set of student activities and endeavors.

c. **Positionality.** The space should exist in or near the dedicated mathematics centers on campus.

We propose that the Board move as soon as possible to examine the viability of such a project.

2. Student-Faculty Interaction

It is inarguable that the interactions between students and faculty are the lifeblood of the Department. Students who are able to develop relationships with faculty receive educational opportunities far beyond those available through attending class alone, and are more likely to contribute to the Department throughout their professional careers, whether through aiding in research or building long-term professional relationships. Access to professors and graduate students is essential to building these relationships. Unfortunately, nearly 82% of surveyed students reported having no interaction with professors or graduate students outside of class, and over 90% agreed that they did not have the opportunity to engage with faculty outside of class. However, 80% of students agreed that they **would** engage with faculty at a greater incidence if given the opportunity. We need to provide opportunities for a connection between the undergraduate student body and the Department's faculty to develop. Intervention recommendations for how this would occur are varied, but we can examine examples from different departments to examine possible ideas:

- **Faculty Coffee/Tea Time.** The Department of Physics and the Department of Astronomy host weekly, informal meetings between faculty and students, providing food and drink, and facilitating conversation and connection between students and faculty.
- **Faculty talks.** The Department of Chemistry and Chemical Engineering hosts biweekly faculty seminars for students to learn about the work of a certain professor, subsets of research, or the importance of an emerging topic in chemistry.
- **Club-Faculty Collaboration.** Faculty in the Department of Computer Science and Engineering lead clubs in collaboration with undergraduates. This allows clubs to serve as a point of contact between faculty and students, while also allowing clubs to provide more interesting and engaging programming. Faculty can allow students to engage with their research, provide activities, and speak with students about applications of their work.

The key to the success of these programs is the support they receive from the Department. Students in Physics and Astronomy classes are told meeting times by their professors and

encouraged to attend. Students in the Department of Engineering enter into a collaborative ecosystem through classes like Fundamentals of Engineering, and attend clubs and classes led in conjunction with faculty. Developing these processes, in conjunction with programming, will be essential to their success if applied to the Department of Mathematics.

3. Standing of the Undergraduate Math Program Nationally (Tcheurekdjian)

1. Student Research Opportunities

Central to the standing and potential development of a Department's undergraduate programming are opportunities to engage with research. Unfortunately, research accessibility in the Department is lackluster. This is not an OSU specific problem: introductions to research in mathematics in general are challenging. Unlike in the physical sciences, mathematics has very little rote work occurring in its research. Students are unable to join a research group to clean test tubes, organize lab subjects, pipette samples, etc. As such, it can be challenging for investigators to incorporate undergraduate students into their research. Because of these conditions, research opportunities in mathematics are often limited solely to highly advanced undergraduates. We believe that these conditions unnecessarily deprive students of the opportunity to conduct research, an important learning opportunity, and an integral building block of their mathematical maturity. Collaboration with active researchers in the Department will be essential to building an undergraduate research ecosystem, and it is likely that no progress in this topic will be made without their assistance; nevertheless, we offer several suggestions on how this could occur.

1. **Expansion of Cycle-like programs.** The Department of Mathematics currently hosts a program known as Cycle, a semester-long opportunity for undergraduates to engage with graduate students and conduct introductory research with them, often expository in nature. Undergraduates are introduced to higher-level mathematics, create a research poster, and develop valuable connections within the Department. It is our opinion that Cycle is an excellent example of programs developed to foster an undergraduate research program, and should be supported and developed to the best of the Department's abilities.

2. **Adoption of an UROP.** At the Massachusetts Institute of Technology, undergraduates have the opportunity to participate in what is known as the Undergraduate Research Opportunities Program. The UROP provides funding and/or academic credit for students conducting research, and pairs them with a faculty member with whom they will collaborate throughout the year. The goal of this collaboration is explicitly to create novel research within their field. Upon completion of the year-long research project, students are expected to present

their findings at the school's research symposium. Although not a requirement, some students may submit their written reports (ranging from 15-25 pages) to the faculty committee in order to be considered for publication in the university's, or exterior, research journals. The UROP, when adopted by universities, is invariably successful: the University of Michigan saw research involvement amongst women and minorities jump nearly 15%, while UC Irvine saw research productivity amongst undergraduates skyrocket nearly 40% by internal metrics. The Ohio State University has both the faculty and the funding to institute an UROP, and should seriously consider doing so.

These systems are complex, and challenging to implement, but not impossible. If the Department is serious in its efforts to increase the standing of its undergraduate program, it must ensure that research opportunities are both readily available and incentivized. Moreover, if the Department wants to change its *branding*, no tool will be more useful than word of mouth. Students, we believe, want to engage with interesting projects. If they are shown those projects exist, and then are given the opportunity to join them, their enthusiasm will create a wholly new vector of engagement.

2. **National Visibility**

A large portion of the perception of the success of a program is simply its visibility. Presence at national and international conferences, **publications in journals**, rankings in national and international mathematics competitions, and talks at undergraduate conferences are essential to achieving this goal. As this is not our area of expertise, we do not offer specific interventions to address this: we bring it to the attention of the Department so that those with greater knowledge in the field can offer their own interventions.

Successfully implementing even some of these programs would drastically improve the national standing of the Department from its already significant position at 27th in the United States.