DEAN'S INNOVATION FUND PROPOSAL: MATHEMATICS PRELIMINARY EXAM MENTORING PROGRAM

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ABSTRACT. We propose the creation of a mathematics preliminary exam mentoring program that will run during the summers. Older graduate students will meet regularly with small groups of new students to discuss problem-solving techniques, exercises and effective study habits. This program aims to relieve some of the anxiety and stress associated with these exams and to create a collaborative environment among the students. In particular, this program will improve the retention of students from underrepresented groups in mathematics. The majority of the requested funding will go towards the mentors' salaries. A small amount will be earmarked to provide food at some of the gatherings. To the best of our knowledge, such a program does not exist in other departments. However, depending on the success in the mathematics department, this format can easily generalize to any department that has preliminary exams.

1. PROJECT SUMMARY

The mathematics preliminary exams are a set of tests covering the basic pillars of modern mathematics: analysis, geometry & topology and algebra. These are the first significant hurdles to obtaining a PhD and students must pass two by the end of their second year to avoid being dismissed from the program. These exams are not mere formalities as they cover years' worth of material and several students have been discharged from the program recently due to their performance on these exams. Naturally, the preliminary exams are a source of much stress for beginning students, who are already dealing with the usual pressures of a graduate workload in an unfamiliar environment.

Although it is reasonable for graduate programs to expect basic competency from their students to remain in the program, we have observed that many preliminary exam failures are not due to lack of effort or intellect, but rather a deficiency of information and structure. We are proposing the creation of a program in which older graduate students mentor younger ones through this grueling examination period. The majority of the requested funds will be disbursed to these mentors. Each mentor will be selected from a pool of applicants based upon their performance on the preliminary exams and their teaching abilities. The mentors will be assigned a small group of three to four students with whom they will be working closely throughout the summer. The mentors' duties will include answering generic

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questions about the structure of the exams, reviewing content covered on the exams and presenting solutions to practice problems. The groups are expected to meet weekly.

The purpose of this program is to ease the apprehension and encourage students to start studying for the exams early. Many new students are not comfortable asking faculty questions and having an approachable mentor is the key to easing new students into the system. Additionally, studying mathematics in groups is a useful tactic as every students brings a slightly different perspective to a theory or problem. However, some beginning students have not established any social support or have been excluded from such studying groups. Our mentoring program will encourage students to study in groups even outside the mentoring sessions.

Although the preliminary exams are often seen by faculty as a time-honored rite of passage, there have been recent studies that suggest there is little correlation between results on these exams and future academic success [2]. Moreover, these exams are damaging to the mental health of students and disproportionately eliminate women and minority students [1]. We advocate for the elimination or complete re-purposing of the preliminary exams, but this more drastic step will likely require years to implement. In the meantime, given the inefficacy of these exams, our proposal aims to move students past this obstacle as painlessly as possible.

As alluded to above, this mentoring program also addresses an important issue of diversity and inclusion. We believe that mathematical talent is distributed equally among different ethnic, economic and social divisions. Clearly, educational opportunities are not availed to all groups equally. The school of Arts and Sciences and the Department of Mathematics affirms this belief and encourages the active inclusion of underrepresented and under-served groups in their graduate program. However, after admission, there is no academic program in place to ensure retention of these students. Many students from under-served groups may not be as traditionally prepared for the graduate program and are prevented from receiving a degree due to the preliminary exams, before they even have a chance to try mathematical research. Thus, far from providing an opportunity for these students, their admission and subsequent dismissal may delay their careers by several years. The program in this proposal hopes to level the playing field a bit for these students.

We initially considered running this program based on volunteers, but the graduate students already have substantial teaching loads and it would be unreasonable to ask them for this type of help without compensation. For the same reason, running the program during the summer rather than during the school year is more appropriate, especially since the first opportunity to take the exam will be at the start of the academic year in August. Many students are around during the summer, but without classes, there is much less social activity. The mentoring program can keep the department more active during the summer months and for those first-year students that arrive early, this is an opportunity to socialize even before their official start date.

We have not seen such a program implemented in other departments and we believe this initiative is well-aligned with the goals of the Dean's innovation fund, particularly to the

justice, equity, diversity and inclusion area and the A&S first year retention. Moreover, this general construction can extend effortlessly to many other STEM departments. We should mention that there are existing peer and faculty mentoring programs in the department, but they address day-to-day graduate life rather than the particulars of the preliminary exams. Moreover, these programs meet less frequently as they are structured around volunteers.

2. Project Budget

2.1. **Personnel.** The proposed program should have a significant impact on the academic experience of the new students in math department, but will only require a modest amount of funding. The bulk of the funds are earmarked for the compensation of the mentors. We calculate that a fair amount for weekly meetings is around $500 for a summer. Most graduate students can earn more from private tutoring. With six mentors, a summer's worth of compensation comes out to $6000.

2.2. **Materials and Supplies.** The only other items in the budget are for snacks and food that are provided during the study sessions. In the beginning, the food will serve the purpose of encouraging students to participate. This tactic has proven to be extremely effective for other events. We estimate that we will need $80 per week for food and for a program that will run about 12 weeks, this will be about $1000 allocated for food.

2.3. **Budget Summary.**

Item	Price
Mentor Salaries	$6000
Food & Snacks	$1000
Total:	$7000

References

[1] Patricia C Jackman, Lisa Jacobs, Rebecca M Hawkins, and Kelly Sisson. Mental health and psychological wellbeing in the early stages of doctoral study: a systematic review. *European Journal of Higher Education*, 12(3):293–313, 2022.
[2] Julie R Posselt. *Equity in science: Representation, culture, and the dynamics of change in graduate education.* Stanford University Press, 2020.

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