

Proposal for Changes to the Mathematics Curriculum

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Proposal

The key component of this proposal is to replace Discrete Mathematics with Linear Algebra as a requirement for the major.

Rationale

It is essential for a mathematics major to be proficient working in abstract spaces, in particular those of high (greater than 3) or infinite dimension. While working in three or fewer dimensions, students can always visualize the data and functions they are working with. In higher dimensions, where students cannot rely on spatial pictures for understanding, a deeper understanding of the mathematics involved is critical. Whether they go on to work in industry or academia, math students will encounter functions that are dependent on more than two variables, so these abstractions are necessary.

Within the current major, students have many options to encounter such abstractions. It does happen to some degree in Multivariable Calculus; however this course focuses mostly on three dimensions. Students certainly also do this in Algebra and Real Analysis, although these classes tend to be quite a bit more abstract than the two and three dimensional spaces studied in the Calculus sequence. We believe that Linear Algebra provides the best introduction to abstraction beyond the three dimensional Euclidean space that students easily adapt to. Studying vector spaces in Linear Algebra provides an exposure to something more abstract than three dimensions while keeping many of the geometric properties that students are used to. This allows students to begin studying mathematical objects they cannot see with their eyes while still being in a somewhat familiar environment. Thus, Linear Algebra becomes the nice gateway into upper level courses such as Algebra and Real Analysis.

There were already many good reasons for a student to take Linear Algebra. Being comfortable with matrices and understanding eigenspaces are extremely valuable skills. Additionally, Linear Algebra is typically required for mathematics graduate study. However, it is the introduction to abstraction that we find essential for all of our mathematics majors.

Support of Proposed Change

In 2010, the Mathematics and Computer Science Department underwent a review by outside examiners. This proposed change in the major encompasses two of the examiners' recommendations. One of the sources on which they based these recommendations was the Mathematical Association of America's *CUPM (Committee on the Undergraduate Mathematics Program) Curriculum Guide*. One notable statement from the *Guidelines* is that, "The program

of every mathematics major should include linear algebra.” Below are two of the examiners’ recommendations.

Recommendation 5.4: Linear Algebra should be required for the major.

Recommendation 5.7: The mathematics faculty should examine the relationship between Discrete Mathematics and Introduction to Advanced Mathematics and determine whether or not both courses need to be required for the major.

It is also very uncommon for a college to not require Linear Algebra for a major in mathematics. In fact, every other ACS school whose degree requirements we could find online (all but 3 of them) requires Linear Algebra.

Logistics

In order to require Linear Algebra for the major without increasing the number of required courses, something has to be taken out. It is proposed that Linear Algebra take the place of Discrete Mathematics. Discrete Mathematics is a wonderful course that we hope many students will take as an elective, but we feel Linear Algebra is more essential for our students. Once Linear Algebra is required, we plan to offer it every year. Discrete Mathematics will still be offered every year as well since it is a requirement for the Computer Science major. A few other changes will have to be made, in particular to the minor and prerequisites for some courses. Official proposal forms are attached.

Other Changes

The same change will happen in three places. A requirement of Discrete Mathematics will be replaced with the option of either Discrete Mathematics or Linear Algebra. This will occur in:

- Mathematics minor,
- Prerequisite for Introduction to Advanced Mathematics,
- Prerequisite for Combinatorics.