Proposal: Applied Mathematics Minor

Submitted by Maryke van der Walt on behalf of the
Department of Mathematics and Computer Science

Rationale:

One of the action items that arose from our department's most recent 6-year review (specifically, from recommendations from our external reviewer) was the creation of a minor program in Applied Mathematics. Such a program would be targeted at mathematically inclined students majoring in the Natural and Behavioral Sciences, Engineering and Economics and Business. We envision that a minor in Applied Mathematics would serve these students by enabling them to expand their mathematical and problem solving skills while strengthening their resumes. At the same time, it would draw more non-major students to our department's classes, thereby enhancing our department's sustainability and diversifying our community.

Proposed requirements for an Applied Mathematics minor:

Currently, our department offers minor programs in Mathematics (24 units) and Computer Science (20 units). We are proposing to add a 24-unit minor in Applied Mathematics with the following course requirements:

Requirements for a minor in Applied Mathematics (24 units):

- MA 009 (Calculus I) (4)
- MA 010 (Calculus II) (4)
- MA 040 (Differential Equations with Linear Algebra) (4)
- CS 010 (Design and Implementation of Solutions to Computational Problems) (4)
- Two of the following: (8)
  - CS/MA 121 (Introduction to Numerical Analysis) (4)
  - CS/MA 124 (Codes and Encryption) (4)
  - MA 130 (Probability and Statistics) (4)
  - CS 150 (Structural Bioinformatics) (4)
  - PHY 115 (Mathematical Physics) (4)

For comparison, the required courses for a B.S. Mathematics major, a B.A. Mathematics major, a Mathematics minor and the proposed Applied Mathematics minor are listed in Table 1. (The corresponding course titles and prerequisites are given in Table 3 at the end of this document.)

We note that, as a whole, the courses in the proposed Applied Mathematics minor program have less emphasis on proof-writing and more emphasis on problem solving in real-world applications.

As such, the Applied Mathematics minor program follows an approach distinct from the current Mathematics minor and should appeal to a different part of the student body.

	Math major (BS)	Math major (BA)	Math minor	Applied Math minor
MA 009	x	x	x	x
MA 010	x	x	x	x
CS/MA 015	x	x	x*	
MA 019	x	x	x*	
MA 020	x	x	x	
MA 040				x
CS 010	x	x*		x
CS 030	x			
MA 108	x	x*		
MA 109	x*			
MA 110	x	x*		
MA 111	x*			
CS/MA 121				x*
CS/MA 124				x*
CS 150				x*
MA 130				x*
PHY 115				x*
MA 180	x	x		
Any 4-unit MA upper div	2	3	2	-

Table 1: Requirements for Mathematics programs at Westmont. (* indicates a choice.)

In Table 2, we compare the proposed minor program with similar programs at comparable institutions (Pepperdine University, Trinity College, Lipscomb University, Albion College, Dordt University, University of California Santa Cruz and University of California Merced). Calculus I/II and a course on Differential Equations are fairly standard to require. Although an introductory Computer Science course is not typically required at comparable institutions, we feel strongly that such skills would complement our students' development in real-world problem solving. It is less straightforward to compare upper division course requirements across the various institutions – Applied Mathematics is a very broad field, and course offerings at smaller departments typically depend on faculty interest. We have similarly made our selection of upper division electives based on faculty skill sets as well as collaborative efforts between departments to highlight the interdisciplinary nature of the field.

	Pepp.	Trinity	Lipscomb	Albion	Dordt	UCSC	UCM	Westmont
Calc I	x		x	x	x	x		x
Calc II	x	x	x	x	x	x		x
Multiv Calc	x		x	x	x*	x		
Lin Alg	x	x			x*	x	x	
Diff Eq / Lin Alg	x	x	x	x	x*	x	x	x
Intro Statistics	x	x			x		x	
Intro CS		x		x				x
Numerical Analysis		x*			x*	x*	x	x*
Prob / Stats						x*		x*
Codes / Encrypt								x*
Bioinformatics								x*
Math Physics								x*
Dyn Systems		x*				x*		
Financial Math		x*						
Complex Analysis					x*			
Math Modeling		x						
Problem Solving					x			
Colloquium				x				

Table 2: Requirements for Applied Mathematics minor programs at comparison institutions. Pepp: Pepperdine University; Trinity: Trinity College; Lipscomb: Lipscomb University; Albion: Albion College; Dordt: Dordt University; UCSC: University of California Santa Cruz; UCM: University of California Merced. (* indicates a choice.)

Resources:

The proposed courses are all currently being taught by faculty in the Mathematics and Computer Science and Physics departments. No new courses are required, although new upper division elective courses might be introduced in the future based on faculty interest and availability.

Timeline:

We plan to launch this program in Fall 2023.

Addendum:

A list of applicable courses with their prerequisites is given in Table 3.

	Course title	Prerequisites
MA 009	Calculus I	Precalculus
MA 010	Calculus II	MA 009
CS/MA 015	Discrete Mathematics	Admissions Math Requirement
MA 019	Multivariable Calculus	MA 010
MA 020	Linear Algebra	MA 010 or CS/MA 015
MA 040	Differential Equations with Linear Algebra	MA 010
CS 010	Design and Implementation of Solutions to Computational Problems	–
CS 030	Abstract Models for Concrete Problems Using Java	CS 010
MA 108	Mathematical Analysis	MA 020
MA 109	Advanced Mathematical Analysis	MA 108
MA 110	Modern Algebra	MA 020
MA 111	Advanced Modern Algebra	MA 110
CS/MA 121	Introduction to Numerical Analysis	MA 010
CS/MA 124	Codes and Encryption	CS/MA 015 or MA 020
MA 130	Probability and Statistics	MA 010
MA 180	Senior Seminar	Senior standing
CS 150	Structural Bioinformatics	CS 010
PHY 115	Mathematical Physics	MA 019

Table 3: Course codes, titles and prerequisites.