

## Proposed Changes to the BS in Mathematics

### Introduction

To provide the students with broad exposure to the most important fields, we propose to include **concentrations** in our existing BS program in Mathematics, as many other math programs have done (either with concentrations or simply different math degrees), for instance, FIU, FSU, UCF, USF from the SUS system, and math programs across the nation, such as UCLA, Arizona State University, Georgia Tech, University of Massachusetts (Amherst), to name a few.

We propose to have four concentrations for the BS in Mathematics:

1. Pure Mathematics (57 credits, excluding science courses)
2. Mathematical Cryptology (57 credits, excluding science courses)
3. Mathematical Biology (59-60 credits, **including** science courses)
4. Statistics and Data Science (57 credits, excluding science courses)

Three of these concentrations (Pure Mathematics, Mathematical Cryptology, and Statistics and Data Science) are similar in structure to the existing BS program in Mathematics. The concentration in Mathematical Biology has some distinguishing features to the existing program. In this document, we would like to justify these distinguishing features.

### Pathways

The four concentrations in Pure Mathematics, Mathematical Cryptology, Mathematical Biology, and Statistics and Data Science will follow the same mathematical pathway for general education courses as the existing program, the “College Algebra to Calculus” pathway. This is a standard pathway for degree programs in the Mathematical Sciences department as well as other SUS Mathematics departments.

### Transferability of Credits

The concentrations in Pure Mathematics, Mathematical Cryptology, and Statistics and Data Science follow similar transferability with the existing BS in Mathematics program. Degree programs throughout the University and SUS in Mathematics, Physics, Engineering, and some other sciences will have transferability in credits and courses into and out of this program.

The concentration in Mathematical Biology will also have transferability into and out of degree programs throughout the University and SUS. We would expect students in this concentration to have an interest in Biology, Chemistry, Psychology, and related programs. There is clear transferability throughout the SUS on this pathway. Students who would like to transfer to another concentration in our BS program will be individually advised on where they can move into the regular Calculus sequence. A few may be able to move into Calculus 3 upon the advice of the MAP 2484 professor.

### Input and Demand from Graduate Programs and Industry

#### Statistics and Data Science

There is a longstanding demand for Statistics and Data Science at this University. “Big Data Analytics” is one of the Platforms of the University Strategic Plan for 2015-2025. In addition, there is an existing interdisciplinary “Bachelor of Science with a Major in Data Science and Analytics.”

The proposed concentration in Statistics and Data Science is building on this investment. While the existing interdisciplinary program is useful for giving a broad background to students intending to prepare for industry, this concentration in the BS program in math is intended to be advantageous to students wanting to continue to graduate school.

## Mathematical Biology

Biological systems are also a clear emphasis of the university. It has clear connections to at least two Pillars (Healthy Aging and Neuroscience) and two Platforms (Big Data Analytics and Undergraduate Research and Inquiry). This concentration is intended to build on this university investment.

Graduates with this degree are expected to have the background and interdisciplinary skills for careers in technical industries and to pursue graduate degrees in Computational Biology, Biomathematics, or Data Science that are looking for students with a strong background in computational mathematics, statistics, as well as a diverse background in sciences. Students from the proposed Mathematical Biology Concentration could also, if they choose the right electives, apply to MD, Do, or Dentistry programs.

A critical issue for the Mathematical Biology Concentration concerns a reasonable credit count for the program as opposed to providing sufficient background coursework for success in upper-division coursework. While upper-division courses in Mathematics often have prerequisites of Calculus 2, Matrix Theory, or Differential Equations, requiring these courses for students with an interest in Mathematical Biology would have a degree program with an unsustainably high credit count. However, if students don't have some background in Calculus, Matrix Theory, or Differential Equations, they won't be successful in the courses that they need.

To address this issue, we would create two new courses that give adequate preparation for upper-division coursework. These are "Mathematics for Biological Sciences 1 and 2" (MAP 2483 and MAP 2484) that were approved at the Nov. 6, 2023 UUPC Meeting. We would then follow up to alter some upper-division course prerequisites to accommodate the newly created courses. This is still in progress.

The proposed Mathematical Biology Concentration is different from most existing similar programs in that our concentration does not require the traditional path Calculus 1-3 and it requires a reduced number of mathematics courses. It has the advantage of preparing students to adapt to the job market and graduate programs in the interdisciplinary fields of mathematics and life sciences. Some similar programs, where Calculus 1—3 are either not enforced or replaced by variations of Calculus courses, can be found at Harvey Mudd College and Brown University.

## Implementation of Concentration

The implementation of the concentrations in Pure Mathematics, Mathematical Cryptology, and Statistics and Data Science will follow the "College Algebra to Calculus" pathway as in the existing BS program in mathematics.

The implementation of the concentration in Mathematical Biology will also follow the "College Algebra to Calculus" pathway by (a) creating new courses that will give the diverse background required for success in the upper-division coursework, and (b) providing waivers for students into upper-division courses that need to be updated to accommodate the broader background of students in an interim way. Apart from the course prerequisite changes that will be required in the long term, all other parts of this implementation are in place.

## Ideal Future of Concentration

In the future, one could see the concentration in Mathematical Biology as a standalone program. To create this program, we will have to collect data associated with establishing demand, financial planning of resources, sufficient benefit to the university, community, and state, as well as issues related to institutional readiness (per Regulation 8.011 - Authorization of New Academic Degree Programs and Other Curricular Offerings). Deploying this concentration will allow us to do due diligence on justifying

this program, while still providing benefits to existing students in the near term. We feel that this is a responsible model for developing a new program.

### Conclusion

To prepare students in mathematics for the fast development of technology and rapidly changing market, we follow the national trend to include concentrations in the BS degree in Mathematics. The three concentrations in Pure Math, Cryptology, and Statistics and Data Science are similar in structure to the existing BS program in Mathematics. The Mathematical Biology concentration is designed to have a balanced combination of courses in mathematics and statistics, computations, and sciences.