Options for Math Department and Programs

Current course offerings:	GenEd	Math	Secondary Math Educ.	Elementary Education	Engineering	Electives
123: Intro to Data Science	√					
131: Fundamentals in Math	√					
171: Elementary Functions	√					
191: Calculus I		√	√	√	√	
192: Calculus II		√	√	√	√	
220: Logic & Proof		√	√			
290: Linear Algebra		√	√		√	
291: Calculus III		√	√		√	
300: Probability & Statistics		√	√	√	√	
301: Statistical Modeling		√	√	√	√ (IE)	
305: Advanced Data Science						√
320: Ordinary Differential Equations		√	√		√ (ME)	
370: Real Analysis		√	√			
380: Abstract Algebra		√	√			
390: Mathematical Programming		√	√			
400: Topics in Mathematics		√				
EDMATH 210				√		
EDMATH 211				√		
EDMATH 340			√			
EDMATH 395				√		
CSCI 281				√		
Credit Hours:	9	39	39	24	21	3

Option 1: Merge department; eliminate math major.
　　　Total savings ≈ $7,000 per year. Revenue reduction = ?
A. Merging the department will save the university two course releases per year (assuming the chair of the merged departments does not receive additional compensation). Maximum savings ≈ $6,000 per year.

B. Eliminating the math major will only allow us to eliminate MATH 400. We typically offer this as an independent study once per year. Maximum savings ≈ $1,000 per year.

Option 2: Merge department; eliminate math major; eliminate secondary math endorsement.
　　　Total savings ≈ $19,000 per year. Revenue reduction = ?. Impact on TEP?
C. This allows us to eliminate MATH 220, 340, 370, 380, 390, 400. We typically offer 4 sections (total) of these courses per year. Maximum savings ≈ $12,000 per year

Option 3: Merge department; eliminate math major; eliminate elementary and secondary math endorsement.
　　　Total savings ≈ $23,000 per year. Revenue reduction = ?. Impact on TEP?
D. This allows us to eliminate MATH 301 (3 cr) and 395 (1 cr). We typically offer one section of each course each year. Maximum savings ≈ $4,000 per year. The TEP may not need to maintain its current staffing levels.

We cannot eliminate any additional courses without affecting engineering and elementary education programs. We will still need our current staffing levels to cover courses under options 1 and 2.

Option 4: Modernize programs (applied math, data science); offer service courses that actually serve student needs

Results:
1. Eliminate three chronically under-enrolled courses.
2. The math major is converted to a more attractive applied math major to attract students and prepare them for employment and graduate school. This program also serves as an attractive second (or alternate) major for engineering students.
3. A new data science major is created that could be part of a popular double major with computer science. A data science certificate program is also created for students in the social, natural, and health sciences.
4. MATH 171 gets focused as a 1-credit hour stats/bio/chem prerequisite (instead of the 3-credit General Education course it currently is). At one credit hour, it can be offered as a summer bridge program and half-semester course to quickly get students into the courses they need for their majors.
5. A true precalculus course is created to serve engineering majors. Unethical lab fees are removed from Calculus.
6. The department serves more students while offering fewer courses and credit hours.

Necessary changes:

A. Eliminate chronically under-enrolled and unpopular courses:
    1. MATH 220: Logic & Proof
    2. MATH 370: Real Analysis
    3. MATH 380: Abstract Algebra

B. Reduce credit hours, eliminate lab fees, and focus courses:
    1. MATH 171: Elementary Functions. (3 –> 1-credit hour; focus on linear/exponential functions for STAT/STEM)
    2. MATH 191: Calculus I. (4 –> 3-credit hours; eliminate lab; no change to course outcomes. Eliminate lab fee.)
    3. MATH 192: Calculus II. (4 –> 3-credits; eliminate lab; no change to course outcomes. Eliminate lab fee.)
    4. MATH 291: Calculus III. (4 –> 3-credits; eliminate lab; no change to course outcomes)

C. Modify courses:
    1. MATH 171: Elementary Functions. (Remove General Education designation)
    2. MATH/STAT 123: Intro to Data Science. (Change name to DATA 123: Intro to Data Science)
    3. MATH/STAT 300: Modern Probability & Statistics. (Change name to DATA 300: Probability & Statistics)
    4. MATH/STAT 301: Statistical Modeling. (Change name to DATA 301: Statistical Modeling)
    5. MATH/STAT 305: Advanced Data Science. (Change name to DATA 305: Statistical and Machine Learning)
    6. MATH 400: Topics in Mathematics. (Cross-list as DATA 400: Advanced Data Science)

D. Add courses:
    1. MATH 181: Precalculus.
    2. MATH 321: Partial Differential Equations
    3. MATH 375: Complex Analysis

E. Modify major requirements:
    1. Math major
        Current: 39 credit hours, including MATH 191, 192, 220, 290, 291, 300, 301, 320, 370, 380, 390, 400
        Proposed: Applied Math Major: 30 credit hours, including MATH 191, 192, 290, 291, 390, 400 (twice).
                      Choose a track: Track A: 320, 321, 375. Track B: 300, 301, 305.

    2. Secondary math endorsement
        Current: 39 credit hours, including MATH 191, 192, 220, 290, 291, 300, 301, 320, 340, 370, 380, 390.
        Proposed: 27 credit hours, including MATH 123, 191, 192, 211, 281, 290, 300, 340, 390.

F. Requirements for new major and certificate programs (using no additional courses)
  1. Data Science major: 30 credit hours: DATA 123, 301, 305, 400; MATH 191, 290, 390; CSCI 195, 294, 360

  2. Certificate program: 6 credit hours: DATA 123 (intro), 400 (capstone), plus
                6 credits from the following: DATA 300, 301, 305; STAT 213, STBE 237, ECON 447

Rationale/effect:
  A. Eliminate chronically under-enrolled and unpopular courses:
    1. MATH 220: Logic & Proof
    2. MATH 370: Real Analysis
    3. MATH 380: Abstract Algebra

  Effect: We typically lose majors in these courses, as students aren't interested in these more abstract, theoretical topics. Eliminating these courses (which are typically offered once per year) will result in a reduction of 9 credit hours per academic year and will increase our overall average revenue per course section.

  B. Reduce credit hours, eliminate lab fees, and focus courses:
    1. MATH 171: Elementary Functions. (3 –> 1-credit hour; focus on linear/exponential functions for STAT/STEM)
    2. MATH 191: Calculus I. (4 –> 3-credit hours; eliminate lab; no change to course outcomes. Eliminate lab fee.)
    3. MATH 192: Calculus II. (4 –> 3-credits; eliminate lab; no change to course outcomes. Eliminate lab fee.)
    4. MATH 291: Calculus III. (4 –> 3-credits; eliminate lab; no change to course outcomes)

  Effect: We typically offer 14 sections of MATH 171 and 6 sections of the Calculus sequence courses each year. These credit hour reductions will result in an overall reduction of 34 credit hours offered by the department each academic year.

    MATH 171, while having solid enrollment, no longer serves a clear purpose. It was originally designed to prepare students for Calculus, but no longer adequately does so (due, in part, to its lack of prerequisites). While it does fulfill the General Education quantitative reasoning requirement, many students go on to take STAT 213 (which also fulfills the same requirement).

    Many students now see MATH 171 solely as a prerequisite (or co-requisite) for statistics, biology, and chemistry courses (other students see no purpose for the course, as they take MATH 171 <u>after</u> completing the courses which list it as a prerequisite). Based on conversations with faculty teaching these subsequent courses, it's unclear how MATH 171 serves as a pre/co-requisite. The course covers too many topics that have no relevance to these subsequent courses. Some of the topics that <u>are</u> relevant are taught too late in the semester for MATH 171 to be a useful co-requisite course.

    Focusing MATH 171 on linear, exponential, and logarithmic functions will better prepare students for statistics, biology, and chemistry courses. Reducing the course to a single credit hour will allow us to better serve the large number of students who need this course. We could offer it as a summer bridge program to allow students to immediately take statistics, biology, or chemistry courses. We could also offer it as a half-semester course (to better serve as a co-requisite) and a winterim course. Students who need to take Calculus (like engineering majors) will be much better served by a true precalculus course.

The Calculus sequence of courses were originally designed as 4-credit hour courses that include a lab where students use *Mathematica* software to further explore concepts and solve problems. The separation of the courses into "regular" 3 credit hours and additional "lab" components has always been artificial. As applications have been built-into the courses – and as we no longer have a departmental license for Mathematica – the labs have evolved to become "extra time" in which students complete homework problems and take exams. This has led to the courses no longer meeting our credit hour policy (i.e., students are not completing 2 hours of work outside class for every hour in-class). Reducing these courses to 3-credit hours will align with our credit hour policy and will allow us to eliminate the unethical lab fee.

C. Modify courses:
   1. MATH 171: Elementary Functions. (Remove General Education designation)
   2. MATH/STAT 123: Intro to Data Science. (Change name to DATA 123: Intro to Data Science)
   3. MATH/STAT 300: Modern Probability & Statistics. (Change name to DATA 300: Probability & Statistics)
   4. MATH/STAT 301: Statistical Modeling. (Change name to DATA 301: Statistical Modeling)
   5. MATH/STAT 305: Advanced Data Science. (Change name to DATA 305: Statistical and Machine Learning)
   6. MATH 400: Topics in Mathematics. (Cross-list as DATA 400: Advanced Data Science)

   Effect: MATH 171, reduced to a single credit hour, will clearly no longer fulfill the General Education outcome. This will have no effect on students who go on to take STAT 213. Students who do not take STAT 213 will not take MATH 171 and will fulfill the General Education requirement through another quantitative reasoning course (DATA 123; MATH 131, 181; CSCI 140, 281; STBE 137).

   Using the DATA prefix for existing DATA 123, 300, 301, 305, and 400 will clarify the focus of these courses on data science. It will also separate these courses from statistics courses offered by other departments.

D. Add courses:
   1. MATH 181: Precalculus.
   2. MATH 321: Partial Differential Equations
   3. MATH 375: Complex Analysis

   Effect: MATH 181 will serve engineering majors (and some other STEM majors) who are required to take Calculus. We anticipate needing no more than 2 sections of this per year, which will result in an additional 6 credit hours per academic year.

   Based on the popularity of MATH 291 and 320, we anticipate solid enrollments in MATH 321 and 375. These courses will become the upper-level core of our applied mathematics major. Until enrollments increase, one section of each course will be offered each year (resulting in an additional 6 credit hours offered each academic year).

E. Modify major requirements:
   1. Math major
       Current: 39 credit hours, including MATH 191, 192, 220, 290, 291, 300, 301, 320, 370, 380, 390, 400
      Proposed: Applied Math Major: 30 credit hours, including MATH 191, 192, 290, 291, 390, 400 (twice).
                             Choose a track: Track A: 320, 321, 375. Track B: 300, 301, 305.

2. Secondary math endorsement
       Current: 39 credit hours, including MATH 191, 192, 220, 290, 291, 300, 301, 320, 340, 370, 380, 390.
     Proposed: 27 credit hours, including MATH 123, 191, 192, 211, 281, 290, 300, 340, 390.

    Effect: With reduced credit hour requirements, the applied math major is more focused than our existing major. It includes courses designed to prepare students for immediate employment or graduate school (as opposed to our current major that is more focused on graduate school prep). Both tracks of the applied math major take advantage of courses we already offer to engineering and education majors.

          While Track A requires the creation of two new courses, we anticipate these courses will be popular with students. Since they are follow-ups to current popular courses, we should have no problem recruiting students.

          The proposed secondary math endorsement curriculum meets state requirements while reducing credit hour requirements by 12 (a full semester). Since we began requiring math education students to complete the full math major, we've noticed a significant drop in majors. Reducing the credit hour requirements will allow us to serve more students, eliminate under-enrolled courses, and produce more qualified secondary math teachers to meet local need.

F. Requirements for new major and certificate programs (using no additional courses)
   1. Data Science major: 30 credit hours: DATA 123, 301, 305, 400; MATH 191, 290, 390; CSCI 195, 294, 360

   2. Certificate program: 6 credit hours: DATA 123 (intro), 400 (capstone), plus
                             6 credits from the following: DATA 300, 301, 305; STAT 213, STBE 237, ECON 447, CSCI

    Effect: The data science major requires <u>no</u> new courses; it takes full advantage of existing math, computer science, and statistics courses. We anticipate this will become a popular major (and, potentially, a popular second major alongside applied math or computer science). The major incorporates project-based introductory and capstone courses, which will allow students to develop portfolios to demonstrate their achievement.

          The certificate program should be a popular option for students who want to demonstrate they have the ability to turn data into insight (importing, transforming, visualizing, modeling, and communicating data). We anticipate this certificate could attract students from the College of Business (Economics, Finance, Marketing); College of Health & Human Services (Kinesiology); and College of Arts & Sciences (social sciences, biology, computer science, engineering).

Comparison of courses offered in 2007, 2017, and 2018 (as proposed).
Courses taught by TEP faculty are not included (210, 211, 340, 395).

	Courses Offered in 2007	Courses offered currently	Courses offered with proposed changes
	090		
	091		
	095		
	096		
	101		
		123	123
	131	131	131
	151		
	152		
	161		
	171 (3 credits)	171 (3 credits)	171 (1 credit)
			181: Precalculus
	191 (4 credits)	191 (4 credits)	191 (3 credits)
	192 (4 credits)	192 (4 credits)	192 (3 credits)
	220	220	
	230		
	280		
	290	290	290
	291 (4 credits)	291 (4 credits)	291 (3 credits)
	300	300	300
	301	301	301
	305	305	305
	320	320	320
			321: Partial Diff Eq
	360		
	370	370	
	371		
	375		375
	380	380	
	381		
		390	390
	395		
	396		
	400	400	400
	490		
Total courses:	**31**	**16**	**16**
Total credit hours:	**88**	**51**	**46**

The proposed changes will result in our department offering 5 fewer credit hours of unique courses.

Program requirements (as proposed):

Proposed course offerings:	GenEd	Applied Math (A)	Applied Math (B)	Data Science	Secondary Educ.	Elementary Education	Engineering
123: Intro to Data Science	√			√	√	√	
131: Fundamentals in Math	√						
171: Elementary Functions							
181: Precalculus	√					√	
191: Calculus I		√	√	√	√	√	√
192: Calculus II		√	√		√	√	√
290: Linear Algebra		√	√	√	√		√
291: Calculus III		√	√				√
300: Probability & Statistics			√		√	√	√
301: Statistical Modeling			√	√			√ (IE)
305: Statistical & Machine Learning			√	√			√ (IE)
320: Ordinary Differential Equations		√					√ (ME)
321: Partial Differential Equations		√					
375: Complex Analysis		√					√ (ME)
390: Mathematical Programming		√	√	√	√		
400: Topics in Mathematics		√√	√√	√			
EDMATH 210						√	
EDMATH 211					√	√	
EDMATH 340					√		
EDMATH 395						√	
CSCI 195				√			
CSCI 281					√		
CSCI 294				√			
CSCI 360				√			
Credit Hours:	9	30	30	30	27	24	21
(change from current credit hours):	(-9)	(-9)	N/A	(-12)	(no change)	(no change)	

Most courses contribute to multiple programs.

Course sections offered (using 2017-18 enrollment and no new majors)

	2017-18 sections	With proposed changes
123: Intro to Data Science	1	1
131: Fundamentals in Math	2	2
171: Elementary Functions	14	9
181: Precalculus		2
191: Calculus I	4	4
192: Calculus II	4	4
220: Logic & Proof	1	(eliminated)
290: Linear Algebra	2	2
291: Calculus III	3	3
300: Probability & Statistics	3	3
301: Statistical Modeling	1	1
305: Statistical & Machine Learning	0	0
320: Ordinary Differential Equations	2	2
321: Partial Differential Equations	0	1 (instead of 220)
375: Complex Analysis	0	1 (instead of 380)
380: Abstract Algebra	1	0
390: Mathematical Programming	1	1
400: Topics in Mathematics	1	1
Total sections:	**40**	**37**
Total credit hours:	**131**	**104**

If the applied math major attracted <u>no</u> additional students and the data science major/certificate attracted <u>no</u> students, these proposals will still allow us to offer 3 fewer course sections and 27 fewer credit hours per academic year.

This results in adjunct/overload cost savings of $27,000.

Internal impact: Describe anticipated resources needed for this program.
Staffing (faculty and staff)
Academic Support Services
Library Resources
Technology Needs
Student Services
Financial Aid
Admissions