SPECIAL REPORT

of the

ACADEMIC MATTERS AND PROGRAM AND BUDGET COUNCILS

concerning a

REVISION OF THE TEACHING CONCENTRATION WITHIN THE MATHEMATICS AND STATISTICS MAJOR

Presented at the
753rd Regular Meeting of the Faculty Senate
December 10, 2015

COUNCIL MEMBERSHIP

ACADEMIC MATTERS COUNCIL


PROGRAM AND BUDGET COUNCIL

ACADEMIC MATTERS COUNCIL

The Department of Mathematics and Statistics is proposing revisions to the Teaching Concentration within the Mathematics and Statistics major. The revisions are intended to bring the concentration into better compliance with the Program Standards for High School Teachers Preparation of the National Council of Teachers of Mathematics. The first proposed change is to replace the required course MATH 551 (Introduction to Scientific Computing) with MATH 471 (Theory of Numbers). The subject of MATH 471 is more relevant to high school math teachers, and with the addition of a computational component the course will satisfy Program Standards for use of technology as part of math studies. The second proposed change is to replace the required course MATH 462 (Geometry II) with an elective course at the 400 level or above in Mathematics or Statistics. This will help to give students a broader exposure to the different fields in math. The course MATH 461 (Geometry I) will still be required and will have material on non-Euclidean geometry added to meet the Program Standards.

The Program Subcommittee recommends approval of the proposed revisions.

At its meeting on October 7, 2015, the Academic Matters Council voted unanimously to recommend Faculty Senate approval of the Revision of the Teaching Concentration within the Mathematics and Statistics Major, submitted as proposal #2043 in the Course and Curriculum Management System.

PROGRAM AND BUDGET COUNCIL

The Program Subcommittee of the Program and Budget Council met on October 14, 2015, reviewed the proposal for a Revision of the Teaching Concentration within the Mathematics and Statistics Major and recommended it for approval.

At its meeting on Wednesday, October 21, 2015, the Program and Budget Council voted to unanimously approve the Revision of the Teaching Concentration within the Mathematics and Statistics Major. It was submitted as proposal #2043 in the Course and Curriculum Management System.

MOVED: That the Faculty Senate approve the Revision of the Teaching Concentration within the Mathematics and Statistics Major, as presented in Sen. Doc. No. 16-019.
Proposal to Revise a Concentration

I. Concentration
   1. Title

   Update to the Teaching Concentration within the Mathematics & Statistics major

   2. Proposed Starting Date

   For students declaring the concentration in Spring 2016 and later.

II. Proposal Development

   1. Briefly describe the Proposal

   This proposal is to update the Teaching Concentration to reflect changes in two requirements:
   1) Math 471 will replace Math 551 to fulfill the 'Use of Technology' requirement; 2) Math 462 is no
      longer be required, and in its place, one additional course in Mathematics or Statistics number 400 or
      above.

   The total number of upper-division Math/Stat courses remains 8, which is consistent with the other
   concentrations within the Math/Stat majors.

   2. Provide a brief overview of the process for developing the proposal

   These changes are in response to the Program Standards of the National Council Teachers of
   Mathematics (NCTM) for High School Teachers Preparation. First, under the NCTM Program
   Standards, math majors in the teaching concentration are not required to take two semesters of
   geometry; they do need exposure to non-Euclidean geometry in one class. The department has
   submitted a revised proposal for Math 461 to address this non-Euclidean geometry requirement.
   And by converting the second geometry class into a general upper-level mathematics and statistics
   elective, students will gain a broader exposure to different areas of mathematics.

   Second, the NCTM Program Standards requires that math majors in the teaching concentration learn
   about and be able to use technology in connection with their mathematics study. Currently the math
   majors in teaching concentration fulfill this requirement by taking Math 551, Introduction to Scientific
   Computing. However, by design Math 551 is intended for students in applied mathematics, engineering
   and other fields who need learn specific computational techniques to solve numerical problems in high
   performance computing (HPC). In particular, both the techniques involved and the problems discussed
   in Math 551 are mostly not of interests to teaching majors. On the other hand, the materials in Math
   471, Theory of Numbers, are directly related to the preparation of high school math teachers. And by
   adding a computational component to Math 471 (the department has submitted a revised proposal on
   that), this revised course will help satisfy the 'Use of Technology' of math teaching majors and
   better align the interests and needs of the students in this concentration.

III. Purpose and Goals

   Describe the proposal’s purpose and the particular knowledge and skills to be acquired.

   The purpose is to update the teaching concentration to reflect the NCTM Program Standards for high
   school teachers preparation. Converting the second upper-level geometry course into an upper-level
   mathematics and statistics elective will also help the math teaching majors gain a broader exposure to
   different areas of mathematics.
IV. Resources

If this proposal requires no additional resources, say so and briefly explain why. If the proposal requires additional resources, explain how they will be paid for. For proposals involving instruction, indicate how many new enrollments are expected and whether the courses have room to accommodate them.

No additional resources.

Curriculum

Provide a curriculum outline showing degree program requirements, requirements of any existing concentrations, requirements of proposed concentration, and how they relate. You may include this outline and any additional documents as attachments below.

See attached document which shows the requirements as we envision them after the approval of this proposal.
Programs for Initial Preparation of Mathematics Teachers
Standards for Secondary Mathematics Teachers

Process Standards (Standards 1-7)

The process standards are based on the belief that mathematics must be approached as a unified whole. Its concepts, procedures, and intellectual processes are so interrelated that, in a significant sense, its “whole is greater than the sum of the parts.” This approach would best be addressed by involvement of the mathematics content, mathematics education, education, and field experience faculty working together in developing the candidates’ experiences.

Likewise, the response to the disposition standard will require total faculty input. This standard addresses the candidates’ nature and temperament relative to being a mathematician, an instructor, a facilitator of learning, a planner of lessons, a member of a professional community, and a communicator with learners and their families.

Standard 1: Knowledge of Mathematical Problem Solving
Candidates know, understand, and apply the process of mathematical problem solving.

Indicators
1.1 Apply and adapt a variety of appropriate strategies to solve problems.
1.2 Solve problems that arise in mathematics and those involving mathematics in other contexts.
1.3 Build new mathematical knowledge through problem solving.
1.4 Monitor and reflect on the process of mathematical problem solving.

Standard 2: Knowledge of Reasoning and Proof
Candidates reason, construct, and evaluate mathematical arguments and develop an appreciation for mathematical rigor and inquiry.

Indicators
2.1 Recognize reasoning and proof as fundamental aspects of mathematics.
2.2 Make and investigate mathematical conjectures.
2.3 Develop and evaluate mathematical arguments and proofs.
2.4 Select and use various types of reasoning and methods of proof.

Standard 3: Knowledge of Mathematical Communication
Candidates communicate their mathematical thinking orally and in writing to peers, faculty, and others.

Indicators
3.1 Communicate their mathematical thinking coherently and clearly to peers, faculty, and others.
3.2 Use the language of mathematics to express ideas precisely.
3.3 Organize mathematical thinking through communication.
3.4 Analyze and evaluate the mathematical thinking and strategies of others.

Standard 4: Knowledge of Mathematical Connections
Candidates recognize, use, and make connections between and among mathematical ideas and in contexts outside mathematics to build mathematical understanding.

Indicators
4.1 Recognize and use connections among mathematical ideas.
4.2 Recognize and apply mathematics in contexts outside of mathematics.
4.3 Demonstrate how mathematical ideas interconnect and build on one another to produce a coherent whole.

Standard 5: Knowledge of Mathematical Representation
Candidates use varied representations of mathematical ideas to support and deepen students’ mathematical understanding.
Indicators
5.1 Use representations to model and interpret physical, social, and mathematical phenomena.
5.2 Create and use representations to organize, record, and communicate mathematical ideas.
5.3 Select, apply, and translate among mathematical representations to solve problems.

Standard 6: Knowledge of Technology
Candidates embrace technology as an essential tool for teaching and learning mathematics.

Indicator
6.1 Use knowledge of mathematics to select and use appropriate technological tools, such as but not limited to, spreadsheets, dynamic graphing tools, computer algebra systems, dynamic statistical packages, graphing calculators, data-collection devices, and presentation software.

Standard 7: Dispositions
Candidates support a positive disposition toward mathematical processes and mathematical learning.

Indicators
7.1 Attention to equity
7.2 Use of stimulating curricula
7.3 Effective teaching
7.4 Commitment to learning with understanding
7.5 Use of various assessments
7.6 Use of various teaching tools including technology

Pedagogy (Standard 8)
In addition to knowing students as learners, mathematics teacher candidates should develop knowledge of and ability to use and evaluate instructional strategies and classroom organizational models, ways to represent mathematical concepts and procedures, instructional materials and resources, ways to promote discourse, and means of assessing student understanding. This section on pedagogy is to address this knowledge and skill.

Standard 8: Knowledge of Mathematics Pedagogy
Candidates possess a deep understanding of how students learn mathematics and of the pedagogical knowledge specific to mathematics teaching and learning.

Indicators
8.1 Selects, uses, and determines suitability of the wide variety of available mathematics curricula and teaching materials for all students including those with special needs such as the gifted, challenged and speakers of other languages.
8.2 Selects and uses appropriate concrete materials for learning mathematics.
8.3 Uses multiple strategies, including listening to and understanding the ways students think about mathematics, to assess students’ mathematical knowledge.
8.4 Plans lessons, units and courses that address appropriate learning goals, including those that address local, state, and national mathematics standards and legislative mandates.
8.5 Participates in professional mathematics organizations and uses their print and on-line resources.
8.6 Demonstrates knowledge of research results in the teaching and learning of mathematics.
8.7 Uses knowledge of different types of instructional strategies in planning mathematics lessons.
8.8 Demonstrates the ability to lead classes in mathematical problem solving and in developing in-depth conceptual understanding, and to help students develop and test generalizations.
8.9 Develop lessons that use technology’s potential for building understanding of mathematical concepts and developing important mathematical ideas.
Content (Standards 9-15)
Candidates’ comfort with, and confidence in, their knowledge of mathematics affects both what they teach and how they teach it. Knowing mathematics includes understanding specific concepts and procedures as well as the process of doing mathematics. That knowledge is the subject of the following standards.

Standard 9: Knowledge of Number and Operation
Candidates demonstrate computational proficiency, including a conceptual understanding of numbers, ways of representing number, relationships among number and number systems, and meanings of operations.

Indicators
9.1 Analyze and explain the mathematics that underlies the procedures used for operations involving integers, rational, real, and complex numbers.
9.2 Use properties involving number and operations, mental computation, and computational estimation.
9.3 Provide equivalent representations of fractions, decimals, and percents.
9.4 Create, solve, and apply proportions.
9.5 Apply the fundamental ideas of number theory.
9.6 Make sense of large and small numbers and use scientific notation.
9.7 Compare and contrast properties of numbers and number systems.
9.8 Represent, use, and apply complex numbers.
9.9 Recognize matrices and vectors as systems that have some of the properties of the real number system.
9.10 Demonstrate knowledge of the historical development of number and number systems including contributions from diverse cultures.

Standard 10: Knowledge of Different Perspectives on Algebra
Candidates emphasize relationships among quantities including functions, ways of representing mathematical relationships, and the analysis of change.

Indicators
10.1 Analyze patterns, relations, and functions of one and two variables.
10.2 Apply fundamental ideas of linear algebra.
10.3 Apply the major concepts of abstract algebra to justify algebraic operations and formally analyze algebraic structures.
10.4 Use mathematical models to represent and understand quantitative relationships.
10.5 Use technological tools to explore algebraic ideas and representations of information and in solving problems.
10.6 Demonstrate knowledge of the historical development of algebra including contributions from diverse cultures.

Standard 11: Knowledge of Geometries
Candidates use spatial visualization and geometric modeling to explore and analyze geometric shapes, structures, and their properties.

Indicators
11.1 Demonstrate knowledge of core concepts and principles of Euclidean and non-Euclidean geometries in two and three dimensions from both formal and informal perspectives.
11.2 Exhibit knowledge of the role of axiomatic systems and proofs in geometry.
11.3 Analyze characteristics and relationships of geometric shapes and structures.
11.4 Build and manipulate representations of two- and three-dimensional objects and visualize objects from different perspectives.
11.5 Specify locations and describe spatial relationships using coordinate geometry, vectors, and other representational systems.
11.6 Apply transformations and use symmetry, similarity, and congruence to analyze mathematical situations.
11.7 Use concrete models, drawings, and dynamic geometric software to explore geometric ideas and their applications in real-world contexts.
11.8 Demonstrate knowledge of the historical development of Euclidean and non-Euclidean geometries including contributions from diverse cultures.
Standard 12: Knowledge of Calculus
Candidates demonstrate a conceptual understanding of limit, continuity, differentiation, and integration and a thorough background in the techniques and application of the calculus.

Indicators
12.1 Demonstrate a conceptual understanding of and procedural facility with basic calculus concepts.
12.2 Apply concepts of function, geometry, and trigonometry in solving problems involving calculus.
12.3 Use the concepts of calculus and mathematical modeling to represent and solve problems taken from real-world contexts.
12.4 Use technological tools to explore and represent fundamental concepts of calculus.
12.5 Demonstrate knowledge of the historical development of calculus including contributions from diverse cultures.

Standard 13: Knowledge of Discrete Mathematics
Candidates apply the fundamental ideas of discrete mathematics in the formulation and solution of problems.

Indicators
13.1 Demonstrate knowledge of basic elements of discrete mathematics such as graph theory, recurrence relations, finite difference approaches, linear programming, and combinatorics.
13.2 Apply the fundamental ideas of discrete mathematics in the formulation and solution of problems arising from real-world situations.
13.3 Use technological tools to solve problems involving the use of discrete structures and the application of algorithms.
13.4 Demonstrate knowledge of the historical development of discrete mathematics including contributions from diverse cultures.

Standard 14: Knowledge of Data Analysis, Statistics, and Probability
Candidates demonstrate an understanding of concepts and practices related to data analysis, statistics, and probability.

Indicators
14.1 Design investigations, collect data, and use a variety of ways to display data and interpret data representations that may include bivariate data, conditional probability and geometric probability.
14.2 Use appropriate methods such as random sampling or random assignment of treatments to estimate population characteristics, test conjectured relationships among variables, and analyze data.
14.3 Use appropriate statistical methods and technological tools to describe shape and analyze spread and center.
14.4 Use statistical inference to draw conclusions from data.
14.5 Identify misuses of statistics and invalid conclusions from probability.
14.6 Draw conclusions involving uncertainty by using hands-on and computer-based simulation for estimating probabilities and gathering data to make inferences and conclusions.
14.7 Determine and interpret confidence intervals.
14.8 Demonstrate knowledge of the historical development of statistics and probability including contributions from diverse cultures.

Standard 15: Knowledge of Measurement
Candidates apply and use measurement concepts and tools.

Indicators
15.1 Recognize the common representations and uses of measurement and choose tools and units for measuring.