ASSESSMENT PLAN
MATHEMATICS PROGRAM BA & BS
COLLEGE OF SCIENCE AND MATHEMATICS
May 2014

Program Goals

The mathematics degree program is designed to prepare its graduates for a variety of career paths. There are two degrees offered: a pure mathematics degree and a mathematics degree with secondary certification. Both are offered as BS and BA degrees with the only difference between the degrees being the language requirement. Both options prepare students for careers in mathematics as well as engineering, computer sciences, physics, economics, operations research, statistics, actuarial sciences, K-12 teaching and for further graduate studies in related areas. In addition, by incorporating substantial Education courses in a degree plan, the secondary certification option allows students to begin teaching in the Colorado K-12 system immediately upon graduation.

The goals of the program are to enable students: to have competence with standard undergraduate level mathematics; to solve quantitative problems; to appreciate mathematical abstraction and proofs; to communicate their ideas effectively; and to learn mathematics independently.

The program goals are aligned with the College of Science and Mathematics goals:

> CSM offers quality, competitive Bachelor's and Master's degree programs that prepare graduates for success in professional and graduate programs, and for careers in the biological and physical sciences and mathematics. The College also supports a strong general education program by providing core curricula in science and mathematics for students pursuing careers in the health and environmental sciences, engineering, technology and teacher education. The CSM provides advanced learning opportunities for students via faculty mentored research projects and internships that promote the discovery of new information and the application of new knowledge. The CSM supports the community, region and related professions through outreach including initiatives that enhance economic development, scientific literacy, and K-12 education.

The program goals are also aligned with the following three University General Education Student Learning Outcomes:

1. Identify, analyze and evaluate arguments and sources of information to make informed and logical judgments, to arrive at reasoned and meaningful arguments and positions, and to formulate and apply ideas to new contexts.

2. Apply numeric, symbolic and geometric skills to formulate and solve quantitative problems.

3. Apply the scientific method, laboratory techniques, mathematical principles and/or experimental design.

Student Learning Outcomes

At the conclusion of the mathematics programs:

1. Students will have facility in the core mathematical content areas: calculus, algebra, and other additional topics.

2. Students will formulate and solve problems using mathematics, working alone or with others at the three cognitive levels: routine problems, non-routine problems and applied problems. They will also be able to formulate and solve applied problems involving applications to other fields and problems involving real-world data.

3. Students will create, analyze and use mathematical abstraction. They will understand and write formal mathematical arguments. They will appreciate the standards for mathematical rigor, elegance and beauty.

4. Students will produce and deliver effective written presentations of mathematical material and ideas.

5. Students will find and select appropriate written sources of mathematics and learn independently from these sources.

Assessment Procedures

1. During their senior year and at the conclusion of one of the two capstone courses: *Math 421 – Introduction to Analysis*, or *Math 427 – Abstract Algebra*, all mathematics majors will take the Major Fields Test (MFT) in Mathematics. This exam is particularly effective at assessing student learning outcomes 1 and 2. Students' scores are broken down by major subject areas contained in learning outcome 1 and by cognitive areas in learning outcome 2. CSU – Pueblo data will be compared with National data and presented as part of the yearly assessment of the program. The overall results will inform the department of any possible changes to the programs' curricula and methods of delivery.

   Criterion: Overall and in the content and cognitive breakdown areas of the MFT, ninety percent of CSU – Pueblo mathematics majors will score at or above the 50^{th} percentile on the MFAT standardized exam.

   This assessment will be performed every spring semester.

2. The mathematics program will evaluate the learning outcomes 3 and 4 with a team of faculty reviewing ungraded and unidentified final exams from the entry level mathematics course *Math 307 – An Introduction to Linear Algebra*, and from the capstone courses *Math 421 – Introduction to Analysis* and *Math 427 – Abstract Algebra*. We will evaluate the program's effectiveness in

developing its students' proficiencies in these SLOs by comparing their early abilities in mathematical argumentation with their abilities at the conclusion of their degree program.

Students enrolled in Math 307 are most likely math majors that have successfully completed the entry level Calculus courses (Math 126, Math 224 and Math 207). These students should be computationally proficient with elementary Calculus application problems, but they have not yet been exposed to formal mathematical arguments or proofs; Math 307 provides the introduction. It is anticipated that students will still be in the development phase of constructing mathematical arguments even at the conclusion of Math 307.

Math 421 and 427 are capstone courses and the expectations are much higher. By the students' senior year, they have been exposed to two or three semesters of courses with problems of increasing difficulty and requiring more sophisticated and advanced techniques of argumentation and proof. Additionally there are the expectations that students will have developed increased confidence, maturity, application of rigor and aesthetic appreciation in creating and writing elegant mathematical arguments.

For these purposes rubrics have been developed and will continue to be refined for evaluating the program's success in helping students to achieve these outcomes. Starting in Fall 2014, a portfolio will be created for each student enrolling in Math 307 so that our current cross-sectional form of study can be more carefully evaluated on a student-by-student and longitudinal basis.

Criterion: By the conclusion of the capstone courses students are expected to be *proficient* in mathematical argumentation and proof at the undergraduate level.

This assessment will begin in the spring semester of 2016 when the first complete student portfolios will be available.

3. At the conclusion of their final semester every major will complete an exit survey and be interviewed by the department chairperson. Students will give their overall impressions as to the strengths and weaknesses of the program, especially as they relate to the student learning outcomes. Also during this assessment students' initial career placement will be noted and followed in subsequent years. The advancement of alumni in their careers will be noted as part of the program's assessment.

   Criterion: At least 90% of all majors will evaluate the department's major program as "excellent."

CORE COURSES MATHEMATICS MAJOR

SLO		126	207	224	307	325	337	350	421	427	493
1	Access Higher Mathematics										
1.A	Calculus	I		I		II					
1.B	Algebra		I		II					III	
1.C	Analysis								III		
1.D	Modeling and Differential Equations						II				
1.E	Probability							II			
2	Solve Problems										
2.A	Routine problems	I	I	I	II	II	II	II	III	III	
2.B	Non-routine and open ended problems	I		I	II	II		II			III
2.C	Problems involving applications to other fields	I	I	I		II	II	II		I	
2.D	Problems involving real world data	I		I		II		II			
2.E	Abstract problems within Mathematics								III	III	
3	Abstract and Prove										
3.A	Create, Analyse and Apply Abstraction				I				II	II	
3.B	Read and Write formal Proofs				I				II	II	
3.C	Appreciate the standards of Mathematical Rigor				I				II	II	
4	Learn Independently										II
5	Communicate effectively										III

CORE COURSES MATHEMATICS MAJOR/SECONDARY CERTIFICATION

SLO		126	207	224	307	325	330	350	356	421	427	463	47
1	Access Higher Mathematics												
1.A	Calculus	I		I		II							
1.B	Algebra		I		II						II		
1.C	Analysis								II				

1.E	Probability and Statistics							II	II				
1.G	Geometry						II						
1.H	Number Theory												
1.I	Historical, philosophical and social prospectives											III	
2	Solve Problems	I											
2.A	Routine problems	I	I	I	II	II	II	II	II	III	III		
2.B	Non-routine and open ended problems	I		I	II	II		II	II				
2.C	Problems involving applications to other fields	I	I	I		II		II	II				
2.D	Problems involving real world data			I		I		II	II				
2.E	Abstract problems within Mathematics									II	II		
3	Abstract and Prove												
3.A	Create, Analyse and Apply Abstraction				I					II	II		
3.B	Read and Write formal Proofs				I		I			II	II		
3.C	Appreciate the standards of Mathematical Rigor				I					II	II		
4	Learn Independently											III	
5	Communicate effectively											III	III

Expected Stages of Learning

I Knowledge and Comprehension

II Application and Analysis

III Synthesis and Evaluation

Assessment Results

Major Field Tests are taken in December and in April. Results are typically returned several months later. The previous two test results are reported to the department faculty at the first department meeting held during convocation week in the fall. Evaluation of the items from Assessment Procedure 2 is still in the developmental phase. A uniform rubric has been developed to standardize and clarify the assessment procedure. Summaries of student exit surveys from the previous two semesters are also reported at that time. The minutes of this meeting along with the supporting documentation (summary score results and comparisons) will be archived and supplied to the assessment committee when requested.

A meta-assessment will be conducted at the second department meeting of the year (typically held during the first week of September) after the faculty have had time to review the assessment reports given at the first department meeting.

Continuous Process

Initiation and support for program improvements and the development of actions plans are primarily the responsibility of the department chair working together with the departmental Curriculum Committee and the departmental Advisory Committee. Input from the assessment committees, the college dean and the university provosts' offices will also be sought.

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