School	Math and Sciences
Program Area	Mathematics
Major Programs	A.S. Mathematics (60 credits)
Review Period	Fall 2012 to Fall 2017
Self-Study Developed	AY 2017-2018
Review Status	Academic Standards Accepted the Program Review Contingent Upon Submission of a Follow-Up Report
Program Leaders	Kira Heater, Pam Peters
Committee Chair	Cindy Henning
Academic Standards Program Review Subcommittee Reviewers	Starla Mason: Faculty, Health Sciences Michael Thompson: Faculty, Hath $ Sciences Maura Hadaway: Academic Dean, Library & Learning Commons Kim Bender: AVP – Institutional Effectiveness Erin Bauer: Chair of SLA Committee Alex Barker: Student Services Representative Sabrina Lane: Administration and Finance Representative

A. Brief Overview of Program

The mathematics department at Laramie County Community College is part of the Mathematics and Sciences Division. The department is staffed by 12 full-time faculty members. Three of these instructors work on the Albany County Campus, one of whom coordinates the developmental mathematics classes at the University of Wyoming. On the Cheyenne Campus, there are 9 full-time faculty members one of whom is the coordinator for the developmental mathematics classes in Cheyenne and one statistics instructor.

Four of the department faculty members work with high schools on concurrent enrollment in College Algebra, Trigonometry, Calculus, and Statistics.

In the past, the Mathematics department has had a single chair to coordinate meetings, help with scheduling classes, and be the adjunct coordinator. In order to allow for more leadership opportunities in the department, these responsibilities have been divided among three members of the department: the adjunct coordinator, the scheduler, and the coordinator of the mathematics department.

The Mathematics department serves LCCC by providing three important academic services:

- Developmental Mathematics
- Service Courses
- Mathematics Majors

Developmental Mathematics

For students to complete their academic paths successfully, they must be prepared for the material in college level classes. When students are lacking these skills, they take developmental math classes to help prepare them for college-level math classes. The mathematics department is continually working to improve student success in these classes and for these students when they go on to college-level math classes. Over the course of the last five years, the math department has worked to reduce the amount of time students take to complete developmental courses.

When this work began a student starting at the lowest level of mathematics trying to get to College Algebra would take Math 0900 (3 credit hours), Math 0920 (5 credit hours), and Math 0930 (4 credit

hours) or 12 credits of developmental math before taking Math 1400 (4 credit hours) bringing the total credit hours for a college level course to 16. Currently, that same student would take Math 900 (3 credit hours), Math 0980 (4 credit hours) or 7 hours of developmental course. This student would then complete Math 1380 (3 credit hours) and the combination of Math 0980 plus Math 1380 would count as credit for Math 1400 for a total of 10 credit hours. Which is a 37.5% reduction in the number of credit hours to complete College Algebra.

Similarly, for a student taking Problem Solving, the old path was Math 0900 (3 credit hours), Math 0920 (5 credit hours), and then the college level class of Math 1000 (3 credit hours) for 8 credit hours of developmental math or 11 hours to complete the college level class. Currently, that has been reduced to Math 0900 (3 credit hours), Math 0970 (4 credit hours), and Math 1070 (3 credit hours). Again, completing both Math 0970 and Math 1070 are equivalent to completing Math 1000. The amount reduction of the amount of credit hours for completing a college level class in the Problem Solving path was 9%.

The math department is continuing work on refining these new classes to ensure students have both a deep understanding of mathematics and are prepared for their college level classes.

Additionally, LCCC provides all developmental mathematics courses for the University of Wyoming in Laramie. Years ago, the university requested that LCCC offer these classes for the University and from there the ACC campus was born.

Service Courses

Since all majors at LCCC require some proficiency in Mathematics, the Mathematics department offers classes that fulfill this requirement. Our Problem Solving class, Math 1000, and its two semester Quantitative Reasoning counter-part, Math 0970 and Math 1070, serve as the Mathematics requirement for programs like art, music, theater, business management, criminal justice, and psychology to name a few.

Math 1400, College Algebra, with its counter-part Math 0980 and Math 1380, serves majors such as nursing, business, economic, legal studies, and the STEM majors going on to Calculus I.

Math 1100, 1105, and 2120, are the three Mathematics for Elementary School Teachers class. These and EDEL 1410 and EDEL 2410 which are seminar course to pair with 1100 and 2120 serve students in the Elementary Education Program.

Business Calculus classes, Math 2350 and 2355, serve the business department.

The Calculus Sequence, Math 2200, 2205, and 2210, Differential Equations, Math 2310, and Linear Algebra, Math 2250 are courses that support STEM degrees (Engineering, Physics, and Mathematics, among others.)

STAT 2070 is designed for students majoring in a social science. Majors include psychology, mass media, and criminal justice.

STAT 2050 is designed for students majoring in a natural science. Majors include biology (human, molecular, etc.), chemistry, and exercise science. STAT 2010 is designed for students majoring in business.

Mathematics Majors

The Mathematics department at LCCC has a small contingent of students working on an AS in mathematics. These are largely students who plan to continue their degree work after completing the AS, seeking a four-year degree in some combination of math, engineering, and/or physics. The Math AS consists of the full Calculus series, Differential Equations, Linear Algebra, and Statistics, with a capstone Mathematics Major Seminar, to introduce students to mathematical proofs as well as other topics in advanced mathematics and requiring a final project and presentation. The extreme overlap with other mathematically heavy majors such as physics and engineering is what makes this AS compatible and desirable either as a stand-alone degree or a double major.

The department sees this as an area where we can grow the program. Students do not frequently see the compatibility of math with their final four-year degree program major, so we recognize that we need further education and marketing to inform these students about the availability and desirability of pairing with a math AS.

We have seen a lack of persistence in the Math AS, and see our challenge as addressing this. We are exploring several options:

1. Establish an initial math major seminar at 1 credit hour, to better introduce students to thinking and reading mathematically and the overall structure and flow or a math degree as well as the immense variety of options within mathematics. This would also establish a cohort and enhance the connection of incoming students with mathematics instructors.
2. Provide further opportunities for exploring future careers in mathematics beyond mathematics education. A common student misperception is that mathematics degrees are solely for pursuit of careers in teaching, missing a vast array of other options that pair well with other disciplines and degrees.
3. Work with advising to better apprise students of the compatibility of the Math AS with engineering and physics.
4. Better integrate students in the larger mathematics community by providing opportunities to connect with mathematics professional societies such as the Mathematics Association of America (MAA) and the American Mathematical Society (AMS). Specific examples: the Rocky Mountain Section of MAA is conference meeting in 2018 in Greeley. This is a student-friendly and accessible organization, with speakers that expose students to the wider world of mathematics and its applications. Additionally, MAA's national conference, MathFest, is in Denver in 2018, another excellent opportunity to mentor students into the larger world of mathematics and pique their interest.

B. Program Achievements Over the Review Period

Over the last five years, the math department has seen many changes. There has been an overhaul of the development math sequence. The number of credit hours for many math classes has been reduced. Positions have been added to the department. The department has worked to complete MMCOR's and Common Course Assessments in each class.

Developmental Mathematics

Mathematics classes, and particularly developmental math courses, are continually disparaged by students and administration. They are often touted as the roadblock to student success in College. While this department does not feel that students should be constrained by superfluous classes, we do feel that students need basic skills to be success in college level mathematics. Students without the basic skills necessary for a course are not able to participate fully in the community of the classroom, which leads to frustration and often failure.

With this in mind, the department started a developmental redesign using an emporium model. In the emporium model, students were required to be in class with their instructor for one hour a week and then students were expected to spend two additional hours in the "math lab" during the week to work on homework and watch instructional videos created by the department. A workbook was also created to go with the videos to help the students keep notes while watching the videos. Students could work at their own pace and were able to finish more than one course during a semester if they so desired.

Prior to the Emporium model, there was a lot of overlap of material from one developmental class to another. As part of the initial redesign, the curriculum was streamlined. Overlapping material was cut and the number of credits for each class was reduced.

Although the emporium model did increase student success, rather than work with that program, it was decided to change to a new program. This program returned to traditional style classes where students met with instructors three times a week. The online homework system was changed to ALEKS. This system met with high student success rates.

While the transition was happened from the emporium model to ALEKS, the "2+2" program was put in to place and the number of credit hours for development math was reduced again (see 1A for details).

However, there were concerns about instruction with ALEKS. There were concerns about how ALEKS approached topics. There were concerns that students were passing the developmental courses without gaining any knowledge of mathematics.

Consequently, the math department has chosen to return to traditional lecture style classes. All developmental sections will use the same book and MyMathlab for online homework. There is minimum repetition of topics and homework list that is being developed by the department and a common course final is being given. Additionally, the department decided that all exams must contain at least 50% of questions from a common list and that exams (excluding the final) must be given as paper and pencil exams, even for online courses.

This model began during the fall 2017 semester. Already, the department is working to improve Math 1380. We plan to use a new book, which better reflects use of technology and a coverage of topics in a more coherent manner. We also plan continue to streamline the content to make sure there is less overlap between Math 0980 and Math 1380. A small group of instructors of Math 1380 will work together to redesign the course for fall 2018.

Math Pathways

In order to both allow students to complete developmental courses more quickly and to streamline the advising process the math pathways were developed. There were four initial developmental pathways:

1. Stemway - for students who need Calculus to complete their degree
2. Algebraway - for students who need College Algebra to complete their degree
3. Quantway - for students who need Problem Solving to complete their degree, but not Statistics
4. Statway - for students who needed Statistics and Problem Solving to complete their degree

A student testing into Developmental Math would complete a two-course sequence. These two classes would combine the developmental and credit bearing topics. The two classes together would be the same as the college level course, see section 1A for information on these class.

This idea was given the name "two and through" because the idea was that students would only take two math classes and be done with their development and college bearing credits (with the exception of Stemway students). Although, it was found that Math 0900 could not be eliminated for these students and so it was not actually two and through. Many students still needed to get through Math 0900.

The Stemway and Statway paths were discontinued in fall 2017. They were continually under enrolled pathways for various reasons. Students who would have taken the Stemway path are now following the Algebraway path. For Statway, students are now taking the Quantway path and then continuing to Statistics.

Quantway and Statway were classes developed by the Carnegie Pathways project. These classes were developed as a non-algebra alternative for developmental math students. They followed a prescribed curriculum that was centered around group work. The cost for the program became prohibitive and so the book was changed to materials from the Dana Center. There are continuing discussions about the number of credit hours need for the Quantitative Reasoning pathway.

One of the major challenges to this plan was getting students advised into the correct pathway and getting enough students into specific pathways to have the classes run. Thus in Spring 2018 we are back to having our original two pathways one for students needing college algebra, whether or not they are taking Calculus, and one for those needing Problem Solving, whether or not they also need Statistics.

Course Credit Hour Changes

The credit hour changes in Developmental Math have been discussed in Section 1A. Since associate degrees were paired down to 60 credit hours per program, math classes were required to cut credit hours. Math 1400 went from 4 hours to 3 credit hours. Math 2200, 2205, and 2210 went from 5 hours to 4 credit hours. Many other colleges around the state have not had to make these changes. The University of Wyoming does match the credit hours for these classes, but each of these classes additionally has a 1-hour seminar with a teaching assistant to help with student success.

Changes have had to be made to pare down the curriculum in each class. There is a concern among instructors that they do not have enough time with students. They department will start in Spring 2018 with the Calculus sequence, Math 2200, 2205, and 2210, to discuss curriculum and make sure all classes are covering basic material, even with the cuts.

Position Changes

In the last five years, a full time Statistics instructor has been added at the Cheyenne campus. An additional mathematics position has been created at ACC.

MCOR's and Common Course Assessments

The math department created MCOR's for each of its classes. Common Course Assessments were also created. A Math Faculty Shell was created in D2L to house Common Course Assessments and to provide a space for faculty to share information. In spring 2018, the department has committed to a reassessment and revision process of all of the MCOR's and Common Course Assessments. We feel like

more time needs to be taken to ensure the entire department is allowed feedback on these and to make sure the Assessments and MCOR's align.

C. Mission and Values

MISSION:

The mathematics program supports the mission of LCCC, to transform our students' lives by providing superior service and mathematical instruction for every student on campus. While we hope to develop a sustainable and qualified group of mathematics majors, we also aspire to developing mathematically literate students that possess critical thinking and problem solving skills. Ultimately, we will inspire students to further their own educational pursuits in the STEM fields, and become life-long learners.

LCCC lists four foundation elements of the comprehensive community college mission:

1. To prepare people to succeed academically in college-level learning (academic preparation) -
Since the math department's mission is to provide superior service and mathematical instruction for every student on campus, this includes the development students who need preparation for college-level learning. Developmental students especially need to work on mathematical literacy, critical thinking and problems solving. Mastering these skills will allow them to be successful in college-level learning across disciplines.

2. To engage our students in learning activities that will prepare and advance them through the pursuit of a baccalaureate degree (transfer preparation)
Students with mathematical literacy, critical thinking, and problem solving skills will prepare students to pursuit a baccalaureate degree.

3. To develop individuals to enter or advance in productive, life-fulfilling occupations and professions (workforce development)
Students who are inspired to enter STEM fields will find life-fulfilling professions.

4. To enrich the communities we serve through activities that stimulate and sustain a healthy society and economy (community development)

If our students become mathematically literate, they will be able to make more informed decisions about their lives and about community matters. As life-long learners they will seek experiences that enrich their lives.

VALUES:

Teaching and Learning

The members of the Mathematics department at Laramie County Community College recognize that mathematics classes instill in students not only the theory and practice of mathematics, but also quantitative reasoning, critical thinking, and problem solving skills, skills that help them succeed in further academic pursuits, their careers, and in their lives as informed citizens. In an encouraging, thought provoking, and engaging classroom environment, instructors use rigorous, innovative, and collaborative teaching techniques to foster students' appreciation of mathematics, a conceptual understanding of the subjects being taught, and persistence, perseverance, and a cooperative approach to problem solving. We understand that our students come to us with various levels of mathematical reasoning and knowledge and that many of them come to us with a negative perspective regarding mathematics. It is our goal as a department to help these students see the beauty of mathematics and acquire the skills to be successful in their mathematics courses.

Technology
Technology is a tool used by practitioners in every profession and as such, we believe in the use of technology as a tool for learning, understanding, and creating mathematics. The department is committed to teaching with appropriate and innovative technologies to make sure students gain the skills that will help them as productive members of society.

Curriculum Development
Our department works as a team to create a comprehensive mathematics curriculum. Thro-ugh a continually evolving process, the math department has created course standards and competencies designed to build a conceptual bridge between successive mathematics classes. Our assessments are mapped with course competencies to ensure students have the knowledge and ability to move easily from one class to the next. We work with institutions with-in the state and within the region to make sure our curriculum is robust and transferable. Thus, our students are prepared for the workforce or transfer to a four-year institution when they leave our classrooms.

Life-Long Learning and Collaboration
We are life-long learners who remain active in our field. Conferences and training opportunities help us keep abreast of new discoveries in mathematics and in mathematics education, and we make an effort to attend them regularly. Wyoming has the unique luxury of being small enough that math faculty from all seven community colleges and the University of Wyoming can come together at the state math articulation conference. We encourage this exchange of ideas and are committed to being a part of statewide initiatives and articulation conferences.

D. Program Competencies and Outcomes

The Math Department is fully invested in efforts to ensure student success at all levels, whether students are in developmental classes, general education classes, classes that support another degree program, or classes working towards their AS in Mathematics. To that end, they have developed objectives that are delineated with the competencies in the MCORS for all courses (attached). We have an experienced instructor as course lead for the remedial math courses that have multiple sections, providing guidance and consistency. Also contributing to the consistency in ensuring students meet objectives for each class, we have common final exam problems for all courses (examples attached). Recently, the department has recognized that the MCORS are not quite as explicit as needed to fully ensure student mastery of the expected outcomes. In many classes, they are too general to assist instructors in structuring courses and they do not rely significantly on Bloom's Taxonomy. Therefore, the department has elected to rework the objectives. Target date to initiate the review is spring 2018, to ensure that any advice or recommendations from the Program Review are incorporated.

<u>Mathematics Program Learning Competencies</u>

Upon successful completion of this program, students will be able to:

- Effectively communicate mathematically and statistically through written, oral, symbolic, and visual forms of expression.
- Use appropriate mathematical models to solve real-world application problems.
- Prepare logic arguments and use them to prove mathematical theorems.
- Apply a range of techniques effectively to solve problems in mathematics and the applications of mathematics, including theory, deduction, approximation, and simulation

How Mathematics Program Learning Competencies Align with Values statement.

Mathematical Modeling often requires tools such as calculators and computer programs in order to create models using data. The department states in our values statement that we are committed to teaching with appropriate and innovative technologies.

Operational Outcomes/Goals

- Increase retention of students entering LCCC in remedial Math.
- Increase success of students in general education math, decreasing the time to complete the math requirements and allowing them to pursue their chosen major more promptly.
- Increase the number of students completing a Math AS, by increasing persistence of students entering with a declared Math major as well as recruiting talented students into the major.
- Increase opportunities for students to have math based Essential Experiences.

- Develop a Healthy Population of Quality Math Majors: The program desires to continue to develop graduates with strong mathematical skills to pursue higher-level studies in STEM fields.
- Responsibly Serve the College's need to Produce Quantitatively Literate Students: Achieve a healthy combined pass rate of 70% for the four courses MATH 1401, MATH 1400, MATH 1390, and MATH 1380.

Here the department needs to discuss what the operational outcomes need to be keeping in mind the three roles of the department: developmental education, general education, and mathematics majors.

How Operational Outcomes Align with Values statement

Students with strong mathematical skills needed to understand the theory and practice of mathematics, but mathematical work also requires critical thinking, problem solving, and persistence and perseverance in problem solving. All of these are values we discuss when we talk about the teaching and learning of mathematics.

E. Abbreviated Summary of Program Data (KPIs)

Program Demand:
The program realizes strong performance for this category with its three-year average annual FTE at 387 and its three-year number of participants enrolled at 2,016. However, it performs in the low range for number of concentrators enrolled with a three-year average at just 34.
Student Success
The program shows strong performance for graduation rate for concentrators with a three-year average at 36%. However, it performed at the low range of performance for course success rates with a three-year average at 67% and for number of degrees/certificates with a three-year average of 2.67. The mathematics has looked at the number of folks who graduate with mathematics degrees and the numbers were never large, but plummeted in the last five years. The department needs to work on a plan to attract and keep math majors. A 10% increase in math majors would be one per year who graduate. That is probably a reasonable goal for a start.

It has been suggested that we add a one-credit class at the beginning of the math program to build a cohort of math majors. The department needs to discuss this and other ways to attract and keep math majors. Hopefully, this discussion can be part of the assessment planning that the department needs to do.

Transfer Preparation:
One of the program's strongest performances was in this category with a three-year average university matriculation rate at 48%.

Efficiency:
The program is very cost effective. Its three-year average for core expenditures per FTE stood at just $2,215. It performs at average or middle levels for average section fill rates with a three-year average of 68% and for average credits to completion with a three-year average of 66 credits. The program faculty are working hard to keep fill rates high while offering a variety of classes and meeting times for our students. The average time to completion is in the low range with a three-year average of 3.41 semesters, but the program is making gains with a current measure at 2.11 semesters.

F. Accomplishing the Program's Previous Action Plan Goals

Accomplishments from the Last Review

Because the previous program review process did not require recommendations or development of action plan goals, there were no action plans for the program to monitor. The last known record of program review is from 2006. It does not seem relevant to discuss that program review, especially since the process has changed significantly since then.

Goal Attainment

As stated many times during this review, the department has not completed any goals per se. However, a discussion of planning and assessment has begun. Given that someone will be assigned the lead role on assessment and planning, the department is at a good place to set goals and review the process for the next five-year cycle.

G. Summary of Review Action Plan Goals

Attached is one action plan goal, which has been added to Aquila. Specifically, the department has decided that it needs to review and update all MCORs and Common Course assessments as a way to ensure the classes are uniform and that common course assessments can be used to help with program assessment, planning, and review.

The co-chairs of the program review will brief the department on the findings of the program review. At that point, the department needs to discuss how to assess the program and student learning. From those discussions should come a plan for assessment over the next five years. Then the process of creating goals for department can begin and they can be added to Aquila. For the department at this point, there is a much larger discussion that needs to happen before adding more to Aquila.

After the revisions to the review, there are several action plans that could be added moving forward.
1. Review and Revise mission statement and share with stakeholders
2. Create Operational Assessment Plans for the three areas of the department
3. Create student-learning Assessments for 1 of the Program Competencies with multiple sources of student data.

H. Identified Strengths, Concerns, Opportunities, and Challenges for Student Learning and Program Operations Resulting from the Review Process

Student Learning

Strengths

- Department is more unified in working on assessments and MCORs

Concerns

- Ensuring we have understanding and consensus on the assessment process
- Ensure assessments are standard across the department
- Establishing an assessment and planning chair with release time
- The time it takes a large department to plan and review assessment

Opportunities

- Create meaningful assessments
- Discussion of plans and goals for the department
- Considering what students should take from classes at a department level
- Discuss teaching and learning within the department
- Ensuring classes within the department are uniform in terms of basic topics

Challenges

- Creating meaningful assessments
- Collecting Data
- Disseminating Data and making changes based on data
- Ensuring everyone on both campuses is involved in the process

Program Operations

Strengths

- Enthusiasm for building a strong department
- Enthusiasm for new ideas to attract and retain math majors

Concerns

- Lack of control by the department of course content with respect to credit hours per class
- Lack of control by the department of the instructional models for classes
- Unity in the department for planning and development
- Learning and understanding of the assessment and planning process

Opportunities

- Learn about using KPI data
- More control for the department into the hands of the department
- Consider the overall structure and purposes of the program/department
- Create a holistic plan for the program and for our majors

Challenges

- Planning for departments on two campuses
- Having someone to manage the process
- Ensuring the planning process is understood and what should be monitored
- Following up on data and revisiting goals

I. Continuous Improvement: Follow-Up Reporting and Planning for Strengthening Program Performance

To be consistent with its continuous improvement processes, LCCC includes follow-up action planning in its academic program review activities. Program review includes a peer-review step where an Academic Standards Subcommittee for Program Review rates program performance using an Academic Program Review Rubric. Programs perform well on the majority of self-study sections, but occasionally the rubric rating identifies a few areas that need additional attention. For these situations, the program review process includes a structured follow-up planning phase to support program strengthening of these areas.

In early May, after programs have had their self-studies peer reviewed, the Academic Standards Committee notifies those programs that are to participate in additional continuous improvement planning. Academic Standards accepted the Mathematics program review contingent on its development of additional follow-up action planning. Programs for the 2017-18 cycle begin developing their follow-up action planning in January 2019.