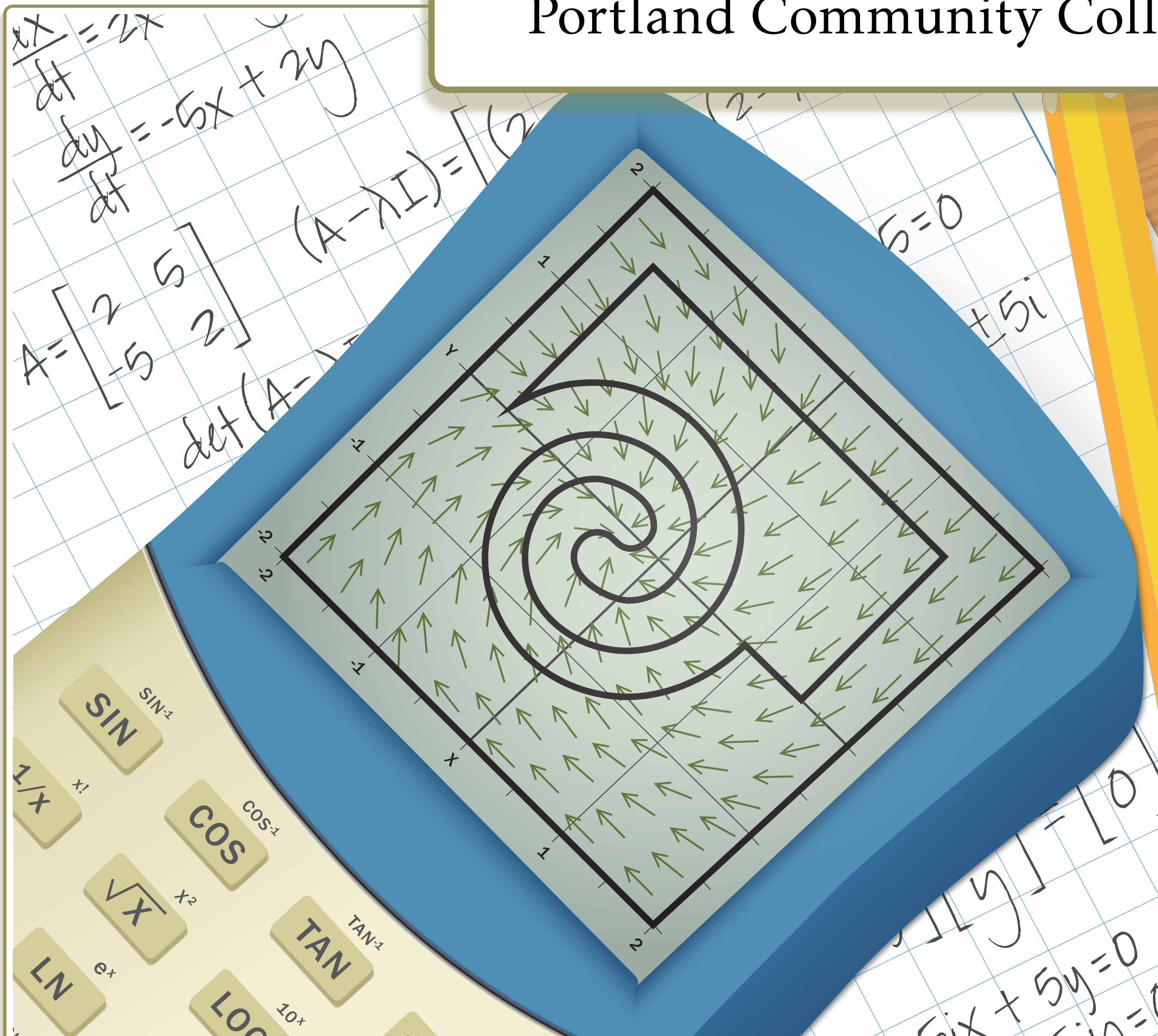
Program Review

Mathematics

Portland Community College



MATHEMATICS

Fall 2008–Fall 2013

Contents

Glossary

ADA Americans with Disabilities Act.

ALC Alternative Learning Center. A former name for the SLC. Several self-paced courses in Math and English have this subject prefix.

ALEKS **A**ssessment and **LE**arning in **K**nowledge **S**paces interactive computer-based math-learning program owned by McGraw-Hill http://www.aleks.com/.

AMP Accelerated Mathematics Program.

AY Academic Year.

CCOG Course Curriculum and Outcome Guide.

CIC Completion Investment Council.

CTE Career Technical Education.

DL Distance Learning.

DOI Deans Of Instruction.

F2F Face-to-face.

FT Full-time (usually in reference to faculty).

LAC Learning Assessment Council.

LAS Learning Assessment Subcommittee (of the LAC).

LDC Lower Division Collegiate.

MML MyMathLab: a commercial computer-based homework management system owned and distributed by Pearson http://www.pearsonmylabandmastering.com/northamerica/mymathlab/.

MSL MyStatLab: a commercial computer-based homework management system owned and distributed by Pearson http://www.pearsonmylabandmastering.com/northamerica/mystatlab/.

OSD Office of Students with Disabilities.

PT Part-time (usually in reference to faculty).

SAC Subject Area Committee.

SLC Student Learning Center. An informal, open study area, with the added benefit of tutoring assistance.

WRC Women's Resource Center.

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Program/Discipline Overview

In two years, Portland Community College will be nationally known for progress from developmental math to college level courses and completion.

Chris Chairsell, Vice President of Academic and Student Affairs; Portland Community College Inservice, September 16, 2013

What are the educational goals or objectives of this program/discipline. How do these compare with national or professional program/discipline trends or guidelines? Have they changed since the last review, or are they expected to change in the next five years?

As with any undergraduate or developmental education department, the primary goal of the faculty in the mathematics SAC can be summarized as follows: we hope to support students' life goals by imparting the skills and cognitive abilities necessary for continued success as they navigate their way through the education system and into the workforce.

As evidenced in the remainder of this document, we have an active faculty who are continually trying innovative strategies to achieve this goal. Many of these strategies have been targeted directly at increasing student success and completion, such as

- Accelerated Math Placement and other placement enhancement tools (see page 36);
- study-skills focused classroom activities (see page 38);
- experimentation with interactive homework/learning systems as well as development of said systems targeted to our students (see page 28 and page 40);
- establishment and dissemination of best practices for online accessibility (see page 49).

While each of these are worthy strategies, it has become increasingly apparent that something of greater scope needs to take place if we hope to see dramatic changes in the success and completion rates for students taking mathematics courses—especially those who initially place into developmental math courses. The call for change nationwide in community colleges from access, to access and completion reinforces the Math SAC's awareness of the vital role we play in creating an environment of student success and completion. We were pleased to hear Dr. Chairsell call for the creation of a college-wide culture for math success, and we are very encouraged by the way in which this challenge has been embraced by departments such as student services. We in the Math SAC also embrace Dr. Chairsell's call for the creation of a college-wide culture for math success. We are dedicated to making the necessary changes to our mathematics curriculum in order to maximize success and completion rates for our students. By necessity, the most dramatic changes will need to take place in our developmental mathematics courses. As we restructure, we are focused on integrating evidence-based best practices in order to achieve the highest rates of success and completion for our students.

Developmental Education (DE)

Historically viewed as 'remediation', developmental education has often been marginalized by higher education entities. However, practices in developmental education have been given wide scientific attention, and best practices are supported with extensive research.

The two largest organizations involved in developmental education research and professional development, the National Council of Developmental Education (NCDE) and the National Association of Developmental Education (NADE), define developmental education as *a comprehensive process that focuses on the intellectual, social, and emotional growth and development of all students*.

The number of reasons students place into pre-college courses are too numerous to list. However, a large number of students entering at the DE mathematics level have the added burden of an intense anxiety that hinders their ability to be successful in a mathematics course. In combination with the academic, social, economic, and psychological issues facing students in DE math courses, we must approach any changes with the whole student in mind.

Over the last several years, there has been a growing sense that the traditional algebra content, as currently taught in our DE math courses, was not meeting the needs of many of our students. The fact that in Fall 2013, over twenty-five SAC members joined the DE Math subcommittee formed specifically to take a deeper look at the developmental math sequence is a strong indicator of the interest and concerns we hold.

Science, Technology, Engineering, and Mathematics (STEM)

Another emerging trend over the past five years has been a nationwide spotlight on STEM education and the dire need to increase the number of college students who ultimately obtain undergraduate degrees in STEM fields. In fact, President Obama has formally designated increasing the number of undergraduate STEM majors by 1 million over the next decade as a Cross-Agency Priority (CAP) goal. [1]

The CAP goal proposes to focus efforts in five promising areas of opportunity:

- Identifying and implementing evidence-based practices to improve STEM teaching and to attract students to STEM courses (see pages 30 and 55);
- Providing more opportunities for students to engage in meaningful STEM activities through research experiences, especially in their first two years of college (see page 9);
- Addressing the mathematics preparation gap that students face when they arrive at college, using evidence-based practices that generate improved results;
- Providing educational opportunities and supports for women and historically underrepresented minorities; and
- Identifying and supporting innovation in higher education.

[1] http://www.whitehouse.gov/blog/2012/12/18/one-decade-one-million-more-stem-graduates

The Math SAC realizes that for many students entering at the developmental education level, math courses serve as a barrier for those who might otherwise choose to pursue careers in STEM; this is well documented in studies such as PCAST: Engage to Excel [18]. As we work to recreate our developmental math curriculum, we are mindful of the need to reform our courses in such a way that they no longer serve as a barrier to the success of our students, and so that they also serve as a gateway to STEM careers for students who may have steered away from math in the past. Most of the goals stated as CAP *areas of opportunity* include elements that can be addressed in our courses, and we hope to create courses that are in alignment with attainment of those goals.

In doing this work, we have an eye not only on students who (eventually) pursue four-year STEM degrees, but we also have a focus on students enrolled in PCC's many CTE programs. We are committed to creating courses that support success and completion for students enrolled in CTE programs. Our courses must not only promote successful completion of the math course, but they must also impart skills that are specifically needed by the students in their CTE courses and ultimately in their chosen careers.

⟨over:sec:DEfuture⟩

The future of DE and undergraduate math at PCC

While we are still in conversation, some themes have begun to emerge. Preliminary discussions have transpired that might lead us to revamp our developmental education courses with an emphasis on

- evidence-based best practices;
- streamlining the developmental education sequence;
- creating developmental education sequences which support STEM education and, ideally, promotes STEM education;
- integrating content into our developmental math courses that will create a math literate populace (intelligent consumers of data and problem solvers);
- tracking our progress through data-analysis and assessment that ensures that completion measures of pass/fail rates do not mask a decrease in quality education.

While our current focus is on DE and STEM, we are also mindful of the need to reexamine our undergraduate level courses. The content and teaching practices we adopt for our developmental education courses need to be created with a clear understanding of the potential effects those changes will have on the students enrolled in our undergraduate level courses. Additionally, we need to ensure that our commitment to using evidence-based best practices makes its way into the classroom for all of our courses, not just our developmental education courses.

We are excited by this opportunity to restructure our courses in ways that better support student success and completion. We realize that this change cannot be developed or implemented in isolation and we look forward to discussing our ideas for DE restructure at the program review meeting. We also look forward to continuing collaborative conversations with all stakeholders including, but not limited to, administration, CTE faculty, advising, counseling, testing, student services, union representatives, and—ultimately—the students themselves.

Addendum

In mid-December, 2013, members of the math SAC were told that they were being given the opportunity to work with administration and members of a grant writing team to develop an NSF-IUSE grant proposal. A team of four math faculty members was assembled for this work and over the next month they, along with the others working on the proposal, did a tremendous amount of research and met together at least weekly. During this time we were working under the assumption that there were no restrictions of any kind on what we could propose in the grant.

A three-part model was developed that involved the creation of a math-specific CG course, a totally redesigned pathway structure through DE math, and a dramatic ramping-up of the way in which the computer platform WeBWorK would be used by our students. The new pathways proposed would require that STEM-based guided learning activities be written for five new courses. Our inspiration for the guided learning approach was based in part on work being done for the New Mathways Project, which is a collaborative project between the Charles A. Dana Center and the Texas Association of Community Colleges. A diagram that illustrates the new pathway is shown in Figure A.1 (Appendix A on page 78).

On January 16, the day before our participation in the project was slated to end, the math team working on the grant was informed that in fact there were restrictions associated with the grant. Because of the restrictions, the grant developers had cut the amount of person hours we had proposed by a factor of ten. The newly proposed amount of faculty release was not nearly sufficient to achieve the goals we had proposed. After much brain-storming about ways we might overcome that deficit or ways in which we might scale back the project, it was agreed by everyone involved—math faculty, administrators, and grant writers—that there was not a good fit between our proposal and that specific grant opportunity.

Not coincidentally, the math SAC met on January 17th in part to discuss the grant proposal. At the end of that meeting the math SAC, without a single no-vote, passed the following recommendations.

The Math SAC endorses the draft outline of the NSF-IUSE grant proposal, with the condition that the outline be fully supported with appropriate funding and services as determined by the Math SAC, and we encourage the Grants Office and PCC cabinet to look into other funding sources.

Regardless of the final design of the DE mathematics pathways, members of the math SAC should continue to work with members of the CG SAC to create a comprehensive CG course designed specifically to address the needs of students registered in DE mathematics courses.

Please summarize changes that have been made since the last review.

The mathematics department faculty is continually striving to improve our courses. The recommendations from the 2003–2008 Program Review (PR) [15] resulted in several changes as outlined in Section C on page 12. Some of the following changes that are mentioned in this section also appear at different sections of this document as referenced. Most notably, our changes that are of a curricular nature are also addressed in Section 3 on page 24.

Discontinue MTH 231 and MTH 232

In Spring 2009 the Math SAC voted to discontinue offering MTH 231 and 232, our discrete mathematics courses. The students taking these courses were mostly computer science students fulfilling requirements at PSU. In order for the courses to transfer, the math department coordinated with the PCC and PSU computer science departments with respect to curriculum. For various reasons it was mutually decided that the PCC computer science department should run the courses that are recognized statewide as CS 250 and 251.

Formed the standing Math Learning Assessment Subcommittee (Math LAS)

The committee was formed to address the college's assessment of the core outcomes. Section 2 of this document (page 14) outlines the results of this committee.

Creation of MTH 84

In Fall 2010 a pilot course was created to provide instruction in the use of the professional freeware publishing software LaTeX. While the emphasis of the course is creating professional mathematical documents, the skills learned can be used in a general context. One online course was run each term and we received positive responses by students and faculty that took the course. Students mention using the program in courses other than mathematics. In May 2011 the math SAC approved to make the one-credit course permanent (MTH 84) and we continue to run one online course every term—see page 40 for more details.

Creation of MTH 111H

We approved the creation of a College Algebra honors course in Fall 2010. A description can be found on page 32.

Creation of faculty department co-chairs

At the Cascade, Rock Creek and Sylvania campuses we offer between 100 to 150 class offerings per term, and thus we require a large part-time faculty pool to run these courses. The formula used to measure the department chair load showed that each campus was either close to double if not more than double compared to the next highest faculty-chair load for any other discipline. Starting in the Fall of 2010, the department chair positions at each of the mentioned campuses were split into co-chair positions. Cascade, Rock Creek and Sylvania campuses each have two department co-chairs.

Creation of SAC co-chairs option

As the AY 2011/12 came to a close, the SAC voted to elect co-chairs for AY 2012/13, rather than a single SAC chair as had always been the custom. This was repeated for AY 2013/14. SAC by-laws will now be rewritten to allow the option for either a single SAC chair or SAC co-chairs. The option for co-chairs may be most helpful in years surrounding Program Review, where SAC chair workload is higher than usual.

Use of WeBWorK

To further increase student accessibility and lower costs, Alex Jordan brought to our attention the freeware program, WeBWorK, partially supported by National Science Foundation grants. The software is an online homework/testing system that can provide *immediate* feedback to the student. Spearheaded by Alex Jordan, faculty have been working on creating databases that fit our current curriculum.

We have been using WeBWorK since Spring 2009 and it is currently being used by several faculty in courses offered at PCC. The advantages to the *student* are that it is free and it is accessible to students with disabilities. The advantages to *faculty* are that we can adapt it to our own curriculum and can be used for other purposes besides coursework. Ideas being proposed would allow for students to use it for preparation before taking placement exams. We still are in the beginning phases as such a proposal would need to overcome technical difficulties. Winter 2014 was the first term that we were able to run the program using PCC servers which allowed us to control the platform of this program. Up to this point we had relied upon University of Oregon servers, which limited the capabilities of this program. Further details are given on page 28.

Social justice workgroup

Four math faculty attended the conference “Creating Balance in an Unjust World” in San Francisco in Winter 2012 and were inspired to form an ongoing collaboration of faculty (including faculty from other disciplines) to create assignments and projects that have a social justice theme. These faculty members share their assignments with others and encourage all math faculty to join them when they meet; see page 32 for more details.

Credit hour change to MTH 243

Students brought to our attention that our MTH 243 course was not transferring cleanly to some institutions. To address this issue, MTH 243 changed from four to five credits effective Fall 2012. An explanation for the change can be found in Section E on page 35.

Offering ALC math courses at Southeast Center

To better serve students at the South East center, in Summer 2012, South East Center started offering self-paced basic math and introductory algebra courses (ALC Math) that were previously only offered at Sylvania. Section E on page 35 contains further explanation of these courses.

Were any of the changes made as a result of the last review? If so, please describe the rationale and result.

In the 2003–2008 PR and the corresponding Administrative Response (AR), a large number of recommendations were given from the Math SAC and the Administration. This section will look at changes that have been made due to those recommendations and some recommendations that are still being addressed.

Incorporation on MTH 20 from DE

One of the recommendations from the 2003–2008 PR ([15], page 30) was to transfer MTH 20 from the Developmental Education department to the Mathematics department. That change has taken effect starting Fall 2013. The change helped to align Sylvania with the rest of the campuses as to how this course was viewed. Due to lack of resources (at other campuses) MTH 20 was, for all practical purposes, under the jurisdiction of the Math department. Due to this change instructors teaching ALC math courses asked to also be incorporated into the Math department, housing all math courses under one legislative body. The move was completed as of January 2013 (see Appendix B on page 79).

Alternative methods to accelerate completion

The Administrative Response (AR) gave a list of recommendations (page 3) relating to alternative methods of moving students through the math sequence and accelerated math sequences. In response to this recommendation, MTH 07/MTH 08 Accelerated Math Review (see Section E on page 36) were created by the Math SAC. Now that these classes are available we are hoping to offer more sections. This will require more advertising when students are placed into a math class. Additionally since the ALC classes have been moved into the Math SAC, the math faculty have become more aware of these courses. The ALC classes were once only available at Sylvania, but now South East Center has incorporated the sequence and other campuses are looking into it.

Assessment and course outcomes

Page 2 of the AR asks the Math SAC to look at assessment more and take our Course Outcomes to the next level. Please see Section 2 on the next page (of this document) for details. We have made major improvements on this front and have a standing assessment committee and action committee. Some of our faculty members have roles in the college wide assessment strategies and the Learning Assessment Council.

Removal of MTH 91 and MTH 92

The success rates for MTH 91 and 92 and additionally MTH 61, 62, and 63 were mentioned on page 2 of the AR. After looking at the success rates of MTH 91 and 92, the Math SAC no longer offers these sections. MTH 61, 62, and 63 are still being offered, but the Math SAC continues to work on Developmental Math and we currently have two committees looking at alternative Math Pathways. Our hope is that a revised math curriculum could improve success and completion rates for students who usually take MTH 61, 62, 63.

Study skills website

Page 28 of the PR ([15]) recommended that an orientation to 'Studying at college' be part of the general orientation process. Since the college has yet to make changes in this area, Jessica Bernards created study skills videos and activities that are currently being used by math faculty in Developmental Math Classes; further details are discussed on page 38.

Enrollment issues with MTH 105

A recommendation in the PR ([15] page 31) wanted department chairs to look at math 105's low enrollment. Since then MTH 111 B and C have been merged into a single MTH 111 class and the enrollment numbers in MTH 105 have increased. Additionally two committees are currently looking at math pathways from the pre-college classes that might also increase 105 numbers. This change also led to the adoption of a new MTH 111 textbook. Normally changing a book wouldn't merit mention in a PR, but this book has a different philosophy and has therefore added additional changes to the college level math sequence.

Distance learning standing committee

A large number of recommendations from the last PR ([15] pages 32–34) are related to Distance Learning. We currently have a DL standing committee that looks into these matters. See Section A on page 24 (of this document) for a list of changes and concerns that the Distance Learning Standing Committee is currently working on.

Academic interventions

Finally, the last PR ([15], pages 30–31) made suggestions related to faculty contact with students outside the classroom and in the learning center. The math faculty has continued to support the learning center over the last five years. At Cascade Campus the math faculty have been working with retention specialists by creating academic interventions for students of concern. This program shows promise and the specialists now have an office in the math department and three staff members.

2

Reflect on learning outcomes and assessment, teaching methodologies, and content in order to improve the quality of teaching, learning and student success.

⟨chap:outcomes⟩

Learning outcomes assessment is key to addressing both affordability and access issues

Knowing What Students Know and Can Do[10]

Identify and give examples of assessment-driven changes made to improve attainment of course-level student learning outcomes. Where key sequences exist, also include information about assessment-driven changes to those sequences.

The SAC has mostly concentrated on college-level outcomes in the last five years for the following two reasons:

1. The Curriculum Committee currently requires an “out there” ([6]) focus for course-level learning outcomes, with no requirement that outcomes be assessable or measurable.

2. The annual assessment reporting for the Learning Assessment Council (LAC) has focused on the college’s core outcomes, not course outcomes.

However, we are fortunate to have math faculty involved with the Learning Assessment Council (LAC) and the Curriculum Committee. This involvement has kept our SAC aware of the college’s ongoing discussions regarding a possible future change for the focus of course-level learning outcomes (i.e., expectation of measurability) and related accreditation standards (e.g., [1, Standard 4.A.3]).

Many of our current learning outcomes were developed to satisfy the requirements of an “out there” focus and this has resulted in oddly worded or aspirational outcomes. Here are two examples from MTH 251 (Calculus 1):

> *Appreciate derivatives and limit-related concepts that are encountered in the real world, [and] understand and be able to communicate the underlying mathematics involved to help another person gain insight into the situation.*
>
> *Enjoy a life enriched by exposure to Calculus.*

While we hope that our students will be able to "help another person gain insight into the situation" and that they will "enjoy a life enriched by exposure to Calculus," we recognize that outcomes like these are not easily measured. Before our SAC can make assessment-driven changes to improve students' attainment of outcomes, we need to first develop measurable outcomes that represent the intent of our courses.

In 2012/13 the MTH 60/65 CCOG subcommittee decided to develop course-level outcomes that were meaningful and assessable; this was done despite concerns that Curriculum Committee might reject them because they lacked the required "out there" focus. The Math SAC was largely supportive of the shift to assessable outcomes, suggesting that we are supportive of the college transitioning toward a culture assessing outcomes at all levels.

While crafting the new (*draft*) course outcomes, the MTH 60/65 CCOG subcommittee connected each proposed outcome to an actual assessment activity used by a member of the committee in order to ensure that each outcome was truly measurable. What follows are a few of the resultant (*draft*) outcomes.

Argument Construction: Construct and judge the validity of an argument. (e.g., Why does a particular symbolic representation match a particular graphical representation?)

Representational Fluency: Demonstrate the ability to distinguish different meanings of 'variable', e.g., a variable can represent a varying quantity in an expression or an unknown quantity in an equation.

Problem Solving: Use appropriate (mathematical) tools in the context of problem solving, modeling, interpreting, etc. (Know what approach to take, what information you have, what information you need, what techniques you have to solve the problem, what the graph tells you, what the formula tells you, what model you can build).

The current layout of the CCOGs does not differentiate critical content from less critical content. To address this, the committee discussed the option of formatting the content area of the CCOGs in a pyramid structure with the most critical content highlighted at the bottom of the pyramid.

The current CCOGs do not align the content to the course outcomes. To help make the CCOG a better communication tool, the committee discussed making explicit connections between the course content and the course outcomes as well as explicit connections between the course outcomes and the college's core outcomes. This work was in progress when we realized that this shift in outcomes should not be done in isolation from other courses in the pre-college math sequence; in response, we formed a DE Math Subcommittee with the goal of creating vertically aligned outcomes that created a coherent progression from MTH 20 through MTH 95. Since its formation in June 2013 there has been a major shift in how we are hoping to approach DE level math courses. As the Math SAC considers new math pathways for DE level students, the CCOGs for these new courses will likewise be explicitly aligned and measurable.

In summary, we are interested in developing rich, meaningful, and measurable outcomes that better represent the intent of our courses than our current outcomes do. Since course outcomes are required in syllabi, properly representing the intended focus for the course in the the course outcomes is critical. We hope that the conversations in the LAC and Curriculum Committee concerning course-level learning outcomes will lead to Curriculum accepting more flexible wording of course outcomes in the near future.

The college should adopt a new model for course-level learning outcomes that allow for outcomes that are more descriptive of the actual content in the course and that are also better suited for student-level and course-level assessment.

Addressing college core outcomes

Describe how each of the College Core Outcomes are addressed in courses, and/or aligned with program and/or course outcomes.

The colleges Core outcomes may be found at [16].

Communication is stated in many of our CCOGs as a course outcome. We believe it is important for students to communicate ideas using mathematics in a meaningful manner through appropriate use of notation and concise, accurate statements. Here are some excerpts from course outcomes in MTH CCOGs:

> *. . . and then interpret and clearly communicate the results.*
> MTH 111–112, MTH 211–213, MTH 251–254

> *. . . and clearly interpret the results via written or oral communication.*
> MTH 243–244

> *. . . understand and be able to communicate the underlying mathematics involved to help another person gain insight into the situation.*
> MTH 111–112, MTH 243–244, MTH 251–254

Community and Environmental Responsibility is not directly addressed in our courses or outcomes. Our Social Justice Workgroup (see page 32 and Appendix C on page 81) discusses issues related to teaching with community and environmental responsibility in mind. Also, sections of MTH 111H (see page 32) have a related component involving tutoring math to someone in a student's community. Examples of Service Learning components used by some faculty are given on page 33.

Critical Thinking and Problem Solving is fundamental to mathematics so, at first glance, it may seem that there would be easy agreement between mathematics faculty for how this core outcome is present in our curriculum. This is not the case.

Some PCC math faculty believe that everything in a math course is a manifestation of this core outcome, including practice problems intended to develop procedural fluency in a non-contextual setting (e.g., solve the quadratic equation by the Zero Product Property). Indeed, one can certainly witness the critical analysis required within the realm of procedural fluency when students struggle with mathematical abstraction. This happens at the most basic level, especially for students who are not detail-oriented or unable to easily generalize abstractly in a non-contextual manner. It is also present at higher levels of math when students are faced with skill-based problems that require integration of several previously learned procedures.

Traditionally, the main focus of most undergraduate math programs is developing a students' algebraic procedural fluency (including our current curriculum). While procedural fluency is important, some PCC math faculty wish to narrow the focus of this core outcome in a way that goes beyond procedural fluency. Some examples include the development of students' ability to solve meaningful contextualized problems, explain concepts and justify results in a mathematically sound manner, analyze mathematical patterns, or create elegant proofs.

Assessment work has made us aware of how we differently we can view critical thinking and problem solving, and it has developed our thinking considerably. This will remain an ongoing conversation. At this time we have chosen to take the broad view of Critical Thinking and Problem Solving that includes procedural fluency.

Cultural Awareness is not formally covered in any of our courses. Some individual instructors may incorporate elements of cultural awareness into their classes. Some examples of how cultural awareness could be addressed by individual math instructors instructors are:

- differences in notations and procedures used by different cultures;
- similarities and differences with regard to the use of mathematics as a tool;
- attitudes toward mathematics in various cultures (e.g., math anxiety is not a world-wide issue);
- history of mathematical development in various cultures and how it was influenced by dominant philosophical attitudes of the region;
- use of mathematics as an agent of social change by shining a light on inequity with regard to treatment of, and resource allocation for, marginalized populations as compared to the dominant culture; the social justice workgroup considers this—see page 32 and Appendix C on page 81.

Professional Competence is described by PCC as the ability to "demonstrate and apply the knowledge, skills and attitudes necessary to enter and succeed in a defined profession or advanced academic program." As a discipline that builds upon prior knowledge and skills, successful completion of any of our sequenced courses prepares students for the next math course. A certain level of mathematical competency is valued by PCC and is required for all of our degree-seeking students. Currently, most students show math competency by taking a math course at PCC. In this way, the Math SAC plays a critical role in the professional competence for students' educational goals whether it be for a defined profession or advanced academic program. Discussions about the necessary mathematical knowledge, skills and attitudes for the wide range of educational goals of PCC's students are ongoing.

Additionally, we offer one sequence that directly addresses professional competence within math education: Our MTH 211–213 "Foundations of Elementary Mathematics" sequence of courses are taken by students interested in pursuing a career in teaching in the K–12 education system. At minimum, two of the three courses are prerequisites for obtaining a degree in Education in Oregon. Each course emphasizes specific topics of mathematical theory that are the basic building blocks of mathematics instruction in the K–12 system. Some instructors require students to maintain a portfolio, learn multiple assessment techniques, do field observations of teachers in the K–12 system, learn about the Common Core Standards and trends in education both state and nation-wide, and are given guidance in areas such as preparing for the CBEST and PRAXIS as well as decision making in the various avenues for pursuing a degree in education. This exposure to what the field of education actually entails helps students make sound career choices early on in their academic pursuits.

Self-Reflection is an outcome that we believe students develop in the course of their educational experience. Many Math SAC faculty believe we can assist this development; others question if this should be a responsibility of faculty (or if this should even be a core outcome of the college). While the SAC needs more discussion to develop a shared understanding of what Self Reflection means in the context of a mathematics course and how to develop it, we believe that it is present in our curriculum.

We are exploring aspects of Self Reflection; here are two examples:

1. Development of strong study skills will improving students' ability to self-reflect; consequently, the SAC has discussed adding study skills as formal components of MTH 20 (see page 35). See page 38 for more information on study skills material that incorporates student self-reflection.

2. In AY 2011/12 the Math Learning Assessment Subcommittee (Math LAS) explored Self-Regulated Learning where students were guided in a self-reflective process that helped them evaluate their depth of understanding (or lack thereof). Although Self-Regulated Learning was not incorporated into the assessment activity (due to the complexity and the lack of time remaining), members of the Math LAS who explored this believe it is worthy of future consideration.

Update the Core Outcomes Mapping Matrix for your SAC as appropriate.[1]

The updated matrix can be viewed in Appendix D on page 87. It is unclear if the college has an expectation for how to rate our courses. For example, should if we rate a course with a 200 designation as "level 4" for a particular outcome, is it appropriate to have a developmental education course also at level 4 or should it be at most level 2? Without a college expectation in this regard, we have opted to rate our courses against the level of attainment expected of the student in the course instead of against the level of attainment expected for a 200-level student. With this view, it is possible to have MTH 20 and MTH 256 at a "level 4."

Given the need for continued conversation with the core outcomes, we have decided to assign the same level indicator for all of our courses rather than attempt to rank courses against one another (e.g., does MTH 60 have more or less "communication" than MTH 112). Further assessment work will likely lead to a more nuanced evaluation in the future. We intend to incorporate discussion of the core outcomes into regular CCOG review as well as conversations that occur with Math LAS members.

A C B ss:sec:coreoutcomes)

For Lower Division Collegiate (Transfer) and Developmental Education Disciplines: Assessment of College Core Outcomes (note: Please include the full text of your annual reports as appendices, and summarize them here).

Our full annual Learning Assessment reports can be found at these links, and are summarized in the pages that follow.

2009/10: [11]

2010/11: [12]

2011/12: [13]

2012/13: [14]

Describe the assessment design and processes that are used to determine how well students are meeting the College Core Outcomes.

We will discuss the evolution of the assessments by academic year, starting from 2009/10.

2009/10: Critical Thinking & Problem Solving This was the first year the LAC asked SACs to assess a core outcome. Our assessment activity was developed by a small group of interested math faculty with minimal coordination with the full SAC. The student work that was obtained came from student volunteers enrolled in sections with the involved faculty; it was not a statistically sound sample. The activity involved both direct and indirect assessment:

[1] http://www.pcc.edu/resources/academic/core-outcomes/mapping-index.html

- The direct assessment involved finding and correcting conceptual, arithmetic, and formatting mistakes in expected procedural skills for MTH 65 and MTH 95. Students must know how to do the problem before they are able to to identify and correct mistakes. This level of analysis is typically very difficult for students and is a high on Bloom's taxonomy.

- The indirect assessment involved asking students to respond to questions like, "Do you feel this class has improved your critical thinking and problem solving skills?"

2010/11: Critical Thinking & Problem Solving and Communication At the beginning of Fall 2010, the Math SAC decided to create a standing committee to ensure assessment work was a high priority. The Math Learning Assessment Subcommittee (Math LAS) was born. There were 14 members, most of whom were full-time faculty. This was a big improvement from last year's work where only a small group of faculty participated.

Although our previous year's CT & PS activity had been high on Bloom's Taxonomy, we decided that procedural skills did not fully capture how we want our student to think critically about mathematics. Instead of continuing with the previous year's work, we decided to develop a new activity for CT & PS.

Still very new to assessment, we did not know what type of activity might generate the most useful information. To help us decide, we developed three assessment activities and collected student artifacts for each activity. The chosen activity was randomly given to 12 of the 72 sections of MTH 65 held in Winter 2011. (Note: We also created an activity for MTH 244, but there was an error in one of the questions. Although a portion of the artifacts were evaluated, we ultimately decided to abandon this attempt and focus our limited resources toward the MTH 65 analysis.)

For the MTH 65 assessment, we collected 240 student artifacts. To help ensure that data would be a true SAC-level assessment (vs. an evaluation of individual instructors), faculty members were instructed to remove identifying information from student work and submit their artifacts to an administrative assistant who tracked submission of work only. Sixteen members of the SAC were normed to the rubric that had been developed by the Math LAS. Two members of the LAC's Program Assessment for Learning (PAL) facilitated this work and guided faculty through a trend analysis. (Note: Our process and involvement of Math SAC members was so impressive as compared to other large SACs that the Learning Assessment Council awarded the Math SAC an "Oscar" at their Spring circus event.)

2011/12: Self Reflection and Professional Competence This year we sent a survey to all students enrolled in a math class in the first week of Spring 2012. The Math LAS was awarded a LAC grant and we used these funds to hire a consultant, Una Chi, to help us refine the survey and evaluate the student responses to the survey. We also discussed the wording of the questions with the DE Reading and Writing faculty members to help ensure the questions would be understood by all students. Approximately 2300 students responded to the survey, and the response rates for particular courses mirrored student enrollment in those courses and other demographic information. The survey was an indirect measure of students' perceptions.

For Self Reflection, we focused on questions that we felt would fit the following three areas:

1. Reflection—Core reflective thinking items; autonomy and relatedness aspects from self-determination theory

2. Orientation—Mastery/performance, internal/external locus of control (hold self responsible vs. holding others responsible)

3. Competency—Belief about self-ability to perform in math

Sample Self Reflection items on the survey:

> *I know when I need help on a math concept.*
>
> *When I get a math test back, my grade is what I expect it to be.*
>
> *My feelings about math affect my learning of math.*

For Professional Competence, we used the suggestions of our LAC coach to craft questions about students' perceptions of math in terms of their future job and career goals.

Sample Professional Competence items on the survey:

> *The skills I learn in a math class are not important to me or my future goals—I just need to pass the course.*
>
> *In PCC math classes, what knowledge, skills, habits or ways of thinking have you practiced that might help you in the work place? [Choices included punctuality, problem solving, working in groups, self discipline, career specific math skills, interpret graphs/charts]*
>
> *My career interest requires some mathematical knowledge.*

2012/13: Critical Thinking & Problem-Solving and Professional Competence This was our third investigation into Critical Thinking & Problem Solving. Our previous attempt had given us rich data, but this year we decided to investigate students' ability to solve nine math problems that specifically represent the topics covered in MTH 95 that we consider essential for success in MTH 111. The assessment activity was administered to every face-to-face section of MTH 95 at all PCC campuses in the Winter of 2013. We collected 677 student responses from 33 different sections across the college; all identifying information for both instructors and students were removed.

The math problems included in the assessment were selected by faculty from our current MTH 95 textbook.

- For Critical Thinking & Problem Solving: We incorporated problems that contain units and involve a real-world context.
- For Professional Competence: We incorporated problems that emphasize the content needed to be successful in the next course, MTH 111. For this activity, Professional Competence was interpreted as the, "knowledge, skills and attitudes necessary to enter and succeed in a defined profession or advanced academic program" ([16]).

During the LAC's summer peer review process, our report won awards in two categories: "Assessment Design" and "Planned Improvements to Increase Student Attainment of Outcomes". The awards were announced at 2013 SAC Chair Inservice. [2]

Summarize the results of assessments of the Core Outcomes.

As a reminder, the full reports for our assessment activity are available using the links on page 18.

[2] http://www.pcc.edu/resources/academic/learning-assessment/sac-resources.html#assessmentwin

2009/10: Critical Thinking & Problem Solving We did not evaluate the student artifacts due to lack of time during the 2009/10 academic year. We intended on completing the work during 2010/11; however, since we did not have a statistically valid sample and since we wished to try a different type of assessment during 2010/11, we decided not to evaluate these artifacts. Even though we did not evaluate student learning, the faculty members gleaned valuable information about the process of assessment. The assessment artifacts have been saved in case the Math LAS wishes to review them to guide future work.

2010/11: Critical Thinking & Problem Solving and Communication Table 2.1 presents the results of the rubric scores for our 2011 assessment of Critical Thinking & Problem Solving and Communication in 13 sections of MTH 65.

Table 2.1: 2010/11 Assessment Scores

⟨ass:tab:201011scores⟩

Rubric Score	1 or 2 (below expectations)	3 (met expectation)	4 or 5 (exceeded expectation)
CT & PS	55%	35%	10%
Communication	50%	28%	22%

We realized that the rubric scores did not tell us specific information (e.g., *why* did the artifact score "below expectation" or "exceeded expectation"?). The LAC Program Assessment for Learning facilitators suggested that we do a trend analysis which produced more meaningful information. Here are some results of the trend analysis:

- Many students did not seem to realize that not all data are linear.
- Many students were not able to give a well-supported conclusion.
- Students typically do not represent equivalence correctly.
- Many students incorrectly applied the idea of percentage.

2011/12: Self Reflection and Professional Competence For Self Reflection:

- Students are not self-critical enough
- There was a significant group mean difference between self-reported grade and self-reflection behavior on all grade level differences. Note: "grade level" is the self-reported grade (A, B, C, D, F, P, NP, other) for the student's previous math class.
- There is a clear difference in the reflective thinking ability of students in high-level math courses versus students in low-level math courses (like MTH 20).

For Professional Competence:

- It was surprising that Engineering was chosen as "my career interest" by 11% of respondents (the plurality). Nursing and Business were both in second at 7%.
- Presentation skills ranked low by students as helpful in the workplace. A good SAC discussion could center around this; we may not wish to "force" students to perform presentations in lower level courses where math anxiety is increased.

2012/13: Critical Thinking & Problem-Solving and Professional Competence Our assessment consisted of nine math problems. After all submissions were graded, the average score was approximately 3.8 out of 9. On a class-to-class basis the average had a low of 1.7 out of 9 to a high of 5.4 out of 9. We were unsure of why the average of all classes was so low, and we found it alarming. Did students not take the activity seriously since most instructors did not assign points to it? Would it have been better to give it with the final exam when most students were prepared for a mathematics assessment?

Data in more detail is presented graphically and with tables in section 3 of the full report, [14]. Some summary points follow:

- The problems that involve working with function notation were answered correctly at a much lower rate than we expected given the amount of time dedicated to that topic in MTH 95.
- A problem that involved linear equations was also answered correctly at a much lower rate than we expected, as that topic is covered in MTH 60, 65 and 95.
- Given that time constraints made it difficult to discern a student's conceptual understanding of a topic and our decision to mark answers as correct or incorrect (with no "partial credit"), we should consider altering this activity if used again.

Identify and give examples of assessment-driven changes that have been made to improve students' attainment of the Core Outcomes.

Below we discuss the assessment-driven changes that came out of our annual assessment projects in academic years 2009/10, 2010/11, 2011/12, and 2012/13:

2009/10: Critical Thinking & Problem Solving We chose to start anew rather than analyze data that was not statistically significant. No course-level assessment driven changes came from this years work, though the SAC did significantly modify its approach to assessment in following years due to this first year finding.

2010/11: Critical Thinking & Problem Solving and Communication During 2010/11, it became clear that the Math LAS members would not be able to develop/conduct assessment *and* lead the SAC with assessment-driven changes from the prior year's work. At the end of this academic year, the SAC created another assessment standing committee, called the Action Subcommittee. This subcommittee will take the results and the recommendations from the previous year's Math LAS research and lead the SAC in deciding what should be changed and how to implement that change. For 2010/11 work, only individual changes to instruction occurred from the assessment results. (See section 1 from the full report, [12].)

2011/12: Self Reflection and Professional Competence The Action Subcommittee brainstormed a list of actionable items from the 2012 research and decided to work on the following item: "disseminate successful ideas already used by our faculty for improving self-reflection via study skills and student-centered learning." The goal was to create activities that faculty could easily incorporate into their classes that would help students develop self-reflection behaviors that would lead to better study skills. Math SAC members were asked to submit activities that were already being used successfully, and the committee received 25 different activities. During an all-day SAC meeting we split into breakout sessions and each group was asked to look over the activities and create a list of best practices for incorporating them into the classroom. These worksheets are available for instructors to download and incorporate into their classes at [19]. Additionally, a faculty member created a series of self-reflection and study skills videos that are being used in a lot of developmental classes (see page 38).

2012/13: Critical Thinking & Problem-Solving and Professional Competence For the complete list of actionable items from this year's research, see section 4 in the full report, [14].

- Add to the CCOGs the expectation that students check the reasonableness of their results (e.g., a result of −5 or 1,000,496 would not be a reasonable result for "the number of hours driven on a weekend trip"). Ideally, students should be encouraged to develop a habit of verifying their results regardless of whether or not the problem is a contextualized problem or not.
- Create a minimum skills test for MTH 95.
- Discuss methods of course content delivery in a way that supports both full- and part-time faculty.
- Form a Developmental Math Committee that will research different ways we might be able to redesign our pre-college curriculum in order to better prepare students for college-level math as well as better serve students in CTE programs.

The Action Subcommittee is currently reviewing the 2012/13 assessment work and may propose to the SAC other ideas for implementation.

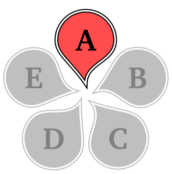
3

Other Curricular Issues

⟨chap:otherissues⟩

Education is the only business still debating the usefulness of technology.

Rod Paige, former U.S. Secretary of Education (2002)



To what degree are courses offered in a Distance modality (online, hybrid, interactive television, etc.)? For courses offered both via DL and on-campus, are there differences in student success? (Contact the Office of Institutional Effectiveness, either Laura Massey or Rob Vergun, for course-level data). If so, how are you, or will you address these differences? What significant revelations, concerns or questions arise in the area of DL delivery?

ec:distancelearning⟩

Presence of DL offerings

The Math SAC offers Distance Learning (DL) courses in online, hybrid, and interactive television (ITV) modalities. We strive to make our DL course experience simulate the face-to-face course experience with respect to instructor presence, feedback, and assessment. We use discussion boards to simulate the classroom learning environment, and an array of online homework platforms to assess and prepare our students effectively. A Math SAC DL standing committee is charged with discussing the structure of our current DL courses, as well as developing and maintaining current DL best practices and standards.

All of our pre-college level math courses (except a calculator skills course) have a DL offering, as do most of our lower-division collegiate courses. Courses that are not offered using a distance modality fall into two categories: those on the high end of our collegiate courses, and specialty courses with low enrollments; Table 3.1 shows complete details.

TABLE 3.1: Course Offerings through Distance Learning

ab:sec3:DLofferings⟩

Offered as DL			Not offered DL upper division			Not offered DL specialty		
020	030	060	251	252	253	015	25C	26C
065	070	084	254	256	261	061	062	063
095	111	112				093	105	211
241	243	244				212	213	

Approximately 14.1% of PCC math enrollments were DL based during the academic year 2012/13 compared to only 9.1% in the 2007/08 academic year. This percentage increase is coupled with a general enrollment surge over the past five years, and the number of DL enrollments has grown by over 150% in this time period. Figures 3.1 and 3.2 show student enrollment in face-to-face courses compared to online courses over six academic years. Note that even while overall enrollment has declined some since its peak in 2011/12, that absolute enrollment in DL courses has still grown. Tables 3.2 and 3.3 give more detailed data—note that we do not offer classes above MTH 244 in a DL modality.

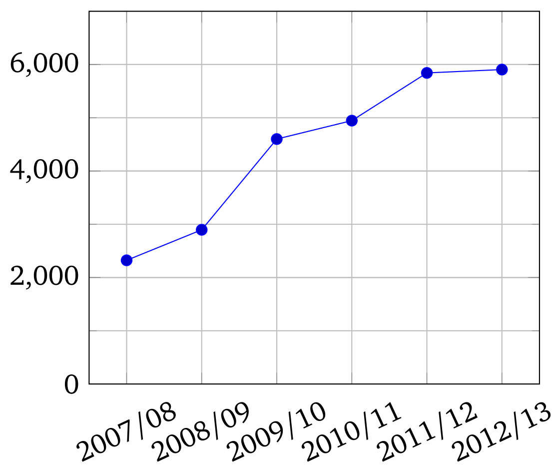


Figure 3.1: Enrollments in DL

⟨fig:sec3:DLenrollments⟩

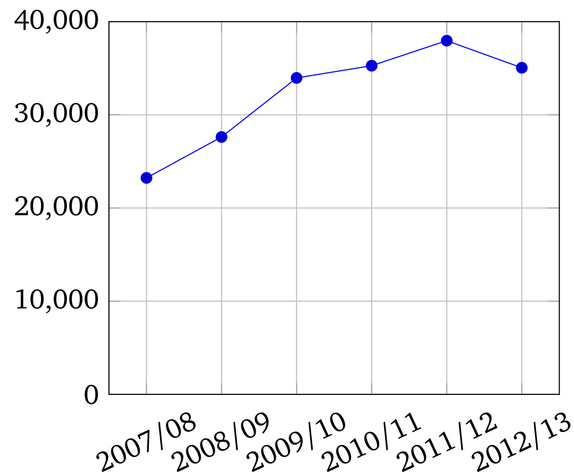


Figure 3.2: Enrollments in face-to-face classes

⟨fig:sec3:F2Fenrollments⟩

As enrollment demand for DL math courses has increased, we have increased the number of sections that we offer and trained more interested faculty in managing DL courses. Between the academic years of 2003/04 and 2007/08, the annual number of sections offered increased from 51 to 87. In the 2012/13 academic year, we offered 185 DL sections. The resulting increase in sections offers access to students that can succeed in this modality and need this option due to outside constraints such as work and family.

Success rates in DL courses

Pass rates in DL courses are quite noticeably lower than those for their face-to-face counterparts; Figure 3.3 visualizes the difference in pass rates between the highest enrollment DL courses that we offer and their face-to-face counterparts. More detailed data for all DL offerings can be seen in Tables 3.2 and 3.3—see also Appendix E on page 89. We recognize that students need a certain level of self-discipline, better study skills, and comfort engaging with technology to succeed in a DL course. However we currently have no method for screening which students are less likely to succeed using a distance modality; our recommendations on page 31 attempt to address this issue.

Referencing Figure 3.3, it is clear that, in the six academic years shown, the pass rates generally decrease regardless of delivery mode. We hypothesize that this overall trend is mostly the result of the economic collapse of 2008 which led to increased enrollment and changes in our student demographics (see demographics data in Appendix F on page 90). But the pass rates in DL courses are as much as 30% lower than in face-to-face counterparts and this large discrepancy needs to be addressed.

The difference in student-success rates between on-campus courses and DL courses is an important issue for the Math SAC. The Distance Learning Standing Committee has met to consider this issue and the factors that lead to this difference in success rates. We can only

TABLE 3.2: DL & Face-to-face (F2F) enrollments and pass rates 2007–2010

3:F2FandDLdata2007)?

Course	2007–2008				2008–2009				2009–2010			
	DL	% Pass	F2F	% Pass	DL	% Pass	F2F	% Pass	DL	% Pass	F2F	% Pass
20	271	70 %	2,799	65 %	352	67 %	3,673	65 %	478	60 %	4,751	62 %
30	38	76 %	31	84 %	15	80 %	13	92 %	57	61 %	0	0 %
60	567	57 %	4,886	63 %	692	50 %	5,989	64 %	1,263	49 %	7,273	64 %
65	425	60 %	3,349	69 %	512	64 %	3,912	69 %	832	62 %	4,915	66 %
70	107	38 %	533	70 %	169	43 %	604	66 %	169	42 %	783	70 %
95	326	53 %	3,009	68 %	417	48 %	3,544	67 %	557	55 %	4,293	68 %
111	0	0 %	0	0 %	0	0 %	0	0 %	0	0 %	0	0 %
111A	11	82 %	127	87 %	0	0 %	0	0 %	0	0 %	0	0 %
111C	89	52 %	1,119	70 %	88	51 %	1,333	66 %	194	51 %	1,595	71 %
111B	61	30 %	1,328	73 %	118	51 %	1,554	76 %	207	45 %	1,829	77 %
112	85	56 %	808	66 %	98	51 %	994	69 %	144	51 %	1,300	63 %
243	221	68 %	1,457	79 %	313	66 %	1,617	77 %	517	66 %	1,912	78 %
244	109	69 %	588	85 %	122	67 %	625	83 %	155	74 %	779	82 %

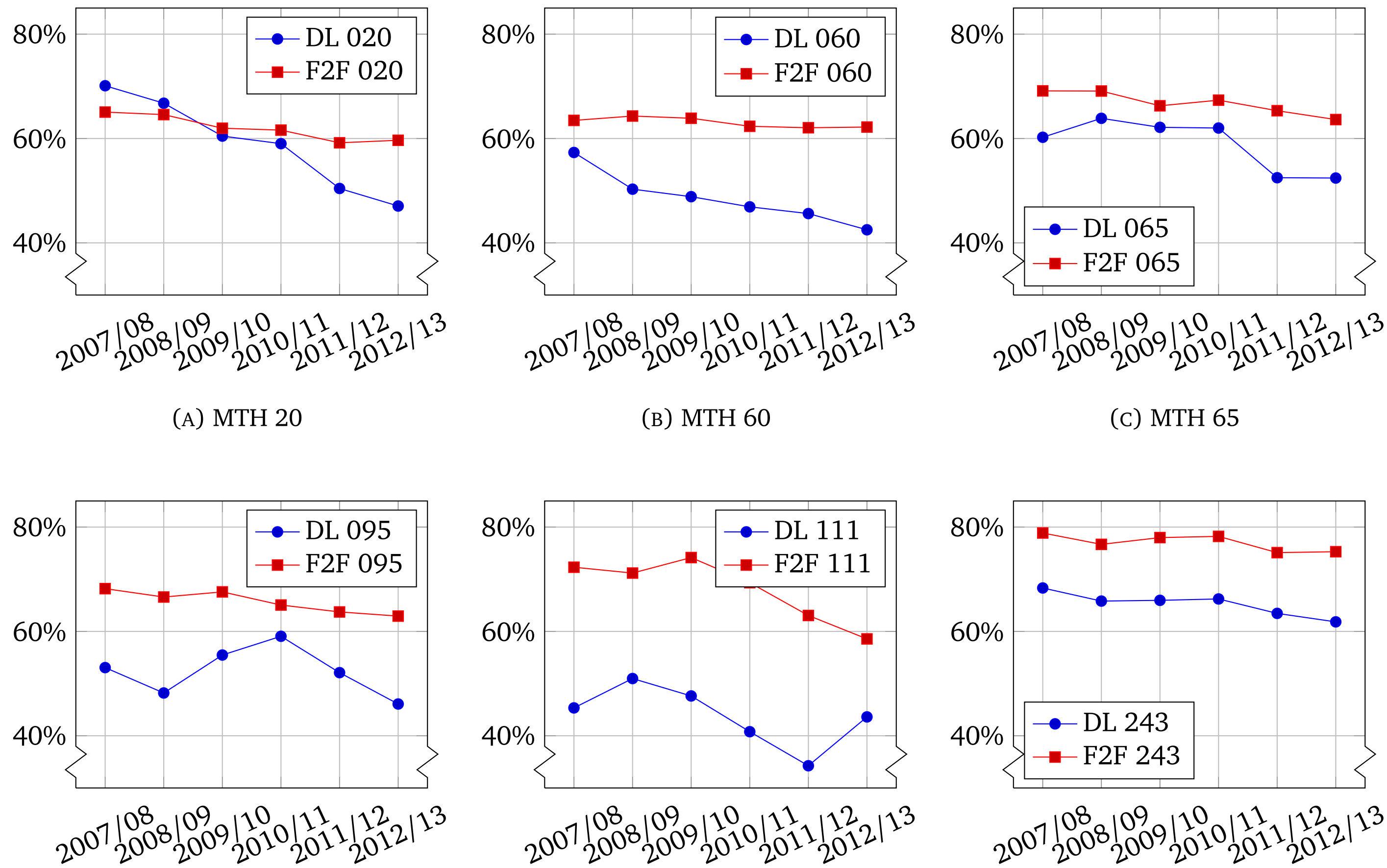
TABLE 3.3: DL & Face-to-face (F2F) enrollments and pass rates 2010–2013

3:F2FandDLdata2010)?

Course	2010–2011				2011–2012				2012–2013			
	DL	% Pass	F2F	% Pass	DL	% Pass	F2F	% Pass	DL	% Pass	F2F	% Pass
20	344	59 %	4,602	62 %	474	50 %	5,181	59 %	425	47 %	4,623	60 %
30	62	60 %	0	0 %	68	49 %	0	0 %	71	48 %	0	0 %
60	1,307	47 %	7,310	62 %	1,618	46 %	7,580	62 %	1,421	43 %	6,840	62 %
65	958	62 %	4,970	67 %	1,168	52 %	5,168	65 %	1,156	52 %	5,122	64 %
70	180	42 %	950	68 %	182	40 %	1,004	66 %	152	45 %	856	68 %
95	579	59 %	4,682	65 %	643	52 %	5,035	64 %	716	46 %	5,056	63 %
111	0	0 %	0	0 %	540	34 %	4,244	63 %	752	44 %	4,103	59 %
111A	0	0 %	0	0 %	0	0 %	0	0 %	0	0 %	0	0 %
111C	231	33 %	1,765	66 %	0	0 %	0	0 %	0	0 %	0	0 %
111B	203	50 %	1,979	72 %	0	0 %	0	0 %	0	0 %	0	0 %
112	217	44 %	1,413	63 %	197	46 %	1,629	64 %	239	46 %	1,574	66 %
243	598	66 %	1,882	78 %	602	63 %	2,028	75 %	655	62 %	1,727	75 %
244	225	76 %	689	77 %	299	70 %	707	79 %	283	72 %	642	84 %

speculate the reason for the disparity based on anecdotal evidence and professional experience. Students may no longer see DL courses as unusual, so they may be unaware that successful DL math students should have stronger study skills, self-discipline, and time management skills than face-to-face math students absolutely need to be successful. We believe that many students register for DL math courses without adequate understanding of the study habits, time commitment, learning styles, and technical skills that are necessary for success in these classes. Anecdotal evidence suggests that some students who are aware of these issues and who would otherwise enroll in a face-to-face section still enroll in a DL section due to a lack of space in face-to-face sections.

There is currently a DL orientation available for DL students, but there is no requirement that students complete it. Furthermore, there is no information in the orientation to help students understand the particular challenges of studying *mathematics* using the DL delivery methods.



(A) MTH 20 (B) MTH 60 (C) MTH 65

(D) MTH 95 (E) MTH 111 (F) MTH 243

Figure 3.3: Pass Rates By Modality

g:sec3:F2FandDLpassRates⟩

In many disciplines, reading, writing, and discussion can be sufficient for learning. Students in mathematics typically do not learn best until they have also acted, by working through exercises or active problem-solving. In face-to-face classes, instructors can monitor that this learning-through-action is happening more easily. In DL courses, there is more of a need for students to rely on self-discipline to complete this portion of their learning, and this is not communicated in the existing DL orientation.

Informing DL students

The Course Information Page (CIP) is accessible to students registering for DL courses and is meant to give section-specific information to students as they decide which sections to register for. Many faculty members use this system to inform students of issues related to an online mathematics course. For example, faculty address the misconception that a DL class requires fewer hours of attention per week than a face-to-face class. We believe that many students do not visit the CIP for DL classes and continue to be unaware of the tools they will need to be successful in a DL mathematics course. Some faculty members send emails to registered students before the term starts, asking them to read the CIP; it is not clear, however, how many students read this email or act on it. The link to a CIP is only available via the online class, and not via MyPCC; this lack of presence may contribute to the issue.

Other methods that are employed by DL faculty to directly communicate with their students include:

- using the Course Progress Notifications (CPNs);
- placing telephone calls to students;
- using Collaborate to hold online office hours in a kind of visual and aural chat session.

Online homework platforms

Faculty have sought to increase engagement by DL students through use of online homework platforms. An online homework platform can provide students with immediate feedback and also hold the student accountable for completion of assigned exercises. Faculty can monitor progress and employ formative assessment from a distance.

The SAC recognizes that program changes should come from research toward best practices. Faculty members Wendy Fresh, Rebecca Ross, Tammy Louie, Jessica Bernards, and Diane Edwards have investigated the effects of use of an online homework system in several experiments in both DL and face-to-face courses. In most cases, results from these experiments suggest there may be positive effects to using an online platform, but it remains too early to declare statistical significance. To demonstrate statistical significance in studies of this nature requires considerably large sample sizes.

However Jessica Bernards has been able to measure one positive effect to a significant degree. Instructor Bernards taught several online sections of MTH 111, with control groups doing homework from the textbook and submitting paper write-ups, and experimental groups using online homework. The withdrawal rate was 32% for the control group and only 16% for the experimental group, and this difference was statistically significant ($P < 1\%$). Instructor Wendy Fresh ran a very similar experiment with online sections of MTH 60. There may still be an effect at that level, but more data is necessary to confirm with statistical significance. Both instructors noted modest improvement in exam scores among the experimental group, but again more data is being gathered to confirm with significance.

For more information on research by Instructors Bernards and Fresh for DL courses, see Appendix G on page 96. For information on research by instructors Edwards and Louie, see Appendix H on page 98 and also page 40. Research on the efficacy of WeBWorK (an online homework platform discussed on page 28) was done in [7]. In [4] it was found that when students are segregated by incoming ability, those who were less prepared when entering a course do benefit significantly from online homework use. As a community college, we have more under prepared students than universities, so this finding suggests that use of online homework may be more helpful at PCC. It is important to note that each of these studies were done with face-to-face courses; in DL courses the traditional homework alternative presents the challenge of delivery, complicating the question in favor of using online homework.

⟨other:sec:webwork⟩

WeBWorK

Recent exciting developments at PCC have centered around the free and open-source online homework platform called WeBWorK that is partially funded by the National Science Foundation and maintained by the Mathematical Association of America. By Spring 2014 we expect that over 20 faculty will be using WeBWorK in their courses. The math SAC is also loaning out the services of Alex Jordan to CTE and LDC science SACs to create free online homework review programs. We envision using WeBWorK for future Learning Assessment research and placement advising. We are working with Dual Credit instructors to offer WeBWorK services to Portland Public Schools.

Most of the textbooks currently in use by the Math SAC are published by Pearson Publishing, which offers MyMathLab for its online homework platform. While MyMathLab and similar commercial products come as a bundled expense with new textbook purchases, a separate online account for pairing with a used textbook purchase is rather expensive. For this reason, face-to-face instructors rarely require MyMathLab in their courses. On the other hand, Distance Learning instructors have a stronger need for an online homework platform and the majority of DL instructors do require that students use (and pay for) MyMathLab.

By contrast, WeBWorK is a platform for online homework that is free and open-source. As there is no central headquarters for WeBWorK, it must be installed on a server somewhere. Since joining the Math SAC in Spring 2009, Alex Jordan has championed the implementation and use of WeBWorK at PCC. Some PCC math faculty have used WeBWorK in various capacities by borrowing server space from the University of Oregon, a relationship formed and maintained by Jordan. This partnership between two Oregon state institutions has been mutually beneficial. While PCC gained server access, PCC faculty members were programming content that the University of Oregon has been able to take advantage of. Each term since Fall 2011, roughly 10 sections of PCC math courses have used the UO server.

Over this period, WeBWorK users in the Math SAC lobbied Technology Solution Services to provide the Math SAC with its own WeBWorK server. While the UO server provided service to us, it came with certain restrictions and complications that prevented WeBWorK at PCC from reaching its full potential. For a time there was a chicken-and-egg situation, as TSS requested a greater usage by PCC faculty before arranging for a server while some faculty chose not to use WeBWorK because of the inconvenience of using the UO server.

In the 2012/13 academic year, faculty Chris Hughes and Scot Leavitt researched accessibility issues (in the ADA sense) alongside Disability Services. See [9] for the full report. Among many other findings, they found that MyMathLab (at the time of the project) had many significant accessibility problems while WeBWorK was quite close to being fully ADA compliant. The open-source nature of WeBWorK meant that the few remaining obstacles to accessibility could be addressed. They recommended that the SAC cease using MyMathLab for newly developed courses and newly developed online shells. They also recommended that faculty migrate from MyMathLab to WeBWorK. Disability Services supported their recommendations, and also began lobbying TSS for a PCC WeBWorK server. Within the WeBWorK community PCC is now seen as a leader when it comes to accessibility issues. See [5] for a post about this on the WeBWorK news blog. As a result of this, PCC is hosting a WeBWorK development camp in August 2014 with a central theme of addressing accessibility issues and enhancing its accessibility.

page:disabilityservices⟩?

TSS partnered with the Clackamas Education Service District to deliver a WeBWorK server that has been fully implemented since Winter 2014. SAC members Alex Jordan, Chris Hughes, and Xiaolong Yao have prepared webwork.pcc.edu for regular use starting Winter 2014 term. A backup server at webwork-dev.pcc.edu is in place for faculty to experiment with.

The arrival of our own WeBWorK installation has significant implications beyond homework management, particularly in the advising department. We envisage that advisors would enroll students in a 'review course' that contains (mostly) pre-college practice problems, and that the student would be encouraged to sit the COMPASS placement test only when they are comfortable with the problems in WeBWorK. Furthermore, we can easily use WeBWorK as an advising tool to replace Hughes' Placement Advisory Test ([15], pages 12–13) in situations when students are not happy with their placement from COMPASS. The SAC should work with advising to implement this.

PCC WeBWorK problem library

WeBWorK has been in use at universities for some time now, and an extensive library exists of math problems for college-level courses. However there was weak content support for basic algebra and other pre-college topics. Over Summer 2013, Alex Jordan, Chris Hughes, and Xiaolong Yao oversaw an effort to create a library of high-quality, algorithmically generated, basic algebra WeBWorK exercises which was partly funded with an IIP development grant; they received support from math instructors Kandace Kling, Debbie Neft, Jeremy Shaw, and Danielle Rice. These exercises currently cover topics from MTH 60 and 65, and the team continues to add problems to the library for MTH 95. The library development was a success because of the strong collaboration and dedication of the three faculty members, and the foundations that Jordan had laid in previous years. Jordan, Hughes, and Yao presented their work at the STEM showcase (Rock Creek) in Fall 2013 (see Figure 3.4). It was at this showcase that the idea was hatched to create free online homework review programs for CTE and LDC science SACs.

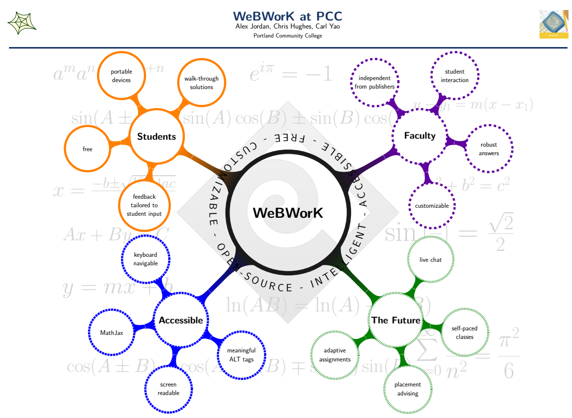


FIGURE 3.4: WeBWorK poster from the PCC STEM Showcase

⟨webworkposter⟩

As time and funding progress, SAC members with the requisite coding experience hope to add more problems to this PCC library, expanding into the arenas of MTH courses 20, 111, 112, 243, and 244. It is important to note the level of quality of the problems from this library. Each problem has a full walk-through solution coded along side the question which can be put to use by faculty in a number of ways. Each problem is given fine attention to detail so that automated feedback messages to the students are as informative as modern technology can allow. This high level of quality requires time and experience to achieve. However it is necessary if any instructor hopes to use WeBWorK as a teaching tool and not just an assessment tool.

Concerns about DL offerings

Each of the following three issues have been raised by SAC members, and during the 2012/13 academic year a group of concerned faculty met to discuss them. The meetings were informal and no binding decisions were reached.

- Faculty are concerned about whether or not Distance Learning is an effective way to deliver math content, especially in light of the low pass rate statistics seen in Figure 3.3. Successfully learning mathematics generally requires heavy active engagement. Face-to-face courses facilitate this engagement by requiring students to be in the physical presence of their instructor and fellow students. In DL courses, the imperative to remain engaged must come mostly from the student's own sense of responsibility and interest.

- Faculty are concerned about the quality and consistency of current DL courses. Some faculty rely on publisher content such as electronic versions of textbooks, while other faculty have created complete sets of online notes themselves and use e-books only as secondary resources. Instructor Chris Hughes serves as an advisor to online faculty creating new courses, and makes recommendations to improve course quality and observe accessibility standards. However there is no enforcement of the online advisor's recommendations.

- Faculty are concerned about the portion of a student's grade that may be computed from online homework. Compared to traditional homework, online homework is more readily vulnerable to cheating. With many math exercises, the exercise can literally be typed in to Google and the search engine itself provides an answer. Online homework provides fewer obstacles for a dishonest student to employ someone else to do their homework for them. In fact, in Craigslist sites nationwide, all one need do is search for 'mymathlab' to find advertisements from those who will 'take your online math course for you' at a cost. The math SAC has always wanted its online courses to mirror its face-to-face courses, and as a consequence has never created CCOGs that treat face-to-face and online courses differently. This has made it difficult to place any cap on the portion of a grade that may be computed from online homework. There is also no consensus on what an appropriate cap would be.

ther:sec:recommendations)

Recommendations

Our main recommendations concern how to best inform students about the particular skills that a distance learning student should have or adopt in order to be successful. We also recommend enacting some prerequisite items for DL registration to help give these skills to students. Lastly there are some recommendations that do not fit these descriptions. Many of these recommendations hold for face-to-face courses as well, and may be repeated elsewhere in this program review.

For the Math SAC:

- Collaborate with advising to implement a WeBWorK-based review mechanism for would-be placement test-takers.
- Consider how the quality of online courses could be improved by more effective regulation by the SAC.

For Administration/Advising:

- Collaborate with the Math SAC to implement a WeBWorK-based review mechanism for would-be placement test-takers.
- Give students more information on DL responsibilities and make students aware of the difference in student-success statistics between DL and face to face courses.
- Encourage students to contemplate why they seek to take a DL course and reflect upon whether it will align well with their learning style and personal skill sets.

For Administration/DL/TSS:

- Have the online orientation linked from the registration tool in MyPCC and require that students complete this orientation before registering for a DL class.
- Include a section in the DL orientation that addresses the specific challenges that DL brings to mathematics courses. Perhaps only students seeking to register for a mathematics DL course would be required to complete this section.
- Add redundant access to the Course Information Page. Along with access through the online Class Schedule, the CIP could be available through MyPCC on the home page for a course and through Desire To Learn.
- Include a pop-up or hover-over window that is activated when a student tries to register for a DL MTH class that gives specific information about the challenges of DL Math courses.

For Administration/Other:

- R Require students to demonstrate pre-requisite computer literacy skills such as those taught in basic internet skills (CAS 104), beginning Word (CAS 216), beginning keyboard (CAS 121), and basic computer skills/MS Office (CAS 133).
- R Develop and require a basic DL/computer skills competency course, possibly offered during week 0 of the term.
- R Provide opportunities for faculty professional development in research design and data analysis to help with research efforts on the efficacy of online homework.
- R Provide support for further development of WeBWorK related projects, including a larger library of math problems for courses beyond 60/65/95, enhancements of the WeBWorK engine, and content for placement advising/review.

A B C D E

Has the SAC made any curricular changes as a result of exploring/adopting educational initiatives (e.g., Service Learning, Internationalization of the Curriculum, Inquiry-Based Learning, Honors, etc.)? If so, please describe.

⟨cur:sub:111H⟩

Math 111H College Algebra: Honors

The course has been offered only at Sylvania campus—Winter 2012 (12 students), Winter 2013 (22 students), Spring 2013 (15 students), and Fall 2013 (17 students). Ronda Lively was the instructor the first three terms, which allowed her to evolve her materials and activities. Ann Cary taught the Fall 2013 term, and has collaborated closely with Ronda Lively.

The honors course must cover the same material as the regular course. It is stressed that honors versions of a course should not be "harder", but different in the use of class time and activities/assignments. There should also be a component of Community and Environmental Responsibility, which is a PCC core outcome that is usually difficult to place in math courses. Instructor Lively regularly teaches MTH 111 and MTH 111H during the same term. The same exams were given in both courses. There were differences in the other evaluation criteria used in the courses. In the MTH 111 class, students submitted take home graded worksheets and participated in an in-class graded group activity. The evaluation of the students in the MTH 111H class included:

- a collaborative computer project involving math history and investigation of several applications of math
- a team quiz-grading activity where each group wrote a key and grading rubric, then applied it to two (fictional) students' quizzes
- a community tutoring project: over several weeks, each student found someone to tutor in math (friend, neighbor, family member, ...) and then wrote a paper on their experience

Since the overall student ability level was high, there was time in class to investigate other topics of interest related to college algebra. Each term there were several students that enrolled because of the time slot, not because they were strong in math. Encouragingly, the stronger students took the less prepared students under their wings and helped them to be successful.

ur:sub:socialJustic⟩

Social justice workgroup

A Math and Social Justice workgroup was formed by Ann Cary and Emiliano Vega in response to a national convention they attended. The group has collected and disseminated data sets and activities to participating math instructors and has gained interest and participants from other disciplines at PCC, as well as area high school math instructors and community activists in Portland. More importantly, the group has the focus of providing a forum on how to discuss potentially sensitive subjects in a classroom setting when using application problems and how to be more culturally and socially aware of individual students and classes. The information they gathered has improved the pool of activities and application problems available, improved the ability of instructors to work effectively with the broad demographic of students and co-workers, and also continues the college's focus on two Core Outcomes: Community and Environmental Responsibility and Cultural Awareness. For a sample of material from this workgroup, see Appendix C on page 81.

ther:sec:servicelearning⟩

Service learning

Service Learning has been a part of many math instructors' courses at PCC, but has been deepened through the Service Learning website which includes additional resources and syllabi submitted by participating Instructors at PCC. In addition, Service Learning will be added to some CCOGs evaluation criteria to encourage instructors to incorporate Service Learning in their math classes. Jeff Pettit participated as an observer in the Service Learning training cohort at Sylvania campus, connecting with instructors in other disciplines and gaining an understanding of how Service Learning is employed in other courses. This has led to new curriculum in his Statistics courses and upper-division courses where Service Learning was not originally employed.

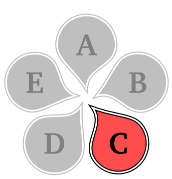
Developmental Education math study group

A new committee was formed by the SAC to address developmental math completion rates. The committee is researching the feasibility, cost and difficulty associated with implementing "pathways" beyond the current calculus focused MTH60–95 courses. The committee is considering options for employing career-based math course series and a statistics-based math course series.

ther:sec:placementreform⟩

Placement test reform group

A committee has been formed to address placement test reform. The group intends to better measure students' needs beyond the current math-skills COMPASS test. We hope to find a way to measure key traits and needs of students to connect student populations with the support needed to better guarantee success.



Are there any courses in the program that are offered as Dual Credit at area High Schools? If so, describe how the SAC develops and maintains relationships with the HS faculty in support of quality instruction. Please note any best practices you have found, or ideas about how to strengthen this interaction.

During the 2012/13 academic year, PCC dual credit was awarded for seven mathematics courses. Classes were offered at seven high schools and there were a total of twelve instructors certified to teach PCC dual credit mathematics classes. There were a total of 750 unduplicated students who enrolled in at least one PCC dual credit mathematics class and collectively those students earned 6032 mathematics credits through PCC. In Fall 2012, an ad hoc committee was formed in the mathematics SAC to investigate the status of our dual credit program. The formation of this committee was prompted, in part, by the discovery that several of the posted dual credit syllabi described courses that bore little resemblance to the course for which students were earning PCC credit. The committee decided that the root cause of this disconnect was a lack of robust support on our part. Three concrete actions were taken to address the disconnect:

- Each dual credit mathematics instructor was assigned a team of two support faculty from the mathematics departments at PCC. Each pair of support faculty visited their assigned instructor at that instructor's high school. These meetings were rather informal; the intent being to establish a concrete support team for each high school instructor.

- A two-day mandatory summer workshop was organized by the committee in conjunction with Beth Molenkamp, who at that time was the coordinator of PCC's dual credit program. At the workshop each dual credit instructor was tasked to complete a robust (and accurate) syllabus for each of their dual credit classes. The PCC faculty helped with this task and all of the dual credit instructors now have syllabi that truly reflect the nature of the course for which the students are earning PCC credit. The remainder of the workshop was spent sharing resources and pedagogical tactics used by various PCC faculty in the courses for which dual credit is also offered.
- A Google Drive site was created to share resources. Although the inspiration for this site was to give our dual credit faculty easy access to shared resources, the pooling of resources is obviously of great benefit for PCC faculty as well.

Does the SAC plan to develop any additional Dual Credit agreements with area high schools? If so please describe. If not, what does the SAC see as barriers to developing further dual credit agreements.

Students at Central Catholic High School will get their first opportunity to earn PCC mathematics dual credit during the 2013/14 academic year. This adoption was coordinated through the dual credit program; that is, the math SAC played no active role in the creation of this dual credit agreement.

There is concern in the mathematics SAC that the state's 40-40-20 initiative, and the accompanying bills aimed at encouraging high school students to earn college credits, might lead to a dramatic increase in the number of high schools offering dual credit for mathematics courses. The greatest challenge is that there are not that many high school mathematics instructors who meet PCC's qualifications to teach post-100 level mathematics courses. We are concerned that the day might come where we are pressured to lower those standards or, of even more concern, we are pressured to start awarding PCC dual credit for developmental mathematics courses (MTH 95 or below).

Addendum

As feared, we are now being asked to allow high school instructors who do not satisfy minimum qualifications to teach transfer level courses. As currently proposed, a high school instructor who does not meet minimum qualifications would be paired with an "instructor of record" who does meet the qualifications. There is also a possibility that after a time the high school instructor will be deemed to have "demonstrated competency" and will at that point be allowed to become the instructor of record based upon that criterion. We are concerned by this proposal on many levels.

The first is fundamental: this proposal undermines our established "minimum qualifications." While we realize that the pressure to make these changes originates from the State of Oregon and other outside parties, we need to be mindful that our accreditation is also at stake.

Additionally, there are fears that the concept will seep into the manner in which we staff classes on our own campuses; an alternative minimum qualification such as "demonstrated competency" cannot be exclusive to teachers in the high school classrooms.

Finally, if the concept takes off at the dual credit level, there are serious workload concerns for the faculty at PCC. The title of "instructor of record" comes with a serious amount of responsibility and accountability; authentic and ongoing involvement in these courses will require time from a faculty that is already stretched for time. We are presently being asked to revamp our entire DE curriculum (and are actively involved in that pursuit), and adding increased dual credit involvement to our list of duties will take away time from that agenda. Priorities need to be established. If the college chooses to pursue this change in dual credit policy we hope that the changes are instituted in a manageable and reputable way.

⟨cur:sec:other⟩

Identify and explain any other significant curricular changes that have been made since the last review.

MTH 20 moved to the Math SAC from the DE SAC

The MTH 20 curriculum was moved into the Math SAC from the DE SAC in Fall 2012, bringing all math curriculum under the same SAC. This move was meant to help create consistency in the CCOGs across the spectrum of math courses, as well as ensure that the MTH 20 curriculum is adequately preparing students for the next math course.

Sylvania Campus, which had a separate DE Math department altogether, transitioned its DE Math instructors into the Math Department in Fall 2013. A Math Integration Work Group was formed and charged with creating a seamless path for this transition. With the DE Math instructors in the Math SAC and the current college focus on success in pre-college math courses, the Math SAC's focus is on producing high-yield instructional practices, student success, and completion across the span of math courses offered by the college.

⟨cur:sub:mth20⟩

MTH 20 proposed credit change: 4- to 5-credit

MTH 20 (Basic Math) is a content-heavy course that covers topics such as fractions, decimals, signed number operations, geometry, proportions, and percents. It can be argued that the amount of material covered in MTH 20 is greater than in any of our other mathematics courses. At times, instructors are forced to either minimize required topics or occasionally cut them entirely due to time constraints. Because of this, for years many MTH 20 instructors have wanted to increase the number of credits for the course.

In October 2012, the SAC received a memo from the DOIs related to class sizes in which we were encouraged to consider converting MTH 20 from 4- to 5-credits; a subcommittee was formed by the SAC to investigate the benefits and consequences of increasing the number of credits. The committee looked into the financial aid impact on students, the impact on degree/certificate programs, and the impact on classroom availability. It also rewrote the CCOG to include study skills and increase the emphasis on reading graphs and geometry in the course.

In April 2013, the Mathematics SAC approved the conversion of MTH 20 from a 4-credit course to a 5-credit course. The conversion was then approved by the Curriculum Committee in November 2013. Unfortunately, the current DOIs denied the recommendation in late November 2013; since the original recommendation came to the Math SAC in 2012, the college leadership has changed at many levels, and with these changes have come changes in perspectives and goals for the math curriculum. The Math SAC is currently engaged in reevaluating and reorganizing pre-college level math at all levels; it is highly likely that the first course will require 5 credits for optimal student success.

MTH 60/65/70/95 curriculum alignment

The Math SAC recognized that students successfully completing MTH 65 often had difficulty passing MTH 95. The same was true for students transitioning between MTH 95 and MTH 111.

It was thought that creating more continuity between the MTH 60/65 series and MTH 95 would improve student success. To this end, during 2008/09, a committee was created to redesign the 60/65/95 curriculum with an eye toward carefully preparing students for the rigor of college level mathematics. While MTH 60, MTH 65 and MTH 95 had been traditionally taught as algebraically focused classes, the committee adjusted the curriculum to reflect the need for students to be able to understand mathematical information via the 'rule of four': algebraically, graphically, numerically and verbally. This was done to prepare students for the demands of college level math and to align with the best practices of our field. Importance was also placed on the use of a graphing calculator in MTH 95 to aid in this. These changes were also reflected in the intermediary course in the MTH 60/65/95 series: MTH 70.

As with all curricular changes, there continues to be a need for ensuring that all of the instructors receive the necessary communication and support in implementing these changes. This is especially true for the part-time instructors who are teaching a large proportion of the MTH 60–95 courses. However, with the nature of the part-time instructor's working conditions, this continues to be a challenge. The Math SAC requests more support from the administration to provide the necessary funding for part-time instructors to attend course-specific meetings similar to the one held for MTH 95 instructors at the Sylvania Campus prior to the Fall 2013 term.

Replaced MTH 111A/111B/111C with MTH 105 and MTH 111

In 1997 the Math SAC split MTH 111 into three courses in order to target different student populations: MTH 111A for liberal art students, MTH 111B for business and other non-technical majors, and MTH 111C for Science and Engineering. In our last Program Review, [15], it was mentioned that we eliminated MTH 111A and resurrected MTH 105 (see [15] page 19). Since then, MTH 111B and 111C have merged again into MTH 111.

The CCOGs for MTH 111B and MTH 111C had grown increasingly similar; since both were prerequisites for the same courses (MTH 243 and MTH 112), they needed to cover the same content. MTH 111B had a reputation for being an easier course and many instructors noticed that students in MTH 112 who had taken MTH 111B instead of MTH 111C were less prepared. Since the two courses no longer served different purposes, and were creating problems with student preparation for subsequent courses, we decided to unify MTH 111B and MTH 111C into a single college algebra course starting in Fall 2012: MTH 111.

⟨other:sec:mth243⟩

MTH 243 credit change: 4- to 5-credit

The Math SAC increased credits for MTH 243 (Statistics I) from 4-credits to 5-credits for several reasons, most of which were related to a need to increase the contact hours from four hours to five hours. In order to address the needs of future coursework in statistics as well as sufficient coverage of material for transfer to many universities, it was essential to add more material to the 4-credit MTH 243 course. Increasing the credit hours allowed for the necessary contact time to cover such material appropriately.

Five contact hours allows for more integration of technology into the classroom, since these technology skills are best learned with hands-on guidance from the instructor. Formerly, it was often difficult to have meaningful technology-oriented statistical classroom exercises due to the lack of contact time.

The change to five contact hours also gives sufficient time to fully engage the students with critical thinking exercises and quantitative and statistical literacy discussions.

⟨other:sec:amp⟩

Creation of two accelerated review courses (also referred to as the Accelerated Math Program, or AMP) MTH 07 and MTH 08

MTH 07: Accelerated Basic Math Review This course presents a review of basic math skills and provides the opportunity for guided practice. Topics include operations with whole numbers, fractions, decimals, proportions and percents.

MTH 08: Accelerated Introductory Algebra Review This course presents a brief review of basic algebra skills and provides the opportunity for guided practice. Topics include real number operations, manipulating linear expressions, solving linear equations, and graphing linear equations in two variables.

These two courses were designed to meet the needs of the following two student populations:

- students who have previously learned the material and are able to test into the next level of math as a result of a brief review;
- students who have difficulty with the materials and can work on a variety of the regular course material in advance of taking the regular course.

Both courses are offered for one week in-between terms and are 15 non-credit lab hours. They are taught with a combination of mini lectures and computer practice/instruction. At the completion of each course, students retake the COMPASS placement test. Each term a significant number of students taking these courses have placed into a MTH course above their previous COMPASS placement.

Sections have been offered at the Rock Creek, Southeast, and Cascade Campuses, with most offerings at the Cascade Campus, where the courses were initially conceived and implemented by math instructors Holli Adams and Michael Marciniak. Data from the sections taught at Cascade Campus since 2010 can be viewed in Appendix I on page 100.

Clarified CCOGs requirements and CCOG addendums

It was found that there were numerous discrepancies among different sections of the same course having different instructors regarding the material being presented. In an effort to ensure that students completing different sections of the same course had similar mathematical competencies, the SAC determined that communicating the requirements for a course needed to be made more concise. Also, since the curriculum had significantly changed, we wanted instructors who had previously taught the course to know about these changes. The CCOG for each course was intentionally written more clearly and now includes specific minimum requirements for testing and grading. In addition, each CCOG now has an addendum that clearly shows examples of what is expected in terms of content, mathematical notation and presentation as well as well-defined assessment strategies. This practice has now been adopted for most of our CCOGs.

Elimination of MTH 91 and MTH 92

MTH 91 and MTH 92 were created to address the issue of the high failure rate in MTH 95 by splitting up the content of MTH 95 into two terms. The course sequence was discontinued after data showed that students taking MTH 91 and 92 were not successful in the subsequent course, MTH 111; it was found that after taking these slower paced classes, the students were not prepared for the speed of the MTH 111 course.

Changes in MTH 251–254

The calculus series has been more strongly split into Calculus I/II and Calculus III/IV by requesting the publisher split the current text into two sections. This change altered the need for Maple in MTH 251 and MTH 252. Maple is an expensive graphing software package that students buy for one year but generally use only for Calculus IV. Attaching Maple to the new second half of the book solved the issue of students losing access to it if they took more than one year to complete the Calculus series.

cur:sub:studyskills⟩

Math study skills material development

Research has shown that students with strong study skills are more successful in their academic pursuits than their counterparts; however, many students entering developmental mathematics courses lack these skills. In an effort to help students build a stronger awareness of how a successful student studies, math SAC member Jessica Bernards from the Rock Creek Campus created a Math Study Skills program to be used in our developmental math courses. This program consists of seven topics all relating to study skills specific to mathematics: how learning math is different, resources available for help at PCC, time management, listening and note-taking skills, how to do homework, test taking strategies, and overcoming math and test anxiety.

Each lesson has three parts: a short video to be watched by students outside of class, a student worksheet to be completed in conjunction with the video, and an in-class discussion lead by the instructor. Additionally, each topic has quotes from successful students which help strengthen the ideas in each video. Many math instructors across all campuses piloted the program in the Spring 2013 and are continuing to use it this Fall 2013. For Winter 2014, fourteen DE math instructors have reported that they will be using it. The study skills website can be found at [3].

⟨cur:sec:111/112doc⟩

MTH 111/112 document project

In Winter 2010, Math SAC member Chris Hughes proposed that the SAC write its own MTH 111/112 textbook. This idea arose from a general frustration with commercially available textbooks for this sequence. Available books tend to fall on one end or another of a spectrum ranging from template-based and lacking in conceptual understanding to abstract and lacking in guidance for students. We seek something with better balance. Such a textbook could also be provided to students at a much lower cost than any commercial product.

Initially over 10 members of the Math SAC became involved, submitting ideas and small sections of what might someday become a textbook. As time passed, four SAC members (Chris Hughes, Alex Jordan, Ann Cary, and Steve Simonds) maintained serious interest in the project. Piecing together earlier work from the larger group, expanding on that work, and editing, these four produced a rough draft chapter representing about 10% of a final product. (Given that this draft would need editing, we estimate that it represents 5% of the work necessary for completion.)

At this point the four remaining editors put active work on hold until some level of release time can be secured that would enable completion in a timely manner. A completed textbook for the entire sequence could be drafted with three faculty taking one-third release time for two consecutive terms. An additional such term would provide for peripherals such as guided lecture notes, an online homework library, and LiveScribe videos. The progress to date can be found at [8].

Supplemental course packets

Textbooks that the Math SAC selects for courses often have gaps when compared to the CCOGs for that course. Supplemental course packets were created to fill in the gaps and are required for those specific classes. These include explanations of topics not covered in the textbook as well as example problems to fully cover a topic that might be lacking in the textbook examples. Supplemental course packets have been created for MTH 60, 65, 95, 111 and 112, and can be (freely) downloaded from the Math department's web site [17].

MTH 251 lab manual

Since the late 1990s, MTH 251 has been taught in a lecture/lab format. From that time through the late 2000s the materials used during the lab portion of the course were frequently modified. By 2009 the lab manual had devolved into a collection of random problems and there was simply no connection between one set of problems and the next; there also were limited central themes to any one set of problems.

In Summer 2009 faculty member Steve Simonds rewrote the lab manual from scratch. The problem sets were written in a deliberate way to help students develop deep understanding of key concepts covered in the course. The majority of the problems from the prior lab manual were then shuttled to the appendix as practice problems for outside of class. All of the practice problems were fully keyed so that the students could continue thinking about the ideas (and practicing the skills) covered in lab and then determine for themselves if they had come to reasonable conclusions.

MTH 105 course material flexibility

Each math course has traditionally used the same SAC approved textbook district-wide. The Math SAC broke from this tradition and voted to allow MTH 105 instructors to choose their own course material, provided it meets the approval of the MTH 105 CCOG committee. Unlike other math classes, MTH 105 is not a prerequisite for other math courses, and is a terminal math course for many of our students. Each term, the instructor selects three to five topics from a list of 17. This allows the instructors flexibility to teach material appropriate for the student population of each class.

ALC math courses

The ALC math courses are self-paced pre-college math courses[1]. They are designed for students to work independently at their own pace and allow them to focus on specific topics. Consequently, a wide range of students take these courses: students who are afraid to take a math class and want to get back into math slowly; students who failed a math class once or several times; students who feel that they placed too low on the placement test and just need a review; students who want to get through the material quickly; and international students who know the math but not the English terminology for it. At Sylvania, the majority of students who take ALC Math are students who have failed math classes, sometimes many times.

Historically, the ALC math courses have been offered at Sylvania Campus, housed by the Developmental Education SAC, and covered math content through MTH 65. Since Summer 2012, they have also been offered at Southeast Campus. Since Winter 2013, ALC is housed in the Math SAC and, since Fall 2013, it also includes MTH 95. For a more thorough look at these changes see Appendix B on page 79. Considerations are currently being made to find ways to have ALC Math at Cascade and Rock Creek. Students from these campuses are already using ALC Math at Sylvania and Southeast and are undergoing the hardship of travel just so they can take these courses.

Enrollments at Sylvania and Southeast both show that there is clearly a need for these courses. Research done by PCC's Institutional Effectiveness on data from five years at Sylvania shows that students who complete ALC Math successfully pass their math classes at a higher rate than before taking ALC Math (see Appendix J on page 101). It would therefore be well worth looking into using the ALC math classes as an early intervention when students fail math classes. At Sylvania, for instance, some full-time advisors have made themselves very familiar with the ALC math courses and suggest them to students early on. Others send students to the Math Coordinator for further advising regarding successfully completing math classes.

[1]The Alternative Learning Center (ALC) was an old name for the current Sylvania Student Learning Center.

⟨other:sec:mth84⟩
MTH 84: Introduction to LaTeX

In Spring 2010, Math SAC members Alex Jordan and Chris Hughes proposed a pilot course to teach the typesetting software LaTeX. The experimental, one-credit course was piloted for three consecutive terms (Fall 2010, Winter 2011, and Spring 2011) and then adopted by the SAC as MTH 84. The course was first run (as MTH 84) in Winter 2012, and has run each term since with one section per term. MTH 84 is a one-credit pass/no-pass course. Its modality has been DL, although the CCOG does not prevent a face-to-face version. The course serves students and faculty alike in many areas. LaTeX is a useful tool in math, the sciences, in graphic design, and in publishing; it can easily be used to typeset internal documents, such as Program Reviews.

MTH 76 Math SAC approval

The SAC approved the CCOG for a one-credit 'Introduction to GeoGebra' course. The course is planned to run as a pilot course in Spring 2014 and Summer 2014, with tentative approval to let it run as a permanent course Fall 2014. The audience for the course includes PCC students, PCC instructors who wish to use it as a teaching tool, and K–12 teachers who wish to use it as a teaching tool. The course was requested by high school teachers participating in the Dual Credit workshop in Summer 2013.

3:subset:alekspilot⟩
Pilot using ALEKS technology in two math courses during AY 2012/13

ALEKS technology requires students to complete each mathematics topic successfully, keeps track of student work time, provides instant feedback, routinely assesses students and requires them to revisit previously learned material. It allows students to study a variety of topics at a time and minimizes practice of mastered material. Two pilots of ALEKS in MTH 20 and MTH 112 were conducted.

MTH 20: Basic Mathematics ALEKS was incorporated into six online and six on-campus MTH 20 classes. Data was compared to the previous year's MTH 20 classes taught by the same two instructors, Diane Edwards and Marilyn Marshall. On average, courses using ALEKS had noticeably higher pass rates than non-ALEKS courses. For example, there was an 11% increase in pass rates in on-campus ALEKS classes in Fall 2012 compared to non-ALEKS Fall 2011 classes. Both on-campus and DL classes showed increased passing rates using ALEKS. In addition, a few students each term were able to complete two courses during one term, finishing Basic Mathematics early and then successfully completing MTH 60.

MTH 112: Elementary Functions ALEKS was incorporated into one Elementary Functions section and compared with two traditional sections, all taught by faculty member Tammy Louie. In this small sample, both the grade distribution and pass rates were similar. However the student retention rate in the ALEKS class was 17.3% higher than in the non-ALEKS classes.

In both pilots students were observed to enjoy using ALEKS and increase their study time while using ALEKS. More detailed data can be found in the Appendix H on page 98 concerning both pilot projects. These pilots of ALEKS had noticeable success with student perception and involvement. Further exploration of ALEKS technology should be pursued as a possible option to improving student success in mathematics courses.

MTH 112 formula sheet

The SAC approved a standardized "formula sheet" for use in MTH 112. Math SAC member Wendy Fresh revised and submitted a formula sheet edited from one provided by SAC member Pete Haberman. The page was added to the course CCOGs to help guide instructors and clarify evaluation expectations.

MTH 212 proficiency exam

With SAC approval, the MTH 211–213 instructors added a basic skills proficiency exam to MTH 212 that must be passed with no less than a 90% in order to pass the course. MTH 212 is the second of a three part series of courses for students preparing to enter a teacher education field. The proficiency exam covers basic operations on integers, fractions, decimals, and percents. Although there is a MTH 95 prerequisite for the MTH 211–213 series, many of the students do not remember these basic operations. Since these are topics covered in MTH 212, it was felt that holding the students responsible for the basic skills would help them grasp the concepts with more success. This approach has been adopted by several of the Oregon community colleges and four-year universities that offer the MTH 211–213 sequence.

Casio Classpad

The SAC approved of the Casio Classpad as an additional accepted graphing calculator in MTH 95 and Lower Division Transfer courses. In addition, the CCOG for MTH 93, the one-credit graphing calculator class, was revised to reflect topics specific to the Casio Classpad. Faculty members Tammy Louie and Alex Jordan created a PCC-specific user guide for the Classpad, which is available for download (along with earlier PCC calculator manuals) at the math department web site [17].

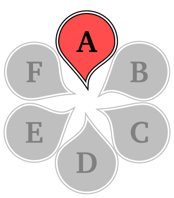
Piloting of DE courses geared to a specific subset of CTE students

In 2009, Choul Wou, a Perkins advisor, asked Michele Marden collaborate with her to create a reference document to support CTE students in the Building Inspection, Interior Design, Architecture, and Drafting programs. There was a particular need to bridge from MTH 65 coursework to ARCH 122. Michele observed an ARCH 122 section and a document was created. Soon after, Michele was approved to teach two sections of MTH 60 and one section of MTH 65 reserved for CTE students in the programs stated above. The course focus was limited by the requirements of the CCOGs, but whenever possible, material was geared to support the mathematical needs for these programs. This experience lead to the awareness that the reference document needed significant revision; however, due to the development of CTE-focused courses, the reference document was not updated. The specialized courses were discontinued due to lack of enrollment.

4

Needs of Students and the Community

> *Everyone can rise above their circumstances and achieve success if they are dedicated to and passionate about what they do.*
>
> Nelson Mandela



How is instruction informed by student demographics?

In order to answer this question, we decided that we needed demographic categories beyond the normal categories that are provided by the college. We decided to use age, sex, gender, race, creed, sexual orientation, learning ability, educational background, and socio-economic status. Our instruction is informed by these student demographics in a variety of ways.

definitiondiversity⟩

Social justice (addresses socio-economic status, race, gender)

The Math SAC has a Social Justice Workgroup that was formed in 2012 (detailed on page 32). Their objectives are to explore and discuss issues relating to diversity within the mathematics classroom as well as to create projects, activities, and other course content related to issues surrounding social and environmental justice.

For example, in MTH 111 topics include: a fine in Yonkers, NY related to segregation; racial profiling in traffic stops; gentrification in Portland; and the Deepwater Horizon Oil Spill. Many of these projects were adapted to fit various mathematical levels from MTH 20 to MTH 252. Problems were also generated for MTH 243, using gun violence and international prison data. Some samples of their work are given in Appendix C on page 81.

Individual faculty awareness

A recent survey of MTH faculty asked if they had ever modified instruction to meet our diversity goals. The survey used our previous program review's diversity statement (Goal 3 on page 4 of [15]) as a point of reference:

> *We will enrich the educational experience by committing to the development of diversity in our student body, faculty and staff.*

Here are some highlights and themes from the survey responses. One faculty member reports

> *I have been learning about Complex Instruction, which has helped me attend to status in my classroom. Who has high status and who has low status? Complex Instruction (CI) provides opportunities to highlight the diversity of ways to be smart in a mathematics classroom... so that all students can participate equally in the classroom activity.*

Another SAC member is dedicated to educating herself in the classroom, and reports

> *If there is a cultural barrier, my awareness and appreciation of diversity enables me to want to learn about the unfamiliar, and educate about my own. My immense experience working in diverse settings with unique individuals constantly increases my awareness of what I can do to make someone feel comfortable and what I need to do to accept individuality without enforcing conformity.*

Many of our faculty commented on the use of group work as a way to expose students to diverse ideas and culture. They also indicated that they tried to be culturally aware when writing application problems by choosing different names, genders and roles for the characters in their problems. The 'Rule of Four' (functions and relations should be presented numerically, graphically, verbally and symbolically) is incorporated into most of our CCOGs. The rule of four recognizes and highlights the different ways people prefer to learn mathematics.

Educational cost (addresses socio-economic condition)

Our SAC is aware of the cost of course materials and considers the socio-economic condition of our student population when selecting texts.

The SAC has a long-standing policy to require the same textbook for all sections of a course. Since PCC has such a large student body and we offer many math classes, this policy has enabled the math SAC to negotiate wholesale prices of textbooks (particularly custom editions) with publishers. This saves students money when taking a sequence course (for example MTH 60/65) and allows students to sell back their book to the bookstore.

Publishers can create a custom edition from an existing textbook by removing material (e.g., chapters) or adding material (e.g., supplemental materials); the publisher labels the textbook 'A Custom Edition for Portland Community College', and thus restricts its resale value, as it can only be used at PCC; this benefits the publisher and enables them to reduce the price to PCC.

Math SAC subcommittees have successfully implemented this idea with the textbooks for almost all of the mathematics classes taught at PCC: MTH 20, the MTH 60/61/62/63/65 sequences, MTH 95, MTH 111, MTH 112, MTH 105, the MTH 243/244 sequence, and the MTH 251/252/253/254 sequence.

In addition to using custom editions uniformly across the district, we have a group that is investigating an in-house Pre-Calculus text to reduce dependency on publishers. The group is inactive at this point because they have been unable to secure adequate release time; for more information, see page 38 and [8].

We actively pursue free and open source products such as WeBWorK—the fully accessible online homework system (see page 28). This meets our goal of providing low cost curricular materials and also supports student access. The University of Oregon has generously hosted several WeBWorK courses for PCC over the past few years. Disability Services has provided strong support for WeBWorK, and we were able to procure our own WeBWorK server at PCC in the Fall of 2013.

Educational background

We have several projects and classes in place to address our students' different educational backgrounds (page 35 details information on some of our initiatives).

The Study Skills program (first discussed on page 38) was created to address the different educational backgrounds of our students, particularly those students who have underdeveloped study skills. This program consists of seven topics all relating to study skills specific to mathematics: how learning math is different, resources available for help at PCC, time management, listening and note-taking skills, why and how to do homework, test taking strategies, and how to overcome math and test anxiety. Each lesson is broken up into three parts: a short video to be watched by students outside of class, a student worksheet to be completed in conjunction with the video, and an in-class discussion lead by the instructor.

MTH 07/08 (also known as AMP) described on page 36 addresses differences in educational backgrounds. It allows students who have previous exposure to the material to attempt to move to a higher level class (see Appendix I on page 100).

Even with the above mentioned programs, we feel that the college could do a lot more when it comes to placing students into classes appropriately and orienting them to the demands of college. We have formed the Placement Test Reform Group described on page 33 and would like to see more wrap-around services for students in developmental classes; these services would ideally begin before the students steps into the classroom. We suggest the adoption of a placement test that measures study skills, motivation and academic preparedness.

R We recommend that students who are not academically prepared be required to take a study skills course. We would like to see more math-specific advisors and have enough advisors so that it is feasible for a student to see an advisor every term. We would also like to see the tutoring center open during the first week of the term. In our experience, students who are behind during the first week have a hard time catching up.

⟨needs:sec:trends⟩

Data trends

Despite the above mentioned efforts to have instruction informed by our student demographics, we have still found that there is an achievement gap when it comes to minority and underrepresented populations. We have displayed data for five years in Appendix F on page 90; see Tables F.1 to F.10. PCC has undergone vast enrollment changes over the last five years since our previous program review; here are the trends that we observed for this time period:

- The percentage of both White and Asian students increases as students progress through the sequence of MTH classes. There appears to be a modest increase in diversity levels in MTH 251–254 over the last 5 years, but this may be due to more students identifying as Multiracial.
- There is a slight increase in diversity since AY 2008 (the percentage of students who identify as white has decreased in most of our courses).
- There is a shockingly high number of students aged 19 or less who place into MTH 20. Since many of these students should have been exposed to the material from MTH 20 recently, we need to further examine both the placement exam and our communication with high schools. For example, are high schools allowing students to use calculators too freely? Are students who are otherwise proficient at algebra placing low due to not understanding fractions? This is something that needs further investigation. If we could decrease the number of young students placing into MTH 20, we might be able to shorten their path to a degree.

- The percentage of students aged 50+ decreases through the DE sequence. We suggest intentionally creating support systems for students aged 50+, particularly in MTH 60. These students likely have been out of the educational system the longest, so they face different challenges than their younger peers.

- There is a large decrease in the percentage of black students from MTH 20 to MTH 60. Not only is there a percentage decrease, there is also a decrease in the total number of black students in MTH 60 compared to MTH 20. This indicates that MTH 20 is likely a significant barrier to some minority students or that minority students place into MTH 20 at a disproportionately high rate. Although this is relatively consistent with national data, we would like the administration to continue to support programs like Passages, Project Independence, ROOTS, and other interventions to increase success rates of minority students. In addition, a more diverse faculty might help with retention and passing rates; *the extent to which [the instructor's attributes] differ from the physical, cultural, and intellectual backgrounds of [his/her] students will have a profound effect on the interactions in [the] classroom.* [1]

- The pass rates for black students are noticeably lower each year and in each course.

R We recommend intentionally creating support systems for black students studying mathematics.

- Females consistently pass MTH 20/60/65/95 at higher rates than males, but a smaller proportion of females enter MTH 112 and the calculus sequence, an important gateway to engineering careers.

R We suggest identifying ways to encourage female students to continue on to MTH 112 and related STEM careers.

Other options that support students in mathematics may not come from the Math SAC itself. For example, the Math Club at Cascade serves as a good opportunity for females who enjoy mathematics to connect with and support each other. However, such clubs are largely student led and participation can vary greatly from year to year and term to term.

- While female students are underrepresented in MTH 112, and MTH 251–254 as noted above, it does appear that many female students take a statistics route (MTH 243, 244) instead of a calculus route (MTH 251 and above). MTH 243 and 244 lead toward many important career paths and is more directly relevant to students interested in these paths. Many female students are by-passing the calculus route and entering 200 level mathematics directly instead. The Math SAC recently voted to change the prerequisite for MTH 243, which could open and shorten this pathway for many more students (male and female alike) in years to come.

- The percentage of men passing MTH 20 is lower than that of female students. In addition, it appears that the percentage of males enrolling in MTH 20 is increasing (perhaps due to the economic downturn). This is consistent with data at the secondary level. Since MTH 20 is pre-algebra, some of this may be due to prior educational experiences and students attitudes of their ability.

Have there been any notable changes in instruction due to changes in demographics since the last review?

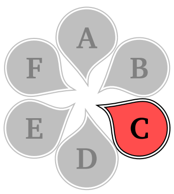
At Cascade, the number of MWF classes has increased since the last program review. This was done in response to the increased demand for MTH 61/62/63. The increase in these classes

[1] http://www.crlt.umich.edu/gsis/p3_2

seemed to coincide with a large influx of under prepared students who returned to school after the recession.

Classes that run three days a week are designed to help students who struggle with the demands of a two-day-a-week class. While there isn't a notable difference in success rates between MWF classes and those that meet less frequently, it is felt that the shorter class time is better for students cognitively, their attention span is held longer and students engage in more frequent practice of mathematics.

We would like to see more MWF or even MTWTh classes to provide more flexible scheduling options for the benefit of students. We suggest that one way to accomplish this is to turn more MW classes into MWF classes.



Describe current and projected demand and enrollment patterns. Include discussion of any impact this will have on the program/discipline.
Demand and enrollment patterns have been divided into two categories: Developmental and Lower Division Transfer Mathematics.

Developmental mathematics

Referring to Figure 4.1, we see that enrollment in pre-college courses increased from AY2008 to AY2011 by 46%; there was a slight decrease (5%) in enrollment from AY2011 to AY2012.

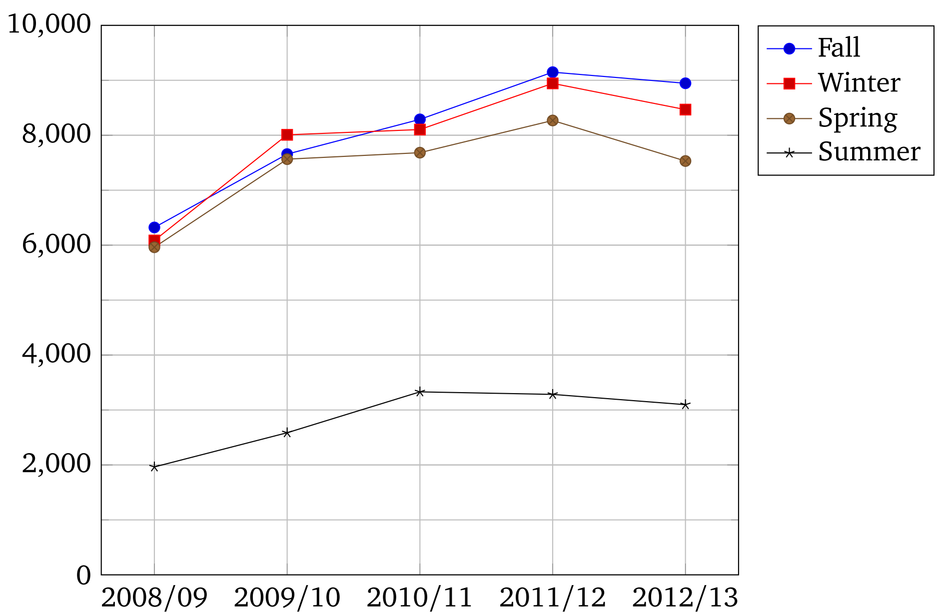


FIGURE 4.1: Enrollment in Developmental MTH by Term

rollmentDevelopTerm⟩

The counterpart to Figure 4.1 *by campus* is given in Table 4.1 (see also Figure K.2 in Appendix K on page 102). Enrollment in Developmental mathematics courses increased most at CA and SEC; from AY 2011 to AY 2012, enrollment in Developmental mathematics courses decreased at all campuses except SEC. In many cases, sections that we would have liked to offer encountered scheduling difficulties in 2011/12 due to a lack in facility space—this is discussed further in Section E on page 67.

Lower division transfer mathematics

Enrollment in Lower Division Collegiate (LDC) courses increased over the 5 year period of this Program Review, but at a decreasing rate (i.e. the graph is concave down). This means that the

TABLE 4.1: Developmental Mathematics Enrollment by Campus

eeds:tab:enrollmentDevelp⟩

	2008/09	2009/10	2010/11	2011/12	2012/13	% change 2008/09–2011/12	% change 2011/12–2012/13	%change 2008/09–2012/13
SY	6764	8155	8847	9682	8840	43.14%	−8.70%	30.70%
CA	4159	5745	5963	6585	5887	58.33%	−10.60%	41.55%
RC	6625	8033	8192	8669	8454	30.85%	−2.48%	27.60%
ELC	2785	3883	4404	4709	4860	69.08%	3.21%	74.50%

overall number of students increased each year, but the rate of increase each year was smaller and smaller. The increase in LDC enrollment could possibly be due to students looking toward PCC as a less expensive alternative to our 4 year counterparts. It could also be a "bubble" of students who came to us during the economic downturn working their way up through our math sequence. There was a 36% enrollment increase from Summer 2011 to Summer 2012. We suspect this is due to changes in financial aid eligibility. Prior to this change, students were awarded financial aid for fall, winter, and spring, and needed a separate application for summer term. After the change in eligibility, students were awarded aid for an entire academic year, commencing with Summer 2012. This increase in enrollment is shown in Figure 4.2 with its per-campus counterpart in Figure K.4 on page 104.

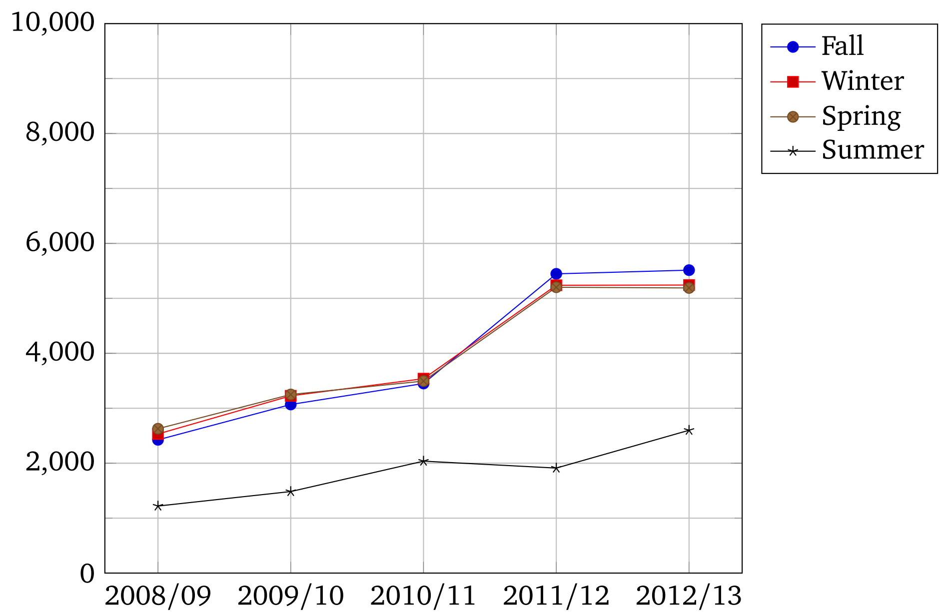


FIGURE 4.2: Enrollment in LDC, College Wide, by term

eds:fig:enrollmentLDCTerm⟩

In particular, five-year enrollment increases in LDC are large at all campuses, as shown in Table 4.2. We expect the increase would be larger at SY if not for lack of facilities space. A lot of this growth is in the Calculus sequence.

Totals (DE and LDC combined)

Overall enrollment increased from AY2008 to AY2011 by 63%. This significant increase reflects the downturn of the economy five years ago. Many students returned to school because their jobs had ceased to exist or they hoped to better their chances of employment with a degree or certificate. There was a slight decrease (2%) in overall enrollment from AY2011 to AY 2012,

TABLE 4.2: LDC enrollment by campus

LDCenrollmentCampus⟩

	2008/09	2009/10	2010/11	2011/12	2012/13	% Increase 2008/09–2012/13
SY	4096	4883	5405	7173	7297	78.15%
CA	1497	2036	2042	3155	3435	129.46%
RC	2920	3625	4451	6262	6424	120.00%
ELC	291	484	621	1207	1387	376.63%

which is mainly due to a decrease in enrollment in developmental mathematics courses (see Figure K.5 on page 104).

Each campus experienced slightly different enrollment trends. Enrollment increases at CA and SEC from 2008–2011 were significantly higher than other campuses. SEC experienced a 92.33% increase in enrollment over the 4 year period and a continued enrollment increase from AY2011 to AY2012. RC experienced the lowest % drop (of campuses whose enrollment dropped) in enrollment from AY2011 to AY2012 (see Table 4.3 and Figure K.6 on page 105).

TABLE 4.3: Enrollment by campus and year

nrollmentcampusyear⟩

	2008/09	2009/10	2010/11	2011/12	2012/13	% change 2008/09–2011/12	% change 2011/12–2012/13
SY	10860	13038	14252	16855	16137	55.20%	−4.26%
CA	5656	7781	8005	9740	9322	72.21%	−4.29%
RC	9545	11658	12643	14931	14878	56.43%	−0.35%
ELC	3076	4367	5025	5916	6247	92.33%	5.59%

Furthermore, while enrollment (number of students) has increased over a five-year period by 60%, the number of sections offered has not kept pace (only increased by 40%) as detailed in Table 4.4; we are concerned that the average class size is increasing.

TABLE 4.4: Average class sizes (district wide)

ab:averageclasssize⟩

Year	Average Class Sizes
AY2008	24.87
AY2009	27.64
AY2010	27.36
AY2011	28.7
AY2012	28.4

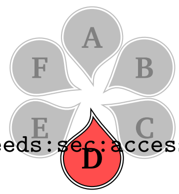
While the average class size is somewhat small, there are classes that are much larger than the average. There is little consistency between campuses when it comes to class size, which seems to be determined almost entirely by room choice; previous attempts at setting SAC-wide class sizes were not accepted by the Deans of Instruction. We have resubmitted our report and are awaiting a response—the report can be viewed in full in Appendix L on page 107.

eeds:page:classsize⟩

The ratio of Pre-College to LDC enrollment has decreased (see Figure K.7 on page 105). We are unsure of the reason for the decline in this ratio, but we are concerned that our completion rates have decreased, especially in developmental mathematics. Our overall success rates have decreased with increased enrollment. This could partially be explained by the large number of under prepared students who entered the institution as a result of the economic recession—see Table K.1 on page 102.

Of concern is that while enrollment has increased from 2008 to 2013, hiring of full-time faculty has not kept pace. In addition, the demands on full-time faculty (subcommittee work, LAS, CIC, etc.) have increased. However, if the economy continues to improve, it is expected that enrollment will level off or slightly decline for a short period of time.

Since Governor Kitzhaber's proposal for the state of Oregon to have 40% of adults earn a bachelors or higher degree, 40% with an Associates, and 20% with a high school or equivalent degree there is concern about how we will handle enrollment demands as policies to meet these goals are implemented. In addition, the state mandate that students graduate with 9 college credits on their transcript means additional demands on faculty to coordinate dual credit programs, middle college and other programs designed to give high school students college credit. Classroom space, faculty workload, class size and student preparedness are all major concerns.



⟨needs:sec:access⟩

What strategies are used within the program/discipline to facilitate access and diversity?

The MTH SAC uses several strategies to facilitate access; for example, we offer all-day classes, hybrid classes, evening classes, distance learning classes and some weekend classes. This allows students who aren't available for traditional weekday classes to access the mathematics program at PCC. We offer many classes (MTH 60, 65, 95, 111, and 243) in either a weekend hybrid format or all day Saturday class.

We facilitate access to students who learn differently or would like a different learning structure by offering Alternative Learning Center (ALC) self-paced math classes (see Appendix B on page 79).

We offer MTH 07/08 to returning students who are not happy with their placement exam scores. This one-week intensive math review program is designed to help students place into higher level MTH courses which saves students time and money. It also facilitates quicker access to a degree if students are able to place higher and shorten their time in the developmental sequence. Even if students do not place into a higher course, it seems to help students fill in gaps in their knowledge.

In Fall 2012 the MTH SAC completed a large project centered around accessibility of online content for students with disabilities. During Fall 2011, Mathematics faculty members had realized that our subject matter presented unique complications not faced by other disciplines. Chris Hughes and Scot Leavit were granted release time to investigate accessibility as it applies to mathematics. We are grateful for the support and the collaborative nature of the project. The page:disabilityservices⟩? full text of the report, including recommendations made to the SAC, can be found at [9] and a summary is given in Appendix M on page 127.

As a result of the project, faculty awareness of accessibility has increased significantly. It has also lead to discussions surrounding adoption of commercial online homework management systems (see details of the ALEKS pilot in Appendix H on page 98) and an increased acceptance of WeBWorK, which is currently the only fully accessible online homework management system. There has been considerable work done to develop problem libraries for Math 60/65 in WeBWorK that match our curriculum—the details are discussed in page 28.

Most faculty feel that we need further education on how to facilitate access and diversity in mathematics classes. In particular we would like further discussion and training on the various types of accessibility challenges that we face, including physical accessibility, learning accessibility, cultural and social accessibility, and access to education.

FIX

Physical accessibility

Many of our instructors have some experience serving students that have either a visual or hearing disability. We appreciate the continued relationship and communication with the disabilities services on this issue. Most of our issues of physical accessibility within the classroom are handled well by disability services.

However, it is worth noting that on a SAC level, we face issues of accessibility in the facilities we use for our meeting space. As one of the largest SACs in the district, we often have trouble finding room space that is large enough to accommodate our group and is accessible at the front of the room. It is our understanding that the bond renovations will mostly address this issue.

Learning accessibility

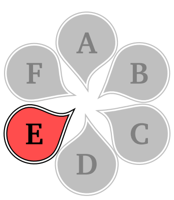
We would like continued training on how to provide equally effective instruction for students with learning disabilities. We think that quarterly workshops (perhaps offered through disability services) could help us to be proactive and learn about methods that are specific to the teaching of mathematics.

Cultural and social accessibility

Given our observations on page 44, we realize that we need further education, research, and training in strategies to provide equally effective instruction to students of all cultures, genders, and other facets (see our definition of diversity on page 42).

Access to education for historically underrepresented populations

We need more support to facilitate topics of social justice in a mathematics classroom. We feel that students should know how to use mathematics as a tool for social change; forming our Social Justice Workgroup (page 32) is a step in the right direction. We are currently working on disseminating the activities and the discussions from this group and sharing them with the larger SAC.



Describe the methods used to ensure faculty are working with Disability Services to implement approved academic accommodations?

During the 2012/2013 academic year, the Office of Students with Disabilities went to a paperless notification system for all academic accommodation notifications. Initially, this change to email notifications led to several problems. One problem arose from the fact that not all faculty, especially part-time faculty, are as diligent in monitoring their PCC email as is necessary to make an email notification system work efficiently. More problematically, there were glitches in PCC's email system that led to many of the notifications being misdirected to quarantine or spam folders. As a result, there were students who had approved accommodations of which their instructors were unaware.

To help remedy this situation, the mathematics department chairs contacted the Office of Students with Disabilities and asked if there were some way that a back-up system could be created to catch notifications that have fallen through the cracks. In response, Kaela Parks (director of the OSD) has created a spaces page that lists every course in which there is at least one student enrolled who has approved accommodations. Kaela had the foresight to create a page that updates in real time. For example, if a student has made an accommodated testing request but the instructor has not yet completed the accommodated testing form, that class is flagged in red and the relevant department chair can contact the faculty member to let them know about the situation.

There had been growing concern among several faculty members about the nature of many accommodations including: calculator usage that contradicts assessment criteria stated in CCOGs, and those that require flexibility in due dates (which can lead to the withholding of keys for other students). Kaela Parks came to a mathematics SAC meeting to discuss these concerns, at which time she reiterated the concept of reasonable accommodations—that accommodations for student disabilities are not meant to compromise student learning outcomes. Kaela also said that faculty can always contact her or the student's assigned OSD counselor to discuss specific accommodations of concern.

Has feedback from students, community groups, transfer institutions, business, industry or government been used to make curriculum or instructional changes (if this has not been addressed elsewhere in this document)? If so, describe.

Mathematics support for Career Technical Education (CTE) has evolved over the years. Currently CTE students take mainstream math courses to fulfill their math requirement; this concerns PCC, other academic institutions, and officials in the State of Oregon as it is not obvious what benefit can be gained by taking courses meant for students destined to take Calculus classes. Current issues involve: should PCC create math courses focused on CTE students only, how would students transfer between these courses and the general mathematics curriculum. The following is taken from [20].

> *The research we did revealed a major gap in the alignment between the mathematics courses taught in the mathematics departments in our community colleges and the mathematics actually needed to be successful in the applied programs students are taking.*

Research to develop a CTE-MTH alternative track was underway but has stopped and be repurposed to fit our changing vision of DE math pathways. The hope is that a STEM-focused pathway will provide more meaningful content for all students, regardless of their goals. If we are not successful in our attempt to create the pathways developed during the NSF-IUSE initiative, we believe that creation of an independent pathway targeted specifically to CTE-MTH students should be pursued. We believe that such a pathway would increase completion rates for CTE students. A CTE-MTH pathway would also address concerns from CTE programs that our classes do not properly prepare their students for the mathematics that is used in their programs.

Finally, the MTH 243 curriculum credit hour change detailed on page 36 was initiated by student feedback.

5

Faculty: reflect on the composition, qualifications and development of the faculty

I want to tell you what went through my head as I saw the D on my 3rd exam in Calc II: "f#$king a&$hole!" That D changed my life. The feeling of failure, not from my incompetence but rather my laziness. I want to let you know that every single success in my life now is due in part to your teachings. I can't thank you enough & I hope that if for nothing else, you have made a great influence on me.

PCC Mathematics Student, December 2013

A

C B

Provide information on each of the following:
Quantity and quality of the faculty needed to meet the needs of the program or discipline.

The total number of full-time faculty at all campuses between 2011 and 2013 varied between 36 to 41 and the part-time faculty varied between 143 to 158 on any given term, not including Summer. The percent of *all* courses (pre-college and college level) taught by full-time instructors during this time period varied from a low of 24.9% at Cascade to a high of 41% at Sylvania (see Table 5.1).

From the academic year 2008/09 to 2012/13 there was a significant increase in the number of students taking math courses at all campuses as shown Table 5.2.

TABLE 5.1: Percentage of courses taught by full-time faculty from 2011–2013

⟨reflect:tab:enrollment⟩

es⟩

SY	RC	ELC	CA
41%	28.2%	26%	24.9%

TABLE 5.2: Enrollment Difference from AY 08/09 to AY 12/13

Campus	Enrollment Difference	% increase
SY	5277	48.59%
CA	3666	64.82%
RC	5333	55.87%
ELC	3171	103.09%

Table 5.3 summarizes the breakdown of courses taught by full-time and part-time faculty from Summer 2011–Spring 2013; breakdowns by *term* are given in Appendix N on page 129.

Table 5.3: Summary of sections taught (by campus) from Summer 2011–Spring 2013

⟨app:tab:analysisPTFT⟩

		Below 100 level	%	Above 100 level	%	Total	%
Cascade	Full-Time	88	21 %	62	36 %	150	25 %
	Part-Time	341	79 %	112	64 %	453	75 %
	Total	429		174		603	
Sylvania	Full-Time	132	21 %	171	43 %	303	29 %
	Part-Time	511	79 %	228	57 %	739	71 %
	Total	643		399		1,042	
Rock Creek	Full-Time	80	12 %	143	38 %	223	22 %
	Part-Time	561	88 %	231	62 %	792	78 %
	Total	641		374		1,015	
South East	Full-Time	65	23 %	26	42 %	91	26 %
	Part-Time	223	77 %	36	58 %	259	74 %
	Total	288		62		350	

In reference to "quality of the faculty needed to meet the needs of the discipline," it is insufficient to look at degree or experience qualifications alone. Even a short list of what we expect from our mathematics faculty would include, but not be limited to that she/he

- possess an understanding of effective mathematics teaching methodologies and strategies, and be able to adjust in response to student needs;
- teach the course content as outlined in CCOGs and with the appropriate mathematical rigor;
- show genuine commitment to students' success;
- identify problems when students encounter difficulties learning;
- demonstrate an ongoing intellectual curiosity about the relationship between teaching and learning;
- manage classroom learning environments and effectively handle student discipline problems;
- demonstrate technological literacy needed in the teaching of mathematics;
- participate in professional organizations;
- develop, evaluate and revise the mathematics curricula;
- serve and contribute to the PCC community as a whole through campus and district wide committees and activities.

In addition, with the enormous enrollment increases of the past several years, there are more students than ever needing both remediation in mathematics and guidance in general about what it takes to be a successful college student.

Addressing this section heading directly, the 'quantity' of full-time faculty needed to achieve the 'quality' goals noted above is currently inadequate. It is primarily the full-time faculty that has the time, resources and institutional support to fully realize the expectations noted above. Part-time faculty are dedicated, but the expectations are different given the many of the challenges they face (discussed below). To increase the probability that a student moves successfully through our mathematics courses without sacrificing quality, having a larger full-time faculty presence than currently exists is needed.

In recognizing the need for more full-time faculty, we do not want to downplay the skills and talents of our part-time faculty. We have approximately 150 part-time instructors that serve our students each term, many of whom have teaching experience from other colleges and universities; they bring additional experiences from industry, other sciences, high school and middle school education, and so much more. Since they teach such a high percentage of our classes, their success is crucial to our students' success.

Given the importance of part-time faculty, efforts needs to be made to minimize the many challenges that are unique to them. Many of these challenges are created by the fact that part-timers frequently work on more than one campus or have a second (or third) job beyond their work for PCC. Many of the problems are created by the institution itself. The challenges include limited office space, limited access to office computers and other resources, limited opportunities to attend meetings, limited opportunities to engage in professional development activities, limited opportunities for peer-to-peer discourse.

R The college should create a task force to find ways to minimize the challenges faced by part-time faculty. Given the heavy reliance on part-time faculty for staffing our courses, there is little chance that we can institutionalize significant changes in our DE courses without an empowered part-time work force.

R The college should allow mathematics departments, at the discretion of each campus' faculty, to hire full-time faculty who meet the approved instructor qualifications for teaching at the pre-100 level but not the approved instructor qualifications for teaching at the post-100 level. A large majority of our courses are at the DE level, and the needs of students enrolled in those courses are frequently different than the needs of students enrolled in undergraduate level courses. Having a robust assortment of full-time faculty educational experience can only help in our pursuit of increased student success and completion.

Extent of faculty turnover and changes anticipated in the next five years.

Since 2011, ten full-time instructors have been hired and seven full-time instructors have left campuses across the district (this includes full-time temporary positions). Of the seven full-time instructors who left, five retired, one left to pursue other job opportunities, and one returned to another teaching job after her temporary full-time position terminated. Three of the retirements occurred at Sylvania and one each at Rock Creek and Cascade. In addition to those that left the college, four full-time instructors transferred from cone campus to another. Given no unexpected events, we anticipate that these demographics will roughly be repeated over the next five years.

Since 2011, 53 part-time instructors have been hired and 35 part-time instructors have left campuses across the district. Of the three campuses, Rock Creek has the most part-time faculty turnover, followed by Cascade and Sylvania. Reasons for leaving varied, but at least eight of the part-time instructors who left campuses simply moved to another campus in the district (see Appendix O on page 132).

Extent of the reliance upon part-time faculty and how they compare with full-time faculty in terms of educational and experiential backgrounds.

Across the district, the mathematics departments rely heavily upon part-time faculty to teach the majority of the math classes offered. Between 2011 and 2013, 75.1% of the classes at Cascade were taught by part-time instructors, 71.8% at Rock Creek, 72.7% at Southeast, and 59% at Sylvania. This reliance on part-time faculty to teach classes has been a challenge to the departments in a number of ways:

- the turnover of part-time faculty is higher and thus there is a need to orient new employees more frequently and provide mentoring and guidance to them as well;
- many part-time faculty are on campus only to teach their courses, and thus often do not attend meetings and keep up with current SAC discussions on curriculum.

For these reasons, classes have a higher probability to be taught with less consistency than the mathematics SAC would like. Increasing the number of full-time faculty (and thus decreasing the dependence on part-time faculty) would mitigate much of this inconsistency; complete details are given in Appendix N on page 129.

Part-time faculty educational backgrounds vary much more than the full-time faculty backgrounds. Full-time instructors have master's or doctorate degrees in mathematics or related fields with extensive math graduate credits. About a quarter of the part-time instructors have bachelor's degrees and the rest have either a master's or doctorate degree. The part-time instructors come from a variety of employment backgrounds and have different reasons for working part-time. They may be high school instructors (active or retired), may come from a household in which only one member is working full time while the other teaches part time, may be recently graduated MS or MAT students seeking full time employment, may be working full time elsewhere in a non-educational field, or may be retired from a non-educational field (see Appendix O on page 132).

How the faculty composition reflects the diversity and cultural competency goals of the institution.

The mathematics SAC is deeply committed to fostering an inclusive campus climate at each location that respects all individuals regardless of race, color, religion, ethnicity, use of native language, national origin, sex, marital status, height/weight ratio, disability, veteran status, age, or sexual orientation. Many of these human characteristics noted above are not measurable nor necessarily discernible. However, PCC does gather data on gender and race/ethnicity, as detailed in Table 5.4 (see also the extensive demographic data displayed in Appendix F on page 90).

Table 5.4: Racial/Ethnic Make-up of PCC Faculty and Students

t:tab:racialethnicmakeup⟩

	PT Faculty	FT Faculty	Students
Male	54.1%	53.2%	55%
Female	45.9%	47%	45%
Asian /Pacific Islander	7.7%	6.4%	8%
Black or African American	1.1%	0.0%	6%
Hispanic/Latino	2.2%	4.3%	11%
Multiracial	1.1%	0.0%	3%
Native American	0.0%	0.0%	1%
Unknown/International	12.2%	4.3%	3%
Caucasian	75.7%	85.1%	68%

Our SAC will continue to strive toward keeping our faculty body ethnically diverse and culturally competent, but it is an area where improvement is needed. In terms of hiring, there is a shortage of minorities in the Science, Technology, Engineering and Mathematics (STEM) undergraduate and graduate programs, which makes our recruitment of minority faculty difficult.

?⟨reflect:page:stem⟩?

Math chairs and deans should strongly recommend that full-time faculty attend workshops related to diversity and cultural competency issues.

- Departments should be encouraged to provide diversity/cultural competency training for part-time faculty as part of their contractual meeting requirements.
- Hiring committees need to work with HR to identify and aggressively target mathematics graduate programs in the Northwest with minority students who are seeking teaching positions in community colleges.
- Departments on all campuses should increase efforts to find candidates for the Faculty Diversity Internship Program [2].

Report any changes the SAC has made to instructor qualifications since the last review and the reason for the changes.

In Spring 2011, prompted by the transfer of Math 20 from Developmental Education (DE) to the Mathematics SAC, the math instructor qualifications were changed. Math 20 had been the only remaining mathematics course in the DE SAC.

The transfer included transitioning three full-time DE math instructors at Sylvania into the Math Department at Sylvania. At this time, instructor qualifications for math faculty were examined and changed to reflect the inclusion of DE math faculty. It was determined that separate qualifications should be written for pre-college and college level courses. These qualifications were written so that all of the full-time DE math faculty transitioning into the math department (as well as any new DE math faculty hired) were qualified to teach the pre-college level courses and any new math faculty were qualified to teach all of the math courses.

For instance, a masters degree in mathematics education (instead of just mathematics) was included as an optional qualification for full-time instructors teaching pre-college level courses. Also a masters degree in mathematics education became an option for part-time instructors teaching MTH 211–213 (the sequence for elementary education math teachers). Additionally, at the request of the administration, the terms 'part-time' and 'full-time' were removed from instructor qualifications in order to satisfy accreditation requirements. Instead of labeling what had traditionally been part-time qualifications as 'part-time,' these qualifications were labeled 'Criteria for Provisional Instructors.'

In Winter 2013, the math instructor qualifications were again changed at the request of the math department chairs. The 'provisional' labeling from the last revision had required math department chairs to regularly re-certify part-time ('provisional') instructors. In order to avoid this unnecessary paperwork, the SAC adopted a three-tiered qualification structure based on full-time, part-time, and provisionally-approved part-time instructors (mainly graduate students currently working on graduate degrees). The part-time (non-provisional) tier was labeled 'Demonstrated Competency.' Complete details of instructor qualifications are given in Appendix P on page 133.

How have professional development activities of the faculty contributed to the strength of the program/discipline? If such activities have resulted in instructional or curricular changes, please describe.

The members of the mathematics SAC, full-time and part-time alike, are very committed to professional development. As with members of any academic discipline, the faculty in the math SAC pursue professional development in a variety of manners. Traditionally these activities have been categorized in ways such as 'membership in professional organizations' or 'presentations at conferences'. The members of the math SAC do not in any way devalue the engagement in such organizations or activities, and in fact a summative list of such things can be found in Appendix Q on page 136.

Nor do the members in any way diminish individual pursuit of professional development. In an attempt to acknowledge such pursuits, each member of the full-time faculty was asked to submit one or two highlights of their professional development activities over the past five years. Those submissions can be found in Appendix R on page 137.

It should be noted that the list of organizations and activities found in these appendices are not exhaustive; they are merely a representative sample of the types of professional development pursuits engaged in by members of the math SAC.

The members of the math SAC realize that if there is going to be institutional-level change that results in increased success and completion rates for students enrolled in DE mathematics courses, there are going to have to be targeted and on-going professional development activities with that goal in mind and that all mathematics faculty, full-time and part-time, are going to have to take advantage of those opportunities. This is especially important since many of our faculty members are not specialists in working with developmental mathematics students. We look forward to working with the broader PCC community as we pursue our common goal of increased student success and completion, and we look forward to the college's support in providing professional development opportunities that promote attainment of this goal.

R The college should provide funds and other necessary resources that allow the SAC members to engage in targeted, on-going professional development geared toward realization of district-wide goals. This should include, for example, support for activities such as annual two-day workshops focusing on goals such as universal adoption of evidence-based best practices.

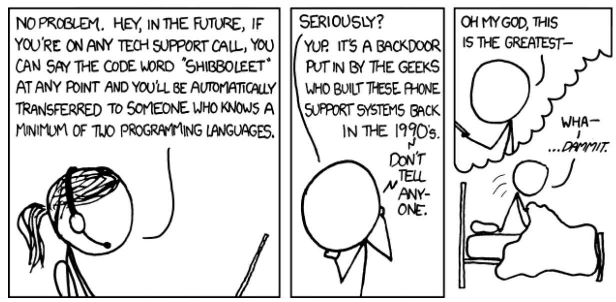
R Each department should create structures and policies that promote sustained professional development. Institutionalization of practices such as faculty-inquiry-groups and peer-to-peer classroom visitations are necessary components of sustained professional development.

R The college should continue to provide funds for activities such as conference attendance, professional organization membership, etc. At the same time, procedures should be put into place that allow for maximal dissemination of "good ideas" and maximum probability that said ideas grow into sustained practices.

R Formalized procedures for mentoring new faculty, full-time and part-time alike, should be adopted and strictly observed. Beginning a new job is a unique opportunity for rapid professional development, and we need to make sure that we provide as supportive and directed an opportunity for new faculty as possible so that the development happens in a positive and long-lasting way.

6

Facilities and Support



http://xkcd.com

Describe how classroom space, classroom technology, laboratory space and equipment impact student success.

Over the past few years, efforts by the college to create classrooms containing the same basic equipment has helped tremendously with consistency issues. The nearly universal presence of classroom podiums with attendant Audio Visual (AV) devices is considerably useful. For example, many instructors use computer-based calculator emulators when instructing their students on calculator use—this allows explicit keystroking examples to be demonstrated that were not possible before the podiums appeared; the document cameras found in most classrooms are also used by most mathematics instructors. Having an instructor computer with internet access has been a great help as instructors have access to a wide variety of tools to engage students, as well as a source for quick answers when unusual questions arise.

Several classrooms on the Sylvania campus have Starboards or Smart Boards integrated with their AV systems. Many mathematics instructors use these tools as their primary presentation vehicles; documents can be preloaded into the software and the screens allow instructors to write their work directly onto the document. Among other things, this makes it easy to save the work into pdf files that can be accessed by students outside of class. This equipment is not used as much on the other campuses, but there are instructors on other campuses that say they would use them if they were widely available on their campus.

A few instructors have begun creating lessons with LiveScribe technology. The technology allows the instructor to make an audio/visual record of their lecture without a computer or third person recording device; instructors can post a 'live copy' of their actual class lecture online. The students do not simply see a static copy of the notes that were written; the students see the notes emerge as they were being written and they hear the words that were spoken while they were written. The use of LiveScribe technology is strongly supported by Disability Services, and for that reason alone continued experimentation with its use is strongly encouraged.

Despite all of the improvements that have been made in classrooms over the past few years, there still are some serious issues.

Rooms are assigned randomly, which often leads to mathematics classes being scheduled in rooms that are not appropriate for a math class. For example, scheduling a math class in a room with individual student desks creates a lot of problems; many instructors have students take notes, refer to their text, and use their calculator all at the same time and there simply is not enough room on the individual desktops to keep all of that material in place. More significantly, this furniture is especially ill-suited for group work. Not only does the movement of desks and sharing of work exacerbate the materials issue (materials frequently falling off the desks), students simply cannot share their work in the efficient way that work can be shared when they are gathered about tables. It would be helpful if all non-computer-based math classes could be scheduled in rooms with tables.

Another problem relates to an inadequate number of computerized classrooms and insufficient space in many of the existing computerized classroom; both of these shortages have greatly increased due to Bond-related construction. Several sections of MTH 243 and MTH 244 (statistics courses), which are normally taught in computerized classrooms, *have* been scheduled in regular classrooms. Many of the statistics courses that were scheduled in computerized classrooms have been scheduled in rooms that seat only 28, 24, or even 20 students. When possible, we generally limit our class capacities at 34 or 35. Needless to say, running multiple sections of classes in rooms well below those capacities creates many problems. This is especially problematic for student success, as it hinders students' ability to register due to undersized classrooms.

Finally, the computerized classrooms could be configured in such a way that maximizes potential for meaningful student engagement and minimizes potential for students to get off course due to internet access. We believe that all computerized classrooms need to come equipped with software that allows the instructor control of the student computers such as LanSchool Classroom Management Software. The need for this technology is dire; it will reduce or eliminate students being off task when using computers, and it will allow another avenue to facilitate instruction as the instructor will be able to 'see' any student computer and 'interact' with any student computer. It can also be used to solicit student feedback in an anonymous manner. The gathering of anonymous feedback can frequently provide a better gauge of the general level of understanding than activities such as the traditional showing of hands.

R All mathematics classes should be scheduled in rooms that are either computerized (upon request) or have multi-person tables (as opposed to individual desks).

R All computerized classrooms should have at least 30, if not 34, individual work stations.

R An adequate number of classrooms on all campuses should be equipped with Smartboards so that all instructors who want access to the technology can teach every one of their classes in rooms equipped with the technology.

R The computer image for all computerized classrooms should include software that allows the instructor computer complete and direct access to each student computer.

A B C D E

Describe how students are using the library or other outside-the-classroom information resources.

We researched this topic by conducting a stratified sampling method survey of 976 on-campus students and 291 online students; the participants were chosen in a random manner. We gave scantron surveys to the on-campus students and used SurveyMonkey for the online students. We found that students are generally knowledgeable about library resources and other outside-the-classroom resources. The complete survey, together with its results, is given in Appendix S on page 138; we have summarized our comments to some of the more interesting questions below.

Q1. Not surprisingly, library resources and other campus-based resources are used more frequently by our on-campus students than by our online students. This could be due to less frequent visits to campus for online students and/or online students already having similar resources available to them via the internet.

Q2. We found that nearly 70% of instructors include resource information in their syllabi. This figure was consistent regardless of the level of the class (DE/transfer level) or the employment status of the instructor (full/part-time).

We found that a majority of our instructors are using online resources to connect with students. Online communication between students and instructors is conducted across many platforms such as instructor websites, Desire2Learn, MyPCC, online graphing applications, and online homework platforms.

We found that students are using external educational websites such as Khan Academy, PatrickJMT, PurpleMath, and YouTube. The data suggest online students use these services more than on-campus students.

Q3. The use of online homework (such as WeBWorK, MyMathLab, MyStatLab, and ALEKS) has grown significantly over the past few years. However, the data suggests that significantly more full-time instructors than part-time instructors are directing their students towards these tools (as either a required or optional component of the course). Additionally, there is a general trend that online homework programs are being used more frequently in online classes than in on-campus classes. Both of these discrepancies may reflect the need to distribute more information to faculty about these software resources.

Q4. The math SAC needs to address whether or not we should be requiring students to use online resources that impose additional costs upon the students and, if so, what would constitute a reasonable cost to the student. To that end, our survey asked if students would be willing to pay up to $35 to access online homework and other resources. We found that online students were more willing to pay an extra fee than those enrolled in on-campus classes.

Q7. The PCC mathematics website offers a wealth of materials that are frequently accessed by students. These include course-specific supplements, calculator manuals, and the required Calculus I lab manual; all of these materials were written by PCC mathematics faculty. Students may print these materials for free from any PCC computer lab. The website also links to PCC-specific information relevant to mathematics students (such as tutoring resources) as well as outside resources (such as the Texas Instruments website).

Q9. In addition to the previously mentioned resources we also encourage students to use resources offered at PCC such as on-campus Student Learning Centers, online tutoring, Collaborate, and/or Elluminate. A significant number of students registered in on-campus sections are using these resources whereas students enrolled in online sections generally are not. This is not especially surprising since on-campus students are, well, on campus whereas many online students rarely visit a campus .

R The majority of our data suggests that students are using a variety of resources to further their knowledge. We recommend that instructors continue to educate students about both PCC resources and non-PCC resources. We need to uniformly encourage students to use resources such as online tutoring, student learning centers, Collaborate, and/or Elluminate; this includes resource citations in each and every course syllabus.

A broader education campaign should be engaged to distribute information to part-time faculty regarding online homework such as WeBWorK, MyMathLab, MyStatLab, and ALEKS.

Instructors should consider quality, accessibility and cost to students when requiring specific curriculum materials.

Provide information on clerical, technical, administrative and/or tutoring support.

Clerical, technical, and administrative support

In terms of clerical and administrative support, these are again, campus based issues for the most part. Across the district, our SAC has an excellent and very involved administrative liaison, Dr. Alyson Lighthart. We would like to thank her for her countless hours of support in attending our SAC meetings and being available to the SAC Co-Chairs. She provides us with thoughtful feedback and insightful perspectives that help us gather our thoughts and make sound decisions.

Cascade

The Cascade math department is located on the third floor of the student services building, sharing a floor with the ROOTS office. The math department also shares space with allied health support staff, medical professions faculty, medical assisting faculty and the Cascade academic intervention specialists (one of whom is also a math part-time faculty). Part-time math faculty share 11 cubicles, each with a computer. Full-time instructors are paired in offices that open up to the part-time cubicles. In Winter 2014, a collective 42 faculty share one high speed Ricoh printer and one copy machine. Our division offices are located in another building . We have a dedicated administrative assistant at the front desk.

Rock Creek

The Rock Creek math department is located in the same floor as the division it belongs to (Mathematics, Aviation, and Industrial Technology) and it is shared with Computer Science. Part-time faculty share fourteen cubicles, each with a computer, located in the same office as full-time instructors, that are used to prepare and meet with students. The sixty-five plus faculty share two high speed printers that can collate, staple and allow double sided printing, and one high speed scanner. Currently we have reached space capacity and we will have to re-think the current office configuration in order to add one more full-time faculty member next Fall. Two years ago the Rock Creek math department added a dedicated administrative assistant, which has helped with scheduling needs, coordinating part-time faculty needs, and providing better service to the students.

Southeast

The clerical and administrative setup at Southeast has changed, as of Winter 2014. There was a recent restructuring of divisions. What used to be the Liberal Arts and Sciences Division split into two divisions: the Liberal Arts and CTE Division (which is in the first floor of Scott Hall, Room 103, where the Liberal Arts and Sciences used to be) and the Math and Science Division (which is on the 2nd floor of the new Student Commons Building, Room 214). All of the math and science faculty are now in this new space, including the part-time instructors (everybody was scattered before, so this is a welcome change).

All of the department chairs have their own offices (with doors), while the rest of the faculty (full-time and part-time) occupy cubicle spaces (approximately 20 cubicles in the space, shared by 4–5 faculty per cubicle). There are two administrative assistants, one of whom is with the math and science faculty and the other of whom is in charge of the STEM program. There is also one clerical staff member.

There is one Ricoh printer in the space, along with a fax machine. Any and all supplies (markers, erasers, etc.) are located across the hall in a designated staff room.

Sylvania

The Sylvania math department belongs to the Math and Industrial Technology division, which is located in the neighboring automotive building. The math department is currently located in two separate areas of adjacent buildings as of Fall 2013, when the developmental math faculty officially merged with the math department. This separation will soon be remedied by construction of the new math department area, scheduled to be completed during Spring 2014. This new location will be next door to the Engineering department, and will share a conference room, copy machine room, and kitchen. The math department will include two department chair offices, seventeen full-time instructor cubicles, six additional cubicles shared by part-time faculty, and two flex-space rooms. Each of the cubicles will have a computer, and there will be two shared laser printers plus one color scanner in the department office.

Our two administrative assistants work an overlapped schedule, which provides dual coverage during the busy midday times and allows the office to remain open to students and visitors for eleven hours. These assistants do an incredible job serving both student and faculty needs, including: scheduling assistance, interfacing with technical support regarding office and classroom equipment, maintaining supplies inventory, arranging for substitute instructors, securing signatures and processing department paperwork, guiding students to campus resources, and organizing syllabi and schedules from approximately 70 math instructors.

Our math department has frequent interaction with both Audio-Visual and Technology Solution Services. Responses by AV to instructor needs in the classroom are extremely prompt–typically within minutes of the notification of a problem. Since the math department is very technology-oriented, we have many needs that require the assistance of TSS. Work orders for computer equipment and operational issues that arise on individual faculty computers can take quite a long time to be implemented or to be resolved. This may be due to the sheer volume of requests that they are processing, but more information during the process, especially notes of any delays, would be welcomed.

Tutoring support

PCC has a Student Learning Center (SLC) on each campus. While it is a testament to PCC's commitment to student success that the four SLCs exist, we feel that the centers would be an even greater resource if they were more consistent in structure, resource availability, physical space, and faculty support. Discrepancies such as unequal distribution of resources, inconsistency in the number and nature of tutors (including faculty 'donating time' to the centers), and disparate hours of operation present challenges to students trying to navigate their way through different centers.

Over the last five years the general environment of PCC has been greatly impacted by historically-unmatched enrollment growth (see Figures 3.1 and 3.2 on page 25). PCC's four Student Learning Centers have been greatly affected by this (see Appendix T on page 143). Most notably, the number of students seeking math tutoring has increased dramatically. Unfortunately, this increase in student need has not been met by increase in tutors or tutoring resources. As a result the amount of attention an individual student receives has decreased in a substantive way, leaving students often frustrated and without the help they needed. Consequently, the numbers of students dropped again as students stopped even trying. While some of this growth has been (or will be) accommodated by increasing the physical space available for tutoring (i.e., by the construction of new facilities at Rock Creek and Southeast), that is still not enough since personnel resources were not increased at the same rate and work-study awards have been decreased significantly. A comprehensive plan needs to be developed and implemented that will ensure each and every student receives high-quality tutoring in a consistent and consistently accessible manner.

As it now stands, the operation of the SLCs is completely campus driven. As such, reporting on the current status needs to be done on a campus-by-campus basis.

Cascade

Averaging over non-summer terms from Fall 2008 to Spring 2013, the Cascade SLC has served about 680 math students with 3900 individual visits and 8 hours per student per term. (See Table T.1 on page 144 for a full accounting.)

The Cascade SLC has increased its operating hours in response to student demand. Statistics tutoring is now offered at most times and the introduction of online homework has led to 'Hybrid Tutoring', where students receive tutoring while working on their online homework.

At the Cascade Campus, all full-time mathematics instructors and many part-time mathematics instructors volunteer 1–4 hours per week in the SLC to help with student demand. To help ensure usage throughout the SLC's operational hours, instructors are notified by email of slow-traffic times; this allows the instructors to direct students who need extra help to take advantage of those times. Other communications such as announcements, ads, and newsletters are sent out regularly.

Full-time faculty have constructed a 'First week lecture series' that they conduct on the first Friday of every term (except summer). It is designed to review basic skills from MTH 20 through MTH 111. It is run in 50-minute segments throughout the day with a 10-minute break between each segment. The first offering of this series began in Winter 2012 with 100 students in attendance; the attendance has since grown steadily and was up to approximately 300 students by Fall 2013.

The Cascade SLC has formalized both the hiring process and the training process for casual tutors. The department chairs interview potential tutors, determine which levels they are qualified to tutor, and give guidance as to tutoring strategies and rules. During their first term, each new tutor is always scheduled in the learning center at the same time as a math instructor, and is encouraged to seek math and tutoring advice from that instructor.

Rock Creek

Averaging over non-summer terms from Fall 2008 to Spring 2013, the Rock Creek SLC has served about 690 math students with 3300 individual visits and 10 hours per student per term. (See Table T.1 on page 144 for a full accounting.)

Everyone who works and learns in the Rock Creek SLC is looking forward to moving into the newly-built space in Building 7 by Spring 2014. The new space will bring the SLC closer to the library and into the same building as the WRC, MC, and TLC. Students seek tutoring largely in math and science, but increasingly for accounting, computer basics, and also college reading. Mathematics full-time faculty hold two of the required five office hours at the tutoring center.

Motivated by the high levels of student demand for math tutoring, in 2012/13 the SLC piloted math tutoring by appointment two days per week. On each of the two days a tutor leads thirty-minute individual sessions or one-hour group tutoring sessions by appointment for most math levels. After some tweaking of days and times, we have settled on Tuesdays and Wednesdays. Students who are seeking a longer, more personalized or intensive tutoring session seem to highly appreciate this new service.

Finally, the Rock Creek SLC has benefited over the last three years from collaboration with advisors, counselors, librarians, the WRC, MC, and the Career Resource Center in offering a wide variety of workshops as well as resource fairs to support student learning.

Southeast

Averaging over non-summer terms from Fall 2008 to Spring 2013, the Southeast SLC has served about 280 math students with 1200 individual visits and 5 hours per student per term. (See Table T.1 on page 144 for a full accounting.)

The SE SLC staff is looking forward to its move into the new tutoring center facilities when the new buildings are completed. In the meantime, it has expanded the math tutoring area by moving the writing tutoring to the back room of the tutoring center.

Since the SE Tutoring Center opened in 2004, it has gone from serving an average of 200 students per term (including math and other subjects) to serving an average of 350 students per term in math alone. With this increase in students seeking assistance, the staff has also grown; the SE SLC now has several faculty members who work part time in the tutoring center.

Many SE math faculty members donate time to the tutoring center. We have developed a service learning project where calculus students volunteer their time in the tutoring center; this practice has been a great help to students who utilize the tutoring center as well as a great opportunity for calculus students to cement their own mathematical skills.

Sylvania

Averaging over non-summer terms from Fall 2008 to Spring 2013, the Sylvania SLC has served about 1100 math students with 6200 individual visits and 7 hours per student per term. (See Table T.1 on page 144 for a full accounting.)

The Sylvania SLC moved into a new location in Fall 2012; it is now in the Library building, together with the Student Computing Center. The creation of a learning commons is working out well and students are taking advantage of having these different study resources in one place. Unfortunately, the new SLC has less space available for math tutoring than the prior Student Success Center which has been addressed by restructuring the space. Since enrollment remains high, having enough space for all students seeking help remains a challenge.

PCC's incredible growth in enrollment created an attendant need for a dramatic increase in the number of tutors available to students. This increased need has been partially addressed by an increase in the budget set aside for paid tutors as well as a heightened solicitation for volunteer tutors. Many instructors (both full-time and part-time) have helped by volunteering in the Sylvania SLC; for several years, the center was also able to recruit up to 10 work-study tutors per academic year, but with recent Federal changes to Financial Aid, the Math Center is now only allowed two work-study tutors per year; this restriction has led to a decrease of up to 50 tutoring hours per week.

In addition to tutoring, the Sylvania SLC hosts the self-paced ALC math classes, provides study material, and offers resources and workshops for students to prepare for the Compass placement test. Efforts are also underway to modernize a vast library of paper-based materials by putting them online and making them available in alternate formats.

Provide information on how Advising, Counseling, Disability Services and other student services impact students.

Advising and counseling

The advising and counseling departments play a vital role in creating pathways for student success; this is especially important when it comes to helping students successfully navigate their mathematics courses. Historically there have been incidents of miscommunication between various math departments and their campus counterparts in advising, but over the past few years a much more deliberate effort to build strong communication links between the two has resulted in far fewer of these incidents.

The advising departments have been very responsive to requests made by the mathematics departments and have been clear that there are policies in place that prevent them from implementing some of the changes we would like.

For example, in the past many advisers would make placement decisions based upon criteria that the Math SAC felt weren't sufficient to support the decision. One example of this was placing students into classes based upon a university's prerequisite structure rather than PCC's prerequisite structure. When the advisers were made aware that this frequently led to students enrolling in courses for which they were not prepared for success, the advising department instituted an ironclad policy not to give any student permission to register for a course unless there was documented evidence that the student had passed a class that could be transcribed to PCC as the PCC prerequisite for the course. Any student who wants permission without a satisfied prerequisite or adequate Compass score is now directed to a math faculty chair or to the instructor of the specific section in which the student wishes to enroll.

On the downside, there are things we would like the advisers to do that we have come to learn they cannot do. For example, for several years the policy of the Math SAC has been that prerequisites that were satisfied at other colleges or universities would only be 'automatically' accepted if they were less than three years old. Many instructors in the math department were under the impression that this policy was in place in the advising department, but it was discovered in 2012 that not only is this policy *not* in place but the policy in fact cannot be enforced by anyone (including math faculty). Apparently such a policy is enforceable only if explicit prerequisite time-limits are written into the CCOGs.

The advising department had been aware of the prerequisite issue for six or seven years, but somehow the word had not been passed along to the general math faculty. This serves as an example that both advising supervisors and the math department chairs need to make every effort possible to inform all relevant parties of policy changes in a clear and timely manner. Towards that end, the math department at Sylvania Campus has now been assigned an official liaison in the Sylvania advising department. and we believe that similar connections should be created on the other campuses as well.

With the college's new focus on student completion, the relationship between the math departments and advising departments needs to become much stronger. Initial placement plays a critical role in completion, as do other things such as enrollment into necessary study skills classes and consecutive term-to-term enrollment through a sequence of courses. We need to make sure that the advisers have all of the tools necessary to help students make the best choices and the advisers need to help us understand their perspective on the needs of students enrolling in mathematics courses. To help establish this collaborative environment, a Math SAC ad hoc committee has been formed to investigate and address advising issues, placement issues, and study skills issues; the committee is going to ask several people involved in advising and counseling to join the committee. It has been speculated that perhaps such a committee should not be under the direct purview of the Math SAC; if the administration decides to create a similar committee under someone else's direction we ask that any such committee have a large contingent of math faculty.

R All four campuses should have an official advising liaison and the four liaisons should themselves have an established relationship. Ideally we would like to have one adviser at each campus dedicated solely to math advising issues.

R A committee consisting of advisers, math faculty, and other relevant parties (e.g. ROOTS representation) should be formed to investigate and establish policies related to student success in mathematics courses. The issues to investigate include, but are not limited to, placement, study skills, and other college success skills as they relate to mathematics courses.

Testing centers

At the time we wrote our last program review there were very uneven procedures at the various testing centers which caused a lot of problems; the inconsistencies were especially problematic for online instructors and their students—see [15], page 26 . We are pleased that the testing centers recognized that inconsistency as a problem and they addressed the issue in a forthright way. The testing centers now have uniform policies and they have made great strides in making their services easily accessible to students and instructors alike. For example, the ability to make testing arrangements online has been a tremendous help as has the increase in the number of options by which a completed exam can be returned to the instructor.

A limited number of hours of operation remains a problem at each of the testing centers; evening and weekend hours are not offered and testing times during the remaining time are limited; for example, the Cascade Testing Center offers only 4 start times for make up exams exam week. It appears to us that the size of the facilities and the number of personnel have not increased in equal parts with the dramatic increase in enrollment. It also appears that the testing centers have not been given adequate funding to offer hours that accommodate students who can only come to campus during the evening or on a weekend.

This lack of access can be especially problematic for students registered in math courses. The majority of the math courses at PCC are taught by part-time faculty and these faculty members do not have the same flexibility in their schedule as full-time faculty to proctor their own exams; as such they are especially dependent on the testing centers for make-up testing. This dependency is all the more problematic since many part-time faculty teach evening or Saturday classes and many of the students in those classes find it difficult to come to campus during 'normal business hours.' Additionally, the Sylvania math department simply does not have the space required to administer make-up testing in the office, so 100% of its faculty are dependent upon the testing centers for make-up testing; we realize this puts a strain on the testing centers.

R We recommend that the space and staffing size in the testing centers be increased to help ease this strain.

As discussed on pages 29 and 49, the Math SAC has a very positive and productive relationship with disability services. For example, disability services was very responsive when some instructors began to question accommodation requests that contradicted specific evaluation criteria mandated in CCOGs (e.g. testing certain material without student access to a calculator). Kaela Parks came to the SAC and assured us that any such accommodation request is something an instructor need only consider; i.e., those type of accommodation requests are not mandates on the part of disability services. The speed with which we received clarity about this issue is indicative of the strong connection that has been forged between the mathematics departments and disability services.

Beginning in the 2012/13 AY, all communication regarding student accommodations (both general and testing-specific) has been done online. Because of issues such as notifications being filtered to spam files, not all accommodation requests were being read by faculty. At the mathematics faculty department chairs' request, Kaela Parks created a spaces page that allow the faculty chairs monitor which instructors have one or more students with accommodation needs and highlights in red any instructor who has an outstanding issue (such as pending exam) that needs immediate attention. This resource has greatly diminished the number of incidents where a student has an accommodation need that is not addressed in a timely manner.

facilities:sec:scheduling)

Describe current patterns of scheduling (such as modality, class size, duration, DC times, location, or other), address the pedagogy of the program/discipline and the needs of students.

The math departments schedule classes that start as early as 7:00 a.m. and others that run as late as 9:50 p.m. About 80% of our math classes are offered in a two-day-a week format, meeting either Monday-Wednesday or Tuesday-Thursday. Some sections are offered in a three-day-a-week format and a few in a four-day-a-week format; sections are offered in these formats to accommodate students who find it helpful to be introduced to less content in any one class session.

We also schedule classes that meet only once a week; some of those classes are scheduled on Saturdays. While once-weekly meetings are not an ideal format for teaching mathematics, having such sections creates options for students who cannot attend college more than one day a week.

We offer several courses online, the enrollment in which has jumped dramatically over the past five years (see Figure 3.2 on page 25 and the discussion surrounding it). We also offer classes in both a web/TV hybrid and an online/on-campus hybrid format.

On-campus class sizes generally range from 20 to 35 students; that number is typically dependent on the room that is assigned for the class (see page 48 and Appendix L on page 107). This has led to some inconsistencies among campuses as distribution of classroom capacities is not consistent from one campus to the next.

Teaching online presents unique obstacles for faculty and students alike. Faculty members, like students, have different methods of addressing these obstacles. The SAC has a recommended capacity limit of twenty-five for each section on its DL course offerings. This recommendation was based upon a determination that twenty-five is a reasonable class size given the extra duties associated with teaching online. Because the attrition rates in online courses can be higher than that in on-campus courses, many DL instructors ask that their class capacity be set at, say, thirty to accommodate for first week attrition.

In addition to increased class sizes that account for anticipated attrition, some faculty members choose to allow additional students when their workload allows for the attendant extra work. In fact, during Winter 2014, only fifteen out of a total of forty-one DL sections are limited to twenty-five students. Of the remaining DL sections, seven are capped between twenty-five and thirty, twelve are capped in the mid-to-low thirties, and seven are capped at greater than forty-five. Further information about scheduling patterns, broken down by campus, can be found in Appendix U on page 145.

There is no specific pedagogical dictates in most of our courses. Class activities can range from lecture to class-discussion to group-work to student-board-work. Some instructors provide their students with pre-printed lecture notes and examples, others write notes on the board; some instructors have their students work mostly on computer-based activities, and yet others mostly work problems from the textbook. The frequency with which each instructor uses each approach is almost entirely up to him/her. Many instructors have a required online homework component, while others do not.

This diversity of classroom experience has both positive and negative consequences. On the positive side, it provides an environment that has the potential to address a wide-range of learning styles. On the negative side, it can lead to very inconsistent experiences for students as they work their way through a sequence. The inconsistency is probably most prevalent and, unfortunately, most problematic at the DE level of instruction. As the Math SAC looks for ways to increase completion rates for students who place into developmental mathematics courses, serious attention will be given to plans that increase the consistency of classroom experience for students; consistency that is built upon evidence-based best practices.

8

Recommendations

Change will not come if we wait for some other person or some other time. We are the ones we've been waiting for. We are the change that we seek.

Barack Obama

The following recommendations have been made throughout this document; they are summarized here for convenience.

FIX

Bibliography

[1] *Accreditation Standards*. Tech. rep. Northwest Commission on Colleges and Universities, 2010. URL: http://www.nwccu.org/Standards%20and%20Policies/Accreditation%20Standards/Accreditation%20Standards.htm.

[2] *Affirmative action at PCC*. URL: http://www.pcc.edu/about/affirmative-action/interns/.

[3] Bernards. *Study skills website*. URL: http://studyskillsmath.wix.com/mathstudyskills.

[4] Brewer. "The Effects of Online Homework on Achievement and Self-Efficacy of College Algebra Students". PhD dissertation. Utah State University, 2009. URL: http://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1414&context=etd.

[5] Gage. *WeBWorK accessibility projects*. 2013. URL: http://michaelgage.blogspot.com/2013/11/webwork-accessibility-projects.html.

[6] *Guidelines for Writing Outcomes*. Tech. rep. Portland Community College. URL: http://www.pcc.edu/resources/academic/eac/curriculum/course-development/new/outcomesguidelines.html.

[7] Hirsch and Weibel. "Statistical Evidence that Web-Based Homework Helps". In: *MAA Focus* (2003). URL: http://www-rohan.sdsu.edu/~ituba/math3cw03/webworkfocus.pdf.

[8] Hughes, Jordan, Cary, and Simonds. *MTH 111 and 112 open source Pre-calculus document project*. URL: https://github.com/cmhughes/precalculusDocument.

[9] Hughes and Leavitt. *Accessible Content Creation in Mathematics*. Tech. rep. 2013. URL: http://www.pcc.edu/resources/instructional-support/access/documents/math-accessibilityreport.pdf.

[10] Kuh, Jankowski, Ikenberry, and Kinziet. *Knowing What Students Know and Can Do: The Current State of Student Learning Outcomes Assessment in U.S. Colleges and Universities*. Tech. rep. National Institute for Learning Outcomes Assessment, 2014. URL: http://www.learningoutcomeassessment.org/documents/2013%20Abridged%20Survey%20Report%20Final.pdf.

[11] *Learning Assessment Report*. Tech. rep. Portland Community College, 2009–2010. URL: http://www.pcc.edu/resources/academic/documents/math.pdf.

[12] *Learning Assessment Report*. Tech. rep. Portland Community College, 2010–2011. URL: http://www.pcc.edu/resources/academic/documents/LDCMTHCritThinkCommunicReport201 pdf.

[13] *Learning Assessment Report*. Tech. rep. Portland Community College, 2011–2012. URL: http://www.pcc.edu/resources/academic/documents/Annual_Report_on_Assessment_MATH_2012_SR_PC.pdf.

[14] *Learning Assessment Report*. Tech. rep. Portland Community College, 2012–2013. URL: http://www.pcc.edu/resources/academic/documents/MTH_2013_report_math.pdf.

[15] *Mathematics Program Review*. Tech. rep. Portland Community College, 2003–2008. URL: http://www.pcc.edu/edserv/program-review/documents/MathProgramReviewMarch2009.pdf.

[16] *PCC Core Outcomes*. Tech. rep. Portland Community College. URL: http://www.pcc.edu/resources/academic/core-outcomes/index.html.

[17] *PCC Mathematics department website*. URL: http://spot.pcc.edu/math/download.htm.

[18] President's Council of Advisors on Science and Technology. *Engage to Excel: Producing One Million Additional College Graduates With Degrees In Science, Technology, Engineering, And Mathematics*. 2012. URL: http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-engage-to-excel-final_feb.pdf.

[19] *Self-Centered Learning/Study Skills for Mathematics*. URL: https://sites.google.com/a/pcc.edu/self-centered-learning-study-skills-for-mathematics.

[20] "The Mathematics Required of First Year College Students". In: *National Center on Education and the Economy* (2013), p. 6.

Appendices

A
Pathways diagram

⟨app:sec:pathways⟩

While Math in Context I is envisioned as the general entry course, a basic arithmetic course would still be needed as an entry course and as a supplemental course for some students enrolled in Math in Context I

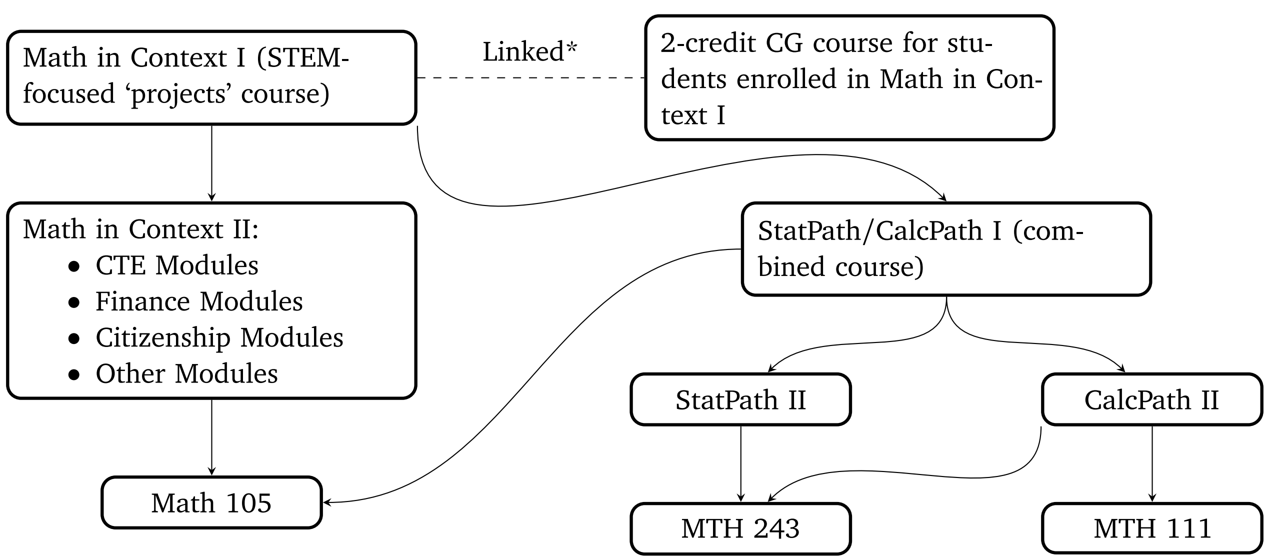


FIGURE A.1: PCC MathPaths– Draft Version III (01/17/2014)

⟨app:figure:pathways⟩

*Every student in a given section of Math in Context I would also be enrolled in a common section of the CG course. The instructors of a given pair of courses would work in a collaborative fashion and ideally visit one another’s classes, especially the first week.

Unlinked sections of the CG course would be offered for entry level DE mathematics students whose initial placement is ‘above’ Math in Context I. Students who pass Math in Context I but not the attendant CG course might be required to retake the course.

B

Changes in ALC Math Courses

⟨app:sec:alc⟩

After MTH 20 was moved to the Math SAC, the ALC math courses were the only math courses left in the DE SAC. The ALC math instructors therefore requested that these courses too would be moved to the Math SAC. After the DE and Math SACs gave their support, the courses were moved in January 2013.

Historically, the ALC math courses have only included curriculum up to MTH 65, but after the move was completed, the Math SAC voted to also include MTH 95 curriculum from Fall 2013 on.

Furthermore, the ALC math courses have been impacted by the new no-repeat policy. Historically, these courses could be repeated many times because they included three math levels (now four). Since Winter 2014, each level has their own set of courses. Following is a listing of the previous and the new/changed courses:

Previous courses (until Fall 2013):

ALC 60 "Basic Math Skills Lab"

ALC 61 "Basic Math Skills Lab"

ALC 62 "Basic Math Skills Lab"

ALC 63 "Basic Math Skills Lab"

New courses (since Winter 2014):

ALC 20A "Math 20 Lab - 0 credits"

ALC 20B "Math 20 Lab - 1 credit"

ALC 20C "Math 20 Lab - 2 credits"

ALC 20D "Math 20 Lab - 3 credits"

ALC 60A "Math 60 Lab - 0 credits"

ALC 60B "Math 60 Lab - 1 credit"

ALC 60C "Math 60 Lab - 2 credits"

ALC 60D "Math 60 Lab - 3 credits"

ALC 65A "Math 65 Lab - 0 credits"

ALC 65B "Math 65 Lab - 1 credit"

ALC 65C "Math 65 Lab - 2 credits"

ALC 65D "Math 65 Lab - 3 credits"

ALC 95A "Math 95 Lab - 0 credits"

ALC 95B "Math 95 Lab - 1 credit"

ALC 95C "Math 95 Lab - 2 credits"

ALC 95D "Math 95 Lab - 3 credits"

C

Social Justice samples

⟨app:sec:socialJustic⟩

The problems below are samples from the Social Justice Work group.

Table C.1 shows the percentage of people living in poverty in the U.S (as defined by the government). Source: http://www.census.gov/prod/2012pubs/p60-243.pdf

TABLE C.1: Percentage of people living in poverty in the U.S

⟨app:tab:poverty⟩

Year	Percentage
1990	13.5 %
1991	14.2 %
1992	14.8 %
1993	15.1 %
1994	14.5 %
1995	13.8 %
1996	13.7 %
1997	13.3 %
1998	12.7 %
1999	11.9 %
2000	11.3 %
2001	11.7 %
2002	12.1 %
2003	12.5 %
2004	12.7 %
2005	12.6 %
2006	12.3 %
2007	12.5 %
2008	13.2 %
2009	14.3 %
2010	15.1 %
2011	15.0 %
2012	16.0 %

Make a graph of the data and try to provide evidence (articles, news stories, policy, etc.) for why these rate of poverty increased or decreased. Once you completed the graph, draw in what *you* think will happen in the next 10 years, give a reason to back up what you draw in.

Math 111 Lecture Notes

Section 4.3: Exponential Functions

In 1988, a judge in Yonkers, New York instituted an *exponential* fine on the city of Yonkers. Below is the background and scenario, published in the New York Times[1]:

> **Dec. 1, 1980:** Justice Department sues Board of Education, City of Yonkers and Yonkers Community Development Agency, charging that the city racially discriminated in education and public housing.
> **Nov. 20, 1985:** Judge Leonard B. Sand of Federal District Court in Manhattan rules that Yonkers's housing and schools were intentionally segregated by race. A housing remedy order directs the city to build 200 units of public housing and to plan additional subsidized housing.
> **Jan. 28, 1988:** City Council approves consent decree that sets timetable for building 200 units of public housing and commits city to an additional 800 subsidized units.
> **July 26, 1988:** Court sets Aug. 1 deadline for Council to adopt zoning amendment needed to build the 800 units.
> **Aug. 1, 1988:** Council rejects amendment in a 4-to-3 vote.
> **Aug. 2, 1988:** Judge Sand finds city and the four Councilmen who voted against the amendment in contempt of court and imposes fines. The city's fines start at \$100 and double every day. The Councilmen's fines start at \$500 a day and increase by \$500 each day.

Example 1. Let P be the amount fined (in dollars) t days after the fines were imposed. Complete the entries in Table 1 and Table 2.

TABLE 1. Councilmen

t	P	Formula
0		
1		
2		
3		
4		
5		
$\vdots$	$\vdots$	$\vdots$
t		

TABLE 2. City of Yonkers

t	P	Formula
0		
1		
2		
3		
4		
5		
$\vdots$	$\vdots$	$\vdots$
t		

[1] http://www.nytimes.com/1988/09/10/nyregion/yonkers-legal-battle-how-it-unfolded.html

Example 2. Graph each of the functions you found that model the fines for the Councilmen and the city of Yonkers. Identify the key features of each graph.

FIGURE 1. Councilmen

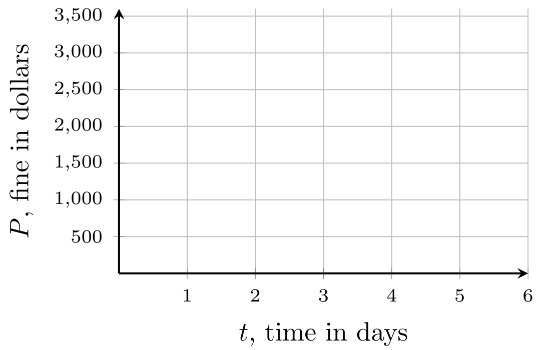
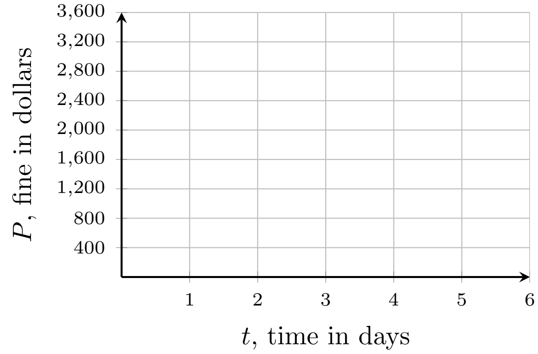


FIGURE 2. City of Yonkers



Group Work 1. On what day will will the city of Yonkers' fine reach over $1,000,000?

Group Work 2. How much will the city of Yonkers be fined on day 30? What will each of the Councilmen's fines be on that day?

PCC Math 60 Group Project   Instructor: Jeff Pettit

Topics: Your group will choose a topic to research that relates to linear equations. You will find or measure two data points, graph that information on a graph, use the information to make a prediction, and finally create an equation based on the data. You will present your findings to the class with the graph of your data, the graph of your equation and an explanation of what the slope and y-intercept of your equation mean in context of your subject. Although our class focused on linear equations (and I encourage you to find linear data to use) if your group prefers: **you can use data sets that are not linear, or make linear approximations of data that are not linear**. I am willing and available to assist you in fitting equation(s) to data.

Submission #1, Due end of Week 5: Names of people in your group and your topic.
Submission #2, Due end of Week 6: Two data points, and what they represent.
Submission #3, Due end of Week 7: Graph of your data with appropriate scale and units.
Submission #4, Due end of Week 8: Graph of your data with appropriate scale and units and a sketch of the line between them, along with a prediction based on that line, and in interpretation of what that prediction point represents.
Submission #5, Due end of Week 9: The equation of your line from Submission #4 in slope-intercept form, with a description of what the slope and intercept represent (intercept may not have practical purpose, but it's implications should still be addressed.)

Presentation Format: Projects will consist of two parts:

1) Writing component – A brief written report beginning with a brief description of your topic and also including the following: a table of data; an accurate graph of your data; a graph of your equation; a graph of your prediction; your equation symbolically; an explanation of your equation (including slope and y-intercept). Your graph should have a correct scale and your expressions and equations should show proper notation and definition of variables. End the report with a brief interpretation of your findings and include any interesting aspects you discovered. I assume this will be approximately one page, more or less.
2) An oral or visual component (e.g. a PowerPoint presentation to the class or a poster or series of posters) explaining your topic. Your explanation should include discussion of your data, your graph and of your equation, with emphasis on the meaning of the slope and intercept.
3) Optional: Service learning component related to your topic. (e.g. planting trees, removing invasive species in Forest Park, working at the Oregon Food Bank, serving in a local soup kitchen) Depending on the type of service learning done, requirements vary, but approximately 8 hours of service learning is expected. Consult with the instructor if you believe you will have significantly less. A discussion of your service learning experience can take the place of your oral / visual component.

I. Sample project:
Student A, Student B Math 60 February 31, 2014
Gun deaths in the U.S.

Guns are a big topic in the news right now, so our group decided to examine this topic in our project, because I don't think people realize that gun violence has gone down! We found data based on the number of people killed by a gun in the U.S. per 100,000 people.

Below is a graph* from 1960 to 2008 showing the number of assault deaths per 100K people in the U.S. From this graph, I chose the ordered pairs: (2001,7) and (2005, 6).

Figure 1

X, Years after 2000	Y, Assault deaths per 100K population
1	7
5	6

Table 1

*http://www.washingtonpost.com/blogs/wonkblog/wp/2012/07/23/six-facts-about-guns-violence-and-gun-control/

As described in Table 1, in the year 2001, out of 100,000 people in the U.S., 7 people were killed. In the year 2005, four years later, there were only 6 people killed out of 100,000. This is a decline of one person per 100K over four years.

The equation for the line between these two points would be $y = -0.25x + 7.25$ where x is the years after 2000 and y is the number of assault deaths per 100,000. Here the slope of -0.25 represents the decline per year (a drop of one fourth of a person per year). The y-intercept of 7.25 represents the value for y, when x is zero (or in the year 2000). This means that based on this model, 7.25 people per 100,000 people would be killed by assault with a gun in the year 2000.

We wanted to predict if the trend would continue, so we used the model to predict the number of deaths by assault weapon in the year 2012. Our model suggests it would be:

$$\begin{aligned} y &= -0.25(12) + 7.25 \\ &= -3 + 7.25 \\ &= 4.25 \end{aligned}$$

This suggests that there would be only 4.25 people per 100000 people killed in 2012 using our model. We tried to compare that number with the actual number, but we couldn't find that information.

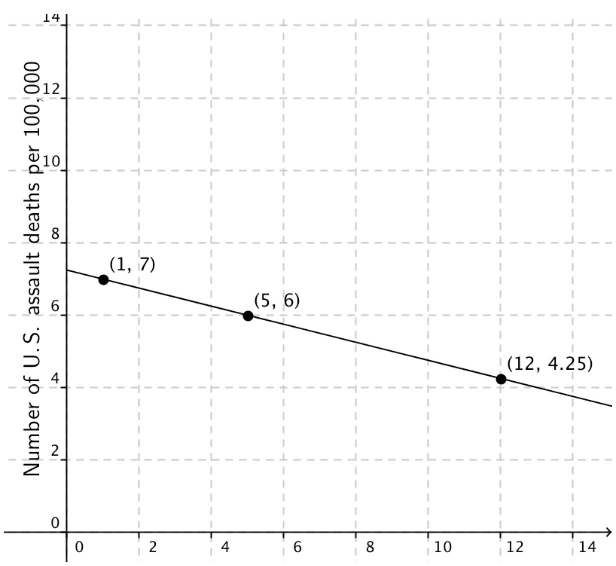


Figure 2

In conclusion, we believe the incidents of deadly assault by gun will continue to go down until we are relatively equal with other countries. Also, in doing this research, we found that Mexico had the highest incident and has been higher than the U.S. for several years.

D

Core Outcomes Mapping

⟨sec:app:coreoutcomes⟩

Mapping Level Indicators:

0. Not Applicable.
1. Limited demonstration or application of knowledge and skills.
2. Basic demonstration and application of knowledge and skills.
3. Demonstrated comprehension and is able to apply essential knowledge and skills.
4. Demonstrates thorough, effective and/or sophisticated application of knowledge and skills.

Core Outcomes (CO):

1. Communication.
2. Community and Environmental Responsibility.
3. Critical Thinking and Problem Solving.
4. Cultural Awareness.
5. Professional Competence.
6. Self-Reflection.

course	name	CO1	CO2	CO3	CO4	CO5	CO6
MTH 20	Basic Math	2	0	3	0	3	3
MTH 30	Business Mathematics I	2	0	3	0	3	3
MTH 60	Introductory Algebra, 1st term	2	0	3	0	3	3
MTH 61	Introductory Algebra, Part I	2	0	3	0	3	3
MTH 62	Introductory Algebra, Part II	2	0	3	0	3	3
MTH 63	Introductory Algebra, Part III	2	0	3	0	3	3
MTH 65	Introductory Algebra, 2nd term	2	0	3	0	3	3
MTH 70	Introduction to Intermediate Algebra	2	0	3	0	3	3
MTH 84	Introduction to $\LaTeX$	3	0	4	0	0	1
MTH 91	Intermediate Algebra, Part I	2	0	3	0	3	3
MTH 92	Intermediate Algebra, Part II	2	0	3	0	3	3
MTH 93	Intro to TI Graphics Calculator	1	0	1	0	2	1
MTH 95	Intermediate Algebra	2	0	3	0	3	3
MTH 105	Explorations in Mathematics	2	0	3	0	2	2
MTH 111	College Algebra	2	0	3	0	3	3
MTH 112	Elementary Functions	2	0	3	0	3	3
MTH 211	Foundations of Elementary Math I	3	0	3	0	3	2
MTH 212	Foundations of Elementary Math II	3	0	3	0	3	2
MTH 213	Foundations of Elementary Math III	3	0	3	0	3	2
MTH 241	Calculus for Management	2	0	3	0	2	1
MTH 243	Statistics I	3	1	4	0	3	3
MTH 244	Statistics II	3	1	4	0	3	3

MTH 251	Calculus I	2	0	3	0	3	2
MTH 252	Calculus II	2	0	3	0	3	2
MTH 253	Calculus III	2	0	3	0	3	2
MTH 254	Calculus IV	2	0	3	0	3	2
MTH 256	Differential Equations	2	0	3	0	3	1
MTH 261	Applied Linear Algebra	2	0	3	0	3	2

E

Distance Learning Successful Completions

⟨app:sec:dlsuccess⟩

Data represent Fall 2011, Winter 2012 and Spring 2012 courses taught both on-campus and through distance learning; courses enrolling fewer than twenty students are excluded.

The following is an overview of success rates in courses taught through distance learning. All delivery methods (i.e. online, TV/Web, etc.) are combined as 'distance learning' with courses delivered online representing the majority of instruction.

The average pass rate (grades A, B, C, P) of distance learning credit courses is 69.5%. Career technical education and lower division transfer DL courses have similar pass rates of 72% and 70%, while developmental education DL rates average less than 50%. These statistics are based on hundreds of DL courses enrolling thousands of students.

Course level data reveals variations in success rates that are not obvious in college wide averages. The following tables highlight some examples. Table E.1 shows some courses that have high success rates, and Table E.2 highlights some examples that have low success rates.

TABLE E.1: Sample *high* success rates

lsuccess⟩

	Course	DL Enrollments	% Pass %
CA	PL 224	28	100.00%
CA	AD 270b	32	100.00%
CA	FP 122	37	100.00%
CA	PL 103	55	95.00%
CA	FP 202	32	94.00%
RC	MUS 105	85	93.00%
SY	BA 206	76	92.00%
SY	GS 108	35	91.00%
SY	WR 227	144	90.00%
SY	BA 212	163	90.00%

TABLE E.2: Sample *low* success rates

⟨app:tab:lowdlsuccess⟩

	Course	DL Enrollments	% Pass %
SY	MTH 111	103	16.00%
SY	MTH 95	50	16.00%
RC	CHLA 201	97	31.00%
CA	MTH 20	132	35.00%
CA	CG 140A	80	35.00%
RC	MTH 111	235	36.00%
RC	MTH 112	60	37.00%
SY	MTH 70	137	37.00%
RC	BA 250	42	38.00%
RC	MTH 60	236	39.00%

F

Demographic data

sec:demographicdata⟩ Tables F.1 to F.10 (on the pages that follow) show demographic data for the academic years 2008 through 2013.

08–2009)?

TABLE F.1: Demographic data for 2008–2009 (Pre-college level MTH and statistics)

2008–2009	MTH 20			MTH 60			MTH 65			MTH 95			MTH 243			MTH 244		
	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass
Headcount	3,650		70 %	6,039		69 %	4,006		74 %	3,540		72 %	1,780			692		
Female	2,209	61 %	75 %	3,266	55 %	72 %	2,282	58 %	75 %	1,965	56 %	73 %	1,021	58 %	80 %	354	52 %	87 %
Male	1,409	39 %	64 %	2,711	45 %	65 %	1,679	42 %	72 %	1,529	44 %	70 %	735	42 %	80 %	327	48 %	83 %
	3,618			5,977			3,961			3,494			1,756			681		
White	2,067	64 %	74 %	3,857	75 %	70 %	2,611	76 %	73 %	2,261	75 %	73 %	1,091	71 %	81 %	381	65 %	86 %
Asian	180	6 %	77 %	312	6 %	69 %	225	7 %	75 %	290	10 %	74 %	202	13 %	77 %	90	15 %	89 %
Hispanic	358	11 %	70 %	445	9 %	68 %	308	9 %	78 %	236	8 %	63 %	91	6 %	73 %	36	6 %	86 %
Black	459	14 %	55 %	343	7 %	50 %	158	5 %	61 %	127	4 %	60 %	56	4 %	66 %	24	4 %	63 %
Native American	78	2 %	59 %	112	2 %	64 %	69	2 %	67 %	47	2 %	74 %	16	1 %	56 %	9	2 %	78 %
Pacific Islander	2	0 %	50 %	2	0 %	0 %	0	0 %	0 %	0	0 %	0 %	1	0 %	0 %	0	0 %	0 %
Multiracial	39	1 %	59 %	54	1 %	41 %	27	1 %	67 %	19	1 %	74 %	9	1 %	100 %	3	1 %	33 %
Foreign/International	24	1 %	79 %	37	1 %	81 %	35	1 %	89 %	36	1 %	86 %	69	4 %	91 %	45	8 %	91 %
	3,207			5,162			3,433			3,016			1,535			588		
Age: 19 & less	1,380	38 %	65 %	2,223	37 %	65 %	1,333	33 %	68 %	1,138	32 %	64 %	370	75 %	75 %	134	19 %	80 %
20-24	812	22 %	68 %	1,440	24 %	68 %	1,057	26 %	69 %	1,000	28 %	69 %	617	76 %	76 %	265	38 %	82 %
25-29	532	15 %	79 %	985	16 %	73 %	700	17 %	81 %	657	19 %	80 %	385	85 %	85 %	147	21 %	88 %
30-39	558	15 %	76 %	877	15 %	74 %	593	15 %	81 %	529	15 %	79 %	300	86 %	86 %	103	15 %	92 %
40-49	244	7 %	77 %	375	6 %	71 %	239	6 %	82 %	170	5 %	81 %	86	83 %	83 %	32	5 %	94 %
50+	124	3 %	71 %	138	2 %	70 %	84	2 %	77 %	46	1 %	83 %	22	82 %	82 %	11	2 %	82 %

TABLE F.2: Demographic data for 2008–2009 (College level MTH)

2008–2009	MTH 111A			MTH 111 B&C			MTH 112			MTH 251			MTH 252			MTH 253			MTH 254		
	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass
Headcount	14			2,849			984		71 %	641		75 %	470		77 %	301		80 %	186		84 %
Female	8	62 %	63 %	1,464	52 %	77 %	321	33 %	73 %	193	30 %	80 %	128	28 %	81 %	61	21 %	82 %	36	20 %	94 %
Male	5	38 %	80 %	1,353	48 %	73 %	654	67 %	71 %	441	70 %	74 %	336	72 %	75 %	235	79 %	80 %	148	80 %	81 %
	13			2,817			975			634			464			296			184		
			67 %																		
White	6	67 %	100 %	1,786	74 %	75 %	613	74 %	72 %	387	72 %	76 %	279	71 %	82 %	186	72 %	80 %	116	73 %	87 %
Asian	2	22 %	100 %	270	11 %	81 %	104	13 %	70 %	70	13 %	83 %	53	14 %	79 %	35	14 %	94 %	22	14 %	86 %
Hispanic	1	11 %	0 %	154	6 %	70 %	43	5 %	65 %	25	5 %	64 %	21	5 %	71 %	11	4 %	91 %	9	6 %	78 %
Black	0	0 %	0 %	80	3 %	58 %	27	3 %	78 %	26	5 %	54 %	15	4 %	40 %	4	2 %	100 %	4	3 %	75 %
Native American	0	0 %	0 %	50	2 %	66 %	12	1 %	67 %	5	1 %	60 %	6	2 %	83 %	2	1 %	100 %	0	0 %	0 %
Pacific Islander	0	0 %	0 %	0	0 %	0 %	0	0 %	0 %	0	0 %	0 %	0	0 %	0 %	0	0 %	0 %	0	0 %	0 %
Multiracial	0	0 %	0 %	24	1 %	63 %	9	1 %	56 %	4	1 %	50 %	1	0 %	100 %	0	0 %	0 %	0	0 %	0 %
Foreign/International	0	0 %		62	3 %	87 %	19	2 %	84 %	21	4 %	90 %	17	4 %	100 %	19	7 %	74 %	8	5 %	88 %
	9			2,426			827			538			392			257			159		
Age: 19 & less	4	29 %	83 %	894	31 %	69 %	307	31 %	64 %	169	26 %	70 %	124	26 %	73 %	84	28 %	88 %	42	23 %	88 %
20-24	6	43 %	0 %	907	32 %	75 %	311	32 %	68 %	194	30 %	76 %	141	30 %	78 %	89	30 %	72 %	58	31 %	84 %
25-29	0	0 %	67 %	518	18 %	82 %	179	18 %	77 %	134	21 %	79 %	105	22 %	82 %	66	22 %	83 %	47	25 %	81 %
30-39	3	21 %	0 %	376	13 %	79 %	142	14 %	84 %	117	18 %	76 %	79	17 %	81 %	49	16 %	82 %	30	16 %	80 %
40-49	0	0 %	100 %	121	4 %	79 %	36	4 %	78 %	21	3 %	90 %	19	4 %	68 %	12	4 %	67 %	8	4 %	88 %
50+	1	7 %	7 %	33	1 %	88 %	9	1 %	89 %	5	1 %	40 %	2	0 %	0 %	1	0 %	100 %	1	1 %	100 %

Table F.3: Demographic data for 2009–2010 (Pre-college level MTH and statistics)

2009–2010	MTH 20			MTH 60			MTH 65			MTH 95			MTH 243			MTH 244		
	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass
Headcount	4,673		68 %	7,714		67 %	5,190		72 %	4,352		72 %	2,219		80 %	859		83 %
Female	2,744	59 %	71 %	3,931	51 %	69 %	2,814	55 %	73 %	2,361	55 %	74 %	1,272	58 %	83 %	441	52 %	85 %
Male	1,876	41 %	63 %	3,706	49 %	65 %	2,327	45 %	71 %	1,948	45 %	70 %	926	42 %	76 %	404	48 %	83 %
	4,620			7,637			5,141			4,309			2,198			845		
White	2,660	63 %	71 %	4,951	73 %	68 %	3,363	75 %	73 %	2,787	75 %	73 %	1,359	73 %	80 %	504	69 %	85 %
Asian	188	4 %	74 %	352	5 %	74 %	257	6 %	72 %	262	7 %	76 %	244	13 %	85 %	101	14 %	87 %
Hispanic	422	10 %	71 %	566	8 %	66 %	372	8 %	68 %	308	8 %	66 %	90	5 %	70 %	43	6 %	84 %
Black	636	15 %	52 %	502	7 %	45 %	260	6 %	61 %	182	5 %	66 %	54	3 %	74 %	27	4 %	70 %
Native American	98	2 %	65 %	121	2 %	64 %	89	2 %	66 %	68	2 %	63 %	26	1 %	69 %	13	2 %	85 %
Pacific Islander	16	0 %	69 %	33	0 %	61 %	15	0 %	53 %	5	0 %	40 %	4	0 %	75 %	0	0 %	0 %
Multiracial	148	4 %	55 %	197	3 %	59 %	91	2 %	65 %	55	1 %	65 %	21	1 %	81 %	7	1 %	71 %
Foreign/International	23	1 %	87 %	47	1 %	85 %	38	1 %	87 %	44	1 %	84 %	68	4 %	81 %	35	5 %	89 %
	4,191			6,769			4,485			3,711			1,866			730		
Age: 19 & less	1,519	33 %	63 %	2,414	31 %	64 %	1,537	30 %	63 %	1,246	29 %	65 %	424	19 %	73 %	133	15 %	77 %
20-24	979	21 %	69 %	1,820	24 %	68 %	1,328	26 %	71 %	1,178	27 %	68 %	706	32 %	77 %	336	39 %	84 %
25-29	763	16 %	72 %	1,443	19 %	70 %	1,001	19 %	78 %	831	19 %	79 %	525	24 %	84 %	198	23 %	86 %
30-39	805	17 %	71 %	1,330	17 %	69 %	919	18 %	80 %	784	18 %	79 %	416	19 %	87 %	135	16 %	85 %
40-49	430	9 %	72 %	500	6 %	67 %	298	6 %	82 %	237	5 %	80 %	120	5 %	84 %	44	5 %	84 %
50+	177	4 %	69 %	207	3 %	65 %	107	2 %	78 %	76	2 %	74 %	28	1 %	75 %	13	2 %	77 %

Table F.4: Demographic data for 2009–2010 (College level MTH). Note that MTH 111A had 0 enrollment for 2009–2010, so its data is not displayed.

2009–2010	MTH 111 B&C			MTH 112			MTH 251			MTH 252			MTH 253			MTH 254		
	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass
Headcount	3,507			1,236		68 %	780		73 %	520		79 %	359		81 %	217		86 %
Female	1,767	51 %	75 %	406	33 %	68 %	210	27 %	72 %	137	26 %	83 %	85	24 %	86 %	47	22 %	91 %
Male	1,704	49 %	78 %	819	67 %	68 %	565	73 %	73 %	380	74 %	78 %	273	76 %	79 %	169	78 %	84 %
	3,471			1,225			775			517			358			216		
White	2,225	75 %	78 %	784	75 %	65 %	481	72 %	72 %	315	75 %	82 %	237	80 %	80 %	139	76 %	85 %
Asian	263	9 %	76 %	128	12 %	74 %	88	13 %	67 %	58	14 %	84 %	32	11 %	84 %	21	12 %	90 %
Hispanic	196	7 %	73 %	55	5 %	78 %	31	5 %	74 %	14	3 %	71 %	10	3 %	70 %	7	4 %	100 %
Black	111	4 %	65 %	24	2 %	79 %	17	3 %	71 %	12	3 %	67 %	5	2 %	100 %	5	3 %	60 %
Native American	49	2 %	71 %	12	1 %	33 %	7	1 %	71 %	2	0 %	50 %	1	0 %	0 %	2	1 %	100 %
Pacific Islander	5	0 %	60 %	1	0 %	0 %	1	0 %	0 %	0	0 %	0 %	0	0 %	0 %	0	0 %	0 %
Multiracial	45	2 %	80 %	15	1 %	60 %	8	1 %	63 %	2	0 %	100 %	2	1 %	100 %	1	1 %	100 %
Foreign/International	54	2 %	96 %	31	3 %	84 %	31	5 %	81 %	19	5 %	95 %	11	4 %	91 %	7	4 %	100 %
	2,948			1,050			664			422			298			182		
Age: 19 & less	988	28 %	75 %	383	31 %	60 %	208	27 %	71 %	118	23 %	74 %	73	20 %	78 %	36	16 %	86 %
20-24	1,070	31 %	75 %	376	30 %	67 %	245	31 %	71 %	176	34 %	78 %	114	32 %	78 %	63	29 %	81 %
25-29	680	19 %	79 %	229	19 %	76 %	171	22 %	77 %	115	22 %	92 %	84	23 %	86 %	56	26 %	93 %
30-39	575	16 %	81 %	168	14 %	73 %	120	15 %	73 %	83	16 %	76 %	66	18 %	80 %	49	22 %	86 %
40-49	143	4 %	80 %	59	5 %	71 %	28	4 %	64 %	22	4 %	68 %	18	5 %	89 %	14	6 %	86 %
50+	51	1 %	71 %	21	2 %	86 %	8	1 %	88 %	7	1 %	86 %	4	1 %	100 %	1	0 %	0 %

TABLE F.5: Demographic data for 2010–2011 (Pre-college level MTH and statistics)

2010–2011	MTH 20			MTH 60			MTH 65			MTH 95			MTH 243			MTH 244		
	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass
Headcount	4,590		66 %	7,937		66 %	5,519		72 %	4,814		71 %	2,330		79 %	904		82 %
Female	2,604	57 %	70 %	4,137	53 %	69 %	2,971	54 %	74 %	2,571	54 %	72 %	1,302	56 %	79 %	473	53 %	86 %
Male	1,970	43 %	61 %	3,727	47 %	63 %	2,496	46 %	70 %	2,197	46 %	70 %	1,005	44 %	78 %	423	47 %	78 %
	4,574			7,864			5,467			4,768			2,307			896		
White	2,604	61 %	69 %	5,155	71 %	68 %	3,681	74 %	73 %	3,113	73 %	71 %	1,422	70 %	79 %	521	66 %	82 %
Asian	156	4 %	76 %	305	4 %	72 %	266	5 %	76 %	306	7 %	78 %	214	11 %	79 %	94	12 %	90 %
Hispanic	422	10 %	67 %	555	8 %	64 %	381	8 %	72 %	313	7 %	69 %	146	7 %	71 %	65	8 %	78 %
Black	607	14 %	47 %	534	7 %	44 %	269	5 %	64 %	187	4 %	60 %	76	4 %	75 %	28	4 %	79 %
Native American	89	2 %	67 %	145	2 %	61 %	90	2 %	73 %	84	2 %	63 %	21	1 %	71 %	6	1 %	33 %
Pacific Islander	35	1 %	69 %	45	1 %	64 %	24	0 %	79 %	25	1 %	80 %	12	1 %	75 %	0	0 %	0 %
Multiracial	305	7 %	69 %	473	7 %	64 %	244	5 %	71 %	188	4 %	69 %	63	3 %	75 %	20	3 %	80 %
Foreign/International	39	1 %	79 %	51	1 %	90 %	38	1 %	92 %	57	1 %	86 %	78	4 %	79 %	55	7 %	84 %
	4,257			7,263			4,993			4,273			2,032			789		
Age: 19 & less	1,386	30 %	65 %	2,383	30 %	66 %	1,497	27 %	69 %	1,313	27 %	68 %	422	18 %	73 %	115	13 %	81 %
20-24	1,021	22 %	64 %	1,966	25 %	65 %	1,460	26 %	68 %	1,345	28 %	66 %	727	31 %	76 %	334	37 %	79 %
25-29	779	17 %	70 %	1,473	19 %	68 %	1,097	20 %	74 %	979	20 %	77 %	535	23 %	81 %	216	24 %	82 %
30-39	759	17 %	67 %	1,333	17 %	68 %	981	18 %	78 %	848	18 %	77 %	470	20 %	83 %	178	20 %	87 %
40-49	412	9 %	63 %	542	7 %	67 %	356	6 %	78 %	256	5 %	75 %	141	6 %	85 %	51	6 %	86 %
50+	233	5 %	72 %	239	3 %	59 %	128	2 %	78 %	72	1 %	69 %	35	2 %	80 %	10	1 %	80 %

TABLE F.6: Demographic data for 2010–2011 (College level MTH). Note that MTH 111A had 0 enrollment for 2010–2011, so its data is not displayed.

2010–2011	MTH 111 B&C			MTH 112			MTH 251			MTH 252			MTH 253			MTH 254		
	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass
Headcount	3,885			1,469		68 %	967		77 %	652		77 %	380		84 %	231		81 %
Female	1,971	51 %	73 %	487	34 %	67 %	266	28 %	77 %	134	21 %	78 %	74	19 %	85 %	55	24 %	84 %
Male	1,880	49 %	72 %	964	66 %	69 %	693	72 %	77 %	514	79 %	77 %	306	81 %	84 %	175	76 %	81 %
	3,851			1,451			959			648			380			230		
White	2,447	72 %	73 %	936	74 %	68 %	586	72 %	77 %	395	72 %	78 %	234	71 %	83 %	150	75 %	80 %
Asian	285	8 %	73 %	119	9 %	76 %	102	13 %	76 %	64	12 %	81 %	42	13 %	93 %	24	12 %	92 %
Hispanic	238	7 %	68 %	74	6 %	65 %	41	5 %	68 %	29	5 %	69 %	23	7 %	87 %	6	3 %	100 %
Black	147	4 %	59 %	30	2 %	47 %	18	2 %	56 %	10	2 %	60 %	3	1 %	100 %	5	3 %	60 %
Native American	57	2 %	58 %	10	1 %	90 %	9	1 %	78 %	7	1 %	43 %	2	1 %	100 %	1	1 %	100 %
Pacific Islander	14	0 %	86 %	3	0 %	100 %	3	0 %	33 %	1	0 %	0 %	1	0 %	100 %	0	0 %	0 %
Multiracial	132	4 %	73 %	53	4 %	57 %	23	3 %	70 %	18	3 %	67 %	6	2 %	50 %	4	2 %	75 %
Foreign/International	69	2 %	90 %	46	4 %	70 %	34	4 %	97 %	24	4 %	79 %	18	5 %	94 %	10	5 %	80 %
	3,389			1,271			816			548			329			200		
Age: 19 & less	967	25 %	74 %	466	32 %	65 %	244	25 %	77 %	152	23 %	79 %	81	21 %	86 %	39	17 %	82 %
20-24	1,152	30 %	68 %	385	26 %	63 %	266	28 %	76 %	188	29 %	72 %	102	27 %	85 %	72	31 %	82 %
25-29	826	21 %	74 %	310	21 %	75 %	225	23 %	81 %	163	25 %	81 %	114	30 %	82 %	67	29 %	79 %
30-39	669	17 %	75 %	234	16 %	71 %	177	18 %	72 %	113	17 %	77 %	63	17 %	89 %	43	19 %	91 %
40-49	209	5 %	75 %	61	4 %	72 %	47	5 %	81 %	33	5 %	67 %	18	5 %	78 %	9	4 %	56 %
50+	61	2 %	69 %	13	1 %	69 %	8	1 %	63 %	3	0 %	100 %	2	1 %	50 %	1	0 %	0 %

TABLE F.7: Demographic data for 2011–2012 (Pre-college level MTH and statistics)

2011–2012	MTH 20			MTH 60			MTH 65			MTH 95			MTH 243			MTH 244		
	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass
Headcount	5,129			8,319			5,756			5,092			2,509			1,004		
Female	2,886	57 %	69 %	4,239	51 %	67 %	3,072	54 %	70 %	2,699	54 %	71 %	1,439	58 %	79 %	491	49 %	82 %
Male	2,198	43 %	61 %	4,009	49 %	64 %	2,625	46 %	71 %	2,343	46 %	68 %	1,053	42 %	77 %	505	51 %	80 %
	5,084			8,248			5,697			5,042			2,492			996		
White	2,843	60 %	68 %	5,175	68 %	67 %	3,685	70 %	71 %	3,241	70 %	70 %	1,569	71 %	78 %	585	66 %	83 %
Asian	160	3 %	79 %	293	4 %	72 %	238	5 %	78 %	316	7 %	72 %	223	10 %	83 %	103	12 %	90 %
Hispanic	440	9 %	70 %	587	8 %	67 %	412	8 %	74 %	327	7 %	69 %	124	6 %	75 %	47	5 %	74 %
Black	685	14 %	49 %	561	7 %	49 %	280	5 %	58 %	200	4 %	59 %	75	3 %	60 %	33	4 %	70 %
Native American	69	1 %	51 %	114	1 %	59 %	86	2 %	65 %	73	2 %	70 %	25	1 %	76 %	11	1 %	91 %
Pacific Islander	36	1 %	72 %	62	1 %	68 %	48	1 %	67 %	37	1 %	68 %	6	0 %	67 %	3	0 %	100 %
Multiracial	468	10 %	63 %	749	10 %	67 %	440	8 %	68 %	338	7 %	67 %	102	5 %	82 %	36	4 %	81 %
Foreign/International	44	1 %	82 %	72	1 %	82 %	62	1 %	79 %	74	2 %	85 %	93	4 %	82 %	73	8 %	78 %
	4,745			7,613			5,251			4,606			2,217			891		
Age: 19 & less	1,603	31 %	65 %	2,579	31 %	69 %	1,625	28 %	67 %	1,470	29 %	68 %	412	16 %	77 %	146	15 %	80 %
20-24	1,140	22 %	66 %	2,080	25 %	63 %	1,509	26 %	68 %	1,411	28 %	66 %	819	33 %	75 %	372	37 %	79 %
25-29	804	16 %	66 %	1,454	17 %	67 %	1,137	20 %	72 %	947	19 %	72 %	561	22 %	81 %	217	22 %	81 %
30-39	879	17 %	66 %	1,417	17 %	66 %	1,002	17 %	76 %	897	18 %	75 %	525	21 %	80 %	205	20 %	86 %
40-49	484	9 %	61 %	551	7 %	65 %	353	6 %	78 %	280	5 %	70 %	151	6 %	77 %	50	5 %	80 %
50+	218	4 %	67 %	237	3 %	55 %	129	2 %	73 %	87	2 %	70 %	41	2 %	80 %	14	1 %	86 %

TABLE F.8: Demographic data for 2011–2012 (College level MTH). Note that MTH 111A, B, and C courses were combined into MTH 111 starting in this AY.

2011–2012	MTH 111			MTH 112			MTH 251			MTH 252			MTH 253			MTH 254		
	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass
Headcount	3,725			1,617			983			722			423			314		
Female	1,938	53 %	66 %	573	36 %	67 %	282	29 %	78 %	159	22 %	78 %	77	18 %	81 %	50	16 %	86 %
Male	1,747	47 %	67 %	1,035	64 %	70 %	691	71 %	76 %	559	78 %	77 %	345	82 %	80 %	263	84 %	86 %
	3,685			1,608			973			718			422			313		
White	2,393	72 %	67 %	1,059	75 %	69 %	620	74 %	78 %	454	73 %	79 %	266	73 %	78 %	192	75 %	90 %
Asian	259	8 %	74 %	116	8 %	67 %	72	9 %	72 %	52	8 %	75 %	34	9 %	94 %	25	10 %	88 %
Hispanic	209	6 %	57 %	64	5 %	67 %	46	5 %	65 %	42	7 %	79 %	19	5 %	63 %	14	5 %	86 %
Black	114	3 %	46 %	34	2 %	65 %	20	2 %	60 %	17	3 %	59 %	6	2 %	50 %	2	1 %	100 %
Native American	43	1 %	58 %	8	1 %	75 %	5	1 %	80 %	2	0 %	50 %	2	1 %	100 %	2	1 %	100 %
Pacific Islander	18	1 %	50 %	2	0 %	0 %	2	0 %	50 %	2	0 %	50 %	1	0 %	100 %	2	1 %	50 %
Multiracial	204	6 %	66 %	81	6 %	68 %	43	5 %	63 %	27	4 %	81 %	21	6 %	57 %	6	2 %	100 %
Foreign/International	83	2 %	75 %	43	3 %	77 %	35	4 %	86 %	26	4 %	81 %	16	4 %	81 %	12	5 %	67 %
	3,323			1,407			843			622			365			255		
Age: 19 & less	1,023	27 %	67 %	482	30 %	67 %	252	26 %	77 %	178	25 %	84 %	87	21 %	80 %	57	18 %	84 %
20-24	1,081	29 %	62 %	449	28 %	65 %	270	27 %	75 %	206	29 %	70 %	117	28 %	73 %	88	28 %	80 %
25-29	723	19 %	71 %	325	20 %	73 %	223	23 %	74 %	168	23 %	78 %	111	26 %	84 %	85	27 %	88 %
30-39	666	18 %	69 %	276	17 %	74 %	182	19 %	81 %	130	18 %	81 %	84	20 %	85 %	64	20 %	94 %
40-49	181	5 %	65 %	72	4 %	72 %	43	4 %	74 %	31	4 %	65 %	17	4 %	76 %	17	5 %	88 %
50+	48	1 %	60 %	13	1 %	62 %	13	1 %	69 %	9	1 %	78 %	7	2 %	71 %	3	1 %	100 %

TABLE F.9: Demographic data for 2012–2013 (Pre-college level MTH and statistics)

2012–2013	MTH 20			MTH 60			MTH 65			MTH 95			MTH 243			MTH 244		
	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass
Headcount	4,534			7,505			5,615			5,105			2,287			885		
Female	2,545	57 %	69 %	3,840	52 %	68 %	2,987	54 %	71 %	2,735	54 %	69 %	1,334	59 %	77 %	479	54 %	86 %
Male	1,926	43 %	62 %	3,599	48 %	64 %	2,583	46 %	69 %	2,322	46 %	68 %	939	41 %	76 %	402	46 %	82 %
	4,471			7,439			5,570			5,057			2,273			881		
White	2,400	57 %	67 %	4,622	67 %	68 %	3,503	68 %	71 %	3,187	68 %	70 %	1,440	69 %	78 %	516	67 %	83 %
Asian	151	4 %	87 %	296	4 %	76 %	262	5 %	74 %	313	7 %	76 %	187	9 %	79 %	85	11 %	84 %
Hispanic	403	10 %	73 %	553	8 %	67 %	422	8 %	69 %	339	7 %	65 %	122	6 %	71 %	54	7 %	85 %
Black	634	15 %	52 %	533	8 %	50 %	296	6 %	56 %	215	5 %	58 %	62	3 %	61 %	23	3 %	83 %
Native American	64	2 %	61 %	87	1 %	62 %	66	1 %	64 %	73	2 %	58 %	22	1 %	68 %	9	1 %	89 %
Pacific Islander	45	1 %	69 %	57	1 %	65 %	32	1 %	56 %	36	1 %	64 %	10	0 %	70 %	3	0 %	100 %
Multiracial	488	12 %	64 %	737	11 %	64 %	542	10 %	68 %	467	10 %	65 %	142	7 %	70 %	47	6 %	83 %
Foreign/International	26	1 %	85 %	50	1 %	92 %	39	1 %	77 %	54	1 %	89 %	88	4 %	83 %	37	5 %	92 %
	4,211			6,935			5,162			4,684			2,073			774		
Age: 19 & less	1,384	31 %	67 %	2,374	32 %	71 %	1,610	29 %	68 %	1,465	29 %	68 %	406	18 %	81 %	132	15 %	90 %
20-24	996	22 %	68 %	1,807	24 %	63 %	1,482	26 %	69 %	1,412	28 %	65 %	712	31 %	74 %	334	38 %	80 %
25-29	679	15 %	63 %	1,254	17 %	67 %	1,029	18 %	70 %	924	18 %	71 %	518	23 %	76 %	174	20 %	81 %
30-39	785	17 %	67 %	1,293	17 %	64 %	981	17 %	72 %	900	18 %	71 %	454	20 %	80 %	181	20 %	87 %
40-49	458	10 %	60 %	547	7 %	61 %	369	7 %	75 %	324	6 %	72 %	158	7 %	74 %	47	5 %	94 %
50+	232	5 %	66 %	230	3 %	54 %	143	3 %	73 %	79	2 %	67 %	39	2 %	74 %	17	2 %	88 %

TABLE F.10: Demographic data for 2012–2013 (College level MTH).

12–2013)?

2012–2013	MTH 111			MTH 112			MTH 251			MTH 252			MTH 253			MTH 254		
	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass	Total	% Total	% Pass
Headcount	4,278			1,613			1,060			710			446			219		
Female	2,167	51 %	63 %	540	34 %	69 %	273	26 %	79 %	173	24 %	79 %	98	22 %	80 %	44	20 %	80 %
Male	2,079	49 %	66 %	1,060	66 %	71 %	776	74 %	79 %	534	76 %	75 %	347	78 %	81 %	174	80 %	83 %
	4,246			1,600			1,049			707			445			218		
White	2,696	69 %	66 %	1,025	70 %	71 %	647	69 %	79 %	444	72 %	76 %	281	75 %	81 %	142	74 %	85 %
Asian	279	7 %	72 %	146	10 %	73 %	103	11 %	79 %	52	8 %	73 %	29	8 %	76 %	17	9 %	71 %
Hispanic	260	7 %	60 %	68	5 %	72 %	44	5 %	82 %	32	5 %	63 %	18	5 %	78 %	8	4 %	88 %
Black	164	4 %	50 %	41	3 %	61 %	20	2 %	60 %	13	2 %	46 %	5	1 %	80 %	3	2 %	67 %
Native American	60	2 %	50 %	18	1 %	67 %	8	1 %	75 %	5	1 %	40 %	1	0 %	100 %	1	1 %	0 %
Pacific Islander	24	1 %	75 %	7	0 %	71 %	3	0 %	67 %	1	0 %	100 %	1	0 %	100 %	0	0 %	0 %
Multiracial	343	9 %	63 %	116	8 %	64 %	79	8 %	78 %	48	8 %	77 %	26	7 %	85 %	10	5 %	90 %
Foreign/International	95	2 %	72 %	37	3 %	92 %	34	4 %	94 %	24	4 %	83 %	13	3 %	69 %	11	6 %	73 %
	3,921			1,458			938			619			374			192		
Age: 19 & less	1,156	27 %	64 %	483	30 %	68 %	285	27 %	80 %	161	23 %	74 %	87	20 %	82 %	29	13 %	86 %
20-24	1,295	30 %	59 %	458	28 %	71 %	318	30 %	76 %	213	30 %	76 %	127	29 %	83 %	67	31 %	79 %
25-29	810	19 %	67 %	334	21 %	72 %	233	22 %	78 %	166	23 %	78 %	111	26 %	80 %	53	24 %	81 %
30-39	736	17 %	68 %	248	15 %	72 %	170	16 %	82 %	129	18 %	72 %	78	18 %	87 %	60	27 %	83 %
40-49	232	5 %	71 %	70	4 %	77 %	44	4 %	77 %	32	5 %	81 %	23	5 %	83 %	9	4 %	89 %
50+	49	1 %	69 %	20	1 %	75 %	10	1 %	70 %	9	1 %	78 %	9	2 %	78 %	1	0 %	100 %

G

Do online homework systems aid retention?

p:sec:onlinehwstudy⟩

1 Overview

During the 2012/2013 school year Wendy Fresh and Jessica Bernards ran a study in their online MTH 60 and MTH 111 courses to see if using an online homework system, instead of the traditional method of paper/pencil homework, would aid in the retention of online students. Each instructor taught multiple sections of the same course. Each course was set up almost identical in nature with the exact same lecture notes, exams, and quizzes, with the exception of the method of homework: some sections did homework out of the textbook along with 4 homework write-ups (the traditional setup), while others only used the online homework system, MyMathLab (MML), for homework with no homework write-ups. The weights of each grade category were the same in all classes and all exams were graded together.

2 Summary of Results for the MTH 111 study

The quantitative results of the study are shown in Table G.1.

TABLE G.1: MTH 111: Traditional vs. MML

ab:onlinehwstudy111⟩

Traditional, Fall and Winter Terms 2012/13, 66 Students	MML Winter and Spring Terms 2013, 99 students
Textbook HW/Homework write-ups	Homework submitted via MyMathLab
Final Grade Average: 64.27	Final Grade Average: 68.5
Final Grade Median: 70	Final Grade Median: 71.02
39/66 Failed (59%), (21 of these students were Ws)	47/99 Failed (48%), (16 of these students were Ws)
Final Exam Average: 66.33	Final Exam Average: 68.5
Final Exam Median: 69	Final Exam Median: 71.5
Midterm Exam Average: 72.8	Midterm Exam Average: 72.12
Midterm Exam Median: 73	Midterm Exam Median: 73

Please keep in mind that these are low sample sizes but there are some interesting things to note:

- In the MTH 111 courses, there wasn't a big difference between grades on exams, except for a 4% average difference in student overall final grades. However, when looking at the fail rates of the courses, the MyMathLab group had an 11% lower fail rate thus helping with retention.

- Additionally, in the MTH 111 courses a higher percentage of students stuck with the class until the end in the MyMathLab courses, compared to the traditional sections. Only 16% of students withdrew from the MML courses compared to 32% in the traditional courses.

3 Summary of Results for the MTH 60 study

The quantitative results of the study are broken down in Table G.2. Please keep in mind that these are low sample sizes but there are some interesting things to note:

TABLE G.2: MTH 60: Traditional vs. MML

⟨app:tab:onlinehwstudy60⟩

Traditional, Winter 2013, 27 students	MML, Winter 2013 25 students
Homework write-ups, bi-weekly Final Grade Average: 65.53 Final Grade Median: 69.94 16/27 Failed (59%), (5 of these students were Ws and 3 of these students didn't complete course)	Homework submitted via MML, weekly Final Grade Average: 71.45 Final Grade Median: 74.05 11/25 Failed (44%), (5 of these students were Ws and 5 of these students didn't complete course)
Traditional, Spring 2013, 26 students	MML, Spring 2013, 27 students
Homework write-ups, bi-weekly Final Grade Average: 58.82 Final Grade Median: 66.43 17/26 Failed (65%), (5 of these students were Ws, 4 of these students didn't complete course, 2 Is)	Homework submitted via MML, weekly Final Grade Average: 63.29 Final Grade Median: 69.75 17/27 Failed (63%), (6 of these students were Ws and 3 of these students didn't complete course)
Traditional, Summer 2013, 42 students	MML, Summer 2013, 37 students
Homework write-ups, bi-weekly Final Grade Average: 60.81 Final Grade Median: 68.72 27/42 Failed (64%), (12 of these students were Ws and 4 of these students didn't complete course)	Homework submitted via MML, weekly Final Grade Average: 62.55 Final Grade Median: 67.83 23/37 Failed (62%), (9 of these students were Ws and 1 of these students didn't complete course)

In summary:

- The Final Grade Average went up on average by 4.3% in each MyMathLab course.
- The Fail Rates went down on average 5.6% in each of the MyMathLab courses.

Some things we noticed in our classes that don't show in the data:

- Students in the MML classes were much more engaged in the discussion board posts and posted more often than the traditional classes.
- Students in the MML courses asked more in depth questions about the mathematical content and asked questions more often throughout the term.

H

ALEKS pilot

⟨app:sec:aleks⟩

1 MTH 20 Several classes during 2012–2013 AY (Edwards)

The pilot includes the extensive use of ALEKS, a technology based assessment learning system, in 2 on campus and 2 online classes each term.

Course logistics:

- Students are walked through an introduction to the system and given an assessment.
- Students are then provided with a very clear visual pie chart showing them what they know.
- ALEKS then provides students the opportunity to work on a range of instructor chosen topics at their current level. Student only work on concepts they have not mastered.
- Explanations and videos are provided with each topic.
- Students are provided instant feedback and instant online teaching.
- Students are not given the option to skip work that they have not mastered, essentially forcing them to learn the material and fill in the concepts gaps that they began the class with.
- Students are routinely assessed with new topics available as they move through the course.
- Students are in the computer lab working on ALEKS throughout the class period.
- Students (generally for whom the material is recent) have the ability to move ahead.

Results and Statistics

I'm reflecting only Fall term math 20 students; this was a definite pilot. A variety of changes were incorporated into Winter and Spring terms which included additional lectures and assignments that had each class more closely resemble more traditional class.

- Students loved the instant feedback.
- Students enjoyed the ability to work in the ALEKS system, choosing their topics, and getting ahead when desired. There were very, very few complaints about the system.
- Students became aware of how much time they studied, with a clear visual of the relationship between study time and learning.
- FOUR students last term completed the math 20 material, moved on to math 60 material, took and passed my math 60 final exam.

On Campus Classes:

- 78% of students passed math 20 last Fall compared to 89% using ALEKS (7am class result was 63% passed using ALEKS).
- Of those that went on to math 60: 60% passed last Fall compared to 69% using ALEKS (7am class result: 13% passed, 1 in 8).

DL Classes:

- 62% of students passed math 20 last Fall compared to 71% using ALEKS.
- Of those that went on to math 60: 61% passed last Fall compared to 46% using ALEKS.

2 Pilot in Math 112 during Winter 2013 (Louie)

The most beneficial aspect of ALEKS was the instant feedback and the chance for students to fill in the holes of their prerequisite knowledge. Regretfully, I can only provide data from a rather small survey; I compared one class (no ALEKS) to two classes (with ALEKS). The data from the ALEKS classes were averaged and compared with non ALEKS class; here is a summary of my findings:

- there was no distinction for either grade distribution or overall pass rate between classes;
- in all three classes the pass rate was 73% which is well above the current 57% campus average pass rate;
- the attrition rate for non-ALEKS classes was 32%. The ALEKS class averaged a mere 14.7%;
- when students were asked how they agreed with the statement, “ALEKS helped me learn the concepts in this course”, 82.2% responded that they agreed or strongly agreed;
- when students were asked how they agreed with the statement, “ALEKS helped me learn concepts from previous math courses”, 75% of the students responded that they agreed or strongly agreed.

The data may suggest that ALEKS has the potential to keep students working towards a goal and less likely to withdraw from the course. Another benefit is the ability to track time spent on required homework. The maximum (average) time spent on ALEKS was 15.4 hours and the minimum 1.6 hours per week. It was beneficial to gauge the amount of work students completed outside of class. Students could only earn full credit if they completed all of the homework which forced them to keep up with the course material. Lectures seemed to flow with little interruption.

Despite my lack of data to support higher grades, I feel that ALEKS was beneficial to the students. I had originally planned to track how students performed in the next class, 1st term Calculus. However, I found little difference in the pass rate of ALEKS students than those of non-ALEKS students.

While my sample may be too small to draw statistical significance the effect that ALEKS had on student success, I feel that the overall outcome was positive. Student feedback suggested that they enjoyed using the program and felt that they were able to learn the concepts taught in the class. Lastly, the lower attrition rate may suggest students stayed involved in the class longer than those that did not use ALEKS.

I

AMP Data Collection

⟨app:sec:ampdata⟩ Cascade Campus data from AMP sections offered since 2010.

- Among students that took both a pre– and post–AMP test, 92% had an increased math compass score; 55.7% were placed at a higher math–level course.
- For students at the MTH 20 level who took the post–AMP test, 78.4% of students passed MTH 20, versus 62.8% of students who did not enroll in the AMP class.
- For students at the MTH 60 level who took the post–AMP test, 65.9% of students passed MTH 60, versus 61.6% of students who did not enroll in the AMP class.
- For students at the MTH 95 level who took the post–AMP test, 66.3% of students passed MTH 95, versus 64.4% of students who did not enroll in the AMP class.

J

Effectiveness of self-paced math (ALC 61, 62, 63)

⟨app:sec:effectivenessALC⟩ Table J.1 provides the pass rates for other math courses that ALC Math students enrolled in pre–ALC and post–ALC. Enrollment in some math courses for ALC students was low. However, the courses with the highest enrollment were MTH 20, MTH 60, MTH 65 and MTH 95.

This comparison of math courses taken pre- and post-ALC Math suggest that ALC Math had a positive impact on a student's ability to pass other math courses, increasing the pass rate from 38% to 52%.

TABLE J.1: Pass rates for ALC Math students in other math courses

⟨app:tab:effectivenessALC⟩

	Pre-ALC Math		Post-ALC Math	
	Frequency	Percent	Frequency	Percent
Math 20	47	44.00%	26	52.00%
Math 30			1	50.00%
Math 60	21	27.00%	35	54.00%
Math 61	3	60.00%	9	53.00%
Math 62	1	25.00%	3	43.00%
Math 63	1	100.00%	1	100.00%
Math 65	10	37.00%	17	50.00%
Math 70	1	20.00%	1	33.00%
Math 91			1	100.00%
Math 93	1	100.00%	2	100.00%
Math 95	6	43.00%	7	50.00%
Math 111			0	0
Math 111B			2	33.00%
Math 111C			1	100.00%
Math 243			2	67.00%
Math 244			1	100.00%

K

Enrollment summaries (by term and campus)

⟨sec:app:enrollment⟩

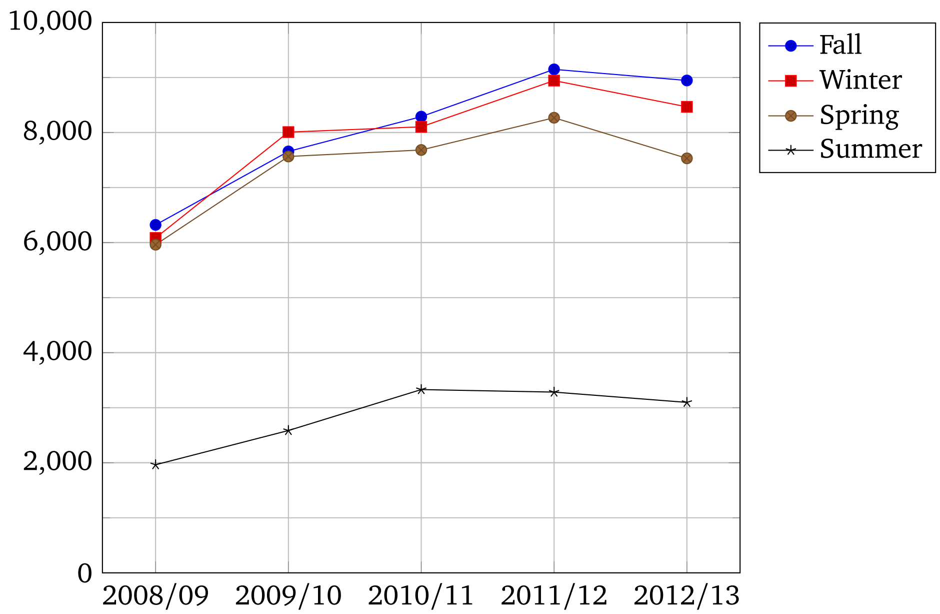


FIGURE K.1: Enrollment in Developmental MTH by Term

TABLE K.1: Success rates by term and year

:successratesbyterm⟩

	Success rates					
	AY2008	AY2009	AY2010	AY2011	AY2012	AY2013
Fall	69.85%	67.63%	69.36%	65.90%	64.40%	61.74%
Winter	69.47%	69.54%	70.30%	67.75%	62.41%	63.60%
Spring	67.33%	67.29%	64.49%	64.49%	59.89%	60.99%
Summer	72.65%	70.86%	66.86%	68.20%	64.49%	62.44%

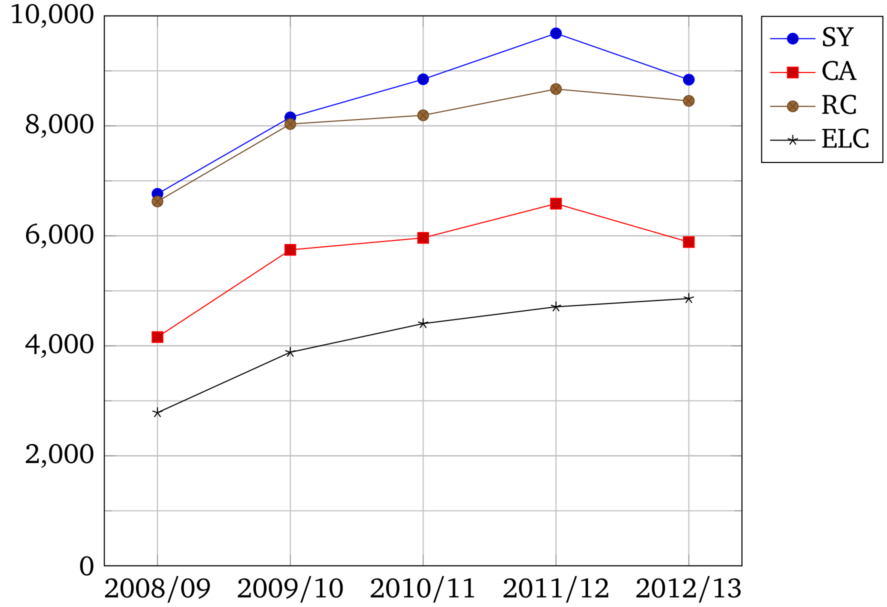


FIGURE K.2: Enrollment by campus and year, College Wide, Developmental Math

:enrollmentDevelopCampus⟩

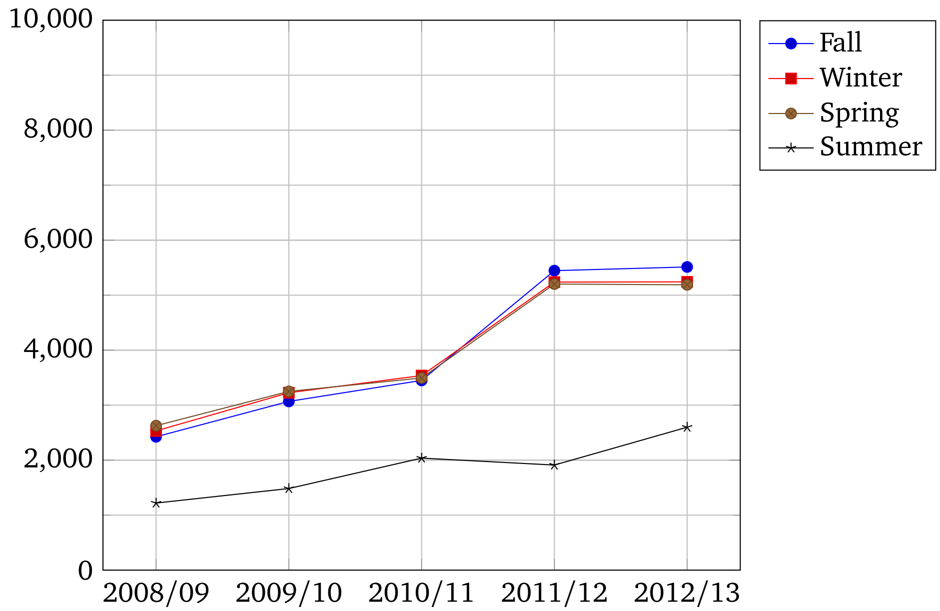


FIGURE K.3: Enrollment in LDC, College Wide, by term

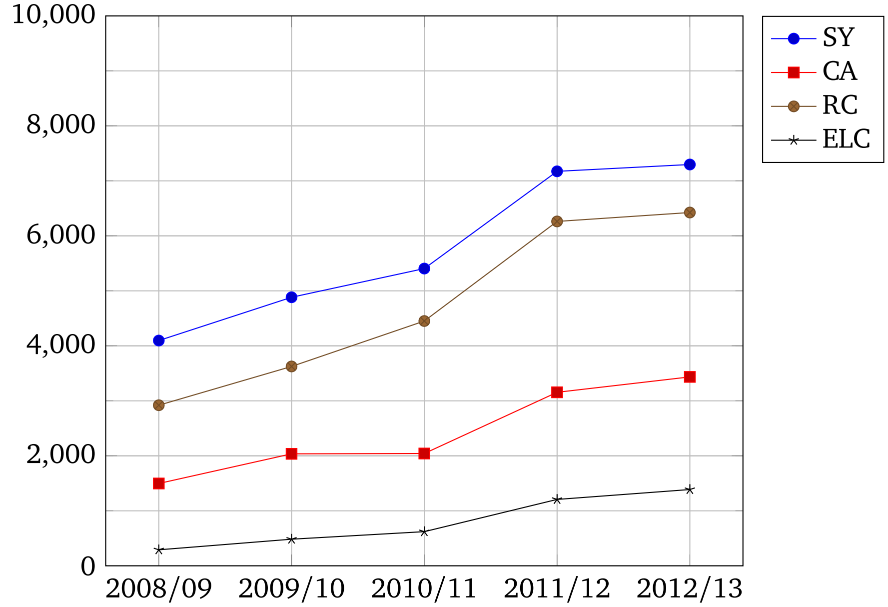


FIGURE K.4: Enrollment in LDC MTH by campus

enrollmentLDCCampus⟩

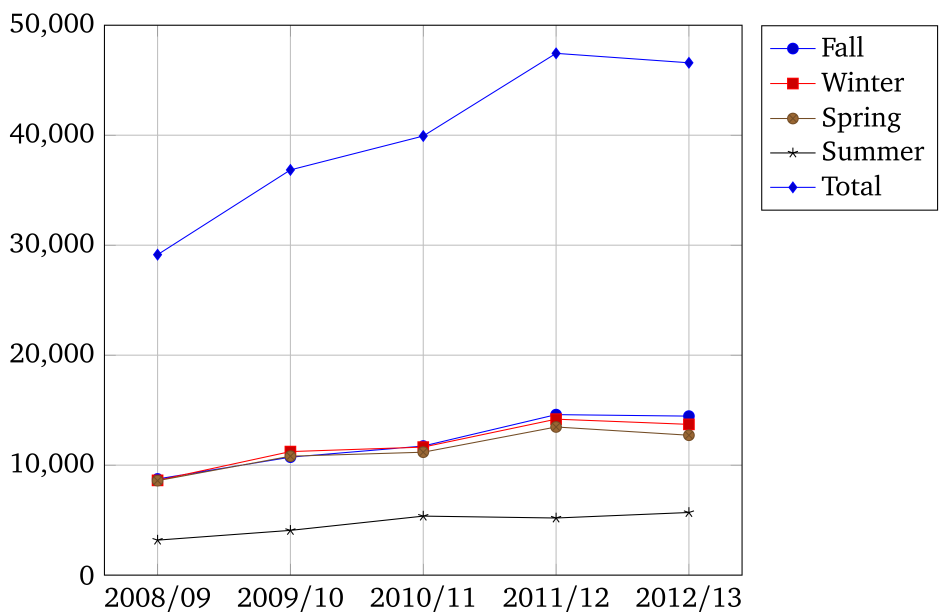


FIGURE K.5: Combined Math enrollment, College Wide, by term and year

totalenrollmentTerm⟩

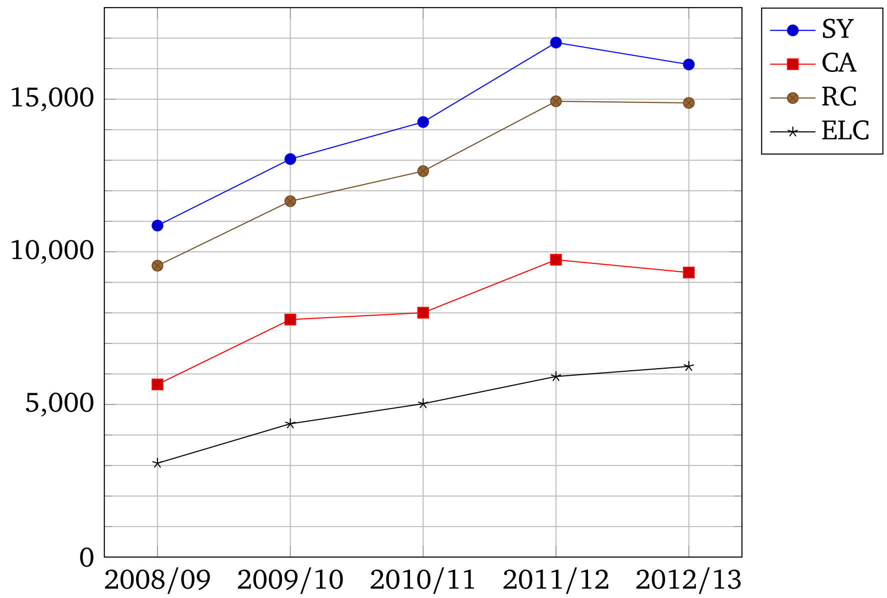


FIGURE K.6: Enrollment trends by campus (combined MTH)

fig:totalenrollmentCampus⟩

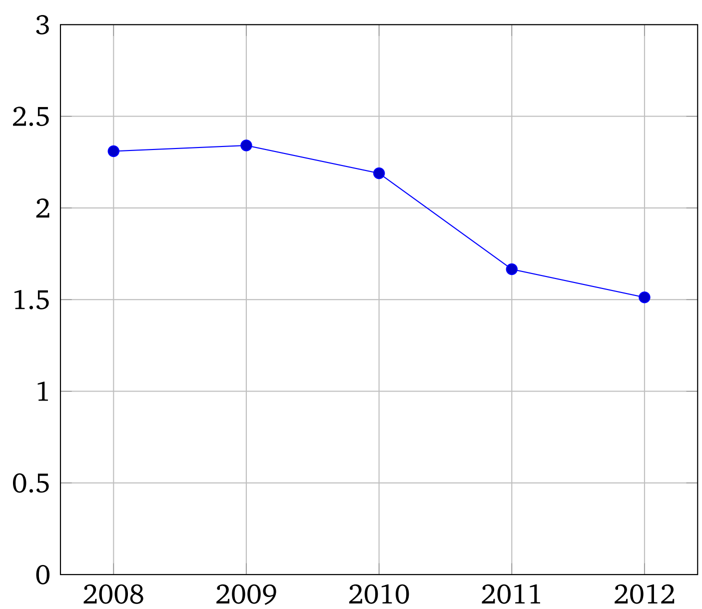


FIGURE K.7: Ratio of Developmental MTH enrollment to LDC MTH enrollment

app:fig:ratioDevelopToLDC⟩

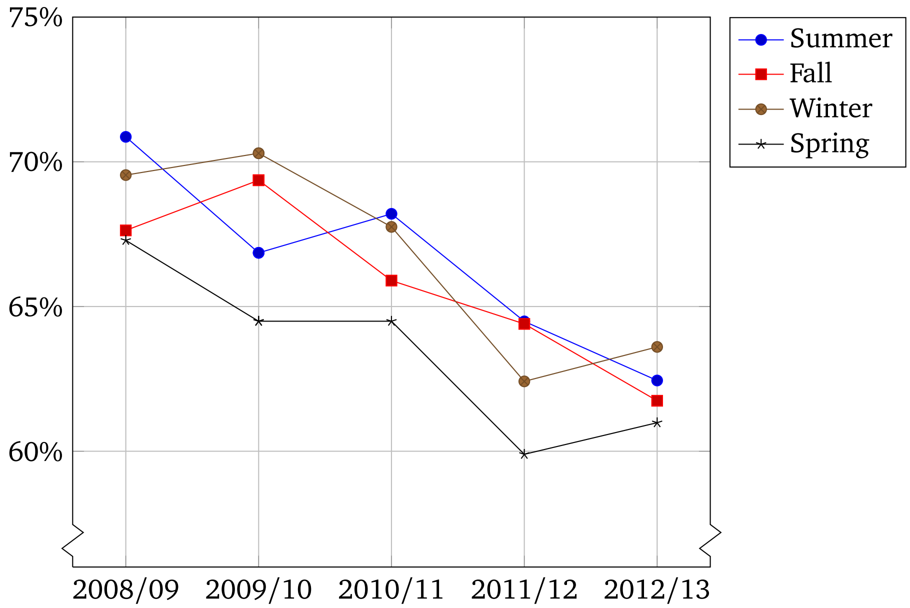


FIGURE K.8: Success rates by year and term

L

Class size report

⟨app:sec:classsize⟩ *The report on the following pages was submitted to the DOIs.*

MATHEMATICS SAC CLASS SIZE RECOMMENDATION

A report prepared for the Math SAC and DOI's

Portland Community College

CONTENTS

BACKGROUND INFORMATION

According to the PCC Faculty Federation,

ARTICLE 26 – PARTICIPATION & COLLEGE SERVICE

26.24 Class Size. The SAC will periodically review class size limits with regard to both instructional soundness and fiscal responsibility. Recommendations for changes will be stated in writing. The SAC and Administrative Supervisor(s) will then reach written consensus (see Article 1.06) regarding any revised limits. Any revisions will be established prior to schedule input deadlines.

At a Math SAC meeting on February 10th, information about class sizes at other colleges and class sizes at PCC was shared. Table 1 below shows class cap size data that was collected from department chairs across the state.

Table 1

Community College	Math 20	Math 60/65	Math 95	Math 111 or higher
Clackamas	30	35	35	35
Clark	30	30	30	35
Mt. Hood	34	34	34	34
Chemeketa	35	35	35	35
Linn-Benton	45 (see note)	35	35	35
Lane	31	31	36	36
Central Oregon	25	35	35	35
Blue Mountain	25	25	25	25
Rogue	30	30	30	30
Treasure Valley	24-30	24-30	24-30	24-30
Portland Community College	35	38	36	38

Note: Linn-Benton's MTH 20 classes have a cap of 45. For each MTH 20 class, there is one instructor, one assistant instructor, and three instructional aides.

Exceptions: A couple of colleges reported smaller caps for the 211-213 sequence (LBCC - 24, LCC - 31). LBCC also has a cap of 30 for statistics courses. LCC has a cap of 28 for their discrete math course.

Table 3 shows the average class size for PCC Math Classes at each campus from Fall 2011 along with the Week 4 Actual Class Size. The concern among faculty was not over the average Cap size, it was over the trend of increasing class sizes. In particular, some class caps were set as high as 38 students. The concern is that larger class sizes are adversely affecting the learning environment of the students. Larger class sizes make it harder to have effective group work sessions and activities in the classroom. Larger classes also make it harder for the teacher to effectively work individually with students. The different class caps at different campuses create an inequity among student learning experiences. As a SAC that values consistency in our program, we feel that as much as possible, class sizes should be consistent (at least in maximum size) so that students can get a consistent educational experience.

Table 3

Campus	**Cap size (Average)**	**Week 4 Actual**
Sylvania	33.7	30.8
Cascade	32.1	31.4
Rock Creek	30.2	26.8
ELC	28.2	27.4
District Wide	31.5	29.1

Table 2

Class	Cap Size	Maximum Week 4 Enrollment[1]
Math 20	35	37
Math 60/65	38	44
Math 61,62,63,91, 92	35	37
Math 70	38	38
Math 93	38	18
Math 95	36	42
Math 111/112	38	46
Math 243/244	35	35
Math 251	35	34
Math 252-254, 256, 261	38	38

[1] Highest enrollment among all sections, campus wide.

As a result of the February 10th , 2012 meeting, the SAC suggested to the DOI's lowering class caps to no more than 35 students while a committee worked to find reasonable class sizes.

> *"The SAC recommends face to face class sizes be changed to no more than 35 starting summer 2012. A committee will be formed to investigate appropriate class sizes. The committee will make their recommendations prior to the deadline for the fall 2012 schedule."*

On April 16th, 2012 we received the following administrative response:

> *Rather than make a decision for summer that may not continue after consideration of the overall review, we'll wait for the MTH SAC's complete report on this subject. Since Summer registration doesn't begin until 15 May, we have time to adjust summer enrollment limits before students begin to register. In conducting the overall review, we would appreciate consideration of how enrollment limits might be reduced, maintained, or increased to provide as close to an enrollment-neutral position as possible. For example, enrollment limits in MTH 20 might be reduced and limits in DL offerings might be increased.*

COMMITTEE RECCOMENDATIONS

A committee was formed to investigate appropriate class sizes and met on March 3rd 2012. A survey of faculty was sent out and 60 faculty members (32 part-time and 28 full-time) responded. Most faculty members were supportive of smaller class sizes in regards to how smaller class sizes would better serve students. The results from this survey can be found in the appendix.

The Mathematics SAC believes that creating class caps that are below our current maximum of 38 students per class will improve the learning environment and college experience for our students. Here are some of the reasons we (the Math SAC) recommend this:

- We believe that group work is an important part of the mathematics classroom. This is related to PCC's core outcome of **Community and Environmental Responsibility and Communication.** Large class sizes do not lend themselves to group work very well because the instructor is unable to give each group enough attention. For example, if you have 8 groups of 4, you can spend 3.75 minutes per group in a 30 minute session. If you have 10 groups of 4, you can only spend 3 minutes per group in a 30 minute session.
- We believe that feedback and assessment is an important part of the learning process. The quality and frequency of feedback can be reduced as class sizes get larger and instructors try to manage their workload. Instructors may choose to give fewer assessments and assignments in a larger class because of the increased workload.
- Quality feedback on things like format and notation cannot be automated. We believe that quality feedback can be useful to improving student work. This is related to PCC's core outcome of **Communication.**

- Timely feedback—if a student is to learn from and correct their mistakes, they need to get their work back in a timely manner. Increasing class sizes could decrease the likelihood that students will receive their work back promptly.
- We believe that questions are an important part of the learning process. In larger classes, students tend to feel they are unable to get all of their questions answered. This was a trend that we noticed in our student survey. Further results will be discussed in our program review.
- Students expect consistency among their classes. Class sizes fluctuate from campus to campus and from class to class at the same campus. We know that not a lot can be done about small class sizes or small classrooms, but we can do something about large class sizes.
- Students have noticed the increase in class sizes (see Responses from Student Survey)
- Students expect lower class sizes at a community college than at a university. While our class sizes/caps are lower in some cases, they are higher in many others. In particular, we have higher class caps in Math 70 and Math 105. Our class caps are very similar to PSU's for Math 111, 112, and 252-256. See Table 4 in the appendix.
- Both the MAA and AMATYC recommend class sizes of no more than 30 students (see Reccomendations from National Mathematics Associations later in this document).

The Math SAC also believes that creating class caps are important for the faculty. High class sizes diminish our ability to serve students and the college effectively. Here is why we think class caps are important for faculty.

- Work load equity. Class sizes for the same class range from 24 students to 38 students. For a full time faculty member, it would be possible to have anywhere from 100-152 students per term. We know that variation is expected. For faculty who are on the higher side of student contact hours, we find it harder to manage group work in class, difficult to complete our student work (such as grading) outside of the class, and manage our many committee responsibilities.

After discussing the results of the Math SAC survey and having follow-up conversations with faculty, the class size subcommittee came up with the following recommendations. In most cases, the class size was set at 32, but in some cases it was set lower (reasons given below).

- Math 20 is a fast paced course with a lot of curriculum. Although it is intended as a review course, many students enter without the necessary pre-requisite skills or have gaps in their knowledge. There needs to be adequate time for student questions. In addition, smaller class sizes allow for more group work and more individual attention.
- Math 61-63 is a slower version of the Math 60/65 sequence. Anxiety and behavioral issues are frequent in this class. A smaller class size allows for the instructor to deal with these issues more effectively.
- Math 93 is the calculator instruction class. Questions are frequent and nearly always require individual attention with the instructor physically going to the student and looking at their calculator entry.
- Math 211-213 employs frequent group work. Class sizes were chosen so that there are no more than 7 groups of 4.
- Math 251 has a lab component where students are working in groups for 3 hours per week. Although a lab assistant is usually hired for classes with more than 25 students, it can still be hard to get to all groups with a lab assistant. The lab assistant should remain a part of the course. There is also a very high grading load with the lab component of this course. The labs are critical to developing student's mathematical communication and timely feedback is crucial to this development.
- Both the MAA and AAMATYC recommend class sizes of no more than 30 students.

Math Class	Recommended Class Size
30	32
20	28
60/65/70	32
61-63	24
91/92	24
93	24
95	32
105	32
111/112	32
211-213	28
243-244	32
251	28
252-256 **261**	32

SUPPORTING RESEARCH/DOCUMENTATION

RESEARCH ON CLASS SIZES/PEDAGOGY

Class size research is limited and often contradictory. Class size is only one factor in a myriad of factors that affect student success. Smaller class sizes do offer more opportunities for instructors to use innovative teaching techniques, for students to participate in meaningful group work and for students to know their peers and interact with their instructor.

Effects of a Syllabus Offer of Help, Student Age, and Class Size on College Students' Willingness to Seek Support from Faculty, Perrine and Lisle, Journal of Experimental Education, Fall95, Vol. 64 Issue 1, p41

> *As class size increases, students perceive teachers to be less concerned about students and less respectful of them. Students also perceive teachers of large classes to be less available and less helpful. If students perceive teachers of large classes to be less concerned about them and less available, they would be more hesitant to seek help from an instructor in a large class than in a smaller class.*

Overview of Class Size Research, Judy Shoemaker, DUE/Research and Evaluation, November 1, 2007

> *Research has shown that the following types of students benefit most from small classes: most able, those with low motivation, those with high affiliation needs, beginners in the subject matter, students from low economic backgrounds, and those predisposed to learn facts rather than apply or synthesize.*

Cohorts and Relatedness: Self-Determination Theory as an Explanation of How Learning Communities Affect Educational Outcomes, Beachboard, M., Beachboard, J., Li, W., & Adkison, S. (2011). Research In Higher Education, 52(8), 853-874. doi:10.1007/s11162-011-9221-8

> *Measuring **student** perceptions of the contributions of their institutions, the study found increased **relatedness** to peers and faculty and increased higher order thinking assignments (a control variable included in the research model) to be substantial predictors of educational outcomes relevant to literacy, critical thinking, and, especially, job preparation. The researchers suggest that institutions will want to ensure that their learning community designs enhance **student** feelings of **relatedness**.*

Classroom Organization and Participation: College Students' Perceptions, Robert R. Weaver; Jiang Qi, The Journal of Higher Education, Vol. 76, No. 5 (Sep. - Oct., 2005), pp. 570-601

> *Students who actively participate in the learning process learn more than those who do not. "Involvement matters," as Tinto (1997) points out, and this involvement can occur both inside and outside the classroom, … Active involvement in class facilitates critical thinking (Garside, 1996) and facilitates the retention of information that might otherwise be lost (Bransford, 1979). If student participation is so central to the learning process, why is participation in the college classroom frequently so low? What constrains the more active involvement of students? Scholars have identified a host of factors ranging from, for instance, class size, faculty authority, gender, age, student preparation, or student emotions such as confidence or fear.*

RECCOMENDATIONS FROM NATIONAL MATHEMATICS ASSOCIATIONS

The American Mathematical Association of Two-Year Colleges Guidelines for Mathematics Departments at two year colleges:

> *Mathematics departments should be adequately staffed to allow for a maximum class size of thirty students. Opportunity for frequent interaction between students and instructors should be provided, both in the classroom and in office consultations.*

The Mathematical Association of Americas Guidelines for Programs and Departments in Undergraduate Mathematical Sciences:

> *Departments must be provided with the resources necessary to deliver high quality teaching that includes the opportunity for students to interact frequently and nontrivially with their instructors. Departments should facilitate these personal interactions by avoiding the use of large lecture settings that require students to become passive audiences. The best way to encourage active student-faculty interactions and to enable faculty to give students individual attention is to provide a small-class environment with fewer than thirty students in each section. Also with restricted class size, faculty members gain flexibility to adopt a teaching style that best fits both the material to be learned and their students' needs.*

RESPONSES FROM FACULTY SURVEY

- Smaller class sizes allow us to devote more energy and attention to each student. This is especially important in the developmental math classes.
- I teach 20 a lot and it's demanding both for students and teacher, as well as involving many students with poor study skills and problematic attitudes, so... smaller is better. That way also we have more time to give detailed feedback on homework.
- I taught a Math 65 this term with 39 students. One of the best groups I have ever had, but even so, there were simply too many students for me to be able to adequately answer questions and work with individuals in class.
- Math 95 has both challenging material for students (less review than previous classes) and moves at quicker pace. For this reason a smaller class size would allow for more "at the board" activities or group interaction. Also this class requires instruction for CAS so this would be ideal on a smaller class size.

RESPONSES FROM STUDENT SURVEY

As part of PCC's assessment of core outcomes, the math department conducted a survey of students to measure self-reflection and professional competence. Here are some un-edited responses from students in reference to class sizes.

Think of a time in a math class where you have NOT experienced success. What prevented you from succeeding?

- I could not understand the concepts and it was hard to get help since it was a large class.

- Time to work on in-class activities is frustrating in a large class when it is a new topic and only once instructor to walk around and help. I find myself sitting for up to fifteen minutes at a time doing absolutely nothing, waiting for an instructor to help. It would be awesome if a teacher's aid were present during this time for additional help.
- large class sizes and teachers who taught straight out of a book.
- Too large of class size. A student becomes lost in a sea of people. The larger the class size, the more intimidated a person is to ask a question when they don't understand something. Hear that PCC? Stop trying to squeeze every last penny out of a classroom!

Think of a time in a math class where you have experienced success. What lead to that success?

- an engaging teacher and smaller class sizes.
- I learn better in small groups where there is not much noise.
- I think a clear understand of what the teacher is saying and working in groups helped me to understand the subject.

INSTITUTIONAL RESEARCH

It is very difficult to isolate class size as a factor in student success. There are many other factors to consider such as instructors, campus, time of day, previous college history, etc.

Using data from Fall 2011, we found the following information (see appendix for regression analysis) with regards to class size and success rates:

- There is a significant negative relationship between class size and success rates for Math 20 at Sylvania (where class sizes for Math 20 are higher than at other campuses). See

Table 4: PCC vs PSU Cap size and enrollment		
Class	PCC Cap /Actual Enrollment	PSU Cap /Actual Enrollment
70	38/34.5	30/29.5
95	36/30.1	40/33.3
105	38/28.33	35/29.5
111	38/30.3	40/37.7

112	38/30.1	40/38.75
211-213	38/18.75	35/20.6
251	35/27.9	40/35
252-256	38/25.3	40/37
261	34/24.5	50/46

- Table 5 for results. Sylvania does have significantly higher success rates for Math 20, so including their data with all campuses distorts any relationship between class size and success rates.
- There is a significant negative relationship between class size and success rates for Math 61-63 and 93 (we recommend smaller class sizes for these classes).
- There is a non-significant negative relationship between class size and success rates for Math 251.
- There is a negative relationship between class size and success rates for Math 211-213 but the sample size is too small for regression results to be valid.

FINANCIAL IMPLICATIONS

The financial implications of reduced class sizes were not thoroughly investigated by the committee or the SAC. We feel that increasing class sizes in not an appropriate response to increases in enrollment. Reducing class sizes *will* result in the need to increase the number of sections offered. Our calculations are based on dividing enrollment by the suggested cap size. Under this assumption, the fill rates for each campus will remain virtually unchanged. We do realize that there are limitations on room size and space that cannot be avoided and that this may change the number of sections needed.

We do agree that it is reasonable to ask instructors to take 1-2 students above their cap so as not to necessitate the need for an additional section. We do not agree with the administrative response to take up the excess students in our online classes. Distance education is not the best option for the vast majority of students and many of our DL classes are already at capacity. Offering more DL sections would in many cases mean taking an experienced instructor out of a classroom. **We are not recommending changing the distance learning cap sizes.**

WITHIN CAMPUS ENROLLMENT NEUTRAL

In order to remain enrollment neutral within campuses (based on actual enrollment from Fall 2011 provided by IE), the following sections would need to be added for a typical **fall term.** (Note: some of these recommendations are not based solely on a reduction of class size, but rather on a trend of high enrollment in these classes. In other words, some additional sections may have been needed regardless of a change in class size).

- Math 20: 3 sections at SY, 1 section at CA
- Math 60: 1 section at SY, 1 at CA
- Math 61/62/63: 1 section of each at either CA, SE or SY. There aren't enough students to justify a whole extra section at any one campus.
- Math 65: No additional sections needed.
- Math 70: 1 additional section needed district wide (either CA or SY)
- Math 95: 1 section at SY, 1 at CA

- Math 111: 0 at SY, 1 at CA
- Math 112: 0 at SY, 0 at CA
- Math 253: 1 section needed district wide

CONCLUSION

The mathematics SAC recommends lowering the class caps for our classes to create consistency between classes and campuses, increase the likelihood of teacher/student interaction and to create workload equity. Lower class sizes will serve our math students better because it will increase the quality of the instructional environment and learning experience. We believe our recommendations to be fair, thoughtful and justified. We look forward to your response.

APPENDIX (FIGURES, CHARTS AND DATA)

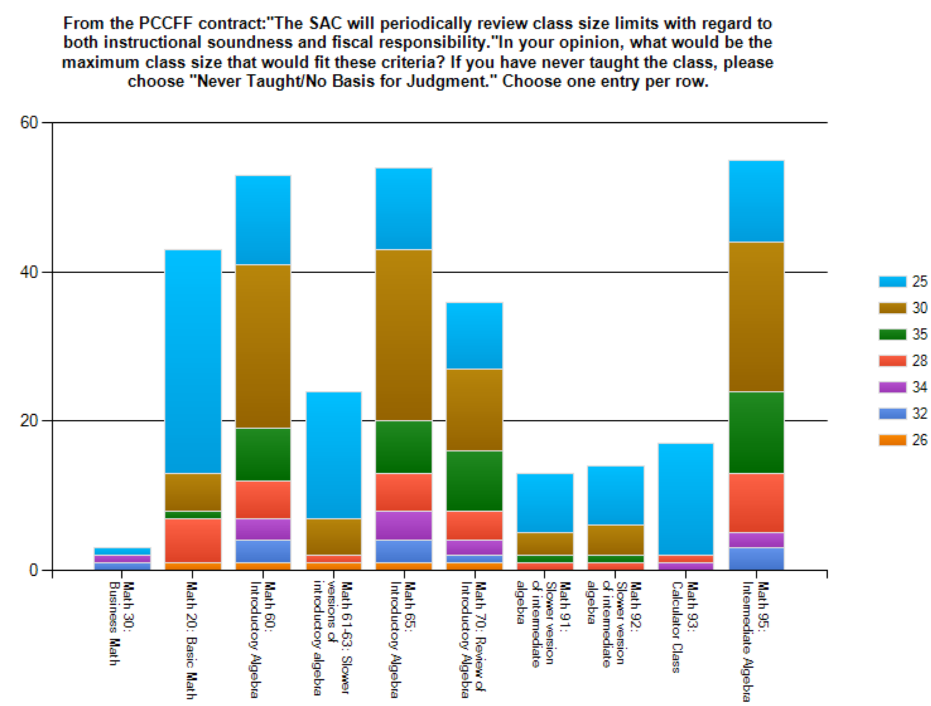


Figure 1: Faculty Class Size Responses for Pre-College Classes

From the PCCFF contract:"The SAC will periodically review class size limits with regard to both instructional soundness and fiscal responsibility."In your opinion, what would be the maximum class size that would fit these criteria? If you have never taught the class, please choose "Never Taught/No Basis for Judgment." Choose one entry per row.

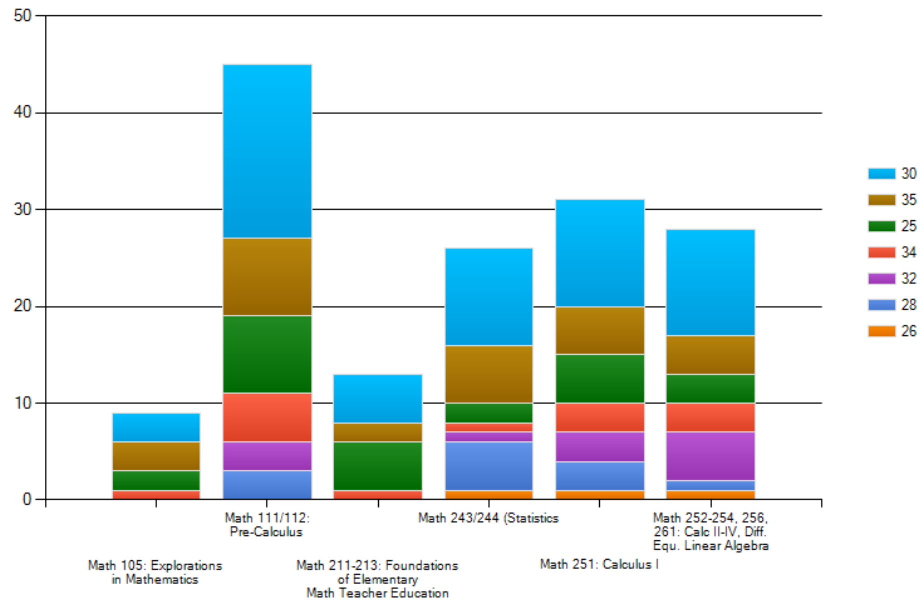


Figure 2: Faculty Class Size Responses for College Level (100+) Classes

Table 4: PCC vs PSU Cap size and enrollment		
Class	PCC Cap[2] /Actual Enrollment[3]	PSU Cap /Actual Enrollment
70	38/34.5	30/29.5
95	36/30.1	40/33.3
105	38/28.33	35/29.5
111	38/30.3	40/37.7
112	38/30.1	40/38.75
211-213	38/18.75	35/20.6
251	35/27.9	40/35
252-256	38/25.3	40/37
261	34/24.5	50[4]/46

[2] The maximum cap across all sections/campuses. Obtained from MyPCC and MyPDX

[3] The average class size across all sections/campuses (at the end of Week 4). Obtained from PCC IE and MyPDX

[4] Math 261 is a markedly different course at PSU with less content and lower pre-requisites.

Table 5: Regression Analysis for Math 20 at SY

Simple linear regression results:

Dependent Variable: Pass Rate

Independent Variable: Math20ClassSize@SY

Pass Rate = 136.29749 - 1.9686614 Math20ClassSize@SY

Sample size: 19

R (correlation coefficient) = -0.5495

R-sq = 0.30199733

Estimate of error standard deviation: 10.279198

Parameter estimates:

Parameter	Estimate	Std. Err.	Alternative	DF	T-Stat	P-Value
Intercept	136.29749	23.462055	≠ 0	17	5.809273	<0.0001
Slope	-1.9686614	0.7258946	≠ 0	17	-2.7120488	0.0148

Analysis of variance table for regression model:

Source	DF	SS	MS	F-stat	P-value
Model	1	777.16534	777.16534	7.355208	0.0148
Error	17	1796.2526	105.66191		
Total	18	2573.418			

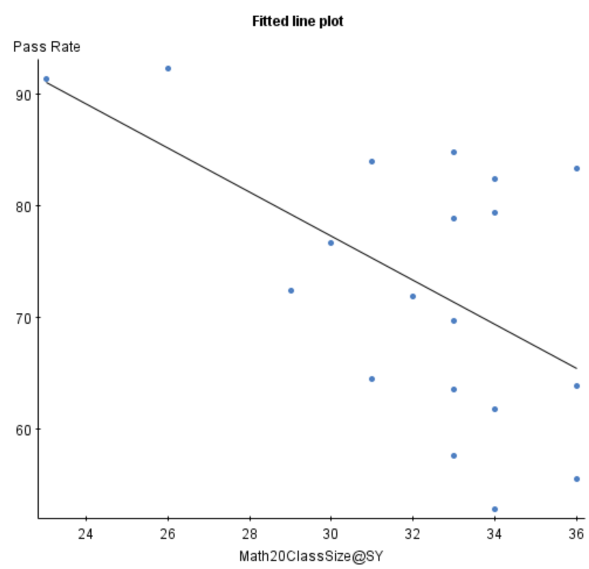


Table 6: Regression Analysis for Math 61-63, 93

Simple linear regression results:
Dependent Variable: Pass Rate
Independent Variable: Math61-63,93 Class Size
Pass Rate = 95.61773 - 1.2053437 Math61-63,93 Class Size
Sample size: 14
R (correlation coefficient) = -0.5199
R-sq = 0.27031055
Estimate of error standard deviation: 14.08319

Parameter estimates:

Parameter	Estimate	Std. Err.	Alternative	DF	T-Stat	P-Value
Intercept	95.61773	16.841545	≠ 0	12	5.6774917	0.0001
Slope	-1.2053437	0.5716863	≠ 0	12	-2.1084003	0.0567

Analysis of variance table for regression model:

Source	DF	SS	MS	F-stat	P-value
Model	1	881.6745	881.6745	4.4453526	0.0567
Error	12	2380.035	198.33623		
Total	13	3261.7092			

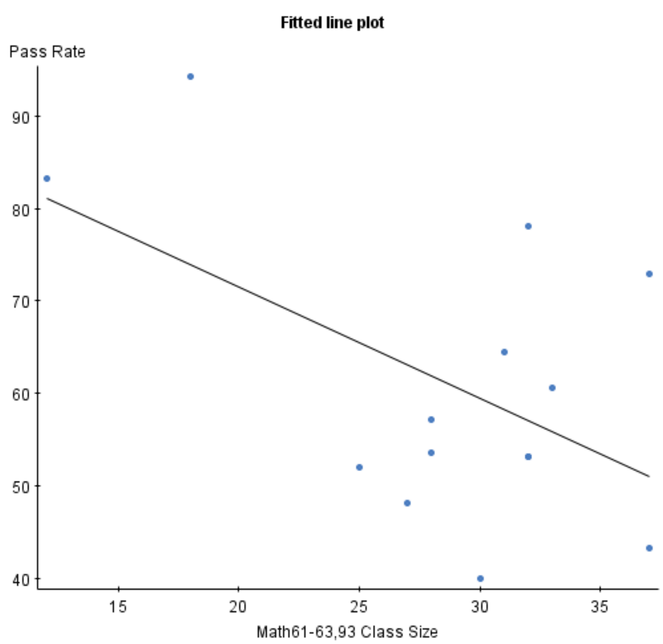


Table 7: Regression Analysis for Math 251

Simple linear regression results:
Dependent Variable: Success Rate
Independent Variable: Math 251 Class Size
Success Rate = 106.12736 - 1.2180774 Math 251 Class Size
Sample size: 12
R (correlation coefficient) = -0.4172
R-sq = 0.17406653
Estimate of error standard deviation: 11.075829

Parameter estimates:

Parameter	Estimate	Std. Err.	Alternative	DF	T-Stat	P-Value
Intercept	106.12736	23.91794	≠ 0	10	4.4371443	0.0013
Slope	-1.2180774	0.8390538	≠ 0	10	-1.4517275	0.1772

Analysis of variance table for regression model:

Source	DF	SS	MS	F-stat	P-value
Model	1	258.53696	258.53696	2.1075127	0.1772
Error	10	1226.7397	122.67397		
Total	11	1485.2766			

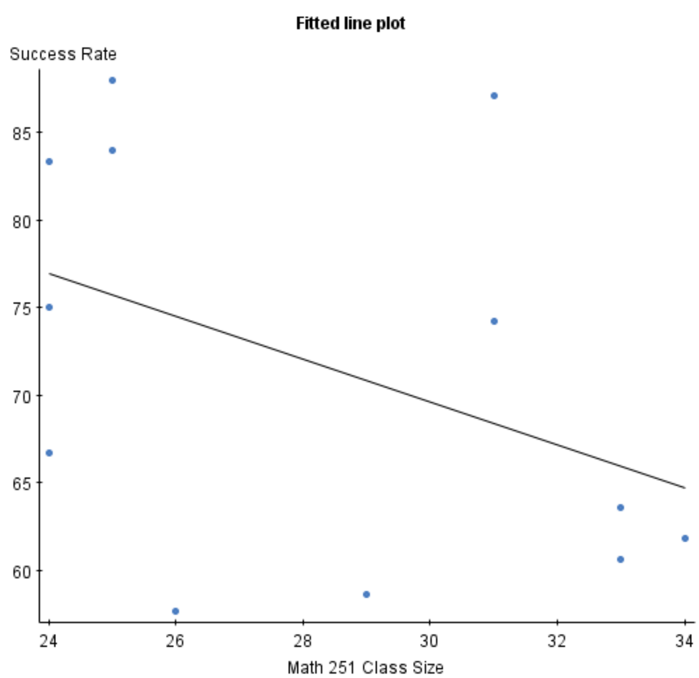


Table 8: Regression Analysis for Math 211-213

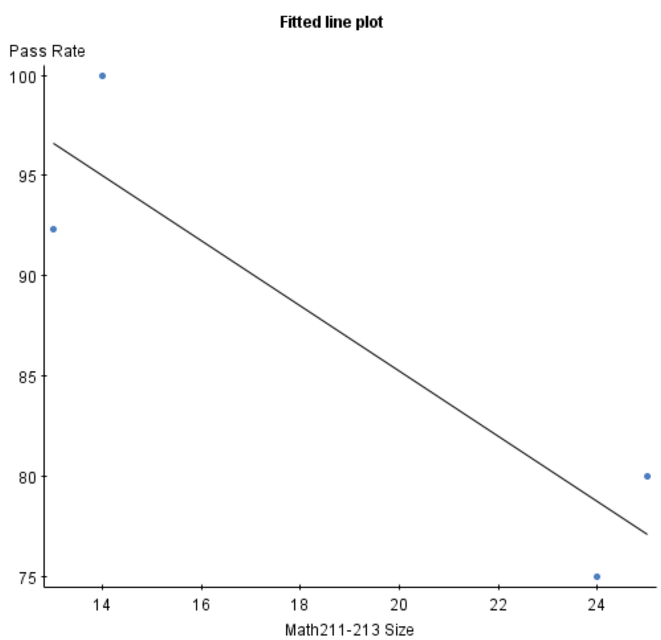
Simple linear regression results:
Dependent Variable: Pass Rate
Independent Variable: Math211-213 Size
Pass Rate = 117.78565 - 1.6295081 Math211-213 Size
Sample size: 4
R (correlation coefficient) = -0.9114
R-sq = 0.8307006
Estimate of error standard deviation: 5.745488

Parameter estimates:

Parameter	Estimate	Std. Err.	Alternative	DF	T-Stat	P-Value
Intercept	117.78565	10.292311	≠ 0	2	11.444043	0.0075
Slope	-1.6295081	0.52017206	≠ 0	2	-3.132633	0.0886

Analysis of variance table for regression model:

Source	DF	SS	MS	F-stat	P-value
Model	1	323.94623	323.94623	9.81339	0.0886
Error	2	66.02127	33.010635		
Total	3	389.9675			



M

Accessibility study summary

⟨app:sec:accessibility⟩

At the start of Fall Term 2011, PCC began its push to make online courses accessible. Realizing the complexity of this issue in relation to our courses in particular, the Math SAC formed a committee to begin investigating methods for making content in online math courses accessible. After a few weeks of meetings and some initial experiments, the committee realized the scope, complexity, and importance of this issue was beyond what we could do outside our regular obligations as instructors. Towards the end of Fall Term 2011 we submitted a request to administration to provide two instructors with release from teaching one class for two terms to more thoroughly investigate the topic.

Shortly before the start of Fall Term 2012, we were informed that through a combined effort of funding, administration had granted a 1-class release for one instructor for two terms. Committee members, while appreciative of the offer, were concerned that this project would weight too heavily on the shoulders of one instructor. It would not only be overwhelming for that instructor, but would also not allow the topic to be fully investigated. Having two instructors with varying backgrounds (Mac vs. PC, Word vs. LaTeX, etc.), we felt the topic could be approached from multiple angles– a collaborative project would be much more successful than a solo project.

As such, we requested that instead of one instructor having a one-class release for two term, we would prefer to have two instructors to have a one-class release for one term. This would allow for the collaboration between two complementary math faculty members as well as spread the cost of the project between a greater number of budgets. The administration agreed to the revised project and Chris Hughes and Scot Leavitt both received a one-class release for Fall Term 2012. Chris and Scot met with Karen Sorensen (accessibility advocate for online classes) and Andy Freed (Manager of Technology and Support) shortly before the start of Fall Term 2012.

The initial phase of the project reoriented Scot and Chris to where they had left off from the previous year: to build off of that work, and see what technological advances had been achieved. They also realized that as they themselves were not end users of assistive technologies, they needed to meet or work with people who were; this follows the mantra "Nothing For Us Without Us." About a third of the way through the term, Kaela Parks introduced them to Maurice Mines, a gentleman from Washington state who is blind and has a bit of both a technological and education background. After the first meeting with Maurice, it became clear that he would be a vital part of the project, and further enhanced the collaborative nature.

Having had many successful translations of mathematical documents into various accessible formats (printed Braille, electronic Braille file for a refreshable Braille device, webpage for a screen reader) and having successfully printed embossed/raised graphs, Maurice agreed to help Chris and Scot with an experiment. They prepared a sample lecture related to a MTH 60 topic (the slope of a line) and presented the material to Maurice in four formats: verbal presentation with the raised graphs, as a webpage that made use of JAWS (a PC-based screen reader), as a printed Braille document, and as a electronic Braille document to be used on a refreshable Braille device.

Prior to the experiment, Scot and Chris were under the impression that JAWS was THE solution to making the content in a math course accessible. Through this initial experiment they came to realize several (now seemingly obvious) truths:

1. Every blind student will have his/her own preferred way of receiving the content in a course, just as every student has his/her own learning styles.
2. There are various grades of Braille which impacts how the mathematics should be encoded into Braille.
3. JAWS is one of many possible assistive technologies available and is NOT the solution.

Through additional experiments and meetings with Maurice, they learned more than they had ever expected. More than just learning about the technologies out there (and what might be coming in the near future), they developed a personal connection to the topic. The report written at the conclusion of the project [9] includes both a summary of our experiences, some general best practices, as well as specific recommendations for mathematics courses.

The success of the project was based on the collaborative effort between the Math SAC, the Distance Learning Department, the respective Division deans, and Disability Services. While the math faculty members took on the majority of the work, it would not have had any success without the support of Karen Sorensen, Andy Freed, Sue Quast, Loraine Schmitt, and Kaela Parks. Over the remainder of the 2012-13 academic year, Chris, Scot, Karen, and Kaela presented the work and findings at eLearning 2013 Conference in San Antonio, TX, online to OCCDLA (Oregon Community College Distance Learning Association), and the Spring 2013 ORAHEAD Conference in Corvallis, OR.

The experience gained in this work continues to inform decisions made within the Math SAC, especially those that concern textbook selection, and the choice to pilot new technologies. It has further enhanced our understanding and awareness of the diverse nature of our student body at PCC.

N

Analysis of sections taught by campus

⟨app:sec:analysisPTFT⟩

TABLE N.1: Summary of sections taught (by campus) for Summer 2011

		Below 100 level	%	Above 100 level	%	Total	%
Cascade	Full-Time	1	3 %	1	6 %	2	4 %
	Part-Time	31	97 %	15	94 %	46	96 %
	Total	32		16		48	
Sylvania	Full-Time	0	0 %	1	3 %	1	1 %
	Part-Time	39	100 %	32	97 %	71	99 %
	Total	39		33		72	
Rock Creek	Full-Time	2	5 %	1	3 %	3	4 %
	Part-Time	35	95 %	31	97 %	66	96 %
	Total	37		32		69	
South East	Full-Time	2	10 %	0	0 %	2	8 %
	Part-Time	19	90 %	3	100 %	22	92 %
	Total	21		3		24	

TABLE N.2: Summary of sections taught (by campus) for Fall 2011

		Below 100 level	%	Above 100 level	%	Total	%
Cascade	Full-Time	18	29 %	8	32 %	26	30 %
	Part-Time	44	71 %	17	68 %	61	70 %
	Total	62		25		87	
Sylvania	Full-Time	24	26 %	35	56 %	59	38 %
	Part-Time	69	74 %	28	44 %	97	62 %
	Total	93		63		156	
Rock Creek	Full-Time	15	15 %	27	49 %	42	28 %
	Part-Time	82	85 %	28	51 %	110	72 %
	Total	97		55		152	
South East	Full-Time	9	24 %	4	57 %	13	29 %
	Part-Time	29	76 %	3	43 %	32	71 %
	Total	38		7		45	

TABLE N.3: Summary of sections taught (by campus) for Winter 2012

		Below 100 level	%	Above 100 level	%	Total	%
Cascade	Full-Time	14	22 %	10	45 %	24	28 %
	Part-Time	51	78 %	12	55 %	63	72 %
	Total	65		22		87	
Sylvania	Full-Time	24	24 %	22	37 %	46	29 %
	Part-Time	74	76 %	38	63 %	112	71 %
	Total	98		60		158	
Rock Creek	Full-Time	15	15 %	51	51 %	66	34 %
	Part-Time	82	85 %	49	49 %	131	66 %
	Total	97		100		197	
South East	Full-Time	7	19 %	6	67 %	13	28 %
	Part-Time	30	81 %	3	33 %	33	72 %
	Total	37		9		46	

TABLE N.4: Summary of sections taught (by campus) for Spring 2012

		Below 100 level	%	Above 100 level	%	Total	%
Cascade	Full-Time	11	18 %	8	32 %	19	22 %
	Part-Time	51	82 %	17	68 %	68	78 %
	Total	62		25		87	
Sylvania	Full-Time	23	23 %	24	48 %	47	31 %
	Part-Time	77	77 %	26	52 %	103	69 %
	Total	100		50		150	
Rock Creek	Full-Time	16	17 %	21	40 %	37	26 %
	Part-Time	76	83 %	31	60 %	107	74 %
	Total	92		52		144	
South East	Full-Time	8	22 %	5	56 %	13	28 %
	Part-Time	29	78 %	4	44 %	33	72 %
	Total	37		9		46	

TABLE N.5: Summary of sections taught (by campus) for Summer 2012

		Below 100 level	%	Above 100 level	%	Total	%
Cascade	Full-Time	0	0 %	0	0 %	0	0 %
	Part-Time	29	100 %	14	100 %	43	100 %
	Total	29		14		43	
Sylvania	Full-Time	0	0 %	3	9 %	3	4 %
	Part-Time	40	100 %	31	91 %	71	96 %
	Total	40		34		74	
Rock Creek	Full-Time	2	5 %	1	3 %	3	4 %
	Part-Time	38	95 %	30	97 %	68	96 %
	Total	40		31		71	
South East	Full-Time	8	25 %	1	25 %	9	25 %
	Part-Time	24	75 %	3	75 %	27	75 %
	Total	32		4		36	

TABLE N.6: Summary of sections taught (by campus) for Fall 2012

		Below 100 level	%	Above 100 level	%	Total	%
Cascade	Full-Time	12	20 %	13	57 %	25	30 %
	Part-Time	48	80 %	10	43 %	58	70 %
	Total	60		23		83	
Sylvania	Full-Time	22	22 %	27	51 %	49	32 %
	Part-Time	76	78 %	26	49 %	102	68 %
	Total	98		53		151	
Rock Creek	Full-Time	8	8 %	21	39 %	29	19 %
	Part-Time	89	92 %	33	61 %	122	81 %
	Total	97		54		151	
South East	Full-Time	11	24 %	4	44 %	15	28 %
	Part-Time	34	76 %	5	56 %	39	72 %
	Total	45		9		54	

TABLE N.7: Summary of sections taught (by campus) for Winter 2013

		Below 100 level	%	Above 100 level	%	Total	%
Cascade	Full-Time	16	27 %	11	48 %	27	33 %
	Part-Time	44	73 %	12	52 %	56	67 %
	Total	60		23		83	
Sylvania	Full-Time	18	20 %	28	53 %	46	32 %
	Part-Time	74	80 %	25	47 %	99	68 %
	Total	92		53		145	
Rock Creek	Full-Time	10	10 %	25	50 %	35	23 %
	Part-Time	89	90 %	25	50 %	114	77 %
	Total	99		50		149	
South East	Full-Time	12	30 %	3	30 %	15	30 %
	Part-Time	28	70 %	7	70 %	35	70 %
	Total	40		10		50	

TABLE N.8: Summary of sections taught (by campus) for Spring 2013

		Below 100 level	%	Above 100 level	%	Total	%
Cascade	Full-Time	16	27 %	11	42 %	27	32 %
	Part-Time	43	73 %	15	58 %	58	68 %
	Total	59		26		85	
Sylvania	Full-Time	21	25 %	31	58 %	52	38 %
	Part-Time	62	75 %	22	42 %	84	62 %
	Total	83		53		136	
Rock Creek	Full-Time	12	15 %	21	43 %	33	25 %
	Part-Time	70	85 %	28	57 %	98	75 %
	Total	82		49		131	
South East	Full-Time	8	21 %	3	27 %	11	22 %
	Part-Time	30	79 %	8	73 %	38	78 %
	Total	38		11		49	

O

Faculty Educational Degrees by campus

:sec:facultyDegrees⟩

Table O.1 shows the highest educational qualifications of full-time and part-time faculty at each of the campuses.

Table O.2 shows the faculty turn over from Summer 2011–Spring 2013.

TABLE O.1: Faculty Education (Highest Degree)

:tab:facultyDegrees⟩

		Bachelor's Degree	Master's Degree	Doctorate
Cascade	Full-Time	0	8	0
	Part-Time	20	25	1
Sylvania	Full-Time	0	16	2
	Part-Time	16	34	1
Rock Creek	Full-Time	0	10	2
	Part-Time	14	50	4

TABLE O.2: Faculty Turnover from Summer 2011–Spring 2013

tab:facultyturnover⟩

				Reason					
		Joined	Left	FT Retired now PT	FT teach elsewhere	FT non-teaching	FT other PCC campus	PT other PCC campus	Stay home with kids
Cascade	Full-time	3	5[1]	1	1		2		
	Part-time	16	10[2]		1	1		2	
	Total	19	15						
Sylvania	Full-time	3	3	3					
	Part-time	8	6		2	1		2	1
	Total	11	9						
Rock Creek	Full-time	4	3	1			2		
	Part-time	29	19					6	
	Total	33	22						

[1] includes 4 FT temps and 1 FT permanent

[2] reasons for leaving often unknown or don't fit into these categories

P

Instructor Qualifications

⟨app:sec:instructorquals⟩

Mathematics Instructor Qualifications (prior to May 2011)

Master degree (MA or MS) in mathematics from an accredited college or university. Or, a graduate degree in a related field with successful completion of at least 30 quarter credits of graduate level mathematics courses.

There are three alternative approval paths for part-time MTH instructors.

1. PSU Mathematics Graduate Students with 27 or more Graduate-level Credits in Mathematics: Any MTH course appropriate for the graduate student, i.e., it's not limited to certain courses. Approved many years ago by then VP for Academic Services Jim Van Dyke, we're allowed to hire PSU mathematics grad students who have completed 27 or more credits of graduate-level MTH courses. This path was worked out as part of a cooperative program with PSU's Mathematics Department. It gives us access to instructors and gives PSU grad students an opportunity to see if teaching is a good career fit.

2. For Teaching MTH 30 through MTH 95: Approved several years ago by the MTH SAC, instructors may teach MTH 30 through MTH 95 provided they have the following credentials.

   - Bachelor degree in Mathematics or Mathematics Education or in Education with an emphasis in mathematics. (Note: Bachelor degree in Business math be substituted for instructors of MTH 30.) AND

   - Three years full-time (or equivalent cumulative part-time) mathematics teaching experience within grades 7 through 16. AND

   - Transcript showing successful completion of a full calculus sequence.

3. Masters degree in a related field such as, but not limited to, Physics or Engineering: Any MTH course appropriate for the instructor, i.e., it's not limited to certain courses. Approved this year by the MTH SAC, individuals may demonstrate competency by having a Masters degree in a related field including, but not limited to, Physics or Engineering. The rationale behind this approval path is that folks with Masters degrees in Physics or Engineering, and other fields, have many math-intensive graduate-level courses in their discipline.

Mathematics Instructor Qualifications (approved May 2011)

MTH 99 AND BELOW

Masters degree (MA or MS) in Mathematics or Mathematics Education from a regionally accredited college or university. Or a graduate degree in a related field [1], such as, but not limited to, Physics or Engineering, with successful completion of at least 27 quarter credits of graduate level mathematics courses.

MTH 100 AND ABOVE

Masters degree (MA or MS) in Mathematics from a regionally accredited college or university. Or a graduate degree in a related field (as above), such as, but not limited to, Education, Physics, or Engineering, with successful completion of at least 27 quarter credits of graduate level mathematics courses.

Criteria for provisional instructors MTH 99 and below

1. Masters degree in a related field (as above) such as, but not limited to, Physics or Engineering; OR
2. Mathematics graduate students who are actively working on a degree (taking at least 1 credit per year) and have successful completion of at least 27quarter credits in graduate level Mathematics courses on their transcript; OR
3. Bachelor's degree in Mathematics or Mathematics Education or in Education with an emphasis in mathematics. (Note: Bachelor degree in Business may be substituted for instructors of MTH 30.) AND
   - Transcript showing successful completion of a full year of calculus. AND
   - Three years full-time (or equivalent cumulative part-time) mathematics teaching experience within grades 6 or above.

Criteria for provisional instructors MTH 100 and above

1. Masters degree in a related field (as above) such as, but not limited to, Physics or Engineering; OR
2. Mathematics graduate students who are actively working on a degree (taking at least 1 credit per year) and have successful completion of at least 27 quarter credits in graduate level Mathematics courses on their transcript; OR
3. Masters degree in Mathematics Education or Education may be substituted for instructors of MTH 211, MTH 212, and MTH 213.

Mathematics Instructor Qualifications (approved February 2013)

MTH 99 and below

1. Master's degree (MA or MS) in Mathematics or Mathematics Education from a regionally accredited college or university; OR
2. A graduate degree in a related field (as above), such as, but not limited to, Physics or Engineering, with successful completion of at least 30 quarter credits of graduate level mathematics courses.

[1] The applicability of a particular degree as 'a related field' will be determined by an appropriate Division Dean in consultation with a Mathematics Faculty Department Chair.

MTH 100 and above

1. Master's degree (MA or MS) in Mathematics from a regionally accredited college or university; OR
2. A graduate degree in a related field (as above), such as, but not limited to, Education, Physics, or Engineering, with successful completion of at least 30 quarter credits of graduate level mathematics courses.

Demonstrated competency MTH 99 and below

1. Master's degree in a related field (as above) such as, but not limited to, Physics or Engineering; OR
2. Bachelor's degree in Mathematics or Mathematics Education or in Education with an emphasis in mathematics AND Transcript showing successful completion of a full year of calculus AND three years full-time (or equivalent cumulative part-time) mathematics teaching experience within grades 6 or above.
3. Bachelor's degree in Business may be substituted for instructors of MTH 30.

Demonstrated competency MTH 100 and above

1. Master's degree in a related field (as above) such as, but not limited to, Physics or Engineering; OR
2. Master's degree in Mathematics Education or Education may be substituted for instructors of MTH 211, MTH 212, and MTH 213.

Provisional approval MTH 99 and below

Mathematics graduate students who are actively working on a degree (taking at least 1 credit per year) and have successful completion of at least 27 quarter credits in graduate level Mathematics courses on their transcript.

Provisional approval MTH 100 and above

Mathematics graduate students who are actively working on a degree (taking at least 1 credit per year) and have successful completion of at least 27 quarter credits in graduate level Mathematics courses on their transcript.

Q

Professional development memberships

app:sec:memberships⟩

FIX

R

Professional development summary

:sec:professionaldevelop⟩

FIX

S

Resource survey results

:sec:resourcesurvey⟩ Survey data details: $n = 976$ face to face and $n = 291$ online responses.

1. Have you used any of the resources available through the library (e.g. calculator, netbook, or iPad rentals, textbook checkouts, scanners, or online database search engines) during your time as a student in a PCC math course?

   (a) Yes. I frequently used these resources.

   (b) Yes, but I seldom/rarely used these resources.

   (c) No, but I knew that such resources were available.

   (d) No, and I was unaware that such resources were available.

   We found that our students both in face-to-face and online classes are generally knowledgeable about library and out of the classroom resources such as calculator rentals, netbook and iPad rentals, textbook checkouts, scanners and online searchable databases.

	Students knowledge of library and out-of classroom resources
Face-to-face	81.45%
Online/hybrid	74.25%

   Not surprising that library and other out-of-the-classroom information is being used more frequently by our face-to-face students than that of online students. This could be due to less frequent visits to campus for online students and/or online students already have the resources available to them.

	Actual use of library and out-of-classroom resources
Face-to-face	48.76%
Online/hybrid	25.77%

2. Were the library and related resources listed on your most recent math course syllabus?

   (a) Yes, it is listed on the syllabus with links.

   (b) Yes, it is mentioned but no links are provided.

   (c) No, it is not listed as a resource.

   (d) I don't have a copy of the syllabus available.

   We found that both Part-time faculty and Full-time faculty included information regarding library and out-of-classroom resources on their syllabi.

	Percentage of classes where the syllabus included resources
Part-time faculty	69.41%
Full-time faculty	69.48%

The data suggests that there was very little distinction of which classes encourage more students to use outside resources in both our college level and pre-college level mathematics.

	Percentage of classes where the syllabus included resources
College level	70.05%
Pre-College level	68.83%

3. Does your current math course have online homework and/or online assessments available (e.g. WeBWorK, MyStatLab, MyMathLab, ALEKS)?

   (a) Yes, it is required.

   (b) Yes, but it is optional.

   (c) No such resource is available.

   Online homework has grown in popularity over the past few years. There has been much debate within our SAC if students should be required to use online homework in face-to-face and online classes. The question has often been raised if students should be required to pay an extra cost for such features and if so, what is a reasonable cost to the student? The data shows a general trend that online homework programs such as WeBWorK, MyMathLab, MyStatLab, and ALEKS are being used more frequently in online than face-to-face classes.

	Percentage of classes requiring online homework
Face-to-face	13.93%
Online/hybrid	70.45%

Data suggests that significantly more Full-time instructors are offering some form of online homework (either required or optional) than that of Part-time instructors. This discrepancy may reflect the need to convey and distribute more information about these programs should Part-time instructors want to offer similar options to their students.

	Percentage of classes offering some form of online homework
Full-time faculty	70.78%
Part-time faculty	54.93%

4. I am willing to pay up to $35 extra for access to online homework and resources that may help me succeed.

   (a) Strongly agree

   (b) Agree

   (c) Neutral

   (d) Disagree

   (e) Strongly disagree

When asked if students would be willing to pay up to $35 to access online homework and resources that may help them to succeed, we found that online students were more willing to pay an extra fee. It should be mentioned that we previously mentioned data that online students were more likely to have used online homework and hence be better equipped to compare cost versus benefit. In contrast, a student who has not been previously exposed to an online homework system may not be able to properly address possible benefits and instead answer purely based on willingness to pay the given dollar amount.

	Percentage of student willing to pay for online homework
Face-to-face	18.44%
Online/hybrid	42.61%
	Percentage of student unwilling to pay for online homework
Face-to-face	56.86%
Online/hybrid	27.14%

Note that the above values do not include the students who responded 'neutral' on the question as these differences were not statistically significant.

5. What Learning Management Software are available for your math course? Bubble in all that apply.

   (a) Instructor web page

   (b) D2L and/or MyPCC

   (c) MyMathLab or MyStatLab

   (d) Other

   (e) None of the above

6. Of the available Learning Management Software, which ones have you used? Bubble in all that apply.

   (a) Instructor web page

   (b) D2L and/or MyPCC

   (c) MyMathLab or MyStatLab

   (d) Other

   (e) None of the above

We found that a majority of our courses are using outside resources to connect with students. These resources include but are not limited to personal instructor websites, D2L, MyPCC, MyMathLab, MyStatLab, etc.

	Percentage of classes offering additional resources
Face-to-face	89.75%
Online/hybrid	99.31%

A larger separation existed for Part-time instructors who do not use any of the above mentioned resources. This could be due to lack of information or lack of knowledge about available resources.

	Percentage of classes offering additional resources
Full-time faculty	95.32%
Part-time faculty	86.72%

Overall MyMathLab and MyStatLab are used more frequently in pre-college level classes in contrast to college level classes.

	Percentage of classes offering MML or MSL
College level	31.49%
Pre-College level	48.54%

7. What resources available from the PCC Math Department have you used? Bubble in all that apply.

   (a) Course supplements

   (b) Calculator manuals

   (c) Math 251 Lab Manual

   (d) Other

   (e) None of the above

   Our math department website offers additional materials for students. This includes course specific supplements to the textbook, calculator manuals specific to PCC math courses, required Calculus I lab, and other information regarding course description. Students may print these materials for free from any PCC computer lab.

8. What graphing software programs have you used? Bubble in all that apply.

   (a) WolframAlpha

   (b) Graph

   (c) WinPlot

   (d) Other (e.g. Fooplot, Maple, GeoGebra)

   (e) None of the above

	Resources used by students in College Level Courses
Wolfram Alpha	24.88%
Graph	14.90%
Winplot	6.14%
Other (Maple, GeoGebra, FooPlot, etc.)	27.34%
None of the above	51.77%

9. Which of the following resources available at PCC have you used? Bubble all that apply.

   (a) On-campus Student Learning Centers

   (b) Online tutoring

   (c) The Student Help Desk

   (d) Other (e.g. Collaborate or Elluminate)

   (e) None of the above

We encourage students to use some of the resources that PCC offers such as On-campus Student Learning centers, online tutoring, student help desk, Collaborate and/or Elluminate. We found that a significant amount of students in Face-to-Face classes were using the resources whereas students enrolled in an online class were not. This is not especially surprising since the nature of online courses allows infrequent campus visits for the student. However, we could work to encourage the use of online tutoring to our online demographic.

	Percentage of students using PCC learning resources
Face-to-face	67.32%
Online/hybrid	36.08%

10. Which of the following resources do you use for your math class that is available outside of PCC? Bubble all that apply.

    (a) Private Tutoring

    (b) Math websites (such as Khan Academy, Purple Math, etc.)

    (c) YouTube videos not provided by instructor

    (d) Other

    (e) None of the above

With the wide-spread availability of the internet, students have been increasingly using sites like Khan academy, PatrickJMT, PurpleMath, YouTube etc. to supplement class time. In the absence of formal lecture, the data suggests online students using these services more than their face-to-face classmates. For others, private tutoring or help from their peers is another option.

	Percentage of students using external web videos like Khan, PatrickJMT, PurpleMath, etc. ...
Face-to-face	45.49%
Online/hybrid	56.36%

The data suggests that both Pre-college and College Level courses/instructors/students are using these resources. It isn't surprising to see these resources used more readily by College Level students based on word of mouth or more knowledge of which sites are reputable and which are not. The more math classes the student takes, the more resources they can use to assist in their learning.

	Percentage of students using some form of learning resource outside of the PCC network.
College level	79.57%
Online/hybrid	63.47%

T

Tutoring hours

⟨app:sec:tutoringhours⟩

Figures T.1 to T.4 show the number of math tutoring hours logged at each of the campuses from 2008–2013.[1]

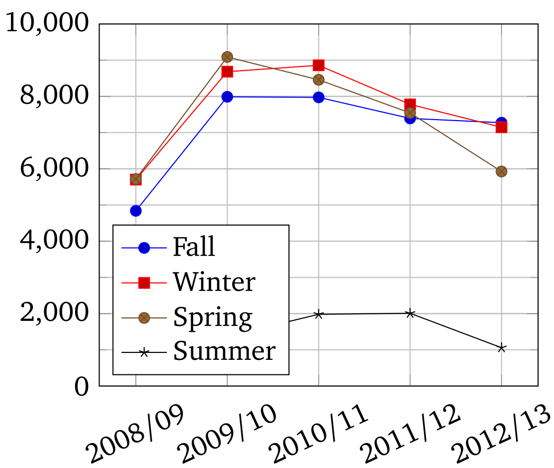


FIGURE T.1: Tutoring hours at Sylvania

tutoringsylvania⟩?

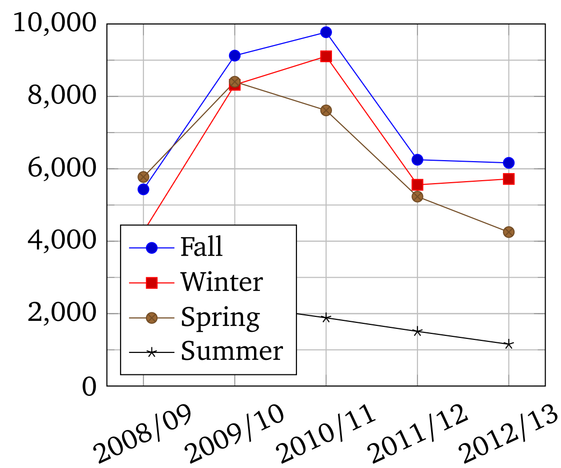


FIGURE T.2: Tutoring hours at Rock Creek

?⟨app:fig:tutoringrockcreek⟩?

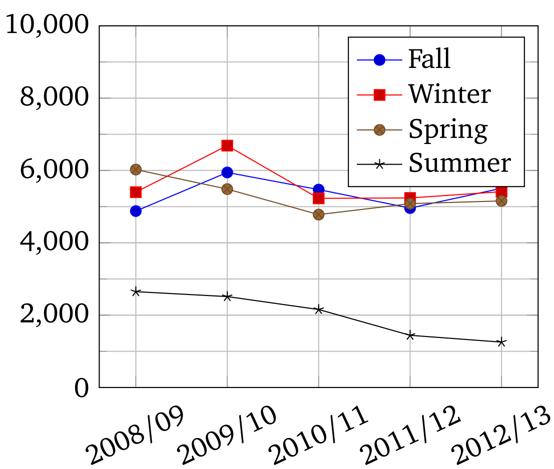


FIGURE T.3: Tutoring hours at Cascade

:tutoringCascade⟩?

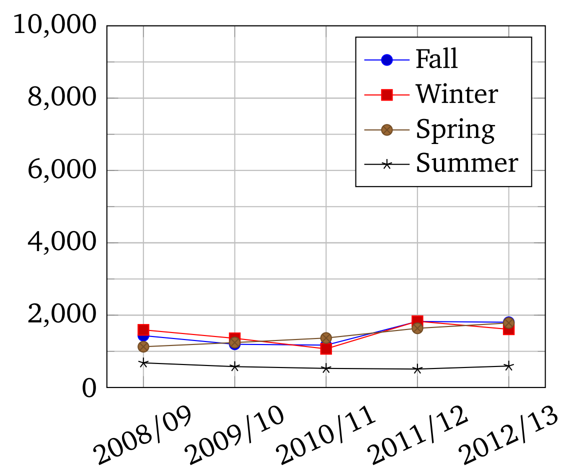


FIGURE T.4: Tutoring hours at South East

?⟨app:fig:tutoringsoutheast⟩?

FIX

[1] The hours at Sylvania campus for 2012–13 are influenced by the new location and changes in the check-in setup and therefore might or might not be comparable to the previous years.

TABLE T.1: Tutoring Center Impact

:tab:SLC⟩

		Number Students					Number Visits					Total Hours Logged (1000)				
		08/09	09/10	10/11	11/12	12/13	08/09	09/10	10/11	11/12	12/13	08/09	09/10	10/11	11/12	12/13
CA	Fall	589	679	718	684	695	3259	4043	3905	3807	4303	4.88	5.94	5.47	4.96	5.51
	Winter	614	751	720	732	707	3612	4476	3849	3985	4088	5.40	6.69	5.23	5.24	5.41
	Spring	683	722	642	66	609	3956	3842	3646	3601	3877	6.02	5.48	4.78	5.08	5.16
	Summer	326	360	317	215	213	1600	1695	1442	1054	938	2.65	2.51	2.16	1.44	1.25
RC	Fall	512	739	751	810	752	2096	3403	3413	4427	4348	5.43	9.13	9.77	6.25	6.16
	Winter	461	713	748	753	718	1734	3038	3467	3938	4035	4.26	8.32	9.11	5.56	5.72
	Spring	561	685	753	749	624	2218	3332	3840	3665	2924	5.77	8.40	7.61	5.23	4.25
	Summer	212	252	257	236	185	688	853	1068	1063	754	1.74	2.24	1.88	1.51	1.16
SE	Fall	244	253	220	321	374	1024	977	870	1445	1703	1.43	1.19	1.17	1.83	1.80
	Winter	277	255	235	343	341	1063	1044	990	1464	1481	1.59	1.36	1.07	1.83	1.61
	Spring	175	222	276	343	343	692	896	1068	1351	1442	1.13	1.24	1.37	1.64	1.78
	Summer	124	115	115	141	153	509	420	382	482	482	0.68	0.58	0.53	0.51	0.59
SY	Fall	940	1257	1227	1188	1030	4813	6932	6781	6104	5837	4.84	7.99	7.97	7.39	7.27
	Winter	974	1323	1255	1148	1039	5092	7544	7035	6373	5660	5.70	8.68	8.86	7.78	7.15
	Spring	994	1242	1119	1043	873	5805	7446	6572	6193	4942	5.72	9.09	8.46	7.54	5.93
	Summer	275	322	335	336	248	904	1069	1243	1297	807	1.18	1.37	1.98	2.01	1.06

U

Course Scheduling Pattern (by campus)

⟨sec:app:courseschedule⟩

1 Cascade

1. Scheduling is term by term, which helps us adjust to enrollment changes and part-time faculty changes.
2. Class size for all Cascade math classes is capped at 35 (if room allows) except MTH 20/61/62/63, which are capped at 30.
3. Since the last program review, we have regularly offered many more MWF classes, especially for MTH 95, in order to try to improve retention and success. MWF classes, meeting for shorter times than typical MW/TuTh classes, enable us to 'pack' more classes into a school day and therefore maximize our usage of the rooms we are assigned.
4. We discontinued MTH 91/92 because we felt that the sequence was inadequately preparing students for MTH 111.
5. We discontinued offering MTH 20 DL because student success rates were lower than in the face-to-face format.
6. We continued to innovate with regard to hybrid offerings, including weekday and Saturday hybrids.
7. We eliminated Sunday hybrids when Cascade decided to eliminate Sunday class offerings. Since we were beginning to see declines in enrollment anyway, this did not seriously impact student access to classes. The Saturday hybrids are still available.

2 Rock Creek

1. Rock Creek schedules term by term. It would help with staffing decisions if the classes would be assigned rooms well ahead of the date the class offerings become visible to students online and the deadline for the photograph proof of the paper class schedule.
2. Rock Creek offers mostly two day a week classes (82%) meeting from 7am to 9 pm, about 10% one day a week either Saturday or Friday mornings, and 8% online.
3. Rock Creek schedules courses at the Hillsboro Center, Willow Creek Center and St Helens (12% of class offerings at RC).

3 Sylvania

1. Scheduling is done one year ahead, which helps students plan out their year.
2. Coordination between campuses for low enrollment or specialty courses.
3. Newberg Center, scheduled by Sylvania, gives more students better access.
4. Increased offering of Distance Learning courses also increases accessibility for students with scheduling conflicts.
5. Class size for all Sylvania math classes is capped at 34 (if room allows) except Statistics (23-28 for computer classrooms).
6. Reorganized the time slots for 2013/14 which should lower possibility of canceled classes (due to room availability or low enrollment).

4 Southeast

1. Southeast assigns classes term by term, due to having mostly part-time faculty who need the flexibility of when to teach and at what times of day.
2. Class size caps for math classes at SE is usually 30 or 35, depending on the size of the room and the room availability.
3. Most classes are offered on a Mon/Wed or Tue/Thu schedule, with a good balance of morning, afternoon, and evening classes.
4. Southeast offers the full range of mathematics courses; however, most of the students at SE take 20, 60, 65, or 95. Slowly but surely, there have been more students taking 111 and 112, along with calculus and beyond.
5. There is a substantial offering of DL classes, mainly in 60, 65, 95, and 243. Over the past year, 111 was added to the mix, while 20 was removed from the offerings (due to abominable passing rates).

Colophon

This document was typeset using pdfLaTeX and BibLaTeX in TeXlive 2013. The text is set in `Bitstream Charter`.
The document was constructed collaboratively at https://github.com/PCCMathProgramReview2014/PCCMathProgramReview2014.