Analyses of Fall 2007 Lower Division Mathematics Courses at UC Merced

Prepared by Cheryl Hedges

January 16, 2008

In Brief

Points of interest in this document are summarized in brief below. You can find a more detailed analysis of all fall courses in the following section.

- In Math 5, 42.7% of 110 students failing at mid-semester were able to improve grade to ñC-ò or better.
    - Gateway Exams, tutoring services, and academic workshops aided in this improvement.
        - Students continuing on to Math 21 at UC Merced will be tracked to review how well Math 5 prepares students for Calculus I. In addition, monthly math faculty meetings will be held during spring 2008 to discuss issues surrounding the Math 5 to Math 21 transition.

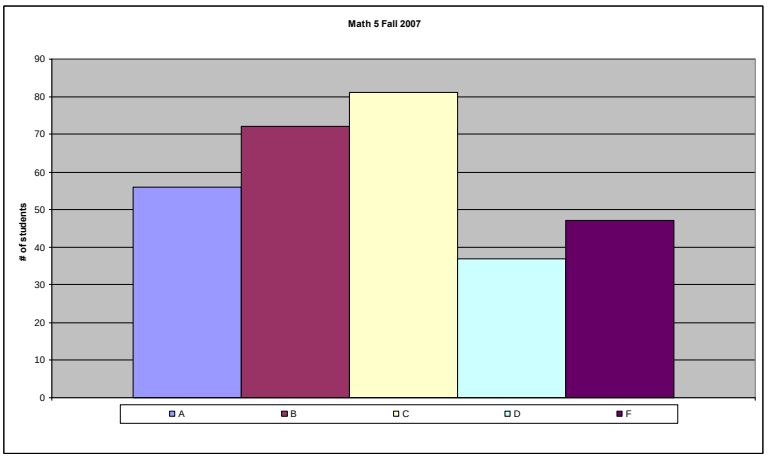
- 45% (68/151) of students failed Math 21.
    - Early assessment exam shows 78.1% (25/32) of students failing exam failed Math 21.
    - Viewing discussion participation scores shows no one receiving less than 80% of discussion points (36 students) received higher than 60% of total possible points.
    - 92.5% (37/40) of students failing at mid-semester failed Math 21.

Course Analyses

The applied mathematics faculty has asked for analyses of mathematics courses offered during the fall 2007 term at UC Merced. Data received from math instructors and the Office of the Registrar is summarized below. For the purpose of this document, a ñpassingò grade is defined as ñC-ò or better in the course.

- Math 005 ï 71.3% (209 of 293) student passed.
- Math 021 ï 55.0% (83 of 151) students passed.
- Math 022 ï 76.9% (93 of 121) students passed.
- Math 023 ï 66.1% (37 of 56) students passed.
- Math 024 ï 74.4% (35 of 49) students passed.
- Math 030 ï 85.2% (23 of 27) students passed.
- Math 032 ï 97.4% (74 of 76) students passed.

Math 5 – Preparatory Calculus



Overview

The chart above shows the final grade distribution for Math 5. Of the 293 students enrolled at the end of the fall 2007 term, 71.3% received an A, B, or C which is similar to the 2006 ï 2007 academic year average of 72.5%.

At mid-semester, 62.8% (110 of 296) were receiving a D or F. Of those 110 students, 47 (42.7%) were able to improve their grades to a level of passing.

Math Placement Exam

Students entering UC Merced in fall 2007 were required to take a 25-question online, non-proctored calculus readiness exam administered by Maple T.A. A student scoring 20 or more is placed into Math 21, Calculus I, while those scoring 19 or less are recommended to enroll in Math 5, Pre-Calculus. The chart below compares studentsô placement score to final Math 5 grade.

Placement Score	n	A, B, C	D, F
20 to 25	3	3 (100%)	0
17 to 19	62	55 (88.7%)	7
11 to 16	98	76 (77.6%)	22
1 to 10	53	27 (50.9%)	26

The Maple T.A. placement exam and 20-score cut-off appear to be achieving acceptable results.

Gateway Exam

Math 5 Gateway Exams were administered for the first time this term, fall 2007. These exams test algebraic and computational skills students should have attained in high school and will be built upon during Math 5. Passing the exam does not increase a studentôs grade; however, failing to pass the exam will decrease a studentôs grade by 1/3. The results of the exam are as follow:

- 217 students passed.
- 66 did not pass.
- 20 did not attempt.

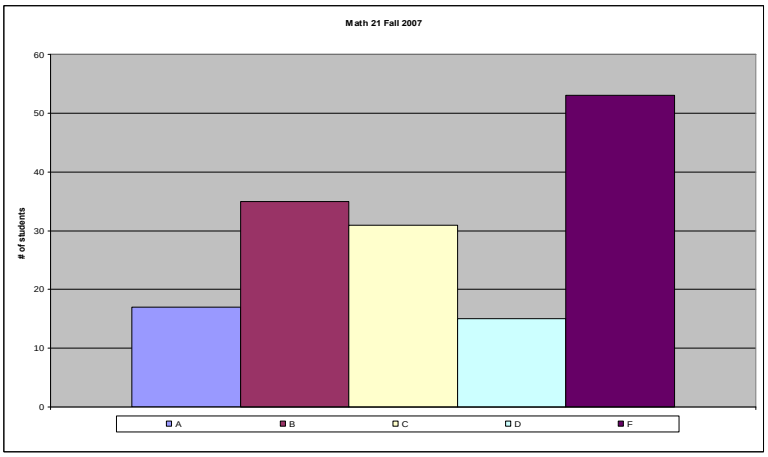
Of the 66 who did not pass, we obtain the following results.

- 3% (2) received an A+, A, or A-.
- 7.6% (5) received a B+, B, or B-.
- 30.3% (20) received a C+, C, or C-.
- 56.1% (37) received a D or F.
- 3% (2) withdrew from course.

The gateway exam is adequately identifying students needing review of fundamental Pre-calculus skills. Earlier completion of the gateway exam will allow more time to address those deficiencies and progress through the semester.

During fall 2006, only 5.7% (2/35) students failing at mid-semester were able to improve their grade from a D or F to a C- or above, compared to 42.7% (47/110) in fall 2007. Anecdotally, a combination of administering the gateway exam, improved student services such as tutoring, and academic workshops all played a role in this improvement.

Math 21 – Calculus of a Single Variable I



Overview

The chart above shows the final grade distribution for Math 21. Of the 151 students enrolled at the end of fall 2007 term, 55% (83) received a letter grade of A, B, or C. The average pass rate for the 2006 ï 2007 academic year was 63%.

At mid-semester, 44 students were receiving a grade of D or F in Math 21, only 40 of which could be identified at end of semester. Of those 40 identified as receiving D or F at mid-semester, 37 received a D or F as a final grade. Therefore, 92.5% (of 40) failing at mid-semester, failed the course. Math 21, Calculus I, is often seen as a transition course. The subject matter is challenging and constantly builds upon previously learned topic. Once a student falls behind, it is often difficult to recover; however, it is not impossible. Early, reliable assessment can help identify students in danger of falling quickly behind.

Assessment

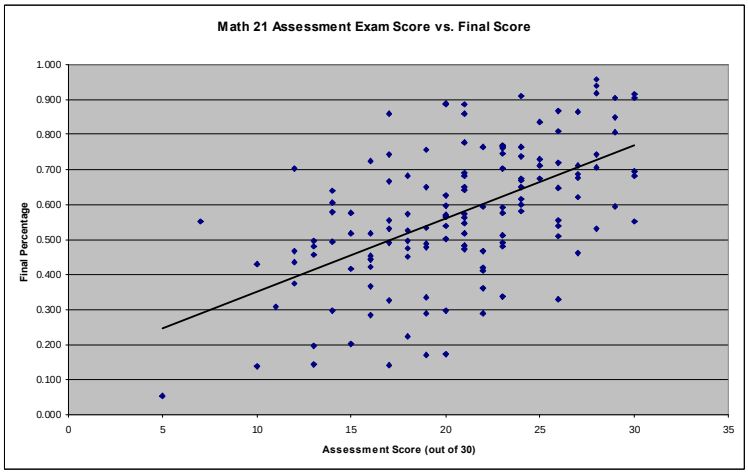
The first step in assessment is given to incoming students as the Math Placement Exam. Students entering UC Merced in fall 2007 were required to take a 25-question online, non-proctored calculus readiness exam administered by Maple T.A. A student scoring 20 or more is placed into Math 21 while those scoring 19 or less are recommended to enroll in Math 5. The chart below compares studentsô placement score and final Math 21 grade.

Scores on the Maple T.A. Math Placement Exam in Relation to
Math 021 Final Grade Fall 2007

	Final Grades					
Placement Test Score	0 F	1 D	2 C	3 B	4 A	Total n
17		1	1			2
18				1	1	2
19	1	1		1		3
20	4	2	5	3		14
21	5		3	6	2	16
22	2		4	3	1	10
23	2		3	5	5	15
24	1	1		4	3	9
25	2	1			2	5
Total	17	6	16	23	14	76
%	**22.4**	**7.9**	**21**	**30.3**	**18.4**	**100**

A weak, but positive correlation ($R^2 = .0451$) between placement and final grade was found, with an average grade of 2.16 for freshmen students. It appears that a score of 20/25 is the pivot point and an adequate cut-off.

The second step of assessment is given as a 30-question diagnostic exam administered at the beginning of the semester by Dr. Michael Sprague. Below are the results correlating studentôs assessment exam score to final score.



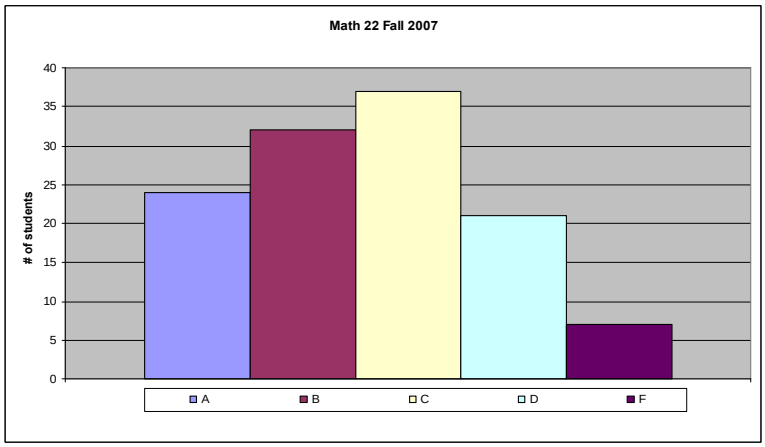
A linear regression computed positively correlates with the final scores ($R^2 = 0.32$).

Of the 151 students enrolled at the end of the term,

- 33.1% (35/106) students scoring 17 or more on assessment failed course.
- 78.1% (25/32) students scoring below 17 failed course.
- 13 had no score.

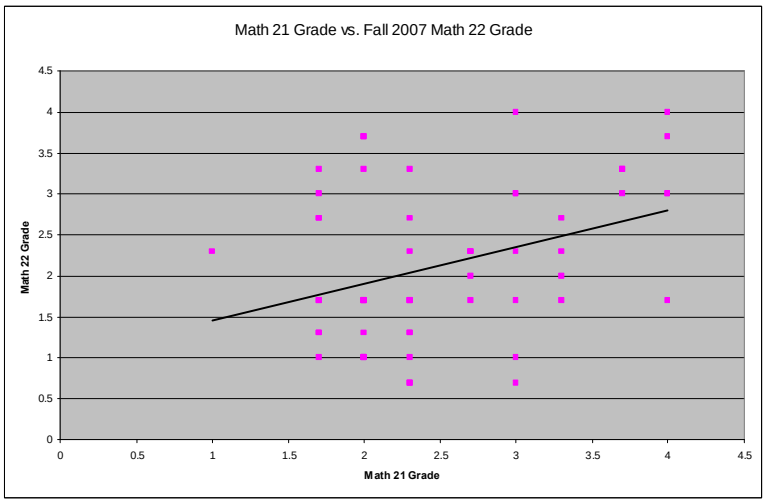
It appears that statistically, a student with a score of 16 or less will fail the course. A score of 17 or more is statistically inconclusive but suggests that a student has the fundamental skills needed to succeed in Math 21. However, this is only a portion of the puzzle for success, with the main portion relying on discipline and effort.

Math 22 – Calculus of a Single Variable II



Overview

The chart above shows the final grade distribution for Math 22. Of the 121 students enrolled at the end of the fall 2007 term, 76.9% (93) received a letter grade of A, B, or C.

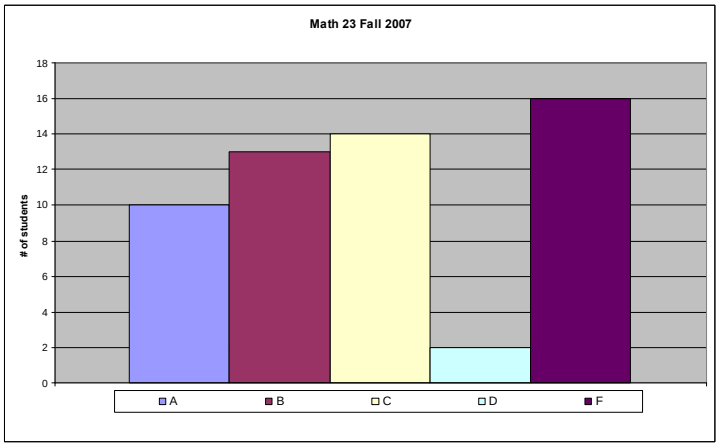


A linear regression computed positively correlates with studentsô fall 2007 Math 22 course grade ($R^2 = 0.1289$).

Math 22 (Calculus of a Single Variable II) is comprised of three categories of students: students passing Math 21 (Calculus of a Single Variable I) at UC Merced, students passing ICP 1 (Integrated Calculus and Physics) at UC Merced, and students who completed Calculus I at another institution. The fall 2007 term is as follows:

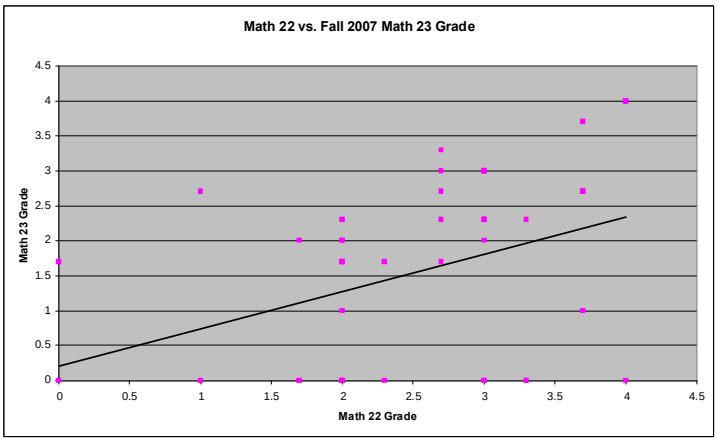
- 57 previous Math 21 at UC Merced students, 15 which failed (26.3%)
- 33 previous ICP at UC Merced students, 11 which failed (33.3%)
- 31 completing Calculus I at other institution, 2 which failed (6.5%)
- 45 students repeating Math 22, 10 which failed (22%)
    - 20 are previous Math 21 students
    - 25 are previous ICP 1 students

Math 23 – Vector Calculus



Overview

The chart above shows final grade distribution for Math 23. Of the 56 students enrolled at the end of the term, 66.1% (37) of students received a letter grade of A, B, or C.

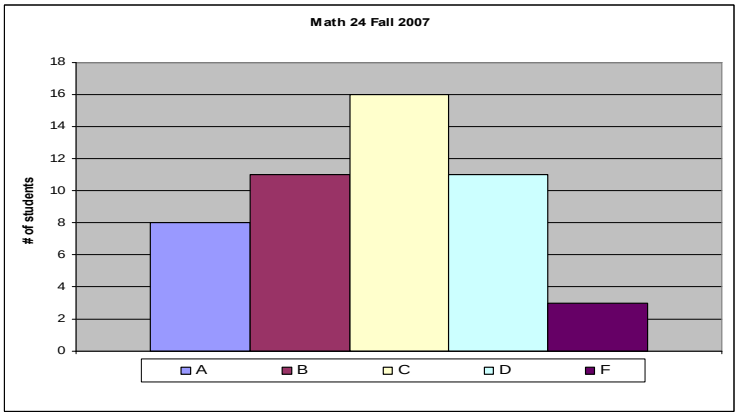


A linear regression computed positively correlates with fall 2007 Math 22 grade (R^2 = 0.144).

Fall 2007 Math 23 student history is as follows:

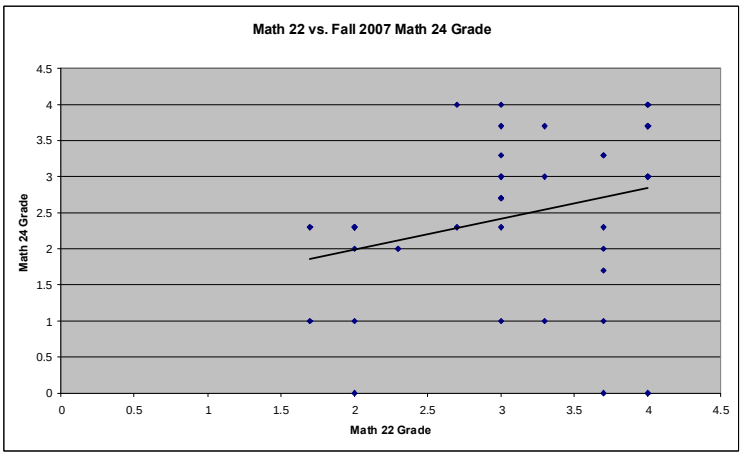
- 48 of the 56 enrolled previously took Math 22 at UC Merced
- 8 students completed Calculus II at other institution
- 7 students repeating Math 23

Math 24 – Linear Algebra and Differential Equations



Overview

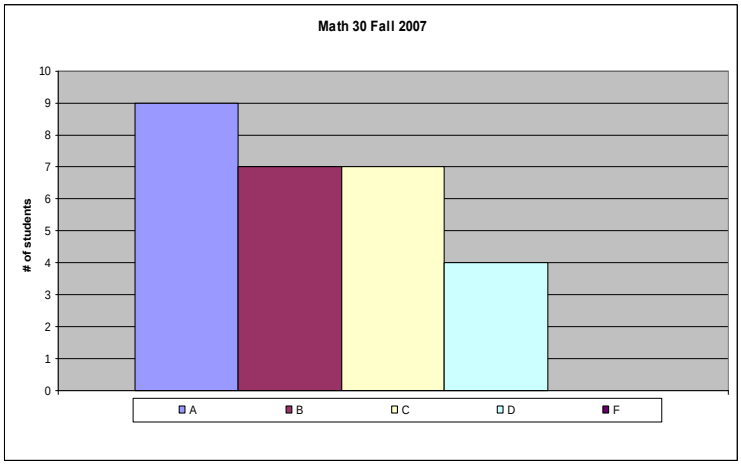
The chart above shows final grade distributions for Math 24. Of the 49 students enroll at the end of the term, 74.4% (35) of students received a letter grade of A, B, or C.



A linear regression computed positively correlates with fall 2007 Math 24 grades, although correlation is not strong (R^2= .0769).

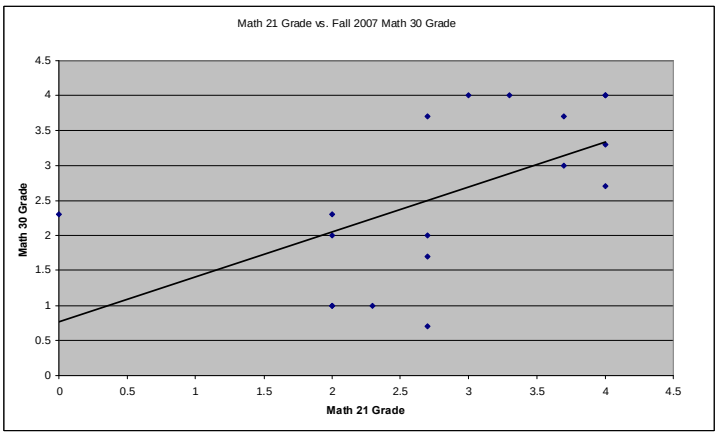
The grades earned in Math 22 correlate more to grades earned in Math 23 than in Math 24.

Math 30 – Mathematical Biology



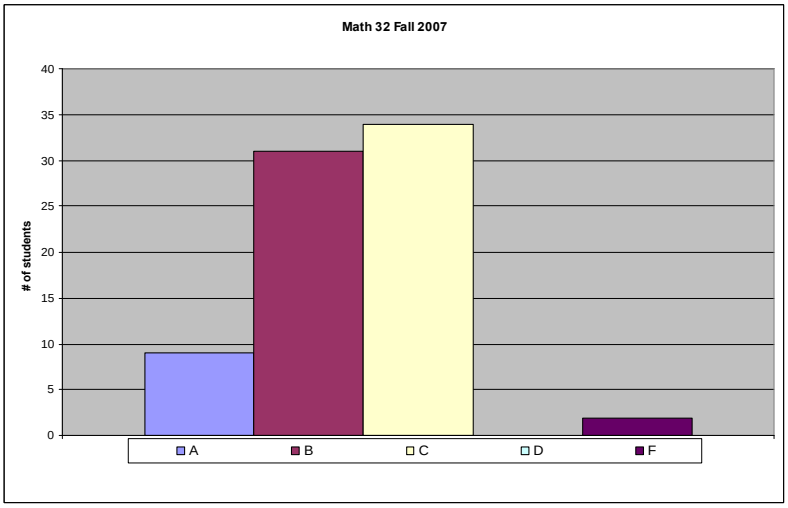
Overview

The above chart shows the final grade distribution for Math 30. Of the 27 students enrolled at the end of the term, 85.2% (23) of students received a letter grade of A, B, or C.



A linear regression computed positively correlates with Math 30 grades ($R^2 = 0.3178$).

Math 32 – Probability and Statistics



Overview

The above chart shows the final grade distribution for Math 32. Of the 76 students enrolled at the end of the term, 97.4% (74) of students received a letter grade of A, B, or C.

Spring 2008 Lower Division Mathematics Course Summary at UC Merced

Prepared by Cheryl Hedges

June 5, 2008

In Brief

Points of interest in this document are summarized in brief below. You can find a more detailed analysis of all spring courses in the following section.

- Average grade point is higher in fall than in spring for each course other than Math 21, which had an anomalously low pass rate during the fall. What techniques can we employ that will help maintain focus and effort during spring term?
- Math 5 pass rate is anomalously poor – 43.4% of 129 enrolled passed course.
  - 41 students repeating Math 5 from fall 2007
    - 24 failed.
  - 49 students did not pass gateway exam
    - 41 of which failed course.
  - Low attendance to office hours and tutorials.
- Previous Math 5 students performed very well in Math 21 – 80.5% of 149 enrolled passed course.
- Math 23 abnormally low pass rate – 48.2% of 56 enrolled passed course.
  - 15 students took Math 22 more than once.
  - 18 students are in "poor academic standing."

Spring 2008 Course Overviews

What follows is an overview of lower division mathematics courses at UC Merced for the spring 2008 term. For the purposes of this document, a "C-" or better is considered "passing."

- Math 005 – 43.4% (56 of 129 students) passed.
- Math 021 – 76.1% (162 of 213 students) passed.
- Math 022 – 73.5% (100 of 136 students) passed.
- Math 023 – 48.2% (27 of 56 students) passed.
- Math 024 – 75.3% (58 of 77 students) passed.
- Math 030 – 93.3% (28 of 30 students) passed.
- Math 032 – 86.3% (69 of 80 students) passed.

Table 1. 2007 – 2008 academic year enrollment, pass rate, and grade average summary of lower division mathematics courses.

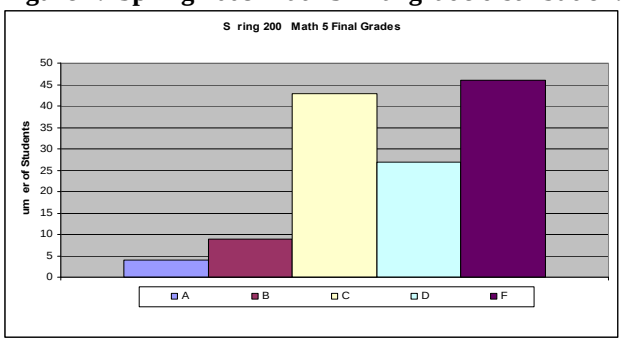
Course	Amount Passing Fall 2008	Fall 2007 Average Grade Point	Amount Passing Spring 2008	Spring 2008 Average Grade Point
Math 5	71.3% of 293	2.16	43.4% of 129	1.18
Math 21	55.0% of 151	1.68	76.1% of 213	2.05
Math 22	76.9% of 121	2.14	73.5% of 136	2.09
Math 23	66.1% of 56	1.95	48.25% of 56	1.57
Math 24	74.4% of 49	2.43	75.3% of 77	2.09

Math 30	85.2% of 27	2.82	93.3% of 30	2.65
Math 32	97.4% of 76	2.58	86.3% of 80	2.39

From Table 1, we see quite an interesting fact -- the average grade point is lower during the spring than fall for all courses, excluding Math 21 which had an anomalously low pass rate during the fall. This trend includes those courses having a higher pass rate in spring than fall.

Math 005: Preparatory Calculus

Figure 1. Spring 2008 Math 5 final grade distribution.



Of the 129 students enrolled in Math 5 during spring 2008, 43.4% (56) passed. Figure 1 above shows the grade distribution for the course. This pass rate is inconsistent from previous terms, which is described in Table 2. A similar pass rate can be seen during the fall 2005 term, but this was prior to the redevelopment of the pre-calculus curriculum. We attempt to explore reasons for this anomaly.

Table 2. Summary Math 5: Pre-Calculus enrollment and pass rates from fall 2005 to spring 2008.

Math 005: Preparatory Calculus		
Semester	Number Enrolled	Number Passing
Fall 2005	306	145 (47.4%)
Spring 2006	123	83 (67.5%)
Fall 2006	178	126 (70.8%)
Spring 2007	46	34 (73.9%)
Fall 2007	293	209 (71.33%)
Spring 2008	129	56 (43.4%)

Sections

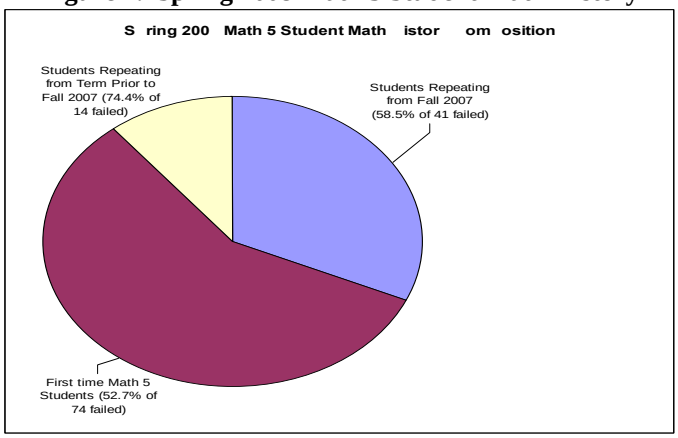
Viewing each section's enrollment numbers and the number of students passing, we hope to bring forth any problems within a particular section. There are five sections of Math 5 during spring 2008 and we have the following results.

- Section 1 (Bianchi) – 51.7% of the 29 enrolled passed.
- Section 4 (Bianchi) – 35.7% of the 28 enrolled passed.
- Section 6 (James) – 43.3% of the 30 enrolled passed.
- Section 7 (DaSilveira) – 40.7% of the 27 enrolled passed.
- Section 8 (James) – 46.7% of the 15 enrolled passed.

From the data, we see each section performed poorly. We conclude that there are no apparent issues with a specific Math 5 instructor.

Student Academic Math History
We begin by looking at the academic math history of students enrolled in Math 5 during the spring 2008 semester. Figure 3 describes the Math 5 course makeup.

Figure 2. Spring 2008 Math 5 Student Math History



From Figure 3, we notice more than 57% of students enrolled in Math 5 during the spring term were taking Math 5 for the first time, of which 39 (52.7%) did not pass the course. Of the 41 students repeating Math 5 from fall 2007, 24 (58.5%) did not pass the course and 10 of the 14 (74.4%) students repeating Math 5 from an earlier term did not pass. Thus, a large portion of the student population in this course had some time between their last math course and enrolling in Math 5. Numerous studies have shown that if mathematical concepts are not used, the ability to recall and utilize these techniques deteriorates. In addition, of the 73 students who failed Math 5, 57.5% (42) are in poor academic standing.

Gateway Exams
The gateway exam tests students in a variety of basic algebraic and computational skills needed throughout Math 5. The exam is administered within the first four weeks of classes and students are able to take the exam twice a day until the end of the four weeks. The results of spring 2008 semester's gateway exams are as follows.

- 80 students passed; 60% (48) passed Math 5.
- 33 students attempted, but did not pass; 15.2% (5) passed Math 5.
- 16 did not attempt; 18.8% (3) passed Math 5.

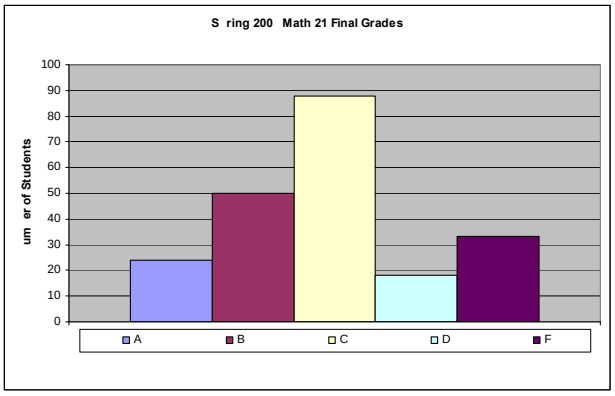
Similar to fall 2007's results, we see that by not passing the exam (attempt or no attempt) yields a substantially larger risk of failing the course – only 8 of 49 students who did not pass gateway managed to pass Math 5 during spring 2008 and 31 of 86 did so during fall 2007. This is somewhat to be expected since this implies two cases; either 1) a student attempted the gateway but lacks the necessary skills to pass the exam, thus lacking essential skills to be successful in pre-calculus or 2) did not attempt to take the gateway, demonstrating a lack of effort on the student's part.

Office Hours and Tutoring
Math 5 has benefited from having a group of instructors who have taught this course several times with adequate results (see Table 2 for each semester's data). One such instructor, Kristen Bianchi, has been teaching Math 5 since fall 2006. She states that

there has been minimal office hour attendance this term and Elizabeth Boretz, Director of the Student Advising and Learning Center, gives comparable data for tutorial sessions -- the same *nine* students attended. From this data, we infer students were not seeking the help needed.

Math 021: Calculus of a Single Variable

Figure 3. Spring 2007 Math 21 final grade distribution.



Of the 213 students enrolled, 76.1% (162) received a passing grade, which is a considerable increase from the fall 2007 pass rate of 55%. Figure 3, above, displays the Math 21 final grade distribution for the spring 2008 term.

Table 3. Summary Math 21: Calculus of a Single Variable enrollment and pass rates from Fall 2005 to spring 2008.

Math 021: Calculus of a Single Variable		
Semester	Number Enrolled	Number passing the course
Fall 2005	39	32 (82.1%)
Spring 2006	65	51 (78.5%)
Fall 2006	234	166 (70.9%)
Spring 2007	128	81 (63.3%)
Fall 2007	153	83 (55.0%)
Spring 2008	213	162 (76.1%)

From Table 3, we see the percentage of students passing Math 21 was steadily declining each term from fall 2005 until fall 2007, and drastically increased this term. At this point, it is unclear why this trend occurred.

Previous Math 5 Students

Previous Math 5 student performance in Math 21 is of interest as it helps us to assess how well our pre-calculus course is preparing students for further mathematics study. Of the 149 students who took Math 5 during fall 2007 and enrolled in Math 21 spring 2008, 80.5% (120) passed Math 21. The grade distribution is as follows.

- 17 received an A+, A, or A-
- 41 received a B+, B, or B-
- 62 received a C+, C, or C-
- 11 received a D+, D, or D-
- 18 received an F

Those students taking pre-calculus during fall 2007 at UC Merced appear to be well prepared for calculus. Table 3 below summarizes the number of students enrolled each term in Math 21, the number of students enrolling in Math 21 the term immediately following in Math 5, and the amount of those students who received a passing grade in Math 21 for each respective term.

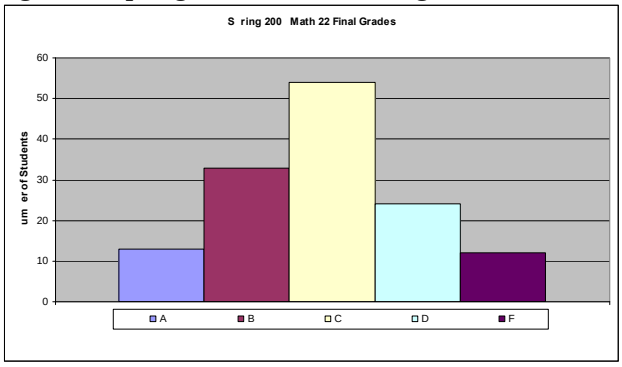
Table 4. Summary of previous Math 5 students' performance in Math 21 from spring 2006 to spring 2008.

Term	Total Enrolled in Math 21	Number enrolled from Math 5 previous semester	Number of Students Receiving an A, B, or C	
Spring 2006	65	47	38	80.90%
Fall 2006	234	54	26	48.10%
Spring 2007	128	72	44	61.10%
Fall 2007	151	11	3	27.30%
Spring 2008	214	149	120	80.50%

From Table 4, we see the fall term pass rate for students previously taking Math 5 at UC Merced are lowest during fall terms. This is somewhat to be expected since this is immediately following summer and the likelihood that students have used their pre-calculus skills during the summer months quite low. As suspected, students are most successful in calculus when taking it the semester immediately following Math 5.

<u>Math 022: Calculus of a Single Variable II</u>

Figure 4. Spring 2008 Math 22 final grade distribution.



Of the 136 students enrolled in Math 22, 73.5% (100) received a passing grade. Figure 4 shows the spring 2008 final grade distribution for Math 22. Table 5 below summarizes the enrollment numbers and pass rates for Math 22 from fall 2005 to spring 2008.

Table 5. Summary Math 22: Calculus of a Single Variable II enrollment and pass rates from fall 2005 to spring 2008.

Math 022: Calculus of a Single Variable II		
Semester	Number Enrolled	Number Passing
Fall 2005	19	18 (94.7%)
Spring 2006	76	68 (89.5%)
Fall 2006	113	69 (61.1%)
Spring 2007	139	54 (39.1%)
Fall 2007	121	93 (76.9%)
Spring 2008	136	100 (73.5%)

From Table 5, enrollment numbers appear to be leveling off at approximately 130 students per semester. The amount of students receiving a passing grade has been inconsistent. However, we have also had several instructors throughout the semesters. For the 2007 – 2008 academic year, Devin Greene has remained the instructor and we see similar pass rates for fall and spring terms.

Among those students enrolled in Math 22 during spring 2008,

- 43% took ICP 001 before Math 22
- 50.7% took Math 21 before Math 22

Among the 58 who took ICP 001,

- 2 received an A+, A, or A-
- 15 received a B+, B, or B-
- 20 received a C+, C, or C-
- 16 received a D+, D, or D-
- 5 received an F

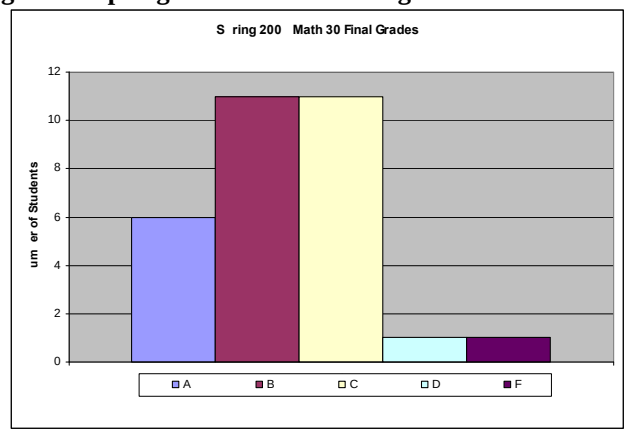
Among the 69 who took Math 21,

- 7 received an A+, A, or A-
- 18 received a B+, B, or B-
- 30 received a C+, C, or C-
- 8 received a D+, D, or D-
- 6 received an F

Thus, 36.2% of previous ICP 001 students failed Math 22 while 20% of previous Math 21 students failed Math 22.

<u>Math 030: Calculus of a Single Variable II for Biological Sciences</u>

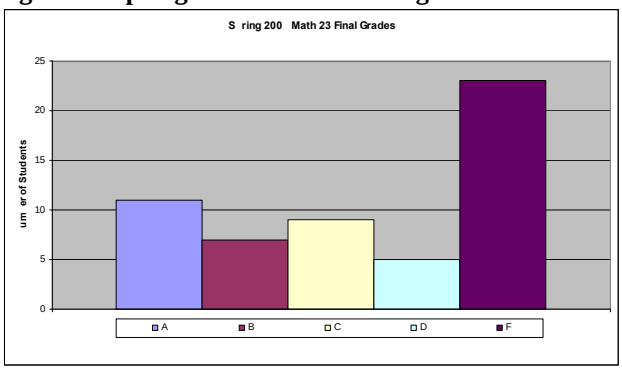
Figure 5. Spring 2008 Math 30 final grade distribution.



Of the 30 students enrolled in Math 30 during spring 2008, 93.3% (28) passed. Figure 5 shows the spring 2008 final grade distribution for the course. Since Math 30 is designed for the Biological Sciences majors, students taking Math 30 are not required to continue on in the mathematics course sequence and have not done so as of yet. Ideas for further assessment of this course are welcomed.

Math 023: Vector Calculus

Figure 6. Spring 2008 Math 23 final grade distribution.



Of the 56 students enrolled in Math 23 spring 2008, only 48.2% (27) received a passing grade. From Table 6, we notice that although there has not been a consistent pass/fail rate for Math 23, 48.2% is an abnormality.

Table 6. Summary Math 23: Vector Calculus enrollment and pass rates from fall 2005 to spring 2008.

Math 023: Vector Calculus		
Semester	Number Enrolled	Number Passing
Fall 2005	7	7 (100%)
Spring 2006	N/A	N/A
Fall 2006	45	27 (60.0%)
Spring 2007	56	45 (80.4%)
Fall 2007	56	37 (66.1%)
Spring 2008	56	27 (48.2%)

Students' Academic Math History

Among the 28 students that failed Math 23,

- 15 took Math 22 more than once
- 9 took Math 22 once, and are taking Math 23 for first time
- 2 are repeating Math 23 for second or third time
- 2 have no previous math history at UC Merced

Furthermore, among the 28 students who failed Math 23, 64.3% (18) are in "poor academic standing," meaning that they are having trouble in other courses as well as Math 23. A sufficient number of these students have a history of academic struggle.

Math 024: Linear Algebra and Differential Equations

Figure 7. Spring 2008 Math 24 final grade distribution.

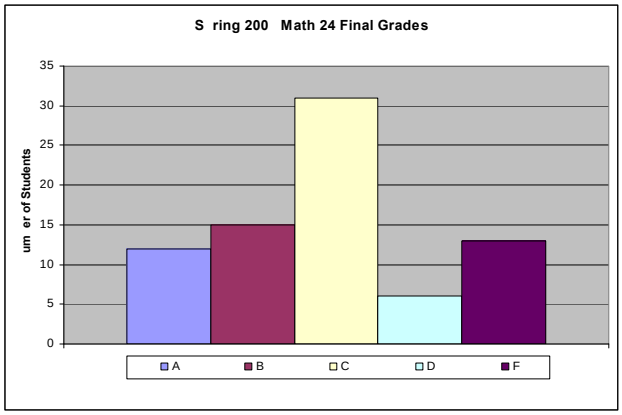


Figure 7 shows the spring 2008 Math 24 final grade distribution. Of the 77 students enrolled, 75.3% (58) received a passing grade. Table 7 gives the enrollment numbers and pass rates for Math 24 from fall 2005 to spring 2008.

Table 7. Summary Math 24: Linear Algebra and Differential Equations enrollment and pass rates from fall 2005 to spring 2008.

Math 023: Vector Calculus		
Semester	Number Enrolled	Number Passing
Fall 2005	N/A	N/A
Spring 2006	17	13 (76.5%)
Fall 2006	30	25 (83.3%)
Spring 2007	31	23 (74.2%)
Fall 2007	49	35 (71.4%)
Spring 2008	77	58 (75.3%)

Math 032: Probability and Statistics

Figure 8. Spring 2008 Math 32 final grade distribution.

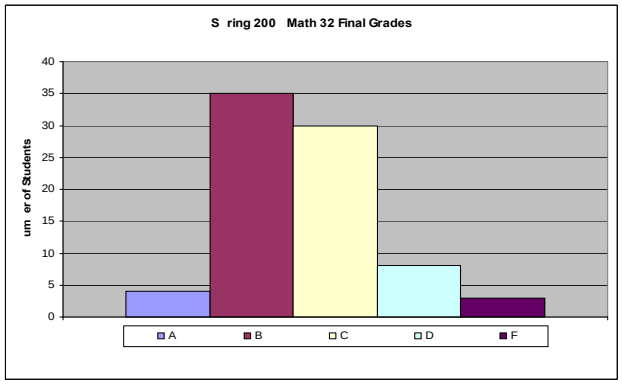


Figure 8 shows the spring 2008 Math 32 final grade distribution. Of the 80 students enrolled, 86.3% (69) received a passing grade.

Analyses of Fall 2008 Lower Division Mathematics Courses at UC Merced
Prepared by Cheryl Hedges
January 16, 2009

1.0 Pass/Fail rates by Course

What follows is an overview of lower division mathematics courses at UC Merced for the fall 2008 term. For the purposes of this document, a "C-" or better is considered "passing."

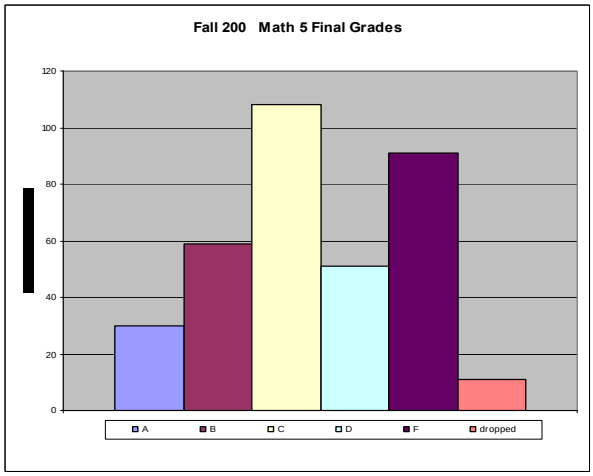
- Math 005 – 58.1% (197 of 339) of students passed
- Math 015 – 89.5% (51 of 57) of students passed
- Math 018 – 90.9% (40 of 44) of students passed
- Math 021 – 59.7% (178 of 298) of students passed
- Math 022 – 72.7% (112 of 152) of students passed
- Math 023 – 64.1% (50 of 78) of students passed
- Math 024 – 76.1% (54 of 71) of students passed
- Math 030 – 85.7% (30 of 35) of students passed
- Math 032 – 72.5% (50 of 69) of students passed

2.0 Course Data Analysis

Final grade distribution for each lower division mathematics course is described below. Additional data analysis follows to assist the UC Merced mathematics faculty in assessing lower division courses and student success.

2.1 Math 005: Pre-Calculus

Figure 1. Fall 2008 Math 5 final grade distribution.



2.1(a) Overview

Of the 339 students enrolled in Math 5 at the end of the fall 2008 semester, 58.1% (197) passed. At mid-semester, 51.3% of the 348 students were passing. Of those 348, 11 students dropped after mid-semester and 2 students enrolled from Math 21 into Math 5. Please refer to Figure 1 for the final grade distribution including those 11 students who dropped.

Table 1, below, shows each term's mid-semester and final pass rates for Math 5. Spring 2008 brought an anomalously poor pass rate, as did fall 2008. Although spring 2008 brought questions of apathetic student nature, the following of fall's pass rate brought forth the age-old question of student academic preparedness. This has been a topic of much discussion throughout the fall semester with the Math 5 instructors and math faculty. Two semesters of low pass rates is hardly a trend, but we explore various student assessment scores to help us gain a broader perspective of the student population and their incoming abilities.

Table 1. Math 5 mid-semester and final pass rates by term.

Term	Total Enrolled	Mid-semester	Final
Fall 2006	177	143 (80.8%)	126 (70.8%)
Spring 2007	46	38 (82.6%)	34 (73.9%)
Fall 2007	293	186 (62.8%)	209 (71.3%)
Spring 2008	129	82 (63.5%)	56 (43.4%)
Fall 2008	339	179 (51.3%)	197 (58.1%)

2.1(b) SAT Math Scores

Students enrolling at UC Merced are required to provide their SAT scores. The SAT Math score data can be broken up into two distinctive parts: those scoring above 500 and those scoring 500 or below. The fall 2008 student data is as follows:

- 154 students scored more than 500 on SAT Math; 76% (117) passed Math 5.
- 167 students scored 500 or less on SAT Math; 42.5% (71) passed Math 5.

Although SAT Math scores on their own cannot predict with accuracy a student's course readiness, it certainly gives us a mode to identify at an early stage potential students needing additional math preparation. We could recommend either a summer program or additional preparation at a community college level prior to fall enrollment.

2.1(c) Math Placement

The second tier of assessment is the math placement exam. Students entering UC Merced in fall 2008 took a math placement exam administered by Maple T.A. to assess their calculus readiness. This exam is a 25-question online, non-proctored exam. A student scoring 20 or more is recommended to enroll in Math 21, Calculus I, while those scoring 19 or less are recommended to take Math 5, Pre-Calculus, the university's only math course offered prior to Calculus I. This is the second year using a score of 20 as the cut-off into Math 21, but this is the third year using the Maple T.A. calculus readiness exam. Because of this, we are able to compare data from fall 2007 with data from 2008.

- During the fall 2008 semester, 75 students scored 10 or less on the math placement exam. *Only 23 of those 75 (30.7%) passed Math 5*. Additionally, 18 of the 23 who passed the course did so with a "C." Compare that number to the 203 students who scored 11 or more on the exam. Of those 203 students, 142 (70%) passed the course – a significant increase.

- Likewise, fall 2007 data shows students scoring 10 or less on the placement exam had an unfavorable pass rate – only 27 (52.9%) of 51 students passed Math 5. 80.7% (134) of the 166 students who scored 11 or more passed the course.

Conversely, viewing student performance for those hovering around the cut-off placement score of 20 yields the following for fall 2008:

- 85% (17) of 20 who scored 19 passed Math 5; 6 passed with a "C"
- 100% (15) of 15 who scored 18 passed Math 5; 9 passed with a "C"

Similarly, fall 2007 data shows the following:

- 80% (16) of 20 who scored 19 passed Math 5; 5 passed with a "C"
- 98.8% (23) of 24 who scored 18 passed Math 5; 6 passed with a "C"

This student population has done well in Math 5 for subsequent semesters. Perhaps we can entertain the idea of lowering the cut-off score for enrollment into Math 21. This would allow those students at the highest end of the spectrum in Math 5 to be challenged to a higher degree as well as narrow the range of preparedness in Math 5. Not only does this benefit the students, it allows instructors to better tailor their lectures to suit the majority of their student population.

The placement exam is proving to be a better predictor of success in Math 5 than SAT scores. Combining these two scores yields an even clearer result for fall 2008[*].

- A score of 510 or more on SAT Math
    - More than 10 on math placement; 14% (15) of 107 failed Math 5.
    - 10 or less on math placement; 47.4% (9) of 19 failed Math 5.
- A score of 500 or less on SAT Math
    - More than 10 on math placement; 37.9% (33) of 87 failed Math 5.
    - 10 or less on math placement; *77.4% (41) of 53 failed Math 5*.

Clearly, those students who scored 500 or less on SAT Math and 10 or less on placement are in need of additional support or even additional course preparation prior to Pre-calculus. Furthermore, all 12 students passing Math 5 in this category passed the course with a "C." Using these two exam scores, we can identify at an early stage those students who are considered "at-risk" in mathematics.

2.1(d) Gateway Exam

During Math 5, students take a gateway exam – an exam which tests students in a variety of basic algebraic and computational skills needed throughout Math 5. The exam is administered within the first four weeks of classes and students are able to take the exam twice a day until the end of the four weeks. Failing to pass the exam lowers the final grade by one-third of a letter grade. The results from fall 2008 are as follows:

[*] Students without SAT Math or placement scores are omitted from results.

- 230 students attempted and passed; 72.6% (167) passed Math 5.
- 94 students attempted the exam, but did not pass; 22.3% (21) passed Math 5.
- 26 did not attempt the exam; 34.6% (9) passed Math 5.

As seen below in Table 2, the odds of a student failing the gateway exam and passing the course are repeatedly low - only 22.3% (21) of the 94 students passed Math 5 this semester. It is important that instructors are given this data so they can clearly communicate the purpose of the gateway exam as well as the odds a student will pass the course if unable to pass the gateway exam. This gives students an opportunity to assess their level of preparedness and take action within the first few weeks of class.

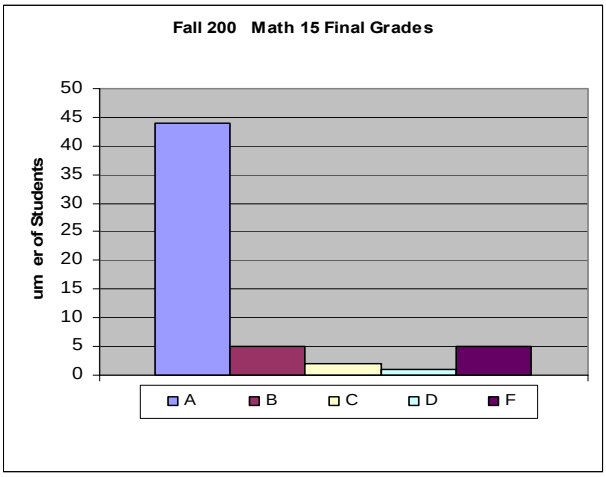
Table 2. Gateway Exam results and Pass rate by semester.

Semester	Passed Gateway	Passed Math 5	Failed Gateway	Passed Math 5
Fall 2007	217	179 (82.5%)	66	27 (40.9%)
Spring 2008	80	48 (60%)	33	5 (15.2%)
Fall 2008	230	167 (72.6%)	94	21 (22.3%)

Furthermore, one would assume students' placement exam score and gateway would be correlated, and indeed it is. During the fall 2008 semester, 46 students scored 10 or less on the placement and did not pass the gateway exam – 33 (71.7%) failed Math 5. The placement exam and gateway exam are two avenues students can assess their abilities within the first few weeks of the course.

2.2 Math 015: Intro to Scientific Data Analysis

Figure 2. Fall 2008 Math 15 final grade distribution.

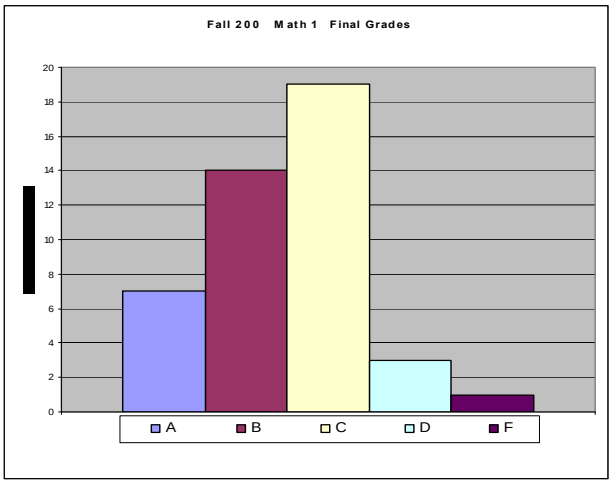


2.2(a) Overview

Of the 57 students enrolled in Math 15 at the end of fall 2008 semester, 89.5% (51) received a passing grade. As you will notice from Figure 2, the largest majority (44) students received an "A" which is consistent with previous semesters.

2.3 Math 018: Statistics for Scientific Data Analysis

Figure 3. Fall 2008 Math 18 final grade distribution.

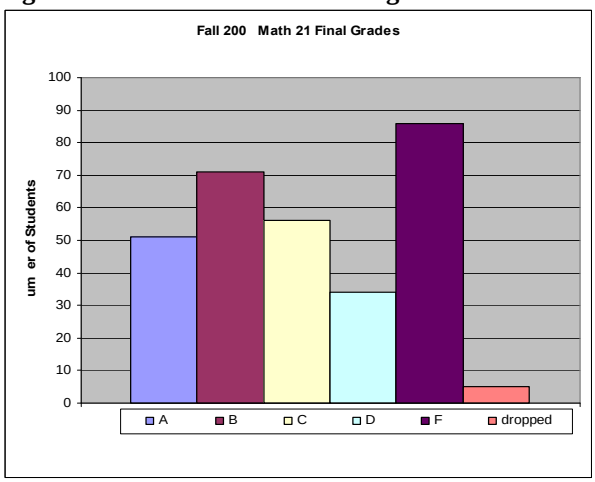


2.3(a) Overview

Of the 44 students enrolled in Math 18 at the end of the term, 90.9% (40) received a passing grade. Please refer to Figure 3 for the final grade distribution.

2.4 Math 021: Calculus of a Single Variable I

Figure 4. Fall 2008 Math 21 final grade distribution.



2.4(a) Overview

At mid-semester, 303 students were enrolled in Math 21 with 76.6% (232) of them passing. After mid-semester, 5 students dropped bringing the total number of enrolled students to 298. Of the 298 students enrolled in Math 21 at the end of the semester, 59.7% (178) received a passing grade. Refer to Figure 4 for the final grade distribution, including those 5 that dropped.

Table 3 shows the pass rates by semester for Math 21. As you can see, fall 2007 had a similar pass rate – 55% of the 153 enrolled. The past two fall semesters had large drops

in the number of people passing after mid-semester grades. We explore the student population to gain insight into this.

Table 3. Math 21 pass rate by semester.

Math 021: Calculus of a Single Variable		
Semester	um er Enrolled	um er assing the course
Fall 2005	39	32 (82.1%)
Spring 2006	65	51 (78.5%)
Fall 2006	234	166 (70.9%)
Spring 2007	128	81 (63.3%)
Fall 2007	153	83 (55.0%)
Spring 2008	213	162 (76.1%)
Fall 2008	298	178 (59.7%)

2.4(b) Student Population and Academic Background

Like that of previous years, the majority of students enrolled in Math 21 during the fall semester are freshmen. In fact, freshmen make up 77.5 % (231) of the 298 enrolled and 87.6% (156) of the 178 who passed. Freshmen make up 62.5% of those students who failed. The data for the remaining population is as follows:

- 62% (31) of the 50 students that took Math 5 at UCM failed Math 21.
    - 21 repeated Math 5 or Math 21; 17 (81%) failed Math 21.
    - 29 took Math 5 during the 2007-08 academic year; 14 (48.3%) failed Math 21.
- 14 students are either transfer or took Math 5 more than 1 year ago; 12 (85.7%) failed Math 21.

Last fall, similar numbers appeared pertaining to those who took Math 5 at UCM - 79.4% (27) of the 34 failed Math 21. However, at closer look, we see that many of those previous Math 5 students have a history of struggling in math courses as seen by the number of times they've repeated either Math 5 or Math 21. We see a similar result for the fall 2008 semester.

2.4(c) Math Placement

The largest population of students enrolled in Math 21 in fall 2008 is freshmen. Thus, it is appropriate to view the placement exam as we have shown in section 2.1(c), this has been a more accurate predictor of student success than SAT Math scores.

Figure 5. Fall 2008 math placement score vs. Math 21 final grade.

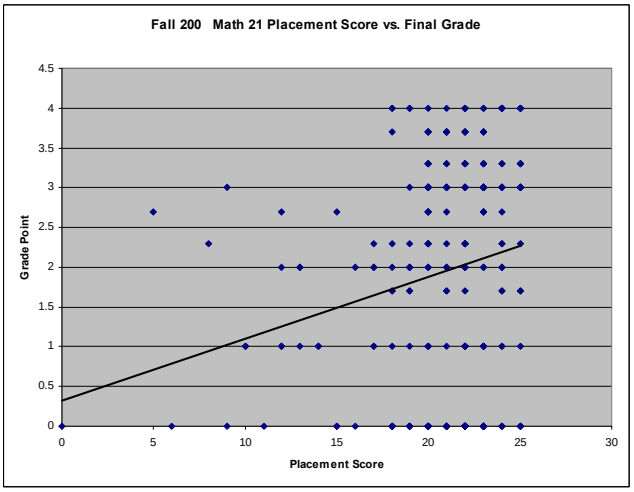


Figure 5, above, shows a weak, but positive correlation (R^2=0.0429). Table 4, below, describes the freshmen placement score for those students enrolled in Math 21 and the number passing the course. Those scoring below 20 faired the worst, along with those who scored 22 and 23. I'm not sure what this implies, if anything.

Table 4. Freshmen math placement score and pass rate for fall 2008.

Placement Score	Number of students	Number passing Math 21	
25	20	15	75.0%
24	26	21	80.8%
23	37	20	54.1%
22	41	22	53.7%
21	29	19	65.0%
20	33	22	66.7%
1	12	6	50.0%
1	10	5	50.0%
17	3	2	66.7%
1 or less	5	2	40.0%
o Score	20	15	75.0%

2.4(d) Class Time, Instructor, and T.A.

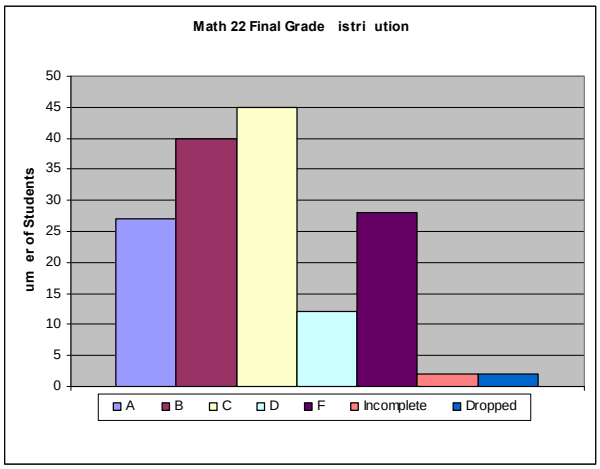
In hopes of gaining insight into reasons for a lower pass rate, I examined lecture and discussion times, lecturer, teaching assistant, and the number of freshmen enrolled by section. What I discovered was an inconsistency on all fronts. Some morning discussions did extremely well, while others did extremely poorly, which was the case for mid-day and evening courses as well. Each T.A. taught more than one section and had a range of outcomes in each section. Some sections with many freshmen preformed outstanding, while other sections with many freshmen did poorly. There appeared to be no recognizable pattern for any of these topics.

As stated earlier, two semesters is not a trend, but the question remains, what happened post mid-semester? Perhaps freshmen get too comfortable, or become overwhelmed or

lazy; however, under further examination on 36 of the 65 students who were performing well at mid-semester and failed at the end of the term were freshmen. Compared to the number of freshmen enrolled in this course, this is not a significant number. Thus, the majority of students whose grade decreased considerably were everyone but freshmen students.

2.5 Math 022: Calculus of a Single Variable II

Figure 6. Fall 2008 Math 22 final grade distribution.



2.5(a) Overview

At mid-semester, 156 students were enrolled in Math 22 with 78.2% (122) of them passing. After mid-semester, 2 students dropped and 2 students have finished the semester with an "incomplete." Of the 154 students enrolled at the end of the semester, 72.7% (112) have received a passing grade. Refer to Figure 6 for final grade distribution.

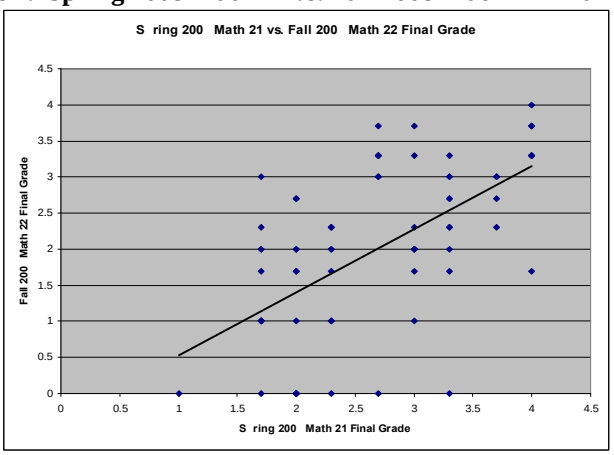
The majority of the Math 22 population is comprised of transfer students and those that took Calculus I at UCM during the spring 2008 term. These two groups of populations make up 72.7% (112) of the 154 enrolled. The academic background for those data is as follows:

- 71.8% (51) of 71 spring 2008 Math 21 students passed Math 22.
- 87.8% (36) of 41 transfer students passed Math 22.
- 46.7% (7) of 15 students repeating Math 22 from spring '08 passed.
- 66.7% (18) of 27 students who took Math 21 before spring 2008 or took Calculus I at other college/university passed Math 22 at UCM.

Transfer students make up 26.6% of the total enrolled and comprise 32.1% of those that passed. UCM students who took Math 21 during spring 08 are 46.1% of the total enrolled and compose 45.5% of those who passed.

Figure 7 below shows the correlation between spring '08 Math 21 grades and fall '08 Math 22 final grades. A positive correlation ($R^2 = 0.3433$) is found, which is stronger than spring 2008's correlation ($R^2=0.1289$).

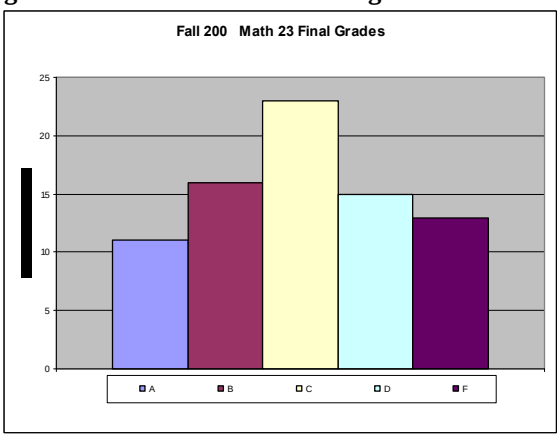
Figure 7. Spring 2008 Math 21 vs. Fall 2008 Math 22 Final Grade



There are 58 students "on track." In other words, they took Math 5 during fall 2007, Math 21 during spring 2008, and Math 22 fall 2008. Of those 58, 43 (74.1%) passed Math 22. These are positive numbers. Thus, 74.1% of the 58 students who entered UCM with a weak background in math (i.e. are not placed into Math 21 during freshmen year), are performing sufficiently well in Math 22. This implied that if students make it through Math 5 and Math 21, they are adequately prepared for Math 22.

2.6 Math 023: Vector Calculus

Figure 8. Fall 2008 Math 23 final grade distribution.



2.6(a) Overview

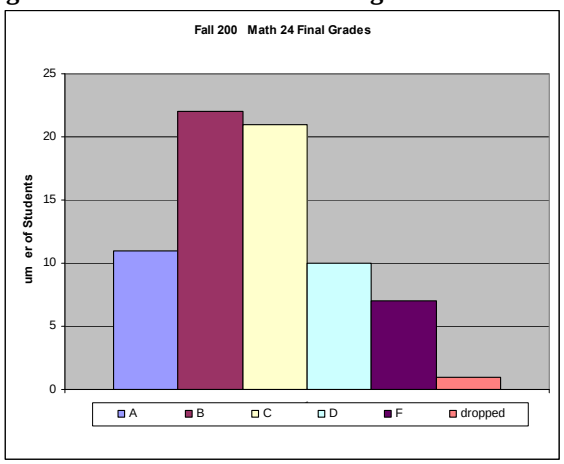
Of the 78 students enrolled in Math 23 during the fall 2008 semester, 64.1% (50) received a passing grade. Refer to Figure 8 for the final grade distribution.

Most students enrolled in Math 23 took Math 22 here at UCM. The student population math background and pass rates are as follows:

- 35 took Math 22 during spring 2008 term; 25 (71.4%) passed Math 23.
- 21 took Math 22 during fall 2007 term; 14 (66.7%) passed Math 23.
- 14 students are repeating Math 23 from the 2007 – 2008 academic year; 8 (57.1%) passed.
- 8 students have no previous math history at UCM; 3 (37.5%) passed.

2.7 Math 024: Linear Algebra and Differential Equations

Figure 9. Fall 2008 Math 24 final grade distribution.



2.7(a) Overview

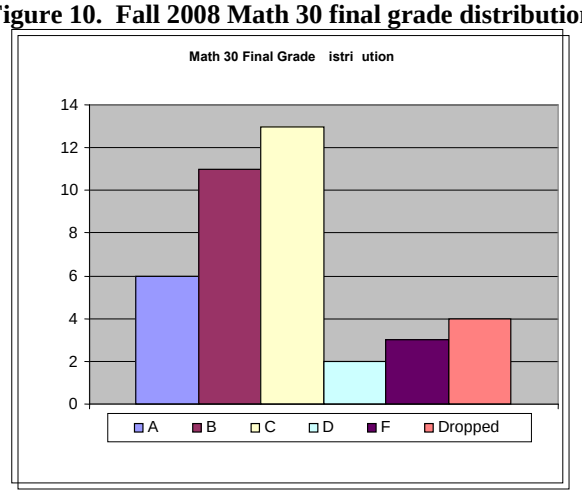
At mid-semester, 73.6% (53) of the 72 students enrolled in Math 24 were passing. At the end of the fall 2008, 71 students remained with 76.1% (54) receiving a passing grade for the course. Refer to Figure 9 to view the final grade distribution.

Math 24's prerequisite is Math 22 and can be taken concurrently with Math 23. However, most students choose to take Math 23 immediately following Math 22 and then enroll in Math 24. At present, the order appears to have no bearing on student success. The number of transfer students passing was the lowest out of all student math backgrounds, however, not enough to be of concern. The data for students enrolled during fall 2008 is as follows:

- 10 students took Math 22 spring 2008; 7 (70%) passed Math 24.
- 7 took Math 23 and Math 24 concurrently during fall 2008; 6 (85.7%) passed Math 24.
- 27 took Math 23 in spring 2008; 24 (88.9%) passed Math 24.
- 15 new transfer students; 10 (66.7%) passed Math 24.
- 12 students who transferred to UCM during a previous term; 7 (58.3%) passed Math 24.

2.8 Math 030: Calculus II for Biological Sciences

Figure 10. Fall 2008 Math 30 final grade distribution.

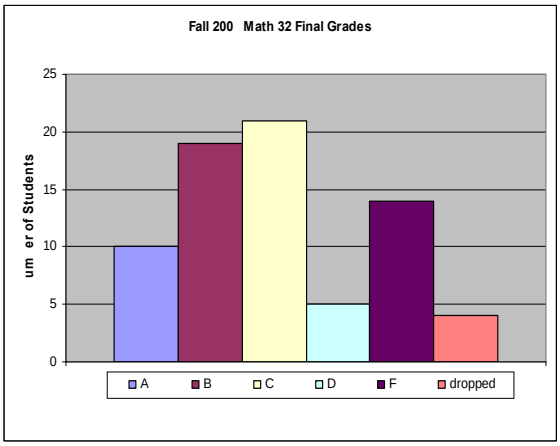


2.8(a) Overview

At mid-semester, 59% (23) of the 39 enrolled students were passing. At the end of the fall 2008 semester, 85.7% (30) of the 35 who remained enrolled in Math 30 passed the course. Refer to Figure 10 to view the final grade distribution, including those 4 students who dropped.

2.9 Math 032: Probability and Statistics

Figure 11. Fall 2008 Math 32 final grade distribution.



2.9(a) Overview

At mid-semester, 54.8% (40) of the 73 enrolled students were passing. After mid-semester, 4 students dropped bringing the total to 69 of which 72.5% (50) passed the course. Refer to Figure 11 for the final grade distribution, including those 4 students who dropped.

Analyses of Fall 2009 Lower Division Mathematics Courses at UC Merced

Prepared by Alice Moua and Masa Watanabe

January 20, 2010

1.0 Pass/Fail rates by Course

What follows is an overview of lower division mathematics courses at UC Merced for the fall 2009 term. For the purposes of this document, a "C-" or better is considered "passing."

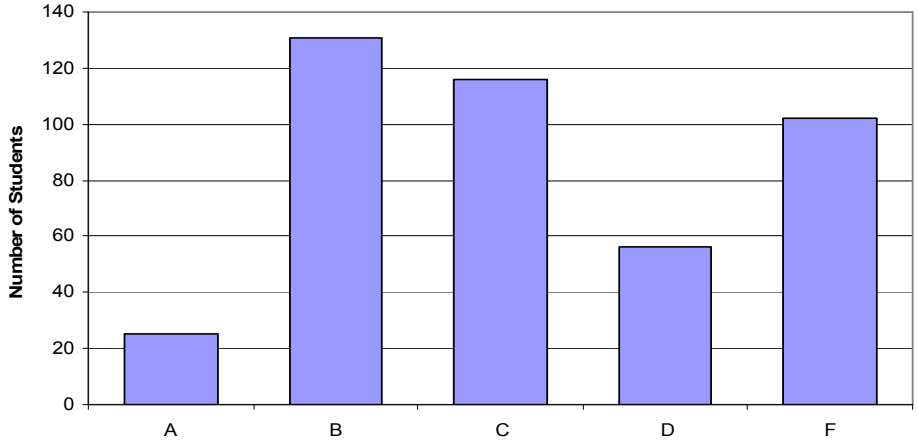
- **Math 005 – 63.3% (272 of 430) of students passed**
- Math 015 – 94.1% (158 of 168) of students passed
- **Math 021 – 63.9% (200 of 313) of students passed**
- Math 022 – 80.5% (132 of 164) of students passed
- Math 023 – 82.2% (106 of 129) of students passed
- Math 024 – 83.5% (66 of 79) of students passed
- Math 030 – 73.5% (25 of 34) of students passed
- Math 032 – 85.1% (57 of 67) of students passed

2.0 Course Data Analysis

Final grade distribution for each lower division mathematics course is described below. Additional data analysis follows to assist the UC Merced mathematics faculty in assessing lower division courses and student success.

2.1 Math 005: Pre-Calculus

Figure 1. Fall 2008 Math 5 final grade distribution.



2.1(a) Overview

Of the 430 students enrolled in Math 5 at the end of the fall 2009 semester, 63.3% (272) passed. At mid-semester, 74.4% of the 434 students were passing. Of those 434, 3 students dropped after mid-semester and 1 student got an "incomplete". Please refer to Figure 1 for the final grade distribution excluding those 4 students.

Table 1, below, shows each term's mid-semester and final pass rates for Math 5. Although Fall 2009 had a highest pass rate among recent years, the pass rate of 63.3% for pre-calculus course certainly brought forth a question of student academic preparedness. We explore various student assessment scores to help us gain a broader perspective of the student population and their incoming abilities.

Table 1. Math 5 mid-semester and final pass rates by term.

Fall	Total	Midterm*	Final	Spring	Total	Midterm*	Final
2006	177	143 (80.8%)	126 (70.8%)	2007	46	38 (82.6%)	34 (73.9%)
2007	293	186 (62.8%)	209 (71.3%)	2008	129	82 (63.5%)	56 (43.4%)
2008	350	179 (51.3%)	197 (56.3%)	2009	175	113 (63.5%)	100 (57.1%)
2009	430	323 (74.4%)	272 (63.3%)				

*In general, total number of Math 5 students prior to Midterm report is slight higher than total number reported here. Numbers of students tends to withdraw the class after having a Midterm grade report.

2.1(b) SAT Math Scores

Students enrolling at UC Merced are required to provide their SAT scores. The SAT Math score data can be broken up into two distinctive parts: those scoring above 500 and those scoring 500 or below. Of the 430 students enrolled in Math 5 at the end of the fall 2009 semester, 320 students are freshmen. The fall 2009 freshman student data is as follows:

- 143 freshman students scored more than 500 on SAT Math; 84% (120) passed Math 5.
- 162 freshman students scored 500 or less on SAT Math; 51% (83) passed Math 5.
- 15 freshman students had no SAT score; 40% (6) passed Math 5.

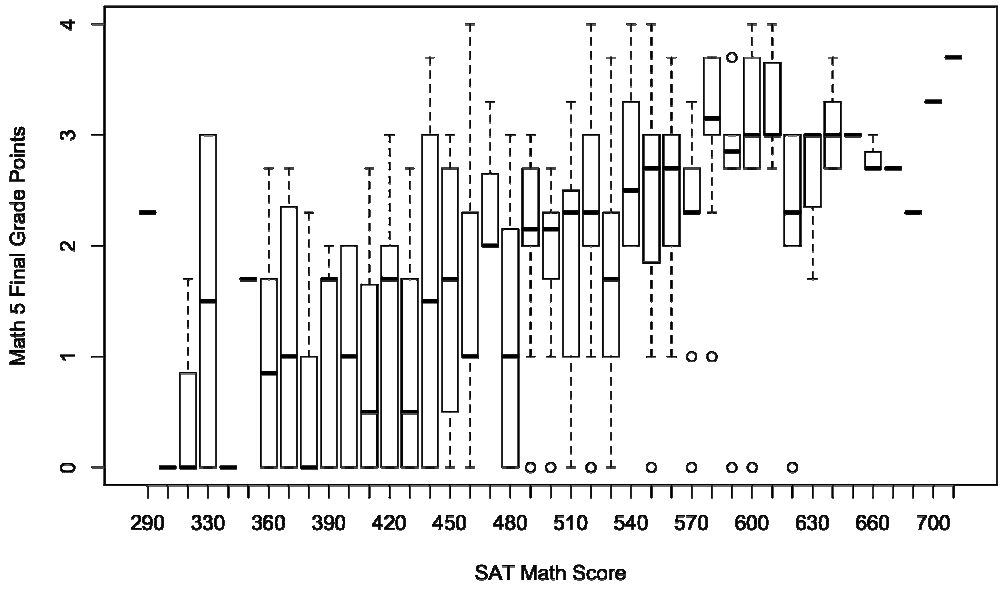


Figure 2 Fall 2009 math SAT score vs. Math 5 final grade. This graph represents its (25% and 75%) quartiles, as well as minimum and maximum values. The bold line indicates a median of each data set.

According to Figure 2, SAT Math Score is correlated with Math 5 Final Grade.(ANOVA shows *p-value* $< 10^{-6}$). SAT Math scores certainly give us a mode to identify at an early stage potential students needing additional math preparation. We could recommend either a summer program or additional preparation at a community college level or summer bridge program prior to fall enrollment.

2.1(c) Math Placement

The second tier of assessment is the math placement exam. Students entering UC Merced in fall 2009 took a math placement exam to assess their calculus readiness. This exam is a 25-question

online, non-proctored exam. A student scoring 20 or more is recommended to enroll in Math 21, Calculus I, while those scoring 19 or less are recommended to take Math 5, Pre-Calculus, the university's only math course offered prior to Calculus I.

- During the fall 2009 semester, 88 students who scored 10 or less on the math placement exam took Math 5. *Only 32 of those 88 (36.4%) passed Math 5*. Additionally, 19 of the 32 who passed the course did so with a "C." Compare that number to the 253 students who scored 11 or more on the exam and took Math 5. Of those 253 students, 183 (72.3%) passed the course – a significant increase. Figure 3 shows that Placement scores is also correlated with Math 5 Final Grade. (ANOVA shows *p-value* $< 10^{-6}$).

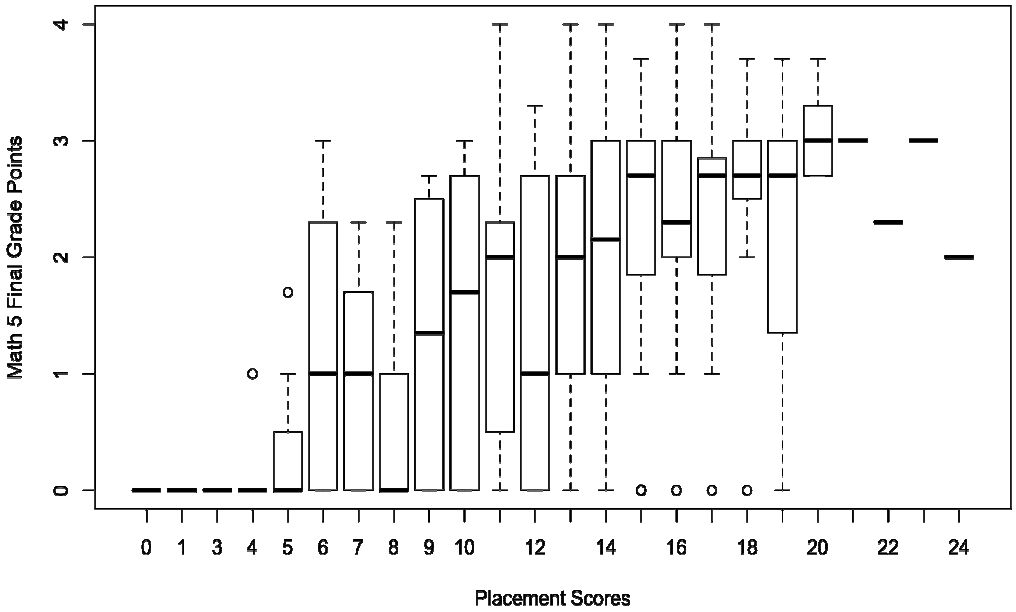


Figure 3 Fall 2009 math placement score vs. Math 5 final grade. The bold line indicates a median of each data set.

- Likewise, fall 2007 and fall 2008 data show that students scoring 10 or less on the placement exam had an unfavorable pass rate. Also we have been observing a significant increase in a pass rate for students who scored 11 or more on the placement.

Conversely, viewing student performance for those hovering around the cut-off placement score of 20 yields the following for fall 2009:

- 75.0% (18) of 24 who scored 19 passed Math 5; 5 passed with a "C"
- 95.7% (22) of 23 who scored 18 passed Math 5; 5 passed with a "C"

Similarly,
Fall 2007 data shows the following:

- 80% (16) of 20 who scored 19 passed Math 5; 5 passed with a "C"
- 98.8% (23) of 24 who scored 18 passed Math 5; 6 passed with a "C"

Fall 2008 data shows the following:

- 85% (17) of 20 who scored 19 passed Math 5; 6 passed with a "C"
- 100% (15) of 15 who scored 18 passed Math 5; 9 passed with a "C"

The placement exam is proving to be a better predictor of success in Math 5 than SAT scores. Combining these two scores yields an even clearer result for fall 2009*.

- A score of 510 or more on SAT Math
  - More than 10 on math placement; 12.6% (14) of 111 freshmen failed Math 5.
  - 10 or less on math placement; 63.6% (7) of 11 freshmen failed Math 5.
- A score of 500 or less on SAT Math
  - More than 10 on math placement; 37.6% (38) of 101 freshmen failed Math 5.
  - 10 or less on math placement; 63.6% (28) of 44 freshmen failed Math 5.

Clearly, those freshman students who scored 500 or less on SAT Math and 10 or less on placement are in need of additional support or even additional course preparation prior to Pre-calculus. Furthermore, all 12 students passing Math 5 in this category passed the course with a "C." Using these two exam scores, we can identify at an early stage those students who are considered "at-risk" in mathematics.

2.1(d) Retake

Table 2 indicates that pass rates for students who retook Math 5 are much lower than one for those who took Math 5 first time.

Table 2. # of retakes and their results

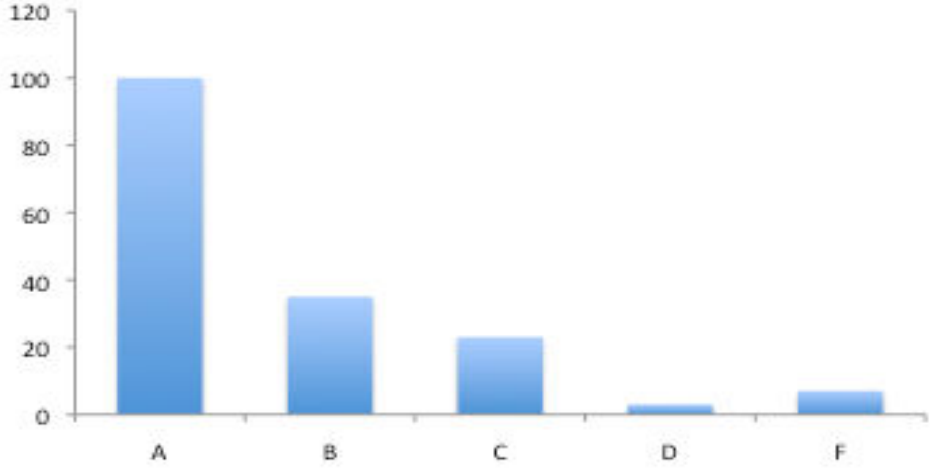
# of Retake	# of Students	Passed Math 5	Failed Math 5
0	342	234 (68.4%)	108 (31.6%)
1	80	34 (42.5%)	46 (57.5%)
2	8	4 (50.0%)	4 (50.0%)

Suggestion: Perhaps we can revisit a rubric to set the cut-off score for enrollment into Math 21. One suggestion of the cut-off is that 1) SAT Math score (> 500) with 10 or more placement score or 2) SAT Math score (<= 500) with 19 or more placement score. If any students meet one of these criteria, those should be recommended to take Math 21. Not only does this benefit the students, it allows instructors to better tailor their lectures to suit the majority of their student population.

* Students without SAT Math or placement scores are omitted from results.

2.2 Math 015: Intro to Scientific Data Analysis

Figure 4. Fall 2009 Math 15 final grade distribution.

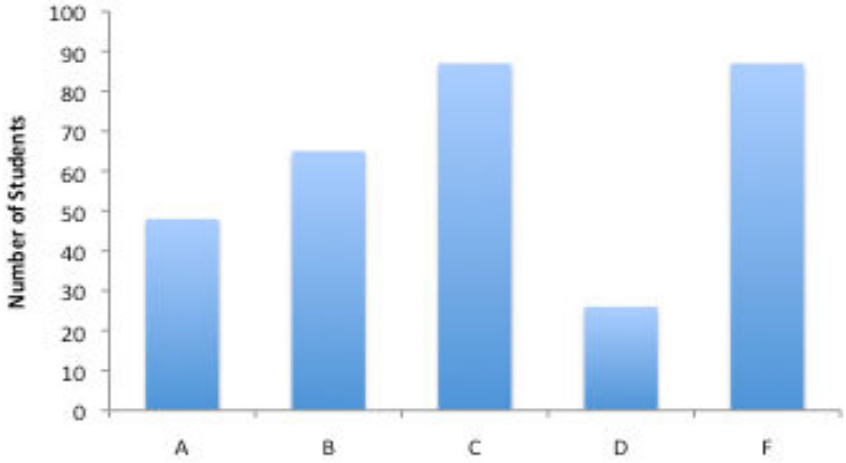


2.2(a) Overview

Of the 169 students enrolled in Math 15 at the end of fall 2009 semester, 94.0% (158) received a passing grade. As you will notice from Figure 4, the largest majority students received an "A-" or better which is consistent with previous semesters.

2.3 Math 021: Calculus of a Single Variable I

Figure 5. Fall 2009 Math 21 final grade distribution.



2.4(a) Overview

At mid-semester, 317 students were enrolled in Math 21 with 74.4% (236) of them passing. After mid-semester, 3 students dropped and 1 student got "incomplete". That brought the total number of enrolled students to 313. Of the 313 students enrolled in Math 21 at the end of the semester, 63.9% (200) received a passing grade. Refer to Figure 5 for the final grade distribution.

Table 3 shows the pass rates by semester for Math 21. As you can see, fall 2009 had a better pass rate than those of the past two fall semesters. Also, we explore the student population to gain more insight into student preparedness and readiness.

Table 3. Math 21 pass rate by semester.

Math 021: Calculus of a Single Variable		
Semester	**Number Enrolled**	**Number passing the course**
Fall 2005	39	32 (82.1%)
Spring 2006	65	51 (78.5%)
Fall 2006	234	166 (70.9%)
Spring 2007	128	81 (63.3%)
Fall 2007	153	83 (55.0%)
Spring 2008	213	162 (76.1%)
Fall 2008	298	178 (59.7%)
Spring 2009	266	154 (57.9%)
Fall 2009	313	200 (63.9%)

2.4(b) Student Population and Academic Background

This semester, 49.2% (154) of students enrolled in Math 21 during the fall semester are freshmen, who had never taken any Math courses at UC Merced before. This number was much smaller than previous three years: in fall 2008, freshmen make up 77.5 %. 76.6% (118) of those 154 freshman students passed. Freshmen make up 31.9% of those students who failed.

This semester, number of sophomore students (132) and twenty-three freshmen, who took Math 5 at UC Merced before, enrolled in Math 21 was increased to 42.2%. The data for the remaining population is as follows:

- 63.4% (69) of the 108 students that took Math 5 at UCM failed Math 21.
    - 57 of those 108 students got Math 5 grade "C+" or lower. Of those 57 students, 42 (75.4%) failed Math 21

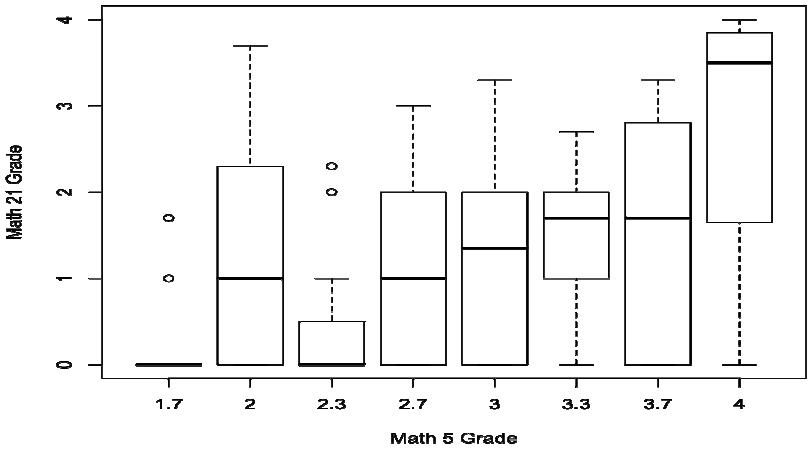


Figure 6 Fall 2009 Math 5 final grade vs Math 21 final grade for students who took Math 5 at UCM. The bold line indicates a median of each data set. The analysis shows *p-value* = 0.001935

- 30 repeated Math 5; 25 (83.3%) failed Math 21.
  - 22 of 108 repeated Math 5 twice
  - 8 of 108 repeated Math 5 three times

- 52 students are either transfer or took pre-calculus at another college; 8 (15.4%) failed Math 21.

We have seen that many of those previous Math 5 students have a history of struggling in math courses as seen by the number of times they've repeated either Math 5 or Math 21. We see a similar result for other semesters.

2.4(c) Math Placement

Among 177 freshmen of students enrolled in Math 21 in fall 2009, it is appropriate to view the placement exam as we have shown in section 2.1(c).

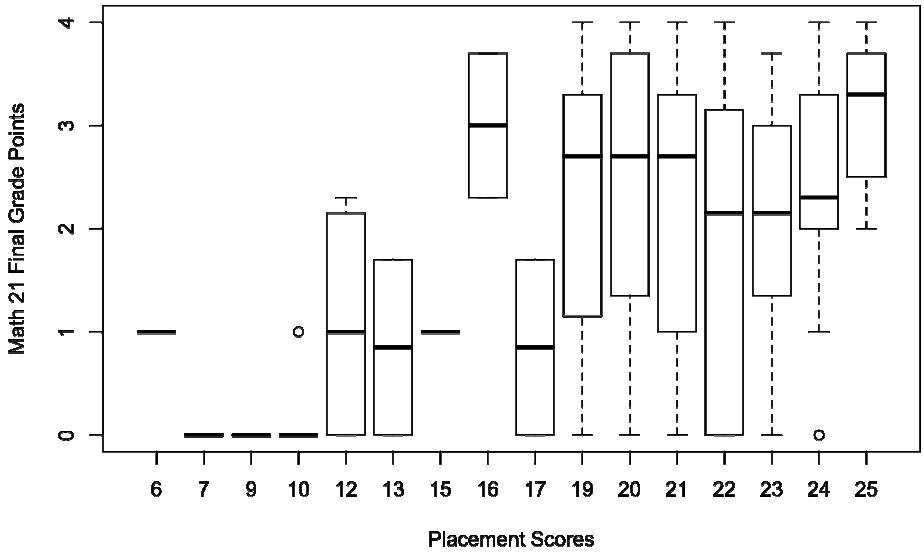


Figure 7 Fall 2009 math placement score vs. Math 21 final grade for freshman students. The bold line indicates a median of each data set.

Figure 7, above, shows that placement scores are also correlated with Math 21 Final Grades. Table 4, below, describes the freshmen placement score for those students enrolled in Math 21 and the number passing the course. Those scoring below 19 faired the worst. Both Figure 7 and Table 4 strongly support that the scoring rubric for 19 if SAT Math scores are not counted.

Table 4. Freshmen math placement score and pass rate for fall 2009.

Placement Score	Number of students	Number passing Math 21	
25	11	11	100.0%
24	21	18	85.8%
23	20	15	75.0%
22	20	13	65.0%
21	29	21	72.4%
20	35	26	74.3%
19	11	8	72.7%
18	0	–	–
17	4	2	50.0%
16 or less	17	5	29.4%
No Score	10	7	70.0%

2.4(d) Math 21 Retake

Table 5 indicates that pass rates for students who retook Math 21 are much lower than one for those who took Math 21 for the first time.

Table 5. Fall 2009 - number of retakes and their results

# of Retake	# of Students	Passed Math 21	Failed Math 21
0	278	180 (64.7%)	98 (35.3%)
1	32	18 (56.2%)	14 (43.8%)
2	2	2 (100%)	0 (0.0%)
3	1	0 (0.0%)	1 (100%)

Suggestion: Based on the observation, we may need to consider reviewing a prerequisite for Math 21. Maybe we should impose that student must pass Math 5 with a grade of "C" or better in order to take Math 21.

2.5 Math 022: Calculus of a Single Variable II

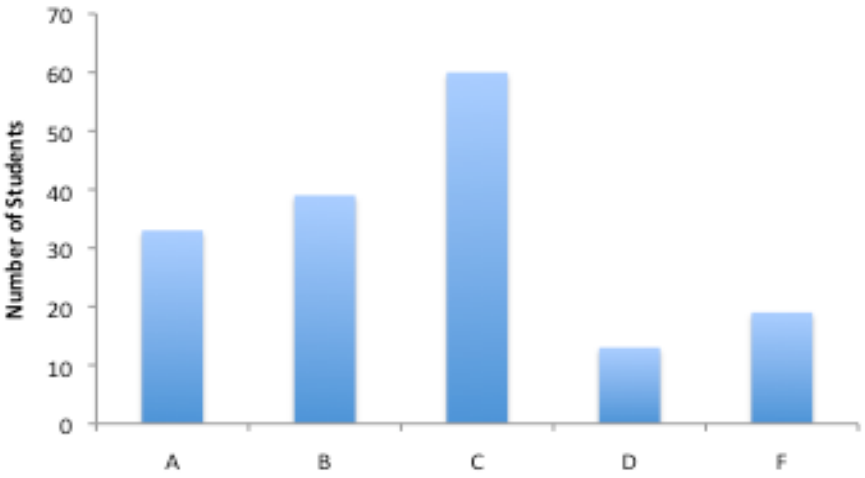


Figure 8 Fall 2009 Math 22 final grade distribution.

2.5(a) Overview

At mid-semester, 166 students were enrolled in Math 22 with 67.5% (112) of them passing. After mid-semester, 2 students dropped. Of the 164 students enrolled at the end of the semester, 80.5% (132) have received a passing grade. Refer to Figure 8 for final grade distribution.

The majority of the Math 22 population is those that took Calculus I at UCM before. These two groups of populations make up 68.9% (113) of the 164 enrolled. Transfer students make up 17.1% of the total enrolled. The academic background for those data is as follows:

- 96.4% (109) of 113 students who took Math 21 at UCM passed Math 22.
    - 97.6% (82) of 84 students who took Math 21 once at UCM passed Math 22.
    - 96.0% (24) of 25 students who took Math 21 twice at UCM passed Math 22.
- 89.2% (25) of 28 transfer students passed Math 22.
- 95.7% (22) of 23 freshmen, who took Calculus I at other college/university or pass AP test, passed Math 22.

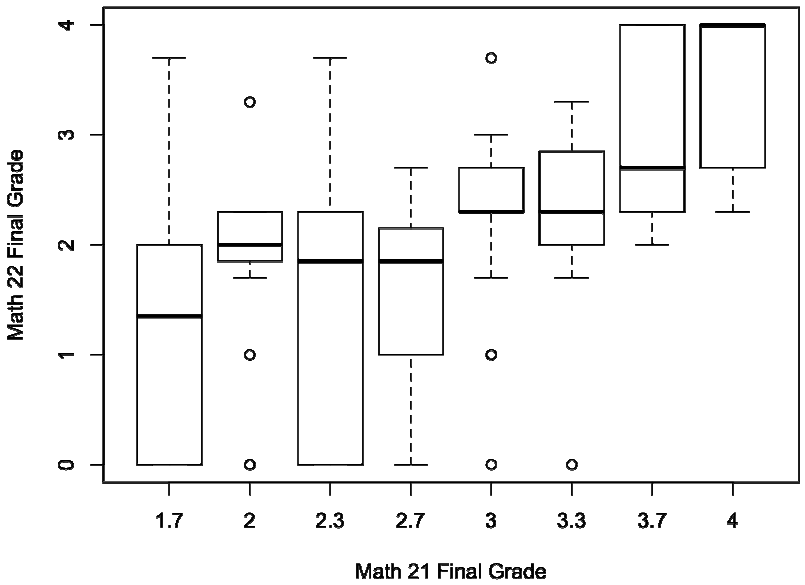


Figure 9 Fall 2009 Math 21 final grade vs. Math 22 final grade for students who took Math 21 at UCM . The bold line indicates a median of each data set. ANOVA indicates p-value is less than 10^{-8}.

Figure 9 below shows the correlation between Math 21 grades and Math 22 final grades. Also, our analysis suggest that if students make Math 22 through Math 21 at UCM, they are adequately prepared for Math 22.

2.6 Math 023: Vector Calculus

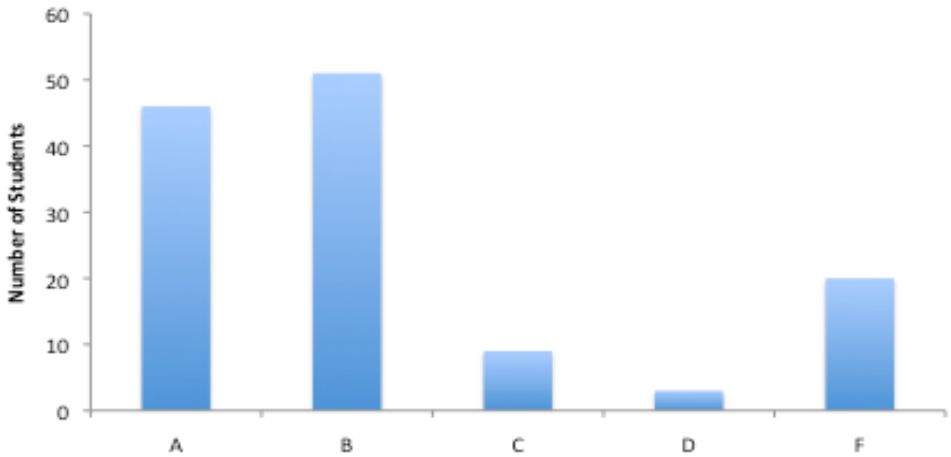


Figure 10. Fall 2009 Math 23 final grade distribution.

2.6(a) Overview

At mid-semester, 136 students were enrolled in Math 23 with 72.8% (99) of them passing. After mid-semester, 7 students dropped. Of the 129 students enrolled at the end of the semester, 82.2% (106) have received a passing grade. Refer to Figure 10 for final grade distribution.

Most students enrolled in Math 23 took Math 22 here at UCM. The student population math background and pass rates are as follows:

- 98 students who passed Math 22 at UCM; 85 (86.7%) passed Math 23.
- 16 students are repeating Math 23 from previous academic years;
    - 83.3% (10) of 12 students who repeated once at UCM passed.
    - 100% (4) of 4 students who repeated twice or more at UCM passed.
- 67.7% (21) of 31 students, who took Calculus II at other college/university or pass AP Calculus BC test, passed Math 23.

2.7 Math 024: Linear Algebra and Differential Equations

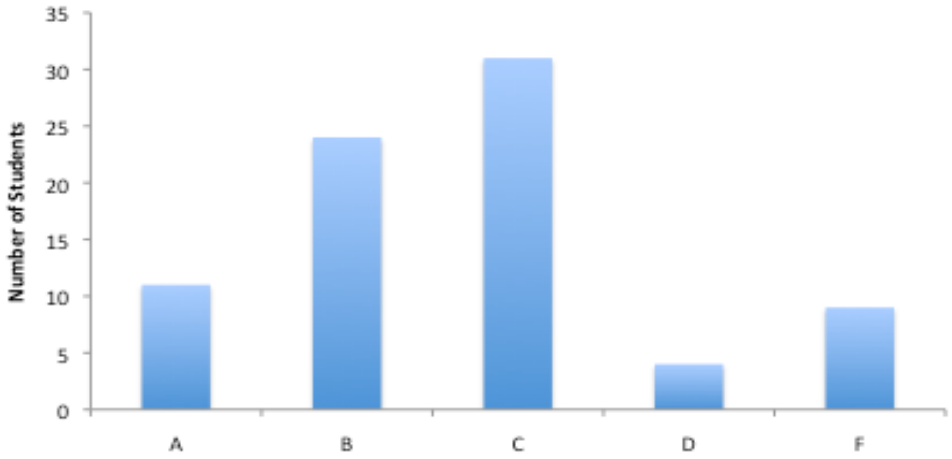


Figure 11. Fall 2009 Math 24 final grade distribution.

2.7(a) Overview

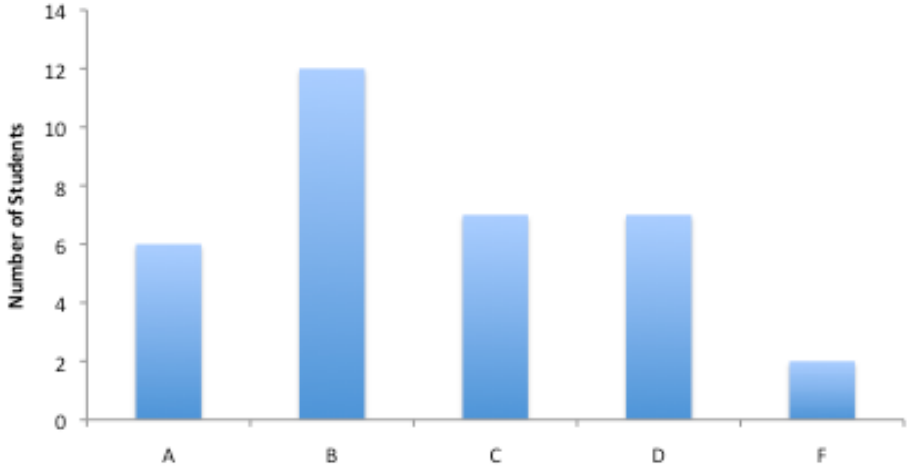
At mid-semester, 74.1% (60) of the 81 students enrolled in Math 24 were passing. At the end of the fall 2009, 79 students remained with 83.5% (66) receiving a passing grade for the course. Refer to Figure 11 to view the final grade distribution.

Math 24's prerequisite is Math 22 and can be taken concurrently with Math 23. However, most students choose to take Math 23 immediately following Math 22 and then enroll in Math 24. The data for students enrolled during fall 2009 is as follows:

- 46 students who previously passed Math 22 at UCM; 42 (91.3%) passed Math 24.
    - Of those 46, nine students are repeating Math 24 from previous academic years;
        - 71.4% (5) of 7 students who repeated once at UCM passed.
        - 50.0% (1) of 2 students who repeated twice at UCM passed.
- 69.7% (23) of 33 students, who took Vector Calculus at other college/university, passed Math 24.
- 15 took both Math 23 and Math 24 concurrently during fall 2009; 11 (73.3%) passed Math 24.
    - Of those 11, 10 students passed Math 23

2.8 Math 030: Calculus II for Biological Sciences

Figure 12. Fall 2009 Math 30 final grade distribution.



2.8(a) Overview

At mid-semester, 85.7% (30) of the 35 enrolled students were passing. At the end of the fall 2009 semester, 73.5% (25) of the 35 who remained enrolled in Math 30 passed the course. Refer to Figure 12 to view the final grade distribution, excluding 1 student who dropped.

2.9 Math 032: Probability and Statistics

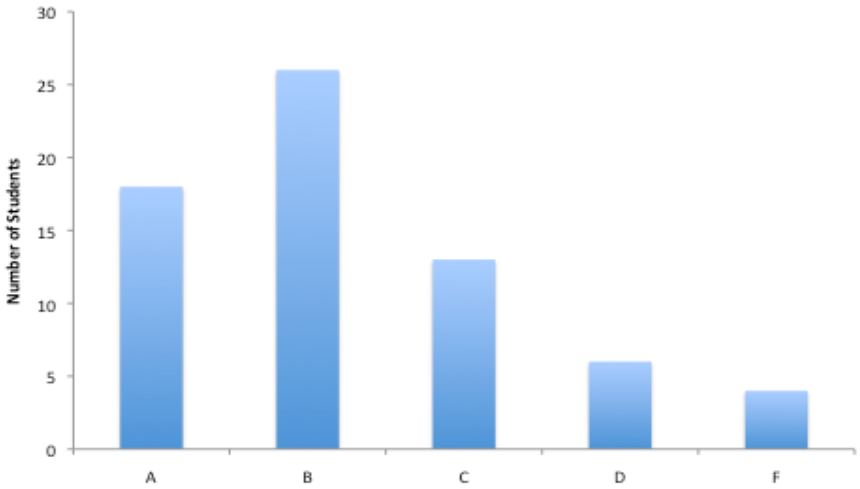


Figure 13 Fall 2009 Math 32 final grade distribution.

2.9(a) Overview

At mid-semester, 59.7% (40) of the 72 enrolled students were passing. After mid-semester, 5 students dropped bringing the total to 67 of which 85.1% (57) passed the course. Refer to Figure 13 for the final grade distribution, excluding those 5 students who dropped.

Spring 2009 Lower Division Mathematics Course Summary
Prepared by Cheryl Hedges
June 26, 2009

Spring 2009 Semester Course Overview

What follows is a brief overview of mathematics courses during the spring 2009 term. For the purpose of this document, a letter grade of "C-" or higher is considered "passing."

- Math 005 – 57.1% (100 of 175) passed
- Math 015 – 94.9% (37 of 39) passed
- Math 018 – 83.8% (31 of 37) passed
- Math 021 – 57.9% (154 of 266) passed
- Math 022 – 76.0% (133 of 175) passed
- Math 023 – 69.2% (63 of 91) passed
- Math 024 – 75.9% (63 of 83) passed
- Math 030 – 90.9% (20 of 22) passed
- Math 032 – 60.0% (45 of 79) passed

Math 005: Preparatory Calculus

Of the 175 students enrolled at the end of spring 2009, 57.1% (100) passed. At mid-semester 63.5% (113) of the 178 students were passing, and 3 students dropped after mid-semester grades. Please refer to Figure 1 for the final grade distribution, including those students who dropped.

Figure 1. Math 005 Final Grade Distribution – Spring 2009

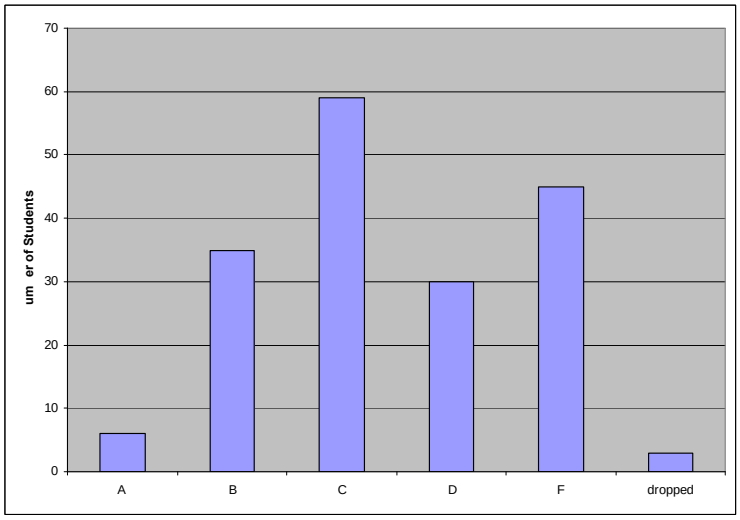


Table 1, below, shows the mid-semester and final pass rates for academic years (AY) 2006-2007, 2007-2008, and 2008-2009. Of notice are the final pass rates of 43.4%, 56.3%, and 57.1% for spring 2008, fall 2008, and spring 2009, respectively. Is the pass rate for Math 5 beginning to level off and if so, what accounts for this level of pass rate? By continuing to collect semester data, we hope to identify components which contribute to or hinder student success and approve upon student learning.

Table 1. Math 005 Mid-semester and Final Pass Rates by Term

Fall	Total	Midterm	Final	Spring	Total	Midterm	Final
2006	177	143 (80.8%)	126 (70.8%)	2007	46	38 (82.6%)	34 (73.9%)
2007	293	186 (62.8%)	209 (71.3%)	2008	129	82 (63.5%)	56 (43.4%)
2008	350	179 (51.3%)	197 (56.3%)	2009	175	113 (63.5%*)	100 (57.1%)

*Based on 178 students

Composition by Major

In an attempt to evenly disburse enrollment numbers in Math 5 across fall and spring semesters, an effort was made to limit fall enrollment to those students whose major required Calculus II and above. Table 2, below, indicates the enrollment numbers in regards to major requirements – those requiring Math 22 or above and those requiring Math 21 or below. Undeclared majors are included as not requiring Math 22 or above.

Table 2. Math 5 semester enrollment by major math requirement.

Semester	Total Enrollment	Number Required Calc. II or above	Number Required Calc. I or below
Fall 2008	339	223 (65.8%)	116 (34.2%)
Spring 2009	175	40 (22.9%)	135 (77.1%)

As you can see from Table 2, the student population in terms of majors was drastically different during fall and spring semesters but both yielded a similar final pass rate. During fall 2008, majors requiring Math 22 or higher composed 65.8% of the Math 5 population and 60.6% of those who failed. During spring 2009, majors requiring Math 22 or higher composed 22.9% of the Math 5 population and only 17.3% of those who failed. During both semesters, the failure rate for these majors was slightly less while the failure rate for students whose major required less than Math 22 was slightly more.

By Section

Viewing final pass rates by section yields the following:

- Section 1 (Bianchi) – 66.7% of 30 passed; 6 repeating students
- Section 2 (Crona) – 58.6% of 30 passed; 2 repeating students
- Section 3 (Crona) – 63.3% of 30 passed; 7 repeating students
- Section 4 (Bianchi) – 46.7% of 30 passed; 13 repeating students
- Section 5 (DaSilveira) – 42.9% of 30 passed; 16 repeating students
- Section 8 (DaSilveira) – 64.3% of 28 passed; 9 repeating students

During spring 2009, 69.7% of students were taking Math 5 for their first time. The two sections with the lowest pass rate, sections 4 and 5, had the highest number of repeating students. We examine repeating student performance across all sections to see if this is a major factor for the failure rate.

Repeating Students

There are 53 students repeating Math 5, 36 of which are freshmen repeating from fall 2008. Repeating students make up 30.3% of the students enrolled and comparably, 33.3% of students that failed. Although only 52.8% of repeating students passed, the failure rate for the course is not highly attributable to repeating students.

Math Placement
Since approximately 70% of students enrolled in Math 5 spring 2009 are taking the course for the first time, we examine the results of the correlation between placement exam scores and final grades. The results are exhibited in Table 3 below.

Table 3. Math placement score, average grade received by student in score range, number of those that failed, and the resulting percent failed.

Placement Score	Total	Average Grade	Number Failed	% Failed
10 or less	39	1.279	20	51.28
11 to 15	50	1.728	19	38.00
16 to 20	25	1.960	5	20.00
21 or more	5	1.600	2	40.00
No Score	56	1.502	29	51.79
Overall Average	175	1.586	75	42.86

As one can see from Table 3, students receiving a score of 10 or below and students with no placement score had the largest percentage of students who failed. Those students who either had or score of 10 or less or had no score at all, make up 54.3% (95 out of 175) of the overall population and 65.3% (49 out of 75) of those students that failed the course. The second largest failing group of students is that which scored between 11 and 15.

Although we are still seeing some predictive qualities between the placement exam score and success in Math 5, it is not as substantial as the one seen during fall 2008 ($R^2 = 0.077$ for spring 2009 and $R^2 = 0.19$ for fall 2008). Of those students enrolled in Math 5 fall 2008 and scoring 10 or less, 69.3% (52 of 75) failed. Only 8 of those 52 students who failed in fall re-enrolled during spring, of which only 3 passed.

Gateways
The Math 5 gateway exam tests students in a variety of basic algebraic and computational skills needed throughout Math 5. The exam is administered within the first four weeks of classes and students are able to take the exam twice a day until the end of the four weeks. The results of spring 2009 semester's gateway exams are as follows.

- 101 students passed, 71.3% of which passed the course
- 54 did not pass, 38.8% of which passed the course
- 21 did not attempt, 28.6% of which passed the course

Not surprising is a higher percentage of students who pass the gateway exam pass the course. Table 4 shows the pass rate for Math 5 per semester along with the number of students not passing or not attempting to take the gateway exam. From the table, it is evident that the likelihood of passing Math 5 having not passed or not attempted the gateway exam is low. Spring 2009 had 62.7% of students who either did not pass the gateway or did not attempt fail the course.

Table 4. Number of students failing gateway exam and Math 5 by semester.

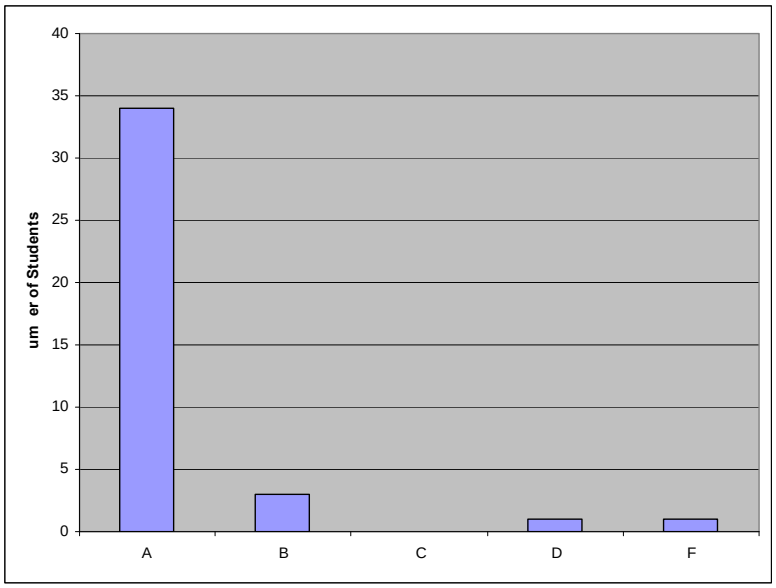
Semester	Math 5 Pass Rate	Gateway Fail or No Attempt	Failed Math 5
Spring 2008	43.4% (56/129)	49 (38.0%)	41 (83.7%)
Fall 2008	58.1% (197/339)	120 (35.4%)	90 (75.0%)
Spring 2009	57.1% (100/175)	75 (42.9%)	47 (62.7%)

The percent of students not passing, including those not attempting the exam, has been 38%, 35%, and 42% for spring 2008, fall 2008, and spring 2009 respectively. Even though there has been a slight increase, it has remained at a rate of approximately 40%. Approximately 30% of students each semester attempt and fail the gateway exam. Thus, the number of students choosing not to take it is not increasing but rather, holding steady.

Math 15: Introduction to Scientific Data Analysis

Of the 40 students enrolled, 94.9% passed. Figure 2 below shows the spring 2009 final grade distribution.

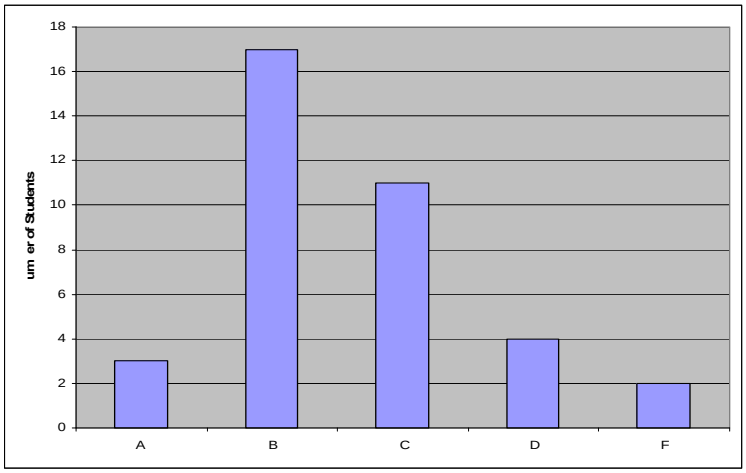
Figure 2. Math 015 Final Grade Distribution – Spring 2009



Math 18: Statistics for Scientific Data Analysis

Of the 37 students enrolled, 83.8% passed. Figure 3, below, shows the spring 2009 final grade distribution.

Figure 3. Math 018 Final Grade Distribution – Spring 2009



Math 21: Calculus I

Of the 266 students enrolled at the end of spring 2009, 57.9% passed. Figure 4, below, shows the spring 2009 final grade distribution.

Figure 4. Math 021 Final Grade Distribution – Spring 2009

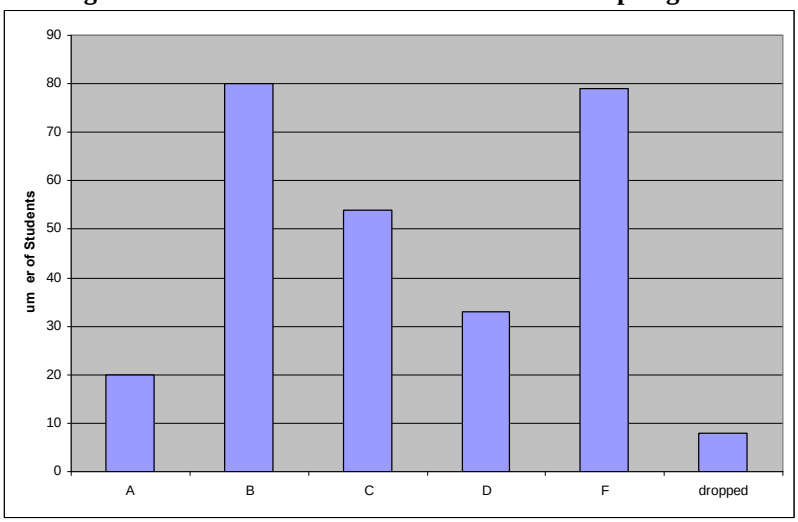


Table 5, below, shows the mid-semester and final pass rate for AY 2006-2007, 2007-2008, and 2008-2009. Enrollment numbers for AY 2008-2009 neared 300 with a final pass rate of approximately 58% each term. In previous semesters, Math 21 final pass rates have varied drastically. We continue to collect semester data to give us insight into why this variance occurs.

Table 5. Math 021 Mid-semester and Final Pass Rates by Term

Fall	Total	Mid	Final	Spring	Total	Mid	Final
2006	234	137 (58.5%)	166 (70.9%)	2007	128	56 (43.8%)	81 (63.3%)
2007	153	109 (71.2%)	83 (55.0%)	2008	213	155 (72.8%)	162 (76.1%)
2008	303	232 (76.6%)	178 (58.7%)	2009	266	168 (61.3%*)	154 (57.9%)

* Based on 274 students

Student Population
Math 21 during spring term is comprised of two primary groups of students – those having previously taken Math 5 during the fall semester and those repeating Math 21 from fall semester. Final semester performance by math backgrounds are as follows for spring 2009.

- Previous Math 5 students
    - 97 (59.5%) of 163 students who passed Math 5 fall 2008 passed
        - 53 (80.3%) of the 66 fall 2008 Math 5 students, who failed Math 21, passed Math 5 with a C+, C, or C-.
    - 7 (53.8%) of 13 students who passed Math 5 during spring 2008 passed
    - 1 (16.7%) of 6 students who repeated Math 5 passed
- 33 (56.9%) of 58 students that are repeating Math 21 from fall 2008 passed
- 10 (58.8%) of 17 students that have not taken a UCM math course passed
- 7 (66.7%) of 9 students taking UCM math courses prior to spring 2008 passed

In spring 2008, previous Math 5 student performance was relatively strong – 80.5% (120/149) passed Math 21. Spring 2009 previous Math 5 performance is comparable to the overall course performance, but would not be deemed "strong" with only 59.5% of the 163 students passing Math 21. Another element important to note is that 80.3% of students who passed Math 5 in fall 2008 with a C+, C, or C- failed Math 21. Furthermore, only 60.9% of students passing Math 5 in fall 2007 with a C+, C, or C- passed Math 21 in spring 2008. It is expected, to some degree, for students that barely pass a course to struggle in the subsequent course, but 80.3% is substantial. It would be beneficial to revisit what it means to get a "C" in Math 5 and note any changes through the semesters.

Course Clustering by Major
Figure 5, below, shows the percent enrolled by major in Math 21 during spring 2009. The following chart, Figure 6, shows the percentage of students failing by major. Figures 5 and 6 are comparable with BIOS and Undeclared having a larger failure rate than the population comprises in Math 21.

Figure 5. Spring 2009 Math 021 Course Enrollment - Percent by Major

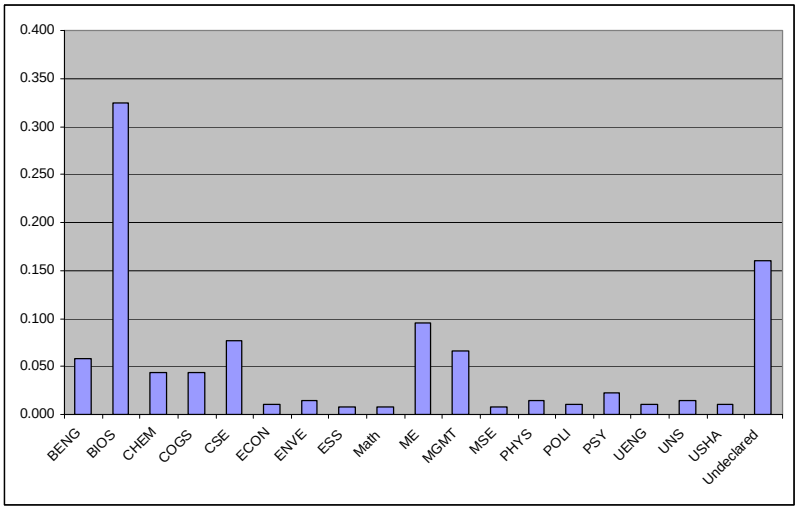
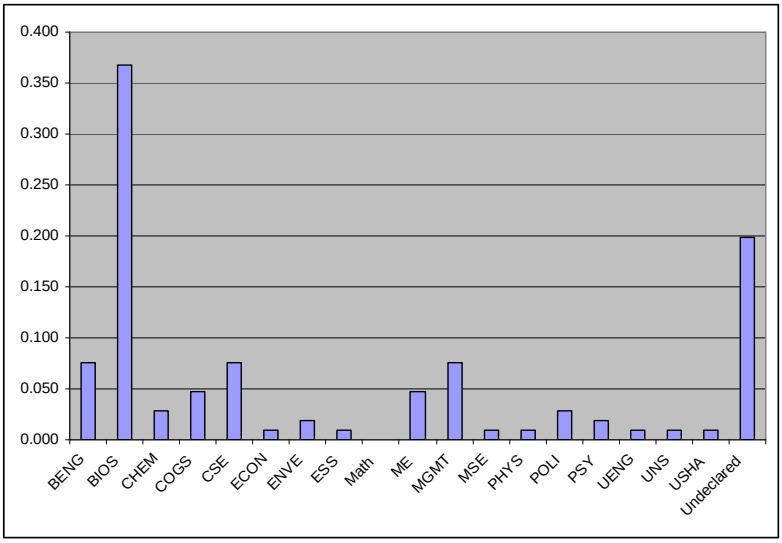


Figure 6. Spring 2009 Math 021 Failure Rates by Major

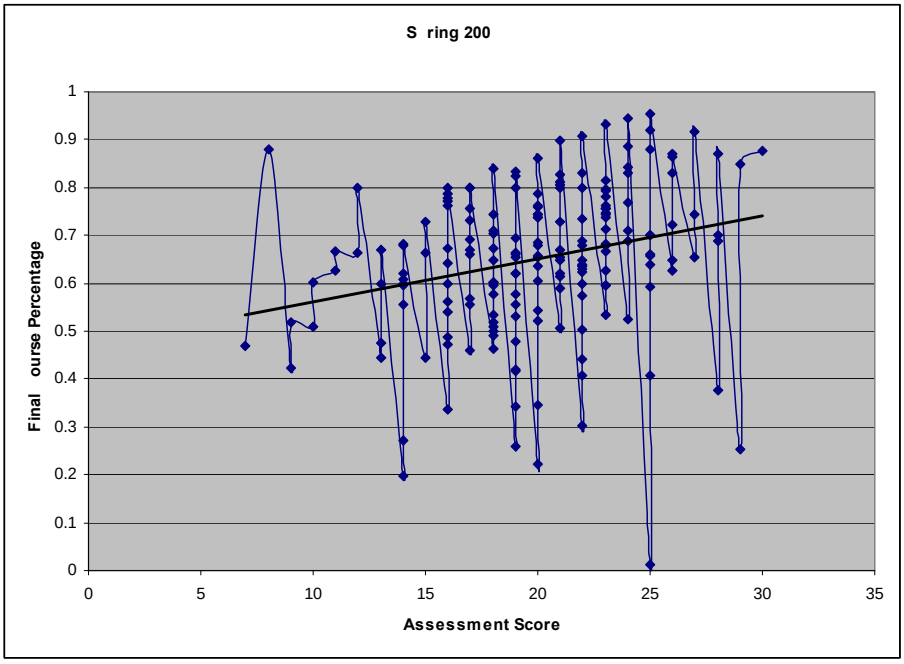


Combining the number of Biology and Undeclared majors shows that these two groups comprise 48.6% of those students in Math 21 and 56.6% of those who failed the course.

Diagnostic Exam

Students are given a 30-question diagnostic exam administered during the beginning of the semester. Below are the results correlating student diagnostic exam scores with the final course percentage.

Figure 7. Spring 2009 Math Diagnostic Exam Score versus Final Course Percentage



A linear regression computed positively correlates with the final course percentage (R^2= 0.063, n = 189). This is, however, less of a correlation than with previous semesters. Specifically, $R^2 = 0.32$, $R^2 = 0.094$, $R^2 = 0.17$ for fall 2007, spring 2008, and fall 2008 respectively. Correlations have been stronger in fall semesters than in spring. Diagnostic exam scores have been collected since fall 2007 and the results are detailed in Table 7.

Since final course percentages translate into different letter grades for different sections and semesters, final course percentage is used.

Table 6. Assessment score, number of students who received particular assessment score, and number who received 60% or higher in Math 21.

Assessment Score	Number of students	Number Receiving 60% or higher in Math 21	
30	2	2	100.00%
29	13	10	76.90%
28	13	11	84.60%
27	25	20	80.00%
26	38	26	68.42%
25	35	28	80.00%
24	64	43	67.20%
23	56	39	69.60%
22	55	39	70.90%
21	46	23	50.00%
20	49	23	46.90%
19	41	18	43.90%
18	89	70	78.70%
17	37	10	27.00%
16	23	10	43.50%
15	20	2	10.00%
14	14	2	14.29%
13	8	3	37.50%
12	5	3	60.00%
11	6	0	0.00%
10 or less	10	0	0.00%

From Table 7, one can see that of the data currently on file, only 24.4% (30 of 123) of students scoring 17 or less on the diagnostic exam have received 60% or higher in the course.

Math 22: Calculus II

Of the 174 enrolled, 76.4% passed Math 22. Figure 8, below, shows the spring 2009 final grade distribution including the 1 student who dropped after mid-semester grades.

Figure 8. Math 022 Final Grade Distribution – Spring 2009

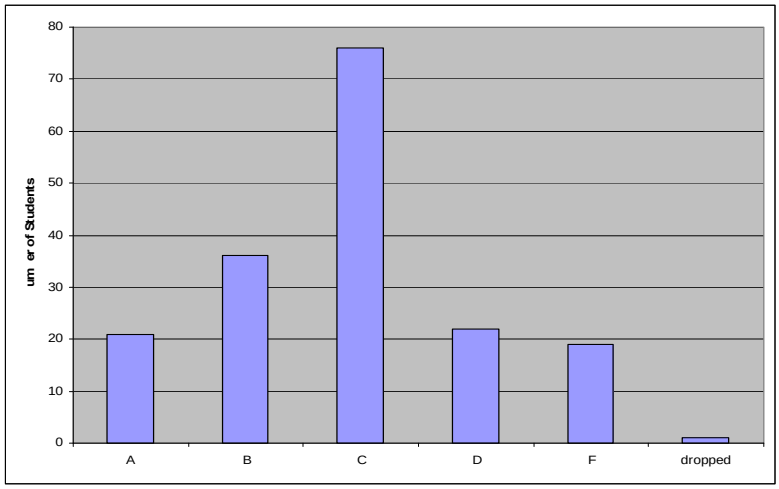


Table 8, below, shows the mid-semester and final pass rate for AY 2006-2007, 2007-2008, and 2008-2009. Math 22 has been fairly consistent over the past 3 academic years. Each year, spring enrollment has been approximately 20 students higher than in fall and pass rates are steady in the mid-70s.

Table 7. Math 022 Mid-semester and Final Pass Rates by Term

Fall	Total	Midterm	Final	Spring	Total	Midterm	Final
2006	113	54 (47.8%)	69 (61.1%)	2007	139	40 (28.8%)	54 (39.1%)
2007	121	102 (84.3%)	93 (76.9%)	2008	136	84 (61.8%)	100 (73.5%)
2008	156	122 (78.2%)	112 (71.8%)	2009	174	144 (82.3%*)	133 (76.4%)

* Based on 175 students

Current course performance by math background is as follows:

- 86.3% (107) of the 124 students that took Math 21 fall 2008 passed
- 37.5% (7) of the 16 students repeating Math 22 from fall 2008 passed
- 66.7% (4) of the 6 transfer students passed
- 53.6% (15) of the 28 students that took Math 21 or ICP prior to fall 2008 passed

Math 023: Vector Calculus

Of the 91 students enrolled, 69.2% passed Math 22. Figure 9, below, shows the spring 2009 final grade distribution including the 1 student that dropped.

Figure 9. Math 023 Final Grade Distribution – Spring 2009

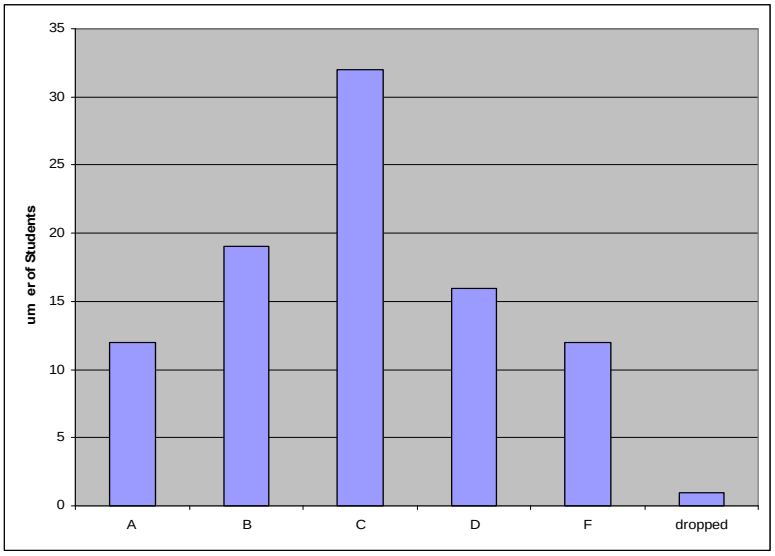


Table 9, below, shows the mid-semester and final pass rate for AY 2006-2007, 2007-2008, and 2008-2009. As you can see from Table 9, fall pass rates have consistently been in the 60s while spring pass rates have varied significantly. AY 2008-2009 has been the steadiest year with pass rates in the mid to upper 60s.

Table 8. Math 023 Mid-semester and Final Pass Rates by Term

Fall	Total	Midterm	Final	Spring	Total	Midterm	Final
2006	45	23 (51.1%)	27 (60.0%)	2007	56	39 (69.6%)	45 (80.4%)
2007	56	37 (66.1%)	37 (66.1%)	2008	56	24 (42.9%)	27 (48.2%)
2008	78	56 (71.8%)	50 (64.1%)	2009	91	57 (62.0%*)	63 (69.2%)

* Based on 92 students

The majority of students enrolling in Math 23 do so immediately following completion of Math 22, although a fair number also enroll in Math 24 prior to Math 23. Here is the performance by student math background for spring 2009:

- 41 students passed Math 22 fall 2008; 82.9% (34) passed
- 15 students passed Math 22 spring 2008; 80% (12) passed
- 25 students took Math 24 fall 2008; 48% (12) passed
- 8 students took Math 23 and Math 24 concurrently; 37.5% (3) passed
- 8 students were repeating Math 23 from fall 2008; 50% (4) passed

A larger percentage of students enrolling in Math 23 immediately following Math 22 are passing than those enrolling in Math 24 before Math 23. Those students taking Math 23 and Math 24 concurrently, albeit only eight, have the lowest percentage of students who passed.

Math 24: Linear Algebra and Differential Equations

Of the 83 students enrolled, 75.9% passed. Figure 10, below, shows the spring 2009 final grade distribution.

Figure 10. Math 024 Final Grade Distribution – Spring 2009

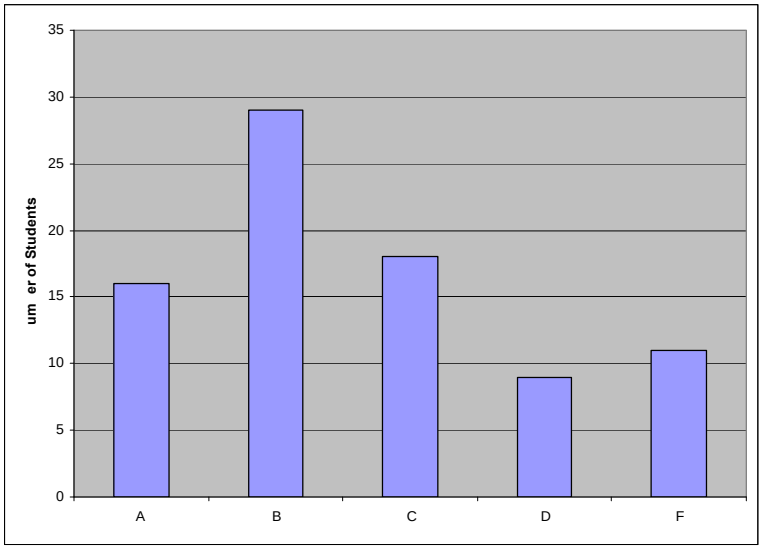


Table 10, below, shows the mid-semester and final pass rate for AY 2006-2007, 2007-2008, and 2008-2009. Math 24 pass rates have been steady at approximately 75% each semester except spring 2006, which had a pass rate of 83.3%.

Table 9. Math 024 Mid-semester and Final Pass Rates by Term

Fall	Total	Midterm	Final	Spring	Total	Midterm	Final
2006	30	26 (86.7%)	25 (83.3%)	2007	31	24 (77.4%)	23 (74.2%)
2007	49	35 (71.4%)	35 (74.4%)	2008	77	56 (72.7%)	58 (75.3%)
2008	71	53 (74.6%)	54 (76.1%)	2009	83	56 (67.5%)	63 (75.9%)

Current course performance by math background is as follows:

- 62.5% (15) of the 24 students that took Math 22 in fall 2008 passed
- 71.4% (5) of the 7 students repeating Math 24 passed
- 100% (24) of the 24 students who took Math 22 spring 2008, Math 23 fall 2008, and now Math 24 spring 2009 passed the course
- 73.3% (11) of the 15 students that took Math 23 in fall 2008 (but not Math 22 in spring '08) passed
- 62.5% (5) of the 8 students concurrently enrolled in Math 23 and Math 24 passed Math 24

Math 30: Calculus II for Biological Sciences

Of the 22 students enrolled, 90.9% passed Math 22. Figure 11, below, shows the spring 2009 final grade distribution.

Figure 11. Math 030 Final Grade Distribution – Spring 2009

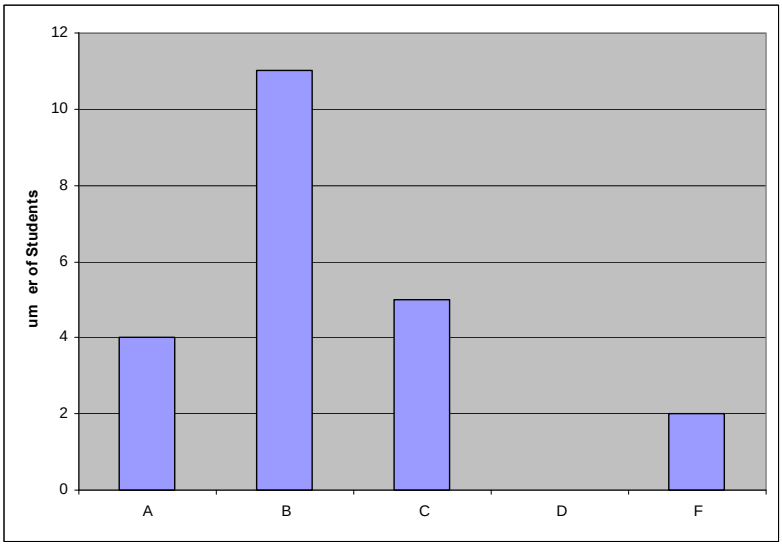


Table 11, below, shows the mid-semester and final pass rate for AY 2006-2007, 2007-2008, and 2008-2009. Math 30's pass rate has remained quite high, although enrollment numbers are decreasing. The final pass rates are averaging in the 80s, with varying mid-semester pass rates. The number of Biological Sciences majors is at a staggering 604, the major with the largest number of students in Natural Sciences. We are seeing, however, a decline in interest in this course even though it is specifically designed for Biology students.

Table 10. Math 030 Mid-semester and Final Pass Rates by Term

Fall	Total	Midterm	Final	Spring	Total	Midterm	Final
2006	10	10 (100%)	10 (100%)	2007	40	35 (87.5%)	34 (85.0%)
2007	27	19 (70.4%)	23 (85.1%)	2008	30	20 (66.7%)	28 (93.3%)
2008	35	23 (65.7%)	30 (85.7%)	2009	22	18 (81.8%)	20 (90.9%)

Math 32: Probability and Statistics

Of the 75 enrolled students, 60% passed Math 32. Figure 12, below, shows the spring 2009 final Math 32 grade distribution.

Figure 12. Math 032 Final Grade Distribution – Spring 2009

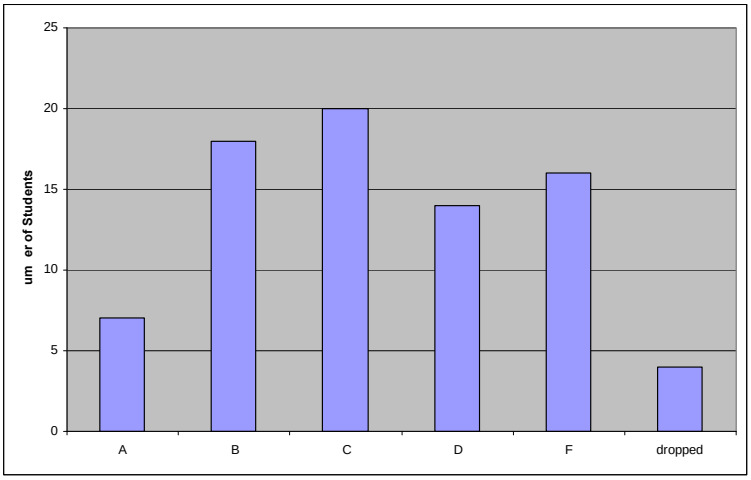


Table 12, below, shows the mid-semester and final pass rate for AY 2006-2007, 2007-2008, and 2008-2009. During fall 2008, Math 32 increased the depth and amount of material covered. We will be tracking student performance in subsequent courses and compare this with data from students who had taken Math 32 prior to the altered course.

Table 11. Math 032 Mid-semester and Final Pass Rates by Term

Fall	Total	Midterm	Final	Spring	Total	Midterm	Final
2006	N/A	N/A	N/A	2007	92	81 (88.0%)	82 (89.1%)
2007	76	69 (90.8%)	74 (97.4%)	2008	80	64 (80.0%)	69 (86.3%)
2008	69	40 (58.0%)	50 (72.5%)	2009	75	51 (64.6%*)	45 (60.0%)

*Based on 79 students

Spring 2009 Mid-Semester Lower Division Mathematics Course Summary
Prepared by Cheryl Hedges
March 24, 2009

Spring 2009 Mid-semester Course Overview

What follows is a brief overview of mathematics courses at mid-semester during the spring 2009 term. Its purpose is to inform mathematics faculty of mid-semester course standings for lower division math courses. For this document, a letter grade of "C-" or higher is considered "passing."

- Math 005 – 63.5% (113 of 178) are passing
- Math 015 – 92.5% (37 of 40) are passing
- Math 018 – 81.1% (30 of 37) are passing
- Math 021 – 61.3% (168 of 274) are passing
- Math 022 – 82.3% (144 of 175) are passing
- Math 023 – 62.0% (57 of 92) are passing
- Math 024 – 67.5% (56 of 83) are passing
- Math 030 – 81.8% (18 of 22) are passing
- Math 032 – 64.6% (51 of 79) are passing

Math 005: Preparatory Calculus

At mid-semester, 63.5% of the 178 enrolled students are passing. Figure 1, below, shows the spring 2009 mid-semester grade distribution.

Figure 1. Math 005 Mid-semester Grade Distribution – Spring 2009

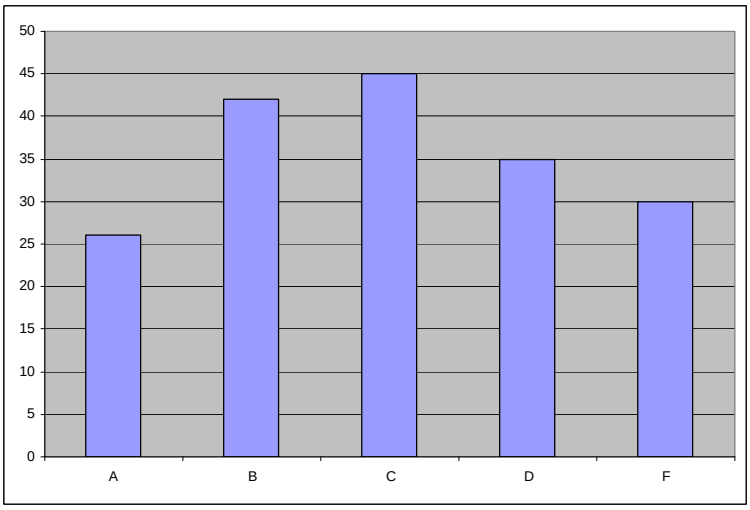


Table 1, below, shows the spring 2009 mid-semester pass rate, as well as the mid-semester and final rates during academic years (AY) 2006 – 2007 and 2007 – 2008. Mid-semester pass rates have been steady for fall and spring semesters of academic years (AY) 2006-2007 and 2007-2008. However, the final pass rate has changed dramatically each semester making accurate predictions of final grades difficult.

Table 1. Math 005 Mid-semester and Final Pass Rates by Term

Fall	Total	Midterm	Final	Spring	Total	Midterm	Final
2006	177	143 (80.8%)	126 (70.8%)	2007	46	38 (82.6%)	34 (73.9%)
2007	293	186 (62.8%)	209 (71.3%)	2008	129	82 (63.5%)	56 (43.4%)
2008	350	179 (51.3%)	197 (56.3%)	2009	178	113 (63.5%)	pending

By Section

Viewing mid-semester pass rates by section yields the following:

- Section 1 (Bianchi) – 67.7% of 31 are passing; 7 repeating students
- Section 2 (Crona) – 60% of 30 are passing; 2 repeating students
- Section 3 (Crona) – 65.5% of 29 are passing; 7 repeating students
- Section 4 (Bianchi) – 46.6% of 30 are passing; 13 repeating students
- Section 5 (DaSilveira) – 56.7% of 30 are passing; 16 repeating students
- Section 8 (DaSilveira) – 85.7% of 28 are passing; 9 repeating students

The majority of students, 70.8% to be exact, are taking Math 5 for their first time. The two sections with the lowest pass rate, sections 4 and 5, have the highest number of repeating students. We examine repeating student performance across all sections to see if this is a major factor for the failure rate.

Repeating Students

There are 52 students repeating Math 5, 36 of which are freshmen repeating from fall 2008. Repeating students make up 29.2% of the students enrolled and comparably, 26.2% of students failing. Thus, the failing rate is not attributable to repeating students. Of the 52 students repeating, 17 (32.7%) are failing at mid-semester.

Gateways

The Math 5 gateway exam tests students in a variety of basic algebraic and computational skills needed throughout Math 5. The exam is administered within the first four weeks of classes and students are able to take the exam twice a day until the end of the four weeks. The results of spring 2009 semester's gateway exams are as follows.

- 101 students passed, 71.3% of which are currently receiving an A, B, or C
- 55 did not pass, 52.7% of which are currently receiving an A, B, or C
- 22 did not attempt, 50% of which are currently receiving an A, B, or C

These numbers are remarkably similar to spring 2008's gateway data. Likewise, spring 2008 had a mid-semester pass rate of 63.5%, equal to this spring term's mid-semester pass rate. However, spring 2008 saw a drastic decline in the number of students passing after mid-semester and finished with 43.4% of students passing the course.

Further Questions

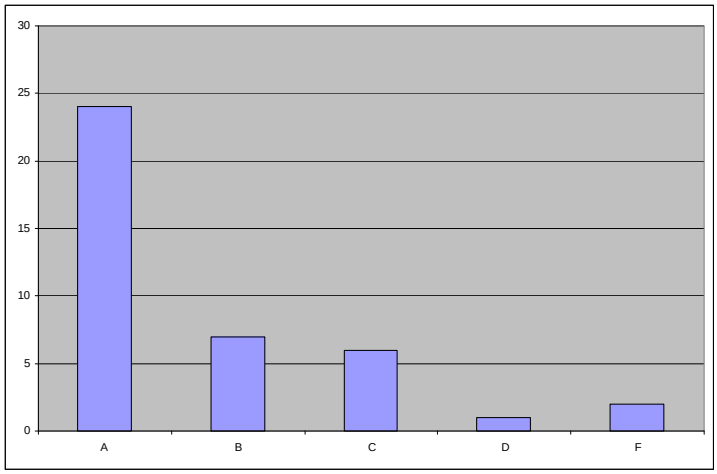
We continue to collect data to help us better understand learning but there are many questions that remain to be answered. In particular, what contributes to the variance each semester from mid-semester to final grades? What happens between mid-semester and final grades that causes pass rates to increases or decreases? Is it attributable to the class structure, teacher, or student? Has there been a change in grading, such as a curve that's

been implemented in some semesters and not in others? Can we attribute this to the student population enrollment (i.e. Math history? Geographical region? First generation? Etc.). This is, of course, a complex answer. Nonetheless, we continue to collect data to look for patterns which will yield insight. Currently, we are gathering enrollment in Math 5 by geographic region to see if this helps us understand the variance from semester to semester. We are awaiting results, which should be available during the final course analyses.

Math 15: Introduction to Scientific Data Analysis

At mid-semester, 92.5% of the 40 enrolled students are passing. Figure 2 (below) shows the spring 2009 mid-semester grade distribution.

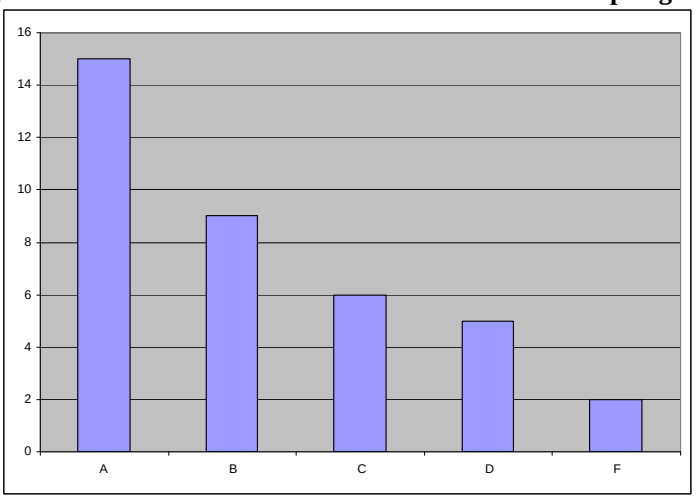
Figure 2. Math 015 Mid-semester Grade Distribution – Spring 2009



Math 18: Statistics for Scientific Data Analysis

At mid-semester, 81.1% of the 37 enrolled students are passing. Figure 3, below, shows the spring 2009 mid-semester grade distribution.

Figure 3. Math 018 Mid-semester Grade Distribution – Spring 2009



Math 21: Calculus I

At mid-semester, 61.5% of the 274 enrolled students are passing. Figure 4, below, shows the spring 2009 mid-semester grade distribution.

Figure 4. Math 021 Mid-semester Grade Distribution – Spring 2009

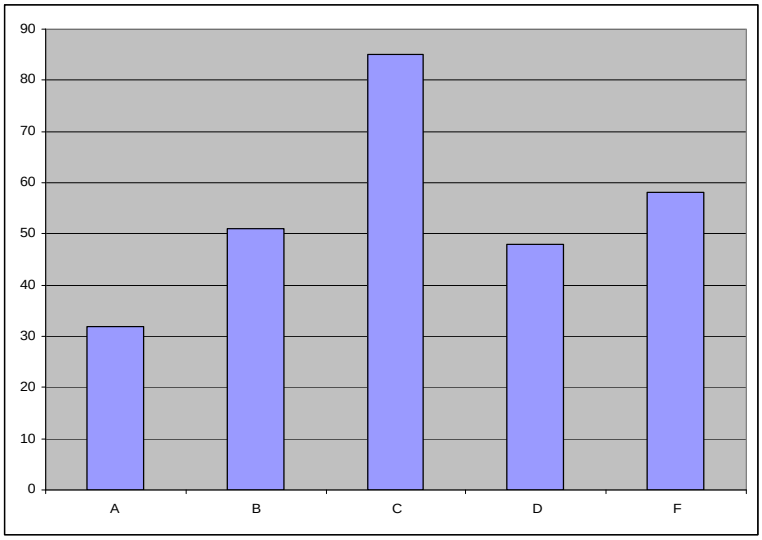


Table 2, below, shows the spring 2009 mid-semester pass rate, as well as the mid-semester and final rates during AY 2006 – 2007 and 2007 – 2008. For the past three semesters, we have seen mid-semester pass rates hover in the 70 percents with the final pass rates varying by term. This spring, however, the mid-semester pass rate is lower than normal – 61.3%. We examine performance by section and student population to gain a better understanding of the issues surrounding this course.

Table 2. Math 021 Mid-semester and Final Pass Rates by Term

Fall	Total	Mid	Final	Spring	Total	Mid	Final
2006	234	137 (58.5%)	166 (70.9%)	2007	128	56 (43.8%)	81 (63.3%)
2007	153	109 (71.2%)	83 (55.0%)	2008	213	155 (72.8%)	162 (76.1%)
2008	303	232 (76.6%)	178 (58.7%)	2009	274	168 (61.3%)	pending

Pass Rates by Section

Table 3, below, shows the total number of students enrolled in Math 21 by section, the percentage of students passing, and the time of each discussion. Large lectures are scheduled from 9:00 – 9:50 A.M. or 10:00 – 10:50 A.M. Monday, Wednesday, and Friday.

Table 3. Spring 2009 Math 021 Enrollment Numbers by Section, Percentage Passing by Section, and Discussion Times

Section	Total	% Passing	Discussion
1	17	0.588	8:00-9:50 AM
2	20	0.550	10:00-11:50 AM
3	19	0.737	1:30-3:20 PM
4	19	0.789	3:30-5:20 PM

5	18	0.500	5:30-7:20 PM
6	20	0.300	7:30-9:20 PM
7	8	0.375	7:30-9:20 AM
8	17	0.471	9:30-11:20 AM
9	20	0.600	11:30-1:20 PM
10	18	0.722	1:30-3:20 PM
11	20	0.650	3:30-5:20 PM
12	19	0.684	5:30-7:20 PM
13	7	0.429	7:30-9:20 PM
14	15	0.800	6:00-7:50 PM
15	20	0.800	4:00-5:50 PM
16	17	0.588	8:00-9:50 AM

The five sections with the lowest percentage passing are indicated in yellow. (To note, two of those sections contain fewer than 10 students which is not adequate to draw any conclusions.) Three of the five lowest performing sections have discussion times that begin either early in the morning (7:30 AM) or late evening (7:30 PM). Speculating, I'd say these sections have poor turnout which would have a large impact on the performance of students in these sections and help to explain the below average pass rate.

Student Population

Math 21 during spring terms is comprised of two primary groups of students – those having previously taken Math 5 during the fall semester and those repeating Math 21 from fall semester. Mid-semester performances by math background are as follows for spring 2009.

- Previous Math 5 Students
  - 89 (61%) of 146 students who passed Math 5 fall 2008 are passing
  - 10 (66.7%) of 15 students who passed Math 5 during spring 2008 are passing
  - 1 (12.3%) of 7 students who repeated Math 5 are passing
- 31 (62%) of 50 students that are repeating Math 21 from fall 2008 are passing Math 21.
- 12 (70.6%) of 17 students that have not taken a UCM math course are passing
- 25 (64.1%) of 39 students taking UCM math courses prior to spring 2008 are passing

Course Clustering by Major

Figure 5, below, shows the number of students enrolled in Math 21 during spring 2009 by major. The following chart, Figure 6, shows the percentage of students failing by major. Figure 5 and 6 are comparable. In other words, Biology majors comprise 32.5% of students in Math 21 and comprise 36.8% of students who are failing at mid-semester.

Figure 5. Spring 2009 Math 021 Course Enrollment by Major

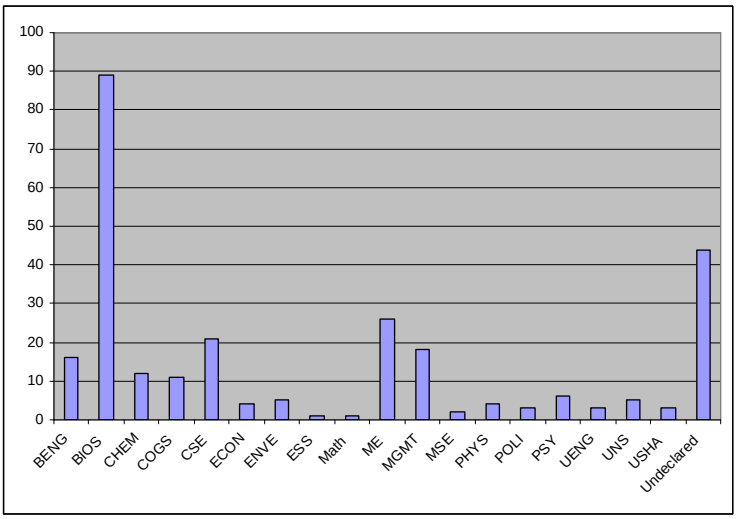
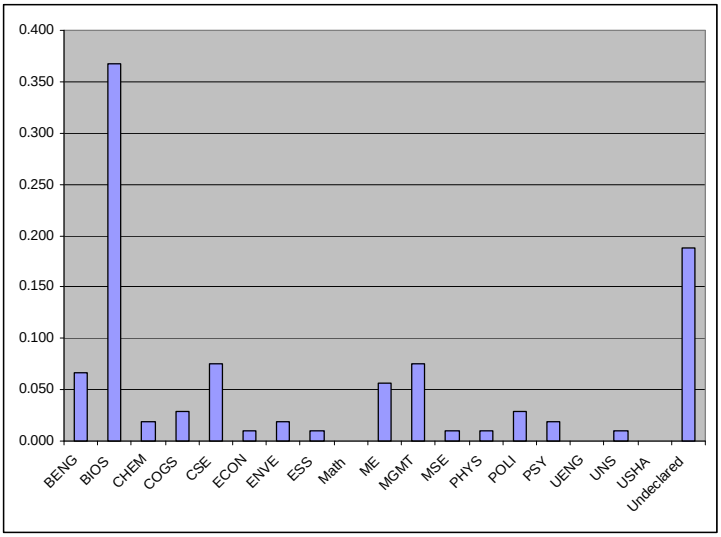


Figure 6. Spring 2009 Math 021 Mid-semester Failure Rates by Major



Combining the number of Biology and Undeclared majors shows that these two groups comprise 48.5% of those students in Math 21 and 55.7% of those who are currently failing.

Math 22: Calculus II

At mid-semester, 82.3% of the 175 enrolled students are passing. Figure 7, below, shows the spring 2009 mid-semester grade distribution.

Figure 7. Math 022 Mid-semester Grade Distribution – Spring 2009

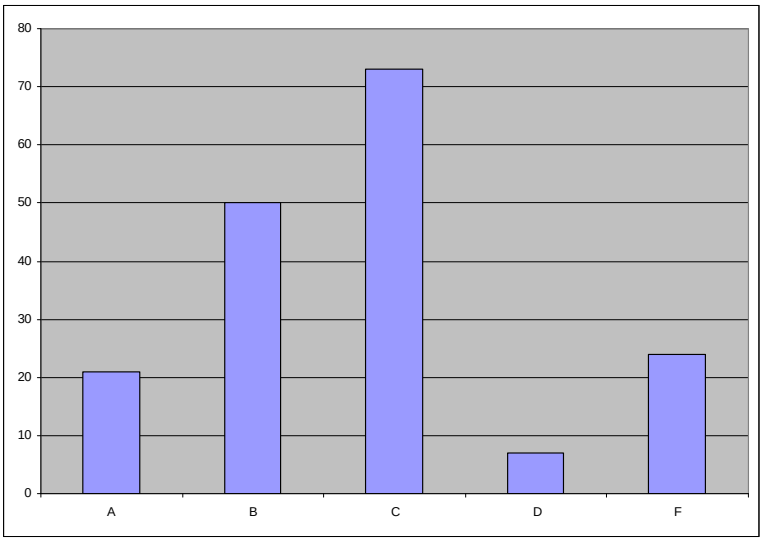


Table 4, below, shows the spring 2009 mid-semester pass rate, as well as the mid-semester and final rates during academic years (AY) 2006 – 2007 and 2007 – 2008. AY 2006-2007 had abnormally low pass rates, but those rates have risen and have remained in the 70s for the past three semesters. With the current mid-semester pass rate of 82.3%, we expect numbers to follow this trend and be in the 70s at the conclusion of spring 2009.

Table 4. Math 022 Mid-semester and Final Pass Rates by Term

Fall	Total	Midterm	Final	Spring	Total	Midterm	Final
2006	113	54 (47.8%)	69 (61.1%)	2007	139	40 (28.8%)	54 (39.1%)
2007	121	102 (84.3%)	93 (76.9%)	2008	136	84 (61.8%)	100 (73.5%)
2008	156	122 (78.2%)	112 (71.8%)	2009	175	144 (82.3%)	pending

Current course performance by math background is as follows:

- 92% (115) of the 125 students that took Math 21 fall 2008 are passing
- 50% (8) of the 16 students repeating Math 22 from fall 2008 are passing
- 66.7% (4) of the 6 transfer students are passing
- 60.7% (17) of the 28 students that took Math 21 or ICP prior to fall 2008 are passing

Math 023: Vector Calculus

At mid-semester, 62% of the 92 enrolled students are passing. Figure 8, below, shows the spring 2009 mid-semester grade distribution.

Figure 8. Math 023 Mid-semester Grade Distribution – Spring 2009

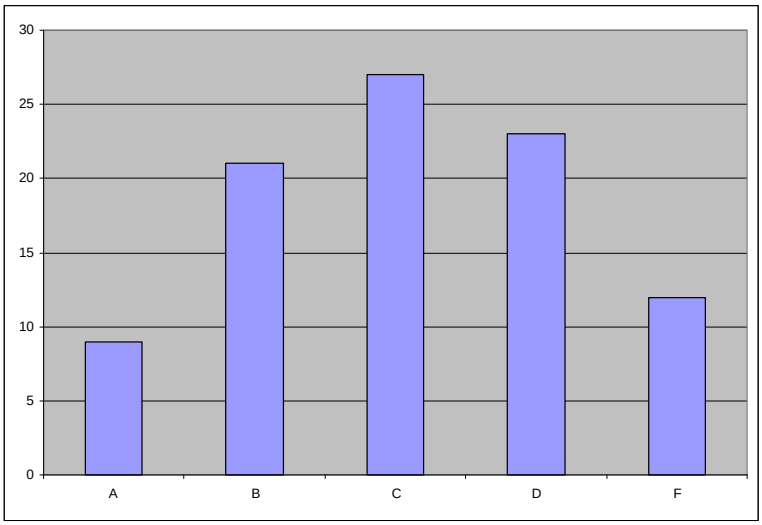


Table 5, below, shows the spring 2009 mid-semester pass rate, as well as the mid-semester and final pass rates during academic years (AY) 2006 – 2007 and 2007 – 2008. Fall pass rates average in the 60s, while spring rates have varied.

Table 5. Math 023 Mid-semester and Final Pass Rates by Term

Fall	Total	Midterm	Final	Spring	Total	Midterm	Final
2006	45	23 (51.1%)	27 (60.0%)	2007	56	39 (69.6%)	45 (80.4%)
2007	56	37 (66.1%)	37 (66.1%)	2008	56	24 (42.9%)	27 (48.2%)
2008	78	56 (71.8%)	50 (64.1%)	2009	92	57 (62.0%)	pending

The majority of students enrolling in Math 23 do so immediately following completion of Math 22, although a fair number also enroll in Math 24 prior to Math 23. Here is the performance by student math background for spring 2009:

- 41 students passed Math 22 fall 2008; 78% (32) are passing
- 12 students passed Math 22 spring 2008; 58.3% (7) are passing
- 21 students took Math 24* fall 2008; 57.1% (12) are passing
- 8 students are taking Math 23 and Math 24 concurrently; 37.5% (3) are passing
- 8 students are repeating Math 23 from fall 2008; 50% (4) are passing

A larger percentage of students enrolling in Math 23 immediately following Math 22 are passing than those enrolling in Math 24 before Math 23. Those students taking Math 23 and Math 24 concurrently, albeit only eight, have the lowest percentage of students passing.

Math 24: Linear Algebra and Differential Equations

At mid-semester, 67.5% of the 83 enrolled students are passing. Figure 9, below, shows the spring 2009 mid-semester grade distribution.

* These students did NOT take Math 22 spring 2008

Figure 9. Math 024 Mid-semester Grade Distribution – Spring 2009

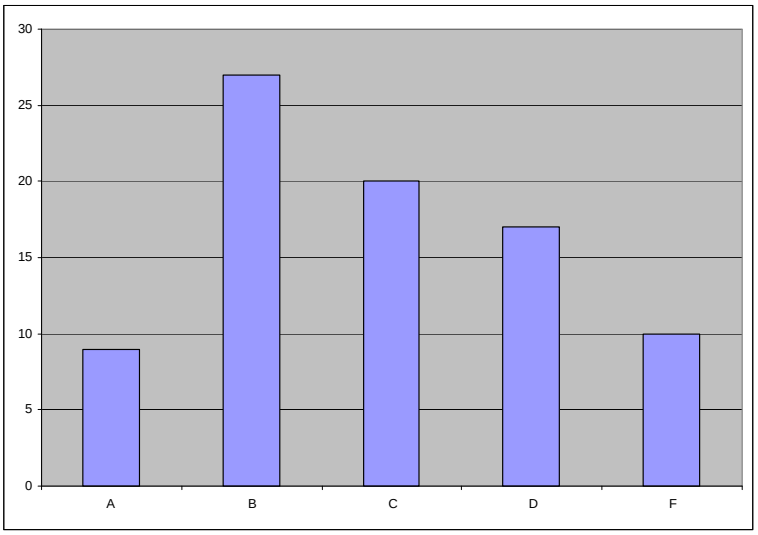


Table 6, below, shows the spring 2009 mid-semester pass rate, as well as the mid-semester and final rates during academic years (AY) 2006 – 2007 and 2007 – 2008. This is one course that has remained fairly consistent each semester. Mid-semester pass rates and final pass rates have been in the 70s each semester except fall 2006, which had pass rates in the 80s. This term's mid-semester pass rate is slightly lower than average at 67.5%.

Table 6. Math 024 Mid-semester and Final Pass Rates by Term

Fall	Total	Midterm	Final	Spring	Total	Midterm	Final
2006	30	26 (86.7%)	25 (83.3%)	2007	31	24 (77.4%)	23 (74.2%)
2007	49	35 (71.4%)	35 (74.4%)	2008	77	56 (72.7%)	58 (75.3%)
2008	71	53 (74.6%)	54 (76.1%)	2009	83	56 (67.5%)	pending

Math 30: Calculus II for Biological Sciences

At mid-semester, 81.8% of the 22 students enrolled are passing. Figure 10, below, shows the spring 2009 mid-semester grade distribution.

Figure 10. Math 030 Mid-semester Grade Distribution – Spring 2009

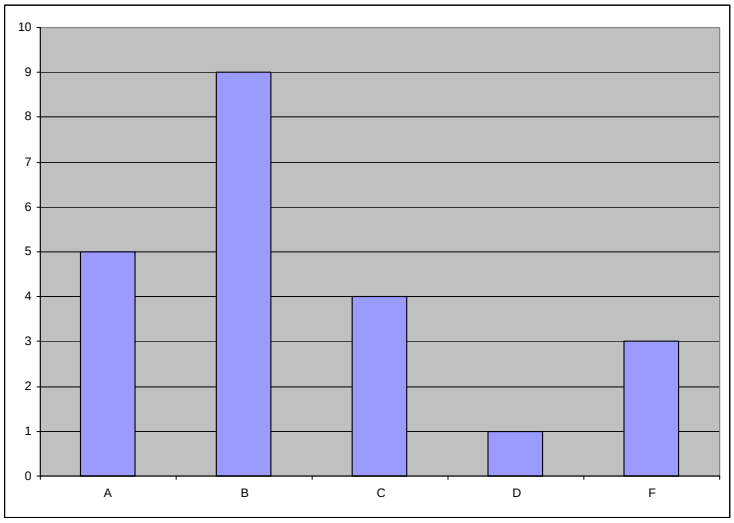


Table 7, below, shows the spring 2009 mid-semester pass rate, as well as the mid-semester and final rates during academic years (AY) 2006 – 2007 and 2007 – 2008. The final pass rates are quite high, averaging in the 80s, with varying mid-semester pass rates. The number of Biological Sciences majors is at a staggering 604, the major with the largest number of students in Natural Sciences. However, we are seeing a decline in interest in this course which is specifically designed for Biology students. I am currently examining how Math 30 students perform in subsequent Biology courses compared to their peers choose to take Math 22. Look for these results in the spring 2009 final course analyses.

Table 7. Math 030 Mid-semester and Final Pass Rates by Term

Fall	Total	Midterm	Final	Spring	Total	Midterm	Final
2006	10	10 (100%)	10 (100%)	2007	40	35 (87.5%)	34 (85.0%)
2007	27	19 (70.4%)	23 (85.1%)	2008	30	20 (66.7%)	28 (93.3%)
2008	35	23 (65.7%)	30 (85.7%)	2009	22	18 (81.8%)	pending

Math 32: Probability and Statistics

At mid-semester, 64.6% of the 79 enrolled students are passing. Figure 11, below, shows the spring 2009 mid-semester Math 32 grade distribution.

Figure 11. Math 032 Mid-semester Grade Distribution – Spring 2009

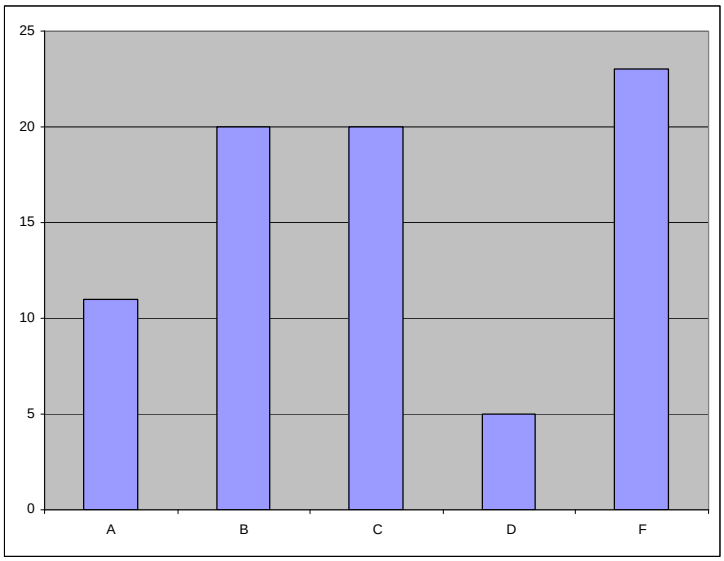


Table 8, below, shows the spring 2009 mid-semester pass rate, as well as the mid-semester and final rates during academic years (AY) 2006 – 2007 and 2007 – 2008. During fall 2008, Math 32 increased the depth and amount of material covered. You can see evidence of this by the lower pass rate. We will be tracking student performance in subsequent courses and compare this with data from students who had taken Math 32 prior to the altered course.

Table 8. Math 032 Mid-semester and Final Pass Rates by Term

Fall	Total	Midterm	Final	Spring	Total	Midterm	Final
2006	N/A	N/A	N/A	2007	92	81 (88.0%)	82 (89.1%)
2007	76	69 (90.8%)	74 (97.4%)	2008	80	64 (80.0%)	69 (86.3%)
2008	69	40 (58.0%)	50 (72.5%)	2009	79	51 (64.6%)	pending