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Implementing a math study skills course

Gregory S. Lewis
University of Toledo

A Thesis

entitled

Implementing a Math Study Skills Course

by

Gregory S. Lewis

Submitted to the Graduate Faculty as partial fulfillment of the requirements for the

Master of Science Degree in Mathematics

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May 2014

An Abstract of

Implementing a Math Study Skills Course

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Helping underprepared students find success in college level mathematics continues to be an issue of great significance in higher education. This is especially true for students in developmental mathematics courses which usually have some the highest levels of failure and non-completion of any such developmental courses. This thesis describes the steps the University of Toledo Department of Mathematics and Statistics took to begin to address this problem. We created a hybrid entry level and credit-bearing math course and partnered it with a co-requisite math study skills course. A post-course survey helps to paint a good picture of the type of students enrolled in the courses. In the survey results, students enrolled in the math study skills courses recognized and acknowledged the important contribution that course had on their success. The main finding of this study is that students who took the math study skills class seriously were able to bridge the gap in their unpreparedness compared to other students taking the same entry level course but not enrolled in the co-requisite math study skills course. Using a general linear regression model our data showed that students caught up, receiving similar and even a slightly higher grade in their entry level math course.

Acknowledgements

This thesis is first dedicated to my wife, children and church family in Toledo UBF and beyond who loved and supported me in the ongoing process of completing all the requirements for my degree and thesis. Secondly, it is dedicated to the vision and dream of the late Dr. William Thomas who had a heart that beat continuously for helping first generation college students to succeed and prosper. Lastly, I dedicate this thesis to my friends and mentors, Dr. Donald White and Dr. Paul Hewitt, who walked alongside me and encouraged me each step of the way.

I would also like to express my gratitude to the Department of Mathematics and Statistics at the University of Toledo. They bore with me and helped me to succeed in graduate level mathematics despite all my weakness. In particular I would like to acknowledge Dr. Rong Liu, Dr. Friedhelm Schwarz, Dr. Samuel Nadler, Dr. Geoffrey Martin, Dr. Harvey Wolff, Dr. Vani Cheruvu, Dr. Ivie Stein, Jr., Dr. Mao-Pei Tsui, Dr. Zeljko Cuckovic, Dr. David Gajewski, Dr. Nathaniel Iverson, Mrs. Theresa Myers, Mrs. Katharine Fisher, Dr. Martin Pettet, Dr. James Anderson, Dr. Sibylle Weck-Schwarz, and Dr. Denis White. I would also like to acknowledge fellow lecturers who also shared my load and supported me in various ways day in and day out. They include Mr. Kevin Gibbs, Mr. Matthew Sutherland, Ms. Katherine Bryant, Ms. Suzan Orra, Mr. Syed Zaidi, Mr. Chase Brady, Ms. Zhiwei Chen, Mr. Paramasamy Karuppuchamy, and Mr. Minhui Paik. I am truly blessed and privileged to be among so many excellent mathematicians.

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List of Abbreviations

ACTSATComp .....ACT-SAT Composite

ACTSATMath.....ACT-SAT Mathematics

EAPLAC .....Elementary Algebra Placement Test Score

HS_GPA .....High School Grade Point Average

M1200Grade .....Math 1200 Grade

M1200NumGrade .....Math 1200 Numerical Grade

M1190Result.....Math 1190 Result

List of Symbols

AB .....A or B in Math 1190
CDF.....C, D or F in Math 1190
NA.....Not enrolled in Math 1190

Chapter 1

Introduction

Many educators throughout the country have been studying, researching, piloting and doing all they can to find ways to improve student retention and completion of developmental math sequences and core general education requirements in mathematics for obtaining an undergraduate degree. Most of the students in such courses have not been taught how to study math. They may have been taught general study skills but these skills usually do not translate to math success. These students lack the learning tools to improve their math success (Nolting, 1986). Developmental and entry level math instructors can play a major role in math student success. According to Bloom (1976) the variance contributing to math success is 50% for cognitive entry skill and intelligence, 25% for quality of instruction and 25% for affective characteristics. These affective characteristics include students' self-concept, locus of control, attitudes, anxiety, study habits and socio-economic status. Instructors can evaluate the predictive validity of the placement test, improve quality of instruction, teach students math study skills and test anxiety reduction techniques along with helping students improve their math self-

efficacy. Explicitly teaching math study skills seems to be an obvious step in the right direction to improving student math success (Boylan, 2011). Many other techniques and teaching strategies have been used and researched in trying to improve student learning.

This thesis will review some of the current literature related to developmental math education and how others have been trying to understand and help developmental students to be successful in mathematics. Next, the thesis will detail the implementation and data analysis of the impact of a math study skills course at the University of Toledo. Lastly in the conclusion, all of the results will be summarized.

Chapter 2

Literature Review

The article, “Developmental Mathematics: Challenges, Promising Practices, and Recent Initiatives” (Bonham & Boylan, 2012), gives a comprehensive overview of the problem and the solutions math educators are trying and finding. Math courses have the highest rates of failure and non-completion of any developmental subject area. The article describes the current state of the art in developmental mathematics, discusses major initiatives designed to reform and improve success rates, and identifies research-based teaching practices associated with improved student performance in developmental mathematics courses. Developmental math programs exist to help students achieve their goals, but in many cases, they become a roadblock to students’ success. Universities, colleges and community colleges alike are offering developmental courses and sequences. The research in the article cites various recommendations for promising practices including greater use of technology as a supplement for classroom instruction, integration of classroom and lab instruction, offering students a variety of delivery formats, project-based instruction, proper student assessment and placement, integration

of counseling for students, and professional development for faculty. They also mention the successful application and use of varied teaching techniques and strategies to improve students' success and retention including mastery learning, attention to affective factors, mentoring programs, integration of math study skills and learning strategies, supplemental instruction, active learning (including cooperative and collaborative learning approaches), contextual learning, problem solving and modeling, integrated classroom activities, laboratory activities, and learning centers.

The article (Bonham & Boylan, 2012) emphasizes that "students actually learn math by doing math rather than spending time listening to someone talk about doing math" (Bonham & Boylan, 2012, p. 16). It discusses delivery models, affective factors, professional development, partnerships and special projects focused on developmental mathematics like the American Mathematical Association of Two-Year Colleges (AMATYC) publications *Crossroads in Mathematics* and *Beyond the Crossroads in Mathematics.* In delivery models, how course content is delivered to the student, the research-based or promising practices include mastery learning, active learning, individualized assistance, modularization, or personalized assistance. Mastery learning is learning that progresses as students master certain objectives before progressing to a more advanced one. Active learning is a broad term that generally refers to instruction that incorporates students' active participation in the learning process by reading, writing, discussing and being actively engaged in the content beyond just listening to a conventional lecture. Individualized assistance is instructional help given to students based on the pace of their learning, their skill level and their individual interests.

Modularization is breaking up the content of perhaps a semester long course into smaller chunks that students could complete and move forward on at a more tailored pace. Personalized assistance would be help or instruction given in a more personal venue such as one-on-one tutoring. In these varied delivery models technology is used where it is most appropriate like on homework, quizzes and tests.

Some of the key affective factors mentioned in the article (Bonham & Boylan, 2012) are low self-efficacy and confidence in ability to do math, test anxiety, and math anxiety. Self-efficacy is a term describing the extent of a student's belief in their own ability to complete tasks and reach goals. Students, faculty, and support staff all need to be aware of and to understand the influence of such affective factors on students' success and retention. To help students with math anxiety, strategies that foster a safe environment and sense of belonging could include discussing classroom etiquette, using ice-breakers or warm-up activities, teaching relaxation techniques, and using affective assessment instruments to help students understand their attitudes toward learning. Professional development is a priority in the places where developmental programs are being successful as well as forming partnerships with high schools, other colleges, business and industry, and even local community agencies. A more obvious route would also be partnerships with faculty in other disciplines. The article concludes emphasizing the need to keep moving forward and working together to find better solutions and changes to the way developmental mathematics courses are structured, taught, and delivered.

Adams (2003) looked at a program at the University of Maryland, College Park involving about 1000 students in need of remedial math instruction. Those who scored in the top 60 percent on the placement test were enrolled in an accelerated math course that combined material from developmental math and the introductory college math course. After five weeks of intensive study students retook the placement test and those who passed continued in the class, fulfilling both their developmental and college math requirements. Those who failed enrolled in the less intensive developmental math course. Adams goes on to compare test scores and grades comparing the students in the accelerated developmental course to regular students in the college math course, though he does not cite the precise data. He also follows the students' success rate in elementary calculus and engineering calculus compared to students who did not take the accelerated course. The article concludes that the students in the accelerated course perform just as well, if not better, than the portion of the student population not in need of math remediation on the final exam and in elementary calculus, but fail at a much higher rate in engineering calculus.

Another study (Bahr, 2008) did a comparative analysis of the long-term academic success of 85,894 freshmen students, enrolled in 107 community colleges, who need remedial mathematics and those who do not need remedial mathematics. The author finds that students who remediate successfully achieve long-term academic attainment in terms of credential completion and transfer that is comparable to students who achieve college-level mathematics without remedial math courses. In conclusion, remedial mathematics

courses are highly effective in assisting students with insufficient math skills. The challenge remains in helping those students who are not remediating successfully.

Donavan (2008) conducted a study at a public, metropolitan, open-enrollment university in Ohio (n=1694) to investigate the relationship of the ACT Mathematics and COMPASS Domain I (Algebra) Placement scores with the success of students in the Intermediate Algebra course. The authors discuss the importance of accurate placement of students in mathematics courses, and the study shows a positive correlation of using the ACT Mathematics and COMPASS Domain I (Algebra) Placement scores with the success of the Intermediate Algebra students. Paying close attention to placement is a key issue.

One study (Eades & Moore, 2007) examines the value and benefits of organized note-taking of students and the provision of a set of notes for reference for students in a developmental math course. The results show that informing students of the value of note-taking and encouraging note-taking enhanced students' use of note-taking. Students felt a sense of security having a reliable set of notes available for reference, both their own notes and the notes provided for reference by the instructor. Furthermore, the note-taking system increased students' understanding and motivation in their developmental math course. This article also presents the methodology of and models a format for taking notes. This is one important facet of teaching math study skills.

Hall & Ponton (2005) conducted a study to determine variations in mathematics self-efficacy between students enrolled in a developmental mathematics course and students enrolled in a calculus course. The researchers examine data from a sample of

185 freshmen students at a 4-year southeastern institution using the Mathematics Self-Efficacy Scale. Results show that calculus students have better mathematical skills as well as more confidence in their ability to succeed in college mathematics. The authors suggest that developmental math instructors should create a learning environment that cultivates self-efficacy and provides the rigor of a college-level course.

Wadsworth, et. al. (2007) examine the learning strategies and self-efficacy of 89 successful college students enrolled in an online developmental mathematics course. The results suggest that the students' self-efficacy, motivation, concentration, information processing, and self-testing skills are most important when predicting grade achievement. Direct instruction, teaching these skills directly and explicitly, can affect these factors. The authors suggest that instructors set up meetings with students enrolled in online courses to focus on learning such strategies and applying these strategies to their online course. The research implies that student success in online courses will increase with strategy education.

A significant number of students entering community colleges are underprepared (McClenney, 2009). According to a report by the Community College Research Center, a study of more than 250,000 students needing remedial courses reveals that many of the students never reach college-level courses. Only 31% of the students requiring remedial math complete their remedial math sequence. Data from a 2002 cohort in the "Achieving the Dream: Community Colleges Count" initiative reveals 72% of first-time college students require at least one remedial math course upon entry. Of those remedial math students, only 23 percent successfully complete the remedial math sequence in three

years. The article discusses the emerging successes of remedial education in several colleges.

The article, “Readiness, Behavior, and Foundational Mathematics Course Success” (Li, et.al., 2013) sought to examine the impact of specific and observable course behaviors on academic performance in developmental math courses. Course behaviors include attendance, participation and homework completion. They noticed the growing disparity in student enrollment in general and student enrollment leading to an actual degree or certificate, especially at community colleges. The important factors for such discrepancies have been linked to lack of academic preparation and student motivation. Thus the article seeks to highlight the importance of linking student behavior like attendance, participation, and homework completion to course success. The model tested in the study combines academic skills and course behavior measures to predict course success. The study was conducted at an open admissions two-year public college in a large Midwestern city serving more than 14,000 students. They used 2 predictor variables, mathematics readiness based on COMPASS assessments and student course behavior based on instructor ratings, and 2 dependent variables, mathematics knowledge based on COMPASS assessments in the 12^{th} week, and course success defined as staying enrolled and passing the course. They found that students’ entering math skills and behavioral effort have direct and indirect effects on course success. Both math readiness and course behavior were useful predictors of posttest math knowledge. Course behavior had consistent and sizable direct effects. Also, students rated with higher levels of effort made larger gains in math knowledge. On the other hand, students who were not well

prepared and demonstrated low effort are at high risk for failure. But students at all math readiness levels were more likely to do well if they engaged in appropriate classroom and homework activities.

Results from this study (Li, et.al., 2013) reinforce the importance of understanding the impact of both academic skills and student effort in course success. Math readiness had a direct effect on posttest math knowledge which in turn had a direct effect on course success. Student course behavior also showed a strong direct effect on course success. Better course behavior was also predictive of larger knowledge gains and greater likelihood of course success. Academic institutions should successfully address both the issues of academic skill and student behavior deficits. Behavioral components are critical to academic mastery and long-term persistence leading to degree attainment. Institutions should have ways to assess and "address students' behavioral needs, such as time management and organizational skills, self-discipline, study habits, communication skills, working in teams, and building resilience when faced with challenges" (Li, et.al., 2013, p. 20). This study's findings suggest that a joint focus on academic skills and academic behaviors is crucial for students to be successful in developmental courses.

The article, "Breaking Down Barriers: Academic Obstacles of First-Generation Students at Research Universities" (Stebleton, & Soria, 2012), examines some of the academic obstacles faced by first-generation students and describes some strategies to use in helping such students. First-generation students face multiple challenges that need to be strategically addressed. The study explored the experiences of students who attended six large, public research universities. One objective was to ascertain whether first-

generation students experience significantly different academic obstacles compared to other students. The instrument they used is called the Student Experience in the Research University (SERU) survey, a census scan of the undergraduate experience. The main question of analysis involved the frequency of how various issues were an obstacle to school work or academic success. The issues included things like competing job responsibilities, competing family responsibilities, weak math skills, inadequate study skills, poor study behaviors, bad study environment and feeling depressed, stressed or upset. Data was gathered from about 12,000 students of which about 60% were female, 60% White, 18% Asian, 6% African-American, and 26% were first-generation students.

The study (Stebleton, & Soria, 2012) found statistically significant higher instances of several issues being obstacles to their academic success including competing job responsibilities, family responsibilities, weak math skills, and inadequate study skills. First-generation students often recognize that they will need assistance in overcoming such obstacles. The article suggests the implementation of programs, services and structures needed “to reduce the size of each step during the adjustment to the post-secondary education experience” (p. 13). Some suggestions the article offers are awareness of on-campus initiatives to offer opportunities for academic and social engagement, engaging students in discussion related to their first-generation student experience, and taking extra measures to help first-generation students foster a sense of belonging on campus and a part of campus life.

Chapter 3

Implementation and Analysis

At the University of Toledo, we introduced an entry level, college-credit bearing course titled Math Modeling and Problem Solving (Math 1200) in the fall of 2009. Math 1200 is a college-paced algebra course that moves quickly through some developmental content while focusing more on mathematical modeling of data using linear, quadratic, rational, and radical functions in their numerical, symbolic, graphic, and verbal forms. Problem solving methods and strategies are emphasized. To see more details regarding the Math 1200 course, the syllabus can be found in Appendix A. The student enrollment in the fall of 2009 was about 315 and has steadily increased to about 765 in the fall of 2012. The typical Math 1200 student has 3 or more years of high school math earning B's or C's (about ¼ had no math in their senior year). We have been using a hybrid format in the course delivery. It is a 4 semester credit hour course that meets 4 times a week for 75 minutes. Generally half the time is lecture and discussion and in the second half students work through assignments on a classroom computer. We had some success in the initial pilots and recognize the apparent need to bolster students' study skills and habits in order

to increase student success even more. To get some initial idea about the students taking Math 1200, the general guidelines for placement were having completed High School Algebra II and having either an ACT Math score of 16 or an SAT Math score of 400, a UT Elementary Algebra Placement Test score of 8, or a UT College Algebra Placement Test score of 5. The Elementary Algebra Placement Test Score could range from 0 to 20, and the College Algebra Placement Test Score could range from 0 to 26.

To take steps toward addressing such needs and trends obviously emerging in research with developmental and even first-generation students, our math department at the University of Toledo considered integrating math study skills into a math course by requiring a co-requisite one credit hour math study skills course. This math study skills class met on the first eight Fridays of a typical 16 week semester course. The course syllabus and content can be seen in Appendix B.

With the help of the late Bill Thomas and Dr. Paul Nolting we came up with some initial plan and design for this one credit hour course titled Math Modeling Study Skills (Math 1190). Professor Bill Thomas served as a high school teacher and a full-time faculty member of the mathematics department at the University of Toledo. In many of his professional pursuits, he worked closely with Dr. Paul Nolting, a Learning Specialist and national expert in assessing math learning problems. Dr. Nolting had seen the positive results of implementing such a math study skills course and helped our university take the initial steps in establishing course content and curriculum. It is described as a course to provide the study skills needed to college mathematics. Students learn and apply skills such as reading textbooks, note-taking, and analyzing tests. Many

more details regarding the course structure and content can be found in course syllabus in Appendix A. We first ran the course in the fall of 2010 with an enrollment of about 180 students that has risen to about 250 in the fall of 2012. We used students' high school grade point average and ACT Math score to place students into the appropriate classes. Various combinations dictated whether they were placed in Math 1200 and Math 1190. Students with certain ACT (SAT) scores and high school GPA values were recommended to enroll in the co-requisite Math 1190 course along with Math 1200 (see Table 3-1). This means that all students in Math 1190 were also enrolled in Math 1200.

Table 3-1: Recommendations for Math 1190 placement

Math ACT (SAT)	High School GPA values:
14 (360)	2.9 thru 3.8
15 (380)	2.7 thru 3.6
16 (400)	2.5 thru 3.4
17 (420)	2.3 thru 3.2
18 (440)	2.1 thru 3.0
19 (460)	1.9 thru 2.8

Math 1190 meets once a week for a 100-minute class during the first 8 weeks of the semester. The course primarily utilizes the framework and content in "Winning at Math" (Nolting, 2008) with some additional skills review assignments relevant to the material being covered in Math 1200. The skills review assignments included problems sets reviewing fraction operations, order of operations, understanding functions and

function notation, domain and range of functions, graphing linear equations and solving two by two linear systems. Some of the math study skills topics included how learning math is different, assessing and using your math-learning strength, how to reduce math anxiety, creating a positive study environment, the memory process, learning styles, note-taking skills, test-taking skills and motivation. Students took several online surveys available through the textbook that used questioning to inventory students' study habits regarding effectiveness, memory and learning, reading and homework, classroom learning and math anxiety. Several in-class mediation and de-stressing activities and exercised are presented and practiced. We learned the qualities of a good study environment like being distraction free (no facebook, distracting music or pictures, etc.), having a calculator handy, pencil and paper and regularity of a study location and time. We took an in-depth look at how our memory works and how the way we study, learn and seek to remember math procedures and concepts should be informed by such an understanding of the memory process. An in-class survey activity was conducted to help students determine their learning style—visual, auditory or kinesthetic. We present a 3-column note-taking strategy that includes a column for key concepts, the symbolic math procedure and written explanation of the steps. Students then use this note-taking strategy in their Math 1200 class and show the notes they took for homework credit in Math 1190. We also looked at different kinds of test-taking errors and how to avoid such errors and how to learn from our mistakes. We also do a session on motivation and goal-setting, where students learn to set specific, achievable and timely goals for their math learning. The instructors for Math 1190 were also instructors for Math 1200, so students had an

additional person and time block to get help and support to be successful in both courses. Their Math 1190 grade consisted of homework, in-class assignments, a group project and a final exam over just the study skills content.

To begin to get some idea of the actual students enrolled in the Math 1200 course, we can see some tallied results for Math 1200 students in Table 3-2. Population is a categorical variable describing whether students are new first time students, continuing, post-secondary, readmits or transfer students. Classification describes whether the students is a freshman (FR), sophomore (SO), junior (JR) or senior (SR).

Table 3-2: Tally for Population and Classification for Math 1200 students

	POPULATION	Count	Percent	CLASSIFICATION	Count	Percent
New	First Time	478	72.53	FR	525	79.67
	Continuing	123	18.66	SO	90	13.66
	Transfer	47	7.13	JR	31	4.70
Post-Secondary/HS	Concurrent	7	1.06	SR	13	1.97
	Readmit	4	0.61	N=	659	
	N=	659				

We can see that most students were new first time (72.53%) and freshman (79.67%) students. The Math 1200 course was primarily designed to help entering college freshman find success in mathematics.

At the end of the semester long Math 1200 course, students took a post-course survey. This survey gathered information regarding students' prior math experiences and coursework in high school, their use of the Learning Resource Center and calculators, their attitude and expectations about math and their course grade, their use and opinion regarding course technology and help features, the importance of group work and course

lectures, questions regarding their pre-course confidence level in teaching different math skills to their peers, and questions specifically related to the Math 1190 study skills course for students who were also enrolled in it. The actual survey that students took can be found in Appendix C. Most instructors encouraged students to complete this and gave students time in class to do so. 392 out of a total of the 659 students completed the survey. 30% of the 392 students received a D or F in Math 1200. Of the 267 students who did not complete the survey, 73% received an F in Math 1200 (see Figure 3-1). In the chart, it is obvious to notice the large number of students failing the class who did not take the survey. Largely this is due to the fact that students in that failure category are often also those students who stop regularly attending the class, so they were not in class to complete the survey.

Many of the survey questions help us to understand who the students were and some of their basic attitudes about mathematics and even their sense of self-efficacy regarding mathematics learning. There is much to dig out and consider from the breadth of this survey data. The tallied survey results from each of the questions is in Appendix D, and again the actual survey is provided in Appendix C. I will highlight some of the questions and responses as they relate to understanding the students who enroll in Math 1200 and their attitudes and perceived skills in mathematics and in learning mathematics.

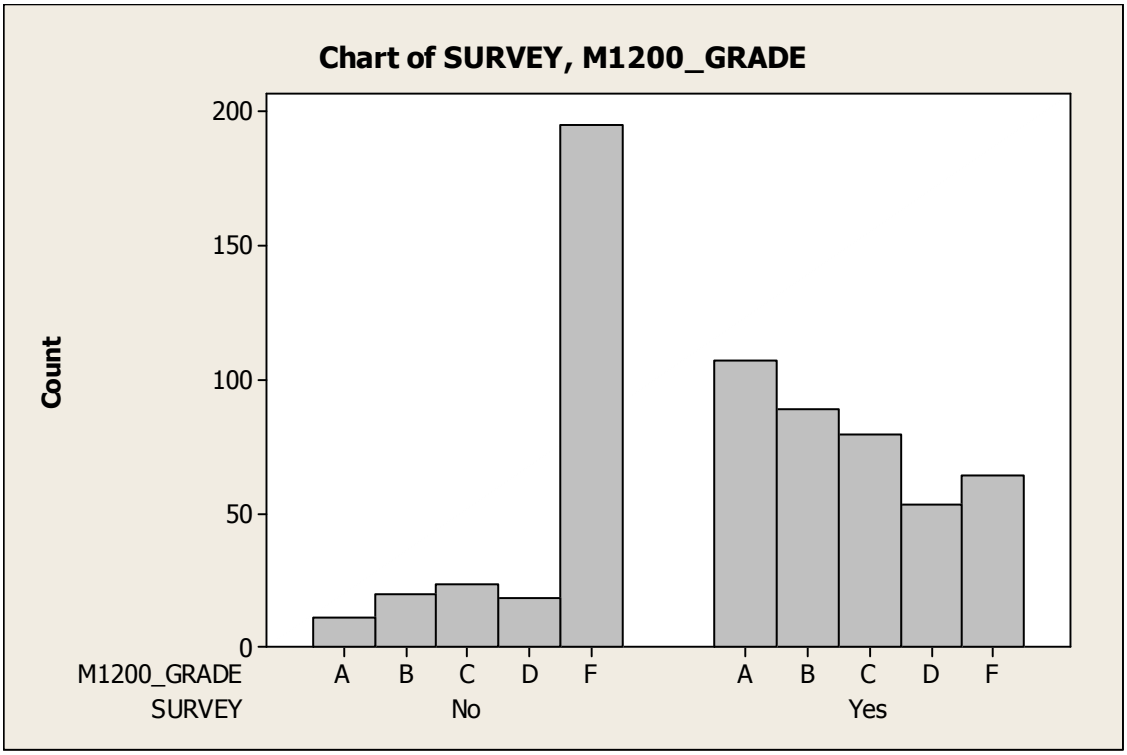

Figure 3-1: Bar Chart of Survey Respondents and Students' Math 1200 Grade

To give us a little more clear idea of the survey respondents, 60% claimed to have taken either Algebra 2 or Pre-Calculus/Trigonometry as their last class in high school (Q_02). 70% said they did not use the math tutoring center at the university at all (Q-05). 47% plan to move on to Calculus for Business as their next math course at the university (Q_10). Based on question 11, 26% were confident in their math skills while 54% were just "OK" but sometimes struggling with either gaps in their basic skills or with concepts (or both). 13% admitted to having a lack of confidence in their math abilities, and 6% said they had "full-blown math anxiety and taking a math class terrifies me." 84% of respondents found the math help features in the Pearson MyMathLab course useful when

they got stuck (Q_18). 85% also felt that the lecture in the course was important in helping them learn the material taught in the course (Q_22).

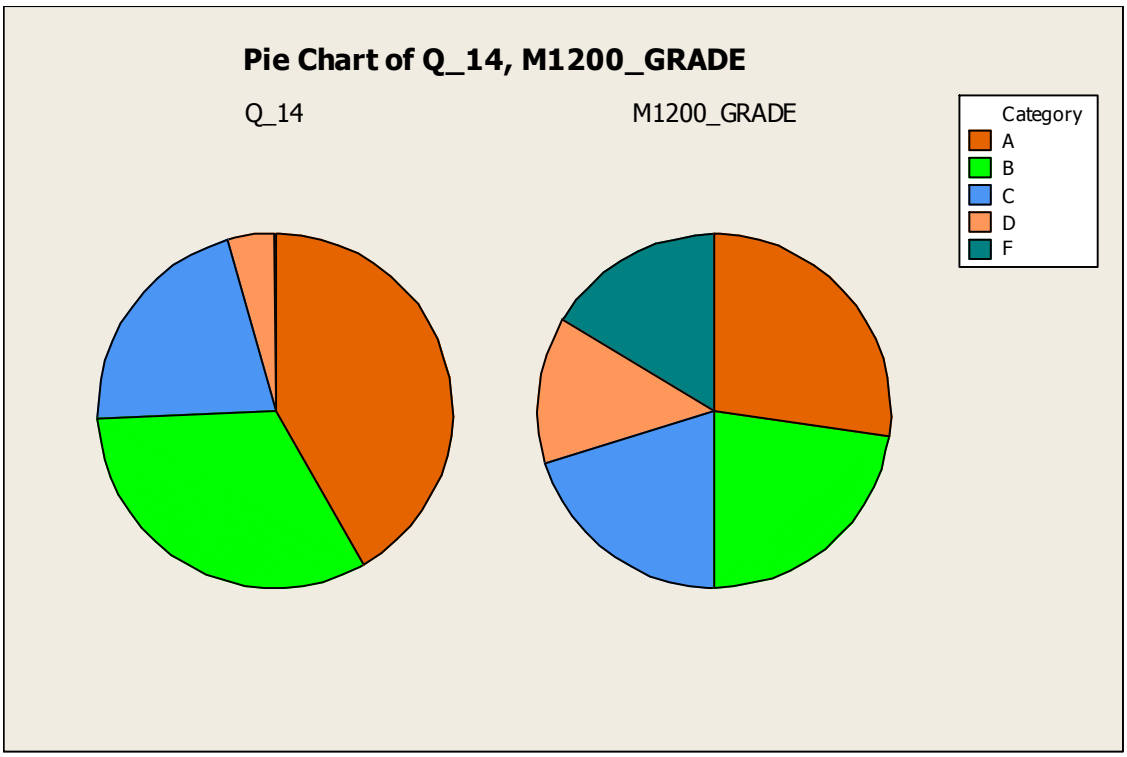

Figure 3-2: Pie Charts of grade students hoped to get (Q_14) and actual grade

We find an interesting but not so shocking disparity between the grade students hoped to get and the grade they actually received (see Figure 3-2). About 75% of students hoped to get an A or B while the reality was much closer to 50%.

In survey questions 24, 25 and 26 we ask students about how the course components helped them learn and understand math concepts. We asked about the course software in #24, the written and group activities in #25 and their instructor's lectures in

#26. Student answered A for very helpful, B for somewhat helpful, C for not very helpful and D for not at all helpful (Figure 3-3). It is interesting that 60% of students felt their instructor's lecture were very helpful, the highest in category A among the three components. Overall more than 90% of students found the course software and instructor lectures either very or somewhat helpful where only about 75% found the group and written activities very or somewhat helpful.

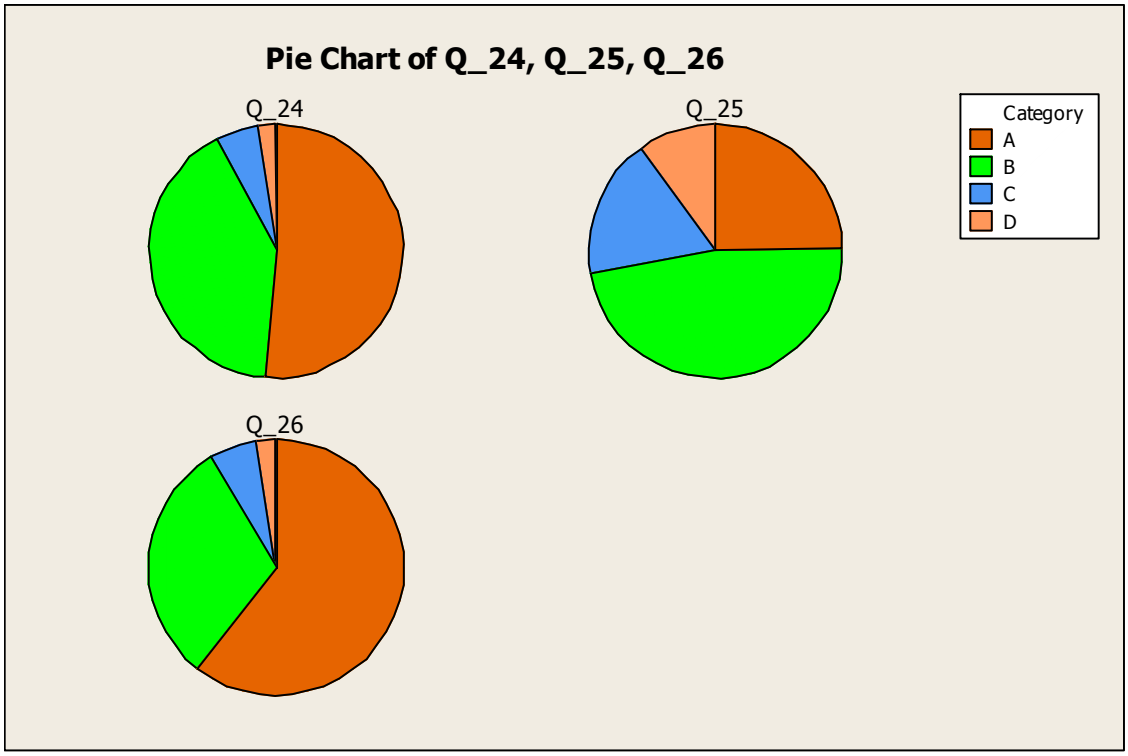

Figure 3-3: Pie Charts of Survey Questions 24, 25 and 26

Another interesting strand of questions, numbers 27 through 35, asked students to grade themselves on their prior knowledge and confidence level in solving story or word problems (#27), working with the definition of a function (#28), linear functions, solving

linear equations and graphing lines (#29), quadratic functions, solving quadratic equations and graphing parabolas (#30), working with inverse functions (#31), working with inequalities (#32), square root functions, solving radical equations and graphing square root functions (#33), rational functions, solving rational equations and graphing rational equations (#34) and exponential and logarithmic function—solving and graphing (#35). They were supposed to base their answers on their knowledge and confidence when they started the Math 1200 class in August.

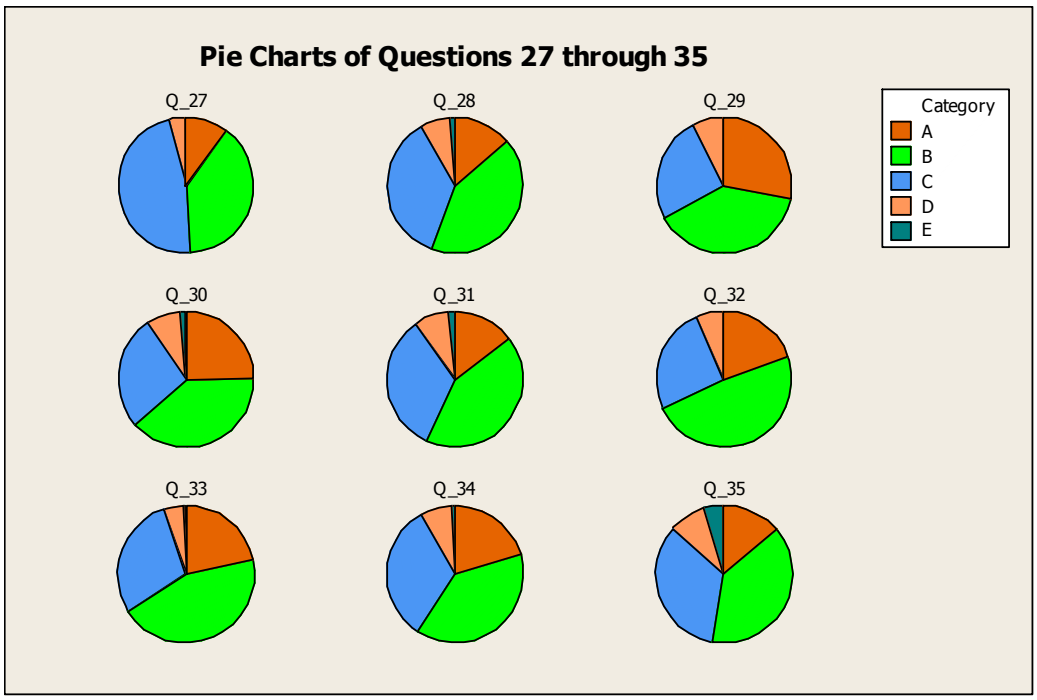

Figure 3-4: Pie Charts of Questions 27 through 35

The rating system was A for "I know this and could teach it to my friends," B for "I am confident that I could successfully solve problems related to this material," C for "I have had this material, but I do not feel confident that I could successfully solve related

problems," D for "I have seen this topic, but I remember very little about it" and E for "I do not recall that I ever learned this topic" (see Figure 3-4). It is interesting that all of the pie charts look very similar with little variance between them. Also interesting is students' confidence that they knew such content prior to even taking the class (categories A and B) at levels as modest as 50% or so for word problems and functions while all other topics were between 60 and 70% (combining category A and B).

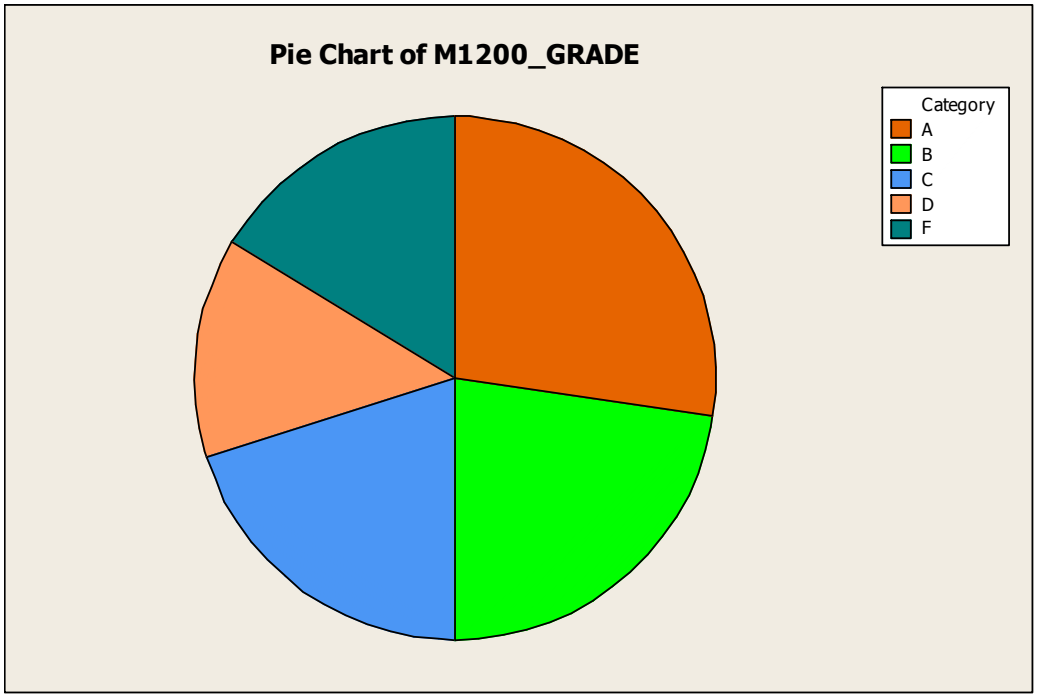

Figure 3-5: Pie Chart of Math 1200 Grades among survey completers

One might anticipate very high levels of achievement given such confidence, but results were not as high as one might expect. In Math 1200, we basically cover all those same

topics, yet when we see their actual grades in Math 1200 only about 50% even received A's or B's (see Figure 3-4).

Of the 392 who did complete the survey, 119 students were also enrolled in Math 1190. 101 took Math 1190 and received an A or B, 18 took 1190 and received a C, D or F, and 273 were not enrolled in Math 1190 at all (see Figure 3-5).

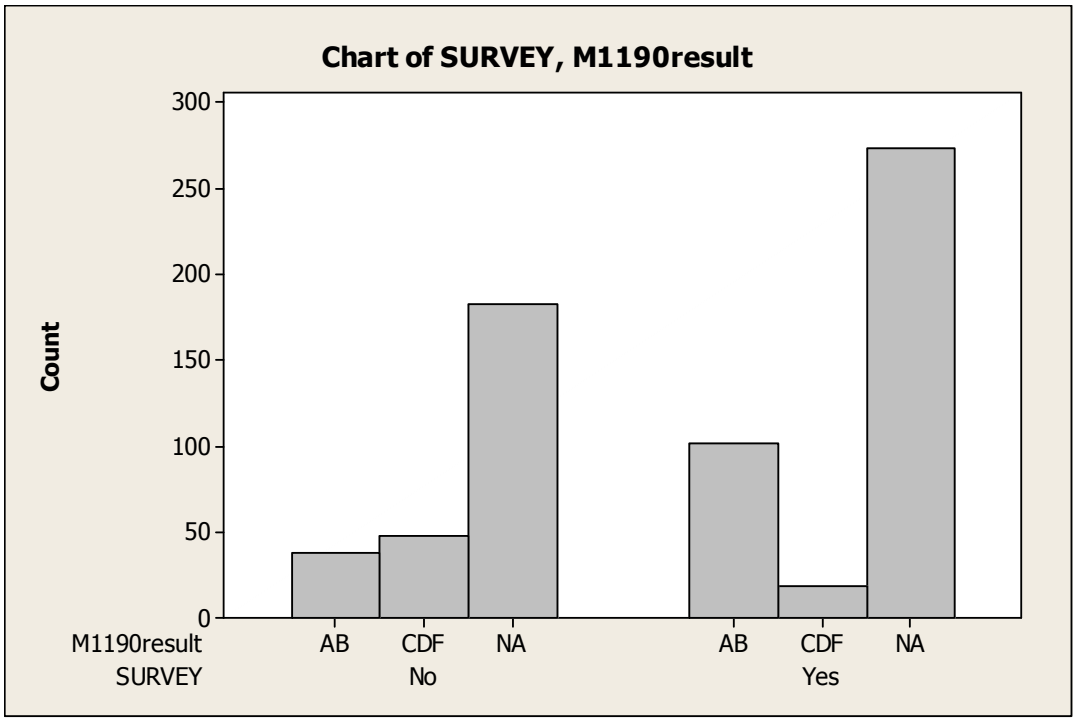

Figure 3-6: Bar Chart of Survey Respondents and Math 1190 Result

Another interesting comparison is students grades in Math 1190 and how they fared in Math 1200 (see Figure 3-6).

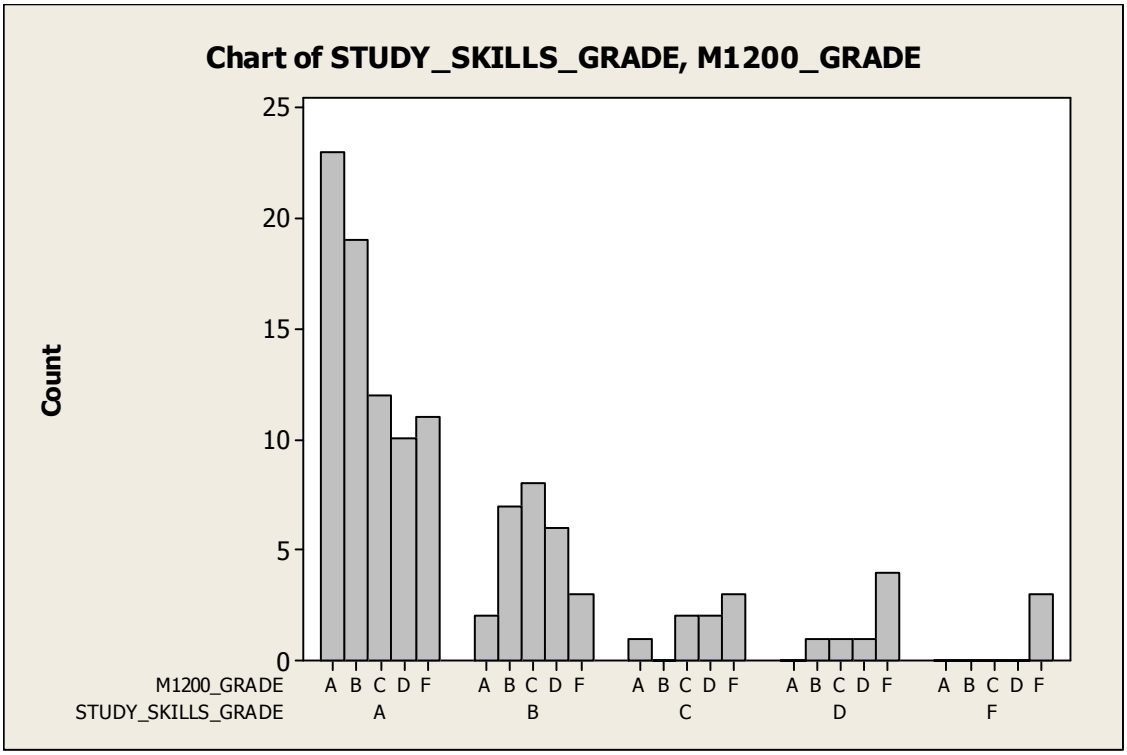

Figure 3-7: Bar Chart of Math 1200 Grade and Math 1190 Study Skills Grade

Passing the Math 1190 math study skills course with an A was no guarantee of passing Math 1200. Still 11 such people failed Math 1200 and 10 got a D. Nonetheless, we definitely see a positive pattern with students' grade in Math 1190 and their corresponding Math 1200 grade. We will see much more explicit results concerning students' Math 1190 and Math 1200 grade later in the analysis.

At the end of survey, students were asked some specific questions (survey questions 36-41) regarding their participation in the eight week Math 1190 course ending weeks earlier. 87% rated their attendance in the Math 1190 as very good or good. Question 37 asked whether students found the Math 1190 course to be helpful for

learning and understanding the math concepts in Math 1200, and Question 38 extended the question to whether it was helpful for learning and understanding material in UT courses other than math. The rating scale was A for very helpful, B for somewhat helpful, C for not very helpful and D for not helpful at all (see Figure 3-7).

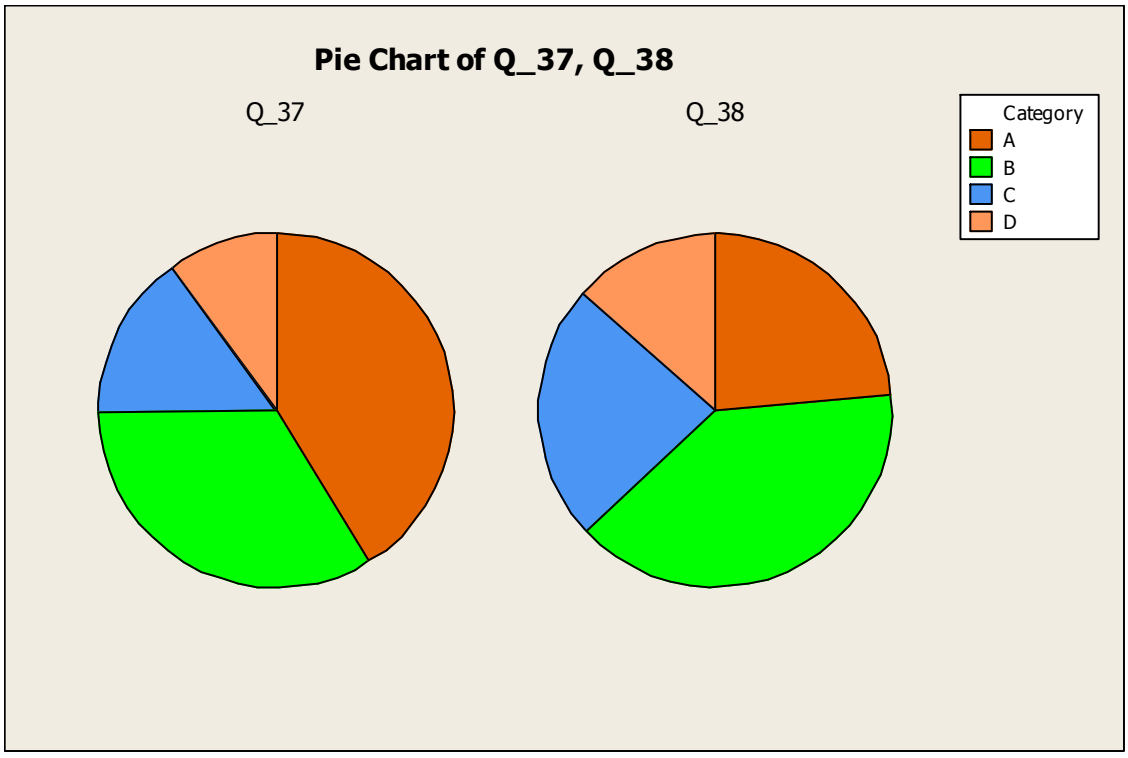

Figure 3-8: Pie Charts of Survey Questions 37 and 38

75% found Math 1190 to be very helpful or somewhat helpful in learning and understanding the math concepts in Math 1200. 63% found Math 1190 to also be helpful or somewhat helpful for learning and understating material in their university courses other than math. In question 39, 78% of students said their time spent in Math 1190 was

completely, mostly or somewhat worth it. In question 40, 68% of students would either highly recommend or recommend with reservations the Math 1190 course to a fellow student. 89% of students said the Math 1200 course very well, well or somewhat employed the content and/or strategies learned in Math 1190. In this post-course survey, it is clear that students recognized and acknowledged the important contribution the math study skills course had on their success.

Next, we will take a closer look at the impact of the Math 1190 course on each individual students' grade in Math 1200. The data collected on each student was extensive. In addition to the survey data already discussed the following information was also collected: the Math 1200 section in which they were enrolled (total of 17 sections with about 40 students in each one), Math 1200 grade, Math 1200 instructor, Math 1190 section (if enrolled in Math 1190), study skills grade, study skills instructor, other previous math course enrollments and information such as Math 950 (a developmental course) and Math 1180 (Math for Liberal Arts), college of enrollment, major, population (new first time, continuing, transfer, post-secondary), classification (freshman, sophomore, junior or senior), age, University of Toledo grade point average, high school grade point average, ACT composite score, ACT math score, SAT sum score, SAT math score, college algebra placement score, elementary algebra placement score and trigonometry placement score. Not all of this data was thought to be helpful in an analysis that intended to focus on the impact of the Math 1190 course on the Math 1200 grade. At the same time, we wanted to take into the account other important factors that might influence this result besides the Math 1190 course grade alone. Also in our analysis any

subject that had any missing data would be left out of an analysis. For this reason, we did not include the following variables due to the amount of missing data for many students: University of Toledo grade point average (most students were incoming freshman with no establish grade point average yet), college algebra placement score and trigonometry placement score (most students take only the elementary algebra placement test unless a high school transcript would suggest otherwise). The following variables were determined to be relevant given our intended focus of the study: Math 1200 grade, Math 1190 study skills grade, high school grade point average, ACT composite score, ACT math score, SAT sum score, SAT math score and college algebra placement score. The Math 1200 score was initially a letter grade which we converted to a numerical grade based on a typical 4 point grade scale.

In order to include as much relevant information as possible, some additional steps were taken to utilize the data we had for students ACT and SAT scores. Most students had ACT scores, while some had both ACT and SAT and others only had SAT. To try to include all of this information with just excluding it, we first looked at a scatterplot to see if in fact such a strong linear relationship could be found, and then we looked at a regression analysis of students' ACT composite score versus SAT sum score (see Figure 3-8 and Table 3-3).

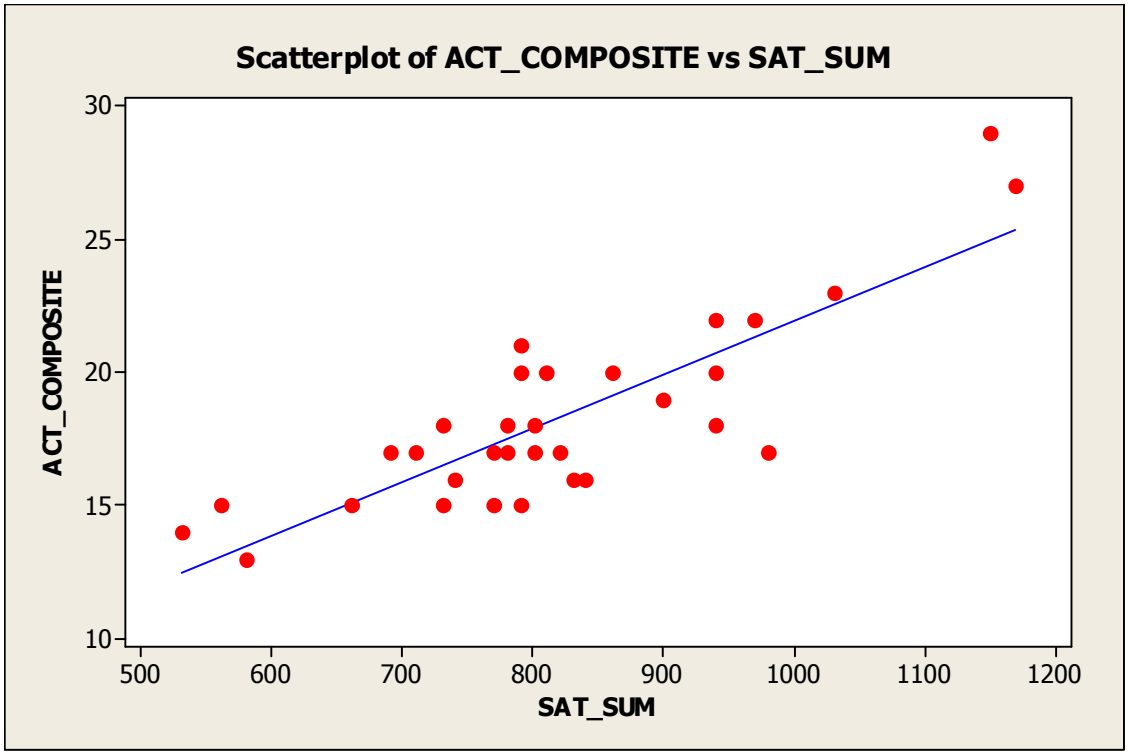

Figure 3-9: Scatterplot with Regression Line of ACT Composite versus SAT Sum

The scatterplot shows an obvious and significant positive correlation between this data. A regression analysis was conducted to predict ACT values to then utilize in the model.

Table 3-3: Regression Analysis: ACT Composite versus SAT Sum

```
The regression equation is
ACT_COMPOSITE = 1.760 + 0.02016 SAT_SUM

S = 1.95259   R-Sq = 70.5%   R-Sq(adj) = 69.5%

Analysis of Variance

Source      DF       SS       MS      F      P
Regression   1  273.621  273.621  71.77  0.000
Error       30  114.379    3.813
Total       31  388.000
```

As anticipated, a strong correlation was found. The large R-Sq value means 70.5% of the variance in the ACT Comp scores can be explained by the SAT Sum scores. Using the regression equation, we predicted a student's ACT Composite score based on their SAT Sum score (if they had one). If a student already had an ACT Composite score, an average of the predicted score and actual score was used in a new variable called ACTSATComp. For students who only took the ACT, their ACT score became their ACTSATComp value. And again, students who had only an SAT Sum score, their ACT Composite score was predicted and became their ACTSATComp score. A similar regression analysis for ACT math versus SAT math was done with similar results, so the same step were taken in determining a student's ACTSATMath score.

First it will be helpful to look at some basic descriptive statistics of the student population (see Table 3-4). To organize and frame the descriptive statistics meaningfully they were grouped according to students overall Math 1190 result. We determined that a grade of an A or B demonstrated a more marked level of seriousness in how the student took the math study skills course. These students were combined into the AB category under the Math1190 Grade column. Again it was determined that students who received a C, D or F displayed a lack of taking the course seriously. Such students were combined into the CDF category under the Math1190 Grade column. The NA category under the Math1190 Grade column represents all the students who were enrolled and received a grade in Math 1200 but were not enrolled in the co-requisite Math 1190 course.

Table 3-4: Descriptive Statistics of M1200NumGrade, EAPLAC, HS_GPA, ACTSATComp, ACTSATMath

Variable	M1190result	N	N*	Mean	StDev
M1200NumGrade	AB	139	0	1.849	1.479
	CDF	65	0	0.329	0.847
	NA	455	0	1.7413	1.5743
EAPLAC	AB	134	5	6.679	2.348
	CDF	60	5	6.783	2.187
	NA	382	73	7.073	2.786
HS_GPA	AB	135	4	2.8442	0.3537
	CDF	63	2	2.5732	0.4808
	NA	406	49	2.9176	0.6050
ACTSATComp	AB	133	6	17.994	2.048
	CDF	60	5	18.027	2.454
	NA	379	76	18.669	2.719
ACTSATMath	AB	133	6	17.022	1.321
	CDF	60	5	17.017	1.240
	NA	379	76	17.631	1.862

We see the same pattern in students' mean score in all the other variables. In the high school grade point average variable (HS_GPA), we see a GPA of 2.57 for the CDF group and 2.84 for the AB group, and the NA group had a high school GPA of almost 3.0. Even on the elementary algebra placement exam that students take at UT to help determine their which course to place them in, both the AB and CDF group in lower than the NA group. These results were expected given the placement criteria of students in the Math 1190 course. Students with a lower high school grade point average and a lower ACT math score were either required or recommended to enroll in the Math 1190 course along with Math 1200. However, when we look at the students Math 1200 numerical

grade, we see the AB category with a mean of 1.85 (basically a C) compared to a 1.74 for students in the NA category who did not take the Math 1190 study skills course. These basic descriptive statistics suggest the positive impact on students who both took Math 1190 and took it seriously enough to get an A or B in the course.

To examine this more closely and try to determine statistical significance, a regression model was constructed using various categorical and numerical variables. Before do so, we first verified the linearity of the data we sought to analyze. With the choice of such a model, it is assumed that all of the variables included have a linear relationship in influencing the Math 1200 numerical grade.

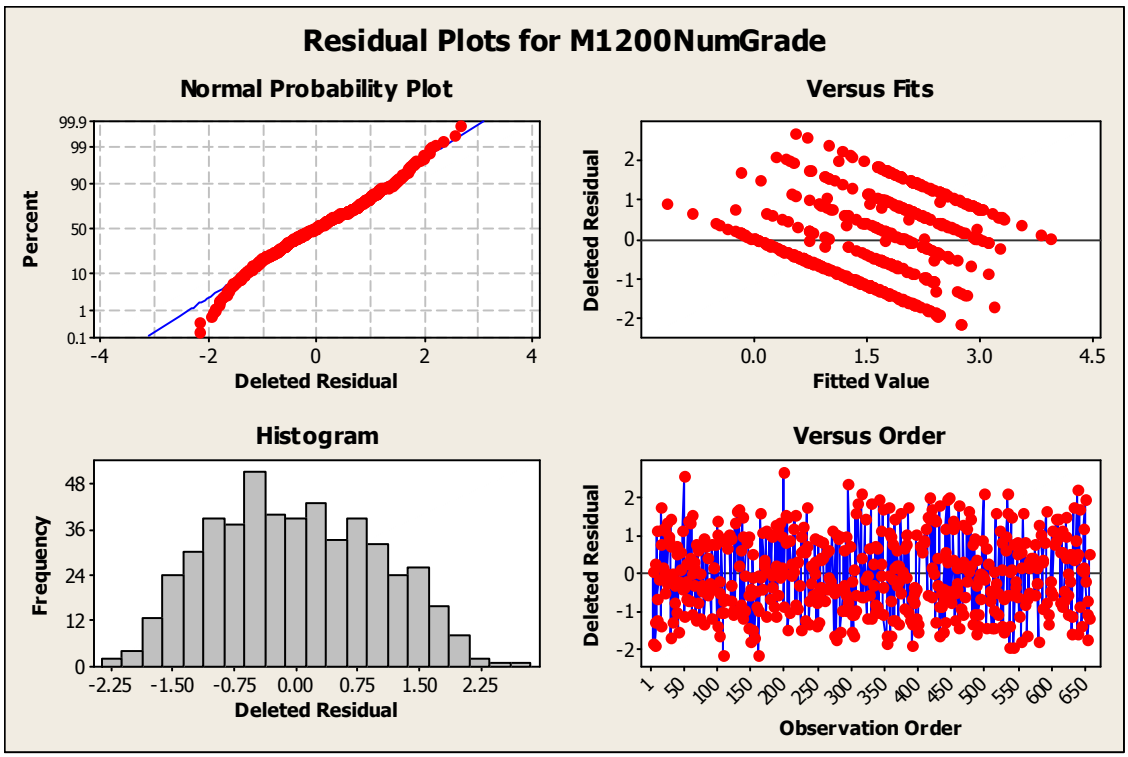

Figure 3-10: Residual Plots for Math 1200 Numerical Grade

Such a model is often used in these types of educational and grade data analysis (Zwick & Himelfarb, 2011). This kind of model is helpful to see the impact of a particular variable like perhaps socioeconomic status, a certain teaching method that was used, a special type of assignment or assessment that was given or any other creative attempts or possible variables that may improve or impact student grades and learning. This kind of model helps to target the specific influence of any such given variable. Since we are working with 3 levels of a categorical variable (M1190 results AB, CDF and NA), we used a single factor covariance model. To determine the appropriateness of such a model, we looked at the normality of the error terms for the Math 1200 numerical grade (see Figure 3-9). In both the Normal Probability Plot and the histogram of the deleted residual, we see evidence of a normal distribution. This is one of the important ways we validate the use of such a model. In the Verses Fit and Verses Plot chart the main thing to check is the lack of any significant patterns showing up. The Verses Fit plot does have some pattern emerging, but such a pattern is typical for such data that is based on letter grades. We even see five lines representing the pattern the grades data of A, B, C, D and F. Based on the results of all the residual plots the error terms look to be distributed normally with no unexpected patterns emerging, so based on this condition the model appears to be appropriate.

Another key issue concerning the appropriateness of this model is the equality of error variances for different treatment factors (see Figure 3-10). In our model we only have one categorical variable with different treatment factors, Math 1190 result (AB, CDF or NA).

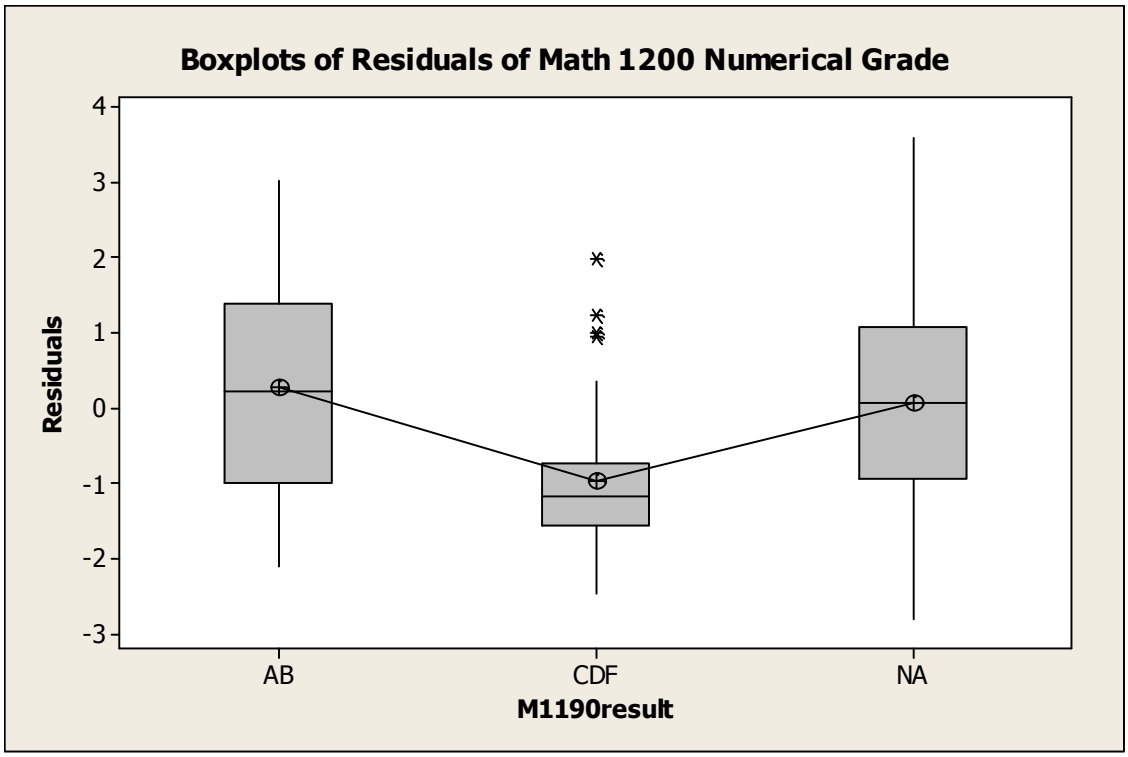

Figure 3-11: Boxplots of Residuals of Math 1200 Numerical Grade

The boxplots for AB and NA look to have variances that are close to equal, but clearly the CDF factor has a much smaller variance. The error data is packed more tightly together than the other two. Despite this, we went ahead with our analysis.

As discussed earlier, the principal investigator sought to include only data related to the focus of determining how Math1190Grade impacted Math1200NumGrade. For this reason, initially the principal investigator initially included the elementary algebra placement score, high school GPA, ACT-SAT composite score and ACT-SAT Math score in the regression analysis. Due to the close correlation between ACT-SAT

composite score and ACT-SAT Math score, only one was likely to be included in the final analysis. After an initial analysis of variance using a general linear model, it was determined that the ACT-SAT Math score was not statistically significant to include (P-value of 0.141) compared to that of the ACT-SAT composite. Out of a total of 659 students, 503 had the needed data for this analysis. This means that some of data collected is left out, but the data and students included remains a significant population to analyze and draw conclusions from.

Table 3-5: General Linear Model: M1200NumGrade versus M1190result

Factor	Type	Levels	Values
M1190result	fixed	3	AB, CDF, NA

Analysis of Variance for M1200NumGrade, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
HS_GPA	1	246.030	152.232	152.232	90.79	0.000
EAPLAC	1	32.466	22.071	22.071	13.16	0.000
ACTSATComp	1	17.822	19.658	19.658	11.72	0.001
M1190result	2	64.254	64.254	32.127	19.16	0.000
Error	498	835.023	835.023	1.677		
Total	503	1195.594				

S = 1.29489 R-Sq = 30.16% R-Sq(adj) = 29.46%

Term	Coef	SE Coef	T	P
Constant	-3.8321	0.4960	-7.73	0.000
HS_GPA	1.0980	0.1152	9.53	0.000
EAPLAC	0.08085	0.02229	3.63	0.000
ACTSATComp	0.08394	0.02452	3.42	0.001
M1190result				
AB	0.49782	0.09937	5.01	0.000
CDF	-0.7841	0.1275	-6.15	0.000
NA	0.41941			

The R-sq value of 30.16% means that basically 30% of the variation in students' Math 1200 numerical grade can be accounted for by the variable included in this model. It is kind of amazing that we could even account for that much given the multiple other factors that could have contributed to the variation like who their Math 1200 or Math 1190 instructor was, what the students' learning style is, student motivation and many other variables, some of which we were able to flesh out in the survey statistics.

Based on the low P values in the linear regression shown in Table 3-5, we see that each predictor variable was a statistically significant indicator on how students would do in Math 1200. All the numerical variables (elementary algebra placement score, high school GPA, ACT-SAT composite score) basically represent their cognitive entry skill and intelligence of which instructors can do little about. Notably, we see the impact of the students' high school grade point average with an F-value of 90.79 and a coefficient of slightly more than 1. Since HS_GPA and M1200NumGrade are both on a 4-point scale, the coefficient of 1 signifies that a student having a B compared to a C average in high school could be predicted to get a full letter grade higher as well in Math 1200. This obviously underscores the significance of a students' high school grade point average to their success in mathematics and college in general. The next highest F-value was M1190result with 19.16 and 2 degrees of freedom, since this categorical variable has 3 levels, AB, CDF and NA. Students' result in Math 1190 was a statistically significant categorical variable in predicting their success in Math 1200. The AB level represents students who took the Math 1190 course seriously enough to get at least an A or B in the

class. The corresponding coefficient for the AB level is 0.49782. Contrarily, students who did not take the Math 1190 course seriously, obtaining a grade of C, D or F, had a negative coefficient value of -0.7841. The coefficient for the NA level, representing students who were not enrolled in the Math 1190 course is 0.41941, lower than the coefficient for the AB level.

To examine the impact more specifically of the Math 1190 results on the Math 1200 numerical grade a main effects plot was generated. A main effects plot is a plot of the means at each level of a factor. In this case, it is the plot of estimated effect of the Math 1190 result (taking into account the other variables) on the Math 1200 numerical grade. This is done for each level of the Math 1190 result (AB, CDF and NA). It is drawn using the fitted values in the analysis, focus on displaying only the impact of the Math 1190 result and not the impact of the other variables. The horizontal line on the plot is the grand mean of the response data, the Math 1200 numerical grade, which is 1.43 (a grade equivalent to a D). A main effect occurs when the mean response changes across the levels of a factor. We see the main effect of the Math 1190 result of AB raising the M1200NumGrade to 1.93. The result of CDF lowered it to 0.66. We see that the AB level effect is even higher than the NA level of 1.71 (students who did not take the study skills course).

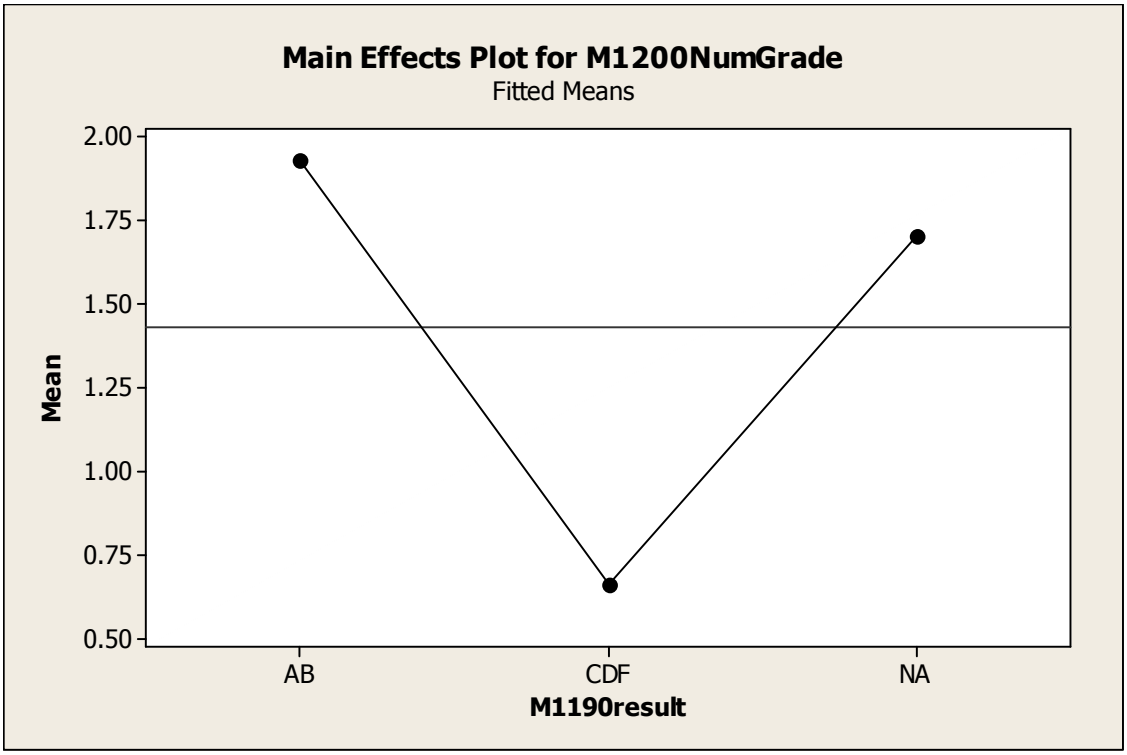

Figure 3-12: Main Effects Plot for Math 1200 Numerical Grade (on a typical 4 point scale) and their Math 1190 Result

Again, in Figure 3-8, we see the main effects plot of the Math 1200 numerical grade. Students with an A or B in Math 1190 had a fitted mean of 1.93, while those students who did not take the course had a fitted mean of 1.71. It seems pretty clear that the students who took the Math 1190 course and took it seriously, were able to close the gap in their deficiencies compared to students who did not.

Chapter 4

Conclusion

Before discussing conclusions regarding the Math 1190 course, it is worth first briefly considering its partner course Math 1200. In view of the literature review, it is good to see that many of the components of the Math 1200 course are founded in research including the implementation of multiple delivery formats, integrating classroom and lab instruction, increased use of technology and the incorporation of collaborative and active learning course components. In essence, Math 1200 was the third course in our developmental sequence. Due to the pace and inclusion of some college algebra content, students could still earn college credit for passing the course. Math 1200 is basically an accelerated 4-credit hour math course that combines material from developmental math and an introductory college math course. We wanted to avoid, if at all possible, students getting stuck in the remedial math courses unnecessarily. We tried to target the upper tier of our developmental students and place them where we hoped they could be successful. Remediating such students successfully while also helping them to meet a core math requirement was the goal. Math 1200 from its inception embraced the inclusion of greater

technology use as a supplement for classroom instruction. Homework and quizzes were conducted via MyMathLab and various multimedia tools were at students' disposal including lecture videos, help features, power points and an e-book. Math 1200 also integrated classroom and lab instruction creating a hybrid classroom environment conducive to the presentation of traditional lectures as well as having a computer for each student allowing for a more lab-like environment. Content was available and delivery in various formats including the use of lectures, online lecture notes, video lectures and various types of help features. We incorporated some active learning teaching strategies where students would have to work together on weekly written assignments that modeled real world situations in ways relevant and related to that week's course content. Careful analysis was done in determining and following up with academic advisors to ensure correct student placement into the course. During class time, usually towards the end, students could also receive more personalized assistance from the instructor. The overall design and structure of the Math 1200 course is embedded in many of the best practices and teaching methods for such a developmentally-oriented student population.

The Math 1190 study skills course was designed to complement what students still needed to be successful. Again based on the literature review, the components of the Math 1190 course reflect a strong research-based foundation. The course paid particular attention to students' affective characteristics like self-concept, locus of control, attitudes, anxiety and study skills. Students did various survey inventories to learn more about themselves. They were helped to consider and set long and short term goals. They actively discussed and collaborated with other students and had some project-based

instruction and assignments. Students reflected on their confidence level in math and some of their basic attitudes in math. They learned how a higher level of confidence in their math ability and a better attitude toward math can positively impact their course success. Students were presented with the facts about math anxiety and how devastating it can become if deliberate steps are not taken. Direct instruction on these topics was given in addition to other important areas of self-discipline like time management and creating a positive study environment. Students were taught very specific study skills including good note-taking strategies, test-taking skills and how to do online homework effectively. The need for consistent course behavior was continuously stressed including the need to complete homework assignments on time, attending class and asking questions in class. Students are also encouraged to practice good classroom etiquette and to establish a good line of communication with their instructor. We did our best to address students' behavior needs which are crucial to their success in math. For first generation students, we sought to make a course that would aid in their transition to a post-secondary experience and provide an additional place of support and understanding.

Based on the survey data, some important conclusions can be found. At the same time, many of the students we needed to hear from were no longer attending by the time we conducted the survey. To find out more from the students who fail Math 1200 (and even Math 1190), we should consider giving a survey earlier in the semester and not only during the last week of classes. In some ways, these are the students we most want to hear from, especially in regards to how to improve and make both the courses more successful. As far as the students who completed the course and responded in the survey,

they are receptive to multiple course components and acknowledge the contribution different components make in their learning and understanding. One important result also was their acknowledgement of the course lectures. 84% found their instructors lectures very helpful or somewhat helpful.

Several articles in the literature review discuss affective characteristics of students. One in particular is student confidence level in doing mathematics. Based on the survey response data, most students were relatively confident in their understanding and learning of most of the math concepts presented in the course, even before the class started. Despite the reality of their lack of ability to display such expertise compared to their confidence level, as shown in their Math 1200 grades, something significant can be seen here. Students' confidence, whether having reason to be or not, translated into modest levels of success and course completion. Another important survey conclusion is that by in large, students recognized the important contribution the Math 1190 course had on their success in Math 1200 and in other UT courses.

Based on simple descriptive statistics, we could see students' who took and passed Math 1190 with an A or B, scored higher overall in Math 1200 than the students who were not enrolled in the course. Despite being lower in all other indicators, high school GPA, ACT-SAT Composite, ACT-SAT Math and the elementary algebra placement exam, students who took Math 1190 seriously had a higher mean in Math 1200. They seem to have bridged the gap in their unpreparedness and caught up with their fellow peers and even perhaps surpassed them a little. It is worth noting the catching up with their peers and doing a little better was getting a C or C- comparing to a D+. This

is obviously still a challenge needing to be faced, raising the overall mean grade for the course.

Based on the other regression analyses and main effects plot, we were successful in finding one avenue of improving student success in Math 1200, implementing an eight week one credit hour study skill co-requisite course. Taking the Math 1190 course and getting at least an A or B caused students' Math 1200 grade to go up about a third of a letter grade. In this improvement, they bridged the gap in their unpreparedness compared to students who did not enroll in Math 1190. We are continuing to try and implement other components in the Math 1190 course and in Math 1200 to improve student success even more. We are thankful to see our efforts are making an impact in student success in mathematics and that students see the value in the Math 1190 course.

The analysis has some limitations and further analysis could be done to perhaps strengthen the results or to see that they are not as significant as we thought. We could collect and analyze more data to see if there is another important variable that impacted student success in Math 1200. More analysis could be done in regard to other factors that may have contributed to the AB group bridging the gap. One possibility is this having more to do with their high school GPA than the impact of the study skills course. Another model could be made to look at an ABC group, including results of how students did in Math 1200 for students who at least received an A, B or C in Math 1190. We could create a model that only focused on the impact of high school GPA and not include the Math 1190 result and see if this was adequate in predicting student grade in Math 1200.

As we move forward with the Math 1200 class some important considerations should be close at hand. The Math 1200 course is in a different situation now as we are getting ready for the fall of 2014. Now Math 1200 meets the typical 50 minutes, 4 times a week. We have a considerably expanded population of students, as the University of Toledo no longer offers any developmental courses. Many more students are who are even less prepared are enrolling in Math 1200. We need to keep reconsidering and rethinking Math 1200 and Math 1190. This fall we expect a student enrollment of over 1000 in Math 1200. Some specific things to consider moving forward include giving a survey earlier in the semester and remembering the value of student self-efficacy (confidence level). Instructors should also wrestle with how to include more active learning during class time which may require some professional development. How to motivate good course behavior is another key issue in moving forward. Forming additional partnerships with faculty in other disciplines and with high schools and local businesses could play a positive role. Last of all is continuous data analysis and keeping close to what emerging research determines to be most effective.

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Appendix A

Math 1200 Syllabus

PREREQUISITES
Satisfactory ACT or SAT Math score or satisfactory placement test score
To be successful in this class, you should be comfortable adding, subtracting, multiplying and dividing signed numbers and fractions, and familiar with the use of variables.

REQUIRED MATERIALS

- **The textbook package** for *Algebra for College Students* 7th edition, Blitzer, Pearson/Prentice Hall. The textbook package, which includes your Access Code, may be purchased at The University of Toledo's bookstore. Once you have registered for Math 1200, on the first day of class you will have temporary access to the online course content. To obtain permanent access, you will need the Access Code.
- Scientific calculator (non-graphing, non-programmable). **Graphing calculators and cell phones are not allowed to be used on tests or the final exam.**
- 3-Ring binder/notebook/folder for the organized taking/keeping class notes, and written assignments.

THIS IS NOT A DISTANCE LEARNING COURSE. Class meeting times are listed above.

All homework, quizzes, tests, and the final exam will be administered online.

Homework will be assigned daily, written activities and quizzes weekly.
There will be 4 tests, plus a comprehensive final exam.

Tests and the final exam can only be taken in the classroom under the instructor's supervision or under special circumstances in a Testing Center, scheduled by the instructor. Only non-graphing, non-programmable calculators may be used on all tests and the final exam. Cell phones **may not** be used on all tests and the final exam. Use of

a cell phone in **any** capacity during a test or the final may result in a grade of 0% for that test or the final. Notes **may not** be used on tests and the final exam. Tests need to be made up within a week of the announced test day, or a grade of 0% may be posted for the missing test. At the end of the semester, your Final Exam grade may be substituted for your lowest test score. According to The University of Toledo's policy, all final exams need to be taken during Final Exam Week.

You have 2 attempts for each quiz, with the higher score automatically recorded by the computer as part of your overall grade. If your first attempt on a quiz is not submitted by the due date/time, your grade for your first attempt will be 0%. You will have until the beginning of your Final Exam to complete your second attempt, or your first attempt grade will stand as your score for that quiz. You do not need to do a second attempt if you are satisfied with your first attempt score.

All **homework problems** may be worked as often as needed to master the material, and each exercise may be reworked to improve your score. Interactive solutions for the homework problems and different forms of tutorials are available online. You may ask for help on homework assignments and quizzes. **Practice tests** will be available a week prior to each test and will be counted as a homework assignment. Homework assignments and Practice Tests not attempted by the beginning of tests will receive a grade of 0%. You may work to improve these scores after the test.

Weekly **Written Assignments** are paper/pencil activities. These may be assigned as an individual or group in-class activity, or as an out-of-class assignment. Due dates/times will be established by your instructor. Makeups for these assignments may be accessed through the course website. Penalties may be assigned for late submissions.

Notebooks should be well organized and contain classroom notes, graded written assignments, and clearly written work associated with homework and quizzes. You may want to include printed copies of the Lecture Notes that are posted in the course website. Notebooks will be checked during your final exam.

LIST OF TOPICS

The material covered in the course corresponds to material in Chapters 1-9 of *Algebra for College Students*, 7th edition, Blitzer.

In general, students will be engaged in the various topics listed below through lectures, interactive computer activities, and group and individual written activities.

An emphasis will be placed on problem solving throughout the course.

- Problem solving strategies and techniques
- Introduction to functions
- Linear functions
- Quadratic functions

- Inverses of functions
- Square root functions
- Rational functions
- Exponential and logarithmic functions

GRADING POLICY
The categories used for evaluation in this course and the percent weights associated with them are:

Homework	15%
Written activities	15%
Quizzes	10%
Tests	40%
Final Exam	20%

GRADING SCALE

Overall %	Grade
93-100%	A
85-92%	B
77-84%	C

Overall %	Grade
70-76%	D
0-69%	F

ATTENDANCE
This course meets MTWR for 50 minutes each day. Attendance will be taken every class day. You are considered present if you are in the classroom, and participating in the class discussion/group work or working on course assignments. Missing more than 10 minutes of a 50-minute class period may be considered an absence by your instructor. Missing 2 or more consecutive classes, or missing every other day, may lead to deactivation of your MyLabsPlus account. When your account is deactivated, you will be unable to access your coursework until you have a conference with your instructor, and/or return to class. No attendance credit is given for sleeping in class.

At the end of the semester Extra Credit may be awarded to your Overall Final Average for good attendance:

+2% if 4 or less days are missed
+1% if 5-8 days are missed.

Reasons for absences have no bearing on earning the attendance extra credit.

VIDEO LECTURES

Throughout the course, video lectures may periodically be used as a substitute for various in-class lectures. When these lectures are made available, you are responsible for watching them in an appropriate time frame.

CLASSROOM RULES AND ETIQUETTE

- The classroom is to be used **only for work on Math1200**.
- No text messaging, facebooking, googling, emailing, game playing, or working on assignments for other classes.
- **No food in the classroom computer lab, this includes before and after class.**
- **Drinks need to be in capped bottles and off the table tops**.
- All electronic devices and cell phones need to be turned off and out of sight during class and tests.
- **Cell phones may not be used as calculators, and need to be turned off before entering the room**.
- The use of cell phones needs to be restricted to outside the classroom, including between classes.
- Be considerate of your classmates and instructor in asking and answering questions, entering, leaving or moving around the classroom.
- Students arriving early for class should wait in the hallway until the previous class has left the room.
- If you fail to comply with any of these rules, you may be asked to leave the classroom.

SOME ADVICE FOR SUCCEEDING IN THIS CLASS

- Attend class regularly and **complete your assignments by the due dates**.
- Schedule sufficient time to devote to this course outside of class.
- Don't hesitate to ask questions, either in class or during your instructor's office hours. If you can't make it during those office hours, make an appointment or make contact by email.
- Get help at the first sign of confusion. Don't wait.
- Study with fellow students. Take turns explaining the material to each other. Teaching someone else is the best way of learning.
- Bring a good **non-graphing scientific calculator** to class every day.

Appendix B

Math 1190 Syllabus

Course Description
This is the syllabus for MATH 1190 Math Modeling Study Skills. MATH 1190 will meet 1 hour and 40 minutes for the first 8 weeks of the semester. MATH 1190 covers study skills particular to success in the MATH 1200 mathematics course.

Why This Course?
This course will assist you in developing the study skills necessary for success in any mathematics course. Our reason for offering this course is to ensure that you pass your mathematics course at the highest level possible.

Course Prerequisite:
- Be currently enrolled in MATH 1200.

Course Goals:
The goals for you associated with this course are to
1. Improve your attitude about mathematics and
2. Equip you with proven study strategies to maximize your ability to do well in mathematics

Required Materials:
- ☐ *Winning at Math*, 5th Edition, Paul Nolting, Academic Success Press
- ☐ Access to the internet

Evaluation:

Homework	25%
In-class assignments	25% (includes attendance and participation in class)
Group Project	20%
Final Exam	30%

The grade you earn will be based on the following scale:

Overall %l	93-100%	85-92%	77-84%	70-76%	0-69%
Grade	A	B	C	D	F

Basic Class Structure:

Weeks 1 and 2	30 min. Skill of the Week and Math 1200 Review, 45 min. presentation with breakout groups and discussion, use remaining class time for skill practice and online review and homework
Weeks 3 to 6	30 min. Skill of the Week and Math 1200 Review, 15 min. Student Group Project, 30 min. presentation with breakout groups and discussion, use remaining class time for skill practice and online review and homework
Week 7	30 min. Skill of the Week and Math 1200 Review, 15 min. Student Group Project, 30 min. Final Exam Review
Week 8	Final Exam

Class Schedule:

Week	**Skill of the Week and Math 1200 Review**	**Course Material from Textbook**
1	Fractions and Order of Operations & Prerequisite Test Questions	Chapter 1: How Learning Math is Different and Why It Pays Off
2	Fractions and Exponents & Quiz 1 and 2 Questions	Chapter 2: Assessing and Using Your Math-Learning Strengths
3	Fractions and Equations & Quiz 3 and Practice Test #1 questions	Chapter 3: Reducing Math Anxiety Chapter 4: Study Environment and Manage Your Time
4	Fractions and Linear Functions & Test #1 questions	Chapter 5: Understanding and Improving the Memory Process, Learning Styles
5	Solving Systems of Equations & Quiz 4 questions	Chapter 6: How to Improve Listening and Note-Taking Skills, Chapter 7: How to Improve Your Reading & Homework Techniques
6	Graphing Systems of Linear Inequalities & Quiz 5 questions	Chapter 8: How to Improve Your Math Test-Taking Skills, Memory Data Dumping
7	Factoring Trinomials & Quiz 6 and Practice Test #2 questions	Chapter 9: How to Take Control and Motivate Yourself to Learn Math, Final Exam Review
8	Final Exam	Final Exam

Appendix C

Math 1200 Course Survey

1. In high school, how many years of mathematics did you pass with a C or better?
   A) at least 3.5
   B) 3
   C) 2 or 2.5
   D) less than 2

2. What was the last math class you took in high school?
   A) Algebra 1 or Integrated Math 1
   B) Algebra 2 or Integrated Math 2
   C) Geometry
   D) Integrated Math 3
   E) Advanced Math
   F) Pre-Calculus or Trigonometry
   G) Calculus or AP Math
   H) Trigonometry
   I) Statistics or AP Statistics

3. What was your grade in that class?
   A) A
   B) B
   C) C
   D) D
   E) F

4. When did you take your last high school math class?
   A) freshman year
   B) sophomore year
   C) junior year
   D) first half of senior year
   E) last half of senior year

5. Tell us about your use of the Math Learning and Resource Center (Tutoring in the basement of Carlson Library).
   A) I have not used this service ever
   B) I have used this service before, but not this semester
   C) I have used this service once this semester
   D) I have used this service 2 or 3 times this semester
   E) I have used this service more than 3 times this semester

6. Tell us about you and your use of calculators.
   A) I always use a calculator for all arithmetic calculations
   B) I need to use my calculator for many arithmetic operations, including addition and/or multiplication of one-digit whole numbers – like 6+9 or 6x9
   C) I only need to use a calculator for such arithmetic when there is more than one digit, like 14x22
   D) I would do 14x22 in my head, so I only use my calculator for really complicated arithmetic
   E) I never use a calculator for arithmetic

7. Have you ever used a programmable calculator?
   A) Yes, and I have used its higher level features
   B) Yes, but I used it mainly for calculating values of trig functions, logs and exponentials and for arithmetic
   C) No

   In the Yes/No questions, please use the T/F bubbles on the scantron sheet.

8. In the summer, were you aware of the UT Math Department's Summer Camp that could be used to improve your placement test score?
   A) Yes
   B) No

9. Did you enroll in the UT Math Department's Summer Camp to improve your placement test score?
   A) Yes
   B) No

10. What is the next Math course that you anticipate taking at UT?
    A) 1210 – Math for Elementary Education majors
    B) 1260 – Calculus for Business with Applications
    C) 1320 – College Algebra
    D) 2600 – Introduction to Statistics
    E) I do not have to take any more math
    F) I am not sure what my next class will be
    G) Other, please specify: _____

11. Which of the following statements best describes your attitude about studying math?
    A) I am confident of my abilities in math.
    B) I am OK at math but sometimes I feel that I have gaps in my basic skills.
    C) I am OK at math, but sometimes I struggle with the concepts.
    D) Both "B2" and "C3" are true of me.
    E) I struggle with math and lack confidence in my math abilities.
    F) I have full-blown math anxiety and taking a math class terrifies me.

12. Which of the following statements best describes your level of comfort in working with math on a computer?
    A) I have no idea because I've never tried to work with math on a computer.
    B) I am confident as I do math problems on the computer.
    C) I sometimes get confused with how to interact with the computer to do math.
    D) I sometimes get frustrated trying to learn the math as I work on the computer.
    E) Both "B2" and "C3".
    F) I struggle with learning math on the computer and very often need interact with the instructor.
    G) I despise working with math on the computer.

13. Do you have access to a computer (with internet access) where you live?
    A) Yes
    B) No

14. What grade do you hope to achieve in this class?
    A) A
    B) B
    C) C
    D) D

15. In addition to the hours in class, approximately how many hours per week above and beyond hours in class are you devoting to studying for this class?
    A) 6 or more
    B) 4-5
    C) 2-3
    D) 1
    E) none

16. I like doing math on the computer because I don't get embarrassed when I make a mistake.
    A) Agree
    B) Disagree
    C) Not Applicable to me

17. How often do you use the help features ("Help me solve this" or "view an example") when you do online homework
    A) I use the help features on nearly every problem
    B) I use the help features on about half of the problems
    C) I use the help features on fewer than half of the problems
    D) I never use the help features

18. Describe your experience with the help features
    A) I couldn't do the problems without the help features
    B) I find the help features useful when I am stuck
    C) I don't find the help features very helpful

19. If I had a choice for my next math course, I would choose a course with
    A) all on-line homework
    B) a mixture of on-line and paper and pencil homework
    C) all paper and pencil homework

20. The immediate feedback provided by the computer when I do my homework is important to help me learn the math.
    A) Agree
    B) Disagree
    C) Not Applicable to me

21. Group activities help me to learn critical thinking skills.
    A) Agree
    B) Disagree
    C) Not Applicable to me

22. The lecture in this course is important to help me learn the material taught in this course.
    A) Agree
    B) Disagree
    C) Not Applicable to me

23. I tend to stay for the entire class period almost every day that the class meets.
    A) Agree
    B) Disagree
    C) Not Applicable to me

24. For learning and understanding math concepts, I find the course software …
    A) Very helpful
    B) Somewhat helpful
    C) Not very helpful
    D) Not at all helpful
    E) There is no course software

25. For learning and understanding math concepts, I find written and group activities …
    A) very helpful
    B) somewhat helpful
    C) not very helpful
    D) not at all helpful
    E) There are no such activities in this course

26. For learning and understanding math concepts, I find my instructor's lectures …
    A) very helpful
    B) somewhat helpful
    C) not very helpful
    D) not at all helpful
    E) There are no lectures in this course

<u>Grade yourself on your prior knowledge and confidence level in each of the following – Questions 24 – 32. Please base your answers on your knowledge and confidence when you started this class in August.</u>

A– I know this and could teach it to my friends.
B– I am confident that I could successfully solve problems related to this material.
C– I have had this material, but I do not feel confident that I could successfully solve related problems.
D– I have seen this topic, but I remember very little about it.
E– I do not recall that I have ever learned this topic.

27. Solving story or word problems.
A B C D E

28. Working with the definition of a function.
A B C D E

29. Linear functions, solving linear equations (example: 2x+3y=10), and graphing lines.
A B C D E

30. Quadratic functions, solving quadratic equations (example: $y=-2x^2+4x+5$), and graphing parabolas.
A B C D E

31. Working with inverse functions.
A B C D E

32. Working with inequalities.
A B C D E

33. Square root functions, solving radical equations, and graphing square root functions.
A B C D E

34. Rational functions, solving rational equations (example: $y = (2x+5)/(x-4)$), and graphing rational equations.
A B C D E

35. Exponential and Logarithmic functions – solving and graphing.
A B C D E

Please answer the remaining questions ***if*** you were also enrolled in Math 1190, Math Modeling Study Skills Lab.

36. How would you rate your attendance in Math 1190?
A) Very good
B) Good
C) Acceptable
D) Poor

37. For learning and understanding the math concepts in Math 1200, I found the Math Modeling Study Skills Lab to be
A) Very helpful
B) Somewhat helpful
C) Not very helpful
D) Not at all helpful

38. For learning and understanding material in my UT courses other than math, I found the Math 1190 – Math Modeling Study Skills Lab to be ...
A) Very helpful
B) Somewhat helpful
C) Not very helpful
D) Not at all helpful

39. On the whole, I found my time spent in the Math Modeling Study Skills Lab to be ...
A) Completely worth it
B) Mostly worth it
C) Somewhat worth it
D) Not worth it

40. If an advisor suggests to a fellow student that s/he take the Math Modeling Study Skills Lab, you would ...
A) Highly recommend it
B) Recommend it with reservations
C) Not recommend it

41. To what extent did your Math 1200 course employ the content skills and/or strategies that you learned in the Math Modeling Study Skills Lab?
A) Very well
B) Well
C) Somewhat
D) Not well
E) Very poorly

Appendix D

Tally for Survey Questions and Answers #1-41

Q_01	Count	Percent
A	220	55.98
B	110	27.99
C	46	11.70
D	16	4.07
N=	393	
*=	267	

Q_02	Count	Percent
A	16	4.08
B	126	32.14
C	31	7.91
D	16	4.08
E	28	7.14
F	109	27.81
G	8	2.04
H	21	5.36
I	36	9.18
N=	392	
*=	268	

Q_03	Count	Percent
A	96	24.49
B	159	40.56
C	109	27.81
D	24	6.12
E	3	0.77
N=	392	
*=	268	

Q_04	Count	Percent
A	4	1.02
B	13	3.32
C	83	21.17
D	82	20.92
E	209	53.32
N=	392	
*=	268	

Q_05	Count	Percent
A	273	69.82
B	23	5.88
C	36	9.21
D	30	7.67
E	28	7.16
N=	391	
*=	269	

Q_06	Count	Percent
A	130	33.16
B	22	5.61
C	205	52.30
D	28	7.14
E	6	1.53
N=	392	
*=	268	

Q_07	Count	Percent
A	131	33.59
B	120	30.77
C	138	35.38
N=	390	
*=	269	

Q_08	Count	Percent
A	63	16.07
B	328	83.67
N=	392	
*=	267	

Q_09	Count	Percent
A	12	3.08
B	377	96.67
N=	390	
*=	269	

Q_10	Count	Percent
A	15	3.85
B	182	46.67
C	55	14.10
D	47	12.05
E	72	18.46
F	18	4.62
N=	390	
*=	269	

Q_11	Count	Percent
A	103	26.28
B	62	15.82
C	68	17.35
D	84	21.43
E	50	12.76
F	24	6.12
N=	392	
*=	268	

Q_12	Count	Percent
A	7	1.79
B	205	52.30
C	66	16.84
D	27	6.89
E	48	12.24
F	11	2.81
G	27	6.89
N=	392	
*=	267	

Q_13	Count	Percent
A	374	95.65
B	16	4.09
N=	391	
*=	269	

Q_14	Count	Percent
A	163	41.48
B	128	32.57
C	84	21.37
D	17	4.33
N=	393	
*=	267	

Q_15	Count	Percent
A	67	17.18
B	111	28.46
C	162	41.54
D	43	11.03
E	6	1.54
N=	390	
*=	269	

Q_16	Count	Percent
A	211	53.96
B	101	25.83
C	78	19.95
N=	391	
*=	268	

Q_17	Count	Percent
A	81	20.72
B	187	47.83
C	115	29.41
D	7	1.79
N=	391	
*=	268	

Q_18	Count	Percent
A	56	14.36
B	326	83.59
C	7	1.79
N=	390	
*=	269	

Q_19	Count	Percent
A	187	47.70
B	144	36.73
C	60	15.31
N=	392	
*=	267	

Q_20	Count	Percent
A	359	91.82
B	24	6.14
C	7	1.79
N=	391	
*=	268	

Q_21	Count	Percent
A	182	46.31
B	143	36.39
C	67	17.05
N=	393	
*=	266	

Q_22	Count	Percent
A	328	84.32
B	47	12.08
C	13	3.34
N=	389	
*=	270	

Q_23	Count	Percent
A	334	85.42
B	45	11.51
C	11	2.81
N=	391	
*=	268	

Q_24	Count	Percent
A	201	51.54
B	158	40.51
C	21	5.38
D	4	1.03
E	5	1.28
N=	390	
*=	269	

Q_25	Count	Percent
A	96	24.74
B	182	46.91
C	70	18.04
D	19	4.90
E	20	5.15
N=	388	
*=	271	

Q_26	Count	Percent
A	235	60.26
B	121	31.03
C	23	5.90
D	10	2.56
N=	390	
*=	269	

Q_27	Count	Percent
A	38	9.74
B	152	38.97
C	183	46.92
D	15	3.85
E	1	0.26
N=	390	
*=	269	

Q_28	Count	Percent
A	54	13.92
B	162	41.75
C	139	35.82
D	27	6.96
E	5	1.29
N=	388	
*=	271	

Q_29	Count	Percent
A	110	28.21
B	150	38.46
C	100	25.64
D	28	7.18
E	1	0.26
N=	390	
*=	269	

Q_30	Count	Percent
A	97	24.81
B	152	38.87
C	104	26.60
D	32	8.18
E	5	1.28
N=	391	
*=	268	

Q_31	Count	Percent
A	58	15.03
B	161	41.71
C	129	33.42
D	30	7.77
E	7	1.81
N=	386	
*=	273	

Q_32	Count	Percent
A	77	19.79
B	188	48.33
C	98	25.19
D	24	6.17
E	1	0.26
N=	389	
*=	270	

Q_33	Count	Percent
A	85	21.85
B	172	44.22
C	111	28.53
D	17	4.37
E	3	0.77
N=	389	
*=	270	

Q_34	Count	Percent
A	79	20.31
B	152	39.07
C	124	31.88
D	29	7.46
E	4	1.03
N=	389	
*=	270	

Q_35	Count	Percent
A	54	13.99
B	153	39.64
C	128	33.16
D	31	8.03
E	19	4.92
N=	386	
*=	273	

Q_36	Count	Percent
A	184	56.62
B	87	26.77
C	35	10.77
D	18	5.54
N=	325	
*=	334	

Q_37	Count	Percent
A	145	44.34
B	127	38.84
C	35	10.70
D	19	5.81
N=	327	
*=	332	

Q_38	Count	Percent
A	97	31.49
B	130	42.21
C	47	15.26
D	33	10.71
N=	308	
*=	351	

Q_39	Count	Percent
A	91	28.44
B	122	38.13
C	66	20.63
D	40	12.50
N=	320	
*=	339	

Q_40	Count	Percent
A	136	43.31
B	121	38.54
C	56	17.83
N=	314	
*=	345	

Q_41	Count	Percent
A	100	30.96
B	133	41.18
C	67	20.74
D	12	3.72
E	10	3.10
N=	323	
*=	336	