Accelerated WARM UPS
Workshop Approach to Remedial Mathematics Using Problem-Solving
CUNY Improving Math Learning Grant
Final Program Report
September 2011

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A. National Significance of Remediation
In 2010-2011, ≈3.2 million students will graduate high school (Snyder & Dillow, 2011). Unfortunately, many will graduate underprepared for the rigors of college. While future improvement in high school preparation is a cherished goal, the current level of student readiness requires a collegiate solution, particularly at open-enrollment community colleges. In fall 2005, of the 1.3 million students enrolled in math courses at two-year colleges, 57% were enrolled in a developmental1 course (Blair, 2006). In theory, the developmental math sequence is designed to prepare students to succeed in college-level math. In practice, it often serves as a trap from which most students never escape, and those who do often do not persist to complete a credit-bearing gatekeeper course. An analysis of 57 community colleges by Bailey, et al. (2010) found that only 33% of students referred to developmental math completed the sequence within 3 years and only 20% passed the gatekeeper course. Their analysis revealed a key barrier to completing the sequence is the persistence of students to enroll in the next course. Students who successfully complete a developmental math course have higher fall to spring retention than those who enroll but do not successfully complete it (Fike & Fike, 2008). Developmental education costs an estimated $1.9-$2.3 billion annually at community colleges (SAS, 2008). Students also suffer additional cost using financial aid. The ongoing discussion about remediation occurs while the current knowledge base is insufficient to inform the decisions of policy makers, educators, scholars, and students (Levin & Calcagno, 2008).

B. Remediation at CUNY
With a large urban enrollment, CUNY is a microcosm of national trends. Recently, the Community College Research Center conducted an analysis of CUNY’s community colleges. Between fall 2004—spring 2008, 74,772 first-time students entered CUNY community colleges. These students were followed until fall 2009. During this period, 82% of students were referred to some type of developmental education including 64% in math. Of the students who enrolled, persistence to completing the gatekeeper course varied significantly based on the severity of remediation need. The most frequent starting point (49%) enrolled at two levels below credit bearing, and only 13% of them persisted and passed the gatekeeper course. At CUNY, students who fail a remedial math course in their first semester are more than four times as likely to drop out as those who pass the course (Jaggars & Hodara, 2011).

C. Intervention at Queensborough Community College
Students entering Queensborough Community College (QCC) are placed into mathematics courses based on their scores on the COMPASS mathematics exam: If they score less than 30 on M1 (arithmetic), they are generally required to take MA-005, a semester long remedial arithmetic course. During the Fall 2008-Spring 2009 academic year, 1,872 students enrolled in our lowest-level remedial arithmetic course. Unfortunately, only about 37% (692) of those students successfully completed it. Anecdotal evidence suggested that many students who 'almost' passed M1, failed or dropped out of MA-005 because they were discouraged by a course which attempts to again teach them material they have already seen for several years in high school. These students often do not reenroll in the following semester and fail to make progress towards a degree despite their initial desire to do so. To meet the needs of such students and prepare them for a credit bearing course, a new course, MA-005M (Arithmetic WARM UPS), was developed in Summer 2009 and offered for the first time in the Fall 2009 semester. Development of this course was supported first by the QCC Office of Academic Affairs and then by an Improving Math Learning Grant from CUNY.

The Arithmetic WARM UPS (Workshop Approach to Remedial Mathematics) model is a 4-week, 20-hour workshop which includes 4 computer lab hours. In this model, the emphasis is on students engaging with problem solving in order to improve their arithmetic skills. To enable the radical change in classroom practices, a new textbook, Arithmetic WARM UPS (Cornick, Guy, Holt, & Russell, 2010) was written. The book tightly aligns with the new structure, curriculum and pedagogical innovations.

On each of the first four meetings, students complete one Skill Sheet that focuses on only a few topics. During these meetings, an instructor presents quick refreshers at the board, and then turns the focus to the students to engage in problem solving. Indeed, most of the period is spent with the student completing problems and not the instructor lecturing. A mantra often repeated throughout this project is, “The instructor must sometimes stop teaching in order for the student to start learning.” After the introductory refreshers, the instructor then becomes an active participant circulating through the classroom and engaging students who are struggling. At this point the instructor offers differentiated instruction to address the learning needs of one or a small group of students. Students have many resources at their disposal: they can

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1 The terms developmental and remedial are occasionally used with different meanings and connotations. We will use them interchangeably with no implied difference in meaning.
remind themselves of what to do next by consulting the Help Pages in the book, ask their instructor for assistance, discuss with a fellow classmate or seek out help from a friend or tutor. After the first four meetings, one Mixed Worksheet is completed per meeting with little to no lecturing to the entire class. The Mixed Worksheets contain problems from all curricular topics, and they are not arranged or subdivided in any particular order. In order for students to begin answering these questions, they must first identify which of their skills they will need to solve the problem.

In order to earn a passing grade, students are required to earn a score of 30 on the COMPASS Arithmetic (M1) test. After completing 20 hours of class time, students are given their first opportunity to take the exam. If a student scores a passing grade, a 30 or higher, they complete their arithmetic requirements and are allowed to take algebra the following semester. If they do not pass, then they continue for 20 more hours of instruction by a peer tutor in the Math Learning Center. In addition to a changed classroom format, students are afforded multiple opportunities to earn a passing grade during a single semester.

Since the course requires only 20 hours of class time, students start the class at three times throughout the semester. Module A begins the course immediately, module B begins the course approximately 5 weeks into the semester, and module C begins approximately 10 weeks into the semester. There is an additional post semester workshop offered in the Math Learning Center for students to have an additional opportunity to pass before the next semester began. Each module has a maximum enrollment of 20 students and one instructor is thus able to teach approximately 60 students per semester.

**D. Brief References to Relevant Existing Literature**

It seems intuitive that students with more deficiencies should require more semesters of remediation. This seemingly intuitive notion has guided the development of many, multi-level remedial sequences. However, Edgecombe (2011) presents myriad arguments against an elongated remedial sequence. Edgecombe argues that many students fail to complete the remedial sequence and a credit-bearing course simply because they drop out of the sequence at every available exit point. She argues that the acceleration of the sequence by giving students an opportunity to earn a passing grade in a gatekeeper course sooner will result in higher rates of credit completion. Additional research also suggests that the faster students progress toward a credential, the more likely they are to complete college (Bowen, Chingos, & McPherson, 2009).

Edgecombe presents several strategies for effectively accelerating the sequence. She cites numerous examples where course acceleration results in improvement of student learning outcomes. She notes that this is not always accompanied by a reduction in overall class time (2011).

Effective teaching in a developmental classroom is a challenging undertaking extending beyond purely cognitive needs (Smittle, 2003). Our practices incorporate a massive departure from teacher-centered lecture and testing and implements student-centered classroom practices that encourage high student engagement. We incorporated practices of highly structured collaborative problem solving and additional learning centered practices described by Hodara (2011). Additional existing research supporting various elements of our intervention can be found in Rutschow and Schneider (2011).

**E. Experimental Design**

Beginning in Fall 2009, arithmetic students with an arithmetic COMPASS M1 score of 25-29 were eligible to enroll in either the traditional arithmetic course or our newly redesigned Arithmetic WARM UPS course. Students self-selected into one of the courses. While initially enrollment in the experimental course was limited to only students in the 25-29 range, students outside this range were allowed to enroll in the course to fill remaining seats in the days immediately prior to the course start date. Factors influencing student decisions were not studied.

Instructors for each class were assigned by the Deputy Chairperson who makes all instructor assignments. There were 12 different instructors for the experimental class and 63 different instructors for the traditional course. Four instructors taught both courses during this time. The majority of instructors in both groups were adjunct instructors, but there were also full time faculty in both groups. Two authors of this report, Guy and Russell, served as experimental instructors for 3 of the 4 semesters in this study and Cornick served as an experimental instructor for approximately 20 students during the study.

We analyze the success of the new program by means of quasi-experimental methods. In this report, we present several results obtained by use of multiple logistic regression techniques. In a logistic regression technique, the statistical
differences between a dichotomous dependent variable are calculated while taking into account the contributions one or more independent variables. In our results below, the dependent variable will be an indicator variable for whether students achieved some milestone success. For example, we will indicate with a 1 a student who passed the course and a 0 for a student who did not pass the course.

**F. Population Studied**

During the four semesters Fall 2009, Spring 2010, Fall 2010 and Spring 2011, 3,783 students enrolled in one of the two courses. Unfortunately, student outcome data is not yet fully available for Spring 2011 students and so these students are all excluded this this analysis. In order to attempt to control for preexisting differences in student populations, we limit the analysis presented here to only students who meet all of the following conditions:

1. Student has a COMPASS Arithmetic (M1) score on file. In addition, this score had to be less than a 30.
2. Student has a COMPASS Algebra (M2) score on file.
3. Student’s first math course was either traditional arithmetic (MA 005) or the experimental course (MA 005M).
4. Student’s first attempt at a math course was during the Fall 2009, Spring 2010 or Fall 2010.

These conditions limit our study to 2,306 students. For data calculation, we assigned students to the experimental group (MA 005M) or the control group (MA 005) based on the course they self-selected into on their attempt.

Only brief demographic data is presented here, and in this report, demographic data is not factored into our calculations. Table 1 contains the reported sex of each student and Table 3 contains the age of each student when entering the study.

Since the new class was still unproven, we initially opened it to only students whose COMPASS M1 scores were in the 25-29 range. This did create a disparity in this measure of student test characteristics, as seen in Table 4. In our analysis below, we make use of regression techniques with hope of accounting for some of those differences. Roughly speaking, in a regression analysis students with “similar” characteristics are compared based on each independent variable. Thus the outcome accounts for some of the differences between the two groups by factoring these differences into the final results. See H Plans for Future Research (page 6) for a discussion of future plans to analyze the data.

**G. Measures of Success**

We now explore various measures of success of our students. In each of the regression calculations below, the student’s Arithmetic (M1) and Algebra (M2) COMPASS scores are included as independent variables in the logistic regressions. In addition, an indicator variable, course1_en, is assigned a value of 0 if the student first enrolled in the traditional arithmetic course (MA 005) and value of 1 if the student first enrolled in the experimental arithmetic course.

**Note:** The authors of this report are not statisticians, despite being mathematicians. The attempts at analysis here using advanced statistical methods may well have gone astray, and comments about the appropriateness and execution of these tests are welcomed. More simplistic cross tabulations are also included with each analysis.

**i) Passing Arithmetic on First Enrollment**

For this measure of success, we define success as earning a score of 30 or higher without enrolling in arithmetic again. This indicates that the student earned a 30 or higher either during the regular semester or during a post semester workshop in the Math Learning Center. A simple cross tabulation Table 6 shows that the pass rate was approximately 44% for the control group versus approximately 73% for the experimental group. Fisher’s exact test indicates that this is a statistically significant difference.

The output from the logistical regression is included in Table 5. This output indicates a logit of .5467034 for students enrolled in the experimental group. The p-values for all coefficients and the model indicate statistical significance at the 0.001 level.

We pause momentarily to explain an interpretation of the logit values from Stata as summarized on UCLA’s Academic Technology Services Website. A logit value of .546703 is the log of the odds ratio between the experimental group and control group when taking into account differences between the entering COMPASS scores of the students. We can translate this into odds by taking the exponential. Thus the odds are exp(.546703) = 1.727548. This can be interpreted to say that the odds of passing arithmetic in the experimental group are roughly 73% *higher* than those in the control group. Again, the regression techniques take into account the differences in the population.
ii) Same Semester Math Retention
Many studies have indicated that the largest barrier to student success is the student actually staying enrolled and not quitting. In this course, we hoped that the shorter, yet more intensive, requirement for the student to complete the class would result in an increase in retention.

Students who enroll in the traditional arithmetic course are required to complete approximately 14 weeks before an opportunity to take the COMPASS exam. Certainly a student who is still enrolled at the 14th week and takes the exam should be considered retained. As a result, we assign students in the control group a value of 1 (success) if they take the COMPASS exam after enrolling in the course.

For students in the experimental group, retention is less obvious. Recall that students begin this course at 3 distinct times throughout the semester. Students who begin during module A have their first opportunity to take the COMPASS after approximately 4 weeks of class. Those who pass have completed the course. Certainly those students should be assigned a value of 1, and we do so. However, students from module A who do not pass are afforded an opportunity to continue with the class and take the exam again 4 weeks later. The dilemma is whether we should require a student to take the exam a second time (or third and even forth available opportunities) to be considered retained or is taking the exam at least once sufficient? To further complicate matters, students who enroll in module B must wait 5 weeks before even beginning class, then take class for 4 weeks before being allowed to take the exam. Those who pass are certainly counted as retained. But those who didn’t pass now fall into the same situation as those in module A who did not pass, but are now allowed another opportunity after taking 4 weeks of additional class. Module C has similar complications.

For simplicity, in this report, we offer the following definition. We define a student in the experimental group to be retained if they take the COMPASS exam at least once following enrollment in the course. This indicates they took the exam either approximately 4 weeks, 9 weeks or 14 weeks during the semester, or in the post semester workshop that followed. In a future analysis, we will examine other possible definitions of retention.

The cross tabulation Table 8 shows that retention under this definition is approximately 65% for the control group and approximately 84% for the experimental group. Fisher’s exact test indicates that this is a statistically significant difference.

The results of the logistical regression are in Table 7. The logit for students in the control group is .7794594. As before, we can take the exp(.7794594)=2.180293 and interpret this to mean that the odds of retention are approximately 118% greater for the experimental group.

iii) Enrollment in Following Math Course
Unfortunately, many students who pass one course in a sequence never register for the following course. A detailed discussion of this phenomenon is available in many sources including Edgecombe (2011), Bailey et al. (2010), Jaggars and Hodara (2011), and Hern (2010).

We study the enrollment behavior here. Since our data is incomplete for the Spring 2011 term, we limit our analysis of this indicator to only students enrolling in our study during Fall 2009 and Spring 2010 (n=1,528). A cross tabulation Table 9 indicates a statistically significant difference of approximately 58% from the experimental group and only 44% from the control group enrolled in developmental algebra.

In this case, the logistical regression is not statistically significant (likely due to lower population sizes) and is not presented.

iv) Passing the Following Math Course
One hopes that the hard work in creating a new, more successful class will result in gains beyond the single semester of the new course. But as with the previous result, we cement a pattern that is highly predictable from examining existing research (eg Weissman et al., 2011). Succinctly stated, single semester interventions result in single semester gains. The enrollment numbers alone are unfortunate, but the passing rates are even more disturbing.

We again limit ourselves to the 1,528 students who enrolled during the Fall 2009 and Spring 2010 terms. A cross tabulation Table 10 indicates a statistically insignificant comparison of approximately 15% for the control group and 19% for the experimental group.
One should note that many of these students had only a short window in which to pass arithmetic, enroll in and then pass algebra. In order to further highlight the issues at hand, we restrict ourselves to only the 881 students enrolling in Fall 2009. These students had the longest timeframe to complete the sequence of any in our study. A cross tabulation Table 11 again indicates a statistically insignificant comparison of approximately 18% for the control group and 19% for the experimental group. While the differences are statistically insignificant, it is evident that as time progresses, the gains from a single semester intervention tend to fade and those in the treatment group and control group have more similar outcomes.

v) Supporting Role by Math Learning Center
Students in the experimental course who did not pass on their first attempt were eligible to attend a workshop in the Math Learning Center and take the COMPASS again after 20 additional class hours led by a peer tutor. There were 284 (of 693) experimental students did not pass the COMPASS on their first attempt. A total of 116 of these students attended a workshop and took the COMPASS a second time. Of those 116 students, 95 students (82%) earned a passing grade for the course. In sum, this indicates that while only 116 of the 284 (41%) made use of the additional supporting workshop, it was extremely successful for those who did participate.

H. Plans for Future Research
There are a number of issues which we have not addressed in this report. For example, we have not addressed any differences between experimental students enrolling in modules A, B and C. We would like to study the differences in outcomes when accounting for this difference in start time. Moreover, we have merely listed various demographic details here, but have made no attempt at determining any difference in effectiveness among these subpopulations. We have yet to analyze if students with additional remediation deficiencies in other areas are equally well served under this newer model. In addition, Spring 2011 students were not included in this analysis. We intend to collect the remaining data, and study the behavior of these students in the Fall 2011 as well. In summary, there are quite a few questions which this report has not yet addressed. We will address these issues, and others, and submit our study for peer reviewed publication(s).

I. Future Practice
We have already made the decision to scale up this new course. In the Fall 2011 semester, it is now the dominant mode of arithmetic offering. There are over 1,000 students enrolled in MA 005M this semester, and we will continue to study the effectiveness of this new course in the wider population.

In addition, it is evident that a single semester intervention results in a single semester gain. As a result, our attention has shifted from focusing on a single course to the entire developmental sequence. Several experiments and projects are now underway to expand on our success in this course, and cover the entire sequence. Several of these projects are supported by competitively awarded QCC and CUNY grants. Additional funding opportunities for external resources are also under consideration.

J. Acknowledgements
Any complete listing of all those who played a significant role in this project would go on longer than we are allotted for our entire report. However, we must thank our Department Chairperson Dr. Mona Fabricant for getting this projected started by sharing her great ideas and helping secure initial funding. We offer our highest praise to Ms. Elizabeth Nercessian, the director of the Math Learning Center, for playing such a strong supporting role in this new course. Our Deputy Chairperson Ms. Sandra Peskin and Mr. Ed Molina also contributed a wealth of experience and helped make our project a success. We also offer our appreciation to our many colleagues, including faculty, staff and administrators, who supported and enabled this work. Our students have truly benefited from your support. As our work continues, we look forward to your continued support.

All data in this report was generously provided by the CUNY Central Office of Institutional Research with the oversight of QCC’s IRB. Special thanks to Dean David Crook, Cheryl Littman and Stephen Sheets for their very thorough assistance with our data requests.
### K. Appendix: Data Tables

#### Table 1: Student Sex

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall 2009</th>
<th>Spring 2010</th>
<th>Fall 2010</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (MA005)</td>
<td>579</td>
<td>517</td>
<td>517</td>
<td>1,613</td>
</tr>
<tr>
<td>M</td>
<td>344</td>
<td>322</td>
<td>316</td>
<td>982</td>
</tr>
<tr>
<td>F</td>
<td>235</td>
<td>195</td>
<td>201</td>
<td>621</td>
</tr>
<tr>
<td>Experimental (MA005M)</td>
<td>302</td>
<td>130</td>
<td>261</td>
<td>693</td>
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<tr>
<td>M</td>
<td>160</td>
<td>59</td>
<td>120</td>
<td>339</td>
</tr>
<tr>
<td>F</td>
<td>142</td>
<td>71</td>
<td>72</td>
<td>285</td>
</tr>
<tr>
<td>Grand Total</td>
<td>881</td>
<td>647</td>
<td>778</td>
<td>2,306</td>
</tr>
</tbody>
</table>

#### Table 2: Meaning of semester1 Variable in Statistical Output

<table>
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<tr>
<th>semester1 Value</th>
<th>Fall 2009</th>
<th>Spring 2010</th>
<th>Spring 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
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<td>0</td>
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</tr>
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<td>2</td>
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<td>2</td>
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</tr>
<tr>
<td>3</td>
<td>0</td>
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#### Table 3: Student Age

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall 2009</th>
<th>Spring 2010</th>
<th>Fall 2010</th>
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<tr>
<td>Control (MA005)</td>
<td>579</td>
<td>517</td>
<td>517</td>
<td>1,613</td>
</tr>
<tr>
<td>17-21</td>
<td>469</td>
<td>344</td>
<td>322</td>
<td>1,135</td>
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<tr>
<td>22-26</td>
<td>322</td>
<td>195</td>
<td>201</td>
<td>718</td>
</tr>
<tr>
<td>27-31</td>
<td>261</td>
<td>130</td>
<td>261</td>
<td>652</td>
</tr>
<tr>
<td>32-36</td>
<td>693</td>
<td>302</td>
<td>130</td>
<td>1,125</td>
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<tr>
<td>37-41</td>
<td>604</td>
<td>142</td>
<td>71</td>
<td>275</td>
</tr>
<tr>
<td>42-46</td>
<td>778</td>
<td>235</td>
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<td>2,306</td>
<td>579</td>
<td>172</td>
<td>3,197</td>
</tr>
<tr>
<td>Grand Total</td>
<td>881</td>
<td>647</td>
<td>778</td>
<td>2,306</td>
</tr>
</tbody>
</table>

#### Table 4: Initial COMPASS Test Scores

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<tr>
<th>Scores</th>
<th>Control</th>
<th>Experimental</th>
<th>Control</th>
<th>Experimental</th>
<th>Control</th>
<th>Experimental</th>
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</thead>
<tbody>
<tr>
<td>COMPASS M1</td>
<td>21.71</td>
<td>26.46</td>
<td>2.71</td>
<td>2.06</td>
<td>1613</td>
<td>693</td>
</tr>
<tr>
<td>COMPASS M2</td>
<td>18.63</td>
<td>20.45</td>
<td>4.16</td>
<td>4.80</td>
<td>1613</td>
<td>693</td>
</tr>
</tbody>
</table>

#### Table 5: Logistic Regression Output for Passing Arithmetic on First Enrollment

```
. logit did_pass_arithmetic initials1_score initials2_score i.course1_en if semester1<3
Logistic regression                               Number of obs   =       2306
LR chi2(3)      =     247.55
Prob > chi2     =     0.0000
Log likelihood = -1452.6269                       Pseudo R2       =     0.0785
```

```
   did_pass_arithmetic |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
----------------------+---------------------------------+------------------
  initials1_score     |  .1251368   .017554     7.13   0.000     .0907316    .1595419
  initials2_score     |   .0584985   .0110389     5.30   0.000     .0368625    .0801344
  1.course1_en        |   .5467034   .1301678     4.20   0.000     .2915792    .8018277
  _cons               |  -3.859068   .4188744    -9.21   0.000    -4.680047   -3.038089
```

#### Table 6: Cross Tabulation Output for Passing Arithmetic on First Enrollment

```
. tab2 course1_en did_pass_first_semester if semester1<3, exact
<table>
<thead>
<tr>
<th>did_pass_first_semester</th>
<th>No</th>
<th>Yes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA005</td>
<td>901</td>
<td>712</td>
<td>1,613</td>
</tr>
<tr>
<td>MA005M</td>
<td>189</td>
<td>504</td>
<td>693</td>
</tr>
<tr>
<td>Total</td>
<td>1,090</td>
<td>1,216</td>
<td>2,306</td>
</tr>
</tbody>
</table>
```

Fisher's exact = 0.000
1-sided Fisher's exact = 0.000

#### Table 7: Logistic Regression Output for Testing at Least Once

```
. logit did_test initials1_score initials2_score i.course1_en if semester1<3
Logistic regression                               Number of obs   =       2306
LR chi2(3)      =     101.20
Prob > chi2     =     0.0000
Log likelihood = -1346.1622                       Pseudo R2       =     0.0362
```

```
   did_test |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
------------------+---------------------------------+------------------+-
  initials1_score  |   .0399709   .0181139     2.21   0.027     .0044682    .0754735
  initials2_score  |   .0295013   .0115562     2.55   0.011     .0070516    .0519509
  1.course1_en     |   .7794594   .1435288     5.43   0.000     .5081551    1.050763
  _cons            |  -3.7949681  .4262577     -1.86   0.062    -1.630418    -0.959516
```

#### Table 8: Cross Tabulation Output for Testing at Least Once

```
. tab2 course1_en did_test if semester1<3, exact
<table>
<thead>
<tr>
<th>did_test</th>
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<th>Total</th>
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</thead>
<tbody>
<tr>
<td>MA005</td>
<td>901</td>
<td>712</td>
<td>1,613</td>
</tr>
<tr>
<td>MA005M</td>
<td>189</td>
<td>504</td>
<td>693</td>
</tr>
<tr>
<td>Total</td>
<td>1,090</td>
<td>1,216</td>
<td>2,306</td>
</tr>
</tbody>
</table>
```

Fisher's exact = 0.000
1-sided Fisher's exact = 0.000

#### Table 9: Logistic Regression Output for Testing at Least Once

```
. logit did_test initials1_score initials2_score i.course1_en if semester1<3
Logistic regression                               Number of obs   =       2306
LR chi2(3)      =     101.20
Prob > chi2     =     0.0000
Log likelihood = -1346.1622                       Pseudo R2       =     0.0362
```

```
   did_test |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
------------------+---------------------------------+------------------+-
  initials1_score  |   .0399709   .0181139     2.21   0.027     .0044682    .0754735
  initials2_score  |   .0295013   .0115562     2.55   0.011     .0070516    .0519509
  1.course1_en     |   .7794594   .1435288     5.43   0.000     .5081551    1.050763
  _cons            |  -3.7949681  .4262577     -1.86   0.062    -1.630418    -0.959516
```

#### Table 10: Cross Tabulation Output for Testing at Least Once

```
. tab2 course1_en did_test if semester1<3, exact
<table>
<thead>
<tr>
<th>did_test</th>
<th>No</th>
<th>Yes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA005</td>
<td>901</td>
<td>712</td>
<td>1,613</td>
</tr>
<tr>
<td>MA005M</td>
<td>189</td>
<td>504</td>
<td>693</td>
</tr>
<tr>
<td>Total</td>
<td>1,090</td>
<td>1,216</td>
<td>2,306</td>
</tr>
</tbody>
</table>
```

Fisher's exact = 0.000
1-sided Fisher's exact = 0.000
Table 9: Cross Tabulation of Enrollment in Algebra

<table>
<thead>
<tr>
<th>course1_en</th>
<th>did_test</th>
<th>No</th>
<th>Yes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA005</td>
<td></td>
<td>565</td>
<td>1,048</td>
<td>1,613</td>
</tr>
<tr>
<td>MA005M</td>
<td></td>
<td>113</td>
<td>580</td>
<td>693</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>678</td>
<td>1,628</td>
<td>2,306</td>
</tr>
</tbody>
</table>

Fisher's exact = 0.000
1-sided Fisher's exact = 0.000

Table 10: Cross Tabulation of Passing Algebra

<table>
<thead>
<tr>
<th>course1_en</th>
<th>did_pass_algebra</th>
<th>No</th>
<th>Yes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA005</td>
<td></td>
<td>934</td>
<td>162</td>
<td>1,096</td>
</tr>
<tr>
<td>MA005M</td>
<td></td>
<td>351</td>
<td>81</td>
<td>432</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1,285</td>
<td>243</td>
<td>1,528</td>
</tr>
</tbody>
</table>

Fisher's exact = 0.062
1-sided Fisher's exact = 0.035

Table 11: Cross Tabulation of Passing Algebra (Fall 2009 students only)

<table>
<thead>
<tr>
<th>course1_en</th>
<th>did_pass_algebra</th>
<th>No</th>
<th>Yes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA005</td>
<td></td>
<td>477</td>
<td>102</td>
<td>579</td>
</tr>
<tr>
<td>MA005M</td>
<td></td>
<td>244</td>
<td>58</td>
<td>302</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>721</td>
<td>160</td>
<td>881</td>
</tr>
</tbody>
</table>

Fisher's exact = 0.581
1-sided Fisher's exact = 0.311

L. Works Cited


