UAB Mathematics Department Technical Report:
Success Rates in Calculus I (MA 125)[1]

Fall 2006 – Spring 2012
Submitted by Data Coordinator William Bond

       This part is a comparison of Freshman vs. Transfer students for students that took MA125 as their first mathematics course at UAB. Grades are coded as:
A = 4, B = 3, C = 2, D =1, F+W = 0.

First term type	N	Mean	Std. Deviation	Std. Error Mean	Significance
Students whose first course was MA125					
Freshman	1115	2.676	1.432	0.043	0.000
Transfer	268	1.545	1.529	0.093	

       Levene's Test at level of .000 indicates that we must use the "equal variances not assumed" statistical results. An independent t test for students whose first math course at UAB was MA125 shows that freshman score significantly better than transfer students at the significance of .000 (alpha = .05).

Descriptive statistics for students whose first course was MA125					
1st Grade in MA125 for students whose 1st course was MA 125					
Grade	F+W	D	C	B	A	Total
Freshman	190	22	175	300	428	1115
Transfer	119	12	41	64	32	268
Total	309	34	216	364	460	1383
Percentages for 1st Grade in MA125 for students whose 1st course was 125					
Grade	F+W	D	C	B	A	Total
Freshman	17.0	2.0	15.7	26.9	38.4	100.0
Transfer	44.4	4.5	15.3	23.9	11.9	100.0

       The following is a look at how students' scores in MA125 compared according to whether their first math course at UAB was MA125 or some course lower than MA125. (This is later broken down further, by exactly which course students started in first and whether or not students were transfer students or freshman)

First course at UAB	N	Mean	Std. Deviation	Std. Error Mean	Significance
Combined transfer student and freshman					
Not MA125	1211	1.739	1.53568	0.04413	0.000
MA125	1383	2.457	1.51815	0.04082	

---

[1] Thanks to UAB Office of Enrollment Management for raw student data.

Levene's Test at a level of .009 indicates that we must use the "equal variance not assumed" statistical results. We find that students who start in MA125 score significantly better than students who have started at a lower course at UAB with a significance of .000 (alpha = .05).

Comparison of Student Grades in MA125 for transfer students and freshman combined based on students first math course at UAB

Levene's test for each of the following indicates we may assume the variances are equal. Each of the following was statistically significant at the .000 significance level. Students who start in MA125 score significantly better in MA125 than student who started at a lower UAB math course. It should be noted that there is a trend that the higher the course students start in, the higher the mean in MA125.

MA125 scores for freshman and transfer students based first math course at UAB						
First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance
125	1383	2.457	1.51815	0.04082	0.191	0.000
98	131	1.0382	1.35536	0.11842		

First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance
125	1383	2.457	1.51815	0.04082	0.75	0.000
102	220	1.4636	1.4314	0.0965		

First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance
125	1383	2.457	1.51815	0.04082	0.26	0.000
105	349	1.8768	1.53849	0.08235		

First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance
125	1383	2.457	1.51815	0.04082	0.057	0.000
106	296	1.9459	1.58503	0.09213		

Levene's test for the MA125 vs MA107 as a first course indicates that we cannot assume the variances are equal. There is a significant difference with a significance level of .035.

First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance
125	1383	2.4570	1.51815	.04082	0.042	0.000
107	140	2.1929	1.39318	.11775		

William Bond   1/7/2013

The following table is a look at comparisons for students who started at different levels of math at UAB for Freshman ONLY. The graph that follows shows the descriptive statistics for students who started in 105, 107, 106, and 125 for freshman only.

Comparison of scores in MA125 based on first math course at UAB for Freshman						
First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance level
125	1115	2.6762	1.43191	0.04288	0.554	0.000
98	101	0.9307	1.28263	0.12763		

First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance level
125	1115	2.6762	1.43191	0.04288	0.101	0.000
102	204	1.4265	1.42098	0.09949		

First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance level
125	1115	2.6762	1.43191	0.04288	0.005	0.000
105	299	1.9766	1.54011	0.08907		

First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance level
125	1115	2.6762	1.43191	0.04288	0.326	0.326
107	118	2.2034	1.33691	0.12307		

First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance level
125	1115	2.6762	1.43191	0.04288	0.778	0.836
106	128	2.6484	1.45586	0.12868		
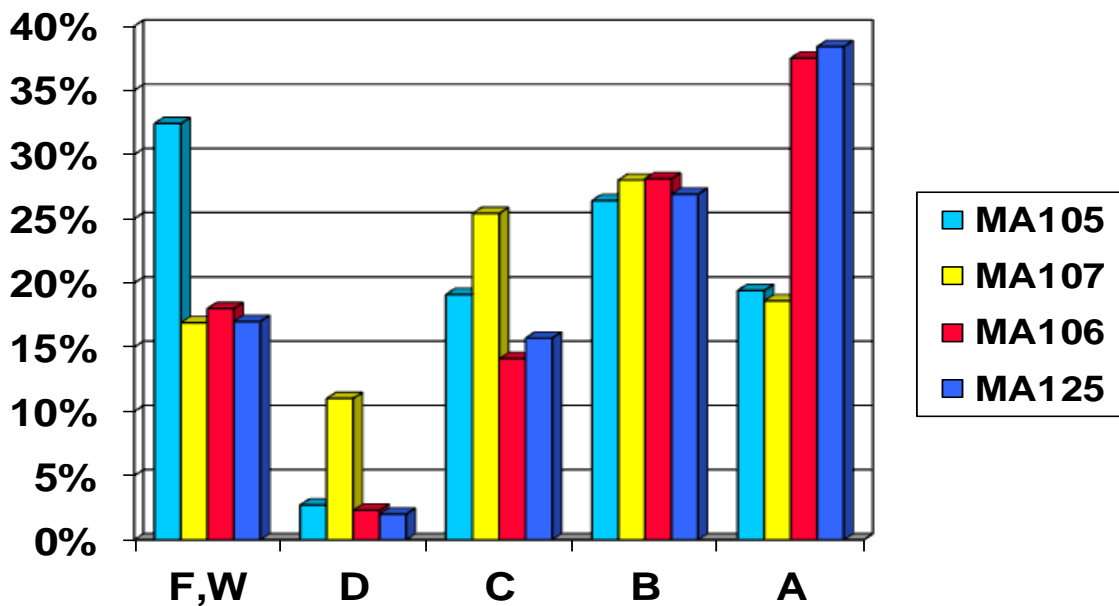
Several interesting conclusions can be drawn from the preceding table. One thing to notice is the general trend that means of student scores in MA125 based on what level math course was first taken at UAB goes up as the level of their first course goes up. That is to say that students who place into MA098 as their first course are the least likely to succeed in MA125 and students placing into MA106 are the most likely (of students who don't place into MA125 directly).

As it turns out , there is a significant difference in MA125 scores only for the groups of students whose first course was MA098, MA102, or MA105 when compared to students placing directly into calculus (as seen above). This means that while students who take MA106 first perform statistically significantly better in MA125 than students who take MA107 first (as seen in table below under 106 vs. 107), that both of these groups are indistinguishable from students whose first course was MA125. Looking at the above information we see that students who take MA106 or MA107 first are actually being remediated to a level that puts them on par with students who place directly into calculus, a good sign for the UAB mathematics department.

The following table is a look at comparisons between groups of students whose first course was not MA125. There is a significant difference for both the comparison between MA105 and MA106, and that of the comparison between MA107 and MA106. Recall though that both groups of students who took MA106 or MA107 first were indistinguishable from students who placed directly into MA125. There was no significant difference for the MA105, MA107 comparison.

Comparison of scores in MA125 based on first math course at UAB for Freshman						
First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance level
105	299	1.9766	1.54011	0.08907	0.133	0.000
106	128	2.6484	1.45586	0.12868		

First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance level
105	299	1.9766	1.54011	0.08907	0.008	0.137
107	118	2.2034	1.33691	0.12307		

First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance level
106	128	2.6484	1.45586	0.12868	0.328	0.013
107	118	2.2034	1.33691	0.12307		

The following table shows the results from running a non-parametric test on the above data. The levels of significance agree with the independent t-test run. There is no significant difference between 105 and 107, but there is a significant difference between 105 and 106 and between 106 and 107.

Freshman -- Mann-Whitney					
First MA course	N	Mean Rank	Sum of ranks	Asymp. Sig. (2-tailed)	Mann-Whitney U
105	299	197.61	59086.5	0.000	14236.5
106	128	252.28	32291.5		

First MA course	N	Mean Rank	Sum of ranks	Asymp. Sig. (2-tailed)	Mann-Whitney U
105	299	204.86	61254.5	0.251	16404.5
107	118	219.48	25898.5		

First MA course	N	Mean Rank	Sum of ranks	Asymp. Sig. (2-tailed)	Mann-Whitney U
106	128	136.15	17427.5	0.003	5932.5
107	118	109.78	12953.5		

If there is going to be some course revision for pre-calculus, one can argue that we should first be looking into the MA105 course. As we move lower in courses from calculus, students who start in MA105 first are the first group to score significantly lower in MA125 than students whose first course was MA125. This is the group that has the highest of the means of all the groups that are significantly different in scores from students who start in MA125, and as such stands the best chance of success if we can improve their pre-calculus learning.

Weakest of the Strong versus Strongest of the Weak

In the following table we make some of the same comparisons as above, but this time only with freshman whose ACT math sub-score was a 27 or lower. That is to say, the following is a comparison of different groups based on their first math course at UAB to the weaker group of students who placed directly into calculus. This gives us some insight into whether our classes MA105, MA106, and MA107 are at least catching students up to the weaker group of students that placed directly in MA125.

Only Freshman whose ACT was 27 or lower

First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance level
125	525	2.3467	1.44023	0.06286	0.135	0.001
105	265	1.9736	1.51609	0.09313		

First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance level
125	525	2.3467	1.44023	0.06286	0.368	0.728
106	89	2.4045	1.51297	0.16037		

First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance level
125	525	2.3467	1.44023	0.06286	0.025	0.229
107	106	2.1792	1.2709	0.12344		

   From the table directly above we see that when we consider only students whose ACT math sub-score was 27 or lower that we get the same results with respect to MA105, MA106, and MA107. It is still the case that there is a statistically significant difference in students who start in MA105 when compared to students whose first course was MA125, and there still is no significant difference when we look at students whose first course was MA106 or MA107 when compared to students starting in MA125. (This makes sense since if there was no difference between first course MA106 and MA107 students against first course MA125 students respectively when the stronger students were included, i.e. students with ACT above 27, then there should not be any difference when we take the stronger students out.) The check above was really to see if we look at the weaker of the students starting in calculus compared to students starting in MA105 if there would be a difference. It turns out there still is a significant difference, giving even more credence to the idea that students starting in MA105 really are scoring lower when they get to calculus. If our goal is to get more students through calculus, then the group of students starting in MA105 is the group that needs attention first.

Comparison of MA125 Grade Distribution Based on First UAB Math Course for Freshman With a 27 or Less on ACT Math Sub-score

William Bond

1/7/2013
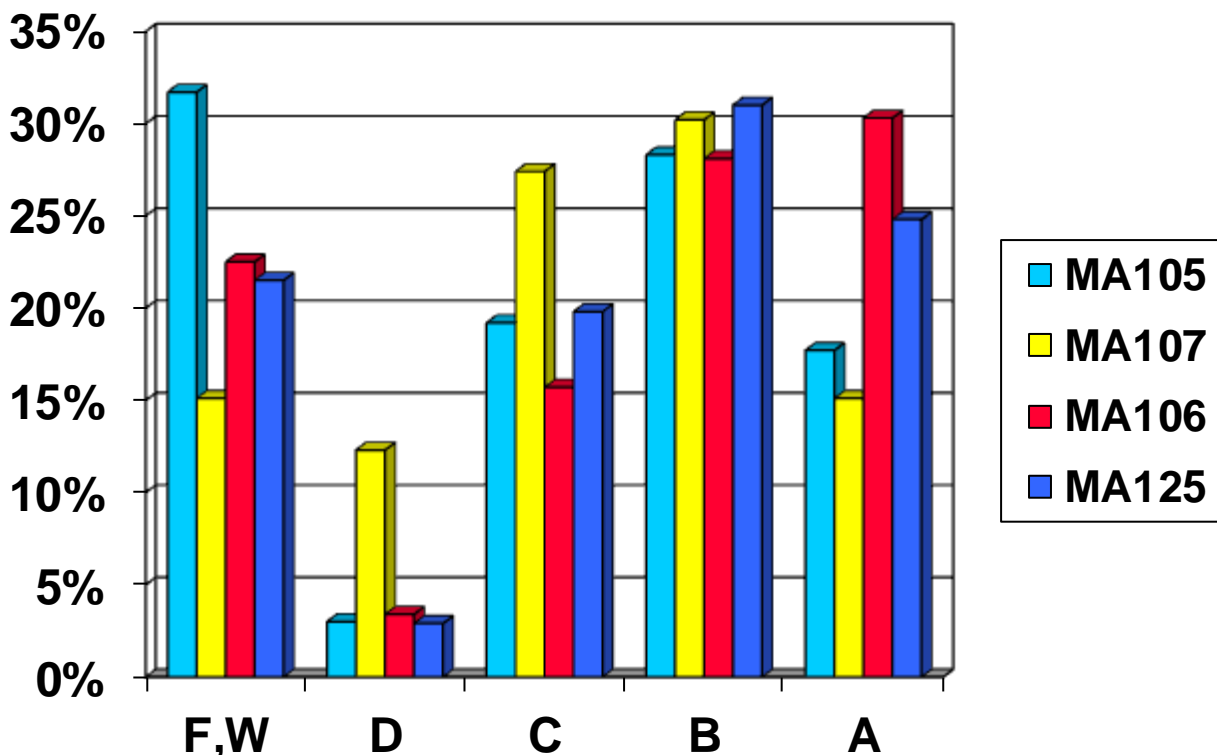
The following table is the results from running a non-parametric statistical test for students in 105, 107, and 106 compared with students who first took 125. There is still not a statistically significant difference between students who start in 106 or 107 vs 125, and there still is a statistically significant difference between students who start in 105 and those who start in 125.

Freshman and ACT less than or equal to 27 - Mann-Whitney					
First MA course	N	Mean Rank	Sum of ranks	Asymp. Sig. (2-tailed)	Mann-Whitney U
125	525	413.67	217177.5	0.001	60022.5
105	265	359.5	95267.5		

First MA course	N	Mean Rank	Sum of ranks	Asymp. Sig. (2-tailed)	Mann-Whitney U
125	525	321.22	168642.5	0.098	25082.5
107	106	290.13	30753.5		

First MA course	N	Mean Rank	Sum of ranks	Asymp. Sig. (2-tailed)	Mann-Whitney U
125	525	305.77	160531	0.545	22456
106	89	317.69	28274		

The following table is a look at comparisons of student grades in MA125 based on their first math course at UAB for transfer students ONLY.

Comparisons of MA125 grades based on first math course at UAB for Transfer students only						
First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance level
125	268	1.5448	1.52932	0.09342	0.849	0.624
98	30	1.4	1.54474	0.28203		

First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance level
125	268	1.5448	1.52932	0.09342	0.162	0.319
102	16	1.9375	1.52616	0.38154		

First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance level
125	268	1.5448	1.52932	0.09342	0.28	0.256
105	50	1.28	1.40029	0.19803		

First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance level
125	268	1.5448	1.52932	0.09342	0.533	0.085
107	22	2.1364	1.69861	0.36215		

First MA course	N	Mean	Std. Deviation	Std. Error Mean	Levene's test	Significance level
125	268	1.5448	1.52932	0.09342	0.227	0.366
106	168	1.4107	1.46957	0.11338		

The preceding table is for transfer students only. The first thing to note is that Levene's test indicates that we may assume that the variances are equal for each of the comparisons. The next thing to note is that there are no significant differences for scores in MA125 between any students when grouped by their first course taken (though students starting in MA107 are close with a significance level of .085). On the face of it this seems very odd, but after careful consideration of some of our previous tables it makes sense. Transfer students as a group have a mean score in their first attempt at MA125 of 1.5018 with a standard deviation of 1.51307. This produces a floor effect when we do comparisons among groups of transfer students, since they are all quite close to the bottom. Another factor that plays a large role is that there are so many less students in each of the above comparisons than we had with first time freshman. Since the statistical significance is based on a difference of means **and** the size of the population, we have a problem with the low numbers of students in some of the preceding categories for transfers.

Since this is really a document about how students do in MA125, I've run a graph comparing the entire group of students who got right into MA125 with the group of students who got right into MA125 but had an ACT of 27 or lower. The graph is below.

Grade distributions for MA125 grades for freshman who placed directly into calculus: comparing the group as a whole to the subset whose math ACT was 27 or less.
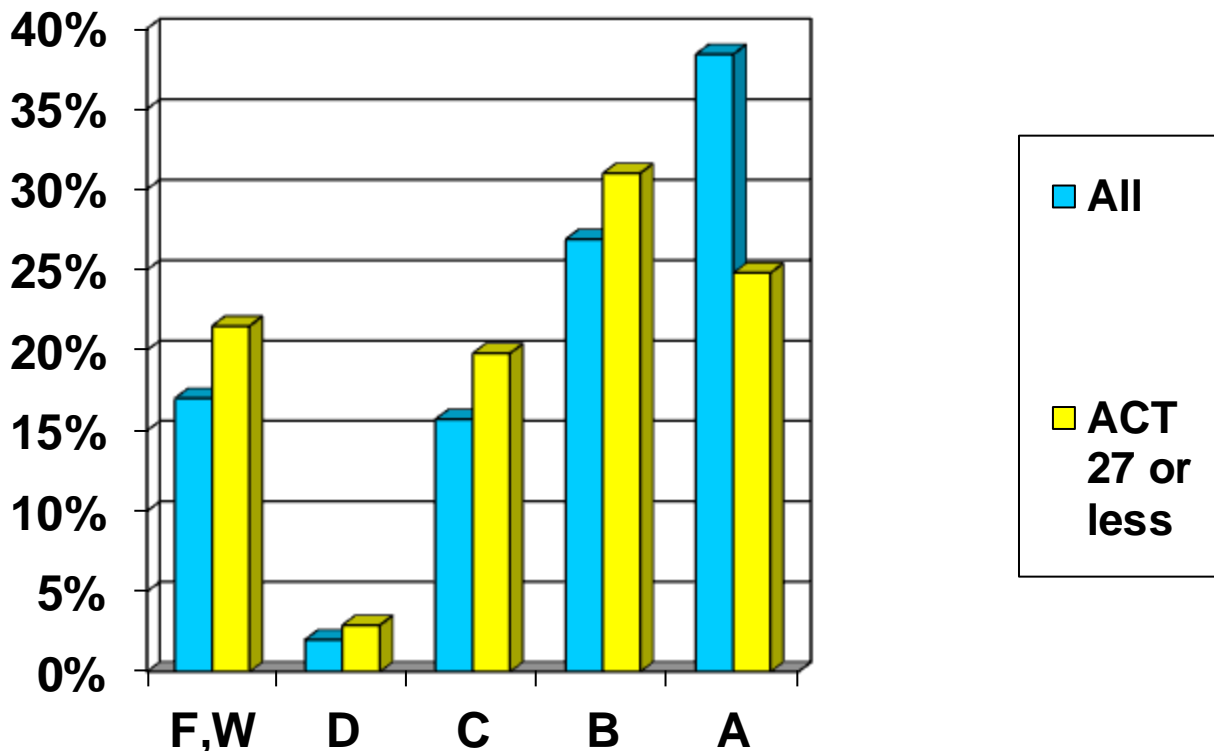
Keeping in mind that the group of students' whose first course in math at UAB is MA105 is the group with the highest mean of all groups scoring significantly lower than students starting in MA125, the following table is a closer look at students who start in MA105. The students' who start in MA105 have been broken into four groups based on their ACT math sub-scores. These groups are students with the following ACT math sub-score: 22, 23, 24, and 25. Each of these groups has been compared to the group of students whose first course was MA125. The following tables use both freshman and transfer students.

Grades in MA 125 for Freshman whose 1st course was MA125 and ACT was 27 or less vs. students whose first course was MA105 and ACT was 22					
First UAB Math	N	Mean	Std. Deviation	Std. Error Mean	Significance
125	525	2.3467	1.44023	0.06286	0.068
105	32	1.7813	1.66044	0.29353	

Grades in MA 125 for Freshman whose 1st course was MA125 and ACT was 27 or less vs. students whose first course was MA105 and ACT was 23					
First UAB Math	N	Mean	Std. Deviation	Std. Error Mean	Significance
125	525	2.3467	1.44023	0.06286	0.005
105	70	1.8286	1.42413	0.17022	

Grades in MA 125 for Freshman whose 1st course was MA125 and ACT was 27 or less vs. students whose first course was MA105 and ACT was 24					
First UAB Math	N	Mean	Std. Deviation	Std. Error Mean	Significance
125	525	2.3467	1.44023	0.06286	0.901
105	71	2.3239	1.48107	0.17577	

Grades in MA 125 for Freshman whose 1st course was MA125 and ACT was 27 or less vs. students whose first course was MA105 and ACT was 25					
First UAB Math	N	Mean	Std. Deviation	Std. Error Mean	Significance
125	525	2.3467	1.44023	0.06286	0.002
105	41	1.6098	1.53098	0.2391	

We see that for students whose first course was MA105 and who had an ACT math sub-score of 22 that their mean in MA125 was lower than students who had an ACT math sub-score of 23, which in turn was lower than those that had a math sub-score of 24. Oddly, the table shows that the group of students whose first course was MA105 and had an ACT math sub-score of 25 had the lowest mean of all of these four groups in MA125.