AC 2007-58: PREDICTING STUDENT SUCCESS IN CALCULUS

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Predicting Student Success in Calculus I

Abstract

Five years ago Louisiana Tech University began using a web-based tutorial program, ALEKS, in an effort to provide more effective mathematics tutoring for its students. Results on performance indicate that, for students in Math 240 (our Calculus I), strong student use of ALEKS highly correlates with student retention and success. Students are placed into Calculus I based on their Math ACT score, although there are always students whose Math ACT scores and success in Calculus I do not correlate well. Students are permitted to take the ACT multiple times and use their highest score for placement. Because our state implemented high-stakes standardized testing seven years ago in the public school system for 3rd through 12th grades, many students are now approaching the ACT with a substantial amount of long-term training and practice in taking standardized tests. Therefore, we wanted to investigate whether or not the Math ACT score is still a sufficiently accurate method of placement into Calculus I. In a preliminary study, we examined whether or not the Math ACT accurately reflects student preparedness for calculus. This study looks at student performance on the initial ALEKS assessment and total hours spent using ALEKS during the term to see if these might be more accurate predictors of student success in Calculus I than the Math ACT or if they, together with the Math ACT, might be more reliable than the Math ACT data alone. Statistical analysis of the data indicates that the best predictor is the combination of Math ACT score, interaction between initial ALEKS assessment score and total hours of ALEKS usage, and the quadratic effect of Math ACT. Together, however, these account for only about half of the variability seen in course grade in Calculus I, indicating that other factors have a strong effect on student success in Calculus I. The data also suggests that there is a slightly negative relationship between Math ACT score and total hours spent using ALEKS during the term. That is, students with higher Math ACT scores spend slightly less time using ALEKS. This could be caused by a lower perceived need for assistance among students with higher Math ACT scores.

Background

Five years ago the Mathematics Program at Louisiana Tech University began using a web-based tutorial program marketed by McGraw-Hill entitled ALEKS (Assessment and LEarning in Knowledge Spaces)[1] in an effort to provide a more effective mathematics tutoring program for our students. The goals were to 1) increase student retention and success in freshman and sophomore-level mathematics courses (such as calculus, which all engineering majors take), and 2) increase the willingness of students to utilize the available tutorial services. Note that "student success" is defined as "making an "A", "B" or "C" in the course" (since all engineering and science majors are required to earn a grade of "C" or higher in all math courses which are prerequisites for other courses).

ALEKS is a web-based system (versus software-based) that can be accessed from any computer with web access and a java-enabled web browser. The ALEKS syllabus for each course is aligned with the actual content of the syllabus for the corresponding course at our university. Students who purchase an ALEKS access code and are provided a course code by the instructor of their mathematics class can then access the ALEKS program for that course via the internet

from any computer 24 hours a day for the entire term. After completing the initial log-on process, students are required to take an initial assessment in ALEKS to determine their level of concept mastery. All work in ALEKS requires that the student work the problem and enter the resulting solutions. There are no multiple-choice or true-false questions. This initial assessment measures both mastery of prerequisite material and course content for the course in which the student is enrolled. Based on the student's performance on the initial assessment, ALEKS provides online tutorial instruction and associated practice problems (called Learning Mode) that start "where the student is" and work toward student mastery of the course syllabus. Periodically, ALEKS will have the student complete a new assessment (of both prerequisite material and course content) in order to maintain an accurate evaluation of that student's needs and abilities. ALEKS provides a detailed progress history for each student, which includes hours spent using ALEKS and percent of content covered on both prerequisite material and course content, at any time.

ALEKS is a mandatory component of the course for every student who enrolls in Math 240-241, "Mathematics for Engineering and Science I & II" (our Calculus I and II courses). We encourage students to spend at least 3 hours *and* make at least 6% progress on ALEKS outside of class each week. Each instructor has some discretion as to how the ALEKS grade counts toward the class grade. Data on student performance indicates that strong student use of ALEKS in Math 240 does highly correlate with both student retention and success, not only in Calculus I and Calculus II, but throughout the entire freshman-sophomore calculus and differential equations sequence[2]. A working theory is that some of this behavior may be attributable to the fact that mathematically stronger and/or mature students, who would have likely been successful even without ALEKS, are the ones taking advantage of the opportunity to boost their skills via ALEKS. Data also indicates that students are using ALEKS in far greater numbers (approximately 1500 students per term for all mathematics courses at the level of calculus and below) than any other tutorial program we have ever had at our university, including come-and-go tutoring sessions and the more formal Supplemental Instruction program (both of which averaged 10 – 20 students per day *total* from all lower-level mathematics courses, including calculus). We now have students using ALEKS almost 24 hours per day, 7 days per week (the only time we see very few students logged on is between 4:00 a.m. and 6:00 a.m.).[2]

Predicting Student Preparedness for Calculus

In order to be eligible to enroll in Math 240, our Calculus I, a student must either i) have at least a Math ACT of 26 or higher; ii) pass the Math 240 Credit Exam, or iii) successfully complete Math 101, College Algebra, with a grade of "C" or higher. The vast majority of students satisfy either criteria i) or iii). Students who successfully complete College Algebra are usually encouraged to take Math 112, Trigonometry, prior to enrolling in Math 240, although it is not at present a requirement. It has been our observation that students who first take trigonometry are more likely to be successful in calculus than those who go directly from college algebra to calculus.

Approximately eight years ago, our department determined the current Math ACT cut-off score of 26 by looking at the previous five years of data on students, their Math ACT score, and their success in their first college math course (again, success here is defined as making a "C" or

higher). A majority of students with a Math ACT of 26 or higher were able to successfully complete Math 240 on their first try. It has been observed, however, that students with a Math ACT of 24 – 25 often do better in Math 240 (after first having successfully completed College Algebra and perhaps Trigonometry also) than those with a Math ACT of 26-27. This is likely due to the fact that the Math 24-25 group have stronger algebra and trigonometry skills by virtue of having taken these courses prior to taking Calculus I.

Students are allowed to re-take the ACT multiple times and are allowed to use their highest Math ACT score for math placement. Anecdotal feedback from students suggests that some students may take the ACT and spend all of their time on the mathematics portion of the ACT in an effort to improve their Math ACT score. Third party prep courses and materials are also available to help students increase their scores. Perusing student ACT data from Fall 2005 revealed students with as much as a 5-point difference in Math ACT scores from one test attempt to the next, although most fluctuations were at most 1 or 2 points. At our university, as at most, scholarships, admittance to the honors program, etc., depend, at least in part, on ACT scores. Studies have shown that short-term programs and training only boost the Math ACT score by 0 to 0.4 point, on average.[3] Studies have also shown that additional instruction (such as taking another mathematics course) is the most effective way to increase test scores, such as the ACT.[4]

Starting in 1999, our state (from which the majority of our students come) implemented a comprehensive accountability program in which standardized tests linked to the state assessment standards play a major role. High stakes standardized tests (equivalent to the National Assessment of Education Progress or NAEP tests) in 4^{th}, 8^{th}, 10^{th} and 11th grades determine whether students are allowed to matriculate to the next grade. In 3^{rd}, 5^{th}, 6^{th}, 7^{th} and 9^{th} grades, the state administers the IOWA Tests as the state's norm-referenced tests. The NAEP-equivalent and IOWA test scores constitute 90% of each public school's annual performance score (SPS). An SPS of below 30 or failure to reach a biannual SPS growth target together with an SPS of below 100 automatically triggers progressively more intense levels of corrective action for the school. Schools that meet their growth targets and show improvement in scores of students classified as coming from high poverty backgrounds are eligible for monetary rewards and recognition[5]. Consequently, the public schools must devote time and attention to preparing students to take and perform their best on these standardized tests. Whether or not this prolonged emphasis and training from 3^{rd} – 12^{th} grade affects performance on the standardized tests, such as the ACT and SAT, is not known.

There are always students whose Math ACT score and performance in Calculus I do not correlate. This has led faculty to question whether or not the number of these students has climbed in the last two to three years because of the combined effect of students taking the ACT multiple times and the long-term emphasis and training on standardized tests in the public school system.

A Comparison of Math ACT Scores, ALEKS Initial Assessments and Course Grades

Previously, we examined whether or not the Math ACT accurately reflects student *preparedness* for calculus. First, we compared the ALEKS initial assessment and course grade. The results showed that students with an initial ALEKS assessment score between 20 and 28 (out of 100,

with 28 being the highest score) had significantly higher course grades than those with an initial ALEKS assessment score of 11 and below (again, out of 100). That is, those students with a higher initial ALEKS assessment score earned higher grades in the class. Next, we compared Math ACT score and ALEKS initial assessment score. The data indicated that a high Math ACT did correlate with a high initial ALEKS assessment score. However, it showed that the Math ACT is not a good predictor for the initial ALEKS assessment score. Namely, the *only* statistically significant difference in initial ALEKS assessment scores were between those students with a Math ACT score of over 32 (out of 36) and those students with a Math ACT score of 14 to 18 (again, out of 36). Consequently, this data suggests that the Math ACT is not as clear an indicator of *preparedness* as the initial ALEKS assessment score.

This study looks at student performance on the initial ALEKS assessment and total hours spent using ALEKS during the term to see if these might be more accurate predictors of student *success* in Calculus I than the Math ACT or if they, together with the Math ACT, might be more reliable than the Math ACT data alone.

Data Analysis

Data from 260 Calculus I students from Fall 2005 were examined. For each student, the following data was collected: Math ACT score, total number of hours they spent using ALEKS during the fall term, initial ALEKS assessment score and numerical final grade for the course. (see tables in Appendix for complete list of data).

The data was analyzed using linear and multiple regression to determine if the Math ACT score, initial ALEKS assessment score and/or the total hours of ALEKS usage during the term might be reliable predictors of success in Calculus I. Pearson Correlation Coefficients were calculated to determine the relative strength of the linear relationship between these quantities and numerical course grade in Calculus I. Note that here "success" is defined as making a letter grade of "C" or higher in the course, since that is the prerequisite requirement for matriculation to Calculus II.

The first test was a simple linear regression with one predictor variable (Math ACT score, initial ALEKS assessment or total hours of ALEKS usage) versus numerical course grade in Calculus I. Based on the results of the analysis, all three R-*square* values are similar and small, ranging from a high of 0.2221 for the initial ALEKS assessment score to 0.1262 for the total hours of ALEKS usage to a low of 0.0642 for the Math ACT score. All three predictors were statistically significant for the model, with a p-value of less than 0.0001. The low R-*square* values, however, indicate that none of Math ACT, initial ALEKS assessment score or total hours of ALEKS usage alone is a good predictor of numerical course grade in Calculus I. Other significant factors contribute a substantial portion of the variability in numerical course grade in Calculus I.

A multiple regression analysis was run to examine the relationship between Math ACT score, total number of hours spent using ALEKS, and initial ALEKS assessment score and their factor interactions with numerical course grade in Calculus I to determine if a combination of factors might be good predicators of numerical course grade. A full quadratic model was used, with both Stepwise and Backward elimination to determine the subset of significant predictors. For each student we recorded the Math ACT score (coded as variable X3), the total number on hours

using ALEKS (coded as variable X1) and the initial ALEKS assessment scores (coded as variable X2). The full quadratic model considered all the main effects (linear terms), X1, X2, X3; their interactions (X1X2, X1X3, X2X3), as well as the quadratic terms (X1X1, X2X2, X3X3). The backward elimination tested for significance of explanatory variables by starting with the full quadratic model and eliminating, in succession, the variables with the highest p-value for the test of significance of the variable, conditioned on the p-value being bigger than a pre-determined level. With the stepwise regression procedure, each time a new variable was removed from the model, the significance of each of the variables still in the model was re-examined. In addition, a model was fit relating numerical course grade and Math ACT score, hours using ALEKS and initial ALEKS assessment score.

The full model with Stepwise elimination method indicated that Math ACT (p-value=0.0041), interaction between initial ALEKS assessment and total hours of ALEKS usage (p-value < 0.0001) and the quadratic effect of Math ACT (p-value < 0.0001) were the most significant factors. However, the R-*square* value for this model was only 0.3950 (all variables significant at the 5% level), indicating that a significant amount of variability in numerical course grade is not accounted for by these variables.

For the multiple regression analysis using the full model with Backward elimination and a 5% level of significance, the variables whose regression were significant were Math ACT, initial ALEKS assessment, total hours of ALEKS usage and the quadratic effect of the Math ACT score. The R-*square* value for this model was again only 0.4107, indicating that more than half of the variability in numerical course grade is not accounted for by these factors.

The multiple regressions analysis using the three predictors of Math ACT score, initial ALEKS assessment and total hours of ALEKS usage indicated that all three-variables were significant at the 5% level, with total hours of ALEKS usage having a p-value < 0.0001, initial ALEKS assessment score a p-value < 0.0001 and Math ACT a p-value <0.0046. The R-*square* however was only 0.36, again indicating that this model does not account for most of the variability in numerical course grade in Calculus I.

The next analysis took the last 50 observations in our study and ran a multiple regression for the three models (the model suggested by the Stepwise elimination regression, the Backward elimination regression and the multiple regression with Math ACT, total hours spent on ALEKS and initial ALEKS assessment score as predictors) to determine if the models were good *predictors* of the observations. The residual sum of squares and R-*square* values were used to decide which model was the best fit for the data.

For the model obtained from the Stepwise elimination method we obtained SSE= 2968.725 and R-*square* 0.4969, for the model obtained from the Backward method we obtained SSE= 3098.411 and R-*square* = 0.4749, and for the model with the three predictors we obtained SSE= 3661.151 and R-*square* = 0.3795**.** Consequently, the Stepwise elimination method (with the Math ACT score, the factor interaction between the total number of hours spent on ALEKS with the Math ACT score and the quadratic effect of the Math ACT score) was the best fit, predicting 49.7% of the variability in the numerical course grades using this quadratic model.. Since the R-*square* value for the Backward model is very close to that of the Stepwise model, it is a good

alternate. Again, it only predicts 47.5% of the variability in the numerical course grades. These R-*square* values again indicated that these models account for only about half of the variability seen in numerical course grades in Calculus I.

The last analysis of the data was determining the Pearson Correlation Coefficients, which measure the strength and direction of the linear relationship between variables. The correlation between total hours spent on ALEKS and initial ALEKS assessment had a value of 0.19813, which indicates a very weak correlation. That is, we can't guess how many hours a student spends on ALEKS during the term based only on their ALEKS initial assessment score. The correlation between initial ALEKS assessment score and Math ACT score was 0.27045, which is again a weak correlation. Again, we can't guess the student's score on the initial ALEKS assessment given their Math ACT score. Lastly, the correlation between total hours spent on ALEKS and Math ACT score had a value of -0.02958, which is a negative weak correlation. This means that we can't guess how many hours a student will spend on ALEKS during the term given their Math ACT score. In addition, the negative correlation indicates that students with higher Math ACT scores tend to spend slightly less time using ALEKS during the term.

Conclusion

This study looks at student performance on the initial ALEKS assessment and total hours spent using ALEKS during the term to see if these might be more accurate predictors of student success in Calculus I than the Math ACT or if they, together with the Math ACT, might be more reliable than the Math ACT data alone. Statistical analysis of the data showed that the best predictor of student success in Calculus I is the combination of the student's Math ACT score, the interaction between their initial ALEKS assessment score and the total hours of ALEKS usage during the term, along with the quadratic effect of Math ACT. At best, these account for only about half of the variability seen in course grade in Calculus I, indicating that other factors have a strong effect on student success in Calculus I. Given the strong relationship between ALEKS usage and success in Calculus I and the relationship between initial ALEKS assessment scores and preparedness for calculus, these results are disappointing. However, the course content on ALEKS does not include topics from the calculus course itself, but rather covers prerequisite topics in algebra and trigonometry. This may explain why it is not a strong predictor of success in calculus.

The data also suggests that there is a slightly negative relationship between a student's Math ACT score and the total number of hours they spent using ALEKS during the term. That is, a student with higher a student's Math ACT score is likely to spend slightly less time using ALEKS. A lower perceived need for assistance among students with higher Math ACT scores might be a contributing factor to this observation.

In conclusion, it does not appear that incorporating the initial ALEKS assessment score into the Math Placement procedure would serve to substantially improve student placement (and success) in Calculus I. Further studies could examine different courses, such as college algebra, where ALEKS content duplicates actual course content to determine if initial ALEKS assessment scores could improve student placement (and success) in these courses.

Bibliography

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Appendix

Data from 260 Calculus I students from Fall 2005 were examined. For each student, the following data was collected: Math ACT score, total number of hours they spent using ALEKS during the fall term, initial ALEKS assessment score and numerical final grade for the course. For purposes of presentation here, the following five tables group the data by course letter grade, although that information was not used in this analysis, since grading scales differ from instructor to instructor. Note that students in Table 6 dropped the course and received a grade of "W". Consequently, not all data is available for these students who did not complete the term.

Student #	Total Hours Spent using ALEKS	Initial ALEKS Assessment Score	Math ACT Score	Numerical Course Grade	Student #	Total Hours Spent using ALEKS	Initial ALEKS Assessment Score	Math ACT Score	Numerical Course Grade
3	9.7	22	29	98	141	32	21	28	96
5	23.3	23	33	95	150	20.1	15	30	91
13	42.1	22	31	92	154	28.2	21	31	95
29	30.4	20	33	94	155	30.3	23	31	91
34	26.1	9	29	89	156	25.2	20	21	91
39	24.8	19	28	92	163	30.4	23	32	102
43	33.3	18	29	96	164	25.4	23	0	90
47	33	28	27	96	168	24.8	18	29	91
51	26.5	25	35	97	175	26	23	29	95
61	26.5	15	32	93	176	5.9	18	30	95
71	26.2	19	28	96	177	21	19	28	89
75	24.8	19	30	90	178	22.8	9	24	96
78	25	19	0	89	188	27	20	26	89
79	31.4	10	31	95	198	24.4	21	28	88
84	34.3	15	31	91	203	16.7	13	27	92
85	24.9	16	29	93	216	24.1	18	35	96
89	24.7	13	27	94	221	29.2	23	28	98
95	25.2	15	28	95	222	24.3	21	27	91
97	26.2	22	33	98	227	16.8	17	33	92

Student #	Total Hours Spent using ALEKS	Initial ALEKS Assessment Score	Math ACT Score	Numerical Course Grade	Student #	Total Hours Spent using ALEKS	Initial ALEKS Assessment Score	Math ACT Score	Numerical Course Grade
99	24.1	18	32	93	230	0.5		28	91
106	24.4	18	32	89	232	25.5	13	26	94
116	32.2	19	30	95	245	25.3	18	32	98
117	26.6	15	0	91	249	42	17	29	91
128	3.4	23	36	91	251	21.2	10	28	90
129	23.3	19	33	95	252	24.6	9	28	94
135	29.3	15	31	92	257	23	22	25	95

Table 1 – Total Hours Spent using ALEKS, Initial ALEKS Assessment Score, Math ACT Score, and Numerical Calculus I Course Grade for Fall 2005 Calculus I students with Course Letter Grade of A

Student #	Total Hours Spent using ALEKS	Initial ALEKS Assessment Score	Math ACT Score	Numerical Course Grade	Student #	Total Hours Spent using ALEKS	Initial ALEKS Assessment Score	Math ACT Score	Numerical Course Grade
7	53.5	7	30	82	132	25	17	29	84
8	22.9	15	32	84	134	24.3	20	29	82
11	20.2	25	23	85	142	11.7	15	27	86
16	25	14	27	85	145	24.5	16	26	79
21	23.2	12	26	81	149	26.2	15	26	80
25	28.6	1	0	85	152	26.4	23	28	87
27	21.1	19	27	81	153	27.8	17	35	80
31	28.1	5	27	83	160	28.5	9	32	80
32	32.2	7	27	83	165	23	17	28	87
44	17.6	10	30	80	172	14.2	10	23	80
54	36.2	21	29	84	183	28.2	5	27	89
56	24.8	15	28	88	184	13.3	8	26	79
62	24.5	10	19	81	185	25.2	15	28	85
66	2.5	18	26	81	186	24.6	15	26	82
70	31.9	22	28	84	189	22.1	13	31	89
74	28.2	18	26	81	191	24	17	27	84
80	26.8	15	28	87	196	22.8	9	28	84
82	16.7	16	0	84	200	16.8	5	27	80
96	2.6	20	29	94	202	25.2	19	34	82
103	11	9	31	82	205	25	6	27	87
107	25.1	22	24	80	208	40.1	19	0	85
108	31.9	9	31	87	209	15.7	19	26	87
110	29.4	11	28	85	218	23.4	12	28	83

Student #	Total Hours Spent using ALEKS	Initial ALEKS Assessment Score	Math ACT Score	Numerical Course Grade	Student #	Total Hours Spent using ALEKS	Initial ALEKS Assessment Score	Math ACT Score	Numerical Course Grade
113	2.1		33	84	223	23.1	15	29	86
120	17.3	27	25	86	231	32.5	21	0	87
123	28.6	21	30	86	236	25.1	5	29	80
131	25.1	23	25	86	239	27	20	29	84
					253	25.6	21	28	80

Table 2 – Total Hours Spent using ALEKS, Initial ALEKS Assessment Score, Math ACT Score, and Numerical Calculus I Course Grade for Fall 2005 Calculus I students with Course Letter Grade of B

Student #	Total Hours Spent using ALEKS	Initial ALEKS Assessment Score	Math ACT Score	Numerical Course Grade	Student #	Total Hours Spent using ALEKS	Initial ALEKS Assessment Score	Math ACT Score	Numerical Course Grade
9	15.7	15	26	75	143	24.6	13	28	78
12	18.8	10	26	76	147	15.7	13	22	75
26	5.1	4	26	73	151	18	24	33	70
28	24.5	18	26	75	161	16.3	15	22	72
30	24.5	13	29	73	167	24.7	17	27	76
36	25	4	20	75	169	23.6	22	29	72
40	24.2	18	26	76	173	6.5	12	26	74
45	20	20	28	74	181	13.7	10	28	71
48	25.2	0	24	71	182	24	15	27	71
50	24.6	5	20	74	190	12.1	14	26	73
53	17.2	19	31	73	192	0.8	7	33	75
55	1.6	10	27	75	193	28	5	29	71
63	20.1	12	26	72	197	15.5	16	26	74
65	20	18	27	74	199	22.5	6	27	75
83	13.8	2	29	75	201	0.6	15	25	75
90	17.2	13	29	79	210	0.4		25	70
93	22.7	0	28	75	211	11.9	9	26	72
98	14.6	7	26	69	212	24.6	10	27	69
101	25	5	27	75	213	31.8	3	29	73
102	15.3	14	20	73	215	26	16	25	78
114	10.2	6	27	74	217	27.7	19	25	77
118	33.7	6	22	75	219	24.7	7	29	70
122	18.2	12	31	78	233	21.5	17	27	73
125	10	19	28	75	242	24.4	11	27	76
126	2.1	15	29	71	243	13.9	23	28	75
133	25.1	27	24	74	244	40	12	27	73
137	21.5	6	23	74	248	13.1	13	28	71

Student #	Total Hours Spent using ALEKS	Initial ALEKS Assessment Score	Math ACT Score	Numerical Course Grade	Student #	Total Hours Spent using ALEKS	Initial ALEKS Assessment Score	Math ACT Score	Numerical Course Grade
138	16.5	3	26	69	259	19.1	15	26	72
140	23.8	10	0	71	260	19.1	13	27	74

Table 3 – Total Hours Spent using ALEKS, Initial ALEKS Assessment Score, Math ACT Score, and Numerical Calculus I Course Grade for Fall 2005 Calculus I students with Course Letter Grade of C

Student #	Total Hours Spent using ALEKS	Initial ALEKS Assessment Score	Math ACT Score	Numerical Course Grade	Student #	Total Hours Spent using ALEKS	Initial ALEKS Assessment Score	Math ACT Score	Numerical Course Grade
17	16.8	9	17	74	127	7.5	4	23	66
24	29.5	8	26	64	144	20.6	6	23	56
41	7.9	6	26	55	157	23.3	13	31	60
42	24.1	2	0	63	158	22.3	21	25	60
46	20.3	23	26	43	159	28	4	0	67
52	1.5	14	28	67	180	36.2	2	31	67
60	20.1	10	29	63	187	8.9	3	14	64
67	30	2	23	61	195	5.1	8	26	61
72	23.9	2	0	62	220	24.9	9	25	59
81	20.8	8	15	66	226	11.2	17	24	61
88	14.3	3	26	58	234	8.3	23	29	60
94	13.5	10	26	62	240	1.4	17	30	61
100	34.2	15	31	60	250	32.9	18	25	66
121	19.9	17	24	66	254	6.4	11	25	65

Table 4 – Total Hours Spent using ALEKS, Initial ALEKS Assessment Score, Math ACT Score, and Numerical Calculus I Course Grade for Fall 2005 Calculus I students with Course Letter Grade of D

Student #	Total Hours Spent using ALEKS	Initial ALEKS Assessment Score	Math ACT Score	Numerical Course Grade	Student #	Total Hours Spent using ALEKS	Initial ALEKS Assessment Score	Math ACT Score	Numerical Course Grade
1	18	0	0	58	87	24.1	14	29	43
2	18.4	4	25	57	91	12.2	7	29	59
19	2	10	21		112	22	15	24	45
35	18.3	1	16		148	25.1	8	17	58
37	23.6	6	21	36	170	2.9	17	25	56

Student #	Total Hours Spent using ALEKS	Initial ALEKS Assessment Score	Math ACT Score	Numerical Course Grade	Student #	Total Hours Spent using ALEKS	Initial ALEKS Assessment Score	Math ACT Score	Numerical Course Grade
38	28	0	18	47	171	24.8	8	26	45
49	9.2	11	29	45	174	1.2	16	28	54
58	18.5	7	0	33	179	16.1	23	28	45
59	10.6	6	27	46	238	8.6	7	27	42
64	6.5	19	24	46	241	16.5	10	24	55

Table 5 – Total Hours Spent using ALEKS, Initial ALEKS Assessment Score, Math ACT Score, and Numerical Calculus I Course Grade for Fall 2005 Calculus I students with Course Letter Grade of F

Student #	Total Hours Spent using ALEKS	Initial ALEKS Assessment Score	Math ACT Score	Numerical Course Grade	Student #	Total Hours Spent using ALEKS	Initial ALEKS Assessment Score	Math ACT Score	Numerical Course Grade
4	6.7	2	27	58	124	12	12	27	
6	12	14	28		130	12.9	10	26	
10	5.4	0	26		136	3.6	10	26	
14	16.1	12	24		139	0.5		26	
15	14.9	1	0		146	0.3		26	
18	12.2	7	27		162	1.6	4	18	
20	5.4	12	28		166	3	9	26	
22	9.8	1	27		194	8.8	9	26	
23	8.2	6	23		204	3	13	28	
33	2.3		21		206	3	13	22	
57	0.7	16	29		207	14.7	4	27	
68	9.7	6	20		214	2.1	10	25	37
69	1.2	10	27		224	3.1	10	20	
73	8	15	18		225	0.4		25	
76	5.6	1	26		228	0.8		25	
77	16.3	3	18		229	14.6	14	29	
86	1.5	14	28		235	9.2	6	26	
92	7.4	6	28		237	8.4	11	29	
109	3.3	16	28		246	1.1	4	27	
111	5.4	15	27		247	0.1		25	
115	0.3		29		255	0.3		28	
119	18.1	5	22		256	0.9	13	27	
					258	23.1	8	26	

Table 6 – Total Hours Spent using ALEKS, Initial ALEKS Assessment Score, Math ACT Score, and Numerical Calculus I Course Grade for Fall 2005 Calculus I students who Withdrew from the Course with at Grade of W