Accuplacer Math Placement Test scores, SAT-Math Scores and High School Grade Averages as Predictors of MA145 and MA200 Final Grades

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Purpose of the Analyses

Before registering for their first semester at Hilbert College, entering first-time-college freshmen take a computerized Accuplacer Elementary Algebra (EA) diagnostic test administered and scored through the College Board. The Elementary Algebra test consists of 12 multiple-choice questions measuring: a) integers and rationals, b) algebraic expressions, and c) equations, inequalities and word problems. Scores can range from 21 to 120. Proficiency statements provided by College Board suggest that scores around 25 indicate minimal pre-algebra skills; scores around 57 indicate minimal algebra skills, scores of about 76 indicate sufficient algebra skills, and scores of about 108 indicate substantial algebra skills. The cut-off scores used by Hilbert College for math course placement decisions are such that a student scoring 40 or below is placed in MA099, scores of 41 to 59 are placed into MA100, and scores of 60 or greater are recommended to any college-level math course. MA099 and MA100 are both non-credit bearing, developmental courses intended to help prepare students with little or minimal pre-algebra skills for credit-bearing college math.

For the fall 2009 cohort of matriculated first-time-college students, 41% (86) scored below the 60 points cutoff and thereby were recommended for either MA099, MA100 or both. Since fall 2009 this percentage has been declining as shown in Table 1 below. At the same time the average high school grade of admitted students has been increasing.

Table 1. Accuplacer Elementary Algebra Diagnostic test scores and high school average grade points for first-time-college cohorts of fall 2009 through fall 2012.

	N	AccuEA* > 60	AccuEA* = 59-41	AccuEA* < 40	Mean HS gpa
Fall 2012	180	144 (80%)	25 (14%)	11 (6%)	86.36
Fall 2011	221	152 (69%)	36 (16%)	33 (15%)	85.38
Fall 2010	245	153 (62%)	49 (20%)	43 (18%)	84.45
Fall 2009	210	124 (59%)	42 (20%)	44 (21%)	84.11

AccuEA = Accuplacer Elementary Algebra Diagnostic Test

When incoming students are required to take one or more developmental (or remedial) non-credit bearing courses it can quickly put them behind schedule for timely graduation and increase the costs of their college education if they must take additional terms to complete. Furthermore there is a large body of research at the national level that shows that retention and graduation rates decrease as the number of developmental/remedial courses that students take increases (e.g., Complete College America, 2012).

Finally, there are unspecified costs to the college associated with diagnostic testing and providing sufficient sections of developmental/remedial math courses each academic year.

It is in the interest of the college and of the students, therefore, to inquire as to the validity and effectiveness of the Accuplacer program of math skills diagnostic testing and subsequent course placement. Literature on the use of the Accuplacer tests for diagnostic purposes is somewhat limited. One study available from the College Board (Mattern & Packman, 2009) indicates that the Elementary Algebra test can correctly place students in courses in which they earn a C or better grade 73% of the time with an r_{obs} = .23 and an estimated validity for applied use of r = .35. The College Board also recommends that institutions using the Accuplacer diagnostic tests regularly conduct their own validity studies to check and, if necessary, recalculate appropriate cutoff scores. Conversations with staff in Hilbert College's Academic Center indicate that such a study has not been conducted here since the Accuplacer Elementary Algebra test was initiated in 2008.

While not strictly a validity study, the purpose of this investigation is to examine the relationship of Accuplacer Elementary Algebra test scores with grades in college-level, credit-bearing courses. Additionally, it is of interest to compare the predictive ability of the Accuplacer test scores to that of alternative and available measures such as students' high school grade averages and SAT scores.

Methodology

Although Accuplacer tests have been used by Hilbert College since 2008, only scores of tests administered since June, 2009 are included in this study. It was at that time that the Accuplacer testing program was taken over and revised by the College Board and it was not possible to verify that prior testing used the same scoring procedures or anchor points. The fall 2009, 2010, 2011 and 2012 first-time-college cohorts were included. Only students with letter grades A – F were included in the database. In the fall of 2011, the MA 100 course changed from awarding A – F grades to a Pass/Fail grading system. To allow consistent comparisons with other math courses, those P/F grades were eliminated from further analyses. Also grades of Incomplete (I) and Withdrawal (W) were excluded. Six hundred and twenty-seven students with post-June, 2009 Accuplacer math scores were identified as having subsequently taken and completed one or more math courses, developmental/remedial, college-level or both. All but 5 of those 627 had high school grade averages on record and 419 (67%) had provided SAT scores at application. One hundred and six ((17%) had provided ACT scores.

Descriptive statistics for these variables are presented in Table 2. The average number of math courses taken during this period was 1.6 with a range from 1 to 4 courses (not including repeated courses).

Letter grades were converted to numerical scores using the conversion chart found in the college catalog where an A = 4.0, A- = 3.7, B+ = 3.3, B = 3.0 and so on.

Table 1. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Elementary Algebra Placement Test	627	21	120	69.12	27.196
Total SAT Score	419	420	1490	899.79	157.159
SAT Math Score	419	220	730	457.24	86.825
Total ACT Score	106	12	30	20.14	3.996
High School Grade Average	622	70.00	97.00	84.8539	5.42990
MA099	124	.00	4.00	2.3500	1.42295
MA100	150	.00	4.00	2.6627	1.32364
MA135	48	.00	4.00	2.4792	1.38025
MA145	242	.00	4.00	2.4004	1.37166
MA146	52	.00	4.00	2.6231	1.11981
MA180	9	.00	3.30	2.4111	1.05646
MA200	331	.00	4.00	2.6737	1.15806
MA205	6	1.70	4.00	2.8333	.85010
MA315	36	1.70	4.00	3.6056	.59182

Analyses and Results

Analyses of the relationships between predictors (Accuplacer scores, High School GPAs, and SAT scores) and math course final grades were restricted to MA 145 (College Algebra) and MA 200 (Topics in Statistics). The numbers of students having taken other credit-bearing math courses were considered too small to provide meaningful results and the Accuplacer scores for students placed into MA 099 or MA 100 would be too restricted. Both MA 145 and MA 200 were included in these analyses because depending on students' majors many students may take one or the other as their only math course. For example, less than one half (117) of the 331 students who took MA 200 had also taken MA 145.

Correlations obtained among the key variables are presented in Table 3. Both the Accuplacer EA test and high school grade averages were significantly correlated with grades in MA 145 and MA 200. However, for final grades in MA 145, the correlation with high school grade averages (r = .469) was significantly higher than the correlation with the Accuplacer EA scores (r = .338), t(238) = 15.46, p < .001. The same was found for the correlations with MA 200 grades. Both predictors were likewise significantly correlated with MA 200 grades and the correlation of MA 200 grades with high school grade averages (r = .49) was again significantly higher than that with Accuplacer EA scores (r = .41), t(326) = 21.11, p < .001.

For the sample as a whole, the Accuplacer EA scores showed a significant and moderately strong correlation with high school grade averages, r = .49, p < .001 indicating that about 24% of the variance in Accuplacer scores can be explained by the variance in high school grade averages.

Table 3. Correlations

		Elementary Algebra Placement Test	High School Grade Average	MA145	MA200
Elementary Algebra Placement Test	Pearson Correlation	1	.493[**]	.338[**]	.413[**]
	N	627	622	242	331
High School Grade Average	Pearson Correlation	.493[**]	1	.469[**]	.489[**]
	N	622	622	241	329
MA145	Pearson Correlation	.338[**]	.469[**]	1	.562[**]
	N	242	241	242	117
MA200	Pearson Correlation	.413[**]	.489[**]	.562[**]	1
	N	331	329	117	331

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations of the other available predictors also showed significant relationship to math final grades. SAT-Math scores correlated r = .596 (p<.001) with MA 145 final grades and with MA 200 grades (r = .440,p < .01). The total SAT score was significantly correlated with MA 145 grades, r = .514 (p < .001), but not with MA 200 grades, r = .27 (p = .07). Total ACT scores correlated significantly with final grades in both math courses, however, the number of first-time-college students at Hilbert College submitting ACT scores remains rather small (less than 15%) and so the stability of these relationships is considered questionable at present. On the other hand, although not required for admission, an increasing number of applicants who enroll each year do provide SAT scores.

Multiple regression analyses (stepwise) were conducted to provide some comparison of the predictor roles of Accuplacer EA scores, high school grade averages, and SAT-Math scores together in predicting math course grades.

The results of the regression on MA 145 final grades produced a model in which a combination of high school grade averages and SAT-Math scores explained 32% of the variance in final grades, R2 = .32, F(2,173) = 41.34, p < .001. Accuplacer-EA scores were not included in the final model.

A similar result was found in regressing MA 200 final grades on the three predictors. The final model including high school grade averages and SAT-Math scores explained 33% of the variance in MA 200 grades and Accuplacer-EA scores was excluded from the model, r2 = .33, F (2,238) = 50.21, p < .001.

Finally, two separate linear regression analyses were conducted using only Accuplacer_EA scores as a predictor. For MA 145 scores, Accuplacer-EA scores explained 11% of the variance, $R^2 = .11$, $F (1, 240) = 30.87$, $p < .001$. For MA 200 final grades, Accuplacer-EA scores explained 17% of the variance, $R^2 = .17$, $F (1, 329) = 67.80$, $p < .001$.

So, it appears that while the Accuplacer-EA scores can provide a statistically significant prediction of final grades in both math courses by itself, in combination with high school grade averages and SAT-Math scores, its unique predictive contribution is too small for inclusion.

Conclusions

- This preliminary study indicates that although the Accuplacer diagnostic test for Elementary Algebra skills produces a statistically significant and reasonable prediction of future success in college-level math courses, it's value as a predictor may be secondary to other available scores, specifically a student's average high school grade and score on the math portion of the SAT.
- This raises the question of whether math placement decisions could be as well or even somewhat better made using information from a student's college application than from the additional administration of the Elementary Algebra Accuplacer diagnostic test.
- It should be noted that even with the best model for prediction using a combination of high school averages and SAT-math scores, no more than about 25% – 30% of the variance in math course final grades was explained. Thus, an additional question which may need to be addressed is whether any combination of available information, including use of the Accuplacer-EA, does well enough at identifying those students who without some developmental math instruction would be most likely to fail at college-level math. The criteria of "well enough" should take into account the costs previously mentioned both to the students and to the college.
- It is also possible that a different math skills diagnostic test from Accuplacer might prove to be more effective in placing Hilbert freshmen into appropriate math courses. Or, these results may suggest, that at a minimum, a validity study of cutoff scores currently in use with the Elementary Algebra test is warranted.
- A limitation of these data is that students who do poorly on the Accuplacer test and subsequently do not progress beyond the remedial/developmental math courses into college-level courses are not represented in the analyses. Hence the results could be under-representing the predictive effectiveness of the Accuplacer test. Likewise, because only the lowest portion of the distribution of Accuplacer-EA scores are represented in the MA 099 and MA 100 sequence, the analyses do not provide any findings that bear on the appropriateness of those placements. It might be argued that students who score low and proceed through the developmental sequence are able to improve their skills to such a degree that the Accuplacer scores are no longer predictive of their performance in college-level math courses.
- Finally, it should be reiterated that these results do not invalidate the use of the Accuplacer Elementary Algebra diagnostic test for placement decisions. Rather they indicate that for incoming Hilbert students, the current use of the test may not be any more useful than a close examination of students' high school transcripts and, if available, SAT scores.

- It might be worthwhile to follow-up this study with a closer examination of high school math performance to see if using actual math grades from the high school transcript rather than an overall average, provides an even better predictive model.
- Given that the high school grade averages of admitted students have been increasing in recent cohorts while the percentages of students placed into remedial/developmental math courses have been declining, this may be a propitious time to rethink the way in which students' math deficiencies are identified and remediated.

References

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