Using Demographic Data to Predict Students' Achievement in DSPM Courses

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Abstract

Current regulations in the Tennessee Board of Regents system place students into developmental or regular classes based solely on scores on either the ACT or COMPASS. This study examined whether a combination of other readily available factors might better predict a student's success.

Students at East Tennessee State University taking elementary algebra, intermediate algebra, and probability and statistics (the core math class at the university) were surveyed in Fall, 2004, to find out when they took their last mathematics class in high school and what mathematics courses they took in high school. Other variables were obtained from the student information system when available: age; ACT/SAT composite, mathematics, and reading scores or COMPASS reading, arithmetic, and intermediate algebra scores; overall high school GPA, and final grade in the course they were taking. End-of-semester grades (the dependent variables) were correlated with the other independent variables. Stepwise multiple regression equations were attempted for each course – one for students with ACT scores and another for students with COMPASS scores – to see whether several of the independent variables together could predict these grades.

For students in elementary algebra, end-of-course grades were significantly correlated with COMPASS reading scores and overall high school GPA. Grades in intermediate algebra were significantly correlated with ACT mathematics and English scores, COMPASS arithmetic and intermediate algebra scores, number of college preparatory mathematics classes taken in high school, and overall high school GPA. Grades in probability and statistics were correlated with the same variables as intermediate algebra except for COMPASS reading.

Regression equations to predict grades were possible for traditional age students (students with ACT scores) in all three courses with high school GPA and a few other scores as independent variables. For nontraditional students, the regression equations were only possible for intermediate algebra and statistics using COMPASS arithmetic scores. No regression equation was possible for elementary algebra.

The equations found could be used to target students who might be in danger of failing and be referred to additional sources of help. It is further recommended that study be repeated for spring and summer semesters.

Predicting Course Success in Developmental Math: A Literature Review

Researchers have proposed a number of factors which possibly contribute to the success of students taking college mathematics courses at an introductory or lower level. Most of these factors can be broadly divided into three categories – academic, demographic, or affective. Academic factors include scores on various tests such as the SAT or ACT, various commercial or locally-produced placement tests, and grade point averages from high school. Demographic variables include sex, age, athlete status, time between high school and college mathematics classes, and race. Examples of affective variables measures of mathematics anxiety, study skills, social enrichment scores, and various measures of student attitude. Many of the researchers have examined combinations of these factors to propose a more complete model to use for improved placement or advising. The following discussion summarizes the results of several studies of both developmental and early college-level mathematics courses. Information was gleaned from journal articles, ERIC documents, and other dissertations. Some of the studies examined students in both levels of mathematics courses, and others focused on one course or even one particular type of course. The subjects of these studies were students at community colleges and universities, public and private. Some looked at both types of institutions or multiple campuses. They ranged from as narrow as students from one Maryland county entering one college (Larson et al., 1996) to as wide as a sampling of a national study (Stribling, 1990).

Academic variables often tend to make some contribution to a student's final course grade. In many cases, a student's high school grade point average was found to have a significant relationship with the grade on a developmental mathematics course. Autrey (1998), Wambach & del Mas (1998), Lott (1990), McFadden (1986), Thompson (1998), and Rives (1992) found this to be true for developmental mathematics courses in general. The models proposed by McLean & Williams (2003) showed high school GPA to be a significant predictor for elementary algebra grades ($p < .001$) at ETSU any time it was available. Hutson (1999) found overall high school GPA to be a significant predictor of success in intermediate algebra, but not in a fundamentals of mathematics course; likewise, the grade point average for high school mathematics courses tended to be a significant predictor for intermediate algebra but not for fundamentals of mathematics. Marwick (2002) also noted a significant predictive tendency for self-reported high school mathematics grades in developmental mathematics courses. Meeks (1989) found that high school mathematics grades can be used to predict success for traditional aged development mathematics students, but not for students aged 25 or older. Long (2003), on the other hand, found no significant correlation between overall high school GPA and grade in a developmental mathematics course.

Another academic variable used by researchers was the student's score on college entrance exams such as the ACT or the SAT, depending on which test was more likely to be used at the institutions studied. Composite scores as well as scores on the mathematics section were used. Lott (1990) found that the SAT mathematics score to contribute significantly to predicting grades in development mathematics courses for students with a high school diploma, whether or not they had taken a full selection of college preparatory courses; however, such was not the case for students with a GED. McLean & Williams (2003) found ACT mathematics scores to be significant predictors of elementary algebra grades at ETSU in the fall of 2002. Larson et al. (1996) found that for Montgomery County, Maryland students entering Montgomery College, "performing well on the SAT" (p. 14) was one of the three best predictors of whether or not a student was placed into a developmental mathematics course. However, Long (2003) found no predictive ability for either the ACT composite or mathematics scores.

In addition to–or instead of–entrance exam scores, some institutions and states employ instruments designed specifically for placing students into the correct mathematics course level.

These include the COMPASS, ASSET, CPT (College Placement Test), Basic Skills Exam, locally produced tests, and state tests such as Texas' Pre-TASP Test or Florida's CLAST. Researchers have had mixed results in finding whether these tests contribute significantly to predicting success in developmental mathematics courses. McLean & Williams (2003) proposed models of predicting elementary algebra grades at ETSU in which the Algebra 2 portion of the COMPASS was a significant predictor when available (p ranging between .006 and .045 depending on other independent variables involved). Long (2003) found no predictive ability for the COMPASS math, reading, or English sections for any of five developmental mathematics courses at the community college studied. Day (1997) found that the CPT was the very best predictor for elementary algebra, but its use for intermediate algebra was inconclusive. Little (2002) found a significant relationship between score on an algebra achievement test and elementary algebra grades. Preast (1998) found a strong significant relationship existed between the reading section of the Texas Academic Skills Program test and elementary algebra grades. McFadden (1986) showed a significant relationship between the Basic Skills Exam and grades in developmental mathematics.

Some students enter college a number of years after dropping out of high school and consequently may have a GED score instead of a useful high school GPA. Norman (1997) investigated whether the GED test could be used for placement purposes for those students who had recently taken the test and applied to enter a community college. The ASSET Test is the paper-and-pencil equivalent of the COMPASS test sometimes used by TBR institutions for placement. There was only a moderate correlation between ASSET and similar parts of the GED test (ranging between .44 and .69), leading Norman to conclude that while the GED could not replace ASSET for placement purposes, it could be used as an adjunct in assisting in the placement process.

Several researchers considered a student's background in high school mathematics or mathematics GPA in anticipating grade in developmental mathematics courses. Rives (1992) and Marwick (2002) found that the number of high school mathematics courses taken made a difference. Branum (1990) found the number of semesters of algebra in high school to be significant only for elementary algebra students' course grade. Meeks (1989) determined that high school mathematics background was important only for traditional students, not for nontraditional students. High school mathematics GPA was significantly related to final developmental mathematics grades for intermediate algebra, but not fundamentals of mathematics in Hutson's (1999) study.

Finally, a few academic variables which could not be determined before the beginning of a course were identified by several researchers. College GPA and the instructor were both predictors of elementary algebra grade (Little, 2002), thought Smith et al. (1996) saw no predictive value based on instructor. Attendance was found to contribute significantly to developmental mathematics course grade by both Faro-Schroeder (1995) and Smith et al. (1996). For traditional students, the results of a survey on study habits was found to be significantly related to course grade (Meeks, 1989).

In addition to academic variables, several demographic variables have been studied to see if they have any relationship to successfully completing a developmental mathematics course. One such variable is age, often in the form of reporting whether a student's age falls in the traditional or nontraditional category. Long (2003) and Smith (1996) found that age was not significantly related to end of course grade in a developmental mathematics course. Hutson (1999) did find a significant relationship for intermediate algebra students, but not for students in a fundamentals of mathematics class. Rives (1992) noted a significant relationship between the length of time since the last mathematics course and grade in developmental mathematics.

Gender of students has also been studied with mixed results for whether it affected successful completion of development mathematics courses. Some researchers (Branum, 1990;

Little, 2002) did find that grades were significantly different between the sexes. Others (Lawrence, 1988; Long, 2003; Smith et al., 1996) saw no such significant difference. Lott (1990) discovered differences in success between the sexes for students who completed high school with or without a college preparatory curriculum, but not for those who had a GED instead.

Another demographic variable that a few researchers have included in their studies was that of race. Race was significant in the findings of Lott (1990) and Little (2002). Only being black was a distinguishing racial difference in the studies of Autrey (1998) and Faro-Schroeder (1995). Lawrence (1988) and McFadden (1986) saw no racial differences in their studies.

Affective variables have also been examined to find whether they have a significant impact on developmental mathematics course success rates. Because the present study does not deal with affective variables, only a cursory look at this area is provided here. Much more information is available in the literature. Smith et al. (1996) did not see a significant grade difference based on anxiety levels, but Little (2002) did see a relationship between mathematics attitude and elementary algebra grade. Autrey (1998) found relationships between developmental mathematics success and the results of the College Student Inventory along with another variable known as the social enrichment score. Smith et al. also deduced in their qualitative study that students' perception of their success and their engagement in class were also important qualities that contributed towards completing developmental mathematics courses. Those who were attentive during class even infrequently were about five times more likely to pass the class than those who were not. Teacher-student interaction and student note-taking behavior did not seem to make as large an impact.

Research Questions

1. For students with ACT scores, is there a relationship between ACT mathematics scores and course grade in elementary algebra (DSPM 0800), intermediate algebra (DSPM 0850), or probability and statistics (MATH 1530)?
2. Similarly, is there a relationship between ACT reading scores and grades in DSPM 0800, DSPM 0850, or MATH 1530?
3. For students without ACT scores, is there a relationship between their intermediate algebra score on COMPASS and their grade in DSPM 0800, DSPM 0850, or MATH 1530?
4. Similarly, is there a relationship between the reading score on COMPASS and course grades in these three courses?
5. For students in the courses studied, is there a relationship between the number of college preparatory mathematics classes taken in high school and a student's grade in the course?
6. Is there a relationship between students' high school grade point averages and their course grade in any of the three ETSU courses under study?
7. For students with valid ACT scores, can separate multiple regression equations to predict final course grade in DSPM 0800, DSPM 0850, or MATH 1530 be developed using ACT composite scores, ACT math, reading and English scores, high school GPA, number of high school mathematics classes taken, age at entry, and number of years since the last mathematics class as independent variables?
8. For students without valid ACT scores, can separate multiple regression equations to predict final course grade in DSPM 0800, DSPM 0850, or MATH 1530 be developed using COMPASS writing, reading comprehension, prealgebra and algebra scores, number of college preparatory high school mathematics classes taken, age at entry, and number of years since the last mathematics class as independent variables?

Method

- Collect information about courses taken in high school and year of last high school math class from students via survey
- Obtain other information from SIS (Birth date: screen 007; ACT / DSPP / COMPASS: A89 or 136; HSGPA: A89; Course grade: 1G7 or 136)
- Use Pearson correlation for relationship questions
- Use stepwise multiple regression for grade prediction questions
- Not counted: grades of W, WF, I
- FN (failure due to nonattendance) grade not counted to be consistent with some other ETSU studies
- Online sections, RODP sections not included

Surveys Returned

DSPM 0800: 149 / 304 (49%) — No night, off-campus, or ITV sections
DSPM 0850: 214 / 455 (47%) — Included Kingsport, night, ITV
MATH 1530: 631 / 1074 (59%)

Results Tables

End of Semester Course Grades for Students Surveyed

Grade	DSPM 0800	DSPM 0850	MATH 1530
A	35	75	70
A-	17	18	48
B+	14	17	35
B	21	21	98
B-	8	11	36
C+	9	13	34
C	13	25	89
C-	*	*	35
D+	*	*	42
D	*	*	28
F	19	19	49
FN**	10	8	58
I**	0	1	1
W**	3	6	5
WF**	0	0	3
Total	149	214	631
Mean	2.785	2.991	2.419
Std.Dev.	1.2993	1.2075	1.1526

* Grades of C-, D+, and D are not allowed in developmental studies courses.
**Not used in answering the research questions.

Pearson Correlations between ACT Mathematics Score (ACTM) and Grade (GPTS)

		ACT Math		
		0800	0850	1530
GPTS	*r*	.025	.322**	.481**
	p	.802	.000	.000
	N	102	169	499

** $p < .01$

Pearson Correlations between ACT Reading Scores and Course Grade

	ACT Reading		
	0800	0850	1530
r	.047	.164*	.338**
p	.642	.033	.000
N	102	169	497

* $p < .05$ ** $p < .01$

Pearson Correlation between COMPASS Intermediate Algebra Scores and Course Grade

	COMPASS Intermediate Algebra Score		
	0800	0850	1530
r	.107	.326*	.133
p	.448	.029	.348
N	52	45	52

* $p < .05$

Pearson Correlation between COMPASS Reading Scores and Course Grade

	COMPASS Reading Score		
	0800	0850	1530
r	.222	.206	.118
p	.194	.323	.513
N	36	25	33

High School Math Courses Taken (Most Common)

Course	0800	0850	1530
Prealgebra	47	37	67
Foundations 2	16	26	28
Algebra 1	123	181	518
Algebra 2	111	182	556
Geometry	102	176	544
Precalculus	6	27	211
Trig / Adv. Alg.	4	27	133
Prob. & Stat.	4	6	72
Calculus	2	4	88
N	149	214	633

Pearson Correlation between Course Grade (GPTS) and Number of College Preparatory Mathematics Taken (HSMATH)

	HSMATH		
	0800	0850	1530
All students			
r	-.068	.191**	.265**
p	.434	.007	.000
N	135	198	564
Mean # taken	2.52	3.11	3.73
SD taken	1.034	.955	1.115
Students with ACT scores			
r	-.237*	.193*	.298**
p	.017	.012	.000
N	102	168	499
Mean # taken	2.84	3.28	3.85
SD taken	1.2333	1.2000	1.034
Students with COMPASS scores			
r	-.061	.131	.171
p	.671	.392	.226
N	51	45	52
Mean # taken	1.88	2.53	2.85
SD taken	1.103	1.254	1.036

Note. Total *N* for groups with ACT and COMPASS scores does not equal *N* for the entire group because some students have both scores.

*$p < .05$ ** $p < .01$

Pearson Correlation between Overall High School GPA and Course Grade

	HS Overall GPA		
	0800	0850	1530
r	.389**	.333**	.445**
p	.000	.000	.000
N	105	176	500

**Significant at the .01 level.
(Note: $p < .001$ in all three courses.)

Regression Using ACT

DSPM 0800 (95 students)

- Model 1:

$y = -.589(\text{HSMATH}) + 4.599$ ($p = .001$)

- Model 2:

$y = -.765(\text{HSMATH}) + 1.009(\text{HSOGPA}) + 2.298$ ($p < .001$)

DSPM 0850 (160 students)

- Model 1:

$y = .364(\text{ACTM}) - 3.238$ ($p < .001$)

- Model 2:

$y = .301(\text{ACTM}) + .662(\text{HSOGPA}) - 4.111$ ($p < .001$)

MATH 1530 (475 students)
Four models ($p < .001$ in each case; r^2 ranging from .233 to .353):

- $y = .134(\text{ACTM}) - .521$
- $y = .092(\text{ACTM}) + .771(\text{HSOGPA}) - 2.181$
- $y = .103(\text{ACTM}) + .910(\text{HSOGPA}) + .108(\text{AGE}) - 4.953$
- $y = .089(\text{ACTM}) + .855(\text{HSOGPA}) + .105(\text{AGE}) + .025(\text{ACTE}) - 4.9$

Regression Using COMPASS

DSPM 0800 (33 students) – no equation possible

DSPM 0850 (23 students with all sections)
$y = .020$ (COMPASS writing) + 1.374 ($r^2 = .221$, $p = .024$)

DSPM 0850 (44 students with math scores)
$y = .023$ (COMPASS arithmetic) + 1.730 ($r^2 = .190$, $p = .033$)

MATH 1530
(22 students with all COMPASS sections): no equation possible
51 students with just math sections:
$y = .027$(COMPASS arithmetic) + .671 ($r^2 = .276$, $p < .001$)

Observations

- Elementary algebra: only high school GPA showed a significant correlation with course grade; math preparation in high school showed a little bit of predictive value.
- Finding agrees with Long (2003) – ACT math score not significantly correlated with E.A. course grade
- Odd finding: Why a negative correlation between HS math prep and grade in 0800?
- Intermediate algebra: course grade correlated with ACT math and reading, COMPASS intermediate algebra and reading, high school math preparation, high school GPA.
- ACT math correlation agrees with Lott (1990)
- HS math preparation agrees with 4 studies
- Probability and statistics grade was significantly correlated with ACT math and reading and HSGPA, but regression used ACT math and English, age, and HSGPA. Only COMPASS arithmetic score was in regression for students without ACT scores.

Recommendations for Future Research

- For students with borderline placement scores, use the regression equation to fine-tune the placement.
- If student's regression equation predicts a failing grade, give extra attention to that student (watch attendance, recommend tutoring, etc.), or consider placement in a lower level class if possible.
- Repeat study with data from spring and summer. Historically, grades in developmental math classes are significantly higher in summer and lower in spring. (Unknown if true for 1530)
- Repeat treating repeaters separately, or include number of previous attempts as a variable
- Is grade in 1530 affected by other college-level or developmental math experience?
- Characteristics of repeating students (mostly qualitative research)
- What if core curriculum at ETSU changes allowing other math courses to count for graduation?
- How would raising cutoff scores affect grades? (TBR uses 19, ACT recommends 22)
- Qualitative study (suggested by a student): What kind of guidance were students given in selecting high school math classes?
- Why a negative correlation between HS math prep and 0800 grade?

Entire dissertation on which this presentation is based is available online: `http://faculty.etsu.edu/stephen/`. It will be online from UTK in Jan. or Feb., but will stay on my faculty web page unless there's a space crunch.
The slide show originally designed for this presentation is also on my faculty web page. Look for the "conference presentations" link.

References

ACT, Inc. (1997). *ACT Assessment Technical Manual.* Iowa City, IA: Author.

ACT, Inc. (2003). *COMPASS/ESL with e-Write reference manual.* Iowa City, IA: Author.

Akst, G., & Hirsch, L. (1991). Selected studies on math placement. *Review of Research in Developmental Education,* 8(4).

American Mathematical Association of Two-Year Colleges (AMATYC) (1995). *Crossroads in mathematics: Standards for introductory college mathematics before calculus.* Memphis: Author.

Armstrong, A. G. (1999) An analysis of student placement into college algebra. (Doctoral dissertation, Texas A&M University - Commerce). *Dissertation Abstracts International, 60* (10A), 3621.

Autrey, K. R. (1998). Using mathematical modeling for the prediction of success in developmental math. Unpublished doctoral dissertation, Louisiana State University and Agricultural and Mechanical College.

Bader, C. H., & Hardin, C. J. (2002). History of developmental studies in Tennessee. In Lundell, D. B., & Higbee, J. L. (Eds.), *Histories of Developmental Education* (pp. 35-45). Minneapolis, MN: Center for Research on Developmental Education and Urban Literacy.

Blansett, W. (1988). Relationship of achievement in entry-level college mathematics courses to selected math scores and variables. (Doctoral dissertation, Delta State University, 1988). *Dissertation Abstracts International, 49* (06A), 1382.

Boylan, H.R. (1995). Making the case for developmental education. *Research in Developmental Education, 12*(2), 1-4.

Branum, B. K. (1990). Performance on selected mathematics and reading assessment tests as predictors of achievement in remedial mathematics. (Doctoral dissertation, University of North Texas, 1990). *Dissertation Abstracts International, 51* (12A), 4098.

Brubacher, J. S., & Rudy, W. (1976). *Higher education in transition: A history of American colleges and universities, 1636-1976* (3rd revised ed.). New York: Harper & Row.

Burns, E. H., Jr. (1990). Differences between college algebra grades of freshman students in the Mississippi community college system who take a mathematics course their senior year of high school and those who do not. (Doctoral dissertation, University of Mississippi, 1990). *Dissertation Abstracts International, 51* (06A), 1942.

Carmichael, J. W. Jr. (1986). Predictors of first-year college mathematics grades for black Americans. (ERIC Document Reproduction Service No. 277302).

Casazza, M. E. (1999). Who are we and where did we come from? *Journal of Developmental Education, 23*(1), 2-7.

Casazza, M. E., & Silverman, S. L. (1996). *Learning assistance and developmental education: A guide for effective practice*. San Francisco: Jossey-Bass.

Darbro, D. G. (2002). Odds of success for students placed into their initial math course according to the results from a locally developed placement test with those who were permitted self-placement opportunities. (Doctoral dissertation, University of Kentucky, 2002). *Dissertation Abstracts International, 63* (1), 156.

Day, C. L. (1997). A predictive validity study of computer adaptive placement tests for Tennessee higher education institutions. (Doctoral dissertation, University of Tennessee, 1997). *Dissertation Abstracts International, 59* (7), 2464.

Developmental Studies Program, ETSU (2004). Mission of developmental studies at ETSU. Retrieved August 4, 2004, from http://www.etsu.edu/devstudy/mission.htm

Diehl, M. (2002, May 1). Re: Math aptitude testing. Message posted to MathSPIN electronic mailing list, archived at http://groups.yahoo.com/group/mathspin/message/382

Division of Developmental Studies, ETSU (2002). COMPASS results sheet. Johnson City, TN: Author.

East Tennessee State University (ETSU) (2004). *Undergraduate catalog 2004-2005.* Johnson City, TN: Author.

Elimination of office of developmental studies (2003, February 27). Internal memo, East Tennessee State University, Johnson City.

Faro-Schroeder, J. (1995). Developmental education: Factors that contribute to academic success. (Doctoral dissertation, Southern Illinois University at Carbondale, 1995). *Dissertation Abstracts International, 56*, 2652.

Fry, K. C. (2004). ETSU fall enrollment sets several all-time records. Press release copied to faculty, East Tennessee State University, Johnson City.

Garcia, R. C. (1998). Mathematics achievement predictors for college algebra. (Doctoral dissertation, Texas A&M University-Kingsville, 1998). *Dissertation Abstracts International, 59* (04A), 1101.

Hardin, C. (1998). Who belongs in college: A second look. In J. L. Higbee & P. L. Dwinell, eds., *Developmental education: Preparing successful college students*, pp. 15-24. Columbia, SC: National Resource Center for the First Year Experience in Students in Transition, University of South Carolina.

Higbee, J. L., & Dwinell, P. L., eds. (2000). *The many faces of developmental education.* Monograph of the National Association for Developmental Education (NADE). Warrensburg, MO: NADE.

Hodge-Hardin, S. L. (1995). *Interactive television in the classroom : a comparison of student math achievement among three instructional settings.* (Doctoral dissertation, East Tennessee State University, Johnson City). *Dissertation Abstracts International, 56* (11A), 4366.

Hooper, H. L., Jr. (1979). *Development of a prediction model for students in beginning level mathematics courses at Chattanooga State Technical Community College.*(Doctoral dissertation, University of Tennessee-Knoxville, 1979). *Dissertation Abstracts International, 40,* 4938.

Hopkins, T., & Stephens, D. (2002, October 31). In which semester do developmental math students do best? Presentation at the Tennessee Association for Developmental Education 18th Annual Conference, Gatlinburg, TN.

Hutson, T. L. (1999). An assessment of a mathematics program including the scheme for placing students into developmental courses. (Doctoral dissertation, The University of Memphis, 1999). *Dissertation Abstracts International, 60* (11A), 3886.

Jackson-Teal, R. F. (1990). High school mathematics courses and grades as predictors of mathematics performance for Black college freshmen. (Doctoral dissertation, Memphis State University, 1990). *Dissertation Abstracts International, 51* (04A), 1099.

Johnson, K. D. (1996). A system for mathematics students: Placement in college algebra. (Doctoral dissertation, Oklahoma State University, 1996). *Dissertation Abstracts International, 57* (06A), 2402.

Johnson, R. R. (1996). An analysis of learner variables related to achievement in an introductory graduate statistics course. (Doctoral dissertation, Wayne State University, 1996). *Dissertation Abstracts International, 57* (04A), 1530.

Larson, J. C., Garies, R. S., & Campbell, W. R. (1996). *A profile of MCPS graduates and their performance at Montgomery College.* Joint report of Montgomery County [MD] Public Schools and Montgomery College. (ERIC Document Reproduction Service No. ED 412998).

Little, S. C. (2002). Factors influencing the success of students in introductory algebra at a community college. (Doctoral dissertation, University of Houston, 2002). *Dissertation Abstracts International, 63* (06A), 2103.

Long, W. J. (2003). Mathematics placement and mathematics achievement in the community college. (Doctoral dissertation, University of Missouri - Saint Louis, 2003). *Dissertation Abstracts International, 64* (05A), 1572.

Lott, W. R. (1990). A relationship of selected factors to academic success of students in developmental studies mathematics. (Doctoral dissertation, Georgia State University, 1990). *Dissertation Abstracts International, 51* (06A), 1944.

Martin-Gay, K. E. (2001). *Beginning & Intermediate Algebra* (2nd ed.). Upper Saddle River, NJ: Prentice Hall.

Martin-Gay, K. E. (2004). *Beginning & Intermediate Algebra* (3rd ed.). Upper Saddle River, NJ: Prentice Hall.

Marwick, J. D. (2002). Charting a path to success: How alternative methods of mathematics placement impact the academic success of community college students. (Doctoral dissertation, University of Illinois at Urbana-Champaign, 2002). *Dissertation Abstracts International, 63* (11A), 3831.

Maxwell, M. (1979). *Improving student learning skills: A comprehensive guide to successful practices and programs for increasing the performance of underprepared students.* San Francisco: Jossey-Bass.

McCabe, R. H., & Day, P. R., (Eds). (1998). *Developmental education: A twenty-first century social and economic imperative.* Mission Viejo, CA: League for Innovation in the Community College.

McFadden, M. S. (1986). *The prediction of college course grades in a developmental studies program using preenrollment academic and demographic variables* (Doctoral dissertation,

University of Georgia, 1986). *Dissertation Abstracts International, 47,* 1208.

McLean, J. E., & Williams, R. (2003). *The development and evaluation of a prediction model for the placement of students entering East Tennessee State University into developmental classes.* Unpublished manuscript, East Tennessee State University, Johnson City.

Meeks, K. I. (1989). *A comparison of adult versus traditional age mathematics students and the development of equations for the prediction of student success in developmental mathematics at the University of Tennessee - Chattanooga.* (Doctoral dissertation, University of Tennessee-Knoxville, 1989). *Dissertation Abstracts International, 51,* 776.

National Council of Teachers of Mathematics (NCTM) (2000). *Principles and standards for school mathematics.* Reston, VA: Author.

Norman, P. A. (1997). Predictive validity of the GED tests as a surrogate for the basic ASSET test (Doctoral dissertation, North Carolina State University, 1997). *Dissertation Abstracts International* 58 (03A), 0838.

Norušis, M. J. (2000). *SPSS 10.0 guide to data analysis.* Upper Saddle River, NJ: Prentice Hall.

Osborn, P. B. (2002). A comparison of academic performance in college algebra between high school dual-enrolled and traditional college students. (Doctoral dissertation, University of Arkansas, 2002). *Dissertation Abstracts International, 63* (5A), 1653.

Parsad, B., & Lewis, L. (2003). *Remedial education at degree-granting postsecondary institutions in fall 2000* (NCES Publication No. NCES 2004-010). Washington, DC: National Center for Education Statistics.

Preast, K. L. (1998). Placement of students in mathematics courses according to TASP test scores and course reading levels. (Doctoral dissertation, Texas A&M University - Commerce, 1998). *Dissertation Abstracts International, 59* (04A), 1103.

Price, R. (2004). Stat Cave project. In Godbole, A., *Self-study report for external program review*. Internal document, East Tennessee State University, Johnson City.

Rives, B. S. (1992). A structural model of factors relating to success in calculus, college algebra and developmental mathematics. (Doctoral dissertation, University of Houston, 1992.) *Dissertation Abstracts International, 53* (9), 3134.

Salter, R., & Noblett, A.G. (1994). The role of institutional support in developmental studies student retention. In *Proceedings of the 18th annual conference of the National Association for Developmental Education*, pp. 39-40. Carol Stream, IL: National Association for Developmental Education.

Scott, J. S. (2001). Modeling aspects of students' attitudes and performance in an undergraduate introductory statistics course. (Doctoral dissertation, University of Georgia, 2001). *Dissertation Abstracts International, 62* (09A), 2973.

Seier, E. (2004). MATH 1530 resource page. Retrieved September 12, 2004, from http://www.etsu.edu/math/seier/1530/1530link.htm

Sigler, G. L. (2002). Factors predicting success in a college-level algebra course at an applied vocational/technical community college. (Doctoral dissertation, Baylor University, 2002). *Dissertation Abstracts International, 63* (10A), 3476.

Smith, D., O'Hear, M., Baden, W., Hayden, D., Gorham, D., Ahuja, Y., & Jacobsen, M. (1996, Fall). Factors influencing success in developmental math: An observational study. *Research & Teaching in Developmental Education, 13*(1), 33-43.

Tennessee Board of Regents (TBR) (1998). *First-time freshmen 1998-99 enrollment report instructions.* Nashville: Author.

Tennessee Board of Regents (TBR) (2001). *Defining our future: A report to the Tennessee General Assembly assessing impacts of current and future budget reductions and reporting new efficiency measures for the Tennessee Board of Regents System pursuant to HB 2038/SB 2000.* Nashville: Author. Retrieved January 6, 2002, from http://www.tbr.state.tn.us/press_releases/future/FinalDOFApproved.pdf

Tennessee Board of Regents (2003). *Guideline A-100 basic/developmental studies program (DSP) operational guidelines.* Nashville: Author. Retrieved July 20, 2004, from http://www.tbr.state.tn.us/policies_guidelines/academic_guidelines/A-100.htm

Thompson, J. M. (1998). Developmental students in higher education: Path analysis of a national sample. *College Student Journal, 32,* 499-510.

Wambach, C., & del Mas, R. (1998). Developmental education at a public research university. In *Developmental education: Preparing successful college students,* pp. 63-72. Columbia, SC: National Resource Center for the First Year Experience in Students in Transition, University of South Carolina.

Wheat, J. R. (1990). Effects of certain affective and cognitive variables on performance in college algebra. (Doctoral dissertation, East Texas State University, 1990). *Dissertation Abstracts International, 51* (04A), 1149.

Yablonsky, D. (1989). Predicting a student's success in an elementary statistics course. (Doctoral dissertation, The Union Institute, 1989). *Dissertation Abstracts International, 51* (05B), 2444.

Zankofski, D. A. (1999). The effects of demographic and background variables on student performance in mathematics for general education. (Doctoral dissertation, George Mason University, 1999). *Dissertation Abstracts International, 59* (11A), 4040.