

**Location of Developmental/Remedial Coursework
Predicts Successful Completion of College Algebra: A
Study of Louisiana's Developmental Students**

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Developmental education programs and services have long provided underprepared and unprepared postsecondary students with the academic tools and life-management skills necessary to successfully complete college-level coursework. Legislation and policy changes, including implementing statewide minimum admissions requirements and restricting developmental coursework to the campuses of community colleges, have changed the landscape of developmental education within the State of Louisiana. While both four-year and two-year institutions have offered developmental coursework in the past, these policy changes have added to the debate of whether developmental learners are better served on the campuses of four-year institutions or community colleges. Using data from the Louisiana Board of Regents' Statewide Student Profile System, Student Transcript System, ACT Class Profiles, and Financial Aid Data System for AY 2006, this study sought to determine if the location of developmental English and math courses could predict success in college-level English and math courses. Results indicated that students who completed developmental mathematics courses at a four-year university were 20% less likely to successfully complete college algebra than students who completed developmental mathematics at a community college (OR=.796; CI95 \leq .05). Location of developmental English coursework did not predict freshman English performance in a statistically significant manner. Implications for developmental education/remedial education policy and practice are discussed.

Developmental education programs and services have long provided underprepared and unprepared postsecondary students with the academic tools and life-management skills necessary to successfully complete college-level coursework. In fact, developmental education has existed in some form in postsecondary education since the 17th century (Merisotis & Phipps, 2000). Developmental education has become an integral part of postsecondary education as evidenced by the fact that in 2000, more than 76% of all postsecondary institutions and 98% of all community colleges offered at least one developmental education course (Parsad & Lewis, 2003). Additionally, Sparks and Malkus (2013) found that in 2007-08, 24% of all first time freshmen attending 2-year and 21% of all first time freshmen attending 4-year public postsecondary institutions reported that they required at least one developmental course. According to Attewell, Lavin, Domina, and Levey (2006), the percent is higher with 40% of traditional college students needing at least one developmental course. Further, in a study of remedial and developmental education policies, Jenkins (2002) found that seven states had mandatory placement exams, 20 had placement policies or statutes, 22 tracked developmental students within their postsecondary education systems, and 37 required that postsecondary institutions report information about remedial and developmental education within the state (Williams, 2009). Wilson (2012) found that 35 states now have policies regarding placement in developmental education courses.

While developmental education has become an integral part of postsecondary education in this country, it has not existed without controversy. In recent years, there has been an increase in efforts to either eliminate or reduce developmental education programs in four-year institutions and relegate the majority of these courses to community, technical community, or technical colleges (Pretlow &

Wathington, 2011; Wilson, 2012). Further, Wilson (2012) found that several states no longer fund developmental coursework at four-year universities.

The state of Louisiana has joined several other states in implementing statewide minimum admissions requirements that have affected the delivery of developmental programs and services within the state. In Louisiana, *The Master Plan for Public Education: 2001* articulated minimum admissions standards that required students who needed more than one developmental education course to complete the courses prior to enrolling in four-year institutions (Board of Regents, 2001). More recently, the State of Louisiana implemented legislation that removed developmental education courses from public four-year institutions and placed them in community colleges (Board of Regents, 2010; 2012). However, as of June 2015 the policies were again revised and students may now be admitted to some regional four-year institutions if they need developmental coursework, but only two-year community colleges and Historically Black Colleges and Universities are permitted to teach developmental coursework (Board of Regents, 2015a; 2015b).

While there have been policy changes that have affected the location of developmental coursework, there are few studies that examine the relationship between location (i.e., where developmental students complete their developmental coursework) and their success in freshman-level coursework. It is therefore important to examine the outcomes of developmental learners before additional policies are implemented that may affect the state's population of developmental students. This study provides an examination of developmental course outcomes after the statewide minimum admissions standards were implemented within the state of Louisiana, but before the teaching of developmental coursework was restricted to community colleges. Therefore, the purpose of this study is to determine

if the successful completion of college-level coursework could be predicted based on where students completed their developmental English and mathematics coursework (i.e., completion at a community college or completion at a four-year university).

Theoretical framework

The theoretical framework underlying this study builds upon the models developed by Tinto (1975) and Pascarella and Chapman (1983). The classic model hypothesized by Tinto attempted to explain the process of dropping out of postsecondary education. Tinto posited that an individual's background, personal, and pre-college characteristics influence his or her commitment to a postsecondary institution. These commitments to a postsecondary institution, in turn, influence the student's ability to adjust to the institution's academic and social systems. The model also suggests that the interaction of several individual, academic, and social systems is directly related to a student's decision to persist in postsecondary education. These interactions include those with faculty, administrators and other students as well as institutional characteristics such as the institution type, institution quality, student composition and size.

Pascarella and Chapman (1983) conducted a study in which they investigated the validity of Tinto's (1975) classic dropout model across three types of institutions: two-year commuter institutions and four-year commuter and residential institutions. Pascarella and Chapman asserted that institutional characteristics such as institution type, institution size, and the percent of undergraduate students living on campus were associated with the background characteristics of students and that these variables, in turn, influence students' social and academic interactions. Thus, location of coursework can be investigated as a predictor of academic performance. In this case, our study investigated the location

of developmental coursework—coded as institution type—as a predictor of successful completion of college-level coursework.

Methodology

This study investigated if the location of developmental English and math coursework can predict the successful completion of college-level English and math coursework. In this study, we examined the following research question: Can the location of developmental English and math coursework predict the successful completion of college-level coursework? We hypothesized that the successful completion of college-level English and math could be predicted by whether students took their developmental English and math courses at a community college or at a four-year university. Other predictors serving as controls were high school GPA, Pell Grant status, completion of Louisiana Board of Regents' core curriculum, race/ethnicity, age, and gender.

Data Source

Data for the study were compiled by the Louisiana Board of Regents and drawn from the Louisiana Board of Regents' Statewide Student Profile System, Student Transcript System, ACT Class Profiles, and Financial Aid Data System. The Louisiana Board of Regents identified the cohort of students who entered the postsecondary institutions between Spring 2006 and Spring 2008. The dataset included developmental students from all institutions within the state of Louisiana with the exception of Louisiana State University and A & M University in Baton Rouge. The population consisted of 9,769 students—the population of all first-time freshmen—who enrolled in one or more developmental English or mathematics course(s) in a public community college or university within the state of Louisiana in Spring 2006. This cohort was tracked from Spring 2006

through Spring 2008 (Board of Regents, 2009).

Measurements and Procedures

Successful completion of college algebra was measured using the Louisiana Board of Regents' grading system. This grading system varies across 25 categories capturing the student's performance in college algebra. These categories included grades such as "A", "B", "C", "D", "F", "I" (incomplete), and "W" (withdrawal). A listing of relevant Board of Regents' grading codes can be found in Appendix A. For our final analysis, we dichotomized performance. Students who earned a grade of "D" or higher in college algebra were coded "1" (passed) and students who earned a grade of "F" or "incomplete" were coded "0" (not passed).

Successful completion of freshman English was also measured using the Louisiana Board of Regents' grading system. As with the previous measure, performance was dichotomized. Students who earned a grade of "D" or higher in freshman English were coded "1" (passed) and students who earned a grade of "F" or "incomplete" were coded "0" (not passed).

Location of developmental math course and *Location of developmental English course* were both measured as dichotomies. The dataset reported the name of the university at which the student had taken his or her developmental English and math courses. We then coded this home university as either "community college" (0) or "four year university" (1), as indicated by the Louisiana Board of Regents' college and university classification system.

High school grade point average (GPA) was reported on an interval scale of 0 to 4 with 4 representing an "A" average. This measure was dichotomized based on the Louisiana Board of Regents' 2.5 high school grade point average requirement for admission into college. Students with a high school grade point average of 2.49 or less were coded "0"

while students with a 2.5 or higher grade point average were coded “1”.

Students who were eligible for a Pell Grant (i.e., *Pell Grant Status*) were coded “1” while those students who were not eligible for the Pell Grant were coded “0”. Pell Grant status was used as a measure of socioeconomic status in this study.

The Louisiana Board of Regents developed a core curriculum to prepare high school students for the academic demands of college. Recommended core curriculum courses included four levels of English, two levels of algebra, biology, chemistry, computer science, and other courses encompassing a variety of arts and sciences (A complete listing of the Board of Regents’ Core Curriculum can be found in Appendix B). *Completion of the State of Louisiana Board of Regents’ core curriculum* was coded as “completed all of the required courses” (1) or “not completed all required courses” (0).

ACT/SAT performance was collected at the interval level in the dataset. For our analytical purposes, we coded students as being either above the state average (1) of 20(ACT)/420(SAT) or below the state average (0) of 20(ACT)/420(SAT), as indicated by the Louisiana Board of Regents.

Race was measured nominally as Black, White, Hispanic, Asian, American Indian, and international students. Due to an underrepresentation of the Hispanic, Asian, American Indian, and international students in our analytical sample, only Black (0) and White students (1) were considered.

Age was measured continuously in the dataset. However, for our analysis we coded students below the age of 24 as “traditional students” (1) and those students who were 24 and above as “non-traditional students” (0).

Gender was coded female (0) and male (1).

Logistic regression was used to determine the

relationship between location of developmental training and academic success in college algebra and/or freshman English. STATA was used to generate the results.

Findings

A Profile of the Participants

Table 1 displays the characteristics of the population of developmental learners comprising the dataset (N=9,769).

Table 1: Characteristics of the Population of Developmental Learners within the Dataset

Variable	Categories	Frequency (%)
Race	Asian (1)	132 (1.4)
	American Indian/Alaskan Native (2)	81 (.8)
	Black, non-Hispanic (3)	4,561 (48.3)
	Hispanic (4)	4,359 (46.1)
	White, non-Hispanic (5)	233 (2.5)
	International (6)	<u>86</u> (.9)
	Total	9,452
Gender	Women (0)	6,059 (62)
	Men (1)	<u>3,710</u> (38)
	Total	9,769
Age	25 to 74 (0)	1,896 (19.41)
	17 to 24 (1)	<u>7,873</u> (80.59)
	Total	9,769
ACT/SAT Performance	Below State Average of 20 (0)	2,858 (78.69)
	Above State Average of 20 (1)	<u>774</u> (21.31)
	Total	3,632
Pell Grant Status	No (0)	2211 (50.99)
	Yes (1)	<u>2125</u> (49.01)
	Total	4,336
High School GPA	Less than 2.5 (0)	964 (28.55)
	Greater than 2.5 (1)	<u>2,412</u> (71.45)
	Total	3,376
LA BOR Core	No (0)	1,629 (41.74)

Curriculum	Yes (1)	<u>2,274</u> (58.26)
	Total	3,903

Slightly more of the students in the dataset were Black (4,561 or 48.3%) while 46% of the sample were White students (4,359 or 46.1%), followed by Hispanic (233 or 2.5%), Asian (132 or 1.4%), American Indian (81 or .8%), and international students (86 or .9%). An examination of the dataset by gender revealed that more students in the dataset were women (6,059 or 62%). The majority of the students in the dataset were between the ages of 19 and 21 (4,169 or 42.7%) and 18 or younger (2,842 or 29.1%). More than 71% of the students in the study were less than 21 years of age.

The mean ACT score for the students in this profile was a 17 with most students scoring below a 20 (6,341 or 83.31%). With regard to Pell Grant eligibility—a socioeconomic measure in this study—students were nearly equal in terms of students who were eligible for the Pell Grant with (4,899 or 50.1%) identified as being eligible for the Pell Grant. Interestingly, most developmental students entered postsecondary institutions with GPAs of a 2.5 or above (2,412 or 71.45%). Additionally, students completed the Louisiana Board of Regents' Core Curriculum courses at a rate that was slightly less than students who did not (1,629 or 41.74%).

Our final analysis considered only students who completed a developmental English and/or math course and a freshman English and/or college algebra course between Spring 2006 and Spring 2008. Because Hispanic, Asian, American Indian, and international students together comprised less than 5% of the final sample, they were excluded from the analysis.

Table 2 displays the characteristics for the sample of Black and White students completing both developmental math and college algebra between Spring 2006 and Spring

2008. More than 50% (56.78%) of the sample took their developmental math course at a four-year university, 73.69% of the sample passed their college algebra course, and 58.26% completed the Louisiana Board of Regents' Core Curriculum. Additionally, 71.45% of the sample had a high school GPA of less than 2.5 while 78.69% had an ACT/SAT score below the state average. Almost half the sample (49.01%) were eligible to receive the Pell Grant.

Table 2: Sample Characteristics for Developmental Learners Completing College Algebra

Variable	Item Measured	Frequency (%)
Developmental Mathematics Coursework	4-Year University	1,931 (56.78)
	Community College	<u>1,470</u> (43.22)
		3,401
Passed College Algebra	Failed	1,141 (26.31)
	Passed	<u>3,195</u> (73.69)
		4,336
Louisiana Board of Regents' Core Curriculum	No	1,629 (41.75)
	Yes	<u>2,274</u> (58.26)
		3,903
High School GPA	<2.5	964 (28.55)
	≥2.5	<u>2,412</u> (71.45)
		3,376
ACT/SAT Performance	Below State Average	2,858 (78.69)
	Above State Average	<u>774</u> (21.31)
		3,632
Pell Grant Status	No	2,211 (50.99)
	Yes	<u>2,125</u> (49.01)
		4,336
Race	White	2,098 (53.44)
	Black	<u>1,828</u> (46.56)
		3,926
Gender	Female	2,829 (65.24)
	Male	<u>1,507</u> (34.76)
		4,336

Age	Non Traditional Student (≥25)	797 (18.38)			
	Traditional Student	3,539 (81.62%)			
		4,336			
Variable	N	Mean	Std. Dev.	Min	Max
Age	4336	21.83	6.76	17	67
College Math GPA	4256	2.526	1.09	0	4
Dev. Math GPA	2565	2.757	0.95	0	4
HS GPA	3376	2.766	0.49	0	4
ACT Score	3559	17.41	2.49	5	28
SAT Score	73	821.2	126.06	420	1250

More than half of the sample (53.44%) were White while 46.56% of the sample were Black, 65.24% of the sample were female, and 81.62% of the sample was below the age of 25. The mean developmental math GPA was 2.7 while the mean college algebra GPA was 2.5.

Table 3 displays the sample characteristics for those Black and White students completing both developmental English and freshman English between Spring 2006 and Spring 2008. Less than half the sample (42.64%) took their developmental English course at a four-year university, 84.12% of the sample passed their college freshman English course, and 57.38% completed the Louisiana Board of Regents' Core Curriculum. In terms of high school GPA, 32.86% of the sample had a high school GPA of less than 2.5 while 80.459% had an ACT/SAT score below the state average. More than half (51.95%) of the sample were eligible to receive the Pell Grant. Less than half (47.97%) of the sample were White, 52.03% of the sample were Black, 63.18% of the sample were female, and 86.97% of the sample were below the age of 25. The mean developmental English GPA was 2.7 while the mean college English GPA was 2.2.

Developmental English and Mathematics Coursework Outcomes

Two logistic regression analyses were used to determine if the location of developmental English and math

coursework can predict the successful completion of college-level English and math coursework. Analysis 1 predicts successful completion of college algebra courses with location of developmental math course as the key predictor. Other predictors treated as controls included: race, sex, age, high school grade point average, ACT/SAT performance, Pell Grant status, and Louisiana Board of Regents' Core Course Completion status.

Table 3: Sample characteristics for developmental learners completing Freshman English

Variable	Item Measured	Frequency (%)
Developmental English Coursework	4-Year University	1,087 (42.64)
	Community College	<u>1,462</u> (57.36)
		2,549
Passed Freshman English	Failed	865 (15.88)
	Passed	<u>4,583</u> (84.12)
		5,448
Pell Grant Status	No	2,618 (48.05)
	Yes	<u>2,830</u> (51.95)
		5,448
Louisiana Board of Regents' Core Credits	No	2,144 (42.62)
	Yes	<u>2,887</u> (57.38)
		5,031
High School GPA	<2.5	1,517 (32.86)
	≥2.5	<u>3,100</u> (67.14)
		4,617
ACT/SAT Performance	Below State Average	3,773 (80.45)
	Above State Average	<u>917</u> (19.55)
		4,690
Race	White	2,397 (47.97)
	Black	<u>2,600</u> (52.03)
		4,997
Gender	Female	3,442 (63.18)
	Male	<u>2,006</u> (36.82)
		5,448
Age	Non Traditional Student	710 (13.03)

Variable	N	Mean	(≥ 25) Traditional Student		
			Std. Dev.	Min	Max
Age	5448	20.67	5.38	17	67
College Eng. GPA	5368	2.238	1.23	0	4
Dev. Eng. GPA	2096	2.768	0.91	0	4
HS GPA	4617	2.711	0.52	0	4
ACT Score	4585	17.16	2.50	5	26
SAT Score	105	808.76	127.62	420	1250

Analysis 2 mirrors Analysis 1 but replaces successful completion of freshman English as the criterion and replaces location of developmental English course as the key predictor. All control variables remained the same for both analyses.

Logistic regression results indicated that location of developmental mathematics was a statistically significant predictor of successful completion of college algebra (Table 4) with completing developmental math courses at a community college being more beneficial than completing developmental math courses at a four-year institution. Students who completed developmental mathematics courses at a four-year university were 20% less likely to successfully complete college algebra than students who completed developmental mathematics at a community college (OR=.796; CI95 \leq .05).

Race and high school GPA also predicted successful completion of college algebra. Students with a high school GPA of 2.5 or above were 45% more likely to successfully complete college algebra than students with a high school GPA of less than 2.5 (OR=1.450; CI95 \leq .05) (Table 4).

An analysis of interaction effects suggests that developmental students with a high school GPA of less than 2.5 benefit particularly from completing developmental math courses at a community college. Students who took their developmental math course at a community college and who

had a high school GPA of less than 2.5 had an 85% increased likelihood of successfully completing college algebra compared to all other groups (OR=1.846; CI95 \leq .05) (Table 4). In contrast, developmental students who took their developmental math course at a four-year university and had a high school GPA of less than 2.5 were 46% less likely to successfully complete college algebra than other groups (OR=0.542; CI95 \leq .05).

Table 4: Logistic Regression Results: Dependent Variable: College Algebra Performance (N=2121)

Predictors	OR	Std. Err	CI95
Location of Dev. Math (LODM)	0.796*	0.088	0.640-0.989
Race	0.655*	0.075	0.522-0.821
Sex	0.811	0.052	0.657-1.002
Age	0.522	0.182	0.263-1.035
HS GPA	1.450***	0.179	1.187-1.894
ACT/SAT Performance	1.116	0.150	0.903-1.498
Pell Grant Status	0.966	0.109	0.774-1.204
Core Course Completion	1.189	0.141	0.941-1.499
Interaction Effects			
LODM x Race	1.009	0.216	0.663-1.535
LODM (CC) x HS GPA (<2.5)	1.846*	0.422	1.179-2.889
LODM (4yr) x HS GPA (<2.5)	0.542**	0.124	0.346-0.848

* p \leq .05. ** p \leq .01. ***p \leq .001.

Table 5 revealed that location of developmental English failed to predict freshman English performance in a statistically significant manner. While completing developmental English courses at a community college did predict a 7.6% increased likelihood of successfully completing freshman English, this coefficient failed to reach statistical significance. However, several of our control variables were strong predictors. Black students were almost 42% less likely

to pass freshman English than their White counterparts (OR=.587; $P \leq .05$). Students with high school GPAs of 2.5 and higher were more than twice as likely to pass freshman English than students with lower high school GPAs (OR=2.02; $P \leq .05$). Finally, students completing the Louisiana Board of Regents'

Core Course Curriculum were almost 42% more likely to pass freshman English than those students not completing the curriculum (OR=1.42; $P \leq .05$).

Table 5: Logistic Regression Results: Dependent Variable: Freshman English Performance (N=1768)

Predictors	OR	Std. Err	CI95
Location of Dev. Eng. (LODE)	1.077	0.155	0.811-1.428
Race	0.587*	0.100	0.420-0.820
Sex	0.820	0.109	0.632-1.065
Age	0.522	0.258	0.198-1.378
HS GPA	2.016***	0.283	1.531-2.655
ACT/SAT Performance	0.860	0.258	0.478-1.548
Pell Grant Status	0.783	0.122	0.577-1.063
Core Course Completion	1.417*	0.207	1.065-1.885

* $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

Discussion

Overall, the study revealed that most of the students in this dataset were women and traditional aged students (between 17 and 24 years of age) who scored below a 20 on the ACT and who had earned high school GPAs above a 2.5. Additionally, slightly more of the students were Black, qualified for the Pell Grant, and did not complete the Louisiana Board of Regents core credits.

Logistic regression results indicated that race, high school GPA, and location of developmental mathematics were significant predictors of successful completion of college algebra. However, location was not a significant

predictor of the successful completion of freshman English.

Overall, students who attended community colleges tended to perform better in college algebra than other students. This was true even when race, sex, and age were held constant. This result appears to be more positive for students with lower high school GPAs (less than 2.5). Students who entered public postsecondary institutions with lower high school GPAs (less than 2.5) benefitted more from completing their developmental mathematics coursework at a community college as compared to other groups.

Implications

This study has several implications for improving college performance among developmental learners. First, developmental learners may benefit from stronger collaborations between high schools and postsecondary institutions. This is evidenced by the findings that high school GPA is a significant predictor of successful completion of college algebra and that higher GPAs (2.5 or greater) increased the likelihood that developmental students successfully completed college algebra. The importance of such collaborations is echoed in the finding that completing the Louisiana Board of Regents' Core Courses significantly increased the chances that a student would pass freshman English.

Second, those developmental learners who earn high school GPAs of less than a 2.5 and who test into developmental coursework may benefit from beginning their studies at a community college since these students were more likely to successfully complete college algebra after completing their developmental education courses at a community college. However, this should only be the case where strong collaboration and articulation agreements exist between community colleges and four-year universities since

many community college students do not actually transfer to four-year universities (Monaghan & Attewell, 2015). Further, students who begin their postsecondary educations at community colleges are less likely to complete a four-year degree than students who begin their postsecondary educations at a four-year university (Sandy, Gonzalez, & Hilmer, 2006).

Third, developmental learners may benefit from stronger collaborations between community colleges and four-year universities. The results of the current study suggest that community colleges adequately prepare developmental students for college-level coursework. However, the ability of community colleges to better prepare developmental students for college-level coursework is moot in the absence of partnerships between community colleges and four-year universities to ensure the seamless transfer from the community college to the four-year university.

Therefore, collaborations between community colleges and four-year universities should include a smooth and efficient developmental and college-level credit transfer process. Further, comprehensive support mechanisms should be in place to ensure that community college students have the support that they need to adjust to life on the campus of a four-year university. Developmental students need true access to four-year universities and to the opportunity to earn a bachelor's degree. Strong community college/four-year university collaborations and articulation agreements might prove beneficial to the retention of developmental learners who intend to complete bachelor's degrees.

Fourth, since the trend in Louisiana is to eliminate the teaching of developmental courses and the delivery of developmental programs on four-year university campuses, it may be beneficial for four-year universities and community colleges to collaborate on implementing programs, services, and policies so that four-year universities can assist with

serving developmental students. Further, not only should community colleges implement programs and services on their individual campuses, but they should also consider working with four year universities to help them to implement “best practices” on their campuses as well. They could perhaps collaborate to host workshops and training programs for community college faculty and staff.

Finally, the results of this study further validate developmental educators’ efforts to not only advocate for the delivery of developmental education courses and programs within Louisiana’s postsecondary institutions, but also to make them more of a priority to institutional and governmental policymakers, postsecondary faculty, administrators, students, and parents. If the state of Louisiana is to provide developmental education students with true access to postsecondary education, then there needs to be strong collaborations between community colleges, four-year universities, high schools, and developmental educators to provide comprehensive and systematic support to these students; particularly, if these students wish to transfer to four-year institutions.

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Appendix A

A	Excellent
B	Above average
C	Average
D	Below average
F	Failure
FX	Failure Excessive Absences
IP	Approved Course/In progress
W	Withdrawn
I	Incomplete
IX	Incomplete Extended
P	Pass
S	Satisfactory
SP	Passing
NC	No credit
NG	Incomplete
NS	Not Satisfactory
U	Unsatisfactory
UW	Unofficial withdrawal
AU	Audit
XF	Failure
YC	Incomplete
YD	Incomplete Pending Judicial Action
Z	Incomplete

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Louisiana Board of Regents' Core Curriculum
Requirements

Units	Course
4	English I, English II, English III, English IV
1	Algebra I (one unit) or Applied Algebra 1A and 1B (two units)
1	Algebra II
1	Geometry, Trigonometry, Calculus, or an approved advanced math substitute

1	Biology
1	Chemistry
1	Earth Science, Environmental Science, Physical Science, Biology II, Chemistry II, Physics, Physics II, or Physics for Technology (one unit)
1	American History
1	World History, Western Civilization, or World Geography 1 Civics and Free Enterprise (one unit combined) or Civics (one unit)
1	Fine Arts Survey (or substitute two units of performance courses in music, dance and/or theater; or substitute two units of visual art; or substitute two units of studio art; or substitute one unit of an elective from among the other subjects listed in this core curriculum)
2	Foreign Language (two units in the same language)
½	Computer Science, Computer Literacy, or Business Computer Applications (or substitute at least one-half unit of an elective course related to computers approved by the State Board of Elementary and Secondary Education or one-half unit as an elective from among the other subjects listed in this core curriculum)

Visualizing the Sample Standard Deviation

Jyotirmoy Sarkar

Indiana University

Mamunur Rashid

DePauw University

The standard deviation (SD) of a random sample is defined as the square-root of the sample variance, which is the 'mean' squared deviation of the sample observations from the sample mean. Here, we interpret the sample SD as the square-root of twice the mean square of all pairwise half deviations between any two sample observations. This interpretation leads to a geometric visualization of the sample SD, and a more