CollegeBoard

THE PREDICTIVE PLACEMENT VALIDITY STUDY OF TEXAS SUCCESS INITIATIVE ASSESSMENT (TSIA)

Prepared by

Weiwei Cui, Ph.D.
Luz Bay, Ph.D.

The College Board
Psychometrics

29 July 2016
Updated 14 June 2017

TABLE OF CONTENTS

List of Tables 3

List of Figures 4

Introduction 5

Statement of Purpose 6

Methodology 7

Data 8

Analyses 15

Results 19

References 32

Appendix A: Predictive Placement Validity Study Data Requirements and File Layout 33

Appendix B: Expected Probability of Successful Mathematics Course Completion Predicted by TSIA-M 36

Appendix C: Expected Probability of Successful Reading-intensive Course Completion Predicted by TSIA-R 38

Appendix D-1: Expected Probability of Successful English Composition Course Completion Predicted by WritePlacer Score 40

Appendix D-2: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W ... 41

Appendix D-3: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for WritePlacer Score of 4 43

Appendix D-4: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for Students with WritePlacer Score of 1-8 45

Appendix D-5: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for Students with WritePlacer Score of 2-8 47

Appendix D-6: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for Students with WritePlacer Score of 3-8 49

Appendix D-7: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for Students with WritePlacer Score of 4-8 51

Appendix D-8: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for Students with WritePlacer Score of 5-8 53

Appendix D-9: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for Students with WritePlacer Score of 6-8 55

Table 1: Number of Records and Students for Each Semester 9

Table 2: Data Distribution Across Institution Types 9

Table 3: Grade Distribution for Mathematics Courses 10

Table 4: Grade Distribution for Reading-Intensive Courses 11

Table 5: Grade Distribution for English Composition Courses 12

Table 6: Descriptive Statistics for TSIA Placement Tests and WritePlacer Scores 13

Table 7: Percentage of Successful (C- or Higher) Students by TSIA Score 14

Table 8: Percentage of Successful (C- or Higher) Students by WritePlacer Score 15

Table 9: Frequencies of Multiple Course Grades for Individual Students 15

Table 10: Correlation Between TSIA and WritePlacer Scores and Success in Associated Courses 16

Table 11: Summary of Logistic Regression Analysis Performed 17

Table 12: Summary of Results 19

Table 13: Percentages of Correct Placement, Under-Placement, and Over-Placement 31

Figure 1: Expected Probability of Success in Mathematics Courses Predicted by TSIA-M 20

Figure 2: Expected Probability of Successful Reading-Intensive Course Completion Predicted by TSIA-R 21

Figure 3: Expected Probability of Successful English Composition Course Completion Predicted by WritePlacer 22

Figure 4: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W 23

Figure 5: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for Students with WritePlacer Score of 4 24

Figure 6: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for Students with WritePlacer Score of 1 or Higher 25

Figure 7: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for Students with WritePlacer Score of 2 or Higher 26

Figure 8: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for Students with WritePlacer Score of 3 or Higher 27

Figure 9: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for Students with WritePlacer Score of 4 or Higher 28

Figure 10: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for Students with WritePlacer Score of 5 or Higher 29

Figure 11: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for Students with WritePlacer Score of 6 or Higher 30

INTRODUCTION

In August 2013, the Texas Higher Education Coordinating Board (THECB) launched the Texas Success Initiative Assessment (TSIA). The TSIA is designed to assess the academic skills of entering undergraduate students and determine whether and at what level students are prepared to enroll and succeed in entry-level college courses. This state-legislated assessment program was designed to improve student success in college by determining if students are ready for college-level course work in the general areas of reading, writing, and mathematics. Any student who is not deemed college-ready must be placed in a developmental education program designed to help the student achieve college readiness. The law requires all entering college students to be assessed for college readiness in reading, mathematics, and writing unless the student qualifies for an exemption. Students passing the threshold for each exam are placed in entry-level credit-bearing courses.

The TSIA Mathematics Placement test measures skills in four content categories: Elementary Algebra and Functions; Intermediate Algebra and Functions; Geometry and Measurement; and Data Analysis, Statistics, and Probability. With scores ranging from 310 to 390, the threshold for placement is 350. That is, students who receive scores of 350 or higher are placed in introductory credit-bearing mathematics courses.

The TSIA Reading Placement test measures four content categories: Main Idea and Supporting Details, Author's Use of Language, Inferences in a Text or Texts, and Literary Analysis. The reported scores for this test also range from 310 to 390. Students who receive scores of 351 or higher are considered ready for college level work and are placed in introductory credit-bearing reading-intensive courses.

The TSIA Writing Placement multiple-choice test measures four content categories: Sentence Structure, Agreement, Sentence Logic, and Essay Revision. The reported scale for the TSIA Writing Placement test is from 310 to 390. Students who receive a score of 350 or higher on the multiple choice component were directed to take WritePlacer which is the essay portion of the TSIA Writing test. Students who receive a WritePlacer score of 5 or higher and a TSIA Writing Placement score of 350 or higher are placed in introductory English composition. Students who scored 4 on WritePlacer and 363 or higher on the TSIA Writing Placement test were also placed in introductory composition course.[1]

As part of the College Board's contractual obligation to the THECB, the predictive placement validity of each of the tests above is being investigated. The studies conducted here investigate the relationship between performance on the assessments and success on the introductory credit-bearing college courses for which the assessments are used for placement.

While validity studies can be very informative about how well test score(s) are able to predict success in a subsequent course, there are some cautions to keep in mind. Prediction of success using logistic regression can be influenced by a number of factors which are often hard to identify and/or explain without in depth investigation. Among these is the integrity of the criterion used in the prediction equation, such as course grade. Grades are known to have a high degree of variability among instructors in how the grades are assigned and the frequency with which an instructor may assign one grade versus another. The criterion can become more confounded and difficult to predict when composed of grades from multiple courses in addition to multiple instructors due to the greater variance in course content and coverage.

[1] Students who score lower than 350 on TSIA-W are directed to take ABE Writing. Those who score 4, 5, or 6 on ABE Writing were further directed to take WritePlacer. A score of 4 or higher on WritePlacer placed those students in an introductory composition course. This placement decision is not part of the study. Data provided by the THECB only contain ABE Writing for one semester out of the four, with only 61 records containing ABE Writing scores.

Another influential factor is the presence of an intervening course of treatment between the test administration that results in a score being used as a predictor and matriculation to the course for which the grade serves as the criterion. As the time between test administration and course matriculation increases, the potential that additional learning is occurring also increases such that, by the time the student enrolls in the course, it is possible that the student's level of knowledge is greater than what was demonstrated at the time of test administration. Intervening courses and treatments skew the relationship between the test score being used as a predictor and the course grade--resulting in less predictive ability when combined with data from other examinees that may or may not have also had an intervening treatment. Due to the possible bias that can be introduced into the predictive relationship when course matriculation occurs in a time frame that is significantly removed from the time of testing, it is ideal to keep the distance between testing time and course matriculation as short as possible.

Student motivation can also play an important role in the predictive relationship between test scores and course grades. An unmotivated examinee may have two possible outcomes. First, ideally the examinee performs at an acceptable level and is accurately placed into a course where the examinee is successful; this is the desired outcome. Alternatively, the examinee may be placed into a course which is not a good fit for their level of ability, most likely placed below the optimal level. The examinee has under-performed on the exam and earns a high grade (Low Score, High Grade). This second scenario (Low Score, High Grade) can seriously decrease the predictive relationship. A third possibility that sometimes occurs is when a student professes to have been unmotivated or not performed as well as they are capable. Thus a "waiver" can occur at the discretion of the local institution. At times a student may successfully lobby to be admitted to a class despite not earning the test score required due to numerous possible rationales. As a result the inclusion of students in a course for which they did not achieve a qualifying placement score can also introduce bias and decrease the power of the predictive relationship, especially if the student is then able to be successful in the course which again results in the Low Score, High Grade scenario.

While all of the above factors are potential threats to the predictive relationship, all require a level of investigation to completely identify and untangle that are beyond what is possible when viewing a single set of data. A more in-depth review of course syllabus, grading policies across instructors, intervening course work or developmental studies, and waiver of placement decisions would need to be conducted to fully explain the factors that may contribute to a predictive relationship between test score and course grade. In addition, numerous other factors not considered here may also be a threat to the predictive relationship.

The following sections of the document state the purpose of the study, describe the data used, detail the analysis performed, and discuss the results of the study. Some details of the results are provided in the appendices.

Students entering college in Texas public institutions are required to take TSIA placement tests in mathematics, writing, and reading to be placed in credit-bearing courses. These credit-bearing courses are:[2]

- Mathematics
    - MATH 1314 – College Algebra (3 SCH version)
    - MATH 1324 – Mathematics for Business & Social Sciences I (Finite Mathematics)
    - MATH 1332 – Contemporary Mathematics I
    - MATH 1342 – Elementary Statistical Methods (3 SCH version, freshman level)
    - MATH 1414 – College Algebra (4 SCH version)

[2] Course names and numbers are based on the Texas Common Course Numbering System 2013 matrix available at http://www.tccns.org/search/download/.

- English Composition
    - ENGL 1301 – Composition I
    - ENGL 1302 – Composition II
- Reading-Intensive
    - GOVT 2301 – American Government I (Federal & Texas constitutions)
    - GOVT 2302 – American Government II (Federal and Texas Topics)
    - GOVT 2305 – Federal Government (Federal Const & Topics)
    - GOVT 2306 – Texas Government (Texas Const & Topics)
    - HIST 1301 – United States History I
    - HIST 1302 – United States History II
    - HUMA 1301 – Introduction to the Humanities I
    - PHIL 1301 – Introduction to Philosophy
    - PSYC 2301 – General Psychology
    - SOCI 1301 – Introductory Sociology

The current TSIA cut scores approved by the THECB are as follows:[3]

- Mathematics — 350
- Reading — 351
- Writing
    - Essay Score of 5 and Multiple Choice Score of 350, or
    - Essay Score of 4 and Multiple Choice Score of 363

The purpose of the study is to determine the relationship between TSIA test scores and success in the introductory credit-bearing college courses listed above. Furthermore, the study will compute the probability of success associated with the current cut scores. Results of the study aim to provide to the THECB information that could help confirm or improve its current course placement policies.

To determine the relationship between TSIA placement test scores and success in college courses, the biserial correlation between scores and success in associated courses are computed. To compute probability of success associated with current cut scores, a model-based method (i.e., logistic regression) was used to derive the probability of success in mathematics, English composition, and reading-intensive courses associated with the respective placement cut scores. Logistic regression is a statistical method that uses binary outcome information (e.g., success versus failure) to predict the probability of success based on one or more predictor variables.

The logistic regression model

$$\log_e\left(\frac{p_i}{1-p_i}\right) = (Intercept) + (Slope)(TSIA\ score_i) \qquad (1)$$

provides the expected probabilities of success, p_i, in a course given a TSIA test score. In accordance with the THECB's placement policies, logistic regression models were built to predict probability of succeeding in mathematics and reading-intensive course using TSIA mathematics and reading placement tests, respectively, as

[3] From the TSIA Program Manual (2014, The College Board).

predictors. Each of TSIA Writing placement test and WritePlacer was used as predictor for success in English composition course. A separate logistic regression model was built to predict success in English composition courses for students who receive a WritePlacer score of 4. Additionally, a logistic regression model was fitted for predicting success in English composition using TSIA writing given different levels of performance in WritePlacer:

- WritePlacer score of 1-8
- WritePlacer score of 2-8
- WritePlacer score of 3-8
- WritePlacer score of 4-8
- WritePlacer score of 5-8
- WritePlacer score of 6-8

Sample sizes for students with WP score of 7-8 and students with WP score of 8 are not large enough (less than 200 records) to obtain reliable regression estimates, thus analyses for these two subsets are not included in this report.

Student course grade data used for this study were prepared by the THECB based on the data requirements document provided by The College Board. This document (see Appendix A) included a file layout that specifies all the data elements that will be used for the analysis. Included in the data file are first time first year students in TX public higher education institutions in fall 2013, spring 2014, summer 2014, and fall 2014.

The student course grades data, with one student record per course taken, consist of 21,197 records. This data set consists of 20,587 unique students. The distribution of the data across semesters is presented in Table 1 and the distribution of the data per the type of institution is presented in Table 2. Note that a high proportion of the data is from the Fall 2014 semester, and two year institutions, while a very low proportion of the data is from the Fall 2013 semester, which was when the TSIA was launched.

Table 1: Number of Records and Students for Each Semester

Semester	Number of Records	Percentage of Records	Number of Students	Percentage of Students
Fall 2013	130	0.61	123	0.60
Spring 2014	3,767	17.77	3,694	17.94
Summer 2014	1,599	7.54	1,571	7.63
Fall 2014	15,701	74.07	15,199	73.83
Total	**21,197**	100.00	**20,587**	100.00

Table 2: Data Distribution Across Institution Types

Institution Type/Peer Group		All Records	Percentage of Records
Two Year Institutions[4]	Very Large Colleges	10,371	48.93
	Large Colleges	3,248	15.32
	Medium Colleges	2,793	13.18
	Small Colleges	576	2.72
	Other	390	1.84
Four-Year Institutions		3,819	18.02

Records with course grade of I=Incomplete, NC=None Credit, and Cr=Credit were not included in any analysis. In total, 120 records were excluded from the analysis due to invalid course grade (55 records for mathematics courses, 53 records for reading-intensive courses and 12 for English composition courses).

Consistent with the desired analyses, a data set was extracted for each group of courses. There were a total of 3,690 records for TSIA math placement scores and math course grades, while there are 11,911 records for TSI reading scores and grades in reading-intensive courses. Table 3 and Table 4 present the distribution of grades in mathematics and reading-intensive courses for those subsets used in the analyses.

There is a total of 5,476 records with English compositions grades, excluding records with course grade of "Cr", "I" or "NC." Of those,

- 120 have missing scores (i.e., 0) on both TSIA Writing and WritePlacer
- 154 with scores in WritePlacer but missing TSIA Writing
- 1,046 with score in TSIA-Writing but missing WritePlacer
- 4,156 with scores on both TSIA-Writing and WritePlacer

Table 5 presents the course grade distribution for English composition courses based on the 4,156 records with scores on both TSIA Writing and WritePlacer.

[4] Assigned peer group based on classifications published in http://www.txhighereddata.org/Interactive/Accountability/PeerGroup.cfm

Table 3: Grade Distribution for Mathematics Courses

Course Grade	Frequency	MATH 1314	MATH 1324	MATH 1332	MATH 1342	MATH 1414	All
A	n	499	104	105	40	67	815
	%	21.47	25.94	20.51	19.51	27.02	22.09
A-	n						
	%						
B+	n						
	%						
B	n	529	90	114	38	43	814
	%	22.76	22.44	22.27	18.54	17.34	22.06
B-	n	2					2
	%	0.09					0.05
C+	n	4					4
	%	0.17					0.11
C	n	485	92	125	46	43	791
	%	20.87	22.94	24.41	22.44	17.34	21.44
C-	n						
	%						
D+	n						
	%						
D	n	266	42	64	28	29	429
	%	11.45	10.47	12.5	13.66	11.69	11.63
D-	n			1			1
	%			0.2			0.03
F	n	515	67	102	50	64	798
	%	22.16	16.71	19.92	24.39	25.81	21.63
W	n	24	6	1	3	2	36
	%	1.03	1.5	0.2	1.46	0.81	0.98
All	n	2,324	401	512	205	248	3,690
	%	100	100	100	100	100	100

Table 4: Grade Distribution for Reading-Intensive Courses

Course Grade	Frequency	GOVT 2301	GOVT 2302	GOVT 2305	GOVT 2306	HIST 1301	HIST 1302	HUMA 1301	PHIL 1301	PSYC 2301	SOCI 1301	All
A	n	20	4	381	106	971	199	54	69	772	267	2,843
	%	18.02	9.76	23.22	20.31	22.98	20.45	29.51	22.92	27.97	23.16	23.87
A-	n	6	1			4				2		13
	%	5.41	2.44			0.09				0.07		0.11
B+	n	3	1			6	1				1	12
	%	2.7	2.44			0.14	0.1				0.09	0.1
B	n	27	19	442	127	1,129	242	45	91	724	272	3,118
	%	24.32	46.34	26.93	24.33	26.72	24.87	24.59	30.23	26.23	23.59	26.18
B-	n	5				8	3			2		18
	%	4.5				0.19	0.31			0.07		0.15
C+	n		1			9	0			1	1	12
	%		2.44			0.21	0			0.04	0.09	0.1
C	n	22	10	380	123	946	226	34	51	544	256	2,592
	%	19.82	24.39	23.16	23.56	22.39	23.23	18.58	16.94	19.71	22.2	21.76
C-	n											
	%											
D+	n											
	%											
D	n	13	4	151	49	397	98	17	25	219	110	1,083
	%	11.71	9.76	9.2	9.39	9.39	10.07	9.29	8.31	7.93	9.54	9.09
D-	n											
	%											
F	n	15	1	284	115	746	199	33	62	486	242	2,183
	%	13.51	2.44	17.31	22.03	17.65	20.45	18.03	20.6	17.61	20.99	18.33
W	n			3	2	10	5		3	10	4	37
	%			0.18	0.38	0.24	0.51		1	0.36	0.35	0.31
All	n	111	41	1,641	522	4,226	973	183	301	2,760	1,153	11,911
	%	100	100	100	100	100	100	100	100	100	1000	100

Table 5: Grade Distribution for English Composition Courses

Course Grade	Frequency	ENGL 1301	ENGL 1302	All
A	n	1,177	22	1,199
	%	28.76	34.38	28.85
A-	n	6		6
	%	0.15		0.14
B+	n	11		11
	%	0.27		0.26
B	n	1,193	20	1,213
	%	29.15	31.25	29.19
B-	n	1		1
	%	0.02		0.02
C+	n	1		1
	%	0.02		0.02
C	n	770	9	779
	%	18.82	14.06	18.74
C-	n	4		4
	%	0.1		0.1
D+	n	1		1
	%	0.02		0.02
D	n	278	3	281
	%	6.79	4.69	6.76
D-	n			
	%			
F	n	644	9	653
	%	15.74	14.06	15.71
W	n	6	1	7
	%	0.15	1.56	0.17
All	n	4,092	64	4,156
	%	100	100	100

Average TSIA test scores for the extracted subsets are 351.98 for TSIA mathematics, 357.27 for TSIA reading, 362.35 for TSIA writing (based on records having none-zero writing placement score) and 4.88 for WritePlacer (based on records having none-zero WritePlacer score, respectively). Standard deviation, minimum, median, and maximum scores for each subset are also shown in Table 6.

Table 6: Descriptive Statistics for TSIA Placement Tests and WritePlacer Scores[5]

	Mean	Standard Deviation	Number of Records	Minimum	Median	Maximum
TSIA Mathematics	352.14	9.10	3,690	310	352	390
TSIA Reading	357.30	10.79	11,911	310	357	390
TSIA Writing	362.35	9.73	5,202	324	363	390
WritePlacer	4.88	0.96	4,310	1	5	8

Table 7 and Table 8 provide the percentage of successful (C- or higher) students by TSIA and WritePlacer scores. Students are classified into score intervals, and the proportion of students in that interval who received a score of C- or higher is the observed probability of success in the course. As expected, the proportion of successful completion tends to increase for students in higher score intervals.

[5] Descriptive test statistics were computed from data used in the study; that is, from Fall 2013, Spring 2014, Summer 2014, and Fall 2014.

Table 7: Percentage of Successful (C- or Higher) Students by TSIA Score

Mathematics				Reading-Intensive				English Composition			
TSIA Score Interval	N (C- or Higher)	N Total	%	TSIA Score Interval	N (C- or Higher)	N Total	%	TSIA Score Interval	N(C- or Higher)	N Total	%
310 - 315	6	13	46.15	310 - 315	19	35	54.29	310 - 315	0	0	NA
316 - 320	4	9	44.44	316 - 320	4	8	50.00	316 - 320	0	0	NA
321 - 325	10	21	47.62	321 - 325	21	47	44.68	321 - 325	1	1	100.00
326 - 330	13	34	38.24	326 - 330	50	101	49.50	326 - 330	5	6	83.33
331 - 335	40	80	50.00	331 - 335	99	185	53.51	331 - 335	15	16	93.75
336 - 340	70	137	51.09	336 - 340	195	338	57.69	336 - 340	31	45	68.89
341 - 345	157	291	53.95	341 - 345	298	506	58.89	341 - 345	116	162	71.60
346 - 349	249	395	63.04	346 - 350	570	854	66.74	346 - 349	167	237	70.46
350 - 355	1,071	1,700	63.00	351 - 355	2,233	3,239	68.94	350 - 355	573	746	76.81
356 - 360	382	517	73.89	356 - 360	1,818	2,453	74.11	356 - 362	989	1,313	75.32
361 - 365	212	256	82.81	361 - 365	1,393	1,841	75.67	363 - 365	625	816	76.59
366 - 370	102	121	84.30	366 - 370	956	1,165	82.06	366 - 370	708	905	78.23
371 - 375	61	66	92.42	371 - 375	479	582	82.30	371 - 375	449	548	81.93
376 - 380	26	27	96.30	376 - 380	241	282	85.46	376 - 380	185	218	84.86
381 - 385	15	15	100.00	381 - 385	98	124	79.03	381 - 385	88	104	84.62
386 - 390	8	8	100.00	386 - 390	134	151	88.74	386 - 390	74	85	87.06

Note: The lower bound of the TSIA interval below each of the thick lines are the college-ready cut scores.

Table 8: Percentage of Successful (C- or Higher) Students by WritePlacer Score

WritePlacer Score	N (C- or Higher)	N Total	%
1	6	8	75.00
2	22	29	75.86
3	138	218	63.30
4	794	1,072	74.07
5	1,649	2,110	78.15
6	560	691	81.04
7	108	124	87.10
8	50	58	86.21

Note: The low number of test takers with a score below 4 on WritePlacer should be interpreted with cautions, as most students with these scores did not appear in a college-level course, thus, were not included in the dataset for this study .

Data sets extracted for each course group contains multiple records for students who took multiple courses with different TCCN number. All of their grades in those courses were included in the analysis. Table 9 provides information on the number of students with grades in multiple courses in each data set used for the analyses. There were only four students in the mathematics data set who took two of the five mathematics courses and four in the English composition data set who took both English composition courses. There was no student in the mathematics data set who took more than two courses. For reading-intensive courses, one student took four, 14 students took three, and 159 students took two, of the 10 reading-intensive courses.

Table 9: Frequencies of Multiple Course Grades for Individual Students

Number of Course Grades	Mathematics	Reading-intensive	English Composition
One	3,682	11,547	4,148
Two	4	159	4
Three		14	
Four		1	

ANALYSES

Of primary interest to the THECB is the probability of success associated with each cut score. Specifically, these are as follows:

- Probability of successful completion of first semester credit-bearing mathematics courses associated with TSIA-M score of 350
- Probability of successful completion of first semester credit-bearing reading-intensive courses associated with TSIA -R score of 351
- Probability of successful completion of first semester credit-bearing English composition courses associated with WritePlacer score of 5 or higher and TSIA-W score of 350
- Probability of successful completion of first semester credit-bearing English composition courses associated with WritePlacer score of 4 and TSIA-W score of 363

The THECB defines successful completion of a course as receiving a grade of C- or higher. Withdrawal from the course is considered as unsuccessful completion. Students who received grades of I=Incomplete, NC=None Credit, and Cr=Credit were not included in any of the analyses. Biserial correlations were computed and logistic regression

models were fit to the data based on these rules. To provide the THECB additional comparative information, additional correlations were computed further logistic regression models were built to consider

- successful completion of a course is receiving a grade of B- or higher
- not including withdrawals in the analyses (i.e., removing from the data sets)

Biseral correlations were computed between the TSIA and WritePlacer scores and success in a course and presented in Table 10. For computing these correlations, withdrawal from the course is considered an unsuccessful completion.

Table 10: Correlation Between TSIA and WritePlacer Scores and Success in Associated Courses

Test	Course Grade (C- or Higher)	Course Grade (B- or Higher)
TSIA Mathematics	0.21	0.26
TSIA Reading	0.16	0.20
TSIA Writing	0.07	0.14
WritePlacer	0.09	0.13

The summary of logistic regression analyses performed for this study is presented in Table 11 for mathematics, reading-intensive, and English composition courses where a logistic regression model is appropriately fitted to the data. Analyses 1, 5, 9, 13, 17, and 37 highlighted on the table are the obligatory analyses while results from other analyses provide comparative information. The intercept and slope of the fitted logistic regression model for each analysis are also included in Table 11. Along with the slope and intercept coefficients are model-fit indicators that show how well the regression models fit the observed data. Two estimates of R^2 (Cox and Snell (1989) R^2 and Nagelkerke (1991) R^2) are provided in Table 11. The Nagelkerke R^2 estimate rescales the Cox and Snell R^2 value to obtain an upper bound of 1.00. Higher values indicate better model fit because more of the variance in the outcome (successful course completion) can be accounted for by variance in the predictor score. The Pearson χ^2 statistic for the Hosmer-Lemeshow (H-L) test, which tests the extent to which the fitted model reproduces the observed data, is also provided for each model. When the probability of the χ^2 is greater than .05 ($p > .05$), it is considered indicative that the model fits the data well. The slope estimate, R^2, and χ^2 are commonly used indices to assess model fit. The THECB might consider these statistics in deciding which model is best or if it chooses to adjust placement cut scores. Caution is highly encouraged in interpreting the results of the Hosmer and Lemeshow test as the χ^2 is highly sensitive to fairly small fit discrepancies in large samples.

The TSIA test score is a statistically significant predictor of successful completion of the course with a Wald χ^2 value that corresponds to a p-value less than 0.0001 for mathematics and reading-intensive, and the WritePlacer score is a statistically significant predictor of successful completion of the course with a Wald χ^2value that corresponds to a p-value less than 0.01 for English composition. For students who receive a WritePlacer score of 4, TSIA-W is not a statistically significant predictor of successful completion of the course when defining successful completion of a course as receiving a grade of C- or higher. However, when defining successful completion of a course as receiving a grade of B- or higher, TSIA-W is a statistically significant predictor of successful completion of the course with a Wald χ^2 value that corresponds to a p-value less than 0.01 for students who receive a WritePacer score of 4.

Table 11: Summary of Logistic Regression Analysis Performed

Analysis	Course	Predictor	Successful Completion		Withdrawal		Intercept	Slope	R^2		Hosmer and Lemeshow Test	
			C- or Higher	B- or Higher	Included	Not Included			Cox and Snell	Nagelkerke	^{2}	p-value
1	Mathematics	TSIA-M	✓		✓		-17.7950	0.0525*	0.0448	0.0619	35.3972	<.0001
2				✓	✓		-23.1489	0.0650*	0.0676	0.0905	63.7106	<.0001
3			✓			✓	-18.1183	0.0535*	0.0461	0.0640	35.8562	<.0001
4				✓		✓	-23.3090	0.0655*	0.0687	0.0920	63.7942	<.0001
5	Reading-Intensive	TSIA-R	✓		✓		-11.3518	0.0345*	0.0263	0.0380	4.2439	0.7513
6				✓	✓		-13.8092	0.0387*	0.0389	0.0519	10.3043	0.1720
7			✓			✓	-11.4665	0.0349*	0.0268	0.0387	11.3696	0.1816
8				✓		✓	-13.8603	0.0389*	0.0392	0.0523	10.3785	0.2395
9	English Composition	WritePlacer	✓		✓		0.1489	0.2218*	0.0072	0.0109	0.9212	0.6309
10				✓	✓		-1.0270	0.2798*	0.0156	0.0210	5.7726	0.0558
11			✓			✓	0.1655	0.2199*	0.0070	0.0107	1.0614	0.5882
12				✓		✓	-1.0173	0.2787*	0.0155	0.0208	6.0968	0.0474
13		TSIA-W	✓		✓		-5.1731	0.0177*	0.0051	0.0078	9.4833	0.3032
14				✓	✓		-10.2797	0.0294*	0.0190	0.0256	10.2356	0.2489
15			✓			✓	-5.2691	0.0180*	0.0053	0.0080	8.8794	0.3526
16				✓		✓	-10.3449	0.0296*	0.0192	0.0259	9.7414	0.2836
17		TSIA-W WrtiePlacer Scores of 4	✓		✓		-3.7459	0.0132	0.0024	0.0035	10.7162	0.2183
18				✓	✓		-7.5407	0.0212**	0.0077	0.0104	15.4994	0.0501
19			✓			✓	-4.0330	0.0140	0.0026	0.0039	11.3732	0.1814
20				✓		✓	-7.7595	0.0218**	0.0081	0.0109	15.8633	0.0444
21		TSIA-W WP Scores of 1-8	✓		✓		-6.1000	0.0203*	0.0068	0.0103	7.9720	0.4362
22				✓	✓		-11.1261	0.0317*	0.0222	0.0300	10.6250	0.2239
23			✓			✓	-6.2337	0.0207*	0.0070	0.0107	6.5373	0.5873
24				✓		✓	-11.2133	0.0319*	0.0226	0.0304	10.3573	0.2408
25		TSIA-W WP Scores of 2-8	✓		✓		-6.0914	0.0202*	0.0068	0.0103	6.8736	0.5503
26				✓	✓		-11.1522	0.0318*	0.0223	0.0300	10.5560	0.2281
27			✓			✓	-6.2253	0.0206*	0.0070	0.0106	6.6446	0.5754
28				✓		✓	-11.2399	0.0320*	0.0226	0.0304	10.5011	0.2316

Analysis	Course	Predictor	Successful Completion		Withdrawal		Intercept	Slope	R^2		Hosmer and Lemeshow Test	
			C- or Higher	B- or Higher	Included	Not Included			Cox and Snell	Nagelkerke	χ^2	p-value
29		TSIA-W WP Scores of 3-8	✓		✓		-6.1728	0.0205*	0.0069	0.0105	6.5229	0.5889
30				✓	✓		-11.0622	0.0315*	0.0219	0.0295	10.5466	0.2287
31			✓			✓	-6.3070	0.0209*	0.0071	0.0108	6.2845	0.6154
32				✓		✓	-11.1495	0.0318*	0.0222	0.0299	10.4987	0.2318
33		TSIA-W WP Scores of 4-8	✓		✓		-5.7246	0.0193*	0.0060	0.0091	7.2899	0.5057
34				✓	✓		-10.6955	0.0306*	0.0203	0.0274	8.7371	0.3650
35			✓			✓	-5.8592	0.0197*	0.0062	0.0095	6.3546	0.6076
36				✓		✓	-10.7837	0.0308*	0.0206	0.0278	8.2976	0.4050
37		TSIA-W WP Scores of 5-8	✓		✓		-7.2815	0.0239*	0.0092	0.0144	4.1086	0.8472
38				✓	✓		-12.5315	0.0359*	0.0291	0.0394	1.9398	0.9828
39			✓			✓	-7.3332	0.0240*	0.0093	0.0146	3.6954	0.8835
40				✓		✓	-12.5552	0.0360*	0.0292	0.0396	1.9464	0.9826
41		TSIA-W WP Scores of 6-8	✓		✓		-10.1415	0.0321*	0.0164	0.0269	23.6228	0.0027
42				✓	✓		-11.6569	0.0340*	0.0268	0.0373	14.1567	0.0778
43			✓			✓	-10.1684	0.0322*	0.0164	0.0270	24.0422	0.0023
44				✓		✓	-11.6598	0.0340*	0.0268	0.0374	14.7383	0.0644

* Slopes are statistically significant with Wald χ^2 p-values less than 0.0001.

** Slopes are statistically significant with Wald χ^2 p-values less than 0.01.

RESULTS

Forty-four logistic regression models were fitted to the data to predict success in mathematics, reading-intensive, and English composition courses. TSIA mathematics and reading multiple choice tests were used as respective predictors of success in mathematics courses and reading-intensive courses. WritePlacer was used as a predictor for success in the English composition courses in this study. Given that TSIA writing and WritePlacer scores were used conjunctively for placement if the student was not placed using WritePlacer, regression models were also fitted for English composition data using TSIA-W scores conditioned on WritePlacer scores, as well as TSIA-W, per se. Each model provides the expected probability of successful course completion associated with placement scores or WritePlacer scores plotted in Figures 1 through 11 and tabulated in Appendix B, C, and D-1 – D-9. Each of the logistic regression model estimated by the data indicates that there is an increase in the predicted probability of success in the courses as the TSIA test score or WritePlacer score increases. That is, students with higher test scores have a higher probability of succeeding in the courses than students with lower test scores. For example in Figure 1 (orange curve), a student with an TSIA-M score of 347 has a 60% chance of obtaining a C- or higher grade in the mathematics courses, while the corresponding probability for a student with a score of 365 is 80%.

Results provided in detail in Figures 1—11 and Appendices B, C, and D-1 — D-9 are summarized in Table 12, where the expected probability of success associated with the Placement cut scores are indicated for each definition of successful completion on a course and each manner of accounting for course withdrawals. The results highlighted in the table are those that are of particular interest to the THECB. They are the expected probabilities of successful course completion associated with the placement cut scores, where successful course completion means receiving a grade of C- or higher and that withdrawing from the course is considered an unsuccessful completion.
Caution is highly encouraged when interpreting the expected probability of successful course completion for English composition courses for cut score of the WritePlacer of 4 and TSIA-W of 363, as the prediction slope for this model is not statistically significant.

Other expected probabilities in Table 12 and Appendices B, C, and D-1 – D-9 are provided as additional information to the THECB in reviewing its placement policy.

Table 12: Summary of Results

Course	Predictor/Cut Score	P(C- or Higher; W Included)	P(C- or Higher; W Excluded)	P(B- or Higher; W Included)	P(B- or Higher; W Excluded)
Mathematics	**TSIA-M=350**	0.64	0.65	0.40	0.41
Reading-Intensive	**TSIA-R=351**	0.68	0.69	0.44	0.45
English Composition	**WP=5 and TSIA-W=350**	0.75	0.74	0.51	0.51
	WP= 4 and TSIA-W=363	0.74	0.74	0.54	0.54
	WP=5	0.78	0.78	0.59	0.59
	TSIA-W=350	0.74	0.74	0.50	0.50
	TSIA-W=363	0.78	0.78	0.60	0.60

Figure 1: Expected Probability of Success in Mathematics Courses Predicted by TSIA-M

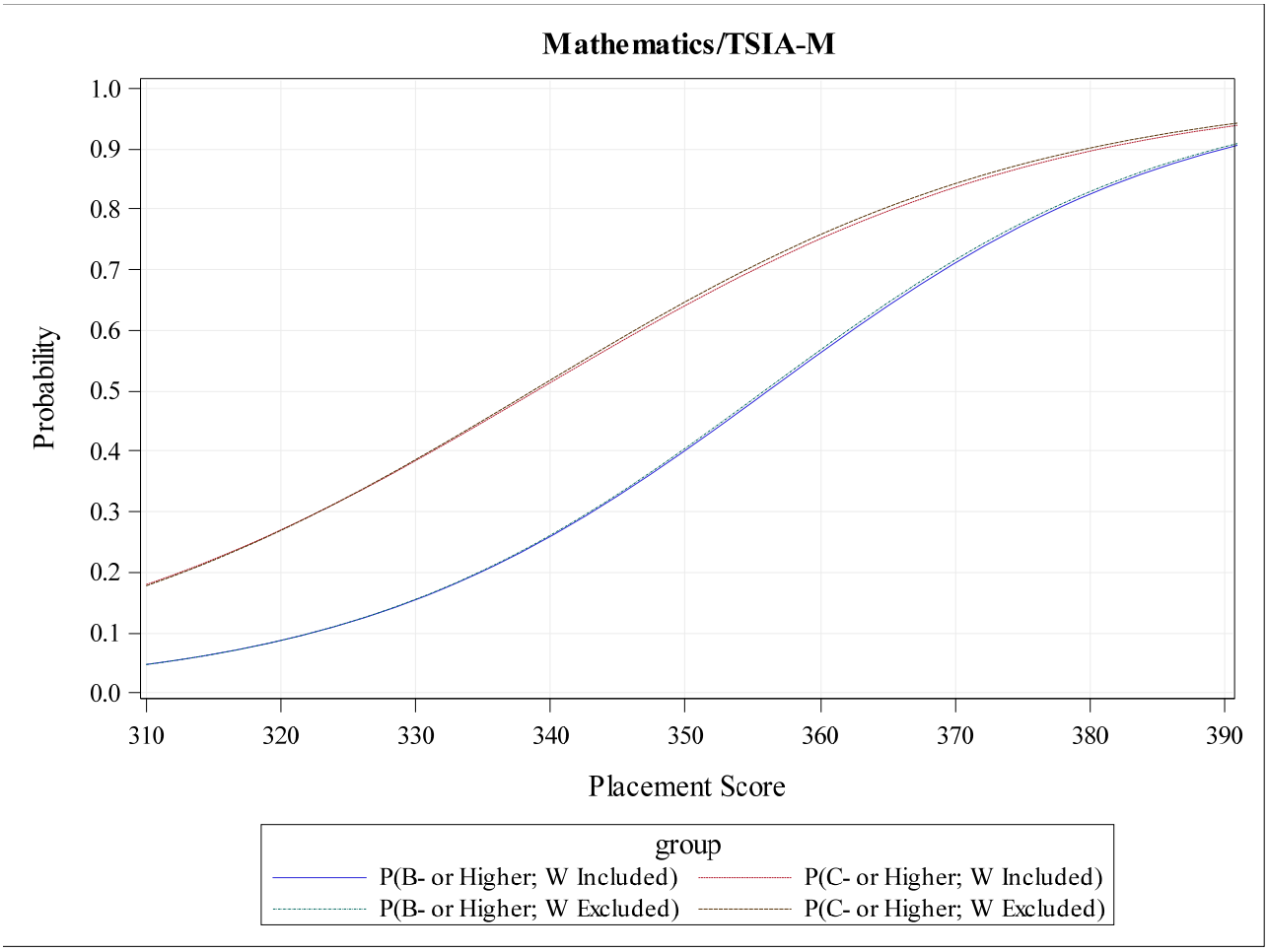

Figure 2: Expected Probability of Successful Reading-Intensive Course Completion Predicted by TSIA-R

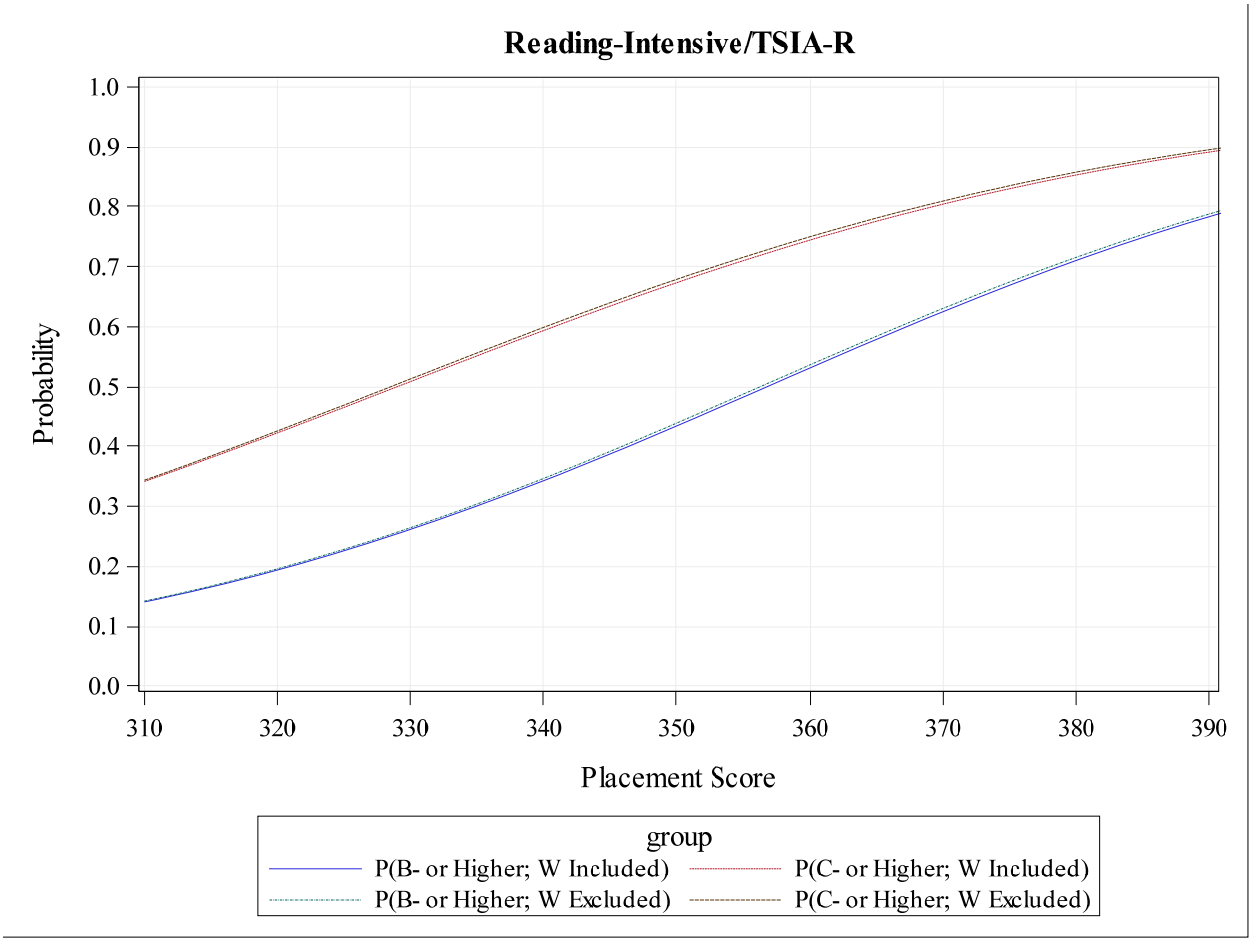

Figure 3: Expected Probability of Successful English Composition Course Completion Predicted by WritePlacer

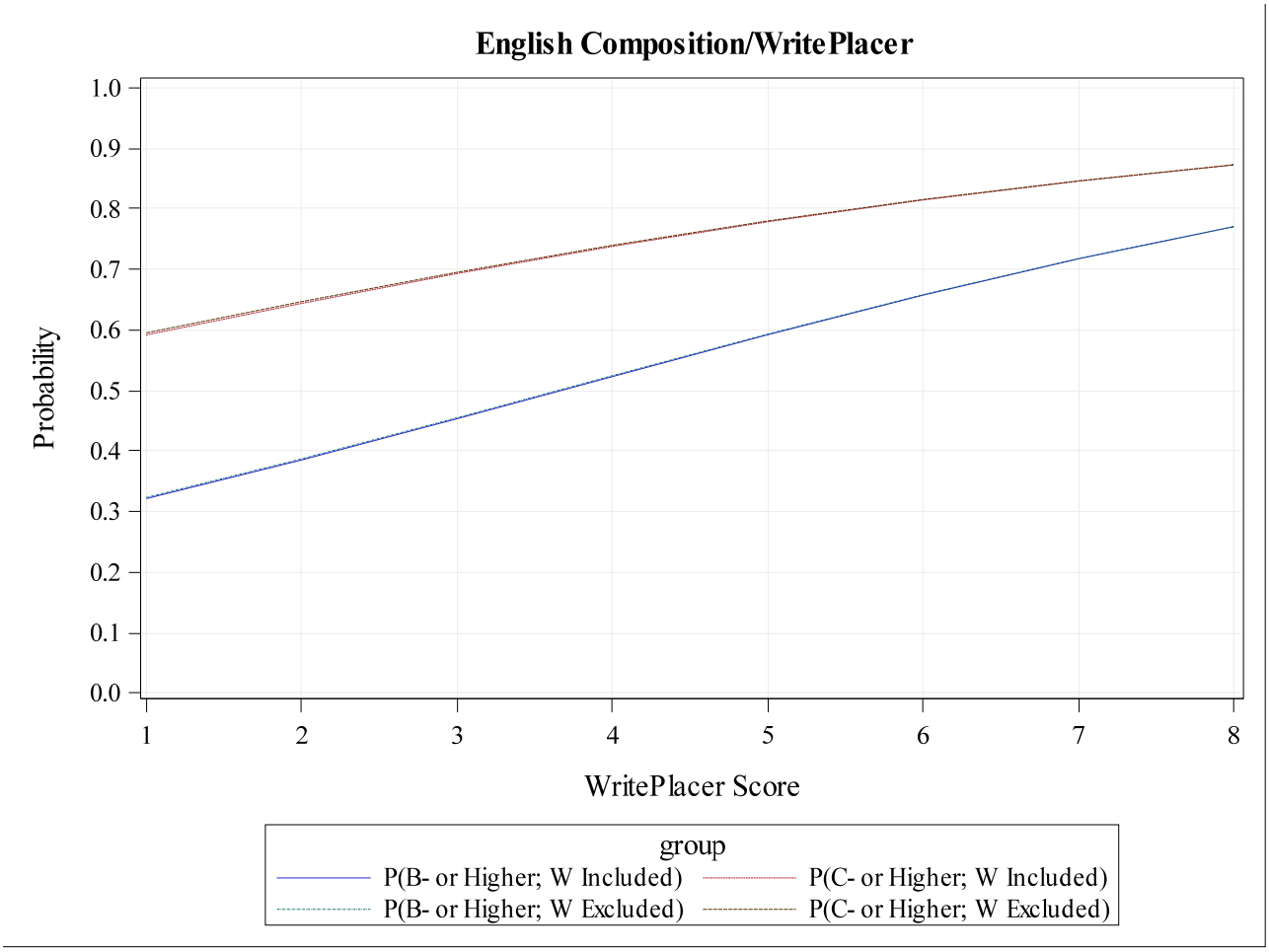

Figure 4: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W

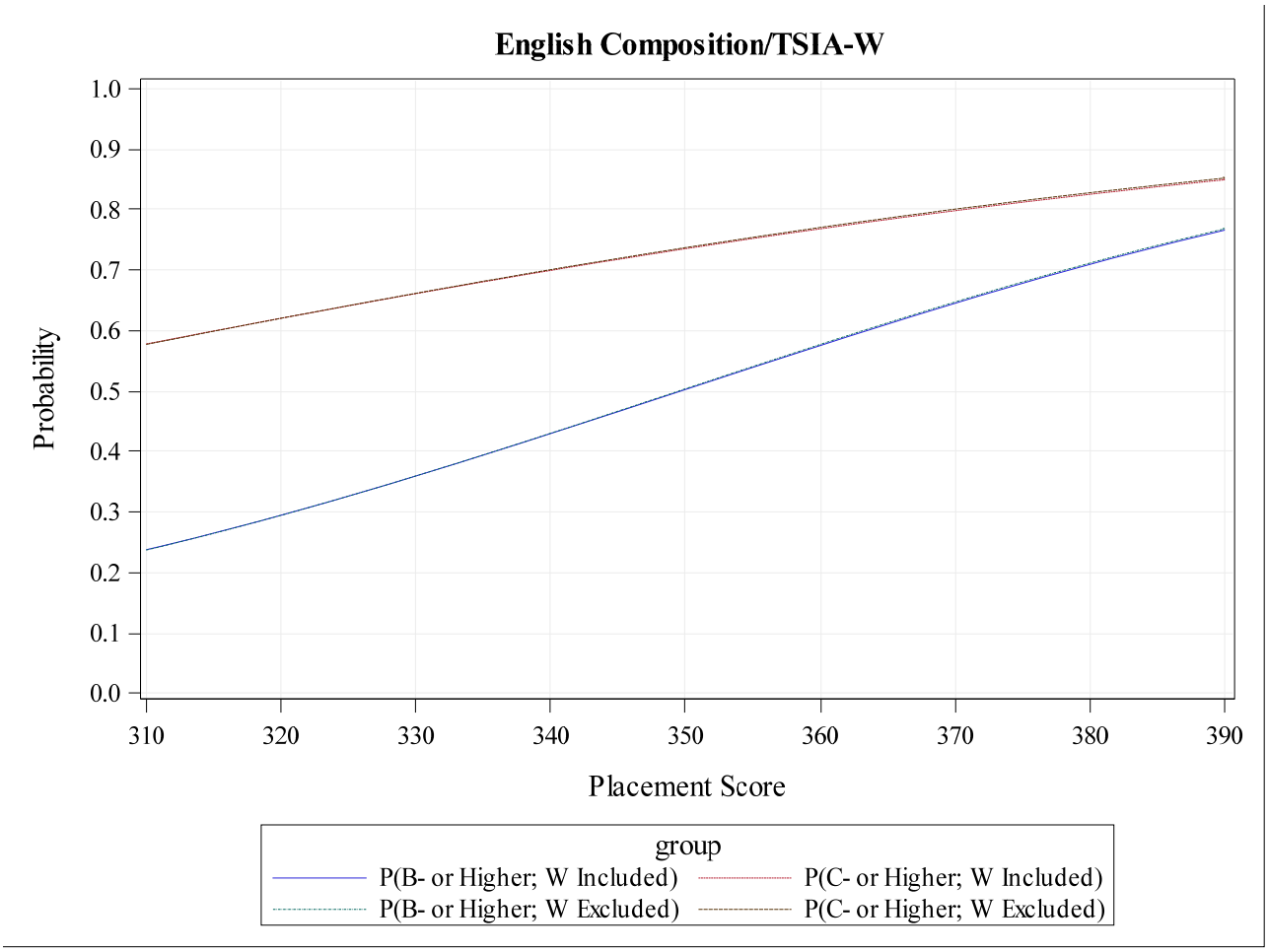

Figure 5: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for Students with WritePlacer Score of 4

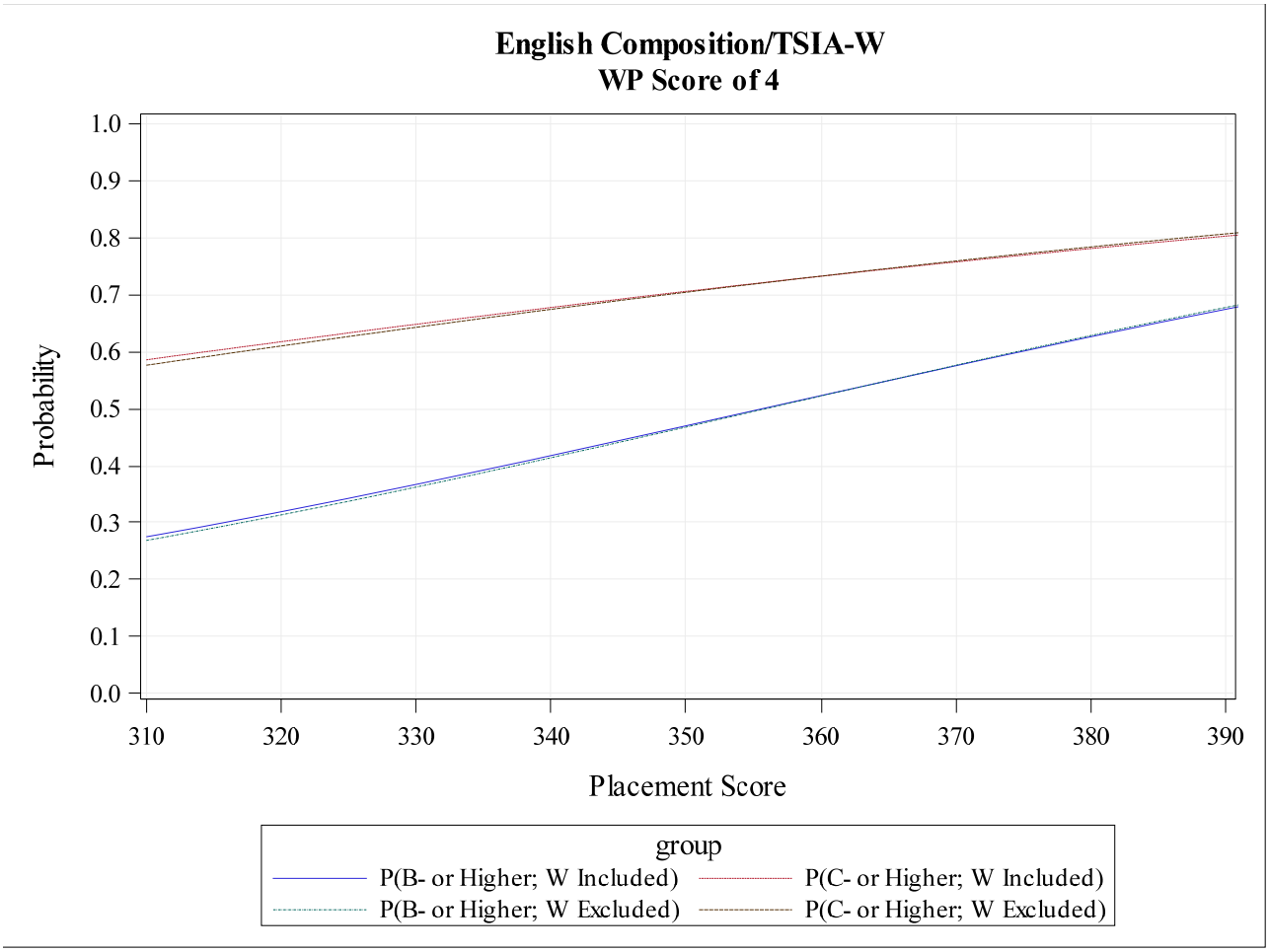

Figure 6: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for Students with WritePlacer Score of 1 or Higher

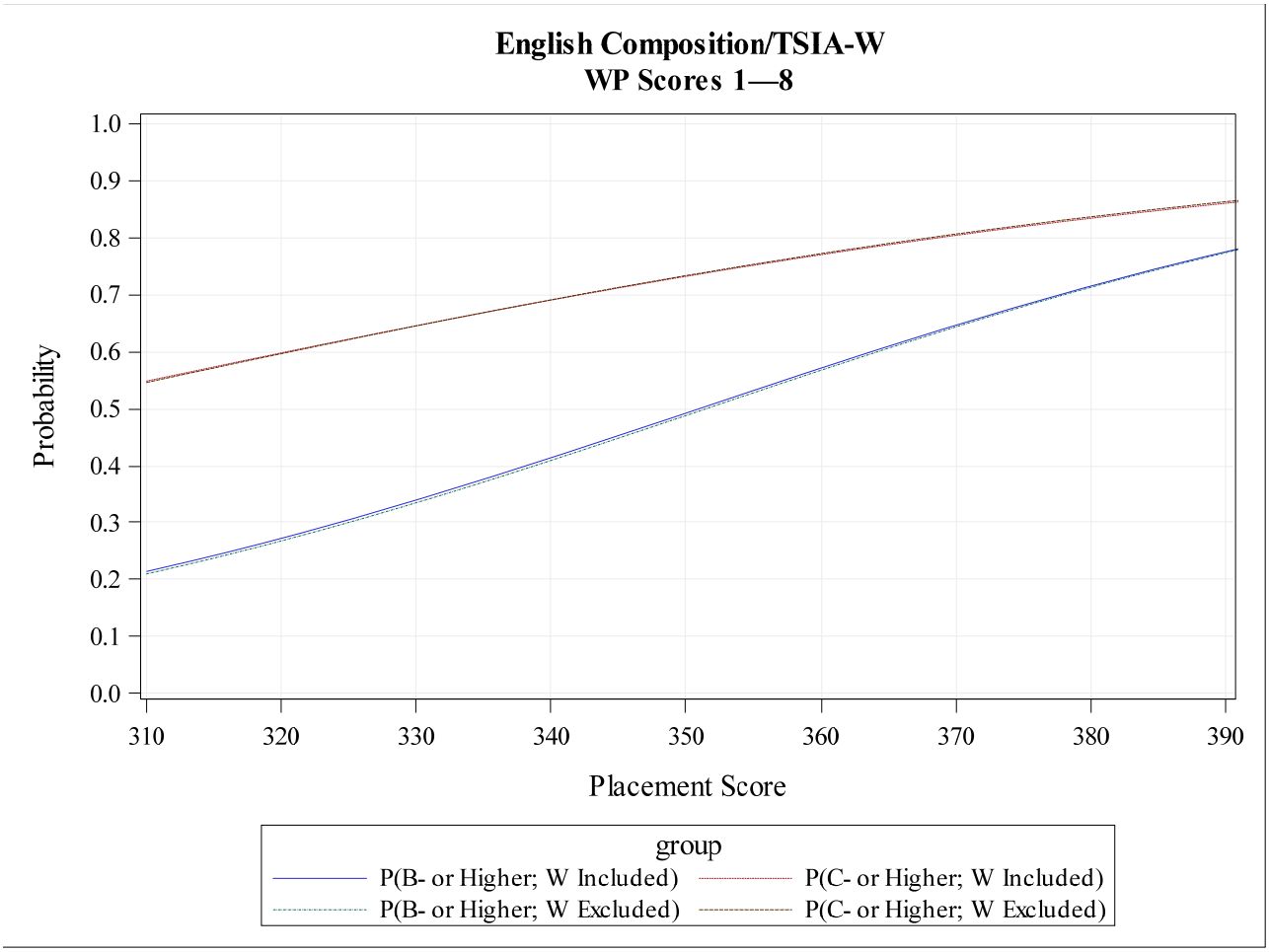

Figure 7: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for Students with WritePlacer Score of 2 or Higher

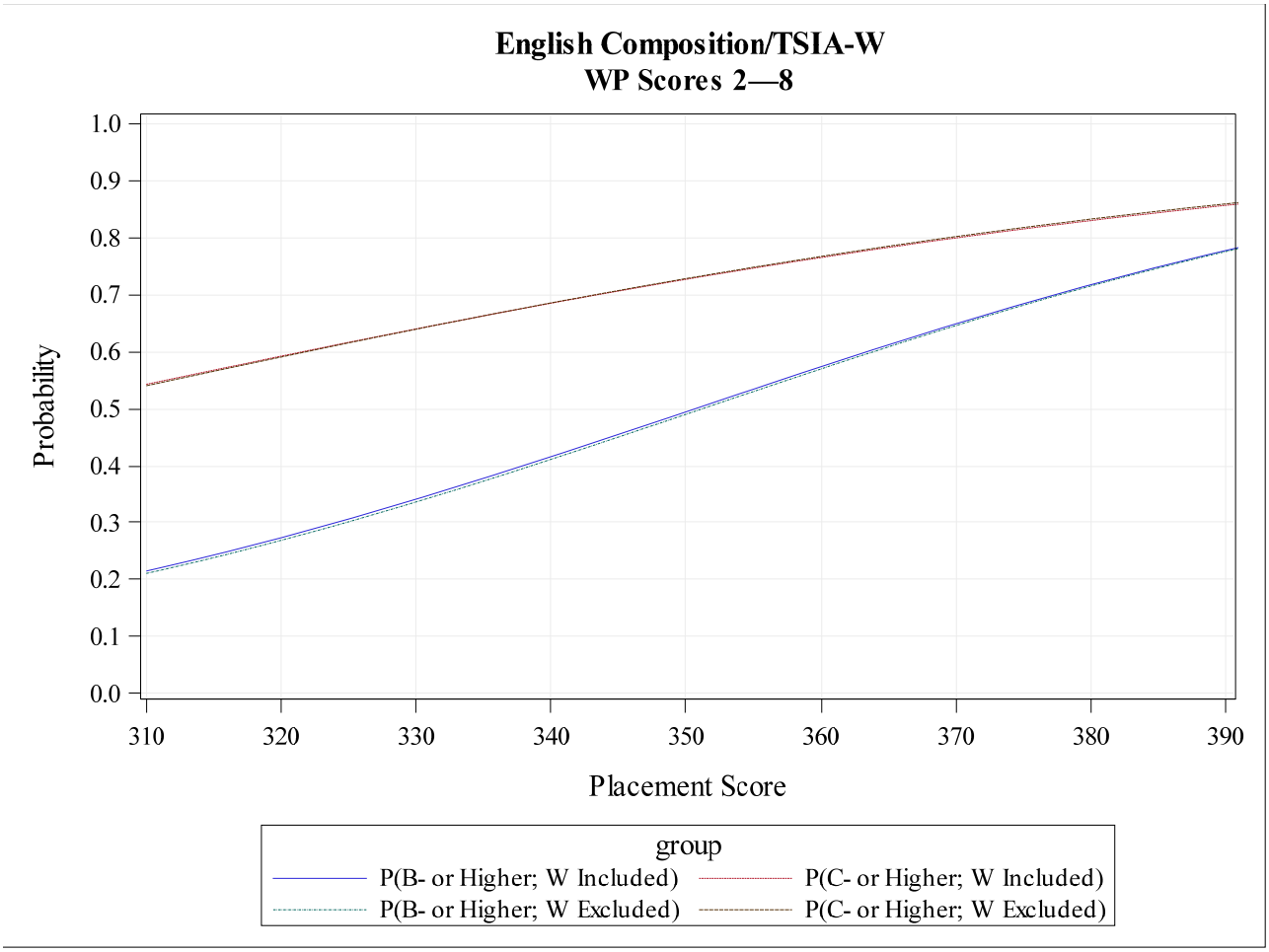

Figure 8: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for Students with WritePlacer Score of 3 or Higher

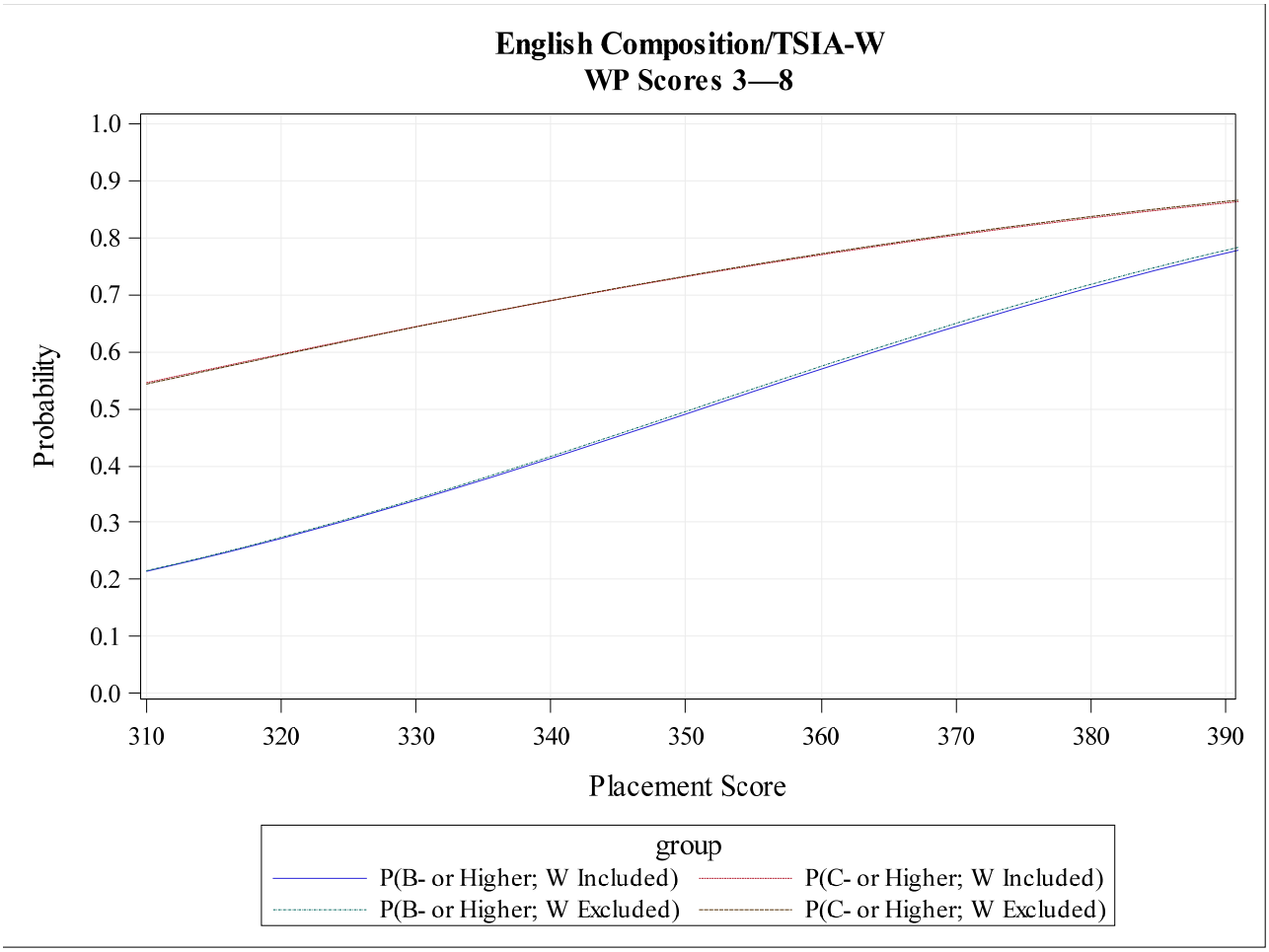

Figure 9: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for Students with WritePlacer Score of 4 or Higher

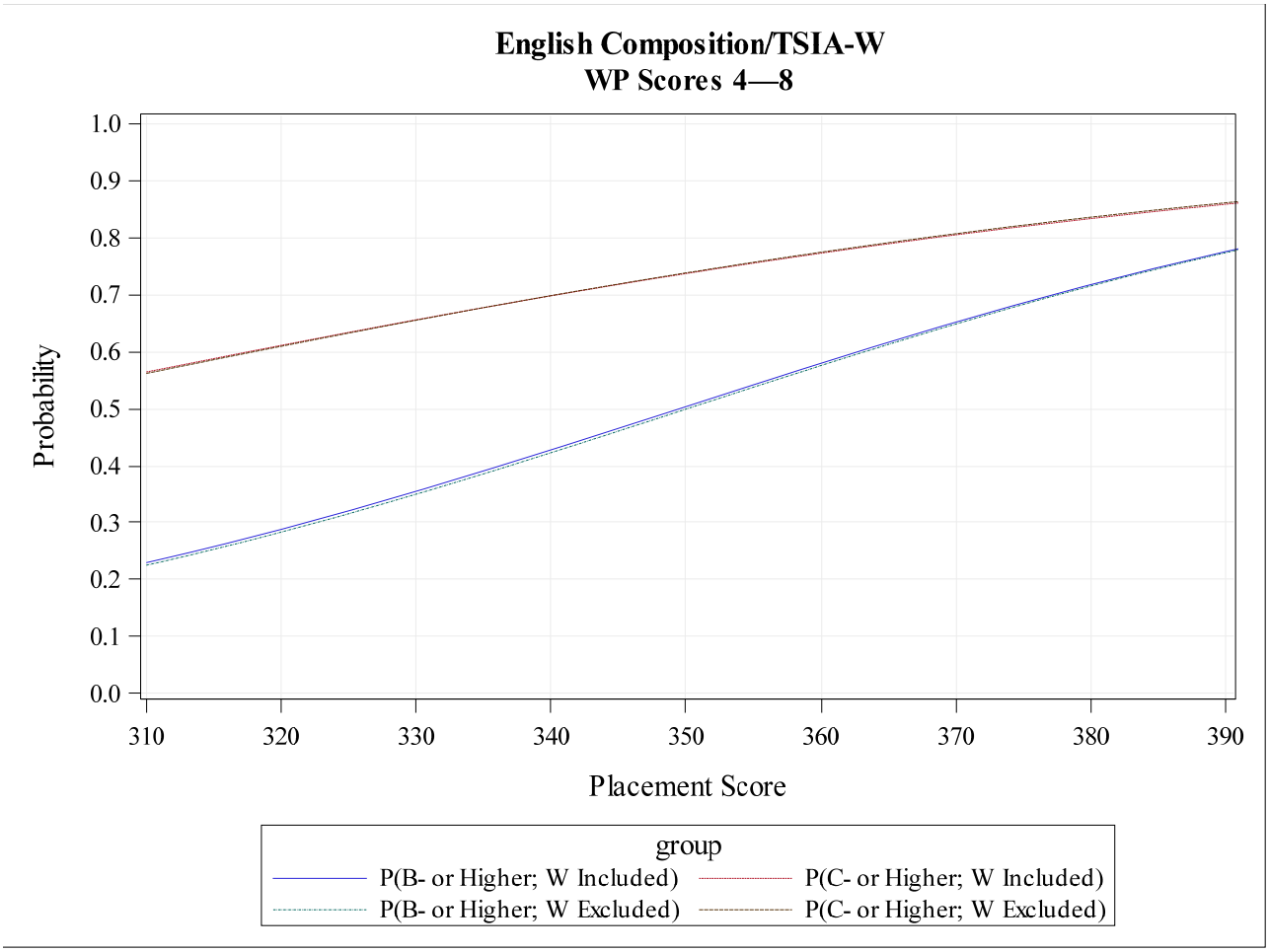

Figure 10: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for Students with WritePlacer Score of 5 or Higher

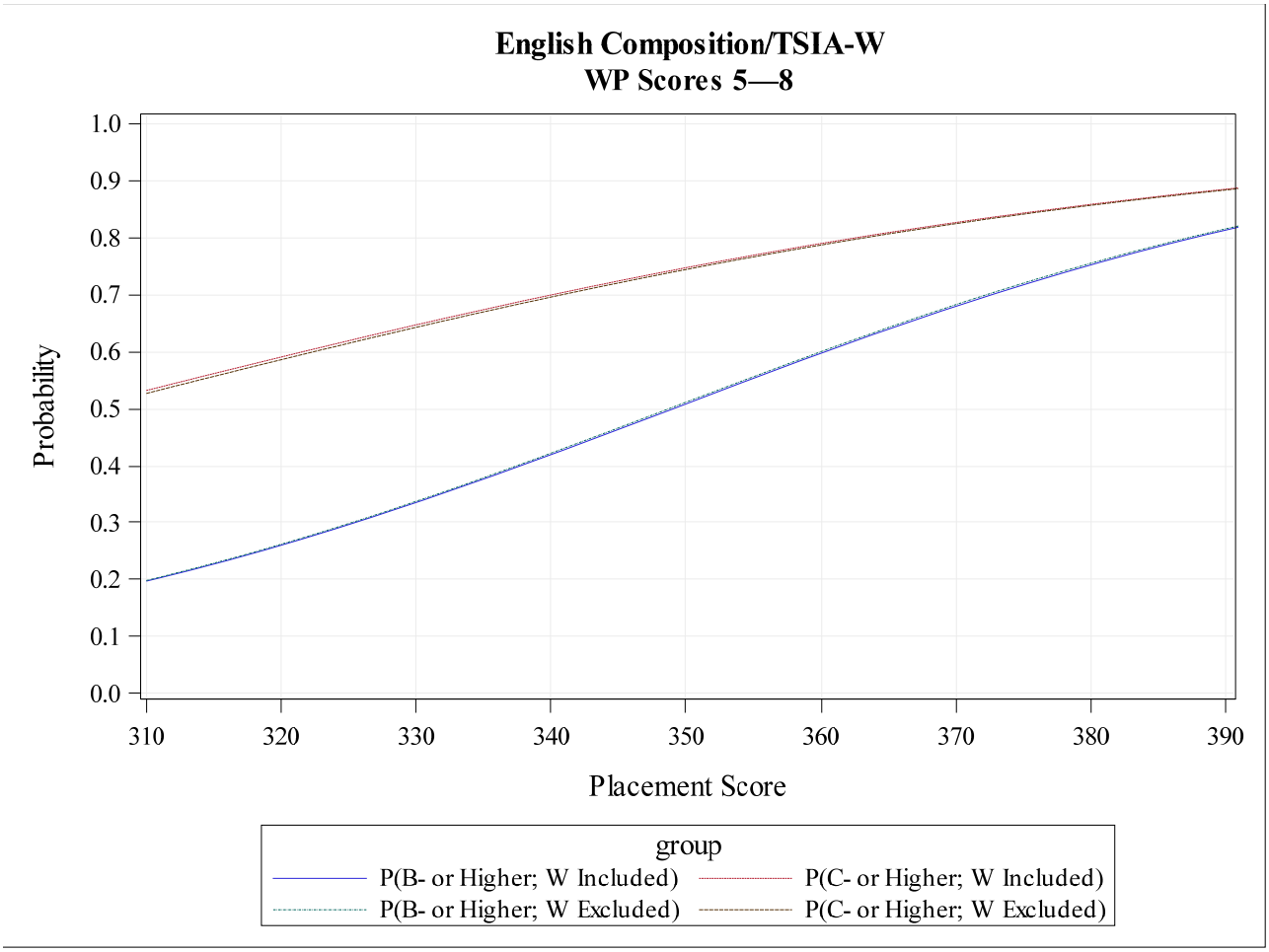

Figure 11: Expected Probability of Successful English Composition Course Completion Predicted by TSIA-W for Students with WritePlacer Score of 6 or Higher

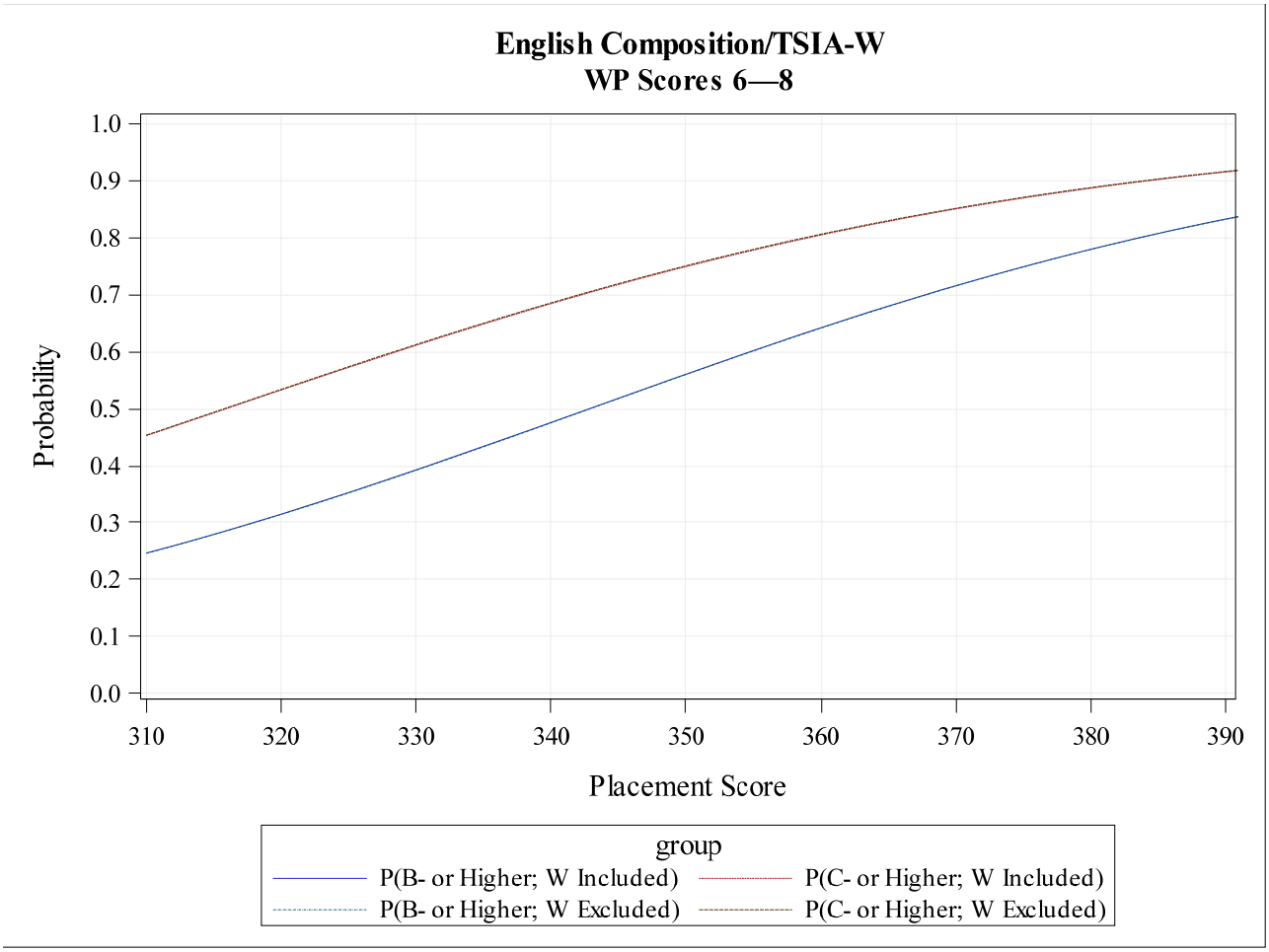

Table 13 presents the percentage of students for whom a placement decision based on current cut scores would be considered correct given the grades they received. Correctly-placed students are those who satisfied the placement requirements (receiving a score higher than the cut score) and passed the course, or who didn't satisfy the placement requirements and failed the course. Table 13 also includes the percentages of students who were under-placed as well as those who were over-placed. Under-placed students are those who did not satisfy the placement requirements but passed the course while over-placed students are those who satisfied the placement requirements but failed the course.

Table 13: Percentages of Correct Placement, Under-Placement, and Over-Placement

Course	Cut Scores	Correct Placement	Under Placement	Over Placement
Mathematics	**TSIA-M=350**	62.55	14.88	22.57
Reading-Intensive	**TSIA-R=351**	68.59	10.54	20.86
English Composition	**WP=5 and TSIA-W=350**	74.87	7.36	17.77
	WP= 4 and TSIA-W=363	59.91	24.39	15.70
	WP=5	63.43	22.27	14.29
	TSIA-W=350	73.49	6.44	20.07
	TSIA-W=363	53.02	36.47	10.52

Note: The THECB defines successful completion of a course as receiving a grade of C- or higher. Withdrawal from the course is considered as unsuccessful completion. Students who received grades of Incomplete, No Credit, or Credit were not included in these analyses.

Cox, D. R. and Snell, E. J. (1989). *The analysis of binary data, second edition*. London: Chapman & Hall.

Hosmer D.W. and S. Lemeshow (1980). A goodness-of-fit test for the multiple logistic regression model. *Communications in statistics,* A10, 1043-1069.

Nagelkerke, N. J. D. (1991). A note on a general definition of the coefficient of determination. *Biometrika*, 78, 691–692.

The College Board (2014). TSI Assessments Program Manual Combined. New York: Author.

The College Board (2015). TSI Assessments Program Technical Manual. New York: Author.