TECHNICAL MANUAL

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1. Introduction to Tailwind Placement Exams

The Tailwind Placement Exams program is a partnership between the University of Wisconsin System and Castle Worldwide Inc. which brings the highly successful University of Wisconsin placement tests to the national market. Tailwind Placement Exams are designed to provide information about students' readiness to study in college-level courses in mathematics, English/College Writing, French, German, and Spanish. The test objectives and items are written by University of Wisconsin faculty and staff who teach the introductory courses in which students are placed in these disciplines. The item writers work in conjunction with experts in Educational Measurement when writing and assessing the quality of test items. Exams are delivered through Castle Worldwide's secure Internet-based test delivery engine.

1.1 The Purpose of Placement Testing

Placement into college courses is the sole purpose of the Tailwind Placement exams. The exams are a tool to assist advisors in placing students into the best course in a sequence in each of the five disciplines. The questions on the exams were selected with this single purpose in mind, therefore the exams are narrowly focused on the knowledge and skills required to begin study in these courses and not the full range of material that is learned in the course. Placement testing in higher education is part of the instructional process. It is a specific kind of testing designed to provide information to advisors to help them determine in which courses students should be placed. If students are properly placed in a given subject, it is expected that they will learn more than they will if they are improperly placed.

Placement testing is done under the assumption that no one course provides the greatest payoff (i.e. in terms of material learned, cost of instruction, institutional expenditures, etc.) for students at all levels of incoming preparation. The different levels of preparation students bring with them are assumed to be directly related to differences in their abilities to learn at either a beginning or a more advanced level in a particular sequence of courses. Thus, a test used for making placement decisions must be able to (a) measure the student's level of educational preparation and also (b) predict which course placement will maximize learning. That is, the outcome of a placement test is the placement of a student in one of the courses in a particular sequence. This placement is based on the expectation that learning is maximized when a student is placed into a course which is challenging yet doable.

Although placement tests have gained national prominence due to their role in identifying students in need of remediation, national research shows that most students attending college are, in fact, ready for credit-bearing work. Consequently, placement exams have to be informative enough to place students into an appropriate course within the remedial/developmental sequence, yet also must be complex enough to accurately identify those students whose skills are mature enough to warrant placing above the first course in a sequence. As such, placement exams must not only include enough pre-college material to accurately place students into or out of remedial/developmental level coursework, but also must include advanced college level material to differentiate between placement into multiple credit-bearing courses within the course sequence.

1.2 The Test Development Committees

Each discipline represented in the Tailwind Placement Exams Program has a test development committee associated with it. The members of these committees are University of Wisconsin System faculty and instructional staff in the various disciplines. In addition, each committee has a representative from Wisconsin high schools, and the math and Combined Writing and Reading committees include one faculty member from the Wisconsin Technical College System. The committees for the world language exams always contain at least one member who is a native speaker of the language. The responsibilities of these committees are to develop a set of specifications for the exam, balance the content to be represented on the exam, and write items for that exam.

The members of the test development committees undergo an initial period of training in principles of educational testing, including writing test items and interpreting item analysis statistics. As a result of this training, committee members are expected to serve a minimum of five years on the committees; ordinarily, the maximum appointment is eight years, so that more faculty and staff are able to be involved and the committee continues to hear new perspectives. In addition, an expert in Educational Measurement is present at each meeting to guide item writing and consult on issues of test construction, test validation, scaling, scoring or reporting.

Each committee meets multiple times a year to write items, review results from the previous administration of the test items, and to construct new test forms.

2. Description of Tailwind Exams

2.1 The Combined Writing and Reading Exam

2.1.1 Overview and Blueprint

The Combined Writing and Reading Placement Exam is comprised of three broad categories of items: Usage, Sentence Correction, and Reading Comprehension. The Usage and Sentence Correction items together make up the Writing Mechanics Section of the exam. While the length of the exam varies slightly from year to year, in any given year the test will consist of approximately 100, five-alternative, multiple choice items. The Combined Writing and Reading Placement Exam is designed to be completed in 90 minutes. The UW Center for Placement Testing has conducted extensive research on the test's timing and speededness and has found that the current length and timing is sufficient time for the overwhelming majority of students to complete the test comfortably. Scores on the Combined Writing and Reading exam range from 15 to 85 and are scaled to have a mean of 50 and standard deviation of 10.

The Writing Mechanics section deals with a student's ability to distinguish problems in ten different classifications. The percentage of total Writing Mechanics items (i.e., Usage and Sentence Correction combined) selected from each classification is shown in Table 1.

Table 1

Writing Mechanics Blueprint for the Tailwind Combined Writing and Reading Placement Exam

	Objectives	Percentage of Exam
1.	Run-on, Comma-splice, Fragment	17.5
2.	Parallelism and Subordination	12.5
3.	Adverb/Adjective/Comparison	10.0
4.	Punctuation for Clarity	10.0
5.	Subject-Verb Agreement	10.0
6.	Tense and Form	10.0
7.	Pronoun Agreement, Case, Reference	10.0
8.	Dangling and Misplaced Modifiers	7.5
9.	Idiom and Diction	7.5
10.	Economy and Word Order	5.0

The Reading Comprehension section requires students to demonstrate the ability to understand and interpret prose passages comparable to those they will read in college. A list of objectives covered on the Reading Comprehension section is provided in Table 2.

Table 2

Reading Comprehension Objectives or the Tailwind Combined Writing and Reading Placement Exam

	Objectives
1.	Literal Meaning
2.	Inference
3.	Principles of Organization
4.	Main Point/Main Idea
5.	Development
6.	Tone
7.	Audience
8.	Vocabulary in Context
9.	Figurative Language
10.	Purpose
11.	Rhetorical Strategy

Three scores are reported for the Tailwind Combined Writing and Reading Placement Exam: (1) a Writing Mechanics subscore, (2) a Reading Comprehension subscore, and (3) a Total Combined Writing and Reading score based on all scored items.

2.1.2 Sample Items

English Usage (Writing Mechanics)

English Usage items require a student to identify deviations from standard written American English. The directions for the English Usage section and a sample item are provided below.

Directions:

Some of the following sentences contain an error in grammar, usage, punctuation, or word choice. Some sentences are correct. No sentence contains more than one error. The error, if there is one, is underlined and lettered. It is permissible to change, add, or delete words or punctuation when correcting the error. Assume that all other elements of the sentence are correct and cannot be changed. In choosing answers, follow the requirements of standard written English.

If there is an error, select the one underlined part that must be changed in order to make the sentence correct. If there is no error, select the final option, E.

EXAMPLES

1. Allan is afraid of the rain, he likes the thunder. No error.
   A B C D E

The correct answer is C. Note that when the punctuation is in question, the underlining may extend beneath a space, as in 1C.

2. How well the new comedy series does in the ratings depends almost entirely on its
   A B C D
   competition. No error.
   E

The correct answer is E. This sentence does not contain an error.

3. Having enjoyed the scenery, the steamer next took us to Bird Isle, an island whose history
   A B C
   was hardly known until 1900. No error.
   D E

The correct answer is A.

Sentence Correction (Writing Mechanics)

Sentence Correction items require a student to select the most effective expression from among five choices. The directions for the Sentence Correction section and example items are provided below.

Directions:

This is a test of correctness and effectiveness of expression. In choosing answers, follow the requirements of standard written English; that is, pay attention to acceptable usage in grammar, word choice, sentence construction, and punctuation. Choose the answer that produces the most effective sentence -- clear and exact, without wordiness or ambiguity. **Do not make a choice that changes the meaning of the original sentence.**

In each of the sentences of this section, one portion is underlined. Beneath each sentence you will find five ways of writing the underlined part; the first of these always repeats the original, and the other four are all different. If you think the original sentence is better than any of the suggested changes, choose the first answer A; otherwise, select the best revision.

EXAMPLES

1. One method of ending discrimination in business and industry is to demand quotas to be met by employers.

    A. to demand quotas to be met by employers.
    B. demanding employers to meet quotas.
    C. to demand that employers meet quotas.
    D. that employers be demanded to meet quotas.
    E. that of demanding employers to meet quotas.

The correct answer is C.

2. Coach Jones is a remarkable physical specimen: although sixty, he is as vigorous as ever.

    A. although sixty, he is as vigorous as ever.
    B. he, seeing that he is sixty, is as vigorous as ever.
    C. he is sixty, being as vigorous as ever.
    D. as vigorous as ever, he is sixty years of age.
    E. he is as vigorous as ever; however he is sixty.

The original sentence is the best option, therefore the correct answer is A.

3. Just as I was despairing, a nun passes by and whispers encouragement.
   A. passes by and whispers
   B. is passing by and whispered
   C. is passing by and whispers
   D. passed by and whispers
   E. passed by and whispered

The correct answer is E.

Reading Comprehension

The Reading Comprehension section of the Combined Writing and Reading exam consists of 6-7 reading passages, each accompanied by a set of items. The directions for the Reading Comprehension section and an example passage with items are provided on the next page.

Directions:

The passages below are followed by questions on the vocabulary, style, and meaning of the passages. After reading each passage, choose the best answer to each question. Answer all questions in terms of the context within the passage.

EXAMPLE

Neurobiology, the study of the brain and its behavior, is one of the fastest growing of the biological sciences today. Electrical recording devices can be inserted even into single cells within the brain; the electron microscope can be used for fine study of the brain structures; and biochemical techniques are available for detecting changes in the brains of experimental animals as they learn. All of these have contributed to an increasing understanding of the relationship between brain structure and function, and of the control processes which govern the relationships between the brain and the rest of the body, and between both of these and behavior. People often ask to what extent the operation of an animal or a human brain is predictable and manipulable—to what extent the brain is like a computer.

We can describe the operation of the brain in terms of information theory, which has also been used in the design of computers, and quite a few research workers today believe that it would be possible to understand more of the mechanism of the brain if we could make mathematical models of the interactions of individual nerve cells.

. . . The comparison with computers is a valuable analogy of the sort that is useful in stimulating scientific research and understand, but the most powerful computers yet built are not really capable of showing the "intelligence" of a worm, still less of a human being. Nonetheless, if we understand computers, we may learn more about the brain, and by studying the brain we may well discover how to build better computers.

Cells and Organisms
Science Foundation Course Team
The Open University, Walton Hall
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1. The word "analogy" in line 13 most nearly means
   A. experiment.
   B. function.
   C. structure.
   D. comparison.
   E. cause.

2. The first paragraph states that there are
   A. detectable changes in the brains of animals as they learn.
   B. changes in the size of brains of animals as they learn.
   C. microscopic electronic changes in animal brain cells during learning.
   D. changes in the relationship between brain and behavior as animals learn.
   E. no changes in the brains of animals as they learn.

3. The third paragraph implies that the most powerful computers
   A. are "smarter" than the most intelligent human being.
   B. promise to solve the riddle of the brain structure and function.
   C. are incapable of human intelligence.
   D. utilize electronic and biochemical techniques.
   E. will work their way into more scientific research.

4. The passage implies that if we could make mathematical models of the interactions of brain cells we would
   A. reach a greater understanding of the brain.
   B. no longer need electron microscopes and biochemical techniques.
   C. dictate human behavior absolutely.
   D. move beyond the use of the worm as an experimental animal.
   E. be able to insert electrical recording devices even into single brain cells.

5. The passage describes the relationship between neurobiology and computer science as
   A. competitive.
   B. mutually helpful.
   C. a relation of an art to a science.
   D. a relation of a young science to a mature one.
   E. a relation of a fast growing science into a static one.

The correct answers are:

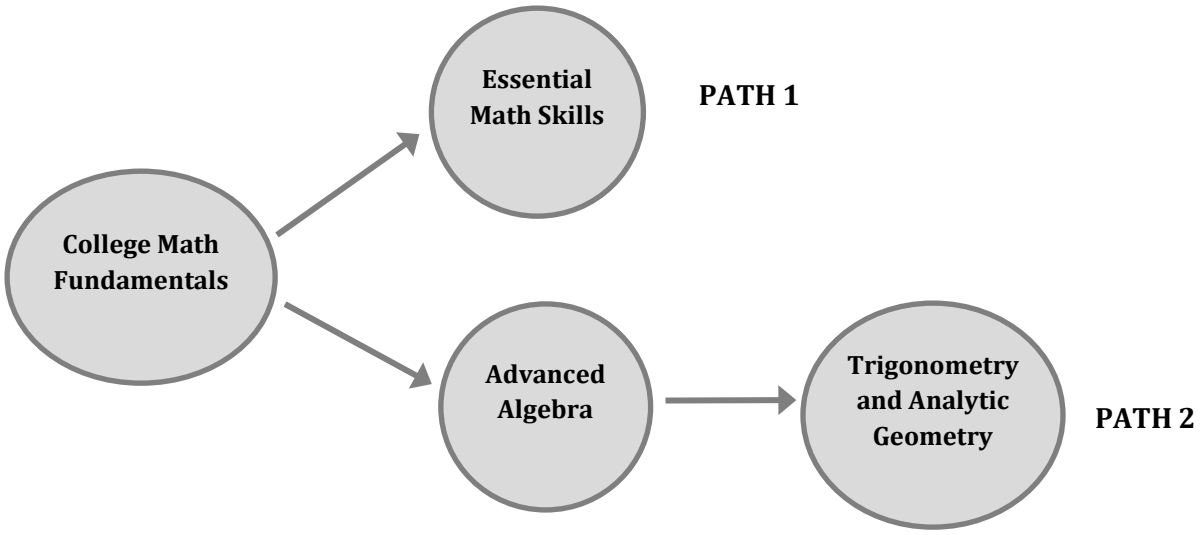
1. D
2. A
3. C
4. A
5. B

2.2 The Mathematics Exam

2.2.1 Overview and Blueprints

The Tailwind Mathematics Placement Exam is a 90 minute stage-adaptive exam. The exam consists of four distinct content areas: Essential Math Skills, College Math Fundamentals, Advanced Algebra and Trigonometry and Analytic Geometry; however no student will receive items from all four areas. The exam begins with an assessment of College Math Fundamentals, which all students will receive. Depending on how well a student performs on the College Math Fundamentals items, s/he will receive either the Essential Math Skills content or both the Advanced Algebra and Trigonometry and Analytic Geometry content. The two paths comprising the mathematics exam are shown in Figure 1. Further details about the stage-adaptive exam are provided in the next section.

Figure 1. Two pathways of the Mathematics Placement Exam



Scores for each of the four areas of the mathematics exam range from 15 to 85 and are scaled to have a mean of 50 and standard deviation of 10. A combination of scores can be used to place students into mathematics courses ranging from developmental level courses to first-semester calculus. Note that each circle in Figure 1 generates a score, but depending on the path, students will receive either two scores (Path 1) or three scores (Path 2). While placement decisions will vary across campuses based on student population and curricula, students who follow Path 1 generally are placed into courses such as developmental mathematics, quantitative reasoning, or a first credit-bearing mathematics course in a traditional algebra sequence. Students who follow Path 2 typically are placed into credit-bearing mathematics courses ranging from algebra to first-semester calculus. There is not an overall composite score based on all operational items reported for the mathematics exam.

All of the items are multiple-choice with either four or five alternatives. The use of a non-graphing calculator is allowed for the College Math Fundamentals, Advanced Algebra, and Trigonometry and Analytic Geometry portions of the exam. A calculator is not permitted for the Essential Math Skills section. For items on which a calculator is permitted, an electronic scientific calculator will be provided on the computer. Students may not provide their own hand-held calculators.

Items for each of the four components are selected to conform to a carefully created set of detailed objectives. The percentage of items selected from each component is shown in Table 3.

Table 3
Blueprints for the Tailwind Mathematics Placement Exam

Essential Math Skills Score (30 Items)

	Objectives	**Percentage of Scale**
1.	Basic Number Sense	15.0
2.	Integer Arithmetic	25.0
3.	Decimal Arithmetic	10.0
4.	Fraction Arithmetic	25.0
5.	Basic Algebra	15.0
6.	Mathematical Language	5.0
7.	Applied Skills and Abilities	5.0

College Math Fundamentals Score (30 Items)

	Objectives	Percentage of Scale
ARITHMETIC		
1.	Integer Arithmetic	5.0
2.	Rational and Decimal Arithmetic	10.0
3.	Introducing Algebraic Skills	10.0
ALGEBRA		
1.	Simplifying Algebraic Expressions	10.0
2.	Factoring Algebraic Expressions	7.5
3.	Linear and Quadratic Equations	10.0
4.	Linear Equalities	5.0
5.	Introduction to Solving Rational and Radical Equations	5.0
6.	Functions	7.5
7.	Solving Literal Equations	5.0
GEOMETRY		
1.	Plane Geometry	10.0
2.	Three-Dimensional Geometry	5.0
3.	Geometric Relationships	10.0

Advanced Algebra Score (25 Items)

	Objectives	Percentage of Scale
ALGEBRA		
1.	Graphs and Systems of Non-Linear Equations	3.0
2.	Simplifying Expressions	3.0
3.	Quadratics	12.0
GEOMETRY		
1.	Geometric Relationships	3.0
2.	Circles and Other Conics	12.0
ADVANCED ALGEBRA		
1.	Radicals and Fractional Exponents	8.0
2.	Absolute Value and Inequalities	8.0
3.	Functions	20.0
4.	Exponentials and Logarithms	15.0
5.	Complex Numbers and Theory of Equations	8.0
6.	Applications	8.0

Trigonometry and Analytic Geometry Score (20 Items)

	Objectives	Percentage of Scale
TRIGONOMETRY		
1.	Basic Trigonometry Definitions	30.0
2.	Identities	20.0
3.	Triangles	10.0
4.	Graphs	10.0
GEOMETRY		
1.	Circles	15.0
2.	Triangles	10.0
3.	Parallel/Perpendicular Lines	5.0

2.2.2 Stage-Adaptivity

As mentioned above, the Tailwind Mathematics Exam is a stage-adaptive test. In a traditional computerized adaptive test, the test adapts after each item (i.e. a student's response to a particular test question influences the next question that is presented to the student). However, in a stage-adaptive test, the test adapts after a particular section of the test rather than after each item. The Tailwind Mathematics Placement Exam has a single, fixed point of adaptivity. All students will receive the College Math Fundamentals (CMF) section of the placement exam. Students who score between 15 and 46 on the College Math Fundamentals section of the test will receive the Essential Math Skills portion of the test (Path 1 in Figure 1) and students who score between 47 and 85 on College Math Fundamentals will receive the Advanced Algebra and Trigonometry and Analytic Geometry portions of the test (Path 2 in Figure 1).

The CMF cutscore to determine which of the two paths the student will follow has been determined by the Tailwind program through a rigorous standard setting process to identify the performance level corresponding to college-readiness in mathematics, based on national standards. The branching score, therefore, cannot be modified. The assumption is that no student should need to complete all four sections of the mathematics exam in order to be placed appropriately. Students who score high enough on CMF will have demonstrated adequate knowledge to be placed into a credit-bearing mathematics course and therefore, it is unnecessary for them complete the Essential Math Skills section of the test. Similarly, students who score low on CMF are likely in the position that the content measured on the Advanced Algebra and Trigonometry and Analytic Geometry portions of the test is too advanced and therefore these students would benefit from receiving the Essential Math Skills section of the test to help determine placement. By utilizing a stage-adaptive format, the Tailwind Mathematics Exam can be efficient while maintaining accurate placement for students at all ability levels. More information about how the CMF cutscore was determined is given in the next section.

2.2.3 Standard Setting to Determine the College Math Fundamentals Cutscore

Simply put, standard setting is the process by which a cutscore is established. Cizek (1993) further defined standard setting as "the proper following of a prescribed, rational system of rules or procedures resulting in the assignment of a number to differentiate between two or more states or degrees of performance" (p. 100). The purpose of the math placement test standard setting meetings was to determine the score on the CMF scale which a student must achieve in order to receive the Advanced Algebra and Trigonometry and Analytic Geometry sections of the test during stage two of the stage-adaptive math exam (i.e. to follow Path 2 in Figure 1). The intent was to select the cutscore which minimizes the chances of students receiving the Advanced Algebra and Trigonometry and Analytic Geometry sections of the test who do not possess the necessary level of math ability (false-positives) or students receiving the Essential Math Skills section who had adequate pre-requisite knowledge (false-negatives).

In order to do so, two separate standard setting meetings were held. The panels consisted of experts in mathematics education including representatives from two- and four-year higher education institutions, high school teachers, and mathematics policy makers. For the standard setting, the modified-Angoff procedure with four rounds of ratings was used. Using this technique, participants were asked to rate a set of College Math Fundamentals items with regards to how difficult they think the items are for the target student group (i.e. students who have just met national standards for college readiness). For each individual item, participants were asked to think of this target student group and estimate what proportion of those students would answer the item correctly. The same items were rated over multiple rounds in order to hone in on the appropriate ability level at which to place the cutscore. After each round of ratings, participants were provided with additional information to help assist with the rating process. Some information that was provided was related to the items themselves (e.g., difficulty levels based on classical item statistics) and other information was related to the impact of the ratings (e.g., what percentage of students would follow path 1 in Figure 1 for different cutscores).

The results from the two panels were highly similar, and were highly consistent with expectations. As expected, the variability in ratings decreased considerably between Rounds 1 and 2, after which the variability largely leveled off. For each item, the standard deviation of ratings across panelists provided a measure of item-level rater consistency. The criterion used by the facilitators to identify items for which there were large amounts of disagreement was a standard deviation of 0.20 or greater for Round 1. At the conclusion of Round 1, there were 13 items for Panel 1 and 7 items for Panel 2 which exceeded that threshold. By the end of Round 2, neither group had any items that exceeded the threshold. At the conclusion of the standard setting, only one item for either panel had a standard deviation as high as 0.17. This provides evidence that the standard setting process allowed raters to converge on a recommendation.

As would be expected from the similar item ratings, the cutscores recommended by each panel were also quite similar. One panel recommended that students must receive at least a score of 49 on the CMF section of the placement exam and the other panel recommended at least a score of 47. The two panels came together for a third meeting to discuss the two cutscores and at the conclusion of the meeting, the groups unanimously voted to adopt the second of the two cutscores. Therefore any student who scores between 15 and 46 on CMF receives the Essential Math Skills portion of the exam in stage two and any student who scores a 47 or above on CMF receives the Advanced Algebra and Trigonometry and Analytic Geometry portions of the placement test for stage two.

At the conclusion of the standard setting panels, panelists were asked to provide feedback on their overall satisfaction with the standard setting process and their comfort with their panel's recommendation through a survey. The data in the evaluation provided evidence of strong support for the process and the conclusions. The vast majority of raters reported having understood the process, felt comfortable with the procedure used, believed that their opinions were considered and valued, believed that everyone was given an opportunity to contribute, and would defend the standards recommended.

2.2.4 Sample Items

Sample items from the four sections of the Tailwind Mathematics Placement Exam are provided below.

Sample Items from the Essential Math Skills Section

1. Simplify: 10 + (-2)
   a. -12
   b. 8
   c. -8
   d. -20

2. $\frac{4}{5}$ is the same as
   a. 0.8%
   b. 40%
   c. 0.08%
   d. 80%

3. Distribute $-5(3x - 6y - 2)$
   a. $-15x - 30y + 10$
   b. $-15x + 30y + 10$
   c. $15x + 30y + 10$
   d. $-8x - 11y - 7$

4. The prime factorization of 24 is
    a. $6 \cdot 4$
    b. $8 \cdot 3$
    c. $2^3 \cdot 3$
    d. $2^2 \cdot 6$

The correct answers are:

1. b
2. d
3. b
4. c

Sample Items from the College Math Fundamentals Section

Sample Arithmetic Items

1. The greatest common divisor of 20 and 36 is
   a. 180
   b. 108
   c. 56
   d. 4
   e. 2

2. 2 ¼ yards is
   a. 27 in.
   b. 36 in.
   c. 72 in.
   d. 81 in.
   e. 96 in.

The correct answers are:

1. d
2. d

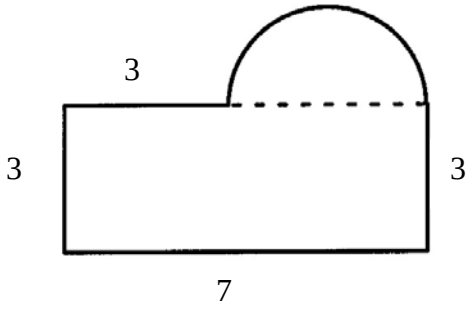
Sample Algebra Item

3. One factor of $3x^2 - 6x + 9$ is
   a. $x^2 - 2x + 3$
   b. $x^2 - 6x + 9$
   c. $x^2 - 2x + 9$
   d. $x + 3$
   e. None of these

The correct answer is: a

Sample Geometry Items

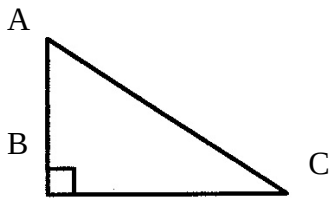
4. The perimeter of the figure with semicircular top is



   a. 21
   b. 16 + 2π
   b. 16 + 4π
   c. 16 + 8π
   d. None of these

5. In the triangle shown below the measure of angle C is (x + 30º). The measure of angle A is

   a. (60 – x)º
   b. (90 – x)º
   c. (120 – x)º
   d. (x – 60)º
   e. (x – 120)º



The correct answers are:

4. b
5. a

Sample Items from the Advanced Algebra Section

Sample Algebra Item

1. $2^{-m} =$
   a. -2^m
   b. $-2m$
   c. $2 - m$
   d. $\frac{1}{2^m}$
   e. $2^{1/m}$

The correct answer is: d

Sample Geometry Item

2. The center of the circle given by equation $x^2 + 6x + 9 + (y - 2)^2 = 10$ is
   a. (9 , 2)
   b. (9 ,-2)
   c. (3 , -2)
   d. (-3 , 2)
   e. (3 , 2)

The correct answer is: d

Sample Advanced Algebra Items

3. If $log_2 x + log_2(x - 3) = 2$, then x is equal to

   a. -4
   b. 1
   c. 2
   d. $\frac{5}{2}$
   e. 4

4. | 6 + 3x | < 9 is equivalent to

   a. -1 < x < 1
   b. 1 < x < -5
   c. x < 1
   d. -5 < x < 5
   e. -5 < x < 1

5. A rope is 300 feet long and weighs 90 pounds. A 30-foot piece of the rope is cut off and sold. What is the weight of the unsold piece of rope?

   a. 9 pounds
   b. 27 pounds
   c. 60 pounds
   d. 80 pounds
   e. 81 pounds

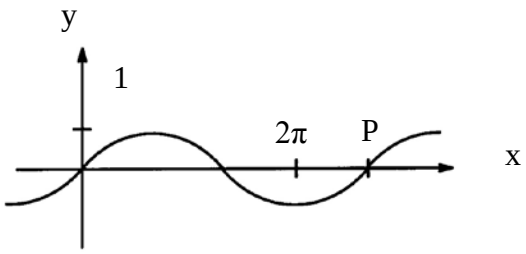
The correct answers are:

3. e
4. e
5. e

Sample Items from the Trigonometry and Analytic Geometry Section

Sample Trigonometry Items

1. The sine function shown below has a minimum at x = 2π and an x-intercept at x = 0.



The x-intercept at P is given by

a. $x = \frac{9\pi}{4}$

b. $x = \frac{5\pi}{2}$

c. $x = \frac{8\pi}{3}$

d. $x = 3\pi$

e. $x = 4\pi$

2. sin(x) + sin(π – x) equals

a. 0

b. 1

c. 2sin(x)

d. sin(x) + cos(x)

e. $\cos^2(x)$

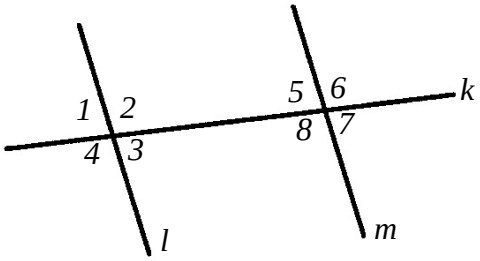
3. The value of $\cos(\sin^{-1} x)$ is
    a. 1
    b. x
    c. $\frac{1}{x}$
    d. $\frac{1}{\sqrt{1-x^2}}$
    e. $\sqrt{1-x^2}$

The correct answers are:

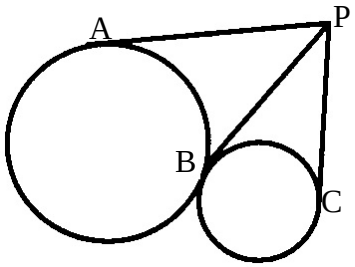
1. c
2. c
3. e

Sample Geometry Items

4. Lines *l* and *m* intersect line *k*. Assume angles *4* and *7* are supplementary.
   Then we can conclude that
   a. lines *l* and *m* are perpendicular.
   b. angle *8* and angle *1* are congruent.
   c. lines *l* and *m* are parallel.
   d. angles *1* and *2* are complementary.
   e. angles *1* and *5* are supplementary.



5. PA, PB, and PC are tangents. One circle has radius 4; the
   Other has radius 2. How are PC, PB, and PA related?
   a. PC < PB = PA
   b. PC = PB < PA
   c. PC < PB < PA
   c. PC = PB = PA
   d. PB < PC = PA



The correct answers are:

4. c
5. c

2.3 The French Exam

2.3.1 Overview and Blueprint

The French Placement Exam is comprised of two broad categories of items: Language Mechanics and Reading Comprehension. The Language Mechanics section of the exam consists of two modules: sentence completion and logical rejoinders. The length of the French Placement Exam varies from year to year; however, in any given year the exam is comprised of 50-60 four-alternative multiple choice items. Students have 60 minutes to complete the exam. Three scores are provided for the exam: (1) a Language Mechanics subscore, (2) a Reading Comprehension subscore, and (3) a total French score based on all operational items. Scores on the French exam range from 15 to 85 and are scaled to have a mean of 50 and standard deviation of 10. Table 4 shows the test objectives for the sentence completion module of the French Placement Exam.

Table 4
Blueprint for the Tailwind French Placement Exam

	Objectives	Percentage of Exam
1.	Lexical	32.5
2.	Verbs	20.0
3.	Pronouns	20.0
4.	Syntax	12.5
5.	Articles and Adjectives	10.0
6.	Relatives and Questions	5.0

2.3.2 Sample Items

Section 1: Language Mechanics (Sentence Completion)

The Sentence Completion module is the more traditional of the two Language Mechanics modules, in which sentences are provided from which one or two words are missing. From four choices, students pick the one form that is correct and appropriate to the context of the sentence. The following items are representative of the kind of questions students are asked to answer for the Language Mechanics section of the French Placement Exam.

1. Je _____ assez bien Paris, mais je ne _____ pas où habite le Président de la République.

   a. sais…connais
   b. sais…sais
   c. connais…sais
   d. connais…connais

2. J'ai rencontré Claudine et je _____ invitée à sortir ce soir.

   a. l'ai
   b. la ai
   c. lui ai
   d. l'y ai

3. Réflection d'un touriste: _____ Bordeaux les enfants parlent français!

   a. à
   b. aux
   c. en
   d. dans

The correct answers are:

1. c
2. a
3. a

Section 1: Language Mechanics (Logical Rejoinders)

The second Language Mechanics module consists of Logical Rejoinder items. These items aim to capture learners' ability beyond formal accuracy. They assess learners' understanding of what is situationally appropriate and thereby emphasize a functional and fuller definition of communication. Learners select the most appropriate response from four formally correct options. They judge the appropriateness of the four rejoinders relative to the situational criteria implied in the prompt. Criteria relate to the relationship between speakers, features of speech acts (e.g., apologies, compliments, requests, congratulations, etc.), and scripted conventions of language use in certain common and recurring speech events, such as wishing a happy birthday, ordering in a restaurant, taking one's leave, etc. A sample item is provided below.

Carefully read the following brief exchanges. Then, from the given lists, select the choice that most logically completes the exchange.

1. X: Qu'est-ce que tu préfères, le café ou le thé?
   Y: _____

   a. Je veux bien.
   b. C'est ça!
   c. Ca m'est égal.
   d. Moi non plus.

The correct answer is : c

Section 2: Reading Comprehension

The Reading Comprehension portion of the test is designed to be a proficiency-based measure of students' understanding of facts and ideas in context. The reading passages consist of complete and meaningful texts drawn from authentic sources, including newspapers, magazines, advertisements, and short stories. Only minor editing has been done for length or to simplify particularly difficult vocabulary or structures. This portion of the test is designed to stress variety by including a sampling of different topics, functions, situations, styles, level of difficulty, lengths of passages, and types of questions.

Questions are constructed to encourage thinking and intelligent guessing. Some questions require students to understand factual information. Other questions require students to go beyond simple decoding at the sentence level, to skim and scan for general ideas, understand logical development of ideas and sequential ordering of events, analyze and synthesize, make inferences and deductions, and also to interpret point of view and tone. In short, the reading section measures the understanding of written French and the reading skills needed to perform well in university courses.

A sample passage and its corresponding questions are provided below.

Je n'ai jamais voyagé en Concorde. Et pourtant, après l'avoir vu pour la première fois en 1973, j'en ai rêvé. A l'époque, les constructeurs franco-britanniques croyaient encore à l'avenir supersonique du transport aérien. Ils avaient l'espoir de remplir un carnet d'une centaine de commandes pour le Concorde. D'un coup d'aile, ils comptaient relier Paris à Rio, Londres à Bahreïn…

Je crains que la tragédie du 25 juillet ne mette fin à mes aspirations de voyager en Concorde. Car cette catastrophe où 114 personnes ont perdu la vie pourrait amener non seulement la fin du Concorde, mais aussi la fin d'une merveilleuse aventure technologique et esthétique.

(Journal Français, Septembre 2000)

1. Depuis quand l'éditorialiste rêve-t-il de voyager en Concorde?

   a. Depuis le début de sa construction.
   b. Depuis le 25 juillet.
   c. Depuis qu'il l'a vu en 1973.
   d. Depuis que la ligne Paris-Rio est entrée en service.

2. Quel était l'espoir des constructeurs franco-britanniques?

    a. Ils voulaient voyager de Londres à Bahreïn.
    b. Ils souhaitaient voir une centaine de commandes.
    c. Ils désiraient éviter la catastrophe du 25 juillet.
    d. Ils espéraient la fin d'une merveilleuse aventure.

3. Pourquoi la date du 25 juillet marque-t-elle une tragédie?

    a. Il n'y a eu qu'une centaine de commandes pour le Concorde.
    b. Il y a eu 114 personnes qui sont mortes en Concorde.
    c. Le Concorde de Paris à Rio a perdu une aile.
    d. Le Concorde a été aspiré le 25 juillet 1973.

4. Quel est le ton de cet éditorial?

    a. Il est optimiste.
    b. Il est agressif.
    c. Il est ironique.
    d. Il est nostalgique.

The correct answers are:

1. c
2. b
3. b
4. d

2.4 The German Exam

2.4.1 Overview and Blueprint

The German Exam is comprised of two broad categories of items: Language Mechanics and Reading Comprehension. In any given year, the German exam contains approximately 50-60 items, each with four alternatives. Students have 60 minutes to complete the exam. Three scores are provided for the exam: (1) a Language Mechanics subscore, (2) a Reading Comprehension subscore, and (3) a total German score based on all operational items. Scores on the German exam range from 15 to 85 and are scaled to have a mean of 50 and standard deviation of 10.

The test objectives and relative percentages for the Language Mechanics section are represented in Table 5.

Table 5
Blueprint for the Tailwind German Placement Exam

	Objectives	Percentage of Exam
1.	Verbs: Present Tense	10.0
2.	Verbs: Other Tenses	25.0
3.	Nominal Phrases	30.0
4.	Sentences	15.0
5.	Special Cases	10.0
6.	Pragmatics	10.0

2.4.2 Sample Items

Section 1: Language Mechanics

The test objectives for the Language Mechanics module comprise issues of verb-related features, nominal morphology, word order, idiomatic lexico-grammatical matters (e.g., the selection of prepositions or context-appropriate verbs), and pragmatics (socio-cultural aspects of appropriateness). In all items, regardless of test objective, students encounter sentences from which words or phrases are missing or which are scrambled in different ways. Students pick the one choice of four that is most correct and appropriate to the context of the sentence. Contextual clues are strongly evident, so that items are functionally full and semantically clear.

The following items are representative of the kind of questions students are asked to answer.

1. Sprich nicht mehr davon! Das können wir _____ nicht leisten.

   a. euch
   b. uns
   c. dich
   d. sich

2. X: Was wollt ihr zu Weihnachten bekommen?
   Y: Wir _____ viele schöne Geschenke bekommen!

   a. mögen
   b. mochten
   c. wollten
   d. möchten

3. Das ist das Ende, _____ ihr alle lange gewartet habt!

   a. für die
   b. bis die
   c. auf das
   d. an das

The correct answers are:

1. b
2. d
3. c

Section 2: Reading Comprehension

The Reading Comprehension section is designed to include the kinds of skills that students will need to perform well in university-level German courses. This section contains items measuring the broad categories of discrimination, comparison, numerical comparison, conclusion, vocabulary in context, and grammar in context. The texts that students encounter are drawn from authentic sources and are subjected to minor editing. Examples of editing include (a) shortening of texts whose original length exceed the constraints of the placement test; and (b) minor adaptations in wording that are necessitated by the deletions or lack of contextual clues. Some reading passages also include select glossed words.

A sample reading passage and the corresponding items are provided below.

Karriere: Frau in der Falle

Frauen haben besonders gute Chancen, in die Führung eines Unternehmens aufzurücken, wenn es der Firma schlecht geht. Das fand der britische Sozialpsychologe Alex Haslam von der Universität Exeter bei einer Untersuchung der Personalpolitik in den 100 größten Firmen Großbritaniens heraus: Zeigen die Wirtschaftsdaten ins Minus, steigt die Neigung, in der Not eine Frau **in die Verantwortung zu heben**. Damit haben Frauen gleichzeitig ein ungleich höheres Risiko zu **scheitern** als Männer, sagt Haslam. Ein krisengeschütteltes Unternehmen steht wiederum häufiger in den Medien – und die Chefinnen werden öffentlich für Managementfehler kritisiert, die noch vor ihrer Zeit begangen wurden. Dieser Effekt war auch der Auslöser für Haslams Untersuchung gewesen. Im vergangenen Jahr hatte eine andere Studie der Universität Cranfield nahe gelegt, Unternehmen mit hohem Frauenanteil in der Führung hätten auch schlechtere Wirtschaftsdaten.

(*Der Spiegel* 40, 2004)

1. Der britische Sozialpsychologe Haslam schreibt über Frauen, die

    a. schlechte Wirtschaftsdaten untersuchen.
    b. Managementfehler kritisieren.
    c. in den Medien arbeiten.
    d. aufrücken, wenn es der Firma schlecht geht.

2. Das Wort ***scheitern*** bedeutet auf Englisch

    a. to scream.
    b. to take.
    c. to fail.
    d. to succeed.

3. Frauen bekommen oft Führungspositionen, wenn sie

   a. Managementfehler machen.
   b. schlechte Personalpolitik machen.
   c. schlechtgeführte Firmen übernehmen.
   d. in den Medien stehen.

4. ***In die Verantwortung heben*** heißt im Text

   a. schlechte Wirtschaftsdaten akzeptieren.
   b. in eine wichtige Position bringen.
   c. eine Studie unternehmen.
   d. Medien kritisieren.

The correct answers are:

1. d
2. c
3. c
4. b

2.5 The Spanish Exam

2.5.1 Overview and Blueprint

The Spanish Exam is comprised of two broad categories of items: Language Mechanics and Reading Comprehension. The test development committee takes great care in writing questions to avoid problems which might require special knowledge of regional or dialectical differences. The Spanish exam contains 50-60 items, each with 4 alternatives, and students have 60 minutes to complete the exam. Three scores are provided for the exam: (1) a Language Mechanics subscore, (2) a Reading Comprehension subscore, and (3) a total Spanish score based on all operational items. Scores on the Spanish exam range from 15 to 85 and are scaled to have a mean of 50 and standard deviation of 10.

Table 6 provides a detailed description of the various test objectives for the Language Mechanics section and an indication of the relative weight given to each objective on the exam.

Table 6
Blueprint for the Tailwind Spanish Placement Exam

	Objectives	**Percentage of Exam**
1.	Verb Tense, Aspect, and Agreement	20.0
2.	Communicative Items/Logical Completions	15.0
3.	Mood	15.0
4.	Ser/Estar/Haber/Tener/Hacer	15.0
5.	Lexicon	10.0
6.	Direct and Indirect Object Pronouns	5.0
7.	Other Pronouns, Conjunctions, and Negatives	5.0
8.	Uses of "se" including Reciprocals, Passive and Impersonal se	5.0
9.	Modifiers and Comparisons	5.0

2.5.2 Sample Items

Section 1: Language Mechanics (Sentence Completion)

The Language Mechanics portion includes three different types of items dealing with language usage. One of these item types presents 4-alternative multiple choice questions which contain a statement that is to be completed by selecting the choice that makes that sentence grammatically correct. A second item type uses a cloze format to test certain concepts that are more successfully tested in context. This cloze items test a variety of different language usage objectives, including verb forms and uses, pronoun forms and uses, adjective, adverb, and article usage, and expressions for comparisons and negation. The third item type presents short dialogues in which the examinee is asked to complete the dialogue by identifying the statement that follows most logically from the rest of the dialogue. Items in this section are designed to measure skills necessary for effective communication. The following items are representative of the kind of questions test takers are asked to answer.

1. Los hombres _____ afeitan cuando tienen barba.

    a. le
    b. lo
    c. me
    d. se

2. Cuando llegamos allí, nos dijeron que Roberto ya _____.

    a. ha salido
    b. salga
    c. había salido
    d. saliera

3. ¿A usted _____ bien su nuevo secretario?

    a. te cae
    b. me cae
    c. se cae
    d. le cae

The correct answers are:

1. d
2. c
3. d

Section 1: Language Mechanics (Cloze)

The Cloze format is used to test certain concepts that are more successfully tested in context. This section tests a variety of different language usage objectives, including verb forms and uses, pronoun forms and uses, adjective, adverb, and article usage, and expressions for comparisons and negation. The directions for the cloze section and a sample passage are provided on the next page.

You will be given a reading passage from which several words have been omitted. For each blank, select the correct choice from the possible answers given.

Uno de mis pasatiempos favoritos es montar en bicicleta, pero no ha sido siempre así. Antes de ___(1)___ a mi esposo en la universidad, yo ni tenía una bicicleta, pero a él ___(2)___

a. conociendo
b. conocer
c. conocí
d. conocía

a. lo
b. se
c. les
d. le

encantaba pasar los fines de semana haciendo viajes en bicicleta a todas partes. Cuando yo ___(3)___ veinte años, me compró mi primera bicicleta para ___(4)___ cumpleaños y

a. estaba
b. tenía
c. era
d. hacía

a. mi
b. mío
c. míos
d. mis

empecé a salir con él en estos viajes. Para nuestro ___(5)___ viaje, fuimos desde Nueva York

a. primero
b. primera
c. primer
d. primeros

hasta Vermont. ___(6)___ el viaje en una semana, viajando más de ___(7)___ kilómetros cada

a. Hicimos
b. Hacemos
c. Hagamos
d. Haremos

a. ciento
b. cientos
c. cien
d. centenar

día. Ahora, ya no tenemos tiempo para hacer viajes tan largos, pero ___(8)___ día, cuando

a. alguna
b. alguno
c. algún
d. algunos

nuestros niños ___(9)___ mayores, me gustaría hacer otro viaje en bicicleta con ellos.

a. son
b. serán
c. eran
d. sean

The correct answers are:

1. b
2. d
3. b
4. a
5. c
6. a
7. c
8. c
9. d

Section 1: Language Mechanics (Logical Rejoinder)

The Logical Rejoinder portion presents short dialogues in which the examinee is asked to complete the dialogue by identifying the statement that follows most logically from the rest of the dialogue. Items in this section are designed to measure skills necessary for effective communication. The directions and a few sample items are given below.

Select the choice that logically completes the dialogue. The two speakers are labeled by X and Y.

1. X: Necesito saber por qué no vino a la fiesta Ramón.
   Y: _____.

   a. Va a traer cerveza, ¿no?
   b. Es hora de preguntárselo.
   c. Me la pidió esta mañana.
   d. ¿No sabe qué hora es?

2. X: ¿Le llevaste tu coche al mecánico?
   Y: _____.

   a. No, se me olvidó
   b. Sí, te lo hago esta tarde
   c. No, lo vas a arreglar pronto
   d. Sí, es del mecánico

3. X: _____
   Y: Llevo cinco años viviendo aquí.

   a. ¿Cuántos años tienes?
   b. ¿Qué se lleva a los cinco años?
   c. ¿Cuánto tiempo hace que vives aquí?
   d. ¿Qué tiempo hace donde vives?

The correct answers are:

1. b
2. a
3. c

Section 2: Reading Comprehension

An important consideration in the development of this section is comprehension of the sense of the text beyond a mere knowledge of Spanish. A large number of possible texts are considered when developing items for the reading comprehension section. Passages which provided the best material for the reading test are ones which had an internal structure independent of their original purpose. As a rule, passages filled with facts but without a clearly stated point do not meet this criterion. Variety in subject matter and content is an important objective in selection of reading passages.

In most cases, the original text is edited to bring it within the range of the vocabulary representative of what is used in high school texts. The authenticity of the original style is maintained wherever possible. Two to six questions are asked after each passage.

The instructions and a sample passage with accompanying questions are given on the next page.

The Reading Comprehension section consists of reading passages and their respective questions. Read each passage carefully focusing on general content. Study the set of questions and answer as many as you can, returning to the text as often as necessary. There is only ONE possible answer per question. Select the BEST answer.

De cada 100 horas de trabajo no remuneradas al año en España, 80 las hacen las mujeres. Sin embargo, de cada 100 horas pagadas, sólo 31 corresponden a las trabajadoras y, además, con salario inferior al que reciben los hombres por igual actividad. Éstas son algunas de las cifras que ilustran el enorme camino que queda por recorrer para conseguir la igualdad entre los sexos. Aunque la igualdad entre los sexos está asegurada por ley, en la vida real las cosas son muy diferentes.

Amalia Gómez, secretaria general de Asuntos Sociales, comparó la igualdad formal con "un espejismo", y la profesora de sociología e investigadora del CSIC María Ángeles Durán, hizo hincapié en que "no sólo se necesita un cambio, sino toda una revolución", y alertó ante el futuro: "Hay que ser consciente de los muchísimos obstáculos que quedan por superar y no bajar la guardia, porque la situación no está consolidada".

Adapted from *La revista/El mundo* (España)

1. Según este artículo, las mujeres españolas

    a. trabajan menos que los hombres.
    b. trabajan mucho sin recibir dinero por su trabajo.
    c. reciben sólo 80% del sueldo de los hombres.
    d. trabajan 31 horas por semana.

2. En este texto, el término "espejismo" se refiere a

    a. algo irreal.
    b. algo imposible.
    c. algo del futuro.
    d. algo flexible.

3. La frase “Hay que ser consciente de los muchísimos obstáculos que quedan por superar...” significa que

    a. hay un claro futuro para las trabajadoras españolas.
    b. en la vida real se aplica la ley laboral.
    c. no hay posibilidad de cambio.
    d. hay que seguir luchando por la igualdad entre los sexos.

4. Esta lectura habla

    a. de los progresos conseguidos en la lucha por la igualdad.
    b. de la importancia de las contribuciones femeninas al mundo del trabajo.
    c. de la necesidad de trabajar más por los derechos de las mujeres en el campo laboral.
    d. del alto número de mujeres que trabajan fuera de la casa.

The correct answers are:

1. b
2. a
3. d
4. c

3. Administering the Exams

3.1 Standard Testing Conditions

Examinations should be administered so that all examinees have the same opportunity to demonstrate their capabilities. The objective is to make certain that standard procedures are followed each time the examination is administered so that all examinees take the exams under the same set of conditions. Factors which might affect scores on the examination should be either eliminated or held constant. For this reason, the time limits for the examinations are held constant. Examinees are also informed that guessing is permitted and that there is no correction for guessing. In keeping with best practices for fairness in test administration, testing environments should be set up to minimize environmental variables from unduly affecting an examinee's test performance. For example, test rooms should be comfortable, quiet, and well lit.

3.2 Exam Delivery

Tailwind Placement Exams are delivered by Castle Worldwide, a full-service testing solutions provider with 28 years of experience in test security, both domestically and internationally. Tailwind Placement Exams are delivered via Castle's secure Internet-based test delivery engine (PASS) which has a reliability rate of greater than 99.9%.

Tailwind Placement Exams must be administered in a live, proctored environment. Various exam delivery options are available, including local test administration via PASS, off-campus testing using Castle's established network of test sites, and off-campus testing using Live Online Proctoring.

For certain sections of the Mathematics Placement Exam, a non-graphing calculator is available in the test delivery engine for student use. Therefore, students do not need to provide their own calculator when completing the Mathematics Placement Exam.

4. Psychometric Methods

4.1 Item Statistics

The statistical information on item performance described in this section is used by the Tailwind Placement Testing Program for screening pilot items for use on future forms of the placement tests and for monitoring the performance of existing operational items. The two statistics described below, item difficulty and item discrimination, provide excellent indicators of item quality.

Item Difficulty. The difficulty of a test item is defined as the proportion of examinees answering the item correctly (i.e., the number of examinees who answered the item correctly divided by the number of examinees who took the test). This definition of difficulty indicates that the easier the item, the higher the resulting proportion. The more difficult an item, the lower the proportion.

Tailwind Placement Exam forms are constructed so that the first few items in each section are somewhat easier. This is done to help encourage test takers and to prevent those who are less well-prepared from becoming discouraged early in the examination.

Item Discrimination. The extent to which a test question can discriminate between examinees who have high ability on the material being tested versus those who have low ability is referred to as item discrimination. The statistic used for the Tailwind Placement Exams is the point-biserial correlation (r_{pbi}). This correlation coefficient indicates the magnitude and direction of the relationship between the score on the test and answering the item correctly or not.
The formula for r_{pbi} is

$$r_{pbi} = \frac{M_{+i} - M_{-i}}{s_x}\sqrt{p_i q_i} \qquad (1)$$

where M_{+i} is the mean score on the test for examinees who answered item i correctly, M_{-i} is the mean score on the test for examinees who answered item i incorrectly, p_i is the difficulty or proportion correct on item i, q_i is the proportion incorrect on item i and s_x is the standard deviation of the test scores for all examinees. The r_{pbi} ranges from a low of -1.00 to a high of 1.00. r_{pbi} values near zero indicate that there is no relationship between the test score and the item score, whereas values near ±1 indicate a perfect linear relationship between test score and item score. The sign of the correlation relates to the direction of the relationship, with positive values indicating that high scorers are more likely to answer the question correctly than are low scorers, and negative values indicating that low scorers are more likely to answer to the question correctly than are high scorers.

An item discriminates well if students answering the item correctly have a tendency to score high on the exam, while students answering that item incorrectly have a tendency to score low on the exam. It is clear from (1) that the greater the difference between M_{+i} and M_{-i} , the higher the value of r_{pbi} .

4.2 Use of Item Statistics for Item Selection

A primary task for a placement test is to determine in which course in a sequence a student is likely to do best. It makes sense, therefore, that items selected for a placement test are selected for their capability to maximally differentiate between adjacent courses. Items in the Tailwind Placement Testing program are selected with this in mind. The following procedures are used to achieve this objective.

Evaluating Test Items. The most common statistics used for item selection are item difficulty and item discrimination indices (described above). The most important statistic is the item discrimination. Discrimination indices which are too small indicate that students with differing amounts of knowledge are performing similarly on the item. Items with discrimination indices above .30 tend to sufficiently differentiate among students of differing ability levels. In the item development process, the Tailwind Placement program has adopted the general rule that items with an r_{pbi} of less than .30 should not be included on an operational form of the test. This criterion is very rigorous, and is consistent with best practices for test development.

The item difficulty is also important, although not as important as the item discrimination. Items which are either too hard or too easy do not tend to discriminate well among students of differing abilities. To increase the discriminating potential of an item, its difficulty should fall between .40 and .80 for a 4- or 5-alternative item.

Performance statistics are prepared and reviewed for every single item on the Tailwind Placement Exams. Items which do not meet the criteria of an item discrimination value of .30 or higher or which are too hard or too easy are either revised and re-piloted on a future version of the exam or are removed from the exam and retired in the bank of items.

4.3 Item Response Theory

In addition to the classical item statistics mentioned above, the Tailwind testing program also uses methods based in Item Response Theory (IRT) for assessing the quality of items and for equating test forms. IRT is a mathematical modeling approach to test scoring and analysis which can be used to describe the relationship between an examinee's response and their ability on the construct being measured.

There are several IRT models, each of which differs in some of the underlying assumptions about the ability being measured. Each of these models, however, assumes that an examinee's response to a given question is based only on a single underlying ability. That is, the probability that an examinee will answer a question correctly is based only on the ability being measured by the test. The Tailwind Placement Exams for the languages (Combined Writing and Reading, French, German, and Spanish) are modeled using the simplest form of the IRT models, the one-parameter or Rasch model. This model is expressed by the following formula:

$$P_{ij} = \frac{1}{1+e^{-(\theta_j - b_i)}} \qquad (2)$$

where P_{ij} is the probability that examinee j will answer item i correct, e indicates that a natural logarithm is computed to the power contained in the exponent, θ_j is the parameter for the ability of examinee j and b_i represents the parameter describing the difficulty of the test item i. One θ is estimated for each examinee and one b for each item. This is done through a process known as calibration.

One of the important assumptions about the Rasch model is that examinees do not guess on any question. Although in actual practice guessing does occur, our experience with the placement tests in the Tailwind Placement Testing Program is that the Rasch model is reasonably robust to violations of the "no guessing" assumption. In fact, the instructions for the tests explicitly direct examinees to make an educated guess if they are not certain of the answer to a particular question.

The Mathematics Tailwind Placement Exam uses the three-parameter logistic (3-PL) model. The 3-PL model is expressed by the following formula:

$$P_{ij} = c_i + \frac{1-c_i}{1+e^{-[a_i(\theta_j - b_i)]}} \qquad (3)$$

where P_{ij} , θ_j , and b_i are the same as in (2), a_i is the parameter describing the discrimination of test item i and c_i is an estimate of the likelihood of the lowest ability examinees getting the item right. Again, one θ is estimated for each examinee and one b, a, and c parameter are estimated for each item. A further discussion of IRT and the equating methods used is presented in Chapter 6.

The Data Used for Calibration. When new items are developed for use on a future form of a Tailwind Placement Exam, they must first be tried out on examinees who are reasonably representative of all those who will take the test. This procedure is referred to variously as either item tryout or as pilot testing of new items. Each form of a placement test contains some pilot items which are not to be used for placement. The data from the administration of pilot items are used to determine whether each item has the desired psychometric characteristics for inclusion as an operational item in the Tailwind Placement Testing Program.

4.4 Reliability

Test reliability is an important characteristic of a test. It reflects the consistency of the test measures. Reliability is also transitory. That is, each time a test is administered, the reliability may change. Consequently, test reliability needs to be estimated for each test administration. In general, however, we can expect the reliability of the test to remain close to those values already obtained if the test is given to another group of examinees of the same ability and preparation and under the same administration conditions.

It is sometimes useful to think of the reliability of a test as the relationship between the score on the test and the "true" score of an examinee. True score, as used in this sense, does not refer to some Platonic truth, but rather to a psychometric concept: the average score of the examinee if that person were to take the test over and over again, assuming that no learning or practice effect intervened. (Note that true score can also be defined to include the concept of parallel forms of a test. For purposes of this explanation, however, the definition of true score as an average over repeated testing of the examinee is sufficient.) It should be evident that we cannot determine an individual's true score. We can estimate it, however. Reliability in this sense is viewed as the ratio of the true score variance to the total test variance. That is, the reliability is the proportion of the test variance which is due to differences in true scores and (1 - reliability) is the proportion of the test variance which is due to error.

In any test development situation, it is important to determine what things affect test scores and cause them to be inconsistent. Stated another way, the reliability of the test indicates how much measurement error is present in the test scores. We need to estimate several different kinds of reliability in order to be certain that various types of errors are not intruding on our measurements.

Different methods of estimating reliability are each designed to take into account a different source (or sources) of measurement errors. The following are the three major sources of error causing test scores to be unreliable:

a. The conditions under which the test is administered - if there is an interruption during testing, an individual taking a test is likely to have a different score than if there were none; similarly, altering the scoring procedures from one examinee's work to the next would be a source of measurement error;
b. The particular items used on the test - they may not be exactly parallel to those on the other forms;
c. The errors associated with examinees - including short term influences such as lapses in attention, motivation to work hard, reaction to specific items, temporary illness and longer term influences such as learning, training or personality factors.

Reliability as Comparability of Scores on Two Parallel Forms. One way to conceive of the reliability of a test is to think of it as the correlation between two parallel forms of the test. The closer the two forms are to being perfectly parallel, the closer the correlation should be to 1.00. The less these two forms are alike, the closer the reliability coefficient will be to 0.00.

The precise definition of parallel is important. Loosely speaking, however, two forms are thought of as parallel if the following conditions hold:

1. the type and balance of content are the same on both forms;
2. the errors of measurement are the same on the two forms;
3. the true scores are the same on both tests.

Normally, if the first condition holds and if the two forms have the same reliabilities, the two forms are considered to be reasonably parallel.

Reliability as Consistency of Scores for a Single Administration of a Single Test. When we do not have two forms of the test and when we can administer the test only a single time, it is still possible to look at a type of reliability called "internal consistency." One internal consistency reliability coefficient that is commonly reported is Cronbach's Alpha Coefficient. This coefficient is a measure of the extent to which the items on the test measure the same general ability. The more homogeneous the items are on the test, the higher the reliability will usually be. This is the type of reliability most often reported for Tailwind Placement Exams.

The Cronbach Alpha reliability (Cronbach, 1951) is estimated as follows:

$$\alpha = \frac{k}{k-1}\left[\frac{s_x^2 - \sum_{i=1}^{k} s_i^2}{s_x^2}\right] \qquad (4)$$

where k is the number of items on the test, s_x^2 is the variance of the test scores and s_i^2 is the variance of item i.

The internal consistency reliability coefficients reported for Tailwind Placement Exams are Cronbach's Alpha coefficients. Lord (1980) has shown that the alpha coefficient is a lower bound for the reliability.

4.5 Standard Error of Measurement

The standard error of measurement (SEM) is a measure of the variability of the individual scores on the test. It is related to the true score (as true score has been defined previously) in the following way: The scores on a test are **observed scores**. These observed scores differ from true scores to the extent that there is error in the measurements yielding the observed scores. The SEM is a measure of that error and it is expressed in terms of the score scale for the test. An SEM of 1.4, for example, means 1.4 units on the score scale of the test. On average, (i.e., across a group of examinees) the true score will fall within ±1 SEM of the observed score approximately 68 percent of the time and within ±2 SEM approximately 95 percent of the time.

The formula for the SEM is

$$SEM = s_x\sqrt{1 - r_{xx'}} \qquad (5)$$

where s_x is the standard deviation of the observed scores and $r_{xx'}$ is the reliability of the test.

It is clear from (5) that the SEM is affected by the reliability (i.e., $r_{xx'}$) of the test. The higher the reliability, the smaller the SEM. This makes sense because one would expect that there would be less error in the measurements obtained from a test that has high reliability compared to one with low reliability. Similarly, the ratio of true score variance to observed score variance should be higher to the extent that the observed score contained less error.

The SEM provides us with a measure of the expected range of scores that a student would to receive over repeated administrations of the test, provided no learning occurred between administrations. For example, the Math Fundamentals portion of the Tailwind math exam has 30 items which count towards a student's score and the standard error of measurement is 2.4. Suppose a student obtained a score of 20 on the Math Fundamentals section. If we were to re-administer an alternate form of the math test to that same student, we would expect the student's Math Fundamentals score to fall somewhere between 17.6 and 22.4 or, rounding to the nearest whole number, between 18 and 22 approximately 68 percent of the time.

Typical reliability and standard error of measurement values for each of the exams are provided in Table 7. It is important to note that, while subscores for mechanics and reading comprehension are reported for the Tailwind Combined Writing and Reading and World Language assessments, the reliability coefficients for these subscores are lower than for the composite score. It is the recommendation of the Tailwind placement testing program that placement decisions be made using the composite score for the language exams.

Table 7
Typical Reliability and Standard Error of Measurement Statistics for Tailwind Placement Exams

Test/Subtest	**Reliability**	**SEM**	**Approximate # of Scored Items on Scale**
Combined Writing and Reading	.94	4.1	85-90**
Writing Mechanics	.93	3.0	48
Reading Comprehension	.88	2.7	37-42
Math	NA*	NA*	
Essential Math Skills	.84	2.4	30
College Math Fundamentals	.89	2.4	30
Advanced Algebra	.88	2.1	25
Trigonometry and Analytic Geometry	.83	1.9	20
French	.92	2.7	40-50**
Language Mechanics	.85	1.9	20-25
Reading Comprehension	.86	2.0	20-25
German	.92	2.7	40-50**
Language Mechanics	.85	1.9	20-25
Reading Comprehension	.86	1.9	20-25
Spanish	.92	2.8	40-50**
Language Mechanics	.85	1.9	20-25
Reading Comprehension	.86	2.0	20-25

**Note. An overall mathematics score is not reported for Tailwind Placement Exams*

***Note. Overall item counts only include operational items. The addition of pilot items will increase test length slightly*

5. Validity

An important component of any test development process is validation. The process of validation involves accumulating relevant evidence to support the intended interpretations of test scores (AERA, APA, & NCME, 2014). It is important to note that it is not the test(s) itself being validated, but rather the interpretations being made from the test scores. For placement testing, the decisions being made based on test scores (i.e. whether or not a student is academically prepared for a particular class) and their accuracy are of primary importance. Validity is not a coefficient, but rather an argument to be made by gathering multiple sources of evidence which support the use(s) and interpretations of test scores. Appropriate types of validity evidence may vary depending on the purpose of a test; however a sound validity argument will include multiple sources of evidence. Furthermore, the process of validation is on-going and should be continually revisited. Various types of validity evidence and corresponding results for the Tailwind exams are discussed below.

5.1. Evidence Based on Test Content

This type of validity evidence focuses on the content the test items measure. As an example, suppose our concern is to determine if a student should begin in an introductory Spanish language course or in a more advanced course. We would need to test that student in skills that are necessary for beginning study in either course. If we did not have a test with the appropriate content coverage, then we could not accurately judge from the test score whether the student's levels of preparation and readiness were optimal for beginning study in one or the other of the two courses.

Placement tests need to be examined closely to ensure that the test content adequately represents the domain to be measured. This is a critical issue for any institution of higher education considering a new test for use as a placement instrument. Test content can be assessed by closely examining the content specified in the test blueprints and item objectives with relative weights to determine whether the coverage of content is appropriate to the courses in a given sequence. When assessing validity evidence for test content, there are two general issues that need to be addressed: is the test content appropriate and is the coverage of the content adequate?

5.1.1 Appropriateness of Content

The first content validity issue is not how well the test measures all of the skills and objectives that are important, but rather whether the skills and objectives which are measured are appropriate. That is, is the test content relevant to the courses in the sequence? This requires a content analysis. Normally, such an analysis should be done by faculty who teach the courses.

The content analysis should compare the test content with *the content required to begin study in each of the courses in the sequence*. Note that the content analysis is done in reference to those areas that are needed for a student to begin study in the course and not with respect to the entire course. The point of reference of the analysis is crucial. The test content needs to be examined to find out whether it provides information appropriate for determining whether the student is ready to begin study in a given course in a sequence. The content analysis does not have to consider how closely the test measures everything that is taught in the course. The placement test helps place students into a course and is not intended to be used to determine achievement in a course.

Normally, it is possible to do this by having faculty who teach the courses examine the list of test objectives that are covered on the examination. This approach provides a view of the kinds of content covered on the test at the expense of being able to view the items themselves. Using the list of test objectives, however, generally provides a good indication of the balance of item content that can be expected from any of the forms of the test. Examination of an operational form of the test or a practice examination provides a closer look at the way the test items are written but, depending on the test, may not provide as clear an indication of the balance of item content.

5.1.2 Adequacy of Content Coverage

A second and equally important concern has to do with the adequacy of coverage of content on the test. The question to be addressed is, "Does the test content fairly or adequately represent the types of content that should be covered?" It is important to note that adequacy of coverage should be addressed to content that is required for a student to be ready to learn in a given course. Adequacy is not determined with respect to the entire course.

To answer this question, the coverage of the test needs to be compared with the content needed for beginning each course in the sequence. Faculty who teach these courses need to consider the proportions of each of the major content divisions of the test. If these proportions are in agreement with or close enough to the proportions of the content relevant to each of the courses in the sequence, then the coverage of the test may be considered adequate.

5.1.3 Development of Tailwind Placement Exams

The test blueprints for all Tailwind exams are developed by content experts in each of the five disciplines. Blueprints are reviewed on an annual basis to determine if any modifications need to be made to ensure that the content covered on each test is aligned with the learning objectives being assessed in the relevant course sequence. When writing test items, the writers are required to identify which test objective the item is intended to measure. Each item is reviewed closely for content and clarity and it is verified that the correct item objective has been identified. All forms of the Tailwind placement exams are built to follow the blueprints provided in Section 2.

5.2 Evidence Based on Internal Structure

Validity evidence based on the internal structure of the test helps to determine the degree to which test items conform to the construct on which the proposed test score interpretations are based (AERA, APA, & NCME, 2014). Evidence of internal structure often includes assessing a measure for dimensionality. If a composite score is reported for a test, then investigations of the structure of the test should show evidence of unidimensionality. Similarly, if separate scores are reported for various sections of a test, then evidence must be provided that the sections are measuring unique constructs. Two methods of assessing dimensionality include assessing the correlations, corrected for attenuation, between sections on a test and factor analysis.

Correlations between the four sections of the Mathematics Placement Exam are provided in Table 8. The moderate correlations indicate that the three sections of the exam are measuring related, yet

slightly different areas of mathematics. This provides evidence for the use of three separate scores, rather than one overall score on the mathematics exam.

Table 8
Correlations between the Sections of the Mathematics Exam

	Essential Math Skills	College Math Fundamentals	Advanced Algebra	Trigonometry and Analytic Geometry
Essential Math Skills	1.00			
College Math Fundamentals	.51	1.00		
Advanced Algebra	--	.67	1.00	
Trigonometry and Analytic Geometry	--	.70	.63	1.00

Note. Due to the stage adaptive nature of the math exam, students receive either the Essential Math Skills section or both the Advanced Algebra and Trigonometry and Analytic Geometry sections. All students receive College Math Fundamentals. As such, there are no correlation coefficients for Essential Math Skills and Advanced Algebra or Trigonometry and Analytic Geometry.

Internal Structure: Correlations. Correlations between the Mechanics and Reading Comprehension portions of the language tests are provided in Table 9. The correlations between the sections of each language exam are much higher than those of the mathematics exam. The magnitude of these correlations provides evidence for reporting a composite score on the language exams.

Table 9
Correlations between the Mechanics and Reading Components of the Language Exams

	Reading Comprehension
Combined Writing and Reading	
Writing Mechanics	.84
French	
Language Mechanics	.95
German	
Language Mechanics	.88
Spanish	
Language Mechanics	.93

Internal Structure: Factor Analysis. Confirmatory factor analysis (CFA) is a method which can be used to test our underlying assumptions about the structure of a test. For example, confirmatory factor analysis could be used for the Tailwind mathematics exam to test the assumption that there are four underlying dimensions assessed by the test (essential math skills, college math fundamentals, advanced algebra, and trigonometry and analytic geometry). The assumed structure of the test is specified and the results of the CFA can be used to assess how well our data fits that specified model. Results of the CFA include multiple indices to gauge model-data fit. When multiple fit indices support good model-data fit, this provides evidence supporting the use of either a composite score or multiple scores on a test.

For the math placement test, the structure specified would be a either a two factor or a three-factor structure, depending on which path a student followed. In the two factor structure all of the items intended to measure essential math skills would be specified to load on one factor and all of the college math fundamentals items would be specified to load on a second factor. In the three-factor structure all of the college math fundamentals items would load under one factor, the advanced algebra items would be specified to load on a second factor, and all of the trigonometry and analytic geometry items would be specified to load on a third factor. We would also assume that the factors would be correlated. For the language exams, a one factor model would be specified in order to provide evidence supporting the use of a composite score.

When assessing model fit, it is important to use multiple fit indices to provide the best picture as to how well the data fit the model. High values (close to 1) of the Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) and low values (close to zero) of the root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR) are indicative of good model fit. Results of confirmatory factor analyses for the Tailwind mathematics exam for students who follow path two, support the three factor structure, and thus reporting of different scores on the math exam, as evidenced by fit statistics which are indicative of good model-data fit (CFI = .92, TLI = .91, RMSEA = .02, SRMR = .02). Results for a two-factor structure for the essential math skills and college math fundamentals sections are not yet provided due to the relatively new implementation of the stage adaptive exam.

Results of confirmatory factor analyses for the language exams also show good model fit (see Table 10.)

Table 10
Results from Confirmatory Factor Analysis for the Language Exams

Test	CFI	TLI	RMSEA	SRMR
Combined Writing and Reading	.84	.83	.03	.03
French	.93	.93	.03	.03
German	.90	.89	.03	.04
Spanish	.94	.94	.02	.02

Language Exam Subscores. The Tailwind Combined Writing and Reading, French, German, and Spanish exams do report subscores for mechanics and reading comprehension, in addition to the composite score. Investigations of the internal structure of these exams, however, provide evidence to support unidimensionality. In addition, unlike on the mathematics exam, the items on each of the language exams are scaled together, therefore it is the recommendation of the Tailwind testing program that placement decisions be made on the basis of the composite score for the Combined Writing and Reading, French, German, and Spanish exams.

5.3 Evidence Based on Relationships to Other Variables

This type of validity evidence focuses on the relationship of test scores to external criteria. This may include evidence supporting the relationship between scores on the test of interest with scores on other tests designed to measure similar constructs (generally referred to as convergent evidence) or on tests designed to measure different constructs (referred to as divergent evidence). This also includes the extent to which score interpretations can be used to predict an examinee's future performance on some behavior without actually having to observe the complete behavior. For example, if we want to admit students to the institution who are likely to be successful, we must do this without waiting until students have completed a year of study before deciding to admit them. Thus, we need to have some means of predicting their performance. If first-year grade point average (GPA) is the criterion used as the measure of success in college, then we must have sufficient evidence supporting accurate prediction to warrant our using the test.

Comparing Correctly-Enrolled Students to Over-Enrolled Students. One approach to validation that is commonly used by the Tailwind testing program is to compare different groups of students; particularly students who enroll in the course in which they were placed (correctly-enrolled) versus students who enroll in a course which is a higher level than the course in which they were placed (over-enrolled). Generally speaking, students who over-enroll tend to be highly motivated to be successful in the course, since these are likely students who placed just below a cutscore and have convinced an advisor that they will work extra hard to be successful. Consequently, comparing students who enroll in the recommended course with students who are over-placed provides a rigorous assessment of the test's utility. Our research shows that students who correctly enroll, based on the recommendation of the placement test, score approximately half a grade point higher on a midterm or early semester assessment than the students who over-enroll. In addition, correctly enrolled students tend to drop the course less frequently, continue in the discipline longer, and report higher course satisfaction.

Tailwind Combined Writing and Reading Exam. Various studies have been conducted on the Combined Writing and Reading Placement Exam to determine its relationship with other English assessments. One larger study (n = 41,649) found that scores on the Tailwind Combined Writing and Reading placement test and the English section of the ACT were correlated (r = .81; Sedivy & Wollack, 2011). In addition, the correlation between Reading placement test scores and ACT Reading scores was found to be moderately high (r = .69). The high correlations between ACT English and Combined Writing and Reading placement test scores provides evidence that these two tests are measuring similar constructs. That is, the content being measured on these exams is

related. Finally, Tailwind Combined Writing and Reading placement test scores were found to be a significant predictor of success in first English course (as defined as a grade of a B- or better).

A second study conducted at one institution found that scores on the Tailwind Combined Writing and Reading placement exam were highly associated with incoming writing skills, as measured by faculty ratings of student essays in actual freshman-level courses (Wollack, Young, Klein, Westphal-Johnson, 2011). Placement exam scores correlated with faculty ratings of students' written work at r = .53 (n =79). This correlation was significantly higher than was the correlation between writing scores and scores from standardized writing assessments, including the ACT-Writing test (r = .19; n = 77), the AP Language test (r =.18, n = 16), and the AP Literature exam (r = .44, n = 26). These results provides evidence that a stand-alone standardized writing assessment may be of limited value in assessing college writing, whereas the Combine Writing and Reading Placement Exam works well at predicting actual student writing.

Tailwind Mathematics Exam. One study (Sedivy, 2015) found that, as expected, students who took four years of high school math scored significantly higher on the College Math Fundamentals, Advanced Algebra, and Trigonometry and Analytic Geometry sections of the math placement exam than students who did not complete math during their senior year of high school. On average, students completing four years of math scored 10 points higher on each of the three aforementioned sections (n = 49,347). These increased scores on the placement test resulted in placement into higher level math courses and, specifically, a reduction in the percentage of students placing into developmental level mathematics. This finding was consistent with previous research which determined that course-taking patterns in high school were a primary predictor of college-readiness and college success (Kirst, Venezia, & Antonio, 2044). As the Essential Math Skills section of the test was finalized in 2017, it was not a part of this investigation.

Tailwind World Language Exams. One of the most important factors related to the world language placement scores is number of years studying the language. Not surprisingly, students' scores on the world language placement exams are in direct relationship to the number of language courses they took in middle and high school: the more language courses taken, the higher the placement. We have also noticed that the assumed high school/college equivalence may be somewhat different from what is expected. Generally speaking, it appears that three years of high school language are roughly equivalent to one year (two semesters) of college study (Wollack, 2008).

Another crucial factor that has emerged from the pilot studies conducted to develop these exams is that time away from studying the language appears to have detrimental consequences. Statistics show that students who take a language in the senior year of high school generally place higher than students who do not take the language in their senior year, even when both groups have studied the language for the same number of years.

5.4 Fairness Assessment

Another issue central to validity is that of fairness in assessment. Test fairness is first and foremost a validity concern because a compromise in fairness could interfere with the accurate

interpretation of test scores. A test that is not fair, may introduce extraneous factors which influence the interpretation of test scores for different groups of test takers. Any variable that is not intended to be measured by the assessment, but influences test score interpretation is known as construct-irrelevant variance. Two examples of potential threats to fairness in test score interpretation include a lack of fairness during the testing process and the presence measurement bias.

Item Review. One step to minimize the influence of construct-irrelevant variance is to ensure that test items are written in such a way that they are understandable to test-takers. The ideal when testing is for everyone to fully understand the question that is being asked of them. Students who know the content should answer the item correctly and students who do not know the content should answer the item incorrectly, with the exception of random measurement error. For Tailwind placement exams, item writers are trained to write items in such a way that they are as clear and concise as possible. Items that are deemed unnecessarily "tricky" are not included on exams. Prior to pilot testing, items are subjected to multiple rounds of revision by item writers and the test editor. This process not only includes review for clarity, but also review to minimize the use of any content or language which may inadvertently advantage one group of test takers over another (e.g. males vs. females).

Test Administration. All Tailwind placement exams must be given under standardized administration conditions. Please see Sections 3.1 and 3.2 for more information.

Investigation of Potential Measurement Bias. An important step in assessing the fairness of a standardized test is to investigate the individual items for differential item functioning (DIF). Differential item functioning (DIF) is said to occur when examinees of equal traits, but from separate populations, differ in their probability of answering an item correctly (Roussous & Stout, 1996). One reason for which an item may exhibit DIF is due to the presence of construct-irrelevant variance. All items on the Tailwind placement exams are assessed for gender DIF using the Mantel-Haenszel procedure (Mantel & Haenszel, 1959; Holland & Thayer, 1988). This procedure has been well researched and has consistently been found to be a robust procedure for detecting DIF. Items which are flagged as having moderate to large DIF are either revised and re-piloted on a new form of the test or are retired from the item bank.

6. Procedures used for Equating and Scaling

Every year the operational forms of each test include new items. This is done because pedagogy changes and the tests need to reflect those changes. Anytime new items are added to a test, we strive to maintain a similarity in content and difficulty with previous forms. In spite of these efforts, differences in difficulty occur. Since placement decisions have been made on the basis of the original form of the test, it is important that the results from the new form be interpreted in terms of the original form. Unless this is done, placement decision cut-off scores would need to be continually redone every time a test form changes. This would be a costly undertaking and, in light of the current state of psychometric theory, is not necessary.

The Tailwind Testing Program uses a statistical procedure called test equating to adjust the scores from the new form for difficulty relative to the original form so that the scores from the new form are comparable to those from the previous forms. This in turn enables institutions to retain the placement decision cut-off scores without having to re-establish them every time a test form changes.

6.1 Equating Design and Process

The approach taken for equating all tests in the Tailwind Placement Testing Program is based on use of Item Response Theory (IRT) (cf., Lord, 1980). The IRT equating procedures are based on mathematical models describing the relationship between an examinee's response and their ability which were presented earlier. The Tailwind language exams use the Rasch model for equating (see Formula 2) and the mathematics exam uses the 3-PL model for equating (see Formula 3).

Anchor Test. While a new form of each test is published every year, a certain percentage of the items are common between two adjacent test forms. Approximately 25-30% of the operational items are carried over from one test form to the next for potential use as the anchor test during the equating process. Common items are carefully chosen to accurately represent the range of item objectives measured on each exam. For the language exams, common items always include both mechanics and reading comprehension items. For the mathematics test, the three sections are calibrated separately and therefore, each section has its own set of anchor items. The common items are also chosen to cover a range of item difficulties.

Drift Testing and Equating Procedure. In order to accurately conduct the equating, it is important first ensure that the item statistics for the anchor items have remained stable over time. Prior to being used as part of the anchor test, all common items are tested for item drift using the Lord's chi-square procedure with iterative linking. The steps of the iterative linking, as described in Candell and Drasgow (1988) are as follows:

1. Estimate item parameters for the reference and focal groups separately.
2. Place the focal group item parameter estimates onto the scale of the reference group.
3. Calculate DIF indexes and stop the process if no DIF items are found.
4. Otherwise, remove the DIF items and recalculate the linking coefficients using only the remaining non-DIF items.
5. Calculate DIF indexes for all items (including previously identified DIF items).

Steps 4 and 5 continue until the same set of items are identified as DIF items on subsequent iterations. In the case of drift testing, the item parameters from the past administration represent the reference group and the item parameters from the most recent administration represent the focal group. For the Tailwind testing program, item parameters are placed onto a common metric using the either the characteristic curve method presented by Stocking and Lord (1983) or using a mean-mean equating procedure. The process results in linear coefficients that are used to place the focal group item parameter estimates onto the metric of the reference group using the following transformations for the 3-PL model:

$$a_{jF}^{*} = \frac{a_{jF}}{A} \ , \tag{6}$$

$$b_{jF}^{*} = A \ \times b_{jF} + B \ , \tag{7}$$

$$c_{jF}^{*} = c_{jF} \ , \tag{8}$$

in which * indicates a transformed value (Kim & Cohen, 1995). The lower asymptote parameter is not transformed, as shown in (8). For the Rasch model, the only parameter which is transformed is the item difficulty parameter, *b*. After the above transformations have been applied, the focal group item parameters have been calibrated to the same metric as the reference group parameters.

6.2 Estimating Examinee Ability

To estimate an examinee's ability, an iterative, two-step procedure is used which begins by making an initial, educated guess of the examinee's ability $(\hat{\theta}_j)$ and an estimate of the margin of error. In the second step, a new ability estimate is found which adjusts the old one to account for this margin of error. This two-step process then repeats itself with the adjusted ability estimate from step 2 being used as the initial input into step 1. The formula for estimating ability is:

$$[\hat{\theta}_j]_{final} = [\hat{\theta}_j]_{initial} + \frac{X - \sum_{i=1}^{n} \hat{P}_{ij}}{\sum_{i=1}^{n} \hat{P}_{ij}(1 - \hat{P}_{ij})} \tag{9}$$

where $[\hat{\theta}_j]_{initial}$ and $[\hat{\theta}_j]_{final}$ are the results of steps 1 and 2 respectively, X is the raw score and $\hat{P}_{ij}$ is the probability of an examinee with ability $[\hat{\theta}_j]_{initial}$ answering item *i* correctly (as given in (2) and (3) for the Rasch and 3-PL models). It is important to note that an examinee's ability is determined using only the information from the operational items on a test form; the pilot items are not used.

The estimation procedure described above continues iterating over (9) until the difference between initial and final ability estimates is less than some pre-set criterion value. This procedure is performed for each possible raw score. Each raw score will produce a unique ability estimate.

6.3 Scaled Scores

Scaled scores are useful when multiple forms of a test exist and it is important that the scores on each form are comparable to one another. Once the ability estimates have been computed using the procedure described above, they are transformed to a scaled score. The scale used for Tailwind produces scores which range between 15 and 85 and has a mean of 50 and standard deviation of 10.

Through the equating process, an overall score of 58 on any form of the Tailwind Combined Writing and Reading Placement Test, for example, has the same meaning. It means that the same ability

level is required on each form of the Combined Writing and Reading test to achieve a score of 58. It does not mean that the same number of items have been answered correctly on all forms.

We have adopted the value of 15 as the lowest standard score reported for all Tailwind Placement Exams; it does not necessarily mean that an examinee failed to answer a single question correctly. Likewise, a score of 85 is the highest score reported and does not mean an examinee got all items correct. These two scores simply represent the effective limits within which the tests can be depended upon to yield useful measurements.

Since new forms of the test are continually being developed, it is easier to have all new forms expressed in terms of a single score scale rather than have multiple sets of score scales. The cut-off scores used for placing students can be determined based on the scaled score for the first form of the test and need not be changed just because a new form of the test is used. In fact, a major benefit of a scaled score for the test is that the placement advisor does not need to know which form of the test the student has taken in order to advise the student.

7. Setting Institutional Policies for Placement Test Usage

This section is intended to provide faculty and administrators charged with development of a placement testing program some background on how placement tests should be used and how placement decisions should be made. Much of this information is also germane for maintenance of an ongoing placement testing program.

The institutional placement policies used to place students in courses are dictated by two primary factors: the resources available at the institution and the achievement levels of the students entering the instructional sequence. The intent underlying placement is to maximize student learning given the available institutional resources. The policies used to determine which placement practices are used rest in large part on the nature and quality of the measurements yielded by the placement test(s).

7.1 The Nature of Good Measurement

Placement testing is a process, not a product. A test is an instrument for collecting information about some event or behavior. The intent of a placement program is to measure an individual's level of achievement in a specific area of study. The purpose of such measurement is to learn enough about the individual to place him or her at the appropriate point in the instructional sequence to maximize both that student's learning and the use of institutional resources. The point to be emphasized in this context is that measurement is a carefully structured process designed to yield information that can be used to make specific decisions.

Multiple sources of information should be used whenever possible. In a sense, this is done to "triangulate" on the target; in this case, the target is the minimal level of achievement needed to begin study at a given level of instruction. Multiple sources of information could include:

- high school courses taken in the subject and the grades in those courses,

- performance on a placement test in the subject,
- observation of performance in a specially structured problem situation (e.g., in an Oral Performance Interview for a world language).

Several sources of information should give a more accurate picture of the individual's achievement in the subject than a single source.

The process should be systematic, not random or indirect, with primary reliance on direct observation of the skills or abilities to be measured.

In as much as it is normally not possible to observe everything a person does, it is necessary to find a sample of the kinds of behavior that can be expected to demonstrate achievement. Questions on placement tests are samples of the possible content that needs to be measured. They do not comprise the full set of behaviors. Testing over the full set of behaviors in any discipline would take far too much time and would not be likely to yield appreciably better information than the sample does.

The information from all sources should be integrated before making any decisions about an individual. Integrating means bringing together everything that is known about the individual and comparing the different pieces of information in as structured a way as possible. If scores from several tests are available, they can be added to get a final score. This final score could then be compared against some criterion, perhaps a standard which was determined according to the principles described below. Observations of activities which are indicative of the achievement, such as an Oral Performance Interview, also may be integrated into the final decision. It is important that the examination accurately reflect the true skill or ability being measured. Questions must clearly reflect the underlying skill or ability being measured.

7.2 Setting Standards for Performance

The cut-off scores for achievement levels are the standards against which examinees' scores are compared. Standards are set when cut-off scores are determined. If a continuous model for achievement in the discipline is assumed, then setting the standard means determining where these points of demarcation, these cut-off scores, lie on this continuum. It is at these points that the cut-off scores for placement are established.

The Meaning of Placement Standards. Placing some students in a higher course in a sequence means deciding that they have a sufficient level of achievement in the discipline to begin study at that point. Determining who is to be placed in a specific course in a sequence requires that some standard be set so that individuals who score at or above that standard are placed higher than the ones who score below it.

7.3 Standard-Setting Methods in Placement

There are several methods which are useful for helping to decide where cut-off scores on the placement tests should be.

Use of Enrolled Students' Performance. One approach is to use the actual test performance of students who are enrolled in the course to determine what the cut-off scores should be. One very simple method is to use the halfway point between the averages for two adjacent courses in a sequence. This technique is useful if only a single score is used for placement. It is also predicated on the assumption that students are correctly placed in the course.

Comparing Groups of Students. Cut-off scores can also be set by comparing groups of individuals who are very close to some specific level of performance. For example, after administering the test to all students in a course, average test scores for students who earned a grade of C in the course could be compared to average test scores for students who earned a grade of D or worse in the course. It would be expected that the average score for students who earned a grade of D or worse would be lower than the average score for students who earned a C in the course. Taking the average of these two values would result in a cut-off score for placing into the course.

Students may not always enroll in the course in which they were placed based on their placement test score. A similar approach to setting cut-off scores would be to compare students who enrolled in the course in which they placed (i.e. correctly enrolled) to students who enrolled in a course higher than where they placed (i.e. over-enrolled). Students who over-enroll in a course are generally highly motivated to do well in the course; however research has shown that they often will not perform as well as the students who have correctly enrolled. Cut-off scores can be set by maximizing course GPA (grade) differences between these two groups of students. In order to do so, one would select a hypothetical cut-off score for placement into a course. Students would be assigned to either the correctly enrolled or over-enrolled group based on their standing on the placement test and this hypothetical cut-off score. For example, if a cut-off score of ≥35 is selected, then any student scoring a 35 or higher would be classified as correctly enrolled and any student scoring lower than 35 would be classified as over-enrolled because they did not meet the cut-off score, but still took the class. Average grades (as given on the GPA metric) would then be compared. Multiple hypothetical cut-off scores would be evaluated in this way by reclassifying students based on each cut-off score, until the score which maximizes the differences in GPA is found.

However, to do either of these would require waiting until the end of the course to obtain course grades. Furthermore, final grades often include components which are not direct indicators of correct placement (i.e. attendance, class participation, homework scores, student motivation, etc.). To the extent that final grade is contaminated by these sources of construct-irrelevant variance, then final grade may not be the most appropriate outcome variable to determine if students were correctly placed. Recall that a student is appropriately placed when they are enrolled in a course for which they have the prerequisite knowledge, but have not yet mastered the content of the given course (Kane, 2006). What we really want to know when setting cut-off scores is whether or not the student is ready to learn the content in a given course. With this in mind, a mid-term grade or mid-semester grade may be a more appropriate outcome variable. Not only could the study be conducted earlier, but this helps to ensure that the outcome variable is less contaminated with construct-irrelevant factors.

Course Capacity. Still another approach is to set the cut-off scores on the basis of the numbers of students that can be allocated to each course based on enrollment capacities. To do this, all students

would be given the placement test from which the distribution of test scores would be estimated. Next, either the percentage or number of students who could be taught in each course would be used to allocate students to courses in the sequence. As many students who could be accommodated in the first course would be taken from the bottom of the test score distribution. The students who would be enrolled in the next higher course would be selected from students who had scores just above those of the students in the first course. The score halfway between the highest score of students in the first course and the lowest score of students in the second course would be the cut-off score between the two courses.

Setting Cut-off Scores: What Is the Right Approach? It is important to note that there is no single way to define the right approach. The cut-off scores that are decided upon will depend upon the methods used to set them. The most appropriate approach would be one which combines elements from a number of different standard-setting methods. This would enable a comparison among the standards that result from each method and would provide the information needed to make an informed judgment of what the most appropriate standards should be. Such elements as

- expectations of student performance on test questions,
- comparison of performance of students in adjacent courses,
- comparison of students who correctly enrolled in a course and those who over-enrolled in the same course,
- determination of acceptable passing rates and the monitoring of the effects of the standards, and
- consideration of the costs associated with making classification errors,

should all be included in the set of methods that are used. Reconciling the results from these different methods, however, is not likely to be an easy task. The recommendation here is to use methods which enable collection of performance data on examinees to confirm the choice of method. No doubt adjustments in the initial standards will need to be made on the basis of subsequent experience.

7.4 Profiles of Institutions and Sample Cut-off Scores

Appropriate cut-off scores are determined by the preparation-level of incoming students and by the college curricula to which they will be exposed. Each institution using a given placement test should conduct the research necessary to determine what score ranges of the test result in the most accurate placements into each course level. Provided below are profiles of six institutions, as well as their cut-off scores. When available, course explanations are also provided. Unless otherwise indicated, the sample cut-off scores are based on the overall score on the given assessment. They are given as examples only and are not intended to represent ideal cutscores for colleges and universities. Institutions using the Tailwind Placement Exams can locate the sample institution that most closely matches their own. The cut-off scores provided for the matching institution can be used as a starting point for determining one's own cut-off scores. Once preliminary cut-off scores are in place, it is recommended that the institution collect its own data to monitor the appropriateness of the cut-off scores and adjust as necessary.

7.4.1 Institution 1: Two-Year Transfer College

Profile.

- Total enrollment: 14,045
- Undergraduate percent admitted: 100%
- Percentage of undergraduates who are enrolled full-time: 52%
- ACT Composite score (25th percentile, 75th percentile): (18, 23)

Combined Writing and Reading Cut-Off Scores.

Table 11
Combined Writing and Reading Cut-Off Scores and Placement Levels for Institution 1

Writing Mechanics and Reading Score	Course Placement
Writing Mechanics score + Reading score of 15-69	Introduction to College Writing
Writing Mechanics + Reading score of 70-99	College Writing and Critical Reading
Writing Mechanics + Reading score of ≥ 100	Critical Writing, Reading, and Research

Course Descriptions.

- Introduction to College Writing: A composition course focusing on the conventions of academic writing, the composing process, critical thinking, and critical reading. Emphasis will be on reading and writing activities designed to prepare students for successful transition to college-level writing. **This is a remedial course and does not carry degree credit.**
- College Writing and Critical Reading: A composition course focusing on academic writing, the writing process, and critical reading. Emphasis will be on essays that incorporate readings.
- Critical Writing, Reading, and Research: A composition course focusing on researched academic writing that presents information, ideas, and arguments. Emphasis will be on the writing process, critical thinking, and critical reading.

Mathematics Cut-Off Scores.

Table 12
Mathematics Cut-Off Scores and Placement Levels for Institution 1

College Math Fundamentals	Essential Math Skills	Advanced Algebra	Trigonometry & Analytic Geometry	Course Placement
15-46	15-41	--	--	Basic Mathematics
	42-50	--	--	Elementary Algebra
	51-85	--	--	Beginning and Intermediate Algebra **OR** Introduction to College Algebra **OR** Mathematical Literacy and Algebra for College Students
47-85	--	15-50	15-85	Quantitative Reasoning **OR** College Algebra (student will need to take Trigonometry before Calculus) **OR** Elementary Statistics
	--	51-57	15-56	College Algebra (student will need to take Trigonometry before Calculus) **OR** Elementary Statistics **OR** Pre-Calculus
			57-85	College Algebra (student will NOT need to take Trigonometry before Calculus) **OR** Elementary Statistics
	--	58-85	15-56	Trigonometry **OR** Elementary Statistics **OR** Topics in Finite Mathematics **OR** Calculus
			57-85	Elementary Statistics **OR** Topics in Finite Mathematics **OR** Calculus **OR** Calculus and Analytical Geometry I

**Note. Scores on the math exam are non-compensatory. In order to determine placement, the College Math Fundamentals score should be located first, then Essential Math Skills (if in use) or the Advanced Algebra score, and finally the Trigonometry and Analytic Geometry score.*

Mathematics Course Descriptions.

- Basic Mathematics: Designed for students with minimum algebra background or who have been away from mathematics for several years. Subject areas to be covered include arithmetic of whole numbers, fraction and decimals, ratios and percents, and basic algebraic concepts. **This is a remedial course and does not carry degree credit.**
- Elementary Algebra: Intended for students with little or no previous algebra. Topics include the real number system and operations with real numbers and algebraic expressions, linear equations and inequalities, polynomials, factoring, and introduction to quadratic equations. **This is a remedial course and does not carry degree credit.**
- Beginning and Intermediate Algebra: Integer, rational, real and complex numbers, polynomials, exponents and radicals, rational expressions and functions are defined. Arithmetic operations of addition, subtraction multiplication and division are extended to these algebraic objects. Equations and inequalities involving the algebraic objects are solved including polynomial equations through the quadratic formula. Applications that utilize linear and quadratic, rational and radical equations are studied as well as algebraic and graphical representation of lines and interpreting graphical representation of functions.
- Introduction to College Algebra: Emphasizes algebraic techniques with polynomials, fractional expressions, exponents and radicals, linear and quadratic equations, and inequalities. Introduction to functions, their graphs, and analytic geometry.
- Mathematical Literacy and Algebra for College Students: Introduction to numeracy, proportional reasoning, algebraic reasoning, and functions. Emphasis on developing conceptual and procedural tools that support the use of key mathematical concepts in context. Algebraic techniques with polynomials, fractional expressions, exponents and radicals, and linear and quadratic equations are also developed.
- Quantitative Reasoning: This course is intended to develop analytic reasoning and the ability to solve quantitative problems. Topics to be covered include construction and interpretation of graphs, functional relationships, descriptive statistics, geometry and spatial visualization, math of finance, exponential growth, and basic probability. Appropriate use of units and dimensions, estimates, mathematical notation and available technology will be emphasized throughout the course.
- College Algebra: Definition of function and sequence; linear and nonlinear functions and graphs including logarithmic and exponential functions; systems of linear equations and Gauss-Jordan method; theory of polynomial equations; conic sections and optional topics such as mathematical induction, matrix solution of linear systems and Cramer's rule.
- Elementary Statistics: The aim of the course is a basic understanding and use of statistical concepts and methods to facilitate study and research in other disciplines. Includes measures of central tendency, measures of variability, grouped data, the normal distribution, central limit theorem, hypothesis testing, estimation, t-distribution and chi square test.
- Pre-Calculus: Functions and graphs, including linear, polynomial, logarithmic and exponential functions: complex numbers and theory of equations; binomial theorem; mathematical induction; trigonometric functions, their basic properties and graphs;

identities; inverse trigonometric functions; solving trigonometric equations; de Moivre's theorem.

- Trigonometry: Trigonometric functions, their basic properties and graphs, identities, inverse trigonometric functions, solving trigonometric equations, solutions of triangles.
- Topics in Finite Mathematics: Matrices, linear programming and applications, probability, Markov chains, and mathematics of finance.
- Calculus: Primarily for students in business, the social sciences, and biological sciences who wish to acquire some knowledge of the techniques and applications of calculus. Topics include concepts, techniques, and applications of differential and integral calculus including multivariate calculus.
- Calculus and Analytical Geometry I: Analytic geometry, functions, limits and continuity, the derivative, integrals, techniques and applications of differentiation, applications of integration, logarithmic and exponential functions, and trigonometric functions.

World Language Cut-Off Scores.

Table 13
World Language Cut-Off Scores and Placement Levels for Institution 1

French	German	Spanish	Course Placement
15-41	15-42	15-39	First Semester
42-49	43-48		Second Semester
50-59	49-57	40-50	Third Semester
60-72	58-71		Fourth Semester
73-85	72-85	51-85	Fifth Semester

**Note. Spanish II and Spanish IV are only offered during the spring semesters; therefore incoming students are placed only into first, third, or fifth semester.*

7.4.2 Institution 2: Four-Year Comprehensive University

Profile.

- Undergraduate enrollment: 4,168
- Total enrollment: 4,308
- Undergraduate percent admitted: 80%
- Percentage of undergraduates who are enrolled full-time: 79%
- ACT Composite score (25th percentile, 75th percentile): (18, 23)

Combined Writing and Reading Cut-Off Scores.

Table 14
Combined Writing and Reading Cut-Off Scores and Placement Levels for Institution 2

Combined Writing and Reading Composite Score	Course Placement
15-45	Fundamentals of English
46-64	Composition and Reading
65-85	Exempt from the General Education English requirement

English Course Descriptions.

- Fundamentals of English: Introduces student to rhetorical, logical, and analytical concepts, including synthesis of rhetorical modes in the context of short essays. Emphasizes vocabulary development, reading comprehension, and the mastery of grammar and mechanics. Implements peer review and assessment. Introduces students to persuasive writing.
- Composition and Reading: Develops college-level competencies in writing and reading in a variety of subject and thematic contexts, with an emphasis on argumentation. Satisfies skills requirements in reading and writing.

Mathematics Cut-Off Scores.

Table 15
Mathematics Cut-Off Scores and Placement Levels for Institution 2

College Math Fundamentals	Essential Math Skills	Advanced Algebra	Trigonometry & Analytic Geometry	Course Placement
15-46	15-46	--	--	Essential Math Skills
	47-85	--	--	Intermediate Algebra
47-85	--	15-32	15-85	Survey of Mathematics **OR** Elementary Statistics **OR** College Algebra I
	--	33-47	15-85	College Algebra II
	--	48-85	15-53	College Algebra II with Trigonometry
	--		54-85	Calculus & Analytic Geometry

**Note. Scores on the math exam are non-compensatory. In order to determine placement, the College Math Fundamentals score should be located first, then Essential Math Skills (if in use) or the Advanced Algebra score, and finally the Trigonometry and Analytic Geometry score.*

Mathematics Course Descriptions.

- Essential Math Skills: Reviews basic arithmetic and order of operations with integers, fractions and decimals. Includes applied proportions and percents; evaluation and simplification of algebraic expressions and geometric formulas; linear equations involving integers, fractions and decimals; positive exponents; greatest common factor; basic graphs and inequalities.Course graded on credit/no credit basis.
- Intermediate Algebra: Covers linear equations and inequalities with applications; equations of lines and linear systems with applications; exponential and polynomial operations with introduction to functions; polynomial factoring by combinations of GCF, grouping, trinomial, and difference of squares; quadratic equations by factoring with applications; rational operations and equations with applications; radical operations and single-radical equations; square root property and quadratic formula for quadratic equations. Course graded on credit/no credit basis.
- Survey of Mathematics: Covers topics selected from sets, logic, number theory, geometry, consumer math, linear and exponential modeling, math and the arts, voting methods, probability, and statistics. Intended for students who need no further mathematics courses beyond competency.
- Elementary Statistics: Introduces modern statistics including descriptive statistic; binomial and normal distributions, estimation, hypothesis testing; and an introduction to the z, t, F and chi-square test statistics.
- College Algebra I: Studies linear equations, single and compound inequalities, and absolute value equations and inequalities; exponential and polynomial operations with function

evaluation; polynomial factoring by combinations of GCF, grouping, trinomial including quadratic-in-form, difference of squares, and sum and difference of cubes; quadratic and higher-degree equations by factoring with applications; rational operations and equations with applications; variation; radical operations and equations with up to two radical terms; complex numbers; completing the square and quadratic formula for quadratic equations; general polynomial equations; quadratic functions with graphing and applications; introduction to exponential and logarithmic functions and equations.

- College Algebra II: Explores functions and graphs, polynomial functions, exponential and logarithmic functions, sequences, series, induction and combinatorics.
- College Algebra II with Trigonometry: Functions and graphs, polynomials and rational functions, exponential and logarithmic functions, trigonometric functions, trigonometric identities and equations, applications, sequences, series.
- Calculus & Analytic Geometry: Explains rate of change and limits, differentiation, applications of the derivative, integration, applications of the integral and transcendental functions.

French Cut-Off Scores.

Table 16
French Cut-Off Scores and Placement Levels for Institution 2

French	Course Placement
15-32	Introductory French I
33-42	Introductory French II
43-51	Intermediate French I
52-63	Intermediate French II
64-85	French Conversation and Composition

French Course Descriptions.

- Introductory French I: Development of basic listening, speaking, reading and writing skills in French.
- Introductory French II: Continuation of Introductory French I
- Intermediate French I: Reviews and further develops listening, speaking, reading, and writing skills in French at the intermediate level.
- Intermediate French II: Continuation of Intermediate French I
- French Conversation and Composition: Advanced training in conversation and composition with emphasis on acquiring communicative skills in colloquial French.

Spanish Cut-Off Scores.

Table 17
Spanish Cut-Off Scores and Placement Levels for Institution 2

Spanish	Course Placement
15-37	Introductory Spanish I
38-47	Introductory Spanish II
48-53	Intermediate Spanish I
54-62	Intermediate Spanish II
63-85	Spanish Grammar/Composition I

Spanish Course Descriptions.

- Introductory Spanish I: Development of basic listening, speaking, reading and writing skills in Spanish.
- Introductory Spanish II: Continuation of Introductory Spanish I
- Intermediate Spanish I: Review and further development of listening, speaking, reading and writing skills in Spanish.
- Intermediate Spanish II: Continuation of Intermediate Spanish I
- Spanish Grammar/Composition I: Essential points of grammar, with emphasis on syntax and development of writing skills.

7.4.3 Institution 3: Four-Year Comprehensive University

Profile.

- Undergraduate enrollment: 8,279
- Total enrollment: 9,394
- Undergraduate percent admitted: 91%
- Percentage of undergraduates who are enrolled full-time: 84%
- ACT Composite score (25th percentile, 75th percentile): (20, 25)

Combined Writing and Reading Cut-Off Scores.

Table 18
Combined Writing and Reading Cut-Off Scores and Placement Levels for Institution 3

Combined Writing and Reading Composite Score	Course Placement
15-35	Writing Workshop
36-53	Composition I
54-85	Composition I **OR** Freshman English—Honors I

Course Descriptions.

- Writing Workshop: Developmental composition course. **This is a remedial course and does not carry degree credit.**
- Composition I: Introductory, first-semester composition course. Practice in college-level writing, critical thinking and reading. Introduction to academic research, source-supported writing, argumentation, and conventions of structure, style, grammar, mechanics, and format appropriate to specific rhetorical situations.
- Freshman English – Honors I: Readings in world literature and related writing for training in composition techniques.

Mathematics Cut-Off Scores.

Table 19
Mathematics Cut-Off Scores and Placement Levels for Institution 3

College Math Fundamentals	Essential Math Skills	Advanced Algebra	Trigonometry & Analytic Geometry	Course Placement
15-28	15-85	--	--	Fundamentals of Algebra
29-46	15-85	--	--	Intermediate Algebra
47-85	--	15-50	15-85	Concepts of Math **OR** College Math I **OR** Finite Mathematics **OR** Calculus with Pre-Calculus A
	--	51-85	15-35	College Math II
	--		36-85	Calculus I

**Note. Scores on the math exam are non-compensatory. In order to determine placement, the College Math Fundamentals score should be located first, then Essential Math Skills (if in use) or the Advanced Algebra score, and finally the Trigonometry and Analytic Geometry score.*

Mathematics Course Descriptions.

- Fundamentals of Algebra: Review of fundamental principles of elementary algebra. **This is a remedial course and does not carry degree credit.**
- Intermediate Algebra: Basic algebraic skills: factoring, exponents, rational expressions, linear equations and inequalities, systems of equations, quadratic equations, and an introduction to functions.
- Concepts of Mathematics: Elementary concepts in mathematical language and reasoning, sets, number systems and theory, algebraic equations, statistics and probability, geometry, computers; historical survey.
- College Math I: Review of basic algebra, solving equations and inequalities, applications of equations and inequalities, functions and their graphs, polynomial equations, and systems of equations.
- College Math II: Continuation of College Math I. Study of functions to include rational, exponential, logarithmic, and trigonometric functions and two-dimensional analytic geometry.
- Finite Mathematics: Topics in business-related mathematical problem solving including simple and compound interest, annuities, mortgages, supply and demand, break-even analysis. Best-fit lines, problem solving with systems of linear equations, linear programming, matrices, Gaussian elimination, set theory, Venn diagrams, permutations, combinations, basic and conditional probability, expected value.
- Calculus with Pre-Calculus A: First course in a two-course sequence. Review of basic algebra, solving equations and inequalities, graphing polynomial and rational functions. Limits and derivatives of polynomial and rational functions. Applications of derivatives.

- Calculus I: Functions, limits, continuity, bounds, sets; the derivative of functions and applications; exponential, logarithmic, trigonometric and inverse functions.

French Cut-Off Scores.

Table 20
French Cut-Off Scores and Placement Levels for Institution 3

French	Course Placement
15-39	Elementary French I **OR**
	Practical French I (first half of Elementary French I)
40-42	Practical French II (second half of Elementary French I)
43-50	Elementary French II
51-85	Intermediate French I (Humanities) **OR**
	Intermediate French II (Grammar Review)

French Course Descriptions.

- Elementary French I: Listening, pronunciation, reading, and writing. Basic vocabulary, polite phrases, questions and answers. Adjective agreement, present and some past-tense verbs. Cultural information about the French-speaking world.
- Practical French I: First quarter college French. Conversational phrases and vocabulary for practical situations. Basic present tense verb patterns. Intensive pronunciation drill.
- Practical French II: Second quarter college French, conversational phrases and vocabulary, irregular and past tense verb patterns.
- Elementary French II: Second level of understanding, speaking, reading, and writing in French. Introduction to future, conditional, imperfect and subjunctive verbs. Direct and indirect object pronouns. Short spontaneous and directed conversations. Topics in cultures of French-speaking people.
- Intermediate French I: Vocabulary development through readings and discussion on French and Francophone civilization. History, art, music, short stories and poems, including contemporary culture. Taught in French.
- Intermediate French II: Grammar review, contemporary vocabulary, free conversation in French.

Spanish Cut-Off Scores.

Table 21
Spanish Cut-Off Scores and Placement Levels for Institution 3

Spanish	Course Placement
15-42	Elementary Spanish I
43-50	Elementary Spanish II
51-59	Intermediate Spanish I (Humanities) **OR** Intermediate Spanish II (Grammar Review)
60-85	Spanish Composition and Conversation I **OR** Hispanic Literature in America **OR** Latin American Short Story **OR** Cinema for Spanish Proficiency

Spanish Course Descriptions.

- Elementary Spanish I: Understanding, speaking, reading and writing in Spanish. Culture of Spanish-speaking peoples, including those in the United States. Grammatical gender, present and past tense verbs, pronouns, adjectives.
- Elementary Spanish II: Second level of understanding, speaking, reading and writing in Spanish. Topics in the culture of Spanish-speaking people, including those in the United States. Compound verb tenses, the subjunctive and commands.
- Intermediate Spanish I: Extensive development of vocabulary including common idioms, aural comprehension, correct pronunciation and recognition of verb tenses. Readings and class discussion based on historical background and contemporary Hispanic life, including Hispanic culture in the United States.
- Intermediate Spanish II: Complete grammar review of standard Spanish, applicable to both conversational situations and business or personal correspondence. Review of essential vocabulary and phrases. Accuracy and fluency in spontaneous conversation and free composition.
- Spanish Composition and Conversation I: Fifth semester college Spanish. Advanced grammar review. Introduction to composition. Writing paragraphs and short essays. Advanced conversation. Emphasis on native-like pronunciation, vocabulary and structural fluency.
- Hispanic Literature in America: Sixth semester college Spanish. Themes and techniques of Hispanic literature. Vocabulary in Spanish for discussion of a variety of literary genres. Historical and cultural contexts. Emphasis on increasing oral and written fluency in Spanish.
- Latin American Short Story: Introduction to the 20th and 21st century Latin American short story. Vocabulary and readings in Spanish of prominent authors and distinct literary periods of this genre. Related historical and cultural contexts. Taught in Spanish.
- Cinema for Spanish Proficiency: Sixth semester college Spanish course. Outstanding films from the Spanish-speaking world on themes of cultural relevance; advanced composition; advanced conversation and discussion. Taught in Spanish.

7.4.4 Institution 4: Four-Year Comprehensive University

Profile.

- Undergraduate enrollment: 9,820
- Total enrollment: 10,669
- Undergraduate percent admitted: 76%
- Percentage of undergraduates who are enrolled full-time: 95%
- ACT Composite score (25th percentile, 75th percentile): (23, 27)

Combined Writing and Reading Cut-Off Scores.

Table 22
Combined Writing and Reading Cut-Off Scores and Placement Levels for Institution 4

Combined Writing and Reading Composite Score	Course Placement
15-35	Fundamentals of Composition
36-85	College Writing I

Course Descriptions.

- Fundamentals of Composition: To learn conventions of formal academic writing and to understand and employ effective writing processes and habits are the objectives of this course. **This is a remedial course and does not carry degree credit.**
- College Writing I: This course in composition addresses writing as a symbolic action that writers participate in for multiple purposes, with diverse audiences, and in various genres. It emphasizes writing as a thinking process through the learning and practice of rhetorical strategies for inquiry, persuasion, and collaboration in context.

Mathematics Cut-Off Scores.

Table 23
Mathematics Cut-Off Scores and Placement Levels for Institution 4

College Math Fundamentals	Essential Math Skills	Advanced Algebra	Trigonometry & Analytic Geometry	Course Placement
15-39	15-85	--	--	Basic Algebra
40-46	15-85	--	--	Topics in Intermediate Algebra **OR** Mathematics for Decision Making **OR** Mathematics for Elementary Teachers I **OR** Elementary Statistics
47-85	--	15-48	15-85	Mathematics for Decision Making **OR** Mathematics for Elementary Teachers I **OR** Elementary Statistics **OR** College Algebra
	--	49-85	15-54	Mathematics for Decision Making **OR** Mathematics for Elementary Teachers I **OR** Elementary Statistics **OR** College Algebra **OR** Precalculus **OR** Applied Calculus
	--		55-85	Mathematics for Decision Making **OR** Mathematics for Elementary Teachers I **OR** Elementary Statistics **OR** College Algebra **OR** Precalculus **OR** Applied Calculus **OR** Calculus I

**Note. Scores on the math exam are non-compensatory. In order to determine placement, the College Math Fundamentals score should be located first, then Essential Math Skills (if in use) or the Advanced Algebra score, and finally the Trigonometry and Analytic Geometry score.*

Mathematics Course Descriptions.

- Basic Algebra: A review of beginning algebra. Topics include an elementary treatment of real numbers, polynomials, linear equations, inequalities, rational expressions, systems of linear equations, radicals, and quadratic equations. **This is a remedial course and does not carry degree credit.**
- Topics in Intermediate Algebra: A course to enhance the student's skills in selected areas of intermediate algebra; areas covered include polynomials, rational expressions, exponents, equations, and inequalities. **This is a remedial course and does not carry degree credit.**
- Mathematics for Decision Making: Teaches students the mathematical skills needed for decision making in the 21st century. Topics for this course include set theory, syllogisms and fallacies, counting and probability, financial mathematics, and statistical concepts.
- Mathematics for Elementary Teachers I (For Elementary Ed Majors only): Content strands include number and operations and algebra and functions. Number and operations topics include set theory and pre-number concepts, place-value and numeracy, multiple representations and algorithms for arithmetic, number theory (e.g. divisors, multiples), and proportional reasoning. Algebra and functions topics include the concepts of variable and function, algebraic thinking, linear, polynomial, rational, and exponential functions, mathematical models, rates of change, and multiple representations of relations.
- Elementary Statistics: An introductory course covering fundamentals of modern statistical methods. Topics include descriptive statistics, the binomial and normal distributions, estimation, and hypothesis testing. The z, t, F and chi-square test statistics are introduced.
- College Algebra: A college algebra course on the properties, graphs, and applications of elementary functions. Topics include the real and complex numbers, concepts from analytic geometry, solutions to equations and inequalities, the elementary algebraic functions, and the logarithmic and exponential functions.
- Precalculus: A precalculus course on properties, graphs, and applications of elementary transcendental functions. Topics include concepts from analytic geometry; theory of equations; the logarithmic, exponential, trigonometric, and inverse trigonometric functions; and analytic trigonometry.
- Applied Calculus: Basic concepts and methods from differential, integral, and multivariate calculus. Logarithmic and exponential functions are included, but not trigonometric functions. Emphasis of the course is on models and applications in business and the social, life, and physical sciences.
- Calculus I: A rigorous introduction to calculus. Topics include limits, rules for differentiation, derivatives of trigonometric, logarithmic and exponential functions, the Mean Value Theorem, integration, and the Fundamental Theorem of Calculus. In the area of applications, the course covers problems on related rates, extrema, areas, volumes, and Newton's Second Law.

World Language Cut-Off Scores.

Table 24
World Language Cut-Off Scores and Placement Levels for Institution 4

French	German	Spanish	Course Placement
15-37	15-32	15-17	First Semester
38-46	33-43	18-49	Second Semester
47-54	44-51	50-56	Third Semester
55-64	52-58	57-63	Fourth Semester
65-85	59-85	64-85	Fifth Semester

7.4.5 Institution 5: Urban Doctoral University, R1 Research Institution

Profile.

- Undergraduate enrollment: 22,674
- Total enrollment: 27,596
- Undergraduate percent admitted: 90%
- Percentage of undergraduates who are enrolled full-time: 83%
- ACT Composite score (25th percentile, 75th percentile): (19, 24)

Combined Writing and Reading Cut-Off Scores.

Table 25
Combined Writing and Reading Cut-Off Scores and Placement Levels for Institution 5

Combined Writing and Reading Composite Score	Course Placement
15-29	Fundamentals of Composition
30-46	Introduction to College Writing
47-85	College Writing and Research

Course Descriptions.

- Fundamentals of Composition: Critical reading and writing, with an emphasis on the processes of writing and revision. **This is a remedial course and does not carry degree credit.**
- Introduction to College Writing: Critical reading, writing, and revision, with an emphasis on reflective inquiry and academic writing conventions.
- College Writing and Research: Extensive engagement with academic research writing and reflective analysis.

Mathematics Cut-Off Scores.

Table 26
Mathematics Cut-Off Scores and Placement Levels for Institution 5

College Math Fundamentals	Essential Math Skills	Advanced Algebra	Trigonometry & Analytic Geometry	Course Placement
15-36	15-85	--	--	Mathematical Literacy **OR** Foundations of Elementary Math
37-46	15-85	--	--	Mathematical Literacy **OR** Algebraic Literacy I
47-85	--	15-52	15-85	Contemporary Applications in Mathematics **OR** Intermediate Algebra **OR** Mathematical Explorations for Elementary Teachers
	--	53-56	15-56	Precalculus **OR** College Algebra **OR** Mathematical Explorations for Elementary Teachers **OR** Trigonometry **OR** Introductory Finite Mathematics **OR** Survey in Calculus and Analytic Geometry
			57-85	College Algebra **OR** Mathematical Explorations for Elementary Teachers **OR** Introductory Finite Mathematics **OR** Survey in Calculus and Analytic Geometry
	--	57-85	15-56	Trigonometry **OR** Mathematical Explorations for Elementary Teachers **OR** Introductory Finite Mathematics **OR** Survey in Calculus and Analytic Geometry
	--	57-60	57-85	Mathematical Explorations for Elementary Teachers **OR** Introductory Finite Mathematics **OR** Survey in Calculus and Analytic Geometry **OR** Calculus and Analytic Geometry I **OR** Introduction to the Language and Practice of Mathematics
	--	61-85	57-85	Mathematical Explorations for Elementary Teachers **OR** Introductory Finite Mathematics **OR** Survey in Calculus and Analytic Geometry **OR** Honors Calculus **OR** Calculus and Analytic Geometry I **OR** Introduction to the Language and Practice of Mathematics

**Note. Scores on the math exam are non-compensatory. In order to determine placement, the College Math Fundamentals score should be located first, then Essential Math Skills (if in use) or the Advanced Algebra score, and finally the Trigonometry and Analytic Geometry score.*

Mathematics Course Descriptions.

- Mathematical Literacy: Introduction to numeracy, proportional reasoning, algebraic reasoning, and functions. Emphasis on developing conceptual and procedural tools that support the use of key mathematical concepts in context. **This is a remedial course and does not carry degree credit.**
- Foundations of Elementary Mathematics: Arithmetic, geometry, and beginning algebra; develops mathematical reasoning, problem solving, and facility with basic mathematical objects and their relationships. **This is a remedial course and does not carry degree credit.**
- Algebraic Literacy I: Arithmetic number systems; linear equations, inequalities; exponent notation, radicals; polynomials, operations, factoring; modeling; coordinate geometry; linear systems; quadratic equations. **This is a remedial course and does not carry degree credit.**
- Contemporary Applications in Mathematics: Logical inference, probability and statistical inference, geometric growth, with selected topics such as linear programming, patterns, binary codes.
- Intermediate Algebra: Algebraic techniques with polynomials, rational expressions, equations and inequalities, exponential and logarithmic functions, rational exponents, systems of linear equations.
- Mathematical Explorations for Elementary Teachers: Theory of arithmetic of whole numbers, fractions, and decimals. Introduction to algebra, estimation and problem-solving strategies.
- Precalculus: Essential topics from college algebra and trigonometry for students intending to enroll in calculus.
- College Algebra: Function concepts. Polynomial, rational, exponential, and logarithmic functions. Systems of equations and inequalities. Matrices and determinants. Sequences and series. Analytic geometry and conic sections.
- Trigonometry: Trigonometric functions; graphs, identities, equations, inequalities; inverse trigonometric functions; solutions of triangles with applications; complex numbers; polar coordinates.
- Introductory Finite Mathematics: Elements of mathematical logic, structures in sets; partitions and counting; probability theory, stochastic processes.
- Survey in Calculus and Analytic Geometry: A one-semester survey with applications to business administration, economics, and non-physical sciences. Topics include coordinate systems, equations of curves, limits, differentiation, integration, applications.
- Calculus and Analytic Geometry I: Limits, derivatives, and graphs of algebraic, trigonometric, exponential, and logarithmic functions; antiderivatives, the definite integral, and the fundamental theorem of calculus, with applications.

- Introduction to the Language and Practice of Mathematics: Facility with mathematical language and method of conjecture, proof and counter example, with emphasis on proofs.
- Honors Calculus: Calculus of functions of one and several variables; sequences, series, differentiation, integration; introduction to differential equations; vectors and vector functions; applications.

World Language Cut-Off Scores.

Table 27
World Language Cut-Off Scores and Placement Levels for Institution 5

French	German	Spanish	Course Placement
15-35	15-42	15-44	First Semester
36-50	43-47	45-50	Second Semester
51-58	48-56	51-57	Third Semester
59-67	57-65	58-65	Fourth Semester
68-85	66-85	66-85	Fifth Semester

7.4.6 Institution 6: Doctoral University, R1 Research Institution

Profile.

- Undergraduate enrollment: 30,694
- Total enrollment: 42,598
- Undergraduate percent admitted: 57%
- Percentage of undergraduates who are enrolled full-time: 92%
- ACT Composite score (25th percentile, 75th percentile): (26, 31)

Combined Reading and Writing Cut-Off Scores.

Table 28
Combined Writing and Reading Cut-Off Scores and Placement Levels for Institution 6

Combined Writing and Reading Composite Score	Course Placement
15-60	Communication-A
61-85	Communication-B

Course Descriptions.

- Communication-A: a basic course in communication skills at the college level, developing student abilities in writing and public speaking, for both exposition and argumentation. The course will advance basic skills in the four modes of literacy (writing, speaking, reading & listening), critical thinking, and information-seeking skills and strategies.
- Communication-B: a course involving substantial instruction in the four modes of literacy (that is, speaking, reading, writing, and listening), with emphasis on speaking and writing, either in the conventions of specific fields or in more advanced courses in communication.

Mathematics Cut-off Scores.

Table 29
Mathematics Cut-Off Scores and Placement Levels for Institution 6

College Math Fundamentals	Essential Math Skills	Advanced Algebra	Trigonometry & Analytic Geometry	Course Placement
15-36	15-85	--	--	Preparatory Algebra
37-46	15-85	--	--	Preparatory Algebra **OR** Quantitative Reasoning
47-85	--	15-48	15-55	Algebra (followed by Trigonometry)
			56-85	Algebra **OR** Algebra and Trigonometry **OR** Calculus with Algebra and Trigonometry I
	--	49-53	15-55	Algebra and Trigonometry **OR** Calculus with Algebra and Trigonometry I
			56-85	Algebra **OR** Algebra and Trigonometry **OR** Calculus with Algebra and Trigonometry I
	--	54-85	15-55	Trigonometry **OR** Topics in Finite Mathematics **OR** Calculus **OR** Algebra and Trigonometry **OR** Calculus with Algebra and Trigonometry I
			56-85	Topics in Finite Mathematics **OR** Calculus or Calculus and Analytic Geometry I

**Note. Scores on the math exam are non-compensatory. In order to determine placement, the College Math Fundamentals score should be located first, then Essential Math Skills (if in use) or the Advanced Algebra score, and finally the Trigonometry and Analytic Geometry score.*

Mathematics Course Descriptions.

- Preparatory Algebra: Covers the necessary mathematical tools needed to succeed in algebra and provides fundamental mathematical skills. Topics include real numbers, linear equations and inequalities, integral and fractional exponents, polynomials and their arithmetic, polynomial equations and equations with fractional exponents, the quadratic formula and completing the square, systems of two linear equations, graphing, and problem solving using algebra and graphs. **This is a remedial course and does not carry degree credit.**
- Quantitative Reasoning: The emphasis of this course is on reasoning and problem-solving. It is not intended to be a technique-oriented, template-problem-solving course, in which one practices on a lot of problems of a similar nature and then is tested on his or her ability to do problems presented in a very similar way. Course content includes statistics, coding information, social choice and decision making, and consumer finance models.
- Algebra: The main focus is preparation for continued work in mathematics, especially in the various calculus sequences. At the same time it incorporates instruction in quantitative reasoning skills. Course content includes exponential and logarithmic functions, complex numbers, division of polynomials, an introduction to matrices, and nonlinear systems of equations.
- Algebra and Trigonometry: A course on the mathematical fundamentals required for success in calculus. Course content will include basic algebra material, transformations, composition of functions, inverse functions, angles, trigonometry functions and graphs, Law of sines and Law of cosines.
- Calculus with Algebra and Trigonometry I: Intended for students who need some extra knowledge in precalculus or need a first semester calculus course. Topic covered include basic algebra, functions and graphs, differentiation, and trigonometric functions.
- Trigonometry: covers the graphs, properties and geometric significance of trigonometric functions of a real variable. Other topics include trigonometric equations and identities, applications, trigonometric form of complex numbers and DeMoivre's theorem.
- Topics in Finite Mathematics: covers topics in finite mathematics including elementary matrix algebra, linear programming, introduction to probability, and mathematics of finance.
- Calculus: covers essential concepts of differential and integral calculus; exponential and logarithm functions and functions of several variables. This course forms an introduction to calculus and related topics designed primarily for pre-business students.
- Calculus and Analytic Geometry: covers differential and integral calculus, plane analytic geometry, applications; transcendental functions, etc. The first two semesters of the standard three-semester calculus sequence, which is normally required for all higher level math courses and should be taken by those preparing for major study in mathematics, the physical sciences, computer sciences, or engineering.

World Language Cut-off Scores.

Table 30
World Language Cut-Off Scores and Placement Levels for Institution 6

French	German	Spanish	Course Placement
15-40	15-40	15-42	First Semester
41-47	41-46	43-54	Second Semester
48-56	47-53	55-63	Third Semester
57-66	54-61	64-74	Fourth Semester
67-85	62-85	75-85	Fifth Semester

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