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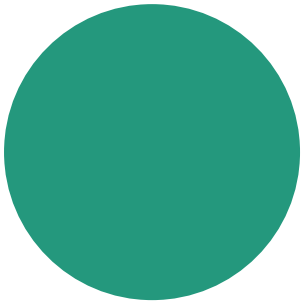
TECHNICAL MANUAL



ACT® Plan®

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TECHNICAL MANUAL

ACT®

ACT endorses the *Code of Fair Testing Practices in Education* and the *Code of Professional Responsibilities in Educational Measurement*, guides to the conduct of those involved in educational testing. ACT is committed to ensuring that each of its testing programs upholds the guidelines in each *Code*.

A copy of each *Code* may be obtained free of charge from ACT Customer Services (68), P.O. Box 1008, Iowa City, IA 52243-1008, 319.337.1429.

Visit ACT's website at **www.act.org**.

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Preface

This manual contains information, primarily of a technical nature, about the ACT Plan® program. The principal focus of this manual is to document the Plan program's technical adequacy in light of its intended purposes. This manual supersedes the 2011 edition.

The content of this manual responds to requirements of the testing industry as established in the *Code of Professional Responsibilities in Educational Measurement* (NCME Ad Hoc Committee on the Development of a Code of Ethics, 1995), the *Standards for Educational and Psychological Testing* (AERA, APA, & NCME, 1999), and the *Code of Fair Testing Practices in Education* (Joint Committee on Testing Practices, 2004).

ACT regularly conducts research studies as part of the ongoing formative evaluation of its programs. These studies are aimed at ensuring that the programs remain technically sound. Information gleaned from these studies is also used to identify aspects of the programs that might be improved or enhanced. The information reported in this manual was derived from studies that have been conducted for the Plan program since its inception. ACT will continue to conduct research on the Plan program and will report future findings in updated versions of this manual. Those who wish to receive more detailed information on a topic discussed in this manual, or on a related topic, are encouraged to contact ACT.

Qualified researchers wishing to access data in order to conduct research designed to advance knowledge about the Plan program are also encouraged to contact ACT. As part of its involvement in the testing process, ACT is committed to continuing and supporting such research, documenting and disseminating its outcomes, and encouraging others to engage in research that sheds light on the Plan program and its uses. Please direct comments or inquiries to Elementary and Secondary School Programs, ACT Development Area, P.O. Box 168, Iowa City, Iowa 2243-0168.

Iowa City, Iowa
May 2013

Chapter 1
The ACT Plan® Program

Overview and Purpose of the ACT Plan Program

The comprehensive ACT Plan® program from ACT helps 10th-grade students make the most of their opportunities and helps guide them in future educational and career planning.

Like all of ACT's assessment programs, Plan is based on the belief that young people—and their parents, teachers, counselors, and school administrators—will make more productive plans and decisions if they have organized, relevant information available when they need it most.

Plan is designed to be an every-student program administered in Grade 10 to provide students with an early indication of their educational progress in the context of the post–high school educational and career options they are considering. The results from Plan can be used to help students make adjustments in their course work to help ensure that they are prepared for what they want to do after high school. High schools use the data in academic advising and counseling.

Plan includes four multiple-choice tests—English, Mathematics, Reading, and Science. Plan also collects information about student interests, needs, plans, and selected background characteristics that can be useful in guidance and planning activities.

ACT makes available to Plan test takers and prospective Plan test takers various materials about test preparation and the interpretation of test results. An overview of the test and a selection of sample test questions are available to students online at **www.act.org/planstudent/**. The Student Score Report each examinee receives after testing contains sections about the student's scores, plans, career possibilities, and skills. The report is accompanied by a booklet, *Using Your ACT Plan Results*, which provides interpretive information about the test results and provides suggestions for making educational plans, for building academic skills, and for exploring occupations.

Plan functions as a stand-alone program or as the midpoint of the secondary-school level of ACT's College and Career Readiness System—an integrated series of assessment programs that includes ACT Explore®, Plan, and the ACT® college readiness assessment. When used together, the assessments in the system give educators at the middle-school and secondary-school levels a powerful, interrelated sequence of instruments to measure student development from Grade 8 through Grade 12.

The Explore, Plan, and ACT programs are scored along a common scale extending from 1 to 36; the maximum score on Explore is 25, the maximum Plan score is 32, and the maximum ACT score is 36. Because they are reported on the same score scale, the programs' assessment results inform students, parents, teachers, and counselors about individual student strengths and weaknesses while there is still time to address them.

The Explore, Plan, and ACT assessments provide information about how well a student performs compared to other students. They also provide standards-based interpretations through ACT's College Readiness Standards—statements that describe students' performance in terms of the knowledge and skills they have acquired. Because the College Readiness Standards focus on the integrated, higher-order thinking skills that students develop in Grades K–12 and that are important for success both during and after high school, the Standards provide a common language for secondary and postsecondary educators.

Using the College Readiness Standards, secondary educators can pinpoint the skills students have and those they are ready to learn next. The Standards clarify college expectations in terms that high school teachers understand. The Standards also offer teachers guidance for improving instruction to help correct student deficiencies in specific areas. Explore, Plan, and ACT results can be used to identify students who are on track to being ready for college. ACT's College Readiness Benchmark Scores—for English Composition, Algebra, Social Sciences, and Biology—were developed to help identify examinees who would likely be ready for doing college-level work in these courses or course areas. Chapter 3 gives details about the College Readiness Standards and Benchmarks.

ACT's College and Career Readiness System is designed to help students plan for further education and explore careers, based on their own skills, interests, and aspirations. Its results give schools a way to get students engaged in planning their own futures. When they know what colleges expect, in terms they can understand, students can take ownership and control of their information, and they can use it to help make a smooth transition to postsecondary education or training. Table 1.1 summarizes the system's components.

Code of Fair Testing Practices in Education and *Code of Professional Responsibilities in Educational Measurement*

Since publication of the original edition in 1988, ACT has endorsed the *Code of Fair Testing Practices in Education* (Joint Committee on Testing Practices, 2004), a statement of the obligations to test takers of those who develop, administer, or use educational tests and test data. The development of the *Code* was sponsored by a joint committee of the American Association for Counseling and Development, Association for Measurement and Evaluation in Counseling and Development, American Educational Research Association, American Psychological Association, American Speech-Language-Hearing Association, and National Council on Measurement in Education to advance, in the public interest, the quality of testing practices.

The *Code* sets forth fairness criteria in four areas: developing and selecting appropriate tests, administering and scoring tests, reporting and interpreting test results, and informing test takers. Separate standards are provided for test developers and for test users in each of these four areas.

ACT's endorsement of the *Code* represents a commitment to vigorously safeguard the rights of individuals participating in its testing programs. ACT employs an ongoing review process whereby each of its testing programs is routinely reviewed to ensure that it upholds the standards set forth in the *Code* for appropriate test development practice and test use.

Similarly, ACT endorses and is committed to complying with the *Code of Professional Responsibilities in Educational Measurement* (NCME Ad Hoc Committee on the Development of a Code of Ethics, 1995), a statement of professional responsibilities for those who develop assessments; market and sell assessments; select assessments; administer assessments; interpret, use, and communicate assessment results; educate about assessment; and evaluate programs and conduct research on assessments.

A copy of each *Code* may be obtained free of charge from ACT Customer Services (68), P.O. Box 1008, Iowa City, Iowa 52243-1008, 319.337.1429.

Philosophical Basis for the Tests of Educational Development

The Plan multiple-choice tests of educational development share a common philosophical basis with the Explore and ACT tests. These three testing programs measure student development in the same curriculum areas of English, mathematics, reading, and science. In simplest terms, the principal difference between the three testing

Table 1.1
Components of ACT's College and Career Readiness System

Component	Grades 8/9	Grade 10	Grades 11/12
Career and education planning	Explore: Interest Inventory Needs Assessment	Plan: Interest Inventory Course Taking Needs Assessment	ACT: Interest Inventory Course Taking and Grades Student Profile
Objective assessments	Explore: English Mathematics Reading Science	Plan: English Mathematics Reading Science	ACT: English Mathematics Reading Science Writing (optional)
Instructional support	College Readiness Standards	College Readiness Standards	College Readiness Standards
Evaluation	Summary Reports Explore/Plan Linkage Reports	Summary Reports Explore/Plan Linkage Reports Plan/ACT Linkage Reports	Summary Reports Plan/ACT Linkage Reports

programs is that they focus on knowledge and skills typically attained at different times in students' secondary-school experience. The ACT, for college-bound 11th and 12th graders, focuses on knowledge and skills attained as the cumulative effect of school experience. Plan, intended for all 10th graders, focuses on knowledge and skills typically attained early in students' secondary school experience (by Grade 10), and Explore, intended for all students in 8th and 9th grades, focuses on knowledge and skills usually attained by Grade 8; both tests also include knowledge and skills students are learning *in* those respective grades. That is, the tests emphasize what students have learned in the long term and also give the examinees the chance to use knowledge and skills they currently are learning.

Because the content of the Plan tests of educational development is linked to the ACT framework, understanding the philosophical basis of the Plan tests requires an appreciation of the philosophical basis of the ACT.

The ACT tests of educational development are designed to measure how prepared students are to achieve the general academic goals of college. The principal philosophical basis for the ACT is that college preparedness is best assessed by measuring, as directly as possible, the academic skills that students will need in order to perform college-level work. Complexity is certainly a characteristic of such skills. Thus, the ACT tests are designed to determine how skillful students are in solving problems, grasping implied meanings, drawing inferences, evaluating ideas, and making judgments. In addition, the ACT tests of educational development are oriented toward the general content areas of college and high school instructional programs. The test questions require students to integrate the knowledge and skills they possess in major curriculum areas with the stimulus material provided by the test. Briefly, then, the philosophical basis for the ACT tests rests on two pillars: (a) the tests should measure academic skills necessary for education and work after high school and (b) the content of the tests should be related to major curriculum areas.

Tests of general educational development are used in the ACT, Plan, and Explore because, when compared to other types of tests, it was judged that they better satisfy the diverse requirements of tests intended to facilitate the transition to high school, college, or work. By contrast, measures of examinee knowledge of specific course content (as opposed to curriculum areas) often do not provide a common baseline for comparisons of students, because courses vary so much across schools, and even within schools. In addition, course-specific tests may not measure students' skills in problem solving and in the integration of knowledge from a variety of courses.

Tests of educational development can also be contrasted with tests of academic aptitude. The stimuli and test questions for aptitude tests are often purposefully chosen to be dissimilar to instructional materials, and each test within a battery of aptitude tests is usually designed to be homogeneous in psychological structure. Consequently, often aptitude tests are not designed to reflect the complexity of course work or the interactions among the skills measured.

Also, because tests of educational development measure many of the same skills that are taught in school, the best preparation for such tests should be course work. Thus, tests of educational development should send students a clear message that high test scores are not simply a matter of innate ability—they reflect a level of achievement that has been earned as a result of hard work and dedication in school.

Finally, the ACT, Plan, and Explore tests are intended to reflect educational goals that are widely accepted and judged by educators to be important for success in college and work. As such, the content of the tests is designed with educational considerations, rather than statistical and empirical techniques, given paramount importance. For example, content representativeness of the tests is more important than choosing the most highly discriminating items.

Administering the ACT Plan Program

The Plan program is available for administration September through June each year. Consult the *ACT Plan Supervisor's Manual* for further instructions about scheduling your testing and ordering materials.

Participation Procedures

Each spring ACT activates its online ordering system for Plan test materials. Schools are provided notice of this activation and asked to go online and place orders for the next academic year or contact Plan Customer Services for placing their order. Those placing an order online would then be able to track their order through the shipping process approximately 4–5 weeks prior to their test date.

Schools may choose to census test their students in a given grade or provide the testing as optional.

Special Testing for Students With Disabilities. Special provisions are available for administering Plan to students who have diagnosed learning or physical disabilities that require extended time or special materials. Special testing materials available include large-type and Braille test books for visually impaired students, audio recordings of test books on audio cassette or CD, and reader's scripts for oral presentation of the test items. Order forms for special format materials are provided to schools with the letter confirming Plan materials orders. Schools are encouraged to administer special tests on the same day as the timed testing session. However, if necessary, special testing can be conducted on any of the Plan testing dates.

Norms (cumulative percents of examinees who scored at or below the earned scale score of the examinee) reported for students testing under special conditions are based on the same group as the norms reported for examinees testing under standard conditions. The sample of examinees (described in detail in chapter 4 of this manual) used in developing these norms does not include students who required extended time or special materials. This fact should be taken into consideration when interpreting test results of these students.

Administration Schedule

The Plan program has been designed to be administered within a half day during school-supervised sessions. It takes about 3 hours and 15 minutes to complete the entire program: approximately 60–70 minutes for the non-test sections and 2 hours and 10 minutes for the four tests of educational development. The Plan procedures and materials have been designed to allow schools the option of dividing the administration over two or more days. The non-test sections (student plans and background information, Interest Inventory, and course/grade information) may be administered in a non-secure, supervised school setting on or before the test day. The four tests of educational development must be administered in a single session on the designated test day. Consult the *ACT Plan Supervisor's Manual* for information about makeup testing.

ACT Plan Support Materials

Plan includes a coordinated set of support materials to help students, parents, teachers, counselors, and administrators understand the purposes of the program and the information provided.

- The *ACT Plan Supervisor's Manual*, designed to be used by Plan test supervisors, shows how the Plan program can be used to help students build a solid foundation for future academic and career success.
- The *Guide for Interpreting Your ACT Plan Item-Response Summary Report* explains how to use and understand the information in the Item-Response Summary Report.
- An introductory brochure for students and their parents, *Why Take ACT Plan?*, provides a brief overview of the Plan program and tips to help students do their best.
- Test materials are composed of Student Assessment Sets—the test booklet, an answer folder, and *Instructions for Completing Your Answer Folder*. One Supervisor's folder is shipped with each order, consisting of a *Supervisor's Manual*, a copy of *Directions for Testing*, a combination of large and small posters to promote the test, and an order form for Pre-ID labels for test forms. Reports are routinely shipped from ACT about three weeks from the receipt of the completed answer folders.
- Each student who participates in Plan will receive *Using Your ACT Plan Results*, which includes sections on interpreting the Student Score Report, planning for high school and beyond, career possibilities, building academic skills, and coursework planning.
- The Item-Response Summary Report provides tables describing item by item the performance of your Plan examinees. These results are categorized by test (e.g., English), by subscore (e.g., Usage/Mechanics), and by content area (e.g., Punctuation) and provide comparisons to the performance of other students taking the same test form.
- College Readiness Standards help students, teachers, counselors, and others to more fully understand what students who score in various score ranges are *likely* to know and to be able to do in each academic area assessed: English, mathematics, reading, and science. The Standards are complemented by "ideas for progress," which are suggestions for learning experiences that students might benefit from if they wish to progress to higher levels of achievement. The ACT Plan College Readiness Standards are discussed in chapter 3.
- Linkage Reports assist counselors in evaluating student academic development and progress as students move through ACT Explore, ACT Plan, and the ACT. Explore/Plan Linkage Reports are based on a process of matching Explore and Plan student records and analyzing the changes in student performance between Grade 8 or 9 and Grade 10. The match process reflected in Plan/ACT Linkage Reports between Plan and ACT records allows analysis of changes between Grade 10 and Grade 12.

ACT's Standards for Test Administration and Security

ACT provides specific guidelines for test supervision and materials handling in order to maintain testing conditions as uniform as possible across all schools. Test supervisors are provided with a copy of the *ACT Plan Supervisor's Manual*. These documents provide detailed instructions about all aspects of test administration. Among other standard procedures, the manual includes instructions to be read aloud to the examinees. The instructions are to be read without departure from the specified text in order to maintain standard testing conditions.

Chapter 2
The ACT Plan Tests of Educational Achievement

Description of the ACT Plan Tests

Plan contains four multiple-choice tests—English, Mathematics, Reading, and Science. These tests are designed to measure students' curriculum-related knowledge and the complex cognitive skills important for future education and careers. Plan results provide 10th-grade students with the information they need to continue making plans for high school and beyond.

The fundamental idea underlying the development and use of these tests is that the best way to determine how well prepared students are for further education and for work is to measure as directly as possible the knowledge and skills needed in those settings. ACT conducted a detailed analysis of three sources of information to determine which knowledge and skills should be measured by Plan. First, we studied the objectives for instruction in Grades 7 through 12 for all states that had published them. Second, we reviewed textbooks on state-approved lists for courses in Grades 7 through 12. Third, we consulted educators at grade levels 7 through 12 and at the postsecondary level to determine the knowledge and skills taught in Grades 7 through 12 that are prerequisite to successful performance in high school and beyond. Information from these sources helped to define a scope and sequence for each of the areas measured by Plan.

Curriculum study is ongoing at ACT. Curricula in each content area (English, mathematics, reading, and science) in the Plan tests are reviewed on a periodic basis. ACT's analyses include reviews of tests, curriculum guides, and national standards; surveys of current instructional practice; and meetings with content experts (see ACT, *ACT National Curriculum Survey® 2009*, 2009).

The Plan tests are designed to be developmentally and conceptually linked to those of Explore and the ACT. To reflect that continuity, names of the multiple-choice tests are the same across the three programs. The programs are similar in their focus on critical thinking skills and in their common curriculum base. Specifications for the Plan program are consistent with, and should be seen as, a logical extension of, the content and skills measured in the Explore and ACT programs.

The English Test

The Plan English Test (50 items, 30 minutes) measures the student's understanding of the conventions of standard written English (punctuation, grammar and usage, and sentence structure) and of rhetorical skills (strategy, organization, and style). The test stresses the analysis of the kinds of prose that students are required to read and write in most secondary and postsecondary programs, rather than the rote recall of rules of grammar. The test consists of several prose passages, each accompanied by a number of multiple-choice test items. Different passage types are employed to provide a variety of rhetorical situations.

Some items refer to underlined portions of the passage and offer several alternatives to the portion underlined. The student must decide which choice is most appropriate in the context of the passage. Some items ask about an underlined portion, a section of the passage, or the passage as a whole. The student must decide which choice best answers the question posed. Many items offer "NO CHANGE" to the passage as one of the choices.

Two subscores are reported for this test, a Usage/Mechanics subscore based on 30 items and a Rhetorical Skills subscore based on 20 items.

The Mathematics Test

The Plan Mathematics Test (40 items, 40 minutes) measures the student's mathematical reasoning. The test emphasizes quantitative reasoning rather than memorization of formulas or computational skills. In particular, it emphasizes the ability to solve practical quantitative problems that are encountered in many first- and second-year high school courses (pre-algebra, first-year algebra, and plane geometry). While some material from second-year courses is included on the test, most items, including the geometry items, emphasize content presented before the second year of high school. The items included in the Mathematics Test cover four skill areas: knowledge and skills, direct application, understanding concepts, and integrating conceptual understanding.

Calculators, although not required, are permitted for use on the Mathematics Test. Almost any four-function, scientific, or graphing calculator may be used on the Mathematics Test. A few restrictions do apply to the calculator used. These restrictions can be found in the current year's *ACT Plan Supervisor's Manual* or on ACT's website at **www.act.org**.

The items in the Mathematics Test are classified according to four content categories: Pre-Algebra, Elementary Algebra, Coordinate Geometry, and Plane Geometry. Two subscores are reported for the Mathematics Test: Pre-Algebra/Algebra and Geometry, based on 22 and 18 items, respectively.

The Reading Test

The Plan Reading Test (25 items, 20 minutes) measures the student's level of reading comprehension as a product of skill in referring and reasoning. That is, the test items require students to derive meaning from several texts by: (a) referring to what is explicitly stated and (b) reasoning to determine implicit meanings. Specifically, items will ask the student to use referring and reasoning skills to determine main ideas; locate and interpret significant details; understand sequences of events; make comparisons; comprehend cause-effect relationships; determine the meaning of context-dependent words, phrases, and statements; draw generalizations; and analyze the author's or narrator's voice or method. The test comprises three prose passages that are representative of the level and kinds of text commonly encountered in 10th-grade curricula; passages on topics in the social sciences, prose fiction, and the humanities are included. Each passage is preceded by a heading that identifies what type of passage it is (e.g., "Prose Fiction"), names the author, and may include a brief note that helps in understanding the passage. Each passage is accompanied by a set of multiple-choice test items. These items do not test the rote recall of facts from outside the passage, isolated vocabulary questions, or rules of formal logic. Rather, the test focuses upon the complex of complementary and mutually supportive skills that readers must bring to bear in studying written materials across a range of subject areas.

The Science Test

The Plan Science Test (30 items, 25 minutes) measures scientific reasoning skills acquired through Grade 10. The test presents five sets of scientific information, each followed by a number of multiple-choice test items. The scientific information is conveyed in one of three different formats: data representation (graphs, tables, and other schematic forms), research summaries (descriptions of several related experiments), or conflicting viewpoints (expressions of several related hypotheses or views that are inconsistent with one another). The items require students to recognize and understand the basic features of, and concepts related to, the information provided; to examine critically the relationships between the information provided and the conclusions drawn or hypotheses developed; and to generalize from given information to gain new information, draw conclusions, or make predictions.

The Science Test is based on materials drawn from the content areas of biology, the Earth/space sciences, chemistry, and physics. The test emphasizes scientific reasoning skills over recall of scientific content, skill in mathematics, or skill in reading.

Test Development Procedures

This section describes the procedures that are used in developing the four multiple-choice tests described previously. The test development cycle required to produce each new form of the Plan tests takes as long as two and one-half years and involves several stages, beginning with a review of the test specifications.

Reviewing Test Specifications

Two types of test specifications are used in developing the Plan tests: content specifications and statistical specifications.

Content specifications. Content specifications for the Plan tests were developed through the curricular analysis discussed previously. While care is taken to ensure that the basic structure of the Plan tests remains the same from year to year so that the scale scores are comparable, the specific characteristics of the test items used in each specification category are reviewed regularly. Consultant panels are convened to review the new forms of the test in order to verify their content accuracy and the match of the content of the tests to the content specifications. At this time, the characteristics of the items that fulfill the content specifications are also reviewed. While the general content of the test remains constant, the particular kinds of items in a specification category may change slightly. The basic structure of the content specifications for each of the Plan multiple-choice tests is provided in Tables 2.1 through 2.4.

Statistical specifications. Statistical specifications for the tests indicate the level of difficulty (proportion correct) and minimum acceptable level of discrimination (biserial correlation) of the test items to be used.

The tests are constructed to have a mean item difficulty of about .58 for the Plan national population and a range of difficulties from about .20 to .89. The distribution of item difficulties was selected so that the tests will effectively differentiate among students who vary widely in their level of achievement.

The items in the Plan tests are selected to have a biserial correlation of at least 0.20 with scores on a test measuring comparable content. For example, examinees' performance on each English item should have a biserial correlation of 0.20 or higher with their performance on the English Test.

Table 2.1
Content Specifications for the ACT Plan English Test

Six elements of effective writing are included in the English Test. These elements and the approximate proportion of the test devoted to each are given below.

Content/Skills	Proportion of test	Number of items
Usage/Mechanics	**.60**	**30**
Punctuation	.14	7
Grammar and Usage	.18	9
Sentence Structure	.28	14
Rhetorical Skills	**.40**	**20**
Strategy	.12	6
Organization	.14	7
Style	.14	7
Total	**1.00**	**50**

a. *Punctuation.* The items in this category test the student's knowledge of the conventions of internal and end-of-sentence punctuation, with emphasis on the relationship of punctuation to meaning (e.g., avoiding ambiguity, identifying appositives).

b. *Grammar and Usage.* The items in this category test the student's understanding of agreement between subject and verb, between pronoun and antecedent, and between modifiers and the words modified; verb formation; pronoun case; formation of comparative and superlative adjectives and adverbs; and idiomatic usage.

c. *Sentence Structure.* The items in this category test the student's understanding of relationships between and among clauses, placement of modifiers, and shifts in construction.

d. *Strategy.* The items in this category test the student's ability to develop a given topic by choosing expressions appropriate to an essay's audience and purpose; to judge the effect of adding, revising, or deleting supporting material; and to judge the relevance of statements in context.

e. *Organization.* The items in this category test the student's ability to organize ideas and to choose effective opening, transitional, and closing sentences.

f. *Style.* The items in this category test the student's ability to select precise and appropriate words and images, to maintain the level of style and tone in an essay, to manage sentence elements for rhetorical effectiveness, and to avoid ambiguous pronoun references, wordiness, and redundancy.

Table 2.2
Content Specifications for the ACT Plan Mathematics Test

The items in the Mathematics Test are classified according to four content areas. These areas and the approximate proportion of the test devoted to each are given below.

Mathematics content area	Proportion of test	Number of items
Pre-Algebra/Algebra	**.55**	**22**
Pre-Algebra	.35	14
Elementary Algebra	.20	8
Geometry	**.45**	**18**
Coordinate Geometry	.18	7
Plane Geometry	.27	11
Total	**1.00**	**40**

a. *Pre-Algebra.* Items in this category are based on basic operations using whole numbers, decimals, fractions, and integers; place value; square roots and approximations; the concept of exponents; scientific notation; factors; ratio, proportion, and percent; linear equations in one variable; absolute value and ordering numbers by value; elementary counting techniques and simple probability; data collection, representation, and interpretation; and understanding simple descriptive statistics.

b. *Elementary Algebra.* The items in this category are based on properties of exponents and square roots; evaluation of algebraic expressions through substitution; simplification of algebraic expressions; addition, subtraction, and multiplication of polynomials; factorization of polynomials; and solving quadratic equations by factoring.

c. *Coordinate Geometry.* Items in this category are based on graphing and the relations between equations and graphs, including points and lines; graphing inequalities; slope; parallel and perpendicular lines; distance; and midpoints.

d. *Plane Geometry.* Items in this category are based on the properties and relations of plane figures, including angles and relations among perpendicular and parallel lines; properties of circles, triangles, rectangles, parallelograms, and trapezoids; transformations; and volume.

Table 2.3
Content Specifications for the ACT Plan Reading Test

The items in the Reading Test are based on the prose passages that are representative of the kinds of writing commonly encountered in secondary curricula, including the social sciences, prose fiction, and the humanities. The three content areas and the approximate proportion of the test devoted to each are given below.

Reading passage content	Proportion of test	Number of items
Prose Fiction	.32	8
Humanities	.36	9
Social Sciences	.32	8
Total	**1.00**	**25**

a. *Prose Fiction.* The items in this category are based on short stories or excerpts from short stories or novels.

b. *Humanities.* The items in this category are based on passages from memoirs and personal essays, and in the content areas of architecture, art, dance, ethics, film, language, literary criticism, music, philosophy, radio, television, or theater.

c. *Social Sciences.* The items in this category are based on passages in anthropology, archaeology, biography, business, economics, education, geography, history, political science, psychology, or sociology.

Table 2.4
Content Specifications for the ACT Plan Science Test

The Science Test is based on the type of content that is typically covered in early high school general science courses. Materials are drawn from the biological sciences, the earth/space sciences, physics, and chemistry. The test emphasizes scientific reasoning skills over recall of specific scientific content, skill in mathematics, or skill in reading. Minimal arithmetic and algebraic computations may be required to answer some questions. The three formats and the approximate proportion of the test devoted to each are given below.

Content area[a]	Format	Proportion of test	Number of items
Biology Earth/Space Sciences Physics Chemistry	Data Representation	.33	10
	Research Summaries	.47	14
	Conflicting Viewpoints	.20	6
Total		**1.00**	**30**

[a] All four content areas are represented in the test. The content areas are distributed over the different formats.

a. *Data Representation.* This format presents students with graphic and tabular material similar to that found in science journals and texts. The items associated with this format measure skills such as graph reading, interpretation of scatterplots, and interpretation of information presented in tables. The graphic or tabular material may be taken from published materials; the items are composed expressly for the Science Test.

b. *Research Summaries.* This format provides students with descriptions of one or more related experiments. The items focus on the design of experiments and the interpretation of experimental results. The stimulus and items are written expressly for the Science Test.

c. *Conflicting Viewpoints.* This format presents students with expressions of several hypotheses or views that, being based on differing premises or on incomplete data, are inconsistent with one another. The items focus on the understanding, analysis, and comparison of alternative viewpoints or hypotheses. Both the stimulus and the items are written expressly for the Science Test.

Selection of Item Writers

Each year, ACT contracts with item writers to construct items for Plan. The item writers are content specialists in the disciplines measured by the Plan tests. Most are actively engaged in teaching at various levels, from high school to university, and at a variety of institutions, from small private schools to large public institutions. ACT makes every attempt to include item writers who represent the diversity of the population of the United States with respect to ethnic background, gender, and geographic location.

Before being asked to write items for the Plan tests, potential item writers are required to submit a sample set of materials for review. Each item writer receives an item writer's guide that is specific to the content area. The guides include examples of items and provide item writers with the test specifications and ACT's requirements for content and style. Included are specifications for fair portrayal of all groups of individuals, avoidance of subject matter that may be unfamiliar to members of certain groups within society, and nonsexist use of language.

Each sample set submitted by a potential item writer is evaluated by ACT Test Development staff. A decision concerning whether to contract with the item writer is made on the basis of that evaluation.

Each item writer under contract is given an assignment to produce a small number of multiple-choice items. The small size of the assignment ensures production of a diversity of material and maintenance of the security of the testing program, since any item writer will know only a small proportion of the items produced. Item writers work closely with ACT test specialists, who assist them in producing items of high quality that meet the test specifications.

Item Construction

The item writers must create items that are educationally important and psychometrically sound. A large number of items must be constructed because, even with good writers, many items fail to meet ACT's standards.

Each item writer submits a set of items, called a unit, in a given content area. Most Mathematics Test items are discrete (not passage-based), but occasionally some may belong to sets composed of several items based on the same paragraph or chart. All items on the English and Reading Tests are related to prose passages. All items on the Science Test are related to passages and/or other stimulus material (such as graphs and tables).

Review of Items

After a unit is accepted, it is edited to meet ACT's specifications for content accuracy, word count, item classification, item format, and language. During the editing process, all test materials are reviewed for fair portrayal and balanced representation of groups within society and for nonsexist use of language. The unit is reviewed several times by ACT staff to ensure that it meets all of ACT's standards.

Copies of each unit are then submitted to content and fairness experts for external reviews prior to the pretest administration of these units. The content reviewers are high school teachers, curriculum specialists, and college and university faculty members. The content experts review the unit for content accuracy, educational importance, and grade-level appropriateness. The fairness reviewers are experts in diverse educational areas who represent both genders and a variety of racial and ethnic backgrounds. These reviewers help ensure fairness to all examinees.

Any comments on the units by the content consultants are discussed in a panel meeting with all the content consultants and ACT staff, and appropriate changes are made to the unit(s). All fairness consultants' comments are reviewed and discussed, and appropriate changes are made to the unit(s).

Item Tryouts

The items that are judged to be acceptable in the review process are assembled into tryout units for pretesting on samples from the national examinee population. These samples are carefully selected to be representative of the total examinee population. Each sample is administered a tryout unit from one of the four academic areas covered by the Plan tests. The time limits for the tryout units permit the majority of students to respond to all items.

Item Analysis of Tryout Units

Item analyses are performed on the tryout units. For a given booklet the sample is divided into low, medium, and high groups by total tryout test score. The cutoff scores for the three groups are the 27th and the 73rd percentile points in the distribution of those scores.

Proportions of students in each of the groups correctly answering each tryout item are tabulated, as well as the proportion in each group selecting each of the incorrect options. Biserial and point-biserial correlation coefficients between each item score (correct/incorrect) and the total score on the tryout unit are also computed.

The item analyses serve to identify statistically effective test questions. Items that were either too difficult or too easy, and those that failed to discriminate between students of high and low educational development as measured by their tryout test scores, are eliminated or revised. The biserial and point-biserial correlation coefficients, as well as the differences between proportions of students answering the item correctly in each of the three groups, are used as indices of the discriminating power of the tryout items.

Each item is reviewed following the item analysis. ACT staff scrutinizes items determined to be of poor quality in order to identify possible causes. Some items are revised and placed in new tryout units following further review. The review process also provides feedback that helps decrease the incidence of poor quality items in the future.

Assembly of New Forms

Items that are judged acceptable in the review process are placed in an item pool. Preliminary forms of the Plan tests are constructed by selecting from this pool items that match the content, cognitive, and statistical specifications for the tests.

For each test in a battery form, items are selected to match the content distribution for the test shown in Tables 2.1 through 2.4. Items are also selected to comply with statistical specifications as discussed in an earlier section. The distributions of item difficulty levels obtained on recent forms of the four tests are displayed in Table 2.5. The data in the table are taken from random samples of approximately 2,000 students from the operational administration of the tests in 2003 through 2006. In addition to the item difficulty distributions, item discrimination indices in the form of observed mean biserial correlations and completion rates are reported.

The completion rate is an indication of how speeded a test is for a group of students. A test is considered to be speeded if most students do not have sufficient time to answer the items in the time allotted. The completion rate reported in Table 2.5 for each test is the average completion rate for the 2003–2006 Plan operational administrations. The completion rate for each test is computed as the average proportion of examinees who answered each of the last five items.

Table 2.5

Difficulty[a] Distributions, Mean Discrimination[b] Indices, and Average Completion Rates[c] for the 2003–2006 ACT Plan Operational Administrations

	Observed difficulty distributions (frequencies)			
Difficulty range	**English**	**Mathematics**	**Reading**	**Science**
.00–.09	0	0	0	0
.10–.19	0	8	2	0
.20–.29	12	16	8	11
.30–.39	18	18	17	10
.40–.49	27	25	19	20
.50–.59	34	29	21	27
.60–.69	41	27	19	25
.70–.79	44	26	9	20
.80–.89	24	11	5	7
.90–1.00	0	0	0	0
Number of items[d]	200	160	100	120
Mean difficulty[a]	.59	.53	.51	.55
Mean discrimination[b]	0.51	0.51	0.52	0.56
Avg. completion rate[c]	.89	.88	.88	.94

[a]Difficulty is the proportion of examinees correctly answering the item.
[b]Discrimination is the item–total score biserial correlation coefficient.
[c]Average completion rate for all four forms, with the completion rate for any one form being the mean proportion of students responding to each of the last 5 items.
[d]Four forms consisting of the following number of items per test: English 50, Mathematics 40, Reading 25, Science 30.

Content and Fairness Review of Test Items

The preliminary versions of the test forms are subjected to several reviews to ensure that the items are accurate and that the overall test forms are fair and conform to good test construction practice. The first review is performed by ACT staff. Items are checked for content accuracy and conformity to ACT style. The items are also reviewed to ensure that they are free of clues that could allow testwise students to answer the item correctly even though they lack knowledge in the subject area or the required skills.

The preliminary versions of the test forms are then submitted to content and fairness experts for external review prior to the operational administration of the test forms. These experts are not the same individuals consulted for the content and fairness reviews of tryout units.

The content consultants are high school teachers, curriculum specialists, and college and university faculty members. The content consultants review the forms for content accuracy, educational importance, and grade-level appropriateness. The fairness consultants are diversity experts in education who represent both genders and a variety of racial and ethnic backgrounds. The fairness consultants review the forms to help ensure fairness to all examinees.

After the external content and fairness reviews, ACT summarizes the results from the reviews. Comments from the consultants are then reviewed by ACT staff members, and any necessary changes are made to the test forms. Whenever significant changes are made, the revised components are again reviewed by the appropriate consultants and by ACT staff. If no further corrections are needed, the test forms are prepared for printing.

In all, at least sixteen independent reviews are made of each test item before it appears on a national form of Plan. The many reviews are performed to help ensure that each student's level of achievement is accurately and fairly evaluated.

Review Following Operational Administration

After each operational administration, item analysis results are reviewed for any abnormality such as substantial changes in item difficulty and discrimination indices between tryout and national administrations. Only after all anomalies have been thoroughly checked and the final scoring key approved are score reports produced. Examinees are encouraged to challenge any items that they feel are questionable in correctness. Once a challenge to an item is raised and reported, the item is reviewed by the experts in the content area the item is assessing. In the event that a problem is found with an item, necessary actions will be taken to eliminate or minimize the influence of the problem item. In all

cases, the person who challenges an item is sent a letter indicating the results of the review.

Also, after each operational administration, differential item functioning (DIF) analysis is conducted on the test data. DIF can be described as a statistical difference between the probability of the specific population subgroup (the "focal" group) getting the item right and the comparison population subgroup (the "base" group) getting the item right given that both groups have the same level of expertise with respect to the content being tested. The procedures currently used for the analysis include the standardized difference in proportion-correct (STD) procedure and the Mantel-Haenszel common odds-ratio (MH) procedure.

In ACT's experience, the MH and STD procedures are useful techniques in detecting DIF. Both techniques are designed for use with multiple-choice items, and both require data from significant numbers of examinees to provide reliable results. For a description of these statistics and their performance overall in detecting DIF, see the ACT Research Report entitled *Performance of Three Conditional DIF Statistics in Detecting Differential Item Functioning on Simulated Tests* (Spray, 1989). In the analysis on items in a Plan form, large samples representing examinee groups of interest, e.g., males and females, are selected from the total number of examinees taking the test. The examinees' responses to each item on the test are analyzed using the STD and MH procedures. Compared with preestablished criteria, the items with MH and/or STD values exceeding the tolerance level are flagged. The flagged items are then further reviewed by the content specialists for possible explanations of the unusual MH and/or STD results of the items. In the event that a problem is found with an item, necessary actions will be taken to eliminate or minimize the influence of the problem item.

ACT Plan Scoring Procedures

For each of the four tests in Plan (English, Mathematics, Reading, Science), the raw scores (number of correct responses) are converted to scale scores ranging from 1 to 32. The score scale is discussed further on pages 20–22 of this manual.

The Composite score is the average of the four scale scores rounded to the nearest whole number (0.5 rounds up). The minimum Composite score is 1; the maximum is 32.

In addition to the four Plan test scores and Composite score, two subscores are reported for both the English Test and the Mathematics Test. As for each of the four tests, the raw scores for the subscore items are converted to scale scores. These subscores are reported on a score scale ranging from 1 to 16. The score scale is discussed further on pages 20–22 of this manual.

National percentile rank, based on a national normative group, is reported as percent-at-or-below for the four Plan test scores, four subscores, and Composite score. Plan norms are intended to be representative of the performance of all 10th graders in the nation. All norms are based on a fall 2005 administration of Plan to classes of 10th graders in public and private schools throughout the United States.

Chapter 3
ACT's College Readiness Standards and College Readiness Benchmarks

ACT's College Readiness Standards

Description of the College Readiness Standards

In 1997, ACT began an effort to make Explore, Plan, and ACT test results more informative and useful. This effort yielded College Readiness Standards for each of the programs. ACT's College Readiness Standards are statements that describe what students who score in various score ranges on the tests are *likely* to know and to be able to do. For example, students who score in the 16–19 range on the Plan English Test typically are able "to select the most logical place to add a sentence in a paragraph," while students who score in the 28–32 score range are able "to add a sentence to introduce or conclude a fairly complex paragraph." The Standards reflect a progression of skills in each of the five tests: English, Reading, Mathematics, Science, and Writing. ACT has organized the standards by *strands*—related areas of knowledge and skill within each test—for ease of use by teachers and curriculum specialists. The complete College Readiness Standards are posted on ACT's website: **www.act.org**. They also are available in poster format from ACT Educational Services at 319/337-1040.

College Readiness Standards for Explore, Plan, and the ACT are provided for six score ranges (13–15, 16–19, 20–23, 24–27, 28–32, and 33–36) along a score scale that is common to Explore (1–25), Plan (1–32), and the ACT (1–36). Students who score in the 1–12 range are most likely beginning to develop the skills and knowledge described in the 13–15 score range. The Standards are cumulative, which means that if students score, for example, in the 20–23 range on the English Test, they are likely able to demonstrate most or all of the skills and understandings in the 13–15, 16–19, and 20–23 score ranges.

College Readiness Standards for Writing, which ACT developed in 2005, are available only for the ACT and are provided for five score ranges (3–4, 5–6, 7–8, 9–10, and 11–12) based on ACT Writing Test scores obtained (sum of two readers' rating using the six-point holistic scoring rubric for the ACT Writing Test). Scores below 3 do not permit useful generalizations about students' writing abilities.

Since Explore, Plan, and the ACT are designed to measure students' progressive development of knowledge and skills in the same four academic areas through Grades 8–12, the Standards are correlated across programs as much as possible. The Standards in the 13–15, 16–19, 20–23, and 24–27 score ranges apply to scores for all three programs. The Standards in the 28–32 score range are specific to Plan and the ACT, and the scores in the 33–36 score range are specific to the ACT. Figure 3.1 illustrates the score-range overlap among the three programs.

Determining the Score Ranges for the College Readiness Standards (1997)

When ACT began work on the College Readiness Standards in 1997, the first step was to determine the number of score ranges and the width of each score range. To do this, ACT staff reviewed normative data and considered the relationships among Explore, Plan, and the ACT. This information was considered within the context of how the test scores are used—for example, the use of the ACT scores in college admissions and course-placement decisions.

In reviewing the normative data, ACT staff analyzed the distribution of student scores across the three score scales (Explore 1–25, Plan 1–32, and ACT 1–36). The staff also considered course placement research that ACT has conducted over the last forty-five years. ACT's Course Placement Service provides colleges and universities with cutoff scores that are used for placement into appropriate entry-level college courses. Cutoff scores based on admissions and course placement criteria were used to help define the score ranges of all three testing programs.

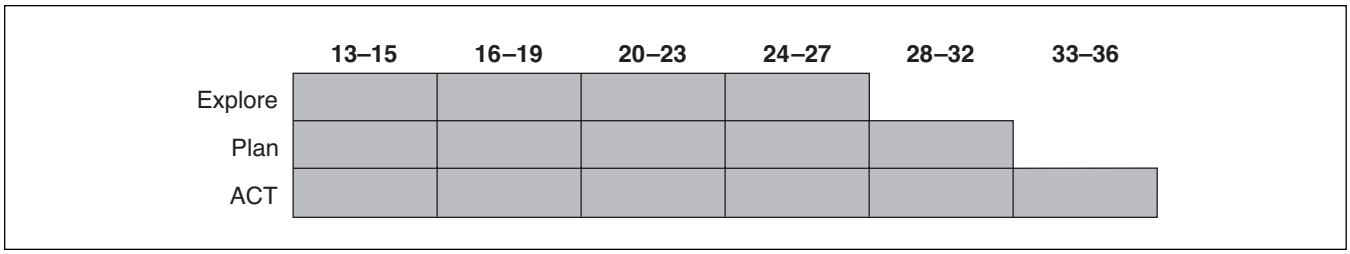


Figure 3.1. Score ranges for ACT Explore, ACT Plan, and the ACT.

After analyzing all the data and reviewing different possible score ranges, ACT staff concluded that the score ranges 1–12, 13–15, 16–19, 20–23, 24–27, 28–32, and 33–36 would best distinguish students' levels of achievement so as to assist teachers, administrators, and others in relating the test scores to students' skills and understandings.

Developing the College Readiness Standards

After reviewing the normative data, college admissions criteria, and information obtained through ACT's Course Placement Service, content area test specialists wrote the College Readiness Standards based on their analysis of the skills and knowledge students need in order to respond successfully to test items that were answered correctly by 80% or more of the examinees who scored within each score range. Content specialists analyzed test items taken from dozens of test forms. The 80% criterion was chosen because it offers those who use the College Readiness Standards a high degree of confidence that students scoring in a given score range will most *likely* be able to demonstrate the skills and knowledge described in that range.

The Process. Four ACT content teams were identified, one for each of the tests (English, Mathematics, Reading, and Science) included in the three testing programs. Each content team was provided with numerous test forms along with tables that showed the percentages of students in each score range who answered each test item correctly (the item difficulties). Item difficulties were computed separately based on groups of students whose scores fell within each of the defined score ranges.

The College Readiness Standards were identified by test, by program, beginning with the ACT. Each content team was provided with 10 forms of the ACT and the item difficulties computed separately for each score range for each of the items on the forms. For example, the mathematics content team reviewed 10 forms of the ACT Mathematics Test. There are 60 items in each ACT Mathematics Test form, so 600 ACT Mathematics items were reviewed in all. An illustrative table displaying the information provided to the mathematics content team for one ACT Mathematics Test form is shown in Table 3.1.

The shaded areas in Table 3.1 show the items that met the 0.80 or above item difficulty criterion for each of the score ranges. As illustrated in Table 3.1, a cumulative effect can be noted: the items that are correctly answered by 80% of the students in Score Range 16–19 also appear in Score Range 20–23; the items that are correctly answered by 80% of the students in Score Range 20–23 also appear in Score Range 24–27; and so on. By using this information, the content teams were able to isolate and review the items by score ranges across test forms.

Table 3.1
Illustrative Listing of Mathematics Items by Score Range

Item no.	Item difficulties for students scoring in the score range of:					
	13–15	16–19	20–23	24–27	28–32	33–36
1	.62	.89	.98	.99	1.00	1.00
2		.87	.98	.99	.99	1.00
6	.60	.86	.94	.97	.99	.99
7	.65	.92	.98	.99	.99	1.00
20		.84	.94	.97	.98	.99
27		.85	.97	.99	.99	.99
4			.92	.97	.99	1.00
5			.94	.97	.99	.99
.			.	.	.	.
.			.	.	.	.
.			.	.	.	.
8			.82	.95	.98	.99
9			.80	.89	.96	.99
21			.82	.92	.97	.99
13				.90	.97	.99
15				.90	.97	.99
17				.87	.98	1.00
18				.83	.93	.98
22				.81	.91	.98
24				.83	.96	.98
29				.87	.98	1.00
34				.86	.95	.99
36				.82	.93	.99
39				.85	.96	.99
44				.84	.96	.99
25					.95	.99
28					.97	1.00
.					.	.
.					.	.
.					.	.
35					.86	.96
47					.86	.97
32						.95
33						.92
46						.90
49						.95
51						.98
52						.98
53						.92
56						.98
57						.86
58						.95
59						.86
60						.96

The procedures described allowed the content teams to conceptualize what is measured by each of the academic tests. Each content team followed the same basic process as they reviewed the test items in each academic test in the three assessment programs, Explore, Plan, and the ACT:

1. Multiple forms of each academic test were distributed.
2. The knowledge, skills, and understandings that are necessary to answer the test items in each score range were identified.
3. The *additional* knowledge, skills, and understandings that are necessary to answer the test items in the *next* score range were identified. This process was repeated for all the score ranges.
4. All the lists of statements identified by each content specialist were merged into a composite list. The composite list was distributed to a larger group of content specialists.
5. The composite list was reviewed by each content specialist and ways to generalize and to consolidate the various skills and understandings were identified.
6. The content specialists met as a group to discuss the individual, consolidated lists and prepared a master list of skills and understandings, organized by score ranges.
7. The master list was used to review at least three additional test forms, and adjustments and refinements were made as necessary.
8. The adjustments were reviewed by the content specialists and "final" revisions were made.
9. The "final" list of skills and understandings was used to review additional test forms. The purpose of this review was to determine whether the College Readiness Standards adequately and accurately described the skills and understandings measured by the items, by score range.
10. The College Readiness Standards were once again refined.

These steps were used to review test items for all four multiple-choice academic tests in all three testing programs. As work began on the Plan and Explore test items, the College Readiness Standards developed for the ACT were used as a baseline, and modifications or revisions were made as necessary.

Table 3.2 reports the total number of test items reviewed for each content area and for each testing program.

Table 3.2
Number of Items Reviewed During 1997 National Review

	Number of items for each testing program		
Content area	**Explore**	**Plan**	**ACT**
English	40	50	75
Mathematics	30	40	60
Reading	30	25	40
Science	28	30	40
Number of items per form	128	145	215
Total number of test forms reviewed	4	9	10
Total number of items reviewed	512	1,305	2,150

Conducting an Independent Review of the College Readiness Standards. As a means of gathering content validity evidence, ACT invited nationally recognized scholars from high school and university English, mathematics, reading, science, and education departments to review the College Readiness Standards. These teachers and researchers were asked to provide ACT with independent, authoritative reviews of the College Readiness Standards.

The content area experts were selected from among candidates having experience with and an understanding of the academic tests on Explore, Plan, and the ACT. The selection process sought and achieved a diverse representation by gender, ethnic background, and geographic location. Each participant had extensive and current knowledge of his or her field, and many had acquired national recognition for their professional accomplishments.

The reviewers were asked to evaluate whether the College Readiness Standards (a) accurately reflected the skills and knowledge needed to correctly respond to test items (in specific score ranges) in Explore, Plan, and the ACT and (b) represented a continuum of increasingly sophisticated skills and understandings across the score ranges. Each national content area team consisted of three college faculty members currently teaching courses in curriculum and instruction, and three classroom teachers, one each from Grades 8, 10, and 12. The reviewers were provided with the complete set of College Readiness Standards and a sample of test items falling in each of the score ranges, by academic test and program.

The samples of items to be reviewed by the consultants were randomly selected for each score range in all four academic tests for all three assessment programs. ACT believed that a random selection of items would ensure a more objective outcome than would preselected items. Ultimately, 17 items for each score range were selected (85 items per testing program, or a total of 255 items for all three programs). Before identifying the number of items that would comprise each set of items in each score range, it was first necessary to determine the target criterion for the level of agreement among the consultants. ACT decided upon a target criterion of 70%. It was deemed most desirable for the percentage of matches to be estimated with an accuracy of plus or minus 0.05. That is, the standard error of the estimated percent of matches to the Standards should be no greater than 0.05. To estimate a percentage around 70% with that level of accuracy, 85 observations were needed. Since there were five score ranges, the number of items per score range to be reviewed was 17 ($85 \div 5 = 17$).

The consultants had two weeks to review the College Readiness Standards. Each reviewer received a packet of materials that contained the College Readiness Standards, sets of randomly selected items (17 per score range), introductory material about the College Readiness Standards, a detailed set of instructions, and two evaluation forms.

The sets of materials submitted for the experts' review were drawn from 13 ACT forms, 8 Plan forms, and 4 Explore forms. The consultants were asked to perform two main tasks in their area of expertise: Task 1—Judge the consistency between the Standards and the corresponding sample items provided for each score range; Task 2—Judge the degree to which the Standards represent a cumulative progression of increasingly sophisticated skills and understandings from the lowest score range to the highest score range. The reviewers were asked to record their ratings using a five-point Likert scale that ranged from *Strongly Agree* to *Strongly Disagree*. They were also asked to suggest revisions to the language of the Standards that would help the Standards better reflect the skills and knowledge measured by the sample items.

ACT collated the consultants' ratings and comments as they were received. The consultants' reviews in all but two cases reached ACT's target criterion, as shown in Table 3.3.

Table 3.3
Percentage of Agreement of 1997 National Expert Review

	Explore		Plan/ACT		
	Task 1	**Task 2**	**Task 1 (Plan)**	**Task 1 (ACT)**	**Task 2**
English	65%	80%	75%	75%	86%
Mathematics	80%	100%	70%	95%	100%
Reading	75%	75%	75%	60%	100%
Science	95%	100%	100%	70%	80%

That is, 70% or more of the consultants' ratings were *Agree* or *Strongly Agree* when judging whether the Standards adequately described the skills required by the test items and whether the Standards adequately represented the cumulative progression of increasingly sophisticated skills from the lowest to the highest score ranges. The two exceptions were the Explore English Test and the ACT Reading Test, where the degree of agreement was 65% and 60%, respectively. Each ACT staff content area team met to review all comments made by all the national consultants. The teams reviewed all suggestions and adopted a number of helpful clarifications in the language of the Standards, particularly in the language of the Explore English Test Standards and the ACT Reading Test Standards—those two cases in which the original language had failed to meet the target criterion.

Refining the College Readiness Standards for ACT Explore and ACT Plan (2001)

In 2001, the score scale for Explore and Plan was refined. This required that the College Readiness Standards for Explore and Plan be reexamined.

The approach used in 1997 to develop the Standards was used to reexamine the Standards for Explore and Plan in 2000. Staff reviewed items, at each Explore and Plan score interval, that were answered correctly by 80% or more of the Explore and Plan examinees. Using the Plan College Readiness Standards as a baseline, Explore test items were reviewed to ensure that the Plan College Readiness Standards adequately described the skills and understandings students were being asked to demonstrate in each score range.

As in the 1997 study, a national independent panel of content experts was convened in each of the four multiple-choice academic tests to ensure that the refined Explore/Plan Standards (a) accurately reflected the skills and knowledge needed to correctly respond to test items in the common score ranges and (b) represented a continuum of increasingly sophisticated skills and understandings across the entire score range. As was the case in 1997, content area experts were identified in the areas of English, mathematics, reading, and science. Each content area team consisted of three reviewers, one each from middle school/junior high, high school, and college/university.

For each academic test, the consultants were asked to review sets of test items, arranged by score range, and the corresponding College Readiness Standards. The Plan reviewers received two sets of test items, an Explore set and a Plan set, along with the corresponding Standards. A criterion of 17 items per score range was chosen.

As was the case in 1997, the reviewers were asked to record their ratings using a five-point Likert scale that ranged from *Strongly Agree* to *Strongly Disagree*. They were also asked to suggest revisions to the language of the Standards that would help the Standards better reflect the skills and knowledge measured by the sample items. A target criterion of 70% agreement was again identified. The consultants' review in all cases reached ACT's target criterion, as shown in Table 3.4.

Periodic Review of the College Readiness Standards

In addition to the regularly scheduled independent reviews conducted by national panels of subject matter experts, ACT also periodically conducts internal reviews of the College Readiness Standards. ACT identifies three to four new forms of the ACT, Plan, and Explore (for Explore, fewer forms are available) and then analyzes the data and the corresponding test items, by score range. The purposes of these reviews are to ensure that (a) the Standards reflect the knowledge and skills being measured by the items in each score range and (b) the Standards reflect a cumulative progression of increasingly sophisticated skills and understandings from the lowest score range to the highest. Minor refinements intended to clarify the language of the Standards have resulted from these reviews.

Table 3.4
Percentage of Agreement of 2000 National Expert Review

	Explore		Plan	
	Task 1	**Task 2**	**Task 1**	**Task 2**
English	90%	100%	73%	100%
Mathematics	75%	100%	100%	100%
Reading	100%	100%	87%	100%
Science	75%	100%	90%	100%

Interpreting and Using the College Readiness Standards

Because new test forms for Explore, Plan, and the ACT are developed at regular intervals and because no one test form measures all of the skills and knowledge included in any particular Standard, the College Readiness Standards must be interpreted as skills and knowledge that *most* students who score in a particular score range are *likely* to be able to demonstrate. Since there were relatively few test items that were answered correctly by 80% or more of the students who scored in the lower score ranges, the standards in these ranges should be interpreted cautiously.

It is important to recognize that the tests neither measure everything students have learned nor does any test measure everything necessary for students to know to be successful in their next level of learning. The tests include questions from a large domain of skills and from areas of knowledge that have been judged important for success in high school, college, and beyond. Thus, the College Readiness Standards should be interpreted in a responsible way that will help students, parents, teachers, and administrators to:

- Identify skill areas in which students might benefit from further instruction
- Monitor student progress and modify instruction to accommodate learners' needs
- Encourage discussion among principals, curriculum coordinators, and classroom teachers as they evaluate their academic programs
- Enhance discussions between educators and parents to ensure that students' course selections are appropriate and consistent with their post–high school plans
- Enhance the communication between secondary and postsecondary institutions
- Identify the knowledge and skills students entering their first year of postsecondary education should know and be able to do in the academic areas of language arts, mathematics, and science
- Assist students as they identify skill areas they need to master in preparation for college-level course work

ACT's College Readiness Benchmarks

Description of the College Readiness Benchmarks

The ACT College Readiness Benchmarks (see Table 3.5) are the minimum ACT test scores required for students to have a high probability of success in first-year, credit-bearing college courses—English Composition I, social science courses, College Algebra, or Biology. In addition to the Benchmarks for the ACT, there are corresponding Explore and Plan Benchmarks for use by students who take these programs to gauge their progress in becoming college ready in grades 8 through 10. Students who meet a Benchmark on the ACT have approximately a 50% chance of earning a B or better and approximately a 75% chance or better of earning a C or better in the corresponding college course or courses. Students who meet a Benchmark on Explore or Plan have approximately a 50% chance of meeting the ACT Benchmark in the same subject, and are likely to have approximately this same chance of earning a B or better grade in the corresponding college course(s) by the time they graduate high school.

Data Used to Establish the Benchmarks for the ACT

The ACT College Readiness Benchmarks are empirically derived based on the actual performance of students in college. As part of its research services, ACT provides reports to colleges to help them place students in entry-level courses as accurately as possible. In providing these research services, ACT has an extensive database consisting of course grade and test score data from a large number of first-year students and across a wide range of postsecondary institutions. These data provide an overall measure of what it takes to be successful in selected first-year college courses. Data from 214 institutions and over 230,000 students were used to establish the Benchmarks. The numbers and types of colleges varied by course. Because the sample of colleges in this study is a "convenience" sample (that is, based on data from colleges that chose to participate in ACT's research services), there is no guarantee that it is representative of all colleges in the

Table 3.5
ACT Explore, ACT Plan, and the ACT College Readiness Benchmarks

Subject test	College course	Assessment and Grade Level			
		Explore		Plan	ACT
		8	9	10	11/12
English	English Composition I	13	14	15	18
Mathematics	College Algebra	17	18	19	22
Reading	Social Sciences	16	17	18	22
Science	Biology	18	19	20	23

United States. Therefore, ACT weighted the sample so that it would be representative of all ACT-tested college students in terms of college type (2-year and 4-year) and selectivity.

Procedures Used to Establish the Benchmarks for ACT Explore and ACT Plan

The College Readiness Benchmarks for Explore and Plan were developed using records of students who had taken Explore or Plan, followed by the ACT in Grades 11 or 12. Separate Benchmarks were developed for Explore for Grade 8 and Grade 9, and Plan for Grade 10. The sample sizes used to develop the Explore and Plan Benchmarks ranged from 210,000 for the Explore Grade 9 Benchmarks to approximately 1.5 million for the Plan Grade 10 Benchmarks. To establish the Benchmarks, the probability of meeting the appropriate ACT Benchmark was estimated at each Explore and Plan test score point. Next, the Explore and Plan test scores were identified in English, Reading, Mathematics, and Science that corresponded most closely to a 50% probability of meeting each of the four Benchmarks established for the ACT.

Intended Uses of the Benchmarks for Students, Schools, Districts, and States

ACT, Plan, and Explore results give students an indication of how likely they are to be ready for college-level work. The results let students know if they have developed or are developing the foundation for the skills they will need by the time they finish high school. Plan and Explore results provide an early indication of college readiness. Students who score at or above the College Readiness Benchmarks in English, mathematics, and science are likely to be on track to do well in entry-level college courses in these subjects. Students scoring at or above the Reading Benchmark are likely to be developing the level of reading skills they will need in all of their college courses. For students taking Explore and Plan, this assumes that these students will continue to work hard and take challenging courses throughout high school.

Researchers and policymakers can use the Benchmarks to monitor the educational progress of schools, districts, and states. Middle and high school personnel can use the Benchmarks for Explore and Plan as a means of evaluating students' early progress toward college readiness so that timely interventions can be made when necessary, or as an educational counseling or career planning tool.

Interpreting ACT's Test Scores With Respect to Both ACT's College Readiness Standards and ACT's College Readiness Benchmarks

The performance levels on ACT's tests necessary for students to be ready to succeed in college-level work are defined by ACT's College Readiness Benchmarks. Meanwhile, the skills and knowledge a student currently has (and areas for improvement) can be identified by examining the student's test scores with respect to ACT's College Readiness Standards. These two empirically derived tools are designed to help a student translate test scores into a clear indicator of the student's current level of college readiness and to help identify key knowledge and skill areas needed to improve the likelihood of achieving college success.

Alignment of ACT's College Readiness Standards With the Common Core State Standards

The Common Core State Standards developed by the National Governors Association and the Council of Chief State School Officers, in partnership with ACT, the College Board, and Achieve, align well with ACT's College Readiness Standards, in both of the large areas in which Common Core State Standards have been published to date: namely, the Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects, and the Common Core State Standards for Mathematics. The alignment of ACT's College Readiness Standards in English, Reading, and Mathematics is sufficient to encourage us to believe that scores earned in ACT's testing programs can provide evidence of current student performance relative to the Common Core State Standards. Given ACT's research base, the percentage of students meeting ACT's College Readiness Benchmarks in English, Reading, and Mathematics can serve as a measure of what percentage of students could potentially meet or exceed the Common Core's English Language Arts and Mathematics standards (ACT, June 2010).

Chapter 4
Technical Characteristics of the ACT Plan Tests of Educational Achievement

This chapter discusses the technical characteristics—the score scale, norms, equating, and reliability—of the Plan tests of educational achievement. The scales were constructed in a special study with data collected in the fall of 1988. These data included both 10th- and 12th-grade students. The scaling process placed the Plan and ACT tests on the same scale. The norms were done in a special study in the fall of 2010. Data for norming the Plan tests were obtained from samples of 10th- and 11th-grade students in the fall of 2010. Other results are based on samples of Plan user data, collected in the course of normal testing, rather than in special studies. The special studies, user data, and results are described below.

The Score Scale and Norms

Scaling

Scale scores are reported for the Plan English, Mathematics, Reading, and Science Tests, and for the Usage/Mechanics, Rhetorical Skills, Pre-Algebra/Algebra, and Geometry subscores. A Composite score, calculated by rounding the unweighted average of the four test scores, is also reported. Because subscores and test scores were scaled separately, there is no arithmetic relationship between subscores and the test score. For example, the Usage/Mechanics and Rhetorical Skills subscores will not necessarily sum to the English Test score.

The Score Scale. The range of the test and Composite scores on the Plan is 1 to 32; the range of the subscores is 1 to 16. The maximum scores for some forms may be less than 32 for tests and 16 for subscores (see the Equating section, which begins on page 34, for details). Properties of the score scale for Plan are summarized in Table 4.1.

The scores reported for the four Plan tests are approximately "on the same scale" as the scores on the corresponding tests of the ACT. The ACT is intended for use by 11th and 12th graders, whereas Plan is intended for use by 10th graders, and both testing programs have similar (although not identical) content specifications. As such, Plan is intended to be a shorter and less difficult version of the ACT.

Table 4.1
Properties of the Score Scale for ACT Plan

- Scores reported for the four Plan tests are approximately "on the same scale" as the scores reported for the corresponding tests of the ACT.
- For Plan, the maximum range of scores is 1–32 on all tests and the Composite and 1–16 for subscores.
- Plan test means are approximately 18 and subscore means are approximately 9 for fall 10th-grade U.S. students who report they plan to attend college.
- The average standard error of measurement is approximately 2 points for each test score and 1 point for the subscores and composite.
- The conditional standard error of measurement is approximately equal along the score scale.
- The occurrence of gaps (unused scale score points) and multiple raw scores converting to the same scale score were minimized in constructing the raw-to-scale score transformation.

Therefore, to facilitate longitudinal comparisons between Plan scores for 10th graders and ACT scores for 12th graders, the score scales for Plan were constructed with the consideration that they be approximately "on the same scale" as the ACT scores. Being "on the same scale" means that the Plan test score obtained by an examinee can be interpreted as approximately the ACT test score the examinee would obtain if that examinee had taken the ACT at the time of the Plan testing. If this property were exactly achieved, the mean Plan and ACT scale scores would be the same for any group of examinees. The Plan score scales were constructed such that the means of the Plan tests and the Composite would be approximately the same as the corresponding means on the ACT among students at the beginning of 12th grade, nationwide, who reported that they plan to attend a two- or four-

year college (12th-grade college-bound examinees). The Plan score scale was constructed such that the mean of 12th-grade college-bound examinees would be approximately 18 for each of the four tests and Composite and 9 for the four subscores.

The rationale for the maximum scale score on the Plan tests being 32, rather than 36 as it is for the ACT tests, was to leave room in the scale for assessment of educational development that occurs between the 10th and 12th grades. The ACT tests are intended to assess skills typically achieved through the 11th and 12th grades—skills not assessed in the Plan tests. Note that the requirement that the maximum scale score on the Plan tests be 32, rather than 36 as for the ACT tests, ensures that the property of the Plan and ACT scores being on the same scale will not be attained for very high values of the ACT scale.

The scales for Plan were constructed using a method described by Kolen (1988) to produce score scales with approximately equal conditional standard errors of measurement along the entire range of scores. Without nearly equal conditional standard errors of measurement, standard errors of measurement at different score levels would need to be presented and considered in score interpretation (see American Psychological Association, 1985, p. 22). The scales for Plan were constructed such that the average standard error of measurement is approximately 2 scale score points for each of the test scores and 1 scale score point for the subscores and the Composite.

Based on the properties of the standard error of measurement just described, if the distribution of measurement error is approximated by a normal distribution, an approximate 68% confidence interval can be constructed for any examinee by adding 2 points to and subtracting 2 points from his or her scale score for any of the Plan tests. An analogous interval for the subscores or the Composite can be constructed by adding 1 point to and subtracting 1 point from the score.

In thinking about standard errors and their use, note that the reported scale score (i.e., the obtained score) for an examinee is only an estimate of that examinee's true score, where the true score can be interpreted as the average obtained score over repeated testings under identical conditions. If 1 standard error of measurement were added to and subtracted from each of these obtained scores, about 68% of the resulting intervals would contain the examinee's true score. Technically, this is how a 68% interval for an examinee's scale score should be interpreted. These statements make normal distribution assumptions.

Another way to view 68% intervals is in terms of groups of examinees. Specifically, if 1 standard error of measurement were added to and subtracted from the obtained score of each examinee in a group of examinees, the resulting intervals would contain the true score for approximately 68% of the examinees. To put it another way, about 68% of the examinees would be mismeasured by less than 1 standard error of measurement. Again, such statements make normal distribution assumptions. Also, these statements assume a constant standard error of measurement, which is a characteristic (approximately) of the Plan score scales. Consequently, it is relatively straightforward to interpret scale scores in relation to measurement error.

Scaling Process. The data used in the scaling process were collected in the fall of 1988 as part of the Academic Skills Study, which provided nationally representative samples of examinees for the scaling of the ACT and Plan. Data from 12th-grade college-bound examinees in the Academic Skills Study were used in scaling Plan. Twelfth-grade data were used to help obtain a desired property of the Plan score scale that test score means be approximately 18 and subscore means be approximately 9 for 12th-grade college-bound examinees. A detailed discussion of the data used in scaling Plan is given in Hanson (1989).

The first step in constructing the score scales was to produce initial scale scores with a specified mean and a specified standard error of measurement that is approximately equal for all examinees. The means and standard errors of measurement specified for each test score and subscore are noted in Table 4.1. The process used was based on Kolen (1988) and presented in detail in Hanson (1989). These initial scale scores were rounded to integers ranging from 1 to 32 for the tests and 1 to 16 for the subscores. Some adjustments of the rounded scale scores were performed to attempt to meet the specified mean and standard error of measurement, as well as to avoid gaps in the score scale (scale score values that were not used) or to avoid having too many raw scores converting to a single scale score. This process resulted in the final raw-to-scale score conversions.

The final score scales for the four Plan tests were evaluated to determine the degree to which the reported Plan scores would be "on the same scale" as the score reported for the corresponding ACT test. Details are given in Hanson (1989). The condition of the Plan and ACT scores being on the same scale was approximately met, except for examinees scoring very high on the ACT, who would have lower Plan than ACT scores. This is due to the lower maximum score on Plan.

The score scales constructed based on data from the Academic Skills Study are different from the score scales used for the 1987 and 1988 administrations of the Plan (which at that time was named P-ACT+). Scores reported for the Plan administered in 1987 and 1988 are not interchangeable with scores reported for the Plan administered in 1989 or later. A concordance table relating scores on the original score scale (reported in the 1987 and 1988 administrations) to the current score scale (reported in the 1989 and later administrations) is available from ACT.

The 1991 and later administrations of Plan used forms with slightly different statistical specifications than forms used for administrations prior to 1991. The change in statistical specifications was made to have the Plan statistical specifications better match the ACT statistical specifications. This change in statistical specifications resulted in forms used for the 1991 and later administrations being, in general, less difficult than forms used in earlier administrations. Scores on forms used in the 1991 and later administrations are equated back to the score scale developed using data from the 1988 Academic Skills Study. Because of the change in the statistical specifications, the highest achievable test scores and subscores may be less than 32 and 16, respectively, for forms used in the 1991 and later administrations (for further information regarding the maximum scale score see the section in this manual on equating, which begins on page 34.

ACT Plan National Norming Study

In the fall of 2010, ACT conducted a research study to provide a new set of nationally representative norms for students taking Plan during and after the fall of 2011. In this study, test score data were collected on students throughout the United States. The norms for Plan are intended to represent the national population of 10th- and 11th-grade students. The numbers of Grade 10 and Grade 11 examinees used to compute the nationally representative norms for the Plan tests were 960,029 and 17,168, respectively. The following sampling and weighting process was used to obtain the norms.

Sample. Data for the Plan norming study were obtained from two sources: (a) the group of schools that used the Plan test during the fall of 2010 and (b) a sample of schools from among the nonusers of Plan. The composition of the sample obtained to compute the nationally representative norms for the Plan tests is presented in Table 4.2. The 10th-grade norms are based on the records from 10,542 students from 93 nonuser schools and 949,487 students from 8,154 user schools. The 11th-grade norms are based on the records from 4,734 students from 60 nonuser schools and 12,434 students from 275 user schools. The sample selected for the study included schools chosen to represent various regions of the United States and sizes of high school sophomore classes.

Weighting. For the sampling and norming process, individual examinee records were multiplied by weights to achieve representativeness with respect to the explicit stratification variables. The weight for an examinee was inversely proportional to the probability of the examinee's being chosen for the sample, given the sampling plan. The weight for each case was:

WGT = W1 • W2,

where W1 = N/n

W2 = M/m

The variables N, n, M, and m are defined as:

N = number of schools, in the population, from the stratum to which the school belongs;

n = number of schools, in the sample, from the stratum to which the school belongs;

M = number of students enrolled in the school associated with the student; and

m = number of students sampled from the school associated with the student.

Note that the first component of the weight is equal to 1 for user schools, as there is no sample to adjust for.

Sample Representativeness. One way to determine the character and extent of sample bias is to compare the demographic characteristics of the sample of examinees with the U.S. statistics for various educational and demographic variables presented in Table 4.2. Precisely comparable U.S. data for the population of interest were not available. However, the data shown allow for a general examination of the representativeness of the sample with respect to the demographic variables. As indicated in Table 4.2, the weighted sample appears to be reasonably representative of the national population of interest.

Obtained Precision. The targeted precision level was to estimate any proportion to within .05 with probability .95. The actual obtained level of precision for the norms was such that any proportion is estimated to within .03 with probability .95 for Grade 10 and within .07 with probability .95 for Grade 11.

Table 4.2

Selected Demographic and Educational Characteristics of Grade 10 and Grade 11 Students[a] for the 2010 ACT Plan Norm Group

Category identifier used in study	Grade 10		Grade 11	
	Weighted sample proportion	U.S. proportion	Weighted sample proportion	U.S. proportion
Gender				
Female	.50	.50	.51	.50
Male	.50	.50	.49	.50
Racial/Ethnic Origin				
African American	.15	.15	.21	.15
Native American	.01	.01	.01	.01
White	.57	.59	.52	.59
Hispanic	.17	.19	.14	.19
Asian American	.03	.05	.03	.05
Multiracial/Other, Prefer Not to Respond	.08	—	.10	—
School Affiliation				
Private	.23	.26	.31	.26
Public	.77	.74	.69	.74
Geographic Region				
East	.39	.39	.39	.39
Midwest	.23	.23	.23	.23
Southwest	.14	.14	.14	.14
West	.24	.24	.24	.24
Size of 10th Grade				
Small	.58	.56	.59	.56
Medium	.25	.25	.20	.25
Large	.18	.20	.21	.20

Note. Due to rounding, proportions may not sum to one.

[a]Population proportions for gender and race come from Keigher (2009, pp.10–11). Population proportions for school affiliation, geographic region, and school size come from the *Market Data Retrieval Educational Database*, 2010.

Scale Score Statistics for the 2010 National Sample

Scale score summary statistics for all Grade 10 students in the 2010 nationally representative sample are given in Table 4.3. Scale score statistics for Grade 11 students are given in Table 4.4. The data used for the results in Tables 4.3 and 4.4 were weighted using the weighting procedure described in the weighting section on page 23, and the distributions were smoothed using the log-linear method. The score scale of Plan was constructed using an early form of Plan with data collected in fall 1988. The results presented in Tables 4.3 and 4.4 were obtained by equating the newer form to earlier forms using the procedures discussed in the equating section of this manual (page 34).

No data were collected on spring-tested tenth graders. Spring Grade 10 norms were interpolated based on the assumption that academic growth between fall of the tenth grade and fall of the eleventh grade is linear, and that the three months of summer count only as one month.

Cumulative Percents for the 2010 National Sample

Data from the national sample were used to develop cumulative percents (percents-at-or-below) for each Plan test and Composite as well as the subscores. The percent-at-or-below corresponding to a scale score is defined as the percent of examinees with scores equal to or less than the scale score. Tables 4.5 through 4.7 are the norms (percents-at-or-below) for the four Plan test scale scores, the four Plan subscores, and Composite score, for national examinees, tested either in the fall or spring of Grade 10, or tested in the fall of Grade 11.

An examinee's standing on different tests should be compared by using the percents-at-or-below shown in the norms tables and not by using scale scores. The reason for preferring percents-at-or-below for such comparisons is that the scales were **not** constructed to ensure that, for example, a scale score of 21 on the English Test is comparable to a 21 on the Mathematics, Reading, or Science Tests. In contrast, examinee percents-at-or-below on different tests indicate standings relative to the same comparison group.

Even comparison of percents-at-or-below do not permit comparison of standing in different skill areas in any absolute sense. The question of whether a particular examinee is stronger in science reasoning than in mathematics, assessed by the corresponding tests, can be answered only in relation to reference groups of other examinees. Whether the answer is "yes" or "no" can depend on the group.

(Text continues on page 29.)

Table 4.3
Scale Score Summary Statistics for a National Sample of Grade 10

Statistic	English	Mathematics	Reading	Science	Composite	Usage/ Mechanics	Rhetorical Skills	Pre-Algebra/ Algebra	Geometry
Mean	16.2	17.6	16.7	17.8	17.2	7.9	8.0	8.2	9.0
SD	4.4	4.7	4.8	3.9	3.9	2.8	3.0	3.5	3.0
Skewness	0.3	0.6	0.3	0.8	0.6	0.3	0.1	0.6	0.4
Kurtosis	3.1	3.6	2.8	4.2	3.1	3.1	2.6	2.8	2.8

Table 4.4
Scale Score Summary Statistics for a National Sample of Grade 11

Statistic	English	Mathematics	Reading	Science	Composite	Usage/ Mechanics	Rhetorical Skills	Pre-Algebra/ Algebra	Geometry
Mean	16.7	18.2	17.2	18.2	17.7	8.2	8.2	8.6	9.3
SD	4.5	4.8	4.8	4.0	4.0	3.0	3.1	3.6	3.0
Skewness	0.3	0.5	0.3	0.8	0.5	0.4	0.0	0.5	0.3
Kurtosis	3.1	3.3	2.9	4.0	3.0	3.0	2.5	2.5	2.6

Table 4.5

ACT Plan 2010 National Norms for Fall Grade 10

	Percent at or below									
Scale Score	**English**	**Mathematics**	**Reading**	**Science**	**Usage/ Mechanics**	**Rhetorical Skills**	**Pre-Algebra/ Algebra**	**Geometry**	**Composite**	**Scale Score**
32	100	100	100	100					100	32
31	99	99	99	99					99	31
30	99	99	99	99					99	30
29	99	98	99	99					99	29
28	99	97	99	98					99	28
27	99	96	98	97					99	27
26	98	94	97	96					98	26
25	98	93	95	95					97	25
24	96	91	93	94					95	24
23	95	88	90	92					92	23
22	92	85	87	89					89	22
21	89	82	83	85					85	21
20	84	77	78	80					80	20
19	78	71	73	72					74	19
18	71	64	67	63					67	18
17	63	55	60	52					58	17
16	54	45	52	40	100	100	100	100	48	16
15	45	35	43	28	99	99	95	98	37	15
14	36	25	35	18	98	99	92	95	26	14
13	27	17	27	10	96	96	89	91	17	13
12	20	10	19	5	93	92	86	86	9	12
11	14	6	13	2	89	86	83	80	5	11
10	9	3	8	1	83	78	78	72	2	10
9	5	2	5	1	74	69	71	62	1	9
8	3	1	3	1	62	58	61	49	1	8
7	1	1	1	1	47	45	49	34	1	7
6	1	1	1	1	32	33	35	20	1	6
5	1	1	1	1	19	21	22	10	1	5
4	1	1	1	1	10	12	12	4	1	4
3	1	1	1	1	5	7	6	2	1	3
2	1	1	1	1	2	3	2	1	1	2
1	1	1	1	1	1	1	1	1	1	1
Mean	16.2	17.6	16.7	17.8	7.9	8.0	8.2	9.0	17.2	Mean
S D	4.4	4.7	4.8	3.9	2.8	3.0	3.5	3.0	3.9	SD

Table 4.6

ACT Plan 2010 National Norms for Spring Grade 10

	Percent at or below									
Scale Score	**English**	**Mathematics**	**Reading**	**Science**	**Usage/ Mechanics**	**Rhetorical Skills**	**Pre-Algebra/ Algebra**	**Geometry**	**Composite**	**Scale Score**
32	100	100	100	100					100	32
31	99	99	99	99					99	31
30	99	99	99	99					99	30
29	99	98	99	99					99	29
28	99	97	99	98					99	28
27	99	95	98	97					99	27
26	98	94	97	96					98	26
25	97	92	95	95					96	25
24	96	89	93	93					94	24
23	94	87	90	91					91	23
22	91	84	86	88					88	22
21	87	80	82	84					84	21
20	82	75	77	78					79	20
19	77	69	72	71					73	19
18	69	61	65	62					65	18
17	61	53	58	51					56	17
16	53	43	50	39	100	100	100	100	45	16
15	43	33	41	27	99	99	95	97	34	15
14	34	23	33	17	97	98	91	94	24	14
13	26	15	25	9	95	96	88	89	15	13
12	19	9	18	5	92	91	84	84	8	12
11	13	5	12	2	87	85	81	78	4	11
10	8	3	8	1	81	77	76	70	2	10
9	5	2	4	1	72	67	68	60	1	9
8	3	1	2	1	60	56	59	47	1	8
7	1	1	1	1	46	44	46	32	1	7
6	1	1	1	1	31	31	33	18	1	6
5	1	1	1	1	18	20	20	9	1	5
4	1	1	1	1	9	12	11	4	1	4
3	1	1	1	1	4	7	5	2	1	3
2	1	1	1	1	2	3	2	1	1	2
1	1	1	1	1	1	1	1	1	1	1
Mean	16.4	17.9	16.9	18.0	8.1	8.1	8.4	9.1	17.5	Mean
S D	4.4	4.8	4.8	4.0	2.9	3.1	3.5	3.0	4.0	SD

Table 4.7

ACT Plan 2010 National Norms for Fall Grade 11

Scale Score	Percent at or below									Scale Score
	English	Mathematics	Reading	Science	Usage/ Mechanics	Rhetorical Skills	Pre-Algebra/ Algebra	Geometry	Composite	
32	100	100	100	100					100	32
31	99	99	99	99					99	31
30	99	99	99	99					99	30
29	99	98	99	98					99	29
28	99	96	99	98					99	28
27	98	95	98	97					98	27
26	98	93	96	95					97	26
25	96	91	94	94					96	25
24	95	88	92	92					93	24
23	93	85	89	90					90	23
22	90	82	86	87					87	22
21	86	78	82	83					83	21
20	81	73	77	77					77	20
19	75	66	71	70					71	19
18	68	59	64	60					63	18
17	59	50	56	49					54	17
16	51	40	48	37	100	100	100	100	43	16
15	42	30	39	26	99	99	94	97	32	15
14	33	21	31	16	97	98	90	93	22	14
13	25	14	23	9	94	95	86	88	14	13
12	18	8	16	4	91	91	83	83	7	12
11	12	5	11	2	86	84	79	77	3	11
10	8	3	7	1	79	75	73	68	1	10
9	4	1	4	1	70	65	66	58	1	9
8	2	1	2	1	58	54	56	44	1	8
7	1	1	1	1	44	42	44	30	1	7
6	1	1	1	1	29	30	30	17	1	6
5	1	1	1	1	17	20	18	8	1	5
4	1	1	1	1	9	12	9	3	1	4
3	1	1	1	1	4	6	4	1	1	3
2	1	1	1	1	2	3	2	1	1	2
1	1	1	1	1	1	1	1	1	1	1
Mean	16.7	18.2	17.2	18.2	8.2	8.2	8.6	9.3	17.7	Mean
S D	4.5	4.8	4.8	4.0	3.0	3.1	3.6	3.0	4.0	SD

(Text continued from page 25.)

Estimated ACT Composite Score Ranges

For every Plan Composite score, ACT constructs an expected ACT Composite score range. These expected score ranges are computed for each of two different Plan testing season/grades (i.e., fall Grade 10 and spring Grade 10) combined with fall Grade 12 ACT test dates, such that there were two groups of students, each with a different interval between Plan and ACT testing. For a given Plan season/grade (e.g., fall Grade 10) scores from three years of data were matched to three years of ACT fall Grade 12 scores. Then, for each of the two Plan season/grade groups, a two-way (Plan by ACT) frequency table was created (Tables 4.8 and 4.9). Within each table, for every Plan score, the approximate middle 75% of the ACT score distribution was selected as the expected ACT Composite score range. The ACT Composite score ranges (given in Tables 4.10 and 4.11) estimate the score that an examinee would obtain in the fall of his or her senior year.

In Table 4.8 the rows contain the Plan Composite scores, which range from 1 to 32, and the columns contain the ACT Composite scores, which range from 1 to 36. The cell corresponding to a Plan Composite score of 15 and an ACT Composite score of 17 contains 7,821 examinees. This means that, of the 717,303 examinees, 7,821 received a Plan Composite score of 15 during the fall of Grade 10 and an ACT Composite score of 17 during the fall of Grade 12. Consider all examines in Table 4.8 who received a Plan Composite score of 15 regardless of their ACT Composite score. There are 43,584 such examinees, and their ACT scores range from 8 to 34. Notice that the number 43,584 is listed in the column labeled "Row Total." This column lists all of the examinees that have a particular Plan Composite score regardless of their ACT Composite score.

If consideration is given to the middle of the ACT score range, containing approximately 75% of the 43,584 scores, then that reduced range of ACT Composite scores is 15 to 19. This means that, of the 43,584 examinees who received a Composite score of 15 on Plan, 31,929 (73%) had ACT Composite scores between 15 and 19, inclusive. Notice that the number 31,929 is listed in the column labeled "Row Hits" and 0.73 is listed in the Column labeled "Prob. Cov." The "Row Hits" column lists the number of examinees in the middle range, and the "Prob. Cov." column, which is referred to as the probability of coverage column, lists the proportion of examinees in the middle range. This range of scores is shaded in Table 4.8, as are all such ranges for each different Plan Composite score. In addition, all of these 75% prediction intervals are conveniently listed in Table 4.10 along with their widths.

The probability of coverage values are fairly constant across the Plan Composite score range, but they do vary between 0.71 and 0.79 between Plan Composite scores 6 and 29. Below a Plan Composite score of 6, where there are very few examinees, the prediction intervals are much less accurate. Above a Plan Composite score of 29, where there are relatively few examinees, interval accuracy also decreases. However, as can be seen in the very bottom entry in the probability of coverage column, the proportion of all 717,303 examinees whose estimated ACT Composite score prediction interval contained their obtained ACT Composite score was 0.73. This is called the overall probability of coverage.

The intervals shown in Table 4.10 vary in width from a low of 3 ACT Composite score points to a high of 7 score points. The variation in interval widths tends to fall near the bottom and near the top of the Plan Composite score range, where there tend to be fewer examinees, especially near the bottom. In the middle of the Plan Composite score range, between score points 11 and 27, where there tend to be more examinees, the widths of the 75% prediction intervals are uniformly equal to 5 ACT Composite score points.

It is worth emphasizing that approximately 25% of examinees fall outside the estimated 75% prediction intervals. In practice, not every examinee who takes Plan in the fall of the tenth grade and then takes ACT in the fall of the twelfth grade will achieve an ACT score within the estimated 75% prediction interval. Because both Plan and ACT are designed to be curriculum-based testing programs, some students will fall outside their estimated ACT Composite score range. If examinees do not maintain good academic work in school between tenth and twelfth grade, then their ACT Composite score may fall short of their estimated score range. Conversely, examinees who improve their academic performance may earn ACT Composite scores higher than their estimated score range.

(Text continues on page 34.)

Table 4.8

Observed Counts and Probabilities of Coverage for Composite Scores

ACT Plan Fall Grade 10 to ACT Fall Grade 12

Using ACT Plan Data From Fall 2005/06, 2006/07, and 2007/08 and ACT Data From Fall 2007/08, 2008/09, and 2009/10

ACT Score

ACT Plan Score	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	Row Total	Row Hits	Prob. Cov.
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0.00
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0.00
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
5	0	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	6	4	0.67
6	0	0	0	0	0	0	0	0	0	1	1	4	2	0	2	0	2	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	14	10	0.71
7	0	0	0	0	0	0	0	0	2	4	3	7	6	4	4	2	3	1	2	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	40	30	0.75
8	0	0	0	0	0	0	1	2	6	6	11	19	24	11	16	6	3	7	0	2	5	3	1	0	1	0	1	0	0	0	0	0	0	0	0	0	125	93	0.74
9	0	0	0	0	0	0	0	1	4	9	30	46	57	37	28	22	23	9	9	5	6	5	3	3	3	3	0	0	0	0	0	0	0	0	0	0	303	229	0.76
10	0	0	0	0	0	2	0	3	6	16	73	172	192	160	105	65	46	46	30	30	26	11	11	12	8	5	3	3	1	1	0	0	0	0	0	0	1027	767	0.75
11	0	0	0	0	0	1	0	3	8	43	158	379	568	459	380	248	154	94	67	62	55	37	35	24	18	13	8	6	7	2	4	0	1	2	1	0	2837	2034	0.72
12	0	0	0	0	0	0	0	7	17	52	253	806	1251	1338	1056	757	481	298	194	131	110	71	48	34	33	20	18	7	8	5	3	2	2	1	0	0	7003	5208	0.74
13	0	0	0	0	0	0	2	2	12	55	311	1099	2105	2763	2647	2025	1427	903	579	338	220	116	75	59	32	24	13	6	4	4	3	2	0	0	1	0	14827	10967	0.74
14	0	0	0	0	0	0	0	1	9	33	209	877	2269	3701	4846	4835	3811	2658	1566	900	552	294	147	78	46	32	22	10	7	1	1	1	0	0	0	0	26906	19851	0.74
15	0	0	0	0	0	0	0	1	5	20	87	426	1504	3307	5581	7338	7821	6610	4579	2881	1650	864	427	229	124	60	41	11	9	4	1	2	0	2	0	0	43584	31929	0.73
16	0	0	0	0	0	1	1	1	1	5	41	193	614	1704	3952	6990	9807	11284	9904	7613	4674	2587	1282	632	263	133	69	26	13	6	3	1	0	0	0	0	61800	45598	0.74
17	0	0	0	0	0	1	0	1	0	3	17	51	236	730	1757	3970	7704	11584	13668	13487	10326	6680	3703	1867	785	379	158	72	32	10	3	1	0	1	0	0	77226	55745	0.72
18	0	0	0	0	0	0	0	0	0	4	7	23	78	224	588	1542	3546	7133	11198	14674	15172	12133	8383	4905	2488	1106	420	174	86	27	11	7	5	1	0	0	83935	61560	0.73
19	0	0	0	0	0	0	0	0	0	0	4	12	33	72	180	443	1180	2915	5818	10133	13571	14626	12992	9494	5737	2939	1389	617	260	97	41	15	9	1	0	0	82578	60816	0.74
20	0	0	0	0	0	0	0	0	0	0	2	5	14	40	63	161	358	811	2040	4371	7892	11444	13189	12631	9818	6369	3352	1616	657	256	88	29	5	3	0	0	75214	54974	0.73
21	0	0	0	0	0	0	0	0	0	0	1	2	8	25	33	64	111	263	611	1458	3140	5797	8932	11176	10927	9010	5992	3533	1645	749	283	126	20	6	2	0	63914	46037	0.72
22	0	0	0	0	0	0	0	0	0	0	0	2	5	6	23	24	47	72	190	416	960	2203	4194	6899	8784	9415	7992	5665	3326	1657	731	247	70	16	2	0	52946	38755	0.73
23	0	0	0	0	0	0	0	0	0	0	0	1	2	5	7	8	15	27	41	113	276	636	1475	3068	4945	6679	7375	6814	4792	3036	1528	618	203	46	5	0	41715	30605	0.73
24	0	0	0	0	0	0	0	0	0	0	0	1	2	2	5	7	9	15	26	40	76	170	424	1016	1995	3499	4953	5611	5090	3815	2362	1198	416	132	23	0	30887	22968	0.74
25	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	6	6	4	6	10	14	33	107	262	645	1305	2386	3395	3940	3781	2762	1581	750	268	48	2	21315	16264	0.76
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	4	2	6	13	15	26	65	182	394	806	1641	2226	2642	2502	1864	1066	463	105	4	14031	10875	0.78
27	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	2	2	2	3	9	12	16	38	99	208	501	948	1365	1637	1489	1154	606	194	11	8298	6593	0.79
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	5	0	3	2	2	2	15	37	123	275	537	730	894	811	604	211	33	4285	3039	0.71
29	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	1	2	2	25	41	118	201	353	434	390	216	33	1819	1378	0.76
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	6	24	46	93	90	141	135	26	563	459	0.82
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	20	33	33	9	99	86	0.87
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3	3	1.00
																																					717303	526877	0.73

Table 4.9

Observed Counts and Probabilities of Coverage for Composite Scores

ACT Plan Spring Grade 10 to ACT Fall Grade 12

Using PLAN Data From Spring 2005/06, 2006/07, and 2007/08 and ACT Data From Fall 2007/08, 2008/09, and 2009/10

ACT Score

ACT Plan Score	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	Row Total	Row Hits	Prob. Cov.
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
6	0	0	0	0	0	0	0		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1.00
7	0	0	0	0	0	0	0		0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0.50
8	0	0	0	0	0	0	0		0	0	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	1.00
9	0	0	0	0	0	0	0		1	0	0	3	5	1	1	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	14	11	0.79
10	0	0	0	0	0	0	0		1	1	1	12	8	15	5	6	2	3	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	59	43	0.73
11	0	0	0	0	0	0	1		0	3	14	26	35	26	17	13	5	4	2	0	0	4	0	1	2	0	0	1	0	1	0	0	0	0	0	0	155	118	0.76
12	0	0	0	0	0	0	0		1	2	20	55	79	70	56	23	21	13	4	14	3	5	0	1	3	1	1	0	0	0	1	0	0	0	0	0	373	283	0.76
13	0	0	0	0	0	0	0		0	2	22	64	126	144	149	87	43	28	14	10	3	2	4	3	0	0	0	0	1	1	0	0	0	0	0	0	703	549	0.78
14	0	0	0	0	0	0	0		0	6	18	49	148	226	278	215	179	79	43	28	10	9	4	3	1	0	1	1	0	0	0	1	0	0	0	0	1299	977	0.75
15	0	0	0	0	0	0	0		0	0	6	21	106	208	313	410	334	242	148	67	28	22	10	7	1	3	3	0	0	0	1	0	0	0	0	0	1930	1507	0.78
16	0	0	0	0	0	0	0		0	1	2	7	46	118	274	371	476	437	330	185	109	35	32	12	8	4	1	1	0	0	0	0	0	0	0	0	2449	1888	0.77
17	0	0	0	0	0	0	0		1	0	2	2	13	47	107	211	414	551	537	451	308	174	74	43	14	1	3	1	0	1	0	0	0	0	0	0	2955	2261	0.77
18	0	0	0	0	0	0	0		0	0	0	1	5	18	39	75	207	343	506	525	498	351	196	113	49	15	15	1	2	1	2	0	0	1	0	0	2963	2223	0.75
19	0	0	0	0	0	0	0		0	0	0	1	3	4	16	18	73	138	272	453	537	481	368	215	120	39	13	10	3	0	0	0	1	0	0	0	2765	2111	0.76
20	0	0	0	0	0	0	0		0	0	0	0	0	4	3	6	22	40	99	210	358	465	441	386	249	140	68	23	10	1	0	0	0	0	0	0	2525	1899	0.75
21	0	0	0	0	0	0	0		0	0	0	1	0	2	0	1	9	17	25	89	161	252	366	397	322	225	117	68	26	8	2	3	0	1	0	0	2092	1562	0.75
22	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	4	7	13	30	53	125	224	264	357	286	235	116	58	25	11	2	1	0	0	0	1811	1366	0.75
23	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	3	1	1	7	15	45	92	174	245	265	263	209	116	62	21	9	4	0	0	0	1532	1156	0.75
24	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	1	1	1	0	3	5	39	61	112	181	208	203	157	99	50	21	7	2	0	0	1151	861	0.75
25	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	1	2	1	2	4	17	38	82	124	157	126	104	58	35	11	2	4	0	768	593	0.77
26	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	5	14	25	78	73	94	95	82	39	19	13	4	0	543	422	0.78
27	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3	4	13	32	43	73	59	41	30	14	4	1	320	248	0.78
28	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	4	10	22	22	39	35	32	15	7	0	189	150	0.79
29	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	4	6	6	9	14	17	15	2	1	76	61	0.80
30	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	3	4	1	0	1	11	8	0.73
31	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2	2	1.00
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
																																					26693	20306	0.76

Table 4.10

Estimated ACT Fall Grade 12 Composite Score Intervals for ACT Plan Fall Grade 10 Composite Scores

Plan score	ACT intervals		
	Low score	High score	Width
1	10	14	5
2	10	14	5
3	10	14	5
4	10	14	5
5	10	14	5
6	10	15	6
7	10	16	7
8	10	16	7
9	10	16	7
10	11	16	6
11	12	16	5
12	12	16	5
13	13	17	5
14	14	18	5
15	15	19	5
16	16	20	5
17	18	22	5
18	19	23	5
19	20	24	5
20	21	25	5
21	23	27	5
22	24	28	5
23	25	29	5
24	26	30	5
25	27	31	5
26	28	32	5
27	29	33	5
28	31	34	4
29	31	34	4
30	32	35	4
31	33	35	3
32	33	36	4

Table 4.11

Estimated ACT Fall Grade 12 Composite Score Intervals for ACT Plan Spring Grade 10 Composite Scores

Plan score	ACT intervals		
	Low score	High score	Width
1	9	15	7
2	9	15	7
3	9	15	7
4	9	15	7
5	9	15	7
6	9	15	7
7	9	15	7
8	9	15	7
9	9	15	7
10	9	15	7
11	11	15	5
12	12	16	5
13	13	17	5
14	14	18	5
15	14	18	5
16	15	19	5
17	17	21	5
18	18	22	5
19	19	23	5
20	21	25	5
21	22	26	5
22	23	27	5
23	24	28	5
24	25	29	5
25	26	30	5
26	27	31	5
27	28	32	5
28	29	33	5
29	30	34	5
30	31	35	5
31	31	35	5
32	31	35	5

(Text continued from page 29.)

Equating

Even though each new form is constructed to adhere to the current content and statistical specifications, the forms may be slightly different in difficulty. To control for these differences, subsequent forms are equated to earlier forms and the scores reported to examinees are scale scores that have the same meaning regardless of the particular form administered to examinees. Thus, scale scores are comparable across test forms and test dates. (Please note the exception for Plan forms administered prior to 1991, as discussed on page 22 of this manual.)

Equating is conducted using a special sample of students from schools who volunteer to participate in an equating study. The examinees in equating samples are administered a spiraled set of forms—the new forms ("n – 1" of them) and one anchor form that has already been equated to previous forms. (The initial anchor form was the form used to establish the score scale.) This spiraling technique, in which every nth examinee receives the same form of the test, results in randomly equivalent groups taking the forms. The use of randomly equivalent groups is an important feature of the equating procedure and provides a basis for confidence in the continuity of scales.

Scores on the alternate forms are equated to the score scale using equipercentile equating methodology. In equipercentile equating, a score on Form X of a test and a score on Form Y are considered to be equivalent if they have the same percentile rank in a given group of examinees. The equipercentile equating results are subsequently smoothed using an analytic method described by Kolen (1984) to establish a smooth curve, and the equivalents are rounded to integers. The conversion tables that result from this process are used to transform raw scores on the new forms to scale scores.

The equipercentile equating technique is applied to the raw scores of each of the four tests for each form separately. The Composite score is not directly equated across forms. Instead, the Composite is calculated by rounding the unweighted average of the scale scores for the four equated tests. The subscores are also separately equated using the equipercentile method. Note, in particular, that the equating process does *not* lead to the English and Mathematics Test scores being a sum of their respective subscores.

Prior to fall 1991, answering all of the items correctly on a test assured an examinee of obtaining a scale score of 32. Similarly, answering all of the items correctly within a subscore area assured an examinee of obtaining a scale subscore of 16. Beginning in fall 1991, the equating was conducted such that it is possible an examinee answering all of the items correctly on a particular test will receive a scale score less than 32. Similarly, an examinee answering all of the items correctly within a subscore area may obtain a scale subscore less than 16.

The reason for allowing the possibility of the maximum scale score being unattainable for some forms is a change in the statistical specifications for forms administered in fall 1991 and later. Plan (formerly P-ACT+) was introduced in 1987, prior to the introduction of the enhanced ACT in 1989. Subsequently, it was decided to modify the statistical specifications of the Plan tests to better match the ACT specifications. This change in specifications has resulted in Plan forms administered in the fall of 1991 and later being, in general, less difficult than earlier Plan forms. The change in test difficulty could create gaps at the top of the score scale if an all-correct raw score were forced to equal a scale score of 32 on all tests. Consequently, there would be a discrepancy between the level of achievement conveyed by a scale score of 32 on later versus earlier forms. By allowing an all-correct raw score to convert to a scale score less than 32, scale scores from different Plan forms are kept more comparable.

Reliability, Measurement Error, and Effective Weights

Some degree of inconsistency or error is potentially contained in the measurement of any cognitive characteristic. An examinee administered one form of a test on one occasion and a second, parallel form on another occasion likely would earn somewhat different scores on the two administrations. These differences might be due to the examinee or the testing situation, such as differential motivation or differential levels of distractions on the two testings. Alternatively, these differences might result from attempting to infer the examinee's level of skill from a relatively small sample of items.

Reliability coefficients are estimates of the consistency of test scores. They typically range from zero to one, with values near one indicating greater consistency and those near zero indicating little or no consistency.

The standard error of measurement (SEM) is closely related to test reliability. The standard error of measurement summarizes the amount of error or inconsistency in scores on a test. As noted previously, the score scales for Plan were developed to have approximately constant standard errors of measurement for all true scale scores (i.e., the conditional standard error of measurement as a function of true scale score is constant). This statement implies, for example, that the standard error of measurement for any particular Plan test score or subscore is approximately the same for low-scoring examinees as it is for high-scoring examinees. As discussed more fully in the score scale section on pages 20–22, if the distribution of measurement error is approximated by a normal distribution, about two thirds of the examinees can be expected to be mismeasured by less than 1 standard error of measurement.

Figure 4.1 presents the conditional standard errors of measurement for the four tests as a function of true scale score. Conditional standard errors of measurement for the subscores are presented in Figure 4.2. Data from the 2010 norming study were used in producing the plots. The conditional standard error of measurement functions were computed using methods discussed in Kolen, Hanson, and Brennan (1992). The minimum true scale score plotted is around 10 for each test and around 4 for each subscore because the probability of a *true* score lower than 10 for each test or lower than 4 for each subscore was very small.

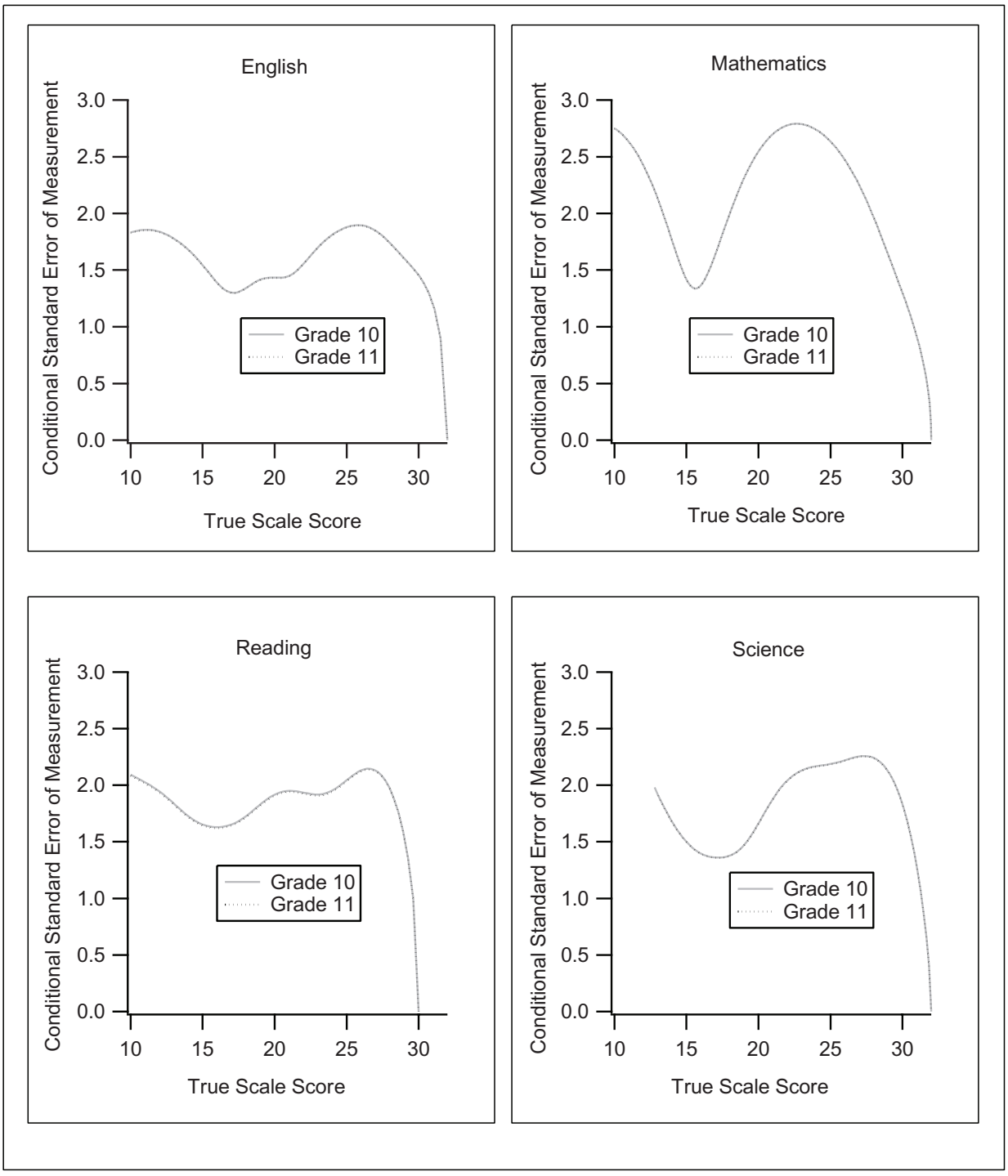


Figure 4.1. Conditional standard error of measurement for the ACT Plan tests.

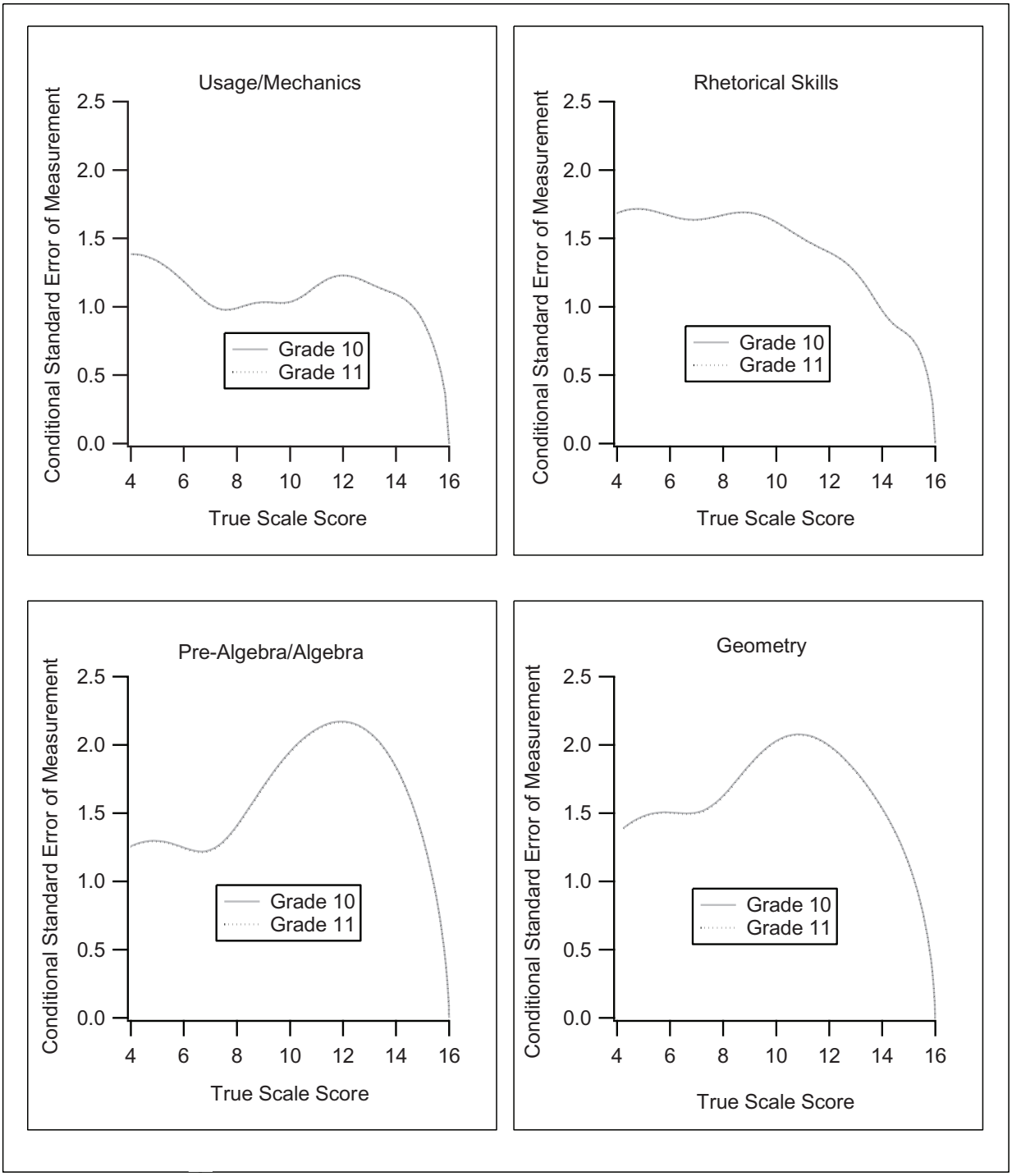


Figure 4.2. Conditional standard error of measurement for the ACT Plan subscores.

For most of the true scale score range, the scale score standard error of measurement is reasonably constant for the English and Reading Tests. For the Mathematics and Science Tests the conditional standard error of measurement is somewhat lower near the middle of the score range than it is for moderately low and moderately high scores. For all tests the standard error of measurement is smaller at very high scores. This is expected, since the conditional standard error of measurement must be zero for the maximum true scale score and near zero for true scale scores near the maximum (note that for some forms for each test the equating may result in a maximum scale score less than 32). The method used to produce the score scales, therefore, cannot guarantee a completely constant standard error of measurement for all true scale scores.

The proportion of examinees with *true* scale scores at the extremes of the score scale, where the deviations from a constant conditional standard error of measurement are most apparent in Figures 4.1 and 4.2, is small. For example, the Grade 10 average standard error of measurement for the Mathematics Test is 2.08. The average standard error of measurement, which is the average of the conditional standard errors of measurement given in Figure 4.1 over the distribution of true scale scores, is approximately equal to the corresponding conditional standard error of measurement at true scale scores in the middle of the scale. This is a reflection of most of the true scores being in the middle of the score range, and very few of the true scale scores being in the extremes of the score range where the conditional standard errors of measurement deviate from the average. It is concluded that the constant conditional standard error of measurement property is, for practical purposes, reasonably well met for these forms.

Plan reliability coefficients and average standard errors of measurement for all examinees in the 2010 norming study are given in Table 4.12. Kuder-Richardson formula 20 (KR-20) internal consistency reliability coefficients of raw scores are listed first. Scale score reliability coefficients and standard errors of measurement are reported next. Scale score average standard errors of measurement were estimated using a four-parameter beta compound binomial model as described in Kolen, Hanson, and Brennan (1992). The estimated scale score reliability for test i (REL_i) was calculated as

$$REL_i = 1 - \frac{SEM_i^2}{S_i^2},$$

where SEM_i is the estimated scale score average standard error of measurement and S_i^2 is the observed scale score variance for test i.

The estimated average standard error of measurement for the Composite (SEM_c) was calculated as

$$SEM_c = \frac{\sqrt{\Sigma_i\, SEM_i^2}}{4},$$

where the summation is over the four tests.The estimated reliability of the Composite (REL_c) was calculated as

$$REL_c = 1 - \frac{SEM_c^2}{S_c^2},$$

where S_c^2 is the estimated variance of scores on the Composite.

Table 4.12
Estimated Reliabilities and Standard Error of Measurement

Statistic	**English**	Usage/ Mechanics	Rhetorical Skills	**Mathematics**	Pre-Algebra/ Algebra	Geometry	**Reading**	**Science**	**Composite**
				Grade 10 national sample					
Raw Scores									
Reliability	0.90	0.86	0.73	0.86	0.81	0.67	0.86	0.84	—
Scale Scores									
Reliability	0.87	0.84	0.72	0.80	0.80	0.65	0.85	0.82	0.95
SEM	1.59	1.14	1.62	2.08	1.55	1.74	1.85	1.64	0.90
				Grade 11 national sample					
Raw Scores									
Reliability	0.90	0.87	0.75	0.86	0.82	0.68	0.86	0.85	—
Scale Scores									
Reliability	0.88	0.86	0.73	0.81	0.80	0.67	0.85	0.83	0.95
SEM	1.58	1.13	1.60	2.11	1.57	1.75	1.83	1.65	0.90

Assuming the measurement errors on the four tests are uncorrelated, the conditional standard error of measurement of the unrounded Composite scale score is

$$s_c(\tau_e,\tau_m,\tau_r,\tau_s) = \frac{\sqrt{\Sigma_i\, s_i^2(\tau_i)}}{4}$$

where $s_i(\tau_i)$ is the conditional standard error of measurement for test i at true scale score τ_i, where i = e, m, r, s for English, Mathematics, Reading, and Science, respectively. The functions $s_i(\tau_i)$ are plotted in Figure 4.1. The conditional standard error of measurement for the Composite, instead of depending on a single variable as the conditional standard errors of measurement for the four tests, depends on four variables—the true scale scores for the four tests. To facilitate presentation of the conditional standard errors of measurement for the Composite, the conditional standard errors will be plotted as a function of the average of the true scale scores for the four tests. In other words, $s_c(\tau_e,\tau_m,\tau_r,\tau_s)$ will be plotted as a function of

$$\frac{\Sigma_i\, \tau_i}{4}\ .$$

A particular true Composite score value can be obtained in a variety of ways (i.e., different combinations of true scale scores on the individual tests could produce the same true Composite score). Consequently, each true Composite score value may correspond to several different values of the conditional standard error of measurement depending on the combination of true scores on the four tests that produced the true Composite score value.

To produce plots of the conditional standard errors of measurement of the Composite, the observed proportion-correct scores (the number of items correct divided by the total number of items) of the examinees on the four tests were treated as the true proportion-correct scores at which the conditional standard errors were calculated. For each test the conditional standard error of measurement was computed for each examinee using the observed proportion-correct score as the true proportion-correct in the formula for the conditional standard error of measurement (Equation 8 in Kolen, Hanson, & Brennan, 1992). In addition, for each test the true scale score corresponding to the observed proportion-correct score (treated as a true proportion-correct score) was computed (Equation 7 in Kolen, Hanson, & Brennan, 1992). The resulting conditional standard errors of measurement for the four tests were substituted in the equation given above to compute a value of the conditional standard error of measurement of the Composite. This is plotted as a function of the average of the true scale scores across the four tests. This procedure was repeated for examinees in the 2010 norming study. Figure 4.3 presents a plot of these calculated conditional Composite standard errors of measurement versus the averages of the true scale scores over the four tests.

The conditional standard errors of measurement, as presented in Figure 4.3, vary not only across average scale scores but also within each average scale score. Different standard errors of measurement are possible for each particular value of the average scale score because more than one combination of the four test scores can produce the same average score. The general trend in the plots is for the conditional standard errors in the middle of the scale to be lower than the conditional standard errors for moderately low and moderately high scores. This trend is similar to the trend in Figure 4.1 for the conditional standard errors of measurement for the Mathematics and Science Tests. The degree to which the conditional standard errors of measurement vary with true scale score is greater for the Mathematics and Science Tests than it is for the Composite. As with the four test scores, it is concluded that the conditional standard error of measurement of the Composite is, for practical purposes, reasonably constant across the score scale.

A limitation of the approach used in producing estimates of the conditional standard error of measurement of the Composite is that standard errors of measurement of the unrounded average of the four test scores are computed rather than the standard errors of measurement of the rounded average of the four test scores (the rounded average is the score reported to examinees).

It is not a problem that the observed scores of the examinees are used in producing the plots because it is standard errors *conditional* on average true scale score that are being plotted, and the observed scores for the examinees are only used to determine the specific average true scale scores at which to plot the standard errors. One effect of using observed scores as the true score values at which to plot the conditional standard errors of measurement is that many points at the extremes of the scale may not represent realistically obtainable average true scale scores (the probability of observing examinees with these values of average *true* scale score is extremely small).

Scale scores from the four tests are summed and divided by 4 in the process of calculating the Composite score. This process suggests that, in a sense, each test is contributing equally to the Composite. The weights used (0.25, in this case) are often referred to as *nominal weights*.

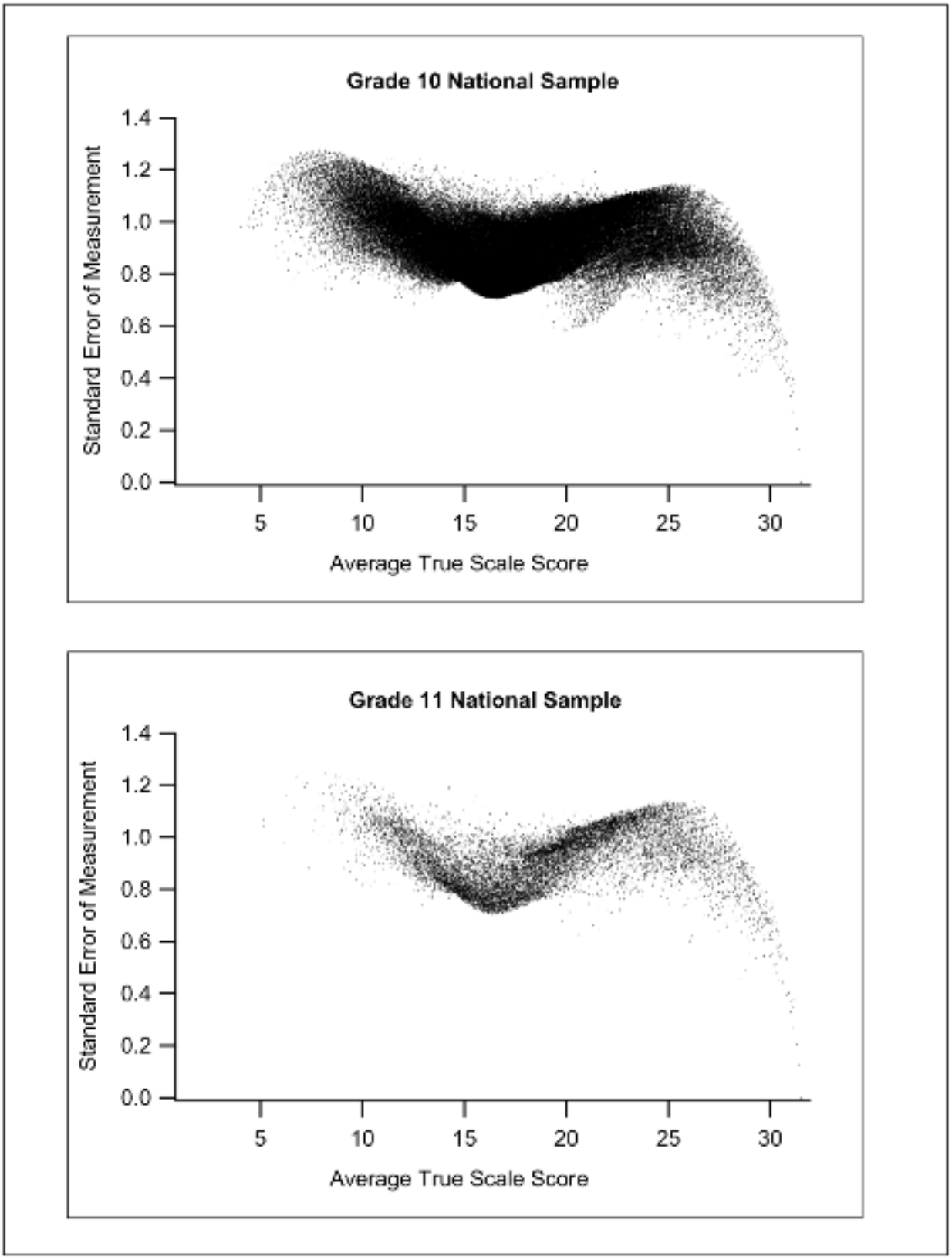


Figure 4.3. Conditional standard error of measurement for the ACT Plan Composite scores.

Other definitions of the contribution of a test to a Composite may be more useful. Wang and Stanley (1970) described *effective weights* as an index of the contribution of a test to a Composite. Specifically, the effective weights are defined as the covariance between a test score and the score on a Composite. These covariances can be summed over tests and then each covariance divided by their sum (i.e., the Composite variance) to arrive at *proportional effective weights*. Proportional effective weights are referred to as effective weights in the remainder of this discussion.

The covariances and effective weights are shown in Table 4.13 for the norming study. The values in the diagonals that are not in brackets are the observed scale score variances; the diagonal values in brackets are the true scale score variances. With nominal weights of 0.25 for each test, the effective weight for a test can be calculated by summing the values in the appropriate row that are not in brackets and dividing the resulting value by the sum of all covariances among the four tests using the formula

$$(\text{effective weight})_i = \frac{\Sigma_j \, \text{cov}_{ij}}{\Sigma_i \Sigma_j \text{cov}_{ij}} ,$$

where cov_{ij} is the observed covariance of test scores corresponding to row i and column j. Effective weights for true scores, shown in brackets, are calculated similarly, with the true score variance $[S_i^2 \cdot \text{REL}_i]$ used in place of the observed score variance.

The effective weights for English, Mathematics, and Reading are the largest of the effective weights. They are relatively high because they had the largest scale score variances and because their covariances with the other measures tended to be the highest. These effective weights imply that these tests are more heavily weighted (relative to Composite variance) in forming the Composite than is Science. Note that these effective weights are for the norming study sample and that the weights might differ from those for other examinee groups.

Table 4.13

Scale Score Covariances and Effective Weights

(Numbers in brackets relate to true scores.)

	English	**Mathematics**	**Reading**	**Science**
Number of items	50	40	25	30
Proportion of total Plan items	0.34	0.28	0.17	0.21
Grade 10 national sample				
English	18.94 [16.42]	14.35	15.52	12.24
Mathematics	14.35	21.98 [17.66]	14.23	13.25
Reading	15.52	14.23	23.38 [19.97]	13.50
Science	12.24	13.25	13.50	15.24 [12.54]
Effective weight	0.25 [0.25]	0.26 [0.26]	0.27 [0.27]	0.22 [0.22]
Reliability	0.87	0.80	0.85	0.82
Grade 11 national sample				
English	20.55 [18.05]	15.09	16.15	13.34
Mathematics	15.09	23.37 [18.93]	14.32	14.10
Reading	16.15	14.32	22.83 [19.49]	13.80
Science	13.34	14.10	13.80	16.20 [13.48]
Effective weight	0.25 [0.26]	0.26 [0.26]	0.26 [0.26]	0.22 [0.22]
Reliability	0.88	0.81	0.85	0.83

Validity

Validity refers to the degree to which particular uses of scores on a test are appropriate. For example, Plan scores are intended to be used as measures of college-bound and non-college-bound students' academic development in early high school, and to provide an estimate of the students' future performance on the ACT test.

Measuring Educational Achievement

Content Validity Argument for Plan Scores. The Plan tests are designed to measure students' problem-solving skills and knowledge in particular subject areas. The usefulness of Plan scores for this purpose provides the foundation for validity arguments for more specific uses (e.g., program evaluation).

The fundamental idea underlying the development and use of Plan tests is that the best way to determine student preparedness for further education and careers is to measure as directly as possible the knowledge and skills students will need in those settings. Tasks presented in the tests must therefore be representative of scholastic tasks. They must be intricate in structure, comprehensive in scope, and significant in their own right, rather than narrow or artificial tasks that can be defended for inclusion in the tests solely on the basis of their statistical correlation with a criterion. In this context, content-related validity is particularly significant.

The Plan tests contain a proportionately large number of complex problem-solving skills. The tests are oriented toward major areas of high school instructional programs, rather than toward a factorial definition of various aspects of intelligence. Thus, Plan scores, subscores, and skill statements based on the ACT College Readiness Standards are directly related to student educational progress and are easily interpreted by instructional staff, parents, and students.

As described earlier in this chapter, the specific knowledge and skills selected for inclusion in Plan were determined through a detailed analysis of three sources of information. First, the objectives for instruction for Grades 7 through 12 were obtained for all states in the United States that had published such objectives. Second, textbooks on state-approved lists for courses in Grades 7 through 12 were reviewed. Third, educators at the secondary (Grades 7 through 12) and postsecondary levels were consulted to determine the knowledge and skills taught in Grades 7 through 12 prerequisite to successful performance in high school and beyond. These three sources of information were analyzed to define a scope and sequence (i.e., test content specifications) for each of the areas measured by Plan. These detailed test content specifications have been developed to ensure that the test content is representative of current high school curricula. All forms are reviewed to ensure that they match these specifications. Throughout the item development process there is an ongoing assessment of the content validity of the tests.

ACT Plan Test Scores. This section provides evidence that the Plan tests and subtests measure separate and distinct skills. The data included all 10th-grade 2005–2006 Plan test takers who took the test under standard conditions (N = 881,976). Correlations were developed for all possible pairs of tests; disattenuated correlations adjust the observed correlations for measurement error associated with each test. As shown in Table 4.14, the scale scores on the four tests have observed correlations in the range of .63 to .74, indicating that examinees who score well on one test also tend to score well on another. Also, the values in the table show that the disattenuated correlation between any two Plan tests is greater than the observed correlation. The disattenuated correlations among the tests are sufficiently below 1.0 to suggest that the tests are measuring skills that are at least somewhat distinct, statistically. In general, the disattenuated correlations between English and Reading scores and Reading and Science scores are the highest of the disattenuated correlations between tests shown in the table, and the disattenuated correlations between Mathematics and Reading scores are the lowest.

Table 4.14
Observed Correlations (On and Above Diagonal) and Disattenuated Correlations (Below Diagonal) Between ACT Plan Test Scores and Subscores

Test score	English	Usage/ Mechanics	Rhetorical Skills	Math	Pre-Algebra/ Algebra	Geometry	Reading	Science	Comp.
English	1.00	.96	.90	.70	.68	.64	.74	.71	.90
Usage/Mechanics	*	1.00	.76	.67	.65	.61	.70	.67	.85
Rhetorical Skills	*	.98	1.00	.65	.64	.59	.70	.65	.83
Mathematics	.84	.82	.85	1.00	.93	.90	.63	.73	.87
Pre-Algebra/Algebra	.83	.81	.85	*	1.00	.73	.61	.70	.83
Plane Geometry	.82	.80	.82	*	.98	1.00	.57	.66	.79
Reading	.89	.86	.92	.78	.77	.76	1.00	.69	.87
Science	.84	.81	.84	.89	.87	.86	.85	1.00	.87

*Disattenuated correlations were not computed between the English and Mathematics scores and subscores, nor between Composite scores and all other scores, as these are not independent.

Statistical Relationships Between ACT Explore, ACT Plan, and ACT scores. The Explore, Plan, and ACT tests all measure student educational development in the same curricular areas of English, mathematics, reading, and science. The Explore scale ranges from 1 (lowest) to 25, Plan from 1 to 32, and the ACT from 1 to 36. Each test includes a computed Composite score equal to the average of the four test scores in the four curriculum areas (English, Mathematics, Reading, and Science). The three programs focus on knowledge and skills typically attained within these curriculum areas at different times in students' secondary-school experience. Thus, performance on Plan should be directly related to performance on Explore and the ACT.

Table 4.15 shows the correlations between Explore, Plan, and ACT scale scores for 481,996 students who took Explore, Plan, and the ACT in Grades 8, 10, and 11–12, respectively. The table shows observed correlations for all test scores and disattenuated correlations (shown in parentheses) for corresponding test scores across Explore, Plan, and the ACT. The observed correlations among the four subject area tests are in the range of .53 to .80 and disattenuated correlations are in the range of .77 to .94. The observed correlations between tests suggest that performance on the three test batteries is related.

Table 4.15
Correlations, Observed and (Disattenuated), Between ACT Explore, ACT Plan, and ACT Test Scale Scores

	Explore				
Plan	**English**	**Mathematics**	**Reading**	**Science**	**Composite**
English	.75 (.88)	.61	.67	.64	.77
Mathematics	.60	.73 (.90)	.57	.63	.73
Reading	.62	.53	.63 (.77)	.59	.69
Science	.59	.61	.59	.63 (.78)	.69
Composite	.75	.72	.72	.72	.84 (.89)

	ACT				
Plan	**English**	**Mathematics**	**Reading**	**Science**	**Composite**
English	.80 (.82)	.64	.72	.65	.80
Mathematics	.66	.81 (.94)	.60	.70	.77
Reading	.67	.55	.70 (.85)	.60	.71
Science	.64	.67	.63	.68 (.83)	.73
Composite	.81	.77	.77	.76	.88 (.93)

ACT Explore and ACT Plan College Readiness Benchmarks. As described in chapter 3, ACT has identified College Readiness Benchmarks for the ACT. These Benchmarks (English = 18, Mathematics = 22, Reading = 22, and Science = 23) reflect a 50% chance of a B or higher grade or an approximate 75% chance of a C or higher grade in entry-level, credit-bearing college English Composition I, College Algebra, Social Science, and Biology courses. Subsequently, corresponding College Readiness Benchmarks were developed for Explore and Plan to reflect a student's probable readiness for college-level work in these same courses by the time he or she graduates from high school.

The Explore and Plan College Readiness Benchmarks were developed using records of students who had taken Explore and the ACT, or Plan and the ACT. Benchmarks were developed for Grade 8 (Explore), Grade 9 (Explore), and Grade 10 (Plan). Each Explore (1–25) or Plan (1–32) score was associated with an estimated probability of meeting or exceeding the relevant ACT Benchmark (see Figure 4.4 for English). We then identified the Explore and Plan scores that came the closest to a .50 probability of meeting or exceeding the ACT Benchmark, by subject area. These scores were selected as the Explore and Plan Benchmarks.

The resulting Explore and Plan Benchmarks, with the corresponding ACT Benchmarks, are given in Table 3.5. Figure 4.5 shows the percentages of Plan-tested students in 2011–2012 who met the Plan Benchmarks.

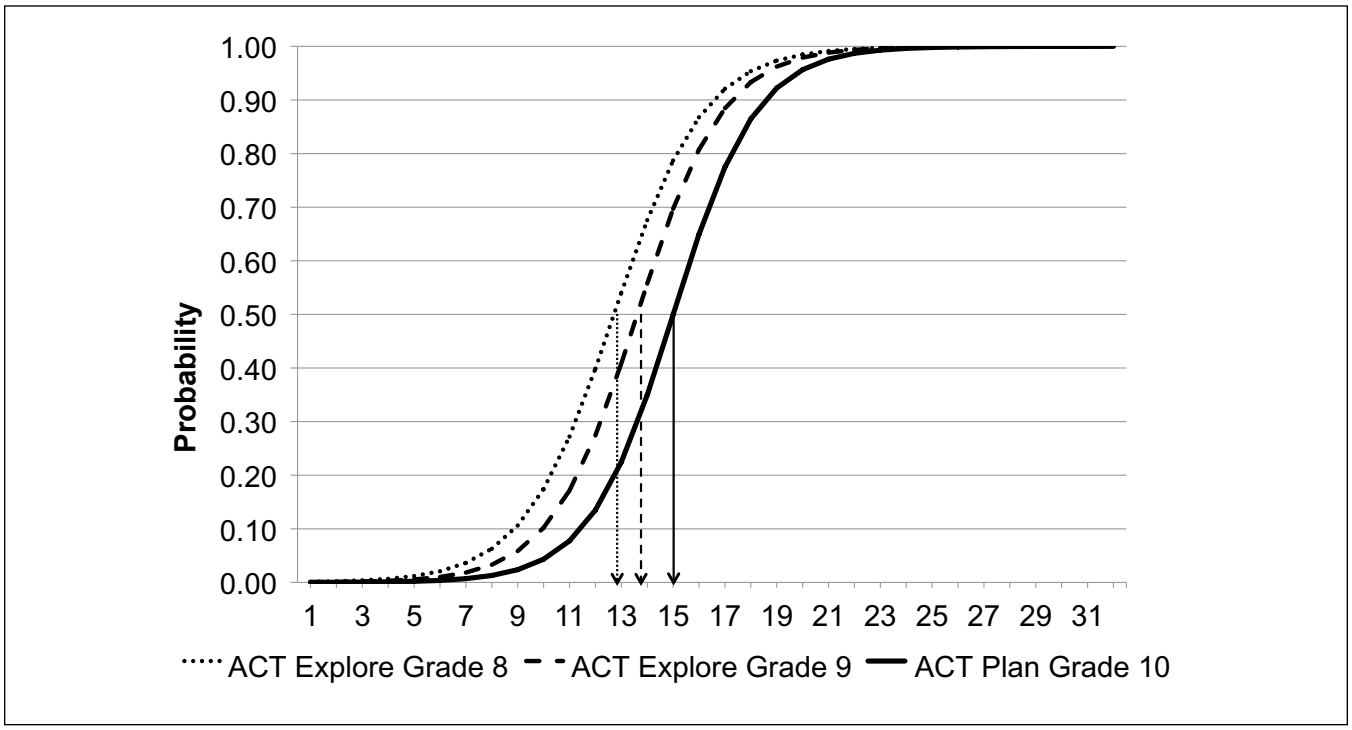


Figure 4.4. Conditional probability of meeting/exceeding an ACT English score = 18, given students' ACT Explore or ACT Plan English score.

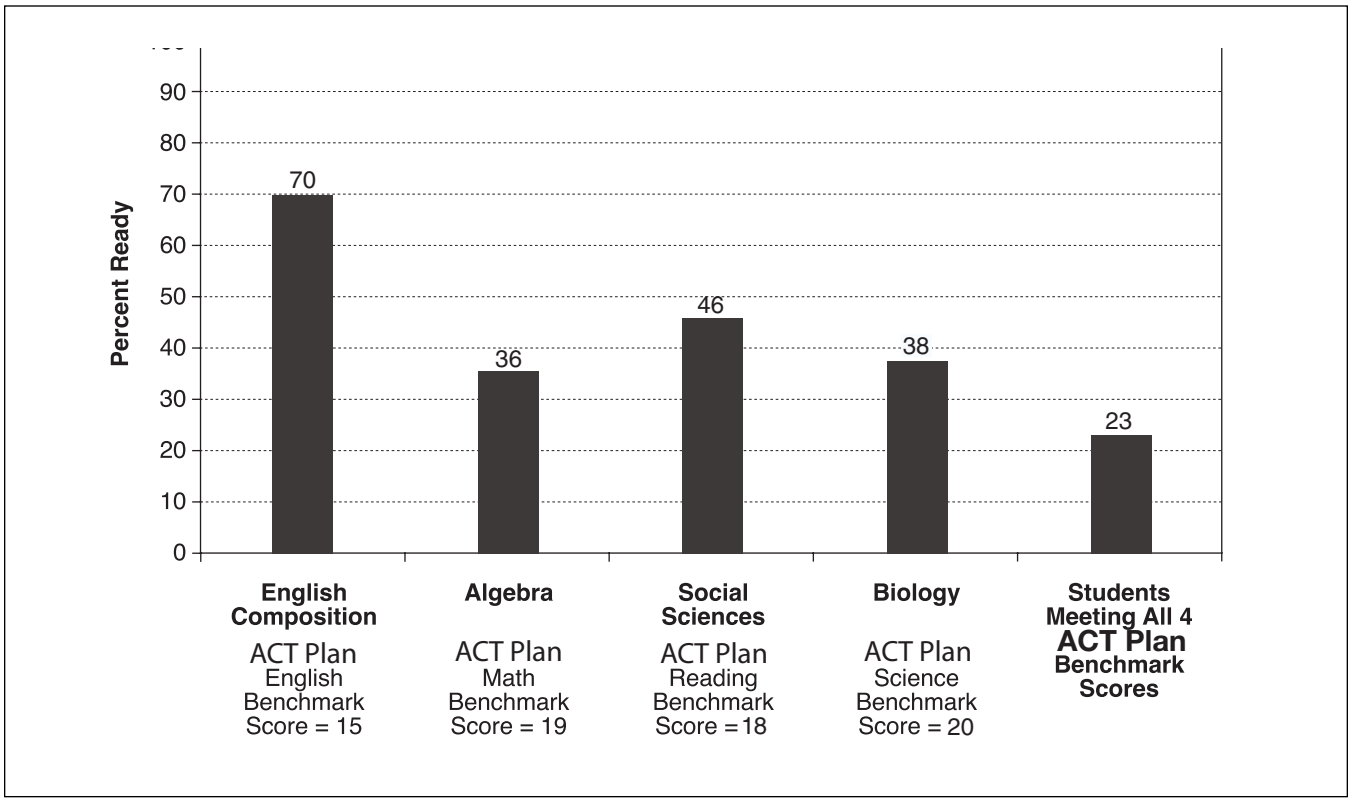


Figure 4.5. 2011–2012 national ACT Plan-tested students likely to be ready for college-level work (in percent).

Statistical Relationships Between ACT Plan Scores and High School Course Work and Grades

The Plan tests are oriented toward the general content areas of high school and college curricula. Students' performance on Plan should therefore be related to the high school courses they have taken and to their performance in these courses.

The Plan Course/Grade Information Section (CGIS) collects information about 38 high school courses in English, mathematics, social studies, and natural sciences. Many of these courses form the basis of a high school core curriculum and are also frequently required for college admission or placement. For each of the 38 courses, students indicate whether they have taken or are currently taking the course, whether they plan to take it, or do not plan to take it. If they have taken the course, they indicate the grade they received (A–F).

ACT Plan Scores and High School Course Work. Table 4.16 includes average Plan scores by course work 10th-grade students nationally reported they had taken or were currently taking at the time of Plan testing (ACT, 2006). Students who had taken additional courses, especially upper-level courses, within each subject area, achieved higher average Plan subject area and Composite scores than students taking fewer courses. Moreover, students who had taken sufficient course work by Grade 10 to be on track to complete the ACT-recommended core curriculum (four years of English and three years each of mathematics, social studies, and science) by high school graduation had higher average Plan scores than those who had not completed these courses.

Table 4.16
Average ACT Plan Scores by Courses Taken in High School

Course work	No. of students	Mean ACT Plan score				
		English	Mathematics	Reading	Science	Composite
English						
English 9	101756	16.3				16.9
English 9 & English 10	567279	18.1				18.5
Other combinations of one or more years of English	102144	17.3				17.9
No English course work information reported	105127	16.2				17.0
Mathematics						
Algebra 1	153907		15.4			15.8
Algebra 1 & Algebra 2	39384		17.1			17.4
Algebra 1 & Geometry	284452		17.8			18.0
Algebra 1, Geometry & Algebra 2	161552		21.3			20.6
Other combinations of one or more years of math	106465		20.3			19.8
No math course work information reported	118221		16.6			16.7
Social Studies						
U.S. History	38037			16.1		16.7
World History	62462			17.5		18.1
World History & U.S. History	93806			17.6		18.2
Other combinations of one year of social studies	153444			17.3		18.0
Other combinations of two or more years of social studies	389979			18.1		18.7
No social studies course work information reported	95996			16.0		16.7
Natural Science						
General Science	104308				17.3	16.4
Biology	61290				17.9	17.2
Chemistry	3124				19.0	18.4
General Science & Biology	367402				18.6	18.0
General Science & Chemistry	9440				20.1	19.6
Biology & Chemistry	86499				20.9	20.8
Other combinations of one or more years of natural science	125695				19.7	19.3
No natural science course work information reported	114641				17.1	16.8
On track for core course work						
English 10, Algebra 1 plus one other math course, any social studies course, and Biology	437179	18.9	19.4	18.7	19.6	19.3
Not taken/not taking these courses	441868	16.2	16.8	16.3	17.7	16.9

ACT Plan Scores and Course Grades. The results shown in Table 4.17 are based on the Plan scores and self-reported course grades of students who took Plan in Grade 10 in 2005–2006. A total of 883,470 10th-grade students had valid Plan Composite scores and took the test under standard conditions.

Across individual courses, correlations between subject area Plan scores and associated course grades ranged from .27 (Geography) to .47 (Algebra 1). However, correlations with subject area GPAs and overall high school GPA were generally somewhat higher, ranging from .38 to .48 for subject area GPAs and from .48 to .53 for overall high school GPA.

In general, correlations between test scores and course grades are smaller than those between test scores due to the lower reliabilities of course grades. For example, the intercorrelations among course grades could be considered an estimate of the reliabilities of individual course grades. For these courses, the median correlation among pairs of grades was .51. Using this value as a reliability estimate for individual course grades, disattenuated correlations among test scores and individual course grades ranged from .27 (Geography) to .47 (Algebra 1; see page 40 for further discussion of disattenuated correlations).

Table 4.17
Correlations Between ACT Plan Scores and Course Grades

Course grade/ grade average	No. of students	Mean	ACT Plan score				
			English	Mathematics	Reading	Science	Composite
English							
English 9	716552	3.05	.44				.48
English 10	375957	3.09	.41				.44
English GPA	733190	3.04	.45				.49
Mathematics							
Algebra 1	642462	3.03		.47			.46
Geometry	360847	3.16		.44			.45
Algebra 2	162739	3.26		.41			.41
Math GPA	686199	2.98		.48			.47
Social Studies							
U.S. History	274000	3.15			.39		.45
World History	329993	3.18			.39		.45
Government/Civics	135686	3.18			.40		.47
World Cultures/ Global Studies	76537	3.25			.40		.46
Geography	297644	3.34			.27		.33
Economics	35937	3.16			.38		.46
Social Studies GPA	708395	3.20			.38		.44
Science							
Physical/Earth/ General Science	503041	3.08				.41	.46
Biology 1	419838	3.10				.42	.43
Chemistry 1	90665	3.25				.39	.46
Science GPA	691247	3.06				.44	.49
Overall							
Overall GPA	609620	3.12	.51	.53	.48	.51	.58

Additional ACT research examined the relationship between high school grade point average (HSGPA) at the time students took the ACT and their Plan test scores at Grade 10. The data included high school students who graduated in 2002, 2003, or 2004 and took Explore, Plan and the ACT. Self-reported high school course grades from the ACT CGIS were used to calculate an overall HSGPA. Plan means, HSPGA means, and correlations for each of the four Plan test scores and the Composite are presented in Table 4.18.

Table 4.18
Means and Correlations for ACT Plan Score and High School Grade Point Average

Explore	N	ACT Plan means	HSGPA means	Correlations
English	221,805	19.0	3.30	.46
Mathematics	210,651	18.9	3.12	.49
Reading	210,666	18.4	3.40	.39
Science	210,493	19.2	3.25	.39
Composite	211,603	19.0	3.27	.55

The results showed a moderate relationship between HSGPA and Plan test scores, even though the time span between Plan testing and HSGPA was about two years. The largest correlation was between the Plan Composite score and HSGPA.

Course Work Associated With Longitudinal Educational Achievement, as Measured by ACT Explore and ACT Plan Scores. Roberts and Noble (2004) examined the extent to which the courses students take or plan to take in high school explain Plan performance at Grade 10, after statistically controlling for prior achievement at Grade 8. The contribution of nonacademic variables, including post–high school plans and needs for help, was also examined.

Data and Method. The sample for this study was based on all students (over 175,000 students) who took Explore in Grade 8 in 1997–1998 and Plan two years later in 1999–2000. Students who were given extended time, high schools with less than 25 student records, and students with missing data on one or more variables were excluded from the study. Initial data screening resulted in a longitudinal sample of 42,193 student records from 488 high schools.

Multiple linear regression was used to examine the effects of taking specific high school courses on students' Plan scores. Simple correlations and regression models based on pooled data were used to identify the final regression models for each Plan score. Within-school regression models were then developed using final regression models. Regression statistics were then summarized across schools using minimum, median, and maximum values. Explore scores were entered into each regression equation first to control for prior achievement before entering five sets of independent variables. Independent variables were required to share a logical relationship with Plan scores, have a zero-order correlation greater than .1 or higher with Plan scores, and regression coefficients for course work variables were required to be > 0.5.

Results. Zero-order correlations between Plan scores and selected independent variables that met the criteria for model selection are shown in Table 4.19 (see Roberts & Noble, 2004 for further information). Mathematics course work taken (Algebra 2, Geometry) and planned (e.g., Trigonometry, Calculus) had the highest correlations with all Plan scores. English and social studies course work taken or planned had low correlations with Plan English and Reading scores; this was typically due to limited variability in the course work variables (e.g., virtually all students take English 9 and 10).

Summary. Results of this study showed that students who take or plan to take rigorous mathematics and science courses (e.g., Algebra 2, Geometry, Trigonometry, and Chemistry), on average, achieve higher Plan Mathematics, Science, and Composite scores than students who do not take these courses, regardless of prior achievement, perceived educational needs, educational plans, educational background, and personal characteristics of the student. Given the benchmarks set for this study, few relationships were detected between Plan English and Reading scores and courses taken or planned in English and social studies. It should not be concluded, however, that these types of courses are not important to Plan performance. Exclusion of English and social studies course work occurred largely because of insufficient variability and problems of highly redundant relationships with other independent variables.

Table 4.19
Percentages and Zero-Order Correlation Coefficients for Blocks of Independent Variables That Met the Criteria of Selection

Independent variable	%	Correlations with ACT Plan Score				
		English	Mathematics	Reading	Science	Composite
Courses taken						
Algebra 1 (not pre)	95	0.18	0.18	0.16	0.16	0.20
Algebra 2	42	0.34	0.44	0.30	0.34	0.41
Geometry	72	0.38	0.43	0.33	0.35	0.43
Trigonometry	6	0.20	0.28	0.19	0.22	0.25
Other math beyond Algebra	3	0.07	0.10	0.06	0.08	0.09
General Science	82	–0.06	–0.10	–0.07	–0.07	–0.08
Biology	89	0.10	0.09	0.08	0.08	0.10
Chemistry	22	0.22	0.29	0.22	0.23	0.27
Art	58	0.10	0.10	0.09	0.08	0.11
German	43	0.12	0.06	0.09	0.07	0.10
Courses taken or planned						
English 11	98	0.10	0.10	0.09	0.09	0.11
English 12	96	0.11	0.10	0.10	0.09	0.12
Algebra 2	94	0.17	0.17	0.15	0.15	0.18
Geometry	95	0.18	0.18	0.16	0.16	0.20
Trigonometry	66	0.26	0.30	0.23	0.26	0.30
Calculus (not pre)	51	0.25	0.34	0.23	0.27	0.31
Other math beyond Algebra	57	0.19	0.25	0.18	0.20	0.23
General Science	87	–0.10	–0.14	–0.10	–0.10	–0.12
Chemistry	91	0.16	0.16	0.14	0.14	0.17
Physics	73	0.15	0.19	0.14	0.17	0.19
Psychology	45	0.12	0.06	0.12	0.07	0.11
French	57	–0.09	–0.09	–0.08	–0.09	–0.10
Educational need						
Expressing ideas in writing	46	0.14	0.02	0.13	0.06	0.10
Increasing reading speed	48	0.23	0.07	0.25	0.15	0.21
Increasing reading understanding	45	0.23	0.15	0.27	0.21	0.25
Developing math skills	36	0.15	0.37	0.10	0.22	0.24
Developing study skills	28	0.14	0.15	0.12	0.14	0.16
Developing test-taking skills	35	0.26	0.28	0.24	0.27	0.30
Investigating my options after high school	27	–0.11	–0.11	–0.10	–0.10	–0.12
College-bound/non-college-bound	94	0.22	0.19	0.19	0.18	0.22
Parents' level of education[a]		0.28	0.30	0.27	0.26	0.32
Student characteristics						
Gender	55	0.15	–0.08	0.10	–0.03	0.05
Black vs. white comparison	8	–0.23	–0.25	–0.21	–0.23	–0.26
Hispanic vs. white comparison	5	–0.13	–0.09	–0.10	–0.10	–0.12
Asian vs. white comparison	2	0.05	0.10	0.05	0.06	0.07
Other vs. white comparison	6	–0.08	–0.08	–0.07	–0.07	–0.08

Note. N = 42,193 students with no missing data on all variables.
[a]From Explore; Mean = 3.79 and standard deviation = 1.43 for parents' level of education.

Median, minimum, and maximum regression statistics for each of the five Plan models are displayed in Tables 4.20 and 4.21. A separate table was constructed for Plan English and Reading, since no course work variables met the criteria for selection for these tests. The typical number of students for each model was 61, and ranged from 25 to 320 across schools. The multiple R medians ranged from .73 for Plan Science to .87 for Plan Composite.

Table 4.20
Distributions, Across Schools, of Regression Statistics for Modeling ACT Plan Mathematics, Science, and Composite Scores

Test/Subtest	ACT Plan Mathematics			ACT Plan Science			ACT Plan Composite		
	Median	Minimum	Maximum	Median	Minimum	Maximum	Median	Minimum	Maximum
R	.83	.63	.95	.73	.31	.90	.87	.58	.97
SEE	2.37	1.20	4.60	2.20	1.24	3.55	1.78	0.97	2.56
Intercept	4.66	–7.40	15.66	6.82	–1.91	18.36	1.83	–6.78	14.32
Regression Coefficients									
Explore									
Mathematics/Composite	0.64	–0.06	1.38	0.68	0.11	1.14	0.92	0.23	1.35
Taken									
Algebra 2	1.53	–6.93	9.33	—	—	—	—	—	—
Geometry	1.37	–8.52	7.85	0.52	–5.18	4.75	0.60	–3.05	3.55
Taken or Planned									
Trigonometry	0.35	–3.19	4.80	0.33	–3.44	3.48	0.31	–3.41	3.57
Chemistry	0.10	–7.52	8.57	—	—	—	—	—	—
Needs help developing test-taking skills	0.64	–2.46	3.35	—	—	—	—	—	—
Educational plans	0.36	–7.09	8.73	—	—	—	0.44	–5.53	5.73
Parents' education	0.10	–1.01	1.33	0.07	–0.58	1.31	0.10	–0.51	0.74
Gender	–0.53	–5.63	4.48	–0.43	–3.30	1.93	–0.08	–1.81	2.85
Majority/Minority	0.53	–12.70	6.60	0.22	–6.98	5.02	0.33	–5.11	3.78

Regression coefficients for the course work variables reflect statistically adjusted mean test score differences between students who took the course (coded as one) and those who did not take the course (coded as zero). For example, as shown in Table 4.20, positive high school median regression coefficients for the Plan Mathematics test were associated with taking Algebra 2, given all other variables in the model. Adjusted mean Plan Mathematics scores of students taking Algebra 2 were typically 1.53 scale score units higher than those of students who did not take Algebra 2. In addition, adjusted mean Plan Mathematics scores of students taking Geometry were, on average, 1.37 scale score units higher than those of students not taking Geometry. Smaller adjusted mean differences were associated with taking or planning to take Trigonometry (.35) or Chemistry (.10). Positive regression coefficients on the Plan Science Test were, on average, associated with taking Geometry (0.52) or taking or planning to take Trigonometry (0.33). Results also indicated, as shown in Tables 4.20 and 4.21, that positive regression coefficients were, on average, associated with planning to attend college for Plan English (0.68), Mathematics (0.36), Reading (0.60), and Composite (0.44) scores.

Table 4.21
Distributions, Across Schools, of Regression Statistics for Modeling ACT Plan English and Reading Scores

	ACT Plan English			ACT Plan Reading		
Statistic	**Median**	**Minimum**	**Maximum**	**Median**	**Minimum**	**Maximum**
R	.81	.45	.93	.76	.37	.93
SEE	2.67	1.73	3.91	3.06	1.03	4.35
Intercept	–1.89	–14.59	13.34	–0.55	–14.33	15.32
Regression coefficients						
Explore Composite	1.11	0.36	1.69	1.00	0.15	1.97
Increasing reading speed	—	—	—	0.72	–3.94	4.66
Increasing reading understanding	—	—	—	0.70	–2.55	6.23
Educational plans	0.68	–5.73	7.00	0.60	–6.82	6.83
Parents' education	0.16	–1.93	1.23	0.13	–0.94	1.55
Gender	0.85	–2.40	3.97	0.36	–3.10	4.44
Majority/Minority	0.46	–5.53	6.61	0.23	–7.94	9.19

The regression coefficients for gender in Tables 4.20 and 4.21 indicated that for the typical high school, Plan adjusted means for females were higher than those for males for Plan English and Reading (median regression coefficients = 0.85 and 0.36), whereas adjusted means for females were typically lower than those for males for Plan Mathematics and Science (median regression coefficients = –0.53 and –0.43). After statistically controlling for prior achievement and the other independent variables, gender differences decreased, on average, by 53% (English), 12% (Mathematics), 70% (Reading), and 80% (Composite). Mathematics continued to show higher average Plan scores for males. To a much lesser degree, English and Reading continued to show higher average scores for females. Although Composite median adjusted means for males were slightly higher than those for females (median regression coefficient = –0.08), the gender difference in unadjusted means was substantially reduced (92%) by statistically controlling for prior achievement and the other independent variables.

For Science, statistically controlling for prior achievement and the other independent variables resulted in an increase in gender differences. Regressing Explore Composite on gender alone showed that within most schools, females scored half a point higher than males (0.56) at Grade 8. Regressing Plan Science on gender after controlling for Explore Composite scores only resulted in an average adjusted mean difference of –0.45 across schools, which is only slightly higher than the result shown in Table 4.19. Within most schools, females score higher than males at Grade 8 on Explore Composite, but by Grade 10 males have caught up and score slightly higher than females on Plan Science. Other research into relationships between gender and achievement provides evidence that males tend to outperform females in mathematics and science over time on the Iowa Test of Basic Skills from Grades 3 through 8 and on the Iowa Test of Educational Development from Grades 9 through 12 (Becker & Forsyth, 1990; Martin & Hoover, 1987). It is possible females begin to lose interest in science by Grade 10 and focus their attention on other subject areas.

After statistically controlling for prior achievement and the other independent variables in this study, Plan scores continued to show higher averages for the majority group. Mean differences were reduced by 81% (English), 77% (Mathematics), 90% (Reading), 87% (Science), and 86% (Composite) by statistically controlling for these variables.

High School Course Work Associated With Longitudinal Educational Achievement, as Measured by ACT Plan and ACT Scores. ACT research has shown that taking rigorous, college-preparatory mathematics courses is associated with higher ACT Mathematics and Composite scores. (e.g., ACT, 2005a; Noble, Davenport, & Sawyer, 2001; Noble, Roberts, & Sawyer, 2006). Schiel, Pommerich, and Noble (1996) statistically controlled for prior achievement using Plan scores and found substantive increases in average ACT Mathematics and Science scores associated with taking upper-level mathematics and science courses. In a recent study (Noble & Schnelker, 2007; ACT, 2005b) researchers examined the effects of taking specific high school course sequences on students' ACT performance in English, Mathematics, and Science based on data for students who had taken both Plan and the ACT.

Data and Method. Data for 403,381 students representing 10,792 high schools were analyzed. The Plan/ACT cohort file for the 2003 graduating class contained matched records of students who completed Plan during their sophomore year (2000–2001) and the ACT during their junior or senior year, prior to graduating in 2003. If students took the ACT more than once, only the most recent ACT record was used. Each record included Plan and ACT scores (in English, Mathematics, and Science), race/ethnicity, grade level at the time of taking the ACT, self-reported course work information from the CGIS, and high school attended. Dummy variables were used to represent specific course sequences; the course sequences were based on previous research (ACT, 2004; Noble et al., 1999) and were constructed such that the incremental benefit of specific courses could be determined.

Hierarchical regression modeling was used to examine the effects of taking specific high school course sequences on students' ACT scores. Hierarchical regression models account for variability in regression coefficients across schools in order to draw correct conclusions about predictor-outcome relationships. In these analyses, student-level regression coefficients were allowed to vary across high schools.

All effects were examined in the context of the high schools students attended, and prior achievement (i.e., Plan scores) and students' grade level at the time of ACT testing were statistically controlled in the models. For a more detailed discussion concerning the data and methods used, including a more in-depth discussion of hierarchical regression, see Noble and Schnelker (2007).

Results. The results of the hierarchical linear regression models are shown in Table 4.22. The table includes the unstandardized regression coefficients for each variable in each model; all regression coefficients were statistically significant ($p < .01$) unless otherwise noted. Overall, about 0.60 of the variance in students' ACT English scores, between 0.50 to 0.60 of the variance in students' ACT Mathematics scores, and between 0.30 to 0.50 of the variance in students' ACT Science scores were explained by the models. High school attended explained 0.16 to 0.25 of the variance across ACT scores (intraclass correlations; see Noble & Schnelker, 2007).

For all models, Plan scores were positively related to ACT scores. A 1-point increase in Plan English score corresponded to about a 1-point increase in ACT English score, and a 1-point increase in Plan Mathematics or Science score corresponded to about a 0.8-point increase in ACT Mathematics or Science score, respectively. Moreover, high school seniors, on average, scored about 0.3 points higher on ACT English, about 0.5 to 0.7 points lower on ACT Mathematics, and about 0.1 to 0.5 points lower on ACT Science than did juniors.

Taking one or more foreign languages, over and above English 9–11, increased students' ACT English score, on average, by 1.1 score points, compared to taking only English 9–11. Taking Algebra 1, Algebra 2, and Geometry was associated with an average ACT Mathematics score increase of about 1.1 score points, compared with taking fewer than these three courses. Taking either Trigonometry or Other Advanced Mathematics, over and above these three courses, resulted in an average increase in ACT Mathematics score of 1.0 to 1.5 score points. Taking Other Advanced Mathematics and Trigonometry, or Trigonometry and Calculus, increased ACT Mathematics scores, on average, by more than 2.0 score points. The greatest average score increase associated with mathematics course work resulted from taking Other Advanced Mathematics, Trigonometry, and Calculus, in addition to Algebra 1, Geometry, and Algebra 2 (3.2 score points).

Compared with taking General Science only, taking General Science and Biology, or Biology alone, resulted in an average ACT Science score increase of about 0.5 points. Taking Biology and Chemistry, or Biology, Chemistry, and Physics, was associated with an average ACT Science score increase of 1.3 and 2.4 score points, respectively, compared to taking Biology only.

Summary. These results indicate that, in a typical high school, students who take upper-level mathematics or science courses (e.g., Trigonometry, Calculus, Chemistry, or Physics) can expect, on average, to earn meaningfully higher ACT Mathematics and Science scores than students who do not take these courses. The benefits of course work taken in high school for increasing ACT performance depend on the high school students attend, regardless of prior achievement and grade level at testing. The relationships between course work taken and ACT performance are also influenced by the characteristics of schools. For a detailed description of these results, see Noble and Schnelker (2007).

Table 4.22
Hierarchical Linear Regression Coefficients for Modeling ACT Scores

Model	Course work comparison	Regression coefficient: Intercept	ACT Plan score	Grade level	Course work	Level 1 R^2
ACT English score						
1	English 9–11 & 1 or more foreign languages vs. English 9–11	1.33	0.99	0.32	1.12	0.60
ACT Mathematics score						
1	Algebra 1, Algebra 2, and Geometry vs. fewer than these courses	5.03	0.75	–0.45	1.07	0.52
Algebra 1, Algebra 2, and Geometry vs.						
2	Algebra 1, Algebra 2, Geometry & Other Advanced Math	5.65	0.79	–0.66	1.01	0.52
3	Algebra 1, Algebra 2, Geometry & Trig	5.63	0.79	–0.70	1.52	0.59
4	Algebra 1, Algebra 2, Geometry, Trig & Other Advanced Math	5.91	0.78	–0.72	2.02	0.60
5	Algebra 1, Algebra 2, Geometry, Trig & Calculus only	5.84	0.78	–0.62	2.91	0.60
6	Algebra 1, Algebra 2, Geometry, Other Advanced Math, Trig & Calculus	5.90	0.77	–0.62	3.16	0.63
ACT Science score						
1	Biology vs. General Science	4.70	0.78	–0.07*	0.46	0.28
Biology vs.						
2	Biology & Chemistry	4.26	0.83	–0.43	1.29	0.37
3	Biology, Chemistry & Physics	4.23	0.84	–0.48	2.41	0.47

*p > .01

High School Course Work Associated With ACT College Readiness Benchmarks. Noble and Schnelker (2007; ACT, 2005b) also examined the contribution of specific high school course sequences to college readiness in English Composition, College Algebra, and Biology.

Data and Method. Students' readiness for college course work in a subject area was defined by whether the relevant ACT Benchmark (see pp. 18–19 for a description of the Plan Benchmarks) had been met or not. Hierarchical logistic regression was used to model the probability of a student meeting or exceeding the English Composition, Algebra, or Biology College Readiness Benchmark as a function of courses taken in high school, while statistically controlling for the relevant Plan score (as a measure of students' prior achievement) and student grade level at the time of taking the ACT (junior or senior). High school attended was also accounted for in the models by allowing the student-level regression coefficients to vary across high schools.

Results. In this study, 74% of the students met the ACT English Benchmark, 44% met the ACT Mathematics Benchmark, and 30% met the ACT Science Benchmark. Table 4.23 gives the unstandardized logistic regression coefficients for each variable from each model; all regression coefficients were statistically significant ($p < .01$) unless otherwise noted. The odds ratios for the course work comparisons are also reported in Table 4.23. Compared to taking only English 9–11, the odds of meeting the ACT English Benchmark for students also taking one or more foreign languages was 2 times greater. Moreover, taking at least one foreign language was typically associated with a 9% increase in students' chances of meeting the Benchmark, compared to taking only English 9–11.

Figure 4.6 illustrates students' chances of meeting the College Algebra Benchmark associated with taking various mathematics course sequences. Taking Algebra 1, Geometry, and Algebra 2 was typically associated with a 22% chance of meeting the Benchmark (an increase of 12% over that for students taking less than Algebra 1, Geometry, and Algebra 2). Taking upper-level mathematics courses beyond Algebra 2 was associated with substantial increases in students' chances of meeting the College Algebra Benchmark, compared to taking less than Algebra 1, Geometry, and Algebra 2. Chances ranged from 34% (other advanced mathematics) to 58% (Other Advanced Mathematics, Trigonometry, and Calculus), compared to 10% for those taking less than Algebra 1, Geometry, and Algebra 2.

Compared to students taking Biology only, the odds of meeting the ACT Science Benchmark were 2 times greater for students taking Biology and Chemistry and were nearly 4 times greater for students taking Biology, Chemistry, and Physics. Taking Biology and Chemistry was typically associated with a 19% chance of meeting the College Biology Benchmark, compared to a 10% chance for students taking Biology only. Students taking Biology, Chemistry, and Physics typically had a 29% chance of meeting the Benchmark.

Summary. The findings from this study indicate that some courses and course sequences better prepare students for postsecondary-level work than others. Each incremental college preparatory course taken, particularly in mathematics and science (e.g., Trigonometry beyond Algebra 2, Physics beyond Chemistry), added to readiness more than did the number of courses in a discipline alone. A more detailed description of these results is provided in the full ACT Research Report (Noble & Schnelker, 2007).

Table 4.23
Hierarchical Logistic Regression Coefficients for Modeling the Probability of Students' Meeting or Exceeding ACT College Readiness Benchmarks

Model	Course work comparison	Regression coefficient: Intercept	ACT Plan score	Grade level	Course work	Odds ratio
College English Benchmark						
1	English 9–11 & 1 or more foreign languages vs. English 9–11	–8.04	0.49	0.02*	0.68	1.97
College Algebra Benchmark						
1	Algebra 1, Algebra 2, and Geometry vs. less than these courses	–10.29	0.47	–0.37	0.91	2.48
Algebra 1, Algebra 2, and Geometry vs.						
2	Algebra 1, Algebra 2, Geometry, & Other Advanced Math only	–9.18	0.46	–0.40	0.63	1.88
3	Algebra 1, Algebra 2, Geometry, & Trig only	–8.91	0.44	–0.43	0.90	2.46
4	Algebra 1, Algebra 2, Geometry, Trig & Other Advanced Math only	–8.86	0.44	–0.42	1.15	3.16
5	Algebra 1, Algebra 2, Geometry, Trig, & Calculus only	–9.01	0.45	–0.40	1.66	5.26
6	Algebra 1, Algebra 2, Geometry, Other Advanced Math, Trig, & Calculus	–8.96	0.44	–0.40	1.76	5.81
College Biology Benchmark						
Biology vs.						
1	Biology & Chemistry	–10.97	0.48	–0.29	0.71	2.03
2	Biology, Chemistry, & Physics	–10.24	0.44	–0.30	1.31	3.71

*p > .01

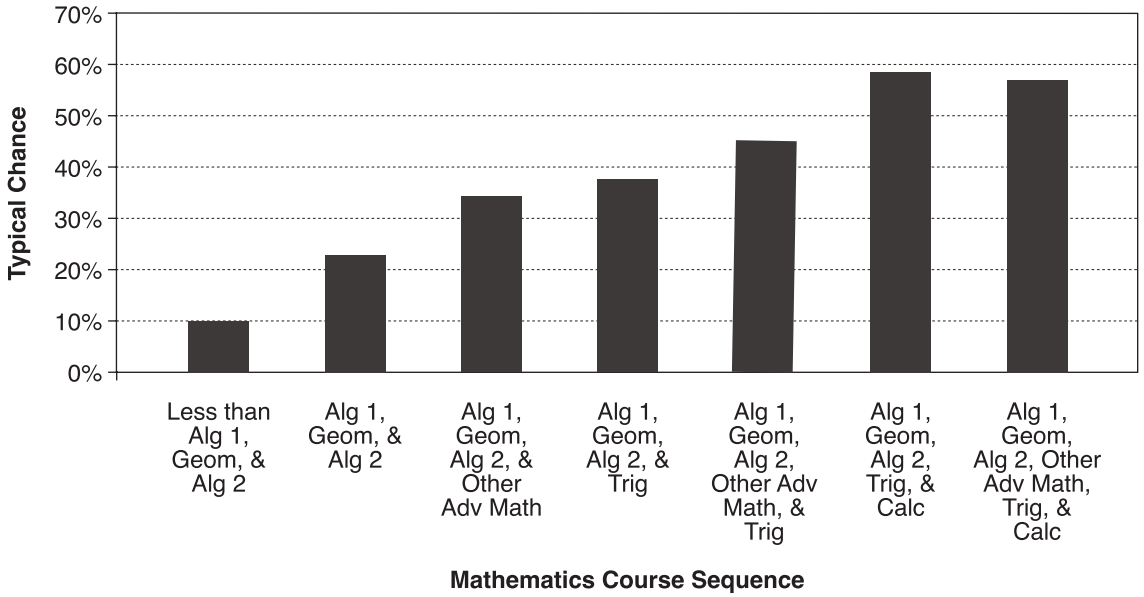


Figure 4.6. Typical chances of meeting the College Readiness Benchmark for College Algebra by specific mathematics course work.

Growth From Grade 8 to Grade 12. Explore, Plan, and the ACT can be used to measure growth in educational achievement across Grades 8, 10, and 12. Roberts and Bassiri (2005) investigated the relationship between the initial academic achievement status of students on Explore at Grade 8, and their rate of change in academic achievement at Grade 10 on Plan and Grades 11/12 on the ACT. The longitudinal achievement data for this study consisted of 34,500 students from 621 high schools who had taken Explore (1998–1999), Plan (1999–2000), and the ACT (2001–2002). Linear growth over time for students within schools was measured using Explore, Plan, and ACT Composite scores. A multilevel growth model was used to test the extent of the relationship between the initial achievement of students (measured by Explore) and their rate of educational growth (measured by Plan and the ACT, respectively). The multilevel growth model for the study was specified, where the time of measure was nested within students and students were nested within high schools to account for variation at both levels.

The unconditional model showed an expected between-school grand mean equal to 16.35 for the Explore Composite and achievement rate of growth equal to 1.16 points per year. A strong correlation (r = .90) was found between where students start on Explore and their rate of academic achievement growth through high school, as measured by Plan and the ACT. Within-school rates of change regressed on students' Explore scores explained 79% of the variation in student-level growth trajectories. These results showed that, on average, students' initial level of academic achievement is an important predictor of change in academic growth for students within schools. Although variation between schools was observed (Figure 4.7), a student might be expected to increase his or her rate of change in academic growth by 0.19 scale score points, on average, for each point increase on the Explore Composite.

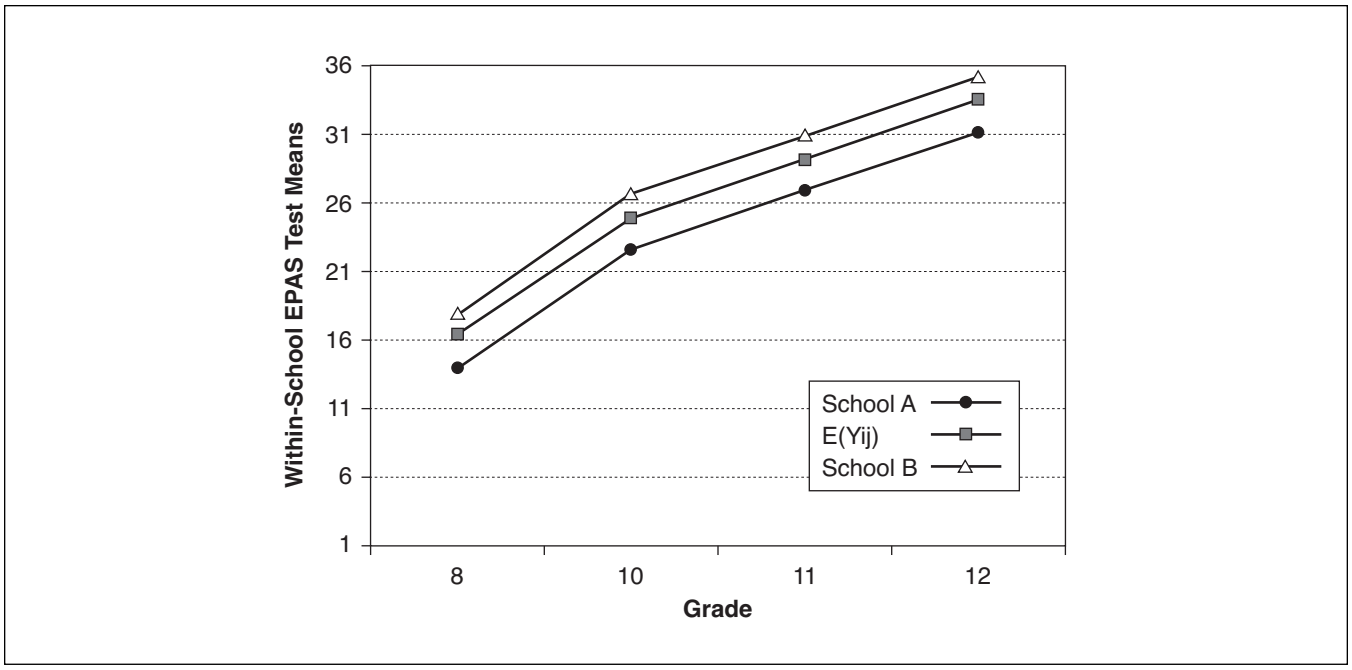


Figure 4.7. Growth trajectories calculated at Grades 8 through 12 for expected within-school average E(Yij), high school A, and high school B.

The Roberts and Bassiri study was extended by Bassiri and Roberts (2005) using the same sample and employing the same growth model statistical methods to examine the relationship between high school core courses (four years of English and three years each of mathematics, science, and social studies) taken and student growth over time measured with Explore, Plan, and the ACT subject tests in English, Mathematics, Reading, and Science. Statistically significant initial status and rate of change variances showed that students attending different schools do not start at the same level on Explore or change at the same rate of academic achievement over time. Yet, on average, students within a school who take Explore can be expected to move to higher Mathematics, English, Reading, and Science scores over time as assessed by Plan and the ACT. After controlling for school-level characteristics (i.e., metropolitan area, proportion of ACT-tested students in a school, degree of integration of race/ethnicity in a school, and initial achievement status of the school), and student-level variables (i.e., gender and race/ethnicity), Explore-tested students who took the high school core curriculum showed statistically significantly faster rates of change to higher achievement scores on English, Mathematics, Reading, and Science, compared to Explore-tested students who did not take core (regression coefficients for each of the four tests equal 1.56, 1.37, 1.32, and 0.96, respectively). Based on these results, regardless of where students start on Explore, the rate of change in achievement is fastest for students who have taken the high school core curriculum.

Using ACT and ACT Plan Scores for Program Evaluation

ACT scores may be used in concert with Plan scores for program evaluation. Plan includes academic tests in the same subject areas as the ACT—English, Mathematics, Reading, and Science. Content specifications for the Plan tests were developed using procedures comparable to those used for the ACT (ACT, *Plan Technical Manual*, 1999). However, results based on both Plan and ACT scores should not be used as sole indicators in program evaluation. They should be considered with other indicators of program effectiveness.

The Plan and ACT tests were designed to be similar in their content and in their focus on higher-order thinking skills. Their scores are reported on a common scale. The Plan and ACT tests, then, are conceptually and psychometrically linked. As shown earlier in this chapter, ACT and Plan scores are highly correlated with each other and with high school course work and grades. They are therefore appropriate for measuring student academic achievement over time.

Student progress within a school can be examined using the percentage of students meeting College Readiness Benchmark Scores on Plan and the ACT (see chapter 3 for a discussion of the Plan College Readiness Benchmarks). The Plan College Readiness Benchmark Scores are based on the ACT College Readiness Benchmark Scores. They reflect students' expected growth from Plan to the ACT and assume sustained academic effort throughout high school. The Plan Benchmarks are 15 in English, 19 in Mathematics, 17 in Reading, and 21 in Science. ACT's Plan/ACT Linkage Reports provide this information for students who have taken both Plan and the ACT.

Chapter 5
The ACT Plan Interest Inventory and Other Program Components

Interest Inventory

Overview

The Unisex Edition of the ACT Interest Inventory (UNIACT) helps students explore personally relevant career (occupational and educational) options. Using their UNIACT results, students can explore occupations and academic courses in line with their preferences for common, everyday activities involving data, ideas, people, and things. UNIACT provides scores on six scales paralleling Holland's (1997) six types of interests and occupations (see also Holland, Whitney, Cole, & Richards, 1969). Scale names (and corresponding Holland types) are Science & Technology (Investigative), Arts (Artistic), Social Service (Social), Administration & Sales (Enterprising), Business Operations (Conventional), and Technical (Realistic). Each scale consists of work-relevant activities (e.g., fix a toy, help settle an argument between friends, sketch and draw pictures) that are familiar to students, either through participation or observation. The activities have been carefully chosen to assess basic interests while minimizing the effects of sex-role connotations. Since males and females obtain similar distributions of scores on the UNIACT scales, combined-sex norms are used to obtain sex-balanced scores.

Score Reporting Procedures

The Plan student score report suggests 2–3 regions on the World-of-Work Map (Figure 5.1), the primary procedure used to link UNIACT scores to career options (Prediger & Swaney, 1995). Holland's hexagonal model of interests and occupations (Holland, 1997; Holland et al., 1969), and the underlying Data/Ideas and Things/People work task dimensions (Prediger, 1982), form the core of the map. Holland types, and corresponding ACT career clusters, appear on the periphery. The map is populated by 26 career areas (groups of occupations). Each career area consists of many occupations sharing similar work tasks.

The student guidebook *Using Your ACT Plan Results* describes how World-of-Work Map regions are used as a basis for career exploration. Students are encouraged to explore occupations in career areas suggested by their UNIACT results and their self-reported career plans. Students are encouraged to visit **www.act.org/planstudent/** to gather occupational information, such as salary, growth, and entry requirements.

World-of-Work Map

The World-of-Work Map (WWM) is an empirically based occupational exploration tool. Career area content and locations on the Map were determined from three databases: (a) expert ratings (Rounds, Smith, Hubert, Lewis, & Rivkin, 1998) on Holland's (1997) six work environments for occupations in the U.S. Department of Labor's (DOL's) O*NET Occupational Information Network (Peterson, Mumford, Borman, Jeanneret, & Fleishman, 1999); (b) job analysis (JA) data for 1,573 recency-screened occupations in the *Dictionary of Occupational Titles* database update (*Dictionary of Occupational Titles,* 1999); and (c) Holland-type mean interest scores (four interest inventories, six samples) for persons pursuing 640 occupations. These databases provided three diverse perspectives for the WWM update: (a) general nature of work (expert ratings); (b) detailed nature of work (JA data); and (c) interests of workers (mean interest scores).

The three databases were used to obtain Data/Ideas and Things/People scores for O*NET occupations. For many of these occupations, scores for all three databases were available. For the Data/Ideas scores, correlations for database pairs were as follows: rating-JA (.78), rating-interest (.78), and JA-interest (.75). For the Things/People scores, the correlations were .81, .77, and .74, respectively. These correlations, which are unusually high for scores based on diverse assessment procedures, provide good support for the work task dimensions underlying the WWM and Holland's (1997) hexagon. As expected, correlations between the Data/Ideas and Things/People scores ranged near zero.

The work task dimension scores were used to plot the O*NET occupations in each of the previous Map's career areas. The assignments of occupations to career areas were then revised in order to increase career area homogeneity with respect to basic work tasks. In addition, some career areas were combined and new career areas were created. After a second set of plots was obtained, occupational assignments were again revised. This process continued until career area homogeneity stabilized. Purpose of work and work setting were also considered (Prediger & Swaney, 2004).

The 3rd Edition WWM has 26 career areas. Of the 26 career areas, 21 have content similar to career areas on the previous edition of the WWM. The 26 career areas are listed at **www.act.org/planstudent/**, where students can learn more about occupations in each area. The occupational information on this site is updated every two years.

Norms

Data for Grade 10 UNIACT norms were obtained from Plan program files. The target population consisted of students enrolled in Grade 10 in the United States. Although the Plan program tests a sizable percentage of U.S. high school students, some sample bias is inevitable. To improve the national representativeness of the sample, individual records were weighted to more closely match the characteristics of the target population with respect to gender, ethnicity, school enrollment, school affiliation (public/private), and region of the country.

Sampling. Development of the norming sample began with schools that participated in Plan testing during the 2003–2004 academic year. Based on Market Data Retrieval (MDR; 2003) data, we retained schools in the US with public, private, Catholic, or Bureau of Indian Affairs affiliation. In addition, we retained schools that contained a 10th grade and had at least 10 Plan-tested students during the 2003–2004 academic year. Within retained schools, we retained students who reported a valid career choice and had a complete set of valid interest inventory responses. Our sample consisted of 407,325 students from 4,030 schools. In

Table 5.1
Selected Characteristics of Grade 10 UNIACT Norm Group Students and Schools

Characteristic	Weighted sample proportion	U.S. proportion[a]	U.S. category
Gender			
Female	.48	.48	Female
Male	.52	.52	Male
Racial/Ethnic			
African American/Black	.13	.13	African American/Black
American Indian, Alaska Native	.01	.01	American Indian/Alaska Native
Asian American, Pacific Islander	.03	.03	Asian/Native Hawaiian/Other Pacific Islander
Caucasian American/White	.57	.60	White
Hispanic[b]	.12	.13	Hispanic/Latino Ethnicity
Other, Prefer Not to Respond, Blank	.12	c	—
Multiracial	.02	.03	Two or more races
Estimated Enrollment			
<170	.24	.25	
170–336	.25	.25	
337–505	.25	.25	
>505	.26	.25	
School Affiliation			
Public	.92	.92	Public
Private	.08	.08	Private
Geographic Region			
East	.41	.42	East
Midwest	.21	.22	Midwest
Southwest	.13	.12	Southwest
West	.25	.24	West

[a] U.S. proportion for gender and ethnicity estimated from the 2000 Census (2001) age 15–19 group. U.S. proportions for enrollment and region obtained from the *Market Data Retrieval Educational Database* (2003).
[b] Combination of two racial/ethnic categories: "Mexican American/Chicano" and "Puerto Rican, Cuban, Other Hispanic Origin."
[c] U.S. proportion not available.

general, schools use Plan to test all Grade 10 students. The median proportion of students tested was .78 for the group of 4,030 schools.

Weighting. As noted above, the sample was weighted to make it more representative of the population of 10th graders in the U.S. The proportion of 10th graders in the U.S. in each gender/ethnicity category was approximated using population counts for the 15–19 age group from the 2000 Census (United States Census Bureau, 2001). The proportion of U.S. 10th graders in each enrollment size/affiliation/region category was calculated using MDR (2003) data. Each student was assigned a weight as WGT = (N1/n1) • (N2/n2) where:

N1 = the number of students, in the population, from the gender/ethnicity category to which the student belongs,

n1 = the number of students, in the sample, from the gender/ethnicity category to which the category belongs,

N2 = the number of students, in the population, from the enrollment size/affiliation/region category to which the student belongs, and

n2 = the number of students, in the sample, from the enrollment size/affiliation/region category to which the student belongs.

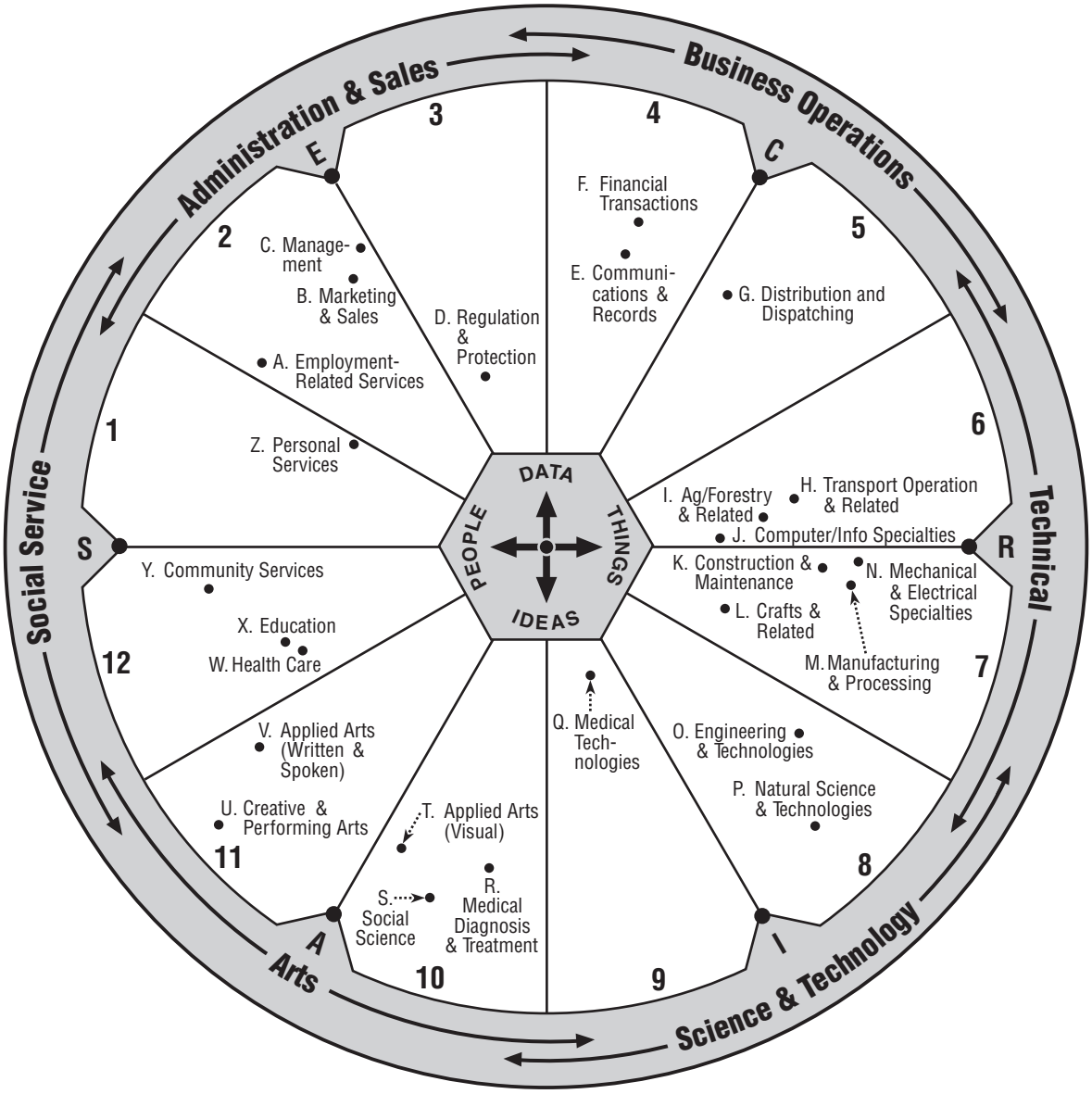
Precision. By obtaining data from Plan program files, we were able to make the norming sample quite large so as to allow a precise estimate of percentile ranks. For a simple random sample of 16,587 student scores, there would be a 99% chance that the 50th percentile of the scores in the sample was within one percentile rank of the 50th percentile of the scores in the target population. Although our sample was not a simple random sample, the norming sample consisted of more than 400,000 students, permitting precise estimation of percentiles.

Representativeness. One way to determine the type and extent of sample bias is to compare demographic characteristics of the norming sample with national statistics for various educational and demographic variables. The sample weights described previously were used to obtain the weighted sample proportions in Table 5.1. This table compares demographic characteristics of the norming sample to national statistics, permitting a general examination of the representativeness of the norming sample. As can be seen, the norming sample appears to be reasonably representative of the national population. For example, the weighted sample is very similar to the national population with respect to geographic region—within 1 percentage point in each region.

Psychometric Support for UNIACT

The *ACT Interest Inventory Technical Manual* (ACT 2009b) describes UNIACT's rationale, interpretive aids, development, norms, reliability, and validity. To provide readers with an overview of the information available, the table of contents of this manual is listed in Figure 5.2. Internal consistency reliability coefficients for the six 12-item scales, based on a nationally representative Grade 10 sample, ranged from .84 to .91 (median = .86). ACT invites readers to examine the full scope of information available on UNIACT, available at **www.act.org/research-policy/research-reports**.

World-of-Work Map
(Third Edition — COUNSELOR Version)



About the Map

- The World-of-Work Map arranges 26 career areas (groups of similar jobs) into 12 regions. Together, the career areas cover all U.S. jobs. Most jobs in a career area are located near the point shown. However, some may be in adjacent Map regions.
- A career area's location is based on its primary work tasks. The four primary work tasks are working with—
  - DATA: Facts, numbers, files, accounts, business procedures.
  - IDEAS: Insights, theories, new ways of saying or doing something—for example, with words, equations, or music.
  - PEOPLE: People you help, serve, inform, care for, or sell things to.
  - THINGS: Machines, tools, living things, and materials such as food, wood, or metal.
- Six general types of work ("career clusters") and related Holland types (RIASEC) are shown around the edge of the Map. The overlapping career cluster arrows indicate overlap in the occupational content of adjacent career clusters.
- Because of their People rather than Things orientation, the following two career areas in the Science & Technology Cluster are located toward the left side of the Map (Region 10): Medical Diagnosis & Treatment and Social Science.

Figure 5.1. World-of-Work Map.

Figure 5.2. The *ACT Interest Inventory Technical Manual* table of contents.

Student Information, Needs Assessment, and High School Course Information Sections

Student Information and Needs Assessment Sections

The Student Information section of the answer folder collects information about educational plans and religious preference for each student who takes Plan. This section collects information useful in discussing future plans with the student: high school course work and future educational and career plans. It is helpful for counselors to consider each student's responses to these items and the High School Course Information section as a unit; for instance, a student who plans an engineering career but expects to take only a year of high school mathematics would likely benefit from a discussion of the skills needed to enter training as an engineer.

The Needs Assessment section of the answer folder provides a place in which the student can indicate a need for assistance in ten selected academic areas and enabling skills. Students are asked to indicate whether they need a lot of help, some help, or little or no help in the following areas:

- Expressing my ideas in writing
- Developing my public speaking skills
- Increasing my reading speed
- Increasing my understanding of what I read
- Developing my math skills
- Developing my study skills and study habits
- Developing my test-taking skills
- Understanding and using computers
- Choosing a college or technical school to attend after high school
- Selecting a career/job that is right for me

High School Course Information Section

The High School Course Information section of the answer folder collects information about the courses students have taken and plan to take before completing high school. Descriptors of courses that constitute the typical high school core curriculum are included to help students relate each of the 48 courses listed to courses offered in their own schools.

This kind of information is useful to school counselors, faculty, and administrators. If students are not taking or planning to take the specific courses appropriate to their career area of interest, counselors can guide them into courses that will best prepare them for further training or allow them to get relevant experience in a particular occupational area. For teachers, curriculum coordinators, and administrators, the course information can be used in conjunction with Plan scores and ACT scores to study the relationship between the curriculum and student performance.

Chapter 6
Reporting and Research Services

Student Report

Plan Student Reports provide valuable information to help students begin to consider their future plans at an early age. Plan school reports provide information that principals, teachers, counselors, and district superintendents can use to monitor and evaluate the academic achievement of their students.

Two copies of the Plan Student Report (Figures 6.1 and 6.2) are provided to the school. One is intended for the student, the other for the school file or for use with parents.

The front of the Student Report includes the following information:

a. *Test Scores* for the four academic tests (English, Mathematics, Reading, and Science), the Composite score, and subscores for the English and Mathematics Tests. The Composite score is the arithmetic average of the 4 test scores.

b. *Cumulative Percents.* The column labeled "In the US" shows how students' scores compared with those of students in the appropriate national norm group (Fall Grade 10, Spring Grade 10, or Fall Grade 11) based on a national study conducted by ACT in the fall of 2010. Because scale scores are not comparable across subject areas, cumulative percents allow students and schools to make comparisons between the four Plan test scores or subscores. The columns labeled "In Your School" and "In Your State" may show how students' scores compare to those of students in the respective group.

c. *Your Estimated ACT Composite Score Range* is the range within which the student's ACT Composite score would be expected to fall when he or she takes the ACT in two years. Score ranges are based on data for examinees who took Plan in the fall of Grade 10 and the ACT in the fall of Grade 12, or examinees who took Plan in the spring of Grade 10 and the ACT in the fall of Grade 12.

d. *Your High School Course Plan Compared to Core.* Students' self-reported plans for high school course work in a set of core courses are compared to the course of study in English, math, social studies, and science recommended by ACT as the minimum necessary for students to be prepared for entry-level college courses.

e. *College Readiness.* Students' test scores are compared with those established by extensive ACT research as the Benchmark in each area, indicating whether students are on track to be ready for college-level work upon graduation from high school.

f. *Your Educational Plans for After High School.* These are the student's self-reported plans for post–high school education or training.

g. *Admission Standards.* This area shows the range of typical ACT scores of entering first-year students at postsecondary institutions with various admission standards.

h. *Profile for Success.* The student can note for comparison the average ACT score achieved by high school students who went on to college and were successful in a major related to the preferred career area he or she reported when taking Plan.

i. *Your Reported Needs.* These are the student's self-reported needs for assistance in seven areas.

j. *Your Career Possibilities*. The lower portion of the front of the Student Report provides the information and guidance students need to begin to narrow down the range of occupational possibilities to consider. Color highlights display Interest Inventory results, expressed both as World-of-Work Map regions and career areas. Students are guided through steps to identify at least three career areas containing occupations in line with self-reported career plans and/or work-relevant interests, and are directed to the booklet *Using Your ACT Plan Results* and **www.act.org/planstudent/** to continue the exploration process. Steps in the booklet encourage students to explore specific occupations in the identified career areas. The information on the Student Report, coupled with the steps in *Using Your ACT Plan Results* and on the web, then encourages students to think about and act upon the following suggestions:
   - Explore careers compatible with work-relevant interests and plans.
   - Identify the level of preparation required after high school for careers under consideration.
   - Identify high school courses related to careers under consideration.
   - Develop plans for high school course work.

k. Your Skills. On the back of the Student Report, the correct response to each test item in the Plan test is listed. To the right are the student's responses. If the response was correct, a "+" is listed; if incorrect, the letter of the incorrect response chosen by the student is indicated. If the item was omitted or the student marked more than one answer for the item, a zero ("0") appears. The third column shown for the English and Mathematics Tests indicates the content area to which each item in the tests belongs (U = Usage/Mechanics; R = Rhetorical Skills; A = Pre-Algebra/Algebra; G = Geometry). For each content area, the reports also provides suggestions for students to improve their skills. These statement are based on the score or subscore achieved by the student on each test. Note: Schools should retain Plan test booklets and return them to students with their Plan Student Reports. Students can then examine their responses to individual test questions.

This information can help students better understand their performance on each Plan test. For instance, students might:

- identify and reexamine the items missed in a test to understand why each item was answered incorrectly.
- identify those areas in the English and Mathematics Tests that were particularly difficult by referring to the subscores.
- review content areas they found difficult and look carefully at the skills described for improvement.

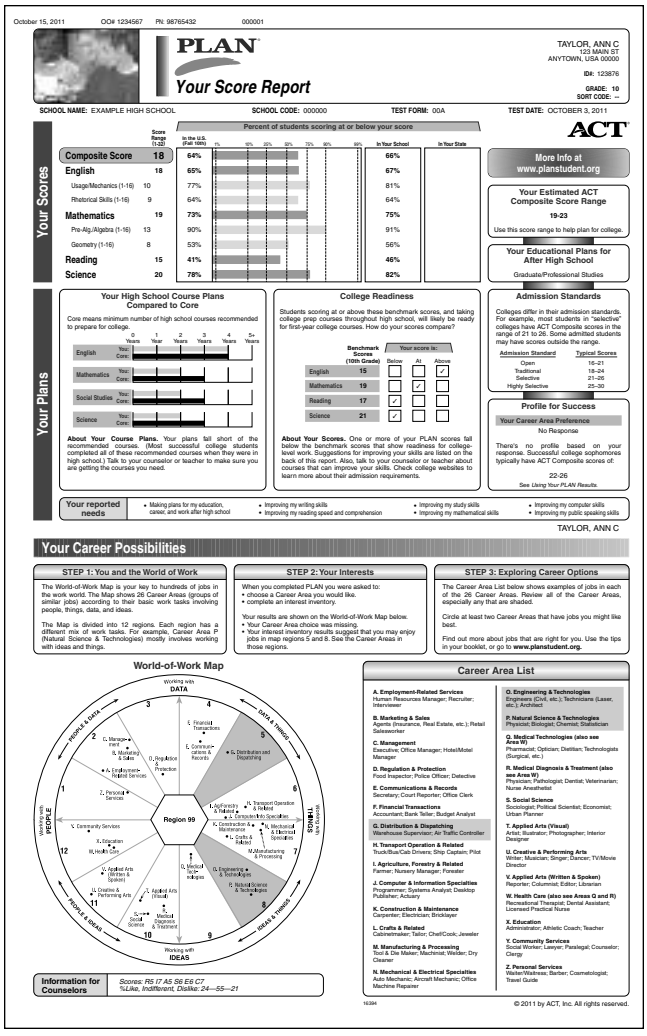


Figure 6.1. Front of ACT Plan Student Score Report.

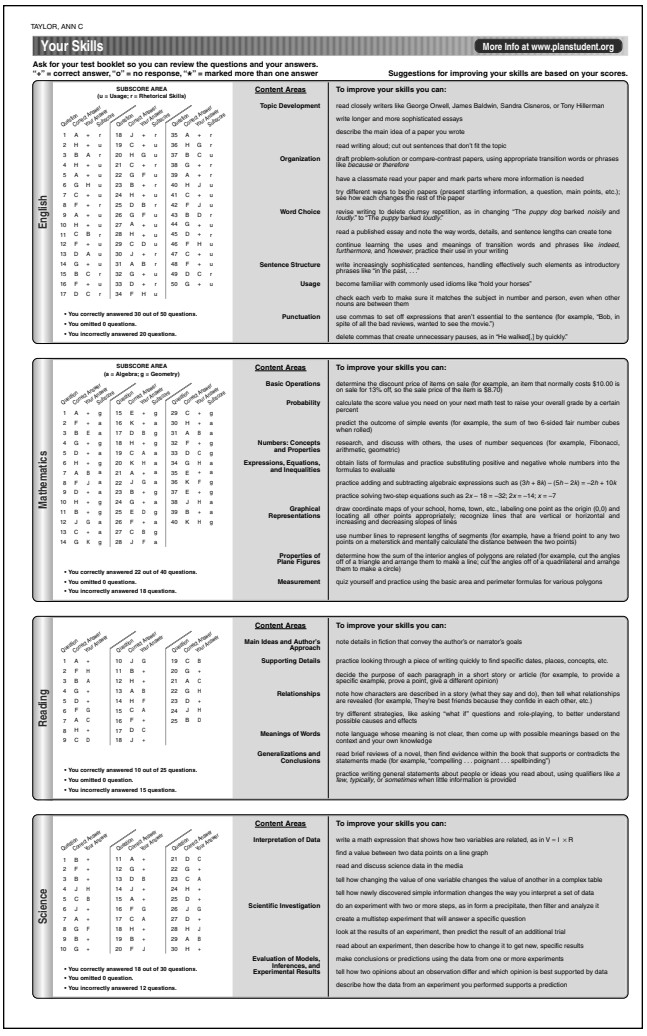


Figure 6.2. Back of ACT Plan Student Score Report.

Student Score Label

ACT provides schools with two self-adhesive labels for each student participating in the Plan program. This label includes student name, Student ID number (if reported by the student), date tested, scores and national cumulative percent at or below for each of the four academic tests and Plan Composite score, and subscores for the English and Mathematics Tests.

Student List Report

In addition to the Plan Student Report, each participating school receives an alphabetical list of students who took part in Plan with a summary of each student's academic tests, career and educational plans, estimated range of ACT Composite scores, and Special Status and Accommodation codes.

On the list report, students from the same grade level (as reported on their answer folders) are grouped together. For example, all 9th-grade students are listed alphabetically, then all 10th-grade students, etc. Students who did not indicate a grade are listed separately. When scores are achieved under extended time, "TE" will be printed following the student's name.

Profile Summary Reports

ACT will provide to schools and districts a *Profile Summary Report*, which aggregates and summarizes Plan results, for the grade with the highest number of students (above or below 25) and any additional grade with 25 or more students.

The *Plan School Profile Summary Report* consists of a series of tables to address the following issues:

- What are the content area strengths and weaknesses of our students relative to the national norms?
- Does our students' performance on Plan differ by gender and/or ethnic group?
- What courses are our students taking or planning to take?
- What are our students' career preferences?
- What are our students' educational aspirations?

The *District Profile Summary Report* consists of the same series of tables found in the *School Profile Summary Report*. These reports summarize selected Plan information about a district's tested population.

Item-Response Summary Reports

High School Reports

The *Item-Response Summary Report for High Schools* provides tables for each academic test, describing item by item the performance of a school's Plan examinees. Item-response results are categorized by test (e.g., English), by subscore area (e.g., Usage/Mechanics), and by category (e.g., Punctuation).

School District Reports

The *Item-Response Summary Report for School Districts* provides tables for each academic test, describing item by item the performance of a district's Plan examinees. Item-response results are categorized by test (e.g., English), by subscore area (e.g., Usage/Mechanics), and by category (e.g., Punctuation).

Data Service

The *Data Service* provides a school's Plan student records on CD. These records can be integrated into a school's database to study important local questions not addressed by Plan standard and special research services.

Optional Supplemental Research and Reporting Services

In addition to the basic reporting services described above, which are included in the Plan fee, schools/districts may purchase the Reporting Services described below and on page 66. Information on procedures, prices, and deadlines for ordering these reporting services will be distributed to all participating schools and districts in the fall.

High Schools

The *Customized School Profile Summary Report* summarizes Plan results by specific subgroups selected by the school—e.g., females, African American males, college-bound, or non-college-bound. The results are presented in the same format as the School Profile Summary Report.

Districts

The *Customized District Profile Summary Report* summarizes Plan results by specific groups selected by the district—e.g., females, African American males, college-bound, or non-college-bound. The results are presented in the same format as the District Profile Summary Report.

The *Data Service* provides a district's Plan student records on CD. These records can be integrated into a school's database to study important local questions not addressed by Plan standard and special research services.

Multiple-school districts that administer Plan as a required testing program on a district-wide basis are eligible to receive a free Special Research and Reporting Service. Districts qualifying for a free service will be notified of their eligibility after testing is completed.

ACT Information Manager® (AIM)

AIM is a reporting component of ACT's College and Career Readiness System (CCRS). Within the CCRS system, students' progress can be monitored between Grades 8 and 12 utilizing information obtained from assessments at the various grade levels. A complete AIM school report package consists of five separate documents: one for principals, one for guidance and counseling staff, and one each for the English/reading, the mathematics, and the science faculties. Information used to create AIM reports is based upon data from students who have taken both Plan and the ACT or both Plan and Explore (ACT's eighth-grade program) depending on the report requested.

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