



Iowa Testing Programs

Establishing Validity Evidence to Assess College Readiness through a Vertical Scale
ITP Research Series

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Introduction

As states “race to the top” under current educational reforms, they are looking for ways to ensure that their high school students are not just “proficient” by graduation but also “college and career ready” (U.S. Department of Education, 2009). A college education holds many benefits for its recipients, such as better paying jobs, community involvement, and life satisfaction, which, in turn, benefit their societies (College Board, 2010). However, evidence exists that a high percentage of students need remediation after high school to be ready for college-level courses (College Board, 2010). Accordingly, there is a need to help students early on assess their potential to be college ready. Informed students can better choose appropriate high school course work that will prepare them to be “college/career ready.” Several professional organizations, individual states, and state consortia have defined college readiness standards (e.g., Conley, 2003; Conley, 2007; Achieve Inc., 2004; College Board, 2010; Texas Education Agency, 2009). There have also been efforts to establish metrics to assess these standards with state assessments, such as in Maryland (Von Secker, 2009) and Tennessee (Tennessee Department of Education, 2009), or with nationally administered assessments, such as *NAEP* (National Assessment Governing Board [NAGB], 2009) and the *ACT* (ACT, 2008).

In line with these efforts, this paper explores methods for linking large-scale achievement tests administered in middle and high school with a college entrance exam. Given the current interest in college readiness, exploring the possibility of mapping high school achievement to existing college readiness benchmarks (CRBs) is important. In this analysis, pertinent high school achievement test scores will be used to predict whether or not a student will score above or below established CRBs in each of four subject areas: English, Math, Reading, and Science.

Several methods can be used to establish CRBs on an assessment, such as with statistical linking to other tests with established benchmarks or to postsecondary outcome data, standard setting, or surveys of postsecondary educators' expectations of college freshmen (NAGB, 2009). This study is unique in that it explores different statistical methods to predict performance on content area college admissions tests from grade 11 achievement test scores, but it then relies on the vertical scale of the achievement test to make similar projections using scores from grades 8 to 10. Accordingly, this study only makes one link between the achievement tests and the college admissions test. Moreover, this link corresponds to the achievement test taken closest in time to the college admissions test. This grade-level test thus has the most overlap in content with the college admissions test. If this link can be established and the vertical scale validated for extending this link downward (in grade level), then score reports can give school administrators, counselors, teachers, and parents useful information about how to help their students reach CRBs and/or stay on a path towards benchmark levels of performance. This study aims to determine the best way to adequately predict whether a student will reach established CRBs in core subject areas using grade 11 achievement test scores.

Methods

This exploratory study involves applying different methods to determine the cut scores on core grade 11 achievement content tests to predict whether a student will score above or below established CRBs on a college admissions test in the same subject areas. The college admissions test used is the *ACT*, which has CRBs for its four content area tests: English, Math, Reading and Science scores on the *ACT* (ACT, 2010a). Each of these subtests have scores ranging from 1 to 36, and the established benchmarks are scores of 18 in English, 21 in Reading, 22 in Math, and

24 in Science (ACT, 2010a). These benchmarks were derived from empirical research and relate to the minimum scores needed for a student to have a 50 percent chance of earning a B or higher or an 80 percent chance of earning a C or higher in entry-level college courses (ACT, 2007).

The achievement tests used in this analysis are the corresponding content area tests of The Iowa Tests (Forsyth, Ansley, Feldt, & Alnot, 2001; Hoover, Dunbar, & Frisbie, 2001). The Iowa Tests and *ACT* share similar content and cognitive test specifications, item and test formats, and technical characteristics. Additionally, since the 1950s, Iowa Testing Programs (ITP) has monitored the relationship between high school achievement and performance in college using The Iowa Tests (ITP, 2003a).

As an exploratory study, two different methods were attempted: the “conditional 50% rule” and the “equal error rate method.” Each method is applied to a matched sample of students with both *ACT* and Iowa scores (see the following “Data” section for more details of this matched dataset). The predictive validity of the two methods is then evaluated using the resulting correct and false classification rates across the four content area tests. The following subsections briefly explain the two methods of interest.

Conditional 50% Rule

The conditional 50% rule is similar to the approach used to determine cut scores on other middle and high school achievement measures, specifically, *EXPLORE* (typically taken in 8th or 9th grade) and *PLAN* (for 10th graders) (ACT, 2007). For each content area grade 11 Iowa test, this rule involves first computing the relative frequency of students at each possible scale score who scored above the corresponding content area *ACT* CRB. For instance, if 20 students obtained a scale score of x on the grade 11 Reading Iowa test and five of those students had *ACT*

Reading scores exceeding the *ACT* Reading CRB of 21, then the relative frequency of interest at score x is $5/20 = 1/4$ or 20 percent. After computing the relative frequencies at all score points, the grade 11 Iowa test scale score that most closely corresponded to a conditional relative frequency of 50 percent was selected as the cut score.

Equal Error Rate Method

The equal error rate method, in contrast, specifically controls false positive (Type I error) and false negative (Type II error) rates. It simply involves computing the complements to the error rates, the specificity and sensitivity, for all possible scale scores on each of the four content area grade 11 Iowa tests of interest. The sensitivity corresponds to the percentage of students who, using their grade 11 Iowa test score, are correctly predicted to meet/exceed the *ACT* CRB. Similarly, the specificity is the percentage of students who, given their grade 11 Iowa score, are correctly predicted to score below the corresponding content area *ACT* CRB. These correct classification rates are computed using each grade 11 scale score as the predictive college readiness cut score. Then, for each content area test, the grade 11 scale score that resulted in the most equal sensitivity or specificity rates, or the point at which these two curves intersect, was selected as the cut score.

Data

The data in this study consisted of students enrolled in public and private schools in Iowa from a single cohort who were enrolled in 11th grade in the 2007-2008 school year. The dataset was formed by merging two data files: one that contained Iowa students' *ACT* scores and one with Iowa students' grade 8 to 11 score records on The Iowa Tests from the 2004-2005 school year to the 2007-2008 school year. If a student took The Iowa Tests multiple times in a given school year, the first testing occasion was used to be consistent with the rule the Iowa

Department of Education uses in the case of multiple testing events for adequate yearly progress purposes under the No Child Left Behind Act. The same rule was applied to the small percentage of students in the data who took the *ACT* multiple times as a junior or senior in high school. The Iowa dataset consists of 38,207 students who have a grade 11 Iowa test score in at least one of the four content area tests of interest. The matched dataset used for analyses only includes the 18,107 students in the Iowa dataset who also have *ACT* scores. These students represent a self-selected sample of *ACT* test takers as students in Iowa are *not* required to take the *ACT*.

In order to describe characteristics of the sample, Table 1 provides the summary statistics for the four content area grade 11 Iowa tests for the *ACT* and non-*ACT* examinee subgroups and for the total sample. As seen in Table 1, there are about 28,000 to 38,000 students with scores in each content area grade 11 Iowa test. Comparing the subgroup *N* counts to the total sample *N* counts, it is apparent that about 45 to 65 percent of students in each content area also have *ACT* scores. The *ACT* takers tend to score, on average, about 35 scale score points higher than the non-*ACT* takers on each of the content area grade 11 Iowa tests. The *ACT* students also have slightly less variable distributions of scores with variances about 1.5 times smaller than those for the non-*ACT* students. Because the *ACT* subgroup is self-selected, it is difficult to obtain a group of students representative of the full spectrum of ability levels.

Table 1

Summary Statistics for the Grade 11 Iowa Content Area Subtests for Students with and without *ACT* Scores

Subject	<i>ACT</i> students			Non- <i>ACT</i> Students			All Students		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
Reading	306.67	33.68	18103	271.03	40.76	20013	287.96	41.57	30649
English	306.85	33.83	14318	268.64	39.92	15183	287.19	41.72	31053
Math	307.82	30.18	18094	273.05	37.98	20004	289.56	38.62	28005
Science	317.13	33.38	18057	279.28	41.13	19833	297.32	42.12	37890

The relationship between the four content area Grade 11 Iowa tests and the corresponding *ACT* tests is apparent through inspection of their bivariate scatterplots. Figure 1 displays these bivariate density scatterplots; the score points that a high density of students earned are indicated with larger black circles. These plots reveal a strong, positive relationship between each pair of content area tests. There are no serious departures from linearity, especially across the high-density points; the scatter of points at the low end of the Iowa scale that show slight departures from linearity represent a small proportion of students.

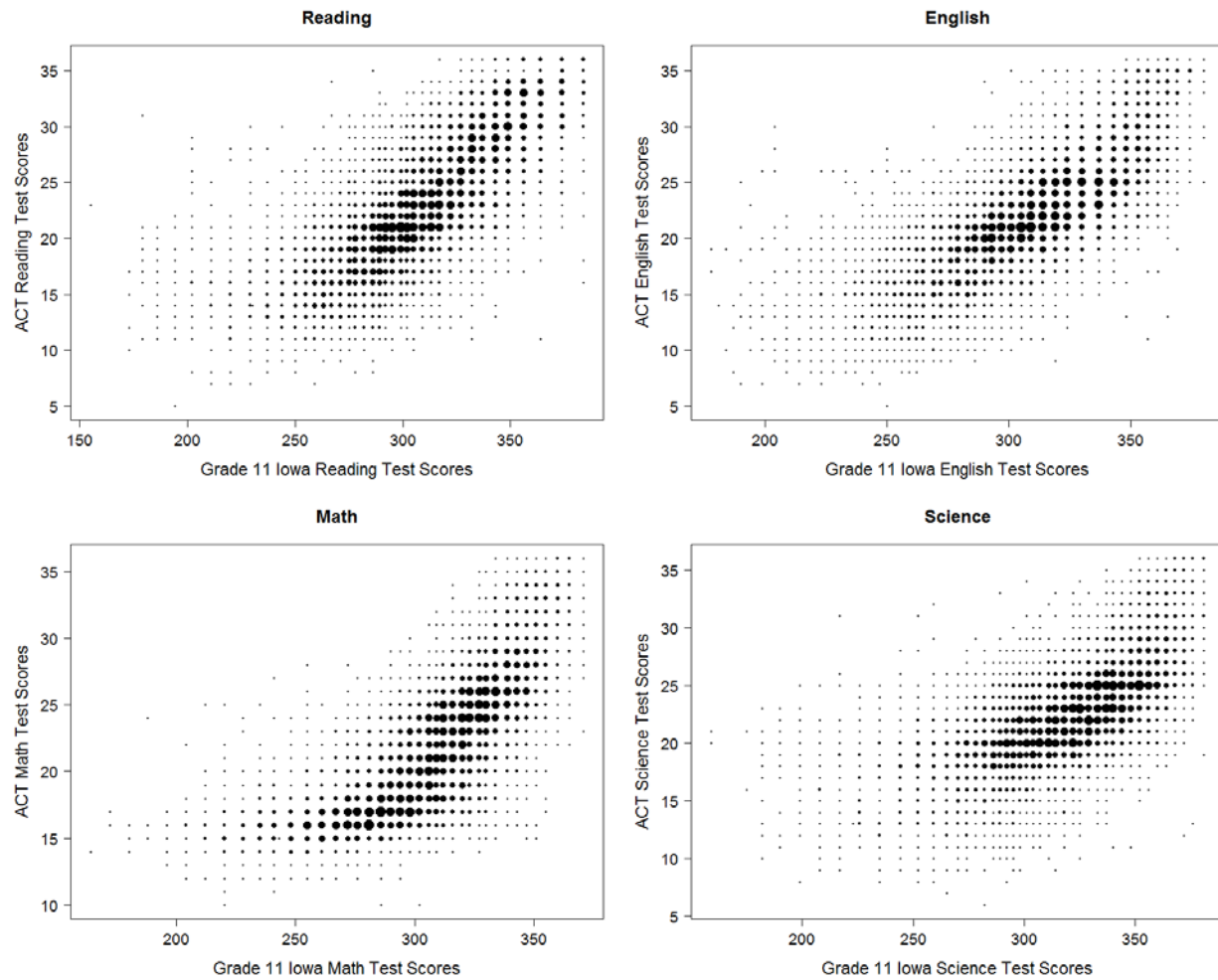


Figure 1. Bivariate scatterplots of Grade 11 Iowa and ACT content area scores.

To further describe the sample of Iowa students, Table 2 gives the percentages of students with both grade 11 Iowa content area scores and ACT scores in the sample who met or exceeded the corresponding CRB on each ACT content area test. Although all 18,107 students with ACT scores have scores in each of the four ACT content area tests, only those students who also had scores in the corresponding grade 11 Iowa test are included in Table 2 as they are the ones used in the analyses for this study. Thus, the sample sizes for each content area vary as not all students who took the grade 11 Iowa test had test scores for all four grade 11 Iowa content

area subtests. The percentage of students who met all four CRBs (i.e., the “Composite” category in Table 2) is derived using the 14,287 grade 11 students who have all four subtest scores.

Table 2

Summary Statistics of *ACT* Scores for the Grade 11 Iowa Sample

	Percentage met or exceeded CRB	Mean (SD)	N
Reading	64	22.9 (5.6)	18103
English	80	22.0 (5.4)	14318
Math	50	22.0 (4.8)	18094
Science	38	22.4 (4.4)	18057
Composite*	30	22.5 (4.5)	14287

*Note: For the “Percentage meeting CRB” category, “Composite” refers to meeting all four college readiness benchmarks.

Results

Characteristics of the Bivariate Distributions

One of the central factors in judging the appropriateness of extending CRBs based on a college admissions test to crucial points on the vertical scale of an achievement test is the strength of the relationship between the two assessments. Both the bivariate scatterplots and summary statistics derived from them are of interest in this regard. For each content area examined, inspection of the scatterplot showed no serious departures from linearity and no obvious abnormalities due to the selection effects present in the Iowa sample of *ACT* test takers. Although the variance of the Iowa and *ACT* score distributions did show some evidence of range restriction, as discussed below, the effects did not appear to distort the bivariate frequency distributions used to define the Conditional 50% Rule and Equal Error Rate Rule for determining CRBs on the Iowa score scale.

Table 3

Correlations between *ACT* and Iowa Content Area Test Scores

Grade	Reading	English	Math	Science
11	.75	.76	.76	.68
10	.72	.79	.75	.67
9	.75	.76	.74	.65
8	.74	.72	.75	.60

Table 3 presents the observed product moment correlations between the corresponding Iowa and *ACT* subtests in grades 8 to 11 in the matched sample. Each correlation is based on the number of students who have both an *ACT* score in the content area of interest and Iowa score in both the content area and grade of interest. These correlations are generally highest in grade 11, ranging from .68 (Science) to .76 (English and Math), providing supporting evidence for the use of the grade 11 Iowa tests to predict whether students are likely to meet or exceed the *ACT* CRBs. Although the reduced variance in the *ACT* test taker sample apparent in Table 1 attenuates the correlations in Table 3, the correlations adjusted for restriction of range (using the variances for the *ACT* subsample versus the total sample in Table 1) are higher at .81, .82, .83, and .76 for Reading, English, Math, and Science, respectively, and thus, further support the use of these data for determining CRBs. Moreover, even the unadjusted correlations between the grade 11 Iowa content area tests and the corresponding *ACT* tests are as high or higher than those between corresponding content area tests on *EXPLORE* and *ACT*, which are .75 for English, .73 for Math, .68 for Reading, and .65 for Science (ACT, 2007, p. 45).

Another consideration given the interest in providing CRBs for grades 8 to 10 is the attenuation of the bivariate relationships over time. Although the correlations are highest

between the grade 11 Iowa test and the *ACT*, the correlations do not diminish in the earlier grade levels: The correlations between the *ACT* subtest scores and the corresponding grade 8 to 10 Iowa test scores fluctuate within +/- .04, .02, .03, and .08 in English, Math, Reading, and Science, respectively, from the corresponding grade 11 correlations. These rather consistent correlations across grade levels provide evidence to support using the Iowa vertical scale to link the grade 11 cut scores to the grade 8 to 10 test scales.

The Conditional 50% Rule

In the first stage of this exploratory analysis, cut scores on each of the four grade 11 Iowa content area tests were established using the conditional 50% rule. Figure 2 illustrates the application of this rule to the four different grade 11 content area tests. For instance, the relative frequency of students whose observed *ACT* Science score met/exceeded the Science CRB of 24 is plotted for each obtained grade 11 Science Iowa test score. As described in the “Methods” section, the conditional 50% rule involves identifying the grade 11 Science score that corresponds closest to a relative frequency of 50 percent. As shown by the arrows in this figure, about 52 percent of students with a score of 333 on Iowa Science met/exceeded the *ACT* Science CRB, making 333 the grade 11 Iowa Science college readiness cut score.

ESTABLISHING VALIDITY EVIDENCE TO ASSESS COLLEGE READINESS

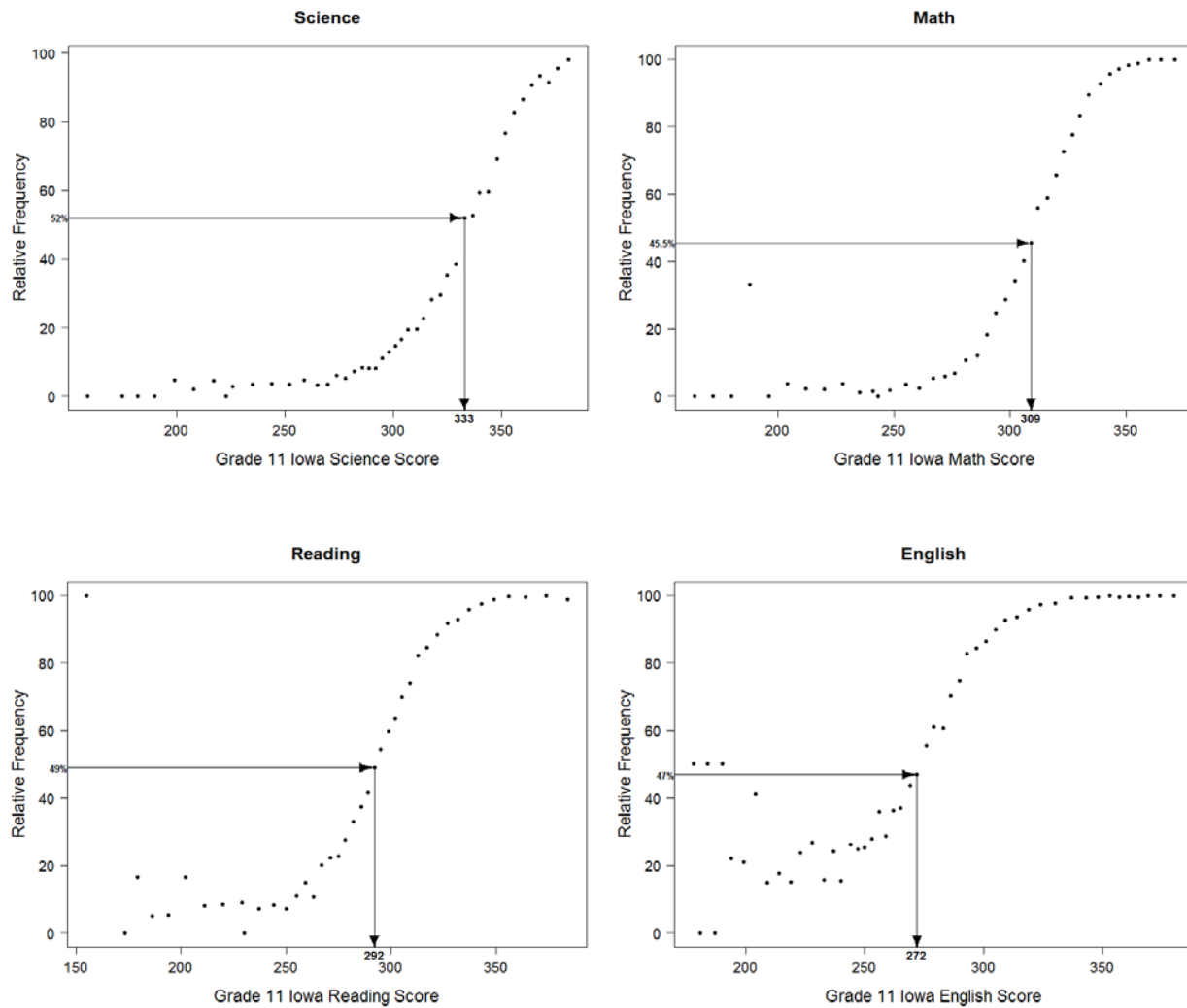


Figure 2. Application of the conditional 50% rule to determine cut scores on the Grade 11 Iowa content area tests that correspond to the ACT CRBs.

The cut scores for the other content area tests were found similarly as shown in Figure 2, resulting in cuts of 272, 292, and 309, respectively. Due to the discreteness of the data, the closest relative frequency to 50 percent ranges from 45.5 percent to 52 percent. Also, because few students obtain the lower scale scores, the relative frequencies often fluctuate for these

scores. For instance, for Math, there is an outlying relative frequency of .33 for the rather low Iowa Math score of 188. This aberrant point occurs because there are only 3 students who earned a score of 188 on the Math grade 11 Iowa test, and 1 of these 3 students earned a 24 on the Math *ACT* test, which is just above the Math CRB of 22.

To investigate the classification accuracy of the resulting cut scores from the conditional 50% rule, the correct and false classification rates are found using the matched dataset. The “correct” classification rates, or the sensitivity and specificity rates, are found as follows:

$$\text{Specificity} = P(\text{Iowa Scale Score} < \text{Iowa CRB} \mid \text{observed ACT score} < \text{ACT CRB})$$

$$\text{Sensitivity} = P(\text{Iowa Scale Score} \geq \text{Iowa CRB} \mid \text{observed ACT score} \geq \text{ACT CRB})$$

More specifically, the specificity is the probability of correctly predicting that a student will not meet/exceed the *ACT* CRB using the cut scores on the grade 11 Iowa tests, whereas the sensitivity is the probability of correctly classifying a student as college ready. The “false” classification rates are the Type I and Type II error rates, which will be referred to as the “false positive” and “false negative” rates, respectively. The false positive rate, as the name suggests, is the probability of incorrectly predicting a student is college ready, while the false negative rate is the probability of incorrectly predicting a student is *not* college ready. They are simply the complements of the specificity and sensitivity rates as shown below:

$$\begin{aligned} \text{False Positive Rate} &= P(\text{Iowa Scale Score} \geq \text{Iowa CRB} \mid \text{observed ACT score} < \text{ACT CRB}) \\ &= 1 - \text{Specificity} \end{aligned}$$

$$\text{False Negative Rate} = P(\text{Iowa Scale Score} < \text{Iowa CRB} \mid \text{observed ACT score} \geq \text{ACT CRB})$$

$$= 1 - \text{Sensitivity}$$

In developing decision rules for any application, the relative consequences of both types of error rates must be considered. In some situations, an optimal rule might be to balance the two error rates in the absence of compelling reasons to minimize one at the expense of the other. In any situation, however, it is important to understand or estimate error rates of a proposed decision rule.

Table 4

Classification Rates for the Grade 11 Iowa Content Area Tests Using the Cut Scores from the Conditional 50% Rule

Content Area	Specificity	False Positive Rate	Sensitivity	False Negative Rate
Reading	64.92	35.08	88.45	11.55
English	48.83	51.17	94.39	5.61
Math	74.65	25.35	84.14	15.86
Science	82.44	17.56	71.58	28.42

Table 4 gives the classification rates in percent units for each content area test that resulted from using the grade 11 Iowa content area cut scores from the conditional 50% rule. The error rates are rather large and vary substantially across the four content areas. For instance, the false positive rates range from 18 percent (for Science) to 51 percent (for English). In other words, over half of the students who did *not* meet or exceed the *ACT* English CRB of 18 are predicted to meet/exceed the benchmark based on their grade 11 Iowa English score. Such a high error rate is unacceptable. The false negative rates are also rather large and variable, although they are not as high overall as the false positive rates; they range from 6 percent (for English) to 28 percent (Science). Accordingly, the content area tests with lower false positive

rates have higher false negative rates and vice versa. Based on these results, the conditional 50% rule produces inconsistent and high error rate levels across the four content area tests, making it suspect as an appropriate method to link the grade 11 Iowa content area tests to the corresponding *ACT* tests.

The Equal Error Rate Method

The rather high and inconsistent error rates from the conditional 50% rule necessitated exploration of another method to determine grade 11 Iowa content area cut scores. The equal error rate method attempts to directly balance the error rates and the correct classification rates by identifying the grade 11 Iowa scale scores that correspond to the most similar sensitivity and specificity. If the sensitivity and specificity are about equal, the Type I and Type II error rates will also be about equal.

Figure 3 illustrates the application of the equal error rate method to each grade 11 content area tests to determine the scale score that corresponds to roughly equal sensitivity and specificity rates. The figure plots the correct classification rates, sensitivity and specificity, against the Iowa standard scale scores. Using each Iowa scale score, the plotted values represent the observed percent of correctly classified students. For instance, if the minimum scale score is used for any of the content area tests, then the sensitivity will be about 100 percent and the specificity about 0 percent. The scale score that corresponds to the intersection of the two classification rates is chosen as Iowa CRB. For instance, for Reading, a scale score of 302 results in the most similar specificity and sensitivity rates; they are both about 80 percent, which implies the error rates are both about 20 percent.

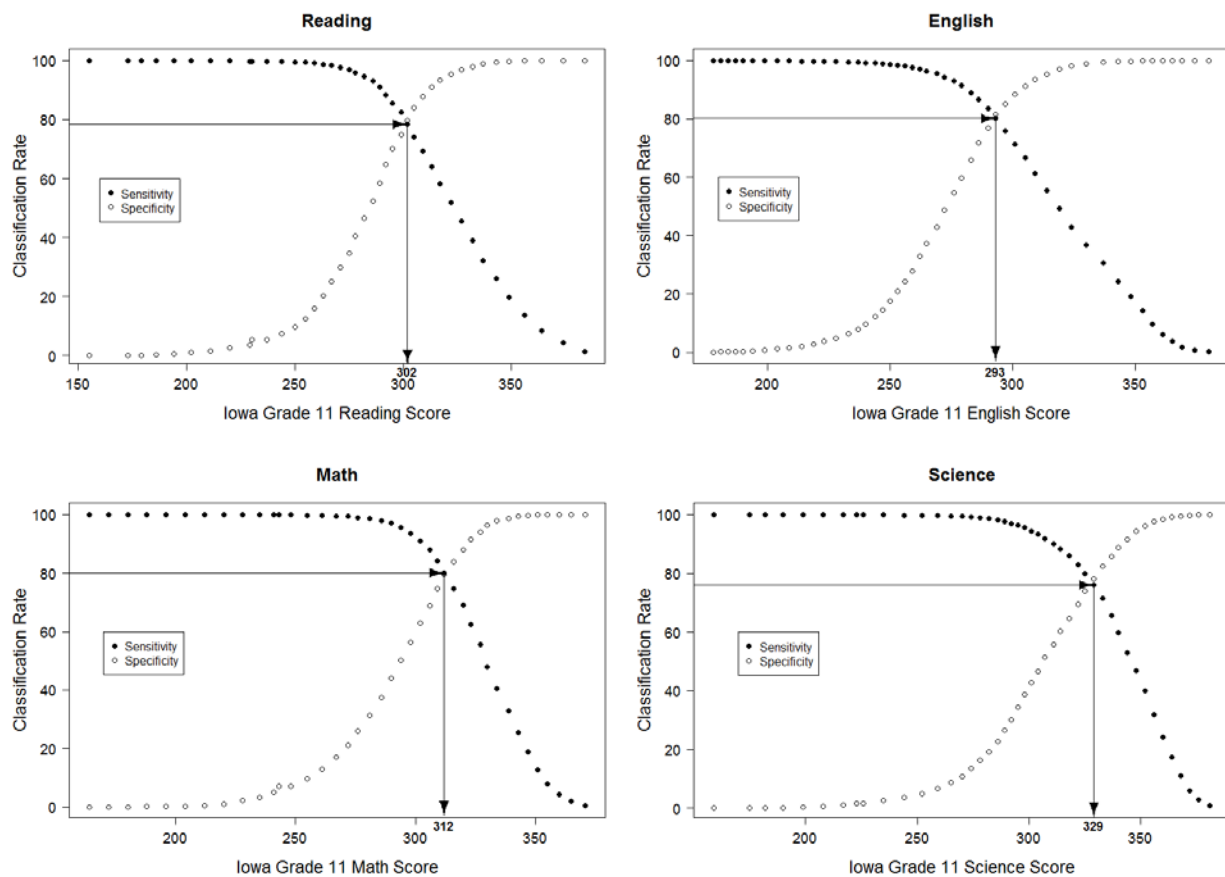


Figure 3. Application of the equal error rate method to determine cut scores on the Grade 11 Iowa content area tests that correspond to the *ACT* CRBs.

Figure 3 shows that the resulting cut scores using the equal error rate method are 293 for English, 302 for Reading, 312 for Math, and 329 for Science. Table 5 gives the classification rates using these cut scores. This table shows that the equal error method not only balances the two error rates, but it also produces consistent classification rates across all the content areas. All of the cuts correspond to sensitivity and specificity rates of about 80 percent, or, equivalently, false positive and false negative rates of about 20 percent. Although 20 percent is

above the typically acceptable Type I levels of 5 or 10 percent, it is less than the Type I error rates produced using the cut scores from the conditional 50% rule with the exception of Science, which had a Type I error rate of about 18 percent.

Table 5

Classification Rates for the Grade 11 Iowa Content Area Tests Using the Cut Scores from the Equal Error Rate Method

Content Area	Specificity	False Positive Rate	Sensitivity	False Negative Rate
Reading	79.69	20.31	78.51	21.49
English	81.49	18.51	80.19	19.81
Math	79.56	20.44	80.10	19.90
Science	78.15	21.85	76.06	23.94

Discussion

This analysis involved exploring methods for identifying cut scores on grade 11 Iowa content area tests that can adequately predict whether students will score at or above the established CRBs on corresponding *ACT* tests. The classification rates given in Tables 4 and 5 for the conditional 50% rule and the equal error rate methods suggest that the equal error rate method is preferable as it results in balanced Type I and Type II error rates that are consistent across content area.

The equal error rate method can be used to identify cut scores on the grade 11 Iowa tests that have predictive validity in terms of predicting performance on the *ACT* content area tests. However, students would be better prepared for college or a career after high school, if they knew prior to grade 11 whether or not they were on track to being college ready. Thus, it is

useful to determine corresponding cut scores on earlier grade level Iowa tests, namely, in grades 8 to 10. If students receive messages as early as 8th grade in regard to whether they are on the right path or not to reaching college readiness standards in the future, they have time to adjust their class schedule accordingly and seek additional resources. Specifically, their counselors who would also receive copies of student score reports with college readiness messages can better advise their students in their course selection and suggest appropriate resources.

The properties of the vertical scale underpinning The Iowa Tests afford a unique method to determine cut scores on the grade level achievement tests prior to 11th grade. The grade 11 Iowa cut scores can be used to identify comparable scale scores for the corresponding grades 8 to 10 Iowa content area tests. In this context, “comparable scale scores” refer to those scores on the grade-level test of interest that situate students at the same relative standing in the particular grade-level distribution as the grade 11 cut scores do in the grade 11 score distribution. Given the qualities of The Iowa Tests’ scale, “comparable scale scores” can be easily found. The identified grade 11 cut scores using the equal error rate method correspond to national percentile ranks (NPRs). The NPR scores reported for each grade level and content area Iowa test are derived from a large national norm group and indicate the relative standing of students’ scale scores within the score distribution of students in the national sample (Forsyth, Ansley, Feldt, & Alnot, 2003). For instance, if a student receives a standard scale score of 269 which corresponds to a NPR of 70 in her grade 8 reading test, then her grade 8 reading standard score is at or above 70 percent of students in the national sample of 8th graders.

The NPRs for the grade 11 Iowa cut scores can be used in linking back to earlier grades to convey “on track to college readiness” messages. First, the NPRs that correspond to each of the grade 11 Iowa cut scores are identified using documented norms information on each of the

content area grade 11 tests. Then, if students in grades 8 to 10 score below the identified NPRs for a specific content area on the corresponding earlier grade level test, their score reports could include a cautionary message about *not* being on track to meeting college readiness standards in that content area in the future. This message follows from the fact that if the student maintained her current NPR, or her relative standing in the distribution of students from a national sample, she will be below the grade 11 NPR cut associated with the predictive college readiness scale score. This procedure takes advantage of the information in the vertical scale of The Iowa Tests to make predictions about being on track to college readiness.

The “linking back” procedure through the Iowa vertical scale is easily executed. The grade 11 Iowa content area cut scores found using the equal error rate method are 293 for English, 302 for Reading, 312 for Math, and 329 for Science. These scale scores correspond to NPRs of 64 for English, 74 for Reading, 81 for Math, and 87 for Science (Forsyth et al., 2003). The order of these NPRs reflects the same order of the *ACT* CRBs of 18, 21, 22, and 24 for English, Reading, Math, and Science. Thus, it is not surprising that students who score at or above only 64 percent of the national norm sample are predicted to be college ready in English, whereas students have to score or above 87 percent of the national norm sample to be predicted to be college ready in Science.

The Iowa Tests not only have scale scores and NPRs but also accompanying achievement levels that describe students’ mastery of each content area in each grade level. For all grade level content area tests, the achievement levels are formed by established ranges of NPRs (ITP, 2003b). Figure 4 displays the spectrum of achievement levels for any grade level content area Iowa test partitioned by the NPRs. The corresponding NPRs for the grade 11 Iowa predictive cut scores are also located within the spectrum of achievement levels in Figure 4. There are three

broad achievement levels, labeled, “low performance,” “intermediate performance,” and “high performance.” These three broad categories are further divided into two levels as shown in Figure 4. For instance, “low performance” consists of the “weak” and “marginal” levels.

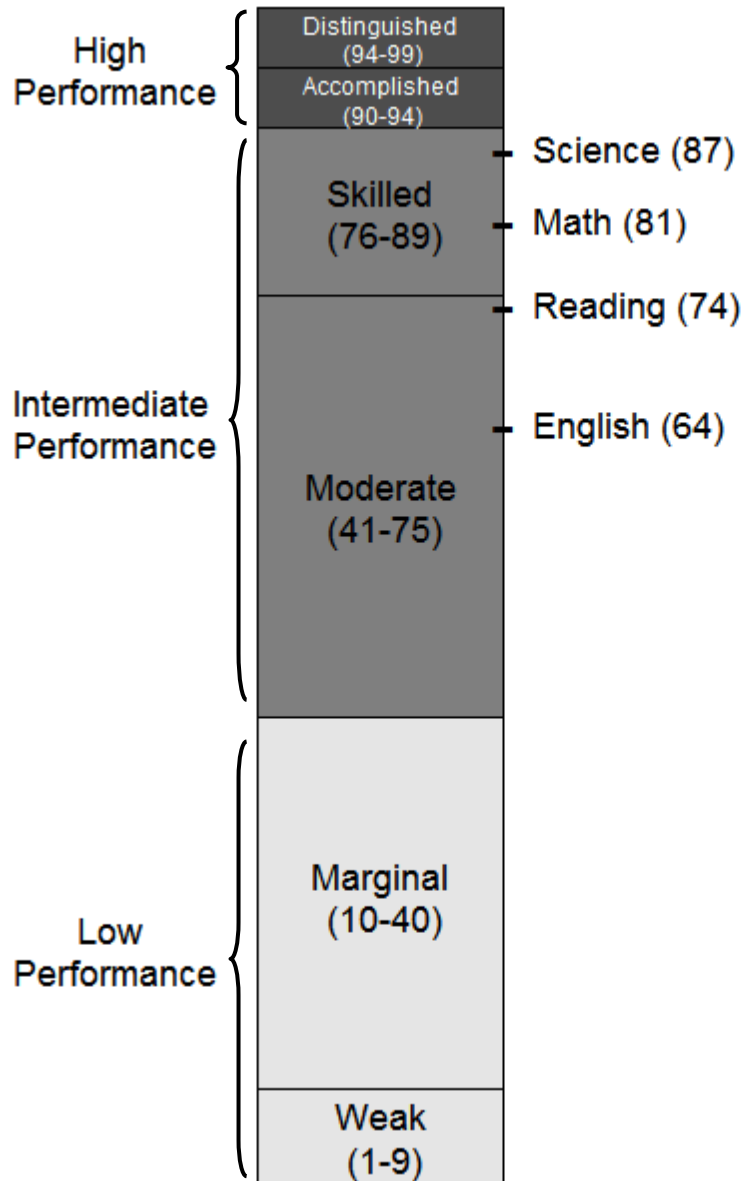


Figure 4. Achievement levels for The Iowa Tests with content area NPR cuts identified.

The locations of the NPRs that correspond to the grade 11 content area predictive college readiness cut scores in Figure 4 provide information about the ability of students who are on track to college readiness. All four content area NPRs fall above the Proficiency cut score, which is at a NPR of 41. Thus, students who are proficient are not necessarily college ready. Both the Reading and English cuts fall in the “moderate” achievement level, though Reading is very close to the border with the next highest achievement level, “skilled.” The “moderate” achievement level is often defined in terms of a mixture of “sometimes” and “usually” being able to master certain tasks (ITP, 2003b). The Math and Science NPRs fall in the “skilled” achievement level, which implies students “usually” or “often” can accomplish certain tasks for a particular grade level content area (ITP, 2003b). Accordingly, this analysis not only results in predictive college readiness scale scores on state high school achievement tests but also augments understanding about what being college and career ready entails and how that might differ from simply being proficient.

Educational Significance

The results of this exploratory study offer a method for linking a state high school achievement test to a college admissions exam. They also add to the discussion of what college and career readiness entails and how messages about being on track to such standards can be delivered to students at pivotal points in time. With these results, score reports for students, teachers, and parents might include interpretations about being on-track to college readiness at a point in which a student’s aspirations for postsecondary education are being formulated. These aspirations affect how students plan their high school course sequences. Thus, providing students in the first couple years of high school with information about their potential to be college ready in four core subjects allows them to select appropriate high school course work

that will help them reach their goals. Perhaps most importantly, messages about being on track to college readiness may identify students with no aspirations for postsecondary education who should indeed consider it.

These potential uses of test results aligns with current goals in educational reform, especially as stated in the Race to the Top competitive grant program, for states to focus on ensuring their students are not only proficient but also prepared for the demands of a postsecondary education. Moreover, this study posits a novel methodology of using a vertical scale to project benchmarks on previous grade-level tests, which may prove to be a more broadly applicable technique for other issues in educational measurement.

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