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# **Mathematics Assessment Task Force**

## **Final Report**

May, 1998

## **Introduction**

This report includes a description of the activities and recommendations of the Mathematics Assessment Task Force. The task force has conducted seven formal meetings, the minutes of which are included. The recommendations herein are made to the Assessment Advisory Group of the Board of Higher Education. This report was prepared by:

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## Narrative

The task force has, from the outset, understood its charge to be to recommend minimum competencies for entry-level college mathematics courses and to recommend a testing system or systems for these competencies, including “cut scores.”

Initially, the deliberations concerned the determination of what courses constitute entry-level college mathematics courses. It was agreed that these, essentially, fell into three categories – college algebra courses, introductory statistics courses, and finite mathematics or general liberal arts mathematics courses. Testing and placement into courses generally considered to be of a higher level than these three categories is outside the charge of the task force and is thus left to the discretion of the individual colleges and universities.

Individuals, with consultations from outside the task force, drew up lists of competencies for each of the three course categories. The three lists were then condensed and merged into a single list. The task force believes that the final list is a necessary core but recognizes that others in the mathematical community may wish to add further items.

While the lists of competencies were being refined, the task force studied various standard testing mechanisms, including Mathematical Association of America placement tests, the Accuplacer computerized system of the College Board, and “in house” tests. Informal surveys of uses of all of these systems were conducted. Contact was made with the College Board and a formal presentation on Accuplacer was conducted for the task force by two individuals from the College Board.

It should be emphasized that the competencies were composed and condensed independently of the various tests under consideration. Relationships between the various tests and the competencies were reviewed and revised. The final list of competencies contains an estimate of the number of times that each skill is “tested” on the paper version (Companion) of the Accuplacer Elementary Algebra test. The task force notes that not all competencies are formally tested. This is to be expected, given that the competencies were determined

independently of any test. Additionally, competencies which involve arithmetic skills were considered. It was concluded, after considerable deliberations and consultations, that most such competencies are covered by tests requiring the demonstration of higher level algebraic skills. In summary, the task force is satisfied that the vast majority of the required competencies are tested several times by the Accuplacer Elementary Algebra test and is confident that this instrument is a good measure of the minimum requirements for entry-level college mathematics.

The task force has chosen to summarize and conclude its work through a series of recommendations. Each recommendation was formally approved by unanimous vote. Additionally, the task force has chosen to send a copy of this report to chairs of mathematics departments at all public institutions of higher learning in the commonwealth. The following list categorizes the recommendations of the task force:

- I. Recommendations on Competencies
- II. Recommendations on Assessment
  - A. Recommendation on Assessment Test
  - B. Recommendation on Minimum Test Scores
  - C. Recommendation on Retesting
  - D. Recommendation on Good Practice in Retest Administration
  - E. Recommendation on the Term of Validity of Assessment
  - F. Recommendation on Alternative Assessment Instruments
  - G. Recommendation on Exemptions
- III. Recommendations on Implementation
  - A. Recommendation on Remedial "Caps"
  - B. Recommendation on Duration of These Policies
  - C. Recommendation on Possible Legal and Contractual Issues

# Recommendations

## I. Recommendations on Competencies

### Competencies for Entry-Level College Mathematics Courses

We recommend that all students entering college level mathematics courses be able to read at or above the tenth grade level and possess basic mathematical and logical reasoning skills. In addition, the following mathematical topics are necessary either as competencies or as basic familiarities.

Students entering into college level courses should be able to:

A.	Basic Mathematics	Number times tested*
1.	Mentally manipulate one and two digit integers	4
2.	Perform operations with integers, fractions and decimals (paper and pencil)	4
3.	Compare and convert between fractions, decimals and percents	1
4.	Understand equality and inequality relationships	6
5.	Recognize numerical patterns	3
6.	Use ratio and proportion to solve problems	4
7.	Calculate percents	
8.	Use a Calculator	
9.	Use rounding and estimation	
10.	Use scientific notation	
11.	Calculate using the order of operations rules	8
12.	Evaluate algebraic expressions and formulas	6
13.	Solve applied problems, e.g. simple interest	6
B.	Basic Geometry	
1.	Solve applied geometric problems including those using perimeter, circumference, area, or volume	
2.	Apply basic geometric principles such as the Pythagorean Theorem and properties of similar triangles	

	Number Times Tested*
<b>C. Basic Statistics</b>	
1. Find the Mean	
2. Read charts, tables and graphs	1
<b>D. Basic Algebra</b>	
1. Basic concepts and manipulations	
a. Understand the concept of variable	8
b. Understand the concept of absolute value	1
c. Perform basic operations with polynomials	4
d. Translate phrases into mathematical expressions	7
e. Factor common factors, difference of squares and other simple cases	4
f. Simplify elementary rational expressions	4
2. Equations and inequalities	
a. Solve linear and simple quadratic equations	3
b. Graph solutions on a number line	2
c. Solve simple inequalities	2
d. Solve simple systems of two linear equations	2
e. Solve basic algebraic word problems	4
3. Lines and their equations	
a. Identify points in a plane	1
b. Sketch the graph of the equation of a line	
c. Understand the concepts of slope and intercepts	
d. Recognize the slope-intercept form	
4. Exponents and roots	
a. Apply the properties of integral exponents	3
b. Use square roots	1

*\*This column refers to the number of times a competency is tested on the paper version of the Accuplacer Elementary Algebra test.*

## II. Recommendations on Assessment

### A. Recommendation on Assessment Test

Readiness for entry-level college mathematics courses should be determined using the Accuplacer Computerized Placement Tests (CPTs). Where a computer is not available for assessment or in the case of accommodations for persons with disabilities, the Companion to the Computerized Placement Tests may be used, as it will yield a comparable score.

**Rationale:** Because the Board of Higher Education recommended the use of a single instrument for comparability between institutions, we chose the Accuplacer Computerized Placement Tests. These tests have been used successfully to place students into mathematics and composition courses in many Massachusetts colleges for several years. The adaptive nature of the test allows for assessment in substantially fewer questions than conventional tests and eliminates the need for multiple paper versions.

### B. Recommendation on Minimum Test Scores

The minimum score necessary for readiness in an entry-level college mathematics course (e.g. College Algebra, Liberal Arts Mathematics or Statistics) should be 76 on the Accuplacer Elementary Algebra test. On the College Level Mathematics test, a score of 40 would also be considered sufficient. The scores above refer to the "Total Right Score," as defined by Accuplacer, based on a scale from 0 to 120.

**Rationale:** A Total Right Score of 76-82 on the Elementary Algebra test corresponds to approximately the eightieth percentile. The Accuplacer proficiency statement for the Total Right Score of 76-82 says, "Students at this

level have sufficient knowledge of elementary algebra. These students can simplify algebraic expressions, add radicals and algebraic functions, factor quadratic expressions in standard form ( $ax^2+bx+c$ , where  $a=1$ ), factor the difference of square binomials, evaluate algebraic expressions, and solve linear equations with integer coefficients.” These competencies correlate well with those identified as needed for entry-level college mathematics courses. The lower cutoff was chosen to allow for its use in College Algebra, Liberal Arts Mathematics, and Statistics courses. On the College Level Mathematics test, a score of 40 corresponds to approximately 76 on the Elementary Algebra test. Students scoring below 40 are recommended to take the Elementary Algebra test, while a score of 40 indicates sufficient knowledge of algebra to begin an entry-level college mathematics class. Individual institutions are encouraged to use higher cutoffs depending on the levels of courses offered.

#### C. Recommendation on Retesting

Institutions should be flexible in their retesting policies, but should also restrict students to two opportunities during a single semester to retake any one level of the placement instrument

Rationale: We recognize the inherent unreliability of a single assessment instrument to give accurate placement results for all students at all times. Student lack of familiarity with multiple choice tests and test-taking strategies appropriate to them may result, in some cases, in low placement. Opportunities to retest should be provided for students who find their initial placements inappropriate when compared with the mathematics coursework they have completed in high school. However, multiple retesting without allowing time for study and review should be curtailed, as experience indicates that student scores are unlikely to improve significantly. Enrollment in a remedial mathematics course may be the appropriate recommendation rather than repeated testing.

D. Recommendation on Good Practice in Retest Administration

Before retesting, institutions should offer guidance and provide, where indicated, review materials for students who believe their initial placements are inappropriate.

Rationale: Students who have not actively practiced mathematics for a period of time see their knowledge and skills rapidly decline. However, improvement may result after a brief period of directed study and review.

E. Recommendation on the Term of Validity of Assessment

The validity of a student's assessment results should expire after a period of one year.

Rationale: It is a well-documented phenomenon that student retention of mathematical knowledge and skills declines sharply as a function of time after completion of coursework. If a student has not yet enrolled in a recommended mathematics course after a period of one year, then retesting is necessary to determine a valid placement.

F. Recommendation on Alternative Assessment Instruments

The Accuplacer system is the recommended assessment instrument. However, institutions may choose a different system, as long as it has a demonstrated comparability to the Accuplacer system. In particular, this comparability extends to issues of topical coverage, the depth of understanding of the topics, and the level of the minimum score.

Rationale: The point of recommending a single assessment instrument is to facilitate the comparability of preparation for entry-level courses from one

institution to another. In the event that an institution would like to use a system different from Accuplacer, it should ensure that the substitute system is demonstrated to be equivalent in its effects, as stated in the recommendation. Such an equivalent instrument would not interfere with the goal of comparability of preparation.

#### G. Recommendation on Exemptions

An institution may exempt a student from meeting the requirement of taking an Accuplacer test if the institution, through its own placement system, places that student into a precalculus or calculus course.

Rationale: The skills needed for precalculus and calculus courses are considerably higher than those required for the three entry-level course categories considered by this task force. Thus, if a student is placed into precalculus or calculus, it should not be necessary to test that student at a lower level.

### **III. Recommendations on Implementation**

#### **A. Recommendation on Remedial "Caps"**

The Board of Higher Education (BHE) caps on remedial instruction at four-year public institutions of higher learning should be suspended until the end of the academic year 2002-2003.

**Rationale:** Several recent policy initiatives of the BHE are at cross-purposes. The Mathematics Assessment Task Force is recommending a set of standard assessment options to be administered to entering students as well as a definition of the competencies students will need to begin college-level work in mathematics. Based upon our experience as college mathematics educators and program administrators, it appears to us that once these options and competencies are put into practice the following scenario will take place:

- Students will be granted admission to four-year state colleges and universities according to new, higher standards mandated by the BHE.
- Subsequently, these students will be assessed by BHE-mandated instruments as to their readiness to begin college-level mathematics coursework.
- A significant number of first-year students (the national average is 26%) will be told that they are not ready for college-level work in mathematics, even though they have been admitted to a college or university, and regardless of their readiness for college courses in all other areas.
- Large numbers of new students, assessed to be in need of remediation in mathematics, will be informed that the four year college or university to which they have gained admittance is unable to offer them the instruction they need to enable them to pursue a degree, due to the BHE-mandated cap on remedial instruction.

We view this scenario as realistic and troubling. Staggered admission of new students over a period of many months makes it unrealistic to assume that those identified as being in need of remediation can arrange to take a course at a community college prior to beginning September coursework. The logistics of enrolling in a remedial course at a community college while at the same time taking other courses at a four-year institution are unworkable for most students. Lastly, the four-year colleges and universities are capable of providing a limited amount of remediation in a cost-effective manner.

Moreover, we also view this situation as temporary. The K-12 State curriculum standards and assessment, which will be fully implemented by 2003, are designed to insure that newly-admitted college students are ready to succeed in college mathematics courses.

#### B. Recommendation on Duration of These Policies

The recommendations in this report apply to the academic years 1999-2000 to 2002-2003, at which time the question of competencies and assessment should be revisited.

**Rationale:** The Massachusetts Education Reform program is currently being phased in, and the class graduating in 2003 will be the first class that has the Grade 10 MCAS test as a requirement for graduation. Since this could have a significant effect on the qualifications of entering college freshmen, the question of assessment for entering college freshmen should be reviewed at that time. Furthermore, the task force believes that the policies in these recommendations should be reassessed in the light of experience.

**C. Recommendation on Possible Legal and Contractual Issues**

The setting of minimum competencies and test scores for entry-level college courses may be seen as interference in the academic prerogative of the faculty. This may involve legal and contractual issues. These concerns should be explored and addressed before any possible action to impose this set of recommendations.

**Rationale:** These issues are beyond the charge of the task force, and this set of recommendations does not address them. However, these issues are substantive, and the Board of Higher Education should be made aware of them.