

# **CAAP Mathematics Skills Test Summary**

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## Introduction

The Collegiate Assessment of Academic Proficiency (CAAP) is a standardized, nationally-normed assessment program from ACT that enables postsecondary institutions to assess, evaluate, and enhance student learning outcomes and general education program outcomes. There are six different CAAP tests that institutions can choose to administer: Reading, Writing Skills, Writing Essay, Mathematics, Science, and Critical Thinking.

Owens adopted the CAAP Mathematics test in the Fall of 2005, and it is administered every year to students enrolled in randomly-chosen sections of Math 108, 110, 118, 125, 128, 130, 151, and 213 courses. The test is 40 minutes in length and includes 35 multiple-choice items that measure students' proficiency in mathematical reasoning encountered in many postsecondary curricula. It emphasizes quantitative reasoning rather than the memorization of formulas. Sample test items are provided in Appendix A.

As indicated in Table 1, test questions fall within two major content categories: Basic Algebra composed of 17 test questions (49 percent of questions) and College Algebra composed of 18 test questions (51% of questions). Subcategories exist for each major content category. In the Basic Algebra category, 3-5 test questions (9-14% of questions) assess pre-algebra skills: operations with whole numbers, decimals, and fractions; order concepts; percentages; averages; exponents; scientific notation; and similar concepts. Three to five test questions (9-14% of questions) assess skills in elementary algebra: basic operations with polynomials, setting up equations, substituting values into algebraic expressions, and the solution of linear equations in one variable. Three to five test questions (9-14% of questions) assess intermediate algebra skills: students' understanding of exponents, rational expressions, systems of linear equations, quadratic formulas and absolute value inequalities. Five to six questions (14 – 18% of questions) assess skills in coordinate geometry: graphing in the standard coordinate plane or the real number line, graphing conics, linear equations in two variables, graphing systems of equations, and similar types of skills. In the College Algebra category, fourteen questions (40% of questions) assess college algebra skills: advanced algebra concepts including rational exponents, exponential and logarithmic functions, complex numbers, matrices, inverses of functions, and domains and ranges. Four test questions (11% of questions) assess trigonometry: concepts such as right triangle trigonometry, graphs of trigonometric functions, basic trigonometric identities, and trigonometric equations and inequalities.

**Table 1: Content Specifications Summary for the CAAP Mathematics Test**

<b>Content Category</b>	<b>Proportion of Test</b>	<b>Number of Items</b>
<b>Basic Algebra</b>	<b>.49</b>	<b>17</b>
Pre-Algebra	.09-.14	3-5
Elementary Algebra	.09-.14	3-5
Intermediate Algebra	.09-.11	3-4
Coordinate Geometry	.14-.18	5-6
<b>College Algebra</b>	<b>.51</b>	<b>18</b>
College Algebra	.40	14
Trigonometry	.11	4
<b>Total</b>	<b>1.00</b>	<b>35</b>

**Methodology**

In November and December 2010, the Mathematics Skills test was administered to students enrolled in randomly selected sections of the following courses: Math 108, Math 110, Math 118, Math 125, Math 128, Math 130, Math 151, and Math 213. These courses are taken by students who have reached a certain level of competence in mathematics (that is, they have passed or tested out of remedial sections). A total of 443 students were enrolled in the selected sections during Fall 2010, and 254 students completed the test, resulting in a 57% response rate and a 5.8% margin of error.<sup>1</sup>

Table 2 shows self-reported demographic characteristics of test respondents.

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<sup>1</sup> The margin of error is a statistic that reflects the amount of sampling error in a survey's results and is based on the size of the sample (n=254) in relation to the size of the population (N=2,357) students enrolled in all sections of the surveyed courses during the Fall of 2010). The lower the margin of error, the more confidence one can have that the data are representative of the full population. Ideally, the margin of error should be 5% or less. The way to reduce the margin of error is to increase the sample size (i.e., survey more students).

**Table 2: Demographic Characteristics of Mathematics Skills Test Respondents, Fall 2010**

<b>Ethnicity</b>	<b>#</b>	<b>%</b>	<b>Status</b>	<b>#</b>	<b>%</b>	<b>Major</b>	<b>#</b>	<b>%</b>		
African-American/Black	14	6%	Full Time	182	72%	Undecided	8	3%		
American Indian/Alaskan Native	1	0%	Part Time	53	21%	Agriculture	0	0%		
White/Caucasian	194	76%	No response	19	7%	Architecture	4	2%		
Mexican American/Chicano	6	2%	<b>Cumulative GPA</b>			Biological Sciences	9	4%		
Asian/Pacific Islander	3	1%		Below 2.00	10	4%	Business	34	13%	
Puerto Rican/Cuban/Hispanic	0	0%		2.01 - 2.50	59	23%	Office Management	2	1%	
Filipino	0	0%		2.51 - 3.00	45	18%	Marketing and Purchasing	1	0%	
Other	3	1%		3.01 - 3.50	74	29%	Communications	3	1%	
Prefer not to respond	12	5%		3.51 and above	44	17%	Community Services	11	4%	
No response	21	8%		No Response	22	9%	Computer and Info Sciences	5	2%	
<b>Gender</b>				<b>Rank (Self-Reported)</b>			General Studies	3	1%	
Male	90	35%			Freshman	69	27%	Education	20	8%
Female	151	59%			Sophomore	108	43%	Engineering	9	4%
No Response	13	5%	Junior		31	12%	Fine & Applied Arts	3	1%	
<b>Age</b>			Senior		16	6%	Foreign Languages	1	0%	
18 and under	41	16%	Other	10	4%	Health Professions	81	32%		
19-20	72	28%	No response	20	8%	Home Economics	4	2%		
21-25	59	23%	<b>Enrolled At Owens as Freshman</b>			Letters	0	0%		
26-30	28	11%		Yes	207	81%	Mathematics	0	0%	
31-39	30	12%		No	27	11%	Philosophy/Religion	0	0%	
40 and older	24	9%		No response	20	8%	Physical Sciences	1	0%	
No response							Social Sciences	7	3%	
						Trade and Industrial	16	6%		
						No response	32	13%		

**Summary of Test Results**

As a general guide, differences in scores should be interpreted based on the standard deviations of the score distribution (s.d.= 3.6 for overall score, 2.3 for basic algebra, 2.1 for college algebra). For the overall Mathematics Skills test, differences of less than 3.6 points (1 s.d.), 3.7 – 7.2 points (2 s.d.), and 7.3 – 10.8 points (3 s.d.) are considered negligible, moderate, and substantial, respectively. For basic algebra scores, differences of less than 2.3 points (1 s.d.), 2.4 – 4.6 points (2 s.d.), and 4.7 – 6.9 points (3 s.d.) are considered negligible, moderate, and substantial, respectively. For college algebra scores, differences of less than 2.1 points (1 s.d.), 2.2 – 4.2 points (2 s.d.), and 4.3 – 6.3 points (3 s.d.) are considered negligible, moderate, and substantial, respectively

Based on this guide, the results, displayed in Tables 3 and 4, show that (a.) Owens students differed very little from the national average, (b.) there has been very little change between 2005 and 2010, and (c.) there was very little difference exhibited between different student groups.

**Table 3: Mathematics Skills Test Comparison, 2005-2010**

	2005		2006		2007		2008		2009		2010		2010 National Average
	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.
<b>Overall</b>	56.2	253	56.2	265	56.0	168	56.3	125	56.0	217	56.5	254	56.1
<b>Ethnicity</b>													
African-American/Black	53.0	9	55.0	13	51.0	10	53.0	7	53.0	14	55.0	14	NA
American Indian/Alaskan Native		3		0		0		0		0		1	NA
White/Caucasian	57.0	208	56.0	202	57.0	103	57.0	93	56.0	164	57.0	194	NA
Mexican American/Chicano		4	57.0	12	54.0	6	57.0	6	56.0	5	53.0	6	NA
Asian/Pacific Islander		1		0		2		4		0		3	NA
Puerto Rican/Cuban/Hispanic		0		3		2		3		4		0	NA
Filipino		1		0		0		0		1		0	NA
Other	57.0	7	56.0	7		3		1		4		3	NA
Prefer not to respond	56.0	14	56.0	14	55.0	8	54.0	6	54.0	13	57.0	12	NA
No response	54.0	6	54.0	14	56.0	34	55.0	5	55.0	12	56.0	21	NA
<b>Gender</b>													
Male	57.0	91	57.0	103	57.0	47	57.0	46	57.0	77	57.0	90	NA
Female	56.0	158	56.0	159	56.0	92	56.0	78	55.0	135	56.0	151	NA
No Response		4		3	56.0	29		1	54.0	5	56.0	13	NA
<b>Age</b>													
18 and under	58.0	47	57.0	48	57.0	46	58.0	26	57.0	30	57.0	41	NA
19-20	56.0	88	57.0	97	56.0	42	56.0	35	57.0	59	57.0	72	NA
21-25	56.0	58	56.0	55	56.0	32	57.0	26	56.0	49	56.0	59	NA
26-30	55.0	20	55.0	30	55.0	20	56.0	17	55.0	28	57.0	28	NA
31-39	56.0	20	55.0	21	55.0	14	54.0	11	54.0	30	56.0	30	NA
40 and older	54.0	20	54.0	14	53.0	14	53.0	10	54.0	21	55.0	24	NA
No response													
<b>Rank (Self-Reported)</b>													
Freshman	57.0	119	57.0	125	57.0	60	58.0	40	57.0	84	57.0	69	56.1
Sophomore	56.0	102	56.0	88	55.0	54	55.0	61	55.0	80	56.0	108	56.1
Junior	55.0	14	55.0	15	55.0	17	58.0	6	55.0	23	57.0	31	NA
Senior		2	55.0	6		3		3	55.0	12	56.0	16	NA
Other	58.0	9	55.0	19	55.0	5	56.0	7	54.0	11	56.0	10	NA
No response	57.0	7	55.0	12	56.0	29	54.0	8	54.0	7	56.0	20	NA
<b>Enrolled At Owens as Freshman</b>													
Yes	56.0	196	56.0	213	56.0	112	57.0	77	56.0	170	56.0	207	NA
No	56.0	43	56.0	36	56.0	27	56.0	20	56.0	40	57.0	27	NA
No response	57.0	14	57.0	16	56.0	29	55.0	28	55.0	7	57.0	20	NA

**Table 3: Mathematics Skills Test Comparison, 2005-2010, Cont.**

Status	2005		2006		2007		2008		2009		2010		2010 National Average
	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.
Full Time	56.0	169	56.0	188	56.0	102	57.0	76	56.0	166	57.0	182	NA
Part Time	56.0	74	56.0	63	55.0	36	56.0	20	55.0	45	56.0	53	NA
No response	57.0	10	57.0	14	56.0	30	55.0	29	55.0	6	57.0	19	NA
<b>Cumulative GPA</b>													
Below 2.00	55.0	11	55.0	12	54.0	7	56.0	6	56.0	13	57.0	10	NA
2.01 - 2.50	55.0	44	55.0	47	55.0	34	56.0	15	55.0	44	56.0	59	NA
2.51 - 3.00	56.0	51	56.0	62	56.0	24	57.0	24	56.0	50	56.0	45	NA
3.01 - 3.50	57.0	86	57.0	71	56.0	36	56.0	26	57.0	54	56.0	74	NA
3.51 and above	57.0	36	58.0	45	58.0	31	57.0	21	57.0	47	59.0	44	NA
No Response	56.0	25	56.0	28	56.0	36	55.0	33	55.0	9	56.0	22	NA
<b>Major</b>													
Undecided	57.0	35	57.0	12	60.0	6	59.0	6	54.0	9	58.0	8	NA
Agriculture		2	56.0	6		3		0		0		0	NA
Architecture		1		3		1		1		1		4	NA
Biological Sciences		3		2		0		1		2	60.0	9	NA
Business	56.0	24	55.0	33	56.0	18	56.0	19	56.0	31	57.0	34	NA
Office Management		0	56.0	6		2		0		1		2	NA
Marketing and Purchasing		1		1		1		1		2		1	NA
Communications	56.0	5		4		1		0	57.0	6		3	NA
Community Services	56.0	18	54.0	12	55.0	12		2	54.0	5	56.0	11	NA
Computer and Info Sciences		4		3		1		3	60.0	6	56.0	5	NA
General Studies		3		3		2		2		1		3	NA
Education	55.0	21	56.0	17	54.0	5	57.0	5	58.0	10	57.0	20	NA
Engineering	58.0	6	59.0	5		2		1	59.0	7	58.0	9	NA
Fine & Applied Arts	55.0	5		2		3		2	56.0	9		3	NA
Foreign Languages		1		0		0		0		1		1	NA
Health Professions	55.0	79	56.0	84	56.0	46	57.0	16	55.0	90	56.0	81	NA
Home Economics		2		1		1		1		3		4	NA
Letters		2		1		1		0		0		0	NA
Mathematics		0		0		0		0		1		0	NA
Philosophy/Religion		0		0		0		0		0		0	NA
Physical Sciences		3		3		0		0		1		1	NA
Social Sciences	57.0	8	55.0	5		2		3		4	54.0	7	NA
Trade and Industrial	57.0	11	57.0	15	58.0	6		1	56.0	7	55.0	16	NA
No response	57.0	19	56.0	47	56.0	55	56.0	61	55.0	20	56.0	32	NA

NOTES: ACT does not provide data for groups with a sample size of less than 5. National averages are only available in aggregate for freshman and sophomores.

**Table 4: Basic Algebra and College Algebra Sub-Scores, 2005-2010**

	2005		2006		2007		2008		2009		2010		National Average
	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.
Basic Algebra	14.4	253	14.3	265	14.4	168	14.7	125	14.4	217	14.6	254	14.2
College Algebra	13.6	253	13.8	265	13.8	168	13.6	125	13.8	217	14.1	254	14.0

The only averages greater or less than 3.6 for the Mathematics Skills test were for African American/Black students in 2007 (n=10); Undecided majors in 2007 (n=6) and Computer and Information Sciences majors in 2009 (n=6). However, because the sample sizes for these subgroups are so small and the national norms for these groups are not provided, the results for these groups should be interpreted with extreme caution.

### Conclusions, Limitations, & Questions for Future Research

Overall, results indicate that:

- Owens students do not differ meaningfully on their mathematics skills from a national sample of students at other two-year public institutions;
- there was no real change in students' mathematical skills from 2005 to 2010; and
- there are no meaningful differences in mathematics skills among different sub-groups of Owens students.

However, there are several limitations to the data that should be considered in the interpretation and use of results:

- Differences in scores from the national average, from year-to-year, and between groups are statistically very small and well within the normal range. Only differences of 3.6 points or more on the overall test, differences of 2.3 points or more on the basic algebra test, and differences of 2.1 or more on the college algebra test are unlikely to be due to chance and are of practical significance.
- Results are based on a small sample size (n=254) and a margin of 5.8% indicating that results are reasonable. However, the margin of error exceeds the ideal of 5% thus reducing confidence that the results are representative of the full population of students.
- Sample sizes for various student groups are very small and national averages for different student groups are not available; therefore, data by student demographic characteristics should be interpreted very cautiously.

Questions for future research and recommendations for maximizing the usefulness of results:

- Have students who take the CAAP Mathematics Skills test completed courses that teach the mathematics skills being assessed?
  - Examine the curriculum map for the Mathematical Reasoning general student learning outcome and identify what courses introduce and reinforce basic algebra and college algebra skills.

- Ensure that the CAAP is administered in courses that enroll a large proportion of students who have completed those courses.
- Order unit-level CAAP data and examine how many test respondents have taken mathematics courses. Perhaps limit the analysis to these students or compare students who have completed the mathematics curriculum to those who have not.
- How do students perform on each of the various content areas of the test?
  - Knowing the average overall mathematics skills score and the Basic Algebra and College Algebra subtest scores provide a general picture of students' skills. However, it does not provide actionable information for curriculum development and improvement.
  - It is recommended that the Mathematics Content Analysis report be ordered from CAAP in order to identify strengths or weaknesses in specific mathematics skills (e.g., pre-algebra, elementary algebra, intermediate algebra, coordinate geometry, college algebra and trigonometry). This report also shows the percentage of students who test at each quartile on the test. For continuous improvement, ACT recommends that goals be established between test administrations to move a particular percentage of students (e.g., 3%) out of the bottom quartile into higher quartiles and develop an action plan to achieve this goal.
- Collect data from a larger sample of students by oversampling to accommodate reduced attendance at the end of the term, in order to have greater confidence in the representativeness of results and to have sufficient data to permit analysis on different student groups. Alternatively, if the assessment is conducted in classes where the subject matter tested has already been taught, the test could be conducted earlier in the semester when attendance is likely to be higher than at the end.
- Link the ACT or Compass Mathematics Scores to the CAAP Mathematics Skills Score. This comparison will demonstrate the learning gained by taking the mathematics curriculum.



## Appendix A

### Mathematics Sample Passages and Items

#### Pre-Algebra (Basic Skills)

1. How much greater is the product of  $-3$ ,  $-7$ , and  $5$  than their sum?
  - A.  $-110$
  - B.  $-100$
  - C.  $90$
  - D.  $100$
  - E.  $110$

#### Pre-Algebra (Application)

2. Mark bought 3 shirts at a clothing store. If he paid a total of \$15.00 for 2 shirts and the average (arithmetic mean) cost of the 3 shirts was \$8.00, how much did Mark pay for the third shirt?
  - A. \$7.00
  - B. \$7.67
  - C. \$8.50
  - D. \$9.00
  - E. \$11.50

#### Coordinate Geometry (Basic Skills)

3. A straight line in the coordinate plane passes through the points with  $(x,y)$  coordinates  $(-1,1)$  and  $(2,3)$ . What are the  $(x,y)$  coordinates of the point at which the line passes through the  $y$ -axis?
  - A.  $(0, \frac{2}{3})$
  - B.  $(0, \frac{5}{3})$
  - C.  $(0,2)$
  - D.  $(0, \frac{5}{2})$
  - E.  $(-2,0)$

#### Intermediate Algebra (Application)

Items 4–5 are based on the following information.

Astonville currently has a property tax of 2% of the market value of each house. Senator Smith has proposed a change in the property tax. Under this Smith proposal, there would be no tax on a house unless the market value of the house was above \$20,000. The tax on a house whose market value was over \$20,000 would be 2.5% of the difference between the house's market value and \$20,000.

4. Sue Miller would pay the same tax on her house under the Smith proposal as under the current plan. What is the market value of her house?
- \$ 10,000
  - \$ 40,000
  - \$100,000
  - \$120,000
  - \$400,000
5. What percentage of Senator Smith's constituents would save money under this new tax proposal?
- 25%
  - $33\frac{1}{3}\%$
  - 50%
  - $66\frac{2}{3}\%$
  - The answer cannot be determined from the given information.

**College Algebra (Basic Skills)**

6. If  $-4x^2 + 4x + 3 > 0$ , then which of the following inequalities must be true?
- $x > 0$
  - $x < 0$
  - $x < -\frac{1}{2}$  or  $x > \frac{3}{2}$
  - $-\frac{1}{2} < x < \frac{3}{2}$
  - $-\frac{2}{3} < x < \frac{1}{2}$

**Trigonometry (Basic Skills)**

7. Which of the following is equivalent to  $\frac{\sin x \tan^2 x + \sin x}{\tan x}$  for  $0 < x < 90^\circ$ ?
- $\sin x + \cos x$
  - $2 \sin x \tan x$
  - $\sec x$
  - $\cos x$
  - $\frac{\sin^2 x}{\cos^3 x}$

**Answers:**

1. E.    2. D.    3. B.    4. C.    5. E.    6. D.    7. C.