

# **CAAP Mathematics Skills Test Summary**

**Administered November 2012**



**Office of Institutional Research**  
**February 2013**

# CAAP Mathematics Skills Test Summary

## 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, 151, 170, 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 2012, the Mathematics Skills test was administered to students enrolled in randomly selected sections of the following courses: Math 110, Math 125, Math 151, Math 180, 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 312 students were enrolled in the selected sections during Fall 2012, and 175 students completed the test, resulting in a 56.1% response rate and a 6.9% 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=312) in relation to the size of the population (N=1,268) students enrolled in all sections of the surveyed courses during the Fall of 2012). 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 2012**

<b>Ethnicity</b>	<b>#</b>	<b>%</b>	<b>Status</b>	<b>#</b>	<b>%</b>	<b>Major</b>	<b>#</b>	<b>%</b>
African-American/Black	16	9%	Full Time	104	59%	Undecided	7	4%
American Indian/Alaskan Native	1	1%	Part Time	44	25%	Agriculture	1	1%
White/Caucasian	115	66%	No response	27	15%	Architecture	1	1%
Mexican American/Chicano	4	2%				Biological Sciences	3	2%
Asian/Pacific Islander	0	0%	<b>Cumulative GPA</b>			Business	33	19%
Puerto Rican/Cuban/Hispanic	0	0%	Below 2.00	2	1%	Office Management	0	0%
Filipino	0	0%	2.01 - 2.50	29	17%	Marketing and Purchasing	3	2%
Other	7	4%	2.51 - 3.00	31	18%	Communications	0	0%
Prefer not to respond	5	3%	3.01 - 3.50	43	25%	Community Services	7	4%
No response	27	15%	3.51 and above	36	21%	Computer and Info Sciences	1	1%
			No Response	34	19%	General Studies	0	0%
<b>Gender</b>						Education	20	0%
Male	67	38%	<b>Rank (Self-Reported)</b>			Engineering	2	1%
Female	86	49%	Freshman	51	29%	Fine & Applied Arts	1	1%
No Response	22	13%	Sophomore	57	33%	Foreign Languages	0	0%
			Junior	25	14%	Health Professions	58	33%
<b>Age</b>			Senior	4	2%	Home Economics	0	0%
18 and under	45	26%	Other	9	9%	Letters	1	1%
19-20	36	21%	No response	25	17%	Mathematics	0	0%
21-25	46	26%				Philosophy/Religion	0	0%
26-30	21	12%	<b>Enrolled At Owens as Freshman</b>			Physical Sciences	3	2%
31-39	15	9%	Yes	121	69%	Social Sciences	3	2%
40 and older	21	7%	No	26	15%	Trade and Industrial	10	6%
No response			No response	28	16%	No response	41	23%

### 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.= 3.4 for overall score, 2.4 for basic algebra, 2.1 for college algebra). For the overall Mathematics Skills test, differences of less than 3.4 points (1 s.d.), 3.5 – 6.8 points (2 s.d.), and 6.9 – 10.2 points (3 s.d.) are considered negligible, moderate, and substantial, respectively. For basic algebra scores, differences of less than 2.4 points (1 s.d.), 2.5 – 5.0 points (2 s.d.), and 5.1 – 7.2 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 2012, and (c.) there was very little difference exhibited among different student groups.

**Table 3: Mathematics Skills Test Comparison, 2006-2012**

Status	2006		2007		2008		2009		2010		2011		2012		2012 National Average
	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.
<b>Overall</b>	56.2	265	56.0	168	56.3	125	56.0	217	56.5	254	55.9	350	56.2	175	56.2
<b>Ethnicity</b>															
African-American/Black	55.0	13	51.0	10	53.0	7	53.0	14	55.0	14	54.0	26	55	16	NA
American Indian/Alaskan Native						0				1				1	NA
White/Caucasian	56.0	202	57.0	103	57.0	93	56.0	164	57.0	194	56.0	263	57	115	NA
Mexican American/Chicano	57.0	12	54.0	6	57.0	6	56.0	5	53.0	6	56.0	10		4	NA
Asian/Pacific Islander				2		4				3		4		0	NA
Puerto Rican/Cuban/Hispanic		3		2		3		4		0		2		0	NA
Filipino								1		0		1		0	NA
Other	56.0	7		3		1		4		3	55.0	7	58	7	NA
Prefer not to respond	56.0	14	55.0	8	54.0	6	54.0	13	57.0	12	55.0	25	58	5	NA
No response	54.0	14	56.0	34	55.0	5	55.0	12	56.0	21	54.0	12	56	27	NA
<b>Gender</b>															
Male	57.0	103	57.0	47	57.0	46	57.0	77	57.0	90	56.0	154	57	67	NA
Female	56.0	159	56.0	92	56.0	78	55.0	135	56.0	151	56.0	190	57	86	NA
No Response		3	56.0	29		1	54.0	5	56.0	13	52.0	6	56	22	NA
<b>Age</b>															
18 and under	57.0	48	57.0	46	58.0	26	57.0	30	57.0	41	57.0	48	57	45	NA
19-20	57.0	97	56.0	42	56.0	35	57.0	59	57.0	72	57.0	85	57	36	NA
21-25	56.0	55	56.0	32	57.0	26	56.0	49	56.0	59	56.0	80	57	46	NA
26-30	55.0	30	55.0	20	56.0	17	55.0	28	57.0	28	56.0	35	57	21	NA
31-39	55.0	21	55.0	14	54.0	11	54.0	30	56.0	30	54.0	61	57	15	NA
40 and older	54.0	14	53.0	14	53.0	10	54.0	21	55.0	24	54.0	41	55	12	NA
No response															
<b>Rank (Self-Reported)</b>															
Freshman	57.0	125	57.0	60	58.0	40	57.0	84	57.0	69	56.0	111	58	51	56.2
Sophomore	56.0	88	55.0	54	55.0	61	55.0	80	56.0	108	56.0	147	56	57	56.2
Junior	55.0	15	55.0	17	58.0	6	55.0	23	57.0	31	56.0	52	57	25	NA
Senior	55.0	6		3		3	55.0	12	56.0	16	55.0	14		4	NA
Other	55.0	19	55.0	5	56.0	7	54.0	11	56.0	10	55.0	15	56	9	NA
No response	55.0	12	56.0	29	54.0	8	54.0	7	56.0	20	53.0	11	56	29	NA
<b>Enrolled At Owens as Freshman</b>															
Yes	56.0	213	56.0	112	57.0	77	56.0	170	56.0	207	56	293	57	121	NA
No	56.0	36	56.0	27	56.0	20	56.0	40	57.0	27	57	47	57	26	NA
No response	57.0	16	56.0	29	55.0	28	55.0	7	57.0	20	52	10	55	28	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 3: Mathematics Skills Test Comparison, 2006-2012, Continued**

Status	2006		2007		2008		2009		2010		2011		2012		2012 National Average
	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.
Full Time	56.0	188	56.0	102	57.0	76	56.0	166	57.0	182	56.0	250	57	104	NA
Part Time	56.0	63	55.0	36	56.0	20	55.0	45	56.0	53	56.0	90	57	44	NA
No response	57.0	14	56.0	30	55.0	29	55.0	6	57.0	19	53.0	10	56	27	NA
<b>Cumulative GPA</b>															
Below 2.00	55.0	12	54.0	7	56.0	6	56.0	13	57.0	10	56.0	17		2	NA
2.01 - 2.50	55.0	47	55.0	34	56.0	15	55.0	44	56.0	59	55.0	66	56	29	NA
2.51 - 3.00	56.0	62	56.0	24	57.0	24	56.0	50	56.0	45	56.0	88	56	31	NA
3.01 - 3.50	57.0	71	56.0	36	56.0	26	57.0	54	56.0	74	56.0	98	58	43	NA
3.51 and above	58.0	45	58.0	31	57.0	21	57.0	47	59.0	44	57.0	62	58	36	NA
No Response	56.0	28	56.0	36	55.0	33	55.0	9	56.0	22	54.0	19	56	34	NA
<b>Major</b>															
Undecided	57.0	12	60.0	6	59.0	6	54.0	9	58.0	8	59.0	5	58	7	NA
Agriculture	56.0	6		3						0		1		1	NA
Architecture		3		1		1		1		4		1		1	NA
Biological Sciences		2				1		2	60.0	9		2		3	NA
Business	55.0	33	56.0	18	56.0	19	56.0	31	57.0	34	57.0	57	57	33	NA
Office Management	56.0	6		2				1		2		0		0	NA
Marketing and Purchasing		1		1		1		2		1		2		3	NA
Communications		4		1			57.0	6		3		1		0	NA
Community Services	54.0	12	55.0	12		2	54.0	5	56.0	11	54.0	23	57	7	NA
Computer and Info Sciences		3		1		3	60.0	6	56.0	5	57.0	12		1	NA
General Studies		3		2		2		1		3		1		0	NA
Education	56.0	17	54.0	5	57.0	5	58.0	10	57.0	20	57.0	22		0	NA
Engineering	59.0	5		2		1	59.0	7	58.0	9	57.0	13		2	NA
Fine & Applied Arts		2		3		2	56.0	9		3	57.0	8		1	NA
Foreign Languages								1		1		0			NA
Health Professions	56.0	84	56.0	46	57.0	16	55.0	90	56.0	81	56.0	103	57	58	NA
Home Economics		1		1		1		3		4	54.0	5		0	NA
Letters		1		1						0		0		1	NA
Mathematics								1		0		0		0	NA
Philosophy/Religion										0		0			NA
Physical Sciences		3						1		1		2		3	NA
Social Sciences	55.0	5		2		3		4	54.0	7	56.0	12		3	NA
Trade and Industrial	57.0	15	58.0	6		1	56.0	7	55.0	16	54.0	32	56	10	NA
No response	56.0	47	56.0	55	56.0	61	55.0	20	56.0	32	54.0	48	56	41	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, 2006-2012**

Status	2006		2007		2008		2009		2010		2011		2012		2012 National Average
	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.	#	Avg.
Basic Algebra	14.3	265	14.4	168	14.7	125	14.4	217	14.6	254	14.4	350	14.7	175	14.2
College Algebra	13.8	265	13.8	168	13.6	125	13.8	217	14.1	254	13.5	350	13.9	175	14.0

### Detailed Results

For the second time since Owens started administering the Mathematics Test, a Content Analysis report was acquired from CAAP. The information provided in this report identifies specific content area in which Owens students (the local group) are strong or weak relative to a normative group of students. The complete report is available in Appendix C.

Table 5 shows the comparisons between Owens students and normative groups upon the six measures of the Mathematics Test: pre-algebra, elementary algebra, intermediate algebra, coordinate geometry, college algebra, and trigonometry. These are further broken down by student performance on this test: bottom 25%, middle 50%, and top 25%.

Differences with magnitudes less than 5%, between 5% and 10%, and greater than 10% are considered negligible, moderate, and substantial, respectively.

**Table 5 – Mathematics Comparison Highlights, 2012**

Content Category	Bottom 25%	Middle 50%	Top 25%
Pre-algebra	15%	23%	10%
Elementary algebra	19%	19%	8%
Intermediate algebra	5%	0%	0%
Coordinate geometry	-8%	-2%	7%
College algebra	13%	-5%	-8%
Trigonometry	-2%	3%	13%

Substantial differences were noted among the bottom 25% group in pre-algebra, who scored lower than the national group. They scored substantially higher in coordinate geometry. They also scored moderately higher on elementary algebra than the national group.

The middle 50% group scored substantially higher than the national group on coordinate geometry and moderately higher on elementary and intermediate algebra. They scored moderately lower on pre-algebra.

The top 25% group scored moderately lower than the national group on pre-algebra and moderately higher on intermediate and coordinate geometry.

All other differences were negligible as per CAAP specifications.

Because 2012 was the second year for which the Content Analysis Report was received, it was possible to track changes in subscores, relative to national norms, between the 2011 and 2012 administrations. In many cases, the changes were quite large and are surprising, given that Table 4 shows no changes in overall percentages over a multi-year trend. Table 6 shows the 2011 value, the 2012 value, and the change, in each cell.

**Table 6– Changes in Mathematics Subscores, 2011 to 2012**

Content Category	Bottom 25%	Middle 50%	Top 25%
Pre-algebra	-11% to 15%, +26%	-9% to 23%, +34%	-9% to 10%, +19%
Elementary algebra	5% to 19%, +14%	9% to 19%, +10%	4% to 8%, +4%
Intermediate algebra	1% to 5%, +4%	8% to 0%, -8%	6% to 0%, -6%
Coordinate geometry	18% to -8%, -26%	17% to -2%, -19%	6% to 7%, +1%
College algebra	-3% to 13%, +16%	0% to -5%, -5%	0% to -8%, -8%
Trigonometry	-3% to -2%, +1%	0% to 3%, +3%	-2% to 13%, +15%

Because each content category is comprised of only 3-6 questions, with the exception of College Algebra at 14 questions, such comparisons may not be valid.

### **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 2011; 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 3.5 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.
- 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.
- 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.