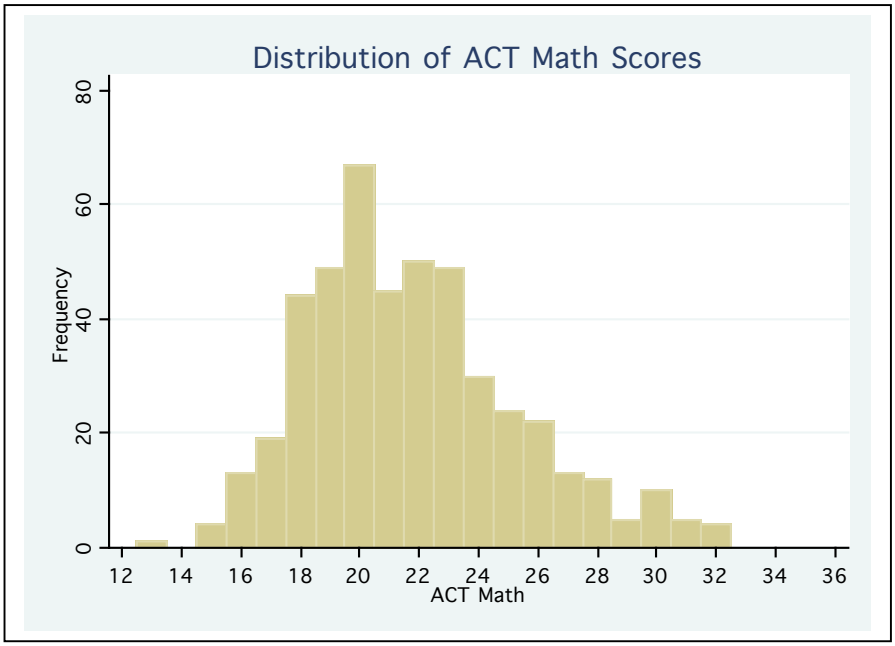
Math Placement Data Analysis

N = 477 students
43% = Male
57% = Female

Missing Data:
ACT MATH -- 18 missing cases (3.8%)
ACT COMP -- 18 missing cases (3.8%)
Of the 18 missing cases, 11 were male students

One student had a MATH ACT score of 1 and an ACT COMPOSITE of 17.
An estimated MATH ACT of 17 was substituted for this student.
Regression: MATH ACT = 0.54 + 0.94(COMPOSITE) = 0.54+0.94(17) = 16.52
All other ACT scores looked valid.



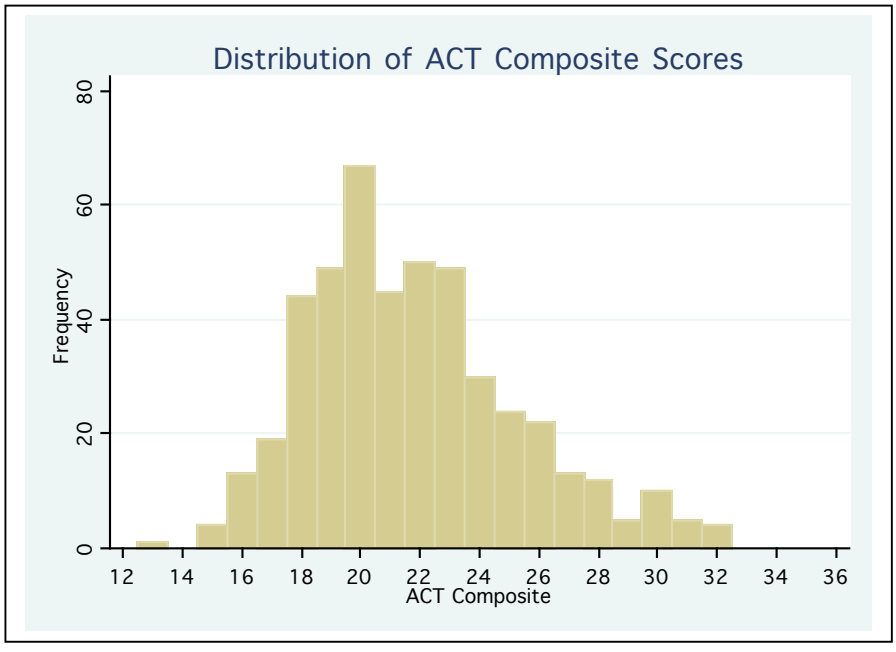
ACT MATH

Minimum = 13
Maximum = 34
Mean = 21.06
StDev = 4.15

Percentile	Score
5	16
10	16
25	17
50	20
75	24
90	27
95	28

Male Average = 21.23
Female Average = 20.93

(No significant difference in means or variances.)



ACT Composite

Minimum = 13
Maximum = 32
Mean = 21.77
StDev = 3.54

Percentile	Score
5	17
10	18
25	19
50	21
75	24
90	27
95	29

Male Average = 21.70
Female Average = 21.85

(No significant difference in means or variances.)

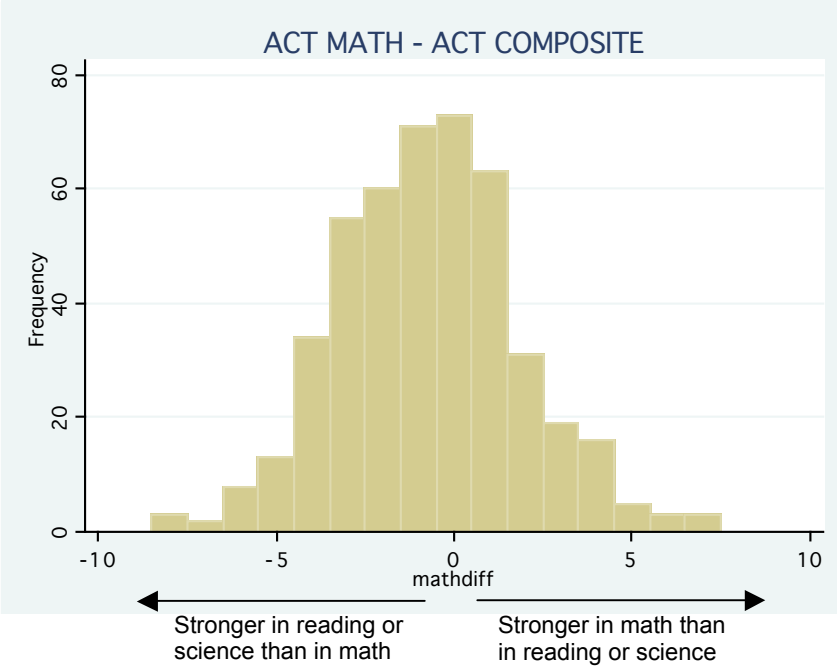
For each student's ACT scores, I computed:

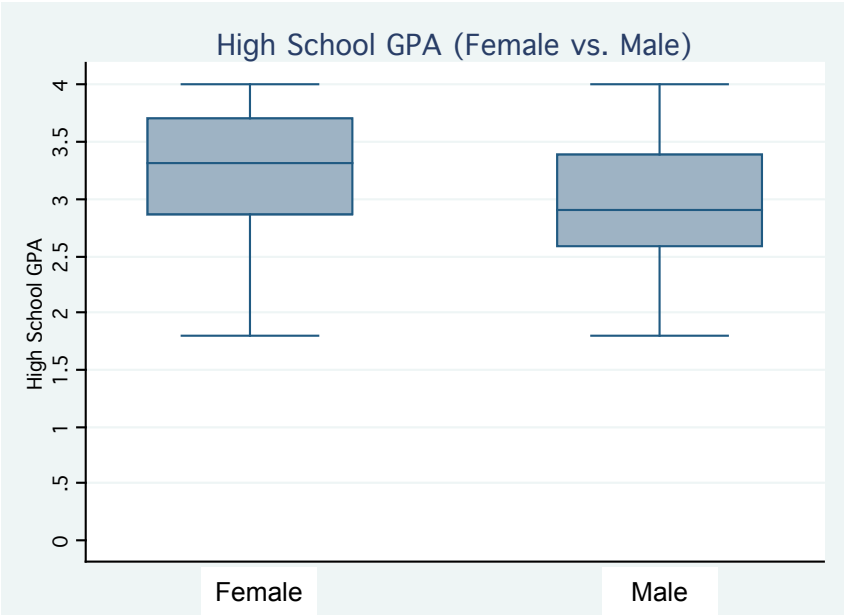
mathdiff = MATH – COMPOSITE

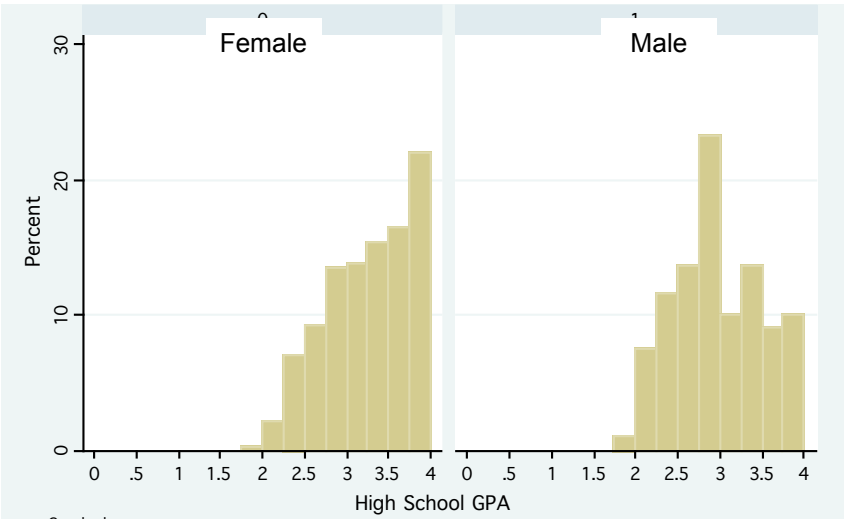
This graph shows the distribution of this difference. Positive values of mathdiff represent students whose Math scores were higher than their Reading or Science scores on the ACT.

54% of students were "weak" in math
31% were "stronger" in math

Male Average = -0.46
Female Average = -0.91
(Significant at p = 0.065)







High School GPA

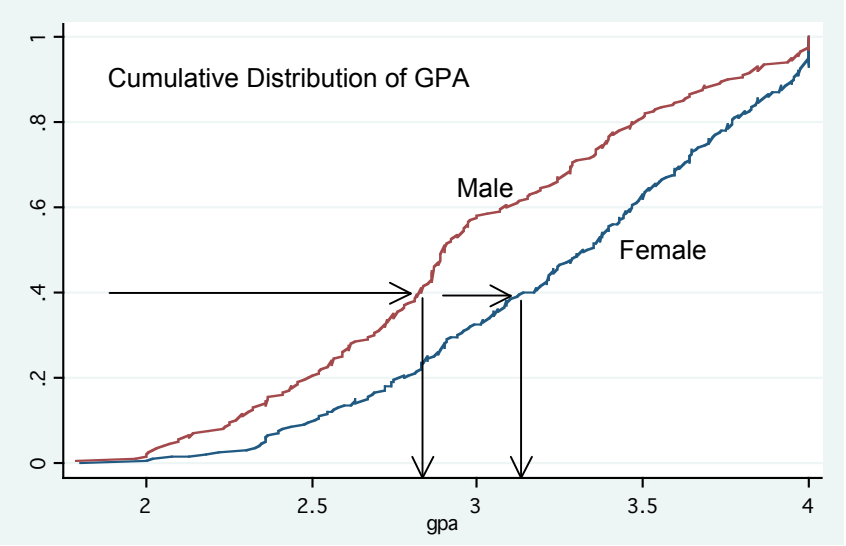
Minimum = 1.79
Maximum = 4.00 (26 students)
Overall Mean GPA = 3.14

Male Mean = 2.98 (mdn = 2.90)
Female Mean = 3.26 (mdn = 3.32)

(Significant differences between male and female high school GPAs.)

GPA Distribution

GPA	Female	Male
0.0 – 0.5	----	----
0.5 – 1.0	----	----
1.0 – 1.5	----	----
1.5 – 2.0	0.7%	2.0%
2.0 – 2.5	9.0%	18.7%
2.5 – 3.0	22.8%	37.4%
3.0 – 3.5	30.2%	23.2%
3.5 – 4.0	37.3%	18.7%



High School GPA

This graph shows the difference in GPA between males and females.

The arrows show that 40% of males had GPAs below 2.8 (approximately) and 40% of females had GPAs below 3.15 (approximately).

Placement:

Course	Number	Percentage
MATH 090	14	2.9%
MATH 095	99	20.8%
MTI	195	41.1%
Completed	167	35.2%
Missing	2	0.4%

Placement by Gender: (No statistical difference between male and female placement)

	Male		Female	
Course	Number	Percentage	Number	Percentage
MATH 090	8	3.9%	6	2.2%
MATH 095	45	22.2%	54	19.9%
MTI	75	36.9%	120	44.1%
Completed	75	36.9%	92	33.8%

Courses Taken:

OVERALL

Course	Number	Percentage
MATH 090	7	1.5%
MATH 095	53	11.1%
MATH 131	4	0.8%
MATH 151	67	14.0%
MATH 152	13	2.7%
MATH 171	7	1.5%
MATH 191	11	2.3%
None/Unknown	315	66.0%

Course	**Female**	**Male**
MATH 090	2 (1%)	5 (3%)
MATH 095	31 (11%)	22 (11%)
MATH 131	4 (2%)	0 (0%)
MATH 151	44 (16%)	23 (11%)
MATH 152	10 (4%)	3 (2%)
MATH 171	2 (1%)	5 (3%)
MATH 191	6 (2%)	5 (3%)
None/Unknown	174 (64%)	141 (69%)

High Schools with 2 or more students:

School	Students
Assumptn	24
West	18
Dowling	18
Wahlert	16
North	13
Marist	11
Central	9
StFrancs	9
Alleman	9
Bettndrf	8
Moline	7
PeoriaND	7
PV	7
NScott	7
NotreDam	6
Mrquette	6
Aquinas	5
Dixon	5
Beckman	5
Rosary	5
Newman	5
Hmpstead	5
Wheaton	5
Provdnce	5
Aurora	5

School	Students
Lincnway	4
Clinton	4
StRita	4
McAuley	4
Baringtn	4
JBConant	4
Wilton	4
Lyons	4
Dunlap	3
OakPark	3
Hinsdale	3
Columbus	3
Mundelen	3
Muscatin	3
Sherrard	3
Minooka	3
Westmer	3
CenClntn	3
RolMeado	3
WBurlngt	3
WDelawar	3
ArchOhara	2
CaryGrv	2
York	2
ValleyH	2

School	Students
LinnMar	2
Washingt	2
RockRdge	2
Canton	2
Stark	2
JFK	2
Richwood	2
Ohio	2
Marion	2
Ottumwa	2
Praire	2
Freeport	2
Ashton	2
Camanche	2
Fulton	2
Indianol	2
Marmion	2
Galva	2
StBede	2
Feldcrst	2
FtMadsn	2
Napervil	2
CrlSndbrg	2
Annawan	2
Total	347 (73%)

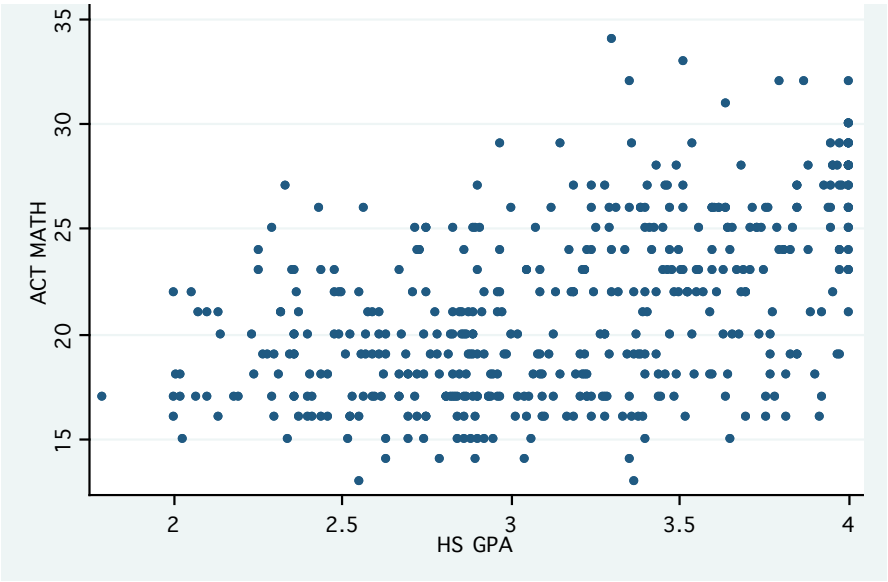
High Schools sorted by ACT scores and GPAs: (only high schools with 5+ students)

School	ACT MATH	Students
Moline	25.0	7
Hmpstead	23.0	5
NotreDam	22.7	6
Marist	22.2	11
Dowling	22.0	18
Rosary	22.0	5
Wheaton	21.6	5
Newman	21.4	5
West	**21.4**	**18**
Mrquette	21.3	6
PeoriaND	21.0	7
Bettndrf	20.9	8
PV	20.7	7
Central	**20.0**	**9**
Aurora	19.6	5
Dixon	19.4	5
North	**19.3**	**13**
Wahlert	19.3	16
StFrancs	19.1	9
Aquinas	19.0	5
Beckman	19.0	5
NScott	19.0	7
Provdnce	19.0	5
Alleman	18.9	9
Assumptn	**18.9**	**24**

School	HS GPA	Students
Moline	3.56	7
Aquinas	3.47	5
West	**3.47**	**18**
Bettndrf	3.45	8
Wahlert	3.37	16
Hmpstead	3.33	5
Central	**3.25**	**9**
Beckman	3.25	5
NotreDam	3.23	6
Aurora	3.22	5
Mrquette	3.20	6
Newman	3.16	5
Provdnce	3.13	5
North	**3.13**	**13**
Assumptn	**3.07**	**24**
Alleman	3.04	9
Wheaton	2.93	5
Rosary	2.91	5
Dowling	2.91	18
PV	2.88	7
Marist	2.87	11
Dixon	2.85	5
StFrancs	2.78	9
NScott	2.68	7
PeoriaND	2.66	7

The lines show the change in rank between a high school's average ACT Math score and average GPA.

For all students, the correlation between rank in HS GPA rank and ACT Composite is 0.48.
For the schools listed above, the correlation between rank in HS GPA rank and ACT Composite = 0.10



Placement by High School:

	Placement				
School	090	095	MTI	Complete	Total
Alleman		3	6		9
Aquinas		1	3	1	5
Assumptn	**2**	**5**	**12**	**5**	**24**
Aurora	1		3	1	5
Beckman		3	1	1	5
Bettndrf		1	4	3	8
Central	**1**	**2**	**3**	**3**	**9**
Dixon		1	3	1	5
Dowling		4	9	5	18
Hmpstead		1	1	3	5
Marist		1	6	4	11
Moline			1	6	7
Mrquette	1	1	1	3	6
NScott	1	4	1	1	7
Newman		2	1	2	5
North		**5**	**5**	**3**	**13**
NotreDam		1	3	1	5
PV		1	5	1	7
PeoriaND		2	3	2	7
Provdnce	1	3		1	5
Rosary		1	1	3	5
StFrancs		3	5	1	9
Wahlert	2	3	7	4	16
West	**1**	**4**	**6**	**7**	**18**
Wheaton		1	1	3	5
Other	4	46	104	102	256
TOTAL	14	99	195	167	475

Courses Taken by High School:

	Course Taken							
School	090	095	131	151	152	171	191	None
Alleman		2		1				6
Aquinas				1			2	2
Assumptn	**1**	**2**		**5**	**1**			**15**
Aurora				1				4
Beckman		1						4
Bettndrf				2	1			5
Central	**1**	**1**		**1**				**6**
Dixon		1		1				3
Dowling		2		3		1		12
Hmpstead				1		1		3
Marist		1		2				8
Moline			1					6
Mrquette	1			1	1			3
NScott		4						3
Newman		2						3
North		**1**						**12**
NotreDam				1				4
PV				2				5
PeoriaND		1		1				5
Provdnce	1	2			1			1
Rosary		1		1				3
StFrancs		2		2				5
Wahlert		3		3	1			9
West	**1**	**3**		**2**	**1**	**1**	**1**	**9**
Wheaton					2			3
Other	2	24	3	36	5	4	7	176
TOTAL	7	53	4	67	13	7	11	315

SAU Math Grades by High School: (only those students who took a math course)

School	A	B	C	D	F	D/F
Alleman		1	1	1		33%
Aquinas	2		1			
Assumptn	**3**	**3**	**1**	**2**		**22%**
Aurora		1				
Beckman					1	100%
Bettndrf	1	2				
Central			**2**		**1**	**33%**
Dixon		2				
Dowling	1	2	2		1	17%
Hmpstead	1	1				
Marist		2	1			
Moline	1					
Mrquette		2		1		33%
NScott		1	2		1	25%
Newman			2			
North					**1**	**100%**
NotreDam	1	1				
PV	1	1				
PeoriaND		1	1			
Provdnce	1	3				
Rosary	2					
StFrancs		3		1		25%
Wahlert	1	3	2	1		14%
West	**3**		**2**	**1**	**3**	**44%**
Wheaton	1	1				
Other	22	28	21	4	6	12%
TOTAL	25%	36%	23%	7%	7%	15%

Ability Level of Placed Students:

Placement	ACT MATH			HS GPA		
	Low	Mean	High	Low	Mean	High
MATH 090	13	15.2	17	1.80	2.81	3.82
MATH 095	13	17.1	22	1.79	2.77	3.92
MTI	15	19.5	26	2.00	3.03	4.00
Completed	19	25.5	34	2.25	3.51	4.00
Total	13	21.0	34	1.79	3.14	4.00

It looks as though ACT MATH is what separated students into placement groups, but it wasn't consistent.

Students with ACT scores below 15 were placed into either MATH 090 or 095.

At least one student with an ACT MATH score of 22 was placed into MATH 095, while students with ACT MATH scores of 15 were allowed to take other courses. This was probably due to high school course work and grades from the student transcripts.

A multivariate analysis of variance finds that the placement groups do differ in their ACT/GPAs.

A univariate ANOVA on this data finds the ACT MATH scores are significantly different for all placement groups (they do differ in math ability). The groups differ in GPAs as well, although the GPAs of MATH 090, MATH 095, and MTI are not statistically different. It appears as though HS GPA is not a potent predictor of placement.

	Course Taken							
Placement	090	095	131	151	152	171	191	None
MATH 090	7							7
MATH 095		53	**1**	**2**		**1**		42
MTI			3	55	2	1	3	131
MTX				10	11	5	7	134

No students placed in MATH 090 enrolled in a higher-level course.

4 students placed in MATH 095 enrolled in higher-level courses:

Marcie Wulff (ACT = 17; GPA = 3.28) earned a B in MATH 131
Darcie Debiase (ACT = 19; GPA = 2.30) earned a C in MATH 151
Megan Sones (ACT = 17; GPA = 3.45) earned a D in MATH 151.
Casey Breitbach (ACT = 19; GPA = 3.43) earned an A in MATH 171.

How were students placed?

Placement decisions were made by examining student ACT MATH scores, HS GPAs, and grades received in the high school math courses. In this analysis, the high school course grades were not used.

If students were adequately placed into math courses using the current method, then the following rule can be used to place students (with about 80% accuracy):

(Placement) = (–10.798) + (0.416 * ACT) + (0.647 * GPA)

If (Placement) < -2.6, then the student should be placed in MATH 090
If { –2.5 < (Placement) < -1.9 }, then the student should be placed in MATH 090
If { –1.9 < (Placement) < -0.5 }, then the student should be placed in MATH 090
If (Placement) > -0.5, then the student should be placed in MATH 090

Course Grades

Grades were recorded for 162 students. 85% of students successfully passed their SAU math course; 15% of students were unsuccessful (and, perhaps, inappropriately placed). Some of the students earning A's may also have been inappropriately placed, but we will ignore these students for now.

	A	B+	B	C+	C	D	F	Total
M090		1	2		2	1	1	7
M095	6	1	12	1	16	7	10	53
M131	1	1	2					4
M151	15	9	21	2	14	3	3	67
M152	7		6					13
M171	5		2					7
M191	7		1		3			11
Total	41	12	46	3	35	11	14	162
	25%	36%		23%		15%		

Since only 4 students chose to place themselves in higher courses, the above table also demonstrates the success rate of the current placement methods.

Multinomial Logistic Regression (Effect of ACT and GPA on our placement decisions):

```
Multinomial logistic regression                 Number of obs   =        449
                                                Wald chi2(6)    =     145.79
                                                Prob > chi2     =     0.0000
Log pseudolikelihood = -234.50675               Pseudo R2       =     0.5492

------------------------------------------------------------------------------
             |               Robust
   placemnt |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
0            |
     actmath |  -1.653118   .3022048    -5.47   0.000    -2.245429   -1.060808
       hsgpa |  -.4365549   .7869236    -0.55   0.579    -1.978897    1.105787
       _cons |   26.55993   5.070189     5.24   0.000     16.62254    36.49732
-------------+----------------------------------------------------------------
1            |
     actmath |  -.6841248   .0949373    -7.21   0.000    -.8701986   -.4980511
       hsgpa |  -1.232749   .3417917    -3.61   0.000    -1.902649   -.5628501
       _cons |   15.34078   2.184551     7.02   0.000     11.05914    19.62242
-------------+----------------------------------------------------------------
3            |
     actmath |   1.128323   .1528112     7.38   0.000     .8288186    1.427828
       hsgpa |   1.570369   .4561456     3.44   0.001     .6763401    2.464398
       _cons |  -30.38062    3.47585    -8.74   0.000    -37.19316   -23.56808
------------------------------------------------------------------------------
(placemnt==2 is the base outcome)
```

The above output displays the change in log-odds of being placed in (GROUP A) vs. (MATH 095) for every unit change in ACT MATH and/or HS GPA. This could be used to create a placement decision rule, but it also shows that ACT MATH scores had more impact on placement than HS GPA.

For each point decrease in ACT MATH scores, the log-odds of being placed below MATH 095 increases by –0.68.

LOGISTIC REGRESSION ANALYSES Success = f(HSGPA, ACTMATH) for each course

MTX: All students placed above MATH 151 successfully completed their courses.

MTI: Students who were allowed to take any course above MATH 095

```
Logistic regression                                     Number of obs   =         54
                                                        Wald chi2(2)    =      11.66
                                                        Prob > chi2     =     0.0029
Log pseudolikelihood = -11.156254                       Pseudo R2       =     0.2176

------------------------------------------------------------------------------
             |               Robust
     success |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       hsgpa |   2.622127   1.713971     1.53   0.126    -.7371953    5.981449
     actmath |  -.3932889   .2805641    -1.40   0.161    -.9431845    .1566068
       _cons |   2.984838   9.490967     0.31   0.753    -15.61711    21.58679
------------------------------------------------------------------------------

------------------------------------------------------------------------------
             |               Robust
     success | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       hsgpa |   13.76497   23.59276     1.53   0.126      .478454    396.0136
     actmath |   .6748338   .1893342    -1.40   0.161     .3893859    1.169536
------------------------------------------------------------------------------
```

MTE: Students placed into MATH 095

```
Logistic regression                                     Number of obs   =         47
                                                        Wald chi2(2)    =       2.25
                                                        Prob > chi2     =     0.3241
Log pseudolikelihood =   -27.7819                       Pseudo R2       =     0.0561

------------------------------------------------------------------------------
             |               Robust
     success |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       hsgpa |   1.027494   .8135075     1.26   0.207    -.5669512     2.62194
     actmath |  -.2281188   .2187916    -1.04   0.297    -.6569424    .2007048
       _cons |   1.795542   4.100812     0.44   0.661    -6.241901    9.832985
------------------------------------------------------------------------------

------------------------------------------------------------------------------
             |               Robust
     success | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       hsgpa |   2.794056   2.272985     1.26   0.207     .5672523    13.76239
     actmath |   .7960297   .1741646    -1.04   0.297     .5184341    1.222264
------------------------------------------------------------------------------
```

MTR: Students placed into MATH 090

Having a HS GPA at 2.7 or above guaranteed success in this course.

We could use a cluster analysis to find 4 groups of students
We could use a discriminant analysis function to classify students (and allow them to test)
We could use a logistic regression analysis and calculate probabilities of success