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ABSTRACT

A study was conducted at Scottsdale and Paradise Valley community colleges to assess the importance of math for the study of economic principles and the extent to which a student's math background determines performance in micro- and macro-economic courses. Students (N=156) from six economic principles classes were surveyed regarding their high school math backgrounds, scores on math placement exams, and college math courses completed. Information for 93 of the students was either regressed/correlated or subjected to analysis of variance against student final term averages in the surveyed classes. The following conclusions were reached: (1) the level of college math completed appears to have a small, but still significant effect on a student's final term average in the micro- and macro-economics courses; (2) some relationship was found between a student's score on the numerical math placement exam and the student's final term average in economics, though no relationship was found for the other placement exams; and (3) no relationship was found between high school math background and final averages in economics. Appendixes include the math survey and the regression analyses. (KP)

MATH BACKGROUND AS A PREDICTOR OF STUDENT SUCCESS IN THE COLLEGE ECONOMIC PRINCIPLES COURSES:

A PRELIMINARY ANALYSIS

GLENDALE COMMUNITY COLLEGE

JUNE 1994

ACKNOWLEDGEMENTS

Mike Morgan, from Scottsdale Community College, and Shirley Green, from Paradise Valley Community College, provided the math placement scores that were used in this study. A word of thanks is also due to the students who completed the survey instrument. Finally, I am indebted to Vicki Rhea for her kindly help and assistance in preparing this document.

- Michael Petrowsky
June 1994

EXECUTIVE SUMMARY

One hundred and fifty-six students, from six economic principles classes at two community colleges, were surveyed in areas pertaining to their high school math backgrounds, scores on a math placement exam and college math courses that they had completed. This information was then either regressed/correlated or subjected to ANOVA against student final term averages in the surveyed micro and macro-economic classes. For the ninety-three students for which data was usable, the following conclusions were reached:

1. The level of college math completed appears to have a small - but still significant - effect on a student's final term average in the micro and macro-economics courses.

2. Some relationship was found between a student's score on the numerical math placement exam and the student's final term average in economics. No relationship was found for the other placement exams.

3. No relationship was found between high school math background and final term averages in economics.

CONTENTS

MATH BACKGROUND AS A PREDICTOR OF STUDENT SUCCESS IN THE COLLEGE ECONOMIC PRINCIPLES COURSES: A PRELIMINARY ANALYSIS

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I

RATIONALE FOR STUDY

How important is mathematics for the study of economic principles? On a somewhat different level, to what extent does a student's math background determine subsequent performance in micro and macro-economic courses? While these questions may appear rather academic, they assume practical significance when consideration is given to the following perceptions that students and faculty have about the principles classes in economics:

1. There is a widespread belief that economics is abstract and mysterious.
2. Students and faculty share a perception that economics is theoretical, and that it is grounded in a confusing (and foreboding) array of graphs, charts and equations.
3. There is a general perception that economics is "harder" than other subjects, and especially so when comparisons are made with the other "softer" social sciences as well as with the humanities.

Perceptions, of course, sometimes conform to reality. Principles classes in economics have historically had a high student "drop" rate. Indeed, it is not unusual, and especially at the larger universities, for drop rates to approach fifty percent or more. Aside from the bad experience that this generates for students, these low retention rates may very well misallocate resources and contribute to fluctuating enrollment patterns.

Colleges in the Maricopa system have attempted to deal with the retention problem (in

economics, as well as in other courses) through a number of strategies. The creation of learning assistance centers, and the use of tutors, are two such examples. So, too, are the use of placement exams, and the development of mini "generic" courses that attempt to deal with such common problems as test anxiety, stress management, and other test-taking skills. To implement this, all the above strategies have been supported by a cadre of advisors, counselors and other educational specialists.

Yet much of this has had very little effect on the retention problem in classes of economic principles. While this is, of course, unfortunate, much of this can be accounted for by the fact that most classes in economics do not require prerequisites. Specifically, math prerequisites are not normally required as background for the courses in micro and macro-economics. Similarly, suggested score levels on the placement exams are not usually required. Given this, it is a rather salient question to ask if adding prerequisites and benching placement scores would make a difference. That is, given the quantitative and graph-oriented nature of economics materials, could retention be improved by (1) establishing minimum levels on a math placement score and/or by (2) adopting a math course prerequisite?

The implementation of either tactic has clear costs. Adding prerequisites or establishing minimum placement scores will in all probability lower enrollment. FTSE reduction, then, is a very real and probable outcome. The benefit, however, could be increased retention <u>if</u> math background (measured as either a placement score or the completion of a course) is a significant determinant of student success in economics. In effect, initial lower FTSE enrollment could be (at least partially) counterbalanced by higher student retention figures at the end of the 45th day cut-off period <u>if</u> math background is a significant variable.

So the issue is largely empirical and centers on the importance of mathematics to subsequent student success in economics. Given this line of reasoning, the study had the following objectives:

1. How is student success (measured by a final term average) in the micro and macro-economics courses, affected by:
   - High school math background?
   - Math placement scores?
   - Completion of college math courses?
2. What recommendations, if any, should follow from these results?

These objectives determined the focus of the study.

II

SCOPE OF SURVEY

Limitizations of time and money are the natural restraints of any survey. This survey was no exception to these constraining factors. Because of this, the survey was limited to classes that I taught at Scottsdale (SCC) and Paradise Valley (PVCC) Community Colleges during the 1992 spring semester. The survey population consisted of micro and macro-economics classes and contained the following elements:

TABLE 1

Classes Surveyed, by College and Class Type

COURSE

COLLEGE	MICRO-ECONOMICS	MACRO-ECONOMICS
PVCC	2	3
SCC	1	
TOTALS	3	3

The number of students surveyed was thus based on six classes drawn from two colleges. The total number of students consisted of:

TABLE 2

Students Surveyed, by College and Class Type

COLLEGE	MICRO-ECONOMICS	MACRO-ECONOMICS
PVCC	54	77
SCC	15	
TOTALS	**79**	**77**

TOTAL SURVEY POPULATION = 156

During the spring of 1992, these students were asked to complete a questionnaire called the "Math Background Survey," which is contained in Appendix 1. The survey asked students to answer three major areas in their math backgrounds. These included their high school math backgrounds, their scores on the math placement exams, and math courses that they had completed at a college.

The data from this instrument provided the bulk of information that is used in the survey. Because of this, several cautionary notes are in order. First, the survey is not random in the statistical sense of the word. Problems are obviously generated in terms of wider validity as a result.

Second, the survey assumes that students answered both truthfully and knowledgeably about their math backgrounds.[1] While this is, of course, a problem with any survey, it does create problems in terms of replicability. Students, for example, may not have correctly remembered their last math course taken or even correctly remembered their grades in a given high school or college math class. (Correcting for this problem would have required going through student records for each and every student. Needless to say, time constraints, as well as issues of confidentiality, precluded this from occurring.)

Third, there is the issue of withdrawals, an issue that was not dealt with in this study. This omission occurred for several reasons. First, many students dropped before the survey was administered. Second, many students were not attending classes at the time the survey was administered and later withdrew before the survey could be taken at a later date. Aside from this, there is also the thorny problem of how to deal with withdrawals in the statistical sense. Because students withdraw for many reasons, it is difficult to assign a numerical grade. For these reasons, then, withdrawals were not considered in this study.

Finally, there is the limitation associated with sample size. As previously noted, 156 students were surveyed. Yet because of nonresponses, partial responses, and questionable answers, only 93 responses were considered usable for this study. This small size precludes making generalizations with strong assurance. But it also poses statistical problems as well. The small sample size prevented the examination of other factors (such as credits previously taken, age, etc.) that might affect outcomes. These other factors may intertwine with math levels in a way that could produce multicollinearity. Treating this would have necessitated a much larger sample.

III

SURVEY RESULTS

Final term averages in the micro and macro-economics courses were used as dependent variables and were regressed, correlated, and tested using ANOVA against the following data:

- College math levels completed
- Reported high school math backgrounds
- Scores on math placement exam

A. RELATIONSHIP BETWEEN FINAL TERM AVERAGES IN ECONOMICS AND COLLEGE MATH LEVELS COMPLETED:

1. Appendix 2 shows the final term averages (listed as "scores") of 93 students for which the previous college math levels were known. Dummy variables were used to distinguish math levels completed and had the following numbers assigned:

Course Description	Course No.	Assigned Variable	No. Surveyed
Arithmetic Review	055	1	1
Intro Algebra	077	2	22
Intermed Algebra	129/124	3	30
College Algebra	155	4	21
Trigonometry	160	5	
College Algebra/Trig	165	5	15
Finite Math	179	5	
Brief Calculus	210	6	9
			Total: 93

Based on the data, a regression equation was fitted and had the form:

- Term Average = 69.0884 + 2.4204 (math level)

The slope of the function (B_1 or 2.4204) was shown to be statistically significant. On an interpretive level, the function indicates that each ascending math level adds 2.42 points to the final term average. Put another way, the equation says that a student with an 055 math background would attain a 71.50 term average, while a student with a math 210 level background would attain an 83.61 term average.

It should be pointed out that while B_1 is statistically significant, Appendix 2 also shows the correlation coefficient and the coefficient of determination to be rather low. This is an indication of a weak relationship or a relationship in which other factors are at work.

2. In Appendix 3, ANOVA was used to test the difference between term averages for each math level. That is, the term averages for all MAT 077, 129, 155, 179 and 210 students were compared.[2] (The null hypothesis was that these averages were similar; the alternative was that the groups showed differences.)

The computed F-value was 2.470, which was under the critical F-value of 2.494, so there was no reason to reject the null hypothesis. At this point, there was no reason to conclude that the group means (term averages) were different. Still, the computed and critical F-values were so close (and the sample sizes so small, given five columns), that it might be beneficial to disaggregate the data.

3. Appendix 4 attempts to do this by comparing the group term averages of MAT 077 students against the group term averages of their MAT 155 counterparts. MAT 077 students had a group term average of 71.59; the MAT 155 students had a group term average of 78.66. A two-sided comparison of means tests shows that this difference is significant at the 5% confidence level.

B. RELATIONSHIP BETWEEN FINAL TERM AVERAGES IN ECONOMICS AND MATH PLACEMENT SCORES:

1. Appendix 5 shows the results of a correlation and regression analysis that

was done for 26 students for which term averages (scores) in economics could be contrasted with student scores on the math numerical skills placement exam. Based on the data, a regression equation was fitted and had the form:

- Term Average = 24.30 + 1.28 (numerical skills placement scores)

The slope of the function (B_1 or 1.2812) was shown to be statistically significant. Each point on the placement exam could conceivably translate into 1.28 points on a student's ending term average. The correlation coefficient (.5502) was also significant. Seen another way, a numerical placement score of 39.6 translates into a final term average of 75; similarly, a placement score of 47-48 translates into a final term average of 85.

2. Term averages in economics were also correlated and regressed for 20 students that had taken the elementary algebra placement test. Appendix 6 shows the results. As the data indicates, no significant relationship was found.

3. Appendix 7 examines the relationship between scores on the intermediate algebra placement exam and final term averages in economics. No significant relationship could be found for the 12 students that had taken the placement exam in intermediate algebra. The small sample size, however, precludes a definitive conclusion.

C. RELATIONSHIP BETWEEN FINAL TERM AVERAGES IN ECONOMICS AND HIGH SCHOOL MATH BACKGROUNDS:

The survey instrument in Appendix 1 asked students to indicate their high school math backgrounds. This would normally consist of first year algebra (Algebra 1-2), geometry, second year algebra (Algebra 3-4), and trigonometry. Dummy variables were assigned to the highest math level students achieved in high school. The variables had the following format:

Reported High School Course Completed	Coded Rank
Algebra 1-2	1
Algebra 3-4	2
Trigonometry	3

Geometry was not used because of the small number that reported. Based on this data, the results listed below were obtained:

1. Appendix 8 uses ANOVA to compare the differences in group term averages in economics between students with different reported high school math backgrounds. (The null hypothesis is that there are no differences. The alternative hypothesis is that there is a difference - i.e., students who had trigonometry should report higher term averages in economics than students who just had Algebra 1-2.)

The ANOVA results supported the null hypothesis. There appears to be no significant difference in economic term averages based on high school math background.

2. Term averages in economics were also correlated and regressed for the 86 students that had reported their high school math backgrounds. Appendix 9 shows the results. As the data indicates, no significant relationship was found. The coefficient of determination and the correlation coefficient was extremely low. B_1 (the slope of the function) was not statistically significant.

3. Classic hypothesis testing was also used to test the difference between two means. The differences in group term averages in economics for students with an Algebra 1-2 background were contrasted with those that reported high school trigonometry. Students that reported having a background of Algebra 1-2 (first year) in high school had a term average of 76.13 in economics; those that reported having had trigonometry had a term average of 81. The difference, however, was not statistically significant.

IV

ANALYSIS OF FINDINGS AND RECOMMENDATIONS

1. The level of college math completed appears to have a small - but significant - effect on a student's final term average in economics. While the correlation coefficient was low, B_1 (the slope of the function) was found to be statistically significant. This was further supported by the use of classic hypothesis testing between two means. Math 155 students had higher term averages than their Math 077 counterparts. This difference was significant at the 5% confidence level.

   A cautious result of these findings would appear to warrant a recommendation that some college math be required as a prerequisite. A recommendation that students have completed at least Math 077 might be a useful first start. Inasmuch as a large number of students have already completed this course, a Math 077 prerequisite would be minimally disruptive in terms of enrollment.

2. Because of the small sample size, the analysis made between math placement scores and final term averages was largely inconclusive. The exception occurred for the numerical math placement exam. A positive relationship was found. Clearly, more work needs to be done in this area.

3. High school math background appears to have no impact on subsequent student success in economics. The age of our students (mid-20's), and thus, the "datedness" of their high school math skills, might be a primary reason for this outcome.

ENDNOTES

1.*Math placement exam scores were also obtained from student records at the two colleges.

2.**Numbers were too small (1) to test for Math 055.

Name _____

Class _____ APPENDIX 1 : MATH BACKGROUND SURVEY INSTRUMENT

Time _____

MATH BACKGROUND SURVEY

I. High School Background

Indicate the highest level of math, and the grade, that you had in high school:

Course	Grade	Date Course Completed

II. PVCC

- ○ Score on math placement exam _____
- ○ Math courses taken at PVCC:

Course	Grade	Date Taken
1.		
2.		
3.		

APPENDIX 2: CORRELATION AND REGRESSION OF COLLEGE MATH LEVEL COMPLETED AND FINAL TERM AVERAGE IN ECONOMICS

CBS-Simple Correlation & Regressi 01-14-1993 - 15:16:17

Information Entered

Number of Data Points:	93
Alpha Error:	.05
Critical t:	1.989667
Dependent Variable:	# 2 - score

	math	score		math	score		math	score		math	score
1 =	1	82	12 =	2	76	23 =	2	69	34 =	3	87
2 =	2	92	13 =	2	75	24 =	3	97	35 =	3	74
3 =	2	77	14 =	2	77	25 =	3	70	36 =	3	67
4 =	2	72	15 =	2	66	26 =	3	60	37 =	3	92
5 =	2	80	16 =	2	79	27 =	3	82	38 =	3	93
6 =	2	76	17 =	2	60	28 =	3	93	39 =	3	92
7 =	2	59	18 =	2	63	29 =	3	82	40 =	3	69
8 =	2	72	19 =	2	93	30 =	3	73	41 =	3	79
9 =	2	67	20 =	2	65	31 =	3	84	42 =	3	73
10 =	2	40	21 =	2	70	32 =	3	94	43 =	3	60
11 =	2	72	22 =	2	75	33 =	3	67	44 =	3	81

	math	score		math	score		math	score
45 =	3	51	64 =	4	72	83 =	5	94
46 =	3	96	65 =	4	70	84 =	5	79
47 =	3	88	66 =	4	78	85 =	6	99
48 =	3	68	67 =	4	91	86 =	6	82
49 =	3	67	68 =	4	80	87 =	6	94
50 =	3	69	69 =	4	79	88 =	6	93
51 =	3	70	70 =	4	75	89 =	6	88
52 =	3	76	71 =	4	85	90 =	6	81
53 =	3	92	72 =	4	73	91 =	6	88
54 =	4	68	73 =	4	65	92 =	6	69
55 =	4	80	74 =	4	89	93 =	6	55
56 =	4	80	75 =	5	72			
57 =	4	76	76 =	5	82			
58 =	4	71	77 =	5	82			
59 =	4	68	78 =	5	77			
60 =	4	84	79 =	5	91			

```
******************   Interval Estimate   *****************
*                                                         *
*  Model:  score =  69.0884  +  2.420368 math             *
***********************************************************
*                                                         *
*  Value of math:          6                              *
*                                                         *
*                                                         *
***********************************************************
*  score =  83.615  +/-  5.041  (mean)                    *
*  score =  83.615  +/-  22.229  (individual)             *
***********************************************************
******************   Interval Estimate   *****************
*                                                         *
*  Model:  score =  69.0884  +  2.420368 math             *
***********************************************************
*                                                         *
*  Value of math:          5                              *
*                                                         *
*                                                         *
***********************************************************
*  score =  81.195  +/-  3.534  (mean)                    *
*  score =  81.195  +/-  21.937  (individual)             *
***********************************************************
******************   Interval Estimate   *****************
*                                                         *
*  Model:  score =  69.0884  +  2.420368 math             *
***********************************************************
*                                                         *
*  Value of math:          4                              *
*                                                         *
*                                                         *
***********************************************************
*  score =  78.774  +/-  2.438  (mean)                    *
*  score =  78.774  +/-  21.787  (individual)             *
***********************************************************
```

```
******************   Interval Estimate   *****************
*                                                         *
*  Model:  score =  69.0884  +  2.420368 math             *
***********************************************************
*                                                         *
*  Value of math:          3                              *
```

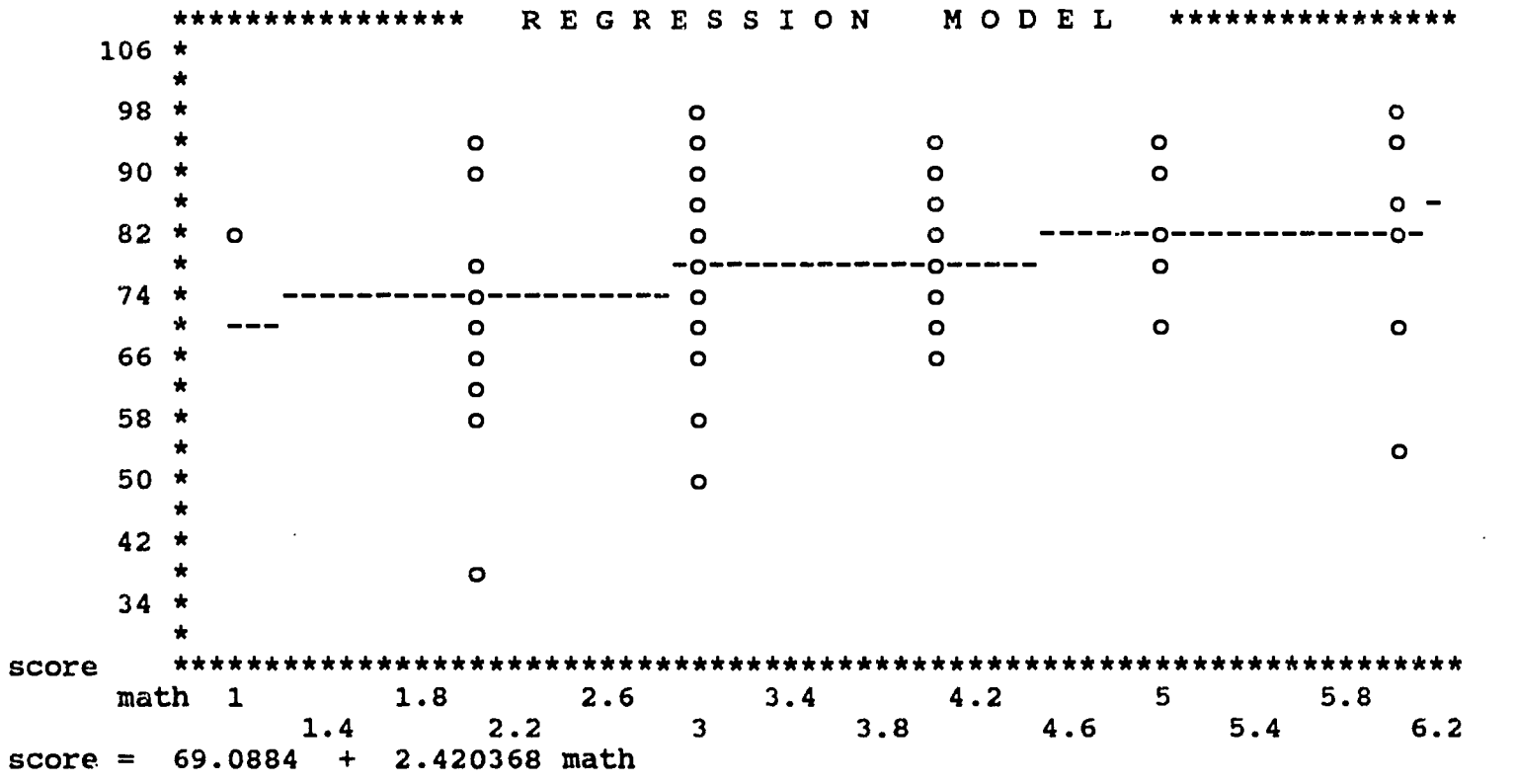
```
*                                                                    *
*                                                                    *
**********************************************************************
*  score =  76.354  +/-  2.403  (mean)                               *
*  score =  76.354  +/-  21.783  (individual)                        *
**********************************************************************
*******************   Interval Estimate   ************************
*                                                                    *
*  Model:  score =  69.0884  +  2.420368 math                        *
**********************************************************************
*                                                                    *
*  Value of math:          2                                         *
*                                                                    *
*                                                                    *
**********************************************************************
*  score =  73.934  +/-  3.461  (mean)                               *
*  score =  73.934  +/-  21.925  (individual)                        *
**********************************************************************
*******************   Interval Estimate   ************************
*                                                                    *
*  Model:  score =  69.0884  +  2.420368 math                        *
**********************************************************************
*                                                                    *
*  Value of math:          1                                         *
*                                                                    *
*                                                                    *
**********************************************************************
*  score =  71.513  +/-  4.955  (mean)                               *
*  score =  71.513  +/-  22.21  (individual)                         *
**********************************************************************
*******************   Interval Estimate   ************************
*                                                                    *
*  Model:  score =  69.0884  +  2.420368 math                        *
**********************************************************************
*                                                                    *
*  Value of math:          0                                         *
*                                                                    *
*                                                                    *
**********************************************************************
*  score =  69.093  +/-  6.595  (mean)                               *
*  score =  69.093  +/-  22.632  (individual)                        *
**********************************************************************
```

Workstation attached to the network

If you did not intend to use the network at this time, please insert your boot floppy in drive A:, close the drive door, then press the R key to reboot the computer

A. Diskette options for drive A:
B. Diskette options for drive B:
L. Login to network
R. Reboot computer
T. Terminal emulate to VAX
E. Connect to Electronic Forum

Please press the letter of the desired option:



55 =	4	80	74 =	4	89	93 =	6	55
56 =	4	80	75 =	5	72			
57 =	4	76	76 =	5	82			
58 =	4	71	77 =	5	82			
59 =	4	68	78 =	5	77			
60 =	4	84	79 =	5	91			
61 =	4	89	80 =	5	79			
62 =	4	95	81 =	5	70			
63 =	4	84	82 =	5	77			

Results

B0 Coefficient:	69.0884
B1 Coefficient:	2.4204
Mean of X (math):	3.4731
Mean of Y (score):	77.4946
Sum of Squares Regression:	862.2236
Sum of Squares Error:	10,771.0234
Sum of Squares Total:	11,633.2471
Coefficient of Determination:	0.0741
Correlation Coefficient:	0.2722
Standard Error Estimate:	10.8795
Standard Error B1:	0.8968
Computed t:	2.6990
Critical t:	1.9897
p value:	0.0083

Conclusion: B1 is statistically significant

Residual Analysis

Number	Y-Actual	Y-Pred	Residual
1	82	71.5088	10.4912
2	92	73.9291	18.0709
3	77	73.9291	3.0709
4	72	73.9291	-1.9291

5	80	73.9291	6.0709
6	76	73.9291	2.0709
7	59	73.9291	-14.9291
8	72	73.9291	-1.9291
9	67	73.9291	-6.9291
10	40	73.9291	-33.9291
11	72	73.9291	-1.9291
12	76	73.9291	2.0709
13	75	73.9291	1.0709
14	77	73.9291	3.0709
15	66	73.9291	-7.9291
16	79	73.9291	5.0709
17	60	73.9291	-13.9291

Residual Analysis

Number	Y-Actual	Y-Pred	Residual
18	63	73.9291	-10.9291
19	93	73.9291	19.0709
20	65	73.9291	-8.9291
21	70	73.9291	-3.9291
22	75	73.9291	1.0709
23	69	73.9291	-4.9291
24	97	76.3495	20.6505
25	70	76.3495	-6.3495
26	60	76.3495	-16.3495
27	82	76.3495	5.6505
28	93	76.3495	16.6505
29	82	76.3495	5.6505
30	73	76.3495	-3.3495
31	84	76.3495	7.6505
32	94	76.3495	17.6505
33	67	76.3495	-9.3495
34	87	76.3495	10.6505

Residual Analysis

Number	Y-Actual	Y-Pred	Residual
35	74	76.3495	-2.3495
36	67	76.3495	-9.3495
37	92	76.3495	15.6505
38	93	76.3495	16.6505
39	92	76.3495	15.6505
40	69	76.3495	-7.3495
41	79	76.3495	2.6505
42	73	76.3495	-3.3495
43	60	76.3495	-16.3495
44	81	76.3495	4.6505
45	51	76.3495	-25.3495
46	96	76.3495	19.6505
47	88	76.3495	11.6505
48	68	76.3495	-8.3495
49	67	76.3495	-9.3495
50	69	76.3495	-7.3495
51	70	76.3495	-6.3495

Residual Analysis

Number	Y-Actual	Y-Pred	Residual
52	76	76.3495	-0.3495
53	92	76.3495	15.6505
54	68	78.7699	-10.7699
55	80	78.7699	1.2301
56	80	78.7699	1.2301
57	76	78.7699	-2.7699
58	71	78.7699	-7.7699
59	68	78.7699	-10.7699
60	84	78.7699	5.2301
61	89	78.7699	10.2301
62	95	78.7699	16.2301
63	84	78.7699	5.2301
64	72	78.7699	-6.7699
65	70	78.7699	-8.7699

66	78	78.7699	-0.7699
67	91	78.7699	12.2301
68	80	78.7699	1.2301

Residual Analysis

Number	Y-Actual	Y-Pred	Residual
69	79	78.7699	0.2301
70	75	78.7699	-3.7699
71	85	78.7699	6.2301
72	73	78.7699	-5.7699
73	65	78.7699	-13.7699
74	89	78.7699	10.2301
75	72	81.1902	-9.1902
76	82	81.1902	0.8098
77	82	81.1902	0.8098
78	77	81.1902	-4.1902
79	91	81.1902	9.8098
80	79	81.1902	-2.1902
81	70	81.1902	-11.1902
82	77	81.1902	-4.1902
83	94	81.1902	12.8098
84	79	81.1902	-2.1902
85	99	83.6106	15.3894

Residual Analysis

Number	Y-Actual	Y-Pred	Residual
86	82	83.6106	-1.6106
87	94	83.6106	10.3894
88	93	83.6106	9.3894
89	88	83.6106	4.3894
90	81	83.6106	-2.6106
91	88	83.6106	4.3894
92	69	83.6106	-14.6106
93	55	83.6106	-28.6106

APPENDIX 3: ANOVA -- GROUP FINAL TERM AVERAGES IN ECONOMICS, BY MATH LEVEL COMPLETED

CBS-Analysis of Variance 01-14-1993 - 14:59:49

Information Entered

Number of Variables:	1
Number of Columns:	5
Alpha Error:	.05

	077	129	155	179	210		077	129	155	179	210
1 =	92	97	68	72	99	13 =	77	67	78		
2 =	77	70	80	82	82	14 =	66	92	91		
3 =	72	60	80	82	94	15 =	79	93	80		
4 =	80	82	76	77	93	16 =	60	92	79		
5 =	76	93	71	91	88	17 =	63	69	75		
6 =	59	82	68	79	81	18 =	93	79	85		
7 =	72	73	84	70	88	19 =	65	73	73		
8 =	67	84	89	77	69	20 =	70	60	65		
9 =	40	94	95	94	55	21 =	75	81	89		
10 =	72	67	84	79		22 =	69	51			
11 =	76	87	72			23 =		96			
12 =	75	74	70			24 =		88			

	077	129	155	179	210
25 =		68			
26 =		67			
27 =		69			
28 =		70			
29 =		76			
30 =		92			

Results

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Squared	Computed F-Value
Columns:	1,184.288	4	296.072	2.470
Error:	10,428.440	87	119.867	
Totals:	11,612.729	91		

Critical F (Col): 2.494 Do Not Reject Null Hypothesis

Information Entered

Number of Variables:	1
Number of Columns:	5
Alpha Error:	.05

	077	129	155	179	210
1 =	92	97	68	72	99
2 =	77	70	80	82	82
3 =	72	60	80	82	94
4 =	80	82	76	77	93
5 =	76	93	71	91	88
6 =	59	82	68	79	81
7 =	72	73	84	70	88
8 =	67	84	89	77	69
9 =	40	94	95	94	55
10 =	72	67	84	79	
11 =	76	87	72		
12 =	75	74	70		
13 =	77	67	78		
14 =	66	92	91		
15 =	79	93	80		
16 =	60	92	79		
17 =	63	69	75		
18 =	93	79	85		
19 =	65	73	73		
20 =	70	60	65		
21 =	75	81	89		
22 =	69	51			
23 =		96			
24 =		88			

	077	129	155	179	210
25 =		68			
26 =		67			
27 =		69			
28 =		70			
29 =		76			
30 =		92			

APPENDIX 4: HYPOTHESIS TESTING - COMPARISON OF GROUP FINAL TERM AVERAGES FOR MATH 077 AND MATH 155 STUDENTS

CBS-Hypothesis Testing 01-14-1993 - 15:29:16

Information Entered

Test Procedure:	Two Sided
Alpha Error:	0.0500
Critical Z (Test Statistic - alpha/2):	1.9600
Hypothesis Value:	0.0500
Sample Size for Group 1:	22
Sample Size for Group 2:	21
Mean for Group 1:	71.5909
Mean for Group 2:	78.6667
Standard Deviation (S) for Group 1:	11.1084

Standard Deviation (S) for Group 2: 8.3086

	077	155		077	155
1 =	92	68	20 =	70	65
2 =	77	80	21 =	75	89
3 =	72	80	22 =	69	
4 =	80	76			
5 =	76	71			
6 =	59	68			
7 =	72	84			
8 =	67	89			
9 =	40	95			
10 =	72	84			
11 =	76	72			
12 =	75	70			
13 =	77	78			
14 =	66	91			
15 =	79	80			
16 =	60	79			
17 =	63	75			
18 =	93	85			
19 =	65	73			

Results

Standard Error of Mean (unequal variances):	2.9827
Lower Limit:	-5.7960
Upper Limit:	5.8960
Standard Error of Mean (equal variances):	3.0028
Lower Limit:	-5.8355
Upper Limit:	5.9355
Mean 1 - Mean 2:	-7.0758
Degrees of Freedom:	41
Critical Z (Test Statistic - alpha/2):	1.9600
Computed Z (unequal variances):	-6.0966
p value:	0.0002

Conclusion: reject hypothesis

Power Curve

-- unequal variances --

	Actual	Beta	1-Beta
1	-6.6405	0.0233	0.9767
2	-6.2182	0.1610	0.8390
3	-5.7960	0.5000	0.5000
4	-5.3738	0.8390	0.1610
5	-4.9515	0.9767	0.0233

-- equal variances--

	Actual	Beta	1-Beta
1	-6.6800	0.0233	0.9767
2	-6.2577	0.1610	0.8390
3	-5.8355	0.5000	0.5000
4	-5.4132	0.8390	0.1610
5	-4.9910	0.9767	0.0233

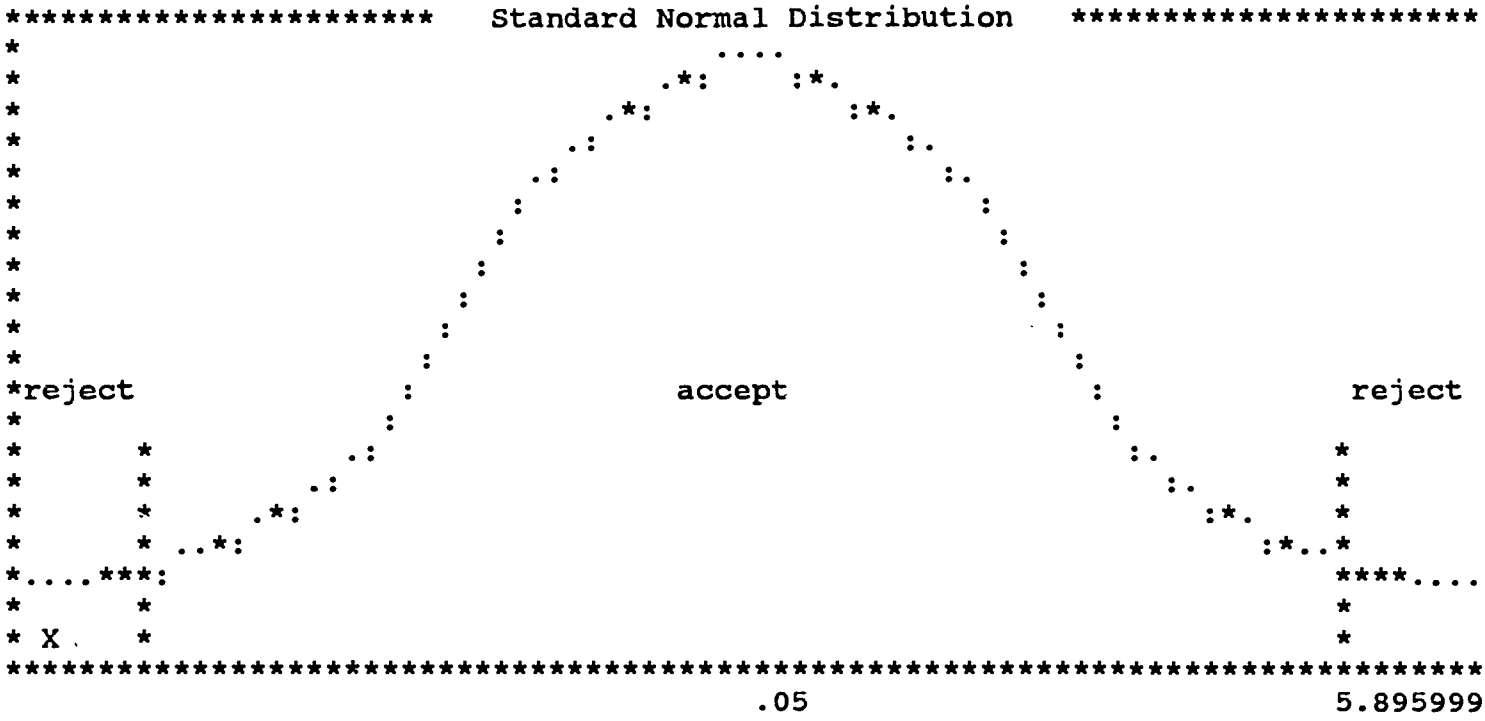
Workstation attached to the network

If you did not intend to use the network at this time, please insert your boot floppy in drive A:, close the drive door, then press the R key to reboot the computer

A. Diskette options for drive A:
B. Diskette options for drive B:

L. Login to network
R. Reboot computer
T. Terminal emulate to VAX
E. Connect to Electronic Forum

Please press the letter of the desired option:



APPENDIX 5: CORRELATION/REGRESSION ANALYSIS OF FINAL TERM AVERAGE IN ECONOMICS WITH SCORES ON NUMERICAL MATH PLACEMENT EXAM

CBS-Simple Correlation & Regressi 01-14-1993 - 15:54:26

Information Entered

Number of Data Points:	26
Alpha Error:	.05
Critical t:	2.064
Dependent Variable:	# 2 - score

	numpl	score		numpl	score		numpl	score
1 =	42	97	12 =	44	76	23 =	35	68
2 =	42	65	13 =	31	59	24 =	52	100
3 =	41	92	14 =	45	94	25 =	47	79
4 =	48	82	15 =	40	74	26 =	48	89
5 =	45	87	16 =	39	67			
6 =	32	68	17 =	51	85			
7 =	50	99	18 =	40	72			
8 =	37	77	19 =	39	76			
9 =	43	80	20 =	46	65			
10 =	36	68	21 =	44	51			
11 =	39	91	22 =	40	75			

CBS-Simple Correlation & Regressi 01-14-1993 - 15:55:33

Information Entered

Number of Data Points:	26
Alpha Error:	.05
Critical t:	2.064
Dependent Variable:	# 2 - score

	numpl	score		numpl	score		numpl	score
1 =	42	97	12 =	44	76	23 =	35	68
2 =	42	65	13 =	31	59	24 =	52	100
3 =	41	92	14 =	45	94	25 =	47	79
4 =	48	82	15 =	40	74	26 =	48	89
5 =	45	87	16 =	39	67			
6 =	32	68	17 =	51	85			
7 =	50	99	18 =	40	72			
8 =	37	77	19 =	39	76			
9 =	43	80	20 =	46	65			
10 =	36	68	21 =	44	51			
11 =	39	91	22 =	40	75			

Results

B0 Coefficient:	24.3018
B1 Coefficient:	1.2812
Mean of X (numpl):	42.1538
Mean of Y (score):	78.3077
Sum of Squares Regression:	1,239.8680
Sum of Squares Error:	2,855.6704
Sum of Squares Total:	4,095.5386
Coefficient of Determination:	0.3027
Correlation Coefficient:	0.5502
Standard Error Estimate:	10.9081
Standard Error B1:	0.3969
Computed t:	3.2280
Critical t:	2.0640
p value:	0.0036

Conclusion: B1 is statistically significant

Residual Analysis

Number	Y-Actual	Y-Pred	Residual
1	97	78.1106	18.8894
2	65	78.1106	-13.1106
3	92	76.8294	15.1706
4	82	85.7976	-3.7976
5	87	81.9541	5.0459
6	68	65.2990	2.7010
7	99	88.3599	10.6401
8	77	71.7048	5.2952
9	80	79.3918	0.6082
10	68	70.4236	-2.4236
11	91	74.2671	16.7329
12	76	80.6729	-4.6729
13	59	64.0178	-5.0178
14	94	81.9541	12.0459
15	74	75.5483	-1.5483
16	67	74.2671	-7.2671
17	85	89.6410	-4.6410

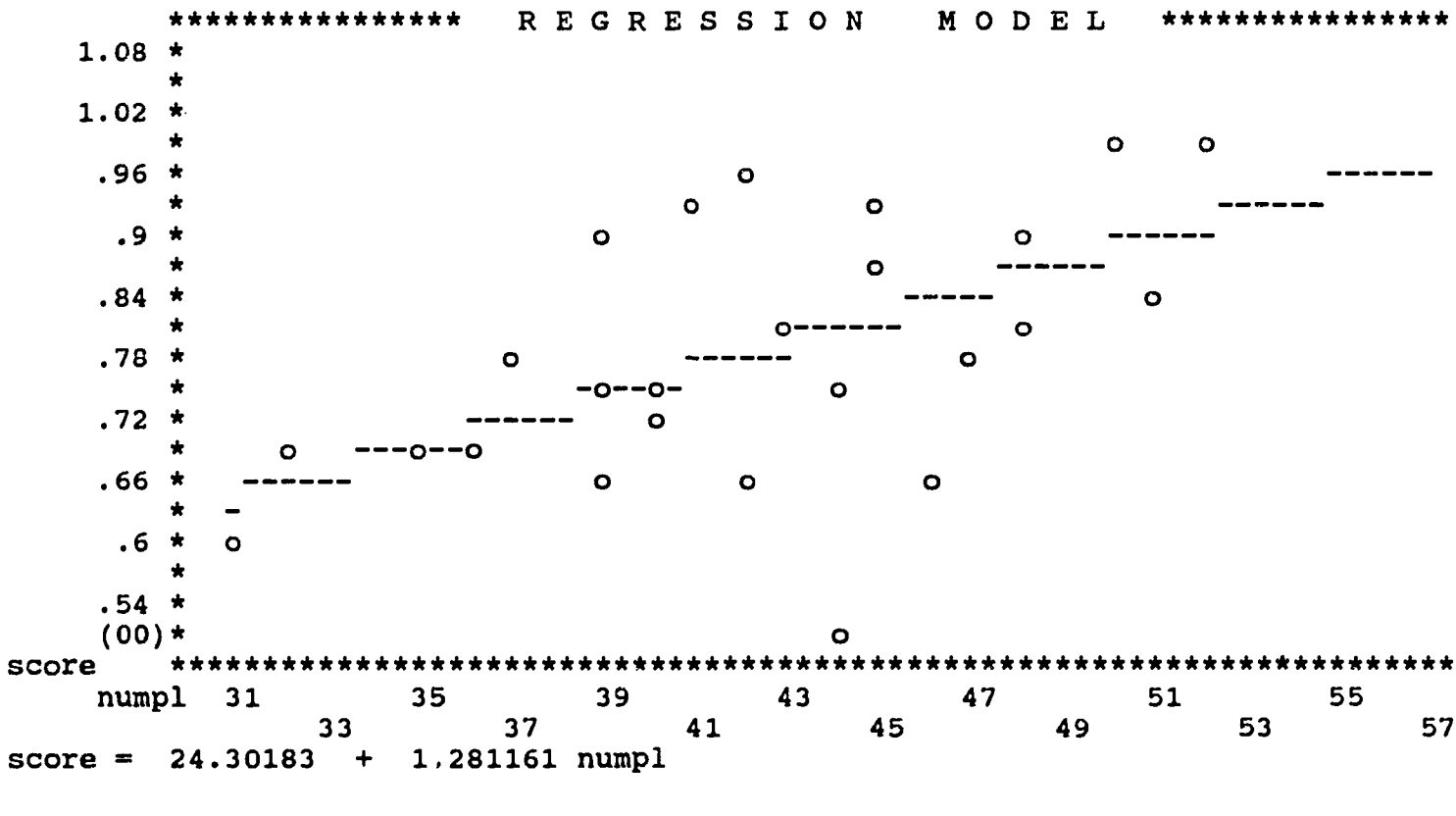
Residual Analysis

Number	Y-Actual	Y-Pred	Residual
18	72	75.5483	-3.5483
19	76	74.2671	1.7329
20	65	83.2352	-18.2352
21	51	80.6729	-29.6729
22	75	75.5483	-0.5483
23	68	69.1425	-1.1425
24	100	90.9222	9.0778
25	79	84.5164	-5.5164
26	89	85.7976	3.2024

```
********************   Interval Estimate   ******************
*                                                            *
*  Model:  score =  24.30183  +  1.281161 numpl              *
************************************************************
*                                                            *
*  Value of numpl:          30                               *
```

```
*                                                                    *
*                                                                    *
**********************************************************************
*  score =  62.741  +/-  10.896  (mean)                              *
*  score =  62.741  +/-  25.015  (individual)                        *
**********************************************************************
```

```
*******************   Interval Estimate   *****************
*                                                                    *
*  Model:  score =  24.30183  +  1.281161 numpl                      *
**********************************************************************
*                                                                    *
*  Value of numpl:          40                                       *
*                                                                    *
*                                                                    *
**********************************************************************
*  score =  75.553  +/-  4.759  (mean)                               *
*  score =  75.553  +/-  23.015  (individual)                        *
**********************************************************************
*******************   Interval Estimate   *****************
*                                                                    *
*  Model:  score =  24.30183  +  1.281161 numpl                      *
**********************************************************************
*                                                                    *
*  Value of numpl:          50                                       *
*                                                                    *
*                                                                    *
**********************************************************************
*  score =  88.364  +/-  7.802  (mean)                               *
*  score =  88.364  +/-  23.831  (individual)                        *
**********************************************************************
*******************   Interval Estimate   *****************
*                                                                    *
*  Model:  score =  24.30183  +  1.281161 numpl                      *
**********************************************************************
*                                                                    *
*  Value of numpl:          20                                       *
*                                                                    *
*                                                                    *
**********************************************************************
*  score =  49.93  +/-  18.682  (mean)                               *
*  score =  49.93  +/-  29.257  (individual)                         *
**********************************************************
```


REGRESSION MODEL
1.08
1.02
.96
.9
.84
.78
.72
.66
.6
.54
(00)
score
numpl 31 33 35 37 39 41 43 45 47 49 51 53 55 57
score = 24.30183 + 1.281161 numpl

APPENDIX 6: CORRELATION/REGRESSION ANALYSIS OF FINAL TERM AVERAGE IN ECONOMICS WITH SCORES ON THE ELEMENTARY ALGEBRA PLACEMENT EXAM

CBS-Simple Correlation & Regressi 01-14-1993 - 16:06:00

Information Entered

Number of Data Points:	20
Alpha Error:	.05
Critical t:	2.101
Dependent Variable:	# 2 - score

	elmpl	score		elmpl	score
1 =	48	70	12 =	40	70
2 =	40	60	13 =	34	65
3 =	45	76	14 =	44	70
4 =	38	56	15 =	34	51
5 =	38	93	16 =	31	75
6 =	50	65	17 =	36	69
7 =	31	71	18 =	44	70
8 =	40	72	19 =	44	76
9 =	31	76	20 =	40	90
10 =	50	75			
11 =	38	60			

CBS-Simple Correlation & Regressi 01-14-1993 - 16:06:55

Information Entered

Number of Data Points:	20
Alpha Error:	.05
Critical t:	2.101
Dependent Variable:	# 2 - score

	elmpl	score		elmpl	score
1 =	48	70	12 =	40	70
2 =	40	60	13 =	34	65
3 =	45	76	14 =	44	70
4 =	38	56	15 =	34	51
5 =	38	93	16 =	31	75
6 =	50	65	17 =	36	69
7 =	31	71	18 =	44	70
8 =	40	72	19 =	44	76
9 =	31	76	20 =	40	90
10 =	50	75			
11 =	38	60			

Results

B0 Coefficient:	64.7574
B1 Coefficient:	0.1443
Mean of X (elmpl):	39.8000
Mean of Y (score):	70.5000
Sum of Squares Regression:	14.1402
Sum of Squares Error:	1,880.8599
Sum of Squares Total:	1,895
Coefficient of Determination:	0.0075
Correlation Coefficient:	0.0864
Standard Error Estimate:	10.2221
Standard Error B1:	0.3922
Computed t:	0.3679
Critical t:	2.1010
p value:	0.7172

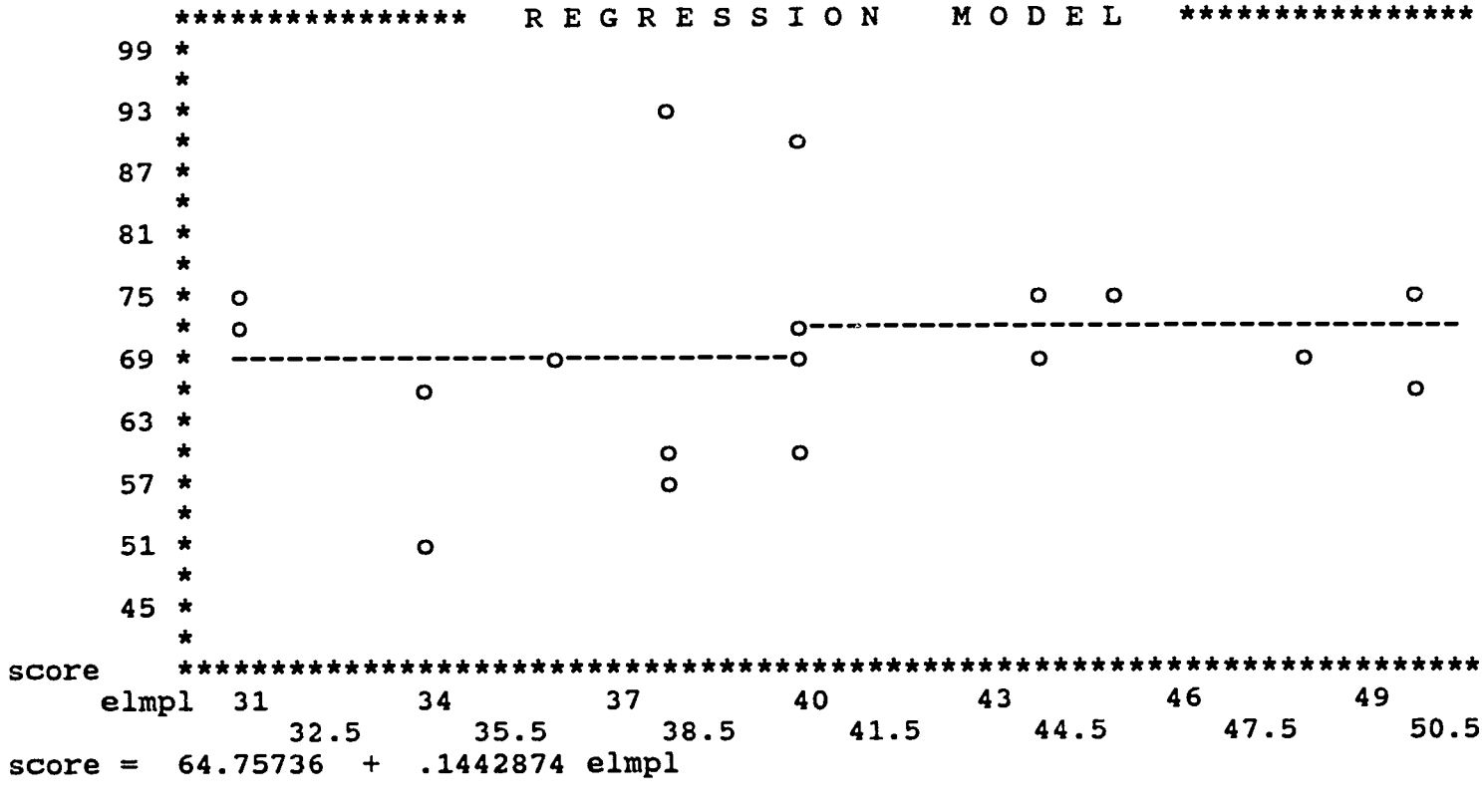
Conclusion: B1 is not statistically significant

Residual Analysis

Number	Y-Actual	Y-Pred	Residual
1	70	71.6832	-1.6832
2	60	70.5289	-10.5289
3	76	71.2503	4.7497
4	56	70.2403	-14.2403
5	93	70.2403	22.7597
6	65	71.9717	-6.9717
7	71	69.2303	1.7697
8	72	70.5289	1.4711
9	76	69.2303	6.7697
10	75	71.9717	3.0283
11	60	70.2403	-10.2403
12	70	70.5289	-0.5289
13	65	69.6631	-4.6631
14	7[illegible]	71.1060	-1.1060
15	5[illegible]	69.6631	-18.6631
16	75	69.2303	5.7697
17	69	69.9517	-0.9517

Residual Analysis

Number	Y-Actual	Y-Pred	Residual
18	70	71.1060	-1.1060
19	76	71.1060	4.8940
20	90	70.5289	19.4711


********** REGRESSION MODEL **********
99
93
87
81
75
69
63
57
51
45
score
elmpl 31 34 37 40 43 46 49
32.5 35.5 38.5 41.5 44.5 47.5 50.5
score = 64.75736 + .1442874 elmpl

APPENDIX 7: CORRELATIO/REGRESSION ANALYSIS OF FINAL TERM AVERAGE IN ECONOMICS WITH SCORES ON THE INTERMEDIATE ALGEBRA PLACEMENT EXAM

CBS-Simple Correlation & Regressi 01-14-1993 - 16:12:11

Information Entered

Number of Data Points:	12
Alpha Error:	.05
Critical t:	2.228
Dependent Variable:	# 2 - score

	intpl	score		intpl	score
1 =	31	60	12 =	43	67
2 =	33	72			
3 =	40	81			
4 =	45	82			
5 =	39	67			
6 =	42	92			
7 =	37	93			
8 =	33	70			
9 =	48	65			
10 =	37	96			
11 =	50	92			

7 =	37	93
8 =	33	70
9 =	48	65
10 =	37	96
11 =	50	92

Results

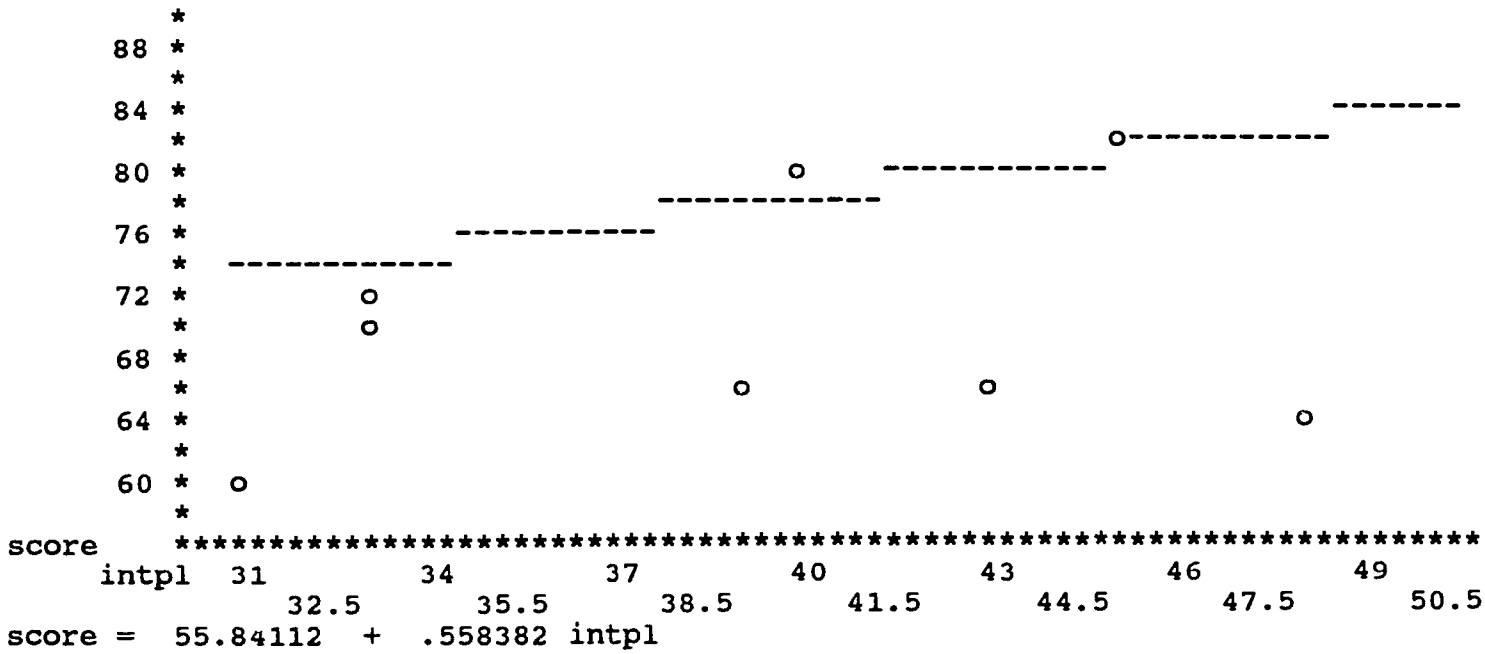
B0 Coefficient:	55.8411
B1 Coefficient:	0.5584
Mean of X (intpl):	39.8333
Mean of Y (score):	78.0833
Sum of Squares Regression:	124.6122
Sum of Squares Error:	1,676.3044
Sum of Squares Total:	1,800.9166
Coefficient of Determination:	0.0692
Correlation Coefficient:	0.2630
Standard Error Estimate:	12.9472
Standard Error B1:	0.6476
Computed t:	0.8622
Critical t:	2.2280
p value:	0.4086

Conclusion: B1 is not statistically significant

Residual Analysis

Number	Y-Actual	Y-Pred	Residual
1	60	73.1510	-13.1510
2	72	74.2677	-2.2677
3	81	78.1764	2.8236
4	82	80.9683	1.0317
5	67	77.6180	-10.6180
6	92	79.2932	12.7068
7	93	76.5013	16.4987
8	70	74.2677	-4.2677

9	65	82.6435	-17.6435
10	96	76.5013	19.4987
11	92	83.7602	8.2398
12	67	79.8515	-12.8515



score = 55.84112 + .558382 intpl

APPENDIX 8: ANOVA - GROUP FINAL TERM AVERAGES IN ECONOMICS, BY HIGH SCHOOL MATH BACKGROUND

CBS-Analysis of Variance 01-14-1993 - 16:48:57

Information Entered

Number of Variables:	1
Number of Columns:	3
Alpha Error:	.05

	alg12	alg34	trigc		alg12	alg34	trigc		alg12	alg34	trigc
1 =	97	86	68	13 =	82	67	73	25 =	74		
2 =	60	68	70	14 =	82	72	96	26 =	67		
3 =	55	72	72	15 =	89	75	89	27 =	82		
4 =	65	81	80	16 =	95	73	94	28 =	93		
5 =	87	56	80	17 =	93	66	55	29 =	92		
6 =	76	65	84	18 =	73	77		30 =	92		
7 =	80	60	94	19 =	84	79		31 =	76		
8 =	93	88	91	20 =	67	70		32 =	77		
9 =	81	72	79	21 =	40	75		33 =	69		
10 =	76	70	88	22 =	78	69		34 =	60		
11 =	62	81	91	23 =	94	92		35 =	85		
12 =	82	80	73	24 =	87			36 =	65		

	alg12	alg34	trigc
37 =	65		
38 =	70		
39 =	51		
40 =	68		
41 =	68		
42 =	67		
43 =	79		
44 =	69		
45 =	76		
46 =	79		

Results

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Squared	Computed F-Value
Columns:	536.647	2	268.323	2.036
Error:	10,936.435	83	131.764	
Totals:	11,473.081	85		

Critical F (Col): 3.119333 Do Not Reject Null Hypothesis

APPENDIX 9: CORRELATION/REGRESSION ANALYSIS OF FINAL TERM AVERAGE IN ECONOMICS AGAINST HIGH SCHOOL MATH BACKGROUND

CBS-Simple Correlation & Regressi 01-14-1993 - 16:34:05

Information Entered

Number of Data Points:	86
Alpha Error:	.05
Critical t:	1.992
Dependent Variable:	# 2 - score

	hsmat	score		hsmat	score		hsmat	score		hsmat	score
1 =	1	97	12 =	1	82	23 =	1	94	34 =	1	60
2 =	1	60	13 =	1	82	24 =	1	87	35 =	1	85
3 =	1	55	14 =	1	82	25 =	1	74	36 =	1	65
4 =	1	65	15 =	1	89	26 =	1	67	37 =	1	65
5 =	1	87	16 =	1	95	27 =	1	82	38 =	1	70
6 =	1	76	17 =	1	93	28 =	1	93	39 =	1	51
7 =	1	80	18 =	1	73	29 =	1	92	40 =	1	68
8 =	1	93	19 =	1	84	30 =	1	92	41 =	1	68
9 =	1	81	20 =	1	67	31 =	1	76	42 =	1	67
10 =	1	76	21 =	1	40	32 =	1	77	43 =	1	79
11 =	1	62	22 =	1	78	33 =	1	69	44 =	1	69

	hsmat	score		hsmat	score		hsmat	score
45 =	1	76	64 =	2	77	83 =	3	96
46 =	1	79	65 =	2	79	84 =	3	89
47 =	2	86	66 =	2	70	85 =	3	94
48 =	2	68	67 =	2	75	86 =	3	55

49 =	2	72	68 =	2	69
50 =	2	81	69 =	2	92
51 =	2	56	70 =	3	68
52 =	2	65	71 =	3	70
53 =	2	60	72 =	3	72
54 =	2	88	73 =	3	80
55 =	2	72	74 =	3	80
56 =	2	70	75 =	3	84
57 =	2	81	76 =	3	94
58 =	2	80	77 =	3	91
59 =	2	67	78 =	3	79
60 =	2	72	79 =	3	88
61 =	2	75	80 =	3	91
62 =	2	73	81 =	3	73
63 =	2	66	82 =	3	73

Results

B0 Coefficient:	73.5722
B1 Coefficient:	1.7188
Mean of X (hsmat):	1.6628
Mean of Y (score):	76.4302
Sum of Squares Regression:	157.2313
Sum of Squares Error:	11,315.8506
Sum of Squares Total:	11,473.0811
Coefficient of Determination:	0.0137
Correlation Coefficient:	0.1171
Standard Error Estimate:	11.6066
Standard Error B1:	1.5910
Computed t:	1.0804
Critical t:	1.9920
p value:	0.2831

Conclusion: B1 is not statistically significant

Residual Analysis

Number	Y-Actual	Y-Pred	Residual
1	97	75.2910	21.7090
2	60	75.2910	-15.2910
3	55	75.2910	-20.2910
4	65	75.2910	-10.2910
5	87	75.2910	11.7090
6	76	75.2910	0.7090
7	80	75.2910	4.7090
8	93	75.2910	17.7090
9	81	75.2910	5.7090
10	76	75.2910	0.7090
11	62	75.2910	-13.2910
12	82	75.2910	6.7090
13	82	75.2910	6.7090
14	82	75.2910	6.7090
15	89	75.2910	13.7090
16	95	75.2910	19.7090
17	93	75.2910	17.7090

Residual Analysis

Number	Y-Actual	Y-Pred	Residual
18	73	75.2910	-2.2910
19	84	75.2910	8.7090
20	67	75.2910	-8.2910
21	40	75.2910	-35.2910
22	78	75.2910	2.7090
23	94	75.2910	18.7090
24	87	75.2910	11.7090
25	74	75.2910	-1.2910
26	67	75.2910	-8.2910
27	82	75.2910	6.7090
28	93	75.2910	17.7090
29	92	75.2910	16.7090
30	92	75.2910	16.7090
31	76	75.2910	0.7090

32	77	75.2910	1.7090
33	69	75.2910	-6.2910
34	60	75.2910	-15.2910

Residual Analysis

Number	Y-Actual	Y-Pred	Residual
35	85	75.2910	9.7090
36	65	75.2910	-10.2910
37	65	75.2910	-10.2910
38	70	75.2910	-5.2910
39	51	75.2910	-24.2910
40	68	75.2910	-7.2910
41	68	75.2910	-7.2910
42	67	75.2910	-8.2910
43	79	75.2910	3.7090
44	69	75.2910	-6.2910
45	76	75.2910	0.7090
46	79	75.2910	3.7090
47	86	77.0098	8.9902
48	68	77.0098	-9.0098
49	72	77.0098	-5.0098
50	81	77.0098	3.9902
51	56	77.0098	-21.0098

Residual Analysis

Number	Y-Actual	Y-Pred	Residual
52	65	77.0098	-12.0098
53	60	77.0098	-17.0098
54	88	77.0098	10.9902
55	72	77.0098	-5.0098
56	70	77.0098	-7.0098
57	81	77.0098	3.9902
58	80	77.0098	2.9902
59	67	77.0098	-10.0098

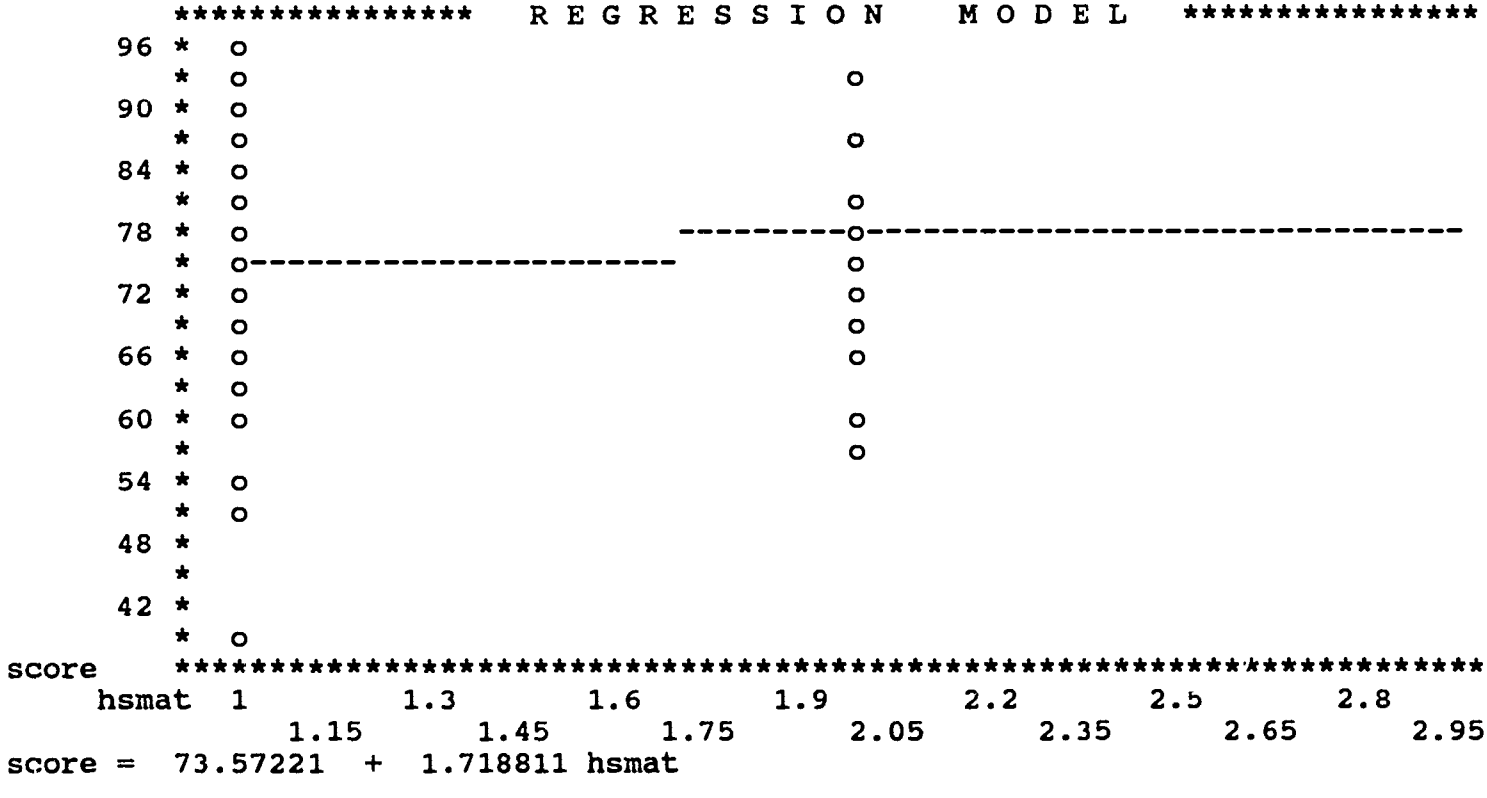
60	72	77.0098	-5.0098
61	75	77.0098	-2.0098
62	73	77.0098	-4.0098
63	66	77.0098	-11.0098
64	77	77.0098	-0.0098
65	79	77.0098	1.9902
66	70	77.0098	-7.0098
67	75	77.0098	-2.0098
68	69	77.0098	-8.0098

Residual Analysis

Number	Y-Actual	Y-Pred	Residual
69	92	77.0098	14.9902
70	68	78.7286	-10.7286
71	70	78.7286	-8.7286
72	72	78.7286	-6.7286
73	80	78.7286	1.2714
74	80	78.7286	1.2714
75	84	78.7286	5.2714
76	94	78.7286	15.2714
77	91	78.7286	12.2714
78	79	78.7286	0.2714
79	88	78.7286	9.2714
80	91	78.7286	12.2714
81	73	78.7286	-5.7286
82	73	78.7286	-5.7286
83	96	78.7286	17.2714
84	89	78.7286	10.2714
85	94	78.7286	15.2714

Residual Analysis

Number	Y-Actual	Y-Pred	Residual
86	55	78.7286	-23.7286


********** REGRESSION MODEL **********
96
90
84
78
72
66
60
54
48
42
score
hsmat 1 1.3 1.6 1.9 2.2 2.5 2.8
1.15 1.45 1.75 2.05 2.35 2.65 2.95
score = 73.57221 + 1.718811 hsmat

APPENDIX 10: HYPOTHESIS TESTING: COMPARISON OF GROUP TERM AVERAGES IN ECONOMICS FOR BEGINNING ALGEBRA AND TRIGONOMETRY STUDENTS

CBS-Hypothesis Testing 01-14-1993 - 16:56:49

Information Entered

Test Procedure:	Two Sided
Alpha Error:	0.0500
Critical Z (Test Statistic - alpha/2):	1.9600
Hypothesis Value:	0.0500
Sample Size for Group 1:	46
Sample Size for Group 2:	17

	alg12	trigc		alg12	trigc		alg12	trigc		alg12	trigc
1 =	97	68	10 =	76	88	19 =	84		28 =	93	
2 =	60	70	11 =	62	91	20 =	67		29 =	92	
3 =	55	72	12 =	82	73	21 =	40		30 =	92	
4 =	65	80	13 =	82	96	22 =	78		31 =	76	
5 =	87	80	14 =	82	89	23 =	94		32 =	77	
6 =	76	84	15 =	89	94	24 =	87		33 =	69	
7 =	80	94	16 =	95	55	25 =	74		34 =	60	
8 =	93	91	17 =	93	73	26 =	67		35 =	85	
9 =	81	79	18 =	73		27 =	82		36 =	65	

	alg12	trigc
37 =	65	
38 =	70	
39 =	51	
40 =	68	
41 =	68	
42 =	67	
43 =	79	
44 =	69	
45 =	76	
46 =	79	

CBS-Hypothesis Testing 01-14-1993 - 16:57:14

Information Entered

Test Procedure:	Two Sided
Alpha Error:	0.0500
Critical Z (Test Statistic - alpha/2):	1.9600
Hypothesis Value:	0.0500
Sample Size for Group 1:	46
Sample Size for Group 2:	17
Mean for Group 1:	76.1304
Mean for Group 2:	81
Standard Deviation (S) for Group 1:	12.6660
Standard Deviation (S) for Group 2:	11.3633

	alg12	trigc		alg12	trigc		alg12	trigc
1 =	97	68	20 =	67		39 =	51	
2 =	60	70	21 =	40		40 =	68	
3 =	55	72	22 =	78		41 =	68	
4 =	65	80	23 =	94		42 =	67	
5 =	87	80	24 =	87		43 =	79	
6 =	76	84	25 =	74		44 =	69	
7 =	80	94	26 =	67		45 =	76	
8 =	93	91	27 =	82		46 =	79	
9 =	81	79	28 =	93				
10 =	76	88	29 =	92				
11 =	62	91	30 =	92				
12 =	82	73	31 =	76				
13 =	82	96	32 =	77				
14 =	82	89	33 =	69				
15 =	89	94	34 =	60				
16 =	95	55	35 =	85				
17 =	93	73	36 =	65				
18 =	73		37 =	65				
19 =	84		38 =	70				

Results

Standard Error of Mean (unequal variances):	3.3291
Lower Limit:	-6.4751
Upper Limit:	6.5751
Standard Error of Mean (equal variances):	3.5019
Lower Limit:	-6.8136
Upper Limit:	6.9136
Mean 1 - Mean 2:	-4.8696
Degrees of Freedom:	61
Critical Z (Test Statistic - alpha/2):	1.9600
Computed Z (unequal variances):	-5.2673
p value:	0.0002

Conclusion: do not reject hypothesis

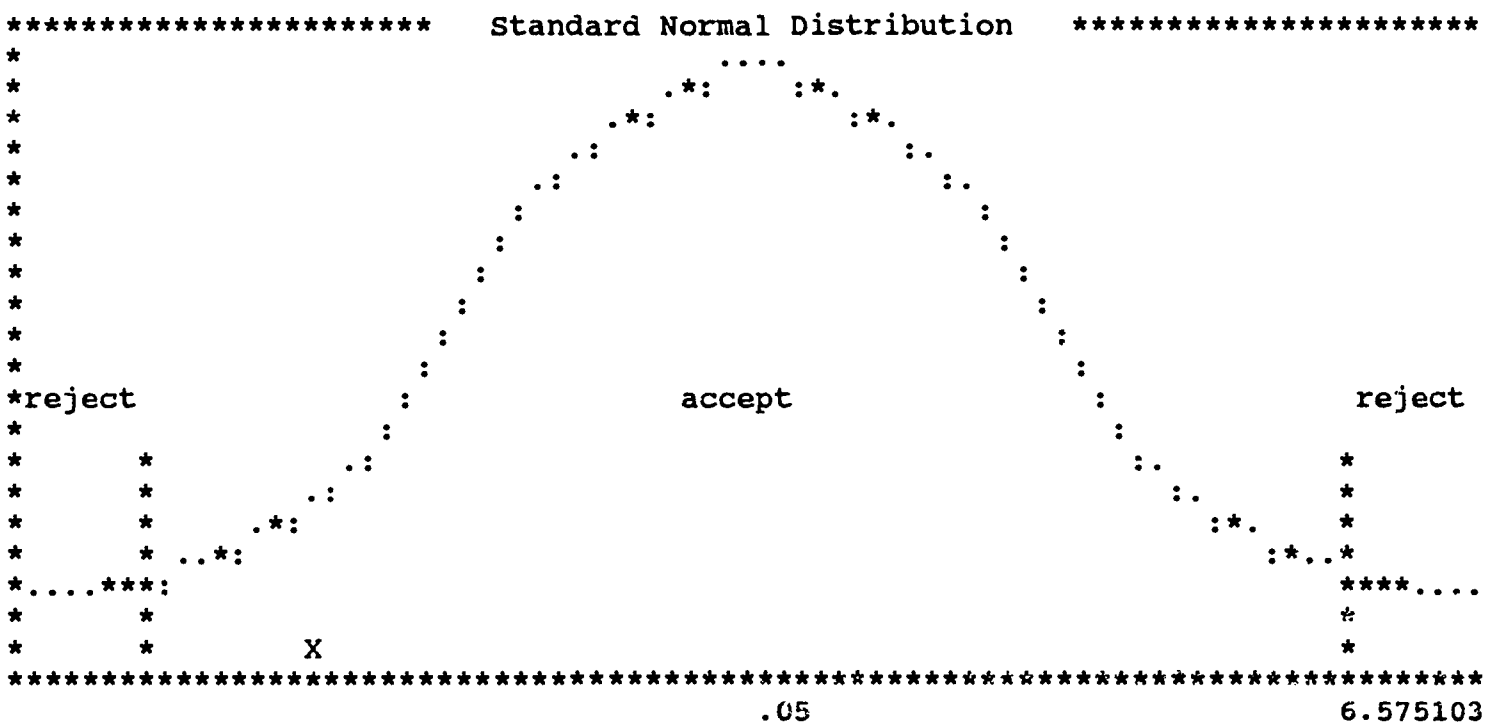
Power Curve

-- unequal variances --

	Actual	Beta	1-Beta
1	-7.5461	0.0233	0.9767
2	-7.0106	0.1610	0.8390
3	-6.4751	0.5000	0.5000
4	-5.9396	0.8390	0.1610
5	-5.4042	0.9767	0.0233

-- equal variances--

	Actual	Beta	1-Beta
1	-7.8846	0.0233	0.9767
2	-7.3491	0.1610	0.8390
3	-6.8136	0.5000	0.5000
4	-6.2782	0.8390	0.1610
5	-5.7427	0.9767	0.0233


Standard Normal Distribution
reject
accept
reject
X
.05
6.575103