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by

Phil Jones and Clarence Jung - 1989

Background

This study is based primarily on financial data from colleges and universities in Virginia for the two academic years 1987-88 and 1988-89. The data base stems from detailed data submitted by virtually all colleges and universities to the federal and state governments and reported in the Integrated Postsecondary Education Data survey (IPEDS). The data were accessed by Professor Jones from the State Council of Higher Education using the Bitnet computer program. (These data can be accessed for any college or university in the country, but this study employs only Virginia data.)

The aim of the study is to gain an understanding of the matrix of financial, economic and academic factors which determine the nature of a college or university; and to interpret these factors as they relate to decisions facing faculty, administrators, government officials, students and families and other interested parties. Attention to these matters in the media today would suggest that this subject is hardly an irrelevant one.

General Approach

This research proceeds, broadly speaking, in two ways. First, regression analysis is used to develop single equation models of the economic and academic factors involved in the source and application of funds for higher education. The equations use SAT scores as representative of the "quality" of schools as the primary dependent variable and various independent variables such as faculty salaries, scholarship assistance, tuition, academic support among others.

Second, ratio analysis and comparisons of revenue and expenditure patterns are employed to find methods of evaluating colleges and universities for efficiency in the use of resources. In this approach, the intent is to aply the model of corporation finance to colleges and universities. (At the time of this writing, a good bit of the work in this approach is yet to be done.)

Table 1

C1 = 452 - 0.0049 C2 + 10.4 C3 + 0.0301 C4 - 0.0064 C5 + 0.0308 C6 + 0.0150 C7
- 245 C8 - 0.119 C9 - 0.0055 C10

Predictor	Coef	Stdev	t-ratio
Constant	452.5	158.5	2.85
C2	-0.00488	0.01663	-0.29
C3	10.375	6.604	1.57
C4	0.03015	0.02054	1.47
C5	-0.00637	0.03310	-0.19
C6	0.03081	0.03828	0.80
C7	0.01504	0.01935	0.78
C8	-244.52	69.52	-3.52
C9	-0.11873	0.06621	-1.79
C10	-0.00545	0.04004	-0.14

s = 60.51 R-sq = 89.1% R-sq(adj) = 82.0%

C1 = SAT
C2 = FTE (School Size)
C3 = Faculty Salary
C4 = Tuition
C5 = (Endowment Income)/Student
C6 = Scholarships/Student
C7 = (Academic Expenditures)/Student
C8 = Black/White
C9 = (Academic Support)/Student
C10 = (Government Appropriations)/Student

Durbin-Watson Statistic = 2.62 (not significant at 5% level)

Data in: ECONED.REG;6

Regression Models

Single equation regression models were developed for the private and public sectors, taken separately. Ultimately, simultaneous equation models are more appropriate (cf. Dolan, Jung and Schmidt, 1985). The data set for Virginia schools does not, however, readily lend itself to such models.

An immediate problem posed by single equation models is that this interdependence manifests itself in the condition of multicollinearity - i.e., variables can be expressed as linear functions of each other. The presence of multicollinearity is shown in a function developed for the private sector in which SAT scores are a linear function of the following factors: size of school, faculty salaries, tuition, endowment income, scholarships, academic expenditures, black/white student composition, student services expenditures, and government aid. (These variables expressed on a per-student basis where appropriate.)

The regression is shown in TAble 1, where it is clear that the high multiple R-squared and the lack of significance in the regression coefficients is the classic case of multicollinearity. This problem is addressed by selecting a few independent variables based on previous research and on observation of what appear to be important relationships among the variables of the world of Academe.

On that basis, the following function suggests that high SATs are associated with: well paid faculty; high tuition, historically white student body composition; and the provision of student services.

$$SAT = 387 + \underset{(7.63)}{11.2}(\text{Faculty Salary}) + \underset{(7.44)}{.04}(\text{Tuition}) \underset{(3.16)}{-82.0}(\text{Race})$$
$$+\underset{(9.48)}{56.9}(\text{Student Services}) - \underset{(1.51)}{.02}(\text{Scholarships})$$

Adjusted R-square = 97%

where faculty salaries are measured in thousands of dollars, tuition in dollars per student, race as zero or one for white vs black composition of student body, student services and scholarships in dollars. t-values are given in parentheses.

This equation yields results that are not counter-intuitive. Quality is associated with higher "price" (tuition), more expensive factors of production (higher faculty salaries), and the provision of amenities (student services). Scholarships do not appear as a statistically significant factor, possibly reflecting the mixture of financial resources available to students for financial aid.

However, the line item of scholarships is related to tuition, as expressed in the following function:

$$\text{Scholarships} = \$554 + \underset{(2.37)}{.18}(\text{Tuition})$$

Adjusted R-square = 17%

indicating that, on average, schools increase scholarship money at a rate of $18 for every $100 increase in tuition. (Looking at increases in tuition versus increases in scholarships for the two years, 1986-87 to 1987-88, it appears that the average increase is about $18, but the measure is statistically insignificant and the correlation is near zero. Appendix I sets out the tuition charges for private colleges and universities versus increases in tuition for these two years - a pattern showing little or no consistency, suggesting that these schools are hardly "colluding" on tuition increases, as has been recently alleged by government.)

That tuition is a major explanatory variable is indicated in the following equation:

$$SAT = 544 + .06(Tuition)$$
$$(5.17)$$

Adjusted R-sq = 53%

indicating that for every $1000 in tuition, SATs rise by 60 points. Of course, as indicated above, for every $100 increase in tuition, scholarships rise $20. And, by the following equation

$$Tuition = \$5120 + 1.27(Endowment\ Income)$$
$$(5.68)$$

for every $100 increase in endowment income, tuition charges rise by $127. (n.b., tuition rises with endowment income rather than being "offset" by endowment income.)

It is interesting to note the role of government aid for the private sector. SATs as a function of government assistance is

$$SAT = 1044 - .14(\$government\ aid).$$

Government aid is defined here as assistance from all levels of government. The direction of "causation" is quite plausibly from low SATs to government aid, suggesting that for every drop of 100 points in average SAT scores, governments invest some $700 in aid. This suggests that government aid to private schools is perhaps doing no more than barely keeping some struggling schools in existence. This, in itself, may have important social significance.

The composite picture which emerges from these regressions is one which shows high quality schools (as measured by average SAT scores of incomng freshmen) with high tuition, high faculty salaries, high levels of spending per student and with the level of government assistance inversely related to SATs. Other research studies indicate that alumni achievement in business and the professions is directly related to quality of student, faculty, and per capital spending (Dolan, Jung, and Schmidt, 1985). Still other research shows that SAT levels are closely correlated with family income (cf <u>The New York Review of Books,</u> October 12, 1989, p 67).

The foregoing analysis is based on standard regression analysis techniques. Another way of comparing schools is to rank order schools along dimensions suich as operating margin, increase in total revenue, return on endowment and so on. Data of this nature ~~is~~ are given in Appendix II. Comparing the institutions which are at the polar edges of wealth, it turns out that St. Paul's and Richmond are (not surprisingly) inversely related:

St. Pauls = 26.2 - 0.63(University of Richmond)
(t-value)

which suggests that the ranking of St. Paul's can be predicted for any item by taking 26.2 as base and subtracting .634 of Richmond's rating. Such a comparison does not yield a recipe for financial and operating management per se, but does suggest that the economic health of an institution is not achieved without large, one might say massive, does of money. It is interesting that St. Paul's and Sweet Briar are not correlated. Perhaps only the polar cases are significant, resource allocation within schools varying so much depending upon the aims, history and mission of particular schools.

(Analysis of this nature - i.e., examination of financial ratios, etc. - is planned for joint work by Professors Jones and Jung. The example shown here is indicative of the nature of this work and possible conclusions which might emerge from such work.)

Analysis of public colleges and universities yields conclusions remarkably similar to those found for the private sector. Indeed, the fiscal factors shaping higher education in the public sector appear to be broadly ther same as those for the private sector, with what seems to be one important difference. The difference is that there are political pressures for "spreading the wealth" in the public sector.

This hypothesis receives support from the equation below which makes SATs a function of: size of school, faculty salaries, tuition, endowment income, scholarship assistance, academic expenditures, race student services and government aid.

$$\text{SATs} = 661 + \underset{(0.74)}{.004(\text{school size})} + \underset{(1.10)}{8.8(\text{Faculty Salaries})}$$

$$+\underset{(0.64)}{.03(\text{Tuition})} + \underset{(2.29)}{.67(\text{Endowment Income})} - \underset{(-2.37)}{.56(\text{Scholarships})}$$

$$-\underset{(-0.39)}{.01(\text{Academic Expenditures})} + \underset{(0.51)}{84(\text{Black/White})} + \underset{(0.39)}{.18(\text{Student Services})}$$

$$+\underset{(0.64)}{.01(\text{Government Aid})}$$

In a sense, these results are surprising. The only variable showing positive association with SATs is endowment income (not a surprise in itself) while the scholarship factors is negative. It is surprisng, for example, however that government appropriations are not positively related to SATs. Certainly the image is that stages spend more on the pretigious flag-ship (high SAT) schools. (Phil has some data which indicates in fact that they do.) The plausible explanation is that governments try to "even things out."

The two-variable regressions (i.e., regressions relating SATs, in turn, one-on-one to faculty salary, tuition,...) do indicate that, broadly speaking the factors at work in the poublic sector are the same as for the private sector. For example, SATs and faculty salaries are positively related, and statistically significant as are the SATs and tuition. However, other variables are not significant: government assistance (as in the multiple regression); student services; academic expenditures. (Appendix III)

Selecting a few variables (addressing multicollinearity and inserting "judgment" into the analysis), SATs in publicly supported colleges and universities are explained well by only three variables: faculty salaries, tuition, and race. (Table 2).

Thus, it appears that state policy is to invest in higher faculty salares in the flagship schools and that these schools charge higher tuition, pay faculty well, and over the years have accumulated endowment resources. These factors reenforce the already-established high quality of the institutions. However, when it comes to scholarships, academic support, and student services - the policy of the state government seems much more egalitarian. Indeed, the two-variable regression relating SAT and scholarships indicates that scholarship monies are "spread" across institutions in such a way that there is no differential impact among schools.

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Table 2

The regression equation is
C1 = 391 + 13.8 C3 + 0.0505 C4 - 331 C8

Predictor	Coef	Stdev	t-ratio	[illegible]
Constant	391.3	152.4	2.57	0.026
C3	[illegible]	[illegible]	2.76	[illegible]
C4	0.05047	0.03074	1.64	0.129
C8	[illegible]	[illegible]	-6.27	0.000

s = 65.29 R-sq = 89.6% R-sq(adj) = 86.8%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	3	403820	134607	31.57	0.000
Error	11	46894	4263		
Total	14	450714			

SOURCE	DF	SEQ SS
C3	[illegible]	[illegible]

C1 = SAT
C3 = Faculty Salary
C4 = Tuition
C8 = Black/White Student Body

All variables statistically significant at 5% level.

Durbin-Watson = 2.57 (n = 24)

A Broader Perspective

The picture which emerges from this analysis is clear. It shows that the quality of an institution depends on the dollars available to it and that these dollars, in turn, produce quality.

Hardly a startling discovery. However, the specificity of the analysis is interesting. While the quality of a school is a function of many factors, it turns out that just a few variables are the crucial ones. These are: tuition, faculty salaries, and endowment income.

Interestingly, scholarship expenditures are either statistically insignificant or are actually inversely related to quality. A plausible explanation for this finding is that the social contract in today's world is one in which the aim - both in the private and public sectors - is to make family income neutral in terms of access to higher education.

While the analysis in this paper, and the analysis in the literature on this subject, find a number of other relationships that are of interest (for example, spending for academic support is statistically significant in the private, but not the public sector), the nub of the matter is that price, income and quality are inextricably entertwined.

Of course, this is the way the world works and that this should be true in higher education is not (as indicated above) surprising. However, the implications are not trivial when viewed in a broader context. That context is that graduates of quality schools go on to high levels of achievement in the business and professsional world and thus are in a position to ensure alma mater's continued success and alma mater's continued ingestion of students whose socio-economic background prepares them well for entrance to prestigious schools and whose family income levels permit the payment of the high cost of higher education.

Thus, the findings of this study might be summed up in the phrase from the popular song of the 1920s (Ain't We Got Fun) that "the rich get rich and the poor get poorer." One might interpret this as evidence of the efficient working of a market system in which innate personal ability and a supportive family background lead to high levels of output and productivity. Or, one might interpret this as evidence for the Marxist view that the whole education system of a society is merely an instrument for the fashioning of a subservient work force.

That the graduates of quality schools do better in the business and professional world is shown in a study by Dolan, Schmidt and Jung (1985, Review of Economics and Statistics) in which a simultaneous equation model was developed showing the interdependence of student ability, faculty salaries and alumni achievement and the role of various exogenous factors. The focus of that study was on the identification of patterns of resource allocation within a school that would produce successful alumni. The study concluded that "faculty salary, academic and administrative suppoprt ...quality students and quality faculty, buttressed by ...libraries, laboratories, and, more recently, computers, appear as the major cogs driving the educational process" pp. 519-520

Although the data base for Virginia schools is more limited in this respect than for the Dolan-Jung-Schmidt study, analysis of this data set via two-variable regressions indicates that the production of Ph.D.s and Executives are related as follows:

$$\text{Executives} = -6.99 + .00843(\text{SAT}) \quad (3.92)$$

$$\text{R-square} = 39\%$$

$$\text{Ph.D.s} = 26.2 + .033(\text{SAT}) \quad (3.52)$$

$$\text{R-square} = 33\%$$

That the quality of students appearing on these campuses is a function of family income and socio-economic status has been documented by the College Board, and set out at some length in a recent review article in the New York Review of Books. This is graphically illustrated in Figure (1). Taking the values in this graph and performing two-variable regression analysis indicates that SATs are a statistically significant function of income. The graph shows unambiguously, also, that scores on the SAT tests are a function of ethnic background.

That financially disadvantaged students lack access to higher education is not clear. The results in this paper indicate that there is an inverse relationship between quality of students and scholarship aid (or that the relationship is not significant). The Dolan et al study found the coefficient for the scholarship variable was negative (and significant at the .01 level). However, at least one study (Machlis, circa 1974) found that

low-income classes are underrepresented in higher education and that

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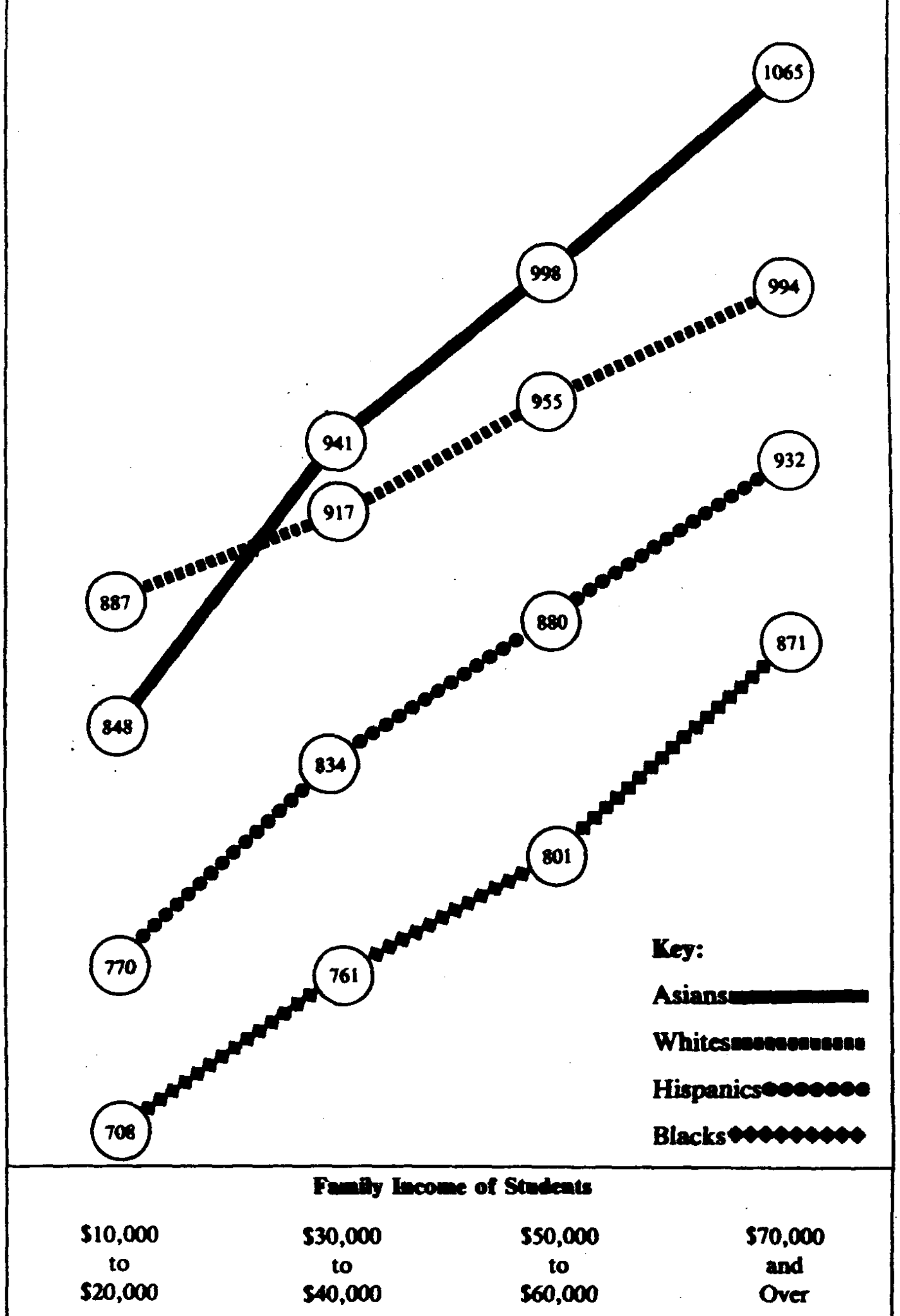
ECONOMIC STATUS AND SCHOLASTIC APTITUDE SCORES



Source: The College Board.

October 12, 1989

the wealthy have a "disproportionately large number of students in attendance."

Policy Implications

The crystal-clear indications are, from this study, that higher education in Virginia is a product of, and a component of, the social and economic system. That this statement is tinged with an economic interpretation of history (Marxist, to some degree) should not blind one to its legitmacy and importance.

It suggests ~~that~~, in the first place, that the system has worked well in the past and serves society well in the present. To use a perhaps tired cliche, whatever is not broken should not be fixed. However, to say that the system works generally well and effectively is not to say that there are not important possibilities for change.

One important change is suggested and that is that consideration should be given to much higher levels of spending for low income and minority groups. The results of the present paper indicate that there is a definite thrust toward financial assistance to these groups. The algebraic signs of the coefficient for scholarship money and for government aid to private instiutitons would suggest this. Also, the apparent "spreading" of financial resources among the public institutions warrants such an inference.

But the overriding evidence here is that this is only marginally effective. The implication is that the term "massive" might be the operative term. Large doses of capital from the private and public sectors might be in order. Much of that capital would be most effectively used at the elementary and secondary school levels (see, e.g., the Dolan and Schmidt study, 1987, Economics of Education Review). Also, one might argue that the pricing system in higher education should, in theory at least, involve even more price discrimination than is presently the case.

While these conclusions would appear to have a considerable support in the context of this paper, an even broader context would suggest that education is not the only scarce resource in society and that spending for health, transportation, corrections, defense, recreation might create an opportunity cost that would preclude higher spending for education. The general equilibrium analysis required to address this matter is beyond the scope of this study.

At the level of partial equilibrium analysis, however, it is clear that quality, price and income are the key determinants of the nature of higher education.

REFERENCES

Dolan, Robert C., Jung, Clarence R., Jr., and Schmidt, Robert M., "Evaluating Educational Inputs in Undergraduate Education," The Review of Economics and Statistics, Harvard University, (Aug. 1985).

Dolan, Robert C., and Schmidt, Robert M., "Assessing the Impact of Expenditure on Achievement; Some Methodological and Policy Considerations," Economics of Education Review, Vol. 6, No. 3 (1987)

Machlis, David P., "Higher Education and the Financially Disadvantaged," paper presented at Atlantic Economic Association meetings, in Richmond, Virginia, (circa 1978).

APPENDIX I

Change in Scholarships per Student versus
Change in Tuition per Student

1986-87 to 1987-88

The regression equation is
C2 = 137 + 0.178 C1

Predictor	Coef	Stdev	t-ratio	p
Constant	137.0	101.4	1.35	0.191
C1	0.1780	0.1807	0.98	0.335

s = 255.8   R-sq = 4.2%   R-sq(adj) = 0.0%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	1	63470	63470	0.97	0.335
Error	22	1439226	65419		
Total	23	1502695			

Obs.	C1	C2	Fit	Stdev.Fit	Residual	St.Resid
1	513	127.0	228.3	52.5	-101.3	-0.40
2	337	88.0	197.0	58.4	-109.0	-0.44
3	457	153.0	218.3	52.4	-65.3	-0.26
4	423	-9.0	212.3	53.3	-221.3	-0.88
5	327	102.0	195.2	59.2	-93.2	-0.37
6	929	206.0	302.3	96.3	-96.3	-0.41
7	876	528.0	292.9	88.4	235.1	0.98
8	207	-28.0	173.8	72.0	-201.8	-0.82
9	58	97.0	147.3	92.6	-50.3	-0.21
10	175	-400.0	168.1	76.1	-568.1	-2.33R
11	822	189.0	283.3	80.7	-94.3	-0.39
12	402	475.0	208.5	54.1	266.5	1.07
13	466	119.0	219.9	52.3	-100.9	-0.40
14	621	142.0	247.5	58.0	-105.5	-0.42
15	11	404.0	139.0	99.7	265.0	1.13
16	801	322.0	279.6	77.9	42.4	0.17
17	-10	194.0	135.2	103.0	58.8	0.25
18	276	394.0	186.1	64.1	207.9	0.84
19	148	791.0	163.3	79.7	627.7	2.58R
20	807	582.0	280.6	78.7	301.4	1.24
21	813	130.0	281.7	79.5	-151.7	-0.62
22	845	631.0	287.4	83.9	343.6	1.42
23	615	91.0	246.5	57.5	-155.5	-0.62
24	633	16.0	249.7	59.0	-233.7	-0.94

R denotes an obs. with a large st. resid.

Durbin-Watson statistic = 1.61

MTB >

APPENDIX II

Appendix II

08/15/89

Rankings of Schools - 1987 & 1988

Public Colleges and Universities

School	%inc. in FA 1987	%inc. in FA 1988	%inc. in OpMarg 1987	%inc. in OpMarg 1988	%inc. in TR 1987	%inc. in TR 1988	%inc. in Endow 1987	%inc. in Endow 1988	"Net Income" % OpMarg. % 1987	"Net Income" % OpMarg. % 1988	OpMarg 1988
William & Mary		7		4		10		4	12	[illegible]	[illegible]
Christopher Newport		12		14		3		2	14	14	[illegible]
Longwood		3		12		7			9	12	10
James Madison		14		10		9		9	4	5	7
Old Dominion		8		6		5		8	3	1	6
Radford		5		13		4			2	9	1
VCU		10		11		14		1	5	7	8
Mary Washington		6		1		1		5	13	[illegible]	[illegible]
Clinch Valley		1		7		12		6	10	[illegible]	[illegible]
George Mason		2		9		2			1	4	2
VMI		15		2		15		7	15	[illegible]	15
Virginia Tech		9		5		12		10	11	[illegible]	11
Virginia State		4		3		6			8	1	[illegible]
Norfolk State		13		13		13			7	15	[illegible]
UVA		11		8		7		9	6	6	4

Private Colleges and Universities

School	%inc. in FA 1987	%inc. in FA 1988	%inc. in OpMarg 1987	%inc. in OpMarg 1988	%inc. in TR 1987	%inc. in TR 1988	%inc. in Endow 1987	%inc. in Endow 1988	"Net Income" % OpMarg. % 1987	"Net Income" % OpMarg. % 1988	OpMarg 1988
Liberty		24		12		18		5	16	16	14
Averett		2		13		12		2	9	11	5
Bluefield		6		17		19		14	16	14	11
Bridgewater		10		14		8		10	14	7	3
Eastern Mennonite		1		6		13		3	15	13	15
Emory & Henry		13		19		16		7	17	19	17
Ferrum		18		21		21		9	12	21	12
Hampden-Sydney		7		8		7		22	7	10	8
Hampton		11		10		6		20	11	15	[illegible]
Hollins		13		11		15		16	19	17	19
Lynchburg		21		9		10		8	5	6	2
Mary Baldwin		4		23		1		23	22	4	23
Marymount		23		5		3		19	3	1	1
Randolph-Macon		5		20		11		17	23	18	22
Randolph-Macon, W.		9		1		20		11	21	23	21
Roanoke		16		15		14		15	10	12	10
Shenandoah		3		4		5		6	8	3	7
Southern Seminary		14		3		2		4	14	8	18
St. Paul's		22		18		24		24	24	20	24
Sweet Briar		8		22		23		13	13	22	13
Univ. of Richmond		15		7		9		12	2	2	4
Virginia Union		19		24		22		1	20	24	20
Virginia Wesleyan		17		2		4		18	18	9	16
Washington & Lee		20		16		17		21	1	5	6

08/15/89

(3) strength

(4) [illegible] + efficiency

School	/Assets 1988	OpMarg/Endow 1987	OpMarg/Endow 1988	OpMarg/As+End 1987	OpMarg/As+End 1988	TR/Assets 1987	TR/Assets 1988	TR/Endow 1987	TR/Endow 1988	TR/As+Endow 1987	TR/As+Endow 1988
William & Mary	11	7	8	12	11	6	6	7	8	7	6
Christopher Newport	14	6	11	14	14	10	7	3	5	10	5
Longwood	13			9	13	12	14			11	11
James Madison	7	1	1	6	6	14	13	1	1	12	11
Old Dominion	2	3	4	5	2	9	8	4	4	8	7
Radford	8			1	7	5	5			4	4
VCU	3	2	3	3	3	1	2	2	2	1	2
Mary Washington	6	9	5	13	5	13	12	8	9	14	13
Clinch Valley	10	4	7	10	10	7	10	6	7	5	10
George Mason	4			2	4	8	9			6	8
VMI	12	10	9	15	12	15	15	9	10	15	15
Virginia Tech	9	5	6	11	9	3	3	5	6	3	3
Virginia State	1		2	8	1	11	11		3	9	9
Norfolk State	15			4	15	2	1			2	1
UVA	5	8	10	7	8	4	4	10	11	13	12
Liberty	4	1	1	7	2	6	1	1	1	3	1
Averett	12	3	3	2	7	1	6	2	2	1	3
Bluefield	16	4	5	6	15	24	24	4	4	18	17
Bridgewater	8	10	11	5	9	16	13	15	14	14	14
Eastern Mennonite	15	6	7	10	13	10	23	5	5	5	12
Emory & Henry	19	17	19	18	19	9	8	14	15	11	13
Ferrum	21	8	22	9	23	14	16	10	8	10	9
Hampden-Sydney	10	13	13	11	11	15	15	20	18	19	18
Hampton	13	15	16	14	16	8	5	18	17	17	15
Hollins	17	19	17	19	17	12	10	19	19	18	19
Lynchburg	3	7	8	3	4	5	4	12	11	9	6
Mary Baldwin	7	23	10	23	6	18	12	16	12	16	11
Marymount	1	2	2	1	1	2	2	3	3	2	2
Randolph-Macon	18	22	18	22	18	21	20	17	16	20	20
Randolph-Macon, W.	22	21	21	21	21	20	22	22	21	23	23
Roanoke	14	12	14	12	14	17	17	13	13	15	16
Shenandoah	2	5	4	4	3	4	9	7	6	4	7
Southern Seminary	11	9	6	15	8	23	19	9	7	12	10
St. Paul's	20	24	24	24	22	13	11	6	24	7	4
Sweet Briar	23	18	20	17	20	11	14	23	22	21	22
Univ. of Richmond	5	16	15	13	12	19	18	24	23	24	24
Virginia Union	24	20	23	20	24	7	7	8	10	6	8
Virginia Wesleyan	6	14	9	16	5	3	3	11	9	8	5
Washington & Lee	10	11	12	8	10	22	21	21	20	22	21

08/15/89

(5.) sf(1) (6) 1,4,6,9 (7) Strength (8) Strength 1,4,6,9 (9)

School	Op&Maint/Assets 1987	Op&Maint/Assets 1988	Tuit/Academ 1987	Tuit/Academ 1988	Instruc/FT Fac 1987	Instruc/FT Fac 1988	AcadExp/FTES 1987	AcadExp/FTES 1988	G[illegible]Exp/FTES 1987	G[illegible]Exp/FTES 1988
William & Mary	11	9	3	4	4	4	5	5	5	5
Christopher Newport	9	5	2	3	14	11	15	15	15	15
Longwood	8	14	9	9	12	13	10	10	7	7
James Madison	10	11	1	5	9	9	13	13	8	8
Old Dominion	3	2	4	6	6	6	8	8	12	11
Radford	7	12	11	11	10	14	14	14	13	12
VCU	13	8	15	14	1	1	2	2	1	1
Mary Washington	6	7	5	1	13	15	11	12	9	9
Clinch Valley	2	3	13	13	8	10	9	11	11	14
George Mason	5	6	8	10	5	5	12	9	14	13
VMI	15	15	7	8	7	7	3	3	3	3
Virginia Tech	4	4	6	7	3	3	4	4	4	4
Virginia State	12	10	12	2	15	12	6	6	6	6
Norfolk State	1	1	14	15	11	8	7	7	10	10
UVA	14	13	10	12	2	2	1	1	2	2
Liberty	14	1	21	11	8		23	24	23	23
Averett	10	21	16	13	15	11	20	20	22	20
Bluefield	13	12	5	9	22	20	24	23	24	24
Bridgewater	19	11	19	16	16	16	7	7	9	11
Eastern Mennonite	23	24	18	19	17	10	8	8	13	15
Emory & Henry	5	4	8	10	14	15	16	19	14	14
Ferrum	24	23	17	17	18		17	13	18	12
Hampden-Sydney	12	9	12	12	10	9	5	5	5	4
Hampton	2	2	9	7		14	21	22	19	19
Hollins	11	16	15	15	3	3	3	4	3	3
Lynchburg	20	17	11	8	9	8	13	14	17	17
Mary Baldwin	9	10	23	22	7	7	6	6	7	6
Marymount	17	14	6	5	1	1	15	16	21	22
Randolph-Macon	3	6	7	6	12	13	9	9	6	7
Randolph-Macon, W.	15	19	13	21	13	17	4	2	2	2
Roanoke	18	18	3	3	5	6	11	11	10	10
Shenandoah	8	13	14	18	20		10	10	16	16
Southern Seminary	16	15	2	4	21	18	14	15	8	8
St. Paul's	4	8	24	24	19	19	18	17	15	18
Sweet Briar	6	7	22	23	6	5	1	1	1	1
Univ. of Richmond	21	20	1	2	4	4	12	12	12	9
Virginia Union	1	3	10	14			22	18	11	13
Virginia Wesleyan	7	5	4	1	11	12	19	21	20	21
Washington & Lee	22	22	20	20	2	2	2	3	4	5

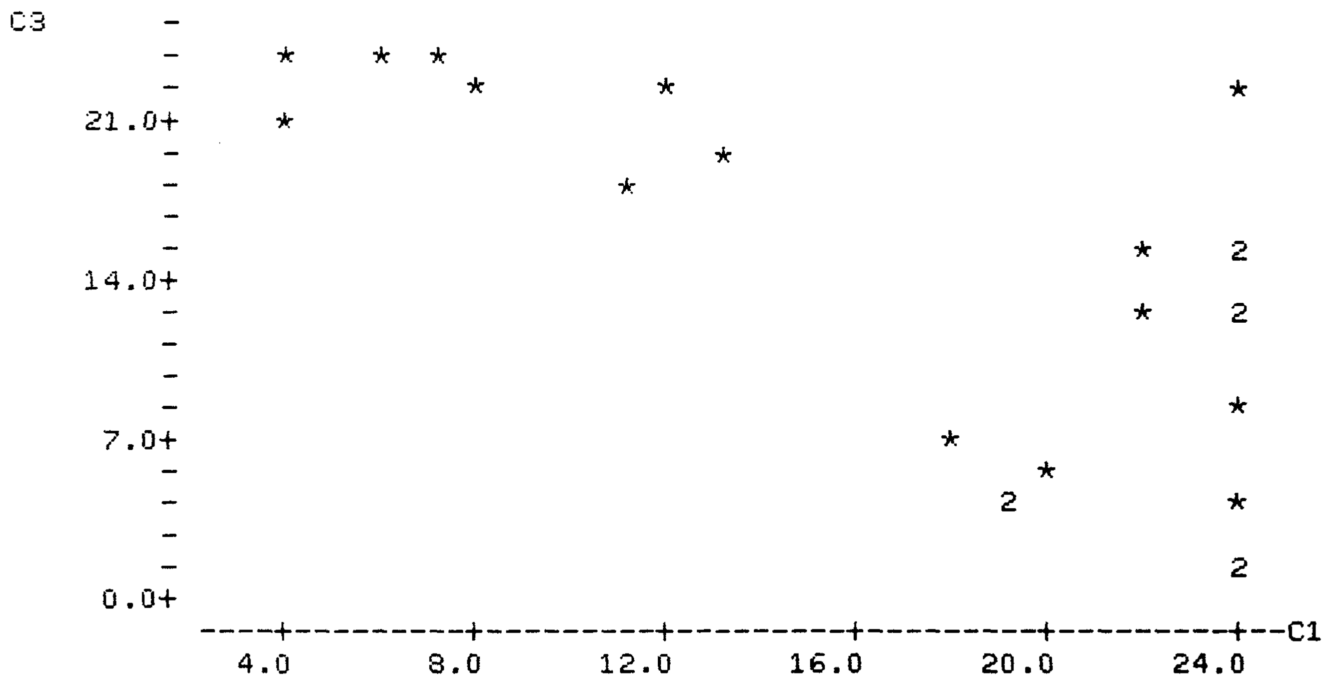
08/15/89

School	Tuit&Fees/FTES 1987	Tuit&Fees/FTES 1988	MAXIMUM 1987	MAXIMUM 1988	MINIMUM 1987	MINIMUM 1988	AVERAGE 1987	AVERAGE 1988
William & Mary	3	3	12	13	3	3	7.23	6.94
Christopher Newport	10	10	15	15	2	2	10.46	9.41
Longwood	11	11	12	14	0	0	8.31	8.94
James Madison	8	9	14	14	1	1	7.23	8.23
Old Dominion	7	8	12	11	3	2	6.00	5.76
Radford	15	14	15	14	0	0	6.38	7.76
VCU	5	6	15	14	1	1	4.15	5.29
Mary Washington	9	7	14	15	5	1	10.46	6.82
Clinch Valley	14	15	14	15	2	1	8.31	9.18
George Mason	12	12	14	13	0	0	5.77	5.71
VMI	2	2	15	15	2	2	10.08	9.29
Virginia Tech	4	4	11	12	3	3	5.69	6.41
Virginia State	6	5	15	12	0	0	7.77	4.82
Norfolk State	13	13	14	15	0	0	5.85	8.24
UVA	1	1	14	13	1	1	6.31	6.82
Liberty	24	24	24	24	1	0	12.38	9.88
Averett	19	20	22	21	1	2	9.62	10.47
Bluefield	23	23	24	24	4	4	13.77	15.41
Bridgewater	11	11	19	16	3	7	11.38	11.18
Eastern Mennonite	13	14	23	24	5	1	12.15	11.82
Emory & Henry	17	17	18	19	5	4	13.62	14.47
Ferrum	18	18	24	23	8	0	14.38	16.00
Hampden-Sydney	3	2	20	22	3	2	10.77	10.59
Hampton	20	21	21	22	0	2	12.54	13.47
Hollins	2	4	19	19	2	3	12.46	12.71
Lynchburg	15	10	20	21	2	3	9.85	9.65
Mary Baldwin	14	16	23	23	6	1	15.92	10.59
Marymount	12	12	21	23	1	1	6.62	7.76
Randolph-Macon	6	7	23	20	3	5	14.62	13.47
Randolph-Macon, W.	4	3	23	23	2	1	15.38	15.18
Roanoke	8	8	18	18	3	3	11.08	12.71
Shenandoah	10	15	20	18	4	0	9.00	7.29
Southern Seminary	9	9	23	19	2	2	13.08	9.47
St. Paul's	22	22	24	24	4	4	17.23	18.88
Sweet Briar	1	1	23	23	1	1	11.77	14.53
Univ. of Richmond	7	6	24	24	1	2	12.23	11.47
Virginia Union	21	19	22	24	0	0	12.77	14.88
Virginia Wesleyan	16	13	20	21	3	1	12.54	9.41
Washington & Lee	5	5	22	22	1	2	11.23	13.53

St Paul's vs U of R

```
ŜC1 = 26.2 - 0.634 C3

Predictor       Coef         Stdev      t-ratio
Constant       26.169        2.375        11.02
C3            -0.6337       0.1500        -4.23

s = 5.607       R-sq = 45.9%     R-sq(adj) = 43.4%

Analysis of Variance

SOURCE          DF          SS          MS
Regression       1      561.33      561.33
Error           21      660.32       31.44
Total           22     1221.65

Obs.      C3         C1        Fit  Stdev.Fit   Residual    St.Resid
  1     15.0      22.00      16.66       1.18       5.34        0.97
  2      7.0      18.00      21.73       1.55      -3.73       -0.69
  3      9.0      24.00      20.47       1.37       3.53        0.65
  4     12.0      24.00      18.56       1.20       5.44        0.99
  5      4.0      24.00      23.63       1.88       0.37        0.07
  6      5.0      20.00      23.00       1.76      -3.00       -0.56
Continue? n
MTB > plo
```

St Paul's vs U of R



MTB >

Va Union on U of R

```
   4    24    15    12     1


MTB > regress c4 on 1 predictor in c3

The regression equation is
C4 = 18.8 - 0.307 C3

Predictor        Coef          Stdev      t-ratio
Constant       18.838          3.153         5.97
C3            -0.3069         0.1991        -1.54

s = 7.445       R-sq = 10.2%     R-sq(adj) = 5.9%

Analysis of Variance

SOURCE       DF          SS           MS
Regression    1      131.63       131.63
Error        21     1163.85        55.42
Total        22     1295.48


MTB >
```

Va Union on Sweet Briar

```
MTB > regress c4 on 1 predictor in c2

The regression equation is
C4 = 9.17 + 0.315 C2

Predictor        Coef        Stdev     t-ratio
Constant        9.173        4.703        1.95
C2          (+) 0.3149       0.2566       1.23

s = 7.587       R-sq = 6.7%     R-sq(adj) = 2.2%

Analysis of Variance

SOURCE        DF          SS          MS
Regression     1        86.70       86.70
Error         21      1208.77       57.56
Total         22      1295.48


MTB >
```

Va Union on St Paul's.

```
The regression equation is
C4 = 7.99 + 0.380 C1

Predictor         Coef          Stdev      t-ratio
Constant         7.988          3.947         2.02  ✓
C1          (+) 0.3797         0.2089         1.82

s = 7.301       R-sq = 13.6%     R-sq(adj) = 9.5%

Analysis of Variance

SOURCE        DF          SS           MS
Regression     1      176.17       176.17
Error         21     1119.31        53.30
Total         22     1295.48

Unusual Observations
Obs.       C1         C4        Fit  Stdev.Fit   Residual    St.Resid
  4      24.0       1.00      17.10       2.05     -16.10      -2.30R

R denotes an obs. with a large st. resid.

MTB >
```

Sweet Briar vs U of R

C2 = 16.0 + 0.095 C3

Predictor	Coef	Stdev	t-ratio
Constant	15.956	2.713	5.88
C3	0.0946	0.1713	0.55

s = 6.407   R-sq = 1.4%   R-sq(adj) = 0.0%

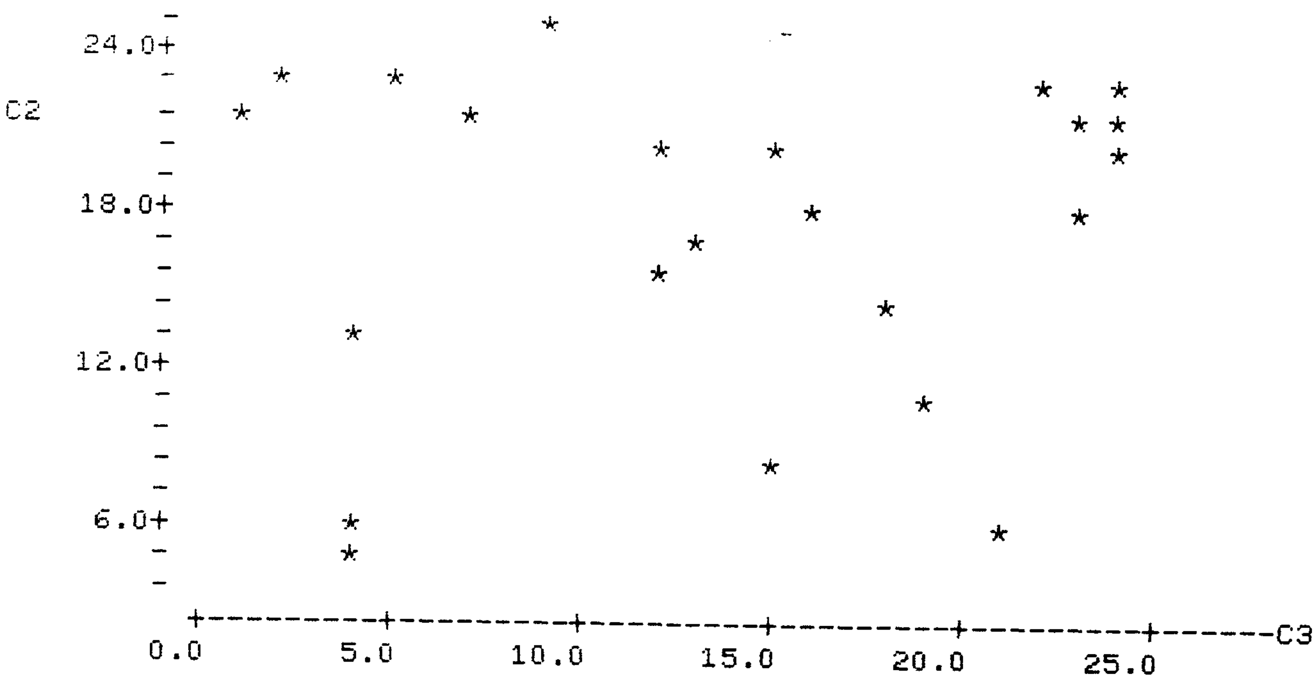
Analysis of Variance

SOURCE	DF	SS	MS
Regression	1	12.52	12.52
Error	21	861.91	41.04
Total	22	874.43	

Obs.	C3	C2	Fit	Stdev.Fit	Residual	St.Resid
1	15.0	8.00	17.38	1.35	-9.38	-1.50
2	7.0	22.00	16.62	1.77	5.38	0.87
3	9.0	25.00	16.81	1.57	8.19	1.32
4	12.0	15.00	17.09	1.37	-2.09	-0.33
5	4.0	13.00	16.34	2.14	-3.34	-0.55
6	5.0	23.00	16.43	2.01	6.57	1.08

Continue? n
MTB >

Sweet Briar vs U of R.



MTB >

St Paul's -vs Sweet Briar.

The regression equation is
C1 = 16.4 + 0.061 C2

Predictor	Coef	Stdev	t-ratio
Constant	16.381	4.721	3.47
C2	0.0611	0.2576	0.24

s = 7.617   R-sq = 0.3%   R-sq(adj) = 0.0%

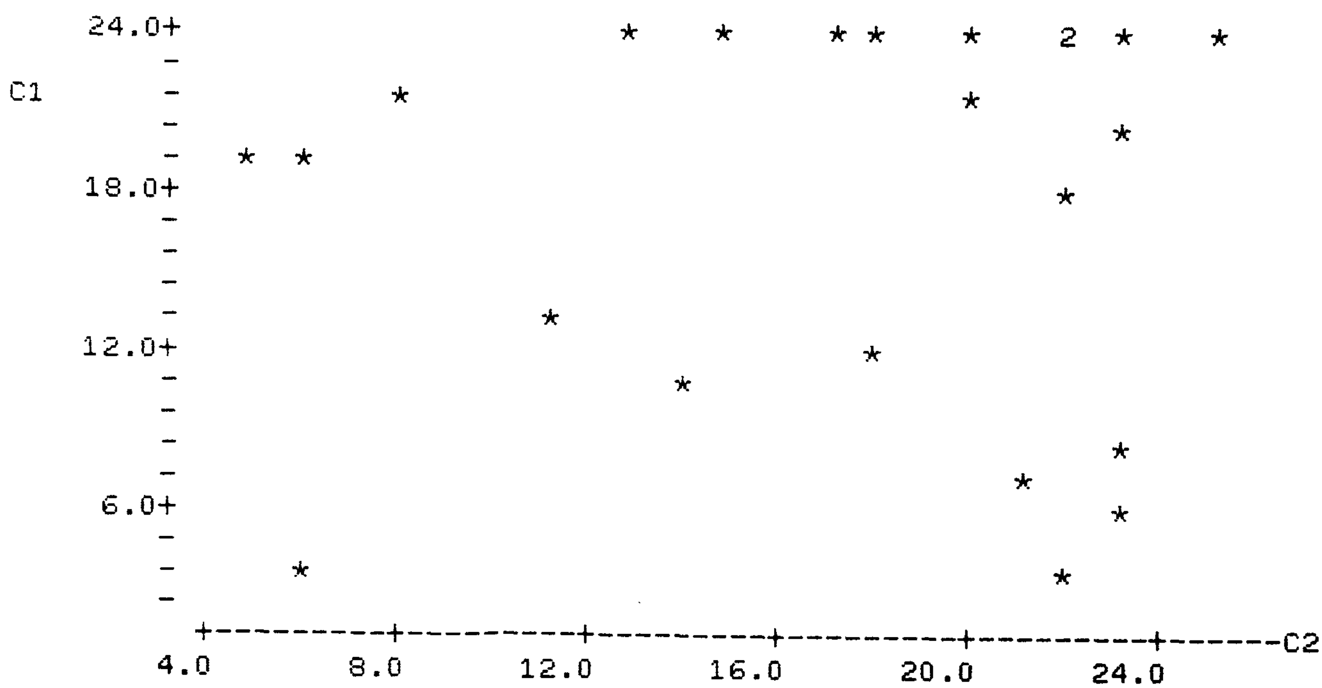
Analysis of Variance

SOURCE	DF	SS	MS
Regression	1	3.26	3.26
Error	21	1218.39	58.02
Total	22	1221.65	

Obs.	C2	C1	Fit	Stdev.Fit	Residual	St.Resid
1	8.0	22.00	16.87	2.87	5.13	0.73
2	22.0	18.00	17.72	2.00	0.28	0.04
3	25.0	24.00	17.91	2.55	6.09	0.85
4	15.0	24.00	17.30	1.69	6.70	0.90
5	13.0	24.00	17.17	1.93	6.83	0.93
6	23.0	20.00	17.79	2.17	2.21	0.30

Continue? n

St Paul's vs Sweet Briar



MTB >

8/14/89

Correlation Matrix

	1	2	3	4	5	6	7
1	x	.42	.38	.52	-.06	-0.77	.72
2	.42	x	.95	.81	.10	-.05	.73
3	.38	.95	x	.72	.21	-.13	.62
4	.52	.81	.72	x	.01	-.05	.67
5	-.06	.10	.21	.01	x	-.07	.01
6	-.77	-.05	-.13	-.05	-.07	x	-.29
7	.72	.72	.62	.67	.01	-.29	x

1 = SAT

2 = Academic #/FTES
3 = Total $/FTES
4 = Tuition #/FTES
5 = Instr #/FTES
6 = Alumni white/Black
7 = Avg Faculty #

C4	0.516	0.345	0.674					
C5	0.510	0.216	0.609	0.651				
C6	-0.362	0.119	0.177	0.381	0.521			
C7	0.415	0.533	0.739	0.814	0.741	0.568		
C8	-0.774	-0.212	-0.289	-0.054	-0.177	0.668	-0.053	
C9	0.132	-0.230	0.115	0.386	0.635	0.464	0.429	-0.000
C10	0.211	0.668	0.627	0.735	0.476	0.596	0.882	0.112

	C9
C10	[illegible]

```
MTB > corr between c1 and c3-c10
```

	C1	C3	C4	C5	C6	C7	C8	C9
C3	0.723							
C4	0.516	0.674						
C5	0.510	0.609	0.651					
C6	-0.362	0.177	0.381	0.521				
C7	0.415	0.739	0.814	0.741	0.568			
C8	-0.774	-0.289	-0.054	-0.177	0.668	-0.053		
C9	0.132	0.115	0.386	0.635	0.464	0.429	-0.000	
C10	0.211	0.627	0.735	0.476	0.596	0.882	0.112	0.243

```
MTB >
```

APPENDIX III

Appendix III

```
C1 = 882 + 0.0113 C2

Predictor        Coef        Stdev     t-ratio        p
Constant       881.66        71.89       12.26    0.000
C2           0.011257     0.006568        1.71    0.110

s = 168.2       R-sq = 18.4%      R-sq(adj) = 12.2%

Analysis of Variance

SOURCE        DF          SS          MS         F        p
Regression     1       83075       83075      2.94    0.110
Error         13      367639       28280
Total         14      450714

Obs.       C2         C1        Fit Stdev.Fit  Residual    St.Resid
  1      6716     1240.0      957.3      45.4     282.7        1.75
  2      3232      939.0      918.0      56.5      21.0        0.13
  3      2936      915.0      914.7      57.7       0.3        0.00
  4      9754     1095.0      991.5      43.9     103.5        0.64
  5     12820      950.0     1026.0      51.1     -76.0       -0.47
  6 [illegible]    914.0      967.3      44.0     -53.3       -0.33
Continue? n
MTB
```

Size

The regression equation is
C1 =10 + 25.7 C3

Predictor	Coef	Stdev	t-ratio	p
Constant	9.9	259.3	0.04	0.970
C3	25.738	6.823	3.77	0.002

s = 129.7   R-sq = 52.3%   R-sq(adj) = 48.6%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	1	235516	235516	14.23	0.002
Error	13	215197	16554		
Total	14	450714			

Obs.	C3	C1	Fit	Stdev.Fit	Residual	St.Resid
1	44.4	1240.0	1152.7	56.6	87.3	0.76
2	33.7	939.0	877.3	42.9	61.7	0.51
3	33.0	915.0	859.2	46.1	55.8	0.46
4	35.6	1095.0	926.2	36.1	168.8	1.37
5	38.5	950.0	1000.8	33.7	-50.8	-0.41
6	35.2	914.0	915.9	37.3	-1.9	-0.02

Continue?

Faculty

Tuition

The regression equation is
C1 = 713 + 0.118 C4

Predictor	Coef	Stdev	t-ratio	p
Constant	712.7	129.8	5.49	0.000
C4	0.11800	0.05438	2.17	0.049

s = 159.5 R-sq = 26.6% R-sq(adj) = 21.0%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	1	119916	119916	4.71	0.049
Error	13	330798	25446		
Total	14	450714			

Obs.	C4	C1	Fit	Stdev.Fit	Residual	St.Resid
1	3143	1240.0	1083.8	63.2	156.2	1.07
2	1662	939.0	908.9	52.6	30.1	0.20
3	1654	915.0	908.0	52.8	7.0	0.05
4	1887	1095.0	935.5	46.0	159.5	1.04
5	2079	950.0	958.2	42.4	-8.2	-0.05
6	1350	914.0	872.1	64.5	41.9	0.29

Continue?

Scholarships

C1 = 1078 - 0.190 C6

Predictor	Coef	Stdev	t-ratio	p
Constant	1078.16	83.23	12.95	0.000
C6	-0.1896	0.1358	-1.40	0.184

s = 173.5   R-sq = 13.1%   R-sq(adj) = 6.4%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	1	59164	59164	1.96	0.184
Error	13	391550	30119		
Total	14	450714			

Obs.	C6	C1	Fit	Stdev.Fit	Residual	St.Resid
1	259	1240.0	1029.1	56.9	210.9	1.29
2	281	939.0	1024.9	55.1	-85.9	-0.52
3	368	915.0	1008.4	49.2	-93.4	-0.56
4	193	1095.0	1041.6	62.8	53.4	0.33
5	387	950.0	1004.8	46.2	-54.8	-0.33
6	262	914.0	1028.5	56.7	-114.5	-0.70

Continue? n
MTB >

Endowment.

The regression equation is
C1 = 937 + 0.458 C5

Predictor	Coef	Stdev	t-ratio	p
Constant	936.62	46.02	20.35	0.000
C5	0.4581	0.2141	2.14	0.052

s = 160.1   R-sq = 26.0%   R-sq(adj) = 20.3%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	1	117351	117351	4.58	0.052
Error	13	333363	25643		
Total	14	450714			

Obs.	C5	C1	Fit	Stdev.Fit	Residual	St.Resid
1	117	1240.0	990.2	41.6	249.8	1.62
2	10	939.0	941.2	45.1	-2.2	-0.01
3	0	915.0	936.6	46.0	-21.6	-0.14
4	25	1095.0	948.1	43.9	146.9	0.95
5	10	950.0	941.2	45.1	8.8	0.06
6	0	914.0	936.6	46.0	-22.6	-0.15

Continue?

academie

C1 = 785 + 0.0359 C7

Predictor	Coef	Stdev	t-ratio	p
Constant	784.7	126.6	6.20	0.000
C7	0.03587	0.02183	1.64	0.124

s = 169.4 R-sq = 17.2% R-sq(adj) = 10.8%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	1	77488	77488	2.70	0.124
Error	13	373226	28710		
Total	14	450714			

Obs.	C7	C1	Fit	Stdev.Fit	Residual	St.Resid
1	6277	1240.0	1009.9	47.4	230.1	1.41
2	3262	939.0	901.7	64.6	37.3	0.24
3	4063	915.0	930.5	53.1	-15.5	-0.10
4	3901	1095.0	924.7	55.2	170.3	1.06
5	4641	950.0	951.2	47.1	-1.2	-0.01
6	3559	914.0	912.4	60.0	1.6	0.01

Continue? n
MTB >

C1 = 1032 - 394 C8

Predictor	Coef	Stdev	t-ratio	p
Constant	1032.46	32.73	31.55	0.000
C8	-394.46	89.63	-4.40	0.001

s = 118.0 R-sq = 59.8% R-sq(adj) = 56.8%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	1	269706	269706	19.37	0.001
Error	13	181007	13924		
Total	14	450714			

Obs.	C8	C1	Fit	Stdev.Fit	Residual	St.Resid
1	0.00	1240.0	1032.5	32.7	207.5	1.83
2	0.00	939.0	1032.5	32.7	-93.5	-0.82
3	0.00	915.0	1032.5	32.7	-117.5	-1.04
4	0.00	1095.0	1032.5	32.7	62.5	0.55
5	0.00	950.0	1032.5	32.7	-82.5	-0.73
6	0.00	914.0	1032.5	32.7	-118.5	-1.04

Continue? n
MTB >

Race.

The regression equation is
C1 = 895 + 0.201 C9

Predictor	Coef	Stdev	t-ratio	p
Constant	895.4	182.0	4.92	0.000
C9	0.2008	0.4176	0.48	0.639

s = 184.6 R-sq = 1.7% R-sq(adj) = 0.0%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	1	7875	7875	0.23	0.639
Error	13	442839	34065		
Total	14	450714			

Obs.	C9	C1	Fit	Stdev.Fit	Residual	St.Resid
1	441	1240.0	984.0	48.4	256.0	1.44
2	446	939.0	985.0	48.8	-46.0	-0.26
3	388	915.0	973.3	49.6	-58.3	-0.33
4	284	1095.0	952.5	74.3	142.5	0.84
5	384	950.0	972.5	50.0	-22.5	-0.13
6	239	914.0	943.4	89.5	-29.4	-0.18

Continue?

Services

C1 = 897 + 0.0156 C10

Predictor	Coef	Stdev	t-ratio	p
Constant	897.1	116.0	7.73	0.000
C10	0.01558	0.01997	0.78	0.449

s = 182.0 R-sq = 4.5% R-sq(adj) = 0.0%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	1	20155	20155	0.61	0.449
Error	13	430559	33120		
Total	14	450714			

Obs.	C10	C1	Fit	Stdev.Fit	Residual	St.Resid
1	4872	1240.0	973.0	47.8	267.0	1.52
2	3047	939.0	944.6	65.2	-5.6	-0.03
3	3863	915.0	957.3	55.2	-42.3	-0.24
4	3360	1095.0	949.5	61.0	145.5	0.85
5	3872	950.0	957.5	55.1	-7.5	-0.04
6	3075	914.0	945.0	64.8	-31.0	-0.18

Continue? n
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