

AN EXAMINATION OF THE INTERRELATIONSHIPS BETWEEN NOMINAL AND DEMOGRAPHIC DIMENSIONS WITHIN THE AMERICAN PROFESSORiate: A CASE STUDY IN MANOVA

Jerrold P. Katz, Simmons College
Andrei S. Markovits, Wesleyan University

Most modern societies embody important structures of stratification which affect the existence of their citizens, both publicly and privately. The major agents of stratification differ geographically as well as longitudinally with, however, certain indicators prevailing over time. Hence, class, ethnicity (race), religion, age and sex have divided all societies, providing unearned advantages to a select few while causing undue hardships to a great number.

The very essence of the existence of the United States is the result of stratification and its inequities in other parts of the world. Unfortunately, however, the new country perpetuated its own structure of stratification and hierarchical differentiation which, albeit different--thus, for example, most political sociologists agree that class is a weaker discriminating factor in the United States than in Europe--is no less an empirical reality and a moral bane. Still, a sincere meritocratic ethic, an ideological characteristic of a burgeoning capitalist development, has pervaded various social structures, notably the realm of knowledge. Science ostensibly rewarded only meritocratically attained achievements which followed strict requirements of intellectual rigor and objectively defined criteria. The American belief in the positive values of meritocracy became institutionally epitomized in the structure of academia.

Universities and their constituents have replicated--and initiated--many changes of contemporary American life. Most importantly, they have stood in the forefront of the battle against discrimination thereby representing a major protagonist for equality and justice. Without denigrating the sincerity of this noble effort in the least we would like to shed some light on certain structural inequities which, despite a meritocratic ideology, have remained inherent to American higher education with all its organizational manifestations.

Using the data from the extensive Carnegie Faculty Survey of 1969 furnished to us by the courtesy of Professors E.C. Ladd and S.M. Lipset we have attempted an in-depth analysis of the extent to which meritocratic criteria determine the institutional existence and rewards of the American professoriate. The present paper embodies a preliminary report of a partial segment of this larger project.

We have selected a number of measures related to personal background such as sex, race, religion and parental education on the one hand, and variables measuring professional achievement such as salary, quality of institution and research funding on the other. Although we have been working extensively with numerous other variables such as for example "parental occupation" and "regional origins" on the independent dimension and "number of publications" in the dependent cluster, our

principal concern in this particular endeavor is to explore some suitable analytic procedures to be implemented in our larger project.

We proceeded to use "analysis of variance" to determine whether the background variables affected the achievement variables. We considered running an ANOVA by using each dependent variable and all six of its independent counterparts. This would have entailed six different analyses each being a six-way ANOVA. A major constraint presented itself in the fact that each analysis would have required the excess of 20 million bytes of core storage. Thus we subdivided the analysis into several one, two, and three-way ANOVAs thereby exploring the effects of different combinations of the independent variables on each of the dependent ones. For example, one analysis encompassed "quality of institution" by "religion", "race" and "father's education". The main effects were significant at a level of less than .001. The overall two-way interaction was significant at .01, while the individual two-way interactions were not all significant. The entire set of results will be found in Table 2.

Similarly we performed another three-way ANOVA using the same dependent variable with the independent variables being "religion", "race" and "sex". The results were again quite similar. Details can be found in Table 3.

Numerous other ANOVAs were performed in the same manner employing each of the dependent achievement variables and different combinations of the independent background variables. In every case, each of the main effects showed an F-statistic which was significant at a level of less than .001 thus indicating the strong effect of the independent background variables on the dependent achievement variables.

The main problem with the above is that we used several different measures of achievement. Ideally, we would have liked to determine whether overall achievement is affected by the set of independent background variables. A conventional procedure would have been to construct a single composite index of achievement derived from its individual components. Regardless of the construction procedure, one faces conceptual problems such as those of proper weighting and scaling in addition to incurring an inevitable loss of information. In order to overcome this obstacle, we decided to try the technique of multivariate analysis of variance. MANOVA permits the use of a set (more than one) of interval variables as the dependent variable in addition to treating independent variables in a manner analogous to ANOVA. The benefit of this process lies in the fact that there is no necessity of building a composite index; rather, the entire set of achievement variables can be incorporated. Subsequently, we can observe whether a difference exists as to the overall achievement determined by the independent

background variables. Furthermore, MANOVA is also suitable for handling several nominal dependent variables. Thus, for example, in a subsequent stage of our research, we would like to use "teaching discipline" as a dependent variable. (This variable has four categories.) This step would require the creation of dummy variables for each category. Under MANOVA we will treat the entire set as a dependent variable, thus avoiding a number of separate and tedious procedures.

We performed several MANOVAs. Each MANOVA consisted of the entire set of achievement variables by three of the background variables. The output was much more complex than that of ANOVA. Summaries of the rather interesting results will be found in Table 4-space does not permit the inclusion of all the tables.

As can be gathered from the table, the independent background variables have a significant effect on the achievement variables. Although more complex than other analytic procedures, the results of this analysis were very informative conceptually and methodologically. While this brief paper has tried to show that achievement is affected decisively by the selected set of background variables, it would be an interesting addition to measure the degree to which each background variable affects the level of achievement. Thus, for instance, it would be important to investigate whether religion has a more substantial effect on academic achievement towards elucidating this problem. However, most of the background variables are nominal in nature. Hence, the use of regression analysis would necessitate the creation of a vast array of dummy variables.

Unquestionable, there is more work to be done in this direction. As pointed out earlier, the present preliminary report represents but a fraction of our eventual analyses concerning this rich data. One can nevertheless state, even at this juncture of our research, that the evidence is overwhelming as to the fact that ascriptive variables such as sex, religion and race play a crucial role in determining an individual's success or failure in a nominally meritocratic environment.

Table 1

VARIABLE SET

Background or Ascriptive Variables--Independent

Religion in which person was raised

Sex

Race

Father's political beliefs

Father's education

Mother's education

Achievement Variables--Dependent

Total annual salary

Quality of institution

S.A.T. scores of students at institution

Research funded by outside sources

Research dollars per student

Revenue per student

Table 2
ANALYSIS OF VARIANCE
QUALITY OF INSTITUTION BY
RELIGION, RACE AND FATHER'S EDUCATION

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	7286.488	13	560.499	133.072	0.000
religion	3518.414	4	879.604	216.680	0.000
race	498.894	3	166.298	41.965	0.000
father's education	2728.738	6	454.790	112.032	0.000
2-WAY INTERACTIONS	320.316	52	6.160	1.517	0.010
religion race	59.271	10	5.927	1.460	0.148
religion father's education	194.507	24	8.104	1.996	0.003
race father's education	71.655	18	3.981	0.981	0.479
3-WAY INTERACTIONS	172.766	49	3.526	0.869	0.730
religion race father's education	172.768	49	3.526	0.869	0.730
EXPLAINED	7779.625	114	68.242	16.811	0.000
RESIDUAL	231994.500	57149	4.059		
TOTAL	239774.125	57263	4.187		

Table 3
ANALYSIS OF VARIANCE
QUALITY OF INSTITUTION BY
RELIGION, RACE, AND SEX

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	6488.738	8	811.092	199.153	0.000
Religion	3567.358	4	891.839	218.979	0.000
Race	504.696	3	168.232	41.307	0.000
Sex	1799.183	1	1799.183	441.765	0.000
2-WAY INTERACTIONS	198.324	17	11.666	2.864	0.000
religion race	71.489	10	7.149	1.755	0.063
religion sex	110.159	4	27.540	6.762	0.000
race sex	13.992	3	4.664	1.145	0.329
3-WAY INTERACTIONS	39.667	10	3.966	0.974	0.464
religion race sex	39.661	10	3.966	0.974	0.464
EXPLAINED	6726.750	35	192.193	47.190	0.000
RESIDUAL	236111.563	57974	4.073		
TOTAL	242838.313	58009	4.186		

Table 4

Multivariate Analysis of Variance Salary,
Quality of Institution, Sponsored Research;
Research Per Student and Revenue Per Student
by Father's Education and Mother's Education

OVERALL SALARY	QUALITY OF INSTITUTION	MEAN SAT SCORE FOR STUDENTS	AMOUNT OF SPONSORED RESEARCH	RESEARCH DOLLAR PER STUDENT
Overall Salary	0.636E 03	AT INSTITUTION		
Quality of Institution	0.133E 03	0.179E 03		
Mean SAT score for students at Institution	0.806E 02	0.918E 02	0.135E 03	REVENUE PER STUDENT
Amount of sponsored research	163E 03	0.889E 02	0.544E 02	0.234E 03
Research dollars per student	110E 03	0.152E 03	0.112E 03	0.309E 03
Revenue per student	176E 02	0.861E 02	0.594E 02	0.138E 03
TEST OF F				0.420E 03
				0.181E 03
				0.116E 03

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS.

TEST OF ROOTS	F	DFHYP	DFERR	PROB.	R
1 THROUGH 6	1.442	216.000	311418.688	0.001	0.041
2 THROUGH 6	1.269	175.000	311224.688	0.013	0.036
3 THROUGH 6	1.130	136.000	311011.375	0.073	0.032
4 THROUGH 6	0.997	99.000	310776.375	0.001	0.030
5 THROUGH 6	0.801	64.000	310517.250	0.895	0.026
6 THROUGH 6	0.529	31.000	310230.938	0.990	0.018

VARIABLE	F (36,52526)	MEAN SQ	PROB.
Overall Salary	1.942	17.653	0.001
Quality of Institution	1.210	4.973	0.172
Mean SAT score for students at Institution	2.036	3.757	0.001
Amount of sponsored research	1.117	7.893	0.261
Research dollars per student	1.556	11.675	0.016
Revenue per student	1.375	3.224	0.062

VARIABLE	STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS			
	1	2	3	4
Overall Salary	0.456	-0.695	-0.451	0.364
Quality of Institution	-0.253	-0.010	0.712	0.883
Mean SAT score for students at Institution	-0.695	-0.748	-0.246	-0.593
Amount of sponsored research	0.928	-0.031	-0.041	-1.007
Research dollars per student	-0.731	0.549	-1.007	0.511
Revenue per student	0.214	0.130	-0.092	0.636

TEST OF F

SUMS OF PRODUCTS FOR HYPOTHESIS ADJUSTED FOR 0 COVARIATES

OVERALL SALARY	QUALITY OF INSTITUTION	MEAN SAT SCORE FOR STUDENT	AMOUNT OF SPONSORED RESEARCH	DOLLAR PER STUDENT
Overall Salary	0.156E 04			
Quality of Institution	0.560E 03	0.246E 04		REVENUE PER STUDENT
Mean SAT score for students at Institution	0.349E 03	0.197E 04	0.159E 04	
Amount of sponsored research	0.374E 03	0.204E 04	0.161E 04	0.173E 04
Research dollars per student	0.406E 03	0.269E 04	0.216E 04	0.225E 04
Revenue per student	0.332E 03	0.169E 04	0.136E 04	0.139E 04
				0.298E 04
				0.185E 04
				0.117E 04

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS.

TEST OF ROOTS	F	DFHYP	DFERR	PROB.	R
1 THROUGH 6	37.564	36.000	230638.500	0.001	0.148
2 THROUGH 6	7.667	25.000	210088.500	0.001	0.056
3 THROUGH 6	1.550	16.000	183229.063	0.070	0.018
4 THROUGH 6	0.801	9.000	148556.813	0.607	0.010
5 THROUGH 6	0.614	4.000	105046.000	0.651	0.007
6 THROUGH 6	0.0	1.000	52523.500	1.000	0.000

UNIVARIATE F TESTS

VARIABLE	F (6,52526)	MEAN SQ	PROB.
Overall salary			
Quality of Institution	28.672	260.638	0.001
Mean SAT score for students	99.809	410.151	0.001
At Institution	143.909	265.512	0.001
Amount of sponsored research	40.733	287.861	0.001
Research dollars per student	66.113	496.096	0.001
Revenue per student	82.848	194.227	0.001

STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS

VARIABLE	1	2	3
Overall Salary	0.359	0.950	-0.089
Quality of Institution	0.386	0.106	0.224
Mean SAT score for students	0.605	-0.236	-0.353
At Institution	0.229	0.534	1.437
Amount of sponsored Research	0.167	-0.452	-0.482
Research dollars per student	0.260	0.018	-0.324
Revenue per student			

OVERALL SALARY	QUALITY OF INSTITUTION	MEAN SAT SCORE FOR STUDENTS	AMOUNT OF SPONSORED RESEARCH	RESEARCH DOLLAR PER STUDENT	REVENUE PER STUDENT
Overall Salary	0.287E 04				
Quality of Institution	0.173E 03	0.989E 02			
Mean SAT score for students	0.916E 02	0.877E 02	0.983E 02		
at Institution	0.122E 03	0.754E 02	0.685E 02	0.105E 03	
Amount of sponsored research	0.396E 02	0.832E 02	0.919E 02	0.107E 03	0.134E 03
Research dollars per student	0.954E 02	0.544E 02	0.567E 02	0.527E 02	0.710E 02
Revenue per student					0.426E 02

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS.

TEST OF ROOTS	F	DFHYP	DFERR	PROB.	R
1 THROUGH 6	11.939	36.000	230638.500	0.001	0.082
2 THROUGH 6	2.938	25.000	210088.500	0.001	0.031
3 THROUGH 6	1.481	16.000	183229.063	0.098	0.017
4 THROUGH 6	0.924	9.000	148556.813	0.473	0.012
5 THROUGH 6	0.150	4.000	105046.000	0.962	0.004
6 THROUGH 6	0.0	1.000	52523.500	1.000	0.001

UNIVARIATE F TESTS

VARIABLE	F (6,52526)	MEAN SQ	PROB.
Overall Salary	2.641	478.523	0.001
Quality of Institution	4.012	16.489	0.001
Mean SAT score for student	3.879	16.382	0.001
at Institution	2.487	17.579	0.018
Amount of sponsored research	2.986	22.405	0.006
Research dollars per student	3.031	7.107	0.005
Revenue per student			

STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS

VARIABLE	1	2	3
Overall Salary	1.024	0.122	-0.007
Quality of Institution	0.174	-0.089	0.701
Mean SAT score for students at Institution	0.141	-0.943	-0.030
Amount of sponsored research	0.020	0.057	1.458
Research dollars per student	0.016	-0.030	-1.764
Revenue per student	0.108	0.023	-0.187

BIBLIOGRAPHY

Buhler Roland and Shirrell Buhler, P-Stat-A Computing System for File Manipulation and Statistical Analysis, Princeton, N.J.: Princeton University Computing Center, 1976

Cooley and Lohnes, Introduction to Statistical Procedures, Wiley, NY: 1968

Morrison, Donald F., Multivariate Statistical Methods, New York, New York: McGraw-Hill Book Company, 1967

Nice, Norman, H., C. Hadlan Hull, Jean G. Jenkins, Karin Steinbrenner, Dale H. Bert, Statistical Package for tr Social Sciences;

Press, S. James, Applied Multivariate Analysis, New York, New York: Holt, Rinehart and Winston, Inc., 1972

Tatsuoka, Maurice, M., Multivariate Analysis, New York, New York: John Wiley & Sons, Inc., 1971

Winer, B. J. Statistical Principles in Social Design, New York, New York: McGraw-Hill Book Company, 1971