THE ARITHMETIC OF AFFIRMATIVE ACTION: PROCEDURES FOR ANALYZING SEX DIFFERENCES IN FACULTY SALARIES

Elizabeth M. Almquist & Ray L. Darville, North Texas State University

METHODOLOGY FOR ANALYZING FACULTY SALARIES

Concern has been expressed over the issue of potential discriminatory salary differences between male and female faculty at all types of colleges and universities. Many studies have been conducted of single institutions and few have used national samples. The results are varied, but a standard methodology for analyzing salary differences by sex has evolved. The following capsule summary of these methods is illustrated with a case study at a single university.

Ordinary least squares regression is the chief statistical tool for analyzing salaries, with separate equations developed for men and women. Annual salary, the dependent variable, is regressed on a series of variables which ordinarily include, but are not necessarily limited to, highest degree obtained, academic rank, years of experience, years in rank, tenure status, and academic discipline. Data for these variables can be obtained from university personnel records. Productivity variables such as publications, performances, and research activity are sometimes included, but this requires distributing questionnaires and making a number of poorly-based decisions about the quality of productivity across different disciplines. Some researchers (Braskamp & Johnson 1978) have found that productivity variables have little impact on salary once other qualifications are included in the regression while others (Feber & Kordick 1978) recommend that salary studies be conducted even in the absence of productivity data. It is inadvisable to put the total population in the equation and include sex as a predictor as this underestimates the impact of sex on salary and prevents discovery of different pay patterns for men and women. Therefore separate equations should be developed. We illustrate with equations as developed for males. The procedures are identical for females.

The coefficients represent the dollar amount of salary gained for each unit increase in the mean score of the relevant predictor variable. For this reason the coefficients are frequently referred to as "exchange rates." The equation produces a model of the process of salary determination. The model is complete only insofar as all pertinent predictor variables have been entered into the equation. If important predictor variables are omitted, and if these predictors are correlated with predictor variables that are actually entered in the equation, the statistical procedure will over-estimate the values of the coefficients of variables that have been included.

Before developing the equations, one should check to determine that the assumptions of regression analysis are met, especially that the relationship between salary and each of the individual predictors is indeed linear. Years of experience frequently exhibits a curvilinear relationship to salary, with faculty in the middle years having the highest pay. The eta correlation statistic can be used to check for curvilinear relationships (Loether & McTavish 1980: 264). If curvilinearity exists, transform the variable by squaring year of experience or by using a log transformation.

An additional problem that can plague the analysis is that of colinearity, i.e., two or more of the predictor variables are strongly related to each other, thus affecting the stability of the coefficients. One rule of thumb for handling colinearity is as follows: if the zero-order correlation between two variables is between .60 and .80, combine them into a single index. If the zero-order correlation is above .80, assume that the two variables are redundant and omit one of them.

One should routinely check for interaction effects among the predictor variables. Create interaction variables by multiplying each pair of variables together. Repeat the regression analysis, forcing the interaction variables into the equation after the individual variables have been entered. In this way only one can determine whether one or more of the interaction variables explains a significant portion of the remaining variance.

All these procedures have been used for two analyses of salaries at a southwestern university. In the full sample, the entire population of 694 faculty members is included. In the re-

stricted sample, only the 568 faculty members who have a master's or doctoral degree, who are eligible for or have been granted tenure, and who are full-time employees are included. This includes 84 percent of the males, but only 74 percent of the total female faculty. Sex differences in average salary should be smaller among the restricted sample than in the total population. However, the reduction is only from $4,777 to $4,496, a modest decrease of only $281. In both instances the data were obtained from the May, 1981, personnel files of the University and salaries represent the 9-month equivalent for full-time work. We shall refer primarily to the restricted sample.

RESULTS OF THE REGRESSION ANALYSES

The regression analyses result in equations of the following form:

$Y = a + b_1X_1 + b_2X_2 + b_3X_3 \ldots + b_nX_n$

where: Y = the dependent variable, average male salary

a = constant (intercept, or point of origin)

b_1 = the coefficient of the first predictor

X_1 = the mean score for males on the first predictor variable

b_n = the coefficient of the last predictor variable.

X_n = the mean score for males on the last predictor variable.

Table 1 displays most of the results needed to depict sex differences in academic salary. Beginning with academic rank, the average for men is just above the associate professor level while the average for women is just below the assistant professor level. From the coefficients, men average $1000 more for each increment in rank than women do ($4308 vs. $3308). At the same time, men gain twice as much as women do for each additional year spent in rank ($241 vs. $120).

Both men and women lose dollars for each year spent in service, but because women have fewer years in service they recieve a small net benefit. Similarly, men experience a large decrement in salary when they attain tenure. The negative effect of tenure on women's salaries is less than one-third as large ($382 vs. $1293). Similar results have been obtained in other studies, and these are readily interpretable once it is recognized that the cofficients reflect the value of tenure, while simultaneously controlling for the effects of all other variables. Note that tenure and rank are strongly correlated especially for women (See Table 2), and that according to the beta weights (See Table 3) rank is a much stronger determinant of salary than is tenure status. In the zero-order correlation (Table 3), tenure and salary are positively associated, as expected. The influence of rank on salary is so strong that it over-rides the effect of tenure.

With highest degree, we encounter the first sharp reversal of effects between men and women. Men experience an increment of $702 for holding a doctoral degree rather than a master's degree, while women experience a decrease of $447 for holding a doctorate. This finding suggests, maximally, that women are blocked from upward mobility within the institution, and, minimally, that a very different pattern of monetary rewards prevails for women and men.

TABLE 1: REGRESSION ANALYSIS: RESTRICTED SAMPLE OF MALE & FEMALE SALARIES

			Mean Coefficient	
Variables	*Male*	*Female*	*Male*	*Female*
Academic Rank	4.15	2.97	+4803	+3308
Years' Rank	7.92	5.98	+241	+ 120
Years' Service	11.72	8.67	-85	-48
Tenure**	2.78	2.30	-1293	-382
Highest Degree	1.83	1.62	+702	-447
Department Grouping by Percent				
Music	10.9	10.8	(Standard)	
Humanities	25.1	28.4	+702	+293
Social Science	18.9	5.9	-1199	+2060
Education	19.1	26.5	-710	+246
Physical Science	14.4	2.9	-101	-659
Mix: Home Econ, Community Service, Information Sci	1.5	13.7	+592	+853
Business	13.7	11.8	+2106	+1507
Total N	466	102	$R^2$71	70
Salary, $1000's	25.2	20.7		
Constant, $1000's			9.0	11.7

* Includes full time faculty with master's or higher, & tenured or elligible.

**Rank codes 1-6, lecturer to department chairperson; code ranks 1-3 for tenure status and for degree level.

TABLE 2: 0-ORDER CORRELATION MATRIX (Decimals omitted: males over females under diagonal)

Variables	*1*	*2*	*3*	*4*	*5*	*6*
1 Academic Rank		05	32	43	56	39
2 Years' Rank	06		77	-03	39	67
3 Years' Service	15	78		-05	56	77
4 Highest Degree	58	-35	-30		20	-21
5 Tenure	72	33	52	28		-47
6 Top Degree Year	15	72	76	-48	39	
7 Sex, M=1; F=0	40	08	14	21	32	16

TABLE 3: CORRELATIONS & BETA WEIGHTS FOR MALE AND FEMALE SALARIES

Variables	Males		Females	
	Simple r	Beta Wt	Simple r	Beta Wt
Academic Rank	.79	.861	.81	.909
Years' Rank	.17	.310	.04	.185
Years' Service	.28	-.137	.15	-.091
Tenure	.39	-.120	.57	-.070
Highest Degree	.39	.051	.43	-.050
Department Groupings				
Humanities	-.10	-.040	-.10	.031
Social Science	-.09	-.093	.20	.113
Education	-.06	-.055	.02	.025
Physical Science	.07	-.007	-.06	-.026
Mixed category	-.03	.014	.04	.068
Business	.20	.144	.06	.113

Departments within the College of Arts and Sciences were grouped into clusters of kindred disciplines, while the other schools and colleges were treated as individual clusters. These clusters partially represent the market value of the various disciplines in employment outside academe, which has been found to be a modest influence on faculty salaries (Reagam & Maynard 1974). Departmental affiliation is coded as a dummy variable, with music faculty constituting the reference category. The dummy variable categories are listed in order from low to high by the average salary of assistant professors. We assumed that assistant professor salaries would most closely reflect the discipline's market value. Note, however, that when faculty of all ranks are included, some of the cofficients are in fact negative. The sign and size of the coefficients reflect the average salary increment for being in the particular department grouping as against being in the music school, with all other variables in the equation controlled. The coefficients for department differ markedly in the male and female equations.

DECOMPOSITION OF SEX DIFFERENCES IN SALARY

We have seen that women's salaries are lower than men's; that women's scores on some of the predictor variables are somewhat lower than men's; and that the coefficients differ in some cases as well. A question then arises about the sources of women's lower salaries. To what extent are women's lower salaries the result of their possessing lower qualifications than men and to what extent are women's lower salaries the result of their receiving lower exchange rates?

A standard technique, called "decomposition," has been developed for answering this question. The decomposition has been done in two ways (See table 4). In the first case, male mean scores (qualifications) were substituted into the female equations, using women's intercept and coefficients. A new mean salary was computed, which is the amount women would receive if they possessed the same qualifications (mean scores on the predictor variables) that men have but exchanged these qualifications for pay at the

TABLE 4: DECOMPOSITION OF MALE-FEMALE SALARY DIFFERENCE (Restricted Sample)

Component	**Percent explained*	*Salary 1000's*
1 Actual Salary, Males		25.23
2 Actual Salary, Females		20.74
3 Difference		4.50
First Decomposition Method		
4a Predicted salary, Male qualifications, Female equations		24.45
4b Difference, predicted & actual salary, men (1-4a)	17%	.78
4c Difference, predicted & actual salary, women (4a-2)	83%	3.72
Second Decomposition Method		
5a Predicted salary: Female qualifications, Male equations		21.00
5b Difference, women's predicted & actual salary	6%	.26
5c Difference, men's predicted & actual salary	94%	4.23

* salary gap explained by male higher change rates and female lower qualifications.

same (high) rate men do (Line 4b). The difference between the newly predicted salary and women's actual salary is the amount women lose because they do not possess the same qualifications men do (Line 4c).

In the second method, women's mean scores on the predictor variables were substituted in the male equations. Using the male intercept and the male coefficients, a new salary for women was computed (See Line 5a), which represents the amount women would earn if they kept the same (lower) qualifications they actually possess, but exchanged these qualifications for increments in salary at the same (high) rate men do. The difference between the newly predicted salary and women's actual salary represents the amount women lose because they do not exchange qualifications for pay at the same high rate men do (Line 5b). The gap between the newly predicted salary for women and men's actual salary represents the amount of earnings women lose because they do not possess the same qualifications that men do (Line 5c).

In this sample, difference between men and women in pay patterns account for either 6 or 17 percent of the salary gap, depending on which decomposition method one prefers. The dollar amounts are somewhat smaller than those found at other universities, but are still sizeable.

INTERPRETATION OF FINDINGS

First, we stress the point that the coefficients reflect the average dollar increment (or decrement) received by faculty members per unit increase in the pertinent variable, while the effects of all other variables in the equation are controlled. Thus, one interpretation of male-female differences is that the university really does pay men $1,000 more for each promotion in rank than it pays women. Similarly, the university over-compensates female social scientists and underpays males in the same discipline. Support for this interpretation is given by the relatively high amount of salary variation that is explained in these equation -- R^2 = 71 and 70 percent for men and women respectively. Support for this interpretation can also be gained through an examination of the residuals--we could detect no pattern in them.

An alternative interpretation is as follows. Differences between men and women in the sign or size of any one coefficient can reflect the influence of variabes not included in the equation. In order for an unmeasured variable to influence a coefficient, however, the two variables must be closely correlated with each other. Among the possible unmeasured variables, one category stands out as being plausibly correlated with one or more of the measured variables, thereby affecting the sign or size of the coefficients. This category includes the productivity variables such as publications, performances, and research activities. Under this interpretation, males at the higher ranks are more productive than women and therefore deserve the extra $1000 they garner with each promotion. Similarly, tenured women are more productive than tenured men, and women holding a doctorate are less productive than similarly qualified men. Under this interpretation, as well women in education are more productive than men, and female social scientists are real super-stars compared to their male colleagues!

This latter interpretation, that unmeasured productivity variables affect the coefficients, can be neither rejected nor confirmed with these data. Only a much fuller and much more costly study which gathered data on productivity could provide the required evidence. The research literature suggests that men do publish more books and articles and receive more research grants than women. However, when rank and years in service are taken into account, productivity differences are greatly diminished (Feber & Kordick 1978: Buzan & Hunt 1976).

CONCLUSIONS

The multiple regression and decomposition techniques described here are highly appropriate for analyzing salary differences within a single institution. The regression techniques provide a fuller and more complete picture of salary patterns than can be developed from simple cross-tabulations of salary by the predictor variable. Indeed, because of cell-attrition cross-tabulations cannot be used when considering more than 3 or 4 variables at a time.

The regression techniques provide a model of the salary determination process. At this University academic rank is the most important criterion by which salary is awarded; rank

appears to be much more important than it is at other universities. Years in rank is second in importance and modestly influences salaries. Other variables appear to play a minor part in the process of salary determination, but it is important to notice that in several cases, the direction of their effects is different for men and women.

We make no claims about the relative importance of market factors in salary determination. Clearly departmental affiliation has an effect on salary, but the patterns are mixed both within and between the sexes. Our operationalization of "market value" is quite crude, albeit in accord with other researchers' judgement about the matter. And in truth, one cannot measure the influence of market factors on salaries by using data from a single university.

Women faculty have lower qualifications than men faculty. This is most evident in the cases of academic rank and years in service, but true also in terms of tenure status and highest degree obtained. There are a variety of reasons for this, including women's previous socialization experiences, their slightly delayed entrance into the academic marketplace, past and current hiring practices at this university, and possibly also current discrimination in granting promotions. We do not make any attempt to account for these qualifications; we only note their existence. We also note that women are only partly responsible for the lower qualifications they present. Treatment by institutions accounts for part of the differences between women and men, particularly in rank and tenure status.

Women's lesser qualifications account for a substantial portion of the salary gap, but the university offers men and women different exchange rates for several of the qualifications analyzed here. There are notable differences between men and women in both the size and sign of the regression coefficients. More importantly, whatever a woman's specific qualifications, she is unable to exchange them for salary at quite the same high rate men do.

These data do not provide evidence that there is widespread, systematic discrimination against women in setting salaries. Neither do they completely reject the possibility of limited and inadvertent mistreatment.

The general picture is one of fragile near-equality between men and women. We stress the fragility of the situation because women are few in number and they are distributed across disciplines and ranks in a different manner than men are.

We stress near-equality because it appears that there are different patterns of compensating women and men. Men's superior qualifications do not totally account for their higher salaries, and women may not deserve their lower qualification, particularly in the area of academic rank. Data not presented here reveal that the number of women at this yniversity has been stable for some time; nonetheless women have made little progress in gaining associate or full professionships. At the current time, 71 percent of men but only 26 percent of women faculty *in the restricted sample* hold associate or full professorships. A longitudinal analysis of starting salaries, productivity, promotions, and merit raises is needed to reduce the tangle of male and female status.

The Committee on the Status of Women of the Faculty Senate at NTSU, which commissioned this study, is recommending that salaries be continuously monitored, that a longitudinal analysis be conducted, and that a joint faculty-administration committee review and develop policies concerning all aspects of salary, not simply the issue of sex differences.

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