

Appendix VIII

Faculty

VIII.C.1 Faculty Salary

Analysis

Johns Hopkins University
Bloomberg School of Public Health

Report on Faculty Salary Analysis, 2002-2003

To

Committee on Affirmative Action
March 10, 2003

By

Elizabeth Johnson
Scott L. Zeger
Department of Biostatistics

1 Introduction

This report presents a statistical analysis of 1999-2003 salaries for Public Health faculty requested by the School Committee on Affirmative Action as part of the School's on-going effort to prevent gender and minority bias in salaries. This study estimates the percent difference in average salaries per fiscal year for men as compared to women and for minority relative to non-minority faculty adjusting for major salary influences such as rank, highest degree (MD or not), department, field of scholarship, track (professorial or not) and date of latest appointment or promotion.

2 Methods

The following data were provided by Dean Fox regarding the 1999-2003 status of 274 faculty (FY99-00, FY00-01, FY01-02 and FY02-03):

- salary in dollars (only faculty who receive full-time salaries are included)
- track (all professional, including tenure-track and non-tenure-track)
- rank (assistant, associate, or full professor, department chairs included)
- department
- highest degree (MD vs. other doctoral degree)
- year of highest degree
- year of present appointment/promotion
- age
- field or discipline of scholarship: social science; biological science; epidemiology; quantitative science (biostatistics, health economics and demography); and physical science (chemistry, radiation science, industrial hygiene); and other.
- gender (M vs. F)
- minority (Yes vs. No, includes all minorities regardless of citizenship, including underrepresented U.S. minorities)

Descriptive statistics and figures were used to explore the relationships among the discrete predictors: gender, minority status, rank, and track.

An extension of linear regression, generalized additive models (Hastie and Tibshirani, 1990, *Generalized Additive Models*, Chapman and Hall, London) was used to describe log salary for each fiscal year as a smooth function of each of the three continuous predictors and of the categorical variables. The logarithmic transformation of salary was used so that variance was roughly independent of the mean and for ease of interpretation of the regression coefficients. Under this model, the coefficient for gender

(minority status) is the fractional amount by which women's (minority) salaries are higher (positive coefficient) or lower (negative coefficient) relative to men with similar values for the other covariates. For example, if the coefficient for gender is $-.01$, the average salary for women is estimated to be 1% less than the average for otherwise similar (as determined by our measured covariates) men. The results for this fiscal year (FY02-03) are compared to the analogous ones from the fiscal years FY99-00, FY00-01 and FY01-02.

In addition, the data were combined and a random effects model was used to describe log salary as a smooth function of each of the three continuous predictors, the categorical variables and interactions of fiscal year with gender, minority, degree and rank. The random effects included in the model were the intercept and year. Thus the model estimated a faculty specific log salary for FY02-03 and a faculty specific year effect. The coefficients have the same interpretation in this model as in the generalized additive model described above.

3 Results

Table 1 displays the number of faculty for FY99-00 through FY02-03. The number of total faculty is increasing across the years, but this is due largely to the increasing number of non-tenure track professorial faculty.

Figures 1 and 2 show the number of faculty by rank and gender for FY99-00 to FY02-03. The number of female assistant and full professors has increased over the last years. The number of male associate professors is increasing while the number of male assistant and full professors has remained stable.

Figure 3 shows the percentage of total faculty whom are non-tenure, female, minority or non-MDs across the fiscal years. The percentage of the under-represented populations in the school remain fairly stable across the four years.

Tables 2 and 3 display the estimated percentage difference in salaries comparing non-MDs to MDs, females to males and minority faculty to non-minority faculty. Table 2 displays the results for the fiscal year-specific generalized additive models and table 3 displays the results for the random effects model. Figure 4 displays the estimates based on both modeling strategies. The results are qualitatively consistent across the two models. We estimate that there is no statistically significant difference in the average salaries comparing female and male faculty. For FY02-03, we estimate that minority faculty are earning on average 3 % less compared to the non-minority faculty (95% CI: 7 % less to 2 % more). Although the non-MDs are still earning approximately 16 % less than the MDs (95% CI: 21 to 11 % less), it appears that the trend is to decrease this difference.

Table 1: Total number of faculty by fiscal year.

		Fiscal Year			
		FY99-00	FY00-01	FY01-02	FY02-03
Total		199	203	236	241
Track	Tenure	199	201	201	207
	Non-tenure	0	2	35	34
Rank	Full	92	98	105	108
	Associate	55	51	60	64
	Assistant	52	54	71	69
Gender	Male	134	135	151	152
	Female	65	68	85	89

Table 2: Coefficients (%diff) and standard errors (se) from the random effects model of log salary on age (3 df), date of last promotion (3 df), date of last degree (3 df), rank (2 df), degree (1 df), field (5 df), track (1 df), gender (1 df), minority status (1 df), year (3 df), rank by year (6 df), degree by year (3 df), minority status by year (3 df) and gender by year (3 df.).

	FY99-00		FY00-01		FY01-02		FY02-03	
Variable	%diff	se	%diff	se	%diff	se	%diff	se
non-MD	-22	2.5	-19	2.4	-18	2.4	-16	2.4
Female	0.3	2.0	0.6	1.9	1.2	1.9	0.7	1.9
Minority	-4.9	2.5	-5.2	2.3	-4.4	2.3	-3.0	2.3

Table 3: Faculty salary regression results for FY99-00, FY00-01, FY01-02 and FY02-3. Coefficients (%diff) and standard errors (se) from regressions of log salary on age (3 df), date of last promotion (3 df), date of last degree (3 df), rank (2 df), degree (1 df), field (5 df), track (1 df), gender (1 df) and minority status (1 df).

	FY99-00		FY00-01		FY01-02		FY02-03	
Variable	%diff	se	%diff	se	%diff	se	%diff	se
non-MD	-20	2.9	-19	2.8	-18	2.6	-16	2.6
Female	-1.1	2.3	-0.4	2.2	-0.4	2.0	-0.7	2.0
Minority	-4.4	2.8	-4.9	2.7	-5.6	2.4	-2.8	2.4

Table 4: Coefficients (%diff) and standard errors (se) from random effects model of log salary on age (3 df), date of last promotion (3 df), date of last degree (3 df), rank (2 df), degree (1 df), field (5 df), track (1 df), gender (1 df), minority status (1 df), year (3 df), rank by year (6 df), degree by year (3 df), minority status by year (3 df) and gender by year (3 df.).

Predictor	Level	Est (SE)
Year	99	-0.099 (0.009)
	00	-0.071 (0.007)
	01	-0.039 (0.005)
	02	0 (ref.)
Professorial Track	Non-tenure	-0.061 (0.015)
	Tenure	0 (ref.)
Gender	Female	0.007 (0.019)
	Male	0 (ref.)
Gender*Year	99	-0.009 (0.009)
	00	-0.001 (0.007)
	01	0.005 (0.009)
	02	0 (ref.)
Minority (All Minority)	Yes	-0.030 (0.023)
	No	0 (ref.)
Minority*Year	99	-0.019 (0.012)
	00	-0.022 (0.009)
	01	-0.014 (0.006)
	02	0 (ref.)
Degree	non-MD	-0.164 (0.024)
	MD	0 (ref.)
Degree*Year	99	-0.052 (0.009)
	00	-0.030 (0.007)
	01	-0.011 (0.005)
	02	0 (ref.)
Rank	Assistant	-0.277 (0.023)
	Associate	-0.147 (0.015)
	Full	0 (ref.)
Assistant*Year	99	-0.039 (0.010)
	00	-0.027 (0.008)
	01	-0.019 (0.006)
	02	0 (ref.)
Associate*Year	99	-0.054 (0.010)
	00	-0.034 (0.007)
	01	-0.010 (0.006)
	02	0 (ref.)

Figure 1: The number of faculty by rank and track for the fiscal years FY99-00 to FY02-03.

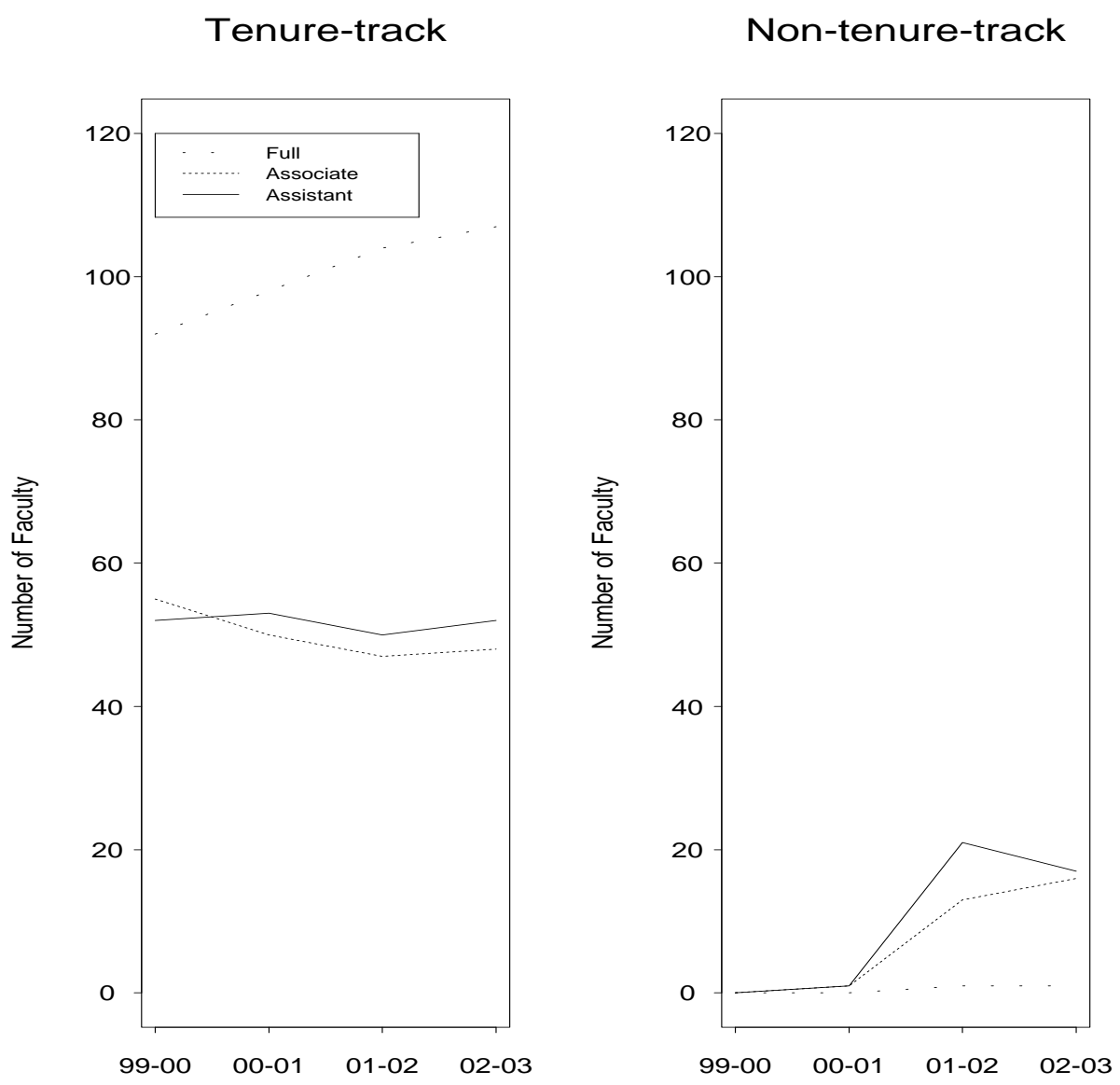


Figure 2: The number of faculty by gender and rank for the fiscal years FY99 to FY02.

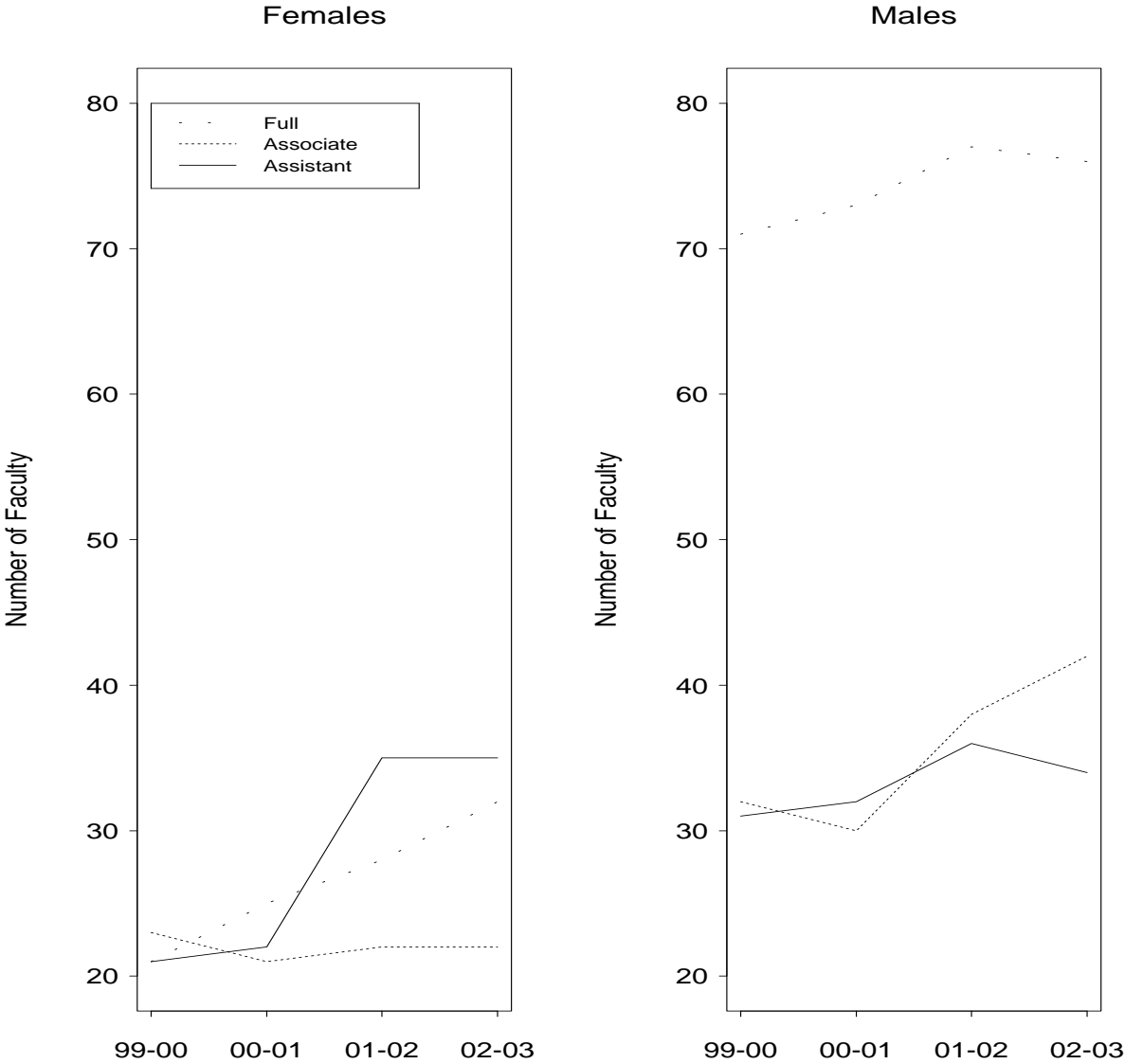


Figure 3: The percent of total faculty whom are non-tenure, minority, female or non-MDs by fiscal year.

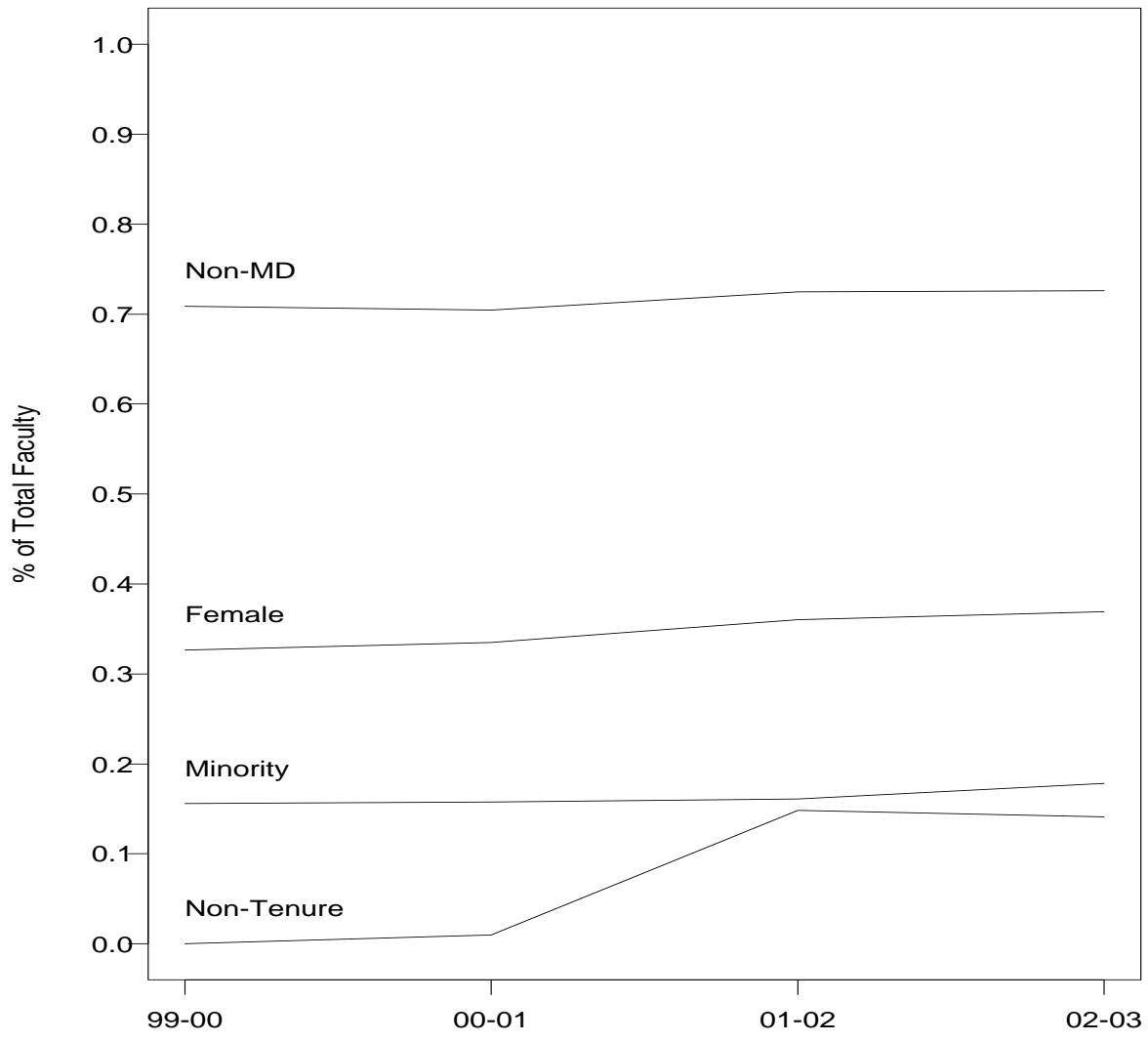
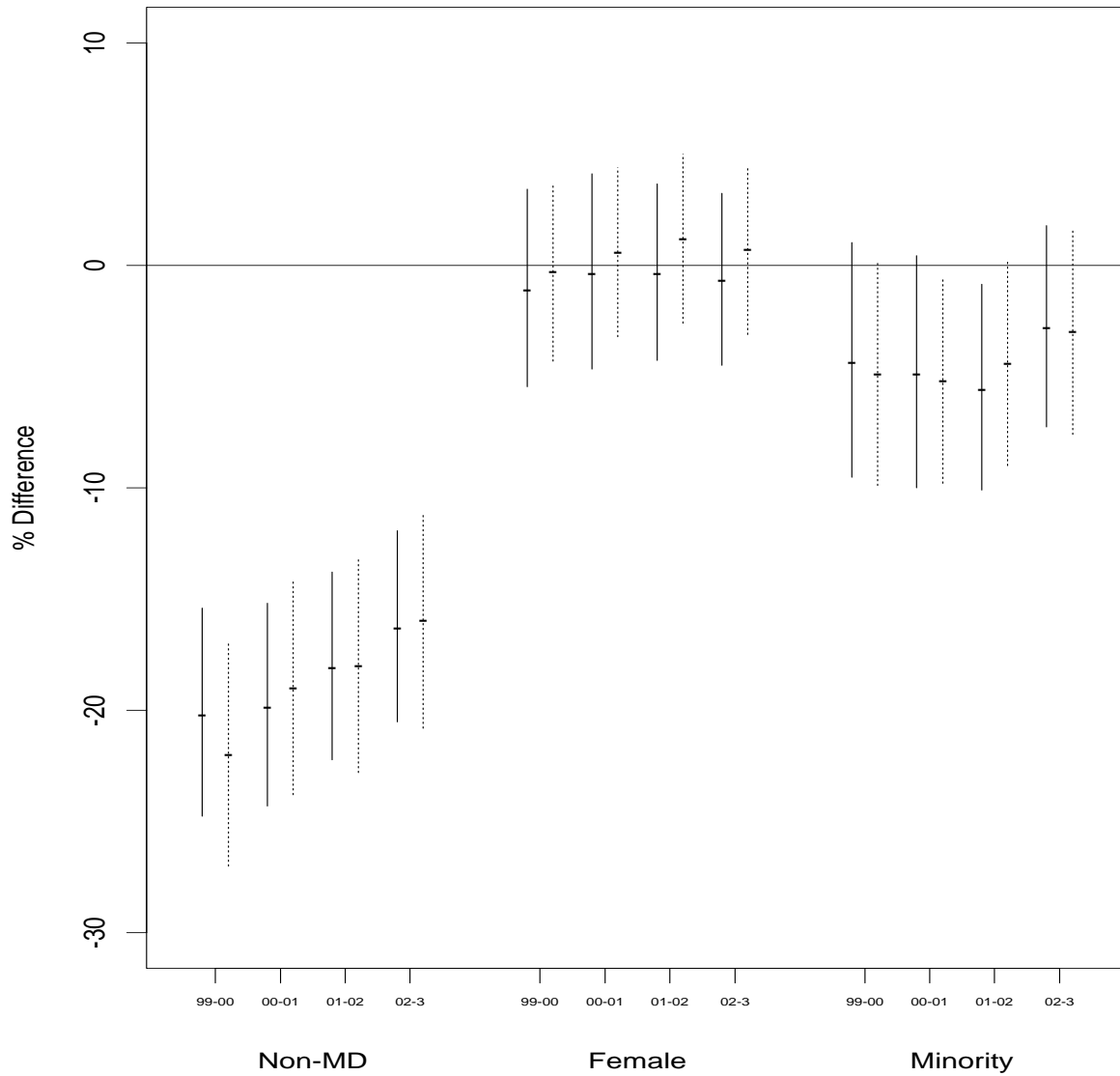


Figure 4: Estimated difference in salary (%) comparing non-MDs to MDs, females to males and minority faculty to non-minority faculty. The solid lines are based on year-specific generalized additive models, the dashed lines are based on the random effects model.



Johns Hopkins University
Bloomberg School of Public Health

Report on Faculty Salary Analysis, 2003-2004

To

Committee on Affirmative Action
April 19, 2004

By

Elizabeth Johnson
Scott L. Zeger
Department of Biostatistics

1. Introduction

This report presents a statistical analysis of 1999-2004 salaries for Public Health faculty requested by the School Committee on Affirmative Action as part of the School's on-going effort to prevent gender and minority salary differentials. This study estimates the percent difference in average annual salaries for women compared to men and for minority relative to non-minority faculty adjusting for major salary determinants such as rank, highest degree (MD or non-MD), department, field of scholarship, track (professorial or not) and date of latest appointment or promotion.

2. Methods

The following data were provided by Dean Fox regarding the status of 311 faculty during the fiscal years FY99-00 to FY03-04:

- salary in dollars (only faculty who receive full-time salaries are included)
- track (all professorial, including tenure-track and non-tenure track)
- rank (assistant, associate, or full professor, department chairs included)
- department
- highest degree completed (MD vs. other doctoral degree)
- year of completion of highest degree
- year of present appointment/promotion
- age
- field or discipline of scholarship: social science; biological science; epidemiology; quantitative science (biostatistics, health economics and demography); and physical science (chemistry, radiation science, and industrial hygiene); and other
- gender (female vs. male)
- minority (yes vs. no, includes all minorities regardless of citizenship)
- under-represented minorities (including African Americans, Hispanics, Native Americans)

Descriptive statistics and figures were used to explore the relationships among the discrete predictors: gender, minority status, rank and track.

A linear model was used to describe log salary for each fiscal year as a smooth function (natural spline with three degrees of freedom) of each of the three continuous predictors and of the categorical variables. The logarithmic transformation of salary was used so that the variance was roughly independent of the mean and for ease of interpretation of the regression coefficients. Under this model, the coefficient for gender (minority status) is the fractional amount by which women's (minority) salaries are higher (positive coefficient) or lower (negative coefficient) relative to men with similar values for the other covariates. For example, if the coefficient for gender is -0.01 , the average salary for women is estimated to be 1% less than the average for otherwise similar (as determined by our measured covariates) men. The results for this fiscal year (FY03-04) are compared to the analogous ones from the fiscal years FY99-00 through FY02-03. An additional model was used to estimate the

relative difference in salaries comparing minorities and under-represented minorities to non-minorities for the fiscal year FY03-04.

In addition, the data were combined and a random effects model was used to describe the log salary as a smooth function of each of the three continuous predictors, the categorical variables and interactions of the fiscal year with gender, minority, degree and rank. The intercept and slope for time were defined as random effects. The coefficients in this model have the same interpretation in this model as in the linear model described above.

3. Results

Table 1 displays the number of faculty for FY99-00 through FY03-04. The number of total faculty is increasing across the years, but this is due largely to the increasing number of non-tenure-track professorial faculty.

Figure 1 shows the percentage of total faculty whom are non-tenure, female, minority or non-MDs across the fiscal years. The percentage of the under-represented minority faculty in the school remains fairly stable across the fiscal years.

Tables 2 and 3 display the estimated percentage difference in salaries comparing non-MDs to MDs, females to males and minority faculty to non-minority faculty. Table 2 displays the results for the fiscal year-specific models and table 3 displays the results for the random effects model. Figure 2 displays the estimates based on both modeling strategies. The results are qualitatively consistent across the two models for the gender and minority status. The estimated average differences between female and male or minority and non-minority faculty salaries are small relative to their standard errors. For FY03-04, we estimate that female faculty are earning on average 0.7 % less compared to otherwise similar male faculty (95% CI: 4 % less to 3 % more). We estimate that for FY03-04 the minority faculty are earning approximately 2 % less than the non-minority faculty (95% CI: 6 % less to 2 % more). For FY03-04, we also estimated a separate effect for the under-represented minority (African American, American Indian/Alaska Native or Hispanic) and other minority faculty (Asian/Pacific Island). Specifically, we estimated that under-represented minority faculty are earning on average 0.4% more than the non-minority faculty (95% CI: 6 % less to 5 % more) and the minority faculty are earning on average 3 % less than the non-minority faculty (95% CI: 8 % less to 2 % more).

Table 4 displays the estimated difference in the average salaries comparing non-MDs to MDs, females to males and minority faculty to non-minority faculty based on the linear regression models using salary as the outcome variable, rather than log salary. We obtain qualitatively similar results comparing the fiscal year-specific analyses using either the log-salary or salary model. Figure 3 displays the predicted (mean) salaries for FY03-04 based on the log-salary and salary models. There appears to be general agreement between the two models, however, the log-salary model appears to predict slightly higher salaries for persons whom have the lowest and highest salaries. Figure 4 displays the distribution of predicted values for both the salary and log-salary models for the biological sciences stratified by rank and gender or minority status. Again, there does not appear to be any systematic bias in

prediction across the two models. Figure 5 displays the Quantile-Quantile plots for the residuals from the log-salary and salary models for FY03-04. These figures compare the distribution of residuals for females and males, non-MDs and MDs and minority and non-minority faculty.

Table 1: Total number of faculty by fiscal year.

		Fiscal Year				
		FY99-00	FY00-01	FY01-02	FY02-03	FY03-04
Total		199	203	236	241	265
Track	Tenure	199	201	201	207	219
	Non-Tenure	0	2	35	34	46
Rank	Full	92	98	105	108	113
	Associate	55	51	60	64	75
	Assistant	52	54	71	69	77
Gender	Male	134	135	151	152	166
	Female	65	68	85	89	99
Minority	Yes	31	32	38	43	56
	No	168	171	198	198	209

Table 2: Faculty salary regression results based on the fiscal year-specific models. Coefficients (%diff) and standard errors (se) from the regressions of log salary on age (3 df), date of last promotion (3 df), date of last degree (3 df), rank (2 df), degree (1 df), field (5 df), track (1 df), gender (1 df), and minority status (1 df).

Variable	FY99-00		FY00-01		FY01-02		FY02-03		FY03-04	
	%diff	se	%diff	se	%diff	se	%diff	se	%diff	se
Non-MD	-20	3.0	-20	2.9	-18	2.6	-16	2.6	-14	2.4
Female	-1.1	2.2	-0.4	2.2	-0.4	2.0	-0.7	1.9	-0.7	1.8
Minority	-4.4	2.8	-4.9	2.7	-5.5	2.5	-2.9	2.3	-1.8	2.0

Table 3: Coefficients (%diff) and standard errors (se) from the random effects model of log salary on age (3 df), date of last promotion (3 df), date of last degree (3 df), rank (2 df), degree (1 df), field (5 df), track (1 df), minority status (1 df), year (3 df), rank by year (6 df), degree by rank (3 df), minority status by year (3 df), and gender by year (3 df).

Variable	FY99-00		FY00-01		FY01-02		FY02-03		FY03-04	
	%diff	se	%diff	se	%diff	se	%diff	se	%diff	se
Non-MD	-15	2.0	-13	2.0	-11	1.9	-10	1.9	-9	2.0
Female	-1.3	1.9	-0.3	1.9	0.4	1.8	-0.1	1.9	-0.3	1.9
Minority	-3.2	1.9	-3.5	1.8	-2.5	1.7	-1.0	1.7	-0.3	1.6

Table 4: Faculty salary regression results based on the fiscal year-specific models. Coefficients (diff in \$100s) and standard errors (se in \$100s) from the regressions of salary on age (3 df), date of last promotion (3 df), date of last degree (3 df), rank (2 df), degree (1 df), field (5 df), track (1 df), gender (1 df), and minority status (1 df).

	FY99-00		FY00-01		FY01-02		FY02-03		FY03-04	
Variable	diff	se	diff	se	diff	se	diff	se	diff	se
Non-MD	-219	30	-232	32	-217	28	-201	30	-177	30
Female	0.4	23	4	22	2	23	-3	23	-4	23
Minority	-41	26	-51	26	-59	25	-35	26	-24	22

Figure 1: The percent of total faculty whom are non-tenure, minority, female or non-MDs by fiscal year.

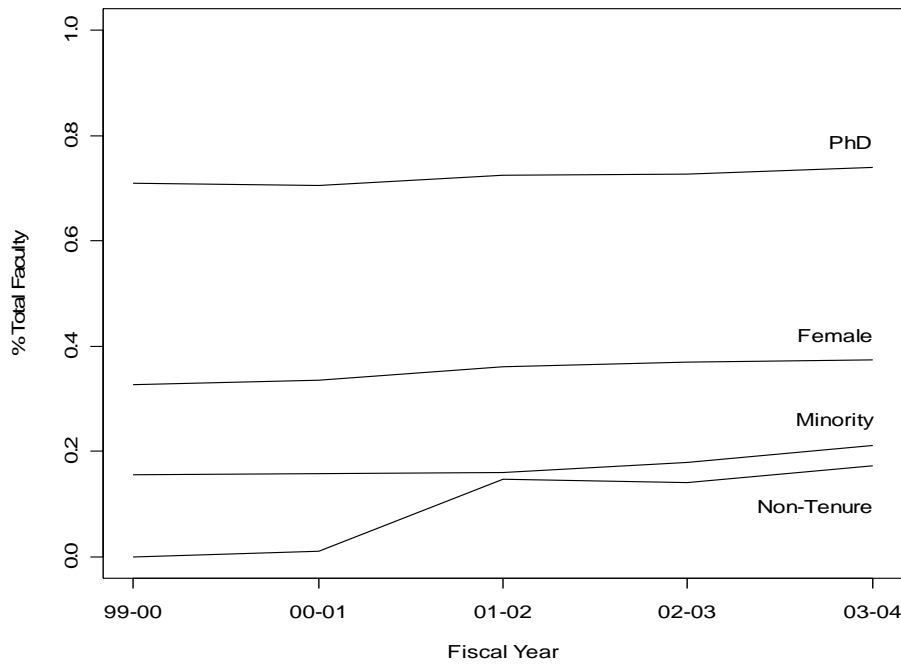


Figure 2: Estimated difference in salary (%) comparing females to males and minority faculty to non-minority faculty. The solid lines are based on year-specific models and the dashed lines are based on the random effects model.

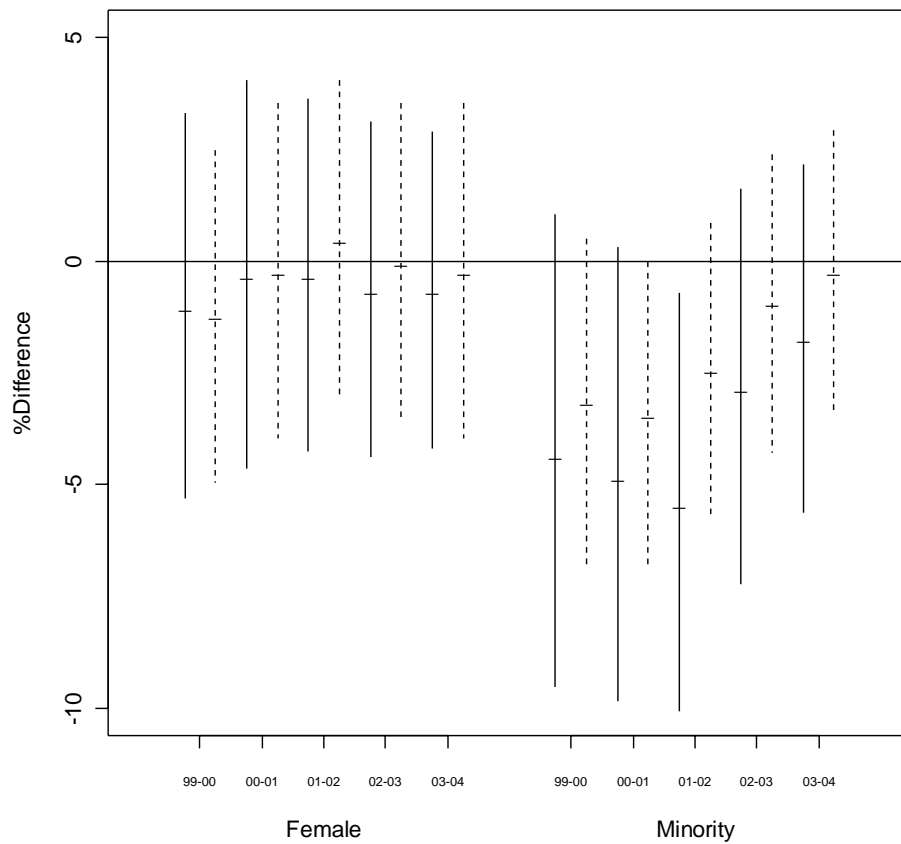


Figure 3: Comparison of the predicted salaries (in \$1000s) for FY03-04 from the models using log-salary and salary.

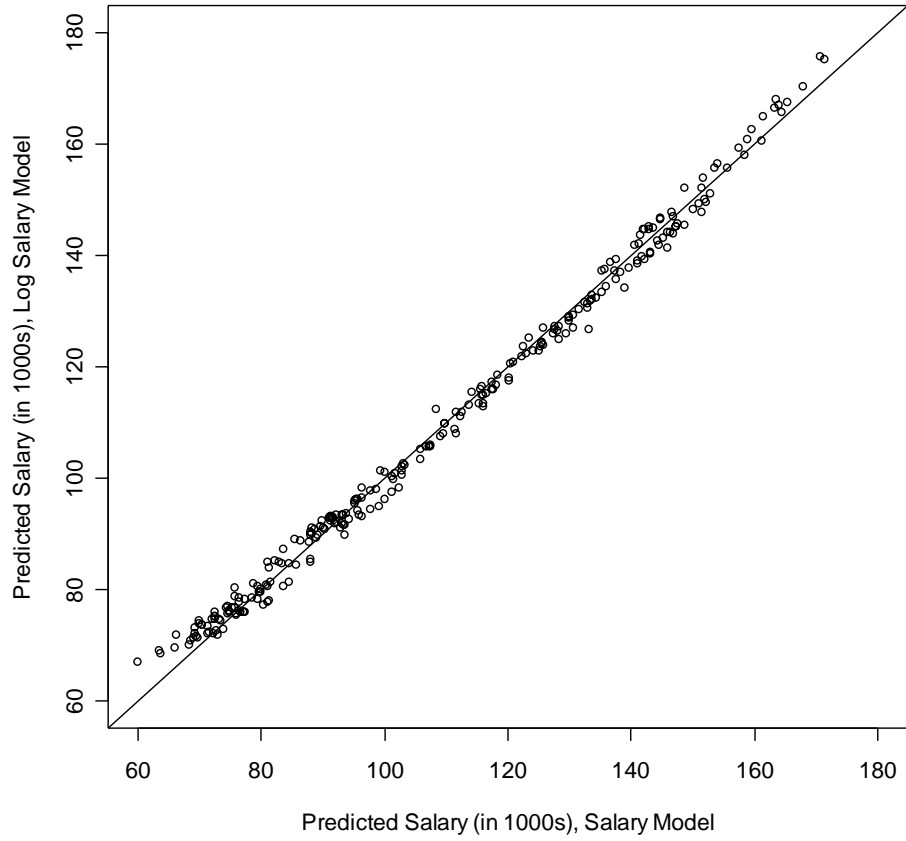


Figure 4: Distribution of predicted values for both the salary (S) and log-salary (LS) models for the biological sciences stratified by rank and gender or minority status.

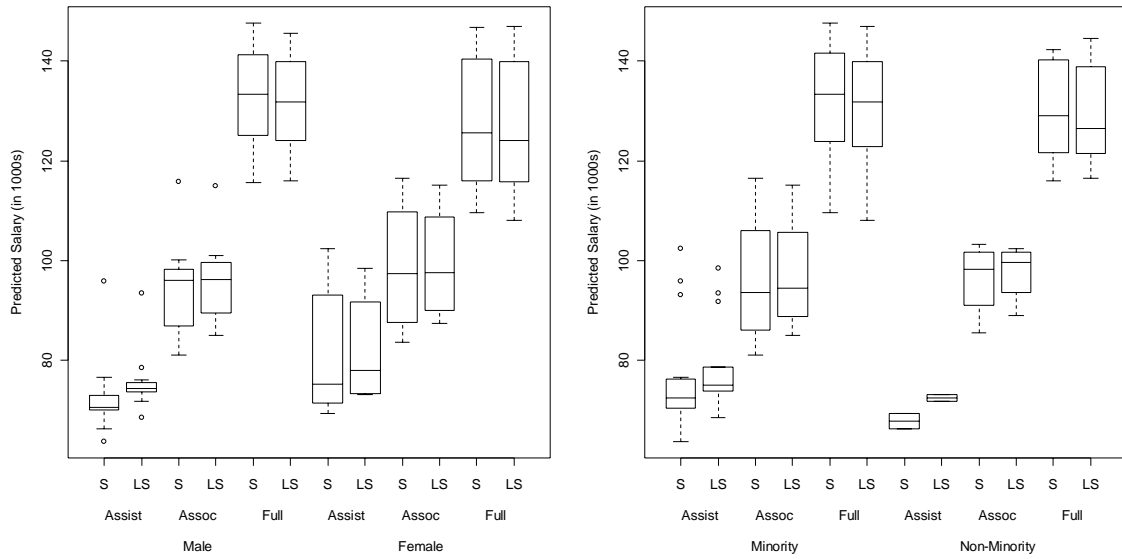


Figure 5: Quantile-Quantile plots for the residuals from the log-salary (figure 5a) and salary (figure 5b) models comparing females to males, non-MDs to MDs and minority to non-minority faculty.

Figure 5a: Log-salary model

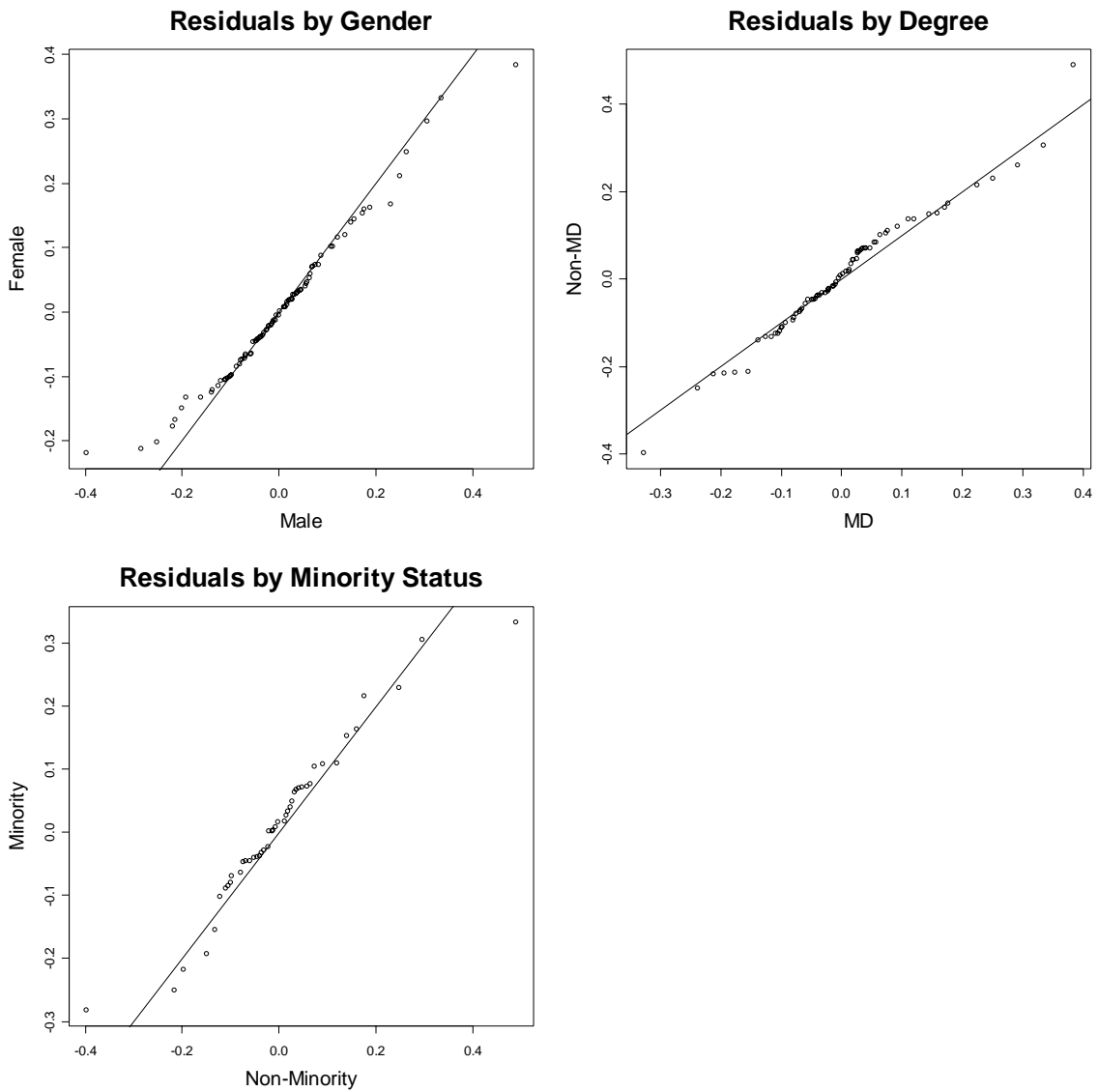


Figure 5b: Salary model

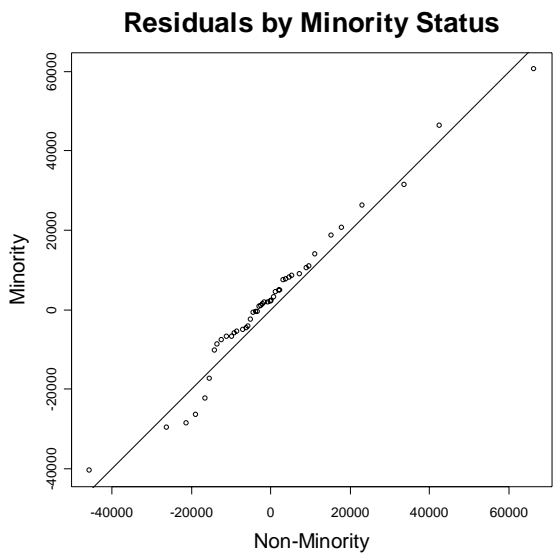
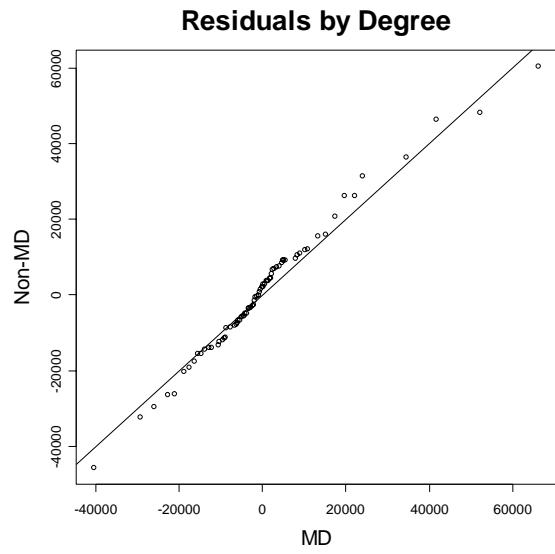
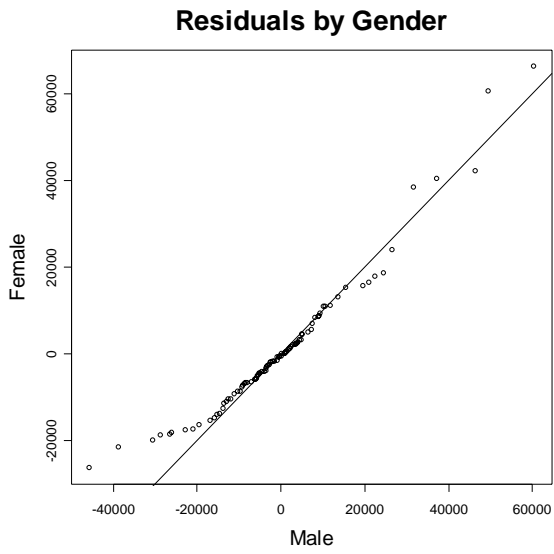


Figure 6: Residuals stratified by minority status (non-minority, minority and under-represented minority). The residuals are calculated from a linear model of log salary on age (3 df), date of last promotion (3 df), date of last degree (3 df), rank (2 df), degree (1 df), field (5 df), and track (1 df).

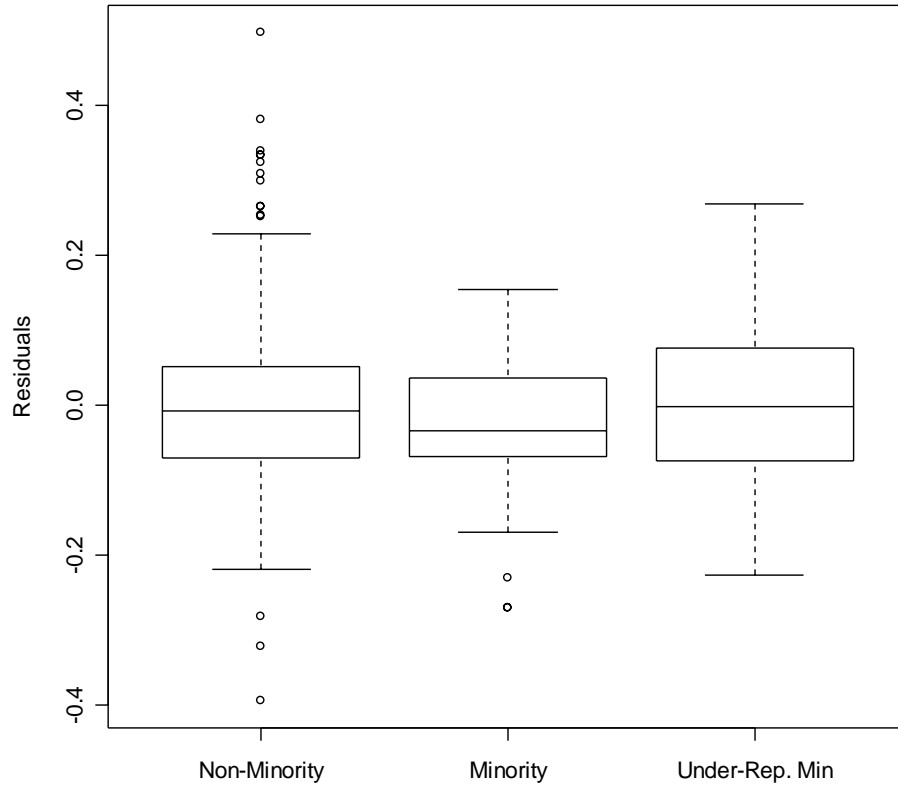


Figure 7: Residuals versus predicted salary (in \$1000s) for the FY03-04 log-salary model. The residual plot shows evidence of heteroscedasticity in the residuals across the predicted salaries. A model with robust variance estimates was fit and the resulting estimates for the non-MD, female and minority effects were -14 (se 2.2), 0.7 (se 1.8) and -1.8 (se 1.8), respectively.

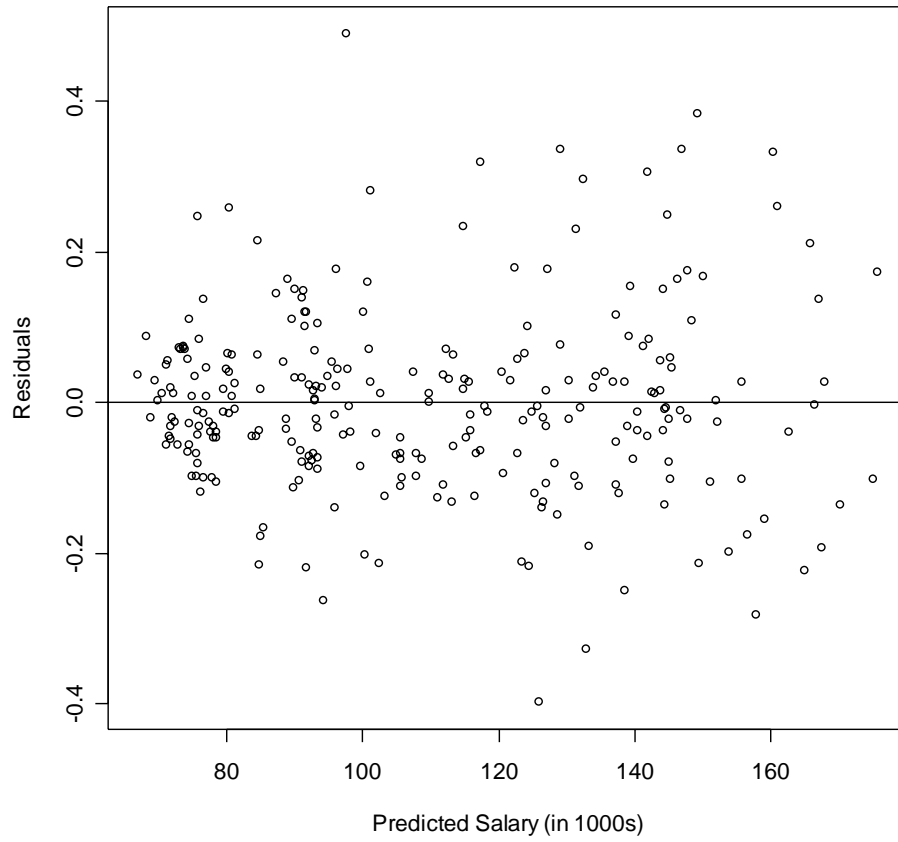
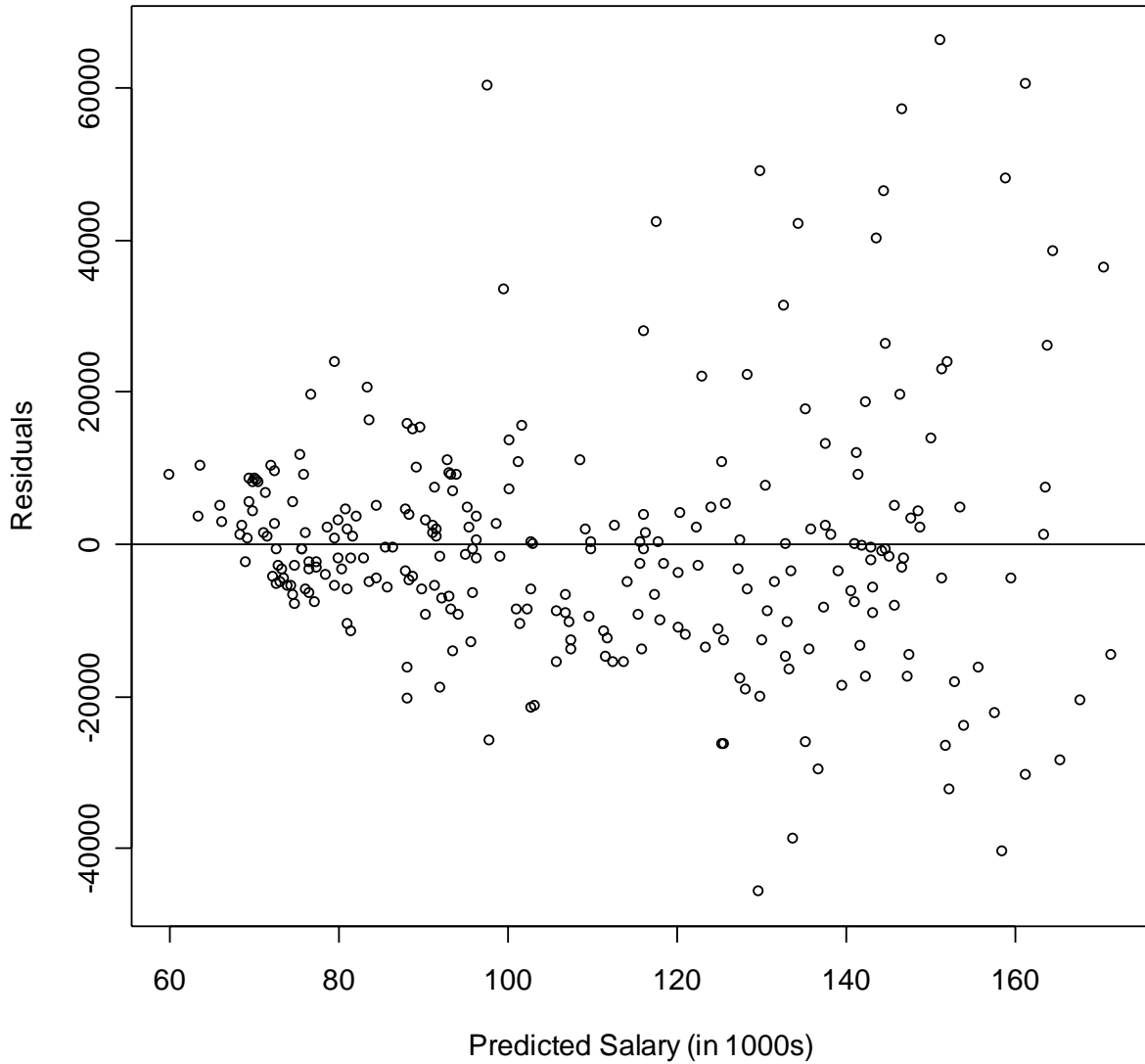


Figure 8: Residuals versus predicted salary (in 1000s) based on the salary model. The residual plot shows evidence of heteroscedasticity in the residuals across the predicted salaries. A model with robust variance estimates was fit and the resulting estimates for the non-MD, female and minority effects were -177 (se 30), -0.4 (se 23) and -24 (se 22), respectively.



Johns Hopkins University
Bloomberg School of Public Health

Report on Faculty Salary Analysis, 2004-2005

To

Committee on Affirmative Action
May 10, 2005

By

Elizabeth Johnson
Scott L. Zeger
Department of Biostatistics

1. Introduction

This report presents two statistical analyses of salaries for Public Health faculty, as requested by the School Committee on Affirmative Action as part of the School's on-going effort to prevent gender and minority salary differentials. The first analysis uses longitudinal data on the salaries of professorial faculty, including tenure- and non-tenure track faculty, from 1999-2005. This analysis estimates the percent difference in average annual salaries for women compared to men and for minority relative to non-minority faculty adjusting for major salary determinants such as rank, highest degree (MD or non-MD), department, field of scholarship, track (tenure track or not) and date of most recent appointment or promotion. The second analysis is cross-sectional based on data from 2004-05 for scientist track faculty only.

This report provides the estimates of gender and minority effects separately for the professorial faculty and for scientist faculty.

2. Methods

Data were provided by Dean Fox regarding the status of 325 professorial track faculty during the academic years 1999-2000 through 2004-2005 and 55 scientist track faculty in 2004-2005. The data included:

- salary in dollars (only faculty who receive full-time salaries are included)
- track (professorial tenure-track vs professorial non-tenure track, or scientist track)
- rank (assistant professor/scientist, associate professor/scientist, or full professor/senior scientist, department chairs included)
- department
- highest degree completed (MD vs. all other degrees)
- year of completion of highest degree
- year of present appointment/promotion
- age
- field or discipline of scholarship: social science; biological science; epidemiology; quantitative science (biostatistics, health economics and demography); and physical science (chemistry, radiation science, and industrial hygiene); and other
- gender (female vs. male)
- minority (yes vs. no, includes all self-defined minorities regardless of citizenship)
- under-represented minorities (includes self-defined African Americans, Hispanics, and Native Americans)

A new variable was added after the preliminary analysis of professorial faculty salaries to indicate the faculty who hold administrative leadership positions within the School. Those included were the department chairs and deans who hold faculty appointments and who are engaged in research and departmental teaching activities.

A linear model was used to describe log salary for each fiscal year as a smooth function (natural spline with two or three degrees of freedom) of each of the three continuous

predictors and of the categorical variables. The logarithmic transformation of salary was used so that the variance was roughly independent of the mean and for ease of interpretation of the regression coefficients. Under this model, the coefficient for gender (or minority status) is the fractional amount by which women's or minority salaries are higher (positive coefficient) or lower (negative coefficient) relative to men with similar values for the other covariates. For example, if the coefficient for gender is -0.01 , the average salary for women is estimated to be 1% less than the average for otherwise similar (as determined by our measured covariates) men. The results for this fiscal year (2004-05) are compared to the analogous ones from the fiscal years 1999-2000 through 2003-2004 for the professorial analysis. An additional model was used to estimate the relative difference in salaries comparing minorities and under-represented minorities to non-minorities for the 2003-04 and 2004-05.

For comparative purposes, the same linear models described above were applied to the actual salary. This model directly estimates the difference in the average salary comparing similar female to male faculty and similar non-minority to minority faculty. Robust variance estimates were calculated to provide more appropriate standard error estimates after we established that the variability of the residuals from these models was not constant as a function of the predicted salaries.

3. Results

3.1 Professorial Faculty

Table 1 displays the number of faculty for years 1999-2000 through 2004-05. The total number of faculty is increasing across the years, due to increases in the size of the both the professorial tenure-track faculty (13% increase since 2001-02) and the professorial non-tenure-track faculty (20% increase since 2001-02.).

Figure 1 shows the percentage of professorial faculty who are non-tenure, female, minority or non-MDs across the academic years. Not shown in Table 1, the percentage of the under-represented minority faculty in the school has remained fairly stable at approximately 8 percent per year.

Table 2 displays the estimated percentage difference in professorial faculty salaries comparing non-MDs to MDs, females to males and minority faculty to non-minority faculty from the year-specific models. Figure 2 displays the estimates with corresponding 95% confidence intervals. The estimated average differences between female and male or minority and non-minority faculty salaries are small relative to their standard errors. For 2004-05, we estimate that female faculty are earning on average approximately 1% less compared to otherwise similar male faculty (95% CI: 5% less to 3% more). We estimate that for 2004-05 the minority faculty earn approximately 1% less than the non-minority faculty (95% CI: 5% less to 3% more). For 2004-05, we also estimated a separate effect for the under-represented minority (African American, American Indian/Alaska Native and Hispanic) and other minority faculty (Asian/Pacific Island). Specifically, we estimated that under-represented minority faculty earn on average 0.4% less than the non-minority faculty

(95% CI: 6% less to 6% more) and the other minority faculty (Asian/Pacific Island) are earning on average 2% less than the non-minority faculty (95% CI: 7% less to 4% more). These estimates were qualitatively similar to those obtained for 2003-04 where we estimated that under-represented minority faculty were earning on average 3% more than the non-minority faculty (95% CI: 5% less to 6% more) and the minority faculty were earning on average 3% less than the non-minority faculty (95% CI: 8% less to 2% more).

Faculty who have administrative leadership roles are included in the data (i.e. department chairs). Because there was concern that these faculty could have an influence on the estimated gender and minority effects, an additional model was fit that took into account whether the faculty member holds an administrative role. Upon adjusting for this variable, we estimated that female faculty earn on average approximately 2% less than otherwise similar male faculty (95% CI: 5% less to 2% more) and minority faculty earn on average approximately 1% less than otherwise similar non-minority faculty (95% CI: 5% less to 3% more). These results are qualitatively similar to those obtained without adjusting for administrative roles.

Table 3 displays the estimated difference in the average professorial salaries comparing non-MDs to MDs, females to males and minority faculty to non-minority faculty based on the linear regression models using salary as the outcome variable, rather than log salary. We obtain qualitatively similar results comparing the year-specific analyses using either the log-salary or salary model. Figure 3 displays the predicted (mean) salaries for 2004-05 based on the log-salary and salary models. There appears to be general agreement between the two models, however, the log-salary model appears to predict slightly higher salaries for persons having the lowest and highest salaries. Figure 4 displays the Quantile-Quantile plots for the residuals from the log-salary and salary models for 2004-05. These figures compare the distribution of residuals for females and males, non-MDs and MDs and minority and non-minority faculty.

Figure 5 displays the residuals vs. predicted salaries from the log salary model. There is some evidence from the figure that the variability in the residuals is not constant across the range of predicted salaries. Therefore a robust variance estimate was fit and the resulting estimates for the non-MD, female and minority effects were -14 (se 2.3), -0.9 (se 1.8) and -1.2 (se 1.8), respectively. These estimates are qualitatively similar to those obtained with the robust variance estimator. Similarly, Figure 6 displays the residuals vs. predicted salaries from the salary model. Clearly, the variability in the residuals increases with the predicted salaries; this figure justifies our use of the robust variance estimates for this model.

3.2 Scientist Faculty

Table 4 presents the number of scientist track faculty by rank, gender, minority status and degree. There is only one senior scientist; this entry will not be included in the subsequent salary analysis.

Figures 7 through 9 display the distribution of salaries by gender, degree and minority status stratified by rank. Each figure displays a boxplot, a.k.a. a box and whiskers plot, for each

classification of faculty. The “box” portion of the boxplot gives the 25th, 50th (median) and 75th percentiles of the total salary. The “whiskers” portion of the boxplot indicates the range where the data are below or above the 25th and 75th percentiles. Any values indicated by “o” below or above the “whiskers” are considered to be extreme observations relative to the majority of the salaries. We observe that the median salaries for the assistant scientists differ by approximately \$20,000 comparing the MDs to Non-MDs. There appears to be little difference in median salary comparing the minority to non-minority faculty within rank.

Figure 10 displays the association between salaries and age, year of latest degree and promotion date. The points on the figures are the observed salaries for each faculty and the lines represent an estimate of the mean salary as a function of age, year of highest degree or promotion date. As we expect, the average salary increases with age and decreases with the year of highest degree. From the plot of salary verses year of promotion, we observe that average salary decreases as the year of appointment or promotion increases.

Table 5 presents the results from the log salary and salary models. Note that the one senior scientist was not included in this analysis. We estimate that female scientists earn on average 11 percent less than otherwise similar male scientists (95% CI: 17% less to 4% less); this difference is statistically significant. We estimate that minority scientists earn on average approximately 4 percent less than otherwise similar non-minority scientists (95% CI: 10% less to 3% more); this finding is not statistically significant. From the salary model, we estimate that female scientists earn on average \$9100 less than otherwise similar male scientists (95% CI: \$15000 less to \$3700 less) and that minority faculty earn on average \$3500 less than otherwise similar non-minority scientists (95% CI: \$8700 less to \$1700 more). The residual vs. predicted value plot (see Figure 12) identified one faculty member as having a large residual. Therefore, the log-salary model was refit excluding this faculty member. As a result, the estimated minority effect changed from 4% less to 2% less, still not statistically significant, and the estimated gender effect remained the same.

Table 1: Total number of professorial faculty by academic year.

		1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05
Total		199	203	236	241	265	270
Track	Tenure	199	201	201	207	219	228
	Non-Tenure	0	2	35	34	46	42
Rank	Full	92	98	105	108	113	117
	Associate	55	51	60	64	75	76
	Assistant	52	54	71	69	77	77
Gender	Male	134	135	151	152	166	173
	Female	65	68	85	89	99	97
Minority	Yes	31	32	39	45	57	57
	No	168	171	197	196	208	213
Degree	Non-MD	141	143	171	175	196	202
	MD	58	60	65	66	69	68

Table 2: Professorial faculty salary regression results based on the academic year-specific models. Coefficients (%diff) and standard errors (se) from the regressions of **log salary** on age (3 df), date of last promotion (3 df), date of highest degree (3 df), rank (2 df), degree (1 df), field (5 df), track (1 df), gender (1 df), and minority status (1 df).

Year	Non-MD		Female		Minority	
	%diff	se	%diff	se	%diff	se
1999-00	-20	3.0	-1.1	2.2	-4.4	2.8
2000-01	-20	2.9	-0.4	2.2	-4.9	2.7
2001-02	-18	2.6	-0.3	2.0	-5.3	2.4
2002-03	-16	2.6	-0.6	2.0	-2.4	2.3
2003-04	-14	2.4	-0.7	1.8	-1.9	2.0
2004-05	-14	2.5	-1.0	1.9	-1.2	2.1

Table 3: Professorial faculty salary regression results based on the academic year-specific models. Coefficients (diff in \$100s) and standard errors (se in \$100s) from the regressions of **salary** on age (3 df), date of last promotion (3 df), date of highest degree (3 df), rank (2 df), degree (1 df), field (5 df), track (1 df), gender (1 df), and minority status (1 df).

Year	Non-MD		Female		Minority	
	diff	se	diff	se	diff	se
1999-00	-219	30	0.4	23	-41	26
2000-01	-232	32	4	22	-51	26
2001-02	-217	28	2	22	-57	25
2002-03	-200	31	-3	23	-31	25
2003-04	-177	30	-5	23	-25	22
2004-05	-179	32	-6	25	-17	23

Table 4: Total number of scientist track faculty in 2004-05

		Senior	Associate	Assistant
Total		1	9	45
Gender	Male	0	5	17
	Female	1	4	28
Minority	Yes	0	3	14
	No	1	6	31
Degree	Non-MD	1	9	38
	MD	0	0	7

Table 5: Faculty salary regression results for scientist track faculty in 2004-05. Coefficients (%diff and diff in \$100s) and standard errors (se in \$100s) from the regressions of log salary and salary on age (1 df), date of last promotion (1 df), date of highest degree (1 df), rank (1 df), degree (1 df), field (3 df), gender (1 df), and minority status (1 df).

	Log Salary Model		Salary Model	
	% diff	se	diff (\$100s)	Se
Non-MD	-11	5.7	-99	44
Female	-11	3.5	-91	27
Minority	-3.5	3.5	-35	26

Figure 1: Percent of professorial faculty who are non-tenure, minority, female or non-MDs by academic year.

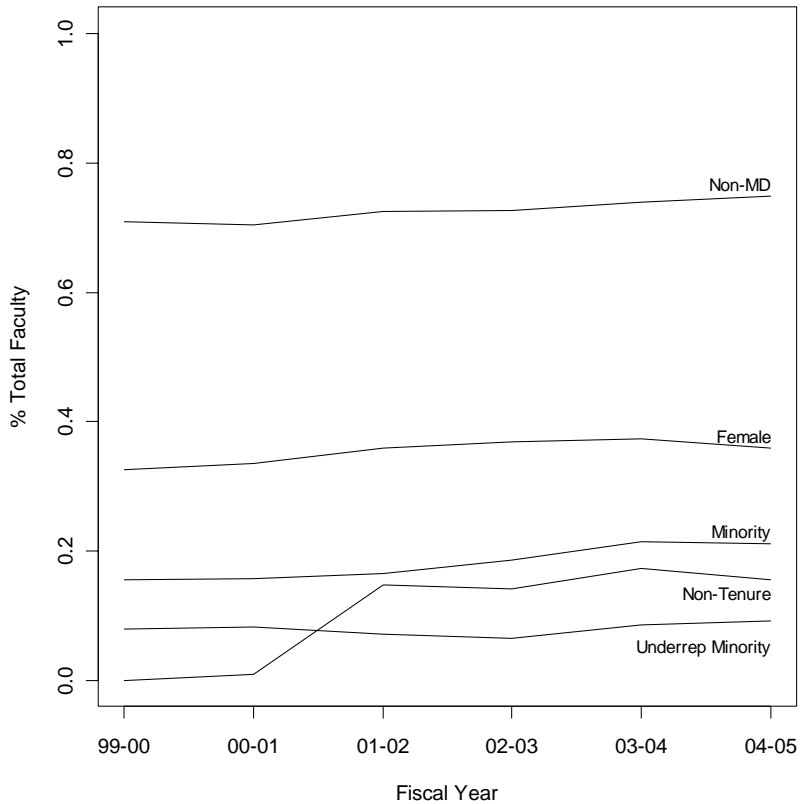


Figure 2: Estimated difference in professorial faculty salary (%) comparing females to males and minority faculty to non-minority faculty.

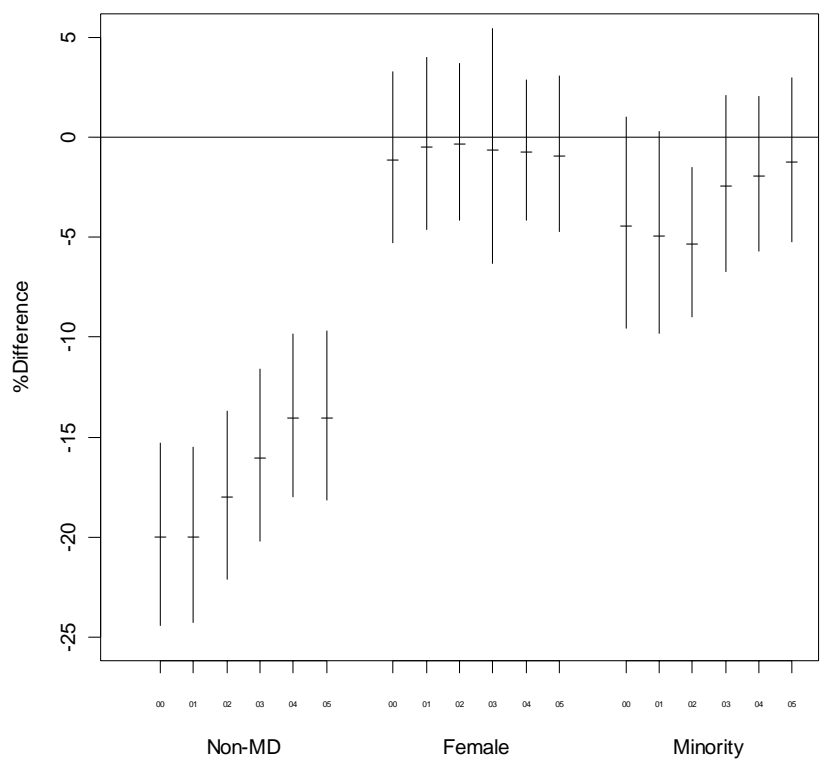


Figure 3: Comparison of the predicted professorial salaries (in \$1000s) for 2004-05 from the models using log-salary and salary.

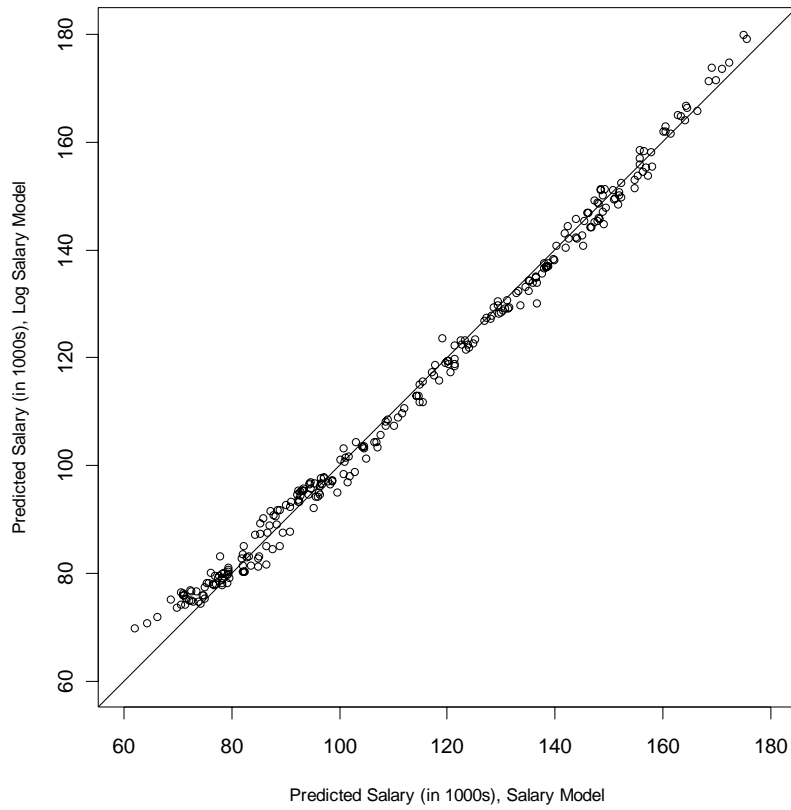


Figure 4: Quantile-Quantile plots for the residuals from the log-salary (Figure 4a) and salary (Figure 4b) models comparing females to males, non-MDs to MDs and minority to non-minority faculty (professorial faculty).

Figure 4a: Professorial Log-salary model

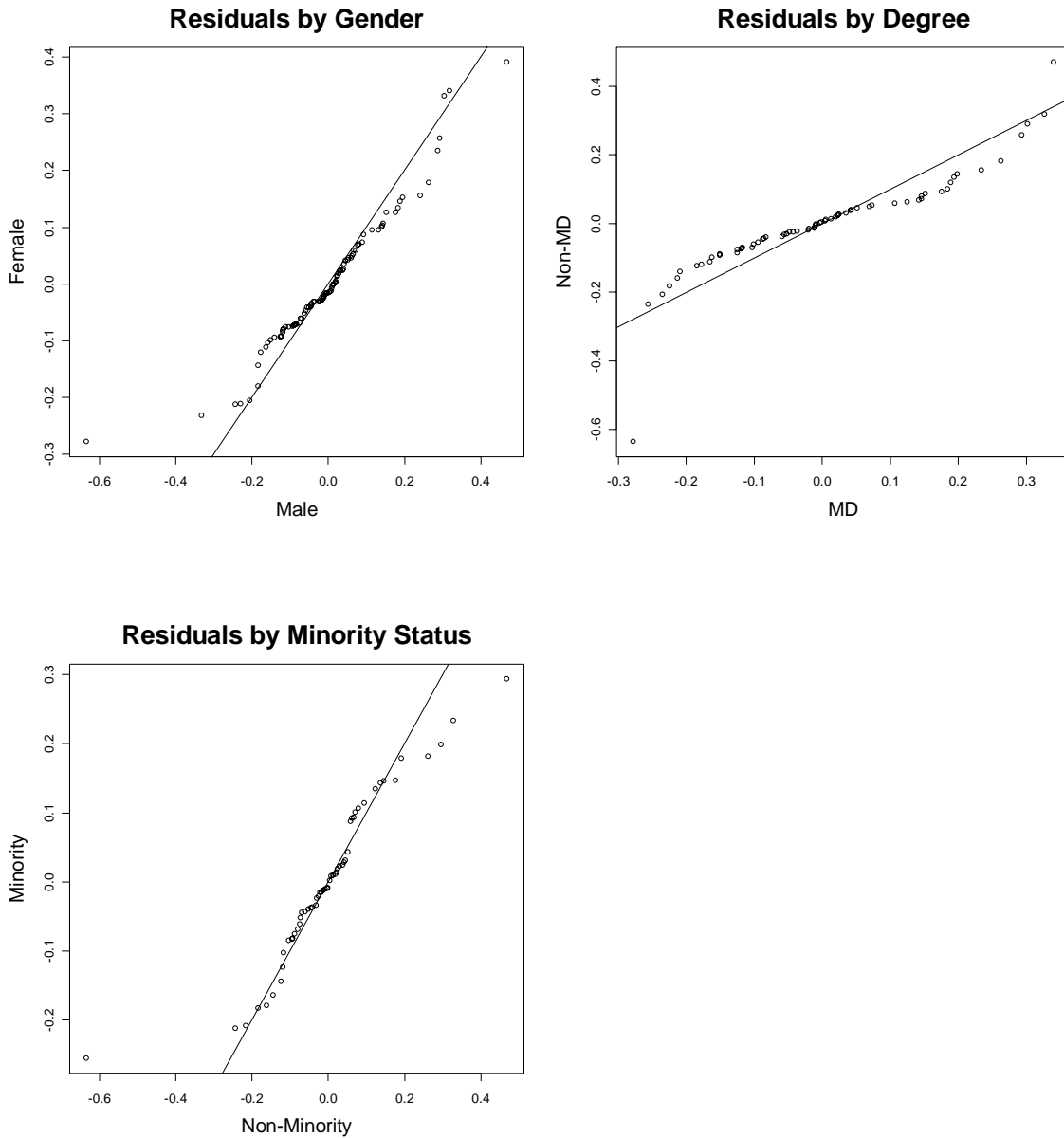


Figure 4b: Professorial Salary model

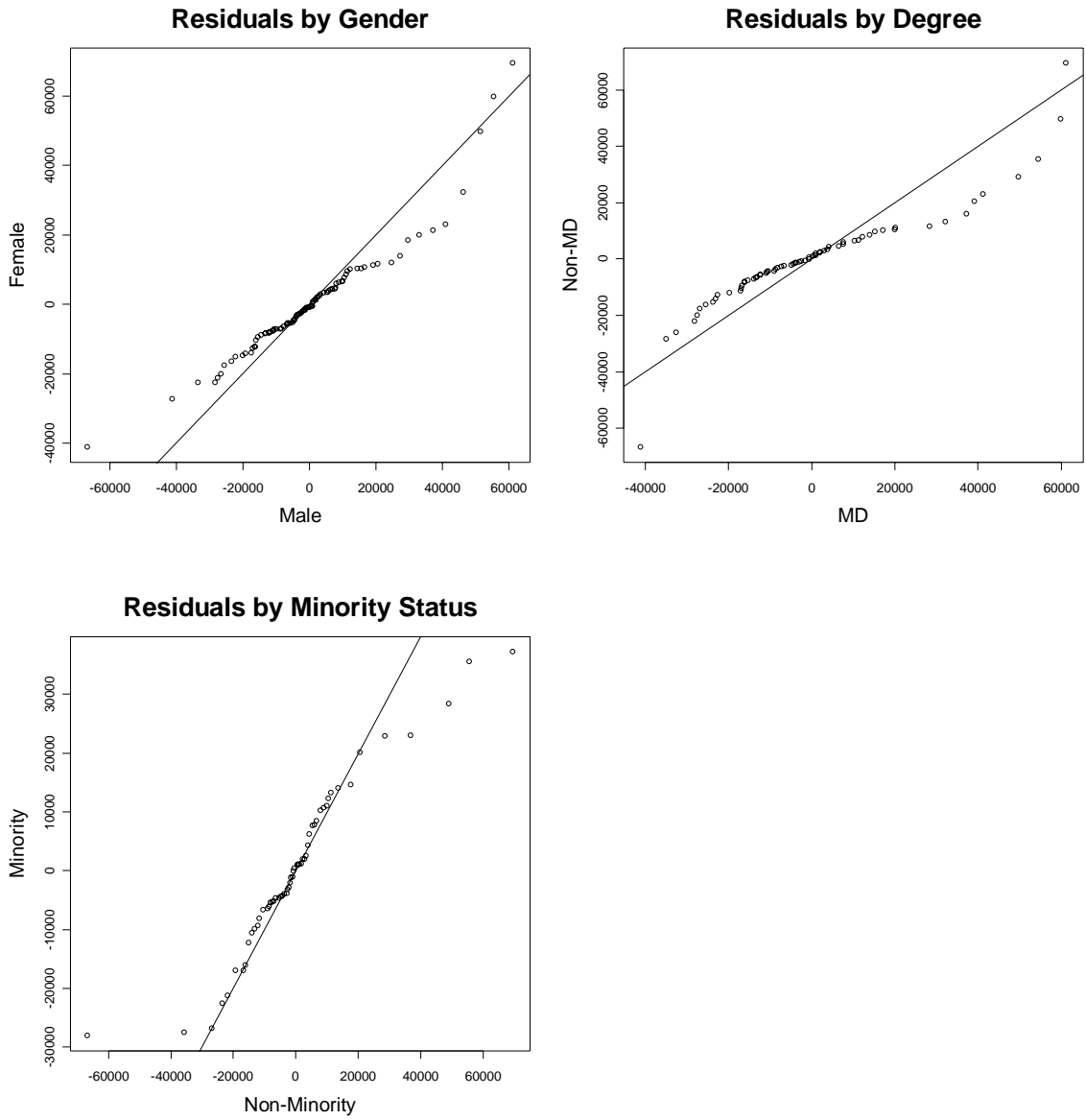


Figure 5: Residuals versus predicted professorial salary (in \$1000s) for 2004-05 log-salary model. The residual plot shows evidence of heteroscedasticity in the residuals across the predicted salaries. A model with robust variance estimates was fit and the resulting estimates for the non-MD, female and minority effects were -14 (se 2.3), -0.9 (se 1.8) and -1.2 (se 1.8), respectively.

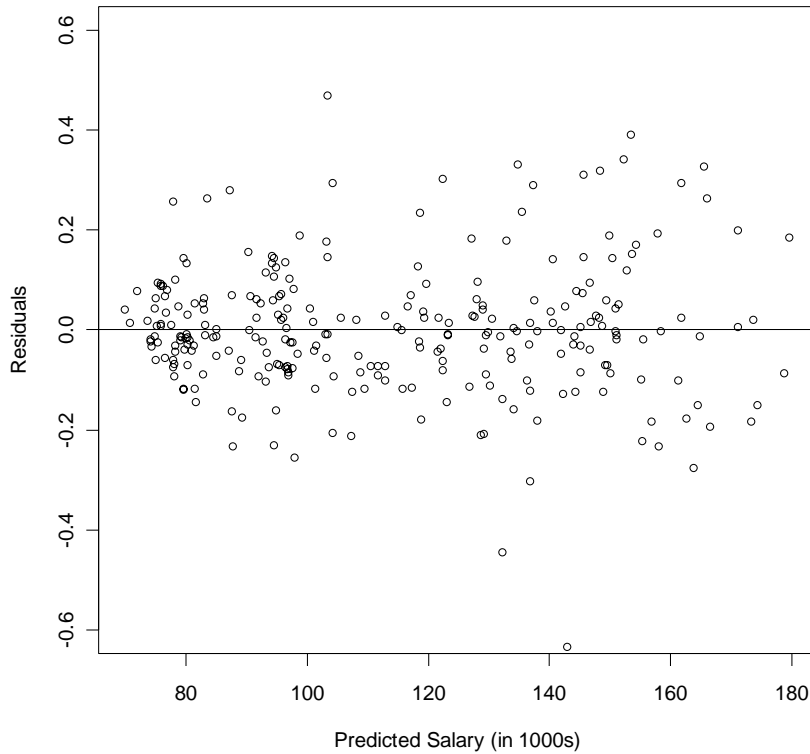


Figure 6: Residuals versus predicted professorial salary (in 1000s) based on the salary model. The residual plot shows evidence of heteroscedasticity in the residuals across the predicted salaries.

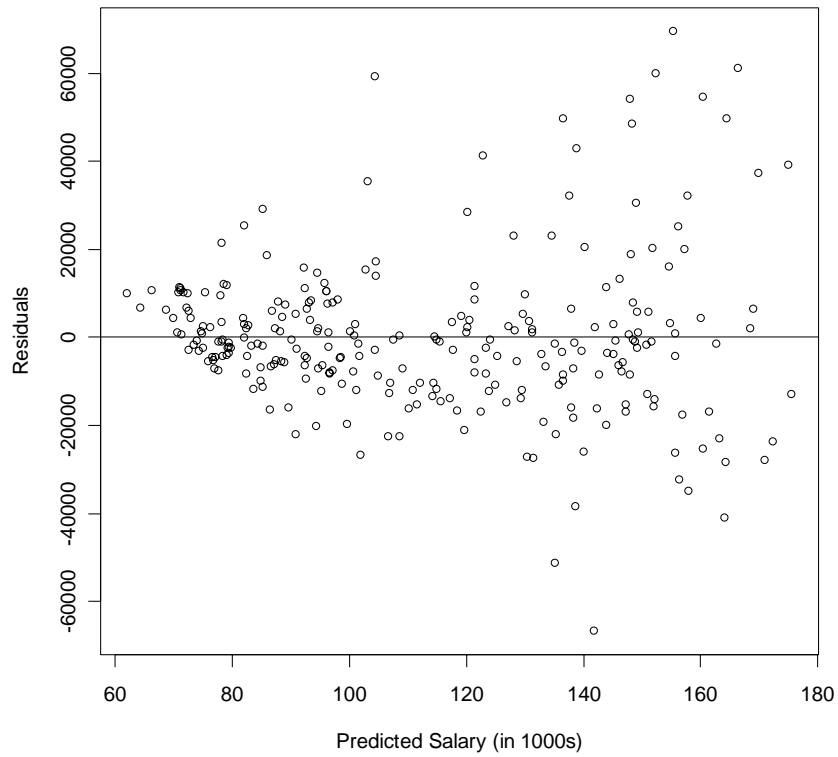


Figure 7: Boxplots of 2004-05 salaries by rank and gender for associate and assistant scientists. Note that the one senior scientist is excluded from the figure. Classifications are labeled as Asso = associate scientist, Asst = assistant scientist, M = male, F = female.

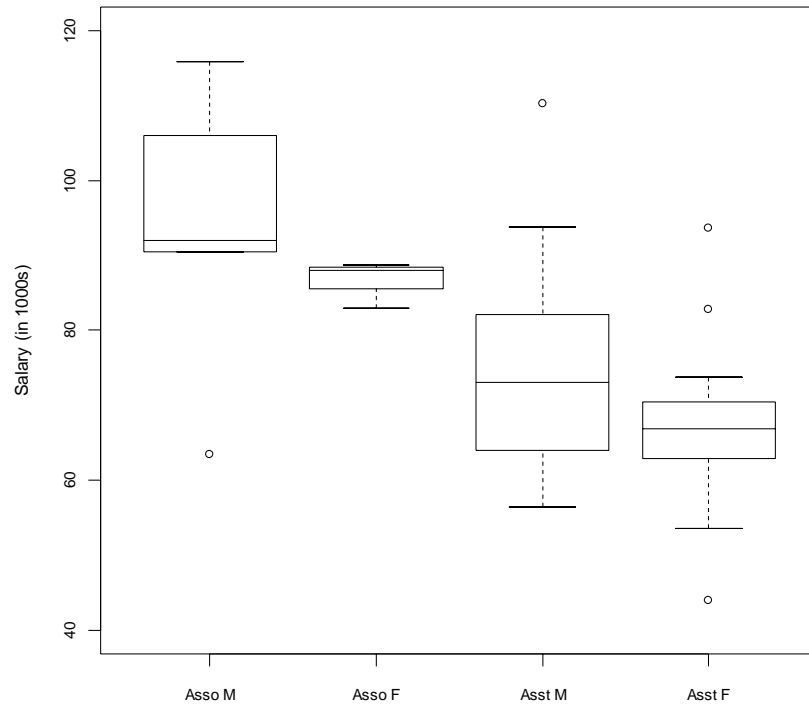


Figure 8: Boxplots of 2004-05 salary by rank and degree for scientist track faculty. Note that one senior scientist is excluded from the figure. Classifications are labeled as Asso = associate scientist, Asst = assistant scientist, MD = MD, NMD = Non-MD. Note that there are no associate scientists with an MD.

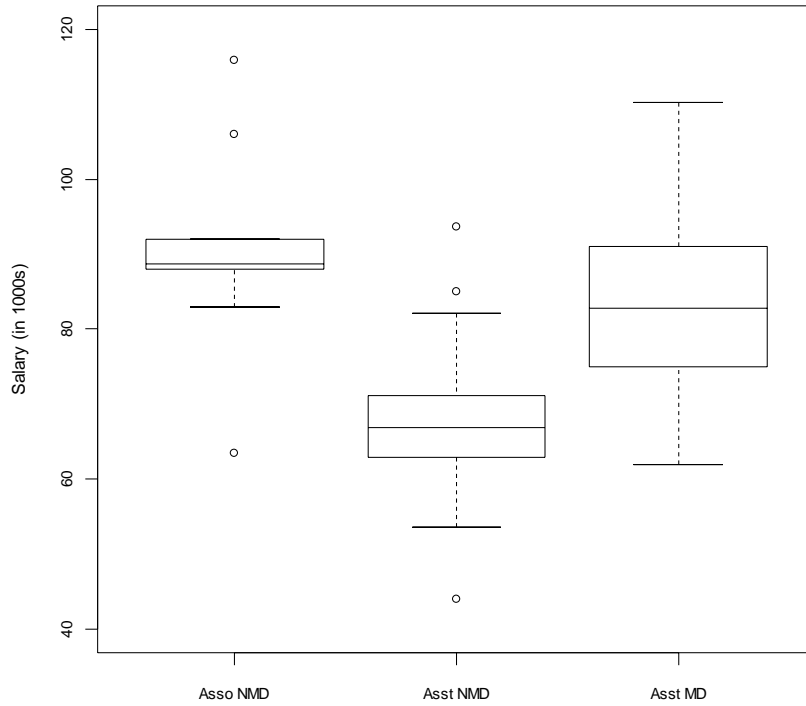


Figure 9: Boxplots of 2004-05 salaries by rank and minority status for scientist track faculty. Note that the one senior scientist is excluded from the figure. Classifications are labeled as Asso = associate scientist, Asst = assistant scientist, Yes = minority, No = non-minority.

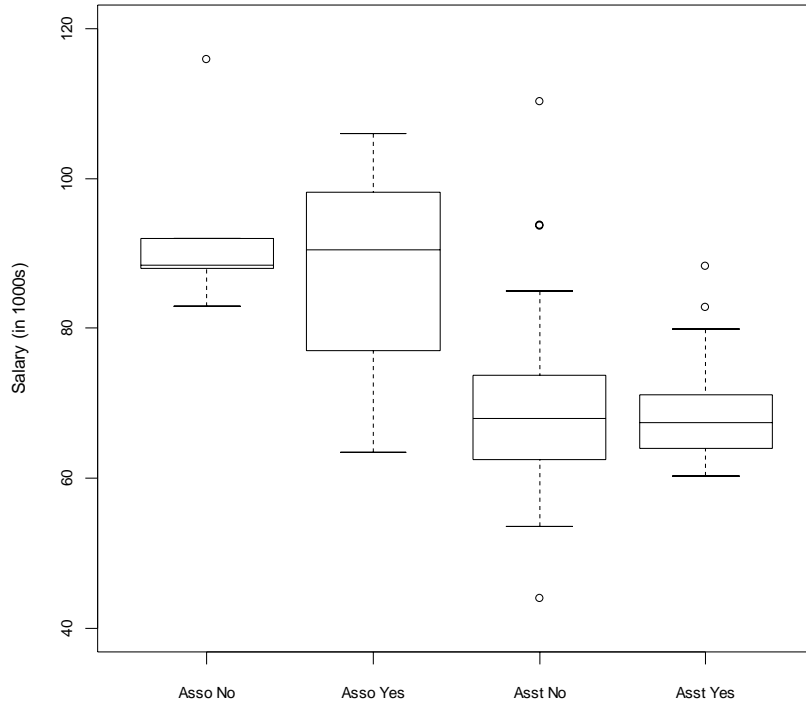


Figure 10: Salary as a function of age, year of latest degree and year of promotion for scientist track faculty.

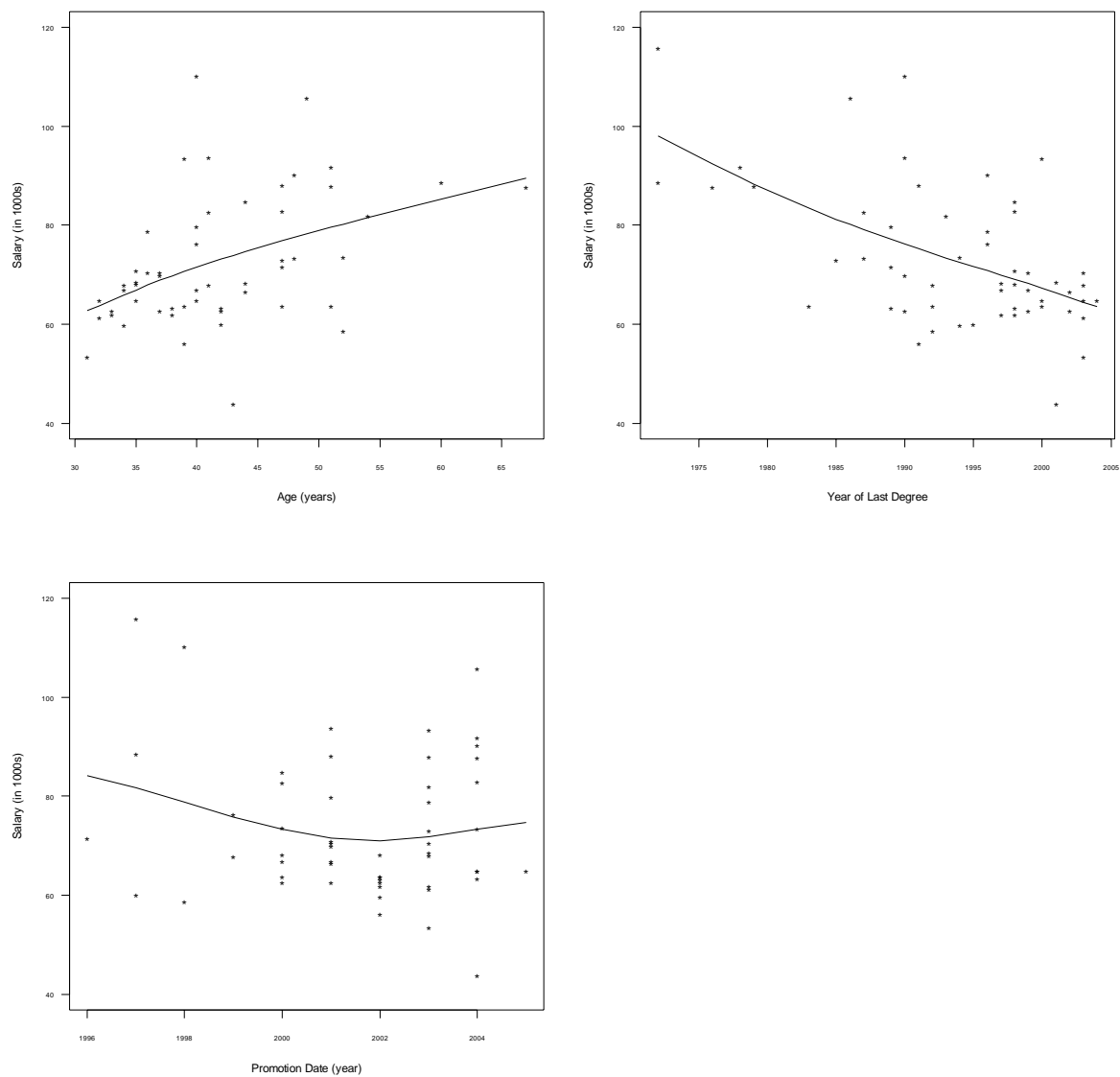


Figure 11: Comparison of the predicted scientist salaries (in \$1000s) for 2004-05 from the models using log-salary and salary.

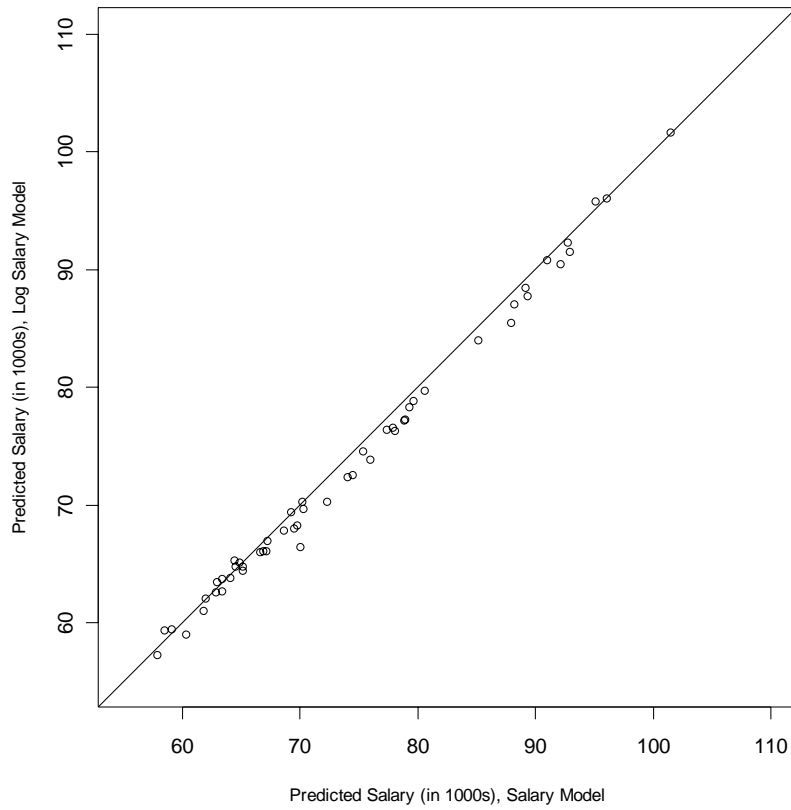


Figure 12: Residuals versus predicted scientist salary (in \$1000s) for the 2004-05 log-salary (left panel) and salary model (right panel). The residual plot on the right shows evidence of heteroscedasticity in the residuals across the predicted salaries (supports the use of the robust variance estimates). The gender and minority effects were also estimated after removing a single scientist with large residual (approximately 0.3 in the log salary model and approximately \$25000 in the salary model, see figure below). The estimated gender effect did not change and the estimated minority effect changed from 4% to 2% after removing this one faculty.

