**Report to the UTK Faculty Senate Budget and Planning Committee on**
**Analysis of Faculty Salary Data based upon Gender using Data from Fall 2007**

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(Dr. Cheryl Travis, Professor of Psychology, provided considerable comments on these reports)

This is a supplementary report to the reports of April 28, 2007 and June 28, 2007 both of which are posted at http://www.tiem.utk.edu/~gross/facpres.html under the Gender and Faculty Salary Report section. The objective of this supplementary report is twofold:
 (1) to repeat the earlier analysis (which were carried out for data from Fall 2006 and May 2007) for a later data set of faculty salaries, those as of October 2007 which included merit and equity raises given in Fall semester 2007, some of which were intended to address gender equity.; and
 (2)  to analyze the expected changes in mean salary based on gender and rank assuming the announced distribution of equity for Fall 2007 were carried out and compare these to the actual data..

**RESAMPLING METHOD 1 for the FALL 2007 data (Calculation of the D and D\*)**

We here repeat the calculation of the D statistic we derived in the earlier report for the Fall 2007 data. The details of the calculation were included in earlier reports and are not repeated here. The objective is to carry out a resampling method which creates a virtual UT salary distribution with identical salaries to those of Fall 2007, but reassorted randomly within unit/rank/longevity status independent of gender. The statistic D is then computed by taking the difference within each unit/rank/longevity status of mean salary for males and that of females, weight these by the number of gender pairs in that grouping, and sum over all unit/rank/longevity status groups which have any gender pairs. In the earlier reports we also calculated the E and E\* and we have again calculated them but do not include them in this report as they were seen to produce similar results to the earlier results.

We include in Table 1 basic descriptive statistics for the Fall 2007 salary data utilized in this study. In comparison to the Spring 2007 salary data, all ranks and genders had increases in mean and median salaries. This is to be expected due to both the across-the-board raise of 3% and the merit raise pool of 2% which were applied in Fall 2007. As in the Spring 2007 data, median salaries are lower than means, and mean male salaries are higher than those of females. The salary values in Table 1 are for nine-months and exclude longevity pay. There are slight changes in the number of faculty at each rank from the earlier year data.

The allocation of salary raises made for Fall 2007 were: an across-the-board raise of 3% for all faculty (excluding those few who were rated as performing unsatisfactorily), and there was a 2% merit pool which was divided into two portions: ¼ of the total pool was reserved for female faculty and allocated based upon merit, while ¾ of the total pool was then allocated based on merit independent of gender. The stated objective of this merit pool allocation was to redress in part the observed differences in salary based upon gender noted in the earlier reports.

Table 1.  Summary of Faculty Salary Data

| Rank | Number in Rank | Mean Salary Males | Mean Salary Females | Median Salary Males | Median Salary Females |
|---|---|---|---|---|---|
| Assistant | 351 | 65823.26 | 58962.65 | 61676.00 | 57496.00 |
| Associate | 367 | 77571.41 | 71545.34 | 76018.00 | 67314.50 |
| Professor | 475 | 104522.18 | 90387.78 | 96658.00 | 87997.00 |

Repeating the analysis in the original report, using the October 2007 data, gives the below figures. These graph the histograms for the distributions of the resampled statistic D for both the case in which longevity status is included and the case in which longevity status is ignored, using 4000 bootstrap samples in each case.  The calculated value for the statistic using the actual faculty salaries, D*, lies well outside the 95% confidence intervals of D in both cases. Thus the null hypothesis is strongly rejected. ***The evidence is very strong that the differences in salary between males and females across UTK do not arise from chance assignments of salaries, nor are they explained by differences in gender distributions across units, ranks or longevity status. This still applies to the situation after the equity raises were distributed in Fall 2007.***

Figure 1: Distribution of 4000 resamples of statistic D using Method 1 and accounting for longevity for the October 2007 data. The D* value of 2923 is calculating using the actual faculty salaries.
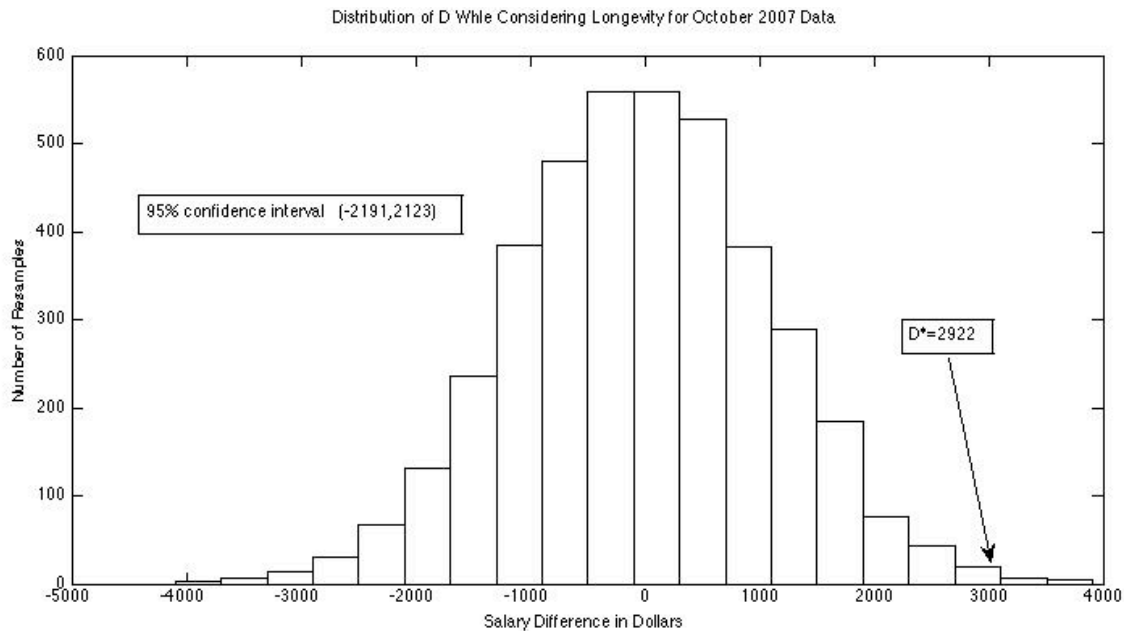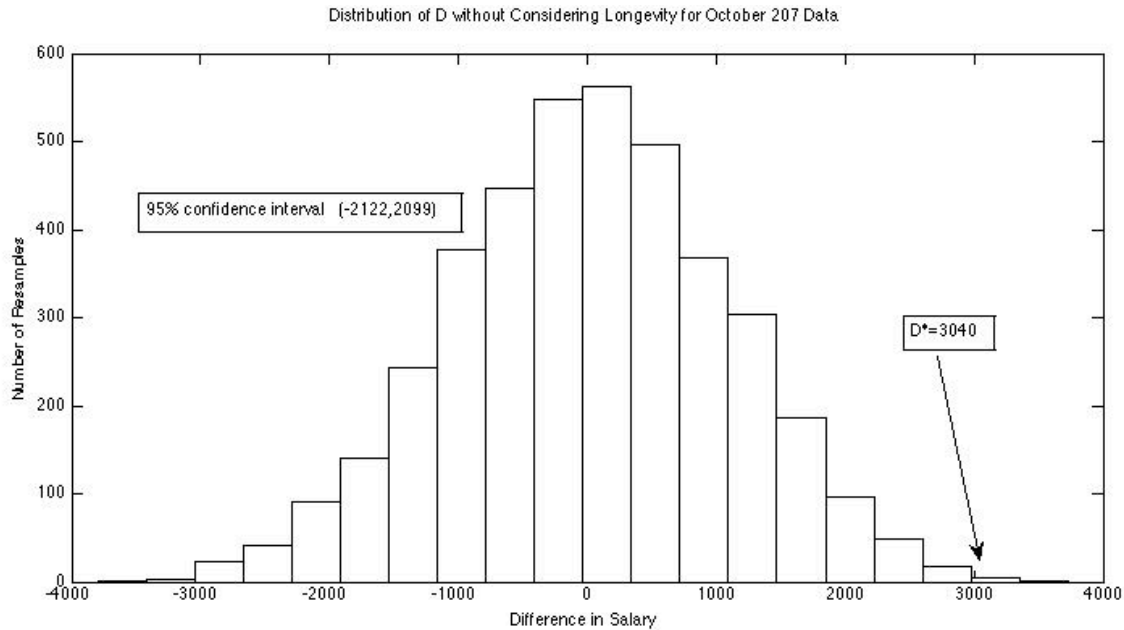
Figure 2: Distribution of 4000 resamples of statistic D using Method 1 without accounting for longevity for the October 2007 data. The D\* value of 3378 is calculating using the actual faculty salaries.



Distribution of D without Considering Longevity for October 207 Data

95% confidence interval (-2122,2099)

D\*=3040

Repeating the calculations in the original report to provide a breakdown by unit as to the contribution of each unit to the calculated value of D\* gives Tables 2 and 3 below. These provide the magnitude of departmental contributions to D\*, from most negative to most positive. The values shown in Table 2 are for the case in which longevity effects within ranks are taken into consideration, while those in Table 3 are the case in which longevity status is not considered. The sum of all departmental contributions in these Tables gives the appropriate D\* (for the cases in which longevity is taken into account and that in which it is not). The departmental contributions are negative if average female salary is higher than average male salary (weighted by number of gender pairs) and positive if the reverse is true. The departmental contributions indicate that there are some units that much more greatly contribute to the observed differences in salary across gender than other units, as was true for the earlier reports.

Table 2: Contributions to the statistic D\* arising from each Department, using Method 1 and taking longevity into account. The Department Contributions sum to D\* = 2922, the Number of Pairs is the number of gender pairs for each Department, and the Contribution per Gender Pair is the Department Contribution divided by the Number of Pairs.

| Department Number | Department Contribution | Number of Pairs | Contribution per Gender Pair |
|---|---|---|---|
| 37 | -158 | 9 | -17.5 |

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| | | | |
|---|---|---|---|
| 58 | -146 | 4 | -36.4 |
| 26 | -104 | 14 | -7.4 |
| 57 | -87 | 10 | -8.6 |
| 56 | -71 | 5 | -14.1 |
| 16 | -66 | 2 | -32.6 |
| 65 | -43 | 9 | -4.7 |
| 1 | -39 | 1 | -38.6 |
| 52 | -37 | 2 | -18.2 |
| 49 | -36 | 1 | -35.8 |
| 60 | -33 | 10 | -3.3 |
| 35 | -24 | 3 | -7.7 |
| 12 | -22 | 1 | -21.9 |
| 43 | -22 | 2 | -10.6 |
| 61 | -21 | 4 | -5.1 |
| 8 | -6 | 1 | -5.4 |
| 51 | -5 | 2 | -2.5 |
| 25 | -5 | 3 | -1.5 |
| 28 | -4 | 6 | -0.5 |
| 2 | 0 | 0 | 0 |
| 4 | 0 | 0 | 0 |
| 6 | 0 | 0 | 0 |
| 19 | 0 | 0 | 0 |
| 20 | 0 | 0 | 0 |
| 27 | 0 | 0 | 0 |
| 34 | 0 | 0 | 0 |
| 44 | 0 | 0 | 0 |
| 47 | 0 | 0 | 0 |
| 62 | 0 | 0 | 0 |
| 21 | 4 | 1 | 4.7 |
| 64 | 5 | 2 | 2.5 |
| 31 | 5 | 2 | 2.6 |
| 15 | 7 | 1 | 7.5 |
| 29 | 17 | 1 | 17.7 |
| 59 | 19 | 12 | 1.6 |
| 42 | 26 | 2 | 13.1 |
| 39 | 28 | 12 | 2.4 |
| 23 | 33 | 2 | 16.7 |
| 30 | 40 | 2 | 20.1 |
| 63 | 43 | 1 | 43.7 |
| 41 | 49 | 4 | 12.4 |
| 55 | 55 | 1 | 55.3 |
| 9 | 61 | 3 | 20.5 |
| 11 | 72 | 2 | 36.2 |
| 7 | 72 | 2 | 36.5 |
| 33 | 79 | 8 | 9.9 |
| 40 | 79 | 4 | 20 |
| 32 | 85 | 2 | 42.7 |
| 45 | 90 | 3 | 30.2 |
| 53 | 100 | 9 | 11.2 |
| 18 | 113 | 2 | 56.7 |

| | | | |
|---|---|---|---|
| 5 | 119 | 1 | 119.7 |
| 50 | 124 | 3 | 41.4 |
| 48 | 130 | 3 | 43.4 |
| 14 | 132 | 3 | 44 |
| 24 | 135 | 8 | 16.9 |
| 3 | 141 | 4 | 35.4 |
| 17 | 147 | 2 | 73.7 |
| 46 | 147 | 10 | 14.7 |
| 22 | 165 | 4 | 41.5 |
| 10 | 172 | 8 | 21.5 |
| 36 | 173 | 4 | 43.3 |
| 54 | 190 | 3 | 63.6 |
| 66 | 239 | 30 | 8 |
| 38 | 304 | 2 | 152.1 |
| 13 | 425 | 2 | 212.7 |

Table 3: Contributions to the statistic D* arising from each Department, using Method 1 without taking longevity into account. The Department Contributions sum to D* = 3040, the Number of Pairs is the number of gender pairs for each Department, and the Contribution per Gender Pair is the Department Contribution divided by the Number of Pairs.

| Department Number | Department Contribution | Number of Pairs | Contribution per Gender Pair |
|---|---|---|---|
| 56 | -146 | 6 | -24.2 |
| 29 | -112 | 1 | -111.5 |
| 37 | -110 | 10 | -10.9 |
| 26 | -79 | 14 | -5.6 |
| 16 | -60 | 2 | -29.9 |
| 32 | -51 | 3 | -17 |
| 58 | -51 | 5 | -10.2 |
| 65 | -47 | 9 | -5.1 |
| 57 | -47 | 10 | -4.6 |
| 1 | -36 | 1 | -35.4 |
| 52 | -35 | 2 | -17.3 |
| 49 | -33 | 1 | -32.9 |
| 61 | -31 | 4 | -7.7 |
| 43 | -31 | 2 | -15.1 |
| 35 | -22 | 3 | -7 |
| 28 | -21 | 7 | -2.9 |
| 21 | -18 | 1 | -17.3 |
| 25 | -17 | 3 | -5.5 |
| 63 | -7 | 3 | -2.3 |
| 42 | -6 | 2 | -2.9 |

| | | | |
|---|---|---|---|
| 8 | -5 | 1 | -5 |
| 2 | 0 | 0 | 0 |
| 4 | 0 | 0 | 0 |
| 6 | 0 | 0 | 0 |
| 19 | 0 | 0 | 0 |
| 20 | 0 | 0 | 0 |
| 34 | 0 | 0 | 0 |
| 44 | 0 | 0 | 0 |
| 47 | 0 | 0 | 0 |
| 62 | 0 | 0 | 0 |
| 51 | 1 | 2 | 0.9 |
| 15 | 6 | 1 | 6.9 |
| 39 | 8 | 12 | 0.7 |
| 31 | 15 | 2 | 7.6 |
| 23 | 23 | 3 | 8 |
| 12 | 30 | 1 | 30.5 |
| 27 | 39 | 1 | 39.2 |
| 66 | 40 | 34 | 1.2 |
| 7 | 41 | 2 | 20.9 |
| 11 | 44 | 2 | 22.2 |
| 40 | 54 | 4 | 13.5 |
| 60 | 64 | 10 | 6.4 |
| 9 | 66 | 4 | 16.7 |
| 64 | 70 | 2 | 35.3 |
| 30 | 71 | 3 | 23.8 |
| 18 | 77 | 3 | 25.7 |
| 5 | 79 | 1 | 79.4 |
| 54 | 83 | 3 | 28 |
| 53 | 89 | 9 | 9.9 |
| 22 | 90 | 4 | 22.7 |
| 41 | 118 | 4 | 29.6 |
| 10 | 119 | 8 | 14.9 |
| 59 | 121 | 12 | 10.1 |
| 50 | 123 | 3 | 41 |
| 17 | 127 | 2 | 63.7 |
| 3 | 129 | 4 | 32.4 |
| 46 | 138 | 10 | 13.8 |
| 33 | 141 | 9 | 15.7 |
| 55 | 154 | 2 | 77.4 |
| 24 | 155 | 10 | 15.6 |
| 14 | 174 | 3 | 58 |
| 48 | 211 | 4 | 52.9 |
| 36 | 250 | 5 | 50.2 |
| 38 | 261 | 2 | 130.9 |
| 13 | 378 | 2 | 189.5 |
| 45 | 388 | 4 | 97.2 |

**EXPECTED CHANGES IN MEAN SALARY  for the FALL 2007 data**

The above results indicate that there was no apparent change in the gender-based differences in salary despite the decision to focus part of the merit pool for Fall 2007 on redressing gender differences. In order to further analyze these data with regard to the issue of why the statistic above indicates a continuing difference in salary based upon gender, despite the attempt to redress it, we analyzed the expected changes in mean salary which would have arisen due to the merit pool allocation.

We below analyzed the changes in mean male and female faculty salaries, comparing the salaries for Spring 2007 to those for Fall 2007. The across-the-board raise pool was 3% and the merit pool was 2%. The merit pool was split so that 25% of it was focused on females only, with the remaining 75% going to both males and females. We assume here that the merit pool fraction not specified for females was split proportionately, based upon relative numbers of faculty of each gender, between males and females within each rank. The projections of mean salaries for males and females makes no assumptions about the actual distribution of salaries within the male and female faculty within a given rank – the exact manner of the salary distribution will not affect the means. We can thus predict the impact on female and male mean salaries of the 25% allocation of the total merit pool to females and compare this to the actual mean salaries.

We have assumed that the merit pools for each rank are assigned within that rank – e.g. none of the merit pool for Assistant Professors was used for faculty at other ranks. Under these assumptions we have the following results for predicted and actual salaries, fraction of female to male salaries, and percentage increases in salaries. (These calculations were done using the Matlab code meansalarychange.m which is available for those interested). The results are shown in Table 4 while in Table 5 we show the ratios of Mean Female to Mean Male Salaries at each rank along with the predicted and actual changes in these based upon the above assumptions for the merit pool distribution.

Table 4: The expected changes in mean salary for male and female faculty based upon the assumptions given on distribution of the merit salary pools from Spring 2007 to Fall 2007 (values in $).

|  | Spring 2007 Mean Salary Males | Fall 2007 Mean Salary Males Predicted | Fall 2007 Mean Salary Males Actual | Spring 2007 Mean Salary Females | Fall 2007 Mean Salary Females Predicted | Fall 2007 Mean Salary Females Actual |
|---|---|---|---|---|---|---|
| Assistant Professor | 61,976 | 64,765 | 65,823 | 55,797 | 58,928 | 58,963 |
| Associate Professor | 74,630 | 77,988 | 77,571 | 67,698 | 71,609 | 71,545 |
| Professor | 98,219 | 102,640 | 104,522 | 85,873 | 92,167 | 90,388 |

Table 5: The expected changes in the ratios of mean salary for females to males compared to actual and the predicted fractional changes in the mean salaries compared to the actual based upon the assumptions given on distribution of the merit salary pools from Spring 2007 to Fall 2007.

| | Spring 2007 Female/Male Mean Salary Ratio | Fall 2007 Female/Male Mean Salary Ratio Predicted | Fall 2007 Female/Male Mean Salary Ratio Actual | Fraction Change Male Mean Salary Predicted | Fraction Change Male Mean Salary Actual | Fraction Change Female Mean Salary Predicted | Fraction Change Female Mean Salary Actual |
|---|---|---|---|---|---|---|---|
| Assistant Professor | .9003 | .9099 | .8958 | .0450 | .0621 | .0561 | .0567 |
| Associate Professor | .9071 | .9182 | .9223 | .0450 | .0394 | .0578 | .0570 |
| Professor | .8743 | .8980 | .8648 | .0450 | .0642 | .0733 | .0526 |

**CONCLUSIONS:**

First, as measured by the D* statistic, the changes in salary made for Fall 2007 had essentially no influence on the gender differences in salary, when accounting for differential representation of gender in different units/ranks and longevity status. This is consistent with the results from the earlier reports. The D* statistic changed from 2983 to 2922 from Spring 2007 to Fall 2007 when longevity status is included and changed from 3378 to 3040 when longevity status is not included. In all cases these are well beyond the 95% confidence interval for the D statistic, indicating a highly significant contribution of gender to the salary differences of faculty after accounting for unit/rank/longevity status.

Second, using the method to account for the differences in numbers of gender pairs across departments, Tables 2 and 3 provide the contribution to D* per gender pair in the unit. While the contributions of each department to D* vary somewhat when longevity status is taken into account versus when it is not, there is a consistent grouping of units at both the very positive and the very negative end of the range. This indicates that longevity status does not greatly modify which departments contribute the most to the unequal salary distributions across gender at UTK, as was true in the earlier reports. Comparing Tables 2 and 3 in this report to those in the original report shows that there are some changes from Spring 2007 to Fall 2007 in which departments provide the highest contributions to the gender differences in salary, but many remain in the same relative position (e.g. positive or negative). This indicates that the raises applied in Fall 2007 made some, but not major changes to the relative contributions of different units to the observed differences in salaries between genders.

Third, Tables 4 and 5 indicate that the expected change in female salaries at the Assistant and Associate Professor level were similar to those which actually occurred, while at the Full Professor level, the expected increase in female salary did not occur. In fact, at the Full Professor level, the female faculty raise was approximately 2% below that expected, while for males it was almost 2% more than expected. These impacts at the Full Professor level assuredly reduced the impact of the merit pool allocation on redressing gender salary differences as measured by the D* statistic.