

# **Report to the UTK Faculty Senate from the Senate Budget and Planning Committee Analysis of Faculty Salary Data based upon Gender using Data from Fall 2015**

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(Note that this report was developed by a sub-committee of the 2015-16 Committee. The sub-committee members included the Chair, Dr. Jennifer Franklin and Dr. Michael Fry)

This is a follow-up report to those produced by this Committee in April 2007, June 2007 and April 2008, as well as the report of April 2016. All of these reports are posted on the current website of the Committee at <http://www.nimbios.org/~gross/SenateBudgetPlanningCommittee2015-16.html> under the Gender and Faculty Salary Report section. The objective of this version of the report is twofold:

- (1) to provide summary statistics for the latest salary data made available to the Committee and provide a historical perspective by analyzing the changes in distribution, mean and median salary based on gender and rank over the eight-year time period from 2007 to 2015 to compare to the April 2008 report; and
- (2) to repeat the earlier analyses (which were carried out for data from Fall 2006, May 2007 and October 2007) for a later dataset of faculty salaries, those as of October 2015.

As best we are aware, no similar reports analyzing gender and faculty salaries have been produced at UTK. Therefore, this report adds to the corpus of knowledge about salaries as it may be impacted by gender, and additionally provides a basis for further investigation by the UTK administration of the salary structure of particular units in which the salary distribution contributes the most to the imbalance noted across the entire campus. The impetus for this report comes from three sources: (i) the differences in aggregated mean and median salaries between male and female faculty at all ranks across campus; (ii) the differences in the gender distribution of the faculty with the highest salaries and most prestigious Chairs across campus; and (iii) the need to determine whether the observed differences in salary by gender can be reasonably argued as arising from differential gender representation in units with different market values for their respective faculty.

## **Summary Statistics**

The data used for this report were provided by the UTK Office of Institutional Research and Assessment, at the request of the Committee, and were provided in a manner consistent with the data provided for the earlier studies in 2006-2007. Thus the data consists of salary (nine-month basis) for all full-time instructional faculty from UTK, UTSI, UTIA and Vet Med, includes base salary plus any additional stipends (but not extra pay for summer effort), and does not include longevity pay. The data are anonymized in that random identifying numbers are assigned for each faculty member and the home departments are also assigned an ID number, with the translation between ID numbers and faculty names and departments not being provided to the Committee. In addition to salary and department ID, for each faculty member we were provided with their rank, gender, longevity date, and longevity pay. The data provided for 2015 included a small number of faculty with no rank (listed as Other Faculty), primarily visiting faculty, and these were excluded from all of the below analysis.

**Fall 2015 Data**

For the 2015 data, there were a total of 1527 faculty, including Instructors and Lecturers. For these, the average salary for all females (643 individuals) was \$79,777 and the average salary for all males (884 individuals) was \$105,460. Including just Professorial faculty (Assistant, Associate and Full) with 1204 individuals, the average salary for all females (452 individuals) was \$92,028 and the average salary for all males (752 individuals) was \$114,709. So the ratio of female-to-male salary was .763 including Instructors and Lecturers and the ratio for only Professorial Faculty was .802, the fraction of the total faculty who were female was .421 and the fraction of the Professorial faculty who were female was .347.

Table 1 summarizes the differences in average and median salaries by gender and rank for the Fall 2015 data. Note that the results include Instructors and Lecturers, which were not included in earlier reports. The median salaries for Instructors and Lecturers are very close to the respective average salaries while the median salaries for Professorial faculty at each rank and for each gender are considerably below the average salaries. The observed differences between average and median salaries arise due to some quite higher salaries at each rank and for each gender that skew the data, leading to a higher mean than median.

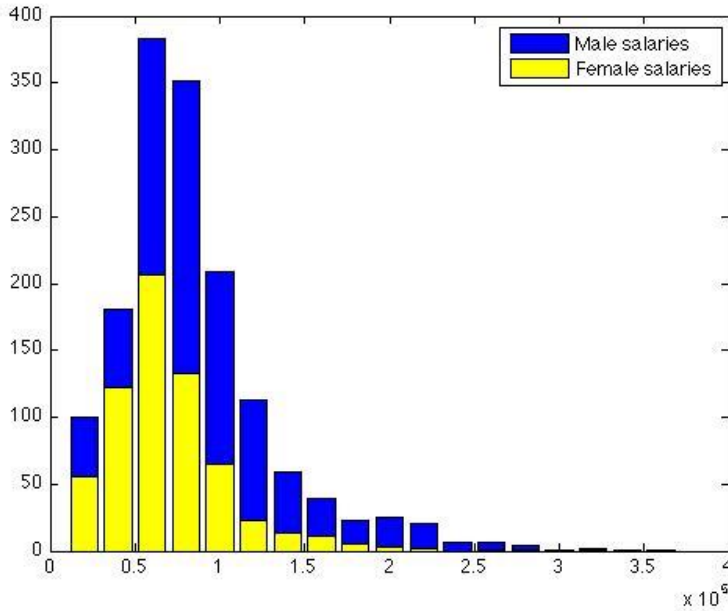
Table 1. Summary of Faculty Salary Data for Fall 2015

Rank	Number in Rank	Mean Salary Males	Mean Salary Females	Median Salary Males	Median Salary Females
Instructor	30	59281	59100	59281	59100
Lecturer	286	52918	49575	45112	45154
Assistant	333	83250	75038	77250	70850
Associate	371	96298	87661	88925	83628
Professor	500	137687	123823	123173	110327

One of the concerns raised by the Committee in a report in September 2015 concerned the fact that the highest faculty salaries at UTK were consistently gender-biased with many more males having the highest salaries than females. That analysis was only based on published reports of the top-100 salaries for public employees though, of which most were Athletics employees or administrators. An extension of this analysis has been done to investigate the gender balance for the top 5% and top 10% of faculty salaries for Fall 2015. For the top 5% of Professorial salaries (not including Instructors and Lecturers) out of 1204 total individuals this is 60 individuals of which 7 are females. So 11.7% of the individuals in the highest 5% of faculty salaries are females and 88.3% are males. For the top 10% of salaries, this is 120 individuals, of which 20 are female so 16.7% of the individuals in the highest 10% of salaries are female faculty and 83.3% are male faculty.

The skew of faculty salaries overall by gender is illustrated in Figure 1. As is evident in the above information on the top 5% and top 10% of salaries, there is a strong skew by gender in Figure 1 with a higher fraction of each bar at the highest salary levels going to males and a higher fraction of the bar at the lower salary levels going to females. Note that this Figure counts the number of faculty at each level though, so it doesn't account for the fact that overall there are more male than female faculty. About 42% of the total faculty are female. So that if faculty by gender were evenly distributed across all salary levels, about 40% of each bar would be female and 60% would be males. This is clearly not the case as is evident in Figure 1.

Figure 1: Histogram of all Fall 2015 Faculty Salaries with the horizontal axis giving salaries in \$ and the vertical axis giving the numbers of males (upper bars – in blue) and females (lower bars –in yellow) at each salary level



**Fall 2007 Data**

For the Fall 2007 data there were a total of 1434 faculty, including Instructors and Lecturers. For these, the average salary for all females (548 individuals) was \$63,078 and the average salary for all males (886 individuals) was \$82,168. Including just Professorial faculty (Assistant, Associate and Full) with 1184 individuals, the average salary for all females (408 individuals) was \$67,001 and the average salary for all males (776 individuals) was \$83,361. So the ratio of female-to-male salary was .768 including Instructors and Lecturers, the ratio for only Professorial Faculty was .804, the fraction of the total faculty who were female was .382 and the fraction of the Professorial faculty who were female was .345.

Table 2 gives averages and medians for the Fall 2007 salary data summarized by gender and rank. The Instructor and Lecturer values have been included - these were not included in earlier reports from the Committee.

Table 2. Summary of Faculty Salary Data for Fall 2007

Rank	Number in Rank	Mean Salary Males	Mean Salary Females	Median Salary Males	Median Salary Females
Instructor	34	46115	47262	42350	51129
Lecturer	207	39165	37763	34586	34333
Assistant	351	65823	58963	61676	57496
Associate	367	77571	71545	76018	67315
Professor	475	104522	90388	96658	87997

## Historical Analysis

The above data show that over the 8-year time period under consideration, the Professorial faculty numbers increased slightly (from 1184 to 1204) while the number of Instructors and Lecturers increased considerably more, from 250 to 323. The gender balance of the faculty overall has remained very similar with a slight increase over the time period for the full faculty including Instructors and Lecturers and no change when just Professorial faculty are considered.

These data allow for a more detailed comparison of changes in salary over the 8-year period as a function of rank and gender than was possible with the data used in the April 2016 report of the Committee which was based on data from the Chronicle of Higher Education. There are evident differences between the data reported in the Chronicle and the data used here, which have been collected in a more uniform manner and thus allow for a more accurate assessment of salary changes over the 8-year period.

Table 3 uses the data in Tables 1 and 2 to calculate the fractional change in mean and median salaries over the 8-year time period of analysis. At all ranks and for all genders there has been significant increases in mean and median salaries over this time period. There is variation in the magnitude of these changes by rank and gender, but there is no evidence of consistent gender differences in these data. The Instructor data are based on a much smaller population size than any of the other ranks, so the large differences in changes of the median salaries for males and females at this rank should likely be discounted as likely arising due to small numbers of faculty included.

Table 3. Fractional change in mean and median salaries by rank and gender from 2007 to 2015

Rank	Fraction Change in Mean Salary Males	Fraction Change in Mean Salary Females	Fraction Change in Median Salary Males	Fraction Change in Median Salary Females
Instructor	.2855	.2505	.3998	.1559
Lecturer	.3511	.3128	.3045	.3152
Assistant	.2647	.2726	.2525	.2323
Associate	.2414	.2252	.1698	.2423
Professor	.3173	.3699	.2743	.2538

## RESAMPLING METHOD for the FALL 2015 data (Calculation of the D and D\*)

We here repeat the calculation of the D statistic derived in the earlier reports for the data in 2006-2007. The details of the calculation were included in earlier reports and are not repeated here. As in the previous reports, these statistics were calculated using only the Professorial salary data in part because the Instructor and Lecturer positions are focused in a relatively small number of units. The objective is to carry out a resampling method which creates a virtual UT salary distribution with identical salaries to those of Fall 2015, 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 the 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. This is then compared to the single value for the statistic when using the actual faculty salary data, not resampled, which is called  $D^*$ . In the earlier reports we also calculated additional statistics (E and  $E^*$ ) and although we have calculated these again, we do not include them in this report as they were deemed not as informative in the earlier reports as the statistics D and  $D^*$ . Additional details of the calculations of D and  $D^*$  are in the published paper by Travis et al. (2009) referenced below.

Repeating the analysis in the original report, using the Fall 2015 data, gives Figures 2 and 3. These graph the histograms for the distributions of the resampled statistic D for both the case in which longevity status is included in the groupings of faculty 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 inside the 95% confidence intervals of D in both cases. Thus the null hypothesis that the gender differences in salary arise from factors other than those driving salary differences between units is rejected. This is a major change from the results of the previous Committee reports in which it was concluded that there was strong evidence that the differences in salary between males and females across UTK do not arise from chance assignments of salaries, nor were they explained by differences in gender distributions across units, ranks or longevity status. *Although this method still provides some evidence (because the  $D^*$  values are positive) that there are gender differences in salary not accounted for differential representation of faculty by gender in units with different faculty market values, the evidence is much weaker than that from 8-years ago and cannot be said to be statistically significant.*

Figure 2: Distribution of 4000 resamples of statistic D and accounting for longevity for the Fall 2015 data. The  $D^*$  value of 1709 is calculating using the actual faculty salaries.

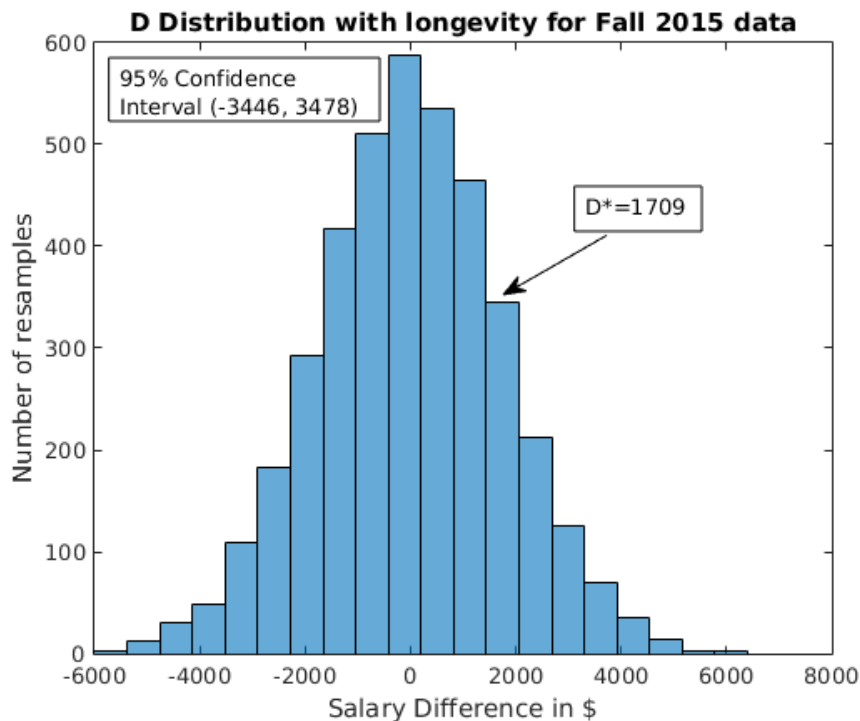
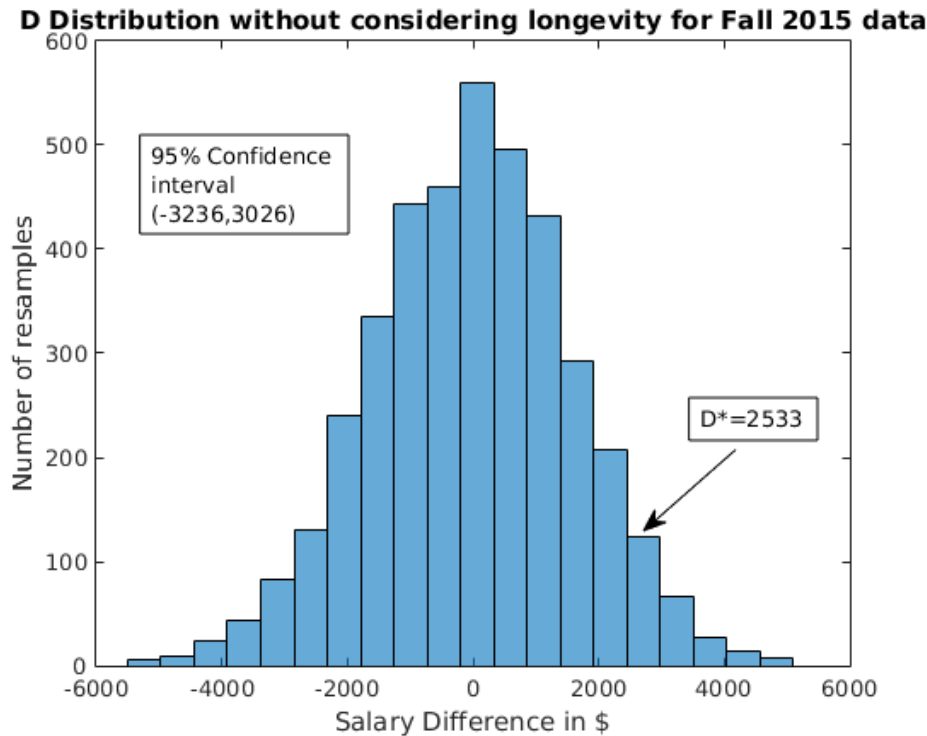


Figure 3: Distribution of 4000 resamples of statistic D without accounting for longevity for the Fall 2015 data. The  $D^*$  value of 2533 is calculating using the actual faculty salaries.



We next repeat the calculations included in the original Committee reports to provide a breakdown by unit as to the contribution of each unit to the calculated value of  $D^*$ , shown in Tables 4 and 5 below. These provide the magnitude of departmental contributions to  $D^*$ , from most negative to most positive. The values shown in Table 4 are for the case in which longevity effects within ranks are taken into consideration, while those in Table 5 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. The  $D^*$  values are smaller for the 2015 data than for previous years, indicating a smaller potential impact of gender on salary, and there are also smaller contributions from units. The results in Tables 4 and 5 are consistent in that there are a small number of units with the greatest contribution to higher male than female salary, and focusing on analysis of these units may be beneficial.

Table 4: Contributions to the statistic  $D^*$  arising from each Department, taking longevity into account. The Department Contributions sum to  $D^* = 1709$ , 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
35	-299	8	-37.3
58	-178	4	-44.3
8	-171	9	-18.9
22	-168	6	-28.0
46	-152	1	-151.7
27	-150	3	-49.8
57	-147	3	-49.0
45	-125	5	-24.8
41	-100	5	-19.9
60	-98	3	-32.4
52	-80	4	-19.8
3	-74	3	-24.4
14	-70	3	-23.3
55	-62	1	-61.1
64	-56	10	-5.6
28	-39	1	-38.6
15	-36	16	-2.2
32	-34	1	-33.1
17	-31	3	-10.3
37	-22	4	-5.4
23	-19	2	-9.1
44	-18	3	-5.9
12	-7	3	-2.1
10	-5	2	-2.0
2	-3	1	-2.6
5	0	0	0
6	0	0	0
7	0	0	0
16	0	0	0
24	0	0	0
26	0	0	0
40	0	0	0
47	0	0	0
50	0	0	0
51	0	0	0
29	3	1	3.6
53	6	1	6.4
18	11	13	0.9
54	16	2	8.0
39	17	4	4.4
33	22	3	7.4
21	26	1	26.1
42	27	4	6.8
1	31	2	15.7

65	35	3	11.9
49	38	6	6.4
36	39	3	13.2
48	40	3	13.4
20	40	2	20.3
13	45	3	15.3
4	50	1	50.3
59	56	12	4.7
62	60	4	15.0
56	62	2	31.2
11	112	4	28.2
34	120	12	10.0
31	146	5	29.2
25	174	11	15.9
43	185	4	46.3
61	224	2	112.0
38	319	12	26.6
30	372	6	62.1
9	423	2	211.8
19	434	5	86.9
63	695	30	23.2

Table 5: Contributions to the statistic  $D^*$  arising from each Department, without taking longevity into account. The Department Contributions sum to  $D^* = 2533$ , 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
58	-149	4	-37.1
8	-149	9	-16.5
45	-141	5	-28.0
33	-138	4	-34.4
22	-129	6	-21.3
21	-117	2	-58.3
57	-112	3	-37.1
46	-112	1	-111.2
3	-92	3	-30.5
41	-78	5	-15.4
17	-72	4	-18.0
14	-59	4	-14.6



2	-57	2	-28.5
37	-38	6	-6.2
55	-37	1	-36.7
53	-28	1	-27.9
36	-18	3	-5.8
23	-17	2	-8.3
44	-17	3	-5.4
65	-14	4	-3.4
15	-13	17	-0.8
39	-7	4	-1.7
64	-5	11	-0.4
10	-4	2	-1.9
42	-2	4	-0.4
5	0	0	0
7	0	0	0
16	0	0	0
24	0	0	0
26	0	0	0
40	0	0	0
47	0	0	0
51	0	0	0
35	0	8	0.1
29	3	1	3.3
28	6	1	6.0
60	12	3	4.2
6	24	3	8.3
1	28	2	14.4
54	36	2	18.4
48	36	3	12.3
20	37	2	18.6
18	39	13	3.0
32	45	2	22.9
27	45	4	11.5
49	47	6	8.0
50	51	1	51.3
31	54	5	10.9
59	58	12	4.9
56	68	2	34.2
13	77	5	15.5
52	81	4	20.4
11	86	5	17.3
62	94	4	23.5
43	109	4	27.3
12	110	3	36.7
25	187	12	15.6
61	203	2	101.9
4	244	2	122.0

9	323	2	161.7
38	330	13	25.4
30	337	6	56.3
19	352	5	70.4
63	476	33	14.4
34	513	12	42.8

## CONCLUSIONS:

First, as noted in earlier reports, considering the faculty as a whole, there are considerable differences by gender in mean and median salaries at all Professorial ranks, with males having consistently higher mean and median salaries. On average, female Professorial faculty receive 80% of the salary of male Professorial faculty. These differences are not present at Instructor and Lecturer ranks. There is a much smaller proportion of females than males at the highest salary levels, than would be expected based on the overall proportion of females on the faculty.

Second, there have been significant increases in mean and median salaries at all ranks and for both genders over the past 8-years. This has arisen from a strong campus commitment to enhancing funding for faculty and staff salaries over this time period. There is no evidence of differences by gender in the magnitude of these increases in mean and median salaries. This is in contrast to the raises in 2007-2008 which for which there were gender differences in application of the raises (males receiving higher than expected raises). The number of Professorial faculty has increased slightly (by about 20 individuals) over this time period while the number of Instructors and Lecturers has increased significantly more (by about 70 individuals).

Third, as measured by the D\* statistic, there is no longer any strong statistically significant evidence that the gender differences in salary cannot be explained by differential representation by gender in units with different market values for faculty. The D\* statistic still indicates that there are some gender differences in salary not accounted for differential representation of faculty by gender in units with different faculty market values, but the evidence is much weaker than that from 8-years ago. By looking at the departmental contributions to this, a small set of units contribute the greatest to the gender salary differences across campus, independent of whether longevity status of faculty is included. This indicates that longevity status does not greatly modify which departments contribute the most to the observed salary distribution differences by gender at UTK, as was true in the earlier reports. Therefore, particular attention might be paid to these units in allocation of future equity and merit components of any raise pool.

## References:

Travis, C. B., L. J. Gross, and B. A. Johnson. 2009. Tracking the gender pay gap: a case study. *Psychology of Women Quarterly* **33**: 410-418.