# Gender-Based Pay Equity Differences and Upward Occupational Mobility Through the Lens of Comparable Worth

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**Editor's note:** This article is based on the book *Human Capital Systems, Analytics and Data Mining* (Hughes 2018). The research is reviewed and updated in the article, which also contains excerpts from the book. The book is available through CRC Press at https://www.crcpress.com/Human-Capital-Systems-Analytics-and-Data-Mining/Hughes/p/book/9781498764780 or through book dealers.

Pay equity issues have been widely written about and researched during the past few decades, often with findings that women are paid less than men by a significant percentage. However, in nearly all cases, the research has not been focused within job and occupational categories. This lack of focus on jobs of comparable worth, based on pay grade assignments, has mostly led to looking at the issue through a foggy lens and at a high altitude, where conclusions and findings may be misleading.

For example, if a division of an organization has an average internal compa-ratio of 105%, a conclusion may be drawn that the average pay is slightly above market rates and all is fine, assuming the salary structure midpoints are in line with the average market rates. However, when drilling down to individual units and/or job families, it is not unusual to find widely varying differences on internal compa-ratios that may be based

on a wide variety of factors including, but not limited to, average length of service, average performance ratings, turnover and organizational factors. If any significant differences exist involving protected groups and/or gender, they may need to be examined.

Research based solely on aggregate gender pay differences — where jobs in all categories are viewed together — results in typically distorted findings because they do not take into account the skewed nature of female participation in higher-paying job categories. As illustrated later, women have low participation in the highest pay grades. This leads to heavily distorted average pay comparisons between genders due to the higher percentage of men employed in higher paying jobs, which inflates gender pay differences when not examining gender compensation differences based on occupations of equal value.

The Equal Pay Act (EPA) prohibits sex-based wage discrimination between men and women in the same establishment who perform jobs that require substantially equal skill, effort and responsibility under similar working conditions.

Given the legal requirement, there should not be pay discrimination between men and women, so why do differences in average pay exist? Does the fact that women and men have differences in employment levels across occupation groups affect the wage differences? For example, if men have higher levels of employment than women in occupation groups with better wage levels, would that account for the differences? If men have longer lengths of employment than women, could that account for some of the differences? Do women have higher levels of wages in female-dominated occupation groups than men?

The U.S. Office of Personnel Management (OPM) FedScope Online Analytical Processing (OLAP) site provides OLAP cubes by quarter for employment, accessions, separations, employment trends and diversity within the federal government. An OLAP online viewer (Cognos PowerPlay) is automatically enabled when accessing any of the available FedScope OLAP cubes. Public access to Federal Human Capital Data stored in OLAP cubes is accessible through the FedScope website at https://www.fedscope.opm.gov/. (Note that only the Mozilla/Firefox Web Browser is compatible with the enhanced or generic cube interfaces with the Cognos PowerPlay Studio OLAP viewer at the FedScope website.)

## MULTIDIMENSIONAL OLAP CUBES

An OLAP cube is a database that is built for high-speed reporting and analysis. While production relational databases are designed for online transaction processing (OLTP) for financial, human capital, sales and other business applications, OLAP databases are built for quick response in analytics and reporting. Regular relational databases treat all data in the database similarly while OLAP cubes separate information into two groups: dimensions and measures. Dimensions are essentially information attributes by which measures are sorted. Measures represent aggregated or summarized information. In essence, data is pre-aggregated in the OLAP

database so that responses to most queries have been previously calculated and can be quickly presented. OLAP cubes can have many dimensions.

Prior to OLAP databases, data had to be extracted from databases using structured query language (SQL) programs, which could take many minutes or hours, depending on the complexity of the request and the amount of data involved. OLAP cubes prebuild summarizations for the data, which results in reports and analytics that can be run in seconds instead of many minutes or hours.

OLAP database sizes are based on the facts or measures and the number of dimensions only and not the size of the database source. OLAP databases are typically much smaller and usually represent only a small fraction of the size of the source production relational databases. As a result, responses from OLAP databases are nearly instantaneous in most cases.

## OLAP DRILL DOWN

In OLAP databases, dimensions may be set into hierarchies, such as days, months, quarters and/or years for a date-specific attribute (for example, a performance review date in a human capital OLAP database). Dimensions with hierarchical structures allow drilling down in OLAP cubes.

Drilling down through the data reveals differences that, for some segments or divisions of the data, hold different results than what hold true at a higher level of aggregation. For example, internal compa-ratios (salary grade midpoint/average salary/100) for a department may be within the 90% to 100% range, indicating a comfortable average of employees with salaries within 10% of the salary grade midpoint on average. However, when drilling down to the job family and by job classification, one may find variances indicating that some job families and/or individual jobs have large variances on average, with internal compa-ratios that are well outside acceptable compensation policy limits.

Figure 1 shows a detailed view of female vs. male pay relationships as developed through the FedScope site. (Extensive tutorials covering all Fedscope OLAP employment database views and analytics are contained in Human Capital Systems, Analytics and Data Mining [Hughes 2018].)

For example, within the cabinet-level agencies in the professional and administrative group jobs in pay grade levels 9 through 13, women make a higher average salary than men. Lower and higher pay grades show the reverse finding. If one did not drill down further to the pay grade level, where jobs of equal value are together in the same category, one would have incorrectly assumed from the higher-level analysis that all women in the professional and administrative group had lower average hourly wages than men.

## COMPARISONS OF FEDSCOPE EMPLOYMENT DATE, 2015 TO 2018

Overall in the GS schedule, women earned 91.5% compared to 92.9% of men from 2015 to 2018 when not adjusting for jobs of comparable worth. Figure 1 shows

**FIGURE 1** OLAP View FedScope Percentage of Women and Men All Measures by Cabinet Level Agency and GS Grade. March 2015 Data

| MEASURES as values | Employment | | | | | Average Salary | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cabinet Level Agencies | Female | Male | Female/Male PCT | Unspecified | Gender - All | Female | Male | Female/Male PCT | Unspecified | Gender - All |
| 01 | 402 | 626 | 64.22% | NA | **1,028** | $21,986 | $22,293 | 98.62% | NA | **$22,173** |
| 02 | 1,236 | 734 | 168.39% | NA | **1,970** | $24,139 | $24,588 | 98.18% | NA | **$24,306** |
| 03 | 7,034 | 3,704 | 189.90% | NA | **10,738** | $28,262 | $27,827 | 101.56% | NA | **$28,112** |
| 04 | 24,367 | 12,702 | 191.84% | NA | **37,069** | $32,991 | $32,530 | 101.42% | NA | **$32,833** |
| 05 | 46,978 | 29,236 | 160.69% | NA | **76,215** | $37,784 | $37,241 | 101.46% | NA | **$37,576** |
| 06 | 54,595 | 30,821 | 177.14% | NA | **85,416** | $43,383 | $42,499 | 102.08% | NA | **$43,064** |
| 07 | 64,077 | 54,350 | 117.90% | NA | **118,427** | $48,115 | $47,520 | 101.25% | NA | **$47,842** |
| 08 | 24,925 | 21,411 | 116.41% | NA | **46,336** | $54,395 | $55,007 | 98.89% | NA | **$54,678** |
| 09 | 58,059 | 61,537 | 94.35% | NA | **119,597** | $58,128 | $57,873 | 100.44% | NA | **$57,997** |
| 10 | 6,605 | 6,494 | 101.71% | NA | **13,099** | $67,816 | $65,326 | 103.81% | NA | **$66,581** |
| 11 | 78,349 | 89,699 | 87.35% | NA | **168,049** | $70,277 | $69,705 | 100.82% | NA | **$69,971** |
| 12 | 101,243 | 156,534 | 64.68% | NA | **257,778** | $85,137 | $83,890 | 101.49% | NA | **$84,379** |
| 13 | 84,260 | 136,571 | 61.70% | NA | **220,831** | $102,752 | $102,498 | 100.25% | NA | **$102,595** |
| 14 | 39,281 | 64,029 | 61.35% | NA | **103,310** | $124,333 | $124,381 | 99.96% | NA | **$124,363** |
| 15 | 17,262 | 30,072 | 57.40% | NA | **47,335** | $150,450 | $150,936 | 99.68% | NA | **$150,759** |
| N/A | 170,342 | 352,061 | 48.38% | NA | **522,403** | $85,722 | $83,390 | 102.80% | NA | **$84,151** |
| **General Schedule and Equivalent Grade (GSEG)-All** | **779,015** | **1,050,581** | **74.15%** | **NA** | 1,829,601 | **$74,866** | **$81,812** | **91.51%** | **NA** | **$78,854** |

Source: Hughes 2018

that for 10 of the 15 GS pay grades, women earned more than 100% of what men earned in the FedScope 2015 Employment OLAP dataset. For 2018, Figure 2 shows women earning in excess of 100% of what men earned for 12 of the 15 GS pay

**FIGURE 2** OLAP View FedScope Percentage of Women/Men All Measures By Cabinet Level Agency and GS Grade. March 2018 Data

| MEASURES as values | Employment | | | | | Average Salary | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cabinet Level Agencies | Female | Male | Female/Male Pct | Unspecified | Gender - All | Female | Male | Female/Male Pct | Unspecified | Gender - All |
| 01 | 30 | 22 | 136.36% | NA | **52** | NA | NA | NA | NA | **NA** |
| 02 | 290 | 538 | 53.90% | NA | **828** | $23,188 | $23,571 | 98.38% | NA | **$23,437** |
| 03 | 1,079 | 588 | 183.50% | NA | **1,667** | $25,261 | $25,874 | 97.63% | NA | **$25,476** |
| 04 | 6,388 | 3,187 | 200.44% | NA | **9,582** | $29,632 | $29,335 | 101.01% | NA | **$29,534** |
| 05 | 20,013 | 10,535 | 189.97% | 24 | **30,572** | $34,397 | $34,150 | 100.72% | $32,907 | **$34,311** |
| 06 | 46,620 | 25,554 | 182.44% | 80 | **72,254** | $39,293 | $38,751 | 101.40% | $36,193 | **$39,105** |
| 07 | 60,107 | 33,036 | 181.94% | 57 | **93,200** | $45,421 | $44,322 | 102.48% | $41,866 | **$45,078** |
| 08 | 59,417 | 54,021 | 109.99% | 60 | **113,498** | $50,160 | $49,054 | 102.25% | $45,128 | **$49,681** |
| 09 | 24,502 | 21,821 | 112.29% | NA | **46,330** | $56,898 | $56,315 | 101.04% | NA | **$56,664** |
| 10 | 56,326 | 61,196 | 92.04% | 28 | **117,550** | $60,690 | $60,193 | 100.82% | $57,282 | **$60,436** |
| 11 | 6,424 | 7,763 | 82.75% | NA | **14,190** | $71,870 | $68,262 | 105.29% | NA | **$69,989** |
| 12 | 77,437 | 91,280 | 84.83% | 28 | **168,745** | $74,022 | $73,212 | 101.11% | $69,980 | **$73,589** |
| 13 | 102,089 | 154,123 | 66.24% | 20 | **256,232** | $90,362 | $89,674 | 100.77% | $86,046 | **$89,981** |
| 14 | 87,174 | 133,719 | 65.19% | NA | **220,899** | $109,583 | $108,833 | 100.69% | NA | **$109,160** |
| 15 | 41,223 | 64,003 | 64.41% | NA | **105,229** | $132,868 | $132,794 | 100.06% | NA | **$132,824** |
| N/A | 18,003 | 28,965 | 62.15% | NA | **46,970** | $159,828 | $160,681 | 99.47% | NA | **$160,340** |
| | 189,679 | 376,334 | 50.40% | 230 | **566,243** | $92,381 | $86,977 | 106.21% | $65,486 | **$88,756** |
| **General Schedule and Equivalent Grade (GSEG)-All** | **796,801** | **1,066,685** | **74.70%** | **555** | 1,864,041 | **$79,541** | **$85,653** | **92.86%** | **$56,437** | **$82,893** |

Source: Hughes 2018

grades. For all GS pay grades, the 2015 to 2018 relationship has remained roughly the same, from 100.6% to 100.8% when adjusted for comparable worth based on pay grade assignments of the Federal Evaluation System (FES). This view would indicate that women are paid equal to men when comparing jobs of equal value.

## FEMALE UPWARD JOB MOBILITY

Lack of upward job mobility for women in the federal workforce is apparent when we look at employment density by GS grade. When looking at the Percent Employment columns for female and male, we see that women have more than 50% employment in GS grades 2 through 10. This is in sharp contrast to grades 11 through 15, where women have less than half of the employment levels of males. (See Figure 3.)

For GS 13 through 15, the rate of employment for women is less than 40% for March 2015. Figure 4, which contains data for March 2018, shows employment rates for women less than 40% of men for GS grades 12 through 15. A small improvement from 36.85% to 38.33% for women compared to men did occur in the highest pay grade, GS 15.

## LENGTH OF SERVICE QUOTIENTS

Figure 5 shows an extended pivot table worksheet where additional length of services (LOS) calculations have been added. The PCT Average Salary/LOS Female/Male column indicates that women earn a much lower percentage of salary than men per length of service. For each year of service based on total length of service, women were paid 76% to 96% for all GS grades from 1 to 15, except for the next to lowest

**FIGURE 3** Pivot Table Stage 1 View Percentage Employment, Fedscope Data March 2015.

Fedscope 03 2015

| | A | H | |
|---|---|---|---|
| 1 | | | |
| 2 | | Pct Employment | |
| 3 | GS Grade | Female | Male |
| 4 | GS-01 | 48.93% | 51.07% |
| 5 | GS-02 | 62.33% | 37.67% |
| 6 | GS-03 | 64.72% | 35.28% |
| 7 | GS-04 | 65.97% | 34.03% |
| 8 | GS-05 | 62.44% | 37.56% |
| 9 | GS-06 | 64.61% | 35.39% |
| 10 | GS-08 | 63.66% | 36.34% |
| 11 | GS-09 | 51.74% | 48.26% |
| 12 | GS-10 | 52.16% | 47.84% |
| 13 | GS-11 | 48.83% | 51.17% |
| 14 | GS-12 | 41.06% | 58.94% |
| 15 | GS-13 | 39.79% | 60.21% |
| 16 | GS-14 | 39.59% | 60.41% |
| 17 | GS-15 | 36.85% | 63.15% |
| 18 | **Grand Total** | **47.54%** | **52.46%** |

Source: Hughes 2018

**FIGURE 4** Pivot Table Stage 1 View Percentage Employment, Fedscope Data March 2018.

Fedscope 03 2018

| | | F | |
|---|---|---|---|
| 1 | | Pct Employment | |
| 2 | GS Grade | Female | Male |
| 3 | GS-01 | 35.02% | 64.98% |
| 4 | GS-02 | 64.73% | 35.27% |
| 5 | GS-03 | 66.72% | 33.28% |
| 6 | GS-04 | 65.51% | 34.49% |
| 7 | GS-05 | 64.59% | 35.41% |
| 8 | GS-06 | 64.53% | 35.47% |
| 9 | GS-07 | 52.38% | 47.62% |
| 10 | GS-08 | 52.89% | 47.11% |
| 11 | GS-09 | 47.93% | 52.07% |
| 12 | GS-10 | 45.28% | 54.72% |
| 13 | GS-11 | 45.90% | 54.10% |
| 14 | GS-12 | 39.85% | 60.15% |
| 15 | GS-13 | 39.46% | 60.54% |
| 16 | GS-14 | 39.18% | 60.82% |
| 17 | GS-15 | 38.33% | 61.67% |
| 18 | **Grand Total** | **42.76%** | **57.24%** |

Source: Hughes 2018

of the pay grades, GS grade 02, where the ratio is 123%. Overall, the length of service earnings gap for women is 19% based on the female versus male length of service earnings quotient of 81%. The base length of service quotient indicates that women have 104% to 132% longer length of service than men for all GS pay grades except for GS 02.

The radar chart in Figure 6 shows the lower salary totals for female versus male categories in the GS pay grades of 12 through 15. As indicated in the pivot chart, the employment levels of women to men in grades 12 through 15 range from 37% to 41%. Both the salary totals and relative employment quotients further indicate a weakness in female employment upward mobility, which may be due in part to discrimination based on sex.

In Figure 7, we can more clearly see the distance between total salaries earned by women versus men in GS 12 through 15.

Figure 8 shows the dominance of women in the lower GS pay grades (1 through 8).

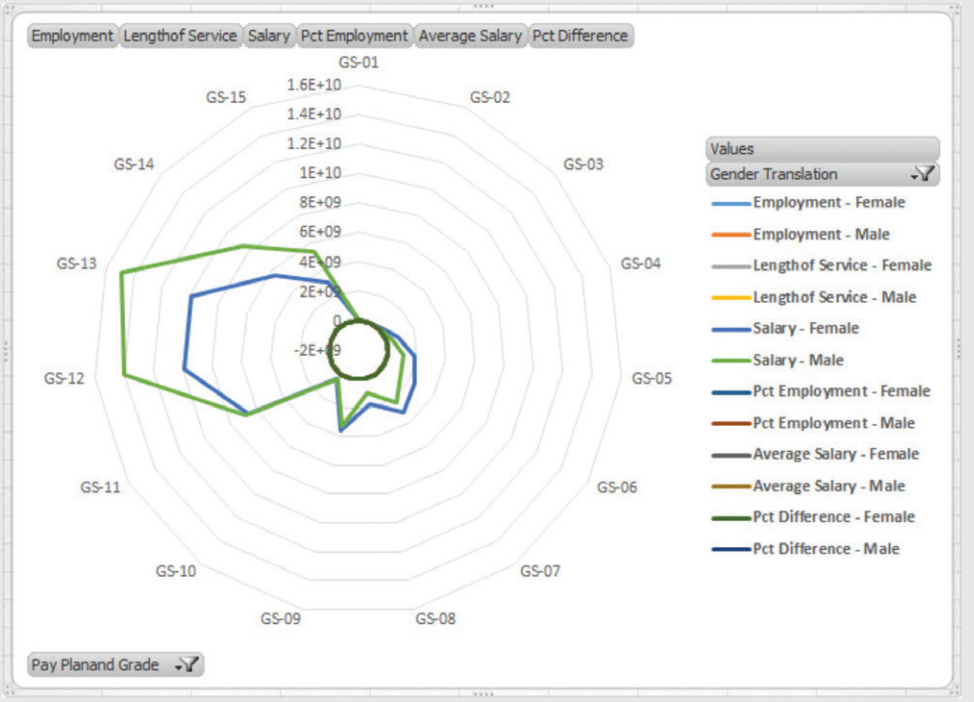
Examining gender-based pay equity issues through the appropriate lens of comparable worth clearly indicates that gender-based pay equity generally exists only at the very highest pay grade levels and that occupational mobility and representation of both genders equally across all occupations and grade levels are the real issues at hand in pay equity research. Past pay equity research has largely distorted and improperly used statistics to paint a pay-fairness problem that does not generally exist in government and misses the real problem of occupational opportunity for both genders.

**FIGURE 5** Gender Wage Gap Pivot Table Stage 3 View

| L | M | N | O | P | Q | R | S | T | U | V |
|---|---|---|---|---|---|---|---|---|---|---|
| Pct Difference | | Average LOS | Average LOS | Length of Service Quotient Pct LOS | Average Salary | Average Salary | Pct Salary | Average Salary/LOS | Average Salary/LOS | Length of Service Earnings Quotient PCT Average |
| Female | Male | Female | Male | Female/Male | Female | Male | Female/Male | Female | Male | Female/Male |
| 0.54% | | 2.23 | 1.69 | 131.64% | 21164 | 21051 | 100.5% | 9501 | 12440 | 76.38% |
| -1.47% | | 2.59 | 3.24 | 80.16% | 23921 | 24277 | 98.5% | 9218 | 7500 | 122.91% |
| 1.57% | | 5.49 | 4.86 | 112.82% | 28087 | 27653 | 101.6% | 5117 | 5685 | 90.02% |
| 1.01% | | 8.33 | 6.99 | 119.17% | 32659 | 32333 | 101.0% | 3922 | 4627 | 84.76% |
| 1.79% | | 9.52 | 7.36 | 129.23% | 37496 | 36836 | 101.8% | 3940 | 5002 | 78.77% |
| 2.17% | | 11.56 | 9.10 | 127.02% | 43102 | 42187 | 102.2% | 3730 | 4637 | 80.43% |
| 2.35% | | 13.58 | 9.19 | 147.84% | 47788 | 46691 | 102.3% | 3518 | 5082 | 69.23% |
| 1.72% | | 14.97 | 12.27 | 121.98% | 54059 | 53143 | 101.7% | 3610 | 4329 | 83.39% |
| 1.16% | | 13.91 | 10.53 | 132.15% | 57921 | 57258 | 101.2% | 4163 | 5439 | 76.55% |
| 4.21% | | 14.27 | 12.92 | 110.45% | 67575 | 64843 | 104.2% | 4735 | 5018 | 94.36% |
| 1.11% | | 14.40 | 11.85 | 121.47% | 70191 | 69421 | 101.1% | 4875 | 5856 | 83.24% |
| 1.63% | | 15.74 | 12.76 | 123.35% | 85021 | 83657 | 101.6% | 5403 | 6558 | 82.39% |
| 0.37% | | 16.96 | 15.23 | 111.39% | 102751 | 102368 | 100.4% | 6059 | 6724 | 90.11% |
| -0.23% | | 18.50 | 17.15 | 107.88% | 123405 | 123683 | 99.8% | 6669 | 7211 | 92.49% |
| -0.21% | | 19.92 | 19.09 | 104.35% | 147556 | 147867 | 99.8% | 7407 | 7746 | 95.63% |
| **-11.33%** | | 14.39 | 12.88 | 111.71% | 72577 | 81855 | 88.7% | 5043 | 6353 | 79.37% |

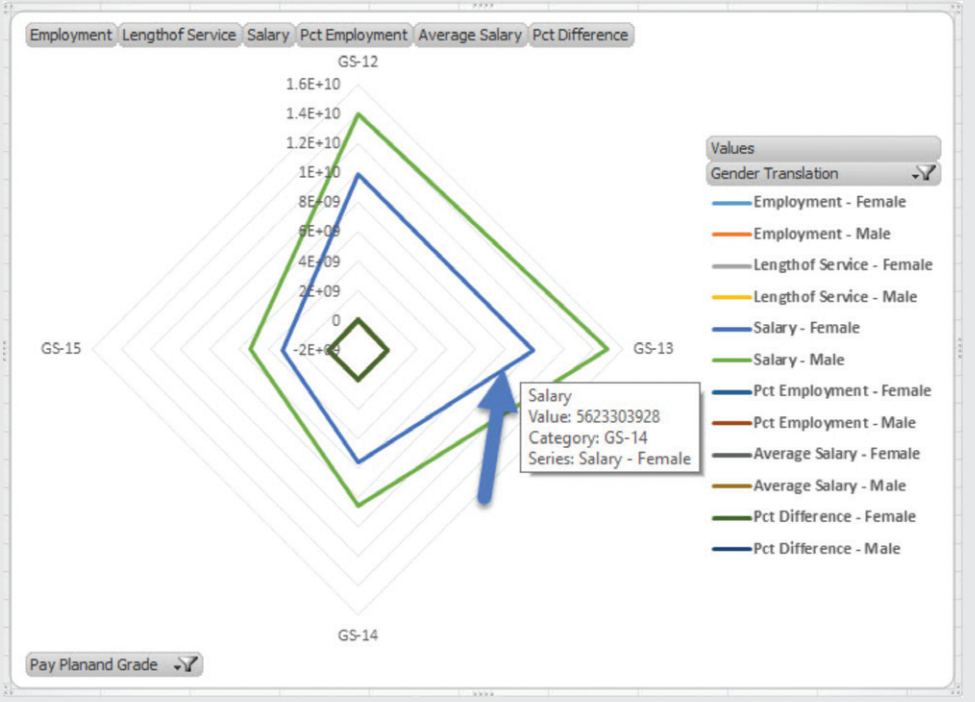
Source: Hughes 2018

FIGURE 6 Pivot Table Radar Chart All GS Levels




Source: Hughes 2018

FIGURE 7 Pivot Table Radar Chart GS Levels 12-15




Source: Hughes 2018

FIGURE 8 Pivot Table Radar Chart GS Levels 1-8


Source: Hughes 2018

From previous analysis of pay equity in the federal government employment, it was found that women earn slightly more than males on average when adjusted for comparable worth after examining gender-based pay relationships for jobs within the same GS pay grade. However, it took longer for women to attain those pay levels and their mobility to higher GS grade levels has been limited.

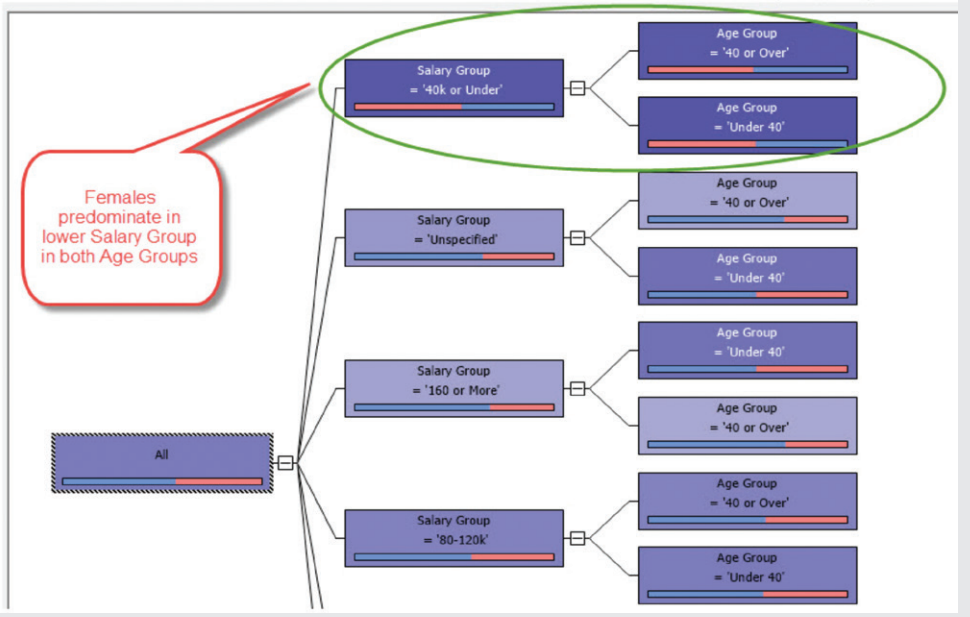
## DATA MINING

OLAP and data mining are used to address different kinds of issues. OLAP summarizes aggregated data and can be used to make forecasts and predictions and to reveal characteristics of data relationships by drilling down through compound levels of data dimensions. Data mining is an exploratory endeavor using algorithms to uncover hidden patterns in data and operates at a more detailed level.

Decision trees are used the most often and are easily understood algorithms in data mining. Based on categorical splits weighted by observations, tree nodes/leaves are developed where multiple independent variables can be used to predict one or more dependent variables. In decision tree and other data mining algorithms, further ranging investigation of variables involved in pay equity and in particular, career mobility, can be explored.

The decision tree in Figure 9 focuses on the gender tree and the background is set to female. The concentration of women in lower-level salary groups is apparent.

FIGURE 9 Decision Tree Gender and Salary Group 01




Source: Hughes 2018

## GENDER MOBILITY ISSUES

In Figure 10, the probability of any case in GS groups 1 through 5 being female is 0.63, or 63%. For all length of service groups, regardless if they are further split by age group, the range of probability for women is 59% to 72% for inclusion in the lowest GS pay grade group segment.

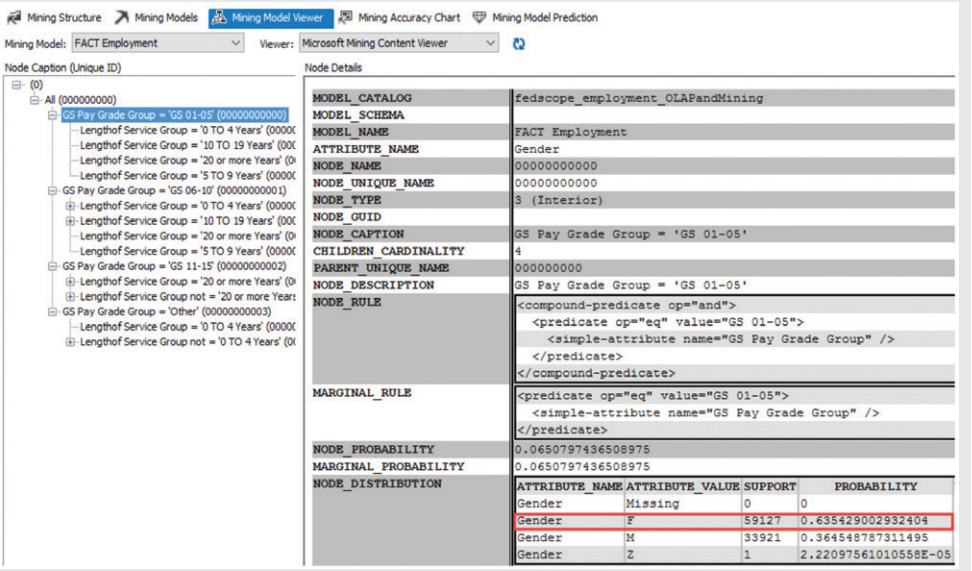
Conversely, women have only a 41% chance of being included in jobs within the highest GS pay grade levels. For those women who are included, most have much longer lengths of service than their male counterparts (48% chance of inclusion with more than 20 years of service and 38% chance of inclusion with less than 20 years).

It is most interesting that, beyond the expected strong prediction link from GS pay grade group to gender, both gender and occupation group have strong bidirectional prediction links. (See Figure 11.)

This further underscores gender mobility issues not only with regard to higher pay grades, it also indicates segregation issues with regard to occupation groups. This led to altering again the variable column input and predict settings, as shown in Figure 12.

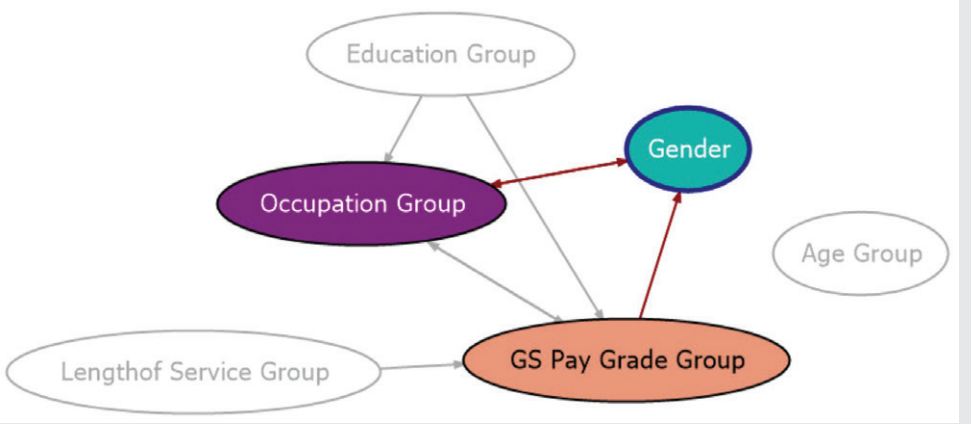
Given previous findings via OLAP-based research, the interest in pay equity based on comparable worth analysis did find occupational mobility issues for women with regard to higher GS grade levels. We also found that men dominate higher GS grade levels, which skews the data on the differences in average wages and salaries based on gender.

FIGURE 10 Decision Tree Gender and GS Grade Group Mining Model Content View 01




Source: Hughes 2018

FIGURE 11 Decision Tree — Dependency Network Stronger Links



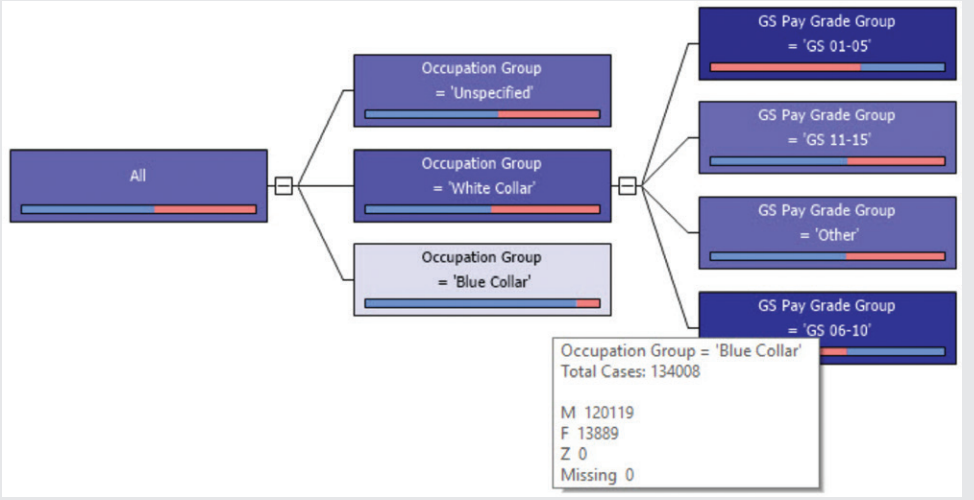

Source: Hughes 2018

## CLUSTERING

Clustering is an example of unsupervised learning in data mining. No dependent variables or predictors are determined initially in unsupervised machine learning endeavors.

Clustering algorithms in data mining consist of processes designed to group data across several variables (such as salary group, age, length of service, gender, etc.) so that the density of data that fall in the same group, or cluster, are more similar to each other than to those in other clusters (based on data relationships in other variables).

FIGURE 12 Decision Tree - Gender Occupation and GS Pay Grade



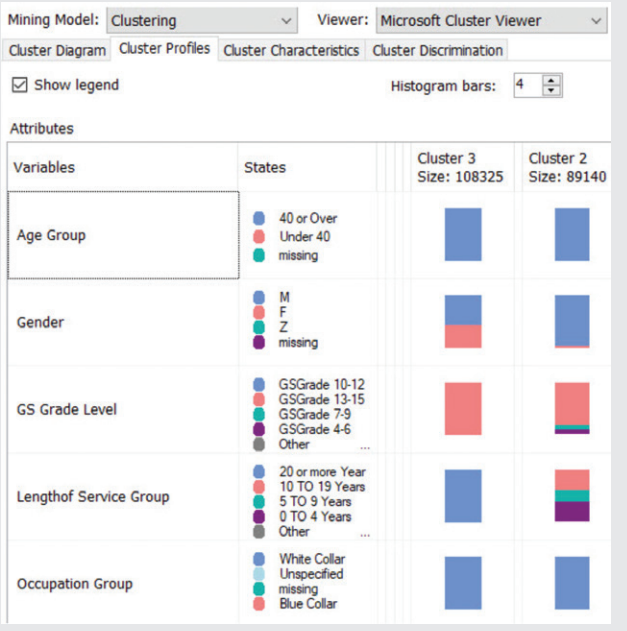

Source: Hughes 2018

Normally, the first order of inquiry in cluster analysis is to examine the clusters that show a preponderance of data points in the highest GS grade levels (13 through 15). Figure 13 shows the two clusters in the latest cluster analysis model, which includes GS grade level as an attribute that has heavy participation in the GS grade levels 13 through 15.

In Cluster 2, men account for 95% of the population. In Cluster 3, they are 56%. In Cluster 3, all members are in GS grade levels 13 through 15, whereas in Cluster 2, 80% are in the highest GS pay grade level bracket.

No other clusters show any significant membership of data in the highest GS grade level bracket, which further confirms the findings dealing with occupation mobility issues for women. This also underscores the conclusion that gender pay equity when measured by average salaries was generally distorted in

FIGURE 13 Profiles for Clusters 2 and 3 with GS Grade




Source: Hughes 2018

previous research and, in fact, is not the issue often portrayed by politicians and the popular press.

In a dependency network view, the strongest links are shown by connectors from attribute categories to predictor attributes. Figure 14 shows that the highest GS grade levels have the strongest relationships to the male gender category, while the lowest GS grades have the strongest connection to the female gender category. This view again confirms earlier findings of gender-based occupation upward mobility problems for women. It further dilutes the findings of other research in regard to significant average gender-based pay differences.

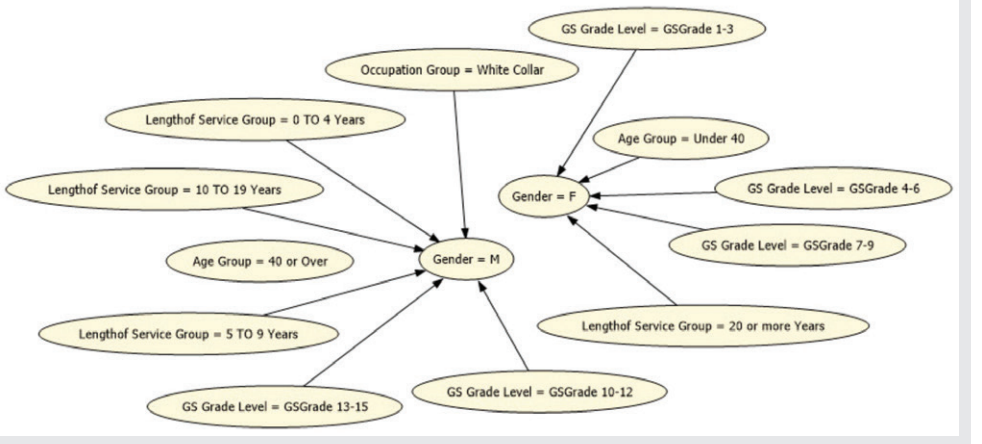
## SUMMARY

When female versus male federal service salaries are compared, women are paid equal to men when comparing jobs of equal value. Poor mobility of women into the higher occupational pay ranks distorts female-to-male pay differences as a whole, due to the skewed nature of the employment profile of women to men.

Korn Ferry studies across 25 countries indicated that women earn 98% of the wages of men who are in the same roles at the same employers (Economist 2017). Analysis of average salary when compared to length of service for women versus men indicates that women receive a much lower percentage of salary than men per length of service years. For each year of service based on total length of service, women are paid 76% to 94% for all GS grades from 1 to 15, except for the next to lowest of the pay grades, GS grade 02, where the ratio is 123%.

Generalization of this study's findings beyond the federal service may be supported by the fact that the government has to compete in the same labor markets for employees across a wide range of occupations including management, professional, technical, scientific, administrative and skilled trades.

**FIGURE 14** Dependency Network View Association Rules




Source: Hughes 2018

## ABOUT THE AUTHOR

**Robert C. Hughes Jr., M.S. (rhughes@ggu.edu)** has more than 40 years' experience in human capital management including compensation and information systems. Hughes, who has taught courses in compensation, management information systems, data analysis, business intelligence and predictive analytics and human resource management information systems at several universities in the San Francisco Bay Area, is currently an adjunct professor in the Ageno School of Business at Golden Gate University in San Francisco. He has developed compensation systems that have been marketed in the United States, Europe and the Middle East. Hughes was awarded WorldatWork's Lifetime Achievement Award in Compensation in 2000. Hughes is an Academic member of WorldatWork, and an Associate member of the American Psychological Association (APA) and Division 14 of the APA, and the Society for Industrial and Organizational Psychology. His blog can be found at compensationarchitectnotes.blogspot.com.

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