

APPENDIX C-2.

ANALYSES OF THE LINKAGE BETWEEN PAY AND PERFORMANCE

METHODS FOR STATISTICAL ANALYSES

The body of this report contains results from statistical analyses performed on the objective data pertaining to the Demonstration and Comparison group employees. In this technical appendix, we provide more detail on the statistical analyses from which the results were derived as well as other methodological issues of relevance to the study design. The following information is provided:

- Use of sample versus census data analysis techniques
- Scatterplots displaying the pay-for-performance correlation in the Demonstration Group
- Results of the analysis of covariance (ANCOVA)

Use of Sample Versus Census Data Analysis Techniques

The database of Demonstration Group participants represents the entire universe of Commerce employees who are receiving the human resource interventions as part of this Demonstration Project. By definition this group is a population rather than a sample. The most widely used inferential statistics, and those used as part of this evaluation (Analysis of Covariance), were designed to be applied to sample data. Despite this theoretical hurdle, it has become common practice among researchers to use these inferential statistics in the absence of a better method.

To most accurately describe the population in question, Booz-Allen produced effect size estimates along with significance levels. By producing these additional data, Booz-Allen hopes to mitigate the theoretical concerns of applying data analysis techniques developed for samples on data derived from a population.

Scatterplots Displaying the Pay-For-Performance Correlation in the Demonstration Group

Figure 1 displays a scatterplot showing the relationship between performance ratings and salary increases (as a percentage of base salary) in the Demonstration Group. Correlational analyses revealed a correlation of $r = .54$. This scatterplot suggests that high performance ratings, to some degree, are associated with higher increase percentages. This plot also suggests that lower performance ratings rarely resulted in higher increases.

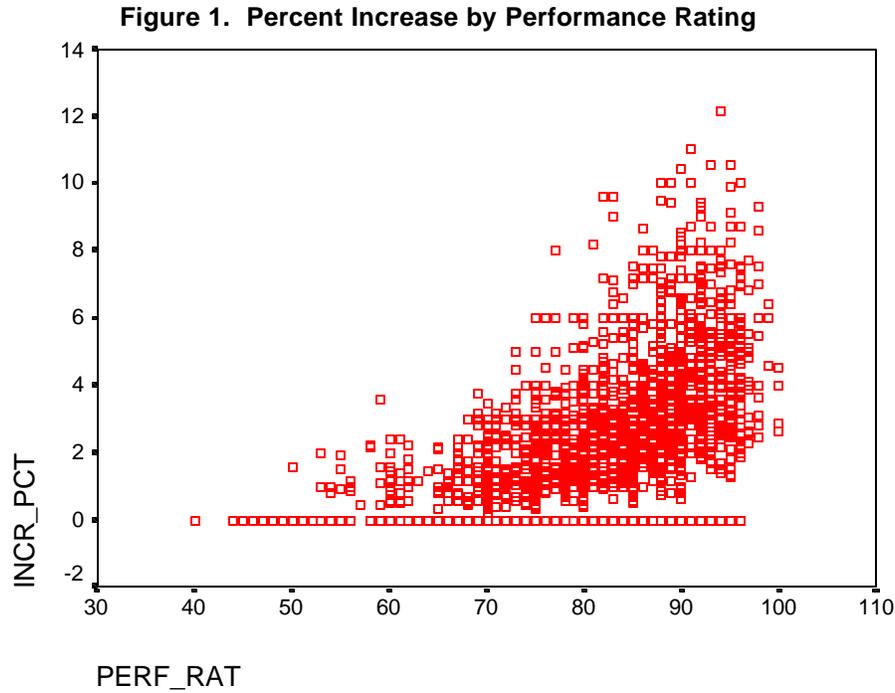
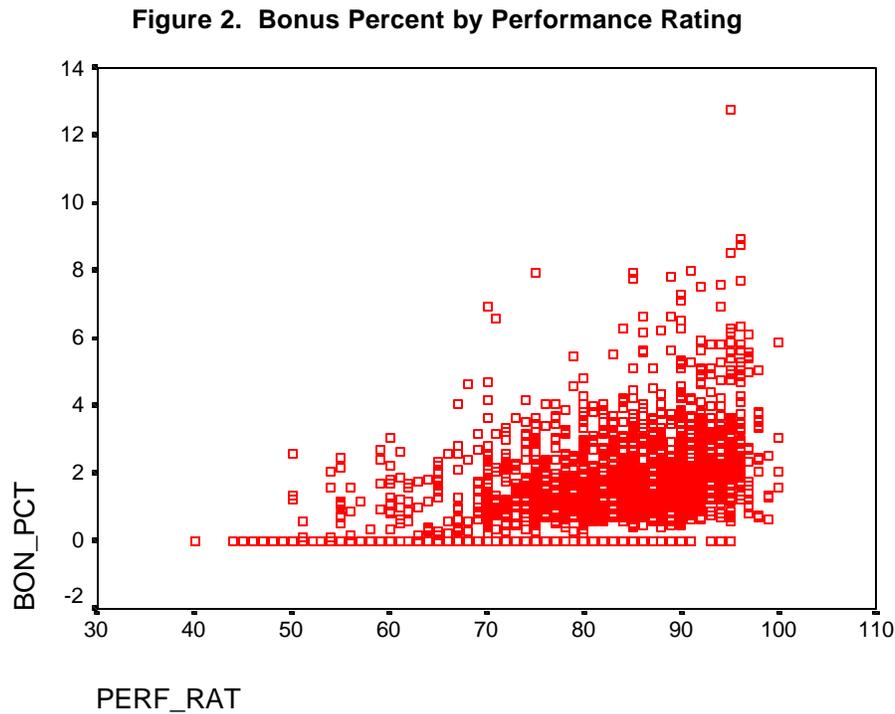


Figure 2 displays a scatterplot showing the relationship between performance ratings and bonuses (as a percentage of base salary) in the Demonstration Group. Correlational analyses revealed a correlation of $r = .46$. The scatterplot below suggests that the employees receiving low performance ratings were unlikely to receive a large bonus. Additionally, those employees who did receive a large bonus were more likely to have received a high performance rating.



Results of the Analysis of Covariance (ANCOVA)

Analysis of variance (ANOVA) involves determining whether the difference between two or more means is statistically significant. Analysis of covariance (ANCOVA, also referred to as ANACOVA) builds one more level of complexity. With ANCOVA, those differences between the means are examined while also *controlling* for the effects that another variable or variables may have on the relationship. That is, the question becomes "what is the effect of something when we take into account something else?" (Will G. Hopkins, *A New View of Statistics*).

When performing ANCOVAs, the output produces means that account for the presence of other specified variables. These means are known as "adjusted" means; they allow closer examination of the relationship between two variables of interest while removing the impact that other variables may have on the relationship.

Using a standard statistical software, Statistical Package for the Social Sciences (SPSS), Booz Allen ran ANCOVA analyses to assess any differences in pay outcomes for EEO groups and veterans within the Demonstration Project. Separate ANCOVA analyses were run for each protected subgroup (i.e., minorities, women, and veterans) to test whether they were adversely affected by the new pay for performance system. In essence, the ANCOVA analyses indicate whether differences for subgroups in average pay increases or bonuses were significant during the first cycle of the new pay for performance system. We examined, for example, differences in average pay increases for females and males. In this example we sought to determine whether 1) there was a statistically significant difference in average pay increases between females and males and 2) whether the size of the effect of gender on average pay increases was large enough to be meaningful.

Separate ANCOVAs were run for several independent variables whose categories were:

1. Minority/non-minority
2. Female/male
3. Veteran/non-veteran

Separate ANCOVAs for each of these subgroups were performed for each of the two dependent variables of interest:

1. Percent Increase in Salary (amount of salary increase expressed as a percent of salary at the beginning of the Demonstration Project)
2. Percent Bonus (bonus amount expressed as a percent of salary at the beginning of the Demonstration Project)

We calculated the ANCOVAs using three covariates: Performance Rating, Career Path, and Time in Service. The ANCOVA analyses were used to address the question of how much impact gender, for example, had on differences in Percent Increase in Salary once the effects of Performance Rating, Career Path, and Time in Service were statistically accounted for.

In these analyses, values less than .01 in the column labeled “Significance” were considered significant. Due to the large number of cases in the data set, it was not unexpected to find that many relationships were statistically significant. Because so many of these relationships were statistically significant, it is important to also consider the Eta squared value.

The column labeled “Eta Squared” is the estimate of the size of the effect that each independent variable had on the dependent variable of interest (Percent Increase in Salary or Percent Bonus). For these data, values greater than .05 were considered to be of interest. However, none of the EEO group variables in any of the analyses reached this level.

For each ANCOVA analysis, raw and estimated marginal means are presented. The raw measures are labeled “Unadjusted Means.” The estimated marginal means are means that have been adjusted for the covariates and are labeled “Adjusted Means.”

In summary, the findings presented below indicate that while many relationships between the independent variables and the dependent variables were statistically significant (due to the large sample size), none had an effect on the distribution of pay increases or bonuses large enough to be meaningful.

DEMONSTRATION GROUP DATA

Dependent Variable = Percent Increase in Salary Independent Variable Categories = Minority/Non-Minority			DEMO GROUP
Group	Unadjusted Means	Standard Deviation	N
Minority	2.73%	1.97	427
Non-Minority	2.73%	2.03	1831
ANCOVA Results		Significance	Eta Squared
Career Path	.010	.003	
Performance Rating	.001	.429	
Time in Service	.000	.251	
Minority/Non-Minority	.607	.000	
Group	Adjusted Means	Standard Error	
Minority	2.70%	.071	
Non-Minority	2.74%	.034	

Dependent Variable = Percent Increase in Salary Independent Variable Categories = Female/Male			DEMO GROUP
Group	Unadjusted Means	Standard Deviation	N
Female	3.10%	2.07	864
Male	2.50%	1.94	1394
ANCOVA Results		Significance	Eta Squared
Career Path	.007	.003	
Performance Rating	.000	.424	
Time in Service	.000	.238	
Female/Male	.499	.000	
Group	Adjusted Means	Standard Error	
Female	2.76%	.051	
Male	2.71%	.039	

Dependent Variable = Percent Increase in Salary Independent Variable Categories = Veteran/Non-Veteran			DEMO GROUP
Group	Unadjusted Means	Standard Deviation	N
Veteran	2.26%	1.76	211
Non-Veteran	2.78%	2.03	2047
ANCOVA Results		Significance	Eta Squared
Career Path	.009	.003	
Performance Rating	.000	.428	
Time in Service	.000	.253	
Veteran/Non-Veteran	.549	.000	
Group	Adjusted Means	Standard Error	
Veteran	2.67%	.101	
Non-Veteran	2.74%	.032	

Dependent Variable = Percent Bonus Independent Variable Categories = Minority/Non-Minority			DEMO GROUP
Group	Unadjusted Means	Standard Deviation	N
Minority	1.46%	1.33	429
Non-Minority	1.72%	1.39	1834
ANCOVA Results		Significance	Eta Squared
Career Path	.000	.010	
Performance Rating	.000	.193	
Time in Service	.000	.008	
Minority/Non-Minority	.001	.004	
Group	Adjusted Means	Standard Error	
Minority	1.50%	.061	
Non-Minority	1.71%	.029	

Dependent Variable = Percent Bonus Independent Variable Categories = Female/Male			DEMO GROUP
Group	Unadjusted Means	Standard Deviation	N
Female	1.95%	1.57	864
Male	1.50%	1.22	1399
ANCOVA Results		Significance	Eta Squared
Career Path	.000	.007	
Performance Rating	.000	.182	
Time in Service	.024	.002	
Female/Male	.000	.017	
Group	Adjusted Means	Standard Error	
Female	1.88%	.043	
Male	1.54%	.033	

Dependent Variable = Percent Bonus Independent Variable Categories = Veteran/Non-Veteran			DEMO GROUP
Group	Unadjusted Means	Standard Deviation	N
Veteran	1.49%	1.26	211
Non-Veteran	1.69%	1.39	2052
ANCOVA Results		Significance	Eta Squared
Career Path	.000	.009	
Performance Rating	.000	.192	
Time in Service	.000	.007	
Veteran/Non-Veteran	.601	.000	
Group	Adjusted Means	Standard Error	
Veteran	1.63%	.085	
Non-Veteran	1.67%	.027	

COMPARISON GROUP DATA

Dependent Variable = Percent Increase in Salary Independent Variable Categories = Minority/Non-Minority			COMPARISON
Group	Unadjusted Means	Standard Deviation	N
Minority	2.07%	3.45	160
Non-Minority	1.91%	2.44	1177
ANCOVA Results		Significance	Eta Squared
Career Path	.142	.002	
Performance Rating	.490	.000	
Time in Service	.000	.058	
Minority/Non-Minority	.951	.000	
Group	Adjusted Means	Standard Error	
Minority	1.94%	.198	
Non-Minority	1.92%	.073	

Dependent Variable = Percent Increase in Salary Independent Variable Categories = Female/Male			COMPARISON
Group	Unadjusted Means	Standard Deviation	N
Female	2.13%	2.90	438
Male	1.83%	2.40	899
ANCOVA Results		Significance	Eta Squared
Career Path	.142	.002	
Performance Rating	.489	.000	
Time in Service	.000	.056	
Female/Male	.969	.000	
Group	Adjusted Means	Standard Error	
Female	1.93%	.122	
Male	1.92%	.084	

Dependent Variable = Percent Increase in Salary Independent Variable Categories = Veteran/Non-Veteran			COMPARISON
Group	Unadjusted Means	Standard Deviation	N
Veteran	1.72%	2.00	110
Non-Veteran	1.94%	2.62	1227
ANCOVA Results		Significance	Eta Squared
Career Path	.163	.001	
Performance Rating	.487	.000	
Time in Service	.000	.059	
Veteran/Non-Veteran	.364	.001	
Group	Adjusted Means	Standard Error	
Veteran	1.72%	.239	
Non-Veteran	1.94%	.071	

Dependent Variable = Percent Bonus Independent Variable Categories = Minority/Non-Minority			COMPARISON
Group	Unadjusted Means	Standard Deviation	N
Minority	1.27%	1.55	173
Non-Minority	1.11%	1.41	1295
ANCOVA Results		Significance	Eta Squared
Career Path		.965	.000
Performance Rating		.436	.000
Time in Service		.898	.000
Minority/Non-Minority		.157	.001
Group	Adjusted Means	Standard Error	
Minority	1.28%	.109	
Non-Minority	1.11%	.040	

Dependent Variable = Percent Bonus Independent Variable Categories = Female/Male			COMPARISON
Group	Unadjusted Means	Standard Deviation	N
Female	1.21%	1.48	486
Male	1.09%	1.40	982
ANCOVA Results		Significance	Eta Squared
Career Path		.964	.000
Performance Rating		.391	.001
Time in Service		.698	.000
Female/Male		.107	.002
Group	Adjusted Means	Standard Error	
Female	1.22%	.066	
Male	1.09%	.046	

Dependent Variable = Percent Bonus Independent Variable Categories = Veteran/Non-Veteran			COMPARISON
Group	Unadjusted Means	Standard Deviation	N
Veteran	0.70%	0.92	122
Non-Veteran	1.17%	1.46	1346
ANCOVA Results		Significance	Eta Squared
Career Path		.802	.000
Performance Rating		.419	.000
Time in Service		.995	.000
Veteran/Non-Veteran		.000	.008
Group	Adjusted Means	Standard Error	
Veteran	0.70%	.129	
Non-Veteran	1.17%	.039	