1. **What is the difference between the average salary of minorities and nonminorities? Does this evidence support Mr. Johnson's claim of discrimination?**

Average Month Salary ($)		
Minority	▾	Total
	1	3175.584416
	2	2910.31746
Grand Total		3056.214286

Difference in the average salary ($)
265.2669553

Pivot table shows the average monthly salaries for minorities (2), non-minorities (white - 1), and the difference between the salaries of two populations. The average salary difference is ~265.267$.

Field Agent Mr. Mark Malone stated that at least a 250$ difference in salaries is not trivial, therefore this evidence supports Mr Johnson's claim of discrimination.

To further check the significance of this statement statistically, it is good to conduct a **t-test of comparing means of two populations assuming unequal variances** to see if we have enough evidence to support the claim.

H_0: $U_{non\text{-}minority}$ = $U_{minority}$ H_a = $U_{non\text{-}minority}$ > $U_{minority}$

t-Test: Two-Sample Assuming Unequal Variances

	Variable 1	Variable 2
Mean	3175.584416	2910.32
Variance	220493.404	146393
Observations	77	63
Hypothesized Mean Differen	0	
df	138	
t Stat	3.683106726	
P(T<=t) one-tail	0.000164922	
t Critical one-tail	1.655970382	
P(T<=t) two-tail	0.000329844	
t Critical two-tail	1.977303542	

Conclusion: **Reject Null Hypothesis in a favour of alternative hypotesis**

At alpha 0.05, we have enough statistical evidence to support the discrimination claim that the monthly mean salary of non-minorities is higher than the monthly mean salary of minorities, as the Pvalue (0.00016) is less than 0.05 alpha level and not significant enough to support the null hypothesis.

2. **What proportion of minority and non-minority employees are found in each pay grade? How do these proportions influence Mr. Johnson's claim of salary discrimination? Do these proportional differences suggest discrimination in promotions across racial groups?**

Question 2

Count of workers in PayGrade by minority status	PayGrade ▾			
Minority ▾	1	2	3	Grand Total
1	19	26	32	77
2	39	15	9	63
Grand Total	58	41	41	140

Percentage of workers in each PayGrade by minority status	PayGrade ▾			
Minority ▾	1	2	3	Grand Total
1	32.76%	63.41%	78.05%	55.00%
2	67.24%	36.59%	21.95%	45.00%
Grand Total	100.00%	100.00%	100.00%	100.00%

First pivot table provides information about the number of company workers by minority status in each PayGrade. Second table shows distribution/proportion of firm workers by minority status in each PayGrade.

Most of the minority proportion is in the 1st paygrade, while other 2 PayGrade levels with higher responsibilities and wages are dominated by non-minority workers. This data supports the claim of Mr. Johnson of the salary discrimination and it further suggests that there is a discrimination in promotions across racial groups.

Chi-Square Test for Independence of Two Qualitative Factors

Observed data

Minority/PayGrade	1	2	3	Row Total
1 (non-minority)	19	26	32	77
2 (minority)	39	15	9	63
Column Totals	58	41	41	140

Expected data (E)

Minority/PayGrade	1	2	3
1 (non-minority)	31.9	22.55	22.55
2 (minority)	26.1	18.45	18.45

$(O-E)^2 / E$

Minority/PayGrade	1	2	3
1 (non-minority)	5.21661442	0.52782705	3.96019956
2 (minority)	6.37586207	0.64512195	4.8402439

X^2	21.565869
DF	2
p-value	2.0751E-05
	2.0751E-05

H_0: There is no association between race and promotions
Ha: There is association between race and promotions
Conclusion: Reject Null Hypothesis in a favour of alternative hypotesis

By conducting a Chi-Square Test for Independence of Two Qualitative Factors between minority status and paygrade, at alpha 0.05, Mr. Johnson's claim about the salary discrimination is also statistically supported. Statistical test also provides enough evidence to assume that there is a race-based discrimination in job promotions as p.value < 0.05.

3. **What is the average tenure of minority and non-minority employees in each pay grade? Do these results suggest discrimination in promotions across racial groups?**

Average Tenure by minority class of workers in each PayG	PayGrade			
Minority	1	2	3	Grand Total
1	1.978947	3.273077	4.28125	3.372727
2	1.794872	3.193333	3.9	2.428571
Grand Total	1.855172	3.243902	4.197561	2.947857

While the average tenure of non-minority workers (1) is larger than average tenure of minority employees (2) in each PayGrade, there is not enough evidence beyond the **BENEFIT OF A DOUBT** to prove that the difference in the tenure was caused by a racial discrimination, as the difference is very small. Therefore, these results do not suggest discrimination in promotions across PayGrade. But we can't exclude the possibility of the racial discrimination of workers solely relying only on a tenure.

4. When was the company's Affirmative Action program started? Does this information help explain why more minorities are in the lower pay grades? Explain.

The company's Affirmative Action program started "over two years ago as being just an example of the philosophy that ServPro values what people do on the job over their trace or gender". If this program really was started only 2 years ago, it could be assumed that employers didn't have time to develop the program and increase the overall wages for the minority population at the company. However, the delays in the program do not explain why there is a strong association between PayGrades and race, as well as the fact that the higher PayGrades are dominated by large proportions of non-minority workers.

There is 2 statistical pieces of evidence that point to the race-based discrimination in salary and promotion, and show problems of this "equal diversity Affirmative Action Program":

1)**Comparing means of 2 populations T-test assuming unequal variance:** The difference in average pay salary is significant and non-minority workers have a higher average salary than minorities.

2) **Chi-Square test for testing independence of two qualitative factors:**There is significant statistical evidence to argue that there is an association between the race of the worker and promotion.

These disparities in salary and promotion and ineffectiveness of this program should be investigated further.
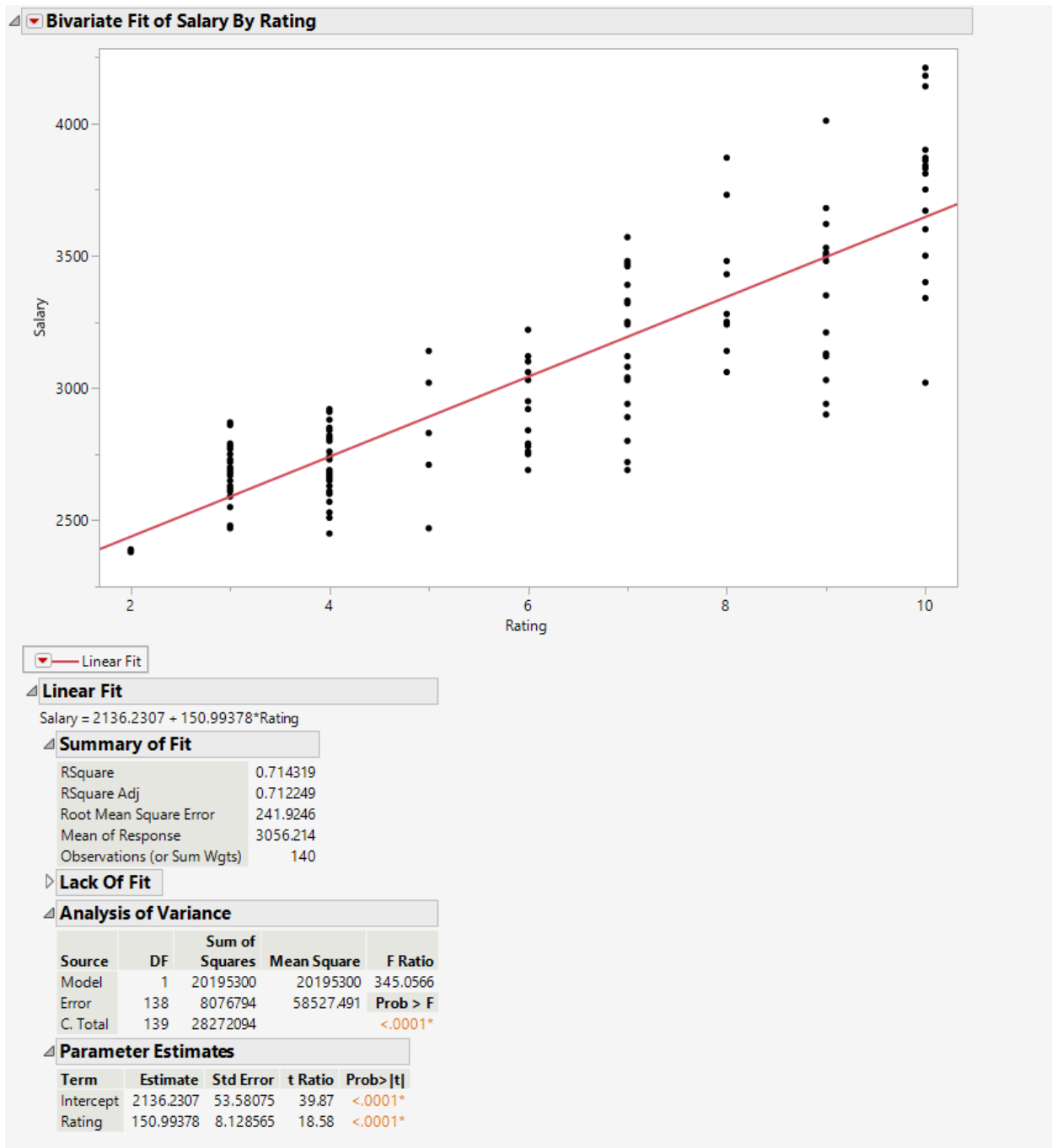
5. What data should be examined to see whether ServPro rewards performance and loyalty, as claimed by Mr. Greer?

Salary, Minority status, tenure, and rating data should be investigated further to test the claim of Mr.Greer that ServPro rewards performance and loyalty.

6. What type of analyses would indicate if pay was dependent upon performance and loyalty? Do these results suggest that ServPro rewards performance and loyalty? Explain.

Average of Rating		
Minority Status	Total	
1	6.961038961	
2	5.031746032	
Grand Total	6.092857143	

Pivot table shows the average rating score between minority and non-minority (white) people. It is seen that there is a clear difference, as non-minority workers have much higher ratings than minority groups.

Bivariate Fit of Salary By Rating

— Linear Fit

Linear Fit

Salary = 2136.2307 + 150.99378*Rating

Summary of Fit

RSquare	0.714319
RSquare Adj	0.712249
Root Mean Square Error	241.9246
Mean of Response	3056.214
Observations (or Sum Wgts)	140

▷ **Lack Of Fit**

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	20195300	20195300	345.0566
Error	138	8076794	58527.491	Prob > F
C. Total	139	28272094		<.0001*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	2136.2307	53.58075	39.87	<.0001*
Rating	150.99378	8.128565	18.58	<.0001*

Rating and Salary variables were fit into a linear regression in order to understand whether there is a statistically significant relationship between these variables. The p-value for the relationship is less than 0.0001, which means that the relationship is significant. The estimate for the rating variable is approximately 150.99. For every increase by one unit in the rating at the company, there is a 150.99 increase in the salary. There is

evidence that company rewards for higher performance. However, not everything is clear.

Another Chi-Square test of independence was conducted between Rating score and Minority group.
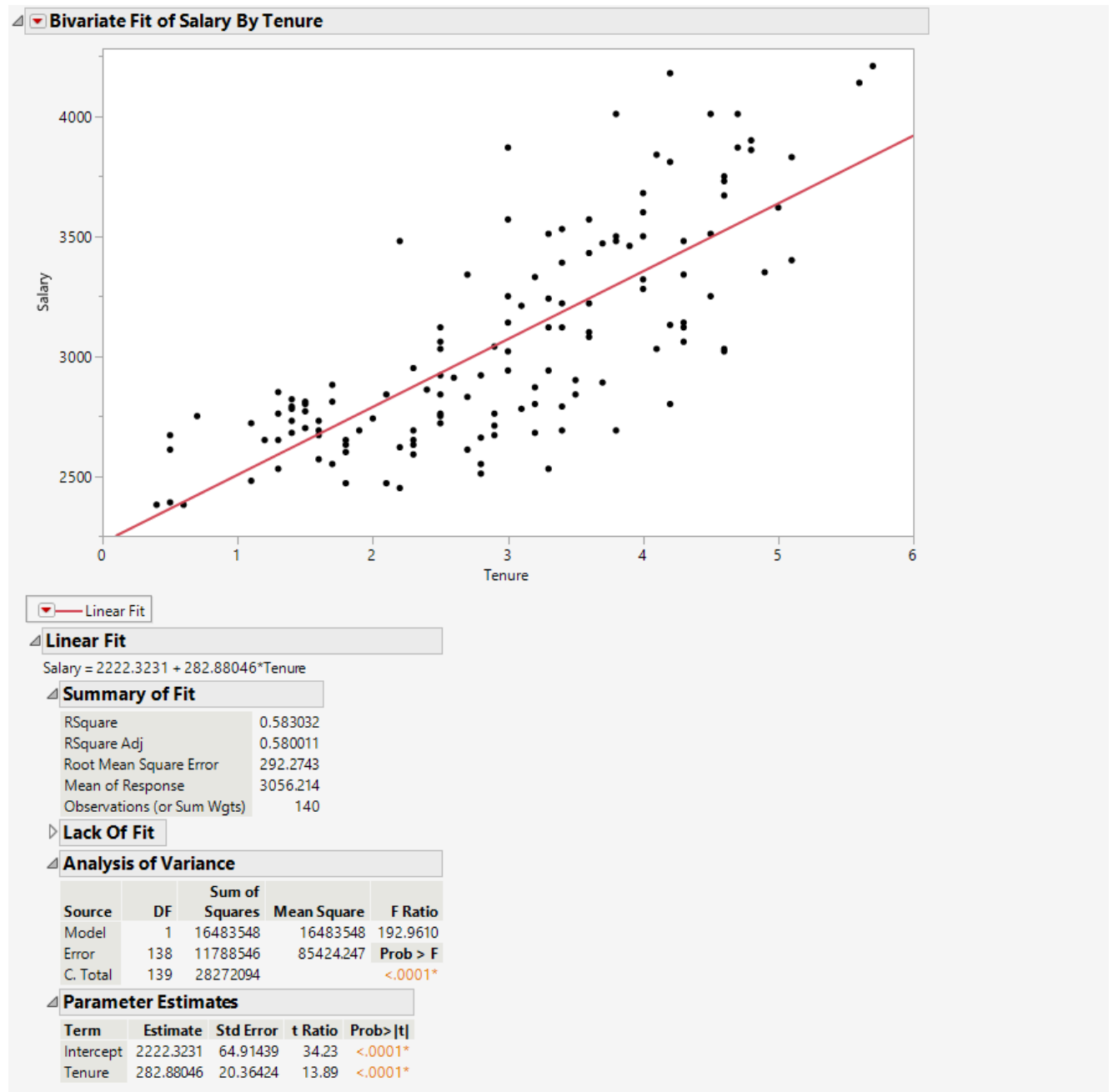
H0: There is no association between race (minority) and rating

Ha: There is an association between race (minority) and rating

Chi-Square Test for Independence of Two Qualitative Factors

Observed data

Minority / Rating	2	3	4	5	6	7	8	9	10	Row Totals
1 (non-minority)	2	7	9	2	10	13	6	14	14	77
2 (minority)	1	17	21	3	4	6	3	5	3	63
Column Totals	3	24	30	5	14	19	9	19	17	140

Expected data (E)

Minority / Rating	2	3	4	5	6	7	8	9	10
1 (non-minority)	1.65	13.2	16.5	2.75	7.7	10.45	4.95	10.45	9.35
2 (minority)	1.35	10.8	13.5	2.25	6.3	8.55	4.05	8.55	7.65

$(O-E)^2/E$

Minority/Rating	2	3	4	5	6	7	8	9	10
1 (non-minority)	0.074242424	2.9121	3.4091	0.204545455	0.687013	0.622249	0.222727273	1.205980861	2.312567
2 (minority)	0.090740741	3.5593	4.1667	0.25	0.839683	0.760526	0.272222222	1.473976608	2.826471

x^2	25.89008171
DF	8
p-value	0.001096762

H_0: There is no association between race and rating

Ha: There is association between race and rating

Conclusion: Reject Null Hypothesis in a favour of alternative hypothesis

The p-value calculated (0.001) is less than 0.05 alpha, which means that we can reject the null hypothesis and we have enough evidence that there is a strong association between Rating score and Race. While the company indeed is rewarding and increasing the salary based on performance, ServPro rewards performance unequally and rewarding is

distributed biased and unequally among races. There is evidence that company rewards for a higher performance, but there is still statistical evidence for a salary discrimination based on minority status.

Bivariate Fit of Salary By Tenure

Linear Fit

Salary = 2222.3231 + 282.88046*Tenure

Summary of Fit

RSquare	0.583032
RSquare Adj	0.580011
Root Mean Square Error	292.2743
Mean of Response	3056.214
Observations (or Sum Wgts)	140

Lack Of Fit

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	16483548	16483548	192.9610
Error	138	11788546	85424.247	Prob > F
C. Total	139	28272094		<.0001*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	2222.3231	64.91439	34.23	<.0001*
Tenure	282.88046	20.36424	13.89	<.0001*

Tenure and Salary variables were fitted into the linear regression model to indicate if there is a significant relationship between these features and company rewards for the loyalty. The p-value for the relationship is less

than 0.0001, which explains that the relationship is significant. The estimate coefficient of the Tenure variable is 282.88. For every one unit increase in Tenure, there is a 282.88 increase in the salary of a worker. This statistical evidence supports the statement that company rewards for loyalty and performance, however it doesn't eliminate the fact that the rating system is based against minority populations which results in unfair and unequal promotions and distribution of salary between races.