

Variance Analysis (ANOVA) of Sexist Attitude at Various Types of Colleges

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Introduction

The dataset provided for this project is from a study which measures and compares sexist attitude of students at various types of colleges. The study has random samples of 10 graduates of each sex were selected from each of three types of colleges. A questionnaire was then administered to each student, from which a score for "degree of sexism", defined as the extent to which a student considered males and females to have different life roles was determined. The higher the score that student provides, the more sexist attitude the student has.

The original resulting data are given in the following table:

Table 1: Original Resulting Dataset of the Study

College Type	Male	Female
Coed with 75% or more males	50,35,37,32,46, 38,36,40,38,41	38,27,34,30,22, 32,26,24,31,33
Coed with less than 75% males	30,29,31,27,22, 20,31,22,25,30	28,31,28,26,20, 24,31,24,31,26
Not coed	45,40,32,31,26, 28,39,27,37,35	40,35,32,29,24, 26,36,25,25,35

ANOVA Results

After calculating the sum and average of the sexist attitude score for each sex from three types of colleges, we see that students from Type 1 college (Coed with 75% or more males) tends to have the highest sexist attitude score. And among the three types of colleges, male students tend to have a higher sum and average of sexist attitude score than female students.

Figure 1: Sum & Average of Attitude Score for Male & Female Among Three Types of Colleges

Gender	Coed with 75% or more males		Coed with less than 75% males		Not coed		Total Sum	Total Avg
	Sum	Avg	Sum	Avg	Sum	Avg		
Male	393	39.3	267	26.7	340	34	1000	33.33
Female	297	29.7	269	26.9	317	31.7	883	29.43
Tot/Avg	690	34.5	536	26.8	657	32.85	1883	31.38

There are two questions of interest appear after conducting the initial ANOVA analysis results:

- Do College Type (Factor A) or Male Female (Factor B) have an effect on the degree of sexism (the Sexist Attitude Score)?
- Is it possible to detect a particular combination of College Type and Male Female works better than other combinations?

Figure 2: Resulting ANOVA Table Calculated by Minitab

Analysis of Variance for Degree of Sexism

Source	DF	SS	MS	F	P
College Type	2	657.4	328.72	13.00	0.000
Male Female	1	228.1	228.15	9.02	0.004
College Type*Male Female	2	259.3	129.65	5.13	0.009
Error	54	1365.3	25.28		
Total	59	2510.2			

With these two question in mind, we then use Minitab to perform a Two-Way ANOVA analysis and the results is shown above. There is one factor that is also included in the result is the interaction factor of variable “College Type” and variable “Male Female”. These factors or their interaction will be the subject of the ANOVA analysis at a 5% significance level, whether or not they significantly contribute to the dependent varibale, the sexist attitude score.

When looking at the individual P-value, all these three variables (College Type, Male Female, and interaction) have a very small P-value, which are all lower than 0.05. It indicates that we can reject the null hypothese that they do not have an effect on the model at the 5% significance level. In other words, these three variables are all significant factors in contributing to the model results. Moreover, College Type seems to contribute the most to variability in degree of sexist among other factors.

ANOVA Diagnostics

We then conduct some of the diagnostics analysis of the ANOVA results. The first approach is to perform the four-in-one plots of the residuals and the residual probability plot.

The findings and figures that support the observations are as follow:

From the charts below, we can see that the residual analysis appears to support the assumption of normality for residuals. Most of the data points follow with the straight line and are also within the confidential boundaries, except for only one data point locates outside of the boundaries. The standard deviation is pretty high with the value of 5.028. The P-value from the residuals plot is greater than 0.250, it indicates the assumption carried with the F-test is validated as supporting the normality test of residuals. The residuals are also very well distributed as shown from the fitted values graph.

Figure 3: Probability Plot of Residuals

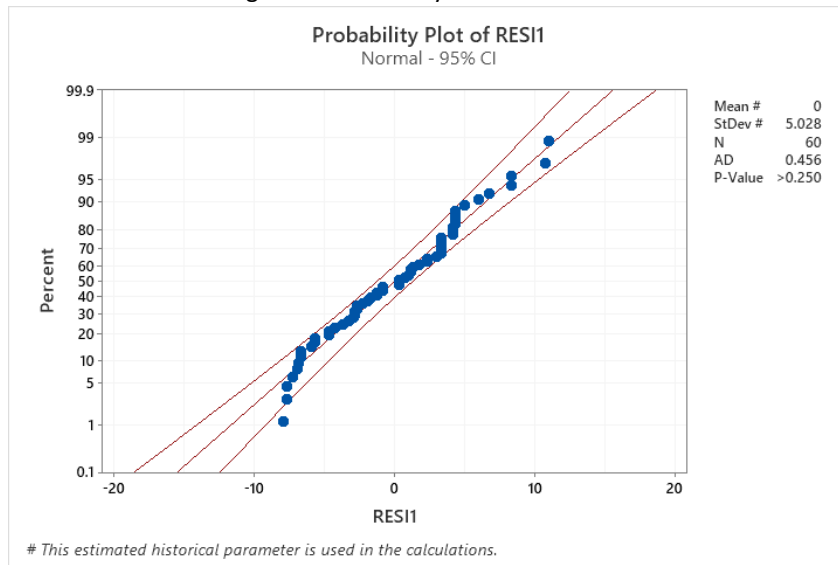
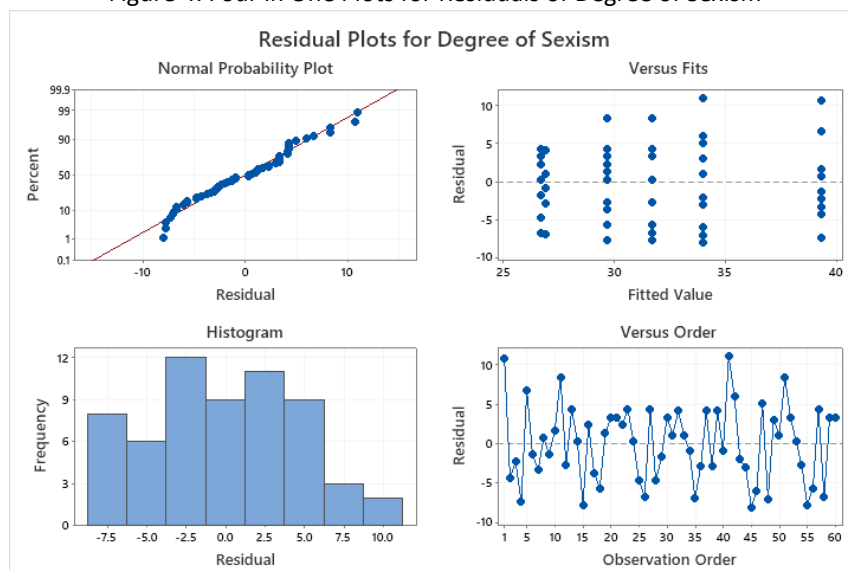


Figure 4: Four in One Plots for Residuals of Degree of Sexism



The next step is to conduct a Two-Way test for Equal Variance against both of the Multiple Comparisons test and Levene's test. The individual P-value from both these two tests are relatively high with the value greatly than the 0.05 significant level. It indicates that the homogeneity assumption of the variances.

The following figures support the observations listed above:

Figure 5: Equal Variance Test of Degree of Sexism

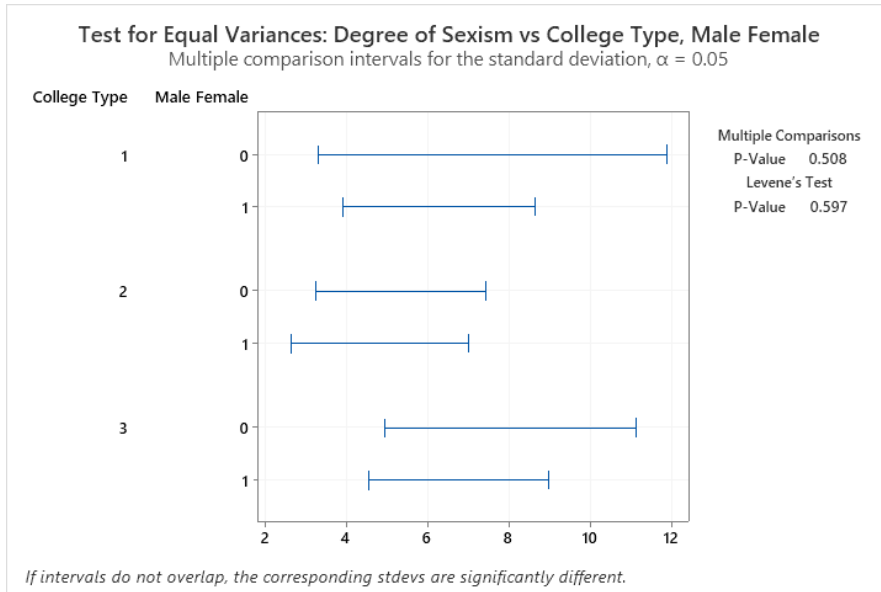
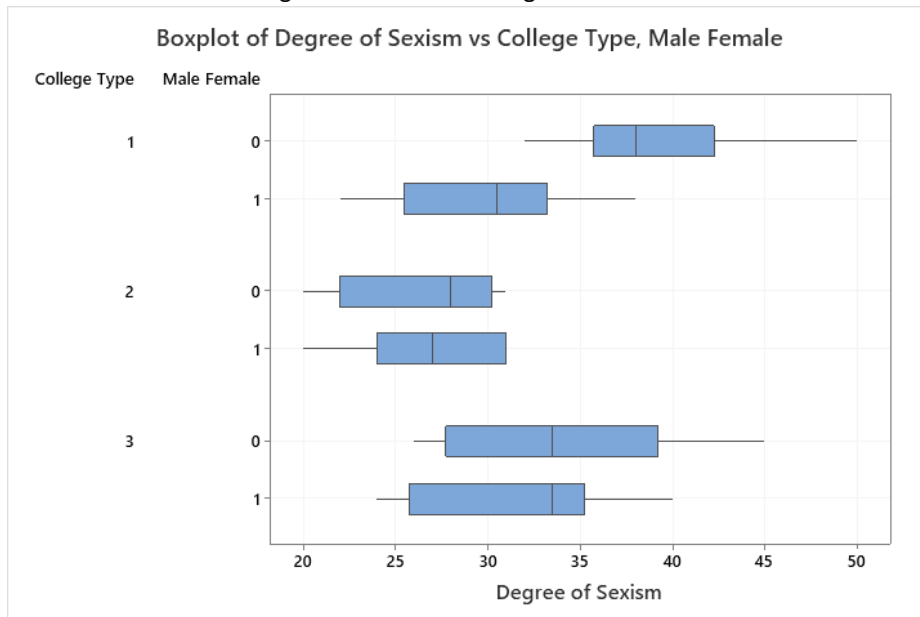


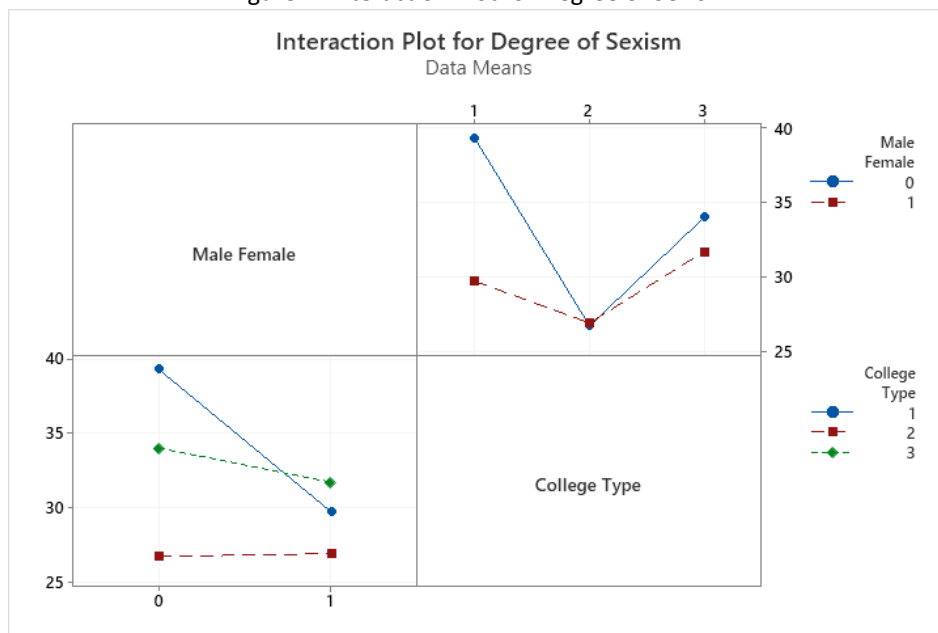
Figure 6: Box Plot for Degree of Sexism



Moreover, the interaction effect between College Type and Male Female demonstrates there is an interaction effect because of the collinearity that is shown on the graph below. As you can see from the graph at the lower left, the slope of these three lines is different. Since they are not parallel lines, it is clear to imply that there are interaction effects between them.

In addition, it is important to notice that male students from both Type 1 colleges (Coed with 75% or more males) and Type 3 colleges (Not coed) tends to have a higher degree of sexism. But for the students in Type 2 colleges (Coed with less than 75% males), both male and female students are having a relatively low score in degree of sexism, comparing to the students in Type 1 and Type 3 colleges.

Figure 7: Interaction Plot for Degree of Sexism



Conclusion

From the results we get from the previous steps, we reject the null hypothesis at a 5% significance level of the College Type (P-value: 0.000), Male Female (P-value: 0.004), and interaction between these two variables (P-value: 0.009) that has no effect on the degree of sexism. In other words, all these three factors have contribution to the dependent variable of the degree of sexism. The variable College Type has the greatest influence on the degree of sexism among all three variables.

Moreover, since the interaction has significant effect at the 5% significance level, the combinations between College Type and Male Female can have great influence on the degree of sexism. As we get the result from the interaction plot, male students from the Type 1 colleges (Coed with 75% or more males) have the highest sexist attitude score. The female students from Type 1 colleges have a lower sexist attitude score than the female students from Type 3 colleges (Not coed). Both male and female students from Type 2 colleges (Coed with less than 75% males) have the lowest sexist attitude score among all three types of colleges. Therefore, male students in Type 1 colleges and female students in Type 3 colleges tend to have a higher degree of sexism.