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One Way ANOVA

Importing dataset for one-way ANOVA: G3 by studytime

Frequencies

[OneWayANOVAData] D:\DATA ANALYSIS\E ANOVA Family\One Way ANOVA\SPSS_Output\sav\One-Way-ANOVA-data.sav

Statistics

studytime

N	Valid	649
	Missing	0

studytime

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	212	32.7	32.7	32.7
	2.00	305	47.0	47.0	79.7
	3.00	97	14.9	14.9	94.6
	4.00	35	5.4	5.4	100.0
	Total	649	100.0	100.0	

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
G3 * studytime	649	100.0%	0	0.0%	649	100.0%

Report

G3

studytime	N	Mean	Std. Deviation	Median	Minimum	Maximum
1.00	212	10.8443	3.21862	11.0000	.00	18.00
2.00	305	12.0918	3.24313	12.0000	.00	19.00
3.00	97	13.2268	2.50210	13.0000	8.00	18.00
4.00	35	13.0571	3.03841	13.0000	6.00	19.00
Total	649	11.9060	3.23066	12.0000	.00	19.00

```
>Warning # 2004.  Command name: SUBTITLE
>The subtitle given exceeds 60 characters in length.  The first 60 characters
>will be used.
```

One Way ANOVA: Main ANOVA Test
The F statistic tests whether mean G3 is equal across studyt

Oneway

Descriptives

G3

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum
					Lower Bound	Upper Bound	
1.00	212	10.8443	3.21862	.22106	10.4086	11.2801	.00
2.00	305	12.0918	3.24313	.18570	11.7264	12.4572	.00
3.00	97	13.2268	2.50210	.25405	12.7225	13.7311	8.00
4.00	35	13.0571	3.03841	.51358	12.0134	14.1009	6.00
Total	649	11.9060	3.23066	.12681	11.6570	12.1550	.00

Descriptives

G3

	Maximum
1.00	18.00
2.00	19.00
3.00	18.00
4.00	19.00
Total	19.00

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
G3	Based on Mean	.985	3	645	.400
	Based on Median	1.026	3	645	.380
	Based on Median and with adjusted df	1.026	3	609.885	.380
	Based on trimmed mean	1.081	3	645	.356

One Way ANOVA: Main ANOVA Test
The F statistic tests whether mean G3 is equal across studyt

ANOVA

G3

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	465.078	3	155.026	15.876	.000
Within Groups	6298.189	645	9.765		
Total	6763.267	648			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: G3

Tukey HSD

(I) studytime	(J) studytime	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-1.24746*	.27942	.000	-1.9672	-.5278
	3.00	-2.38246*	.38305	.000	-3.3691	-1.3958
	4.00	-2.21280*	.57013	.001	-3.6813	-.7443
2.00	1.00	1.24746*	.27942	.000	.5278	1.9672
	3.00	-1.13500*	.36425	.010	-2.0732	-.1968
	4.00	-.96534	.55768	.308	-2.4018	.4711
3.00	1.00	2.38246*	.38305	.000	1.3958	3.3691
	2.00	1.13500*	.36425	.010	.1968	2.0732
	4.00	.16966	.61616	.993	-1.4174	1.7567
4.00	1.00	2.21280*	.57013	.001	.7443	3.6813
	2.00	.96534	.55768	.308	-.4711	2.4018
	3.00	-.16966	.61616	.993	-1.7567	1.4174

*. The mean difference is significant at the 0.05 level.

Homogeneous Subsets

One Way ANOVA: Main ANOVA Test

The F statistic tests whether mean G3 is equal across studyt

G3

Tukey HSD[a,b]

		Subset for alpha = 0.05	
studytime	N	1	2
1.00	212	10.8443	
2.00	305		12.0918
4.00	35		13.0571
3.00	97		13.2268
Sig.		1.000	.083

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 85.331.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

```
>Warning # 2004.  Command name: SUBTITLE
>The subtitle given exceeds 60 characters in length.  The first 60 characters
>will be used.
```

General Linear Model

Between-Subjects Factors

		Value Label	N
studytime	1.00	Studytime 1	212
	2.00	Studytime 2	305
	3.00	Studytime 3	97
	4.00	Studytime 4	35

Descriptive Statistics

Dependent Variable: G3

studytime	Mean	Std. Deviation	N
1.00	10.8443	3.21862	212
2.00	12.0918	3.24313	305
3.00	13.2268	2.50210	97
4.00	13.0571	3.03841	35
Total	11.9060	3.23066	649

Levene's Test of Equality of Error Variances[a,b]

		Levene Statistic	df1	df2	Sig.
G3	Based on Mean	.985	3	645	.400
	Based on Median	1.026	3	645	.380
	Based on Median and with adjusted df	1.026	3	609.885	.380
	Based on trimmed mean	1.081	3	645	.356

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Dependent variable: G3

b. Design: Intercept + studytime

One Way ANOVA: GLM Effect Size Output
GLM reports Tests of Between-Subjects Effects and partial et

Tests of Between-Subjects Effects

Dependent Variable: G3

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	465.078[a]	3	155.026	15.876	.000	.069
Intercept	51680.984	1	51680.984	5292.670	.000	.891
studytime	465.078	3	155.026	15.876	.000	.069
Error	6298.189	645	9.765			
Total	98761.000	649				
Corrected Total	6763.267	648				

a. R Squared = .069 (Adjusted R Squared = .064)

Parameter Estimates

Dependent Variable: G3

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	13.057	.528	24.720	.000	12.020	14.094
[studytime=1.00]	-2.213	.570	-3.881	.000	-3.332	-1.093
[studytime=2.00]	-.965	.558	-1.731	.084	-2.060	.130
[studytime=3.00]	.170	.616	.275	.783	-1.040	1.380
[studytime=4.00]	0[a]	.	.	.	.	.

Parameter Estimates

Dependent Variable: G3

Parameter	Partial Eta Squared
Intercept	.487
[studytime=1.00]	.023
[studytime=2.00]	.005
[studytime=3.00]	.000
[studytime=4.00]	.

a. This parameter is set to zero because it is redundant.

General Linear Model

Between-Subjects Factors

		Value Label	N
studytime	1.00	Studytime 1	212
	2.00	Studytime 2	305
	3.00	Studytime 3	97
	4.00	Studytime 4	35

Descriptive Statistics

Dependent Variable: G3

studytime	Mean	Std. Deviation	N
1.00	10.8443	3.21862	212
2.00	12.0918	3.24313	305
3.00	13.2268	2.50210	97
4.00	13.0571	3.03841	35
Total	11.9060	3.23066	649

Tests of Between-Subjects Effects

Dependent Variable: G3

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	465.078[a]	3	155.026	15.876	.000	.069
Intercept	51680.984	1	51680.984	5292.670	.000	.891
studytime	465.078	3	155.026	15.876	.000	.069
Error	6298.189	645	9.765			
Total	98761.000	649				
Corrected Total	6763.267	648				

a. R Squared = .069 (Adjusted R Squared = .064)

Estimated Marginal Means

Study time group used as one-way ANOVA factor

Estimates

Dependent Variable: G3

Study time group used as one-way ANOVA factor	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1.00	10.844	.215	10.423	11.266
2.00	12.092	.179	11.740	12.443
3.00	13.227	.317	12.604	13.850
4.00	13.057	.528	12.020	14.094

Pairwise Comparisons

Dependent Variable: G3

(I) Study time group used as one-way ANOVA factor	(J) Study time group used as one-way ANOVA factor	Mean Difference (I-J)	Std. Error	Sig.[b]
1.00	2.00	-1.247*	.279	.000
	3.00	-2.382*	.383	.000
	4.00	-2.213*	.570	.000
2.00	1.00	1.247*	.279	.000
	3.00	-1.135*	.364	.002
	4.00	-.965	.558	.084
3.00	1.00	2.382*	.383	.000
	2.00	1.135*	.364	.002
	4.00	.170	.616	.783
4.00	1.00	2.213*	.570	.000
	2.00	.965	.558	.084
	3.00	-.170	.616	.783

Pairwise Comparisons

Dependent Variable: G3

(I) Study time group used as one-way ANOVA factor	(J) Study time group used as one-way ANOVA factor	95% Confidence Interval for Difference[b]	
		Lower Bound	Upper Bound
1.00	2.00	-1.796	-.699
	3.00	-3.135	-1.630
	4.00	-3.332	-1.093
2.00	1.00	.699	1.796
	3.00	-1.850	-.420
	4.00	-2.060	.130
3.00	1.00	1.630	3.135
	2.00	.420	1.850
	4.00	-1.040	1.380
4.00	1.00	1.093	3.332
	2.00	-.130	2.060
	3.00	-1.380	1.040

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable: G3

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Contrast	465.078	3	155.026	15.876	.000	.069
Error	6298.189	645	9.765			

The F tests the effect of Study time group used as one-way ANOVA factor. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

General Linear Model

Between-Subjects Factors

		Value Label	N
studytime	1.00	Studytime 1	212
	2.00	Studytime 2	305
	3.00	Studytime 3	97
	4.00	Studytime 4	35

Tests of Between-Subjects Effects

Dependent Variable: G3

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	465.078[a]	3	155.026	15.876	.000
Intercept	51680.984	1	51680.984	5292.670	.000
studytime	465.078	3	155.026	15.876	.000
Error	6298.189	645	9.765		
Total	98761.000	649			
Corrected Total	6763.267	648			

a. R Squared = .069 (Adjusted R Squared = .064)

Explore

Study time group used as one-way ANOVA factor

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	studytime	N	Percent	N	Percent	N	Percent
G3	1.00	212	100.0%	0	0.0%	212	100.0%
	2.00	305	100.0%	0	0.0%	305	100.0%
	3.00	97	100.0%	0	0.0%	97	100.0%
	4.00	35	100.0%	0	0.0%	35	100.0%

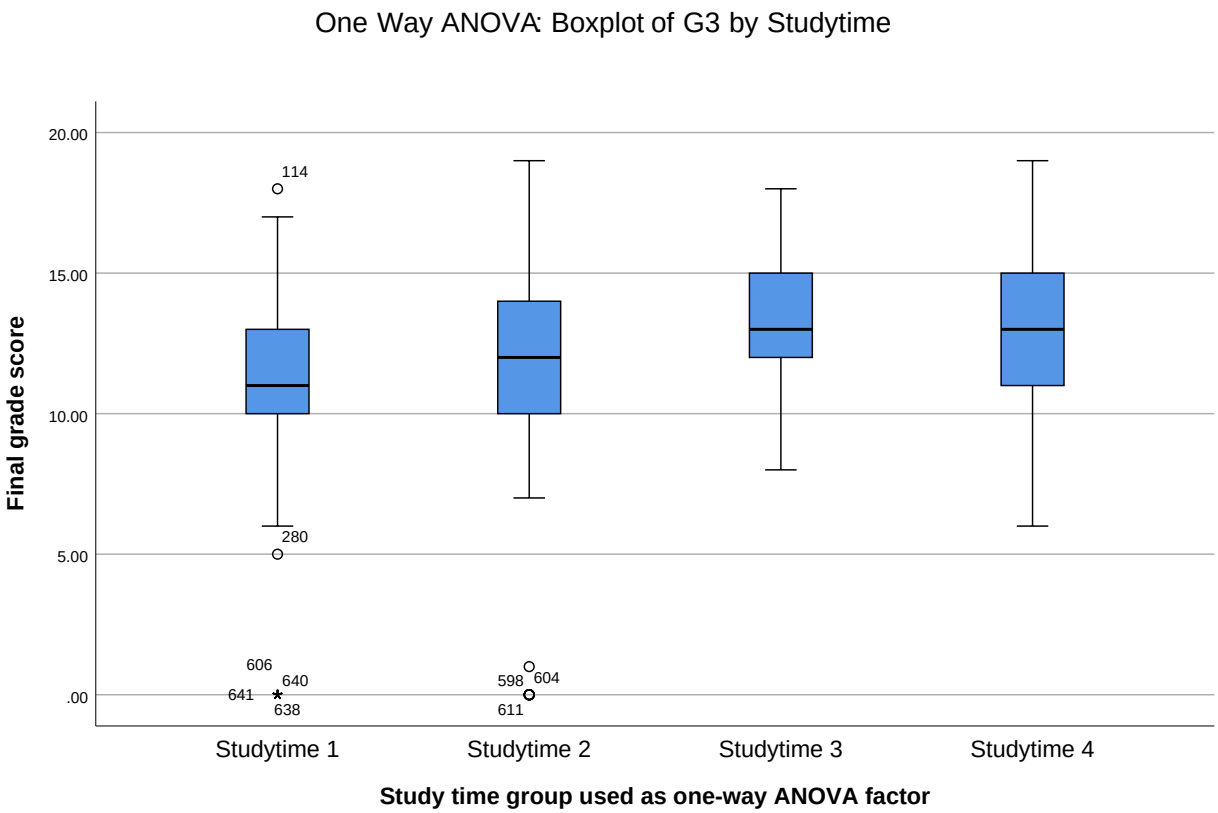
Descriptives

	studytime			Statistic	Std. Error
G3	1.00	Mean		10.8443	.22106
		95% Confidence Interval for Mean	Lower Bound	10.4086	
			Upper Bound	11.2801	
		5% Trimmed Mean		11.0419	
		Median		11.0000	
		Variance		10.360	
		Std. Deviation		3.21862	
		Minimum		.00	
		Maximum		18.00	
		Range		18.00	
		Interquartile Range		3.00	
		Skewness		-1.078	.167
		Kurtosis		3.117	.333
	2.00	Mean		12.0918	.18570
		95% Confidence Interval for Mean	Lower Bound	11.7264	
			Upper Bound	12.4572	
		5% Trimmed Mean		12.2505	
		Median		12.0000	
		Variance		10.518	
		Std. Deviation		3.24313	
		Minimum		.00	

Descriptives

studytime			Statistic	Std. Error
	Maximum		19.00	
	Range		19.00	
	Interquartile Range		4.00	
	Skewness		-1.028	.140
	Kurtosis		3.044	.278
3.00	Mean		13.2268	.25405
	95% Confidence Interval for Mean	Lower Bound	12.7225	
		Upper Bound	13.7311	
	5% Trimmed Mean		13.2732	
	Median		13.0000	
	Variance		6.261	
	Std. Deviation		2.50210	
	Minimum		8.00	
	Maximum		18.00	
	Range		10.00	
	Interquartile Range		3.50	
	Skewness		-.190	.245
	Kurtosis		-.502	.485
4.00	Mean		13.0571	.51358
	95% Confidence Interval for Mean	Lower Bound	12.0134	
		Upper Bound	14.1009	
	5% Trimmed Mean		13.0714	
	Median		13.0000	
	Variance		9.232	
	Std. Deviation		3.03841	
	Minimum		6.00	
	Maximum		19.00	
	Range		13.00	
	Interquartile Range		4.00	
	Skewness		.209	.398
	Kurtosis		-.339	.778

Final grade score


One Way ANOVA: Boxplot of G3 by Studytime
Final grade score
20.00
15.00
10.00
5.00
.00
114
280
606
640
641
638
598
604
611
Studytime 1
Studytime 2
Studytime 3
Studytime 4
Study time group used as one-way ANOVA factor

Explore

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
RES_1	649	100.0%	0	0.0%	649	100.0%

Descriptives

			Statistic	Std. Error
RES_1	Mean		.0000	.12238
	95% Confidence Interval for Mean	Lower Bound	-.2403	
		Upper Bound	.2403	
	5% Trimmed Mean		.1427	
	Median		-.0918	
	Variance		9.719	
	Std. Deviation		3.11760	
	Minimum		-12.09	
	Maximum		7.16	
	Range		19.25	
	Interquartile Range		3.75	
	Skewness		-.930	.096
	Kurtosis		2.793	.192

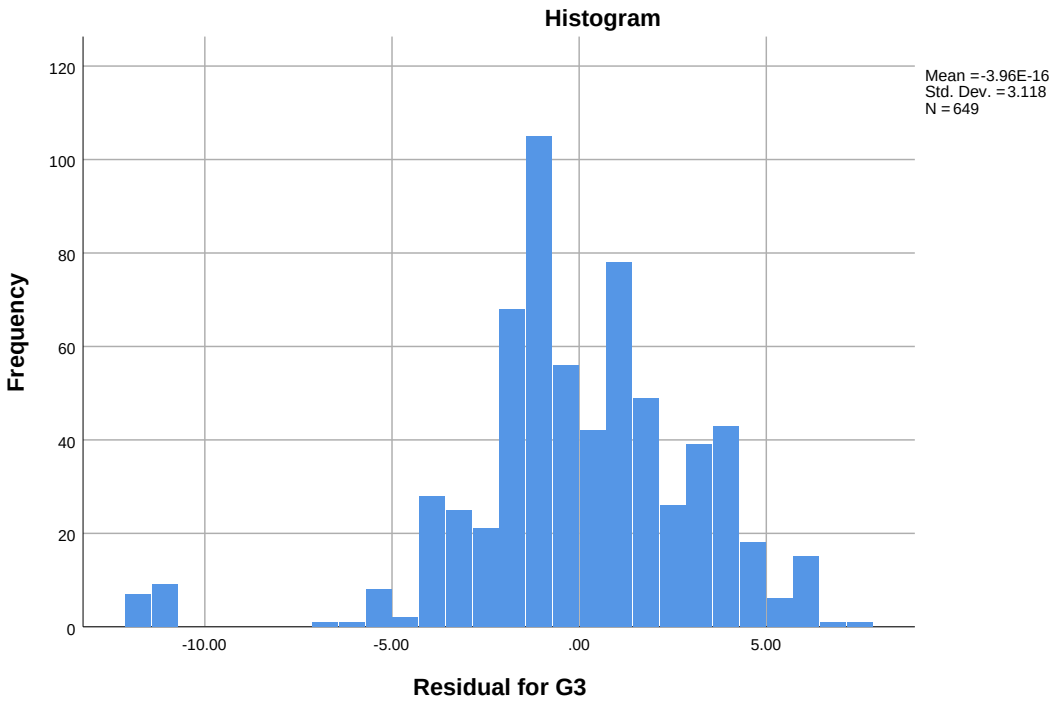
Tests of Normality

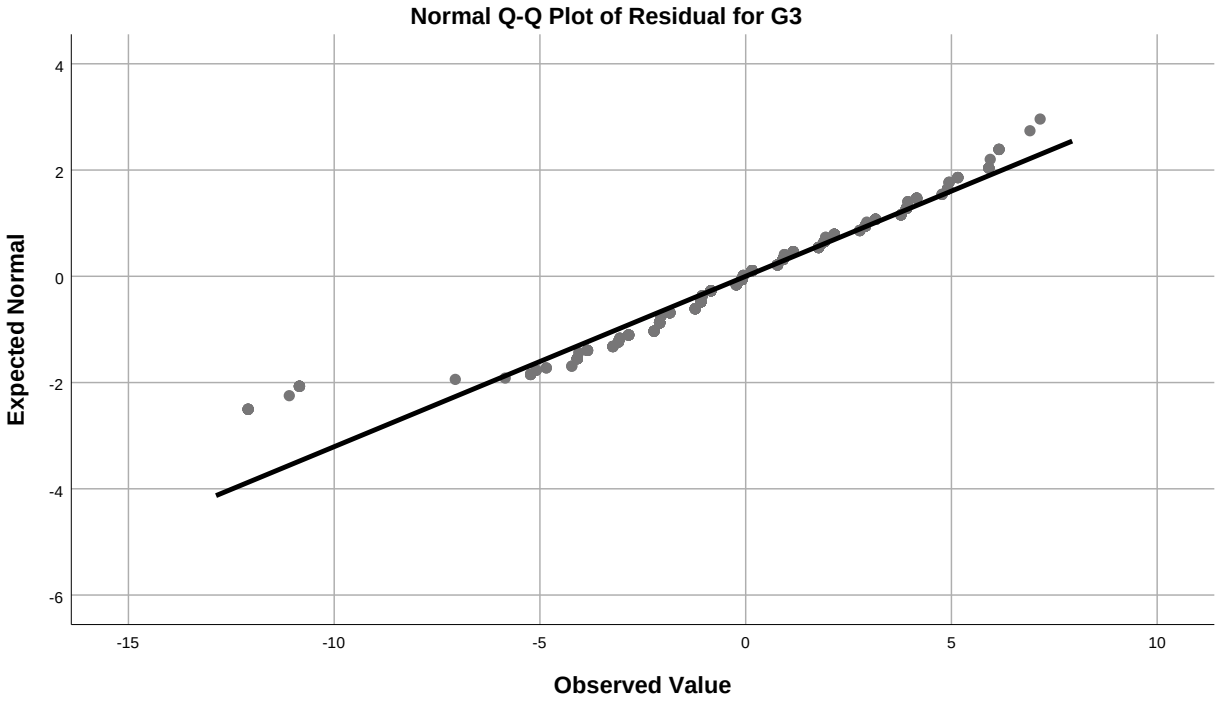
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
RES_1	.094	649	.000	.935	649	.000

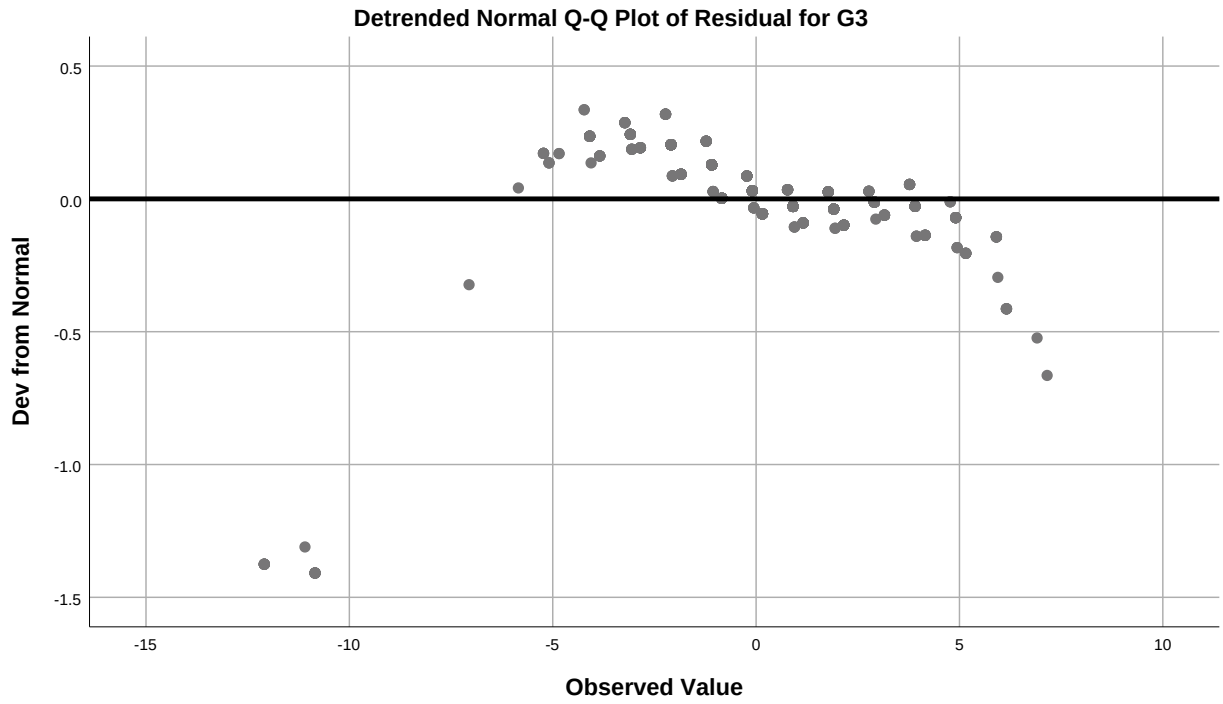
a. Lilliefors Significance Correction

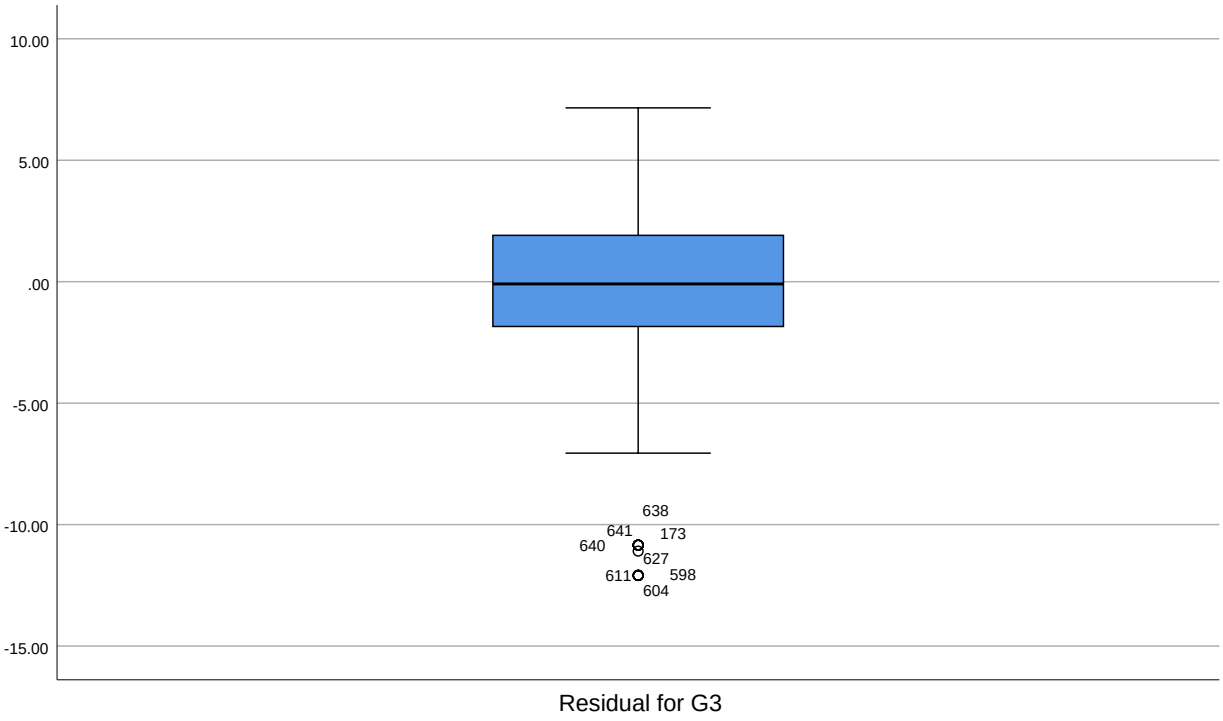
Residual for G3

One Way ANOVA: Residual Diagnostics



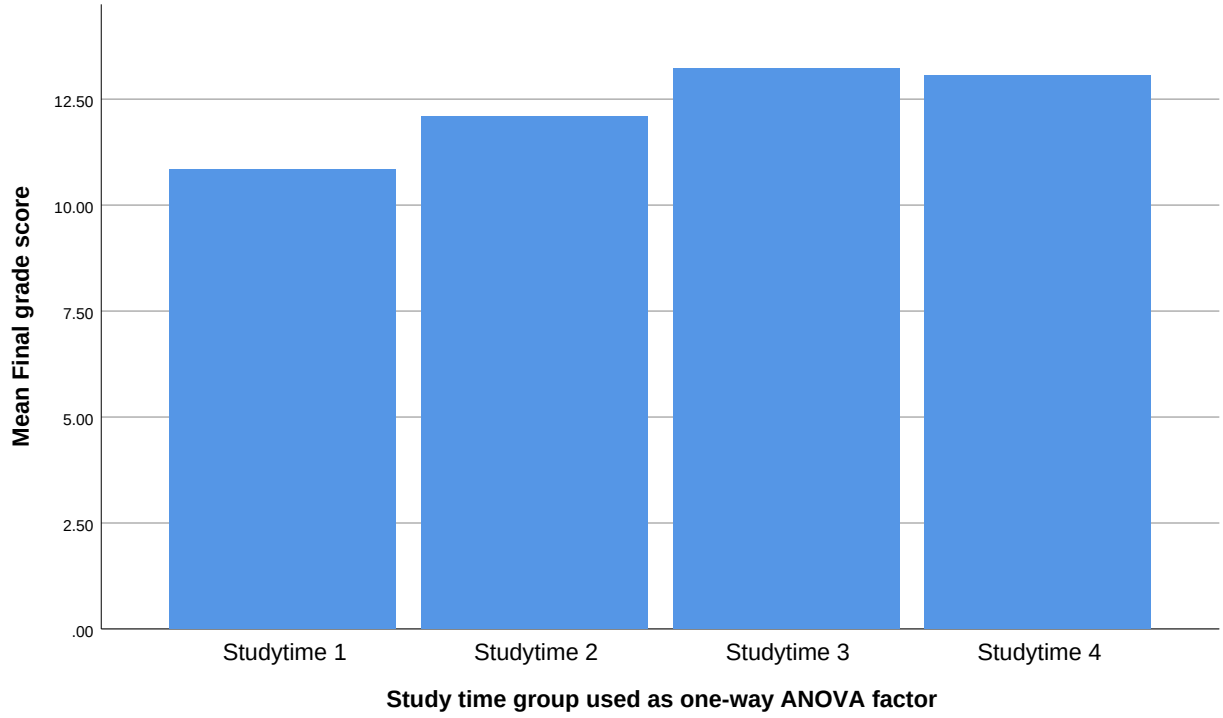



Detrended Normal Q-Q Plot of Residual for G3
Dev from Normal
0.5
0.0
-0.5
-1.0
-1.5
-15
-10
-5
0
5
10
Observed Value

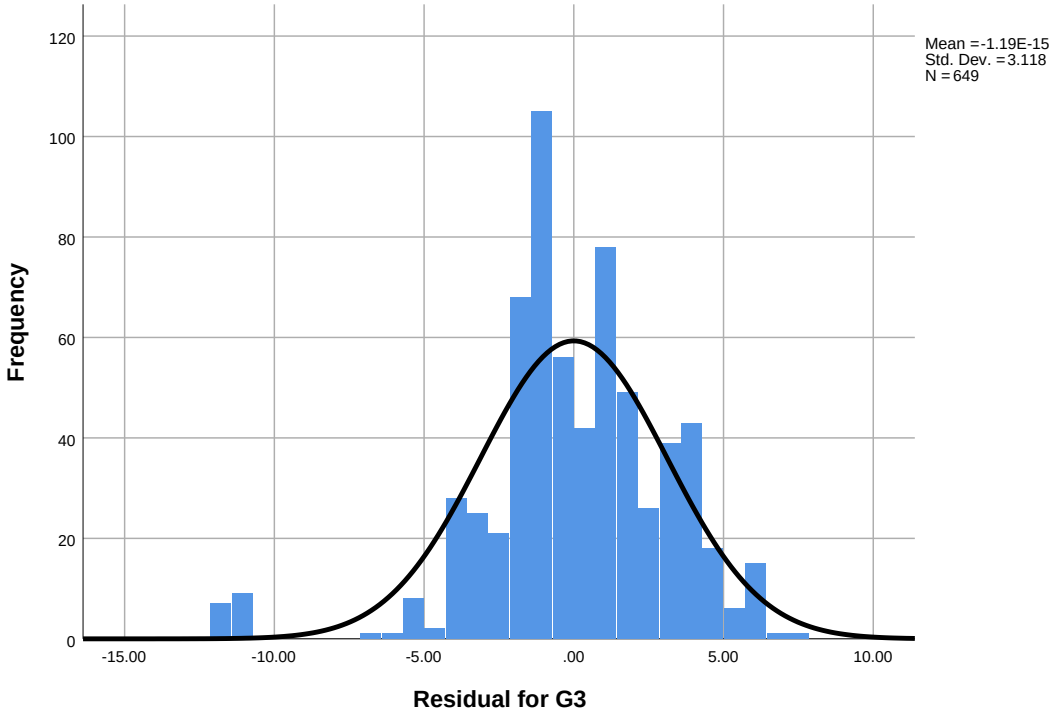

10.00
5.00
.00
-5.00
-10.00
-15.00
638
641
173
640
627
611
598
604
Residual for G3

One Way ANOVA: Means Bar Chart

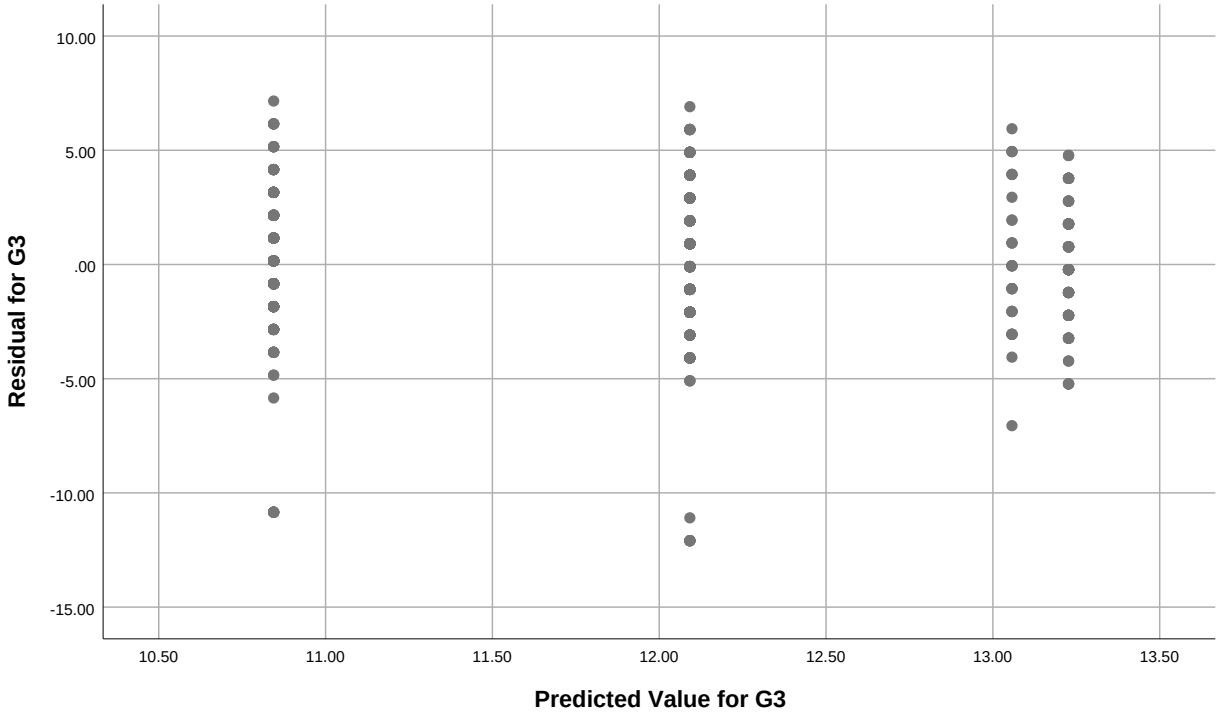
Graph



Graph


Mean =-1.19E-15
Std. Dev. =3.118
N =649
Frequency
120
100
80
60
40
20
0
-15.00
-10.00
-5.00
.00
5.00
10.00
Residual for G3

Graph


10.00
5.00
.00
-5.00
-10.00
-15.00
Residual for G3
10.50
11.00
11.50
12.00
12.50
13.00
13.50
Predicted Value for G3