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Fixed Effects ANOVA

Fixed Effects ANOVA
Import data

Fixed Effects ANOVA descriptives

Fixed Effects ANOVA descriptives
 Dependent variable G3 by fixed factor studytime

Means

[FixedEffectsANOVAData] D:\DATA ANALYSIS\E ANOVA Family\Fixed Effects ANOVA\SPSS_Output\sav\Fixed-Effects-ANOVA-data.sav

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	Variance	Minimum	Maximum
1	212	10.84	3.219	10.360	0	18
2	305	12.09	3.243	10.518	0	19
3	97	13.23	2.502	6.261	8	18
4	35	13.06	3.038	9.232	6	19
Total	649	11.91	3.231	10.437	0	19

Fixed Effects ANOVA: One-way ANOVA

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

Fixed Effects ANOVA: One-way ANOVA
 studytime is treated as a fixed factor with observed levels

Oneway

Descriptives

G3

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum
					Lower Bound	Upper Bound	
1	212	10.84	3.219	.221	10.41	11.28	0
2	305	12.09	3.243	.186	11.73	12.46	0
3	97	13.23	2.502	.254	12.72	13.73	8
4	35	13.06	3.038	.514	12.01	14.10	6
Total	649	11.91	3.231	.127	11.66	12.16	0

Descriptives

G3

	Maximum
1	18
2	19
3	18
4	19
Total	19

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

Fixed Effects ANOVA: One-way ANOVA
 studytime is treated as a fixed factor with observed levels

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	2	-1.247*	.279	.000	-1.97	-.53
	3	-2.382*	.383	.000	-3.37	-1.40
	4	-2.213*	.570	.001	-3.68	-.74
2	1	1.247*	.279	.000	.53	1.97
	3	-1.135*	.364	.010	-2.07	-.20
	4	-.965	.558	.308	-2.40	.47
3	1	2.382*	.383	.000	1.40	3.37
	2	1.135*	.364	.010	.20	2.07
	4	.170	.616	.993	-1.42	1.76
4	1	2.213*	.570	.001	.74	3.68
	2	.965	.558	.308	-.47	2.40
	3	-.170	.616	.993	-1.76	1.42

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

Homogeneous Subsets

Fixed Effects ANOVA: One-way ANOVA
 studytime is treated as a fixed factor with observed levels

G3

Tukey HSD^{a,b}

studytime	N	Subset for alpha = 0.05	
		1	2
1	212	10.84	
2	305		12.09
4	35		13.06
3	97		13.23
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.

Fixed Effects ANOVA: GLM model with effect size

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

Fixed Effects ANOVA: GLM model with effect size
 Fixed factor studytime with partial eta squared and paramete

General Linear Model

Between-Subjects Factors

		Value Label	N
studytime	1	Study time group 1	212
	2	Study time group 2	305
	3	Study time group 3	97
	4	Study time group 4	35

Descriptive Statistics

Dependent Variable: G3

studytime	Mean	Std. Deviation	N
1	10.84	3.219	212
2	12.09	3.243	305
3	13.23	2.502	97
4	13.06	3.038	35
Total	11.91	3.231	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

Fixed Effects ANOVA: GLM model with effect size
Fixed factor studytime with partial eta squared and paramete

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]	-2.213	.570	-3.881	.000	-3.332	-1.093
[studytime=2]	-.965	.558	-1.731	.084	-2.060	.130
[studytime=3]	.170	.616	.275	.783	-1.040	1.380
[studytime=4]	0 ^a

Parameter Estimates

Dependent Variable: G3

Parameter	Partial Eta Squared
Intercept	.487
[studytime=1]	.023
[studytime=2]	.005
[studytime=3]	.000
[studytime=4]	.

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

Fixed Effects ANOVA: Estimated marginal means

Fixed Effects ANOVA: Estimated marginal means
Fixed studytime level means and pairwise comparisons

General Linear Model

Between-Subjects Factors

		Value Label	N
studytime	1	Study time group 1	212
	2	Study time group 2	305
	3	Study time group 3	97
	4	Study time group 4	35

Descriptive Statistics

Dependent Variable: G3

studytime	Mean	Std. Deviation	N
1	10.84	3.219	212
2	12.09	3.243	305
3	13.23	2.502	97
4	13.06	3.038	35
Total	11.91	3.231	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

Fixed Effects ANOVA: Estimated marginal means
 Fixed studytime level means and pairwise comparisons

Fixed factor: study time

Estimates

Dependent Variable: G3

Fixed factor: study time	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	10.844	.215	10.423	11.266
2	12.092	.179	11.740	12.443
3	13.227	.317	12.604	13.850
4	13.057	.528	12.020	14.094

Pairwise Comparisons

Dependent Variable: G3

(I) Fixed factor: study time	(J) Fixed factor: study time	Mean Difference (I-J)	Std. Error	Sig. ^b
1	2	-1.247*	.279	.000
	3	-2.382*	.383	.000
	4	-2.213*	.570	.000
2	1	1.247*	.279	.000
	3	-1.135*	.364	.002
	4	-.965	.558	.084
3	1	2.382*	.383	.000
	2	1.135*	.364	.002
	4	.170	.616	.783
4	1	2.213*	.570	.000
	2	.965	.558	.084
	3	-.170	.616	.783

Fixed Effects ANOVA: Estimated marginal means
Fixed studytime level means and pairwise comparisons

Pairwise Comparisons

Dependent Variable: G3

(I) Fixed factor: study time	(J) Fixed factor: study time	95% Confidence Interval for Difference ^b	
		Lower Bound	Upper Bound
1	2	-1.796	-.699
	3	-3.135	-1.630
	4	-3.332	-1.093
2	1	.699	1.796
	3	-1.850	-.420
	4	-2.060	.130
3	1	1.630	3.135
	2	.420	1.850
	4	-1.040	1.380
4	1	1.093	3.332
	2	-.130	2.060
	3	-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			

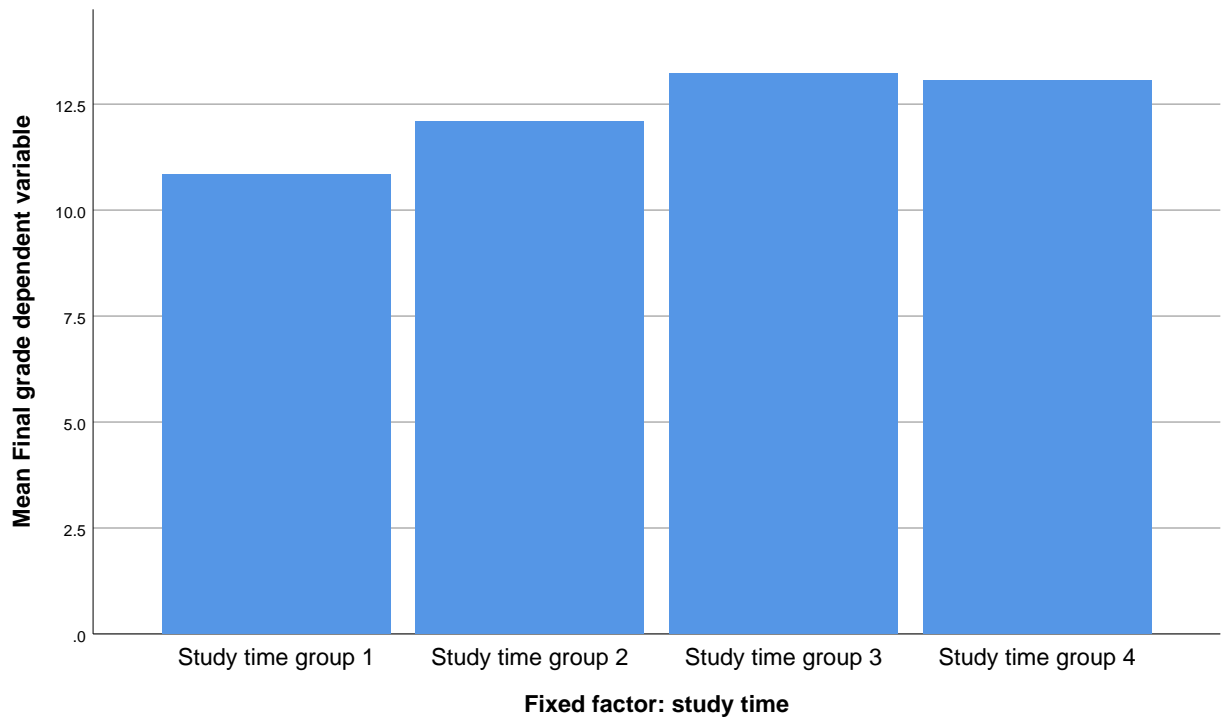
The F tests the effect of Fixed factor: study time. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

Fixed Effects ANOVA: Means plot

Fixed Effects ANOVA: Means plot
Mean G3 across fixed studytime levels

Graph

```
>Warning # 17848  
>The requested bar chart type cannot be drawn with the provided data. Instead  
,  
>Graphics will attempt to draw a simple bar chart.
```



Fixed Effects ANOVA: Group boxplot

Fixed Effects ANOVA: Group boxplot
Distribution of G3 by fixed studytime level

Explore

Fixed factor: study time

Case Processing Summary

	studytime	Valid		Cases Missing		Total	
		N	Percent	N	Percent	N	Percent
G3	1	212	100.0%	0	0.0%	212	100.0%
	2	305	100.0%	0	0.0%	305	100.0%
	3	97	100.0%	0	0.0%	97	100.0%
	4	35	100.0%	0	0.0%	35	100.0%

Descriptives

studytime		Statistic	Std. Error		
G3	1	Mean	10.84	.221	
		95% Confidence Interval for Mean	Lower Bound	10.41	
			Upper Bound	11.28	
		5% Trimmed Mean	11.04		
		Median	11.00		
		Variance	10.360		
		Std. Deviation	3.219		
		Minimum	0		
		Maximum	18		
		Range	18		
		Interquartile Range	3		
		Skewness	-1.078	.167	
		Kurtosis	3.117	.333	
		2	2	Mean	12.09
95% Confidence Interval for Mean	Lower Bound			11.73	
	Upper Bound			12.46	
5% Trimmed Mean	12.25				
Median	12.00				
Variance	10.518				
Std. Deviation	3.243				

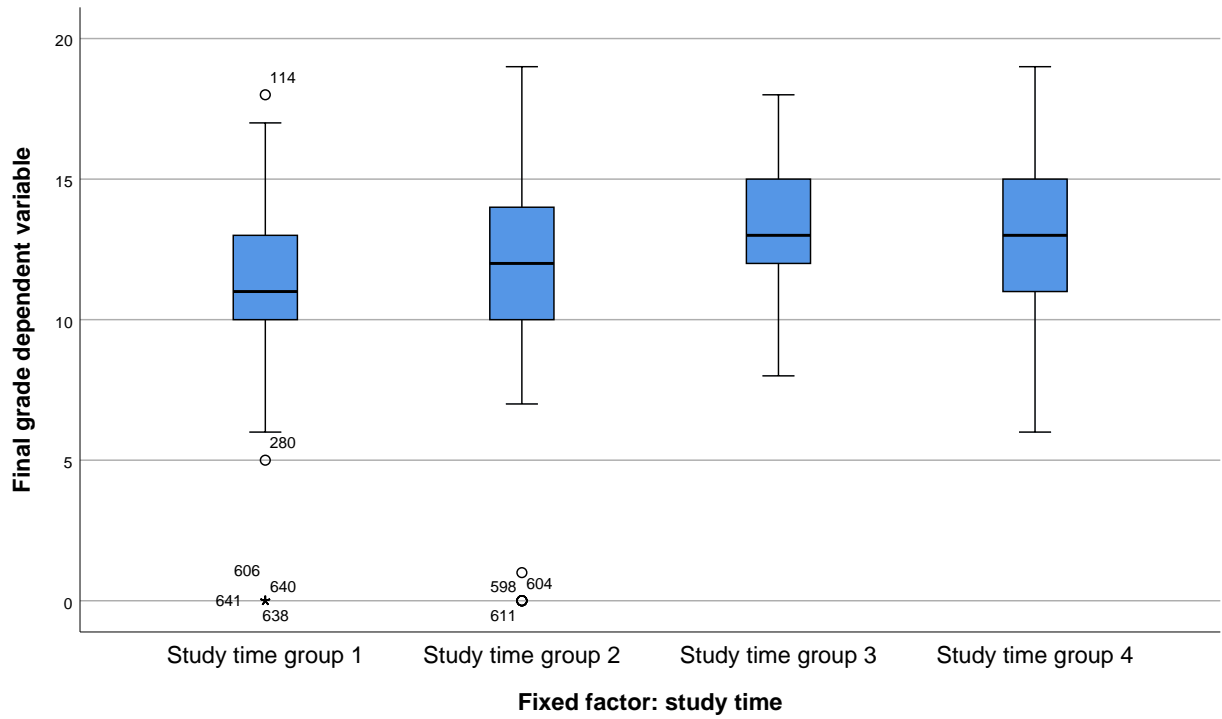
Fixed Effects ANOVA: Group boxplot
Distribution of G3 by fixed studytime level

Descriptives

studytime		Statistic	Std. Error	
3	Minimum	0		
	Maximum	19		
	Range	19		
	Interquartile Range	4		
	Skewness	-1.028	.140	
	Kurtosis	3.044	.278	
	Mean	13.23	.254	
	95% Confidence Interval for Mean	Lower Bound	12.72	
		Upper Bound	13.73	
	5% Trimmed Mean	13.27		
	Median	13.00		
	Variance	6.261		
	Std. Deviation	2.502		
	Minimum	8		
Maximum	18			
Range	10			
Interquartile Range	4			
Skewness	-.190	.245		
Kurtosis	-.502	.485		
4	Mean	13.06	.514	
	95% Confidence Interval for Mean	Lower Bound	12.01	
		Upper Bound	14.10	
	5% Trimmed Mean	13.07		
	Median	13.00		
	Variance	9.232		
	Std. Deviation	3.038		
	Minimum	6		
	Maximum	19		
	Range	13		
	Interquartile Range	4		
	Skewness	.209	.398	
	Kurtosis	-.339	.778	

Fixed Effects ANOVA: Group boxplot
Distribution of G3 by fixed studytime level

Final grade dependent variable



Fixed Effects ANOVA: Residual diagnostics

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

Fixed Effects ANOVA: Residual diagnostics
Save predicted values and residuals for fixed-effects ANOVA

General Linear Model

Between-Subjects Factors

		Value Label	N
studytime	1	Study time group 1	212
	2	Study time group 2	305
	3	Study time group 3	97
	4	Study time group 4	35

Tests of Between-Subjects Effects

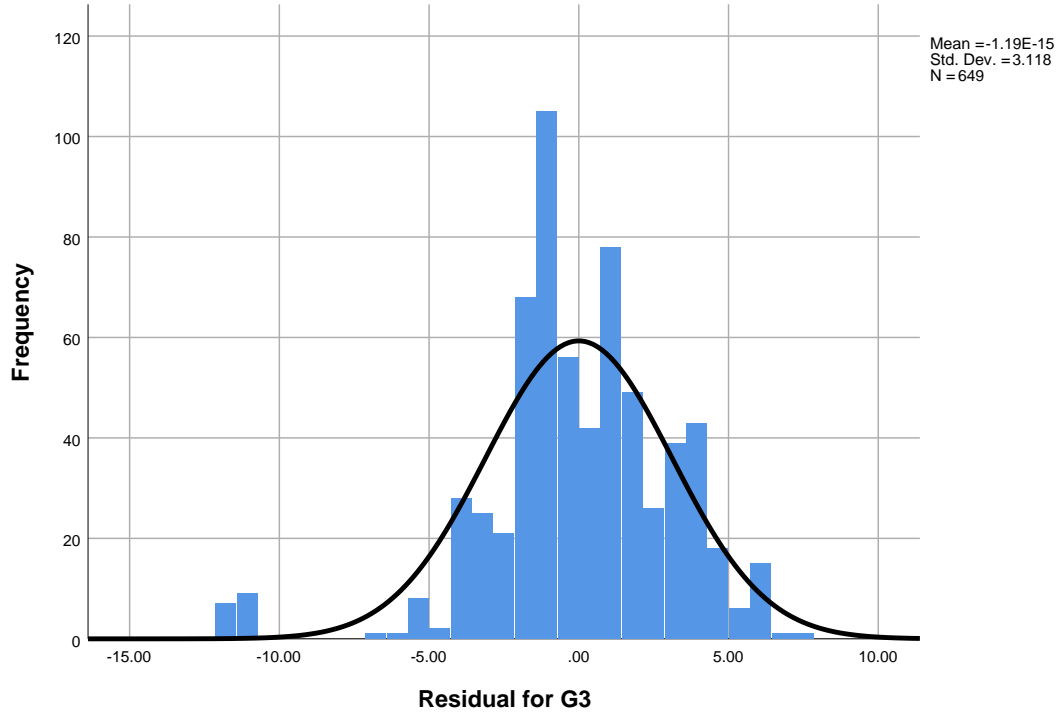
Dependent Variable: G3

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)

Fixed Effects ANOVA: Residual histogram

Graph



Fixed Effects ANOVA: Residual normality

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

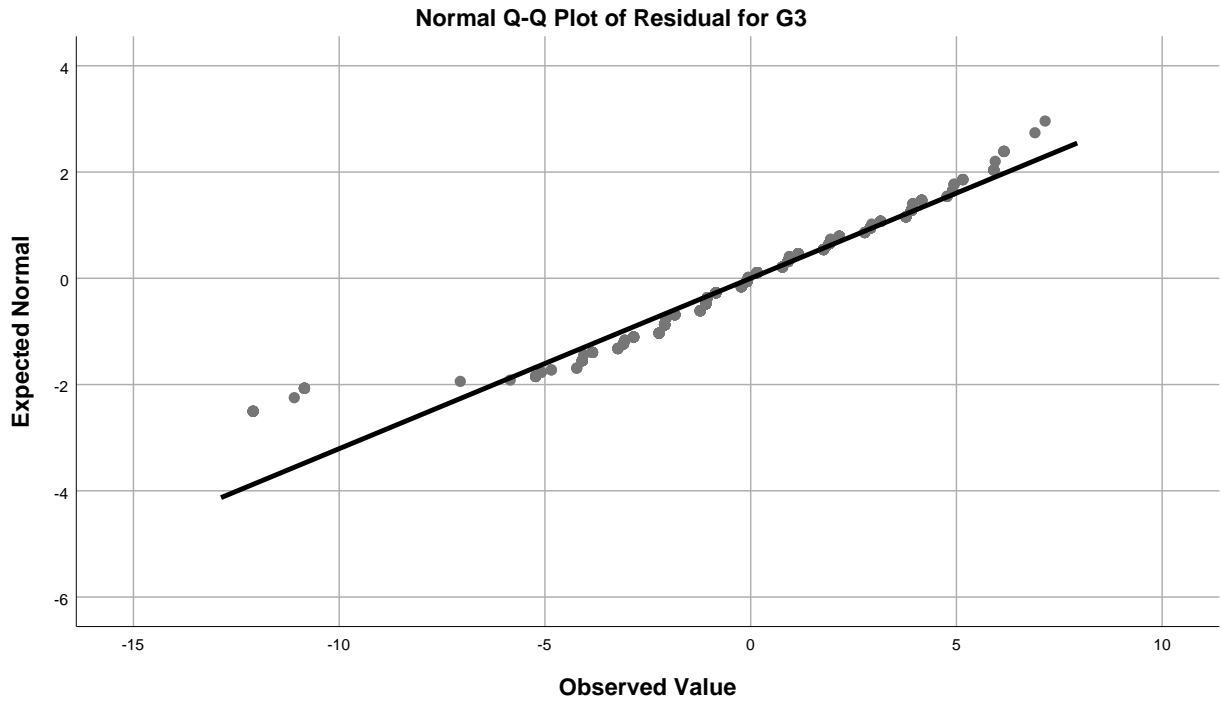
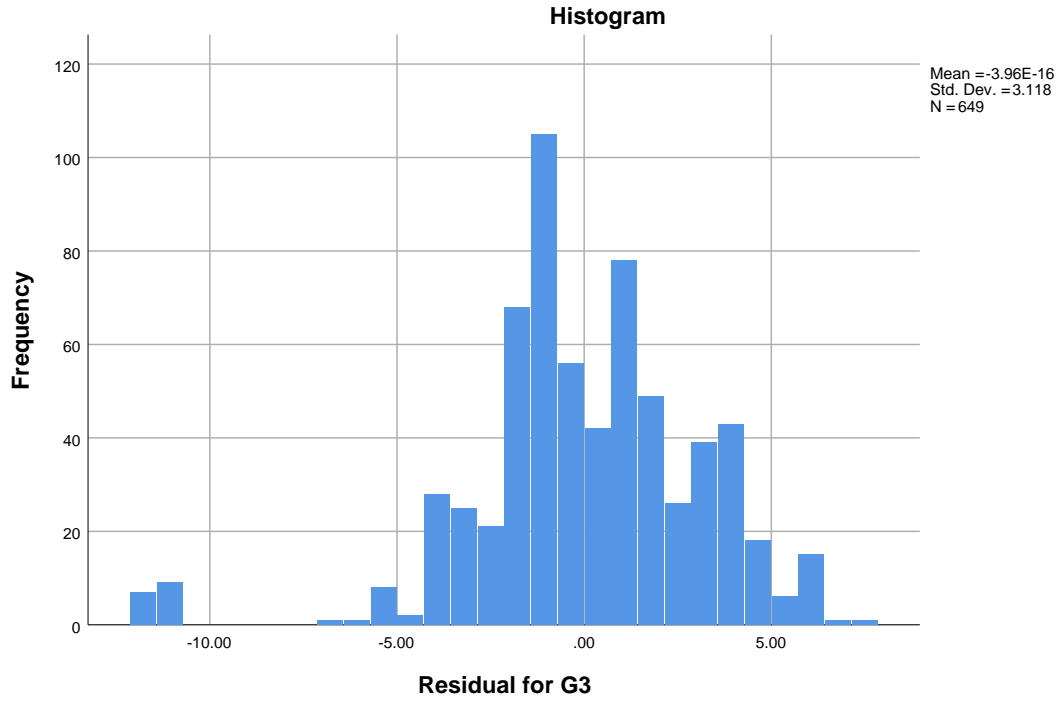
Tests of Normality

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

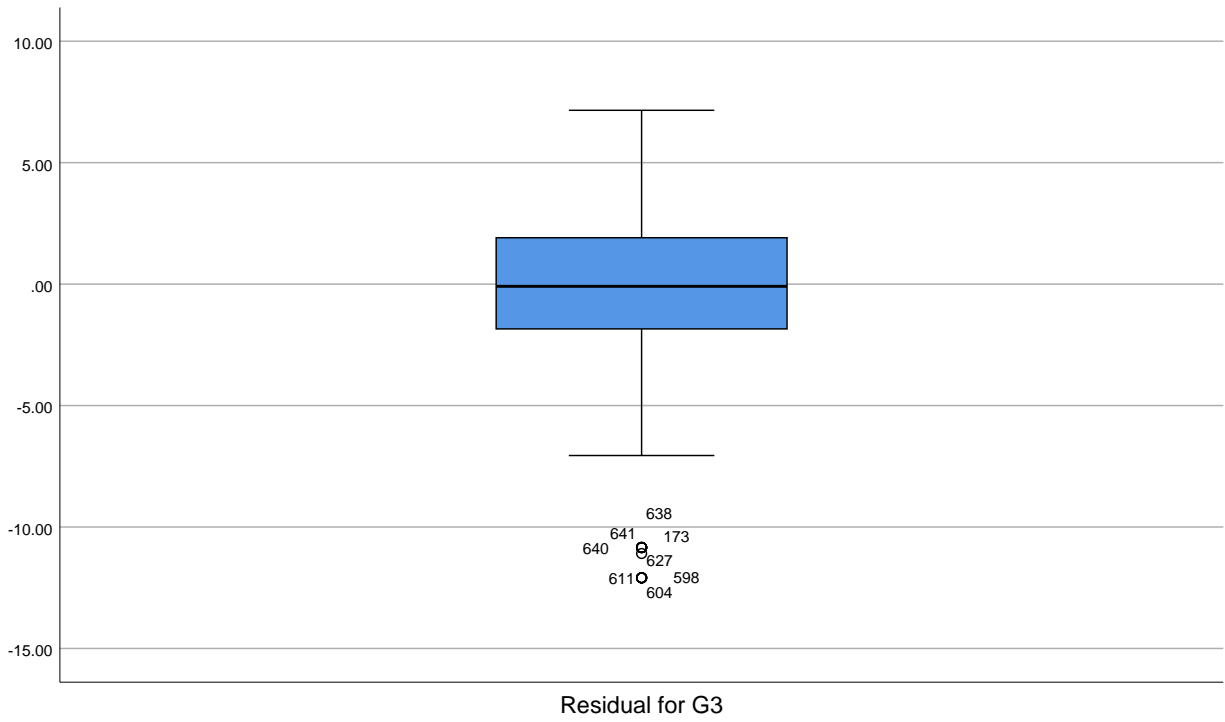
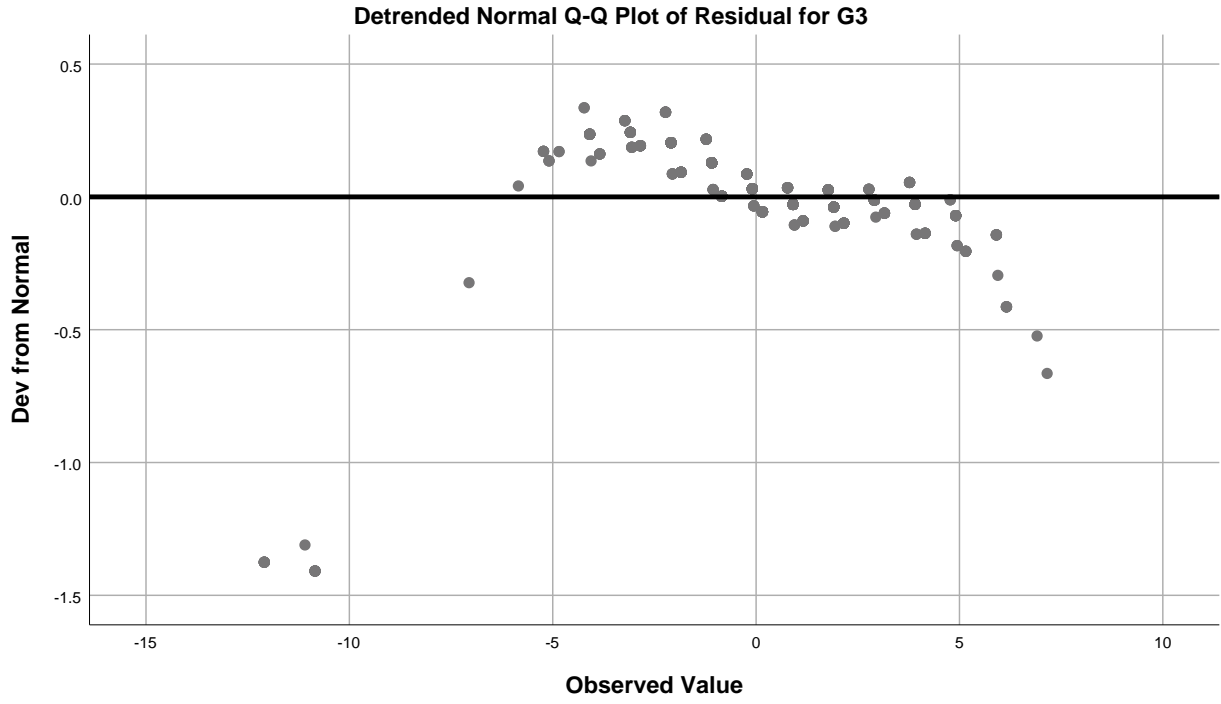
a. Lilliefors Significance Correction

Residual for G3

Fixed Effects ANOVA: Residual normality



Fixed Effects ANOVA: Residual normality



Fixed Effects ANOVA: Residuals versus predicted values

Graph

