Host

Host

Host

Host

F Distribution
Import data

F Distribution descriptives

F Distribution descriptives
Dependent variable G3 by studytime groups

Means

[FDistributionData] D:\DATA ANALYSIS\E ANOVA Family\F Distribution\SPSS_Output\sav\F-Distribution-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

F Distribution: One-way ANOVA example
The F statistic is MS Between divided by MS Within

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

F Distribution: One-way ANOVA example
The F statistic is MS Between divided by MS Within

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

F Distribution: One-way ANOVA example
The F statistic is MS Between divided by MS Within

G3

Tukey HSD[a,b]

		Subset for alpha = 0.05	
studytime	N	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.

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

F Distribution: GLM effect-size output
The Tests of Between-Subjects Effects table reports the F st

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

F Distribution: GLM effect-size output
The Tests of Between-Subjects Effects table reports the F st

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.

F Distribution: Estimated marginal means

F Distribution: Estimated marginal means
Studytime group means and pairwise comparison context

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

F Distribution: Estimated marginal means
Studytime group means and pairwise comparison context

Study time factor

Estimates

Dependent Variable: G3

Study time factor	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) Study time factor	(J) Study time factor	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence [b]...
					Lower Bound
1	2	-1.247*	.279	.000	-1.796
	3	-2.382*	.383	.000	-3.135
	4	-2.213*	.570	.000	-3.332
2	1	1.247*	.279	.000	.699
	3	-1.135*	.364	.002	-1.850
	4	-.965	.558	.084	-2.060
3	1	2.382*	.383	.000	1.630
	2	1.135*	.364	.002	.420
	4	.170	.616	.783	-1.040
4	1	2.213*	.570	.000	1.093
	2	.965	.558	.084	-.130
	3	-.170	.616	.783	-1.380

F Distribution: Estimated marginal means
Studytime group means and pairwise comparison context

Pairwise Comparisons

Dependent Variable: G3

(I) Study time factor	(J) Study time factor	95% Confidence Interval for [b]... Upper Bound
1	2	-.699
	3	-1.630
	4	-1.093
2	1	1.796
	3	-.420
	4	.130
3	1	3.135
	2	1.850
	4	1.380
4	1	3.332
	2	2.060
	3	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			

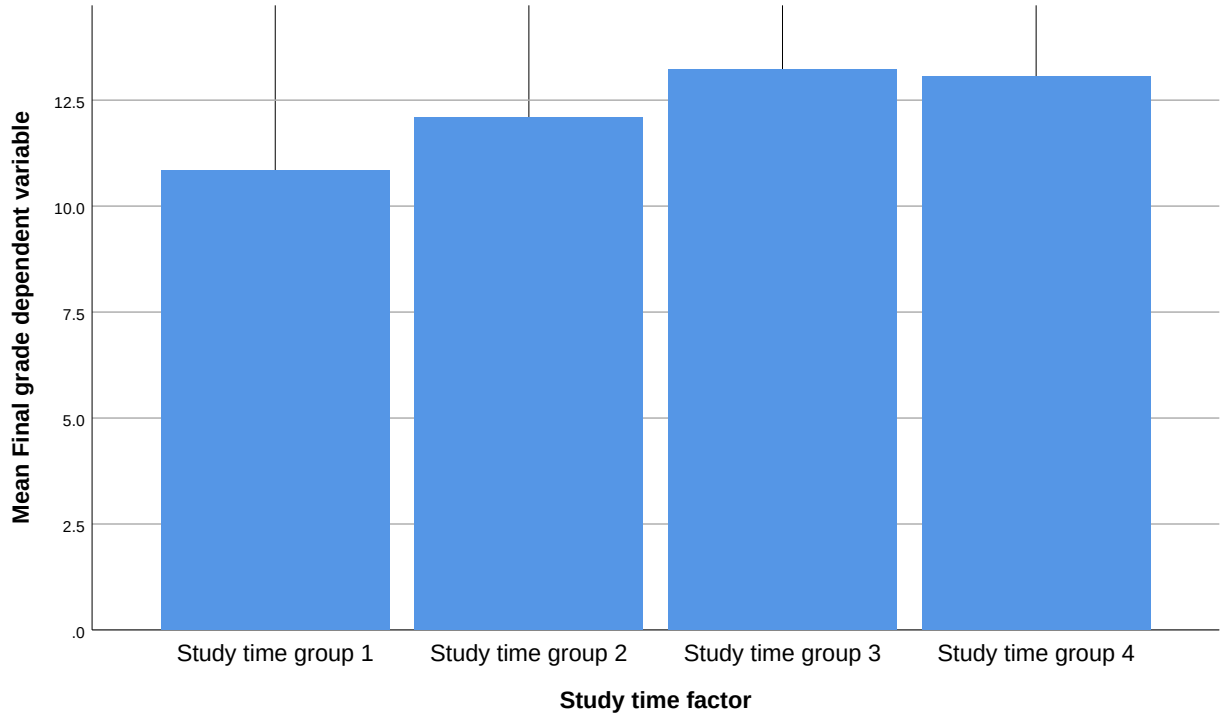
The F tests the effect of Study time factor. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

F Distribution: Means plot

F Distribution: Means plot
Mean G3 across studytime groups

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.
```



F Distribution: Group boxplot

F Distribution: Group boxplot
Distribution of G3 by studytime group

Explore

Study time factor

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	studytime	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	Mean		12.09	.186
		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	

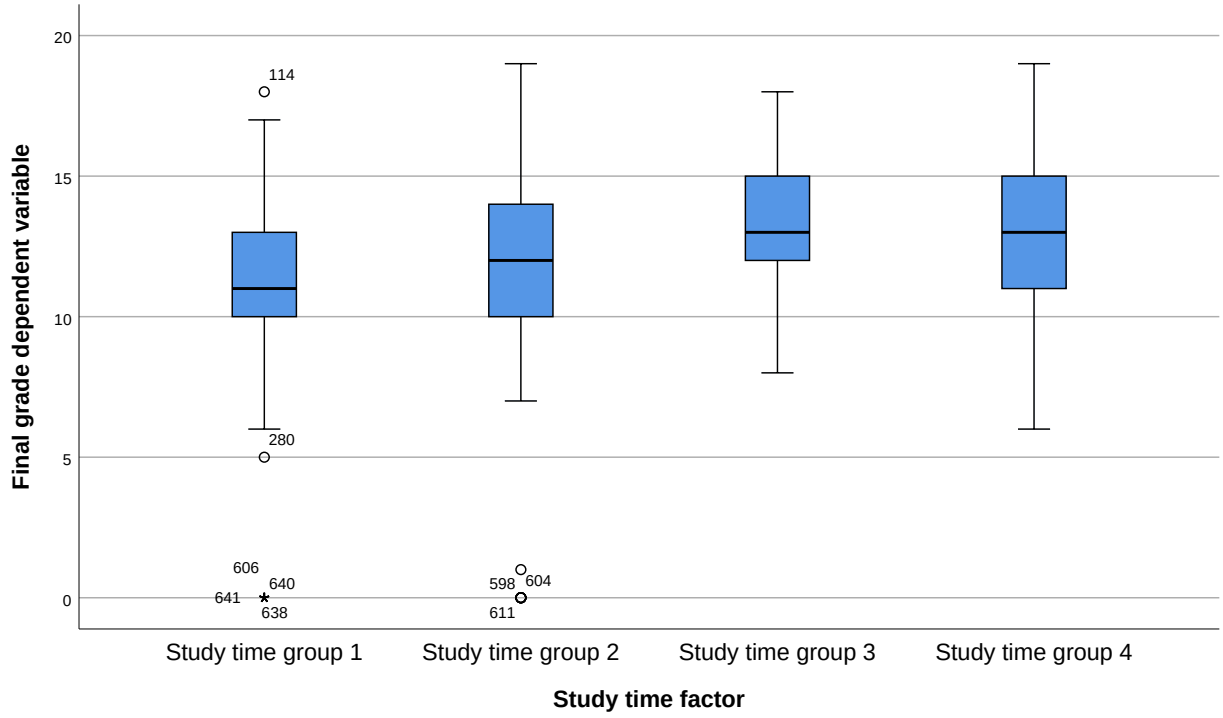
F Distribution: Group boxplot
Distribution of G3 by studytime group

Descriptives

studytime			Statistic	Std. Error
	Minimum		0	
	Maximum		19	
	Range		19	
	Interquartile Range		4	
	Skewness		-1.028	.140
	Kurtosis		3.044	.278
3	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

F Distribution: Group boxplot
Distribution of G3 by studytime group

Final grade dependent variable



F Distribution: Residual diagnostics

F Distribution: Residual diagnostics
Save predicted values and residuals for ANOVA model

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

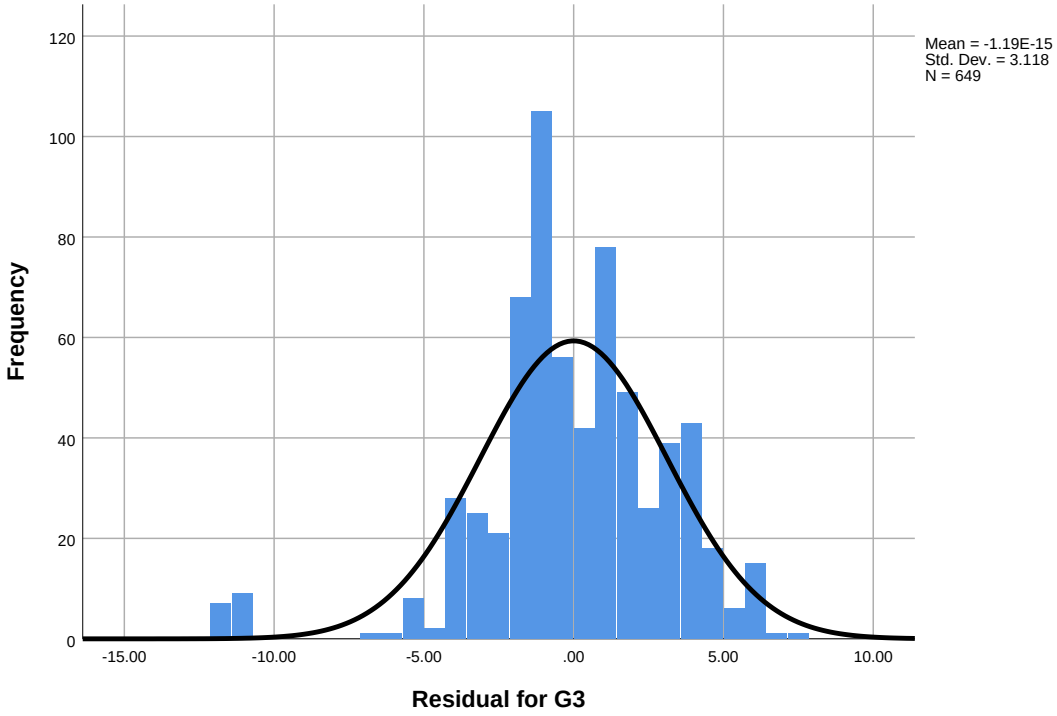
Dependent Variable: G3

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)

F Distribution: Residual histogram

Graph



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

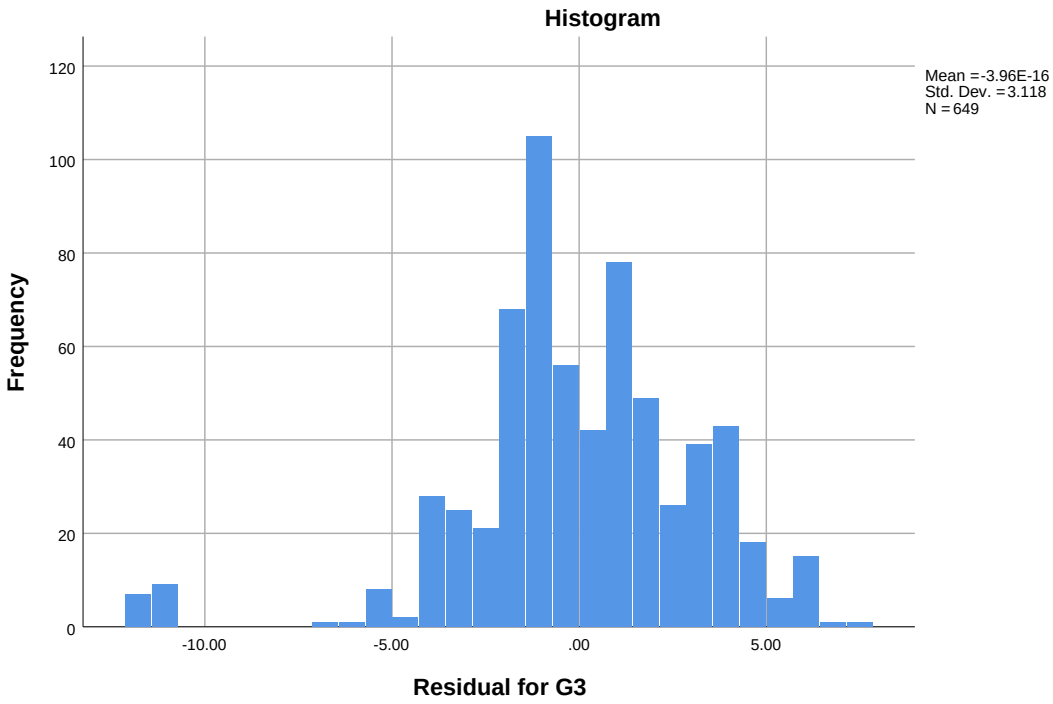
Tests of Normality

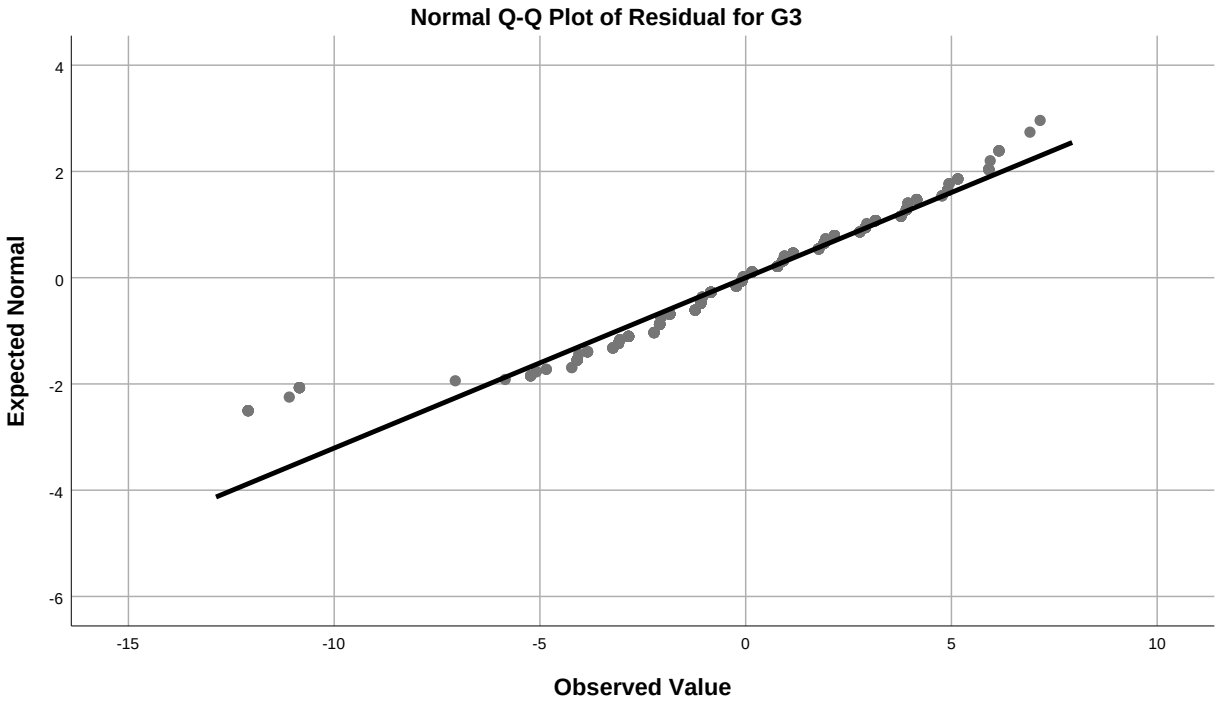
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
RES_1	.094	649	.000	.935	649	.000

a. Lilliefors Significance Correction

Residual for G3

F Distribution: Residual normality





F Distribution: Residual normality