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ANOVA in SPSS

ANOVA in SPSS
Import data

ANOVA in SPSS descriptives

ANOVA in SPSS descriptives
Dependent variable G3 by studytime groups

Means

[ANOVAInSPSSData] D:\DATA ANALYSIS\E ANOVA Family\ANOVA in SPSS\SPSS_Output\sav\ANOVA-in-SPSS-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

ANOVA in SPSS: One-way ANOVA

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>Warning # 2004.  Command name: SUBTITLE  
>The subtitle given exceeds 60 characters in length.  The first 60 characters  
>will be used.
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ANOVA in SPSS: One-way ANOVA
 Classical one-way ANOVA with homogeneity test and Tukey post

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

ANOVA in SPSS: One-way ANOVA
Classical one-way ANOVA with homogeneity test and Tukey post

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

ANOVA in SPSS: One-way ANOVA
Classical one-way ANOVA with homogeneity test and Tukey post

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.

ANOVA in SPSS: GLM with effect size

ANOVA in SPSS: GLM with effect size
 Partial eta squared is shown through ETASQ output

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

ANOVA in SPSS: GLM with effect size
 Partial eta squared is shown through ETASQ output

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.

ANOVA in SPSS: Estimated marginal means

ANOVA in SPSS: Estimated marginal means
Studytime group 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

ANOVA in SPSS: Estimated marginal means
Studytime group means and pairwise comparisons

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 ..
					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

ANOVA in SPSS: Estimated marginal means
Studytime group means and pairwise comparisons

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.

ANOVA in SPSS: Residual diagnostics

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

ANOVA in SPSS: Residual diagnostics
Save predicted values and residuals for checking model assum

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)

ANOVA in SPSS: Residual normality

ANOVA in SPSS: Residual normality
Histogram, boxplot, and normal probability plot of residuals

Explore

Case Processing Summary

	Valid		Cases 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 Upper Bound	
		-.2403 .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

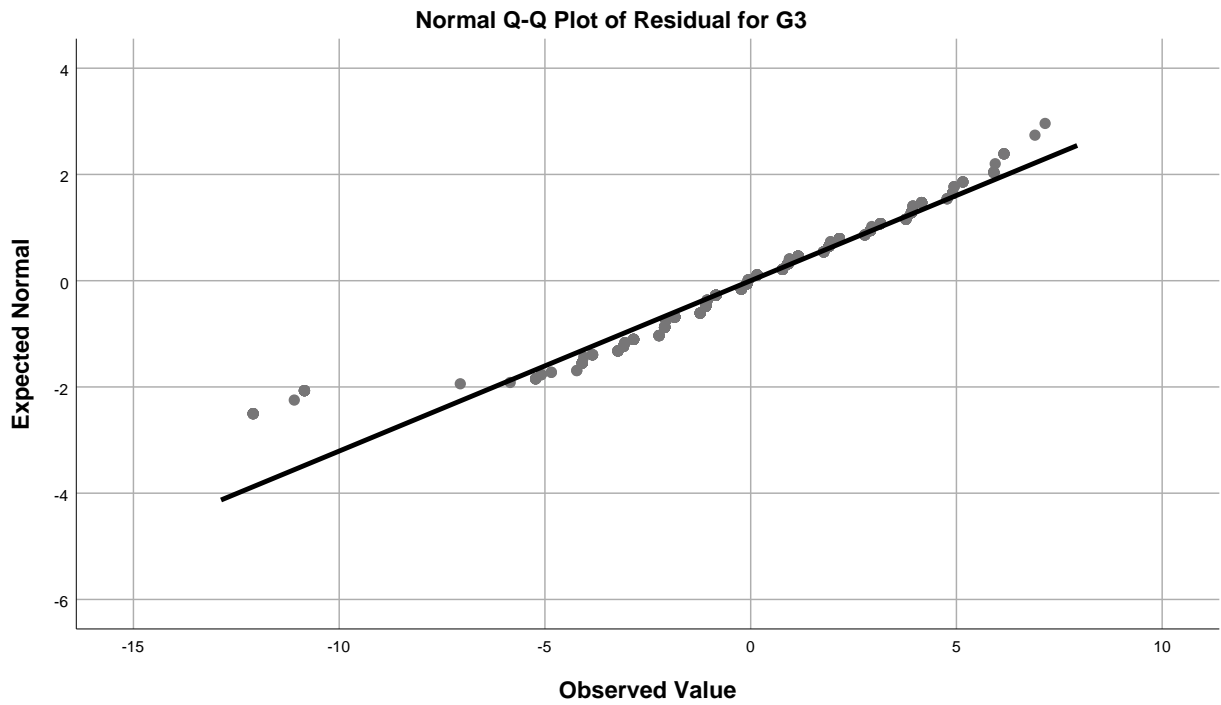
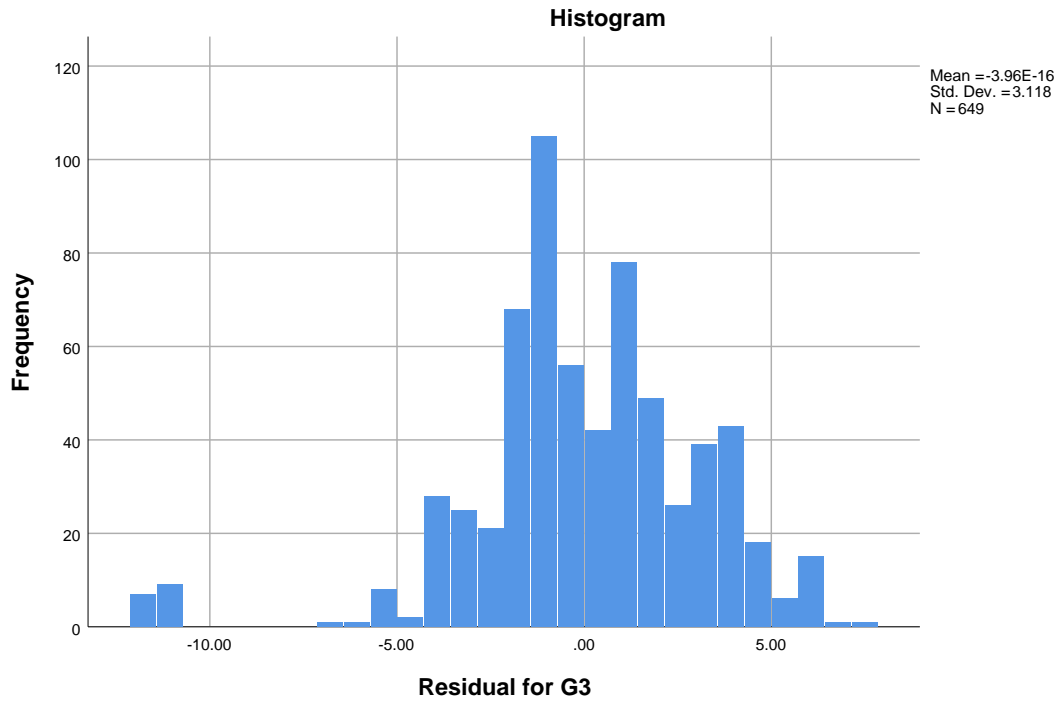
Tests of Normality

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

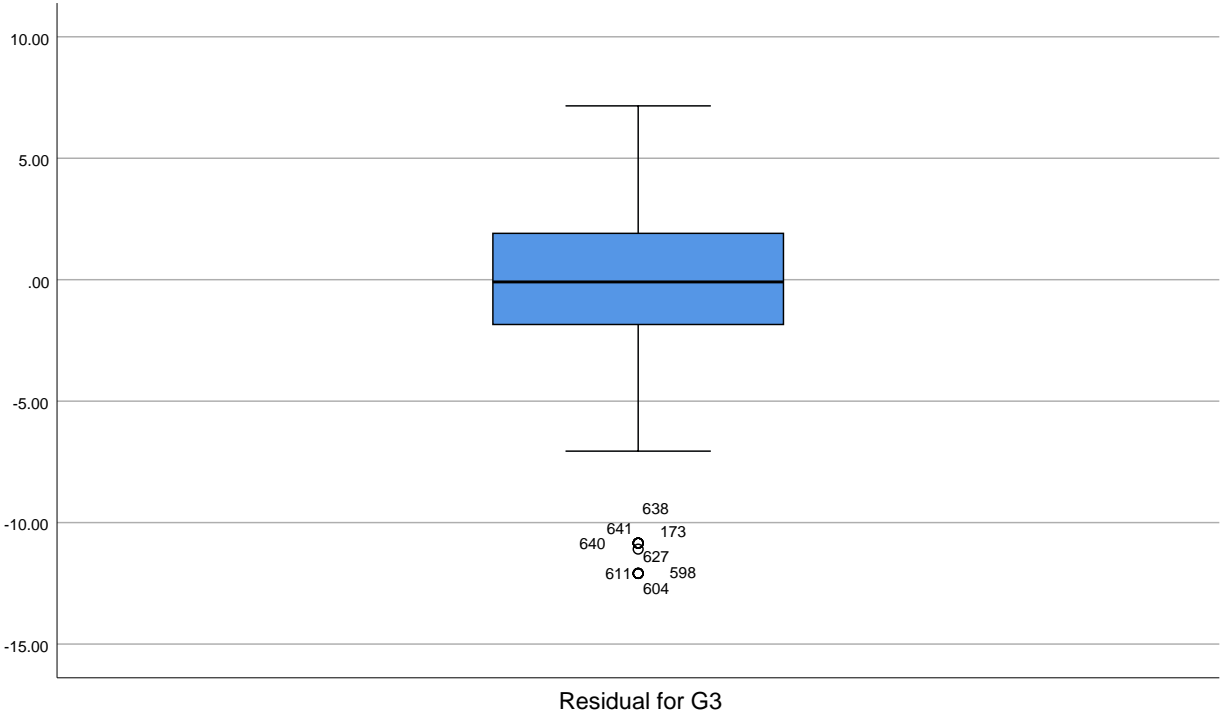
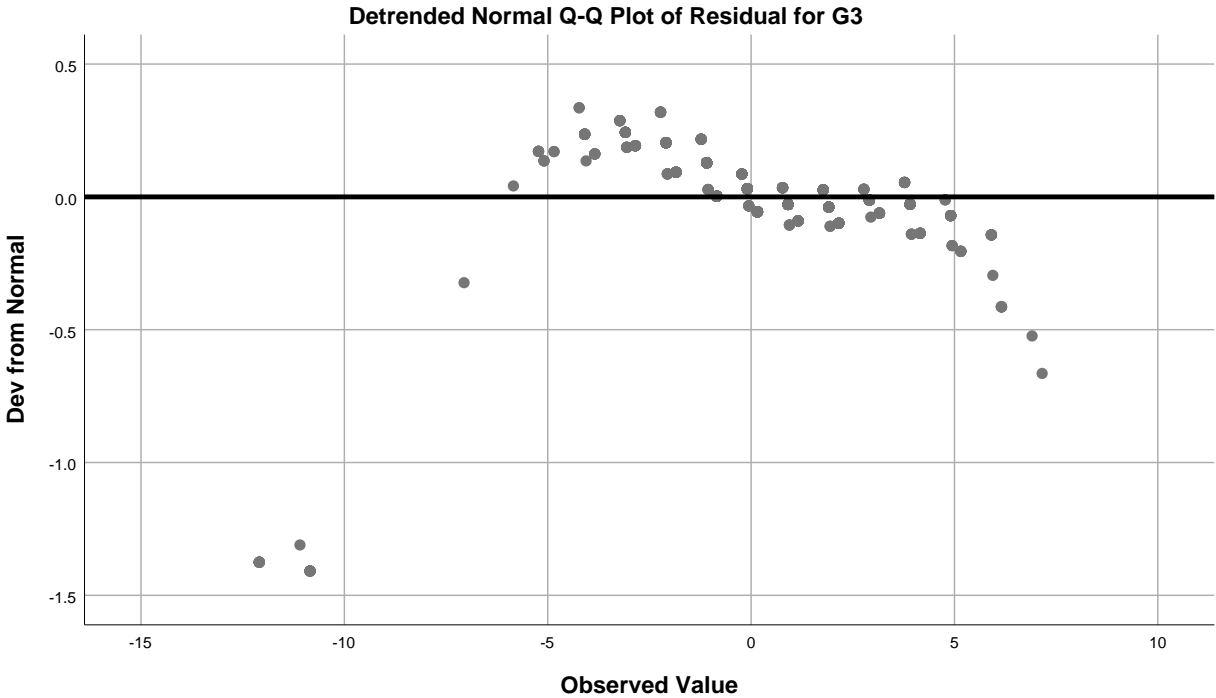
a. Lilliefors Significance Correction

Residual for G3

ANOVA in SPSS: Residual normality
Histogram, boxplot, and normal probability plot of residuals



ANOVA in SPSS: Residual normality
Histogram, boxplot, and normal probability plot of residuals



ANOVA in SPSS: Group boxplot

ANOVA in SPSS: Group boxplot
Boxplot of G3 by studytime group

Explore

Study time factor

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				

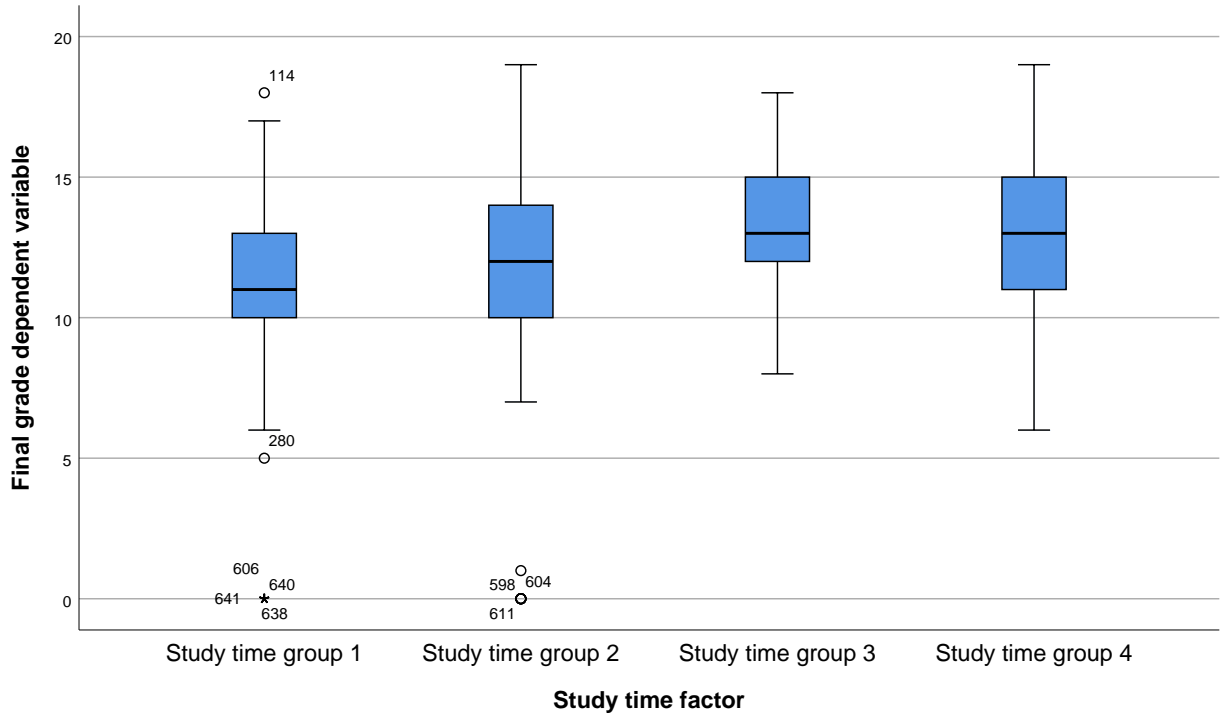
ANOVA in SPSS: Group boxplot
Boxplot of G3 by studytime group

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	

ANOVA in SPSS: Group boxplot
Boxplot of G3 by studytime group

Final grade dependent variable

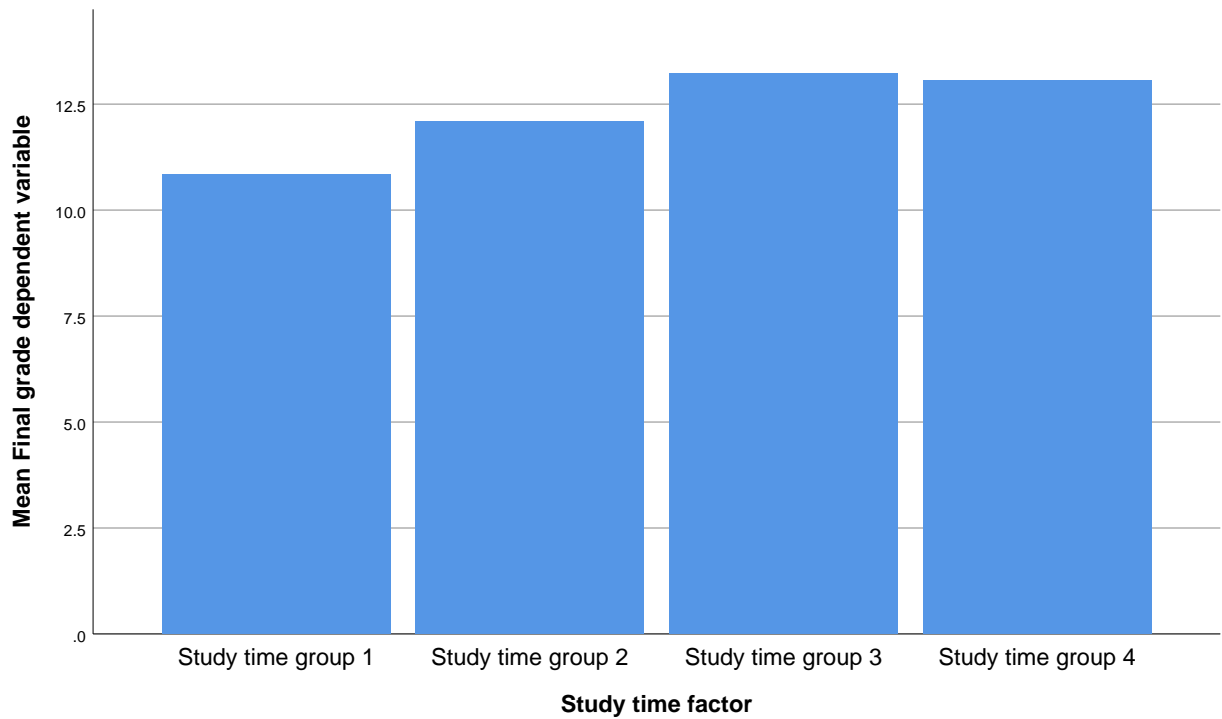


ANOVA in SPSS: Means plot

ANOVA in SPSS: Means plot
Mean G3 across studytime groups

Graph

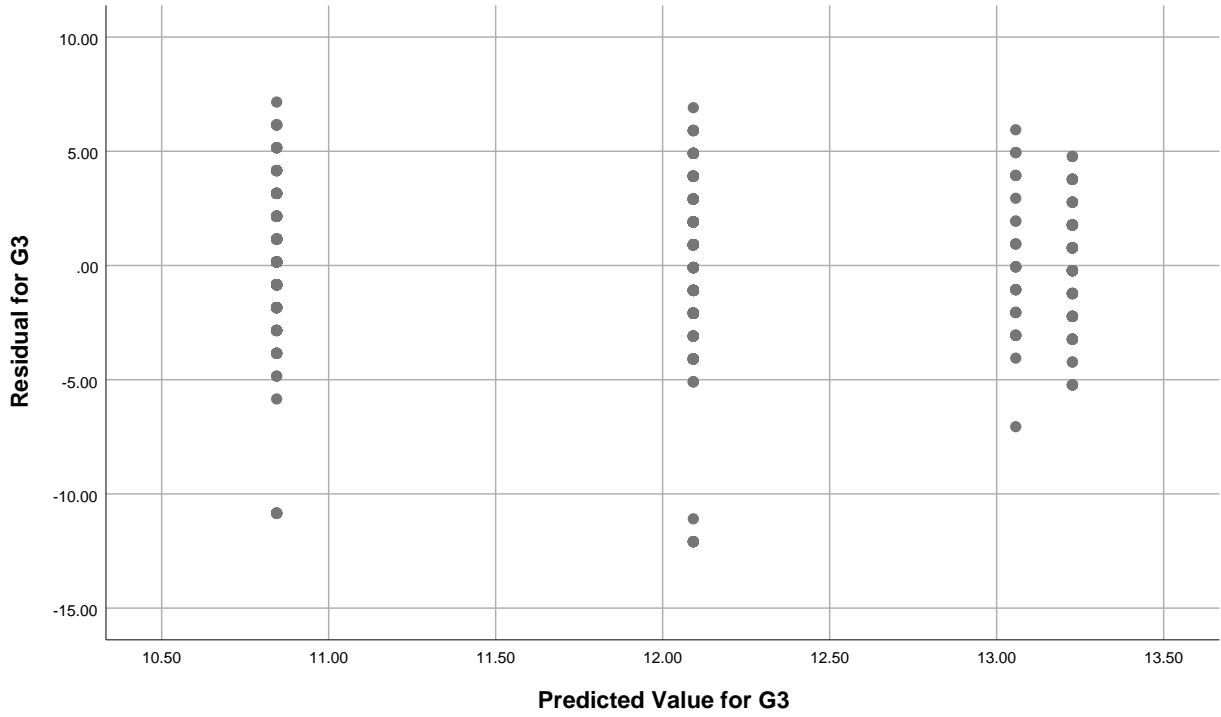
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ANOVA in SPSS: Residuals versus predicted values

ANOVA in SPSS: Residuals versus predicted values
Model diagnostic scatterplot

Graph



ANOVA in SPSS: Residual histogram

Graph

