Gabriel's Test Post Hoc Analysis

Purpose: compare all pairs of group means after a one-way ANOVA.
H0 for each pair: the two group means are equal.
H1 for each pair: the two group means are different.

Summary:

analysis	target_variable	group_variable	number_of_groups	number_of_pairwise_comparisons	significant_pairwise_comparisons_alpha_0_05	omnibus_anova_p_value	alpha	method_note	when_to_use_note
Gabriel's post hoc pairwise comparison test	G3	studytime	4	6	4	5.705728e-10	0.05	Python uses the Gabriel standard error formula with an approximate Studentized maximum modulus critical value. Use SPSS output for the official SPSS Gabriel table.	Gabriel's test is commonly used after one-way ANOVA when equal variances are assumed and group sizes are unequal but not extremely different.

ANOVA table:

source	sum_of_squares	df	mean_square	f_value	p_value
Between groups	465.077825	3	155.025942	15.876268	5.705728e-10
Within groups	6298.188739	645	9.764634	NaN	NaN
Total	6763.266564	648	NaN	NaN	NaN

Assumption context:

check	statistic	p_value	note
Brown-Forsythe / median Levene	NaN	NaN	Robust equal-variance context for post hoc selection.
Bartlett variance test	NaN	NaN	Sensitive to non-normality; use as context only.

Group summary:

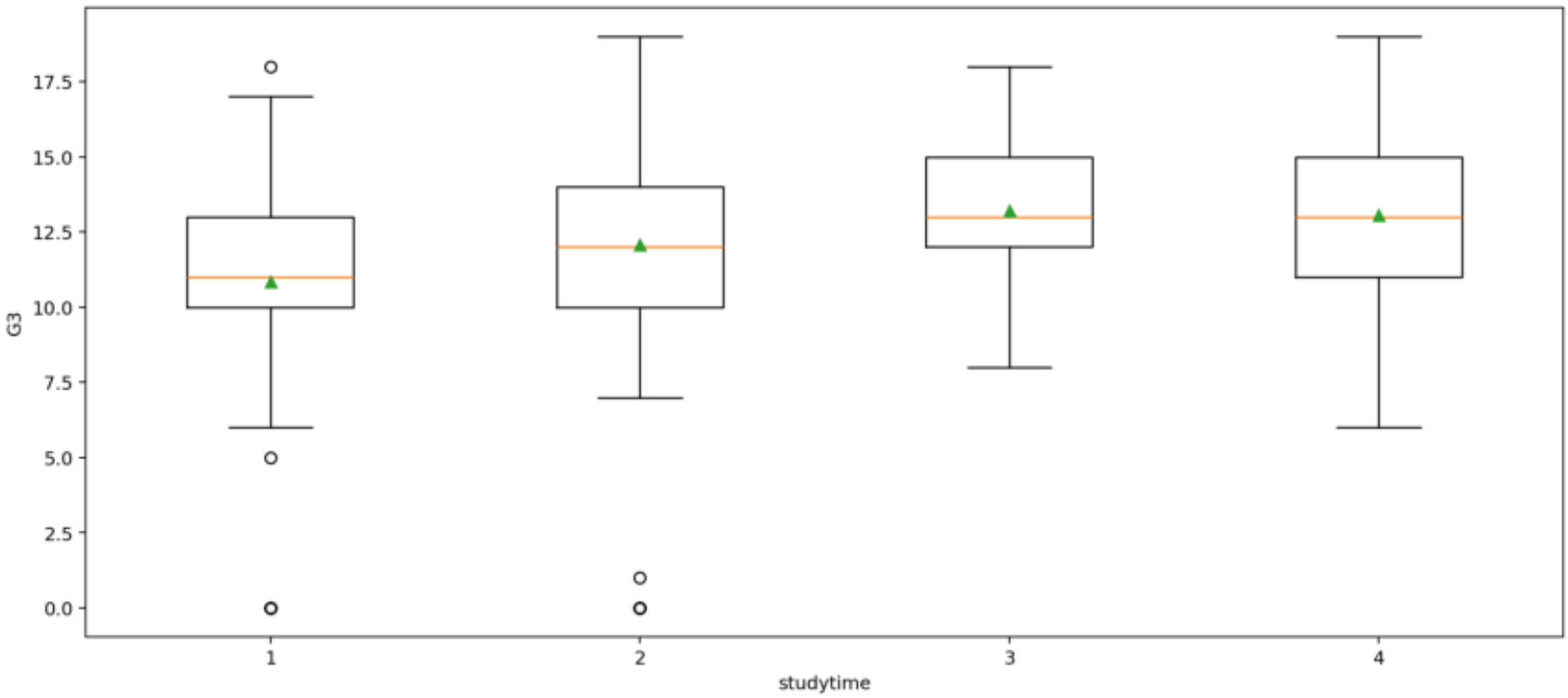
group	n	mean	standard_deviation	variance	standard_error	minimum	maximum	mean_ci95_lower	mean_ci95_upper
1	212	10.844340	3.218624	10.359541	0.221056	0	18	10.411070	11.277609
2	305	12.091803	3.243125	10.517860	0.185701	0	19	11.727830	12.455777
3	97	13.226804	2.502104	6.260524	0.254050	8	18	12.728866	13.724742
4	35	13.057143	3.038410	9.231933	0.513585	6	19	12.050516	14.063769

Gabriel pairwise comparisons:

group_1	group_2	mean_group_1	mean_group_2	mean_difference_group_1_minus_group_2	absolute_mean_difference	n_group_1	n_group_2	mse_within	s_pp_root_mse	gabriel_standard_error	gabriel_max_modulus_statistic	df_error	k_groups	k_star_pairwise_count	max_modulus_critical_alpha_0_05_approx	gabriel_adjusted_p_value_approx	gabriel_critical_difference	gabriel_ci95_lower	gabriel_ci95_upper	alpha	decision_alpha_0_05
1	3	10.844340	13.226804	-2.382465	2.382465	212	97	9.764634	3.124841	0.376106	6.334552	645	4	6	2.639141	2.679463e-09	0.992597	-3.375062	-1.389867	0.05	Significant by Gabriel approx
1	2	10.844340	12.091803	-1.247464	1.247464	212	305	9.764634	3.124841	0.278277	4.482815	645	4	6	2.639141	5.230486e-05	0.734412	-1.981875	-0.513052	0.05	Significant by Gabriel approx
1	4	10.844340	13.057143	-2.212803	2.212803	212	35	9.764634	3.124841	0.525246	4.212892	645	4	6	2.639141	1.728155e-04	1.386197	-3.599001	-0.826606	0.05	Significant by Gabriel approx
2	3	12.091803	13.226804	-1.135001	1.135001	305	97	9.764634	3.124841	0.350872	3.234803	645	4	6	2.639141	7.652156e-03	0.926000	-2.061001	-0.209001	0.05	Significant by Gabriel approx
2	4	12.091803	13.057143	-0.965340	0.965340	305	35	9.764634	3.124841	0.500011	1.930636	645	4	6	2.639141	2.831301e-01	1.319600	-2.284939	0.354260	0.05	Not significant by Gabriel approx
3	4	13.226804	13.057143	0.169661	0.169661	97	35	9.764634	3.124841	0.597841	0.283790	645	4	6	2.639141	9.998759e-01	1.577785	-1.408124	1.747447	0.05	Not significant by Gabriel approx

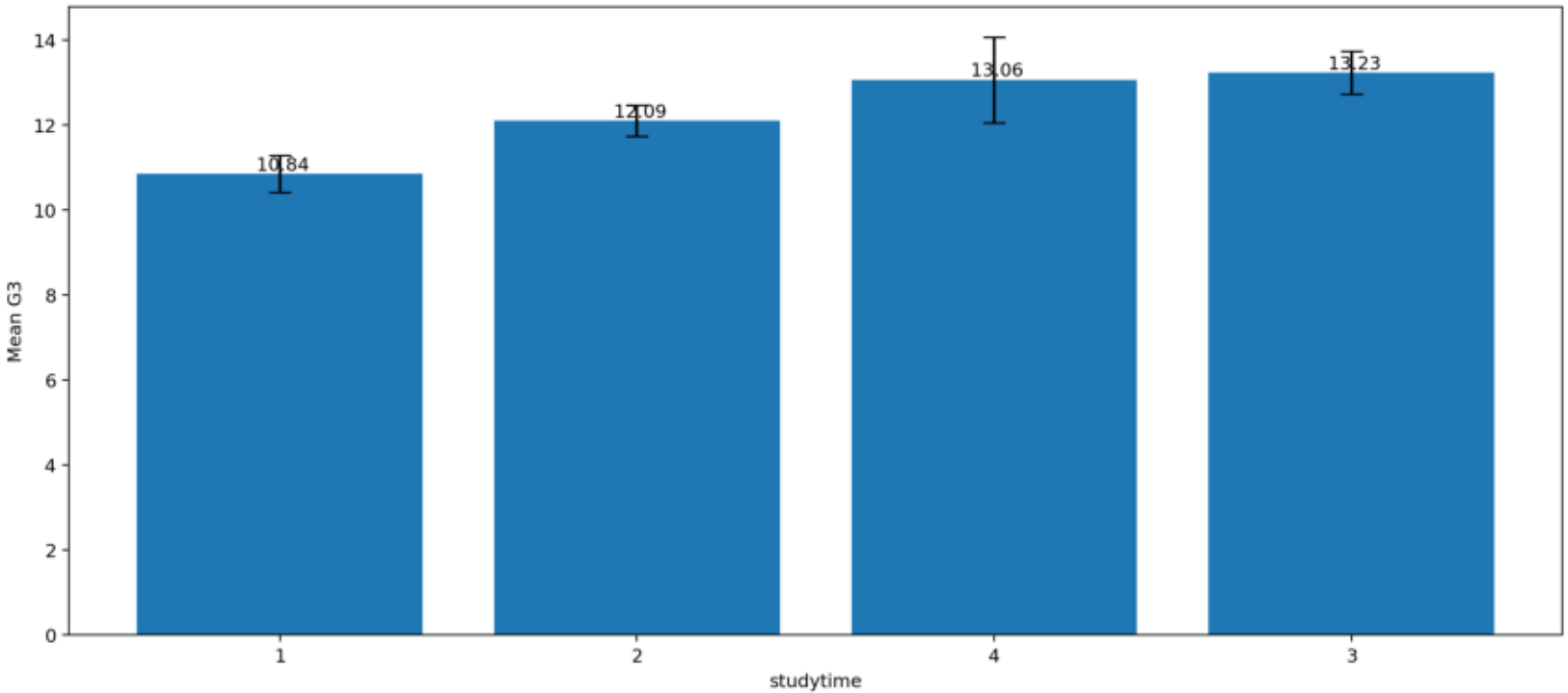
Gabriel's Test: Group Distribution Boxplots

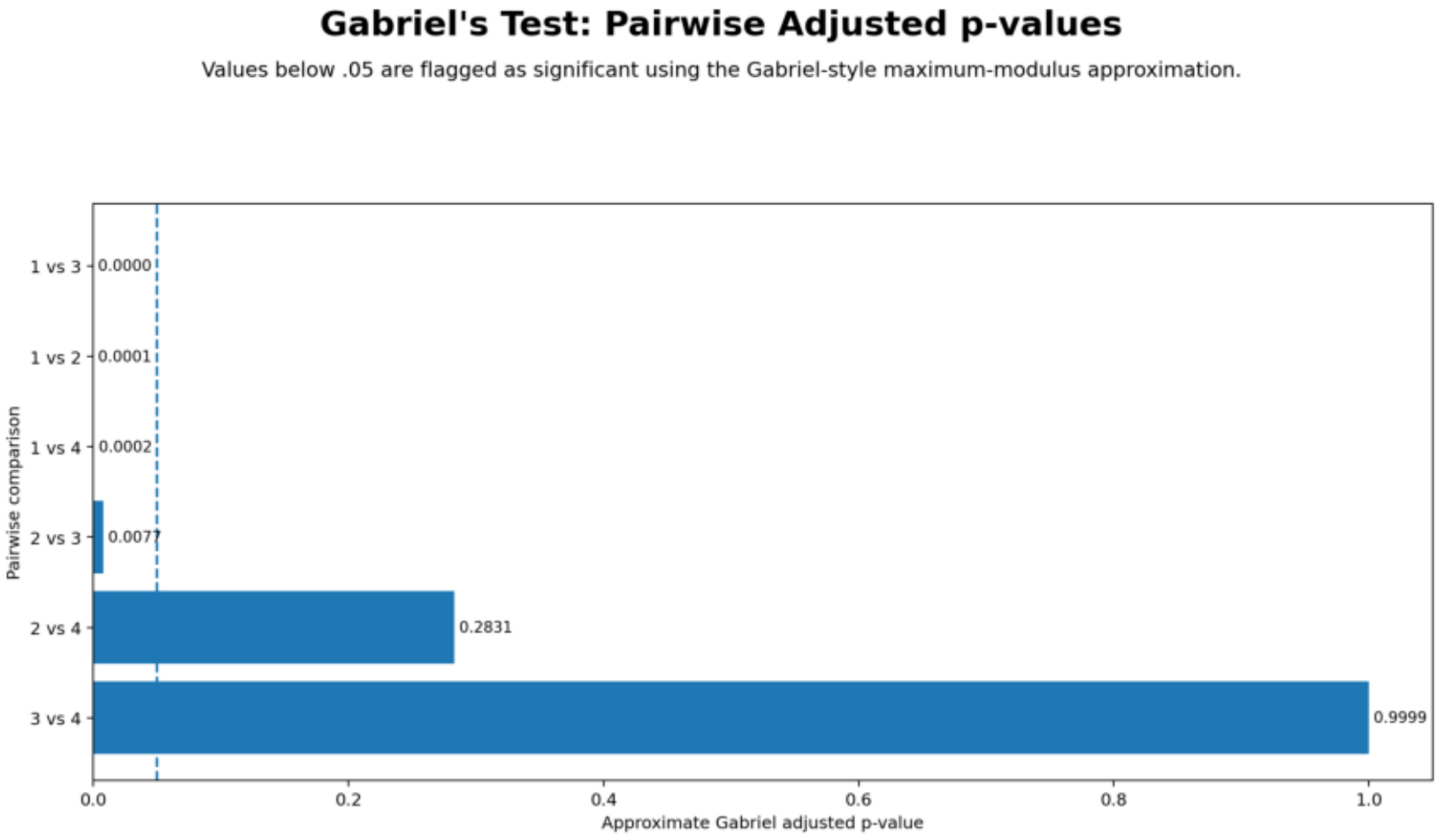
Boxplots show whether group centers and spreads differ before post-hoc pairwise comparisons.

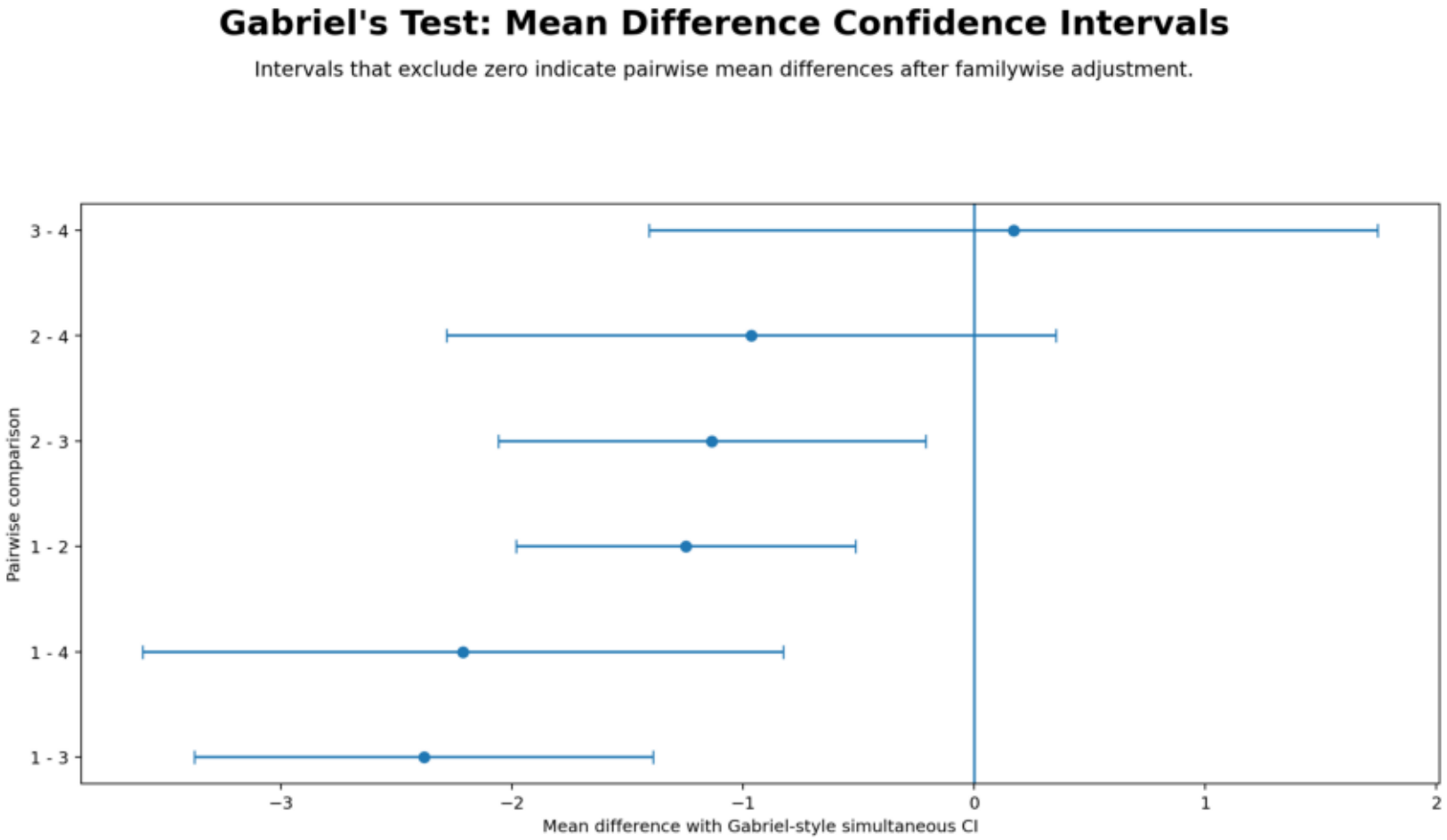


Gabriel's Test: Group Means with 95% CIs

Gabriel's test compares each pair of group means after the omnibus ANOVA.




Gabriel's Test: Pairwise Adjusted p-values
Values below .05 are flagged as significant using the Gabriel-style maximum-modulus approximation.
Pairwise comparison
1 vs 3
1 vs 2
1 vs 4
2 vs 3
2 vs 4
3 vs 4
0.0000
0.0001
0.0002
0.0077
0.2831
0.9999
0.0
0.2
0.4
0.6
0.8
1.0
Approximate Gabriel adjusted p-value


Gabriel's Test: Mean Difference Confidence Intervals
Intervals that exclude zero indicate pairwise mean differences after familywise adjustment.
3 - 4
2 - 4
2 - 3
1 - 2
1 - 4
1 - 3
Pairwise comparison
−3
−2
−1
0
1
2
Mean difference with Gabriel-style simultaneous CI

Gabriel's Test: Significant Difference Count by Group

This chart highlights which groups drive the post-hoc differences.