Waller-Duncan / Bayesian K-Ratio Post Hoc Analysis

Workflow:
1. Run one-way ANOVA for the dependent variable across the selected factor.
2. Review equal-variance context because the procedure uses pooled ANOVA error.
3. Use SPSS WALLER(100) output as the official Waller-Duncan reference.
4. Use Python/R tables and charts for transparent reporting and visualization.

ANOVA result:

target_variable	group_variable	number_of_groups	total_n	grand_mean	ss_between	df_between	ms_between	ss_within_error	df_within_error	ms_within_error	f_statistic	p_value	eta_squared	omega_squared	alpha_reference	waller_duncan_k_ratio	anova_decision_alpha_0_05
G3	studytime	4	649	11.906009	465.077825	3	155.025942	6298.188739	645	9.764634	15.876268	5.705728e-10	0.068765	0.064341	0.05	100	Reject equal means

Levene context:

context_test	statistic	p_value	interpretation
Median-centered Levene / Brown-Forsythe context	1.026312	0.380358	Waller-Duncan is an ANOVA-based post hoc procedure; inspect equal-variance context before relying on pooled-error comparisons.

Group summary:

group	n	mean	standard_deviation	standard_error	variance	minimum	maximum	ci95_low	ci95_high
1	212	10.844340	3.218624	0.221056	10.359541	0.0	18.0	10.411070	11.277609
2	305	12.091803	3.243125	0.185701	10.517860	0.0	19.0	11.727830	12.455777
3	97	13.226804	2.502104	0.254050	6.260524	8.0	18.0	12.728866	13.724742
4	35	13.057143	3.038410	0.513585	9.231933	6.0	19.0	12.050516	14.063769

Interpretation summary:

analysis	dependent_variable	group_variable	k_ratio	anova_p_value	levene_p_value	pairwise_comparisons	different_subset_pairs_python_r_approximation	same_subset_pairs_python_r_approximation	highest_mean_group	lowest_mean_group	official_reference
Waller-Duncan K-ratio post hoc analysis	G3	studytime	100	5.705728e-10	0.380358	6	4	2	3	1	Use SPSS ONEWAY /POSTHOC=WALLER(100) output as the official Waller-Duncan result.

Waller-Duncan Pairwise and Subset Tables

Pairwise comparison table:

comparison_order	ordered_range_size	lower_mean_group	higher_mean_group	lower_mean	higher_mean	mean_difference_high_minus_low	pooled_mse	standard_error_pooled	t_statistic	df_error	waller_duncan_k_ratio	k_ratio_alpha_approximation	critical_t_approximation	critical_mean_difference	unadjusted_t_p_value	decision_k_ratio_approximation	method_note
1	2	1	2	10.844340	12.091803	1.247464	9.764634	0.279419	4.464497	645	100	0.009901	2.58694	0.722839	9.473280e-06	Different subsets	Python/R table uses a transparent K-ratio t-style approximation for reporting; SPSS WALLER(k) output should be treated as official
2	3	1	4	10.844340	13.057143	2.212803	9.764634	0.570131	3.881220	645	100	0.009901	2.58694	1.474894	1.146236e-04	Different subsets	Python/R table uses a transparent K-ratio t-style approximation for reporting; SPSS WALLER(k) output should be treated as official
3	4	1	3	10.844340	13.226804	2.382465	9.764634	0.383048	6.219751	645	100	0.009901	2.58694	0.990923	8.952929e-10	Different subsets	Python/R table uses a transparent K-ratio t-style approximation for reporting; SPSS WALLER(k) output should be treated as official
4	2	2	4	12.091803	13.057143	0.965340	9.764634	0.557678	1.730998	645	100	0.009901	2.58694	1.442679	8.393031e-02	Same subset	Python/R table uses a transparent K-ratio t-style approximation for reporting; SPSS WALLER(k) output should be treated as official
5	3	2	3	12.091803	13.226804	1.135001	9.764634	0.364255	3.115953	645	100	0.009901	2.58694	0.942305	1.914916e-03	Different subsets	Python/R table uses a transparent K-ratio t-style approximation for reporting; SPSS WALLER(k) output should be treated as official
6	2	4	3	13.057143	13.226804	0.169661	9.764634	0.616162	0.275352	645	100	0.009901	2.58694	1.593975	7.831343e-01	Same subset	Python/R table uses a transparent K-ratio t-style approximation for reporting; SPSS WALLER(k) output should be treated as official

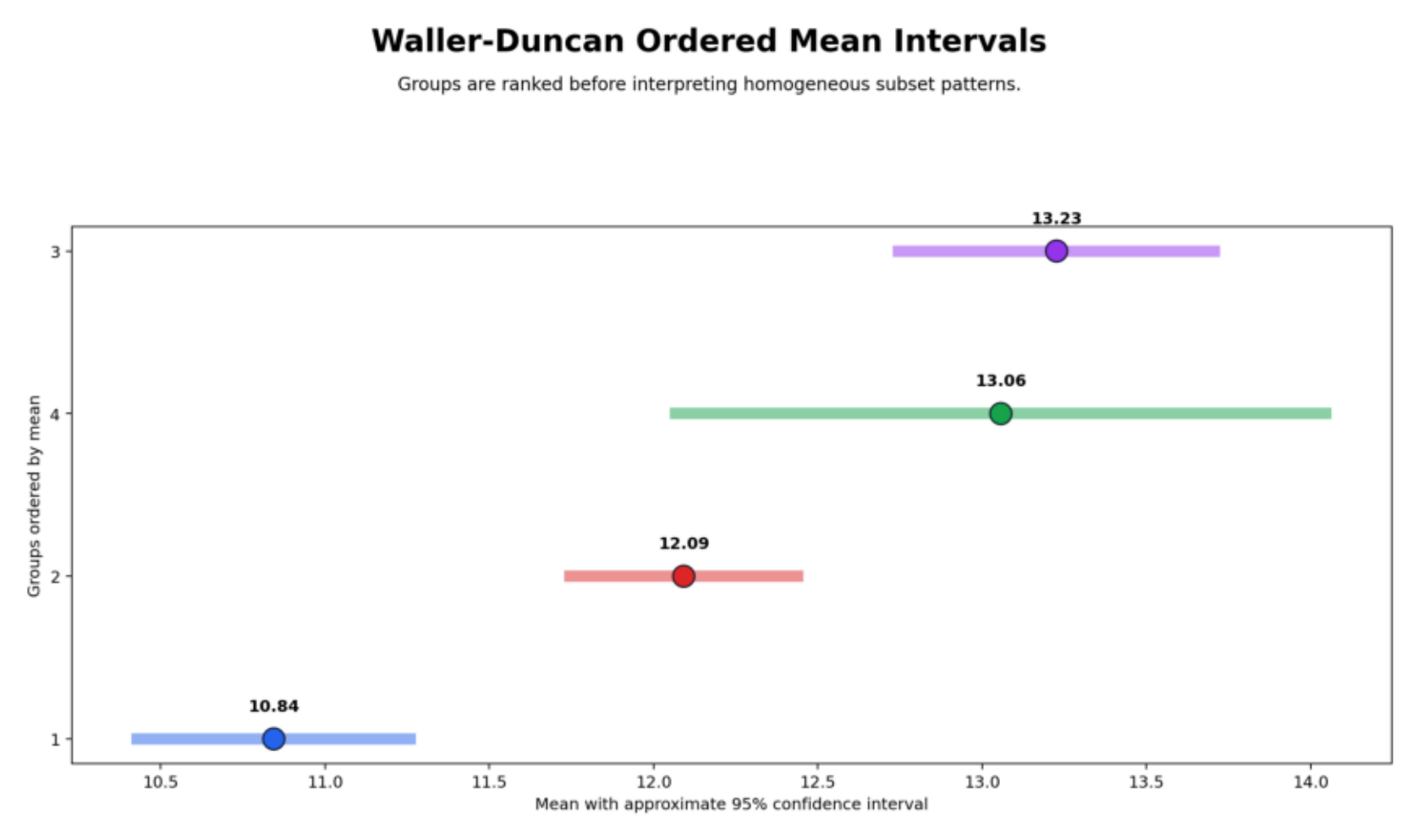
Homogeneous subset letters:

group	mean	waller_duncan_subset_letters
3	13.226804	A
4	13.057143	A
2	12.091803	B
1	10.844340	C

Waller-Duncan Method Report Card

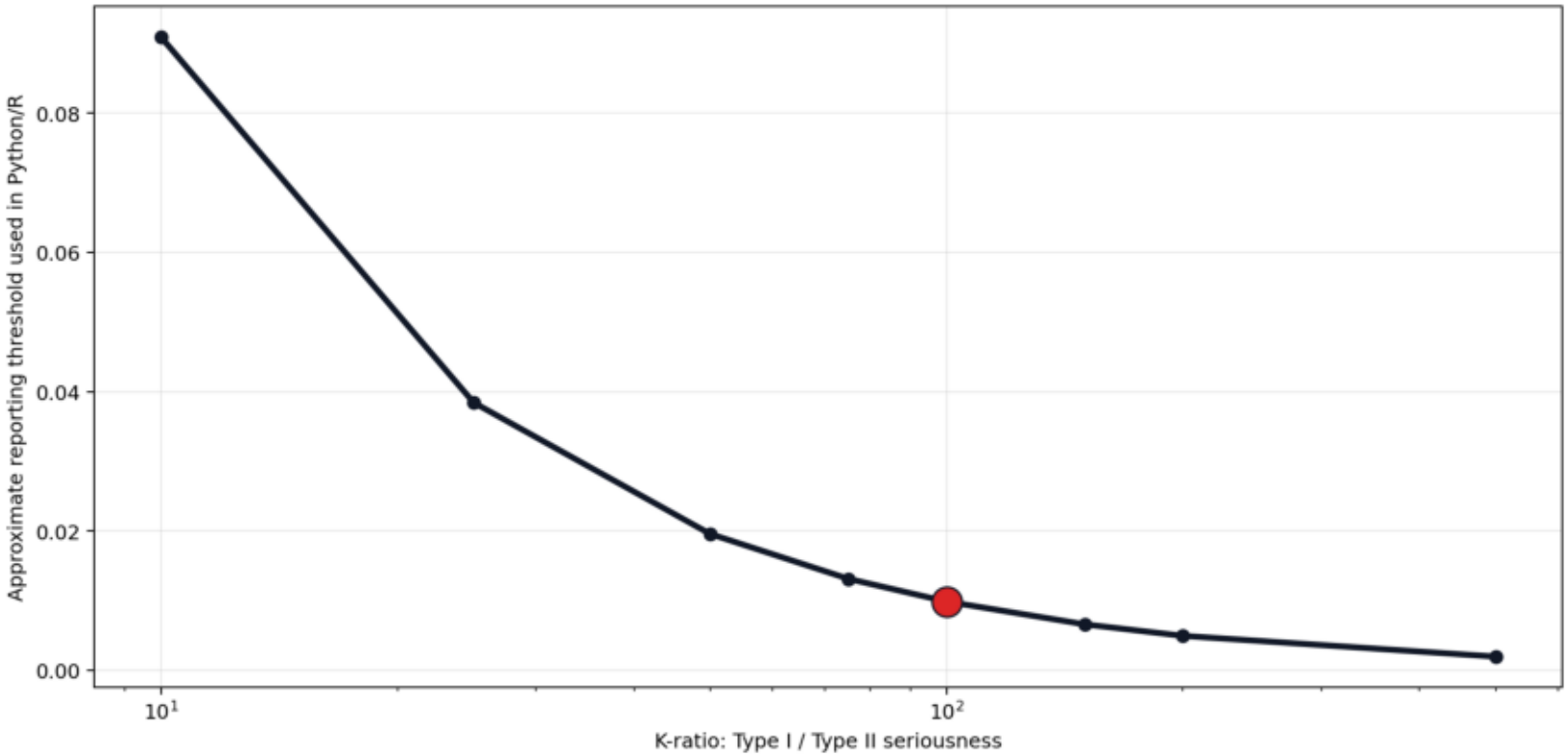
The K-ratio controls the seriousness balance between Type I and Type II errors.

Method	Waller-Duncan Bayesian K-ratio t test
K-ratio	100
Type I / Type II seriousness	100:1
Reference alpha	0.05
K-ratio alpha approximation	0.0099
ANOVA F	15.8763
ANOVA p	0.00000
Pairs classified different	4
Official software reference	SPSS WALLER(100)


Waller-Duncan Ordered Mean Intervals
Groups are ranked before interpreting homogeneous subset patterns.
13.23
13.06
12.09
10.84
Groups ordered by mean
3
4
2
1
10.5
11.0
11.5
12.0
12.5
13.0
13.5
14.0
Mean with approximate 95% confidence interval

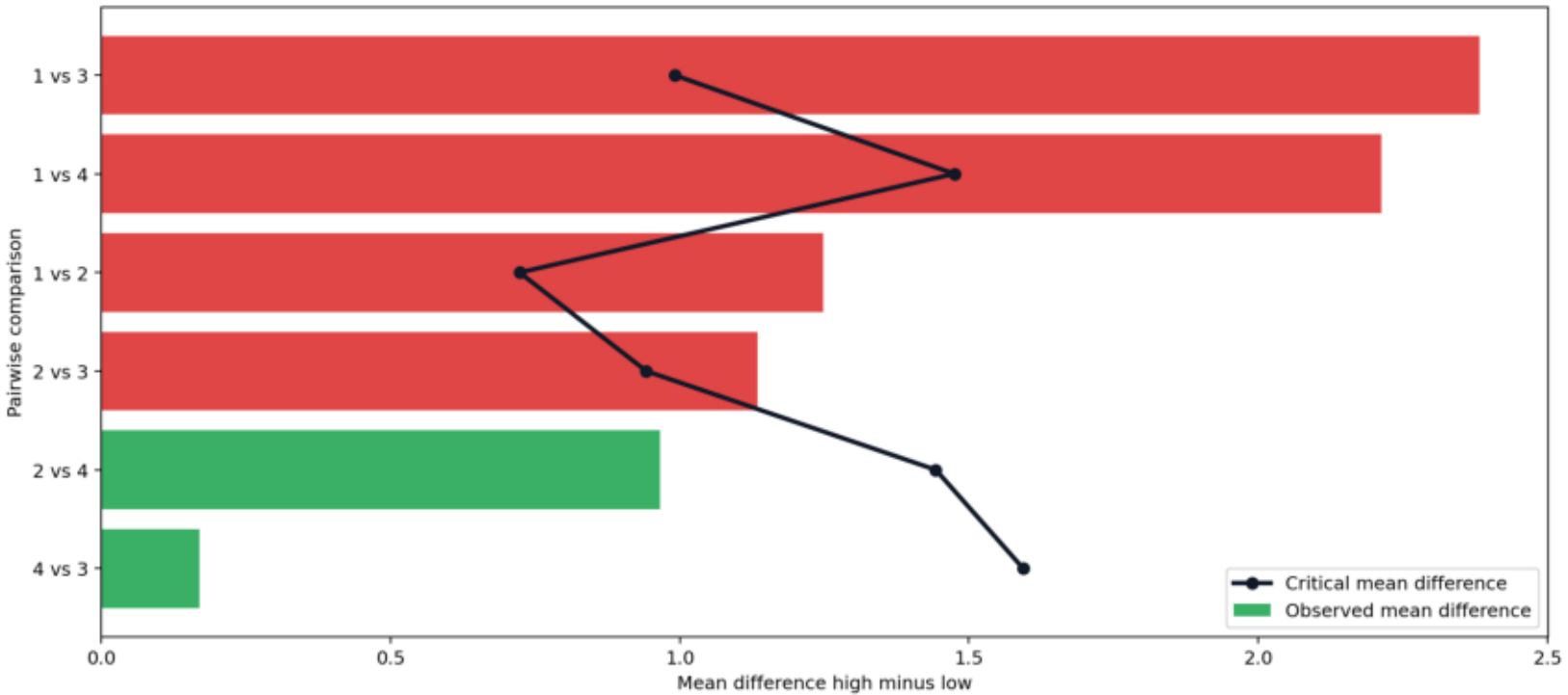
Waller-Duncan K-Ratio Sensitivity

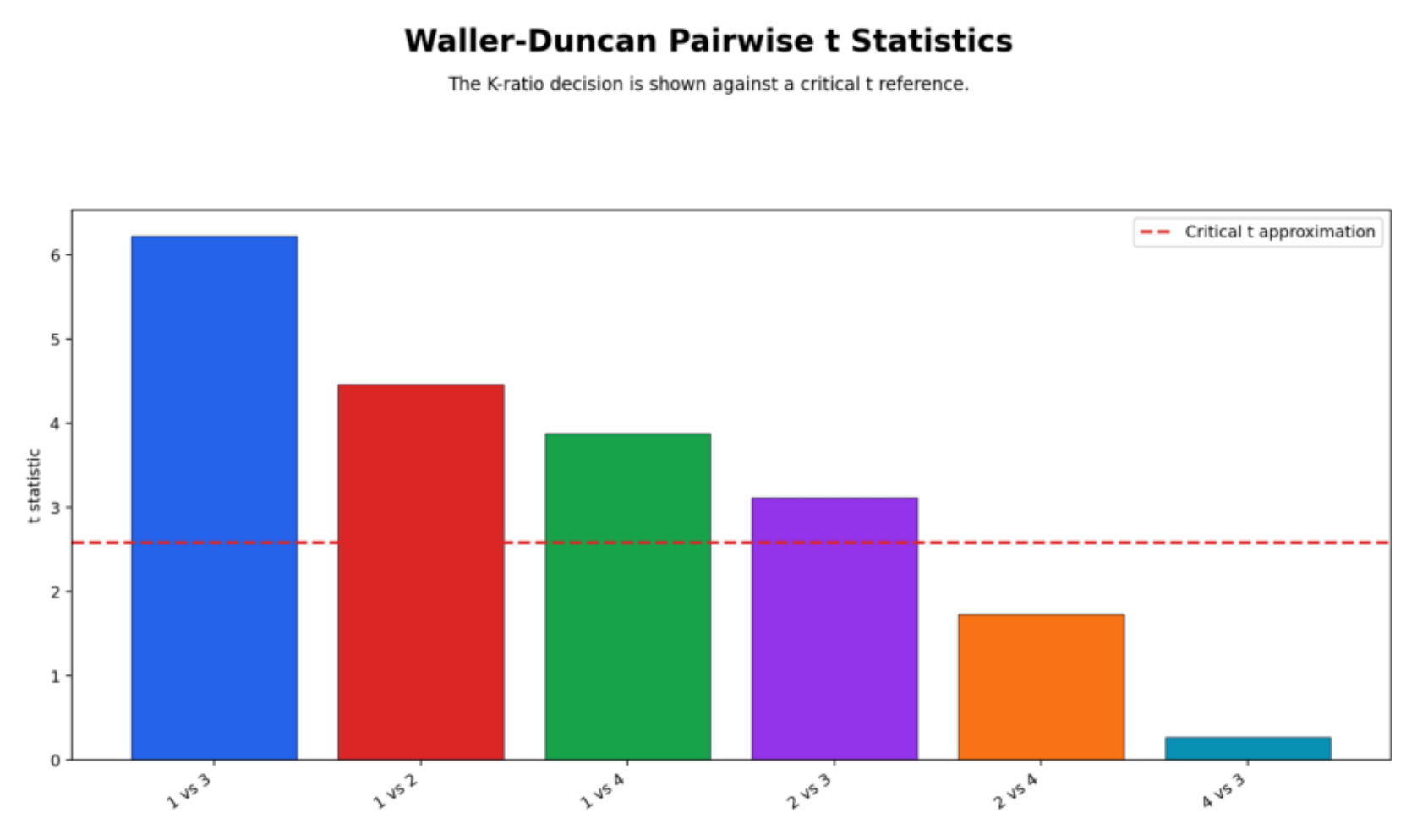
Larger K-ratios make Type I error more serious in the Bayesian decision framing.



Waller-Duncan Mean Difference vs Critical Difference

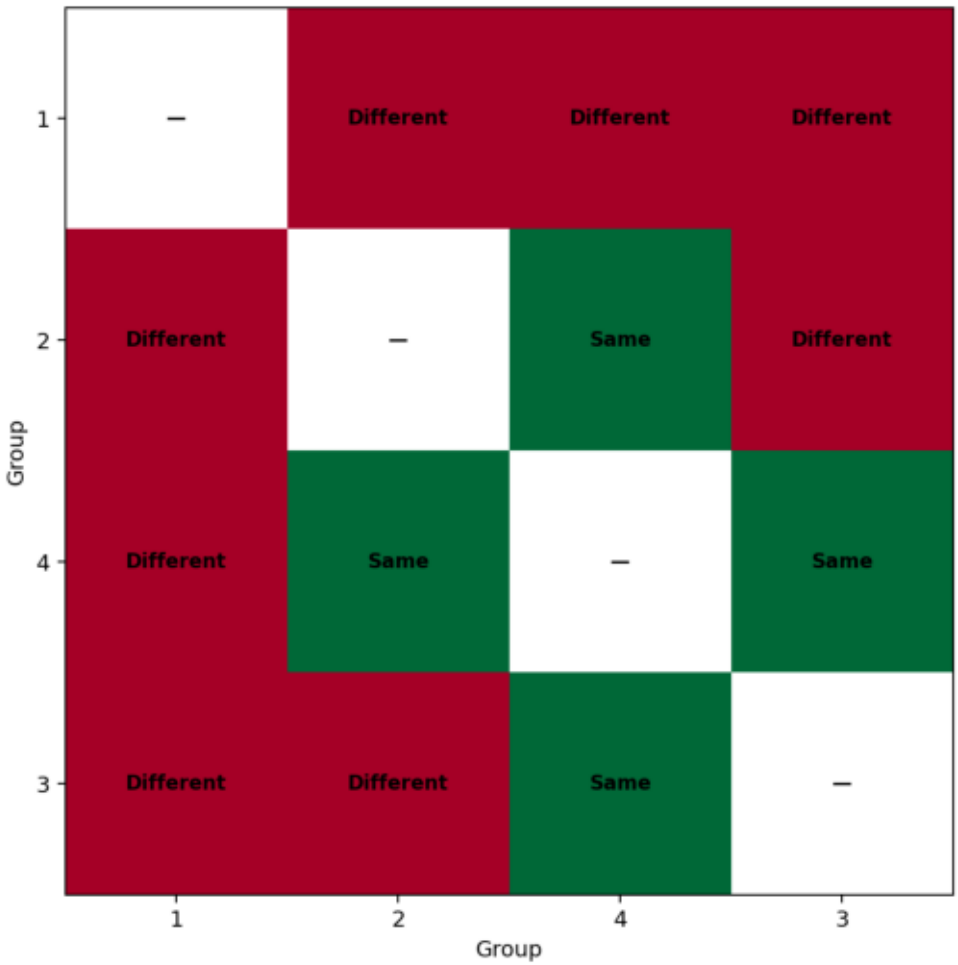
A pair is separated when the observed difference exceeds the K-ratio critical difference.




Waller-Duncan Pairwise t Statistics
The K-ratio decision is shown against a critical t reference.
Critical t approximation
t statistic
0
1
2
3
4
5
6
1 vs 3
1 vs 2
1 vs 4
2 vs 3
2 vs 4
4 vs 3

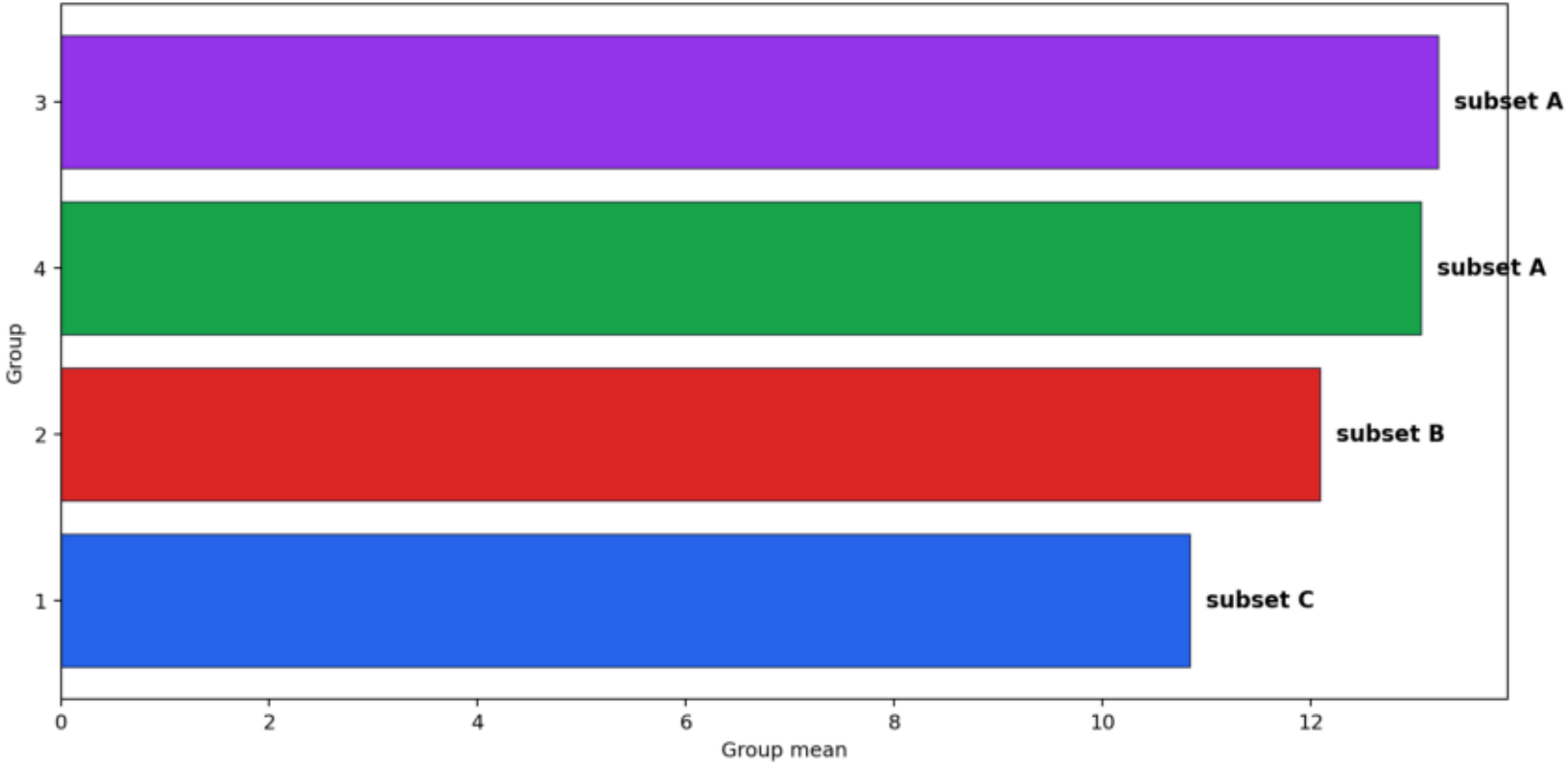
Waller-Duncan Homogeneous Subset Decision Matrix

Cells show whether each pair is separated by the K-ratio approximation.



Waller-Duncan Homogeneous Subset Letters

Groups sharing a letter are not separated in the Python/R approximation.



Waller-Duncan Distribution Context

Violin and boxplot views help check group spread before pooled-error post hoc interpretation.