

Holm-Bonferroni Method Post Hoc Analysis

Purpose: adjust multiple pairwise p-values while controlling family-wise error.
 Workflow: one-way ANOVA context + pooled pairwise t-tests + Holm step-down correction.

Interpretation summary:

analysis	anova_p_value	anova_decision_alpha_0_05	pairwise_comparisons	holm_significant_comparisons
Holm-Bonferroni Method	5.705728e-10	Reject equal means	6	4
smallest_adjusted_p_comparison	smallest_holm_adjusted_p			
	1 vs 3	5.371757e-09		

note

Holm-Bonferroni controls family-wise error by testing the smallest p-value first and then using progressively less strict thresholds.

ANOVA table:

source	sum_of_squares	df	mean_square	f_value	p_value
Between groups	465.0778	3	155.025942	15.87627	5.705728e-10
Within groups	6298.1887	645	9.764634	NA	NA
Total	6763.2666	648	NA	NA	NA

Group summary:

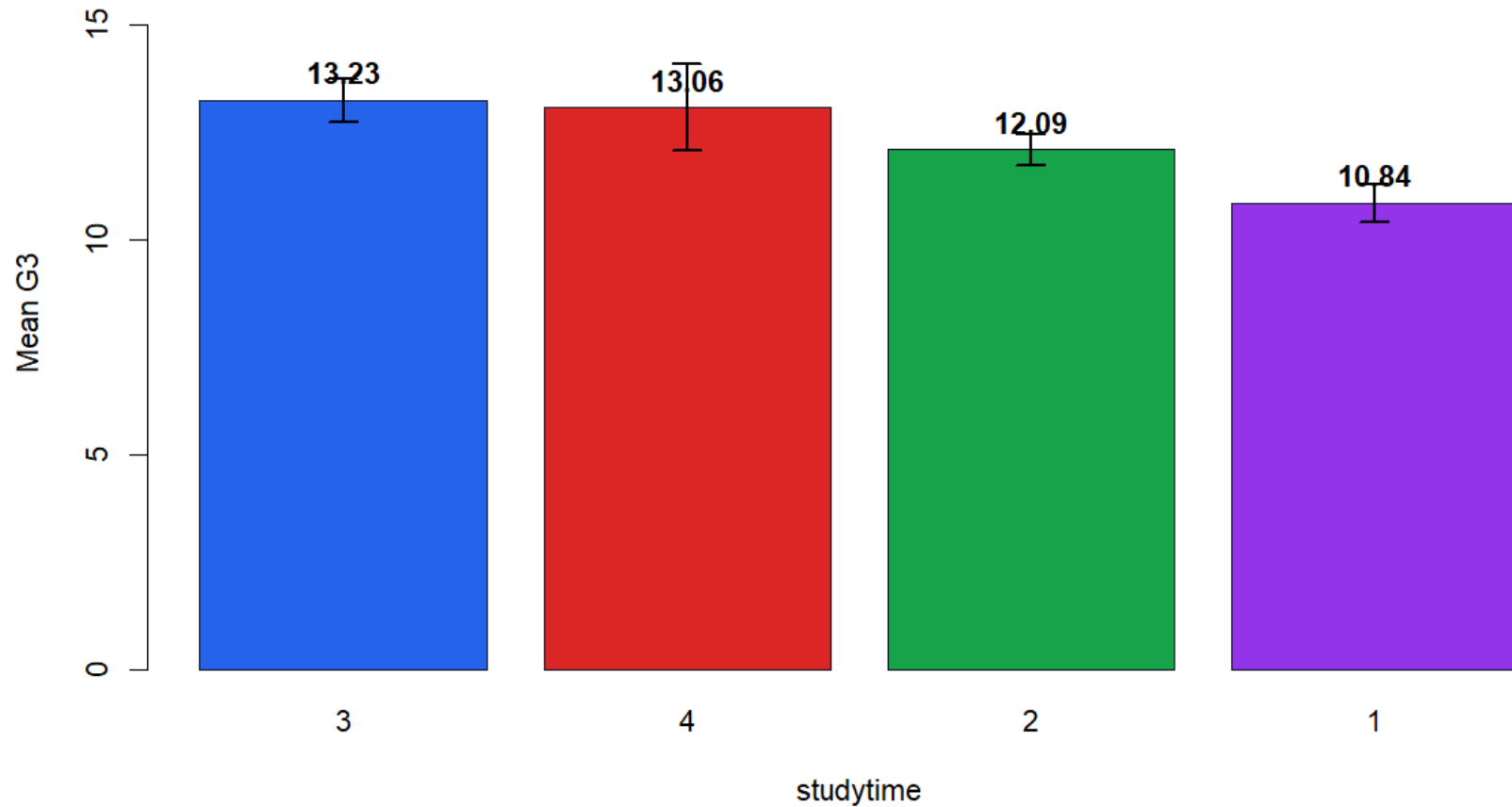
group	n	mean	standard_deviation	variance	standard_error	minimum	maximum	mean_ci95_lower	mean_ci95_upper
1	212	10.84434	3.218624	10.359541	0.2210560	0	18	10.41107	11.27761
2	305	12.09180	3.243125	10.517860	0.1857008	0	19	11.72783	12.45578
3	97	13.22680	2.502104	6.260524	0.2540502	8	18	12.72887	13.72474
4	35	13.05714	3.038410	9.231933	0.5135850	6	19	12.05052	14.06377

Holm-Bonferroni pairwise results:

comparison	mean_difference_group_1_minus_group_2	p_unadjusted	p_holm_adjusted	significant_holm_alpha_0_05
1 vs 3	-2.3824645	8.952929e-10	5.371757e-09	Yes
1 vs 2	-1.2474637	9.473280e-06	4.736640e-05	Yes
1 vs 4	-2.2128032	1.146236e-04	4.584943e-04	Yes
2 vs 3	-1.1350008	1.914916e-03	5.744748e-03	Yes
2 vs 4	-0.9653396	8.393031e-02	1.678606e-01	No
3 vs 4	0.1696613	7.831343e-01	7.831343e-01	No

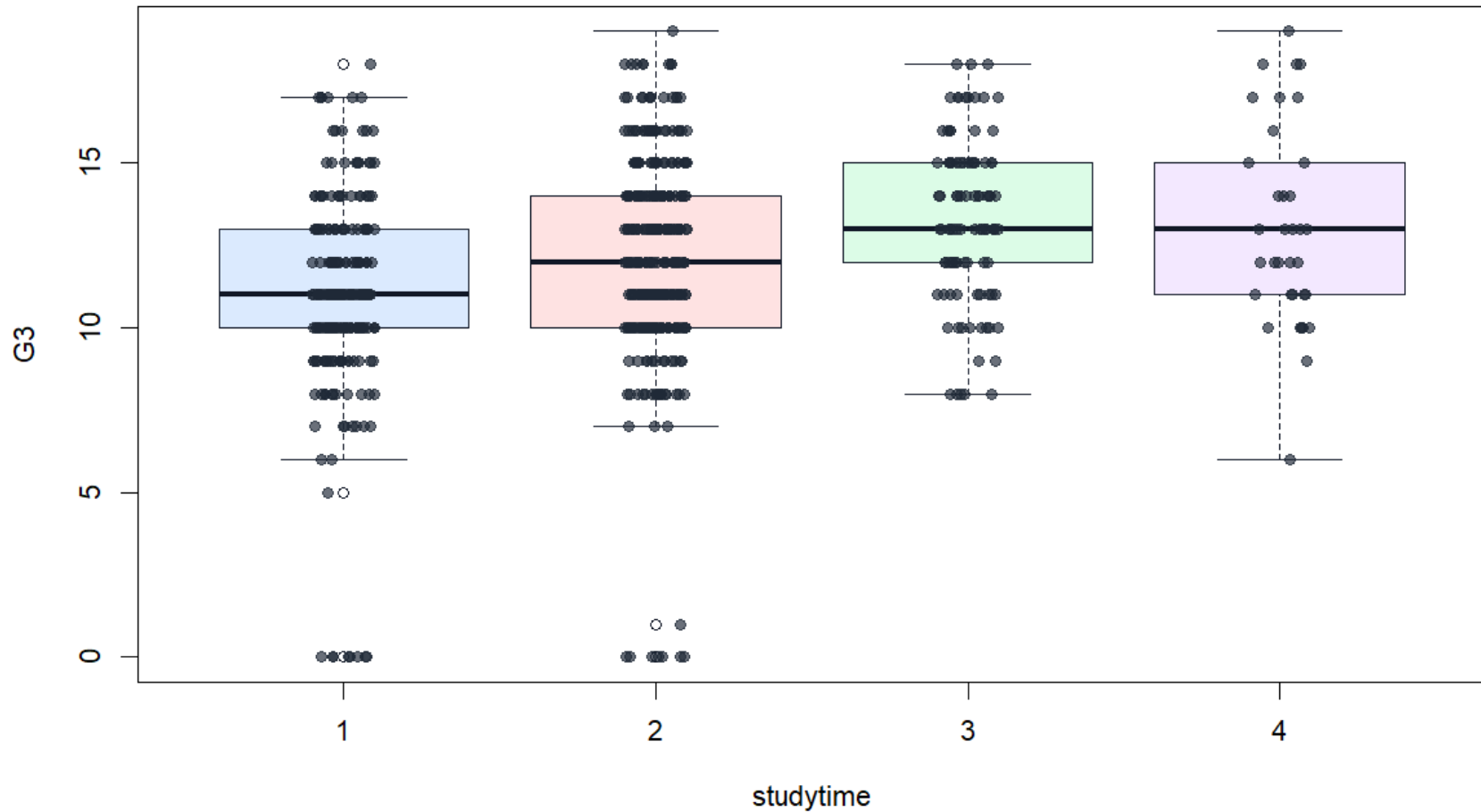
decision
 Reject equal means
 Reject equal means
 Reject equal means
 Reject equal means
 Fail to reject equal means
 Fail to reject equal means

Holm-Bonferroni: Group Means with 95% CI



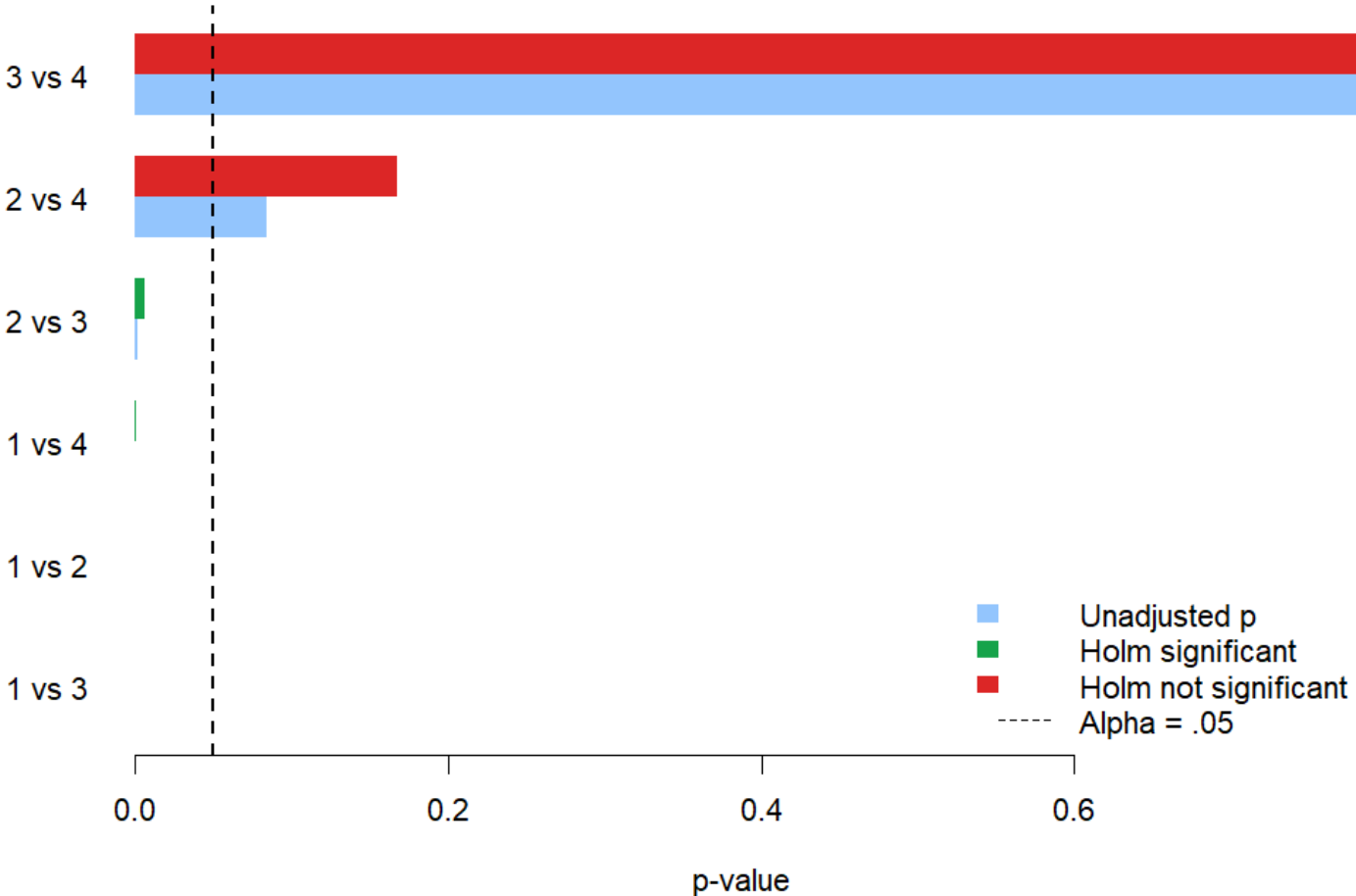
Colorful mean chart for the dependent variable before adjusted pairwise decisions.

Holm-Bonferroni: Group Distribution Boxplots

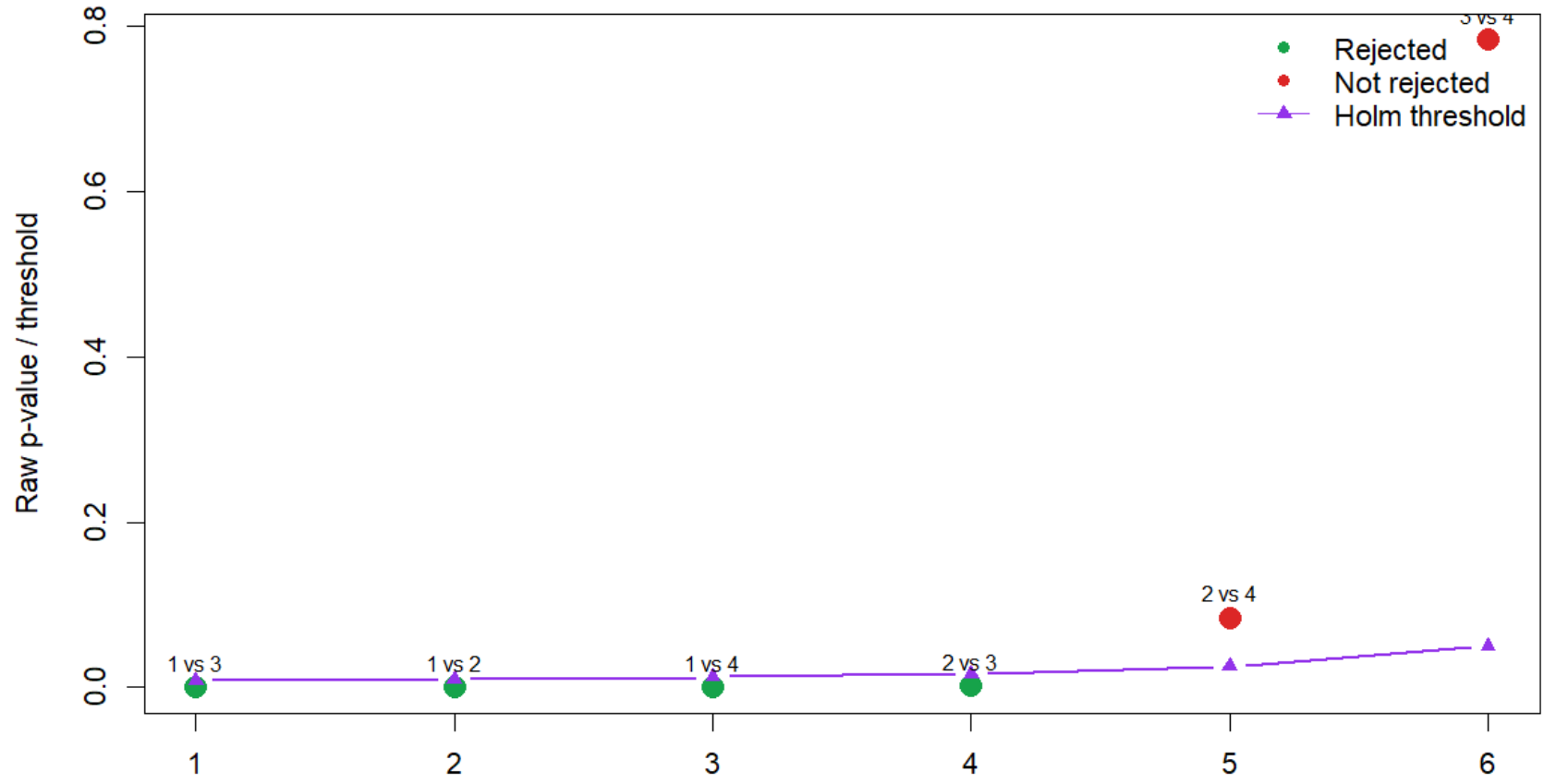


Colorful boxplots show spread, medians, and possible outliers by factor group.

Holm-Bonferroni: Unadjusted vs Adjusted p-values

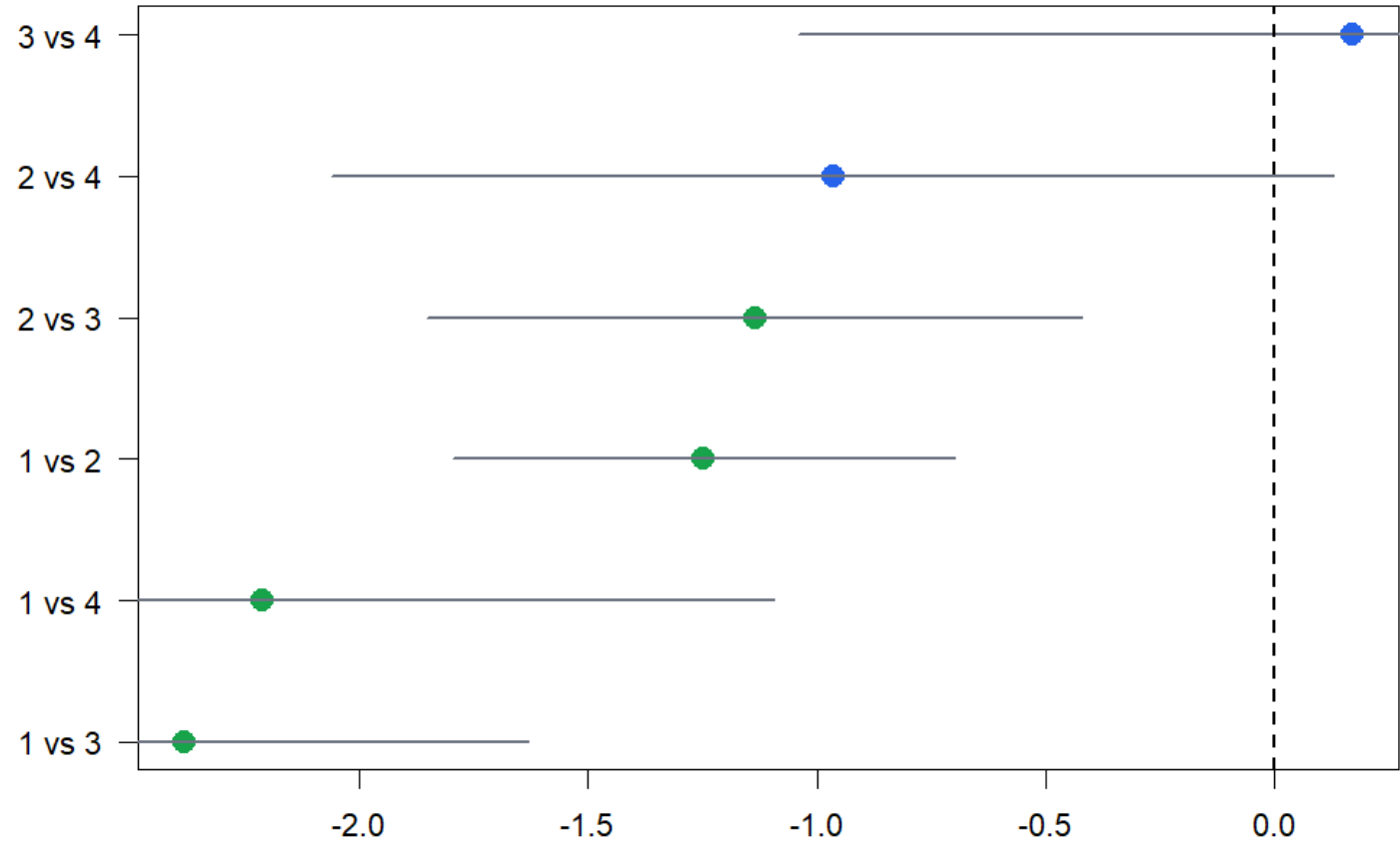


Holm-Bonferroni: Step-Down Decision Path



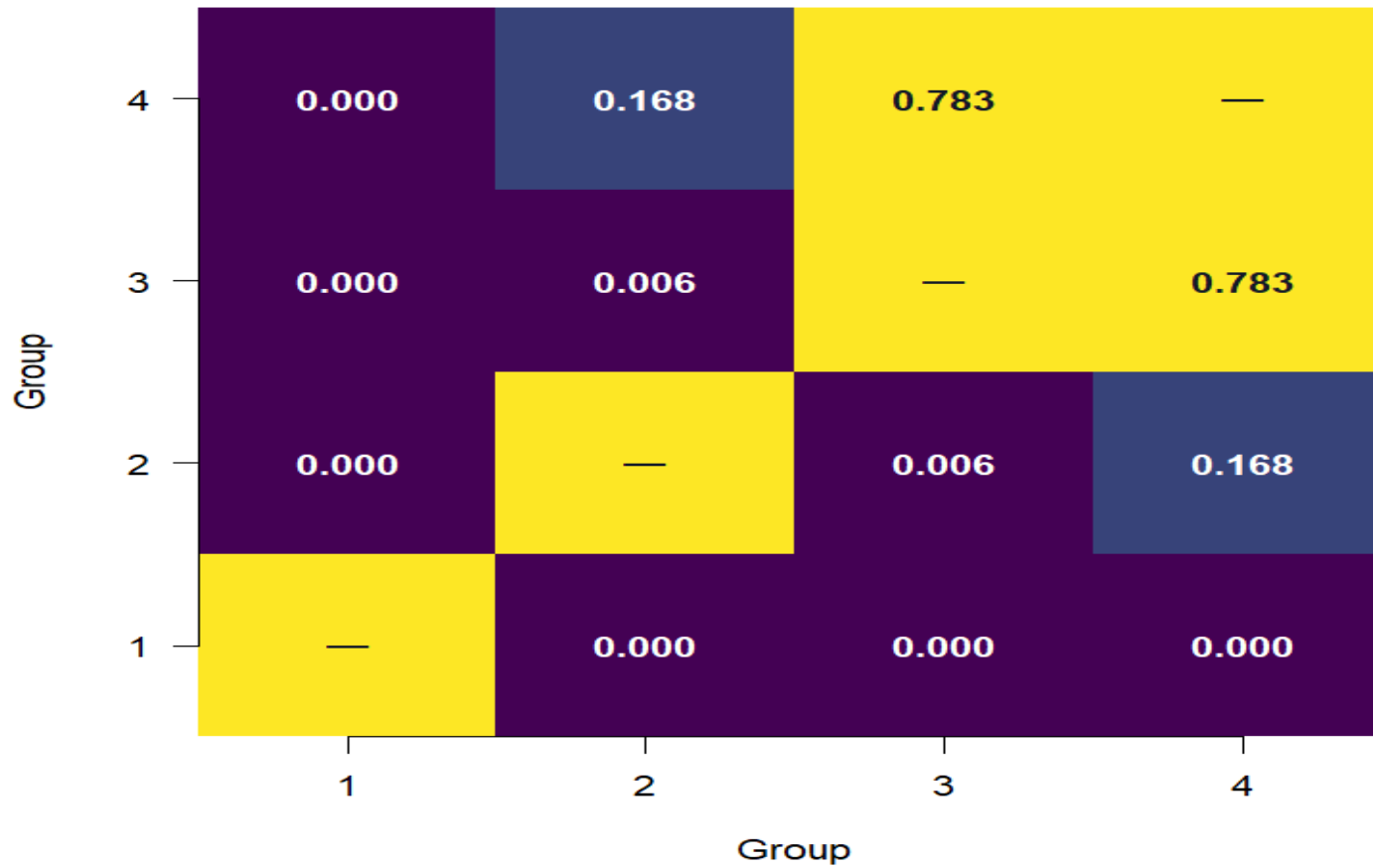
Holm rank: smallest raw p-value first
Each raw p-value is compared with alpha divided by its remaining-comparison multiplier.

Holm-Bonferroni: Pairwise Mean Differences

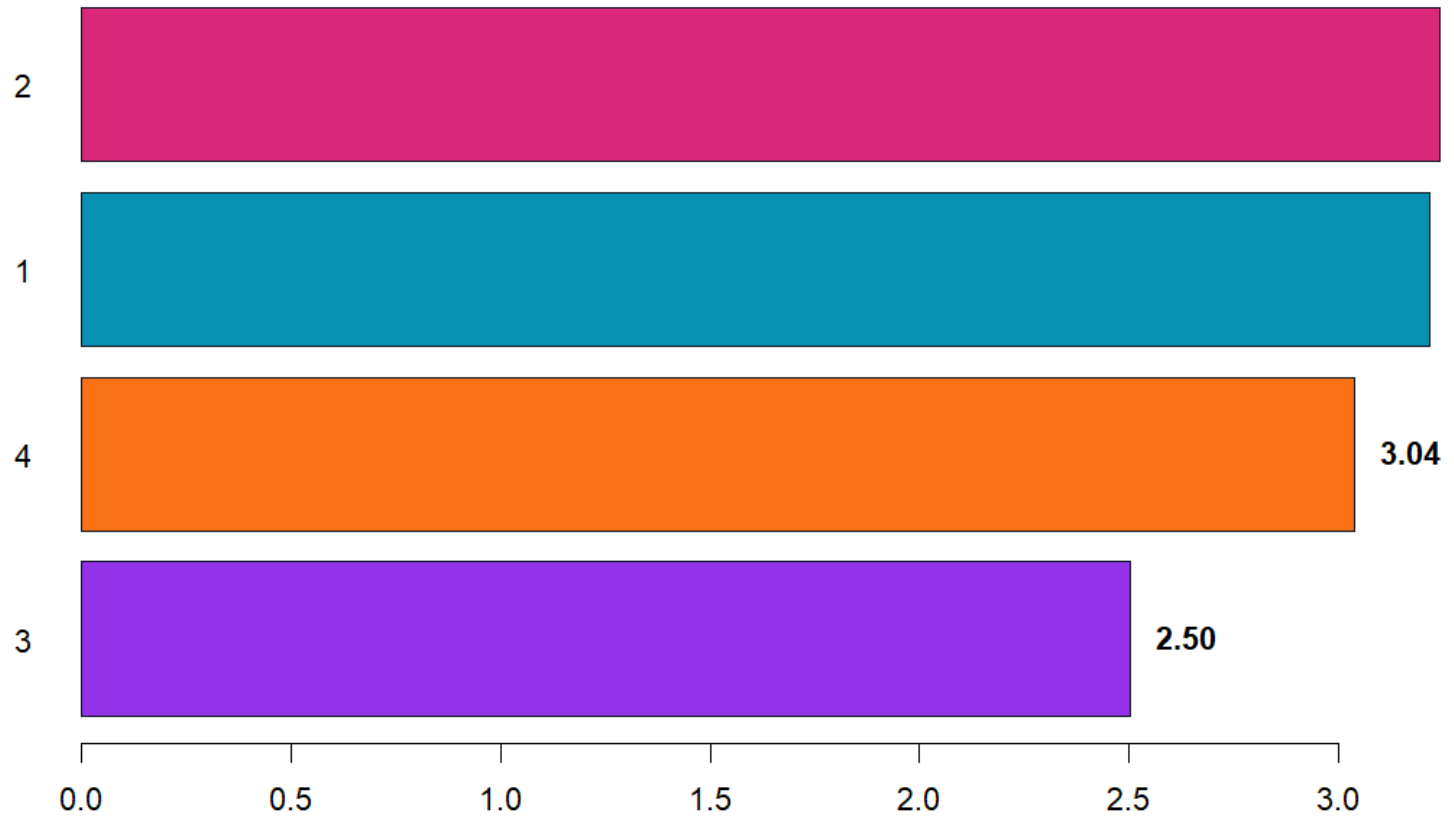


Mean difference with unadjusted 95% CI
Point estimates show direction and size; green points passed Holm correction.

Holm-Bonferroni: Adjusted p-value Heatmap



Holm-Bonferroni: Group Spread Context



Standard deviation of G3
The correction controls multiple tests, but spread and sample size still affect each pairwise test.