

Duncans Multiple Range Test

Dependent variable: G3
Grouping variable: studytime

ANOVA context:

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

Homogeneous subsets:

group	mean	n	duncan_grouping_letters	note
3	13.22680	97	A	Groups sharing a letter are not separated by this Duncan-style rule.
4	13.05714	35	A	Groups sharing a letter are not separated by this Duncan-style rule.
2	12.09180	305	B	Groups sharing a letter are not separated by this Duncan-style rule.
1	10.84434	212	C	Groups sharing a letter are not separated by this Duncan-style rule.

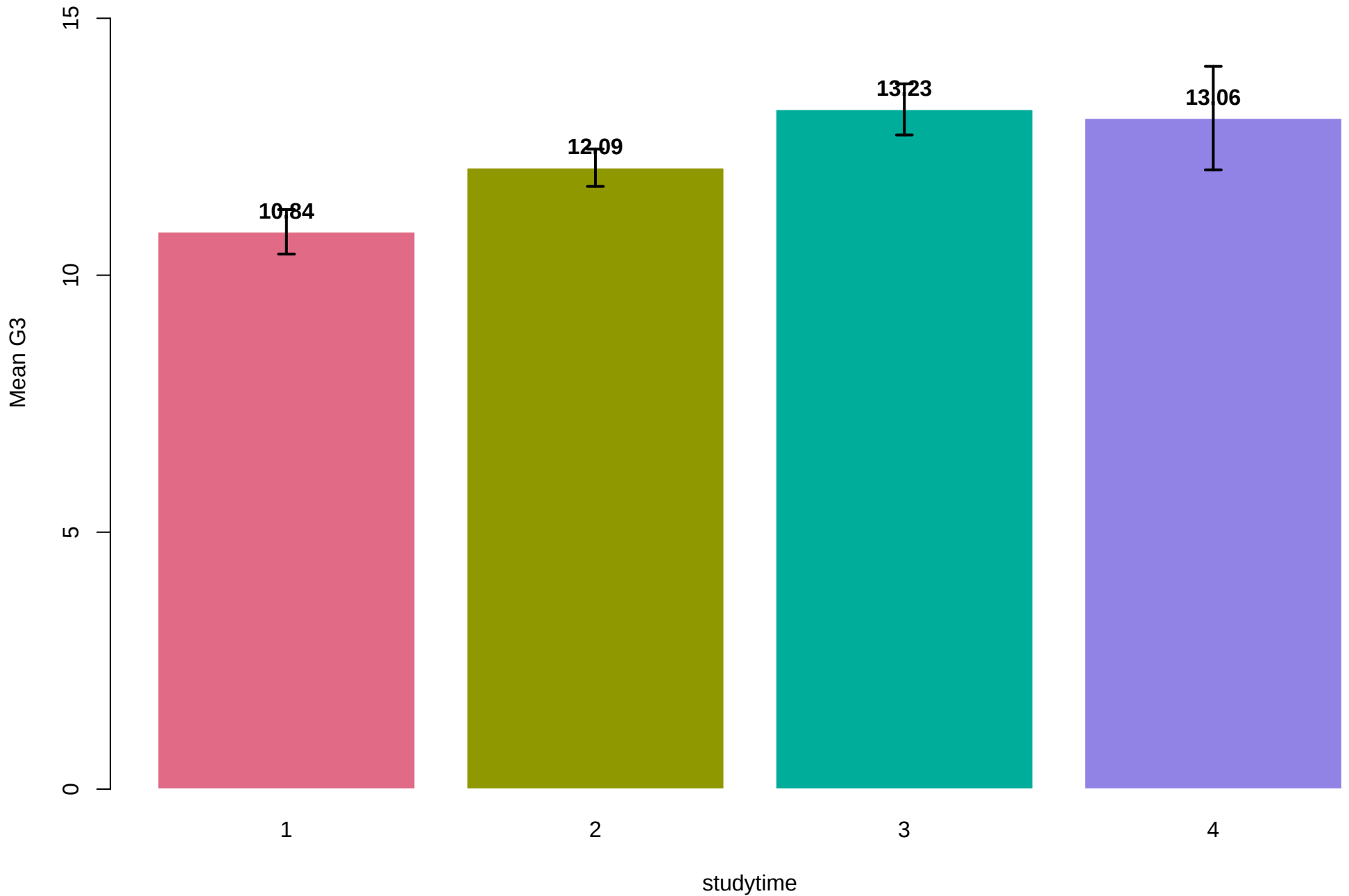
Method note: Duncan-style range testing uses rank-distance critical ranges after one-way ANOVA.

Duncan pairwise range results

lower_mean_group	higher_mean_group	mean_difference	range_size_r	duncan_alpha_for_range	standard_error	q_statistic
1	2	1.2474637	2	0.050000	0.1975788	6.313752
1	4	2.2128032	3	0.097500	0.4031434	5.488874
1	3	2.3824645	4	0.142625	0.2708560	8.796057
2	4	0.9653396	2	0.050000	0.3943379	2.448001
2	3	1.1350008	3	0.097500	0.2575670	4.406624
4	3	0.1696613	2	0.050000	0.4356925	0.389406
q_critical	critical_range	p_value_studentized_range_context	significant_at_alpha_0_05	interpretation		
2.777019	0.5486801	9.472984e-06	Yes	Different	mean	range
2.923689	1.1786657	3.370024e-04	Yes	Different	mean	range
3.021824	0.8184792	5.071332e-09	Yes	Different	mean	range
2.777019	1.0950836	8.393031e-02	No	Homogeneous	mean	range
2.923689	0.7530457	5.431300e-03	Yes	Different	mean	range
2.777019	1.2099261	7.831343e-01	No	Homogeneous	mean	range

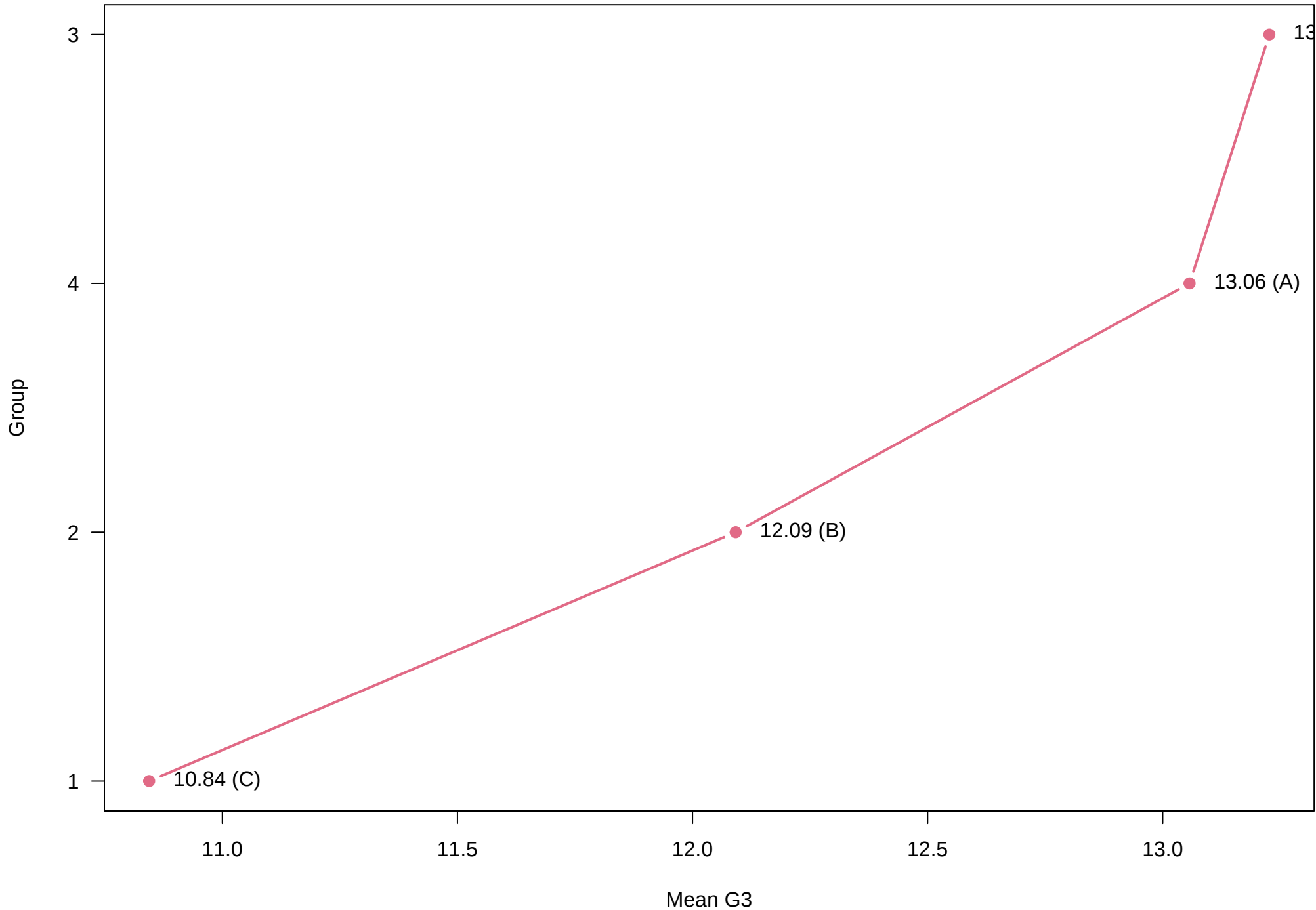
Duncans Multiple Range Test: Group Means

Colorful R chart with approximate 95% confidence intervals.



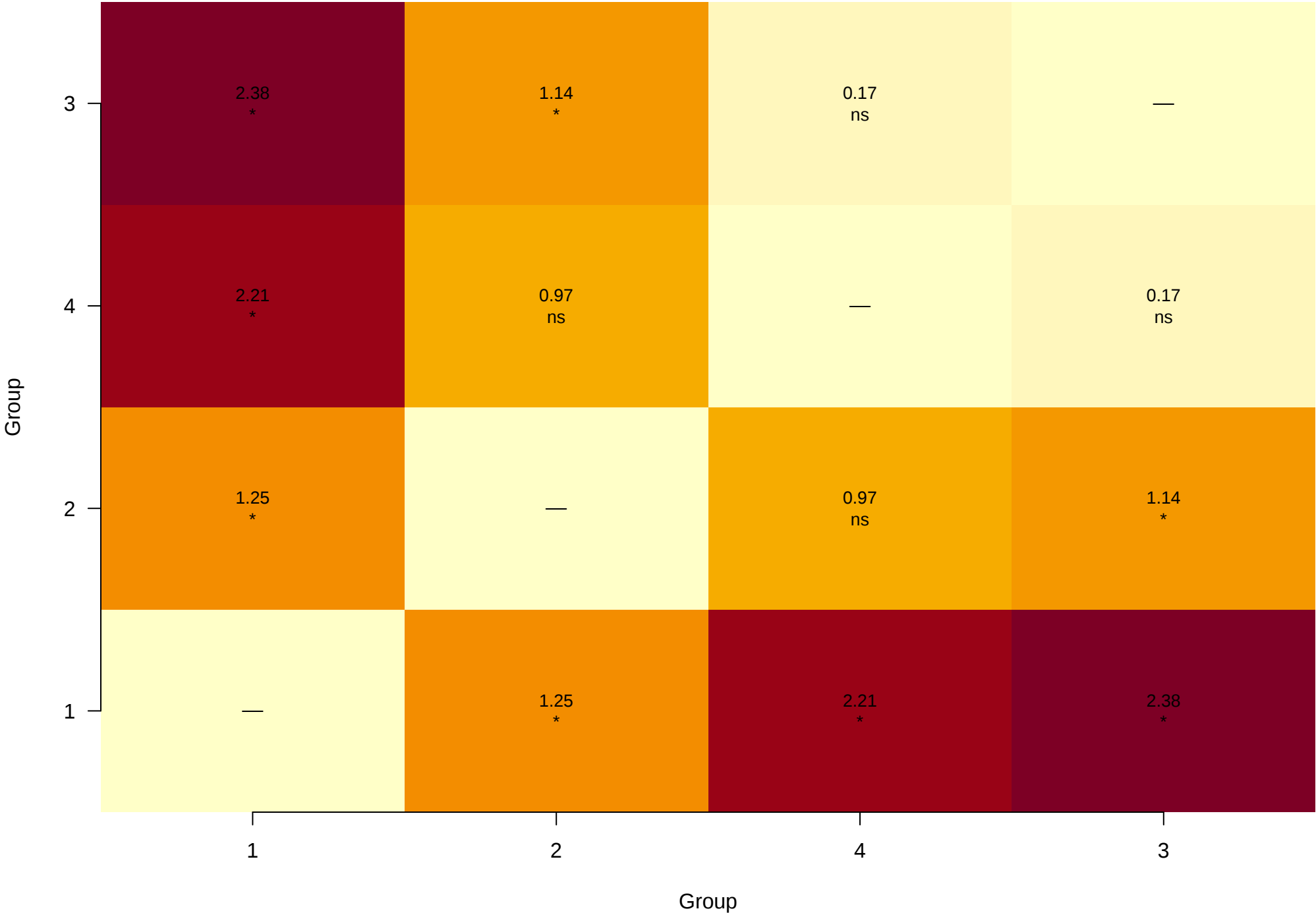
Duncans Multiple Range Test: Ranked Means

Means are sorted from lowest to highest before range comparisons.



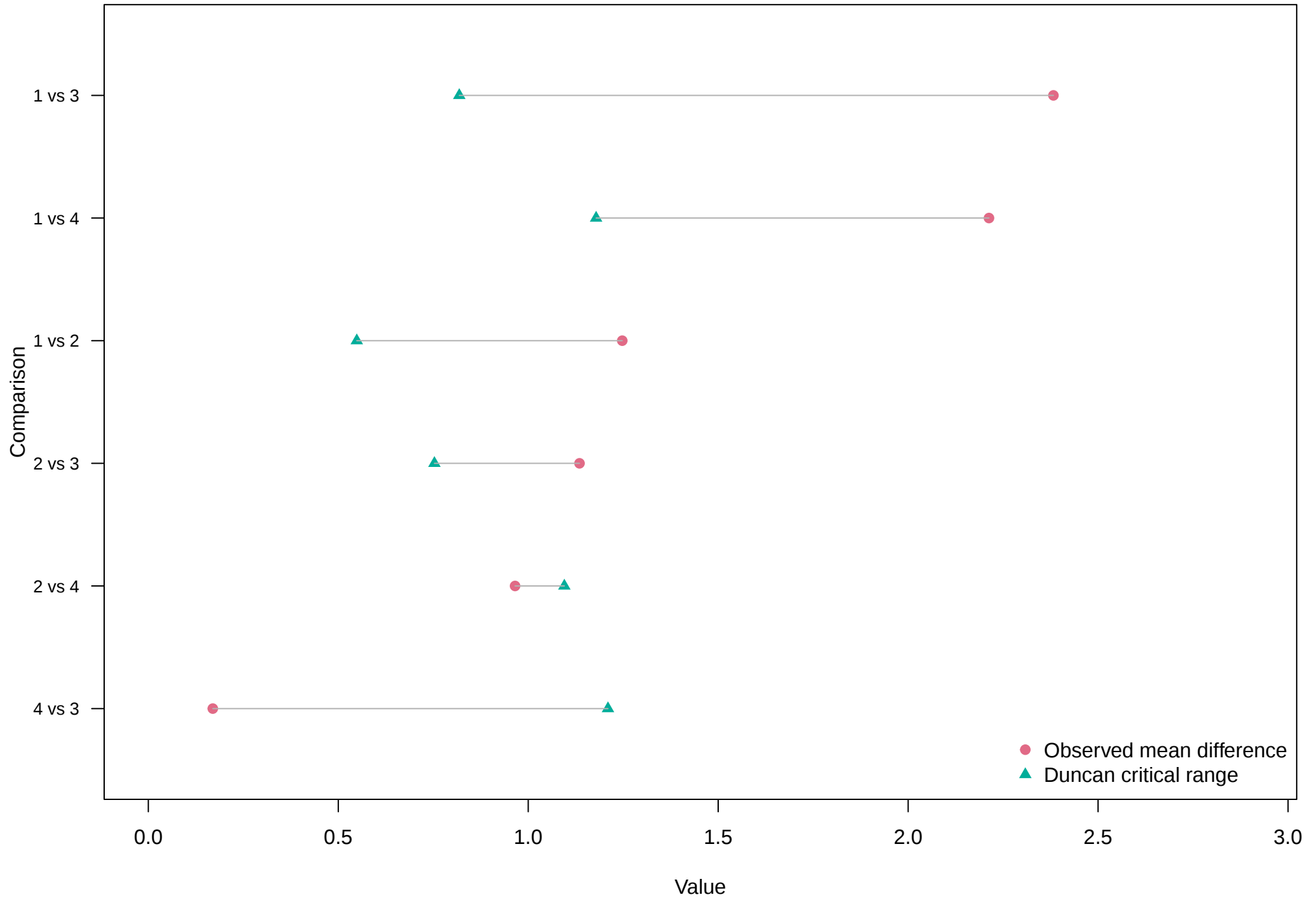
Duncans Multiple Range Test: Pairwise Mean Differences

Starred cells indicate separated mean ranges.



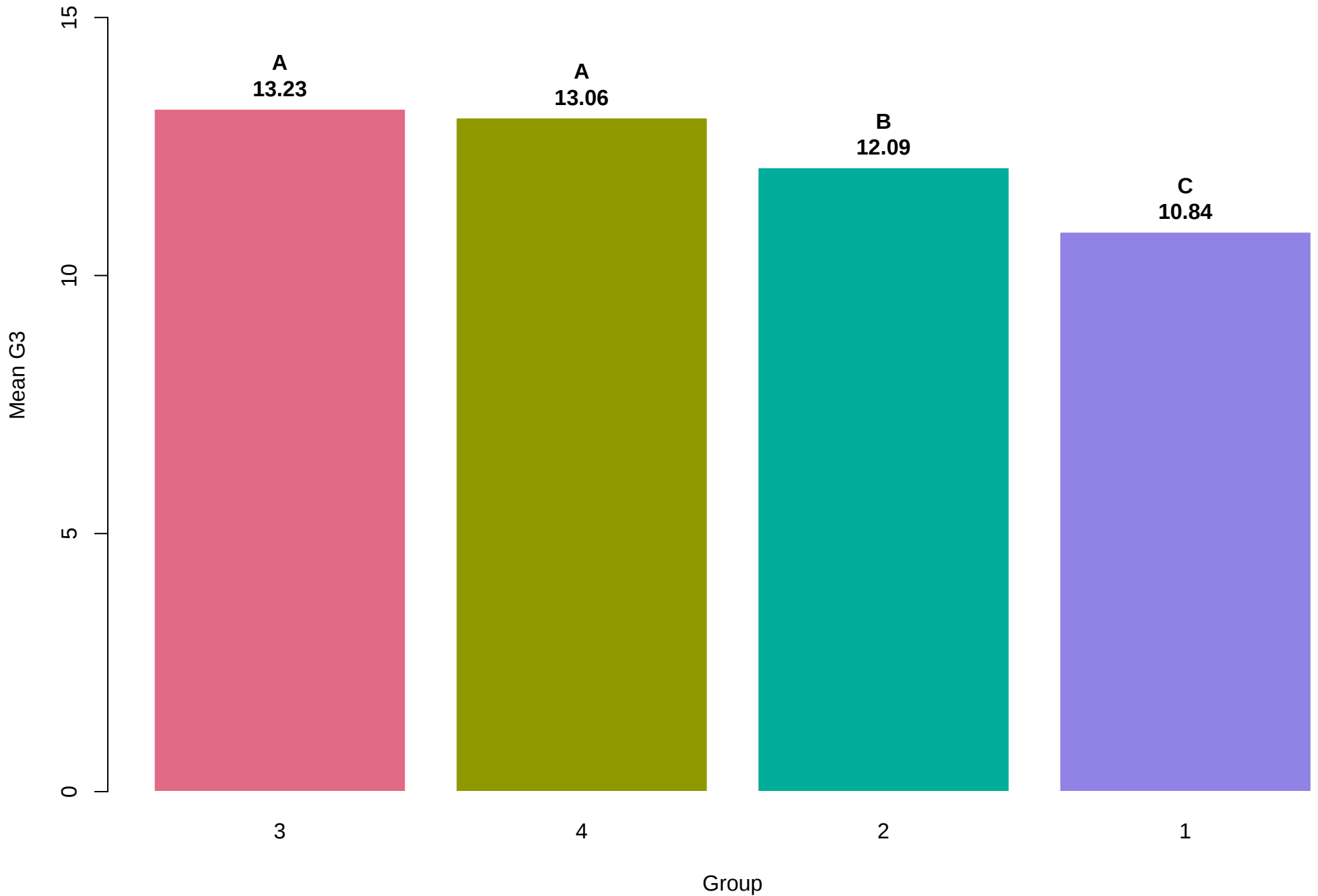
Duncans Multiple Range Test: Difference vs Critical Range

A pair is significant when the observed difference exceeds the critical range.



Duncans Multiple Range Test: Homogeneous Subsets

Groups sharing a letter are treated as not significantly different.



Duncans Multiple Range Test: Distribution by Group

Colorful boxplots show spread and outliers for each group.

