

# Spearman Rank Correlation Analysis

Focus X variable: G1

Focus Y variable: G3

H0: There is no monotonic association between the two variables ( $\rho = 0$ ).

H1: There is a monotonic association between the two variables ( $\rho \neq 0$ ).

Focus result:

| x_variable                  | y_variable                | n_pairwise_valid    | spearman_rho                                         | pearson_correlation_of_average_ranks | t_approximation | df           |  |  |  |  |
|-----------------------------|---------------------------|---------------------|------------------------------------------------------|--------------------------------------|-----------------|--------------|--|--|--|--|
| G1                          | G3                        | 649                 |                                                      |                                      | 0.8832876       | 47.92229 647 |  |  |  |  |
| two_tailed_p_value          | alpha                     | decision_alpha_0_05 | effect_interpretation                                |                                      |                 |              |  |  |  |  |
| 4.987375e-215               | 0.05                      |                     | Reject H0 very strong positive monotonic association |                                      |                 |              |  |  |  |  |
| sum_rank_difference_squared | simple_no_tie_formula_rho |                     |                                                      |                                      |                 |              |  |  |  |  |
| 5250964                     | 0.8847457                 |                     |                                                      |                                      |                 |              |  |  |  |  |

method\_note

Spearman rho is computed as the Pearson correlation between average ranks; this is preferred when tied ranks exist.

Variable summary:

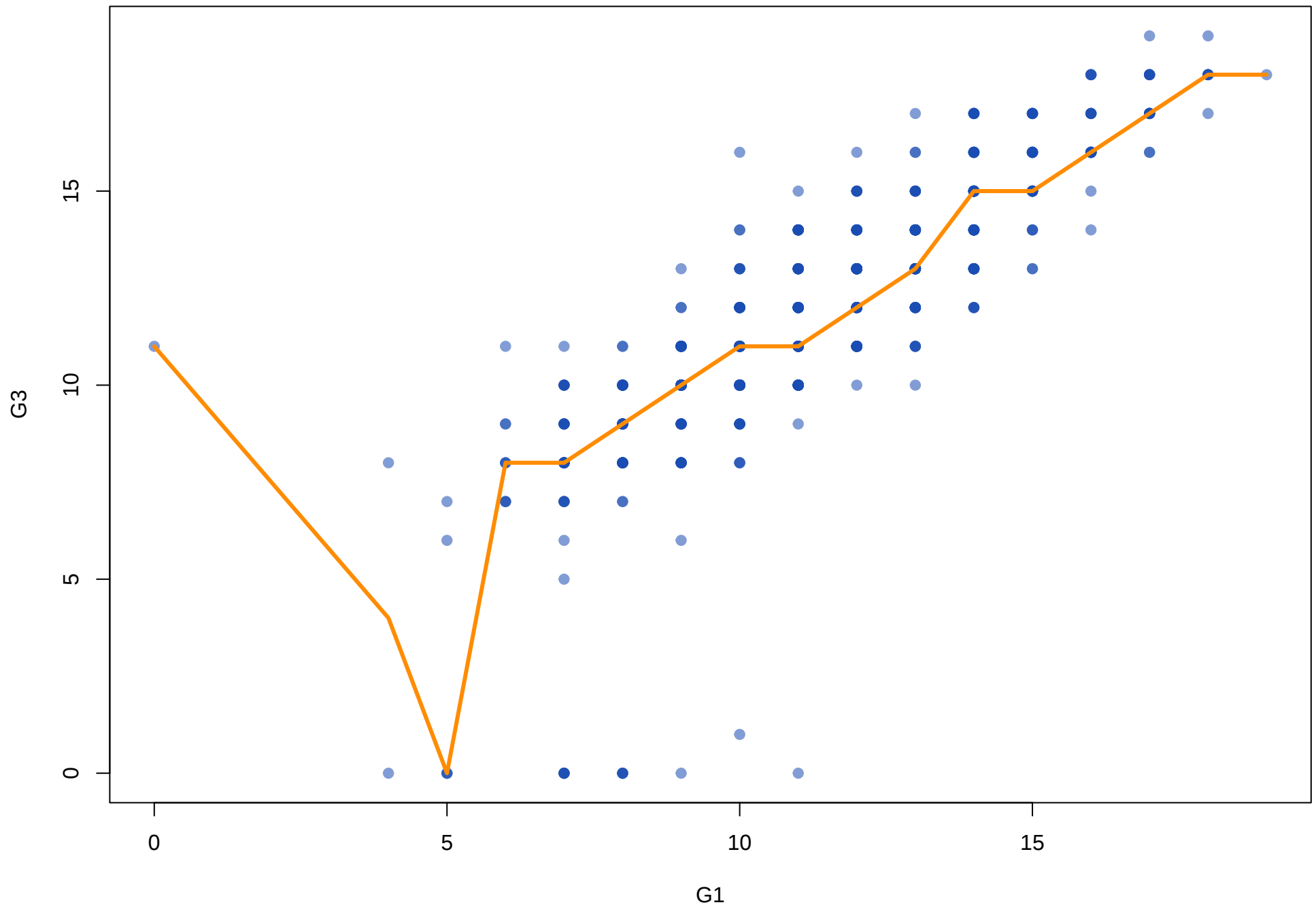
| variable   | n_valid | n_unique | minimum | maximum | mean       | standard_deviation | rank_ties_present |
|------------|---------|----------|---------|---------|------------|--------------------|-------------------|
| age        | 649     | 8        | 15      | 22      | 16.7442219 | 1.2181376          | Yes               |
| Medu       | 649     | 5        | 0       | 4       | 2.5146379  | 1.1345520          | Yes               |
| Fedu       | 649     | 5        | 0       | 4       | 2.3066256  | 1.0999309          | Yes               |
| traveltime | 649     | 4        | 1       | 4       | 1.5685670  | 0.7486601          | Yes               |
| studytime  | 649     | 4        | 1       | 4       | 1.9306626  | 0.8295096          | Yes               |
| failures   | 649     | 4        | 0       | 3       | 0.2218798  | 0.5932351          | Yes               |
| famrel     | 649     | 5        | 1       | 5       | 3.9306626  | 0.9557169          | Yes               |
| freetime   | 649     | 5        | 1       | 5       | 3.1802773  | 1.0510926          | Yes               |
| goout      | 649     | 5        | 1       | 5       | 3.1848998  | 1.1757661          | Yes               |
| Dalc       | 649     | 5        | 1       | 5       | 1.5023112  | 0.9248344          | Yes               |
| Walc       | 649     | 5        | 1       | 5       | 2.2804314  | 1.2843800          | Yes               |
| health     | 649     | 5        | 1       | 5       | 3.5362096  | 1.4462591          | Yes               |
| absences   | 649     | 24       | 0       | 32      | 3.6594761  | 4.6407588          | Yes               |
| G1         | 649     | 17       | 0       | 19      | 11.3990755 | 2.7452651          | Yes               |
| G2         | 649     | 16       | 0       | 19      | 11.5701079 | 2.9136387          | Yes               |
| G3         | 649     | 17       | 0       | 19      | 11.9060092 | 3.2306562          | Yes               |

Top pairwise Spearman correlations:

| x_variable | y_variable | n_pairwise_valid | spearman_rho | t_approximation | df  | two_tailed_p_value |
|------------|------------|------------------|--------------|-----------------|-----|--------------------|
| G2         | G3         | 649              | 0.9444512    | 73.096358       | 647 | 7.066377e-315      |
| G1         | G2         | 649              | 0.8930649    | 50.488471       | 647 | 1.345063e-226      |
| G1         | G3         | 649              | 0.8832876    | 47.922287       | 647 | 4.987375e-215      |
| Medu       | Fedu       | 649              | 0.6471942    | 21.594664       | 647 | 2.686096e-78       |
| Dalc       | Walc       | 649              | 0.6130561    | 19.738022       | 647 | 3.065114e-68       |
| failures   | G3         | 649              | -0.4483603   | -12.758900      | 647 | 2.047460e-33       |
| failures   | G2         | 649              | -0.4357405   | -12.314099      | 647 | 1.869690e-31       |
| failures   | G1         | 649              | -0.4324323   | -12.199005      | 647 | 5.918720e-31       |
| goout      | Walc       | 649              | 0.3724547    | 10.208314       | 647 | 8.709286e-23       |
| freetime   | goout      | 649              | 0.3543453    | 9.638599        | 647 | 1.235716e-20       |
| age        | failures   | 649              | 0.2907347    | 7.729052        | 647 | 4.151787e-14       |
| Medu       | G2         | 649              | 0.2856420    | 7.581520        | 647 | 1.189590e-13       |

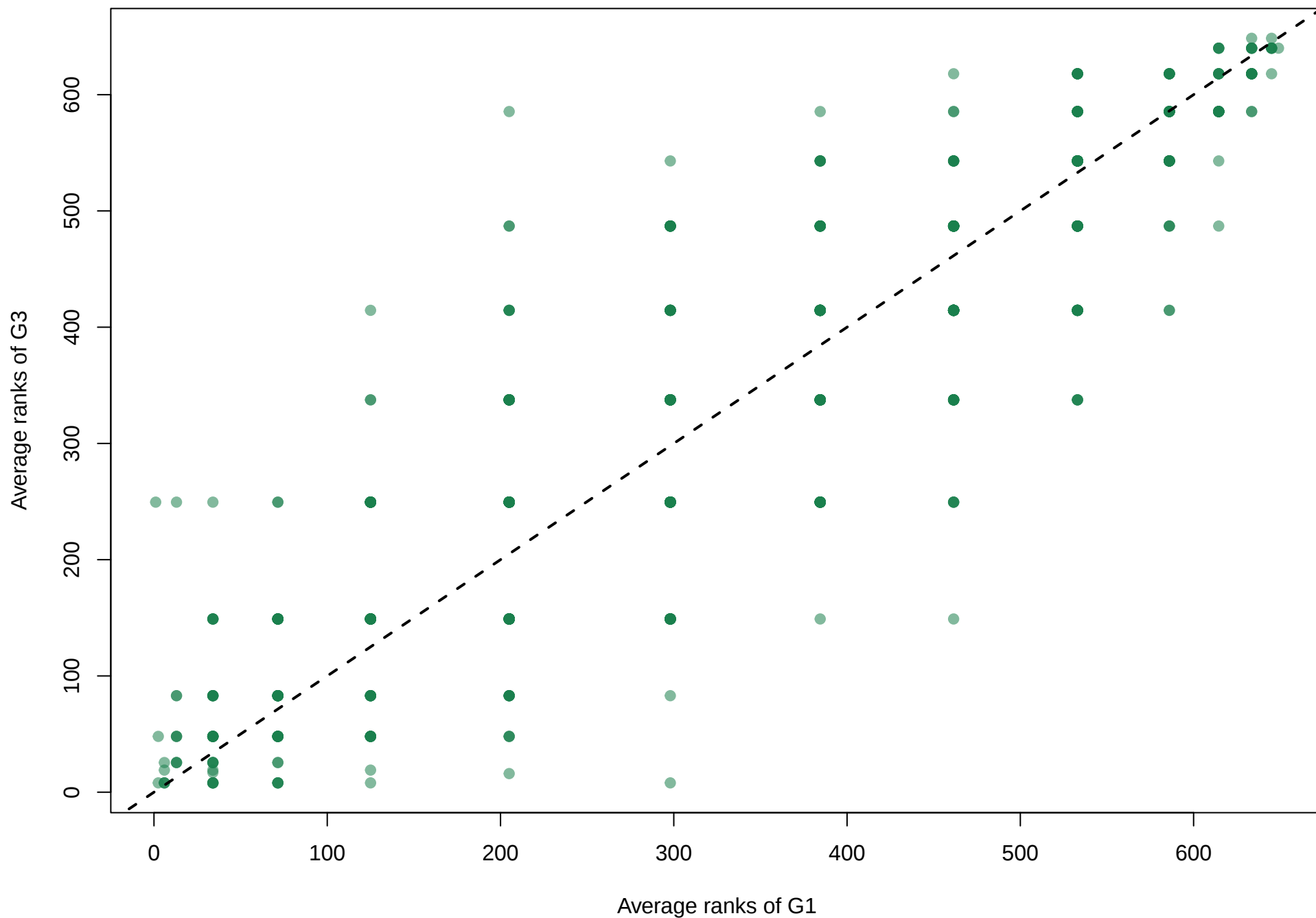
# Spearman Rank Correlation: Original Data Scatter

Focus pair: G1 vs G3;  $\rho = 0.8833$



# Spearman Rank Correlation: Rank Scatter

Spearman rho is the Pearson correlation of these ranks; rho = 0.8833



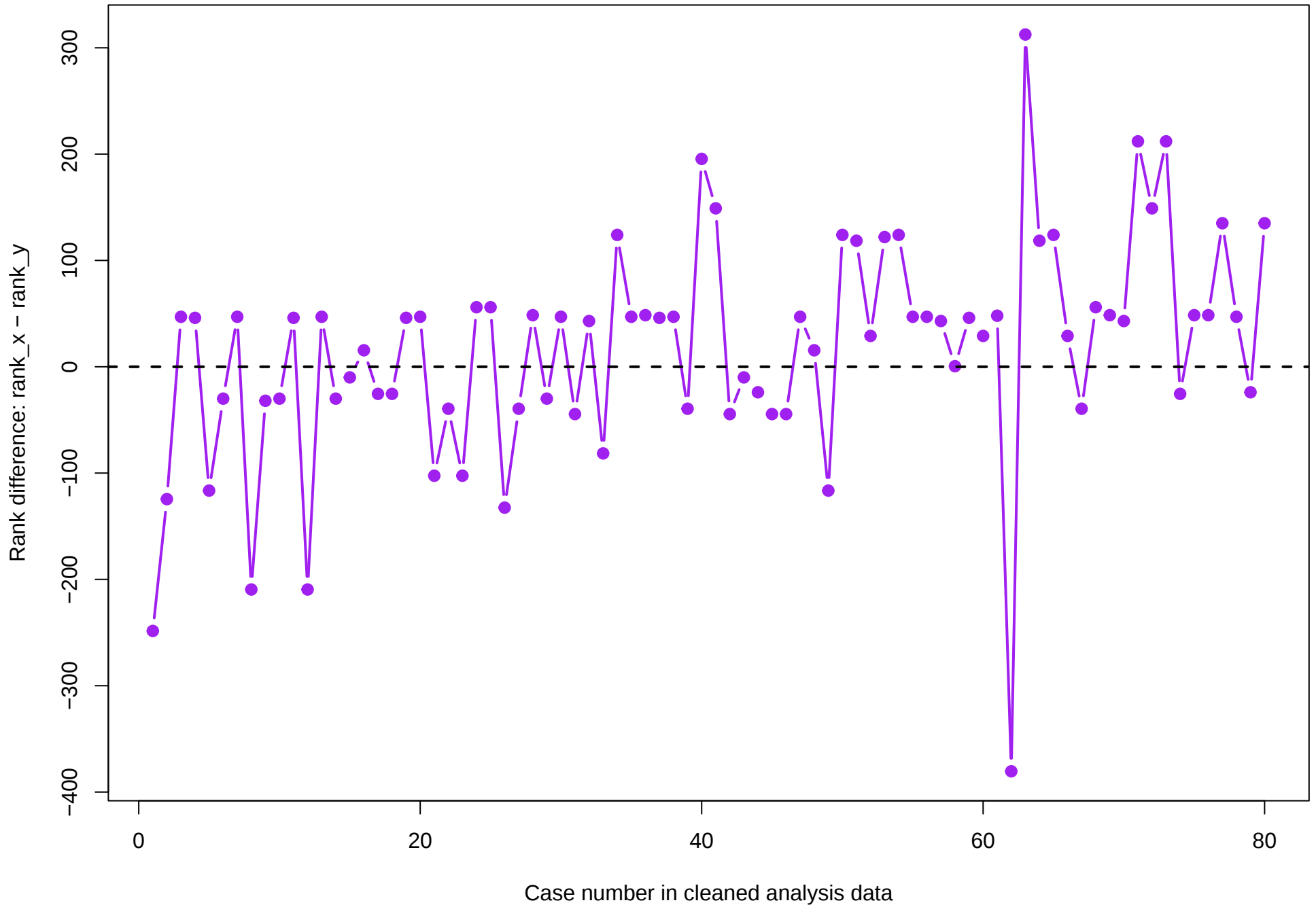
# Spearman Rank Correlation Matrix

Positive values show increasing monotonic association; negative values show decreasing monotonic association.

|            |       |       |       |            |           |          |        |          |       |       |       |        |          |       |       |       |
|------------|-------|-------|-------|------------|-----------|----------|--------|----------|-------|-------|-------|--------|----------|-------|-------|-------|
| age        | 1.00  | -0.10 | -0.11 | 0.07       | 0.02      | 0.29     | -0.02  | -0.01    | 0.13  | 0.08  | 0.09  | -0.02  | 0.12     | -0.17 | -0.11 | -0.07 |
| Medu       | -0.10 | 1.00  | 0.65  | -0.26      | 0.10      | -0.21    | 0.03   | -0.03    | 0.01  | 0.00  | -0.02 | 0.02   | -0.01    | 0.28  | 0.29  | 0.28  |
| Fedu       | -0.11 | 0.65  | 1.00  | -0.22      | 0.07      | -0.16    | 0.02   | -0.00    | 0.03  | -0.00 | 0.03  | 0.05   | 0.03     | 0.23  | 0.25  | 0.23  |
| traveltime | 0.07  | -0.26 | -0.22 | 1.00       | -0.09     | 0.12     | -0.03  | -0.00    | 0.04  | 0.07  | 0.03  | -0.06  | 0.02     | -0.17 | -0.17 | -0.15 |
| studytime  | 0.02  | 0.10  | 0.07  | -0.09      | 1.00      | -0.16    | 0.02   | -0.08    | -0.08 | -0.17 | -0.22 | -0.08  | -0.12    | 0.27  | 0.26  | 0.27  |
| failures   | 0.29  | -0.21 | -0.16 | 0.12       | -0.16     | 1.00     | -0.06  | 0.10     | 0.04  | 0.11  | 0.06  | 0.04   | 0.12     | -0.43 | -0.44 | -0.45 |
| famrel     | -0.02 | 0.03  | 0.02  | -0.03      | 0.02      | -0.06    | 1.00   | 0.14     | 0.09  | -0.10 | -0.10 | 0.09   | -0.10    | 0.03  | 0.06  | 0.05  |
| freetime   | -0.01 | -0.03 | -0.00 | -0.00      | -0.08     | 0.10     | 0.14   | 1.00     | 0.35  | 0.13  | 0.12  | 0.10   | -0.03    | -0.11 | -0.12 | -0.13 |
| goout      | 0.13  | 0.01  | 0.03  | 0.04       | -0.08     | 0.04     | 0.09   | 0.35     | 1.00  | 0.23  | 0.37  | -0.01  | 0.10     | -0.08 | -0.11 | -0.10 |
| Dalc       | 0.08  | 0.00  | -0.00 | 0.07       | -0.17     | 0.11     | -0.10  | 0.13     | 0.23  | 1.00  | 0.61  | 0.08   | 0.10     | -0.20 | -0.20 | -0.21 |
| Walc       | 0.09  | -0.02 | 0.03  | 0.03       | -0.22     | 0.06     | -0.10  | 0.12     | 0.37  | 0.61  | 1.00  | 0.11   | 0.15     | -0.16 | -0.17 | -0.17 |
| health     | -0.02 | 0.02  | 0.05  | -0.06      | -0.08     | 0.04     | 0.09   | 0.10     | -0.01 | 0.08  | 0.11  | 1.00   | -0.01    | -0.06 | -0.10 | -0.11 |
| absences   | 0.12  | -0.01 | 0.03  | 0.02       | -0.12     | 0.12     | -0.10  | -0.03    | 0.10  | 0.10  | 0.15  | -0.01  | 1.00     | -0.17 | -0.16 | -0.16 |
| G1         | -0.17 | 0.28  | 0.23  | -0.17      | 0.27      | -0.43    | 0.03   | -0.11    | -0.08 | -0.20 | -0.16 | -0.06  | -0.17    | 1.00  | 0.89  | 0.88  |
| G2         | -0.11 | 0.29  | 0.25  | -0.17      | 0.26      | -0.44    | 0.06   | -0.12    | -0.11 | -0.20 | -0.17 | -0.10  | -0.16    | 0.89  | 1.00  | 0.94  |
| G3         | -0.07 | 0.28  | 0.23  | -0.15      | 0.27      | -0.45    | 0.05   | -0.13    | -0.10 | -0.21 | -0.17 | -0.11  | -0.16    | 0.88  | 0.94  | 1.00  |
|            | age   | Medu  | Fedu  | traveltime | studytime | failures | famrel | freetime | goout | Dalc  | Walc  | health | absences | G1    | G2    | G3    |

# Spearman Rank Correlation: Rank Difference Diagnostic

Large positive/negative rank gaps reduce agreement between G1 and G3 ranks.



# Spearman Rank Correlation: Strongest Pairwise Associations

Pairs are ranked by absolute Spearman rho across numeric/ordinal variables.

