

## Correlation in Python Analysis Report

Number of numeric variables: 16  
 Target variable for focused interpretation: G3

### Methods included:

Pearson correlation: linear association between numeric variables.  
 Spearman correlation: rank-based monotonic association.  
 Kendall correlation: ordinal concordance association.

### Variable summary:

variable	valid_n	missing_n	mean	standard_deviation	variance	minimum	q1	median	q3	maximum	skewness	kurtosis
age	649	0	16.744222	1.218138	1.483859	15.0	16.0	17.0	18.0	22.0	0.416795	0.071509
Medu	649	0	2.514638	1.134552	1.287208	0.0	2.0	2.0	4.0	4.0	-0.029950	-1.260619
Fedu	649	0	2.306626	1.099931	1.209848	0.0	1.0	2.0	3.0	4.0	0.215343	-1.109241
traveltime	649	0	1.568567	0.748660	0.560492	1.0	1.0	1.0	2.0	4.0	1.247648	1.108865
studytime	649	0	1.930663	0.829510	0.688086	1.0	1.0	2.0	2.0	4.0	0.699619	0.037846
failures	649	0	0.221880	0.593235	0.351928	0.0	0.0	0.0	0.0	3.0	3.092699	9.824409
famrel	649	0	3.930663	0.955717	0.913395	1.0	4.0	4.0	5.0	5.0	-1.105934	1.348973
freetime	649	0	3.180277	1.051093	1.104796	1.0	3.0	3.0	4.0	5.0	-0.181277	-0.396959
goout	649	0	3.184900	1.175766	1.382426	1.0	2.0	3.0	4.0	5.0	-0.008580	-0.865454
Dalc	649	0	1.502311	0.924834	0.855319	1.0	1.0	1.0	2.0	5.0	2.141913	4.349297
Walc	649	0	2.280431	1.284380	1.649632	1.0	1.0	2.0	3.0	5.0	0.635904	-0.770689
health	649	0	3.536210	1.446259	2.091665	1.0	2.0	4.0	5.0	5.0	-0.500656	-1.121175
absences	649	0	3.659476	4.640759	21.536642	0.0	0.0	2.0	6.0	32.0	2.020694	5.781078
G1	649	0	11.399076	2.745265	7.536481	0.0	10.0	11.0	13.0	19.0	-0.002774	0.036638
G2	649	0	11.570108	2.913639	8.489290	0.0	10.0	11.0	13.0	19.0	-0.360283	1.662465
G3	649	0	11.906009	3.230656	10.437140	0.0	10.0	12.0	14.0	19.0	-0.912909	2.712204

### Top strongest correlations:

method	variable_1	variable_2	n_pairwise	correlation	absolute_correlation	direction	strength	p_value	decision_alpha_0_05
Spearman	G2	G3	649	0.944451	0.944451	Positive	Very strong	0.000000e+00	Statistically significant
Pearson	G2	G3	649	0.918548	0.918548	Positive	Very strong	5.642401e-263	Statistically significant
Spearman	G1	G2	649	0.893065	0.893065	Positive	Strong	1.345063e-226	Statistically significant
Spearman	G1	G3	649	0.883288	0.883288	Positive	Strong	4.987375e-215	Statistically significant
Kendall	G2	G3	649	0.869595	0.869595	Positive	Strong	2.113285e-199	Statistically significant
Pearson	G1	G2	649	0.864982	0.864982	Positive	Strong	6.373795e-196	Statistically significant
Pearson	G1	G3	649	0.826387	0.826387	Positive	Strong	1.617571e-163	Statistically significant
Kendall	G1	G2	649	0.780639	0.780639	Positive	Strong	4.403489e-161	Statistically significant
Kendall	G1	G3	649	0.766198	0.766198	Positive	Strong	2.108694e-155	Statistically significant
Pearson	Medu	Fedu	649	0.647477	0.647477	Positive	Moderate	2.190291e-78	Statistically significant
Spearman	Medu	Fedu	649	0.647194	0.647194	Positive	Moderate	2.686096e-78	Statistically significant
Pearson	Dalc	Walc	649	0.616561	0.616561	Positive	Moderate	3.239244e-69	Statistically significant
Spearman	Dalc	Walc	649	0.613056	0.613056	Positive	Moderate	3.065114e-68	Statistically significant
Kendall	Medu	Fedu	649	0.569954	0.569954	Positive	Moderate	5.622318e-68	Statistically significant
Kendall	Dalc	Walc	649	0.555407	0.555407	Positive	Moderate	4.096093e-59	Statistically significant

### Correlations with G3:

method	target_variable	comparison_variable	n_pairwise	correlation	absolute_correlation	direction	strength	p_value	decision_alpha_0_05
Kendall	G3	G2	649	0.869595	0.869595	Positive	Strong	2.113285e-199	Statistically significant
Kendall	G3	G1	649	0.766198	0.766198	Positive	Strong	2.108694e-155	Statistically significant
Kendall	G3	failures	649	-0.378883	0.378883	Negative	Weak to moderate	2.182742e-30	Statistically significant
Kendall	G3	Medu	649	0.222761	0.222761	Positive	Weak	3.982446e-13	Statistically significant
Kendall	G3	studytime	649	0.221596	0.221596	Positive	Weak	2.514569e-12	Statistically significant
Kendall	G3	Fedu	649	0.185576	0.185576	Positive	Weak	1.574629e-09	Statistically significant
Kendall	G3	Dalc	649	-0.171367	0.171367	Negative	Weak	1.110801e-07	Statistically significant
Kendall	G3	Walc	649	-0.133188	0.133188	Negative	Weak	1.352717e-05	Statistically significant
Kendall	G3	absences	649	-0.122860	0.122860	Negative	Weak	3.815039e-05	Statistically significant
Kendall	G3	traveltime	649	-0.120765	0.120765	Negative	Weak	1.885178e-04	Statistically significant
Kendall	G3	freetime	649	-0.101384	0.101384	Negative	Weak	9.719869e-04	Statistically significant
Kendall	G3	health	649	-0.082907	0.082907	Negative	Very weak	6.507219e-03	Statistically significant
Kendall	G3	goout	649	-0.082848	0.082848	Negative	Very weak	6.463161e-03	Statistically significant
Kendall	G3	age	649	-0.048451	0.048451	Negative	Very weak	1.111326e-01	Not statistically significant
Kendall	G3	famrel	649	0.039120	0.039120	Positive	Very weak	2.129976e-01	Not statistically significant

### Interpretation guide:

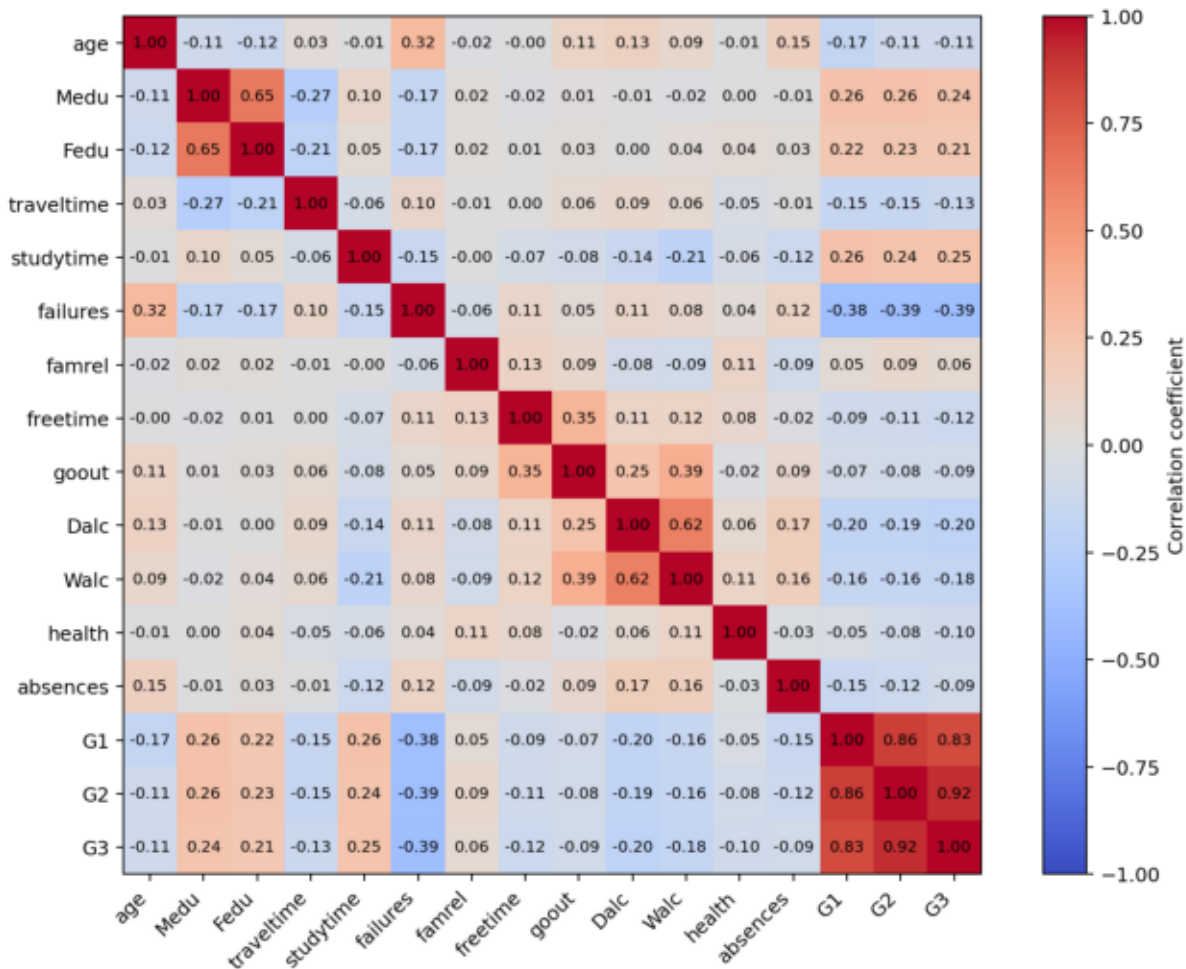
Correlation coefficients range from -1 to +1.

Positive values mean variables tend to increase together; negative values mean one tends to decrease as the other increases.

The p-value tests H0: population correlation equals zero.

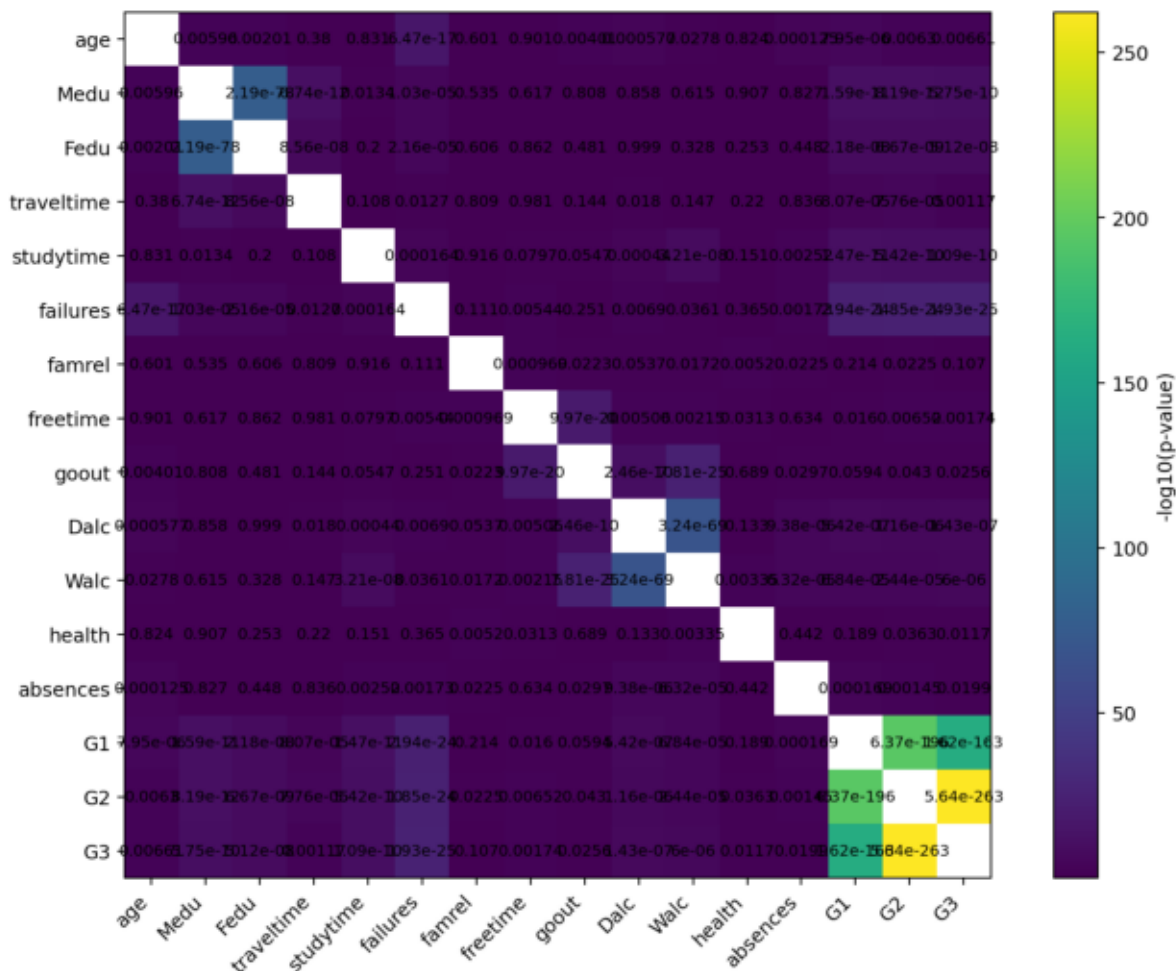
# Correlation in Python: Pearson Correlation Heatmap

Positive values move toward red; negative values move toward blue.



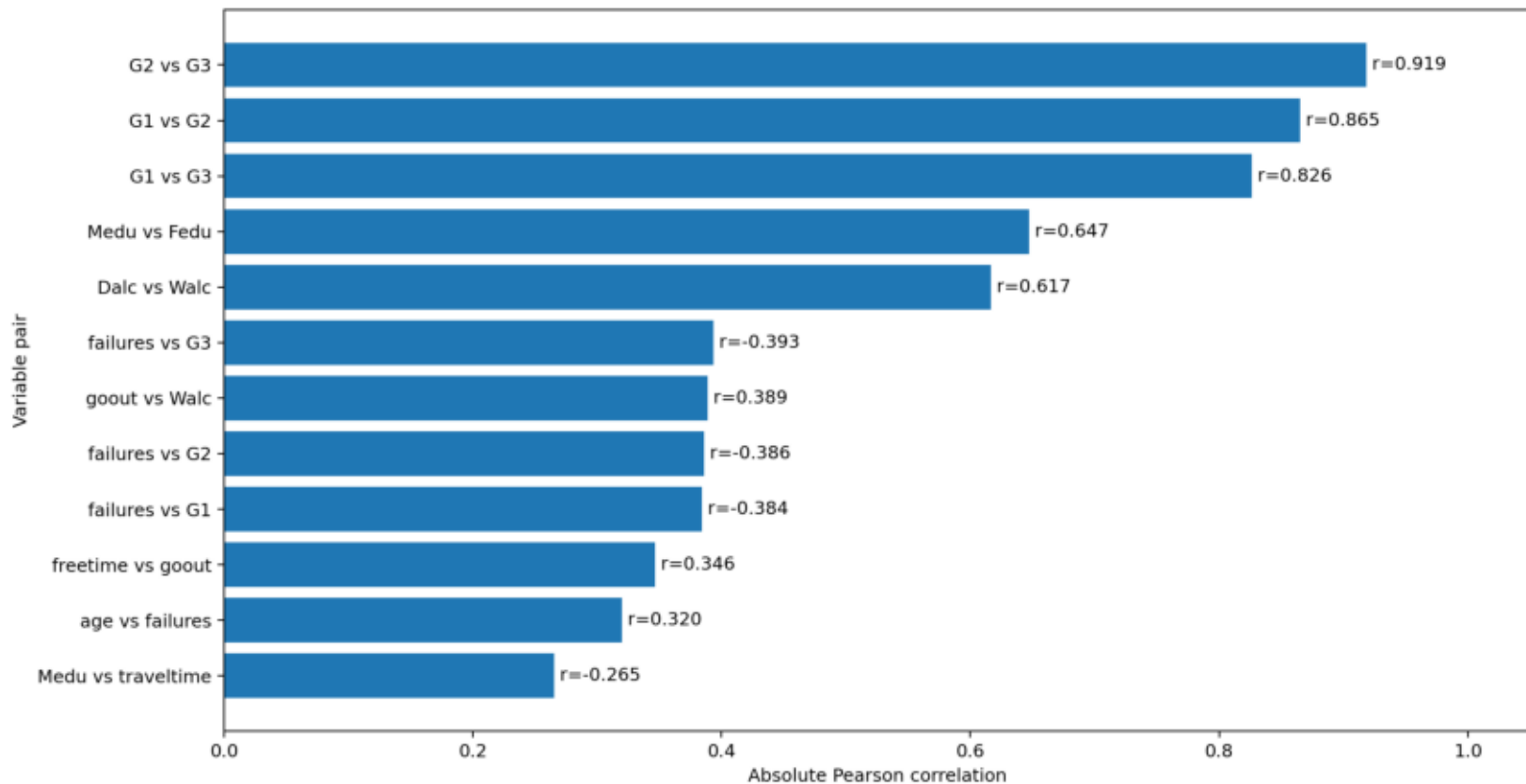
# Correlation in Python: Pearson p-value Heatmap

Each label is the two-tailed p-value for H0: correlation equals zero.



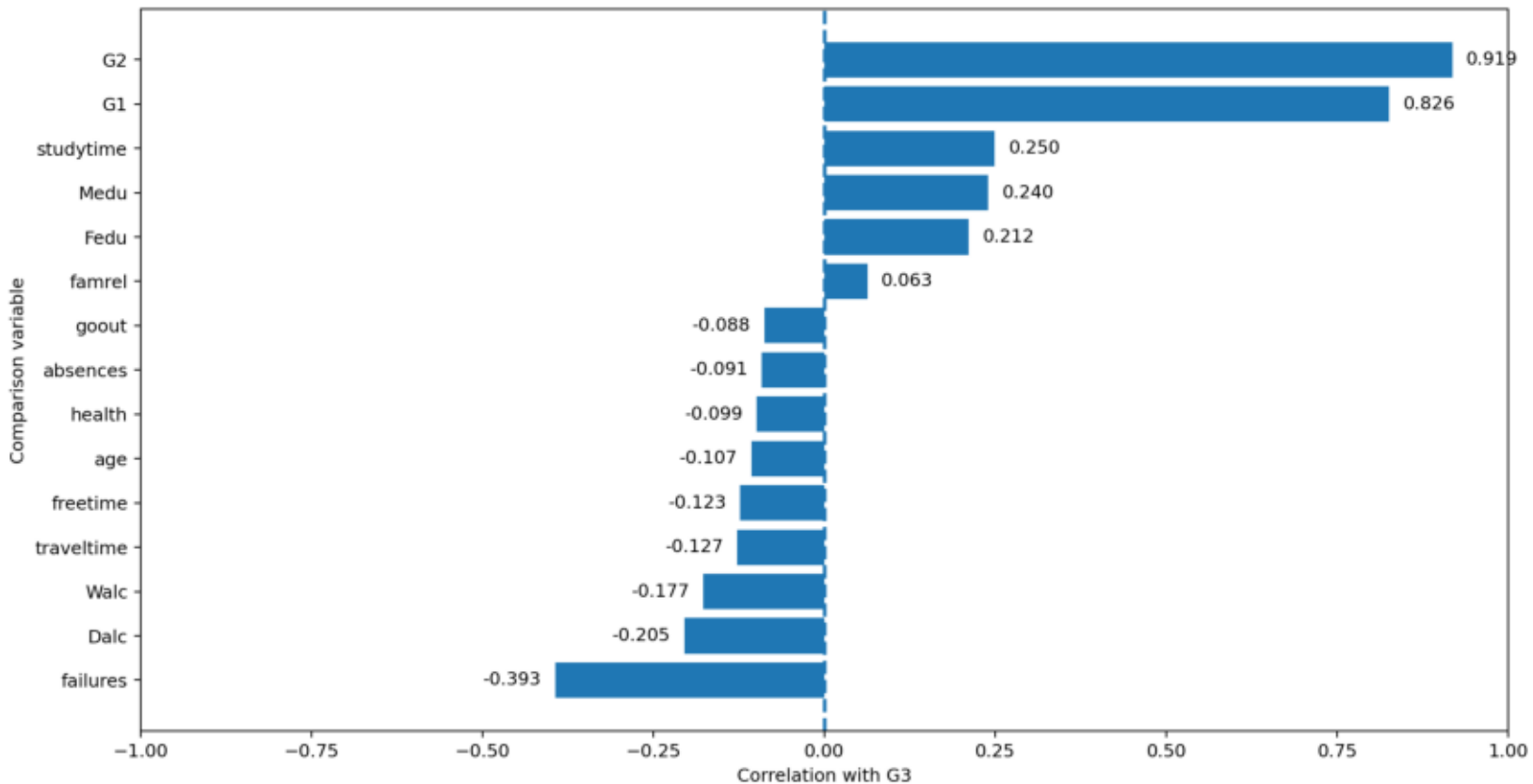
# Correlation in Python: Strongest Pearson Variable Pairs

Ranking uses absolute  $r$ , so strong positive and negative relationships are retained.



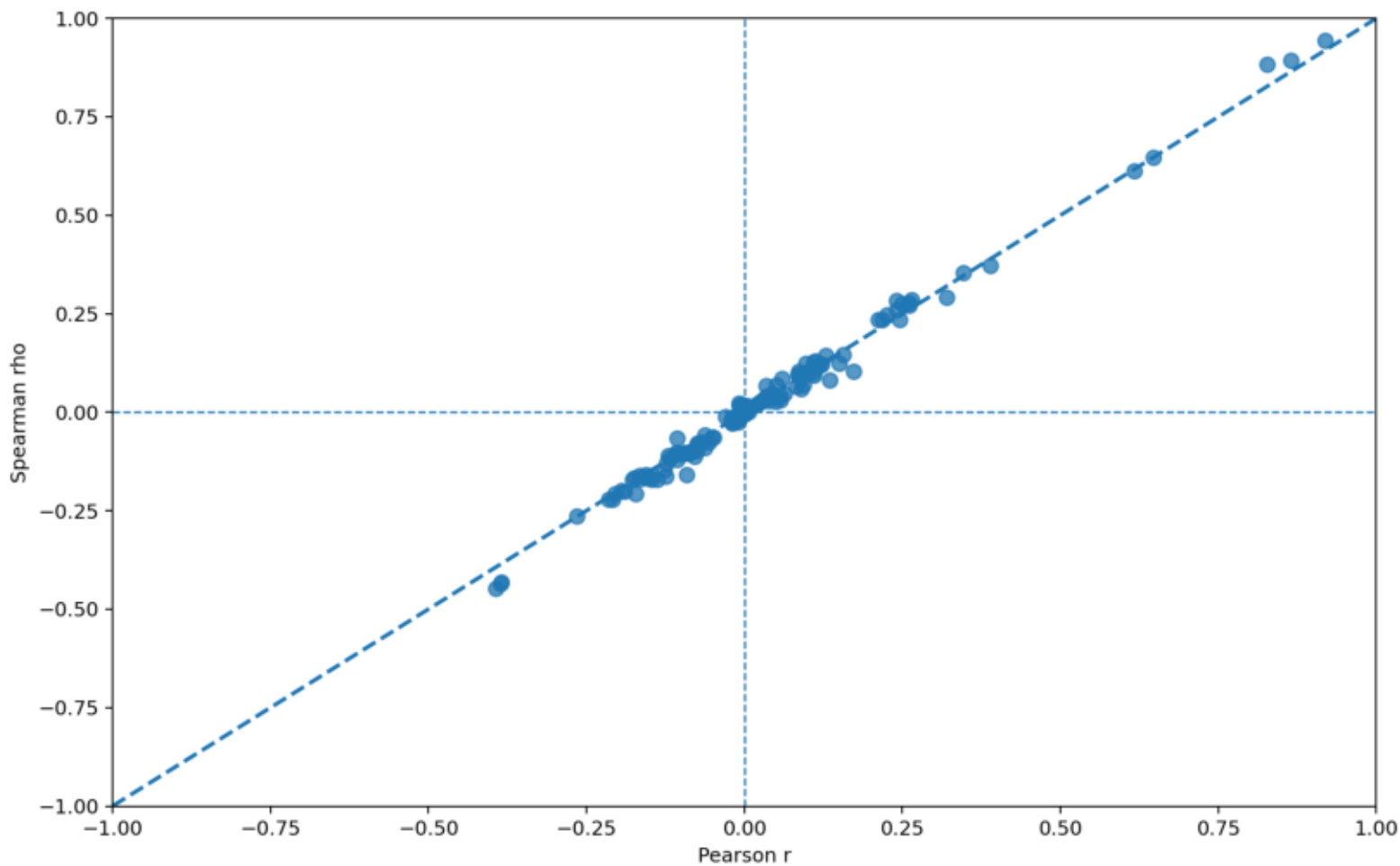
# Correlation in Python: Pearson Correlations with G3

Variables are ordered by signed Pearson correlation with G3.



# Correlation in Python: Pearson vs Spearman Comparison

Pairs near the diagonal have similar linear and rank-based association.





# Correlation in Python: Strongest Pair Scatterplot

G2 vs G3: Pearson  $r = 0.919$ .

