

Multilevel Regression

Test name: Multilevel Regression

Dataset: D:/DATA ANALYSIS/H Regression Tests and Models/Multilevel Regression/dataset.csv

Rows in original dataset: 649

Columns in original dataset: 33

Rows used in multilevel model: 649

Outcome variable: G3

Grouping variable: school

Number of groups: 2

Numeric predictors: G1, G2, studytime, failures, absences, age

Categorical predictors: sex, address, famsize

Fixed-effects formula: $G3 \sim G1 + G2 + \text{studytime} + \text{failures} + \text{absences} + \text{age} + \text{sex} + \text{address} + \text{famsize}$

Random-effects structure: $\sim 1 \mid \text{school}$

Model type: random-intercept multilevel linear regression fitted with nlme::lme.

Null-model ICC: 0.1595

Full-model ICC: 0.0049

The null-model ICC suggests meaningful clustering, so a multilevel model is useful.

OLS AIC: 2145.7617

Null multilevel AIC: 3321.6505

Full multilevel AIC: 2189.1007

Interpretation: fixed effects show adjusted outcome change while accounting for group-level random intercepts.

Decision guide: $p < 0.05$ and CI not crossing 0 indicates stronger evidence for a fixed predictor effect.

Reporting guide: state outcome, grouping variable, predictors, variance components, ICC, fixed effects, random effects, and model fit.

Confidence interval note: fixed-effect CIs are calculated manually from the t table; no bare intervals function call is used.

Charts generated: 8

Fixed effects

	model	term	estimate	standard_error	df	t_value	p_value
Full random-intercept multilevel model	(Intercept)		-0.35244481	0.77441688	638	-0.4551099	6.491850e-01
Full random-intercept multilevel model		G1	0.13498528	0.03669110	638	3.6789652	2.539500e-04
Full random-intercept multilevel model		G2	0.88038105	0.03416164	638	25.7710381	6.400634e-101
Full random-intercept multilevel model		studytime	0.06661856	0.06309048	638	1.0559209	2.914040e-01
Full random-intercept multilevel model		failures	-0.22276676	0.09497681	638	-2.3454857	1.930767e-02
Full random-intercept multilevel model		absences	0.01920627	0.01104354	638	1.7391408	8.249232e-02
Full random-intercept multilevel model		age	0.02099607	0.04352730	638	0.4823656	6.297117e-01
Full random-intercept multilevel model		sexM	-0.20106551	0.10365484	638	-1.9397600	5.284925e-02
Full random-intercept multilevel model		addressU	0.11967412	0.11205180	638	1.0680250	2.859132e-01
Full random-intercept multilevel model		famsizeLE3	0.06092199	0.10874763	638	0.5602144	5.755299e-01
ci95_lower	ci95_upper	decision_alpha_0_05					
-1.87315889	1.16826926	Not statistically significant					
0.06293536	0.20703519	Statistically significant					
0.81329820	0.94746390	Statistically significant					
-0.05727154	0.19050865	Not statistically significant					
-0.40927170	-0.03626181	Statistically significant					
-0.00247981	0.04089236	Not statistically significant					
-0.06447802	0.10647016	Not statistically significant					
-0.40461140	0.00248038	Not statistically significant					
-0.10036080	0.33970904	Not statistically significant					
-0.15262457	0.27446855	Not statistically significant					

Variance components and ICC

	model	group_intercept_variance	residual_variance	total_variance	icc
Null	random-intercept model	1.822876000	9.608405	11.431281	0.159463843
Full	random-intercept model	0.007738107	1.565638	1.573376	0.004918154

Model fit statistics

	model	n	log_likelihood	aic	bic	residual_sd
	OLS comparison model	649	-1061.881	2145.762	2194.991	1.252330
	Null random-intercept model	649	-1657.825	3321.650	3335.072	3.099743
	Full random-intercept model	649	-1082.550	2189.101	2242.620	1.251255
	note					
	Ignores clustering.					
	Random intercept only; used for ICC baseline.					
	Random intercept plus selected predictors.					















