

Robust Regression

Test name: Robust Regression

Dataset rows used: 649

Outcome: G3

Predictors: G1, G2, studytime, failures, absences, age, Medu, Fedu

Primary robust estimator: Huber M-estimation.

Huber tuning constant: 1.345

Huber scale estimate: 0.761446

Huber iterations: 33

OLS RMSE: 1.247020

Huber RMSE: 1.262243

OLS MAE: 0.780019

Huber MAE: 0.771728

Minimum Huber weight: 0.108117

Cases with Huber weight below 0.80: 103

Cases with Huber weight below 0.50: 24

Robust regression reduces the contribution of cases with large residuals rather than automatically deleting them.

Compare OLS and robust coefficients to assess sensitivity to unusual or influential observations.

Robust-model p-values and confidence intervals use large-sample normal approximations.

Model summary

test_name	outcome	predictors	complete_rank	number_of_parameters	initially_robust	huber_tuning_parameter	huber_scale_estimator	number_of_iterations	robust_scale_estimator	ols_scale_estimator	ols_r_squared	adjusted_r_squared	ols_aic	ols_bic	minimum_huber_tuning_parameter	huber_scale_estimator	robust_weight_betas	robust_weight_beta0
Robust Regression	G3	G1, G2, st	649.00000	8.00000	Huber M-estimator	1.34500	0.76145	33.00000	0.75127	0.85078	0.84891	2146.3246	2186.6035	0.10812	1.00000	103.00000	24.00000	

Model performance

model	n	rmse	mae	median_absolute_error	r_squared_descriptive
Ordinary least squares	649.00000	1.24702	0.78002	0.54217	0.85078
Huber robust M-estimator	649.00000	1.26224	0.77173	0.51359	0.84711
Tukey biweight robust M-estim	649.00000	1.27328	0.77017	0.50672	0.84443

Coefficients

model	term	coefficient	standard_error	z_or_t_value	p_value	ci95_lower	ci95_upper	reference_distribution	decision_alpha_0_05
Ordinary least squares	const	-0.50115	0.77395	-0.64753	0.51752	-2.02094	1.01863	Student t	Not statistically significant
Ordinary least squares	G1	0.14340	0.03667	3.91027	0.00010	0.07138	0.21541	Student t	Statistically significant
Ordinary least squares	G2	0.88481	0.03437	25.74397	0.00000	0.81732	0.95230	Student t	Statistically significant
Ordinary least squares	studytime	0.09663	0.06209	1.55630	0.12013	-0.02529	0.21856	Student t	Not statistically significant
Ordinary least squares	failures	-0.23536	0.09523	-2.47139	0.01372	-0.42237	-0.04835	Student t	Statistically significant
Ordinary least squares	absences	0.02276	0.01092	2.08457	0.03750	0.00132	0.04420	Student t	Statistically significant
Ordinary least squares	age	0.02269	0.04367	0.51950	0.60359	-0.06306	0.10844	Student t	Not statistically significant
Ordinary least squares	Medu	-0.04495	0.05794	-0.77585	0.43812	-0.15872	0.06882	Student t	Not statistically significant
Ordinary least squares	Fedu	0.02203	0.05932	0.37133	0.71052	-0.09445	0.13850	Student t	Not statistically significant
Huber robust M-estimator	const	-0.62614	0.50078	-1.25034	0.21118	-1.60765	0.35537	Normal approximation	Not statistically significant
Huber robust M-estimator	G1	0.12280	0.02373	5.17536	0.00000	0.07630	0.16931	Normal approximation	Statistically significant
Huber robust M-estimator	G2	0.86496	0.02224	38.89461	0.00000	0.82137	0.90855	Normal approximation	Statistically significant
Huber robust M-estimator	studytime	0.04534	0.04018	1.12843	0.25914	-0.03341	0.12408	Normal approximation	Not statistically significant
Huber robust M-estimator	failures	-0.16117	0.06162	-2.61549	0.00891	-0.28194	-0.04039	Normal approximation	Statistically significant
Huber robust M-estimator	absences	0.00219	0.00707	0.30952	0.75692	-0.01166	0.01603	Normal approximation	Not statistically significant
Huber robust M-estimator	age	0.06931	0.02825	2.45304	0.01417	0.01393	0.12469	Normal approximation	Statistically significant
Huber robust M-estimator	Medu	0.00450	0.03749	0.12010	0.90441	-0.06897	0.07798	Normal approximation	Not statistically significant
Huber robust M-estimator	Fedu	-0.01184	0.03838	-0.30859	0.75763	-0.08707	0.06338	Normal approximation	Not statistically significant

Weight summary

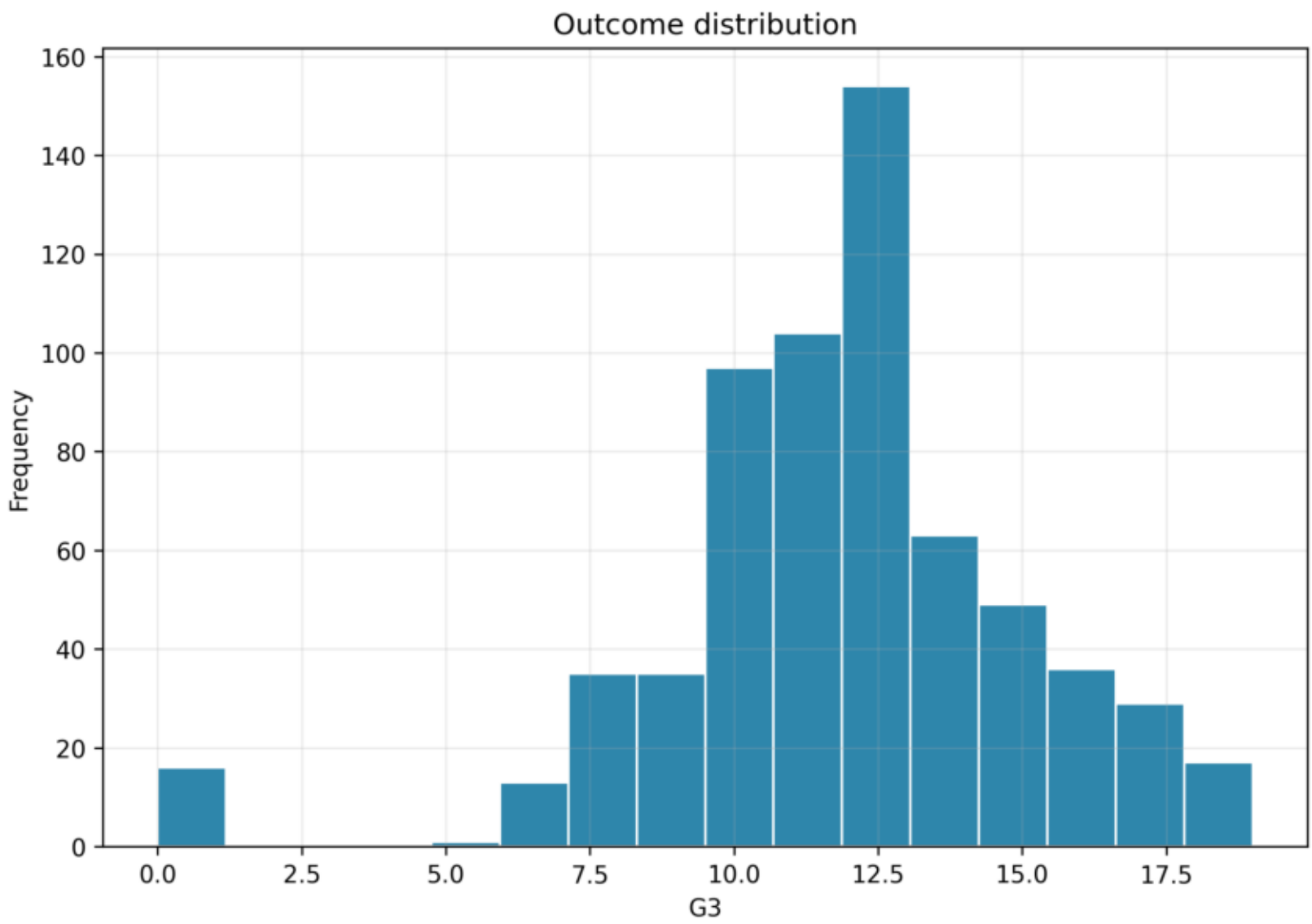
method	minimum_weight	first_quartile_weight	median_weight	mean_weight	third_quartile_weight	maximum_weight	cases_below_0_80	cases_below_0_50
Huber M-estimation	0.10812	1.00000	1.00000	0.93080	1.00000	1.00000	103.00000	24.00000
Tukey biweight	0.00000	0.90711	0.95898	0.88817	0.98015	0.99999	128.00000	24.00000

Predictions and residuals

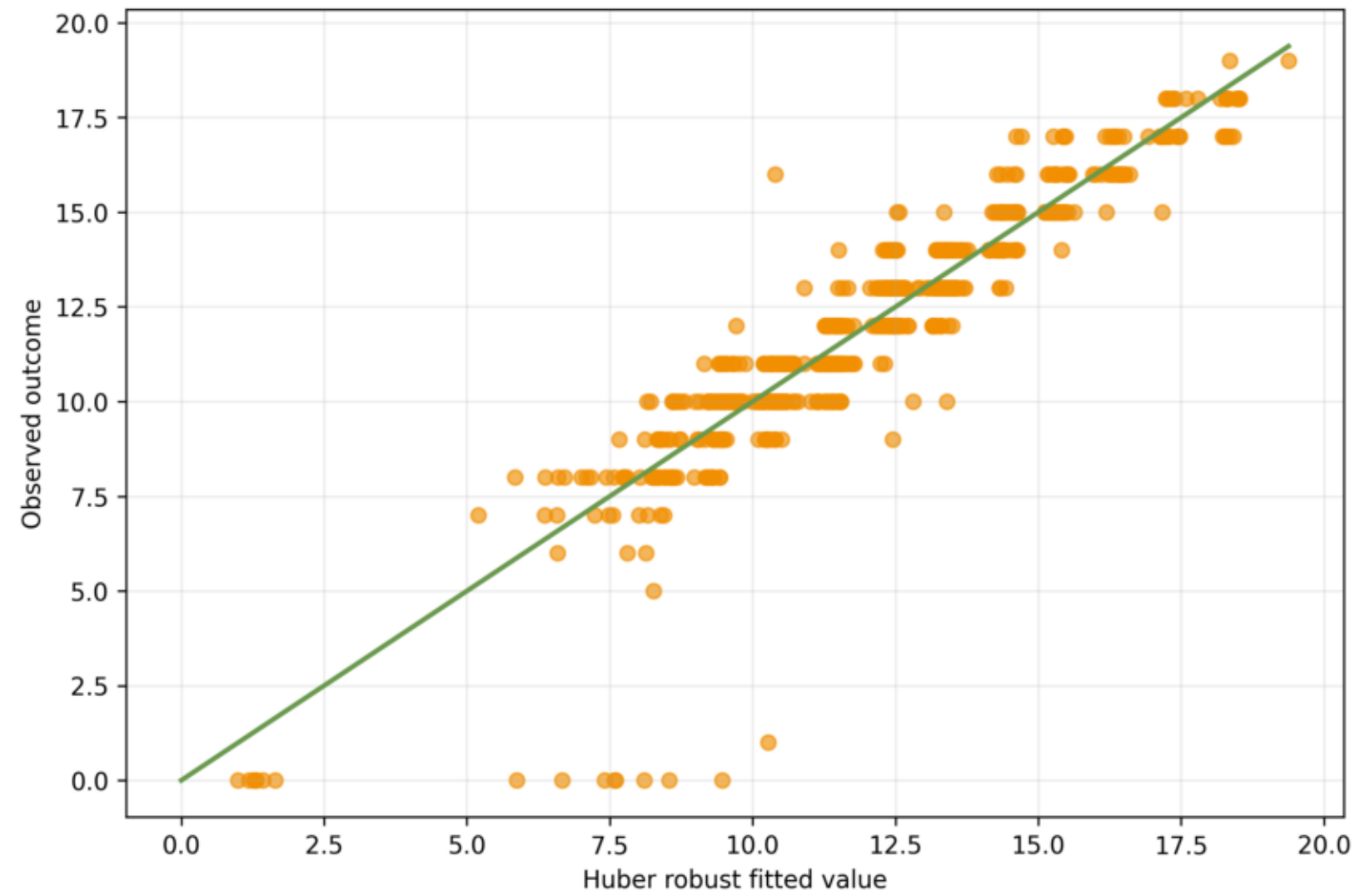
case_num	G3	G1	G2	studytime	failures	absences	age	Medu	Fedu	ols_fitted	ols_resid	uber_fitted	uber_resid	ber_weight	key_fitted	key_resid	key_absolute	total_absolute	total_absolute_scaled	huber_weight	robust_fitted	robust_residual	weight	weighted_ols
1.00000	11.0000	0.00000	11.0000	2.00000	0.00000	4.00000	18.0000	4.00000	4.00000	9.83267	1.16733	10.2060	0.79395	1.00000	10.2578	0.74217	0.91305	1.16733	0.79395	0.00000	0.00000			
2.00000	11.0000	9.00000	11.0000	2.00000	0.00000	2.00000	17.0000	1.00000	1.00000	11.1238	-0.1238	11.2596	-0.2596	1.00000	11.2862	-0.2862	0.98682	0.12381	0.25961	0.00000	0.00000			
3.00000	12.0000	12.0000	13.0000	2.00000	0.00000	6.00000	15.0000	1.00000	1.00000	13.3692	-1.3692	13.2280	-1.2280	0.83395	13.1666	-1.1666	0.79235	1.36929	1.22806	0.00000	0.00000			
4.00000	14.0000	14.0000	14.0000	3.00000	0.00000	0.00000	15.0000	4.00000	2.00000	14.3881	-0.3881	14.3725	-0.3725	1.00000	14.3619	-0.3619	0.97896	0.38813	0.37250	0.00000	0.00000			
5.00000	13.0000	11.0000	13.0000	2.00000	0.00000	0.00000	16.0000	3.00000	3.00000	13.0661	-0.0661	13.1467	-0.1467	1.00000	13.1513	-0.1513	0.99631	0.06616	0.14676	0.00000	0.00000			
6.00000	13.0000	12.0000	12.0000	2.00000	0.00000	6.00000	16.0000	4.00000	3.00000	12.4163	0.58363	12.4222	0.57777	1.00000	12.4254	0.57460	0.94741	0.58363	0.57777	0.00000	0.00000			
7.00000	13.0000	13.0000	12.0000	2.00000	0.00000	0.00000	16.0000	2.00000	2.00000	12.4910	0.50893	12.5347	0.46525	1.00000	12.5470	0.45298	0.96715	0.50893	0.46525	0.00000	0.00000			
8.00000	13.0000	10.0000	13.0000	2.00000	0.00000	2.00000	17.0000	4.00000	4.00000	12.9680	0.03195	13.0903	-0.0903	1.00000	13.1116	-0.1116	0.99799	0.03195	0.09030	0.00000	0.00000			
9.00000	17.0000	15.0000	16.0000	2.00000	0.00000	0.00000	15.0000	3.00000	2.00000	16.2494	0.75054	16.1753	0.82462	1.00000	16.1312	0.86876	0.88186	0.75054	0.82462	0.00000	0.00000			
10.0000	13.0000	12.0000	12.0000	2.00000	0.00000	0.00000	15.0000	3.00000	4.00000	12.3240	0.67591	12.3234	0.67655	1.00000	12.3111	0.68886	0.92486	0.67591	0.67655	0.00000	0.00000			
11.0000	14.0000	14.0000	14.0000	2.00000	0.00000	2.00000	15.0000	4.00000	4.00000	14.3810	-0.3810	14.3078	-0.3078	1.00000	14.2762	-0.2762	0.98772	0.38107	0.30785	0.00000	0.00000			
12.0000	13.0000	10.0000	12.0000	3.00000	0.00000	0.00000	15.0000	2.00000	1.00000	12.1128	0.88720	12.1542	0.84579	1.00000	12.1441	0.85582	0.88525	0.88720	0.84579	0.00000	0.00000			
13.0000	12.0000	12.0000	13.0000	1.00000	0.00000	0.00000	15.0000	4.00000	4.00000	13.0673	-1.0673	13.1475	-1.1475	0.89244	13.1471	-1.1471	0.79885	1.06731	1.14758	0.00000	0.00000			
14.0000	13.0000	12.0000	12.0000	2.00000	0.00000	0.00000	15.0000	4.00000	3.00000	12.2571	0.74289	12.3398	0.66020	1.00000	12.3534	0.64651	0.93366	0.74289	0.66020	0.00000	0.00000			
15.0000	15.0000	14.0000	14.0000	3.00000	0.00000	0.00000	15.0000	2.00000	2.00000	14.4780	0.52197	14.3634	0.63651	1.00000	14.3200	0.67991	0.92676	0.52197	0.63651	0.00000	0.00000			
16.0000	17.0000	17.0000	17.0000	1.00000	0.00000	6.00000	16.0000	4.00000	4.00000	17.4827	-0.4827	17.3038	-0.3038	1.00000	17.2432	-0.2432	0.99047	0.48278	0.30386	0.00000	0.00000			
17.0000	14.0000	13.0000	13.0000	3.00000	0.00000	10.0000	16.0000	4.00000	4.00000	13.6542	0.34572	13.4522	0.54777	1.00000	13.4034	0.59654	0.94337	0.34572	0.54777	0.00000	0.00000			
18.0000	14.0000	13.0000	14.0000	2.00000	0.00000	2.00000	16.0000	3.00000	3.00000	14.2832	-0.2832	14.2617	-0.2617	1.00000	14.2437	-0.2437	0.99043	0.28328	0.26170	0.00000	0.00000			

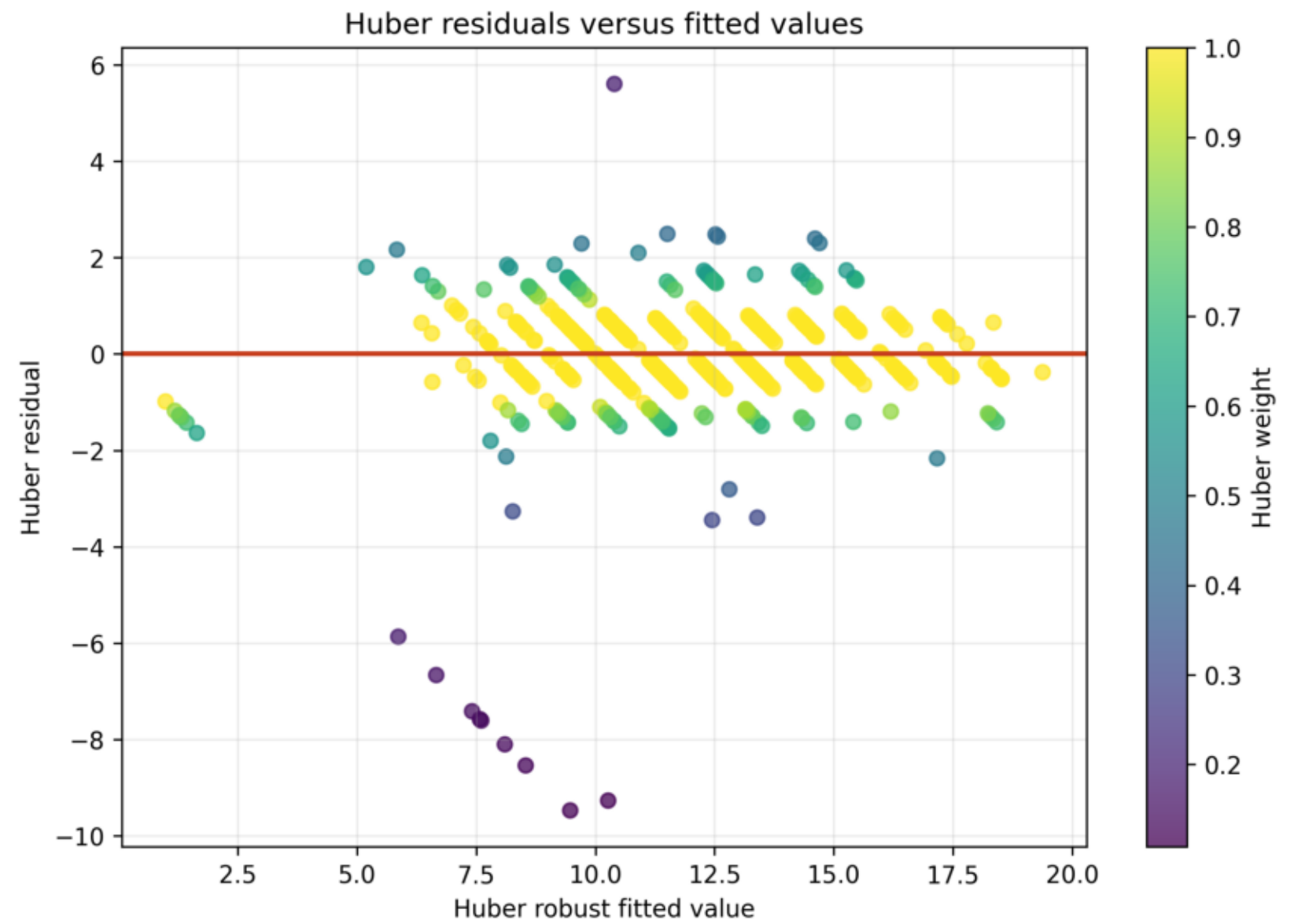
Lowest Huber weights

case_num	G3	G1	G2	studytime	failures	absences	age	Medu	Fedu	ols_fitted	ols_resid	huber_fitted	huber_resid	huber_weight	key_fitted	key_resid	key_abs	total_abs	total_res	whuber_fitted	whuber_resid	whuber_weight	weighted_ols
164.000	0.00000	11.0000	9.00000	1.00000	2.00000	0.00000	18.0000	1.00000	1.00000	9.05080	-9.05080	9.47256	-9.47256	0.10812	9.61933	-9.61933	0.00000	9.05080	9.47256	1.00000	1.00000		
173.000	1.00000	10.0000	10.0000	2.00000	1.00000	0.00000	16.0000	3.00000	3.00000	10.0329	-9.03294	10.2679	-9.26792	0.11050	10.3374	-9.33744	0.00000	9.03298	9.26792	1.00000	1.00000		
587.000	0.00000	8.00000	8.00000	2.00000	0.00000	0.00000	17.0000	4.00000	2.00000	8.16764	-8.16764	8.53922	-8.53922	0.11993	8.65519	-8.65519	0.00000	8.16764	8.53922	1.00000	1.00000		
640.000	0.00000	5.00000	8.00000	1.00000	1.00000	0.00000	19.0000	1.00000	1.00000	7.56366	-7.56366	8.10127	-8.10127	0.12642	8.25251	-8.25251	0.00000	7.56366	8.10127	1.00000	1.00000		
520.000	0.00000	8.00000	7.00000	2.00000	0.00000	0.00000	16.0000	2.00000	1.00000	7.32802	-7.32802	7.60779	-7.60779	0.13462	7.69250	-7.69250	0.00000	7.32802	7.60779	1.00000	1.00000		
638.000	0.00000	7.00000	7.00000	1.00000	0.00000	0.00000	18.0000	2.00000	1.00000	7.13337	-7.13337	7.57827	-7.57827	0.13514	7.71338	-7.71338	0.00000	7.13337	7.57827	1.00000	1.00000		
641.000	0.00000	7.00000	7.00000	1.00000	1.00000	0.00000	18.0000	4.00000	2.00000	6.83013	-6.83013	7.41426	-7.41426	0.13813	7.59862	-7.59862	0.00000	6.83013	7.41426	1.00000	1.00000		
584.000	0.00000	8.00000	6.00000	1.00000	1.00000	0.00000	18.0000	2.00000	2.00000	6.17862	-6.17862	6.66310	-6.66310	0.15370	6.82851	-6.82851	0.00000	6.17862	6.66310	1.00000	1.00000		
627.000	0.00000	7.00000	5.00000	2.00000	0.00000	0.00000	18.0000	4.00000	4.00000	5.43656	-5.43656	5.86716	-5.86716	0.17456	6.02427	-6.02427	0.00000	5.43656	5.86716	1.00000	1.00000		
62.0000	16.0000	10.0000	10.0000	1.00000	0.00000	0.00000	16.0000	1.00000	1.00000	10.2175	5.78244	10.3984	5.60157	0.18283	10.4369	5.56303	0.00000	5.78244	5.60157	1.00000	1.00000		
647.000	9.00000	11.0000	12.0000	2.00000	0.00000	6.00000	18.0000	1.00000	1.00000	12.4091	-3.40915	12.4482	-3.44822	0.29701	12.4629	-3.46299	0.00102	3.40915	3.44823	1.00000	1.00000		
63.0000	10.0000	13.0000	13.0000	2.00000	0.00000	0.00000	16.0000	1.00000	2.00000	13.4208	-3.42083	13.3952	-3.39522	0.30164	13.3778	-3.37780	0.00624	3.42083	3.39521	1.00000	1.00000		
280.000	5.00000	7.00000	8.00000	1.00000	3.00000	12.0000	22.0000	3.00000	1.00000	7.63103	-2.63103	8.26771	-3.26771	0.31341	8.50524	-3.50524	0.00007	2.63103	3.26771	1.00000	1.00000		
559.000	10.0000	8.00000	13.0000	1.00000	0.00000	0.00000	17.0000	2.00000	2.00000	12.5849	-2.58495	12.8096	-2.80962	0.36451	12.8352	-2.83520	0.12329	2.58495	2.80967	1.00000	1.00000		
308.000	14.0000	11.0000	11.0000	2.00000	0.00000	0.00000	17.0000	3.00000	1.00000	11.2751	2.72482	11.5098	2.49016	0.41128	11.5812	2.41877	0.27851	2.72482	2.49016	1.00000	1.00000		
359.000	15.0000	12.0000	12.0000	1.00000	0.00000	8.00000	18.0000	4.00000	3.00000	12.4106	2.58937	12.5198	2.48011	0.41294	12.5635	2.43645	0.27125	2.58937	2.48011	1.00000	1.00000		
355.000	15.0000	12.0000	12.0000	2.00000	0.00000	2.00000	18.0000	2.00000	1.00000	12.4165	2.58346	12.5667	2.43321	0.42090	12.6198	2.38020	0.29451	2.58346	2.43321	1.00000	1.00000		
366.000	17.0000	15.0000	14.0000	2.00000	0.00000	14.0000	17.0000	4.00000	3.00000	14.8209	2.17904	14.6073	2.39264	0.42804	14.5649	2.43503	0.27183	2.17904	2.39264	1.00000	1.00000		



Observed versus Huber robust fitted values





Huber robust residual distribution

