

Generalized Additive Model

Test name: Generalized Additive Model

Dataset: D:/DATA ANALYSIS/H Regression Tests and Models/Generalized Additive Model/dataset.csv

Rows in original dataset: 649

Columns in original dataset: 33

Rows used in GAM model: 649

Outcome variable: G3

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

Categorical predictors: school, sex, address

Formula: $G3 \sim s(G1, k = 10) + s(G2, k = 10) + s(studytime, k = 3) + s(failures, k = 3) + s(absences, k = 10) + s(age, k = 7) + school + sex + address$

Method: mgcv::gam with REML smoothness selection

Model RMSE: 1.2156

Model MAE: 0.7521

Model R-squared: 0.8582

Baseline linear RMSE: 1.241

Number of statistically significant smooth terms at alpha 0.05: 3

Interpretation: GAM smooth terms estimate nonlinear additive predictor effects while categorical factors shift the expected outcome level.

Decision guide: $p < 0.05$ for a smooth term suggests evidence that the predictor contributes to the additive model.

Reporting guide: state outcome, smooth predictors, categorical predictors, family/link, RMSE, explained deviance/R-squared, and important smooth effects.

Charts generated: 7

GAM parametric terms

	model	term_type	term	estimate	standard_error	statistic	p_value
Generalized Additive Model using mgcv::gam	Parametric	(Intercept)	11.9587054	0.1196440	99.9523641	0.0000000	
Generalized Additive Model using mgcv::gam	Parametric	schoolMS	-0.1211751	0.1183998	-1.0234402	0.3064904	
Generalized Additive Model using mgcv::gam	Parametric	sexM	-0.1973973	0.1026297	-1.9233931	0.0548786	
Generalized Additive Model using mgcv::gam	Parametric	addressU	0.1010918	0.1128772	0.8955903	0.3708119	
decision_alpha_0_05							
Statistically significant							
Not statistically significant							
Not statistically significant							
Not statistically significant							

GAM smooth terms

	model	smooth_term	effective_degrees_of_freedom	reference_degrees_of_freedom
	Generalized Additive Model using mgcv::gam	s(G1)	1.013800	1.025841
	Generalized Additive Model using mgcv::gam	s(G2)	2.694538	3.412959
	Generalized Additive Model using mgcv::gam	s(studytime)	1.440731	1.686153
	Generalized Additive Model using mgcv::gam	s(failures)	1.555764	1.801520
	Generalized Additive Model using mgcv::gam	s(absences)	3.102760	3.837271
	Generalized Additive Model using mgcv::gam	s(age)	1.768733	2.239434
statistic	p_value	decision_alpha_0_05		
19.335926	1.336095e-05	Statistically significant nonlinear/additive effect		
195.393731	0.000000e+00	Statistically significant nonlinear/additive effect		
1.446380	3.510927e-01	Not statistically significant		
2.931408	1.027848e-01	Not statistically significant		
2.803430	2.395872e-02	Statistically significant nonlinear/additive effect		
1.059336	3.232714e-01	Not statistically significant		

GAM fit statistics

model	n	family	link	rmse	mae	r_squared	adjusted_r_squared
Generalized Additive Model using mgcv::gam	649	gaussian	identity	1.215615	0.7520882	0.8581986	0.8549355
deviance_explained	baseline_linear_rmse	aic					
0.8581986	1.240967	2133.224					

note

GAM evaluates additive smooth/nonlinear effects; lower RMSE and higher explained deviance indicate better fit.













