

Correlation Matrix

[illegible]

Measures pairwise Pearson correlations between numeric features and final grade.

Grade by Sex

sex	count	mean
F	208	9.966346153846152
M	187	10.914438502673796

Shows the distribution of final grades split by student sex.

Grade by Studytime

studytime	count	mean
1.0	105.0	10.047619047619047
2.0	198.0	10.171717171717171
3.0	65.0	11.4
4.0	27.0	11.25925925925926

Compares grade outcomes across study-time categories.

model	fold	rmse	mae	r2
full	1	1.8856616875781296	1.029	0.856912676056338
mean	1	4.985870533735388	3.7797183098591542	-0.0003583492624064
ols_g1_g2	1	2.107271637805448	1.1796718665594783	0.8213040742253821
last_grade	1	2.230067977499793	1.05	0.7987927565392354
no_g1_g2	1	4.126523960914319	3.071	0.3147605633802817
no_behavior	1	2.160979330603966	1.239236723202134	0.812079208559454
demographic_only	1	4.934559719935637	3.817142478821309	0.0201255682248986
full	2	1.9441265074097835	1.1452228211262578	0.8715613668570772
mean	2	5.4610421671398495	4.373943661971831	-0.0134391827807156
ols_g1_g2	2	2.474060913611427	1.4155515431189034	0.7919980492987916
last_grade	2	2.683281572999748	1.4	0.7553308979695863
no_g1_g2	2	5.172203592280567	3.9775	0.0909288930422225
no_behavior	2	2.460185893355847	1.4349821093849593	0.7943245389561768
demographic_only	2	5.789232964932414	4.77799561252406	-0.1389081071195361
full	3	2.0940893008656527	1.3295	0.8459133413857473
mean	3	5.603236004265757	4.251619718309859	-0.103195474935767
ols_g1_g2	3	2.600963269698076	1.5117084887614038	0.7622923929173249
last_grade	3	2.7658633371878665	1.35	0.7311957834632701
no_g1_g2	3	4.395010807722775	3.3	0.3212739211595475
no_behavior	3	2.7999784351074712	1.8102119821981384	0.7245238436519816
demographic_only	3	5.577924524630135	4.175352954033437	-0.093251064103492
full	4	1.2264428163579122	0.8409611311034496	0.8991130089761692
mean	4	3.895013444927175	2.979647887323944	-0.0175563855737386
ols_g1_g2	4	1.0720179624138777	0.8632484754383369	0.9229194710215552
last_grade	4	0.85146931829632	0.575	0.9513728778033956
no_g1_g2	4	3.461228105745126	2.6710000000000003	0.1964720184447705
no_behavior	4	1.1576803782220526	0.8149465126528493	0.9101086492143128
demographic_only	4	3.955474882816763	2.947551573622983	-0.0493921809998263
full	5	1.588146718662983	0.9855	0.8135494363333949
mean	5	3.689792210173238	2.7390140845070423	-0.0064362634821741
ols_g1_g2	5	1.676939871218497	1.113593050699056	0.7921177355991639
last_grade	5	1.5572411502397436	0.825	0.8207355387174274
no_g1_g2	5	3.8181295962903294	2.619411540286774	-0.0776650241410576
no_behavior	5	2.0261066681265225	1.3346509732308818	0.6965360760948616
demographic_only	5	3.61819482942684	2.7845095446603816	0.0322429256188417
full	6	1.407986383844558	1.040957416958017	0.897967331333636
mean	6	4.526538664085158	3.1201382886776146	-0.0545685237551902
ols_g1_g2	6	2.0877454210553146	1.3729689776742404	0.7756648039214931
last_grade	6	2.087815690853567	1.0256410256410255	0.7756497022198159
no_g1_g2	6	3.5005044874724205	2.6041514108397688	0.3693279079174019
no_behavior	6	2.042928858978009	1.2215061810506218	0.7851928055953055
demographic_only	6	4.202669476313422	3.0927754362403115	0.0909394580409223
full	7	1.694941368333521	0.9559776913257768	0.7860781007433507
mean	7	3.9825453113663993	3.14253817343705	-0.1810474270992146
ols_g1_g2	7	1.804282976132336	0.9004738735975341	0.7575874001195231
last_grade	7	1.8257418583505536	0.7692307692307693	0.7517869382159992
no_g1_g2	7	3.4581572089844737	2.804102564102564	0.109497072358758
no_behavior	7	1.895279762631226	0.9855817566813952	0.732519246993506
demographic_only	7	3.9734839694442674	3.27858558223749	-0.1756791518216933
full	8	1.7771916768908906	1.0210256410256409	0.8350974186461623
mean	8	4.383603212549194	3.288893690579084	-0.0032782235079613
ols_g1_g2	8	1.9088602809485489	1.1398186888546955	0.8097576528460009
last_grade	8	1.9546132150665565	1.0	0.8005286283125086
no_g1_g2	8	3.8734637988909815	2.8394486012281672	0.2166462700876653
no_behavior	8	2.032556924122111	1.2525112995562877	0.7843028794679103
demographic_only	8	4.641494980885736	3.3728052747694317	-0.1247983823695786
full	9	0.898514669226244	0.6612019177482549	0.9574457022092726
mean	9	4.412465240586416	3.312806107749928	-0.0262559290463699
ols_g1_g2	9	1.2892182192517176	0.8653262313857206	0.9123915587319892
last_grade	9	1.3397282541141673	0.6666666666666666	0.90539229276407
no_g1_g2	9	3.6047580954861305	2.771675566586973	0.3150713442637364
no_behavior	9	1.3424225167803794	0.9039702691094637	0.9050113881749656
demographic_only	9	4.239902701625077	3.236394843997611	0.0524440444907249
full	10	1.3966406582242723	0.9589743589743592	0.9044178350515464
mean	10	4.55610168793904	3.485378853356381	-0.0171718170318655
ols_g1_g2	10	1.9404404444444444	0.9487179487179488	0.8285710586422113
last_grade	10	1.9806758753205744	0.8077641752577732	0.8077641752577732
no_g1_g2	10	4.326059435308785	3.221252913882972	0.0829511613488869
no_behavior	10	2.107931419352348	1.273310913742115	0.7822689054355105
demographic_only	10	4.61036578087773	3.5543230957084107	-0.0415455501139092

Statistical Tests

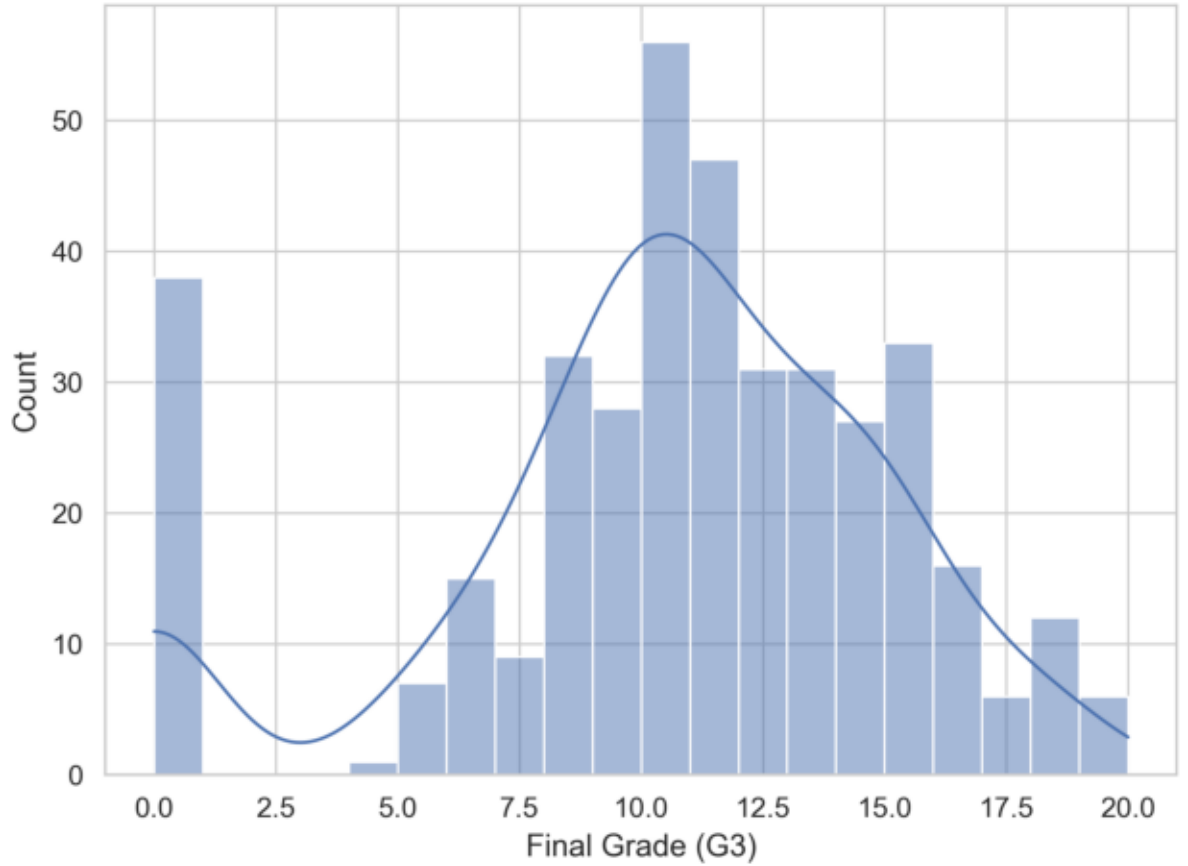
model	test	p_value	effect_size
mean	paired_t	2.177265713379969e-08	-5.726265006838581
ols_g1_g2	paired_t	0.0053447198940307	-1.1531940983737576
last_grade	paired_t	0.0162208454915743	-0.9328729275599432
no_g1_g2	paired_t	3.540067666836518e-08	-5.417492574148331
no_behavior	paired_t	0.0005449295886842	-1.652560012591248
demographic_only	paired_t	3.553686885211942e-08	-5.41511745161214

Summary

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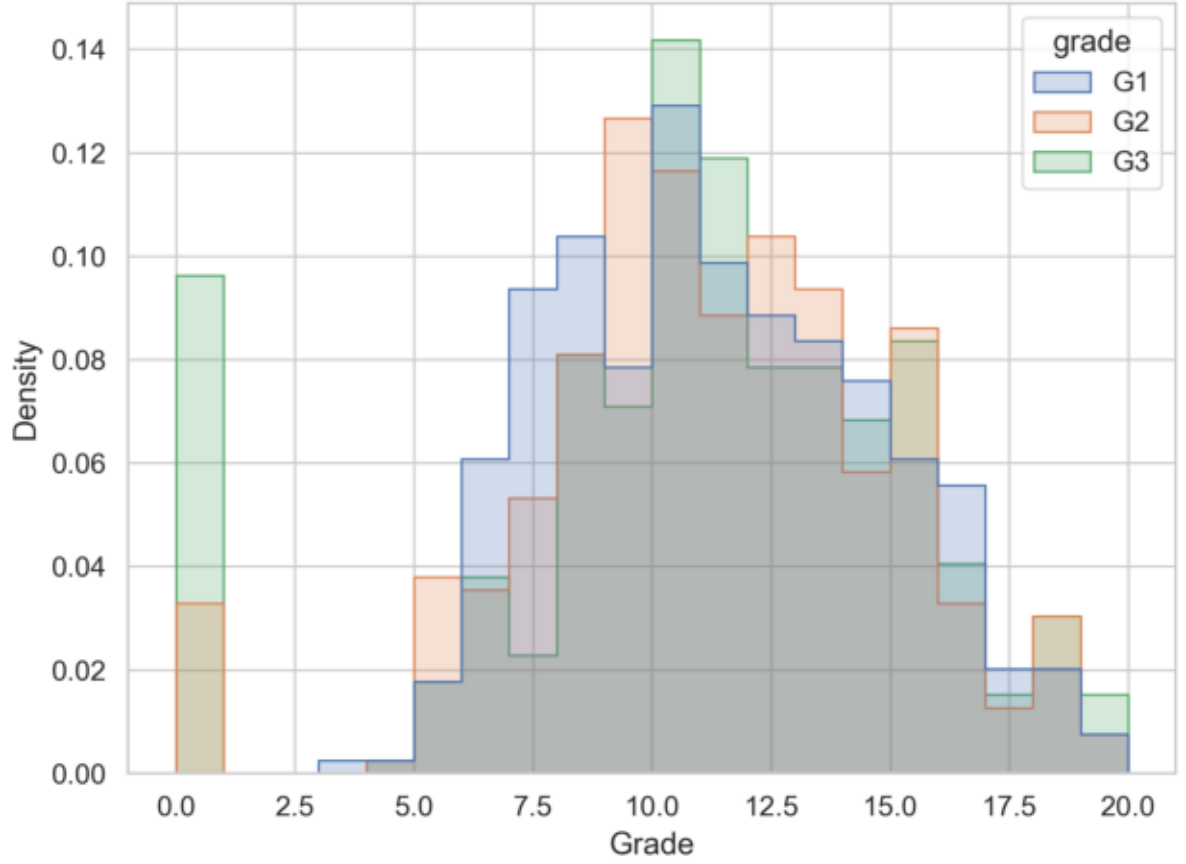
Descriptive statistics of the cleaned dataset.

G3 Distribution



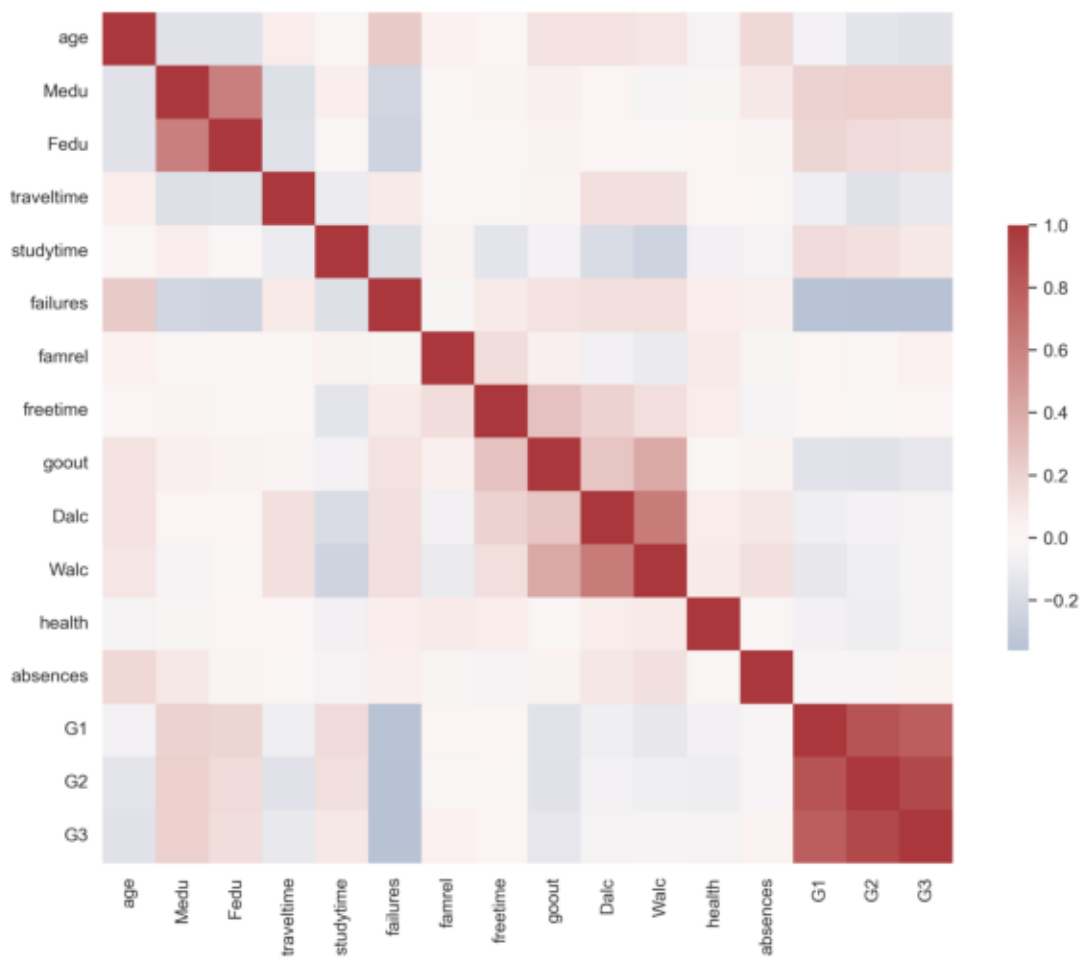
Histogram of final-grade values.

Grades Distribution



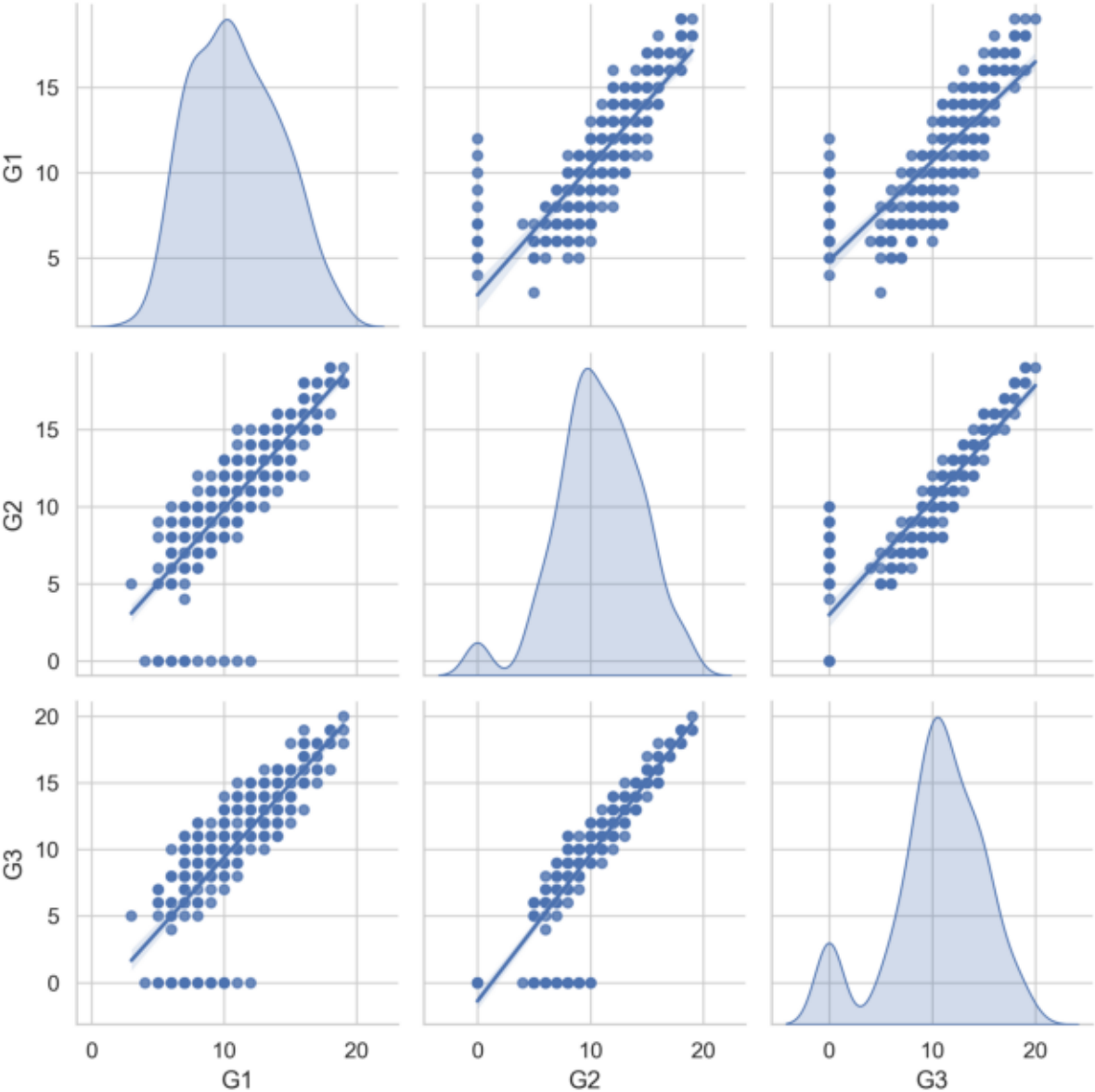
Pairwise scatter plots between G1, G2, and G3.

Correlation Heatmap



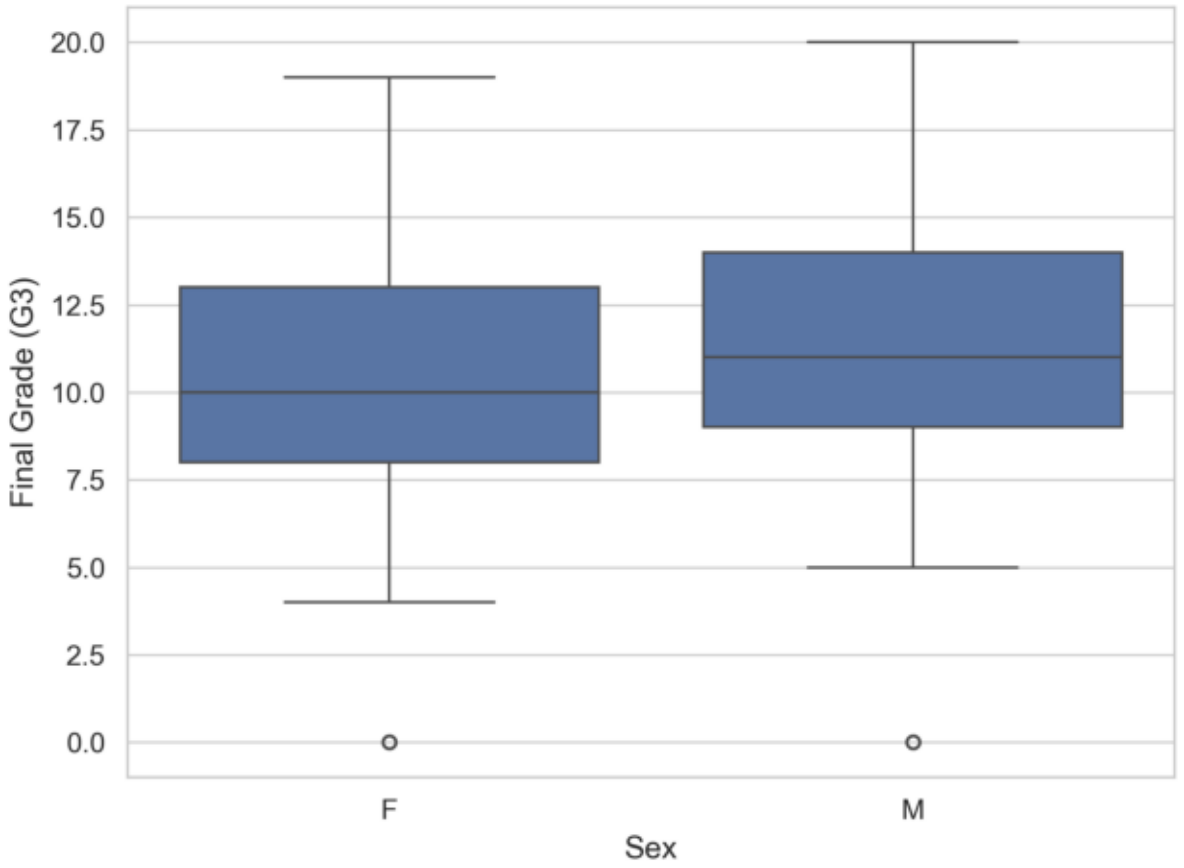
Correlation matrix visualized as a heatmap.

Grades Pairplot



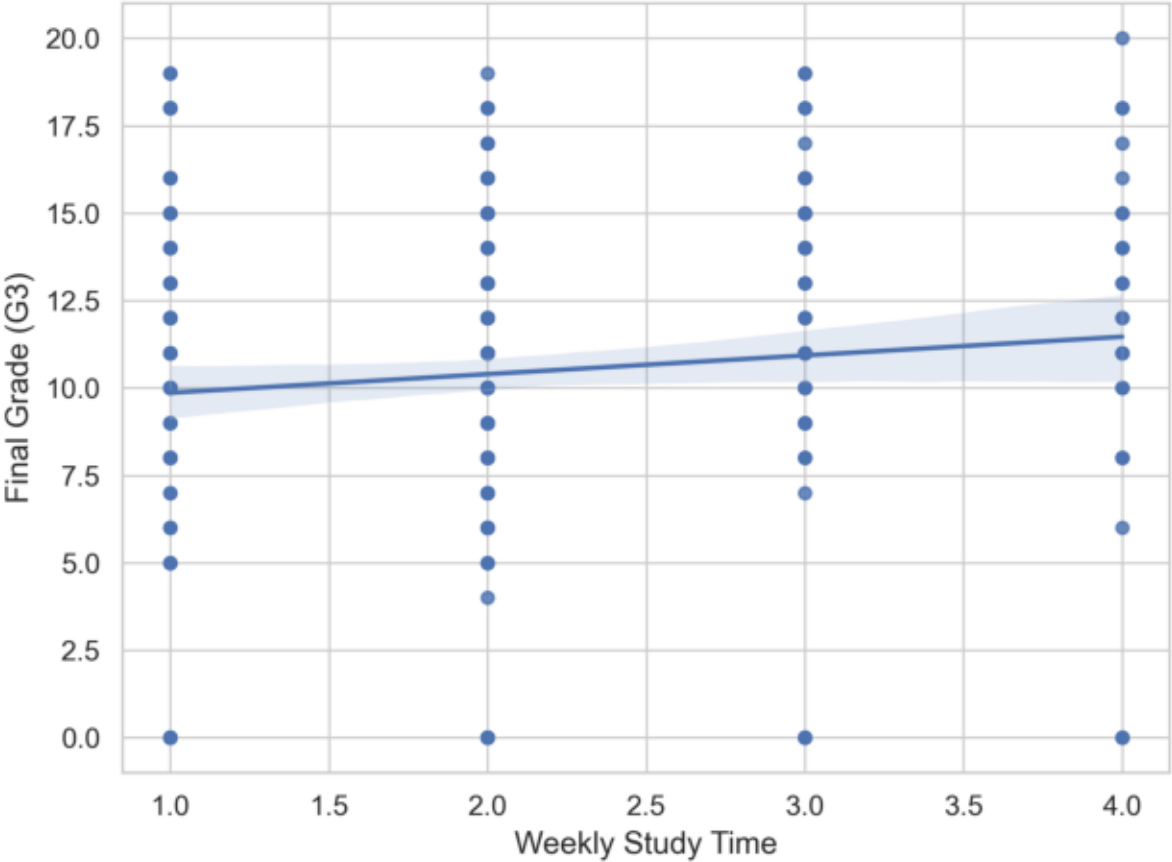
Pairplot showing relationships between grades at different stages.

G3 by Sex



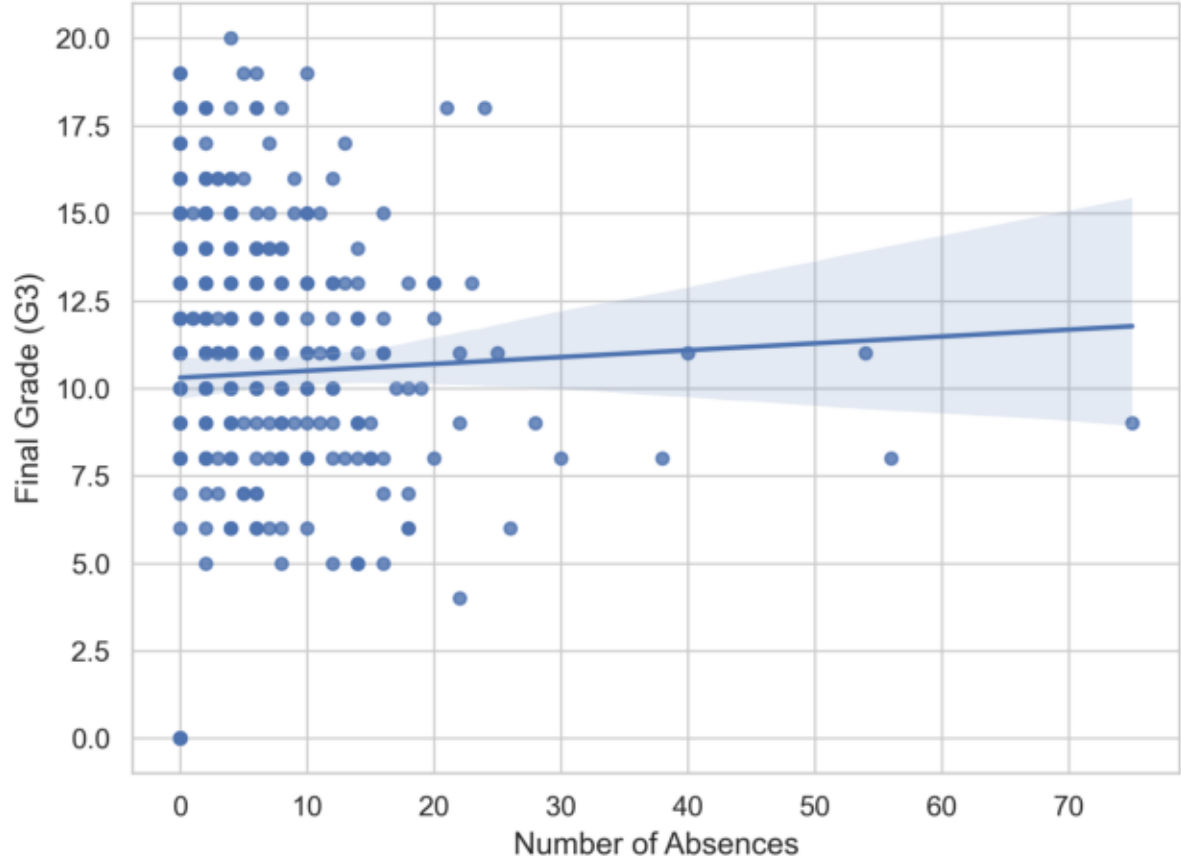
Boxplot of final grades grouped by sex.

Studytime vs G3



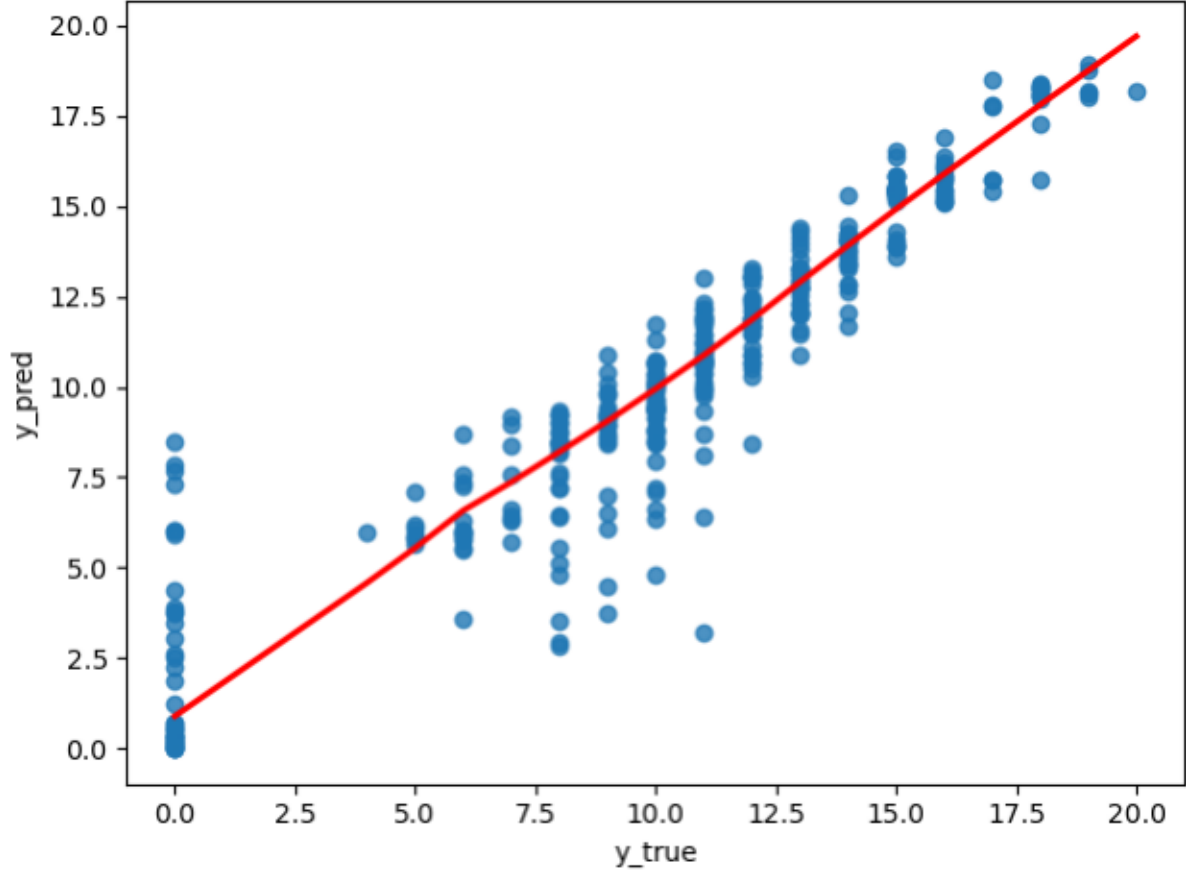
Scatter plot of study time against final grade.

Absences vs G3



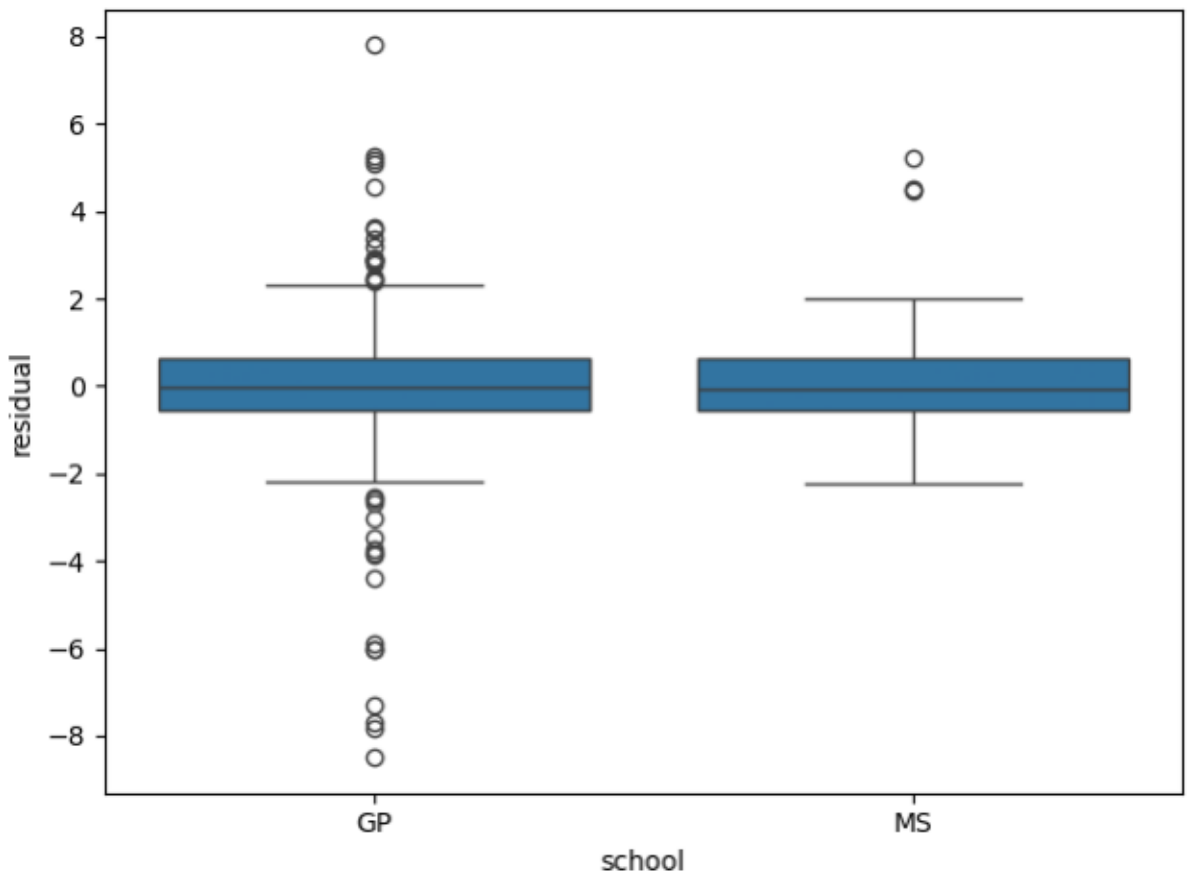
Relationship between class absences and final grade.

Predicted vs Actual



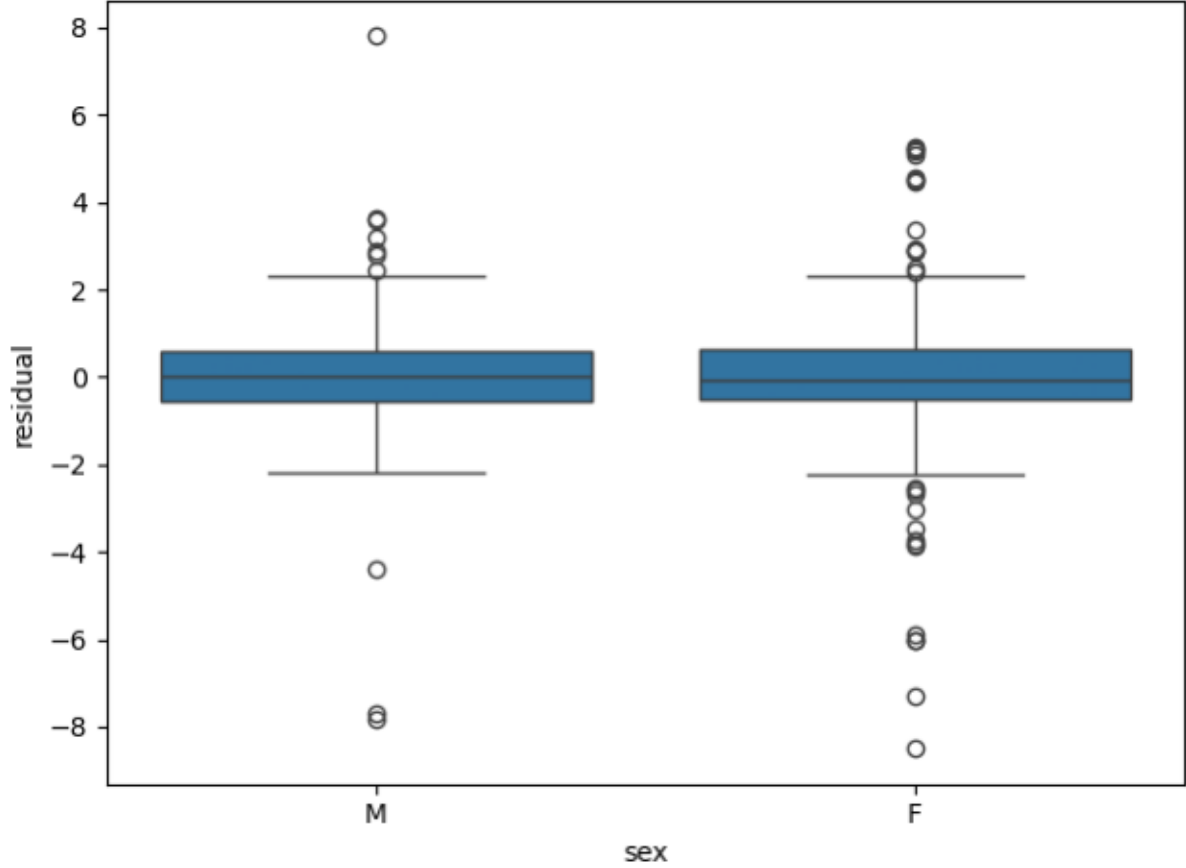
Model predictions compared with actual grades.

Residuals by School



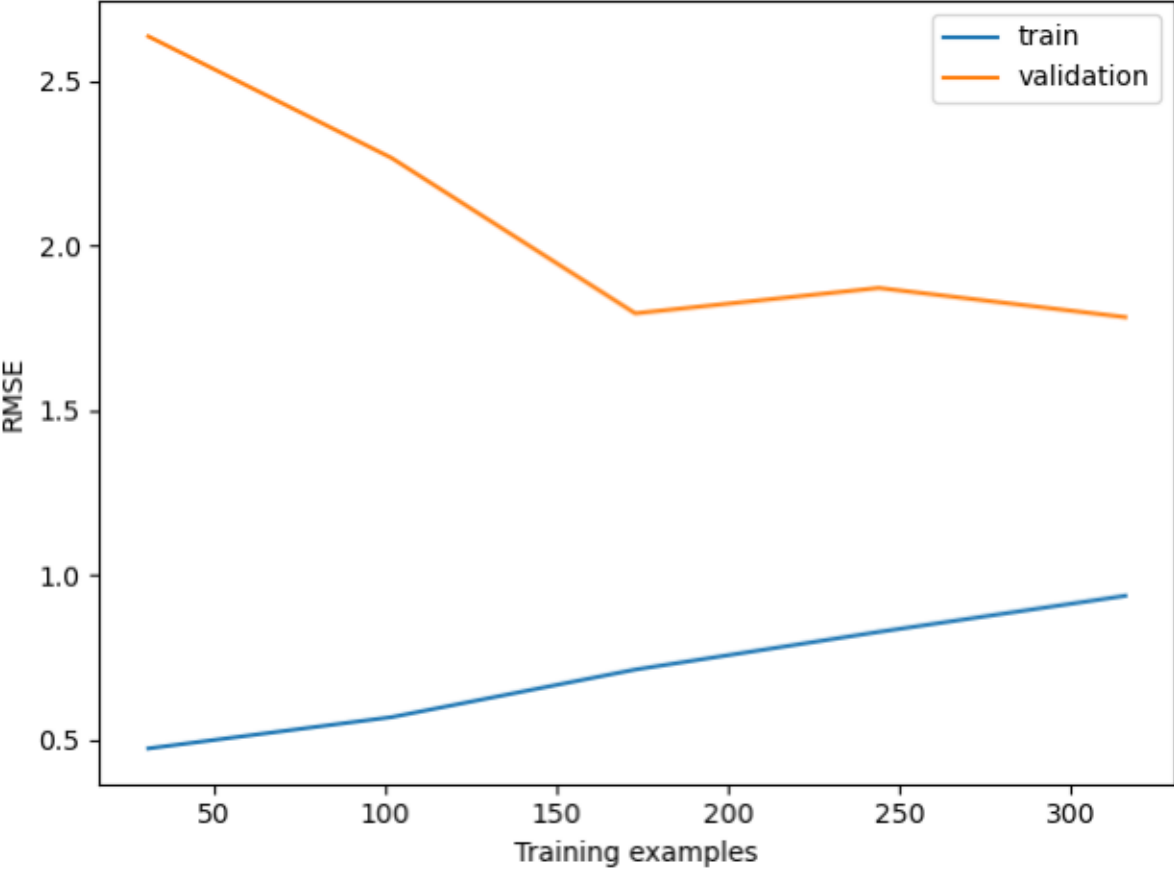
Residual plot split by school.

Residuals by Sex



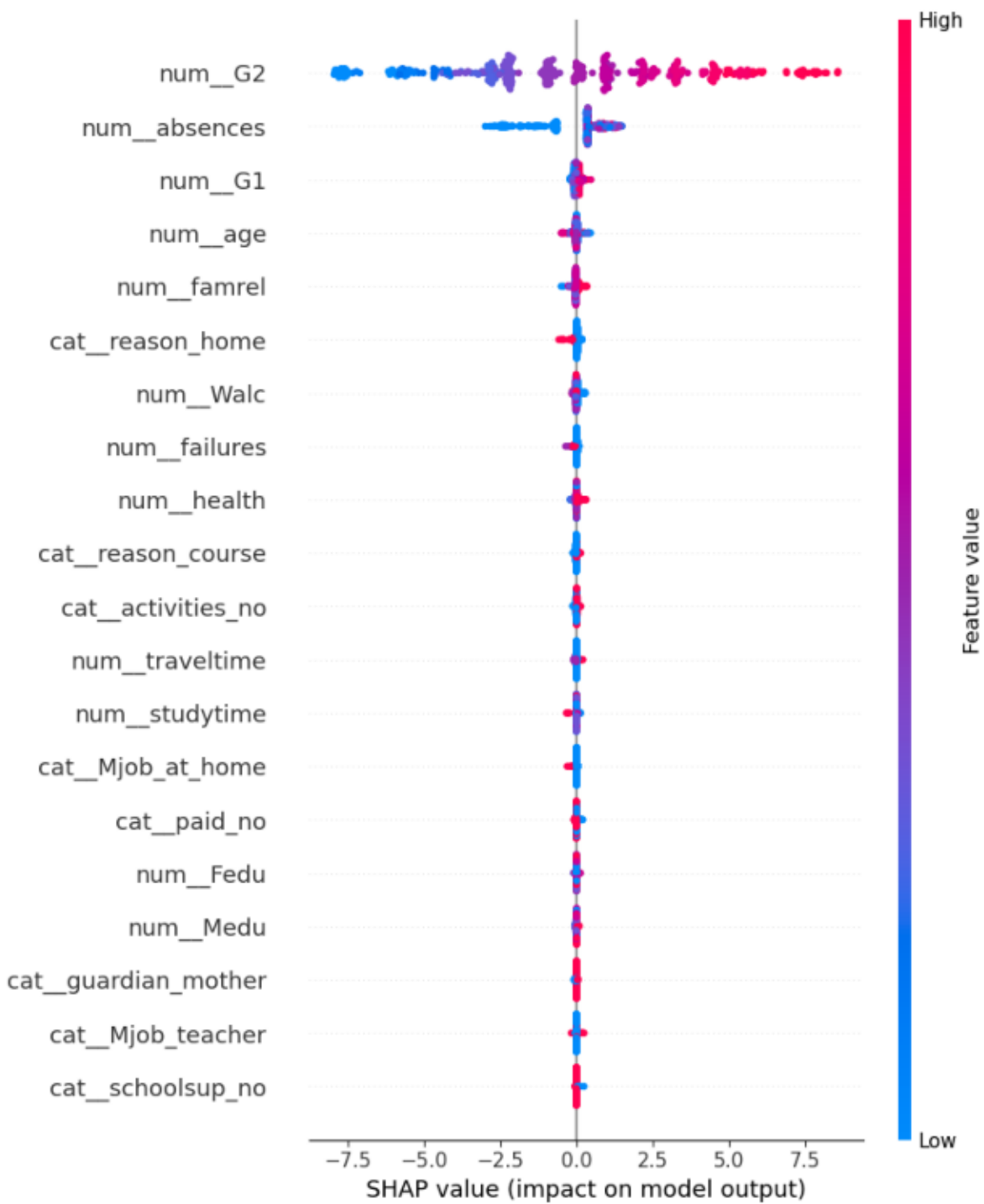
Residual plot split by sex.

Learning Curve



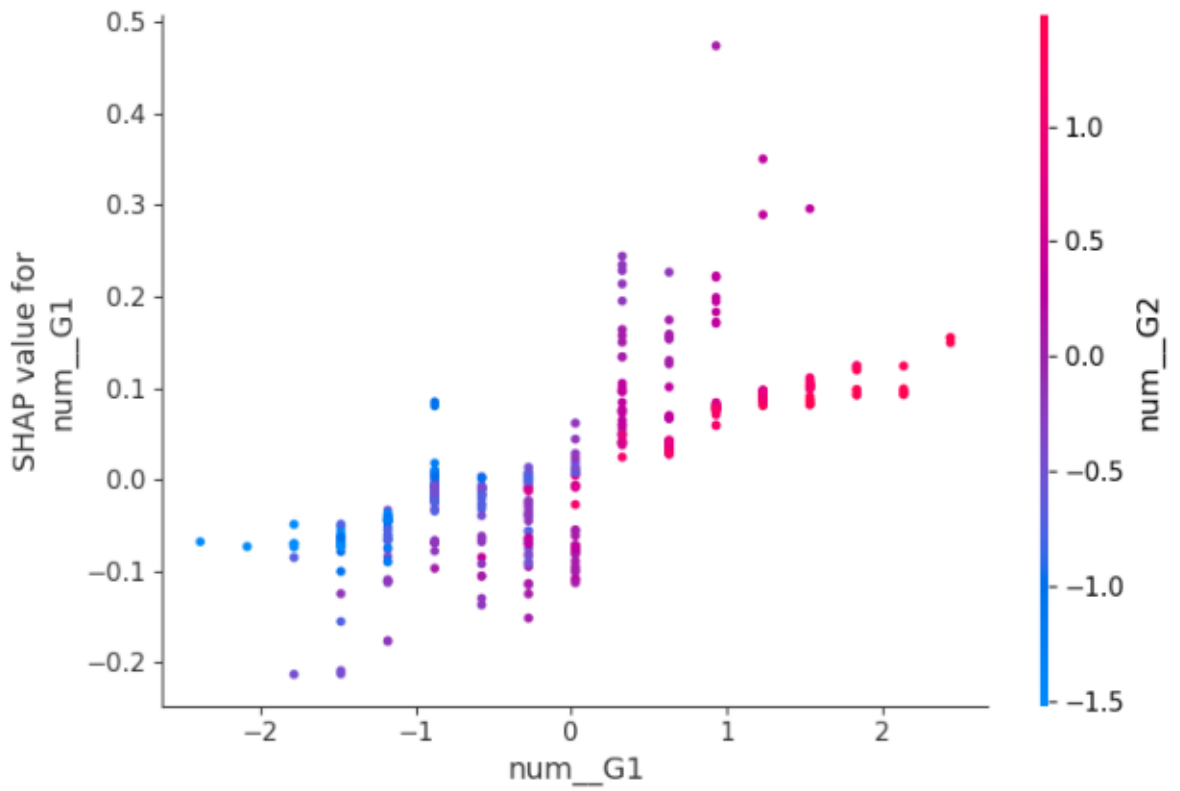
Training/validation score vs. training set size.

SHAP Summary



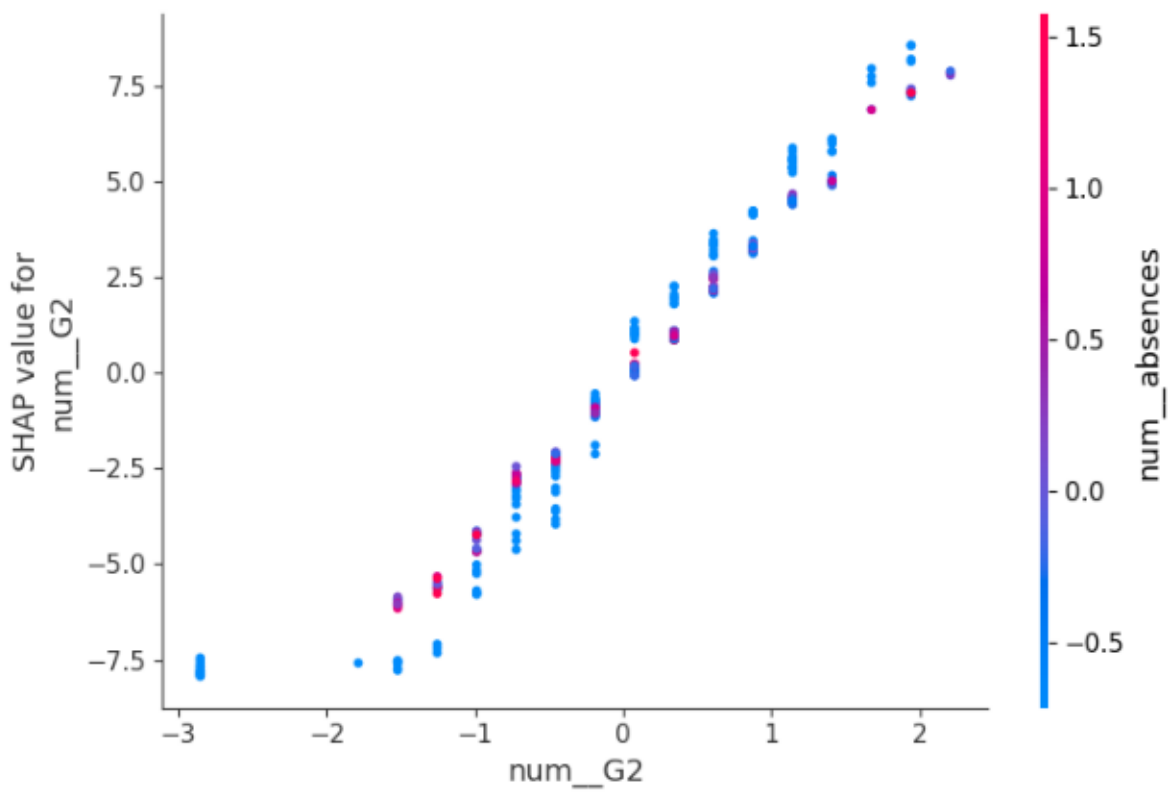
SHAP value summary highlighting feature importance.

SHAP Dependence - G1



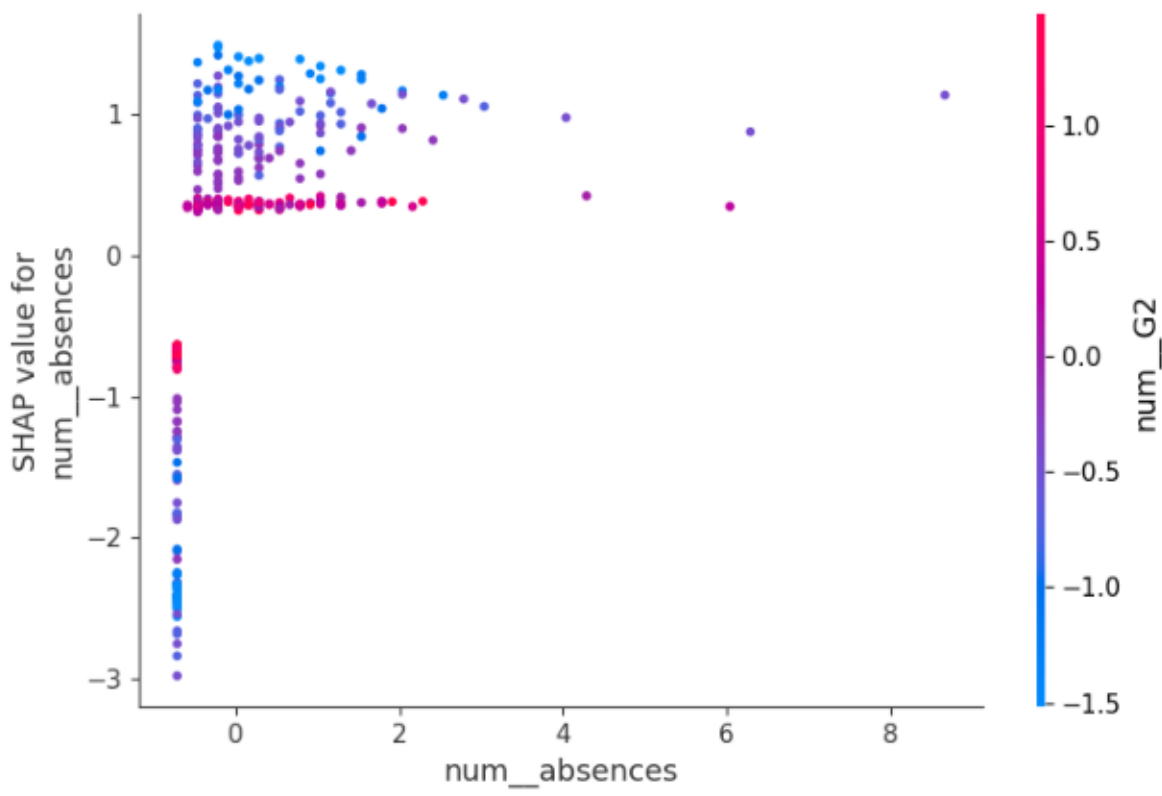
SHAP dependence plot for feature G1.

SHAP Dependence - G2



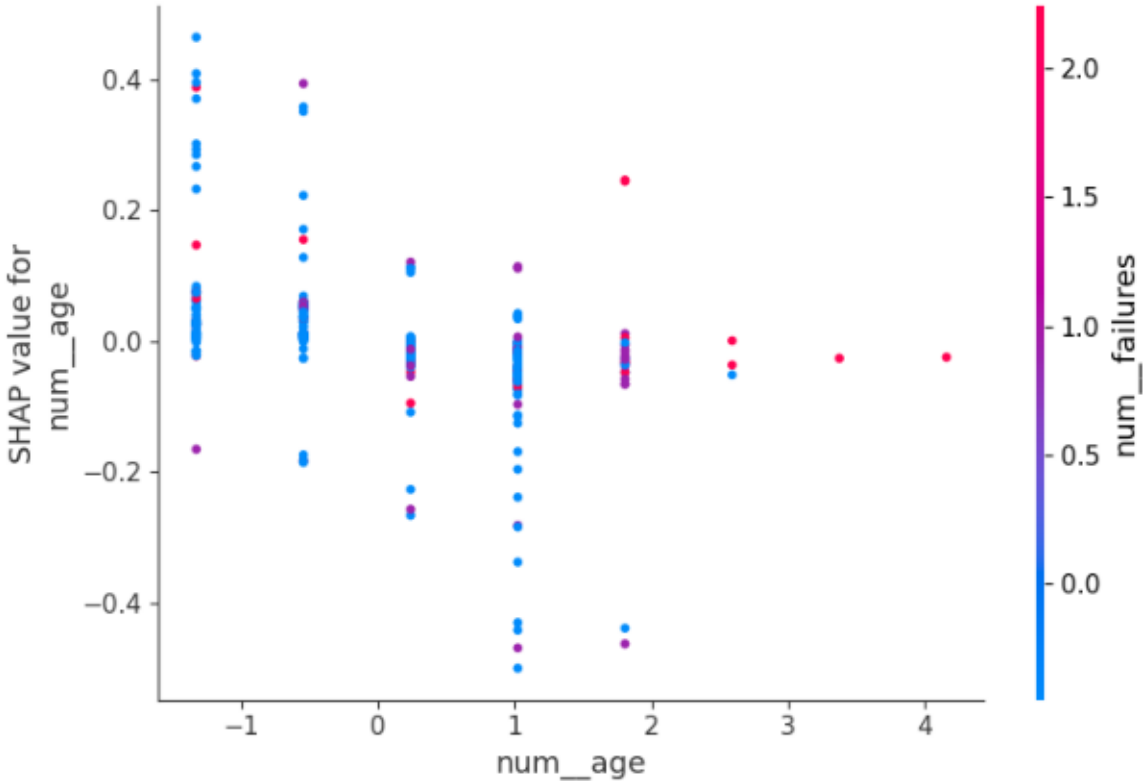
SHAP dependence plot for feature G2.

SHAP Dependence - Absences



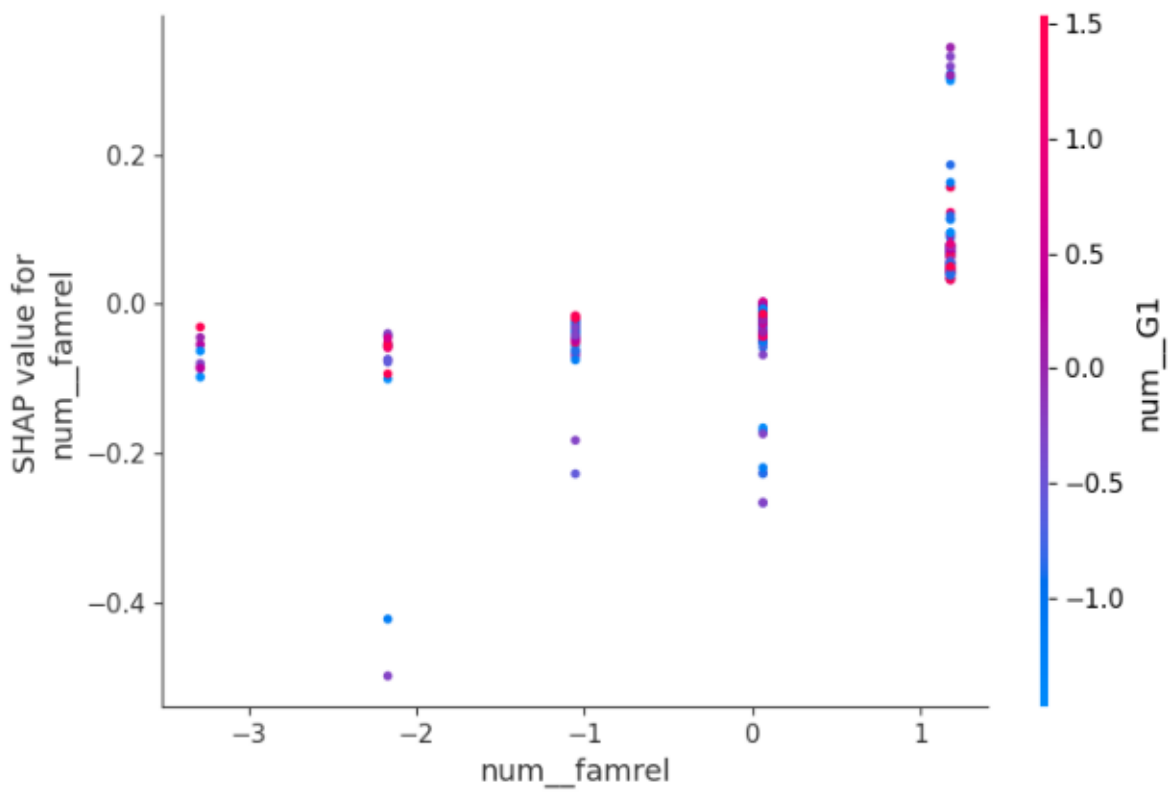
SHAP dependence plot for absences.

SHAP Dependence - Age



SHAP dependence plot for age.

SHAP Dependence - FamRel



SHAP dependence plot for family relationship quality.