

```
1 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
  Scripts\python.exe "C:\Users\alyss\PycharmProjects\  
  PythonProject1\Sulfuric Acid GP XGBoost.py"  
2 <class 'pandas.core.frame.DataFrame'>  
3 RangeIndex: 95 entries, 0 to 94  
4 Data columns (total 30 columns):  
5 #   Column                      Non-Null Count  
6 Dtype  
7 ---  -----  
8  
9  0   ID                         95 non-null  
10 int64  
11  1   MIX ID                     95 non-null  
12 object  
13  2   Fly Ash (kg/m³)           95 non-null  
14 float64  
15  3   Slag (kg/m³)              95 non-null  
16 int64  
17  4   SiO₂                       95 non-null  
18 float64  
19  5   Al₂O₃                      95 non-null  
20 float64  
21  6   SiO₂:Al₂O₃               95 non-null  
22 float64  
23  7   CaO                        95 non-null  
24 float64  
25  8   CaO:SiO₂                 95 non-null  
26 float64  
27  9   CaO:Al₂O₃                95 non-null  
28 float64  
29  10  Fe₂O₃                     95 non-null  
30 float64  
31  11  Fe₂O₃:Al₂O₃              95 non-null  
32 float64  
33  12  Na₂SiO₃ (kg/m³)          95 non-null  
34 float64  
35  13  NaOH (kg/m³)             95 non-null  
36 float64
```

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21 14 Na2SiO3:NaOH           95 non-null
    float64
22 15 NaOH (M)              95 non-null
    int64
23 16 Activator:Binder      95 non-null
    float64
24 17 Extra Water (kg/m3)   95 non-null
    float64
25 18 Liquid:Binder         95 non-null
    float64
26 19 Coarse Aggregate (kg/m3) 95 non-null
    float64
27 20 Fine Aggregate (kg/m3)  95 non-null
    float64
28 21 Fine Aggregate :Total Aggregate 95 non-null
    float64
29 22 Total Aggregate :Binder     95 non-null
    float64
30 23 Curing Temp (C)        95 non-null
    int64
31 24 Curing Time (hr)       91 non-null
    float64
32 25 Age before Exposure (Days) 91 non-null
    float64
33 26 H2SO4 (M)              95 non-null
    float64
34 27 Days Submerged        95 non-null
    int64
35 28 Mass Change (%)       38 non-null
    float64
36 29 Compressive Strength (MPa) 95 non-null
    float64
37 dtypes: float64(24), int64(5), object(1)
38 memory usage: 22.4+ KB
39 None
40          Fly Ash (kg/m3) Slag (kg/m3) SiO2:Al2O3 CaO:
          SiO2  CaO:Al2O3 Fe2O3:Al2O3 Na2SiO3:NaOH  NaOH (M)
          Activator:Binder Extra Water (kg/m3) Liquid:Binder

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40 Fine Aggregate :Total Aggregate Total Aggregate :					
	Binder	Curing Temp (C)	Curing Time (hr)	Age before Exposure (Days)	H2S04 (M)
41 count	95.000000	95.0	95.000000	95.	
	000000	95.000000	95.000000	95.000000	95.000000
		95.000000	95.000000	95.000000	95.000000
			95.000000	95.	
	000000	95.000000	91.000000		
			91.000000	95.000000	95.000000
42 mean	415.051368	0.0	1.907278	0.	
170725	0.268101	0.315825	2.394176	10.442105	
	0.447411		22.082526	0.502091	
		0.304443		4.	
320321	51.263158	35.340659			
		9.307692	0.641705	34.789474	
43 std	37.804456	0.0	0.316069	0.	
270820	0.403263	0.110594	0.778439	2.373236	
	0.134904		19.078534	0.111476	
		0.009488		0.	
486227	15.726526	12.048255			
		6.604194	0.504396	28.551519	
44 min	377.000000	0.0	1.397823	0.	
017018	0.037308	0.138563	1.498423	6.000000	
	0.299939		0.000000	0.339962	
		0.291367		2.	
971698	20.000000	24.000000			
		7.000000	0.050000	0.000000	
45 25%	381.845000	0.0	1.641159	0.	
017018	0.037308	0.334615	1.500000	8.000000	
	0.349996		0.000000	0.412429	
		0.300000		4.	
124294	60.000000	24.000000			
		7.000000	0.050000	15.000000	
46 50%	408.890000	0.0	2.192308	0.	
017018	0.037308	0.334615	2.499878	12.000000	
	0.399985		38.060000	0.499962	
		0.300000		4.	
376658	60.000000	24.000000			

46		7.000000	1.020000	30.000000	
47	75%	424.800000	0.0	2.192308	0.
220294		0.307932	0.346954	3.006032	12.000000
		0.550013		40.150000	0.574988
			0.303030		4.
686906		60.000000		48.000000	
			7.000000	1.020000	45.000000
48	max	530.000000	0.0	2.192308	0.
955236		1.435088	0.551462	3.500314	14.000000
		0.716180		42.460000	0.716180
			0.328767		5.
080940		60.000000		48.000000	
			28.000000	1.580000	144.000000
49	Mass	Change (%)	Compressive Strength (MPa)		
50	count	38.000000		95.000000	
51	mean	-2.310526		35.669132	
52	std	3.286718		13.897638	
53	min	-15.430000		9.790000	
54	25%	-1.937500		22.877100	
55	50%	-1.305000		35.870000	
56	75%	-0.705000		46.055000	
57	max	0.000000		65.580000	
58	Fly Ash (kg/m3)	Slag (kg/m3)	SiO2:Al2O3	CaO:SiO2	CaO:Al2O3
			Na2SiO3:NaOH	NaOH (M)	Activator:Binder
					Extra Water (kg/m3)
			Liquid:Binder	Fine Aggregate	:Total
	Aggregate	Total Aggregate	:Binder	Curing Temp (C)	
	Curing Time (hr)	Age before Exposure (Days)		H2SO4 (M)	
59	Fly Ash (kg/m3)		1.000000		
		NaN	-0.261196	0.576884	0.595435
487423		-0.135260	0.196339		-0.283745
		-0.324846		-0.490260	
			0.421424		-0.
905007		-0.366234		0.363038	
		0.086766	-0.246090		0.013621
		0.012517		-0.274353	

60 Slag (kg/m3)					
	NaN	NaN	NaN	NaN	NaN
	NaN	NaN	NaN	NaN	NaN
		NaN	NaN	NaN	NaN
			NaN		
	NaN	NaN		NaN	
			NaN	NaN	NaN
				NaN	
61	SiO2:Al2O3				-0.261196
		NaN	1.000000	-0.679124	-0.671230
	087084		0.712322	-0.099464	-0.717936
			0.960613	-0.459757	
				-0.228794	0.
	532730		0.296495		-0.925070
				-0.041049	0.827133
					-0.069952
					-0.105891
62	CaO:SiO2				0.780534
		NaN	-0.679124	1.000000	0.999178
	581286		-0.210041	0.175966	0.170323
			-0.646975	-0.068413	
				0.115191	-0.
	528470		-0.406994		0.597724
				-0.136212	-0.537157
					-0.042305
				0.196161	-0.647756
63	CaO:Al2O3				0.595435
		NaN	-0.671230	0.999178	1.000000
	594278		-0.211526	0.176135	0.155198
			-0.649406	-0.087811	
				0.122761	-0.
	541247		-0.421330		0.599428
				-0.125265	-0.536435
					-0.038122
				0.211536	-0.648386
64	Fe2O3:Al2O3				0.487423
		NaN	0.087084	0.581286	0.594278
	000000		0.460337	-0.155655	-0.362269
			0.032682	-0.421083	
				-0.405205	-0.
	181653		-0.016083		-0.203644

64		-0.549446	-0.022204	-0.
	176567	0.243349		0.032009
65	Na2SiO3:NaOH			-0.135260
		NaN	0.712322	-0.210041
	460337	1.000000	-0.203816	-0.611669
		0.729486		-0.427298
			-0.456461	0.
	448892	0.273049		-0.814606
			-0.396111	0.584025
	163324	0.169004		0.623356
66	NaOH (M)			0.196339
		NaN	-0.099464	0.175966
	155655	-0.203816	1.000000	-0.076606
		-0.060023		-0.121442
			0.530429	-0.
	193314	-0.322960		0.303825
			0.533075	0.053824
	086169	-0.240151		-0.185306
67	Activator:Binder			-0.283745
		NaN	-0.717936	0.170323
	362269	-0.611669	-0.076606	1.000000
		-0.647536		0.943468
			-0.137154	-0.
	088897	0.294746		0.598128
			-0.204405	-0.636351
	004638	0.096028		-0.481779
68	Extra Water (kg/m3)			-0.324846
		NaN	0.960613	-0.646975
	032682	0.729486	-0.060023	-0.647536
		1.000000		-0.359035
			-0.263787	0.
	571470	0.411595		-0.963678
			-0.116841	0.839247
	108296	-0.264696		0.805455
69	Liquid:Binder			-0.490260
		NaN	-0.459757	-0.068413
	421083	-0.427298	-0.121442	0.943468
		-0.359035		1.000000

69		-0.283702	0.
143672	0.536095	0.329275	
	-0.312088	-0.413634	-0.
053344	0.070623		-0.247809
70	Fine Aggregate :Total Aggregate		0.421424
	NaN	-0.228794	0.115191
405205	-0.456461	0.530429	-0.137154
	-0.263787	-0.283702	
		1.000000	-0.
502797	-0.685264	0.519794	
	0.884451	-0.044895	0.
230605	-0.276407		-0.467522
71	Total Aggregate :Binder		-0.905007
	NaN	0.532730	-0.528470
181653	0.448892	-0.193314	-0.088897
	0.571470	0.143672	
		-0.502797	1.
000000	0.285092	-0.623217	
	-0.134267	0.476593	-0.
053520	-0.019229		0.437734
72	Curing Temp (C)		-0.366234
	NaN	0.296495	-0.406994
016083	0.273049	-0.322960	0.294746
	0.411595	0.536095	
		-0.685264	0.
285092	1.000000	-0.535998	
	-0.790161	0.159453	-0.
225428	0.134446		0.539138
73	Curing Time (hr)		0.363038
	NaN	-0.925070	0.597724
203644	-0.814606	0.303825	0.598128
	-0.963678	0.329275	
		0.519794	-0.
623217	-0.535998	1.000000	
	0.371231	-0.752698	0.
159889	NaN		-0.830406
74	Age before Exposure (Days)		0.086766
	NaN	-0.041049	-0.136212
		-0.125265	-0.

74	549446	-0.396111	0.533075	-0.204405
		-0.116841	-0.312088	
			0.884451	-0.
	134267	-0.790161	0.371231	
		1.000000	0.107401	0.
	288985	-0.238877		-0.315676
75	H2S04 (M)			-0.246090
		NaN	0.827133 -0.537157	-0.536435 -0.
	022204	0.584025 0.053824		-0.636351
		0.839247	-0.413634	
			-0.044895	0.
	476593	0.159453	-0.752698	
		0.107401	1.000000	-0.
	055630	-0.418548		0.564549
76	Days Submerged			0.013621
		NaN -0.069952 -0.042305	-0.038122	-0.
	176567	-0.163324 0.086169		-0.004638
		-0.108296	-0.053344	
			0.230605	-0.
	053520	-0.225428	0.159889	
		0.288985	-0.055630	1.
	000000	-0.687923		-0.215109
77	Mass Change (%)			0.012517
		NaN -0.105891 0.196161	0.211536	0.
	243349	0.169004 -0.240151		0.096028
		-0.264696	0.070623	
			-0.276407	-0.
	019229	0.134446	NaN	
		-0.238877	-0.418548	-0.
	687923	1.000000		0.392802
78	Compressive Strength (MPa)			-0.274353
		NaN 0.780534 -0.647756	-0.648386	0.
	032009	0.623356 -0.185306		-0.481779
		0.805455	-0.247809	
			-0.467522	0.
	437734	0.539138	-0.830406	
		-0.315676	0.564549	-0.
	215109	0.392802		1.000000

```
79 [I 2025-12-28 18:37:59,941] A new study created in
  memory with name: XGBoost
80 0% | 0/20 [00:00<?, ?it/s]C:\Users\alyss\
  PycharmProjects\PythonProject1\.venv\Lib\site-packages
  \xgboost\training.py:199: UserWarning: [18:38:03]
  WARNING: C:\actions-runner\_work\xgboost\xgboost\src\
  learner.cc:790:
81 Parameters: { "colsample_bytree", "max_depth", "
  min_child_weight", "subsample" } are not used.
82
83 bst.update(dtrain, iteration=i, fobj=obj)
84 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
  Lib\site-packages\xgboost\training.py:199: UserWarning
  : [18:38:03] WARNING: C:\actions-runner\_work\xgboost\
  xgboost\src\learner.cc:790:
85 Parameters: { "colsample_bytree", "max_depth", "
  min_child_weight", "subsample" } are not used.
86
87 bst.update(dtrain, iteration=i, fobj=obj)
88 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
  Lib\site-packages\xgboost\training.py:199: UserWarning
  : [18:38:03] WARNING: C:\actions-runner\_work\xgboost\
  xgboost\src\learner.cc:790:
89 Parameters: { "colsample_bytree", "max_depth", "
  min_child_weight", "subsample" } are not used.
90
91 bst.update(dtrain, iteration=i, fobj=obj)
92 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
  Lib\site-packages\xgboost\training.py:199: UserWarning
  : [18:38:03] WARNING: C:\actions-runner\_work\xgboost\
  xgboost\src\learner.cc:790:
93 Parameters: { "colsample_bytree", "max_depth", "
  min_child_weight", "subsample" } are not used.
94
95 bst.update(dtrain, iteration=i, fobj=obj)
96 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
  Lib\site-packages\xgboost\training.py:199: UserWarning
  : [18:38:03] WARNING: C:\actions-runner\_work\xgboost\
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96 xgboost\src\learner.cc:790:  
97 Parameters: { "colsample_bytree", "max_depth", "  
    min_child_weight", "subsample" } are not used.  
98  
99     bst.update(dtrain, iteration=i, fobj=obj)  
100 Best trial: 0. Best value: -0.186744: 5  
    %| | 1/20 [00:03<01:09, 3.68s/it]R2 scores  
    for each fold: [ 0.11352479  0.01614106 -0.43503487  0  
    .062379   -0.69072783]  
101 Mean R2 score: -0.18674356937408448  
102 [I 2025-12-28 18:38:03,625] Trial 0 finished with  
    value: -0.18674356937408448 and parameters: {'booster': 'gblinear', 'lambda': 0.00021844241749395445, '  
    alpha': 0.18025823536441832, 'subsample': 0.  
    0052927035975608334, 'colsample_bytree': 0.  
    1943586951560198, 'min_child_weight': 5.  
    538925561154711, 'eta': 0.0002099758006431437, '  
    max_depth': 3, 'n_estimators': 217}. Best is trial 0  
    with value: -0.18674356937408448.  
103 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
    Lib\site-packages\xgboost\training.py:199: UserWarning  
    : [18:38:03] WARNING: C:\actions-runner\_work\xgboost\  
    xgboost\src\learner.cc:790:  
104 Parameters: { "colsample_bytree", "max_depth", "  
    min_child_weight", "subsample" } are not used.  
105  
106     bst.update(dtrain, iteration=i, fobj=obj)  
107 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
    Lib\site-packages\xgboost\training.py:199: UserWarning  
    : [18:38:03] WARNING: C:\actions-runner\_work\xgboost\  
    xgboost\src\learner.cc:790:  
108 Parameters: { "colsample_bytree", "max_depth", "  
    min_child_weight", "subsample" } are not used.  
109  
110     bst.update(dtrain, iteration=i, fobj=obj)  
111 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
    Lib\site-packages\xgboost\training.py:199: UserWarning  
    : [18:38:06] WARNING: C:\actions-runner\_work\xgboost\
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111 xgboost\src\learner.cc:790:  
112 Parameters: { "colsample_bytree", "max_depth", "  
    min_child_weight", "subsample" } are not used.  
113  
114     bst.update(dtrain, iteration=i, fobj=obj)  
115 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
    Lib\site-packages\xgboost\training.py:199: UserWarning  
    : [18:38:06] WARNING: C:\actions-runner\_work\xgboost\  
    xgboost\src\learner.cc:790:  
116 Parameters: { "colsample_bytree", "max_depth", "  
    min_child_weight", "subsample" } are not used.  
117  
118     bst.update(dtrain, iteration=i, fobj=obj)  
119 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
    Lib\site-packages\xgboost\training.py:199: UserWarning  
    : [18:38:06] WARNING: C:\actions-runner\_work\xgboost\  
    xgboost\src\learner.cc:790:  
120 Parameters: { "colsample_bytree", "max_depth", "  
    min_child_weight", "subsample" } are not used.  
121  
122     bst.update(dtrain, iteration=i, fobj=obj)  
123 Best trial: 0. Best value: -0.186744: 10  
%|██████████| 2/20 [00:06<00:55, 3.09s/it]R2 scores  
for each fold: [-3.48806381e-04 -8.48666430e-02 -6.  
14494085e-01 -1.93313360e-02  
124 -8.02521944e-01]  
125 Mean R2 score: -0.30431256294250486  
126 [I 2025-12-28 18:38:06,304] Trial 1 finished with  
    value: -0.30431256294250486 and parameters: {'booster':  
        'gblinear', 'lambda': 9.729206909549244e-08, 'alpha':  
        1.0536274368456688e-06, 'subsample': 0.  
        00020870994206125112, 'colsample_bytree': 0.  
        6642179127536642, 'min_child_weight': 7.  
        292580337394208, 'eta': 9.02224443622668e-08, '  
        max_depth': 4, 'n_estimators': 700}. Best is trial 0  
    with value: -0.18674356937408448.  
127 R2 scores for each fold: [-5.30481339e-04 -8.50291252e  
    -02 -6.14788294e-01 -1.94586515e-02
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128 -8.02688360e-01]
129 Mean R2 score: -0.3044989824295044
130 [I 2025-12-28 18:38:06,738] Trial 2 finished with
    value: -0.3044989824295044 and parameters: {'booster':
        'gbtree', 'lambda': 2.562797905101803e-06, 'alpha':
        0.4038560212525926, 'subsample': 0.
        0001854803310248487, 'colsample_bytree': 0.
        9444859487200595, 'min_child_weight': 8.
        486127874952292, 'eta': 4.885842589108806e-07, 'max_depth':
        9, 'n_estimators': 875}. Best is trial 0
    with value: -0.18674356937408448.
131 Best trial: 0. Best value: -0.186744: 15
%|██████████| 3/20 [00:06<00:31, 1.88s/it]C:\Users\alyss\PycharmProjects\PythonProject1\.venv\Lib\site-packages\xgboost\training.py:199: UserWarning: [18:38:06] WARNING: C:\actions-runner\_work\xgboost\xgboost\src\learner.cc:790:
132 Parameters: { "colsample_bytree", "max_depth", "min_child_weight", "subsample" } are not used.
133
134 bst.update(dtrain, iteration=i, fobj=obj)
135 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\Lib\site-packages\xgboost\training.py:199: UserWarning : [18:38:06] WARNING: C:\actions-runner\_work\xgboost\xgboost\src\learner.cc:790:
136 Parameters: { "colsample_bytree", "max_depth", "min_child_weight", "subsample" } are not used.
137
138 bst.update(dtrain, iteration=i, fobj=obj)
139 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\Lib\site-packages\xgboost\training.py:199: UserWarning : [18:38:06] WARNING: C:\actions-runner\_work\xgboost\xgboost\src\learner.cc:790:
140 Parameters: { "colsample_bytree", "max_depth", "min_child_weight", "subsample" } are not used.
141
142 bst.update(dtrain, iteration=i, fobj=obj)
143 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
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143 Lib\site-packages\xgboost\training.py:199: UserWarning
    : [18:38:06] WARNING: C:\actions-runner\_work\xgboost\
    xgboost\src\learner.cc:790:
144 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
145
146     bst.update(dtrain, iteration=i, fobj=obj)
147 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
    Lib\site-packages\xgboost\training.py:199: UserWarning
    : [18:38:06] WARNING: C:\actions-runner\_work\xgboost\
    xgboost\src\learner.cc:790:
148 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
149
150     bst.update(dtrain, iteration=i, fobj=obj)
151 Best trial: 3. Best value: 0.679612: 20%|██████| 4/20 [00:07<00:20, 1.29s/it]C:\Users\alyss\PycharmProjects\PythonProject1\.venv\Lib\site-packages\xgboost\training.py:199: UserWarning: [18:38:07] WARNING: C:\actions-runner\_work\xgboost\xgboost\src\learner.cc:790:
152 R2 scores for each fold: [0.70356905 0.6605438 0.77466738 0.73129421 0.52798748]
153 Mean R2 score: 0.6796123862266541
154 [I 2025-12-28 18:38:07,119] Trial 3 finished with value: 0.6796123862266541 and parameters: {'booster': 'gblinear', 'lambda': 0.017280196621592588, 'alpha': 5.142638022637406e-06, 'subsample': 0.5620119778764905, 'colsample_bytree': 0.9912534523235504, 'min_child_weight': 3.9465552842361493, 'eta': 0.012009882857203785, 'max_depth': 7, 'n_estimators': 951}. Best is trial 3 with value: 0.6796123862266541.
155 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
156
157     bst.update(dtrain, iteration=i, fobj=obj)
158 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
```

```
158 Lib\site-packages\xgboost\training.py:199: UserWarning
    : [18:38:07] WARNING: C:\actions-runner\_work\xgboost\
    xgboost\src\learner.cc:790:
159 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
160
161     bst.update(dtrain, iteration=i, fobj=obj)
162 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
    Lib\site-packages\xgboost\training.py:199: UserWarning
    : [18:38:07] WARNING: C:\actions-runner\_work\xgboost\
    xgboost\src\learner.cc:790:
163 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
164
165     bst.update(dtrain, iteration=i, fobj=obj)
166 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
    Lib\site-packages\xgboost\training.py:199: UserWarning
    : [18:38:07] WARNING: C:\actions-runner\_work\xgboost\
    xgboost\src\learner.cc:790:
167 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
168
169     bst.update(dtrain, iteration=i, fobj=obj)
170 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
    Lib\site-packages\xgboost\training.py:199: UserWarning
    : [18:38:07] WARNING: C:\actions-runner\_work\xgboost\
    xgboost\src\learner.cc:790:
171 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
172
173     bst.update(dtrain, iteration=i, fobj=obj)
174 R2 scores for each fold: [ 0.03235185 -0.05678821 -0.
    56742072  0.00466746 -0.76808345]
175 Mean R2 score: -0.27105461359024047
176 [I 2025-12-28 18:38:07,205] Trial 4 finished with
    value: -0.27105461359024047 and parameters: {'booster':
    'gblinear', 'lambda': 0.03653204541548755, 'alpha':
    0.0042412257828699385, 'subsample': 0.
```

```
176 276410495058131, 'colsample_bytree': 0.  
6045302764971955, 'min_child_weight': 9.  
773163732143198, 'eta': 5.991629810890317e-05, '  
max_depth': 8, 'n_estimators': 225}. Best is trial 3  
with value: 0.6796123862266541.  
177 Best trial: 3. Best value: 0.679612: 30%|██████|  
6/20 [00:07<00:08, 1.56it/s]C:\Users\alyss\  
PycharmProjects\PythonProject1\.venv\Lib\site-packages  
\xgboost\training.py:199: UserWarning: [18:38:07]  
WARNING: C:\actions-runner\_work\xgboost\xgboost\src\  
learner.cc:790:  
178 R2 scores for each fold: [-5.30600548e-04 -8.50137472e  
-02 -6.15669250e-01 -1.93662643e-02  
179 -8.02606106e-01]  
180 Mean R2 score: -0.30463719367980957  
181 [I 2025-12-28 18:38:07,255] Trial 5 finished with  
value: -0.30463719367980957 and parameters: {'booster': 'gbtree', 'lambda': 3.9552544247169064e-05, 'alpha': 1.81917117398179e-07, 'subsample': 0.  
04710096968599116, 'colsample_bytree': 0.  
8143014463949549, 'min_child_weight': 6.  
770179557826804, 'eta': 0.0004962055755808098, '  
max_depth': 6, 'n_estimators': 76}. Best is trial 3  
with value: 0.6796123862266541.  
182 Parameters: { "colsample_bytree", "max_depth", "  
min_child_weight", "subsample" } are not used.  
183  
184 bst.update(dtrain, iteration=i, fobj=obj)  
185 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
Lib\site-packages\xgboost\training.py:199: UserWarning  
: [18:38:07] WARNING: C:\actions-runner\_work\xgboost\  
xgboost\src\learner.cc:790:  
186 Parameters: { "colsample_bytree", "max_depth", "  
min_child_weight", "subsample" } are not used.  
187  
188 bst.update(dtrain, iteration=i, fobj=obj)  
189 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
Lib\site-packages\xgboost\training.py:199: UserWarning
```

```
189 : [18:38:07] WARNING: C:\actions-runner\_work\xgboost\  
xgboost\src\learner.cc:790:  
190 Parameters: { "colsample_bytree", "max_depth", "  
min_child_weight", "subsample" } are not used.  
191  
192     bst.update(dtrain, iteration=i, fobj=obj)  
193 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
Lib\site-packages\xgboost\training.py:199: UserWarning  
: [18:38:07] WARNING: C:\actions-runner\_work\xgboost\  
xgboost\src\learner.cc:790:  
194 Parameters: { "colsample_bytree", "max_depth", "  
min_child_weight", "subsample" } are not used.  
195  
196     bst.update(dtrain, iteration=i, fobj=obj)  
197 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
Lib\site-packages\xgboost\training.py:199: UserWarning  
: [18:38:07] WARNING: C:\actions-runner\_work\xgboost\  
xgboost\src\learner.cc:790:  
198 Parameters: { "colsample_bytree", "max_depth", "  
min_child_weight", "subsample" } are not used.  
199  
200     bst.update(dtrain, iteration=i, fobj=obj)  
201 R2 scores for each fold: [ 0.29039854  0.17192435 -0.  
14665425  0.19225305 -0.50397778]  
202 Mean R2 score: 0.0007887840270996094  
203 [I 2025-12-28 18:38:07,359] Trial 6 finished with  
value: 0.0007887840270996094 and parameters: {'booster':  
'gblinear', 'lambda': 1.4150734301824795e-06, '  
alpha': 0.059911157733482816, 'subsample': 3.  
6182895831112766e-06, 'colsample_bytree': 0.  
6000835231709737, 'min_child_weight': 5.  
024994225711047, 'eta': 0.0003077016036573764, '  
max_depth': 6, 'n_estimators': 427}. Best is trial 3  
with value: 0.6796123862266541.  
204 Best trial: 3. Best value: 0.679612: 40%|██████|  
8/20 [00:07<00:04, 2.49it/s]C:\Users\alyss\  
PycharmProjects\PythonProject1\.venv\Lib\site-packages  
\xgboost\training.py:199: UserWarning: [18:38:07]
```

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204 WARNING: C:\actions-runner\_work\xgboost\xgboost\src\  
learner.cc:790:  
205 R2 scores for each fold: [-5.30481339e-04 -8.50291252e  
-02 -6.14788294e-01 -1.94586515e-02  
206 -8.02688360e-01]  
207 Mean R2 score: -0.3044989824295044  
208 [I 2025-12-28 18:38:07,526] Trial 7 finished with  
value: -0.3044989824295044 and parameters: {'booster':  
'gbtree', 'lambda': 0.5283257856906178, 'alpha': 1.  
073362736470681e-08, 'subsample': 0.  
0002302368678546503, 'colsample_bytree': 0.  
7196936216064247, 'min_child_weight': 7.  
379475537559828, 'eta': 2.6016018879445548e-06, '  
max_depth': 6, 'n_estimators': 327}. Best is trial 3  
with value: 0.6796123862266541.  
209 Parameters: { "colsample_bytree", "max_depth", "  
min_child_weight", "subsample" } are not used.  
210  
211     bst.update(dtrain, iteration=i, fobj=obj)  
212 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
Lib\site-packages\xgboost\training.py:199: UserWarning  
: [18:38:07] WARNING: C:\actions-runner\_work\xgboost\  
xgboost\src\learner.cc:790:  
213 Parameters: { "colsample_bytree", "max_depth", "  
min_child_weight", "subsample" } are not used.  
214  
215     bst.update(dtrain, iteration=i, fobj=obj)  
216 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
Lib\site-packages\xgboost\training.py:199: UserWarning  
: [18:38:07] WARNING: C:\actions-runner\_work\xgboost\  
xgboost\src\learner.cc:790:  
217 Parameters: { "colsample_bytree", "max_depth", "  
min_child_weight", "subsample" } are not used.  
218  
219     bst.update(dtrain, iteration=i, fobj=obj)  
220 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
Lib\site-packages\xgboost\training.py:199: UserWarning  
: [18:38:07] WARNING: C:\actions-runner\_work\xgboost\
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220 xgboost\src\learner.cc:790:  
221 Parameters: { "colsample_bytree", "max_depth", "  
    min_child_weight", "subsample" } are not used.  
222  
223     bst.update(dtrain, iteration=i, fobj=obj)  
224 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
    Lib\site-packages\xgboost\training.py:199: UserWarning  
        : [18:38:07] WARNING: C:\actions-runner\_work\xgboost\  
        xgboost\src\learner.cc:790:  
225 Parameters: { "colsample_bytree", "max_depth", "  
    min_child_weight", "subsample" } are not used.  
226  
227     bst.update(dtrain, iteration=i, fobj=obj)  
228 Best trial: 3. Best value: 0.679612: 45%|██████████|  
    9/20 [00:07<00:03, 3.00it/s]C:\Users\alyss\  
    PycharmProjects\PythonProject1\.venv\Lib\site-packages  
    \xgboost\training.py:199: UserWarning: [18:38:07]  
    WARNING: C:\actions-runner\_work\xgboost\xgboost\src\  
    learner.cc:790:  
229 R2 scores for each fold: [-1.88589096e-04 -8.47231150e  
    -02 -6.14235163e-01 -1.92183256e-02  
230 -8.02373528e-01]  
231 Mean R2 score: -0.304147744178772  
232 [I 2025-12-28 18:38:07,690] Trial 8 finished with  
    value: -0.304147744178772 and parameters: {'booster':  
        'gblinear', 'lambda': 5.401905942117794e-06, 'alpha':  
        0.01006780150615538, 'subsample': 0.  
        07426933332069055, 'colsample_bytree': 0.  
        8532782814868245, 'min_child_weight': 5.  
        396068780079643, 'eta': 3.65098452320061e-07, '  
        max_depth': 7, 'n_estimators': 327}. Best is trial 3  
    with value: 0.6796123862266541.  
233 Parameters: { "colsample_bytree", "max_depth", "  
    min_child_weight", "subsample" } are not used.  
234  
235     bst.update(dtrain, iteration=i, fobj=obj)  
236 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
    Lib\site-packages\xgboost\training.py:199: UserWarning
```

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236 : [18:38:07] WARNING: C:\actions-runner\_work\xgboost\  
xgboost\src\learner.cc:790:  
237 Parameters: { "colsample_bytree", "max_depth", "  
min_child_weight", "subsample" } are not used.  
238  
239     bst.update(dtrain, iteration=i, fobj=obj)  
240 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
Lib\site-packages\xgboost\training.py:199: UserWarning  
: [18:38:07] WARNING: C:\actions-runner\_work\xgboost\  
xgboost\src\learner.cc:790:  
241 Parameters: { "colsample_bytree", "max_depth", "  
min_child_weight", "subsample" } are not used.  
242  
243     bst.update(dtrain, iteration=i, fobj=obj)  
244 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
Lib\site-packages\xgboost\training.py:199: UserWarning  
: [18:38:07] WARNING: C:\actions-runner\_work\xgboost\  
xgboost\src\learner.cc:790:  
245 Parameters: { "colsample_bytree", "max_depth", "  
min_child_weight", "subsample" } are not used.  
246  
247     bst.update(dtrain, iteration=i, fobj=obj)  
248 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
Lib\site-packages\xgboost\training.py:199: UserWarning  
: [18:38:07] WARNING: C:\actions-runner\_work\xgboost\  
xgboost\src\learner.cc:790:  
249 Parameters: { "colsample_bytree", "max_depth", "  
min_child_weight", "subsample" } are not used.  
250  
251     bst.update(dtrain, iteration=i, fobj=obj)  
252 R2 scores for each fold: [0.70676959 0.59514779 0.  
76803881 0.69704705 0.39287835]  
253 Mean R2 score: 0.631976318359375  
254 [I 2025-12-28 18:38:07,741] Trial 9 finished with  
value: 0.631976318359375 and parameters: {'booster': 'gblinear', 'lambda': 2.4435549555138788e-06, 'alpha':  
7.425363858321835e-05, 'subsample': 0.  
00020621075364363103, 'colsample_bytree': 0.
```

```
254 5844703328913752, 'min_child_weight': 1.  
    0716047388282053, 'eta': 0.024247802540795414, '  
    max_depth': 4, 'n_estimators': 82}. Best is trial 3  
    with value: 0.6796123862266541.  
255 Best trial: 3. Best value: 0.679612: 55%|██████|  
    11/20 [00:08<00:02, 3.65it/s]R2 scores for each fold  
    : [-5.30481339e-04 -8.50291252e-02 -6.14788294e-01 -1.  
    94586515e-02  
256 -8.02688360e-01]  
257 Mean R2 score: -0.3044989824295044  
258 [I 2025-12-28 18:38:08,092] Trial 10 finished with  
    value: -0.3044989824295044 and parameters: {'booster':  
    'gbtree', 'lambda': 0.005061928296108544, 'alpha':  
    6.906544718618822e-05, 'subsample': 1.  
    0023857588169731e-08, 'colsample_bytree': 0.  
    3493395500637454, 'min_child_weight': 2.  
    4481563074565584, 'eta': 0.7624982885364815, '  
    max_depth': 9, 'n_estimators': 974}. Best is trial 3  
    with value: 0.6796123862266541.  
259 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
    Lib\site-packages\xgboost\training.py:199: UserWarning  
    : [18:38:08] WARNING: C:\actions-runner\_work\xgboost\  
    xgboost\src\learner.cc:790:  
260 Parameters: { "colsample_bytree", "max_depth", "  
    min_child_weight", "subsample" } are not used.  
261  
262     bst.update(dtrain, iteration=i, fobj=obj)  
263 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
    Lib\site-packages\xgboost\training.py:199: UserWarning  
    : [18:38:08] WARNING: C:\actions-runner\_work\xgboost\  
    xgboost\src\learner.cc:790:  
264 Parameters: { "colsample_bytree", "max_depth", "  
    min_child_weight", "subsample" } are not used.  
265  
266     bst.update(dtrain, iteration=i, fobj=obj)  
267 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
    Lib\site-packages\xgboost\training.py:199: UserWarning  
    : [18:38:08] WARNING: C:\actions-runner\_work\xgboost\
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267 xgboost\src\learner.cc:790:  
268 Parameters: { "colsample_bytree", "max_depth", "  
    min_child_weight", "subsample" } are not used.  
269  
270     bst.update(dtrain, iteration=i, fobj=obj)  
271 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
    Lib\site-packages\xgboost\training.py:199: UserWarning  
    : [18:38:08] WARNING: C:\actions-runner\_work\xgboost\  
    xgboost\src\learner.cc:790:  
272 Parameters: { "colsample_bytree", "max_depth", "  
    min_child_weight", "subsample" } are not used.  
273  
274     bst.update(dtrain, iteration=i, fobj=obj)  
275 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
    Lib\site-packages\xgboost\training.py:199: UserWarning  
    : [18:38:08] WARNING: C:\actions-runner\_work\xgboost\  
    xgboost\src\learner.cc:790:  
276 Parameters: { "colsample_bytree", "max_depth", "  
    min_child_weight", "subsample" } are not used.  
277  
278     bst.update(dtrain, iteration=i, fobj=obj)  
279 Best trial: 11. Best value: 0.736991: 60  
%|██████████| 12/20 [00:08<00:02, 3.90it/s]R2 scores  
for each fold: [0.7994262 0.75156808 0.63573825 0.  
81380296 0.68442035]  
280 Mean R2 score: 0.7369911670684814  
281 [I 2025-12-28 18:38:08,294] Trial 11 finished with  
value: 0.7369911670684814 and parameters: {'booster':  
    'gblinear', 'lambda': 0.0007971739235951274, 'alpha':  
    6.425403861907586e-05, 'subsample': 2.  
    1479896784931384e-06, 'colsample_bytree': 0.  
    4082887878101883, 'min_child_weight': 1.  
    0097290404705326, 'eta': 0.08346617709190912, '  
    max_depth': 4, 'n_estimators': 697}. Best is trial 11  
with value: 0.7369911670684814.  
282 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
    Lib\site-packages\xgboost\training.py:199: UserWarning  
    : [18:38:08] WARNING: C:\actions-runner\_work\xgboost\
```

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282 xgboost\src\learner.cc:790:  
283 Parameters: { "colsample_bytree", "max_depth", "  
    min_child_weight", "subsample" } are not used.  
284  
285     bst.update(dtrain, iteration=i, fobj=obj)  
286 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
    Lib\site-packages\xgboost\training.py:199: UserWarning  
    : [18:38:08] WARNING: C:\actions-runner\_work\xgboost\  
        xgboost\src\learner.cc:790:  
287 Parameters: { "colsample_bytree", "max_depth", "  
    min_child_weight", "subsample" } are not used.  
288  
289     bst.update(dtrain, iteration=i, fobj=obj)  
290 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
    Lib\site-packages\xgboost\training.py:199: UserWarning  
    : [18:38:08] WARNING: C:\actions-runner\_work\xgboost\  
        xgboost\src\learner.cc:790:  
291 Parameters: { "colsample_bytree", "max_depth", "  
    min_child_weight", "subsample" } are not used.  
292  
293     bst.update(dtrain, iteration=i, fobj=obj)  
294 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
    Lib\site-packages\xgboost\training.py:199: UserWarning  
    : [18:38:08] WARNING: C:\actions-runner\_work\xgboost\  
        xgboost\src\learner.cc:790:  
295 Parameters: { "colsample_bytree", "max_depth", "  
    min_child_weight", "subsample" } are not used.  
296  
297     bst.update(dtrain, iteration=i, fobj=obj)  
298 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\  
    Lib\site-packages\xgboost\training.py:199: UserWarning  
    : [18:38:08] WARNING: C:\actions-runner\_work\xgboost\  
        xgboost\src\learner.cc:790:  
299 Parameters: { "colsample_bytree", "max_depth", "  
    min_child_weight", "subsample" } are not used.  
300  
301     bst.update(dtrain, iteration=i, fobj=obj)  
302 R2 scores for each fold: [0.74955547 0.7062878  0.
```

```
302 72978747 0.77525479 0.60454446]
303 Mean R2 score: 0.7130859971046448
304 [I 2025-12-28 18:38:08,634] Trial 12 finished with
    value: 0.7130859971046448 and parameters: {'booster':
        'gblinear', 'lambda': 0.0017569476273098315, 'alpha':
        3.3441366222016514e-06, 'subsample': 1.
        2103705872981408e-06, 'colsample_bytree': 0.
        384612036272853, 'min_child_weight': 3.199909094728074
        , 'eta': 0.03131504434682113, 'max_depth': 5, 'n_estimators': 690}. Best is trial 11 with value: 0.
        7369911670684814.
305 Best trial: 11. Best value: 0.736991: 65
%| ████ | 13/20 [00:08<00:01, 3.60it/s]C:\Users\alyss\PycharmProjects\PythonProject1\.venv\Lib\site-packages\xgboost\training.py:199: UserWarning: [18:38:08] WARNING: C:\actions-runner\_work\xgboost\xgboost\src\learner.cc:790:
306 Parameters: { "colsample_bytree", "max_depth", "min_child_weight", "subsample" } are not used.
307
308 bst.update(dtrain, iteration=i, fobj=obj)
309 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\Lib\site-packages\xgboost\training.py:199: UserWarning : [18:38:08] WARNING: C:\actions-runner\_work\xgboost\xgboost\src\learner.cc:790:
310 Parameters: { "colsample_bytree", "max_depth", "min_child_weight", "subsample" } are not used.
311
312 bst.update(dtrain, iteration=i, fobj=obj)
313 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\Lib\site-packages\xgboost\training.py:199: UserWarning : [18:38:08] WARNING: C:\actions-runner\_work\xgboost\xgboost\src\learner.cc:790:
314 Parameters: { "colsample_bytree", "max_depth", "min_child_weight", "subsample" } are not used.
315
316 bst.update(dtrain, iteration=i, fobj=obj)
317 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
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```
317 Lib\site-packages\xgboost\training.py:199: UserWarning
: [18:38:08] WARNING: C:\actions-runner\_work\xgboost\
xgboost\src\learner.cc:790:
318 Parameters: { "colsample_bytree", "max_depth", "
min_child_weight", "subsample" } are not used.
319
320     bst.update(dtrain, iteration=i, fobj=obj)
321 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
Lib\site-packages\xgboost\training.py:199: UserWarning
: [18:38:08] WARNING: C:\actions-runner\_work\xgboost\
xgboost\src\learner.cc:790:
322 Parameters: { "colsample_bytree", "max_depth", "
min_child_weight", "subsample" } are not used.
323
324     bst.update(dtrain, iteration=i, fobj=obj)
325 R2 scores for each fold: [0.86115444 0.82025146 0.
65098524 0.84568304 0.76668155]
326 Mean R2 score: 0.7889511466026307
327 [I 2025-12-28 18:38:08,837] Trial 13 finished with
value: 0.7889511466026307 and parameters: {'booster'
': 'gblinear', 'lambda': 0.0006354285807977019, 'alpha'
': 0.0007564712810760458, 'subsample': 7.
842999524659622e-07, 'colsample_bytree': 0.
393074942923862, 'min_child_weight': 1.
0132402190449785, 'eta': 0.49546134959618, 'max_depth'
': 4, 'n_estimators': 685}. Best is trial 13 with
value: 0.7889511466026307.
328 Best trial: 13. Best value: 0.788951: 70
%| ████ | 14/20 [00:08<00:01, 3.88it/s]C:\Users\
alyss\PycharmProjects\PythonProject1\.venv\Lib\site-
packages\xgboost\training.py:199: UserWarning: [18:38:
08] WARNING: C:\actions-runner\_work\xgboost\xgboost\
src\learner.cc:790:
329 Parameters: { "colsample_bytree", "max_depth", "
min_child_weight", "subsample" } are not used.
330
331     bst.update(dtrain, iteration=i, fobj=obj)
332 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
```

```
332 Lib\site-packages\xgboost\training.py:199: UserWarning
: [18:38:08] WARNING: C:\actions-runner\_work\xgboost\
xgboost\src\learner.cc:790:
333 Parameters: { "colsample_bytree", "max_depth", "
min_child_weight", "subsample" } are not used.
334
335     bst.update(dtrain, iteration=i, fobj=obj)
336 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
Lib\site-packages\xgboost\training.py:199: UserWarning
: [18:38:08] WARNING: C:\actions-runner\_work\xgboost\
xgboost\src\learner.cc:790:
337 Parameters: { "colsample_bytree", "max_depth", "
min_child_weight", "subsample" } are not used.
338
339     bst.update(dtrain, iteration=i, fobj=obj)
340 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
Lib\site-packages\xgboost\training.py:199: UserWarning
: [18:38:08] WARNING: C:\actions-runner\_work\xgboost\
xgboost\src\learner.cc:790:
341 Parameters: { "colsample_bytree", "max_depth", "
min_child_weight", "subsample" } are not used.
342
343     bst.update(dtrain, iteration=i, fobj=obj)
344 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
Lib\site-packages\xgboost\training.py:199: UserWarning
: [18:38:08] WARNING: C:\actions-runner\_work\xgboost\
xgboost\src\learner.cc:790:
345 Parameters: { "colsample_bytree", "max_depth", "
min_child_weight", "subsample" } are not used.
346
347     bst.update(dtrain, iteration=i, fobj=obj)
348 Best trial: 14. Best value: 0.822615: 75
%|██████████| 15/20 [00:09<00:01, 4.09it/s]R2 scores
for each fold: [0.8934927 0.84816539 0.70808208 0.
87355721 0.78977776]
349 Mean R2 score: 0.8226150274276733
350 [I 2025-12-28 18:38:09,047] Trial 14 finished with
value: 0.8226150274276733 and parameters: {'booster'
```

```
350 ': 'gblinear', 'lambda': 0.00027393131656845417, '
    alpha': 0.0008199689654257539, 'subsample': 5.
    017590447557101e-07, 'colsample_bytree': 0.
    42242827805932054, 'min_child_weight': 1.
    064920949539281, 'eta': 0.906622356353465, 'max_depth'
    ': 3, 'n_estimators': 648}. Best is trial 14 with
    value: 0.8226150274276733.
351 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
    Lib\site-packages\xgboost\training.py:199: UserWarning
        : [18:38:09] WARNING: C:\actions-runner\_work\xgboost\
            xgboost\src\learner.cc:790:
352 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
353
354     bst.update(dtrain, iteration=i, fobj=obj)
355 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
    Lib\site-packages\xgboost\training.py:199: UserWarning
        : [18:38:09] WARNING: C:\actions-runner\_work\xgboost\
            xgboost\src\learner.cc:790:
356 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
357
358     bst.update(dtrain, iteration=i, fobj=obj)
359 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
    Lib\site-packages\xgboost\training.py:199: UserWarning
        : [18:38:09] WARNING: C:\actions-runner\_work\xgboost\
            xgboost\src\learner.cc:790:
360 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
361
362     bst.update(dtrain, iteration=i, fobj=obj)
363 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
    Lib\site-packages\xgboost\training.py:199: UserWarning
        : [18:38:09] WARNING: C:\actions-runner\_work\xgboost\
            xgboost\src\learner.cc:790:
364 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
365
```

```
366 bst.update(dtrain, iteration=i, fobj=obj)
367 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
    Lib\site-packages\xgboost\training.py:199: UserWarning
        : [18:38:09] WARNING: C:\actions-runner\_work\xgboost\
            xgboost\src\learner.cc:790:
368 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
369
370 bst.update(dtrain, iteration=i, fobj=obj)
371 Best trial: 14. Best value: 0.822615: 80
    %|██████████| 16/20 [00:09<00:00, 4.24it/s]R2 scores
    for each fold: [0.86284828 0.82699382 0.63339865 0.
    84651148 0.77010846]
372 Mean R2 score: 0.7879721403121949
373 [I 2025-12-28 18:38:09,261] Trial 15 finished with
    value: 0.7879721403121949 and parameters: {'booster':
        'gblinear', 'lambda': 4.610443320559427e-05, 'alpha':
        0.0009701941781853083, 'subsample': 6.
        926617429092247e-08, 'colsample_bytree': 0.
        21607771039839088, 'min_child_weight': 2.
        125059527188482, 'eta': 0.547648955694564, 'max_depth':
        3, 'n_estimators': 578}. Best is trial 14 with
    value: 0.8226150274276733.
374 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
    Lib\site-packages\xgboost\training.py:199: UserWarning
        : [18:38:09] WARNING: C:\actions-runner\_work\xgboost\
            xgboost\src\learner.cc:790:
375 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
376
377 bst.update(dtrain, iteration=i, fobj=obj)
378 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
    Lib\site-packages\xgboost\training.py:199: UserWarning
        : [18:38:09] WARNING: C:\actions-runner\_work\xgboost\
            xgboost\src\learner.cc:790:
379 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
380
```

```
381 bst.update(dtrain, iteration=i, fobj=obj)
382 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
    Lib\site-packages\xgboost\training.py:199: UserWarning
        : [18:38:09] WARNING: C:\actions-runner\_work\xgboost\
            xgboost\src\learner.cc:790:
383 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
384
385 bst.update(dtrain, iteration=i, fobj=obj)
386 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
    Lib\site-packages\xgboost\training.py:199: UserWarning
        : [18:38:09] WARNING: C:\actions-runner\_work\xgboost\
            xgboost\src\learner.cc:790:
387 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
388
389 bst.update(dtrain, iteration=i, fobj=obj)
390 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
    Lib\site-packages\xgboost\training.py:199: UserWarning
        : [18:38:09] WARNING: C:\actions-runner\_work\xgboost\
            xgboost\src\learner.cc:790:
391 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
392
393 bst.update(dtrain, iteration=i, fobj=obj)
394 R2 scores for each fold: [0.70655566 0.56306899 0.
    68585587 0.62081861 0.2600947 ]
395 Mean R2 score: 0.5672787666320801
396 [I 2025-12-28 18:38:09,438] Trial 16 finished with
    value: 0.5672787666320801 and parameters: {'booster':
        'gblinear', 'lambda': 1.552347292590655e-08, 'alpha':
        0.0005970831998638661, 'subsample': 2.
        1966541916016857e-07, 'colsample_bytree': 0.
        4760078384811143, 'min_child_weight': 2.
        199828651613678, 'eta': 0.0019263084949113808, '
        max_depth': 3, 'n_estimators': 568}. Best is trial 14
    with value: 0.8226150274276733.
397 Best trial: 14. Best value: 0.822615: 85
```

```
397 %| [REDACTED] | 17/20 [00:09<00:00, 4.56it/s]C:\Users\alyss\PycharmProjects\PythonProject1\.venv\Lib\site-packages\xgboost\training.py:199: UserWarning: [18:38:09] WARNING: C:\actions-runner\_work\xgboost\xgboost\src\learner.cc:790:  
398 Parameters: { "colsample_bytree", "max_depth", "min_child_weight", "subsample" } are not used.  
399  
400     bst.update(dtrain, iteration=i, fobj=obj)  
401 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\Lib\site-packages\xgboost\training.py:199: UserWarning : [18:38:09] WARNING: C:\actions-runner\_work\xgboost\xgboost\src\learner.cc:790:  
402 Parameters: { "colsample_bytree", "max_depth", "min_child_weight", "subsample" } are not used.  
403  
404     bst.update(dtrain, iteration=i, fobj=obj)  
405 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\Lib\site-packages\xgboost\training.py:199: UserWarning : [18:38:09] WARNING: C:\actions-runner\_work\xgboost\xgboost\src\learner.cc:790:  
406 Parameters: { "colsample_bytree", "max_depth", "min_child_weight", "subsample" } are not used.  
407  
408     bst.update(dtrain, iteration=i, fobj=obj)  
409 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\Lib\site-packages\xgboost\training.py:199: UserWarning : [18:38:09] WARNING: C:\actions-runner\_work\xgboost\xgboost\src\learner.cc:790:  
410 Parameters: { "colsample_bytree", "max_depth", "min_child_weight", "subsample" } are not used.  
411  
412     bst.update(dtrain, iteration=i, fobj=obj)  
413 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\Lib\site-packages\xgboost\training.py:199: UserWarning : [18:38:09] WARNING: C:\actions-runner\_work\xgboost\xgboost\src\learner.cc:790:  
414 Parameters: { "colsample_bytree", "max_depth", "
```

```
414 min_child_weight", "subsample" } are not used.  
415  
416 bst.update(dtrain, iteration=i, fobj=obj)  
417 Best trial: 14. Best value: 0.822615: 90  
%| [REDACTED] | 18/20 [00:09<00:00, 3.99it/s]R2 scores  
for each fold: [ 0.02226985 -0.06724346 -0.58893764 -0  
.00084138 -0.7710346 ]  
418 Mean R2 score: -0.2811574459075928  
419 [I 2025-12-28 18:38:09,767] Trial 17 finished with  
value: -0.2811574459075928 and parameters: {'booster':  
'gblinear', 'lambda': 0.2112435453726094, 'alpha':  
0.013095138744020528, 'subsample': 1.766369672250977e-  
05, 'colsample_bytree': 0.26950490205039973, '  
min_child_weight': 4.081918861929605, 'eta': 1.  
5503587767122015e-05, 'max_depth': 5, 'n_estimators':  
829}. Best is trial 14 with value: 0.8226150274276733.  
420 R2 scores for each fold: [-5.30481339e-04 -8.50291252e  
-02 -6.14788294e-01 -1.94586515e-02  
421 -8.02688360e-01]  
422 Mean R2 score: -0.3044989824295044  
423 [I 2025-12-28 18:38:10,039] Trial 18 finished with  
value: -0.3044989824295044 and parameters: {'booster':  
'gbtree', 'lambda': 0.000217646614371588, 'alpha':  
0.0005832178744985977, 'subsample': 1.  
4587856388086954e-07, 'colsample_bytree': 0.  
48676295271936554, 'min_child_weight': 1.  
737044605418256, 'eta': 0.2793441191490009, 'max_depth':  
5, 'n_estimators': 796}. Best is trial 14 with  
value: 0.8226150274276733.  
424 Best trial: 14. Best value: 0.822615: 95  
%| [REDACTED] | 19/20 [00:10<00:00, 3.89it/s]C:\Users\  
alyss\PycharmProjects\PythonProject1\.venv\Lib\site-  
packages\xgboost\training.py:199: UserWarning: [18:38:  
10] WARNING: C:\actions-runner\_work\xgboost\xgboost\  
src\learner.cc:790:  
425 Parameters: { "colsample_bytree", "max_depth", "  
min_child_weight", "subsample" } are not used.  
426
```

```
427 bst.update(dtrain, iteration=i, fobj=obj)
428 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
    Lib\site-packages\xgboost\training.py:199: UserWarning
        : [18:38:10] WARNING: C:\actions-runner\_work\xgboost\
            xgboost\src\learner.cc:790:
429 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
430
431 bst.update(dtrain, iteration=i, fobj=obj)
432 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
    Lib\site-packages\xgboost\training.py:199: UserWarning
        : [18:38:10] WARNING: C:\actions-runner\_work\xgboost\
            xgboost\src\learner.cc:790:
433 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
434
435 bst.update(dtrain, iteration=i, fobj=obj)
436 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
    Lib\site-packages\xgboost\training.py:199: UserWarning
        : [18:38:10] WARNING: C:\actions-runner\_work\xgboost\
            xgboost\src\learner.cc:790:
437 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
438
439 bst.update(dtrain, iteration=i, fobj=obj)
440 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
    Lib\site-packages\xgboost\training.py:199: UserWarning
        : [18:38:10] WARNING: C:\actions-runner\_work\xgboost\
            xgboost\src\learner.cc:790:
441 Parameters: { "colsample_bytree", "max_depth", "
    min_child_weight", "subsample" } are not used.
442
443 bst.update(dtrain, iteration=i, fobj=obj)
444 Best trial: 14. Best value: 0.822615: 100
    %|██████| 20/20 [00:10<00:00, 1.96it/s]
445 C:\Users\alyss\PycharmProjects\PythonProject1\.venv\
    Lib\site-packages\xgboost\callback.py:386: UserWarning
        : [18:38:10] WARNING: C:\actions-runner\_work\xgboost\
```

```
445 xgboost\src\learner.cc:790:  
446 Parameters: { "colsample_bytree", "max_depth", "  
    min_child_weight", "subsample" } are not used.  
447  
448     self.starting_round = model.num_boosted_rounds()  
449 R2 scores for each fold: [0.69796157 0.61518598 0.  
    7915526 0.73262727 0.45803452]  
450 Mean R2 score: 0.6590723872184754  
451 [I 2025-12-28 18:38:10,164] Trial 19 finished with  
    value: 0.6590723872184754 and parameters: {'booster':  
        'gblinear', 'lambda': 1.811365579646417e-05, 'alpha':  
        0.0021176845050599954, 'subsample': 2.  
        288228266426018e-05, 'colsample_bytree': 0.  
        12104816139762054, 'min_child_weight': 3.  
        2329766512816667, 'eta': 0.006740222827612952,  
        'max_depth': 10, 'n_estimators': 492}. Best is trial 14  
    with value: 0.8226150274276733.  
452 Best parameters: {'booster': 'gblinear', 'lambda': 0.  
    00027393131656845417, 'alpha': 0.0008199689654257539  
    , 'subsample': 5.017590447557101e-07, '  
    colsample_bytree': 0.42242827805932054, '  
    min_child_weight': 1.064920949539281, 'eta': 0.  
    906622356353465, 'max_depth': 3, 'n_estimators': 648}  
453 [0] validation_0-rmse:6.56064  
454 [1] validation_0-rmse:9.31243  
455 [2] validation_0-rmse:6.92354  
456 [3] validation_0-rmse:7.79505  
457 [4] validation_0-rmse:6.77709  
458 [5] validation_0-rmse:6.41354  
459 [6] validation_0-rmse:6.52193  
460 [7] validation_0-rmse:7.11817  
461 [8] validation_0-rmse:6.40559  
462 [9] validation_0-rmse:6.08618  
463 [10] validation_0-rmse:6.00464  
464 [11] validation_0-rmse:5.72752  
465 [12] validation_0-rmse:5.78646  
466 [13] validation_0-rmse:5.58395  
467 [14] validation_0-rmse:5.49918
```

```
468 [15] validation_0-rmse:5.29850
469 [16] validation_0-rmse:5.23207
470 [17] validation_0-rmse:5.43204
471 [18] validation_0-rmse:5.64873
472 [19] validation_0-rmse:7.31125
473 [20] validation_0-rmse:6.24461
474 [21] validation_0-rmse:6.20397
475 [22] validation_0-rmse:6.31791
476 [23] validation_0-rmse:6.19369
477 [24] validation_0-rmse:6.22569
478 [25] validation_0-rmse:6.54382
479 [26] validation_0-rmse:6.78162
480 Best iteration: 16
481 Best validation error: 5.232073596192121
482 RMSE: 9.434833526611328
483 MAE: 8.000153541564941
484 MSE: 89.01608276367188
485 R2: 0.5527727603912354
486 Fly Ash (kg/m3) Slag (kg/m3) SiO2:Al2O3 CaO:SiO2
    CaO:Al2O3 Fe2O3:Al2O3 Na2SiO3:NaOH NaOH (M)
    Activator:Binder Extra Water (kg/m3) Liquid:Binder
    Fine Aggregate :Total Aggregate Total Aggregate :
    Binder Curing Temp (C) Curing Time (hr) Age before
    Exposure (Days) H2S04 (M) Days Submerged
487 0 500.0 0.0 2.0 0.04
    0.08 0.16 2.0 8.0
    0.3 0.0 0.3
    0.294118
    3.4 60.0
    24.0 14.0
    0.5 14.0
488 [28.112612]
489
490 Process finished with exit code 0
491
```