

★ Regression Model to Predict Cement Compressive Strength

Compressive strength of cement at 7 and 28 days



```
In [1]: # import library
import pandas as pd
```

```
In [2]: # import data
cement = pd.read_csv("Concrete Compressive Strength.csv")
```

```
In [3]: # view data
cement.head(5)
```

```
Out[3]:
```

	Cement (kg in a m ³ mixture)	Blast Furnace Slag (kg in a m ³ mixture)	Fly Ash (kg in a m ³ mixture)	Water (kg in a m ³ mixture)	Superplasticizer (kg in a m ³ mixture)	Coarse Aggregate (kg in a m ³ mixture)	Fine Aggregate (kg in a m ³ mixture)	Age (day)	Conc Compres Strength(M megapascals)
0	540.0	0.0	0.0	162.0	2.5	1040.0	676.0	28	79.98
1	540.0	0.0	0.0	162.0	2.5	1055.0	676.0	28	61.88
2	332.5	142.5	0.0	228.0	0.0	932.0	594.0	270	40.26
3	332.5	142.5	0.0	228.0	0.0	932.0	594.0	365	41.05
4	198.6	132.4	0.0	192.0	0.0	978.4	825.5	360	44.29

```
In [4]: # info of data
cement.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1030 entries, 0 to 1029
Data columns (total 9 columns):
#   Column                                Non-Null Count  Dtype

```

```
-----
0  Cement (kg in a m^3 mixture)          1030 non-null  float64
1  Blast Furnace Slag (kg in a m^3 mixture)  1030 non-null  float64
2  Fly Ash (kg in a m^3 mixture)          1030 non-null  float64
3  Water (kg in a m^3 mixture)            1030 non-null  float64
4  Superplasticizer (kg in a m^3 mixture)  1030 non-null  float64
5  Coarse Aggregate (kg in a m^3 mixture)  1030 non-null  float64
6  Fine Aggregate (kg in a m^3 mixture)    1030 non-null  float64
7  Age (day)                             1030 non-null  int64
8  Concrete Compressive Strength(MPa, megapascals)  1030 non-null  float64
dtypes: float64(8), int64(1)
memory usage: 72.5 KB
```

```
In [5]: # summary statistics
cement.describe()
```

Out[5]:

	Cement (kg in a m^3 mixture)	Blast Furnace Slag (kg in a m^3 mixture)	Fly Ash (kg in a m^3 mixture)	Water (kg in a m^3 mixture)	Superplasticizer (kg in a m^3 mixture)	Coarse Aggregate (kg in a m^3 mixture)	Fine Aggregate (kg in a m^3 mixture)
count	1030.000000	1030.000000	1030.000000	1030.000000	1030.000000	1030.000000	1030.000000
mean	281.165631	73.895485	54.187136	181.566359	6.203112	972.918592	773.578883
std	104.507142	86.279104	63.996469	21.355567	5.973492	77.753818	80.175421
min	102.000000	0.000000	0.000000	121.750000	0.000000	801.000000	594.000000
25%	192.375000	0.000000	0.000000	164.900000	0.000000	932.000000	730.950000
50%	272.900000	22.000000	0.000000	185.000000	6.350000	968.000000	779.510000
75%	350.000000	142.950000	118.270000	192.000000	10.160000	1029.400000	824.000000
max	540.000000	359.400000	200.100000	247.000000	32.200000	1145.000000	992.600000



```
In [6]: # check for missing value
cement.isna().sum()
```

Out[6]:

```
Cement (kg in a m^3 mixture)          0
Blast Furnace Slag (kg in a m^3 mixture)  0
Fly Ash (kg in a m^3 mixture)          0
Water (kg in a m^3 mixture)            0
Superplasticizer (kg in a m^3 mixture)  0
Coarse Aggregate (kg in a m^3 mixture)  0
Fine Aggregate (kg in a m^3 mixture)    0
Age (day)                             0
Concrete Compressive Strength(MPa, megapascals)  0
dtype: int64
```

```
In [7]: # check for categories
cement.nunique()
```

Out[7]:

```
Cement (kg in a m^3 mixture)          280
Blast Furnace Slag (kg in a m^3 mixture)  187
Fly Ash (kg in a m^3 mixture)          163
Water (kg in a m^3 mixture)            205
Superplasticizer (kg in a m^3 mixture)  155
Coarse Aggregate (kg in a m^3 mixture)  284
```

```

Fine Aggregate (kg in a m^3 mixture)      304
Age (day)                                14
Concrete Compressive Strength(MPa, megapascals)  938
dtype: int64

```

In [8]:

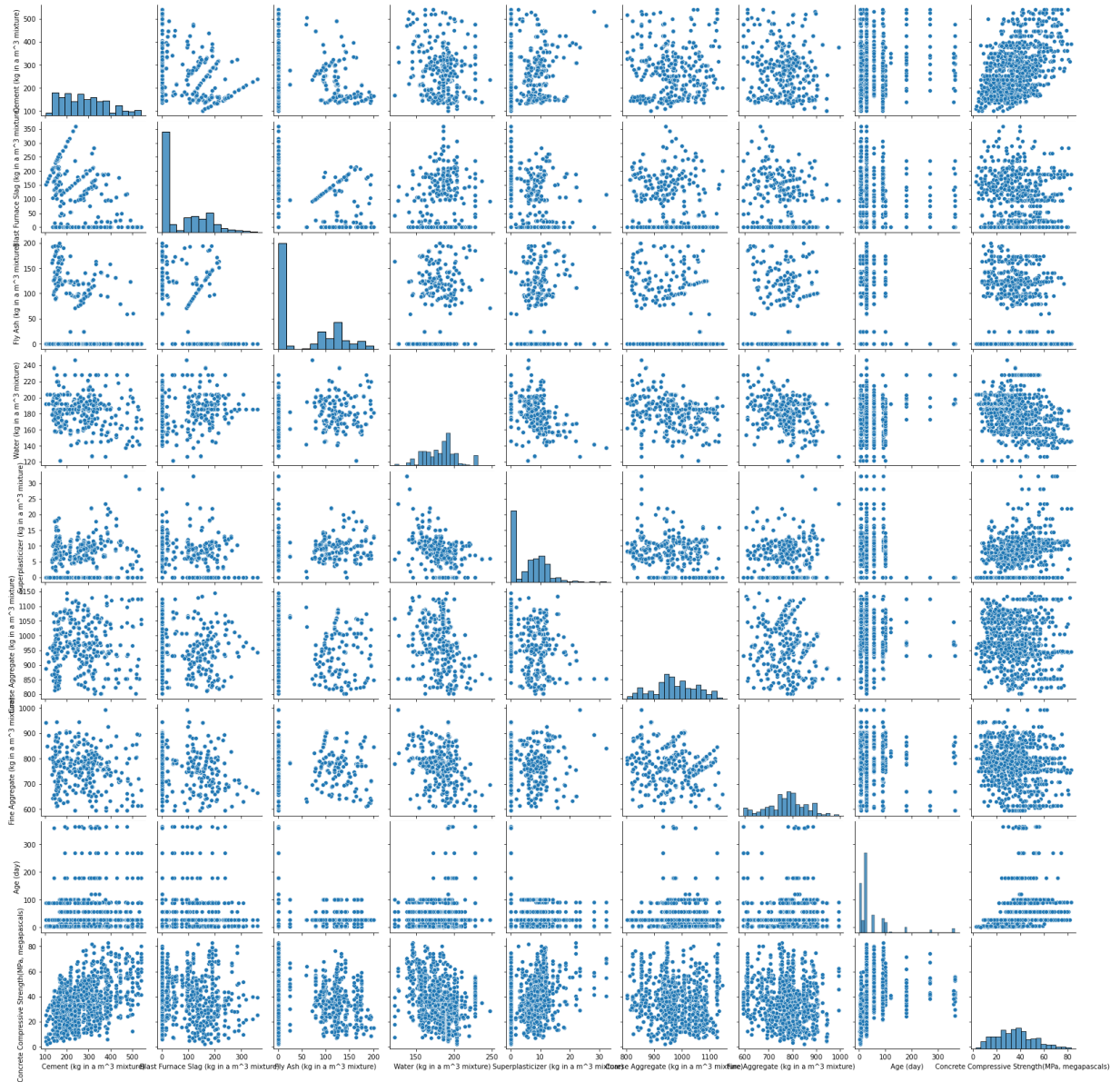
```

# visualize pairplot
import seaborn as sns
sns.pairplot(cement)

```

Out[8]:

```
<seaborn.axisgrid.PairGrid at 0x16db74b3970>
```



In [9]:

```

# columns name
cement.columns

```

Out[9]:

```

Index(['Cement (kg in a m^3 mixture)',
       'Blast Furnace Slag (kg in a m^3 mixture)',
       'Fly Ash (kg in a m^3 mixture)', 'Water (kg in a m^3 mixture)',
       'Superplasticizer (kg in a m^3 mixture)',
       'Coarse Aggregate (kg in a m^3 mixture)',
       'Fine Aggregate (kg in a m^3 mixture)', 'Age (day)',
       'Concrete Compressive Strength(MPa, megapascals)'],
      dtype='object')

```

```
In [10]: # define y
y = cement['Concrete Compressive Strength(MPa, megapascals) ']
```

```
In [11]: # define X
X = cement[['Cement (kg in a m^3 mixture)', 'Blast Furnace Slag (kg in a m^3 mixture)']
```

```
In [12]: # split data
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, train_size=0.7, random_stat
```

```
In [13]: # verify shape
X_train.shape, X_test.shape, y_train.shape, y_test.shape
```

```
Out[13]: ((721, 8), (309, 8), (721,), (309,))
```

```
In [14]: # select model
from sklearn.linear_model import LinearRegression
model = LinearRegression()
```

```
In [15]: # train model
model.fit(X_train, y_train)
```

```
Out[15]: LinearRegression()
```

```
In [16]: # predict with model
y_pred=model.predict(X_test)
```

```
In [17]: # model evaluation
from sklearn.metrics import mean_absolute_error, mean_absolute_percentage_error, mea
```

```
In [18]: # model MAE
mean_absolute_error(y_test, y_pred)
```

```
Out[18]: 8.683767775410708
```

```
In [19]: # model MAPE
mean_absolute_percentage_error(y_test, y_pred)
```

```
Out[19]: 0.3134440184320866
```

```
In [20]: # model MSE
mean_squared_error(y_test, y_pred)
```

```
Out[20]: 120.40313453787671
```

```
In [26]: # future prediction
df=cement.loc[405:405,:]
```

```
df
```

Out[26]:

	Cement (kg in a m^3 mixture)	Blast Furnace Slag (kg in a m^3 mixture)	Fly Ash (kg in a m^3 mixture)	Water (kg in a m^3 mixture)	Superplasticizer (kg in a m^3 mixture)	Coarse Aggregate (kg in a m^3 mixture)	Fine Aggregate (kg in a m^3 mixture)	Age (day)	Co Comp Strengtl megap
405	500.0	0.0	0.0	151.0	9.0	1033.0	655.0	28	69.1

In [29]:

```
# define X_new
xnew=df.drop('Concrete Compressive Strength(MPa, megapascals) ',axis=1)
xnew
```

Out[29]:

	Cement (kg in a m^3 mixture)	Blast Furnace Slag (kg in a m^3 mixture)	Fly Ash (kg in a m^3 mixture)	Water (kg in a m^3 mixture)	Superplasticizer (kg in a m^3 mixture)	Coarse Aggregate (kg in a m^3 mixture)	Fine Aggregate (kg in a m^3 mixture)	Age (day)
405	500.0	0.0	0.0	151.0	9.0	1033.0	655.0	28

In [30]:

```
# predict for X_new
model.predict(xnew)
```

Out[30]:

array([52.94562122])

In []: