COE_CatA_Model

October 5, 2025

1 1. Import libraries and data

[1]:

```
from sklearn.linear_model import LinearRegression, Lasso, Ridge
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, precision_score, recall_score,␣
 ↪r2_score
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import plotly.express as px
```

1.1 1.1: Load initial CSV

[2]:

```
coe_df = pd.read_csv(r"F:\Data Science Grand Track\Machine␣
 ↪Learning\datasets\coe_pricing\COEBiddingResultsPrices.csv")
```

[3]:

```
display(coe_df)
```

```
         month  bidding_no vehicle_class  quota bids_success bids_received  \
0      2010-01           1    Category A   1152         1145          1342
1      2010-01           1    Category B    687          679           883
2      2010-01           1    Category C    173          173           265
3      2010-01           1    Category D    373          365           509
4      2010-01           1    Category E    586          567          1011
…        …         …            …     …          …          …
1855   2025-09           2    Category A   1272         1266          2521
1856   2025-09           2    Category B    792          772          1273
1857   2025-09           2    Category C    276          274           413
1858   2025-09           2    Category D    539          539           617
1859   2025-09           2    Category E    256          252           540

      premium
0       18502
1       19190
2       19001
3         889
4       19889
…         …
```

```
1855   119003
1856   136890
1857    72501
1858     9209
1859   140502

[1860 rows x 7 columns]
```

1.2 1.2. Get Cat A data

[4]:
```
coe_catA_df = coe_df[coe_df['vehicle_class'] == 'Category A']
```

[5]:
```
display(coe_catA_df)
```

```
        month  bidding_no vehicle_class  quota bids_success bids_received  \
0     2010-01           1    Category A   1152         1145          1342
5     2010-01           2    Category A   1151         1149          1673
10    2010-02           1    Category A   1154         1153          1326
15    2010-02           2    Category A   1148         1148          1493
20    2010-03           1    Category A   1148         1141          1758
…       …         …           …    …          …           …
1835  2025-07           2    Category A   1253        1,253         1,874
1840  2025-08           1    Category A   1268        1,257         1,755
1845  2025-08           2    Category A   1264        1,257         1,922
1850  2025-09           1    Category A   1275        1,271         1,844
1855  2025-09           2    Category A   1272         1266          2521

      premium
0       18502
5       20501
10      19989
15      20340
20      20802
…       …
1835  101102
1840  102009
1845  104524
1850  107889
1855  119003

[372 rows x 7 columns]
```

1.3 1.3: Drop month column, keeping only numeric data

[6]:
```
coe_catA_df = coe_catA_df.drop(['vehicle_class'], axis=1)
```

[7]:
```
coe_catA_df = coe_catA_df.drop(['bidding_no', 'month'], axis=1)
```

[8]:

```
display(coe_catA_df)
```

```
      quota bids_success bids_received  premium
0      1152         1145          1342    18502
5      1151         1149          1673    20501
10     1154         1153          1326    19989
15     1148         1148          1493    20340
20     1148         1141          1758    20802
…      …           …            …      …
1835   1253        1,253         1,874   101102
1840   1268        1,257         1,755   102009
1845   1264        1,257         1,922   104524
1850   1275        1,271         1,844   107889
1855   1272         1266          2521   119003

[372 rows x 4 columns]
```

1.4 1.4: Cleaning data:

1.4.1 1.4.1: Function to remove the , in numbers and convert it

[9]:

```
def remove_extra_comma(num: str)-> int:
    num = num.replace(",", "")
    return int(num)
```

1.4.2 1.4.2: Apply function

[10]:

```
coe_catA_df['bids_received'] = coe_catA_df['bids_received'].
  ↪apply(remove_extra_comma)
coe_catA_df['bids_success'] = coe_catA_df['bids_success'].
  ↪apply(remove_extra_comma)
```

[11]:

```
display(coe_catA_df.dtypes)
```

```
quota            int64
bids_success     int64
bids_received    int64
premium          int64
dtype: object
```

2 2. Prepare data for training

2.1 2.1: Set X and y

[12]:

```
X = coe_catA_df[['quota', 'bids_success', 'bids_received']].values
y = coe_catA_df['premium'].values
```

[13]:

```
print(X.shape)
print(y.shape)
```

```
(372, 3)
(372,)
```

2.2 2.2 Split into training and testing data

[14]:

```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.25,␣
 ↪random_state=42)
```

3 3. Train model using Lasso

3.1 3.1: Train model using training data

[15]:

```
# Import LassoCV for automatic cross validation -> auto alpha
from sklearn.linear_model import LassoCV
```

[ ]:

```
# Creating a object:
predict_classA_lasso = LassoCV(
    cv=10, # Set number of cross validation folds to 10
    random_state = 42, # Split data randomly
    max_iter=5000
).fit(X_train, y_train)

# Print out the best
print("Best alpha: {best_alpha}".format(best_alpha = predict_classA_lasso.
 ↪alpha_))
```

```
Best alpha: 5626.363897393403
```

3.2 3.2: Predicting price:

[17]:

```
# Predicting y (label; COE price from testing data)
y_pred = predict_classA_lasso.predict(X_test)
```

[ ]:

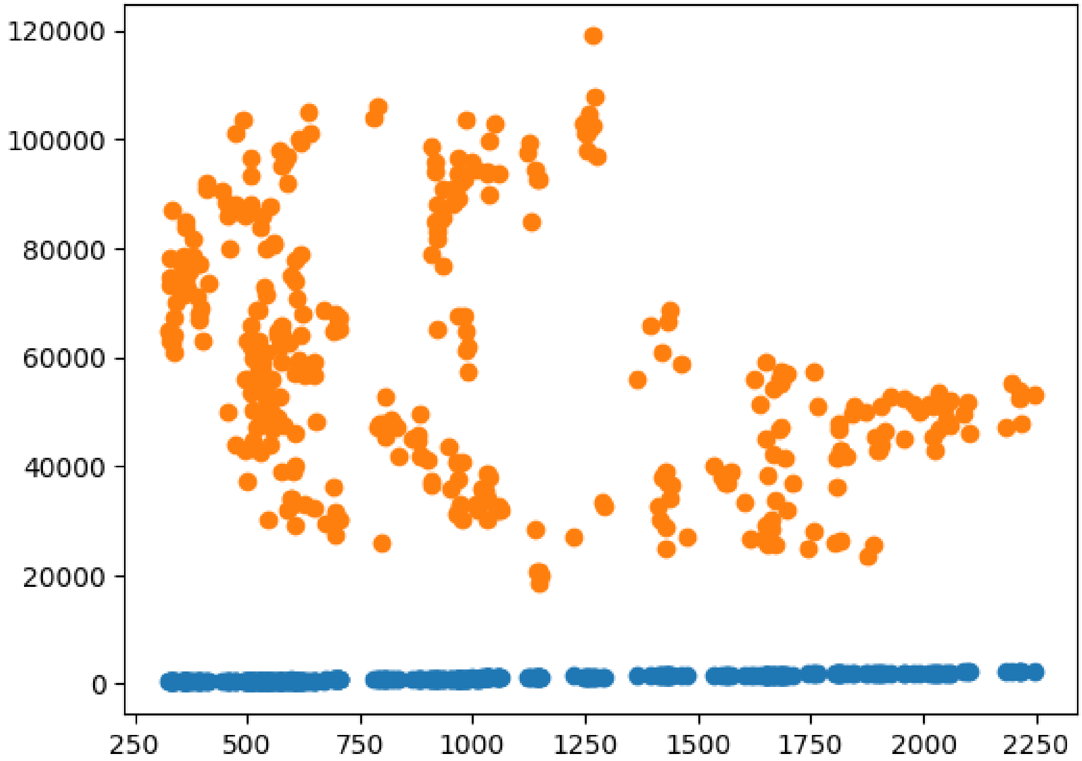
```
display(y_pred)
display(y_pred.shape)
```

4 4. Calculating metrics

4.1 4.1: Plot between

[ ]:

```
plt.scatter(coe_catA_df['bids_success'], coe_catA_df['quota'])
plt.show()
```



4.2 4.2: Calculate metrics

4.2.1 4.2.1: Calculate MSE

[23]:
```
from sklearn.metrics import mean_squared_error
```

[24]:
```
mse = mean_squared_error(y_pred, y_test)
print(f"Mean square error is: {mse}")
```

```
Mean square error is: 462220339.8743456
```

4.2.2 4.2.2: Calculate R_squared

[33]:
```
r2 = predict_classA_lasso.score(X_test, y_test)
print(f"R^2 square score: {r2}")
```

```
R^2 square score: 0.12553682062655902
```

4.2.3 4.2.3: Calculate feature importance

[ ]:
```
feature_coef = predict_classA_lasso = LassoCV(
    cv=10, # Set number of cross validation folds to 10
    random_state = 42, # Split data randomly
    max_iter=5000
).fit(X_train, y_train).coef_
```

```
[-107.38520317   83.96685537    6.06366876]
```

[44]:

```
# Get names of
column_names = ['quota', 'bids_success', 'bids_received']


# Combine into a DataFrame for easier plotting
coef_df = pd.DataFrame({
    'Feature': column_names,
    'Coefficient': feature_coef
})

# Create the bar plot
fig = px.bar(
    coef_df,
    x='Feature',
    y='Coefficient',
    color='Coefficient',  # color based on coefficient value
    color_continuous_scale=['red', 'white', 'green'],  # negative to positive
    title='Lasso Coefficients of Factors to COE Price (Cat A)',
    labels={'Coefficient': 'Lasso Weight'}
)

fig.show()
```