Importing the Data

In [15]:
```python
import pandas as pd
import matplotlib.pyplot as plt

df = pd.read_csv("car.data")
df.head()
```

Out[15]:

	vhigh	vhigh.1	2	2.1	small	low	unacc
0	vhigh	vhigh	2	2	small	med	unacc
1	vhigh	vhigh	2	2	small	high	unacc
2	vhigh	vhigh	2	2	med	low	unacc
3	vhigh	vhigh	2	2	med	med	unacc
4	vhigh	vhigh	2	2	med	high	unacc

In [16]:
```python
# Adding column labels
df.columns = ["buying_price", "maintenance", "doors", "persons", "lug_boot", "safety", "class_value"]
df.head()
```

Out[16]:

	buying_price	maintenance	doors	persons	lug_boot	safety	class_value
0	vhigh	vhigh	2	2	small	med	unacc
1	vhigh	vhigh	2	2	small	high	unacc
2	vhigh	vhigh	2	2	med	low	unacc
3	vhigh	vhigh	2	2	med	med	unacc
4	vhigh	vhigh	2	2	med	high	unacc

In [17]:
```python
df.shape
```

Out[17]:
```
(1727, 7)
```

Exploratory Data Analysis and Preprocessing

In [18]:
```python
# Checking for any null values
df.isnull().sum()
```

Out[18]:
```
buying_price    0
maintenance     0
doors           0
persons         0
lug_boot        0
safety          0
class_value     0
dtype: int64
```

In [19]:
```python
# Checking the distribution of every data column
for col in list(df):
    print(df[col].value_counts())
```

```
med      432
low      432
high     432
vhigh    431
Name: buying_price, dtype: int64
med      432
low      432
high     432
vhigh    431
Name: maintenance, dtype: int64
3        432
5more    432
4        432
2        431
Name: doors, dtype: int64
more    576
4       576
2       575
Name: persons, dtype: int64
med      576
big      576
small    575
Name: lug_boot, dtype: int64
med     576
high    576
low     575
Name: safety, dtype: int64
unacc    1209
acc       384
good       69
vgood      65
Name: class_value, dtype: int64
```

In [20]:
```python
X = df.drop(['buying_price', 'persons'], axis=1)
y = df[['buying_price']]
```

In [21]:
```python
y.value_counts()
```

Out[21]:
```
buying_price
med             432
low             432
high            432
vhigh           431
dtype: int64
```

In [22]:
```python
X.head()
```

Out[22]:

	maintenance	doors	lug_boot	safety	class_value
0	vhigh	2	small	med	unacc
1	vhigh	2	small	high	unacc
2	vhigh	2	med	low	unacc
3	vhigh	2	med	med	unacc
4	vhigh	2	med	high	unacc

In [23]:
```python
X['class_value'].value_counts()
```

Out[23]:
```
unacc    1209
acc       384
good       69
vgood      65
Name: class_value, dtype: int64
```

In [24]:
```python
def maintenance_safety_encode(data):
    if data == "low":
        return 1
    elif data == "med":
        return 2
    elif data == "high":
        return 3
    elif data == "vhigh":
        return 4

def lug_encode(data):
    if data == "small":
        return 1
    elif data == "med":
        return 2
    elif data == "big":
        return 3

def lug_encode(data):
    if data == "small":
        return 1
    elif data == "med":
        return 2
    elif data == "big":
        return 3

def door_encode(data):
    if data == "2":
        return 1
    elif data == "3":
        return 2
    elif data == "4":
        return 3
    elif data == "5more":
        return 4

def class_encode(data):
    if data == "unacc":
        return 1
    elif data == "acc":
        return 2
    elif data == "good":
        return 3
    elif data == "vgood":
        return 4
```

In [25]:
```python
X.columns
```

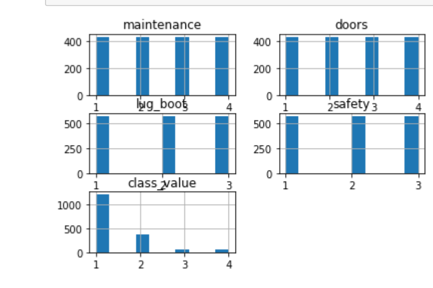
Out[25]:
```
Index(['maintenance', 'doors', 'lug_boot', 'safety', 'class_value'], dtype='object')
```

In [26]:
```python
X['maintenance'] = X['maintenance'].apply(maintenance_safety_encode)
X['doors'] = X['doors'].apply(door_encode)
X['lug_boot'] = X['lug_boot'].apply(lug_encode)
X['safety'] = X['safety'].apply(maintenance_safety_encode)
X['class_value'] = X['class_value'].apply(class_encode)
X.head()
```

Out[26]:

	maintenance	doors	lug_boot	safety	class_value
0	4	1	1	2	1
1	4	1	1	3	1
2	4	1	2	1	1
3	4	1	2	2	1
4	4	1	2	3	1

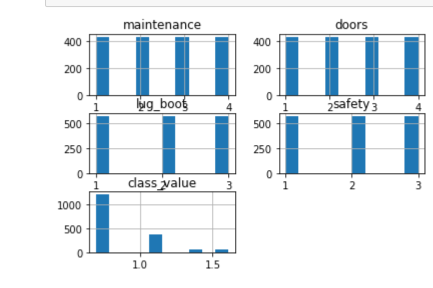
In [27]:
```python
X.hist()
plt.show()
```



In [28]:
```python
import numpy as np

X['class_value'] = X['class_value'].apply(lambda x: np.log(x+1))
X.hist()

plt.show()
```



In [29]:
```python
from sklearn.preprocessing import MinMaxScaler
scaler = MinMaxScaler()

X = pd.DataFrame(scaler.fit_transform(X), columns=list(X))

X.describe()
```

Out[29]:

	maintenance	doors	lug_boot	safety	class_value
count	1727.000000	1727.000000	1727.000000	1727.000000	1727.000000
mean	0.499710	0.500290	0.500290	0.500290	0.166253
std	0.372699	0.372699	0.408307	0.408307	0.276485
min	0.000000	0.000000	0.000000	0.000000	0.000000
25%	0.166667	0.333333	0.000000	0.000000	0.000000
50%	0.333333	0.666667	0.500000	0.500000	0.000000
75%	0.666667	0.833333	1.000000	1.000000	0.442507
max	1.000000	1.000000	1.000000	1.000000	1.000000

In [30]:
```python
from sklearn.model_selection import train_test_split

# Split dataset into training set and test set
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=0) # 80% training and 20% test
```

Base Models

In [34]:
```python
#Import scikit-learn metrics module for accuracy calculation
from sklearn import metrics
from sklearn.metrics import accuracy_score, f1_score, precision_score, recall_score, classification_report, confusion_matrix
```

Logistic Regression

In [35]:
```python
from sklearn.linear_model import LogisticRegression

logreg = LogisticRegression(random_state = 100)
logreg.fit(X_train, y_train)
y_pred = logreg.predict(X_test)
```

```
/Users/zentan/opt/anaconda3/lib/python3.7/site-packages/sklearn/utils/validation.py:72: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ), for example using ravel().
  return f(**kwargs)
```

In [36]:
```python
# Model Accuracy, how often is the classifier correct?
print("Accuracy:",metrics.accuracy_score(y_test, y_pred))
print("F1 Score", f1_score(y_test, y_pred, average="macro"))
print("Precision", precision_score(y_test, y_pred, average="macro"))
print("Recall", recall_score(y_test, y_pred, average="macro"))
```

```
Accuracy: 0.3140655105973025
F1 Score 0.24243704045473213
Precision 0.2565921977627258
Recall 0.3182764284061994
```

KNN

In [39]:
```python
from sklearn.neighbors import KNeighborsClassifier

classifier = KNeighborsClassifier(n_neighbors=5)
classifier.fit(X_train, y_train)
y_pred_knn = classifier.predict(X_test)
```

```
/Users/zentan/opt/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:4: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ), for example using ravel().
  after removing the cwd from sys.path.
```

In [40]:
```python
# Model Accuracy, how often is the classifier correct?
print("Accuracy:",metrics.accuracy_score(y_test, y_pred))
print("F1 Score", f1_score(y_test, y_pred, average="macro"))
print("Precision", precision_score(y_test, y_pred, average="macro"))
print("Recall", recall_score(y_test, y_pred, average="macro"))
```

```
Accuracy: 0.3140655105973025
F1 Score 0.24243704045473213
Precision 0.2565921977627258
Recall 0.3182764284061994
```

Using pycaret to speed up the process

In [41]:
```python
df_pycaret = pd.read_csv("car.data")
df_pycaret.columns = ["buying_price", "maintenance", "doors", "persons", "lug_boot", "safety", "class_value"]
df_pycaret.drop("persons", axis=1, inplace=True)
df_pycaret.head()
```

Out[41]:

	buying_price	maintenance	doors	lug_boot	safety	class_value
0	vhigh	vhigh	2	small	med	unacc
1	vhigh	vhigh	2	small	high	unacc
2	vhigh	vhigh	2	med	low	unacc
3	vhigh	vhigh	2	med	med	unacc
4	vhigh	vhigh	2	med	high	unacc

In [42]:
```python
from pycaret.classification import *

clf = setup(df_pycaret, target='buying_price', session_id=1)
```

	Description	Value
0	session_id	1
1	Target	buying_price
2	Target Type	Multiclass
3	Label Encoded	high: 0, low: 1, med: 2, vhigh: 3
4	Original Data	(1727, 6)
5	Missing Values	False
6	Numeric Features	0
7	Categorical Features	5
8	Ordinal Features	False
9	High Cardinality Features	False
10	High Cardinality Method	None
11	Transformed Train Set	(1208, 18)
12	Transformed Test Set	(519, 18)
13	Shuffle Train-Test	True
14	Stratify Train-Test	False
15	Fold Generator	StratifiedKFold
16	Fold Number	10
17	CPU Jobs	-1
18	Use GPU	False
19	Log Experiment	False
20	Experiment Name	clf-default-name
21	USI	a3ca
22	Imputation Type	simple
23	Iterative Imputation Iteration	None
24	Numeric Imputer	mean
25	Iterative Imputation Numeric Model	None
26	Categorical Imputer	constant
27	Iterative Imputation Categorical Model	None
28	Unknown Categoricals Handling	least_frequent
29	Normalize	False
30	Normalize Method	None
31	Transformation	False
32	Transformation Method	None
33	PCA	False
34	PCA Method	None
35	PCA Components	None
36	Ignore Low Variance	False
37	Combine Rare Levels	False
38	Rare Level Threshold	None
39	Numeric Binning	False
40	Remove Outliers	False
41	Outliers Threshold	None
42	Remove Multicollinearity	False
43	Multicollinearity Threshold	None
44	Remove Perfect Collinearity	True
45	Clustering	False
46	Clustering Iteration	None
47	Polynomial Features	False
48	Polynomial Degree	None
49	Trignometry Features	False
50	Polynomial Threshold	None
51	Group Features	False
52	Feature Selection	False
53	Feature Selection Method	classic
54	Features Selection Threshold	None
55	Feature Interaction	False
56	Feature Ratio	False
57	Interaction Threshold	None
58	Fix Imbalance	False
59	Fix Imbalance Method	SMOTE

In [43]:
```python
compare_models()
```

	Model	Accuracy	AUC	Recall	Prec.	F1	Kappa	MCC	TT (Sec)
nb	Naive Bayes	0.3179	0.5404	0.3180	0.3047	0.2500	0.0900	0.1123	0.1650
ada	Ada Boost Classifier	0.3162	0.5757	0.3153	0.3701	0.3063	0.0863	0.0903	0.0240
ridge	Ridge Classifier	0.3129	0.0000	0.3123	0.3435	0.2963	0.0824	0.0875	0.0050
lda	Linear Discriminant Analysis	0.3121	0.5750	0.3111	0.3702	0.2985	0.0808	0.0855	0.0060
lr	Logistic Regression	0.3055	0.5763	0.3050	0.3311	0.2925	0.0726	0.0764	0.6340
svm	SVM - Linear Kernel	0.2848	0.0000	0.2844	0.2906	0.2422	0.0454	0.0572	0.1520
gbc	Gradient Boosting Classifier	0.2583	0.5740	0.2586	0.2818	0.2581	0.0100	0.0097	0.0770
qda	Quadratic Discriminant Analysis	0.2517	0.0000	0.2500	0.0633	0.1012	0.0000	0.0000	0.0160
knn	K Neighbors Classifier	0.1963	0.4402	0.1965	0.1978	0.1934	-0.0719	-0.0726	0.1890
lightgbm	Light Gradient Boosting Machine	0.1871	0.4956	0.1877	0.1906	0.1864	-0.0842	-0.0849	2.5250
xgboost	Extreme Gradient Boosting	0.1722	0.4595	0.1728	0.1768	0.1722	-0.1041	-0.1051	1.2720
dt	Decision Tree Classifier	0.1681	0.4297	0.1689	0.1545	0.1553	-0.1091	-0.1122	0.0060
et	Extra Trees Classifier	0.1656	0.4248	0.1664	0.1537	0.1538	-0.1124	-0.1155	0.1020
rf	Random Forest Classifier	0.1648	0.4354	0.1653	0.1726	0.1666	-0.1140	-0.1147	0.1070

Out[43]:
```
GaussianNB(priors=None, var_smoothing=1e-09)
```

In [44]:
```python
model = create_model('nb')
```

	Accuracy	AUC	Recall	Prec.	F1	Kappa	MCC
0	0.3388	0.5487	0.3417	0.3347	0.2804	0.1209	0.1529
1	0.2975	0.5287	0.3000	0.3278	0.2266	0.0659	0.0847
2	0.2479	0.4794	0.2500	0.3039	0.1917	0.0000	0.0000
3	0.2975	0.5281	0.3000	0.2923	0.2195	0.0659	0.0872
4	0.3223	0.5242	0.3241	0.3308	0.2774	0.0959	0.1106
5	0.3223	0.5429	0.3156	0.2422	0.2231	0.0899	0.1207
6	0.3636	0.6000	0.3621	0.3274	0.3068	0.1471	0.1786
7	0.3140	0.5295	0.3087	0.2793	0.2437	0.0791	0.1000
8	0.3167	0.5451	0.3181	0.2925	0.2467	0.0896	0.1093
9	0.3583	0.5777	0.3601	0.3160	0.2838	0.1452	0.1793
Mean	0.3179	0.5404	0.3180	0.3047	0.2500	0.0900	0.1123
SD	0.0315	0.0307	0.0311	0.0276	0.0342	0.0408	0.0498

In [48]:
```python
tuned_nb = tune_model(model)
```

	Accuracy	AUC	Recall	Prec.	F1	Kappa	MCC
0	0.3388	0.5487	0.3417	0.3347	0.2804	0.1209	0.1529
1	0.2975	0.5287	0.3000	0.3278	0.2266	0.0659	0.0847
2	0.2479	0.4794	0.2500	0.3039	0.1917	0.0000	0.0000
3	0.2975	0.5281	0.3000	0.2923	0.2195	0.0659	0.0872
4	0.3223	0.5242	0.3241	0.3308	0.2774	0.0959	0.1106
5	0.3223	0.5429	0.3156	0.2422	0.2231	0.0899	0.1207
6	0.3636	0.6000	0.3621	0.3274	0.3068	0.1471	0.1786
7	0.3140	0.5295	0.3087	0.2793	0.2437	0.0791	0.1000
8	0.3167	0.5451	0.3181	0.2925	0.2467	0.0896	0.1093
9	0.3583	0.5777	0.3601	0.3160	0.2838	0.1452	0.1793
Mean	0.3179	0.5404	0.3180	0.3047	0.2500	0.0900	0.1123
SD	0.0315	0.0307	0.0311	0.0276	0.0342	0.0408	0.0498

In [49]:
```python
test = pd.DataFrame([['High', '4', 'Big', 'High', 'Good']])
test.columns = ["maintenance", "doors", "lug_boot", "safety", "class_value"]


test.head()
```

Out[49]:

	maintenance	doors	lug_boot	safety	class_value
0	High	4	Big	High	Good

In [50]:
```python
unseen_predictions = predict_model(tuned_nb, data=test)
unseen_predictions.head()
```

Out[50]:

	maintenance	doors	lug_boot	safety	class_value	Label	Score
0	High	4	Big	High	Good	low	0.9841

The predicted Buying Price would be low

In [ ]: