DAT200 CA4 2022 ¶

Kaggle username: Mohamed Atteyeh

Imports

In [523]:

```
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
import seaborn as sns
from sklearn.pipeline import make_pipeline
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import accuracy_score,confusion_matrix, classification_report,
from sklearn.linear_model import Perceptron
from sklearn.linear_model import LogisticRegression
from sklearn.svm import SVC
from sklearn.decomposition import PCA
from sklearn.svm import LinearSVC
from sklearn.neighbors import KNeighborsClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
from imblearn.over_sampling import SMOTE
from imblearn.under_sampling import TomekLinks
from sklearn.model_selection import StratifiedKFold
from sklearn.model_selection import GridSearchCV
```

Reading data

In [524]:

```
Training_data = pd.read_csv('train.csv', index_col=0)
Test_data = pd.read_csv('test.csv', index_col=0)
df = Training_data.copy()
```

Data exploration and visualisation

NAN values

In [525]:

```
df.isna().sum()
```

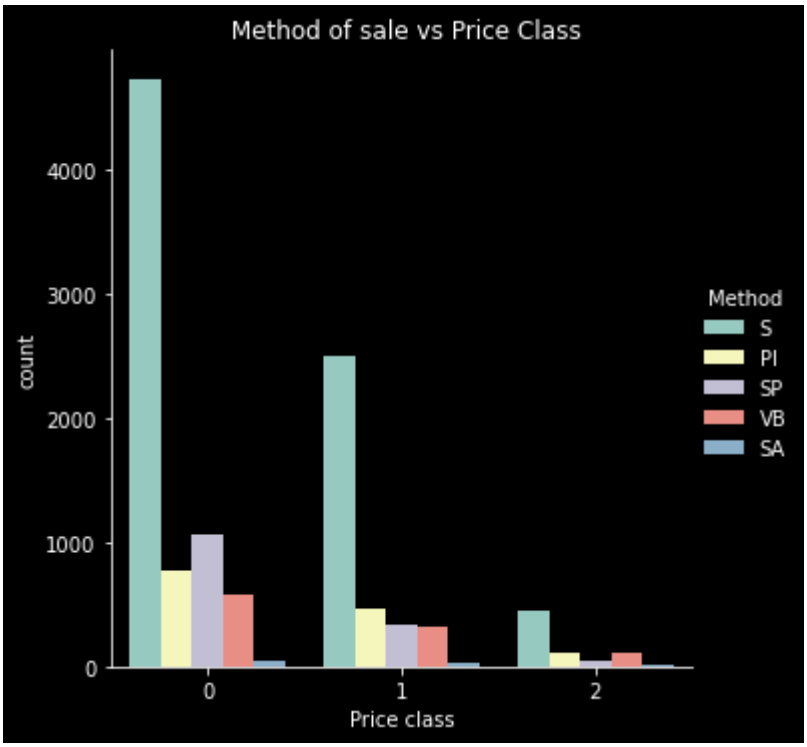
Out[525]:

```
Rooms              0
Type               0
Method             0
Distance           0
Postcode           0
Bedrooms           0
Bathroom          46
Car               53
Landsize          33
YearBuilt       4572
Lattitude          0
Longtitude         0
Regionname         0
Propertycount     40
Price class        0
dtype: int64
```

Graphical representations of the Catigorical Values

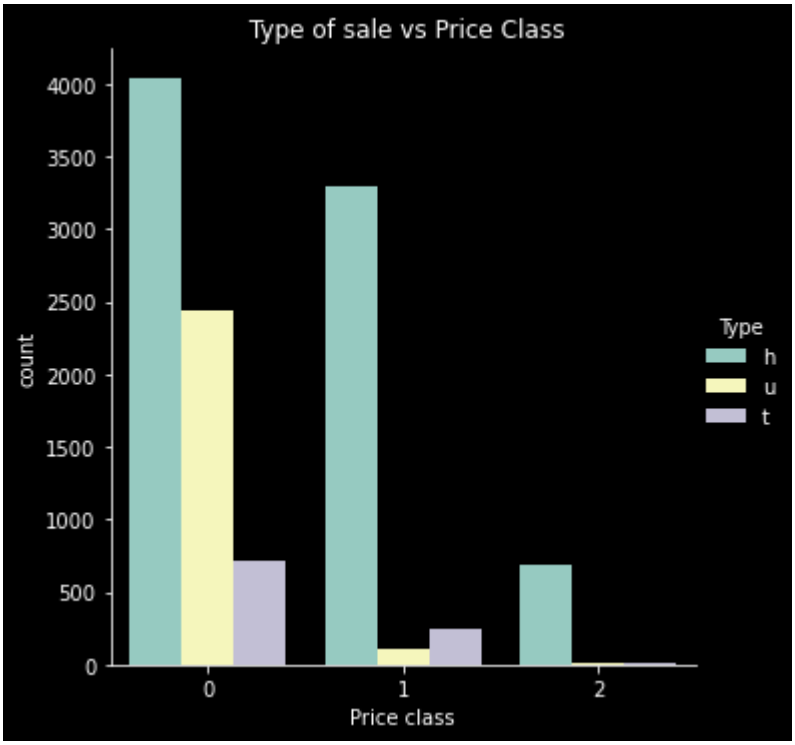
In [526]:

```
#Comparing the Price classes with the Methods of Sale
plt.figure(figsize =(20,10))
sns.catplot(x = "Price class",hue="Method", data=df, kind = 'count')
plt.close(1)
plt.xlabel("Price class")
plt.title(" Method of sale vs Price Class")
plt.show()
```



In [527]:

```
#Comparing the Price classes with the Methods of Sale
plt.figure(figsize =(20,10))
sns.catplot(x = "Price class",hue="Type", data=df, kind = 'count')
plt.close(1)
plt.xlabel("Price class")
plt.title(" Type of sale vs Price Class")
plt.show()
```



Checking for the class imbalances

In [528]:

```
df['Price class'].value_counts()
```

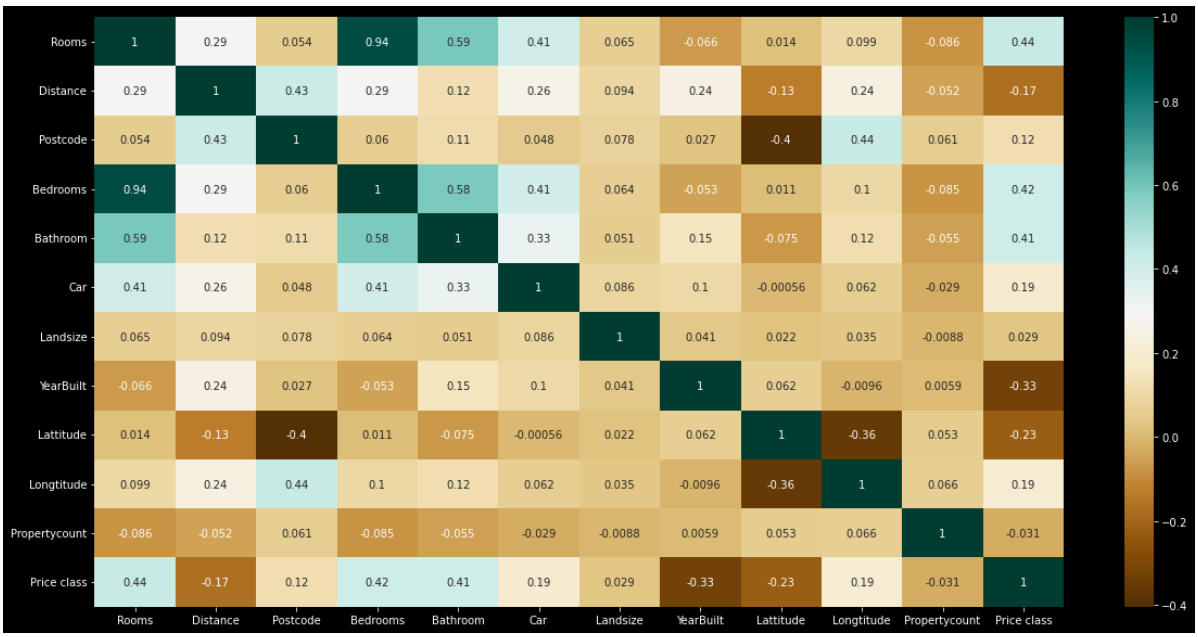
Out[528]:

```
0    7189
1    3643
2     711
Name: Price class, dtype: int64
```

Heatmap

In [529]:

```
Numerical_columns = df.columns[df.dtypes != 'object']
corr = df[list(Numerical_columns)].corr()
plt.figure(figsize= (20,10))
sns.heatmap(corr,annot = True, cmap = 'BrBG')
plt.show()
```



Data cleaning

In [530]:

```
# we delete the column Bedroom, Bathroom and Car for high correlation with Rooms
# We delete the yearbuilt columns because it has a lot of nan values
df = df.drop(['Bedrooms','Bathroom'], axis =1)
# Droping the NAN rows in the rest of the columns
df = df.dropna()
```

In [531]:

```
# Deleting inputs with Landsize  = 0
df = df[df.Landsize != 0.0]
```

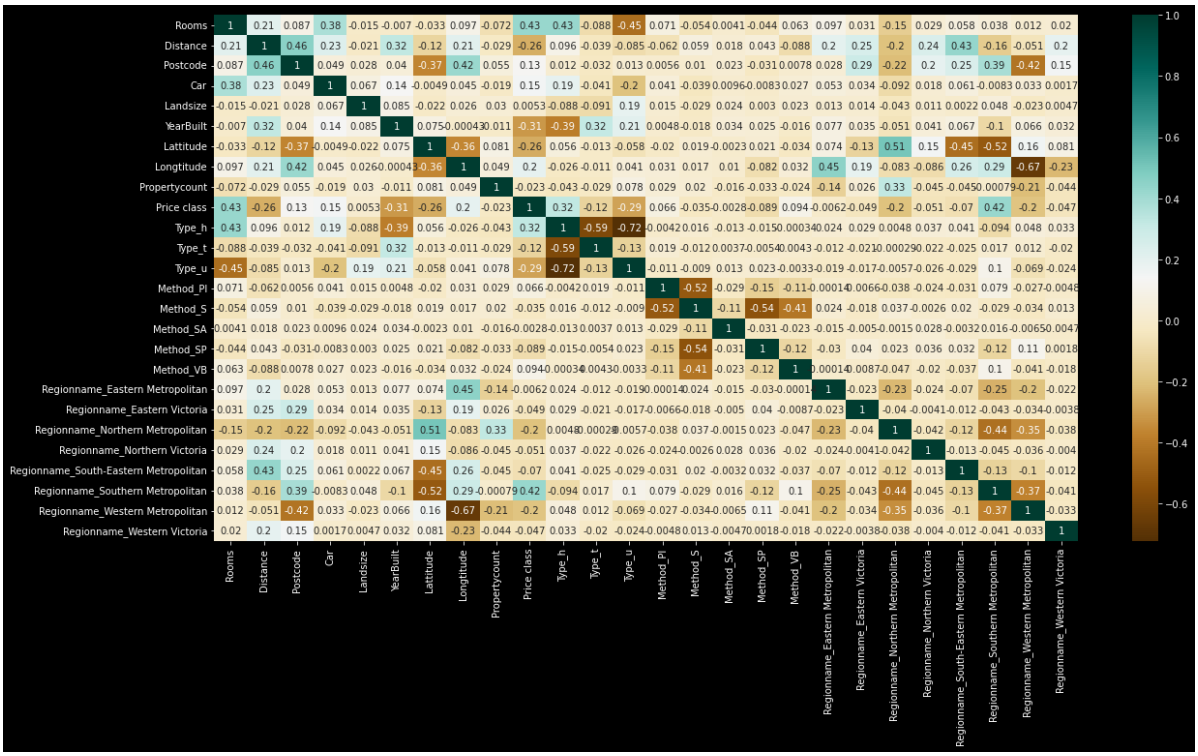
In [532]:

```
# We use the on hot encoding method, to reshape the cateigorical values to integers
df = pd.get_dummies(df,columns=['Type','Method','Regionname'])
```

Data exploration after cleaning

In [533]:

```
# We get a bigger Corr-Map due to the added columns.
Numerical_columns = df.columns[df.dtypes != 'object']
corr = df[list(Numerical_columns)].corr()
plt.figure(figsize= (20,10))
sns.heatmap(corr,annot = True, cmap = 'BrBG')
plt.show()
```



In [534]:

```
# Checking for num values
df.isna().sum()
```

Out[534]:

```
Rooms                                  0
Distance                               0
Postcode                               0
Car                                    0
Landsize                               0
YearBuilt                              0
Lattitude                              0
Longtitude                             0
Propertycount                          0
Price class                            0
Type_h                                 0
Type_t                                 0
Type_u                                 0
Method_PI                              0
Method_S                               0
Method_SA                              0
Method_SP                              0
Method_VB                              0
Regionname_Eastern Metropolitan        0
Regionname_Eastern Victoria            0
Regionname_Northern Metropolitan       0
Regionname_Northern Victoria           0
Regionname_South-Eastern Metropolitan  0
Regionname_Southern Metropolitan       0
Regionname_Western Metropolitan        0
Regionname_Western Victoria            0
dtype: int64
```

Data preprocessing

In [535]:

```
# Fixing the imbalances of the model using TomekLinks

tl = TomekLinks()

undersample_trainX, undersample_trainY = tl.fit_resample(df.drop('Price class', axis
undersample_train = pd.concat([pd.DataFrame(undersample_trainY), pd.DataFrame(unders
df = undersample_train
```

In [536]:

```
X,y = df.drop('Price class', axis = 1).copy(), df['Price class'].copy()
```

Train test split

In [537]:

```
X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.4,random_state=100,
```

Scaling

In [538]:

```
sc = StandardScaler()
sc.fit(X_train)
X_train_sc = sc.transform(X_train)
X_test_sc = sc.transform(X_test)
```

Modelling

Data pipeline with kernel

In [539]:

```
# We Have a Kernal in the svc pipe line
pipe_svc = make_pipeline(SVC(kernel='rbf', C=20, random_state=100))
param_range  = np.linspace(10,50,5)
param_range2 = [0.1, 1.0]

param_grid   = [{'svc__C': param_range, 'svc__kernel': ['linear']},
                {'svc__C': param_range, 'svc__gamma': param_range2, 'svc__kernel': [

gs_svc = GridSearchCV(estimator=pipe_svc,
                  param_grid=param_grid,
                  scoring='accuracy',
                  cv=10,
                  n_jobs=-1)

gs_svc = gs_svc.fit(X_train_sc, y_train)
print(gs_svc.best_score_)
print(gs_svc.best_params_)
```

```
0.8347012332812229
{'svc__C': 10.0, 'svc__gamma': 0.1, 'svc__kernel': 'rbf'}
```

Data pipeline with regularization

In [540]:

```
#Here we see this pipline has an L2 regularisation
pipe_lr = make_pipeline(PCA(n_components=8),LogisticRegression(random_state=1, penal
```

Other models used for Kaggle submission

In [541]:

```
pipe_forest = make_pipeline(RandomForestClassifier(criterion='gini',
                                        n_estimators=50,
                                        random_state= 100,
                                        n_jobs=-1))
```

Final Evaluation and confusion matrix

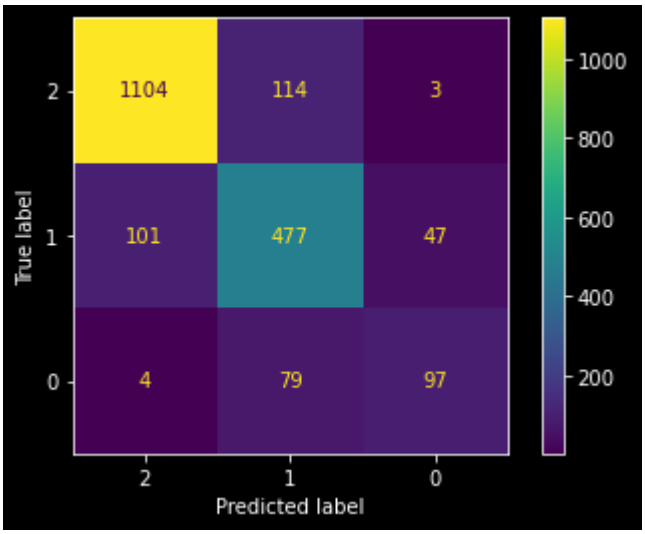
In [542]:

```
clf_svc = gs_svc.best_estimator_
clf_svc.fit(X_train_sc, y_train)
pipe_lr.fit(X_train_sc, y_train)
pipe_forest.fit(X_train, y_train)
pred = clf_svc.predict(X_train_sc)
clf_report = classification_report(y_train, pred)

#-----------------------------------------------------
print('Train accuracy SVC: {0:.5f}'.format(clf_svc.score(X_train_sc, y_train)))
print('Test accuracy SVC: {0:.5f}'.format(clf_svc.score(X_test_sc, y_test)))
#-----------------------------------------------------
print('Train accuracy reggression: {0:.5f}'.format(pipe_lr.score(X_train_sc, y_train
print('Test accuracy reggression: {0:.5f}'.format(pipe_lr.score(X_test_sc, y_test)))
#-----------------------------------------------------

print('Train accuracy forest : {0:.5f}'.format(pipe_forest.score(X_train, y_train)))
print('Test accuracy forest : {0:.5f}'.format(pipe_forest.score(X_test, y_test)))
#-----------------------------------------------------

print(clf_report)

#-----------------------------------------------------
plot_confusion_matrix(clf_svc,X_test_sc,y_test,display_labels=['2','1','0'])
```

```
Train accuracy SVC: 0.93184
Test accuracy SVC: 0.82823
Train accuracy reggression: 0.76589
Test accuracy reggression: 0.74383
Train accuracy forest : 1.00000
Test accuracy forest : 0.85439
              precision    recall  f1-score   support

           0       0.97      0.96      0.96      1829
           1       0.87      0.92      0.89       938
           2       0.93      0.83      0.87       270

    accuracy                           0.93      3037
   macro avg       0.92      0.90      0.91      3037
weighted avg       0.93      0.93      0.93      3037


/Users/mohamedatteyeh/opt/anaconda3/lib/python3.8/site-packages/sklear
n/utils/deprecation.py:87: FutureWarning: Function plot_confusion_matr
ix is deprecated; Function `plot_confusion_matrix` is deprecated in 1.
0 and will be removed in 1.2. Use one of the class methods: ConfusionM
atrixDisplay.from_predictions or ConfusionMatrixDisplay.from_estimato
r.
  warnings.warn(msg, category=FutureWarning)
```

Out[542]:

```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x7f
834ad28520>
```



Kaggle submission

In [543]:

```
gs_svc.best_params_
```

Out[543]:

```
{'svc__C': 10.0, 'svc__gamma': 0.1, 'svc__kernel': 'rbf'}
```

ROC Curve for binary classificaion problem

In [544]:

```
from sklearn.metrics import roc_curve, auc
from sklearn.model_selection import StratifiedKFold

pipe_forest = make_pipeline(RandomForestClassifier(criterion='gini',
                                        n_estimators=50,
                                        random_state= 100,
                                        n_jobs=-1))

X1_train,X1_test,y1_train,y1_test = train_test_split(X,y,test_size=0.3,random_state=

# Cross-validation specification
cv = list(StratifiedKFold(n_splits=5).split(X1_train, y1_train))

for i, (train, test) in enumerate(cv):
    probas = pipe_forest.fit(X1_train[train],
                         y1_train[train]).predict_proba(X1_train[test]) # Predict pr

    # False Positive and True Positive Rates (thresholds for the decision function)
    fpr, tpr, thresholds = roc_curve(y1_train[test],
                                     probas[:, 1],
                                     pos_label=1)
    # Add to mean True Predictive Rate in a smoothed variant (interpolated)
    roc_auc = auc(fpr, tpr)
    plt.plot(fpr,
             tpr,
             label='ROC fold %d (area = %0.2f)'
                   % (i+1, roc_auc))
```

```
---------------------------------------------------------------------------
--------
KeyError                                  Traceback (most recent ca
ll last)
/var/folders/1s/f_hcw9dd7tj7yhsr21xcc_7c0000gn/T/ipykernel_17679/11
18308435.py in <module>
     13
     14 for i, (train, test) in enumerate(cv):
---> 15     probas = pipe_forest.fit(X1_train[train],
     16                              y1_train[train]).predict_proba(X1_
train[test]) # Predict probability of classes
     17

~/opt/anaconda3/lib/python3.8/site-packages/pandas/core/frame.py in
__getitem__(self, key)
   3462             if is_iterator(key):
   3463                 key = list(key)
-> 3464             indexer = self.loc._get_listlike_indexer(key, a
xis=1)[1]
   3465
   3466         # take() does not accept boolean indexers

~/opt/anaconda3/lib/python3.8/site-packages/pandas/core/indexing.py
in _get_listlike_indexer(self, key, axis)
   1312             keyarr, indexer, new_indexer = ax._reindex_non_
unique(keyarr)
   1313
-> 1314         self._validate_read_indexer(keyarr, indexer, axis)
   1315
```

```
   1316         if needs_i8_conversion(ax.dtype) or isinstance(

~/opt/anaconda3/lib/python3.8/site-packages/pandas/core/indexing.py
in _validate_read_indexer(self, key, indexer, axis)
   1372                 if use_interval_msg:
   1373                     key = list(key)
-> 1374                 raise KeyError(f"None of [{key}] are in the
[{axis_name}]")
   1375
   1376             not_found = list(ensure_index(key)[missing_mask
.nonzero()[0]].unique())

KeyError: "None of [Int64Index([ 676,  677,  679,  683,  686,  687,
689,  690,  691,  694,\n            ...\n            3534, 3535, 35
36, 3537, 3538, 3539, 3540, 3541, 3542, 3543],\n           dtype='i
nt64', length=2835)] are in the [columns]"
```