In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split, cross_val_score
from sklearn.ensemble import RandomForestRegressor, RandomForestClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import accuracy_score, classification_report
from sklearn.model_selection import StratifiedKFold,KFold
from sklearn.metrics import mean_squared_error
```

In [2]:

```
# Load the data from the uploaded CSV file
file_path = 'NYPD_Complaint_Data_Current_YTD.csv'
data = pd.read_csv(file_path)
```

In [3]:
```
print(data.describe)
```

```
<bound method NDFrame.describe of         CMPLNT_NUM CMPLNT_FR_DT CMPLNT_FR_T
M CMPLNT_TO_DT CMPLNT_TO_TM  \
0        736216184   09/30/2016     23:25:00   09/30/2016     23:25:00
1        294332956   09/30/2016     23:16:00   09/30/2016     23:21:00
2        852981427   09/30/2016     23:00:00   09/30/2016     23:05:00
3        369976063   09/30/2016     23:00:00          NaN          NaN
4        117213771   09/30/2016     23:00:00   09/30/2016     23:10:00
...            ...          ...          ...          ...          ...
361735   582350583   01/01/2015     03:50:00   01/01/2016     04:00:00
361736   258046495   01/01/2015     01:25:00   01/01/2016     01:30:00
361737   640212578   01/01/2015     00:30:00   01/01/2016     00:40:00
361738   496500431   06/30/2014     12:00:00   12/29/2015     12:00:00
361739   256379572   12/31/2001     16:00:00   01/01/2016     10:50:00

            RPT_DT  KY_CD                      OFNS_DESC  PD_CD  \
0       09/30/2016    236              DANGEROUS WEAPONS  782.0
1       09/30/2016    344   ASSAULT 3 & RELATED OFFENSES  101.0
2       09/30/2016    235                DANGEROUS DRUGS  567.0
3       09/30/2016    118              DANGEROUS WEAPONS  793.0
4       09/30/2016    578                  HARRASSMENT 2  637.0
...            ...    ...                            ...    ...
361735  01/01/2016    105                        ROBBERY  399.0
361736  01/01/2016    578                  HARRASSMENT 2  638.0
361737  01/01/2016    106                 FELONY ASSAULT  109.0
361738  01/01/2016    361  OFF. AGNST PUB ORD SENSBLTY &  639.0
361739  01/01/2016    107                       BURGLARY  213.0

                               PD_DESC  ... ADDR_PCT_CD LOC_OF_OCCUR_DESC  \
0             WEAPONS, POSSESSION, ETC  ...        42.0               NaN
1                            ASSAULT 3  ...        71.0       OPPOSITE OF
2          MARIJUANA, POSSESSION 4 & 5  ...        43.0            INSIDE
3                WEAPONS POSSESSION 3  ...       103.0               NaN
4           HARASSMENT,SUBD 1,CIVILIAN  ...       110.0          FRONT OF
...                                ...  ...         ...               ...
361735  ROBBERY,COMMERCIAL UNCLASSIFIED  ...        30.0            INSIDE
361736             HARASSMENT,SUBD 3,4,5  ...        41.0               NaN
361737          ASSAULT 2,1,UNCLASSIFIED  ...       109.0          FRONT OF
361738           AGGRAVATED HARASSMENT 2  ...        50.0            INSIDE
361739          BURGLARY,COMMERCIAL,NIGHT  ...        84.0            INSIDE

                     PREM_TYP_DESC PARKS_NM   HADEVELOPT X_COORD_CD  \
0             TRANSIT - NYC SUBWAY      NaN          NaN  1015308.0
1                           STREET      NaN          NaN   997932.0
2       RESIDENCE - PUBLIC HOUSING      NaN  CASTLE HILL  1025580.0
3                           STREET      NaN          NaN  1038464.0
4                           STREET      NaN          NaN  1016301.0
...                            ...      ...          ...        ...
361735                 HOTEL/MOTEL      NaN          NaN   998372.0
361736        TRANSIT - NYC SUBWAY      NaN          NaN  1014468.0
361737               BAR/NIGHT CLUB      NaN          NaN  1030529.0
361738      RESIDENCE - APT. HOUSE      NaN          NaN  1009735.0
361739               PUBLIC SCHOOL      NaN          NaN   989682.0

       Y_COORD_CD   Latitude  Longitude                        Lat_Lon
0        244373.0  40.837376 -73.887761  (40.837376359, -73.887760929)
1        180172.0  40.661205 -73.950687  (40.661204871, -73.950686652)
2        236918.0  40.816872 -73.850685  (40.816872438, -73.850684927)
```

```
3         192970.0  40.696177 -73.804492  (40.696177006, -73.804492266)
4         209428.0  40.741458 -73.884339  (40.741458245, -73.884339073)
...            ...        ...        ...                            ...
361735    240146.0  40.825818 -73.948975  (40.825817778, -73.948974825)
361736    238156.0  40.820315 -73.890825  (40.820315396, -73.890824603)
361737    214093.0  40.754199 -73.832963  (40.754199468, -73.832962523)
361738    261272.0  40.883777 -73.907837  (40.883776851, -73.907836928)
361739    188334.0  40.683617 -73.980416  (40.683616638, -73.980416007)

[361740 rows x 24 columns]>
```

In [4]:
```
data.describe()
```

Out[4]:

	CMPLNT_NUM	KY_CD	PD_CD	ADDR_PCT_CD	X_COORD_CD	Y_COORD_
count	3.617400e+05	361740.000000	361477.000000	361739.000000	3.558860e+05	355886.000
mean	5.499403e+08	299.634970	411.857283	63.028830	1.005074e+06	207403.627
std	2.600874e+08	152.791634	221.006223	34.408404	2.152718e+04	30532.453
min	1.000097e+08	101.000000	101.000000	1.000000	9.133570e+05	121250.000
25%	3.241697e+08	118.000000	254.000000	40.000000	9.919450e+05	184359.000
50%	5.502997e+08	341.000000	357.000000	63.000000	1.004550e+06	206483.000
75%	7.757034e+08	351.000000	638.000000	94.000000	1.016781e+06	235493.000
max	9.999994e+08	685.000000	922.000000	123.000000	1.067226e+06	271820.000

In [5]:
```python
# Calculate the percentage of missing values in each column
missing_data = data.isnull().sum().sort_values(ascending=False)
percent_missing = (missing_data / len(data)) * 100

# Create a DataFrame to view the columns with missing values and their per
missing_values_df = pd.DataFrame({'Missing Values': missing_data, 'Percent
missing_values_df[missing_values_df['Missing Values'] > 0]
```

Out[5]:

	Missing Values	Percentage
PARKS_NM	357819	98.916072
HADEVELOPT	343044	94.831647
LOC_OF_OCCUR_DESC	73339	20.273954
CMPLNT_TO_DT	62298	17.221761
CMPLNT_TO_TM	62150	17.180848
Lat_Lon	5854	1.618289
Longitude	5854	1.618289
Latitude	5854	1.618289
Y_COORD_CD	5854	1.618289
X_COORD_CD	5854	1.618289
PREM_TYP_DESC	1414	0.390888
PD_CD	263	0.072704
PD_DESC	263	0.072704
OFNS_DESC	38	0.010505
ADDR_PCT_CD	1	0.000276

In [6]:
```python
# Attempting to remove columns again with direct reference to ensure corre
data.drop(['PARKS_NM', 'HADEVELOPT','X_COORD_CD','Y_COORD_CD','Lat_Lon'],

# Display the current columns to verify the removal
data.columns
```

Out[6]:
```
Index(['CMPLNT_NUM', 'CMPLNT_FR_DT', 'CMPLNT_FR_TM', 'CMPLNT_TO_DT',
       'CMPLNT_TO_TM', 'RPT_DT', 'KY_CD', 'OFNS_DESC', 'PD_CD', 'PD_DESC',
       'CRM_ATPT_CPTD_CD', 'LAW_CAT_CD', 'JURIS_DESC', 'BORO_NM',
       'ADDR_PCT_CD', 'LOC_OF_OCCUR_DESC', 'PREM_TYP_DESC', 'Latitude',
       'Longitude'],
      dtype='object')
```

In [7]:

```
# Remove duplicate rows from the dataset
data_cleaned = data.drop_duplicates()

# Remove rows with any missing values
data_cleaned = data_cleaned.dropna()

# Display the shape of the dataset before and after these operations to sh
original_shape = data.shape
cleaned_shape = data_cleaned.shape
print(original_shape)
print(cleaned_shape)
```

```
(361740, 19)
(235048, 19)
```

In [8]:

```
data_cleaned.head()
```

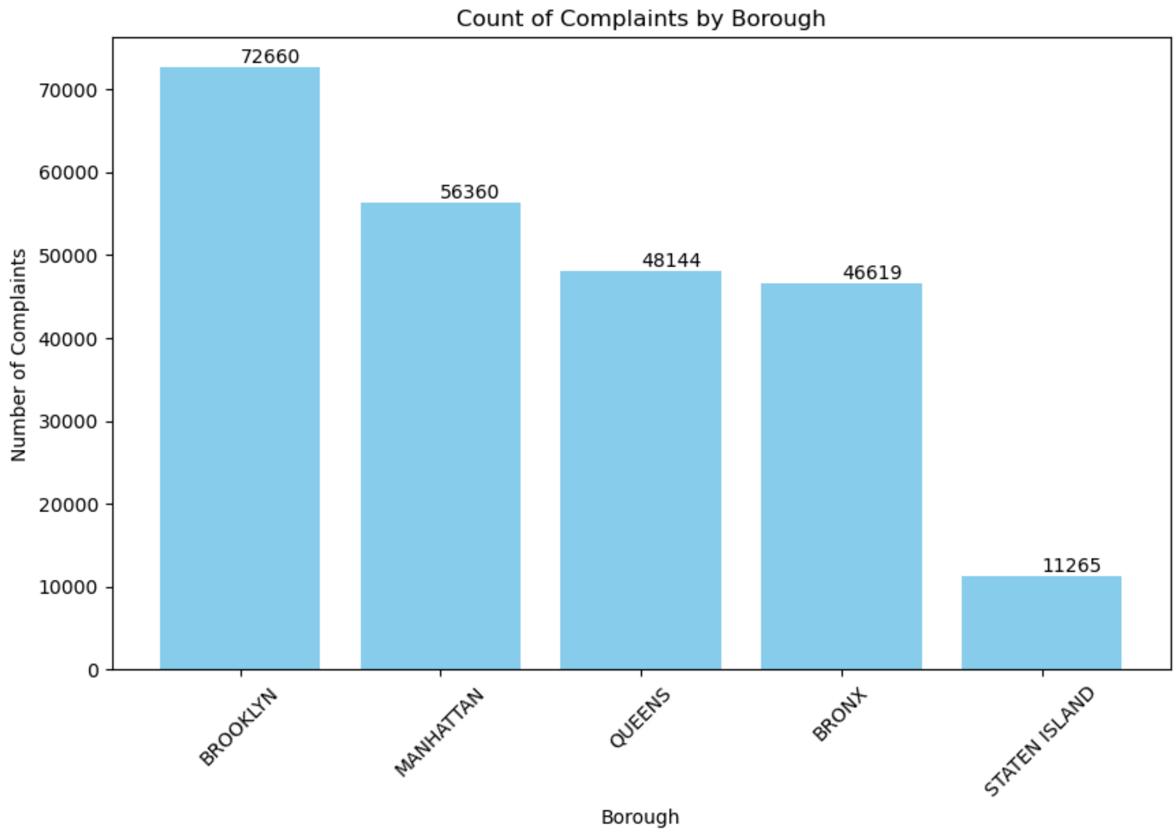
Out[8]:

	CMPLNT_NUM	CMPLNT_FR_DT	CMPLNT_FR_TM	CMPLNT_TO_DT	CMPLNT_TO_TM	RPT_
1	294332956	09/30/2016	23:16:00	09/30/2016	23:21:00	09/30/2
2	852981427	09/30/2016	23:00:00	09/30/2016	23:05:00	09/30/2
4	117213771	09/30/2016	23:00:00	09/30/2016	23:10:00	09/30/2
9	589253624	09/30/2016	22:45:00	09/30/2016	22:50:00	09/30/2
10	585217984	09/30/2016	22:45:00	09/30/2016	23:05:00	09/30/2

In [9]:

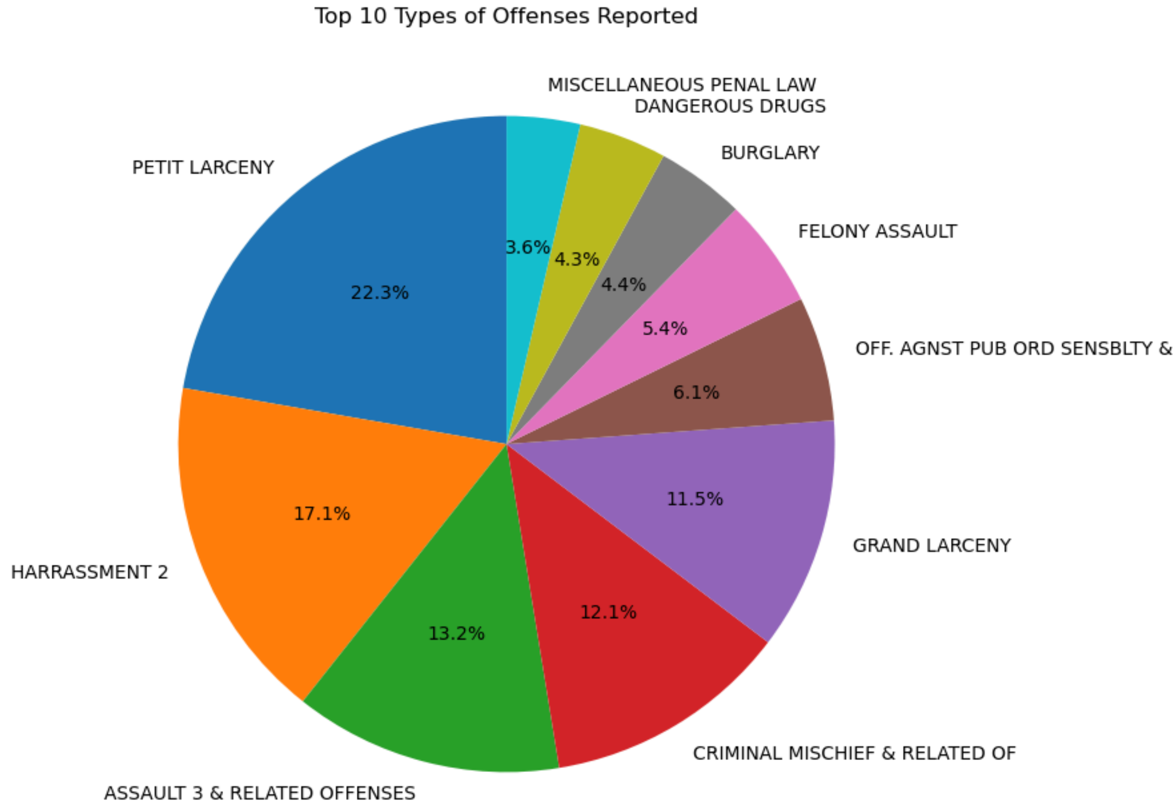
```
#Count of Complaints by Borough (established town or City )

borough_counts = data_cleaned['BORO_NM'].value_counts()
plt.figure(figsize=(10, 6))
bars = plt.bar(borough_counts.index, borough_counts.values, color='skyblue
plt.title('Count of Complaints by Borough')
plt.xlabel('Borough')
plt.ylabel('Number of Complaints')
plt.xticks(rotation=45)
for bar in bars:
    yval = bar.get_height()
    plt.text(bar.get_x() + bar.get_width()/2, yval, int(yval), va='bottom
plt.show()
```



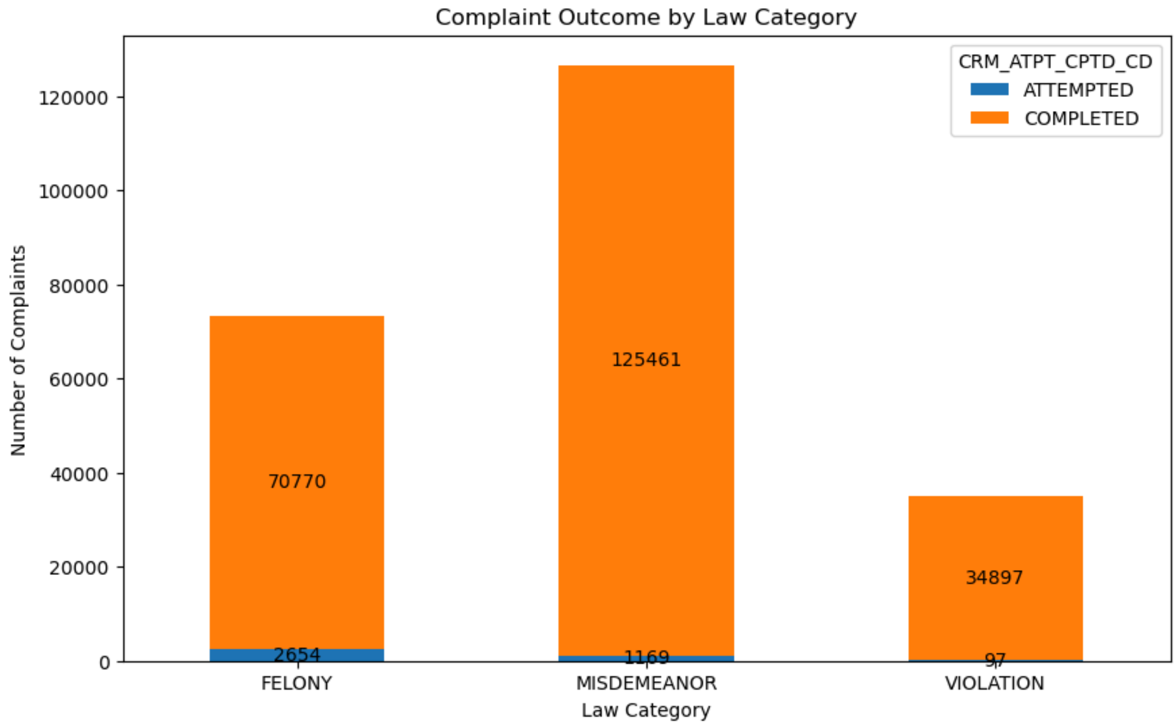
In [10]:
```
#Types of Offenses
offense_counts = data_cleaned['OFNS_DESC'].value_counts().head(10)  # Top
plt.figure(figsize=(10, 8))
patches, texts, autotexts = plt.pie(offense_counts, labels=offense_counts.
for text in autotexts:
    text.set_color('black')
plt.title('Top 10 Types of Offenses Reported')
plt.show()

```



In [11]:

```
#Complaint Outcome by Law Category
outcome_by_category = data_cleaned.groupby(['LAW_CAT_CD', 'CRM_ATPT_CPTD_(
bars = outcome_by_category.plot(kind='bar', stacked=True, figsize=(10, 6))
plt.title('Complaint Outcome by Law Category')
plt.xlabel('Law Category')
plt.ylabel('Number of Complaints')
plt.xticks(rotation=0)
for bar in bars.containers:
    plt.bar_label(bar, label_type='center')
plt.show()
```



In [12]:

```
# Drop non-numeric and redundant datetime columns
data_cleaned.drop(['CMPLNT_FR_DT', 'CMPLNT_FR_TM', 'CMPLNT_TO_DT', 'CMPLN
                   'RPT_DT'], axis=1, inplace=True)

# Label Encoding for categorical variables
label_encoder = LabelEncoder()
categorical_columns = ['OFNS_DESC', 'PD_DESC', 'CRM_ATPT_CPTD_CD', 'LAW_C
                       'BORO_NM', 'LOC_OF_OCCUR_DESC', 'PREM_TYP_DESC']
encoding_mappings = {}
for column in categorical_columns:
    # If the column exists in the dataframe and is of type object (categor
    if column in data_cleaned.columns and data_cleaned[column].dtype == '
        data_cleaned[column] = label_encoder.fit_transform(data_cleaned[c
        encoding_mappings[column] = {index: label for index, label in enu
for column, mapping in encoding_mappings.items():
    print(f"Encoding for {column}: {mapping}")
# Check the datatypes again to confirm all are numeric
print(data_cleaned.dtypes)

# Select features and drop the target variable column for model input
X = data_cleaned.drop(['OFNS_DESC', 'CMPLNT_NUM', 'PD_DESC', 'LAW_CAT_CD',
y = data_cleaned['OFNS_DESC']

# Display the first few rows of the prepared data to verify changes
print(data_cleaned.head())
```

```
E', 240: 'ROBBERY, PAYROLL', 241: 'ROBBERY,ATM LOCATION', 242: 'ROBBERY,BA
NK', 243: 'ROBBERY,BAR/RESTAURANT', 244: 'ROBBERY,BEGIN AS SHOPLIFTING', 2
45: 'ROBBERY,BICYCLE', 246: 'ROBBERY,BODEGA/CONVENIENCE STORE', 247: 'ROBB
ERY,CAR JACKING', 248: 'ROBBERY,CHECK CASHING BUSINESS', 249: 'ROBBERY,CLO
THING', 250: 'ROBBERY,COMMERCIAL UNCLASSIFIED', 251: 'ROBBERY,DELIVERY PER
SON', 252: 'ROBBERY,DOCTOR/DENTIST OFFICE', 253: 'ROBBERY,DWELLING', 254:
'ROBBERY,GAS STATION', 255: 'ROBBERY,HIJACKING', 256: 'ROBBERY,HOME INVASI
ON', 257: 'ROBBERY,LICENSED FOR HIRE VEHICLE', 258: 'ROBBERY,LICENSED MEDA
LLION CAB', 259: 'ROBBERY,LIQUOR STORE', 260: 'ROBBERY,NECKCHAIN/JEWELRY',
261: 'ROBBERY,ON BUS/ OR BUS DRIVER', 262: 'ROBBERY,OPEN AREA UNCLASSIFIE
D', 263: 'ROBBERY,PERSONAL ELECTRONIC DEVICE', 264: 'ROBBERY,PHARMACY', 26
5: 'ROBBERY,POCKETBOOK/CARRIED BAG', 266: 'ROBBERY,PUBLIC PLACE INSIDE', 2
67: 'ROBBERY,RESIDENTIAL COMMON AREA', 268: 'ROBBERY,UNLICENSED FOR HIRE V
EHICLE', 269: 'SALE OF UNAUTHORIZED RECORDING', 270: 'SALE SCHOOL GROUNDS 
4', 271: 'SEXUAL ABUSE 3,2', 272: 'SEXUAL MISCONDUCT,DEVIATE', 273: 'SODOM
Y 1', 274: 'SODOMY 3', 275: 'SOLICITATION 3,2,1, CRIMINAL', 276: 'SOLICITA
TION 4, CRIMINAL', 277: 'STOLEN PROP-MOTOR VEHICLE 3RD,', 278: 'STOLEN PRO
PERTY 2,1,POSSESSION', 279: 'STOLEN PROPERTY 2,POSSESSION B', 280: 'STOLEN
PROPERTY 3,POSSESSION', 281: 'STOLEN PROPERTY-MOTOR VEH 2ND,', 282: 'STRAN
```

In [13]:

```
def get_score_DTC(X_train, X_test, y_train, y_test):
    regressor = DecisionTreeClassifier(max_depth=4)
    regressor.fit(X_train, y_train)
    return regressor.score(X_train, y_train)

def get_score_RFC(X_train, X_test, y_train, y_test):
    regressor = RandomForestClassifier(max_depth=4)
    regressor.fit(X_train, y_train)
    return regressor.score(X_train, y_train)
acc_dtc=[]
acc_rfc=[]

dataset = data_cleaned
# print(dataset)
X = data_cleaned.drop(['OFNS_DESC', 'CMPLNT_NUM', 'PD_DESC', 'LAW_CAT_CD',
y = data_cleaned['OFNS_DESC']

# Initialize KFold
kf = KFold(n_splits=15, shuffle=True, random_state=42)

# Initialize the models
dt = DecisionTreeClassifier(random_state=42)
rf = RandomForestClassifier(n_estimators=100, random_state=42)

# List to store scores
dt_scores = []
rf_scores = []

# Perform K-Fold CV
for train_index, test_index in kf.split(X):
    X_train, X_test = X.iloc[train_index], X.iloc[test_index]
    y_train, y_test = y.iloc[train_index], y.iloc[test_index]

    # Fit Decision Tree
    dt.fit(X_train, y_train)
    dt_scores.append(dt.score(X_test, y_test))

    # Fit Random Forest
    rf.fit(X_train, y_train)
    rf_scores.append(rf.score(X_test, y_test))


from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score

# Initialize the logestic regression model
model = LogisticRegression()
model.fit(X_train, y_train)
y_pred = model.predict(X_test)

# Evaluate the model
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy of Logistic regression: {accuracy:.3f}')
print("Average Decision Tree accuracy: ", sum(dt_scores) / len(dt_scores)
```

```
print("Average Random Forest accuracy: ", sum(rf_scores) / len(rf_scores))
```

```
Accuracy of Logistic regression: 0.836
Average Decision Tree accuracy:  0.9999149111778747
Average Random Forest accuracy:  0.9987917366622838

C:\Users\harin\anaconda3\anaconda\lib\site-packages\sklearn\linear_model\_log
istic.py:458: ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html (https://sciki
t-learn.org/stable/modules/preprocessing.html)
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regres
sion (https://scikit-learn.org/stable/modules/linear_model.html#logistic-regr
ession)
  n_iter_i = _check_optimize_result(
```

In [20]:

```
#using regressor model
# Initialize the Random Forest Regressor
rf_model = RandomForestRegressor()

# Train the model
rf_model.fit(X_train, y_train)

# Predict on the test set
y_pred_rf = rf_model.predict(X_test)

#we'll look at MSE, RMSE and Accuracy
mse = mean_squared_error(y_test, y_pred_rf)
rmse = np.sqrt(mse)

print(f'MSE: {mse:.2f}')
print(f'RMSE: {rmse:.2f}')
```

```
MSE: 0.02
RMSE: 0.13
```