LOK_SABHA_ELECTION_2024_PREDICTION

June 3, 2024

[1]:
```
import numpy as np
import pandas as pd

import matplotlib.pyplot as plt
import seaborn as sns

from sklearn.preprocessing import LabelEncoder, OneHotEncoder

from scipy.stats import ttest_ind

from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import GridSearchCV

from sklearn.linear_model import LogisticRegression
from sklearn.tree import DecisionTreeClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.svm import SVC
from sklearn.naive_bayes import BernoulliNB
from sklearn import ensemble
from sklearn.ensemble import RandomForestClassifier
from sklearn.ensemble import AdaBoostClassifier
import lightgbm as lgb
from xgboost import XGBClassifier
```

[2]:
```
df = pd.read_csv("myneta.csv")
df.describe()
# df.to_csv('test_neta.csv',index=False)
```

[2]:

	Sno .	Criminal Cases	Age	Is State	Zone
count	8337.000000	8337.000000	8337.000000	0.0	0.0
mean	285.825117	0.678661	47.787933	NaN	NaN
std	253.094175	4.460992	11.973695	NaN	NaN
min	1.000000	0.000000	25.000000	NaN	NaN
25%	92.000000	0.000000	38.000000	NaN	NaN
50%	208.000000	0.000000	47.000000	NaN	NaN
75%	411.000000	0.000000	56.000000	NaN	NaN
max	1119.000000	243.000000	88.000000	NaN	NaN

[3]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 8337 entries, 0 to 8336
Data columns (total 11 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   Sno .           8337 non-null   int64
 1   Candidate       8337 non-null   object
 2   Party           8337 non-null   object
 3   Criminal Cases  8337 non-null   int64
 4   Education       8337 non-null   object
 5   Age             8337 non-null   int64
 6   Total Assets    6697 non-null   object
 7   Liabilities     6684 non-null   object
 8   State           8337 non-null   object
 9   Is State        0 non-null      float64
 10  Zone            0 non-null      float64
dtypes: float64(2), int64(3), object(6)
memory usage: 716.6+ KB
```

[4]:
```
def remove_estimation(value):
    # Split the string by '~' and keep the part before it
    if value.startswith('Rs'):
            value = value.replace('Rs', '').strip()
    return value.split('~')[0].strip()


# Apply the function to the 'numbers' column
df['Total Assets'] = df['Total Assets'].astype(str)
df['Total Assets'] = df['Total Assets'].apply(remove_estimation)


df['Liabilities'] = df['Liabilities'].astype(str)
df['Liabilities'] = df['Liabilities'].apply(remove_estimation)

df.head()
```

[4]:

	Sno .	Candidate	Party	Criminal Cases	Education	Age	Total Assets	Liabilities	State	Is State	Zone
0	1	Anand Ramnath Arlekar	IND	0	10th Pass	58	8,43,025	13,36,346	ANDAMAN AND NICOBAR ISLANDS	NaN	NaN
1	2	Bishnu Pada Ray	BJP	0	Graduate	73	2,74,39,170	3,02,788	ANDAMAN AND NICOBAR ISLANDS	NaN	NaN
2	3	D Ayyappan	CPI(M)	0	Post Graduate	60					
3	4	Dr Arun Kumar Mallik	BSP	0	Post Graduate	64					
4	5	K J B Selvaraj	AIADMK	0	Graduate	50					

```
2   1,32,87,710   26,49,000  ANDAMAN AND NICOBAR ISLANDS       NaN   NaN
3  11,18,72,135           0  ANDAMAN AND NICOBAR ISLANDS       NaN   NaN
4           nan         nan  ANDAMAN AND NICOBAR ISLANDS       NaN   NaN
```

[5]:
```
import pandas as pd

# Define the data
data = {
    "State": ["West Bengal", "Uttarakhand", "Uttar Pradesh", "Tripura",␣
 ↪"Telangana", "Tamil Nadu",
                                "Sikkim", "Rajasthan", "Punjab", "Puducherry",␣
 ↪"Odisha", "Nagaland", "Mizoram",
                                "Meghalaya", "Manipur", "Maharashtra", "Madhya␣
 ↪Pradesh", "Lakshadweep", "Ladakh",
                                "Kerala", "Karnataka", "Jharkhand", "Jammu and␣
 ↪Kashmir", "India", "Himachal Pradesh",
                                "Haryana", "Gujarat", "Goa", "Delhi", "Dadra␣
 ↪and Nagar Haveli and Daman and Diu",
                                "Chhattisgarh", "Chandigarh", "Bihar", "Assam",␣
 ↪"Arunachal Pradesh", "Andhra Pradesh",
                                "ANDAMAN AND NICOBAR ISLANDS"],
    "Region": ["Eastern", "Northern", "Northern", "Northeastern", "Southern",␣
 ↪"Southern", "Northeastern", "Western",
               "Northern", "Southern", "Eastern", "Northeastern",␣
 ↪"Northeastern", "Northeastern", "Northeastern",
               "Western", "Central", "Arabian Sea", "Northern", "Southern",␣
 ↪"Southern", "Eastern", "Northern", "",
               "Northern", "Northern", "Western", "Western", "Northern",␣
 ↪"Western", "Central", "Northern", "Eastern",
               "Northeastern", "Northeastern", "Southern", "Bay of Bengal"]
}
for key in data:
    if type(data[key]) == type([]):
        for index, item in enumerate(data[key]):
            data[key][index] = item.upper();

# Create DataFrame
region_df = pd.DataFrame(data)

# region_df.to_csv("region.csv",index=False)
```

[6]:
```
# region_df.columns
```

[7]:
```
# Merge the DataFrames on the State column
merged_df = pd.merge(df, region_df, left_on='State', right_on='State',␣
 ↪how='left')
```

```
# Rename columns if necessary
merged_df = merged_df.rename(columns={'Region': 'Zone'})
merged_df.to_csv("inter.csv",index=False)
```

[8]:
```
merged_df.head()
```

[8]:
```
   Sno .             Candidate   Party  Criminal Cases      Education  Age  \
0      1  Anand Ramnath Arlekar     IND               0      10th Pass   58
1      2        Bishnu Pada Ray     BJP               0       Graduate   73
2      3             D Ayyappan  CPI(M)               0  Post Graduate   60
3      4   Dr Arun Kumar Mallik     BSP               0  Post Graduate   64
4      5         K J B Selvaraj  AIADMK               0       Graduate   50

   Total Assets Liabilities                         State  Is State Zone  \
0     8,43,025   13,36,346  ANDAMAN AND NICOBAR ISLANDS       NaN  NaN
1   2,74,39,170    3,02,788  ANDAMAN AND NICOBAR ISLANDS       NaN  NaN
2   1,32,87,710   26,49,000  ANDAMAN AND NICOBAR ISLANDS       NaN  NaN
3  11,18,72,135           0  ANDAMAN AND NICOBAR ISLANDS       NaN  NaN
4           nan         nan  ANDAMAN AND NICOBAR ISLANDS       NaN  NaN

           Zone
0  BAY OF BENGAL
1  BAY OF BENGAL
2  BAY OF BENGAL
3  BAY OF BENGAL
4  BAY OF BENGAL
```

[9]:
```
df_inter = pd.read_csv("inter.csv")
df_inter.head()
```

[9]:
```
   Sno .             Candidate   Party  Criminal Cases      Education  Age  \
0      1  Anand Ramnath Arlekar     IND               0      10th Pass   58
1      2        Bishnu Pada Ray     BJP               0       Graduate   73
2      3             D Ayyappan  CPI(M)               0  Post Graduate   60
3      4   Dr Arun Kumar Mallik     BSP               0  Post Graduate   64
4      5         K J B Selvaraj  AIADMK               0       Graduate   50

   Total Assets Liabilities                         State  Is State  Zone  \
0     8,43,025   13,36,346  ANDAMAN AND NICOBAR ISLANDS       NaN   NaN
1   2,74,39,170    3,02,788  ANDAMAN AND NICOBAR ISLANDS       NaN   NaN
2   1,32,87,710   26,49,000  ANDAMAN AND NICOBAR ISLANDS       NaN   NaN
3  11,18,72,135           0  ANDAMAN AND NICOBAR ISLANDS       NaN   NaN
4           NaN         NaN  ANDAMAN AND NICOBAR ISLANDS       NaN   NaN

         Zone.1
0  BAY OF BENGAL
```

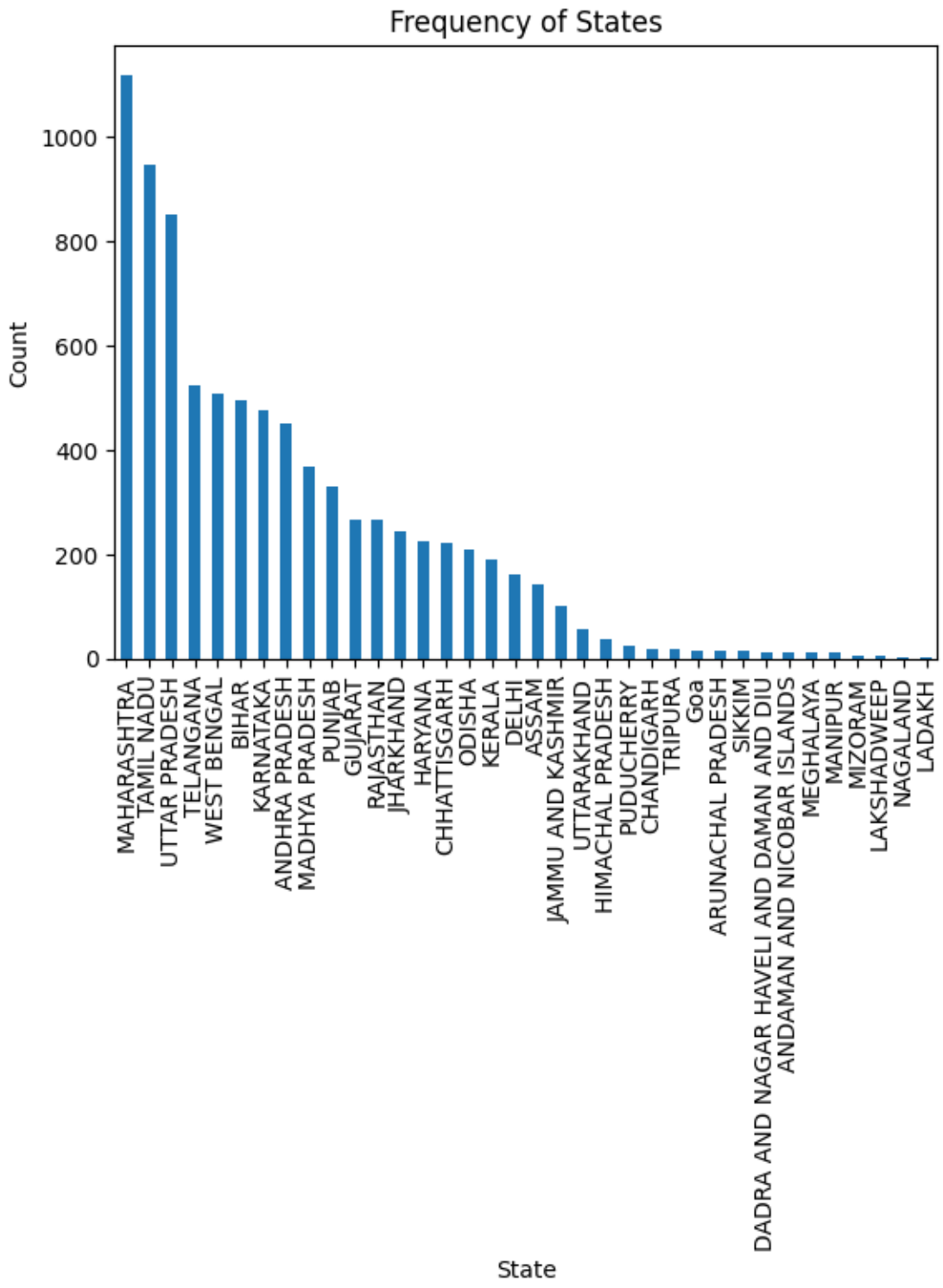
```
1  BAY OF BENGAL
2  BAY OF BENGAL
3  BAY OF BENGAL
4  BAY OF BENGAL
```

[10]:
```
df_inter.drop(columns=['Zone'], inplace=True)  # Drop the 'Zone' column
df_inter.rename(columns={'Zone.1': 'Zone'}, inplace=True)  # Rename 'Zone.1' to␣
↪'Zone'
```

[11]:
```
df_inter.head()
```

[11]:
```
   Sno .              Candidate   Party  Criminal Cases      Education  Age  \
0      1  Anand Ramnath Arlekar     IND               0      10th Pass   58
1      2        Bishnu Pada Ray     BJP               0       Graduate   73
2      3             D Ayyappan  CPI(M)               0  Post Graduate   60
3      4   Dr Arun Kumar Mallik     BSP               0  Post Graduate   64
4      5         K J B Selvaraj  AIADMK               0       Graduate   50

   Total Assets Liabilities                        State  Is State  \
0     8,43,025   13,36,346  ANDAMAN AND NICOBAR ISLANDS       NaN
1   2,74,39,170    3,02,788  ANDAMAN AND NICOBAR ISLANDS       NaN
2   1,32,87,710   26,49,000  ANDAMAN AND NICOBAR ISLANDS       NaN
3  11,18,72,135           0  ANDAMAN AND NICOBAR ISLANDS       NaN
4           NaN         NaN  ANDAMAN AND NICOBAR ISLANDS       NaN

            Zone
0  BAY OF BENGAL
1  BAY OF BENGAL
2  BAY OF BENGAL
3  BAY OF BENGAL
4  BAY OF BENGAL
```

[12]:
```
state_counts = df_inter["State"].value_counts()

# Plot the value counts
state_counts.plot(kind='bar')
plt.xlabel('State')
plt.ylabel('Count')
plt.title('Frequency of States')
plt.show()
```


Frequency of States
Count
0
200
400
600
800
1000
MAHARASHTRA
TAMIL NADU
UTTAR PRADESH
TELANGANA
WEST BENGAL
BIHAR
KARNATAKA
ANDHRA PRADESH
MADHYA PRADESH
PUNJAB
GUJARAT
RAJASTHAN
JHARKHAND
HARYANA
CHHATTISGARH
ODISHA
KERALA
DELHI
ASSAM
JAMMU AND KASHMIR
UTTARAKHAND
HIMACHAL PRADESH
PUDUCHERRY
CHANDIGARH
TRIPURA
Goa
ARUNACHAL PRADESH
SIKKIM
DADRA AND NAGAR HAVELI AND DAMAN AND DIU
ANDAMAN AND NICOBAR ISLANDS
MEGHALAYA
MANIPUR
MIZORAM
LAKSHADWEEP
NAGALAND
LADAKH
State

[13]:

```
states_to_check = ["ANDAMAN AND NICOBAR ISLANDS", "CHANDIGARH", "DADRA AND␣
 ↪NAGAR HAVELI AND DAMAN AND DIU", "DELHI", "JAMMU AND KASHMIR", "LADAKH",␣
 ↪"LAKSHADWEEP", "PUDUCHERRY"]

df_inter['Is State'] = df_inter['State'].map(lambda x: 0 if any(state in x for␣
 ↪state in states_to_check) else 1)
```

[14]:
```
df_inter.head()
```

[14]:

	Sno .	Candidate	Party	Criminal Cases	Education	Age	\
0	1	Anand Ramnath Arlekar	IND	0	10th Pass	58	
1	2	Bishnu Pada Ray	BJP	0	Graduate	73	
2	3	D Ayyappan	CPI(M)	0	Post Graduate	60	
3	4	Dr Arun Kumar Mallik	BSP	0	Post Graduate	64	
4	5	K J B Selvaraj	AIADMK	0	Graduate	50	

	Total Assets	Liabilities	State	Is State	\
0	8,43,025	13,36,346	ANDAMAN AND NICOBAR ISLANDS	0	
1	2,74,39,170	3,02,788	ANDAMAN AND NICOBAR ISLANDS	0	
2	1,32,87,710	26,49,000	ANDAMAN AND NICOBAR ISLANDS	0	
3	11,18,72,135	0	ANDAMAN AND NICOBAR ISLANDS	0	
4	NaN	NaN	ANDAMAN AND NICOBAR ISLANDS	0	

	Zone
0	BAY OF BENGAL
1	BAY OF BENGAL
2	BAY OF BENGAL
3	BAY OF BENGAL
4	BAY OF BENGAL

[15]:
```
winner_df = pd.read_csv("test_neta.csv")
winner_df.head()
```

[15]:

	Sno	Candidate	Constituency	Party	Criminal Case	\
0	1	Bapu Rao Soyam	ADILABAD	BJP	52	
1	2	Satyapal Singh Baghel	AGRA	BJP	5	
2	3	Patel Hasmukhbhai Somabhai	AHMEDABAD EAST	BJP	0	
3	4	Dr. Solanki Kiritbhai	AHMEDABAD WEST	BJP	0	
4	5	Sujay Radhakrishna Vikhe	AHMEDNAGAR	BJP	0	

	Education	Total Assets	Liabilities
0	12th Pass	Rs 30,99,414\n~ 30 Lacs+	Rs 2,31,450\n~ 2 Lacs+
1	Doctorate	Rs 7,42,74,036\n~ 7 Crore+	Rs 86,06,522\n~ 86 Lacs+
2	Others	Rs 7,46,99,690\n~ 7 Crore+	Rs 62,52,577\n~ 62 Lacs+
3	Post Graduate	Rs 8,94,74,039\n~ 8 Crore+	Rs 0\n~
4	Doctorate	NaN	NaN

[16]:
```
# Extract candidate names from both DataFrames
names_df1 = set(df_inter['Candidate'])
names_df2 = set(winner_df['Candidate'])

# Map names and mark winners
winners = {name: 1 if name in names_df1 else 0 for name in names_df2}

# Add a new column 'Is Winner' to df_inter based on the winners dictionary
df_inter['Is Winner'] = df_inter['Candidate'].map(winners)

# Fill NaN values with 0
df_inter['Is Winner'].fillna(0, inplace=True)

# Print df2 to see the result
df_inter.head()
```

[16]:

	Sno .	Candidate	Party	Criminal Cases	Education	Age	\
0	1	Anand Ramnath Arlekar	IND	0	10th Pass	58	
1	2	Bishnu Pada Ray	BJP	0	Graduate	73	
2	3	D Ayyappan	CPI(M)	0	Post Graduate	60	
3	4	Dr Arun Kumar Mallik	BSP	0	Post Graduate	64	
4	5	K J B Selvaraj	AIADMK	0	Graduate	50	

	Total Assets	Liabilities	State	Is State	\
0	8,43,025	13,36,346	ANDAMAN AND NICOBAR ISLANDS	0	
1	2,74,39,170	3,02,788	ANDAMAN AND NICOBAR ISLANDS	0	
2	1,32,87,710	26,49,000	ANDAMAN AND NICOBAR ISLANDS	0	
3	11,18,72,135	0	ANDAMAN AND NICOBAR ISLANDS	0	
4	NaN	NaN	ANDAMAN AND NICOBAR ISLANDS	0	

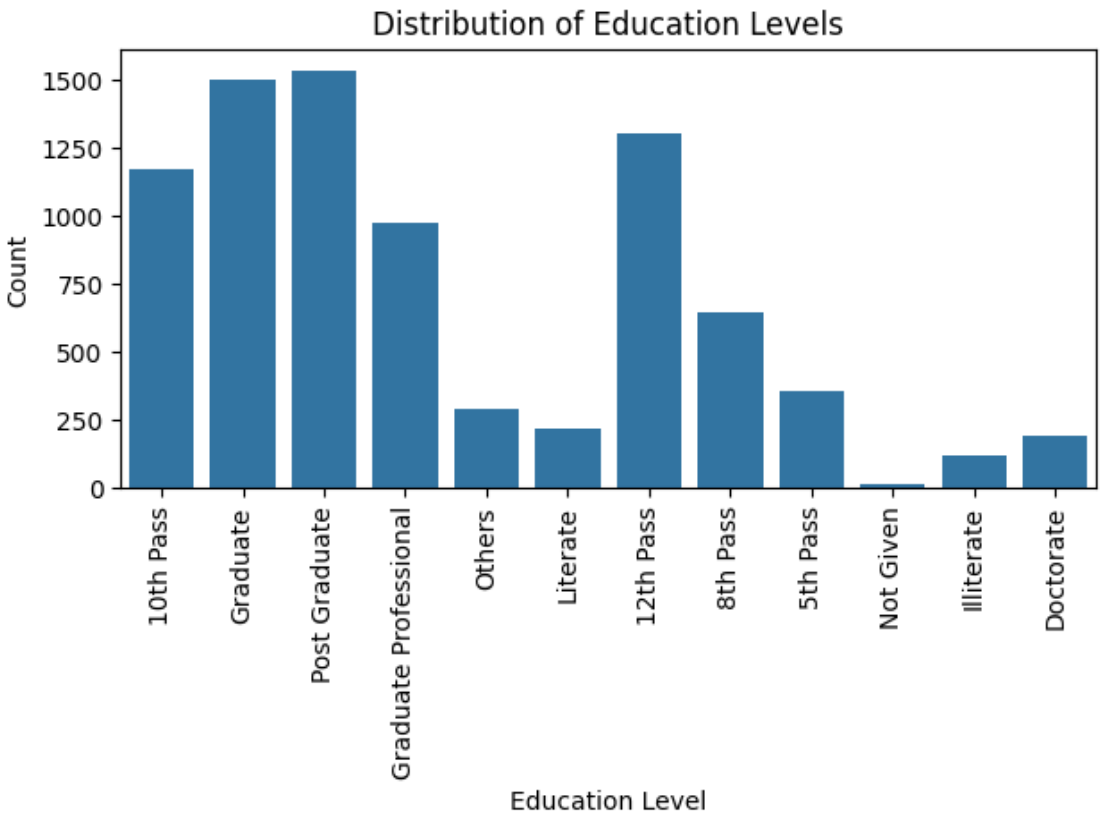
	Zone	Is Winner
0	BAY OF BENGAL	0.0
1	BAY OF BENGAL	0.0
2	BAY OF BENGAL	0.0
3	BAY OF BENGAL	0.0
4	BAY OF BENGAL	0.0

[17]:
```
df_inter["Is Winner"] = df_inter["Is Winner"].astype(int)
df_inter["Is Winner"].value_counts()
```

[17]:
```
0    8095
1     242
Name: Is Winner, dtype: int64
```

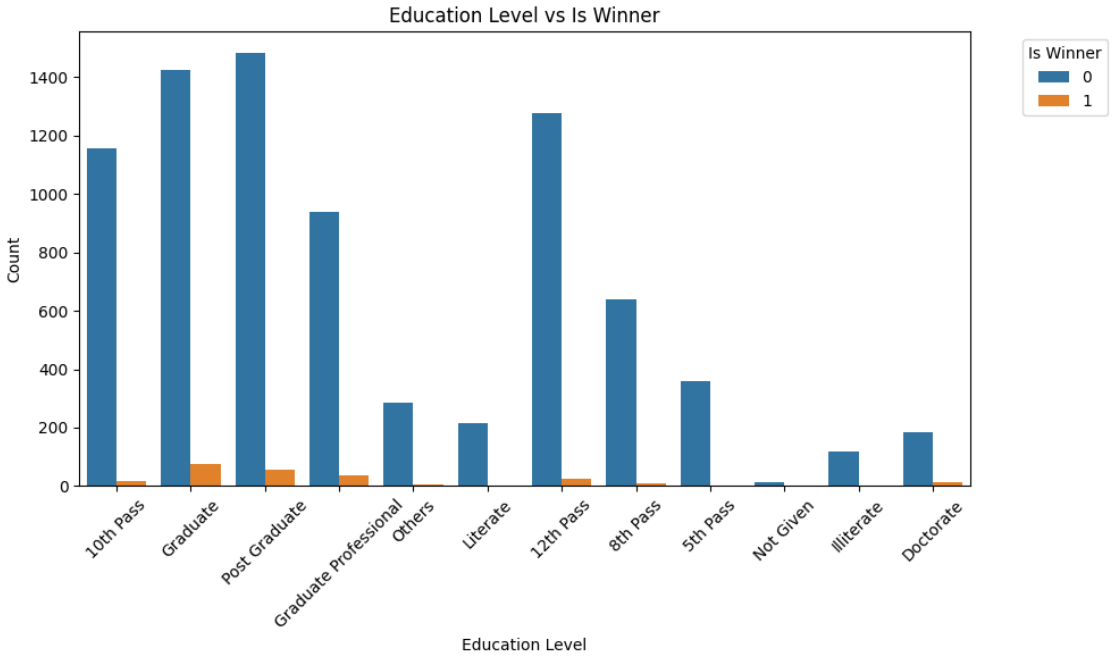
[18]:
```
df_inter.to_csv("final_data.csv",index=False)
```

[19]:
```
# Assuming df is your DataFrame containing the 'Education' and 'Party' columns
sns.countplot(x='Education', data=df_inter)
plt.xlabel('Education Level')
plt.ylabel('Count')
plt.title('Distribution of Education Levels')
plt.xticks(rotation=90)  # Rotate x-labels for better readability if necessary
plt.tight_layout()
plt.show()
```

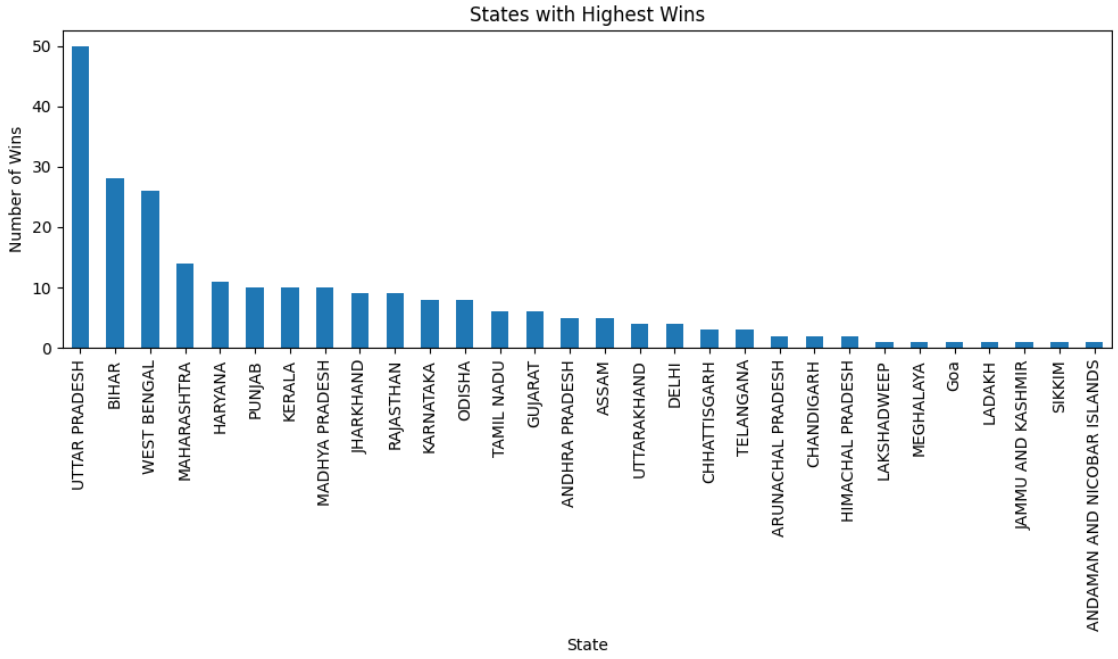


[20]:
```
# Assuming df is your DataFrame containing the 'Education' and 'Is Winner' columns
plt.figure(figsize=(10, 6))  # Adjust the figure size if needed
sns.countplot(x='Education', hue='Is Winner', data=df_inter)
plt.xlabel('Education Level')
plt.ylabel('Count')
plt.title('Education Level vs Is Winner')
plt.xticks(rotation=45)  # Rotate x-labels for better readability if necessary
plt.legend(title='Is Winner', bbox_to_anchor=(1.05, 1), loc='upper left')  # Move the legend outside the plot
plt.tight_layout()
```

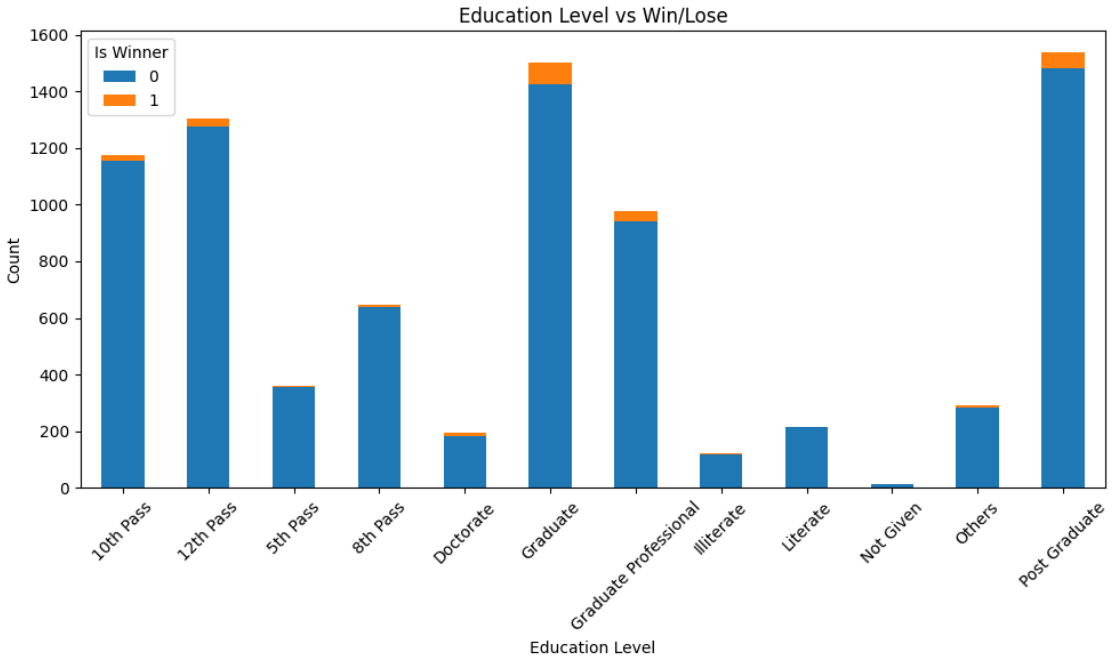
```
plt.show()
```



[21]:
```
winning_states = df_inter[df_inter['Is Winner'] == 1]['State']

# Count the occurrences of each state
state_wins = winning_states.value_counts()

# Plot the states with the highest wins
plt.figure(figsize=(10, 6))
state_wins.plot(kind='bar')
plt.xlabel('State')
plt.ylabel('Number of Wins')
plt.title('States with Highest Wins')
plt.xticks(rotation=90)  # Rotate x-labels for better readability if necessary
plt.tight_layout()
plt.show()
```



[22]:
```
education_win_count = df_inter.groupby(['Education', 'Is Winner']).size().
 ↪unstack(fill_value=0)

# Plot a stacked bar chart
education_win_count.plot(kind='bar', stacked=True, figsize=(10, 6))

# Set labels and title
plt.xlabel('Education Level')
plt.ylabel('Count')
plt.title('Education Level vs Win/Lose')

# Rotate x-labels for better readability if necessary
plt.xticks(rotation=45)

# Set legend
plt.legend(title='Is Winner')

# Show plot
plt.tight_layout()
plt.show()
```



[23]:
```
label_encoder = LabelEncoder()
df_inter['Education'] = label_encoder.fit_transform(df_inter['Education'])

# Next, apply one-hot encoding on the other categorical columns
categorical_cols = ['Party', 'State', 'Zone']
df_inter = pd.get_dummies(df_inter, columns=categorical_cols)
df_inter.head()
```

[23]:

	Sno .	Candidate	Criminal Cases	Education	Age	Total Assets	\
0	1	Anand Ramnath Arlekar	0	0	58	8,43,025	
1	2	Bishnu Pada Ray	0	5	73	2,74,39,170	
2	3	D Ayyappan	0	11	60	1,32,87,710	
3	4	Dr Arun Kumar Mallik	0	11	64	11,18,72,135	
4	5	K J B Selvaraj	0	5	50	NaN	

	Liabilities	Is State	Is Winner	Party_AAP	…	State_UTTARAKHAND	\
0	13,36,346	0	0	0	…	0	
1	3,02,788	0	0	0	…	0	
2	26,49,000	0	0	0	…	0	
3	0	0	0	0	…	0	
4	NaN	0	0	0	…	0	

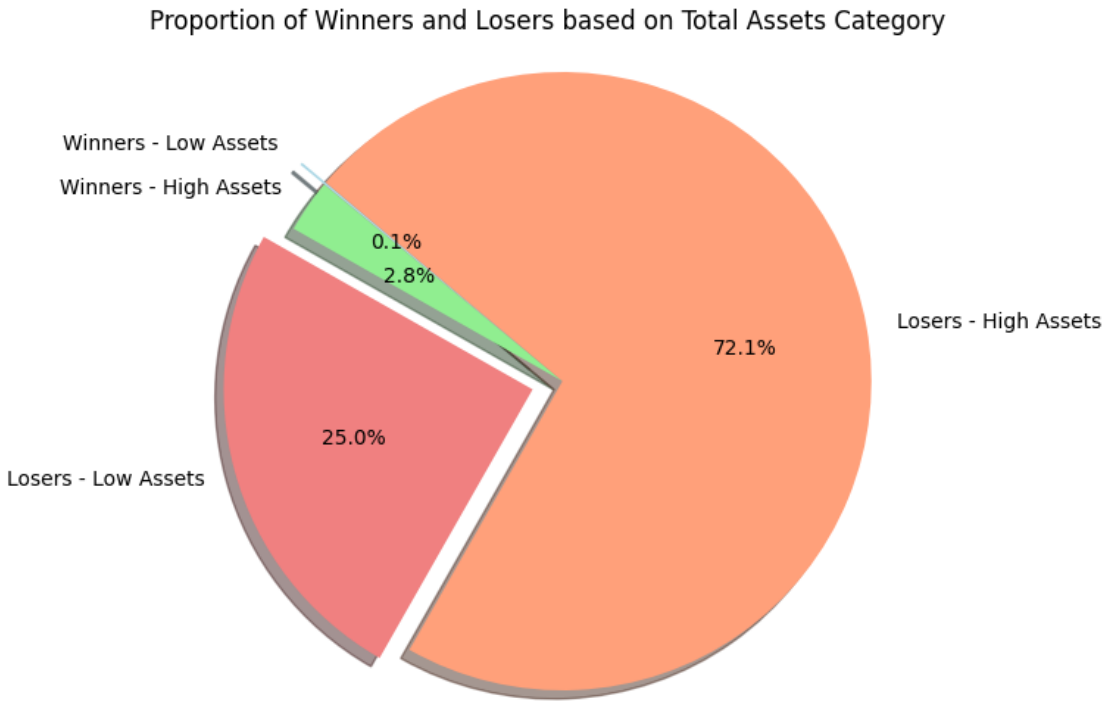
	State_WEST BENGAL	Zone_ARABIAN SEA	Zone_BAY OF BENGAL	Zone_CENTRAL	\
0	0	0	1	0	
1	0	0	1	0	

```
2                    0                    0                    1              0
3                    0                    0                    1              0
4                    0                    0                    1              0

   Zone_EASTERN  Zone_NORTHEASTERN  Zone_NORTHERN  Zone_SOUTHERN  Zone_WESTERN
0             0                  0              0              0             0
1             0                  0              0              0             0
2             0                  0              0              0             0
3             0                  0              0              0             0
4             0                  0              0              0             0

[5 rows x 803 columns]
```

[24]:
```
df_inter.drop(columns=['Sno .'], inplace=True)
df_inter.drop(columns=['Candidate'], inplace=True)
```

[25]:
```
# Define a threshold value to categorize total assets
threshold = 1000000  # For example, assets below this threshold are considered␣
 ↪"Low", and above are considered "High"

# Categorize total assets into "Low" and "High"
df_inter['Total Assets'] = df_inter['Total Assets'].replace('Nil', np.nan)
df_inter['Total Assets'] = df_inter['Total Assets'].str.replace(',', '').
 ↪astype(float)
df_inter['Asset Category'] = df_inter['Total Assets'].apply(lambda x: 'Low' if␣
 ↪x < threshold else 'High')

# Count the number of winners and losers in each category
winners_low_assets = len(df_inter[(df_inter['Is Winner'] == 1) &␣
 ↪(df_inter['Asset Category'] == 'Low')])
winners_high_assets = len(df_inter[(df_inter['Is Winner'] == 1) &␣
 ↪(df_inter['Asset Category'] == 'High')])
losers_low_assets = len(df_inter[(df_inter['Is Winner'] == 0) &␣
 ↪(df_inter['Asset Category'] == 'Low')])
losers_high_assets = len(df_inter[(df_inter['Is Winner'] == 0) &␣
 ↪(df_inter['Asset Category'] == 'High')])

# Create a pie chart
labels = ['Winners - Low Assets', 'Winners - High Assets', 'Losers - Low␣
 ↪Assets', 'Losers - High Assets']
sizes = [winners_low_assets, winners_high_assets, losers_low_assets,␣
 ↪losers_high_assets]
colors = ['lightblue', 'lightgreen', 'lightcoral', 'lightsalmon']
explode = (0.1, 0, 0.1, 0)  # explode the slices for emphasis

plt.figure(figsize=(8, 6))
```

```
plt.pie(sizes, explode=explode, labels=labels, colors=colors, autopct='%1.
  ↪1f%%', shadow=True, startangle=140)
plt.title('Proportion of Winners and Losers based on Total Assets Category')
plt.axis('equal')  # Equal aspect ratio ensures that pie is drawn as a circle.
plt.show()
```



Wealth and Election Outcomes:

Null Hypothesis (H0): There is no difference in mean total assets between winners and losers.

Alternative Hypothesis (H1): There is a difference in mean total assets between winners and losers.

[26]:
```
# Replace 'Nil' with NaN
df_inter['Total Assets'] = df_inter['Total Assets'].replace('Nil', np.nan).
  ↪astype(float)
df_inter['Total Assets'].fillna(0, inplace=True)
# Separate winners and losers
winners_assets = df_inter[df_inter['Is Winner'] == 1]['Total Assets']
losers_assets = df_inter[df_inter['Is Winner'] == 0]['Total Assets']

# Perform t-test
t_stat, p_value = ttest_ind(winners_assets, losers_assets, equal_var=False)
```

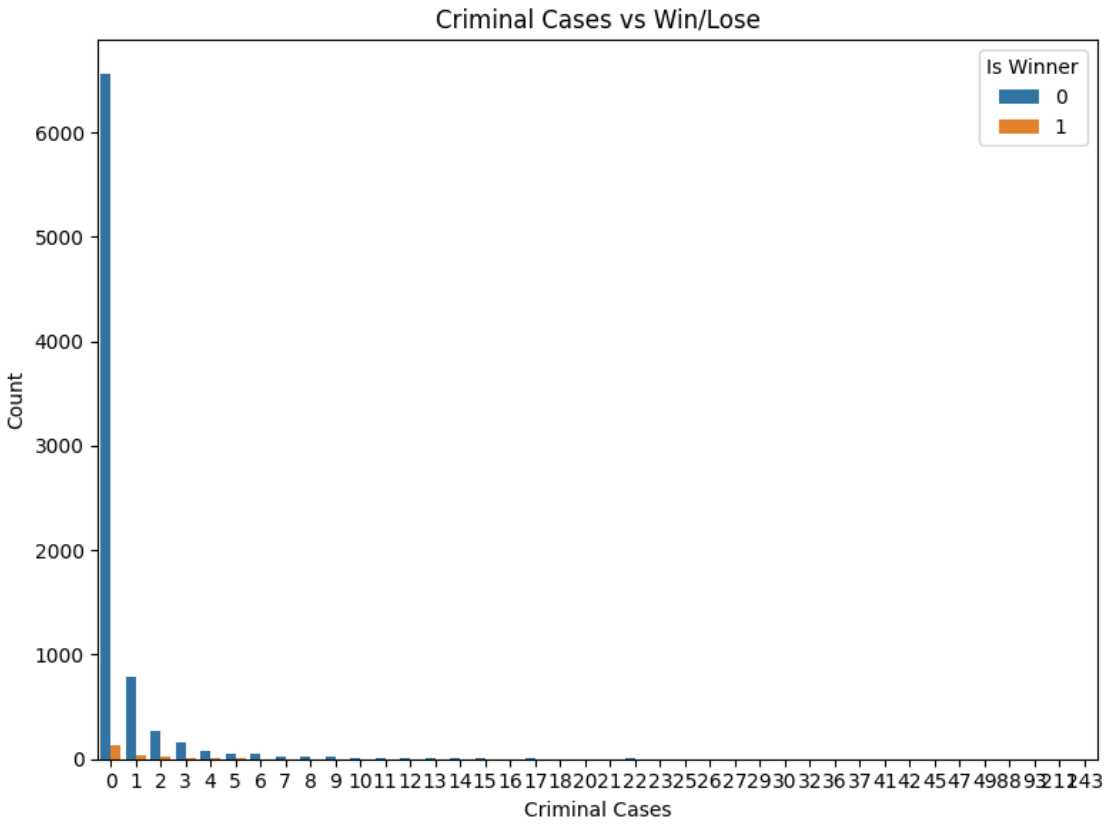
```
# Print the results
print("T-statistic:", t_stat)
print("p-value:", p_value)

# Set significance level
alpha = 0.05

# Check if p-value is less than alpha
if p_value < alpha:
    print("Reject the null hypothesis")
else:
    print("Fail to reject the null hypothesis")
```

```
T-statistic: 3.2864900711204332
p-value: 0.0011515736870632842
Reject the null hypothesis
```

0.0.1 Verdict - Money matters

we have evidence to suggest that winning candidates tend to have a different average level of total assets compared to losing candidates. This information can be valuable for understanding the relationship between wealth and election outcomes.

[27]:
```
import seaborn as sns
import matplotlib.pyplot as plt

# Plot criminal cases vs win/lose
plt.figure(figsize=(8, 6))
sns.countplot(x='Criminal Cases', hue='Is Winner', data=df_inter)
plt.xlabel('Criminal Cases')
plt.ylabel('Count')
plt.title('Criminal Cases vs Win/Lose')
plt.legend(title='Is Winner')
plt.tight_layout()
plt.show()
```



Impact of Criminal Cases on Election Outcomes:

Null Hypothesis (H0): 'Criminal Cases' is a significant predictor of election outcomes.

Alternative Hypothesis (H1): 'Criminal Cases' is not a significant predictor of election outcomes.

[28]:
```
import statsmodels.api as sm

# Perform logistic regression analysis
X = sm.add_constant(df_inter['Criminal Cases'])
y = df_inter['Is Winner']
logit_model = sm.Logit(y, X)
result = logit_model.fit()
print(result.summary())

# Extract p-value for 'Criminal Cases'
p_value_criminal_cases = result.pvalues['Criminal Cases']

# Set significance level
alpha = 0.05
```

```
# Check if p-value is less than alpha
if p_value_criminal_cases < alpha:
    print("Reject the null hypothesis: 'Criminal Cases' is a significant␣
 ↪predictor of election outcomes.")
else:
    print("Fail to reject the null hypothesis: 'Criminal Cases' is not a␣
 ↪significant predictor of election outcomes.")
```

```
Optimization terminated successfully.
         Current function value: 0.130771
         Iterations 7
                           Logit Regression Results
==============================================================================
Dep. Variable:              Is Winner   No. Observations:                 8337
Model:                          Logit   Df Residuals:                     8335
Method:                           MLE   Df Model:                            1
Date:                Mon, 03 Jun 2024   Pseudo R-squ.:                0.004361
Time:                        21:04:56   Log-Likelihood:                -1090.2
converged:                       True   LL-Null:                       -1095.0
Covariance Type:            nonrobust   LLR p-value:                  0.001998
==============================================================================
==
                     coef    std err          z      P>|z|      [0.025
0.975]
------------------------------------------------------------------------------
--
const             -3.5307      0.066    -53.611      0.000      -3.660
-3.402
Criminal Cases     0.0202      0.007      3.084      0.002       0.007
0.033
==============================================================================
==
Reject the null hypothesis: 'Criminal Cases' is a significant predictor of
election outcomes.
```

Verdict - criminal cases is a statistically significant predictor of election outcomes, with each additional criminal case being associated with a slight increase in the log-odds of winning the election.

Relationship between Age and Winning Elections:

Null hypothesis: Age has no effect on winning elections

Alternative hypothesis: Age has an effect on winning elections

[29]:
```
import statsmodels.api as sm
```

```
# Perform logistic regression analysis
X = sm.add_constant(df_inter['Age'])
y = df_inter['Is Winner']
logit_model = sm.Logit(y, X)
result = logit_model.fit()
print(result.summary())

# Extract p-value for 'Age'
p_value_age = result.pvalues['Age']

# Set significance level
alpha = 0.05



# Check if p-value is less than alpha
if p_value_age < alpha:
    print("Reject the null hypothesis: Age has an effect on winning elections.")
else:
    print("Fail to reject the null hypothesis: Age has no effect on winning␣
 ↪elections.")
```

```
Optimization terminated successfully.
         Current function value: 0.125482
         Iterations 8
                           Logit Regression Results
==============================================================================
Dep. Variable:              Is Winner   No. Observations:                 8337
Model:                          Logit   Df Residuals:                     8335
Method:                           MLE   Df Model:                            1
Date:                Mon, 03 Jun 2024   Pseudo R-squ.:                 0.04464
Time:                        21:04:57   Log-Likelihood:                -1046.1
converged:                       True   LL-Null:                       -1095.0
Covariance Type:            nonrobust   LLR p-value:                 4.735e-23
==============================================================================
                 coef    std err          z      P>|z|      [0.025      0.975]
------------------------------------------------------------------------------
const         -6.2497      0.308    -20.268      0.000      -6.854      -5.645
Age            0.0532      0.005      9.735      0.000       0.043       0.064
==============================================================================
Reject the null hypothesis: Age has an effect on winning elections.
```

[30]:
```
import pandas as pd
import numpy as np
import statsmodels.api as sm
```

```python
# Define age groups
bins = [0, 30, 40, 50, 60, 70, np.inf]
labels = ['<30', '30-39', '40-49', '50-59', '60-69', '70+']
df_inter['Age Group'] = pd.cut(df_inter['Age'], bins=bins, labels=labels,␣
 ↪right=False)

# Create dummy variables for each age group
age_dummies = pd.get_dummies(df_inter['Age Group'], drop_first=True)

# Perform logistic regression analysis
X = sm.add_constant(age_dummies)
y = df_inter['Is Winner']
logit_model = sm.Logit(y, X)
result = logit_model.fit()
print(result.summary())

# Extract p-values for each age group
p_values = result.pvalues

# Set significance level
alpha = 0.05

# Check if p-values are less than alpha
for group in age_dummies.columns:
    p_value = p_values[group]
    if p_value < alpha:
        print(f"Reject the null hypothesis for age group {group}: This age␣
 ↪group has an effect on winning elections.")
    else:
        print(f"Fail to reject the null hypothesis for age group {group}: This␣
 ↪age group has no effect on winning elections.")
```

```
Optimization terminated successfully.
         Current function value: 0.125329
         Iterations 9
                           Logit Regression Results
==============================================================================
Dep. Variable:              Is Winner   No. Observations:                 8337
Model:                          Logit   Df Residuals:                     8331
Method:                           MLE   Df Model:                            5
Date:                Mon, 03 Jun 2024   Pseudo R-squ.:                 0.04580
Time:                        21:04:57   Log-Likelihood:                -1044.9
converged:                       True   LL-Null:                       -1095.0
Covariance Type:            nonrobust   LLR p-value:                 4.572e-20
==============================================================================
                 coef    std err          z      P>|z|      [0.025      0.975]
------------------------------------------------------------------------------
```

```
const         -4.9102      0.579     -8.474      0.000      -6.046      -3.774
30-39          0.3427      0.622      0.551      0.581      -0.875       1.561
40-49          0.9889      0.598      1.654      0.098      -0.183       2.161
50-59          1.7074      0.591      2.890      0.004       0.549       2.865
60-69          2.0770      0.593      3.504      0.000       0.915       3.239
70+            2.4157      0.614      3.932      0.000       1.212       3.620
==============================================================================
Fail to reject the null hypothesis for age group 30-39: This age group has no
effect on winning elections.
Fail to reject the null hypothesis for age group 40-49: This age group has no
effect on winning elections.
Reject the null hypothesis for age group 50-59: This age group has an effect on
winning elections.
Reject the null hypothesis for age group 60-69: This age group has an effect on
winning elections.
Reject the null hypothesis for age group 70+: This age group has an effect on
winning elections.
```

Verdict -

Age group 30-39: This age group has no effect on winning elections.

Age group 40-49: This age group has no effect on winning elections.

Age group 50-59: This age group has an effect on winning elections.

Age group 60-69: This age group has an effect on winning elections.

Age group 70+: This age group has an effect on winning elections.

[31]:
```
df_inter.head()
```

[31]:

	Criminal Cases	Education	Age	Total Assets	Liabilities	Is State	\
0	0	0	58	843025.0	13,36,346	0	
1	0	5	73	27439170.0	3,02,788	0	
2	0	11	60	13287710.0	26,49,000	0	
3	0	11	64	111872135.0	0	0	
4	0	5	50	0.0	NaN	0	

	Is Winner	Party_AAP	Party_AARAKSHAN VIRODHI PARTY	Party_AIADMK	…	\
0	0	0	0	0	…	
1	0	0	0	0	…	
2	0	0	0	0	…	
3	0	0	0	0	…	
4	0	0	0	1	…	

	Zone_ARABIAN SEA	Zone_BAY OF BENGAL	Zone_CENTRAL	Zone_EASTERN	\
0	0	1	0	0	

```
1                  0                    1              0              0
2                  0                    1              0              0
3                  0                    1              0              0
4                  0                    1              0              0

   Zone_NORTHEASTERN  Zone_NORTHERN  Zone_SOUTHERN  Zone_WESTERN  \
0                  0              0              0             0
1                  0              0              0             0
2                  0              0              0             0
3                  0              0              0             0
4                  0              0              0             0

   Asset Category  Age Group
0             Low      50-59
1            High        70+
2            High      60-69
3            High      60-69
4            High      50-59

[5 rows x 803 columns]
```

[32]:
```
df_inter['Liabilities'] = df_inter['Liabilities'].str.replace(',', '').
↪astype(float)
```

[33]:
```
df_inter['Asset Category'] = df_inter['Asset Category'].apply(lambda x: 1 if x␣
↪== "High" else 0)
```

[34]:
```
df_inter.drop(columns=['Age Group'], inplace=True)
```

[35]:
```
df_inter.isna().all()
```

[35]:
```
Criminal Cases       False
Education            False
Age                  False
Total Assets         False
Liabilities          False
                     …
Zone_NORTHEASTERN    False
Zone_NORTHERN        False
Zone_SOUTHERN        False
Zone_WESTERN         False
Asset Category       False
Length: 802, dtype: bool
```

[36]:
```
df_inter['Liabilities'].fillna(0, inplace=True)
```

[37]:
```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler

# Ensure df_inter has the 'Is Winner' column and it's clean
df_inter = df_inter.dropna(subset=['Is Winner'])

# Define the features and target variable
X = df_inter.drop(columns=['Is Winner'])
y = df_inter['Is Winner']

# Split the dataset into training and testing sets with stratification
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪stratify=y, random_state=42)

# Apply scaling to the features
scaler = StandardScaler()

# Fit the scaler on the training data and transform both the training and␣
 ↪testing data
X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)

# Convert the scaled arrays back to DataFrames for easier handling
X_train_scaled_df = pd.DataFrame(X_train_scaled, index=X_train.index,␣
 ↪columns=X_train.columns)
X_test_scaled_df = pd.DataFrame(X_test_scaled, index=X_test.index,␣
 ↪columns=X_test.columns)

# Combine the scaled features and target variable back into the training and␣
 ↪testing DataFrames
train_df = pd.concat([X_train_scaled_df, y_train], axis=1)
test_df = pd.concat([X_test_scaled_df, y_test], axis=1)
```

[38]:
```
# Check for NaN values in the training and testing sets
print("Number of NaN values in each column of training set:\n", train_df.isna().
 ↪sum())
print("Number of NaN values in each column of testing set:\n", test_df.isna().
 ↪sum())
```

```
Number of NaN values in each column of training set:
 Criminal Cases    0
Education          0
Age                0
Total Assets       0
Liabilities        0
                  ..
```

```
Zone_NORTHERN     0
Zone_SOUTHERN     0
Zone_WESTERN      0
Asset Category    0
Is Winner         0
Length: 802, dtype: int64
Number of NaN values in each column of testing set:
 Criminal Cases    0
Education         0
Age               0
Total Assets      0
Liabilities       0
                 ..
Zone_NORTHERN     0
Zone_SOUTHERN     0
Zone_WESTERN      0
Asset Category    0
Is Winner         0
Length: 802, dtype: int64
```

[39]:
```python
model_param = {
    'LogisticRegression':{
        'model' : LogisticRegression(solver = 'liblinear',multi_class = 'auto'),
        'param' : {
            'penalty': ('l1', 'l2'),
            'C':[0.01, 0.1, 1, 10]
        }
    },
    'DecisionTreeClassifier':{
        'model':DecisionTreeClassifier(),
        'param':{
            'max_depth': [3, 5]
        }
    },
    'KNeighborsClassifier':{
        'model': KNeighborsClassifier(),
        'param':{
            'n_neighbors':[5,25]
        }
    },
    'SVC':{
        'model': SVC(),
        'param': {
            'C':[10,100]
        }
    },
    'random_forest': {
```

```
        'model': RandomForestClassifier(),
        'param' : {
            'n_estimators': [1000,3000]
        }
    },
    'AdaBoostClassifier':{
        'model': ensemble.AdaBoostClassifier(),
        'param':{
            "n_estimators": [1,100],
            'learning_rate':[.001,.1]
        }
    },
    'XGBClassifier':{
        'model' : XGBClassifier(),
        'param':{
            'min_child_weight': [5, 10],
            'gamma': [0.5, 1],
            'subsample': [0.6, 1.0],
            'colsample_bytree': [0.6, 1.0],
            'max_depth': [3, 5]
        }
    },
    'lgb':{
        'model':lgb.LGBMClassifier(),
        'param':{
                }
    }
}
```

[40]:
```
import warnings
warnings.filterwarnings('ignore')

scores =[]
for model_name, mp in model_param.items():
    model_selection =␣
 ↪GridSearchCV(estimator=mp['model'],param_grid=mp['param'],cv=5,return_train_score=False)
    model_selection.fit(X_train_scaled,y_train)
    scores.append({
        'model': model_name,
        'best_score': model_selection.best_score_,
        'best_params': model_selection.best_params_
    })
    print(model_selection)
```

```
GridSearchCV(cv=5, estimator=LogisticRegression(solver='liblinear'),
             param_grid={'C': [0.01, 0.1, 1, 10], 'penalty': ('l1', 'l2')})
GridSearchCV(cv=5, estimator=DecisionTreeClassifier(),
             param_grid={'max_depth': [3, 5]})
```

```
GridSearchCV(cv=5, estimator=KNeighborsClassifier(),
             param_grid={'n_neighbors': [5, 25]})
GridSearchCV(cv=5, estimator=SVC(), param_grid={'C': [10, 100]})
GridSearchCV(cv=5, estimator=RandomForestClassifier(),
             param_grid={'n_estimators': [1000, 3000]})
GridSearchCV(cv=5, estimator=AdaBoostClassifier(),
             param_grid={'learning_rate': [0.001, 0.1],
                         'n_estimators': [1, 100]})
GridSearchCV(cv=5,
             estimator=XGBClassifier(base_score=None, booster=None,
                                     callbacks=None, colsample_bylevel=None,
                                     colsample_bynode=None,
                                     colsample_bytree=None, device=None,
                                     early_stopping_rounds=None,
                                     enable_categorical=False, eval_metric=None,
                                     feature_types=None, gamma=None,
                                     grow_policy=None, importance_type=None,
                                     interaction_constraints=None,
                                     learning_rate=None,…
                                     max_cat_to_onehot=None,
                                     max_delta_step=None, max_depth=None,
                                     max_leaves=None, min_child_weight=None,
                                     missing=nan, monotone_constraints=None,
                                     multi_strategy=None, n_estimators=None,
                                     n_jobs=None, num_parallel_tree=None,
                                     random_state=None, …),
             param_grid={'colsample_bytree': [0.6, 1.0], 'gamma': [0.5, 1],
                         'max_depth': [3, 5], 'min_child_weight': [5, 10],
                         'subsample': [0.6, 1.0]})
GridSearchCV(cv=5, estimator=LGBMClassifier(), param_grid={})
```

[44]:
```
df_model_score = pd.
 ↪DataFrame(scores,columns=['model','best_score','best_params'])
df_model_score
```

[44]:

	model	best_score	best_params
0	LogisticRegression	0.970910	{'C': 0.01, 'penalty': 'l1'}
1	DecisionTreeClassifier	0.970610	
2	KNeighborsClassifier	0.970910	
3	SVC	0.969111	
4	random_forest	0.968812	
5	AdaBoostClassifier	0.970910	
6	XGBClassifier	0.971060	
7	lgb	0.967162	

```
1                                  {'max_depth': 3}
2                                {'n_neighbors': 25}
3                                         {'C': 10}
4                              {'n_estimators': 1000}
5        {'learning_rate': 0.001, 'n_estimators': 1}
6  {'colsample_bytree': 0.6, 'gamma': 1, 'max_dep…
7                                                {}
```

[45]:
```
model_xgb = XGBClassifier(colsample_bytree= 1.0,gamma= 1,max_depth=␣
↪5,min_child_weight= 5,subsample= 0.8)
```

[46]:
```
model_xgb.fit(X_train_scaled,y_train)
```

[46]:
```
XGBClassifier(base_score=None, booster=None, callbacks=None,
              colsample_bylevel=None, colsample_bynode=None,
              colsample_bytree=1.0, device=None, early_stopping_rounds=None,
              enable_categorical=False, eval_metric=None, feature_types=None,
              gamma=1, grow_policy=None, importance_type=None,
              interaction_constraints=None, learning_rate=None, max_bin=None,
              max_cat_threshold=None, max_cat_to_onehot=None,
              max_delta_step=None, max_depth=5, max_leaves=None,
              min_child_weight=5, missing=nan, monotone_constraints=None,
              multi_strategy=None, n_estimators=None, n_jobs=None,
              num_parallel_tree=None, random_state=None, …)
```

[47]:
```
# Make predictions on the test data
predictions = model_xgb.predict(X_test_scaled)

# Add the predictions as a new column to the test DataFrame
X_test['Result_2024'] = predictions
```

[48]:
```
X_test.head()
```

[48]:

	Criminal Cases	Education	Age	Total Assets	Liabilities	Is State	\
1178	0	1	28	185000.0	0.0	1	
4931	0	11	45	40049264.0	5708458.0	1	
4582	0	1	52	88159766.0	30346543.0	1	
5646	0	1	42	2050000.0	950000.0	1	
1883	0	10	69	47743570.0	400000.0	1	

	Party_AAP	Party_AARAKSHAN VIRODHI PARTY	Party_AIADMK	Party_AITC	…	\
1178	0	0	0	0	…	
4931	0	0	0	0	…	
4582	0	0	0	0	…	
5646	0	0	0	0	…	
1883	0	0	0	0	…	

```
      Zone_ARABIAN SEA  Zone_BAY OF BENGAL  Zone_CENTRAL  Zone_EASTERN  \
1178                 0                   0             0             0
4931                 0                   0             0             0
4582                 0                   0             1             0
5646                 0                   0             0             0
1883                 0                   0             0             0

      Zone_NORTHEASTERN  Zone_NORTHERN  Zone_SOUTHERN  Zone_WESTERN  \
1178                  0              1              0             0
4931                  1              0              0             0
4582                  0              0              0             0
5646                  0              0              1             0
1883                  0              0              1             0

      Asset Category  Result_2024
1178               0            0
4931               1            0
4582               1            0
5646               1            0
1883               1            0

[5 rows x 802 columns]
```

[49]:
```
# Print the rows where Result_2024 is 1
winning_predictions = X_test[X_test['Result_2024'] == 1]
```

[ ]:
```
```

[50]:
```
winning_predictions["Zone_NORTHERN"].value_counts()
```

[50]:
```
0    10
1     8
Name: Zone_NORTHERN, dtype: int64
```

[ ]:
```
```

[51]:
```
winning_predictions.to_csv("Final_results.csv",index=False)
```

[53]:
```
party_columns = [col for col in winning_predictions.columns if col.
 ↪startswith('Party_')]
party_counts = winning_predictions[party_columns].sum().
 ↪sort_values(ascending=False)

print(party_counts)
```

```
Party_BJP      14
Party_INC       2
Party_AITC      1
```

```
Party_BSP                          1
Party_AAP                          0
                                  ..
Party_Ekam Sanatan Bharat Dal      0
Party_Eklavya Samaj Party          0
Party_Gana Suraksha Party          0
Party_Ganasangam Party of India    0
Party_Zoram Peoples Movement       0
Length: 750, dtype: int64
```

[ ]: