Elections Data Analysis

Data Cleaning

1. Importing Libraries

```
[1]: import pandas as pd
     import numpy as np
     import matplotlib.pyplot as plt
     import seaborn as sb
     import plotly.express as px
     import geopandas as gpd
```

2. Reading 2014 data

```
[2]: df_2014 = pd.read_csv('datasets/constituency_wise_results_2014.csv')
     df_2014.head(2)
```

```
[2]:             state   pc_name     candidate sex   age category party  \
     0  Andhra Pradesh  Adilabad  GODAM NAGESH   M  49.0       ST   TRS
     1  Andhra Pradesh  Adilabad        NARESH   M  37.0       ST   INC

       party_symbol  general_votes  postal_votes  total_votes  total_electors
     0          Car         425762          5085       430847         1386282
     1         Hand         257994          1563       259557         1386282
```

3. Reading 2019 data

```
[3]: df_2019 = pd.read_csv('datasets/constituency_wise_results_2019.csv')
     df_2019.head(2)
```

```
[3]:             state pc_name                                         candidate  \
     0  Andhra Pradesh  Aruku                              KISHORE CHANDRA DEO
     1  Andhra Pradesh  Aruku   Dr. KOSURI KASI VISWANADHA VEERA VENKATA SATYA…

         sex   age category party party_symbol  general_votes  postal_votes  \
     0  MALE  72.0       ST   TDP      Bicycle         336163          1938
     1  MALE  54.0       ST   BJP        Lotus          17578           289
```

```
   total_votes  total_electors
0       338101         1451418
1        17867         1451418
```

4. Reading dim_state_codes

[4]:

```
df_sc = pd.read_csv('datasets/dim_states_codes.csv')
df_sc.head(2)
```

[4]:

```
                    state_name abbreviation
0  Andaman & Nicobar Islands           AN
1               Andhra Pradesh           AP
```

[5]:

```
# renaming state_name to state to match it with other df
df_sc.rename(columns = {'state_name':'state'}, inplace=True)
df_sc.head(2)
```

[5]:

```
                         state abbreviation
0  Andaman & Nicobar Islands           AN
1               Andhra Pradesh           AP
```

5. Looking into DataTypes & Null Values of 2014 & 2019 columns

[6]:

```
df_2014.info()
df_2019.info()
#null values in sex & age are for NOTA
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 8355 entries, 0 to 8354
Data columns (total 12 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   state            8355 non-null   object
 1   pc_name          8355 non-null   object
 2   candidate        8355 non-null   object
 3   sex              7845 non-null   object
 4   age              7845 non-null   float64
 5   category         7845 non-null   object
 6   party            8355 non-null   object
 7   party_symbol     8355 non-null   object
 8   general_votes    8355 non-null   int64
 9   postal_votes     8355 non-null   int64
 10  total_votes      8355 non-null   int64
 11  total_electors   8355 non-null   int64
dtypes: float64(1), int64(4), object(7)
memory usage: 783.4+ KB
<class 'pandas.core.frame.DataFrame'>
```

```
RangeIndex: 8597 entries, 0 to 8596
Data columns (total 12 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   state           8597 non-null   object
 1   pc_name         8597 non-null   object
 2   candidate       8597 non-null   object
 3   sex             8054 non-null   object
 4   age             8054 non-null   float64
 5   category        8054 non-null   object
 6   party           8597 non-null   object
 7   party_symbol    8054 non-null   object
 8   general_votes   8597 non-null   int64
 9   postal_votes    8597 non-null   int64
 10  total_votes     8597 non-null   int64
 11  total_electors  8597 non-null   int64
dtypes: float64(1), int64(4), object(7)
memory usage: 806.1+ KB
```

6. Getting Unique Values

[7]:
```
df_2014['state'].nunique()
df_2014['state'].unique()
```

[7]:
```
array(['Andhra Pradesh', 'Arunachal Pradesh', 'Assam', 'Bihar', 'Goa',
       'Gujarat', 'Haryana', 'Himachal Pradesh', 'Jammu & Kashmir',
       'Karnataka', 'Kerala', 'Madhya Pradesh', 'Maharashtra', 'Manipur',
       'Meghalaya', 'Mizoram', 'Nagaland', 'Punjab', 'Rajasthan',
       'Sikkim', 'Tamil Nadu', 'Tripura', 'Uttar Pradesh', 'West Bengal',
       'Jharkhand', 'Uttarakhand', 'Andaman & Nicobar Islands',
       'Chandigarh', 'Dadra & Nagar Haveli', 'Daman & Diu',
       'NCT OF Delhi', 'Lakshadweep', 'Puducherry'], dtype=object)
```

[8]:
```
df_2019['state'].nunique()
df_2019['state'].unique()
```

[8]:
```
array(['Andhra Pradesh', 'Arunachal Pradesh', 'Assam', 'Bihar', 'Goa',
       'Gujarat', 'Haryana', 'Himachal Pradesh', 'Jammu & Kashmir',
       'Karnataka', 'Kerala', 'Madhya Pradesh', 'Maharashtra', 'Manipur',
       'Meghalaya', 'Mizoram', 'Nagaland', 'Odisha', 'Punjab',
       'Rajasthan', 'Sikkim', 'Tamil Nadu', 'Tripura', 'Uttar Pradesh',
       'West Bengal', 'Chhattisgarh', 'Jharkhand', 'Uttarakhand',
       'Telangana', 'Andaman & Nicobar Islands', 'Chandigarh',
       'Dadra & Nagar Haveli', 'Daman & Diu', 'NCT OF Delhi',
       'Lakshadweep', 'Puducherry'], dtype=object)
```

State of AP gets bifurcation in 2014 and Telangana is formed.

7. Replacing state name for Telengana constituencies in df_2014

```
[9]: # getting constituencies that got seperated in 2014 from AP
     df_2019[df_2019['state']=='Telangana']['pc_name'].unique()
```

```
[9]: array(['Adilabad ', 'Peddapalle ', 'Karimnagar ', 'Nizamabad',
            'Zahirabad', 'Medak', 'Malkajgiri', 'Secundrabad', 'Hyderabad',
            'CHEVELLA', 'Mahbubnagar', 'Nagarkurnool', 'Nalgonda', 'Bhongir ',
            'Warangal', 'Mahabubabad  ', 'Khammam '], dtype=object)
```

```
[10]: telangana_pc_names = ['Adilabad ', 'Peddapalle ', 'Karimnagar ', 'Nizamabad',
             'Zahirabad', 'Medak', 'Malkajgiri', 'Secundrabad', 'Hyderabad',
             'CHEVELLA', 'Mahbubnagar', 'Nagarkurnool', 'Nalgonda', 'Bhongir ',
             'Warangal', 'Mahabubabad  ', 'Khammam ']
```

```
[11]: df_2014.loc[df_2014['pc_name'].isin(telangana_pc_names), 'state'] = 'Telangana'
      df_2014['state'].unique()
```

```
[11]: array(['Telangana', 'Andhra Pradesh', 'Arunachal Pradesh', 'Assam',
             'Bihar', 'Goa', 'Gujarat', 'Haryana', 'Himachal Pradesh',
             'Jammu & Kashmir', 'Karnataka', 'Kerala', 'Madhya Pradesh',
             'Maharashtra', 'Manipur', 'Meghalaya', 'Mizoram', 'Nagaland',
             'Punjab', 'Rajasthan', 'Sikkim', 'Tamil Nadu', 'Tripura',
             'Uttar Pradesh', 'West Bengal', 'Jharkhand', 'Uttarakhand',
             'Andaman & Nicobar Islands', 'Chandigarh', 'Dadra & Nagar Haveli',
             'Daman & Diu', 'NCT OF Delhi', 'Lakshadweep', 'Puducherry'],
            dtype=object)
```

```
[12]: df_2014['state'].nunique()
      #telangana has been added
```

```
[12]: 34
```

8. Replacing consituencies name

Few states have same constituency names. So replacing constituency name followed by the respective state name to differentiate

```
[13]: counts = df_2014.groupby('pc_name').size()
```

```
[14]: for index, row in df_2014.iterrows():
          if counts[row['pc_name']] > 1:
              df_2014.at[index, 'pc_name'] = f"{row['pc_name']}_{row['state']}"
```

```
[15]: countb = df_2019.groupby('pc_name').size()
```

```
[16]: for index, row in df_2019.iterrows():
          if countb[row['pc_name']] > 1:
              df_2019.at[index, 'pc_name'] = f"{row['pc_name']}_{row['state']}"
```

```
[17]: df_2019.head(3)
```

```
[17]:
            state                pc_name  \
0  Andhra Pradesh  Aruku _Andhra Pradesh
1  Andhra Pradesh  Aruku _Andhra Pradesh
2  Andhra Pradesh  Aruku _Andhra Pradesh

                                           candidate     sex   age category   \
0                                KISHORE CHANDRA DEO    MALE  72.0       ST
1  Dr. KOSURI KASI VISWANADHA VEERA VENKATA SATYA…    MALE  54.0       ST
2                                   GODDETI. MADHAVI  FEMALE  26.0       ST

   party party_symbol  general_votes  postal_votes  total_votes  \
0    TDP      Bicycle         336163          1938       338101
1    BJP        Lotus          17578           289        17867
2  YSRCP  Ceiling Fan         557561          4629       562190

   total_electors
0         1451418
1         1451418
2         1451418
```

10. Obtaining the descriptive statistics for the dataframe

```
[18]: df_2014.describe()
      df_2019.describe()
```

```
[18]:
               age  general_votes  postal_votes   total_votes  total_electors
count  8054.000000   8.597000e+03   8597.000000  8.597000e+03    8.597000e+03
mean     47.065185   7.117290e+04    267.469699  7.144037e+04    1.705181e+06
std      12.140434   1.735669e+05    929.319680  1.742342e+05    2.969405e+05
min      24.000000   8.400000e+01      0.000000  8.400000e+01    5.518900e+04
25%      38.000000   1.315000e+03      1.000000  1.317000e+03    1.553385e+06
50%      46.000000   3.341000e+03      4.000000  3.350000e+03    1.703279e+06
75%      56.000000   1.239100e+04     36.000000  1.242100e+04    1.856791e+06
max      90.000000   1.066824e+06  19367.000000  1.068569e+06    3.150313e+06
```

Data Analysis & Visualisation

1. List top 5/bottom 5 constituencies of 2014 and 2019 in terms of voter turnout ratio

2014

```
[19]: #Voter Turnout Ratio = (Total Votes Cast / Total Electors)× 100%
      #The percentage of registered voters who actually cast their votes in an␣
       ↪election.
```

```
voter_turnout_ratio_2014 = round((df_2014.groupby('pc_name')['total_votes'].
 ↪sum()
                                    /df_2014.groupby('pc_name')['total_electors']
                                    .max())*100,2)
```

[20]:
```
#top 5
voter_turnout_ratio_2014_desc = voter_turnout_ratio_2014.
 ↪sort_values(ascending=False)
top5_constituencies14 = voter_turnout_ratio_2014_desc.head(5)
top5_constituencies14
```

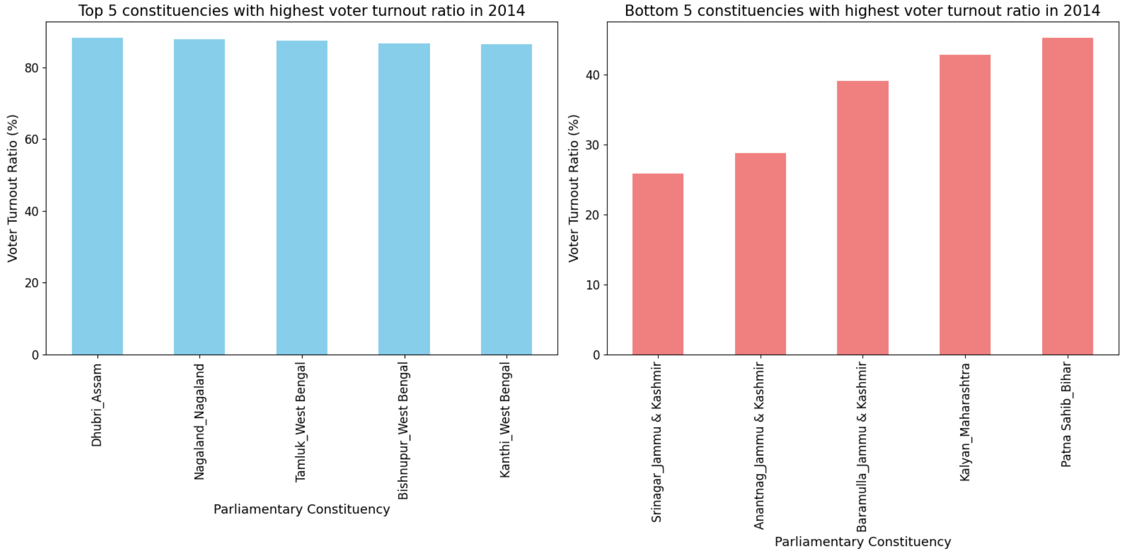
[20]:
```
pc_name
Dhubri_Assam            88.35
Nagaland_Nagaland       87.82
Tamluk_West Bengal      87.59
Bishnupur_West Bengal   86.72
Kanthi_West Bengal      86.61
dtype: float64
```

[21]:
```
#bottom 5
voter_turnout_ratio_2014_asc = voter_turnout_ratio_2014.sort_values()
bottom5_constituencies14 = voter_turnout_ratio_2014_asc.head(5)
bottom5_constituencies14
```

[21]:
```
pc_name
Srinagar_Jammu & Kashmir     25.86
Anantnag_Jammu & Kashmir     28.84
Baramulla_Jammu & Kashmir    39.13
Kalyan_Maharashtra           42.88
Patna Sahib_Bihar            45.33
dtype: float64
```

[22]:
```
fig, axes = plt.subplots(nrows=1, ncols=2, figsize=(16,8))

top5_constituencies14.plot(kind='bar',ax=axes[0], color='skyblue')
axes[0].set_title('Top 5 constituencies with highest voter turnout ratio in␣
 ↪2014', size=15)
axes[0].set_xlabel('Parliamentary Constituency', size=13)
axes[0].set_ylabel('Voter Turnout Ratio (%)', size=13)
axes[0].tick_params(axis='x', labelsize=12)
axes[0].tick_params(axis='y', labelsize=12)

bottom5_constituencies14.plot(kind='bar',ax=axes[1], color='lightcoral')
axes[1].set_title('Bottom 5 constituencies with highest voter turnout ratio in␣
 ↪2014', size=15)
axes[1].set_xlabel('Parliamentary Constituency', size=13)
axes[1].set_ylabel('Voter Turnout Ratio (%)', size=13)
```

```
axes[1].tick_params(axis='x', labelsize=12)
axes[1].tick_params(axis='y', labelsize=12)

plt.tight_layout()
plt.show()
```



2019

```
[23]: #Voter Turnout Ratio = (Total Votes Cast / Total Electors)× 100%
      #The percentage of registered voters who actually cast their votes in an␣
       ↪election.

      voter_turnout_ratio_2019 = round((df_2019.groupby('pc_name')['total_votes'].
       ↪sum()
                                        /df_2019.groupby('pc_name')['total_electors']
                                        .max())*100,2)
      voter_turnout_ratio_2019
```

```
[23]: pc_name
      ARUNACHAL EAST_Arunachal Pradesh    86.46
      ARUNACHAL WEST_Arunachal Pradesh    77.26
      Adilabad _Telangana                 71.40
      Agra_Uttar Pradesh                  59.11
      Ahmadnagar _Maharashtra             64.67
                                          …
      Warangal_Telangana                  63.69
      Wardha_Maharashtra                  61.53
      Wayanad_Kerala                      80.33
      Yavatmal-Washim_Maharashtra         61.28
```

```
Zahirabad_Telangana                  69.69
Length: 543, dtype: float64
```

[24]:
```
#top 5
voter_turnout_ratio_2019_desc = voter_turnout_ratio_2019.
 ↪sort_values(ascending=False)
top5_constituencies19 = voter_turnout_ratio_2019_desc.head(5)
top5_constituencies19
```

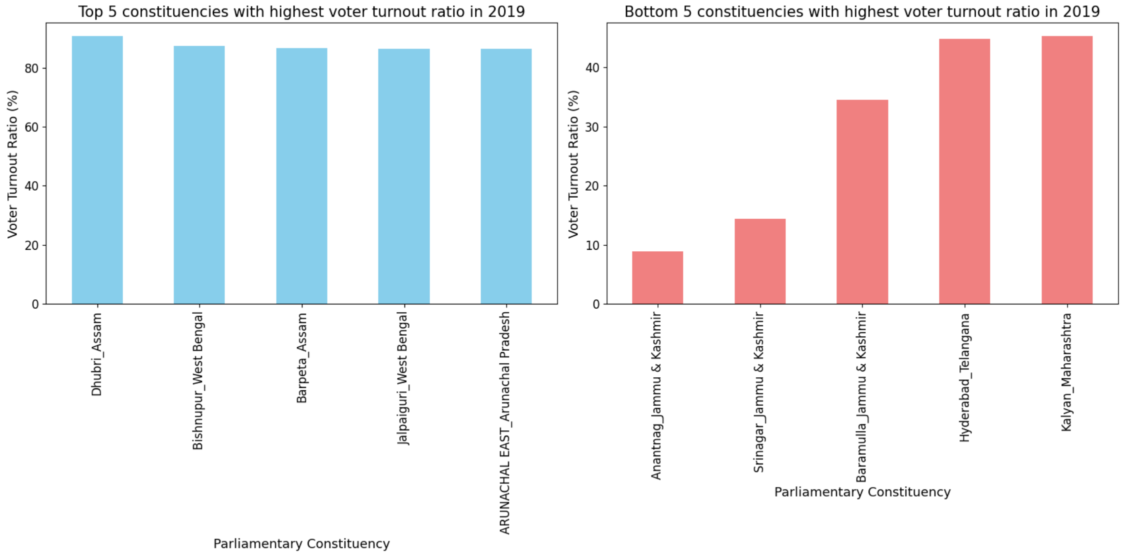
[24]:
```
pc_name
Dhubri_Assam                         90.66
Bishnupur_West Bengal                87.31
Barpeta_Assam                        86.55
Jalpaiguri_West Bengal               86.49
ARUNACHAL EAST_Arunachal Pradesh     86.46
dtype: float64
```

[25]:
```
#bottom 5
voter_turnout_ratio_2019_asc = voter_turnout_ratio_2019.sort_values()
bottom5_constituencies19 = voter_turnout_ratio_2019_asc.head(5)
bottom5_constituencies19
```

[25]:
```
pc_name
Anantnag_Jammu & Kashmir      8.94
Srinagar_Jammu & Kashmir     14.43
Baramulla_Jammu & Kashmir    34.57
Hyderabad_Telangana          44.84
Kalyan_Maharashtra           45.29
dtype: float64
```

[26]:
```
fig, axes = plt.subplots(nrows=1, ncols=2, figsize=(16,8))

top5_constituencies19.plot(kind='bar',ax=axes[0], color='skyblue')
axes[0].set_title('Top 5 constituencies with highest voter turnout ratio in␣
 ↪2019', size=15)
axes[0].set_xlabel('Parliamentary Constituency', size=13)
axes[0].set_ylabel('Voter Turnout Ratio (%)', size=13)
axes[0].tick_params(axis='x', labelsize=12)
axes[0].tick_params(axis='y', labelsize=12)

bottom5_constituencies19.plot(kind='bar',ax=axes[1], color='lightcoral')
axes[1].set_title('Bottom 5 constituencies with highest voter turnout ratio in␣
 ↪2019', size=15)
axes[1].set_xlabel('Parliamentary Constituency', size=13)
axes[1].set_ylabel('Voter Turnout Ratio (%)', size=13)
axes[1].tick_params(axis='x', labelsize=12)
axes[1].tick_params(axis='y', labelsize=12)
```

```
plt.tight_layout()
plt.show()
```



2. List top 5/bottom 5 states of 2014 and 2019 in terms of voter turnout ratio

2014

[27]:

```
#getting unique totalelectors per pc_name
unique_df_2014 = df_2014.drop_duplicates(subset=['pc_name'])

#getting totalelectors per state
total_electors_state14 = unique_df_2014.groupby('state')['total_electors'].sum()

#getting totalvotes per state
total_voters_state14 = df_2014.groupby('state')['total_votes'].sum()

#getting voter_turnout_ratio_2014 by state
voter_turnout_ratio_state14 = round((total_voters_state14/
 ↪total_electors_state14)*100,2)
```

[28]:

```
#top5
top5_state14 = voter_turnout_ratio_state14.sort_values(ascending=False).head(5)
top5_state14
```

[28]:

```
state
Nagaland                87.82
Lakshadweep             86.61
Tripura                 84.72
```

```
Dadra & Nagar Haveli    84.07
Sikkim                  83.33
dtype: float64
```

[29]:

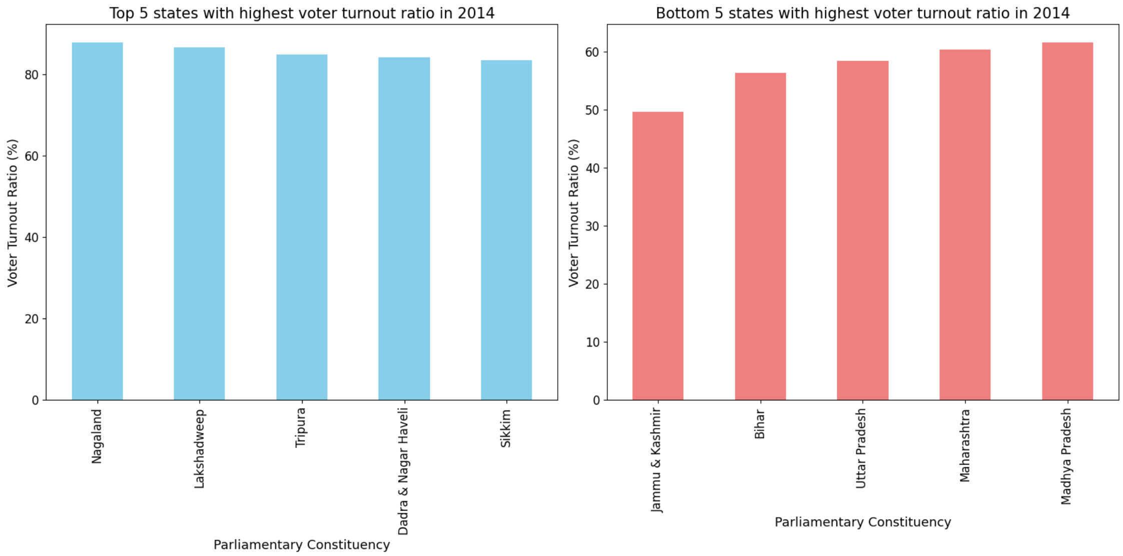
```
#bottom5
bottom5_state14 = voter_turnout_ratio_state14.sort_values().head(5)
bottom5_state14
```

[29]:

```
state
Jammu & Kashmir    49.66
Bihar              56.25
Uttar Pradesh      58.42
Maharashtra        60.29
Madhya Pradesh     61.59
dtype: float64
```

[30]:

```
fig, axes = plt.subplots(nrows=1, ncols=2, figsize=(16,8))

top5_state14.plot(kind='bar',ax=axes[0], color='skyblue')
axes[0].set_title('Top 5 states with highest voter turnout ratio in 2014',␣
 ↪size=15)
axes[0].set_xlabel('Parliamentary Constituency', size=13)
axes[0].set_ylabel('Voter Turnout Ratio (%)', size=13)
axes[0].tick_params(axis='x', labelsize=12)
axes[0].tick_params(axis='y', labelsize=12)

bottom5_state14.plot(kind='bar',ax=axes[1], color='lightcoral')
axes[1].set_title('Bottom 5 states with highest voter turnout ratio in 2014',␣
 ↪size=15)
axes[1].set_xlabel('Parliamentary Constituency', size=13)
axes[1].set_ylabel('Voter Turnout Ratio (%)', size=13)
axes[1].tick_params(axis='x', labelsize=12)
axes[1].tick_params(axis='y', labelsize=12)

plt.tight_layout()
plt.show()
```



2019

[31]:
```
#getting unique totalelectors per pc_name
unique_df_2019 = df_2019.drop_duplicates(subset=['pc_name'])

#getting totalelectors per state
total_electors_state19 = unique_df_2019.groupby('state')['total_electors'].sum()

#getting totalvotes per state
total_voters_state19 = df_2019.groupby('state')['total_votes'].sum()

#getting voter_turnout_ratio_2014 by state
voter_turnout_ratio_state19 = round((total_voters_state19/
 ↪total_electors_state19)*100,2)
```

[32]:
```
#top5
top5_state19 = voter_turnout_ratio_state19.sort_values(ascending=False).head(5)
top5_state19
```

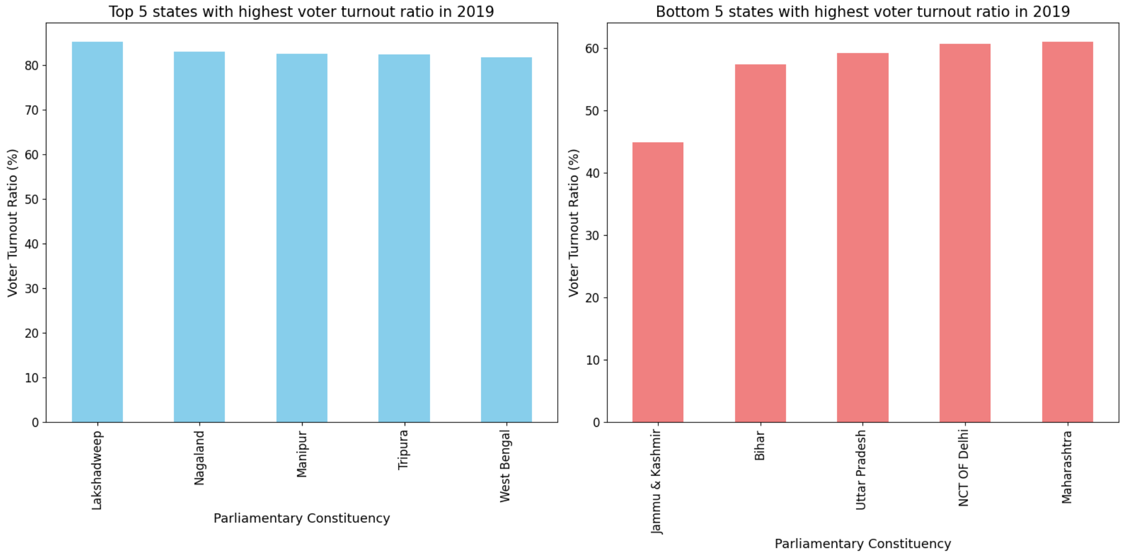
[32]:
```
state
Lakshadweep    85.18
Nagaland       82.91
Manipur        82.54
Tripura        82.35
West Bengal    81.72
dtype: float64
```

[33]:
```
#bottom5
bottom5_state19 = voter_turnout_ratio_state19.sort_values().head(5)
```

```
bottom5_state19
```

[33]:
```
state
Jammu & Kashmir    44.84
Bihar              57.30
Uttar Pradesh      59.18
NCT OF Delhi       60.58
Maharashtra        60.96
dtype: float64
```

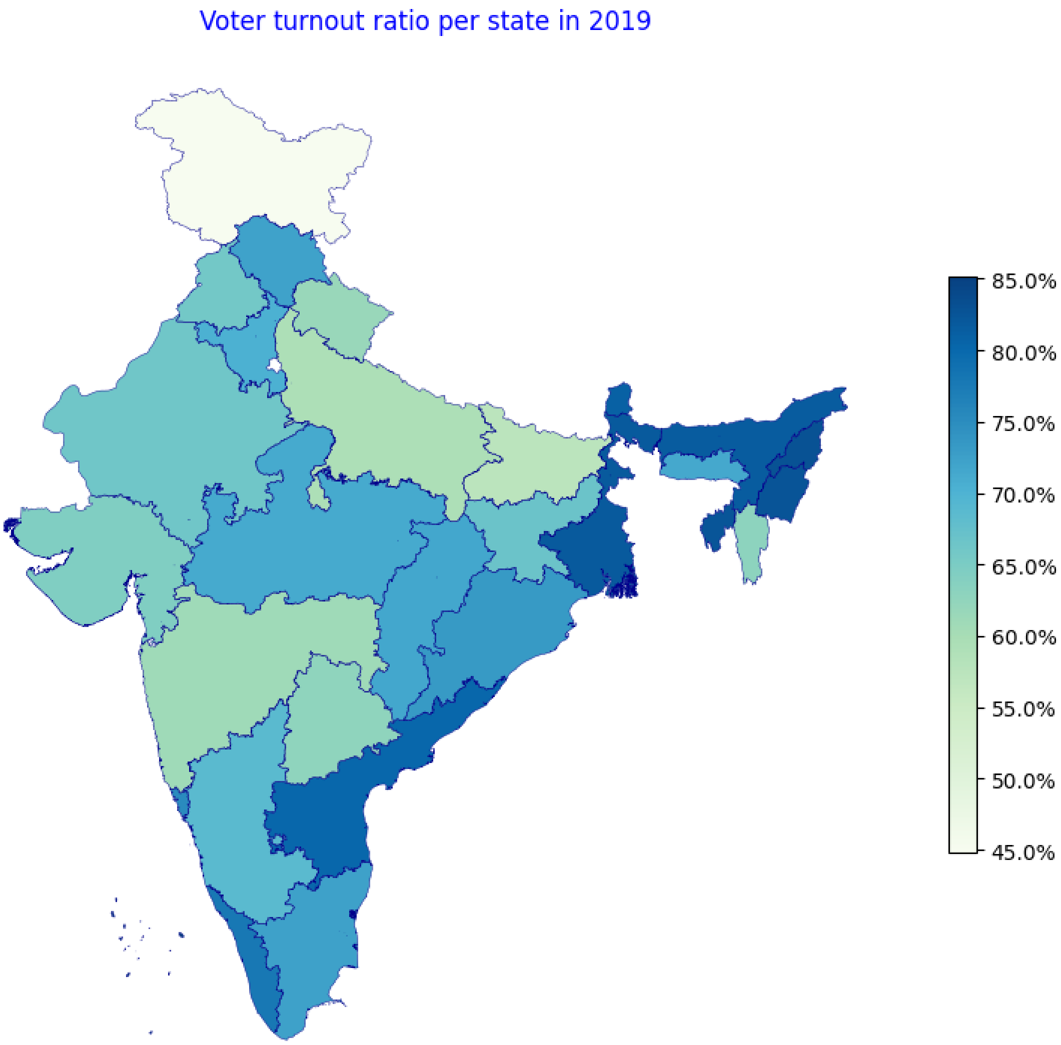
[34]:
```
fig, axes = plt.subplots(nrows=1, ncols=2, figsize=(16,8))

top5_state19.plot(kind='bar',ax=axes[0], color='skyblue')
axes[0].set_title('Top 5 states with highest voter turnout ratio in 2019',␣
 ↪size=15)
axes[0].set_xlabel('Parliamentary Constituency', size=13)
axes[0].set_ylabel('Voter Turnout Ratio (%)', size=13)
axes[0].tick_params(axis='x', labelsize=12)
axes[0].tick_params(axis='y', labelsize=12)

bottom5_state19.plot(kind='bar',ax=axes[1], color='lightcoral')
axes[1].set_title('Bottom 5 states with highest voter turnout ratio in 2019',␣
 ↪size=15)
axes[1].set_xlabel('Parliamentary Constituency', size=13)
axes[1].set_ylabel('Voter Turnout Ratio (%)', size=13)
axes[1].tick_params(axis='x', labelsize=12)
axes[1].tick_params(axis='y', labelsize=12)

plt.tight_layout()
plt.show()
```



Creating a choropleth map to show voter turnout ration per states in 2019

[35]:
```
#Reading indian states shape file
shp_gdf = gpd.read_file('states_shape/Indian_States.shp')
#shp_gdf.head()

#turning voter_turnout_ratio_state19 series to df
df_vtr19 = pd.DataFrame({'State_Name': voter_turnout_ratio_state19.index,
                         'vtr_19': voter_turnout_ratio_state19.values})
#df_vtr19.head()

#merging both files
df_vtr19 = pd.merge(df_vtr19, shp_gdf, left_on = 'State_Name',
                    right_on = 'st_nm', how = 'left')
```

[36]:
```
#chaniging df type to gdf
df_vtr19 = gpd.GeoDataFrame(df_vtr19)
type(df_vtr19)

#Plotting choropleth map
ax = df_vtr19.boundary.plot(edgecolor='darkblue', linewidth = 0.3,␣
 ↪figsize=(10,10))

df_vtr19.plot(ax=ax, column='vtr_19', cmap='GnBu',
            legend=True, legend_kwds={'shrink':0.5, 'format':'%.1f%%'} )

#removing axis and setting title
ax.axis('off')
ax.set_title('Voter turnout ratio per state in 2019', size=12, color='blue')

plt.show()
```



3. Which constituencies have elected the same party for two consecutive elections, rank them by % of votes to that winning party in 2019

```
[37]: #getting df of elected parties of 2014 & 2019
      df_elected_party14 = df_2014.loc[df_2014.groupby('pc_name')['total_votes'].
        ↪idxmax()]
      df_elected_party19 = df_2019.loc[df_2019.groupby('pc_name')['total_votes'].
        ↪idxmax()]
      #removing warning block
      import warnings
      warnings.filterwarnings('ignore')
```

```
[38]: #merge two df for comparison
      df_merged_ep = pd.merge(df_elected_party14, df_elected_party19, on='pc_name',
                              suffixes=('_14','_19'))

      #filtering parties winning consecutively
      df_matching_parties =␣
       ↪df_merged_ep[df_merged_ep['party_14']==df_merged_ep['party_19']]

      #finding percentage change
      df_matching_parties['percentage_change'] =␣
       ↪round(((df_matching_parties['total_votes_19']
                                                               ␣
       ↪-df_matching_parties['total_votes_14'])
                                                               /
       ↪df_matching_parties['total_votes_19']
                                                                *100),2)

      #sorting by percentage
      df_wp_ranked = df_matching_parties.sort_values(by = 'percentage_change',
                                                     ascending=False)

      print(df_wp_ranked[['pc_name','party_14','total_votes_14','party_19','total_votes_19',␣
       ↪'percentage_change']])
```

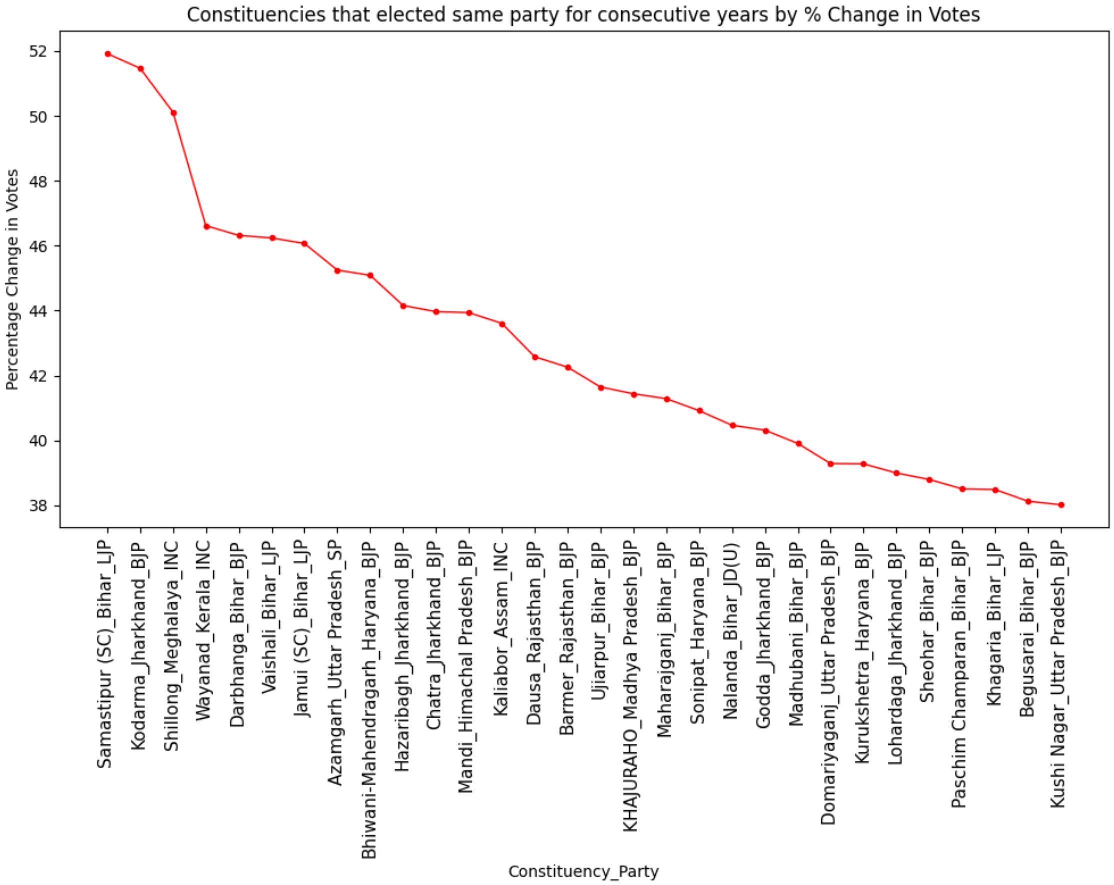
```
                    pc_name party_14  total_votes_14 party_19  \
420    Samastipur (SC)_Bihar      LJP          270401      LJP
266        Kodarma_Jharkhand      BJP          365410      BJP
431       Shillong_Meghalaya      INC          209340      INC
503           Wayanad_Kerala      INC          377035      INC
131          Darbhanga_Bihar      BJP          314949      BJP
..                      …        …             …       …
130  Daman & diu_Daman & Diu      BJP           46960      BJP
377    Peddapalle _Telangana      TRS          565496      TRS
423           Sangrur_Punjab     AAAP          533237     AAAP
267          Kokrajhar_Assam      IND          634428      IND
265         Kishanganj_Bihar      INC          493461      INC

     total_votes_19  percentage_change
420          562443              51.92
266          753016              51.47
431          419689              50.12
503          706367              46.62
131          586668              46.32
..              …                …
130           37597             -24.90
377          441321             -28.14
423          413561             -28.94
```

```
267          484560            -30.93
265          367017            -34.45

[333 rows x 6 columns]
```

Plotting constituencies that elected same party for consecutive years by % Change in Votes

[39]:

```
#plotting top 30 constituencies
df_wp = df_wp_ranked.head(30)

#concatinating constituency and party name
labels = [f'{cons}_{party}' for cons, party in zip(df_wp['pc_name'],␣
 ↪df_wp['party_14'])]


#plot
plt.figure(figsize=(10,8))
plt.plot(labels,df_wp['percentage_change'], 'r.-', linewidth=1)
plt.xlabel('Constituency_Party')
plt.ylabel('Percentage Change in Votes')
plt.title('Constituencies that elected same party for consecutive years by %␣
 ↪Change in Votes')
plt.tick_params(axis='x', labelrotation=90, labelsize=11)
plt.tick_params(axis='y', labelsize=10)
plt.grid=True
plt.tight_layout()
plt.show()
```



4. Which constituencies have voted for different parties in two elections (list top 10 based on the difference (2019-2014) in voter percentage in two elections)

[40]:
```
#getting df of elected parties of 2014 & 2019
df_elected_party14 = df_2014.loc[df_2014.groupby('pc_name')['total_votes'].
  ↪idxmax()]
df_elected_party19 = df_2019.loc[df_2019.groupby('pc_name')['total_votes'].
  ↪idxmax()]

#merge two df for comparison
df_merged_cp = pd.merge(df_elected_party14, df_elected_party19, on='pc_name',␣
  ↪suffixes=('_14','_19'))

df_merged_cp['max_total_votes']=df_merged_cp[['total_votes_14','total_votes_19']].
  ↪max(axis=1)

#filtering constituencies where parties changed
df_changed_parties = df_merged_cp[df_merged_cp['party_14']!
  ↪=df_merged_cp['party_19']]
```

```
#finding percentage change
df_changed_parties['percentage_change'] =␣
↪round(((df_changed_parties['total_votes_19']
                                                          ␣
↪-df_changed_parties['total_votes_14'])
                                                          /
↪df_changed_parties['max_total_votes']*100),2)

#sorting by percentage
df_cp_ranked = df_changed_parties.sort_values(by = 'percentage_change',␣
↪ascending=False).head(10)

print(df_cp_ranked[['pc_name','party_14','total_votes_14','party_19','total_votes_19',␣
↪'percentage_change']])
```

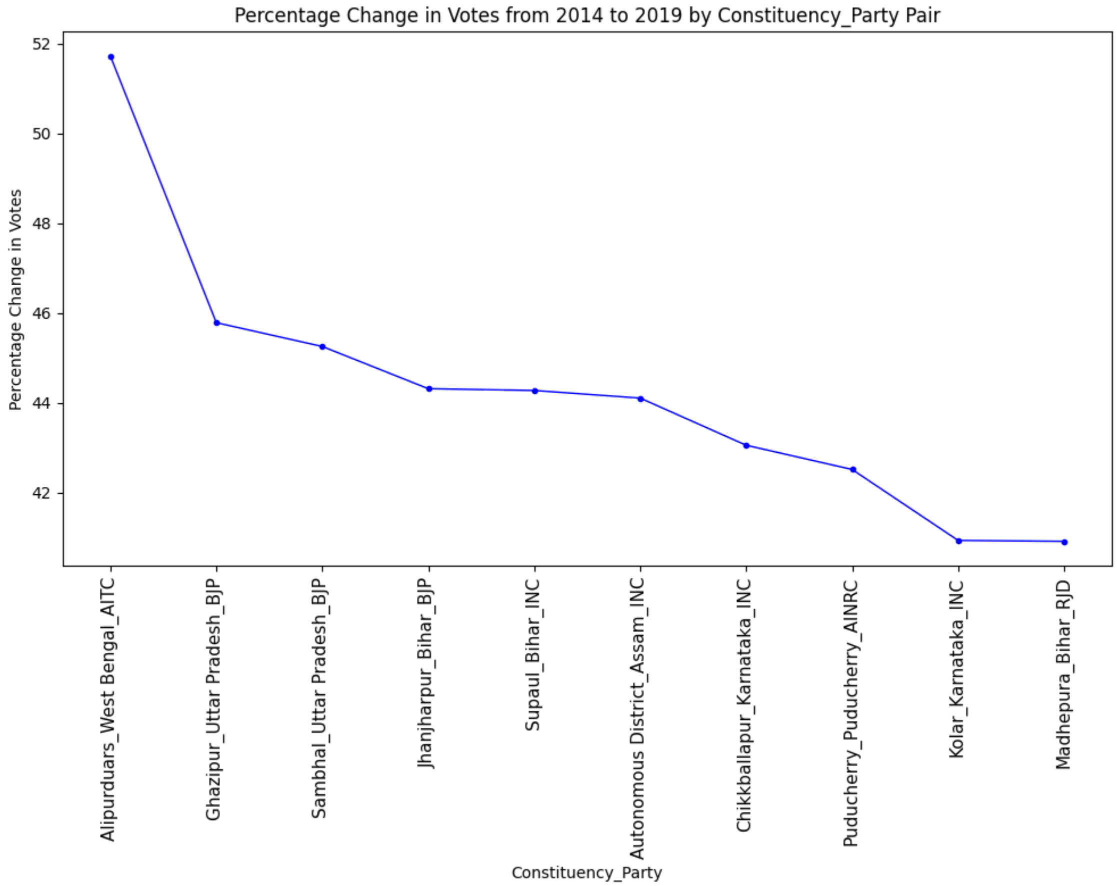
```
                       pc_name party_14  total_votes_14 party_19  \
13      Alipurduars_West Bengal     AITC          362453      BJP
175      Ghazipur_Uttar Pradesh      BJP          306929      BSP
421       Sambhal_Uttar Pradesh      BJP          360242       SP
225           Jhanjharpur_Bihar      BJP          335481    JD(U)
454                Supaul_Bihar      INC          332927    JD(U)
42    Autonomous District_Assam      INC          213152      BJP
116     Chikkballapur_Karnataka      INC          424800      BJP
385       Puducherry_Puducherry    AINRC          255826      INC
268            Kolar_Karnataka      INC          418926      BJP
297             Madhepura_Bihar      RJD          368937    JD(U)

     total_votes_19  percentage_change
13           750804              51.72
175          566082              45.78
421          658006              45.25
225          602391              44.31
454          597377              44.27
42           381316              44.10
116          745912              43.05
385          444981              42.51
268          709165              40.93
297          624334              40.91
```

Plotting percentage Change in Votes from 2014 to 2019 by Constituency-Party Pair

[41]:

```
#concatinating constituency and party name
labels = [f'{cons}_{party}' for cons, party in zip(df_cp_ranked['pc_name'],␣
↪df_cp_ranked['party_14'])]
```

```
#plot
plt.figure(figsize=(10,8))
plt.plot(labels,df_cp_ranked['percentage_change'], 'b.-', linewidth=1)
plt.xlabel('Constituency_Party')
plt.ylabel('Percentage Change in Votes')
plt.title('Percentage Change in Votes from 2014 to 2019 by Constituency_Party␣
 ↪Pair')
plt.tick_params(axis='x', labelrotation=90, labelsize=11)
plt.tick_params(axis='y', labelsize=10)
plt.grid=True
plt.tight_layout()
plt.show()
```



5. Top 5 candidates based on margin difference with runners in 2014 and 2019

2014

[42]:
```
#getting top 2 parties of each constituency
top2_parties14 = df_2014.groupby('pc_name').apply(lambda x: x.nlargest(2,␣
 ↪'total_votes', 'all')).reset_index(drop=True)
```

```
#calculating difference between each
top2_parties14['margin_difference']= top2_parties14.
 ↪groupby('pc_name')['total_votes'].diff().abs()

#filtering top 5 runners based on largest margin
top5_runners_margin = top2_parties14.nlargest(5, 'margin_difference')

#filling NaN values
df_winners_runners = top2_parties14.fillna(method='bfill')

#getting winners
top_winners =  df_winners_runners.groupby('pc_name').apply(lambda x: x.
 ↪nlargest(1, 'margin_difference')).reset_index(drop=True)

#filtering top 5 winners based on largest margin
top5_winners_margin = top_winners.nlargest(5,'margin_difference')
```

[43]:

```
#merging both winners and runners
top_margin = pd.merge(top5_winners_margin,top5_runners_margin, on='pc_name')

#renaming columns
top_margin.rename(columns = {'candidate_x':'winning_candidate',
                             'candidate_y':'runner_candidate',
                             'party_x':'winning_party',
                             'party_y':'runner_party',
                             'margin_difference_y':'margin_difference'},␣
 ↪inplace=True)

#printing both winners and runners by largest margin
print(top_margin[['pc_name','winning_candidate','winning_party','runner_candidate','runner_par
```

```
                  pc_name       winning_candidate winning_party  \
0         Vadodara_Gujarat           NARENDRA MODI           BJP
1  Ghaziabad_Uttar Pradesh       VIJAY KUMAR SINGH           BJP
2          Navsari_Gujarat            C. R. PATIL           BJP
3         Jaipur_Rajasthan         RAMCHARAN BOHARA           BJP
4            Surat_Gujarat  DARSHANA VIKRAM JARDOSH           BJP

               runner_candidate runner_party  margin_difference
0       MISTRI MADHUSUDAN DEVRAM          INC           570128.0
1                    RAJ BABBAR          INC           567260.0
2                  MAKSUD MIRZA          INC           558116.0
3               DR. MAHESH JOSHI          INC           539345.0
4  DESAI NAISHADHBHAI BHUPATBHAI          INC           533190.0
```

2019

[44]:

```
#getting top 2 parties of each constituency
top2_parties19 = df_2019.groupby('pc_name').apply(lambda x: x.nlargest(2,␣
 ↪'total_votes', 'all')).reset_index(drop=True)

#calculating difference between each
top2_parties19['margin_difference']= top2_parties19.
 ↪groupby('pc_name')['total_votes'].diff().abs()

#filtering top 5 runners based on largest margin
top5_runners_margin = top2_parties19.nlargest(5, 'margin_difference')

#filling NaN values
df_winners_runners = top2_parties19.fillna(method='bfill')

#getting winners
top_winners =  df_winners_runners.groupby('pc_name').apply(lambda x: x.
 ↪nlargest(1, 'margin_difference')).reset_index(drop=True)

#filtering top 5 winners based on largest margin
top5_winners_margin = top_winners.nlargest(5,'margin_difference')
```

[45]:

```
#merging both winners and runners
top_margin = pd.merge(top5_winners_margin,top5_runners_margin, on='pc_name')

#renaming columns
top_margin.rename(columns = {'candidate_x':'winning_candidate',
                             'candidate_y':'runner_candidate',
                             'party_x':'winning_party',
                             'party_y':'runner_party',
                             'margin_difference_y':'margin_difference'},␣
 ↪inplace=True)

#printing both winners and runners by largest margin
print(top_margin[['pc_name','winning_candidate','winning_party','runner_candidate','runner_par
```

```
              pc_name        winning_candidate winning_party  \
0     Navsari_Gujarat              C. R. Patil           BJP
1      Karnal_Haryana            Sanjay Bhatia           BJP
2   Faridabad_Haryana              KRISHAN PAL           BJP
3  Bhilwara_Rajasthan  SUBHASH CHANDRA BAHERIA           BJP
4    Vadodara_Gujarat          RANJANBEN BHATT           BJP

              runner_candidate runner_party  margin_difference
0  PATEL DHARMESHBHAI BHIMBHAI          INC           689668.0
1                Kuldip Sharma          INC           656142.0
2          AVTAR SINGH BHADANA          INC           638239.0
3               RAM PAL SHARMA          INC           612000.0
```

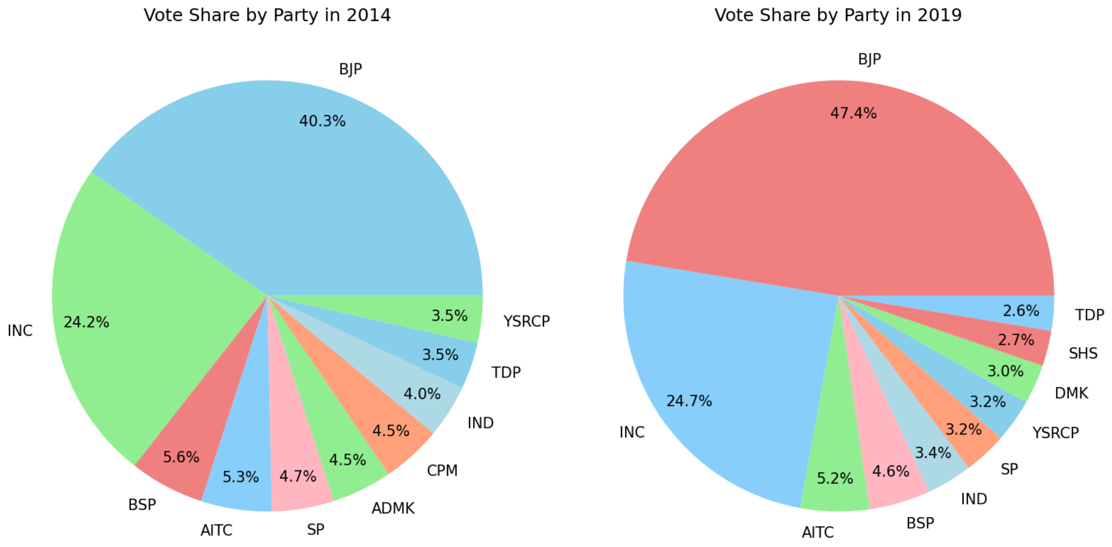
```
4        PRASHANT PATEL (TIKO)          INC           589177.0
```

6. % Split of votes of parties between 2014 vs 2019 at national level

[46]:
```
#votes for each party in 2014
party_votes14 = df_2014.groupby('party')['total_votes'].sum().reset_index()
#total votes in 2014 elections
total_votes14 = df_2014['total_votes'].sum()
#calculating percentage per party
party_votes14['percentage'] = (party_votes14['total_votes']/total_votes14)*100
#top 10 parties by percentage
top10_parties14 = party_votes14.sort_values(by='percentage', ascending=False).
 ↪head(10)

#votes for each party in 2019
party_votes19 = df_2019.groupby('party')['total_votes'].sum().reset_index()
#total votes in 2019 elections
total_votes19 = df_2019['total_votes'].sum()
#calculating percentage per party
party_votes19['percentage'] = (party_votes19['total_votes']/total_votes19)*100
#top 10 parties by percentage
top10_parties19 = party_votes19.sort_values(by='percentage', ascending=False).
 ↪head(10)
```

[47]:
```
#setting variable for plotting
labels14 = top10_parties14['party']
share14 = top10_parties14['percentage']

labels19 = top10_parties19['party']
share19 = top10_parties19['percentage']

colors14 =␣
 ↪['skyblue','lightgreen','lightcoral','lightskyblue','lightpink','lightgreen','lightsalmon',
colors19 =␣
 ↪['lightcoral','lightskyblue','lightgreen','lightpink','lightblue','lightsalmon','skyblue','

#plotting pie chart showing % split of votes of parties between 2014 vs 2019 at␣
 ↪national level
fig, axes = plt.subplots(nrows=1, ncols=2, figsize=(16,8))

share14.plot(kind='pie', ax=axes[0], colors=colors14, labels=labels14,␣
 ↪autopct='%1.1f%%', pctdistance=0.85, textprops = {'fontsize': 15})
axes[0].set_title('Vote Share by Party in 2014', size=18)
axes[0].set_ylabel('')

share19.plot(kind='pie', ax=axes[1], colors=colors19, labels=labels19,␣
 ↪autopct='%1.1f%%', pctdistance=0.85, textprops = {'fontsize': 15})
```

```
axes[1].set_title('Vote Share by Party in 2019', size=18)
axes[1].set_ylabel('')

plt.tight_layout()
plt.show()
```



Vote Share by Party in 2014

Vote Share by Party in 2019

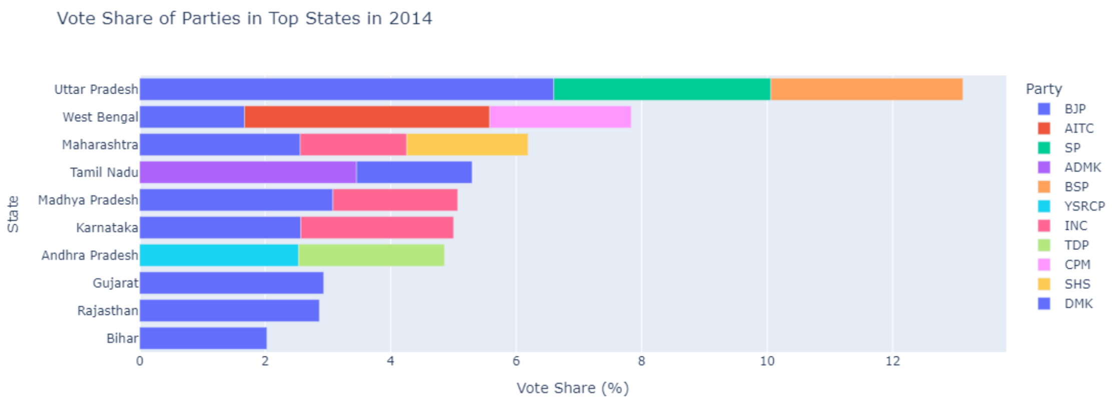
7. % Split of votes of parties between 2014 vs 2019 at state level

2014

[48]:

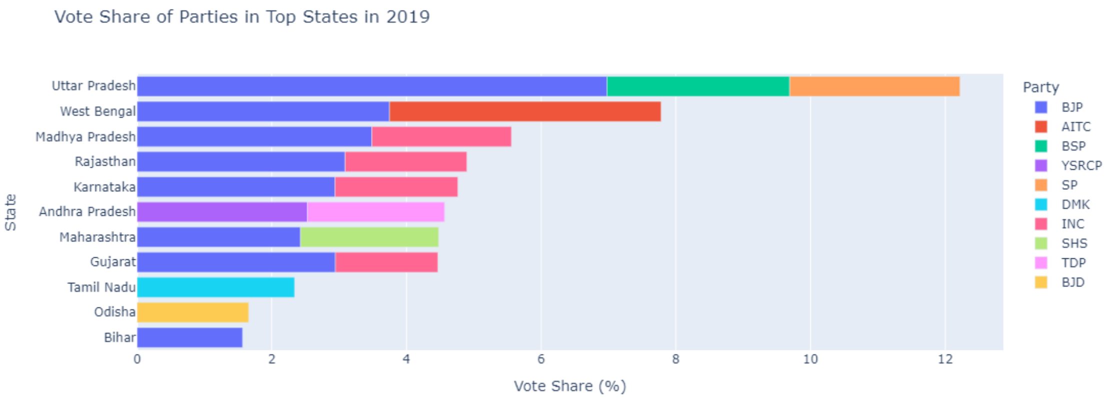
```
#grouping votes by states
state_votes14 = df_2014.groupby(['state','party'])['total_votes'].sum().
 ↪reset_index()
#total votes
total_state_votes14 = state_votes14['total_votes'].sum()
#calculating votes percentage
state_votes14['vote_share']=(state_votes14['total_votes']/
 ↪total_state_votes14)*100
#sorting top20 states for plotting
sorted_state_votes14 = state_votes14.sort_values(by='vote_share',␣
 ↪ascending=False).head(20)

#plotting graph
fig = px.bar(sorted_state_votes14, x='vote_share', y='state',␣
 ↪color='party',orientation='h',
             labels={'state':'State', 'vote_share':'Vote Share%', 'party':
 ↪'Party'},
             title='Vote Share of Parties in Top States in 2014',
             hover_data={'vote_share': ':.2f'})
```

```
fig.update_layout(yaxis={'categoryorder':'total ascending'},
                  xaxis=dict(title='Vote Share (%)'),
                  legend_title='Party',
                 width=1000, height=450)

fig.show()
```



2019

[49]:
```
#grouping votes by states
state_votes19 = df_2019.groupby(['state','party'])['total_votes'].sum().
 ↪reset_index()
#total votes
total_state_votes19 = state_votes19['total_votes'].sum()
#calculating votes percentage
state_votes19['vote_share']=(state_votes19['total_votes']/
 ↪total_state_votes19)*100
#sorting top20 states for plotting
sorted_state_votes19 = state_votes19.sort_values(by='vote_share',␣
 ↪ascending=False).head(20)

#plotting graph
fig = px.bar(sorted_state_votes19, x='vote_share', y='state',␣
 ↪color='party',orientation='h',
             labels={'state':'State', 'vote_share':'Vote Share%', 'party':
 ↪'Party'},
             title='Vote Share of Parties in Top States in 2019',
             hover_data={'vote_share': ':.2f'})

fig.update_layout(yaxis={'categoryorder':'total ascending'},
                  xaxis=dict(title='Vote Share (%)'),
                  legend_title='Party',
                 width=1000, height=450)

fig.show()
```



8. List top 5 constituencies for two major national parties where they have gained vote share in 2019 as compared to 2014

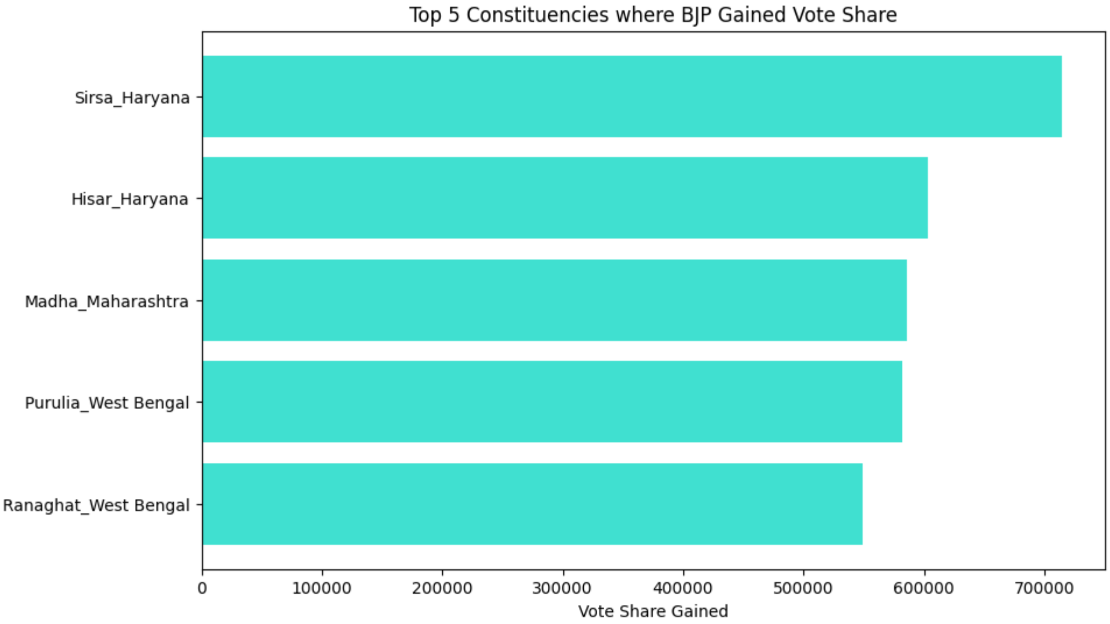
[50]:
```
#2 major national parties
national_parties = ['BJP','INC']

#pivoting df
party_votes14 = df_2014.groupby(['pc_name','party'])['total_votes'].sum().
  ↪unstack(fill_value=0)
party_votes19 = df_2019.groupby(['pc_name','party'])['total_votes'].sum().
  ↪unstack(fill_value=0)

#substracting pivotted df to get difference in votes
vote_share_gained = party_votes19 - party_votes14

#filtering difference for only major parties
national_parties_votes = vote_share_gained[national_parties]

#sorting by top5
top5_constituencies_BJP = national_parties_votes['BJP'].
  ↪sort_values(ascending=False).head(5)
top5_constituencies_INC = national_parties_votes['INC'].
  ↪sort_values(ascending=False).head(5)

#printing result
```

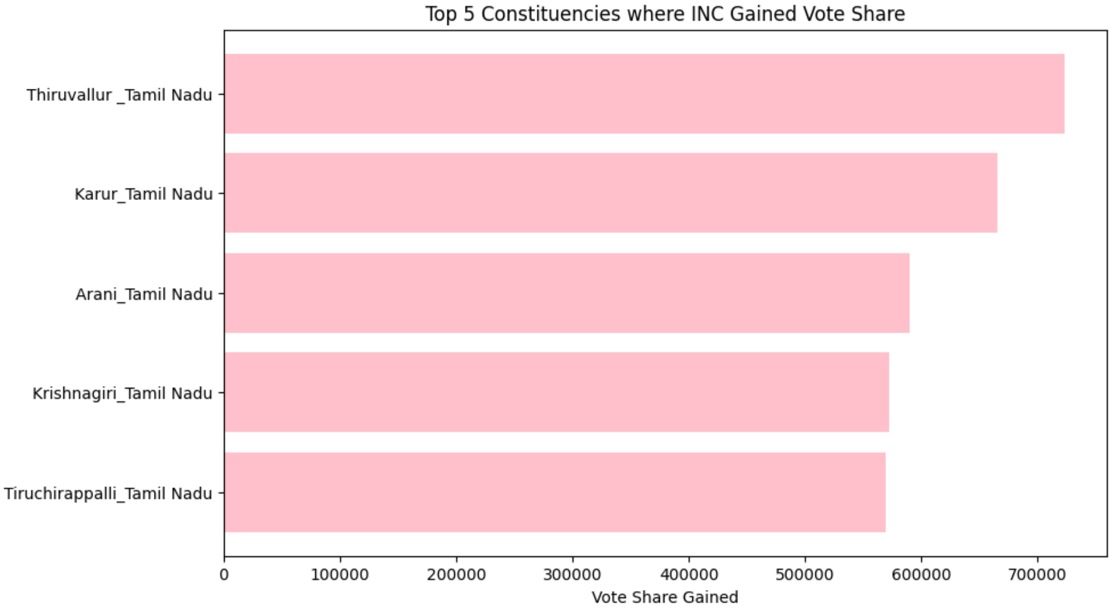
```
print("Top 5 constituencies where BJP gained vote share:")
print(top5_constituencies_BJP)
print("\nTop 5 constituencies where INC gained vote share:")
print(top5_constituencies_INC)
```

```
Top 5 constituencies where BJP gained vote share:
pc_name
Sirsa_Haryana           714351.0
Hisar_Haryana           603289.0
Madha_Maharashtra       586314.0
Purulia_West Bengal     581871.0
Ranaghat_West Bengal    549583.0
Name: BJP, dtype: float64

Top 5 constituencies where INC gained vote share:
pc_name
Thiruvallur _Tamil Nadu       723332.0
Karur_Tamil Nadu              665238.0
Arani_Tamil Nadu              590043.0
Krishnagiri_Tamil Nadu        572413.0
Tiruchirappalli_Tamil Nadu    569748.0
Name: INC, dtype: float64
```

[51]:

```
#plotting for BJP
plt.figure(figsize=(10,6))
plt.barh(top5_constituencies_BJP.index, top5_constituencies_BJP,␣
  ↪color='turquoise')
plt.xlabel('Vote Share Gained')
plt.title('Top 5 Constituencies where BJP Gained Vote Share')
plt.gca().invert_yaxis()
plt.show()

#plotting for INC
plt.figure(figsize=(10,6))
plt.barh(top5_constituencies_INC.index, top5_constituencies_INC, color='pink')
plt.xlabel('Vote Share Gained')
plt.title('Top 5 Constituencies where INC Gained Vote Share')
plt.gca().invert_yaxis()
plt.show()
```





9. List top 5 constituencies for two major national parties where they have lost vote share in 2019 as compared to 2014

[52]:

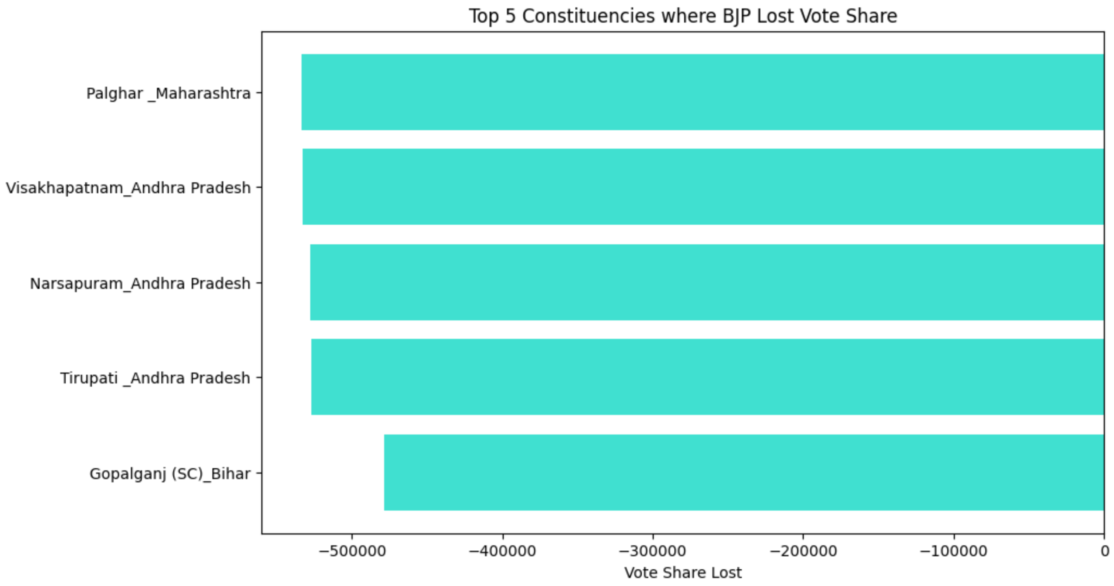
```
#2 major national parties
national_parties = ['BJP','INC']
```

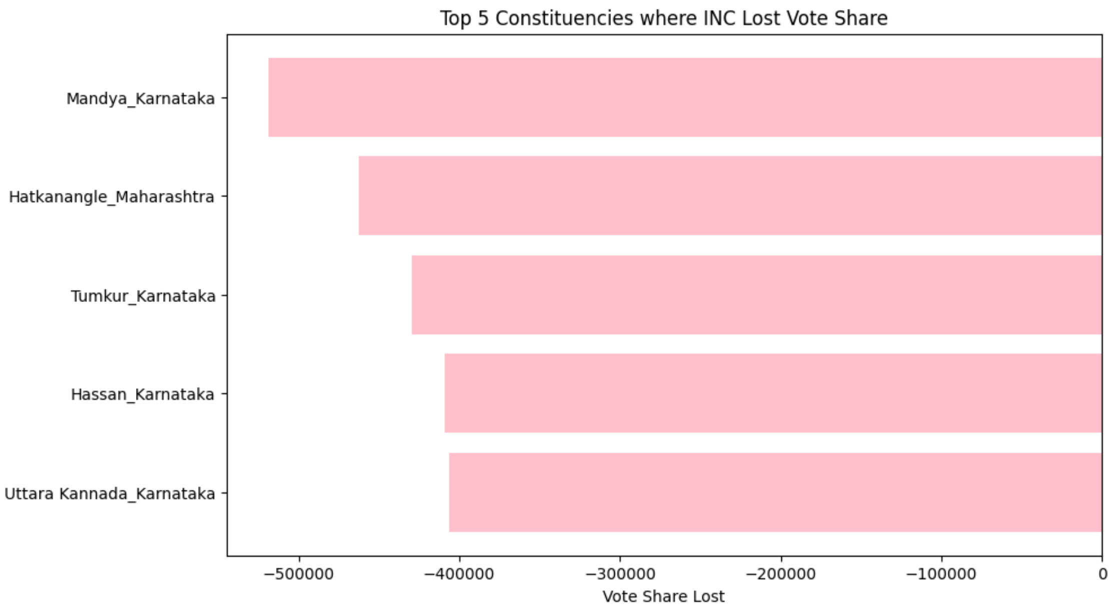
```
#pivoting df
party_votes14 = df_2014.groupby(['pc_name','party'])['total_votes'].sum().
  ↪unstack(fill_value=0)
party_votes19 = df_2019.groupby(['pc_name','party'])['total_votes'].sum().
  ↪unstack(fill_value=0)

#substracting pivotted df to get difference in votes
vote_share_gained = party_votes19 - party_votes14

#replacing votes to NaN where it is 0 or more
vote_share_gained[vote_share_gained>=0] = np.nan

#filtering difference for only major parties
national_parties_votes = vote_share_gained[national_parties]

#sorting by top5
top5_constituencies_lost_BJP = national_parties_votes['BJP'].
  ↪sort_values(ascending=True).head(5)
top5_constituencies_lost_INC = national_parties_votes['INC'].
  ↪sort_values(ascending=True).head(5)

#printing result
print("Top 5 constituencies where BJP lost vote share:")
print(top5_constituencies_lost_BJP)
print("\nTop 5 constituencies where INC lost vote share:")
print(top5_constituencies_lost_INC)
```

```
Top 5 constituencies where BJP lost vote share:
pc_name
Palghar _Maharashtra           -533201.0
Visakhapatnam_Andhra Pradesh   -532940.0
Narsapuram_Andhra Pradesh      -527892.0
Tirupati _Andhra Pradesh       -526826.0
Gopalganj (SC)_Bihar           -478773.0
Name: BJP, dtype: float64

Top 5 constituencies where INC lost vote share:
pc_name
Mandya_Karnataka           -518852.0
Hatkanangle_Maharashtra    -462618.0
Tumkur_Karnataka           -429868.0
Hassan_Karnataka           -409379.0
Uttara Kannada_Karnataka   -406239.0
Name: INC, dtype: float64
```

[53]:

```
#plotting for BJP
plt.figure(figsize=(10,6))
plt.barh(top5_constituencies_lost_BJP.index, top5_constituencies_lost_BJP,␣
  ↪color='turquoise')
plt.xlabel('Vote Share Lost')
plt.title('Top 5 Constituencies where BJP Lost Vote Share')
plt.gca().invert_yaxis()
plt.show()

#plotting for INC
plt.figure(figsize=(10,6))
plt.barh(top5_constituencies_lost_INC.index, top5_constituencies_lost_INC,␣
  ↪color='pink')
plt.xlabel('Vote Share Lost')
plt.title('Top 5 Constituencies where INC Lost Vote Share')
plt.gca().invert_yaxis()
plt.show()
```

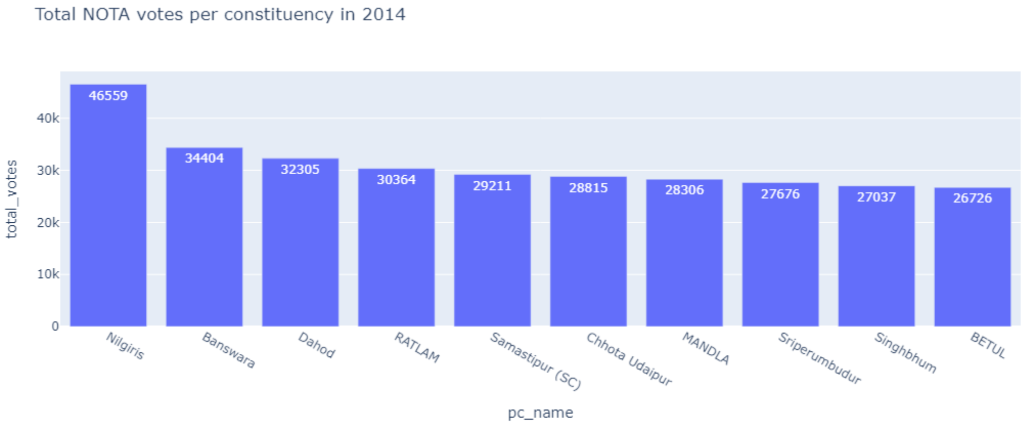




10. Which constituency has voted the most for NOTA?

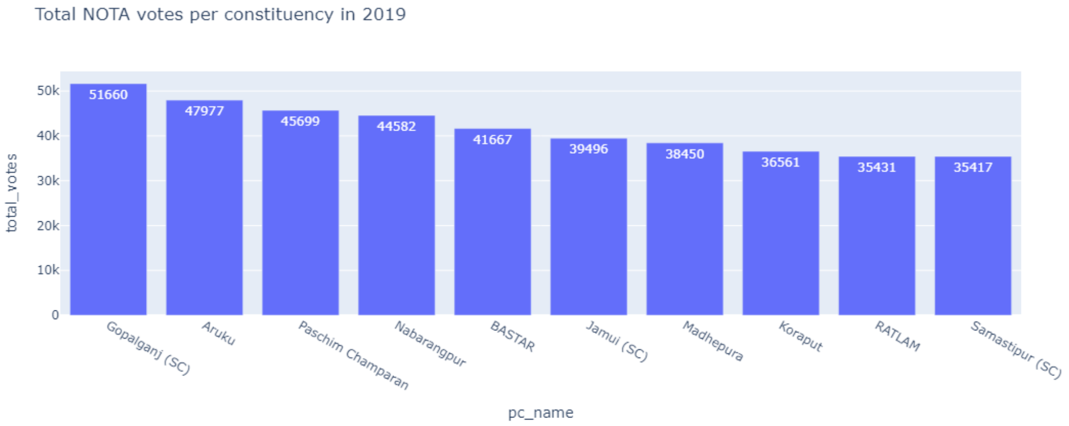
2014

[54]:
```
#getting NOTA for each constituencies
nota14 = df_2014[df_2014['candidate']=='None of the Above']

#sorting by most votes
sorted_nota14 = nota14.sort_values(by='total_votes', ascending=False).head(10)

#removing suffiexes of state from constituency
sorted_nota14['pc_name'] = sorted_nota14['pc_name'].str.split('_').str[0]

#plotting
fig = px.bar(sorted_nota14, x='pc_name', y='total_votes', title='Total NOTA␣
 ↪votes per constituency in 2014',
            text='total_votes', width=1000, height=450)

fig.update_traces(textposition='inside')

fig.show()
```



2019

[55]:
```
#getting NOTA for each constituencies
nota19 = df_2019[df_2019['candidate']=='NOTA']

#sorting by most votes
sorted_nota19 = nota19.sort_values(by='total_votes', ascending=False).head(10)

#removing suffiexes of state from constituency
sorted_nota19['pc_name'] = sorted_nota19['pc_name'].str.split('_').str[0]

#plotting
fig = px.bar(sorted_nota19, x='pc_name', y='total_votes', title='Total NOTA␣
 ↪votes per constituency in 2019',
            text='total_votes', width=1000, height=450)

fig.update_traces(textposition='inside')

fig.show()
```



11. Which constituencies have elected candidates whose party has less than 10% vote share at state level in 2019

[56]:
```
# Calculating total votes cast for each party in each constituency
party_votes = df_2019.
  ↪groupby(['state','pc_name','candidate','party'])['total_votes'].sum().
  ↪reset_index()

# Determining the winning party for each constituency
winning_party_indices = party_votes.groupby('pc_name')['total_votes'].idxmax()
winning_party = party_votes.loc[winning_party_indices]

# Calculating total votes cast in each state
total_votes_state = df_2019.groupby('state')['total_votes'].sum().reset_index()

#merging the two df
winning_parties = pd.merge(winning_party, total_votes_state, on='state',␣
  ↪suffixes=['_party','_total'])

# Calculating percentage vote share for the winning party in each constituency␣
  ↪by state
winning_parties['vote_share_percentage'] =␣
  ↪(winning_parties['total_votes_party']/
  ↪winning_parties['total_votes_total'])*100

#Identifying constituencies with less than 10% vote share
constituencies_less_than_10_percent =␣
  ↪winning_parties[winning_parties['vote_share_percentage']<10]
[['pc_name','candidate','party','vote_share_percentage']]

#printing constituencies name
```

```
print("Constituencies where the winning party's vote share is less than 10% at␣
 ↪the state level in 2019:")
print(constituencies_less_than_10_percent.
 ↪sort_values(by='vote_share_percentage').head(10))
```

```
Constituencies where the winning party's vote share is less than 10% at the
state level in 2019:
            state                         pc_name             candidate party  \
67  Uttar Pradesh         Kaushambi_Uttar Pradesh    VINOD KUMAR SONKAR   BJP
85  Uttar Pradesh        Pratapgarh_Uttar Pradesh      SANGAM LAL GUPTA   BJP
94  Uttar Pradesh         Shrawasti_Uttar Pradesh         RAM SHIROMANI   BSP
88  Uttar Pradesh       Robertsganj_Uttar Pradesh       PAKAURI LAL KOL  ADAL
96  Uttar Pradesh         Sultanpur_Uttar Pradesh  MANEKA SANJAI GANDHI   BJP
92  Uttar Pradesh  Sant Kabir Nagar_Uttar Pradesh  PRAVEEN KUMAR NISHAD   BJP
90  Uttar Pradesh          Salempur_Uttar Pradesh              RAVINDER   BJP
24  Uttar Pradesh            Amethi_Uttar Pradesh          Smriti Irani   BJP
66  Uttar Pradesh            Kanpur_Uttar Pradesh     Satyadev Pachauri   BJP
31  Uttar Pradesh            Ballia_Uttar Pradesh        Virendra Singh   BJP

    total_votes_party  total_votes_total  vote_share_percentage
67             383009           86481398               0.442880
85             436291           86481398               0.504491
94             441771           86481398               0.510828
88             447914           86481398               0.517931
96             459196           86481398               0.530977
92             467543           86481398               0.540628
90             467940           86481398               0.541087
24             468514           86481398               0.541751
66             468937           86481398               0.542240
31             469114           86481398               0.542445
```

12. Is there a correlation between postal votes % and voter turnout % ?

[57]:

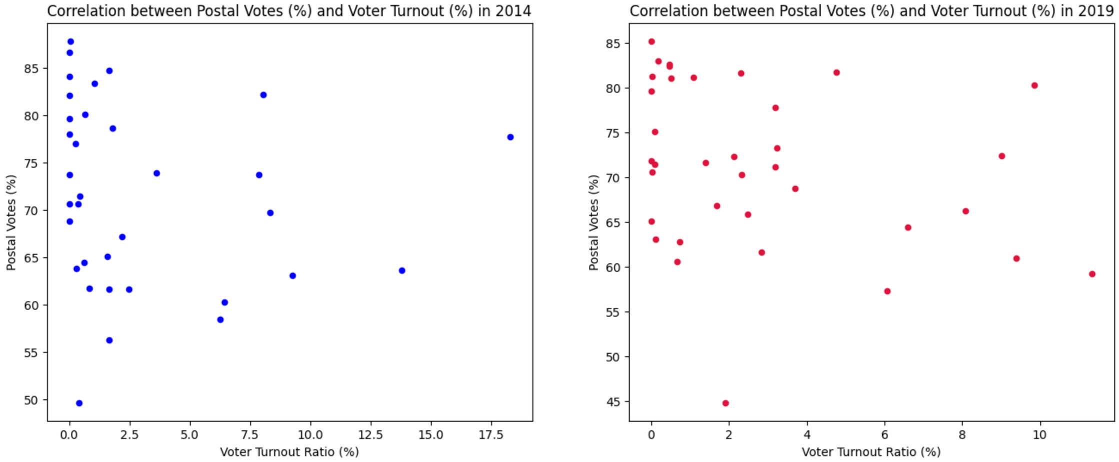
```
#2014
#postal votes of states
postal_votes_state14 = df_2014.groupby('state')['postal_votes'].sum()

#total postal votes of country
postal_votes_total14 = df_2014['postal_votes'].sum()

#postal votes%
postal_votes_pct14 = round((postal_votes_state14/postal_votes_total14)*100,2)

#filtering total electors per constituency
unique_df_2014 = df_2014.drop_duplicates(subset=['pc_name'])

#total electors state
total_electors_state14 = unique_df_2014.groupby('state')['total_electors'].sum()
```

```
total_electors_state14

#total votes state
total_votes_state14 = df_2014.groupby('state')['total_votes'].sum()

#voter turnout%
voter_turnout_pct14 = round((total_votes_state14/total_electors_state14)*100,2)

#creating correlation dataframe
correlation_df_2014 = pd.DataFrame({'Postal Votes (%) 2014':postal_votes_pct14,
                                    'Voter Turnout (%) 2014':
 ↪voter_turnout_pct14})

#------------------------------------------------------------------------------------------
#2019
#postal votes of states
postal_votes_state19 = df_2019.groupby('state')['postal_votes'].sum()

#total postal votes of country
postal_votes_total19 = df_2019['postal_votes'].sum()

#postal votes%
postal_votes_pct19 = round((postal_votes_state19/postal_votes_total19)*100,2)

#filtering total electors per constituency
unique_df_2019 = df_2019.drop_duplicates(subset=['pc_name'])

#total electors state
total_electors_state19 = unique_df_2019.groupby('state')['total_electors'].sum()
total_electors_state19

#total votes state
total_votes_state19 = df_2019.groupby('state')['total_votes'].sum()

#voter turnout%
voter_turnout_pct19 = round((total_votes_state19/total_electors_state19)*100,2)

#creating correlation dataframe
correlation_df_2019 = pd.DataFrame({'Postal Votes (%) 2019':postal_votes_pct19,
                                    'Voter Turnout (%) 2019':
 ↪voter_turnout_pct19})
```

[58]:

```
fig, axes = plt.subplots(nrows=1, ncols=2, figsize=(16,6))

correlation_df_2014.plot(kind='scatter', ax=axes[0], color='blue',  x='Postal␣
 ↪Votes (%) 2014', y='Voter Turnout (%) 2014')
```

```
axes[0].set_title('Correlation between Postal Votes (%) and Voter Turnout (%)␣
 ↪in 2014')
axes[0].set_ylabel('Postal Votes (%)')
axes[0].set_xlabel('Voter Turnout Ratio (%)')

correlation_df_2019.plot(kind='scatter', ax=axes[1], color='crimson', ␣
 ↪x='Postal Votes (%) 2019', y='Voter Turnout (%) 2019')
axes[1].set_title('Correlation between Postal Votes (%) and Voter Turnout (%)␣
 ↪in 2019')
axes[1].set_ylabel('Postal Votes (%)')
axes[1].set_xlabel('Voter Turnout Ratio (%)')

plt.tight_layout
plt.show()
```



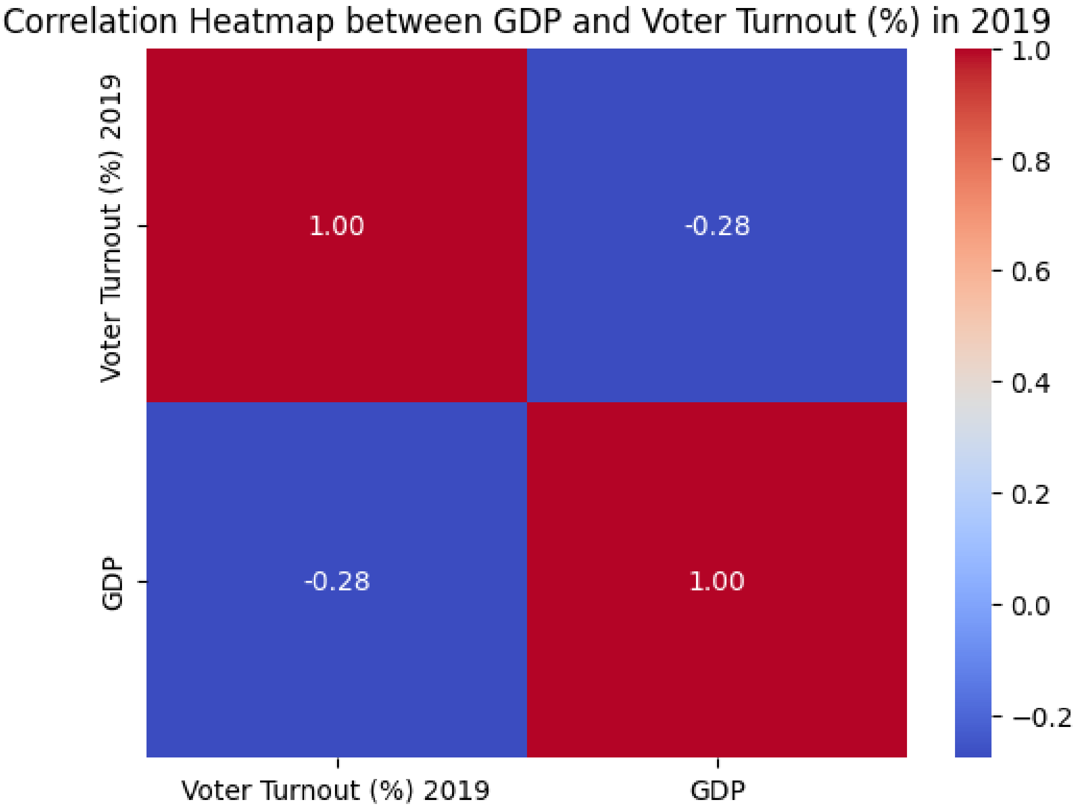
Correlation between Postal Votes (%) and Voter Turnout (%) in 2014

Correlation between Postal Votes (%) and Voter Turnout (%) in 2019

13. Is there a correlation between GDP of a state and voter turnout % ?

```
[59]: #defined in question above
correlation_df_2019

#importing GDP data
df_gdp = pd.read_csv('GDP.csv')
df_gdp

#merging the two
gdp_vto = pd.merge(correlation_df_2019, df_gdp, on='state')



#plotting
```

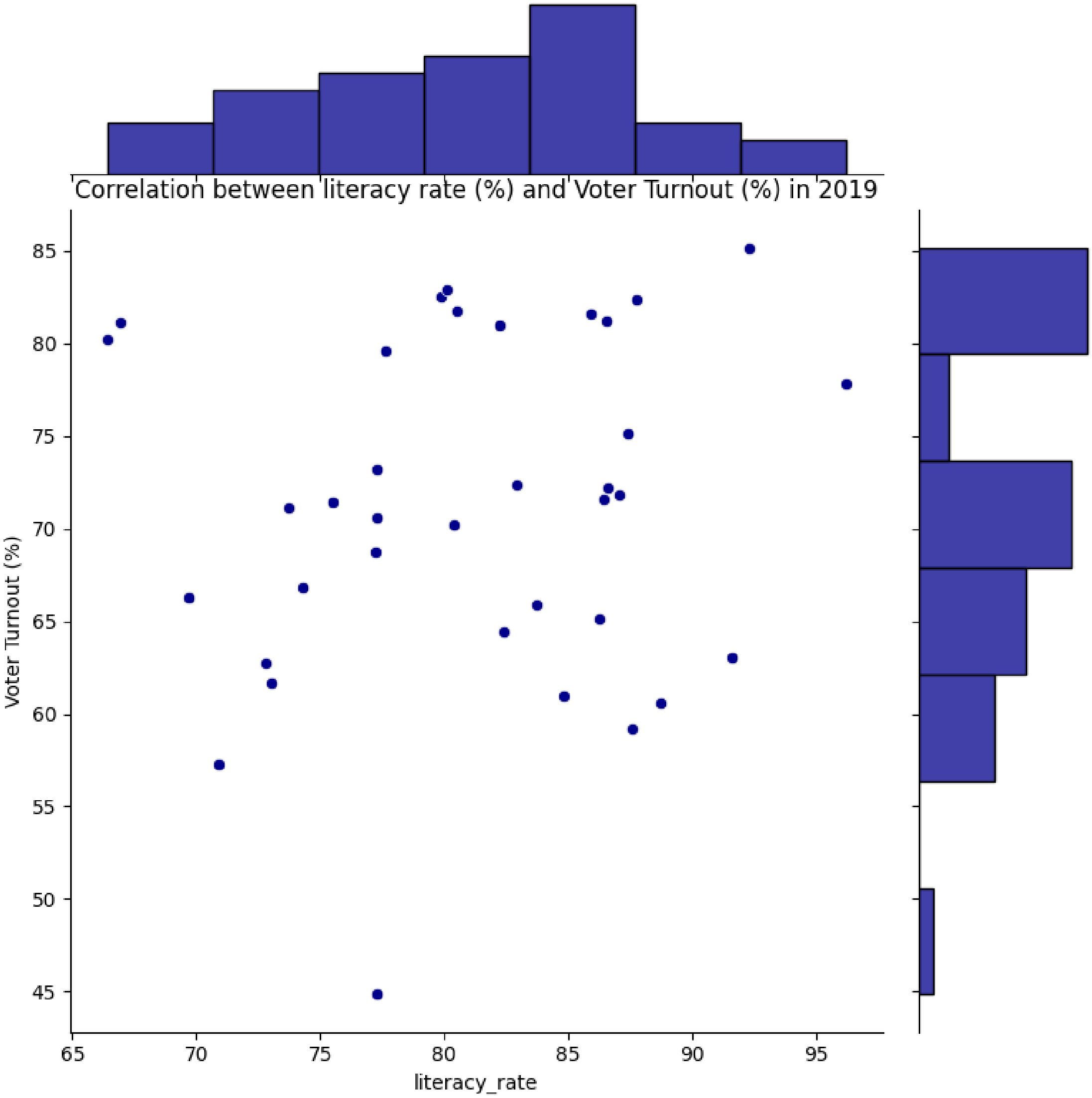
```
# gdp_vto.plot(kind='scatter', color='blue', x='GDP', y='Voter Turnout (%)␣
↪2019')
sb.heatmap(gdp_vto[['Voter Turnout (%) 2019','GDP']].corr(), annot=True,␣
↪cmap='coolwarm', fmt=".2f")
plt.title('Correlation Heatmap between GDP and Voter Turnout (%) in 2019')
plt.show()
```



14. Is there a correlation between literacy % of the state and voter turnout % ?

[60]:
```
#defined in question above
correlation_df_2019

#importing csv file containg literacy% by state
df_literacy = pd.read_csv('literacy rate.csv')

#merging the two
lr_vto = pd.merge(correlation_df_2019, df_literacy, on='state', how='right')

#sb.heatmap(lr_vto[['Voter Turnout (%) 2019','literacy_rate']].corr(),␣
↪annot=True, cmap='coolwarm', fmt=".2f")
```

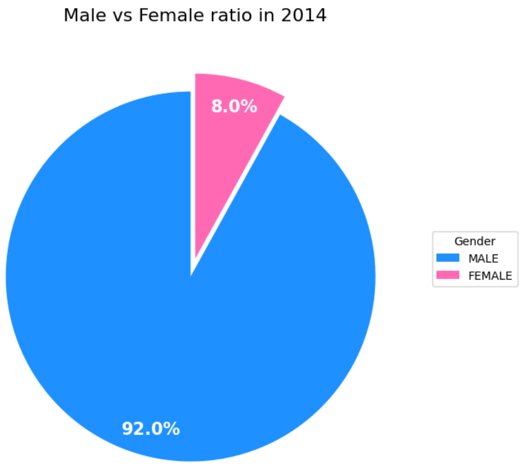
```
sb.jointplot(data=lr_vto, x='literacy_rate', y='Voter Turnout (%)␣
↪2019',height=8, ratio=4, cmap='Purples', color='darkblue')
plt.title('Correlation between literacy rate (%) and Voter Turnout (%) in␣
↪2019', size=12)
plt.xlabel('literacy_rate')
plt.ylabel('Voter Turnout (%)')
plt.show()
```

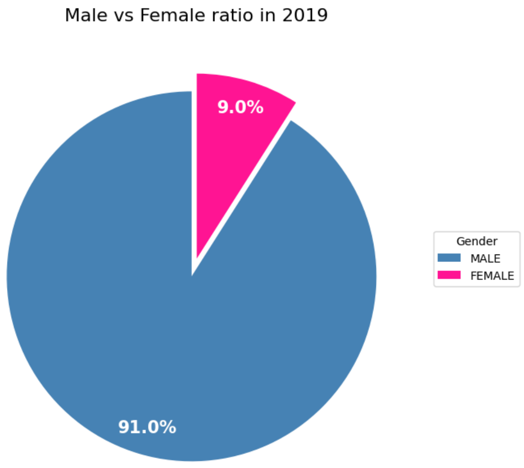


15.Candidates ratio based on gender in 2014 and 2019

```
[61]: #gender count from 2014
male_candidates14 = (df_2014['sex']=='M').sum()
female_candidates14 = (df_2014['sex']=='F').sum()
```

```
#gender count from 2019
male_candidates19 = (df_2019['sex']=='MALE').sum()
female_candidates19 = (df_2019['sex']=='FEMALE').sum()

#setting up values in list/arrays
data14 = [male_candidates14,female_candidates14]
data19 = [male_candidates19,female_candidates19]

labels_mf = ['MALE','FEMALE']
explodeTuple = (0.1, 0.0)

color14 = ['dodgerblue','hotpink']
color19 = ['steelblue','deeppink']

#plotting
fig, axes = plt.subplots(nrows=1, ncols=2, figsize=(16,8))

axes[0].pie(data14, colors=color14, explode=(0.1,0.0), labels=labels_mf,␣
 ↪autopct='%1.1f%%',
            pctdistance=0.85, startangle=90, textprops={'color':"w", 'size':
 ↪15,'weight':'bold'})
axes[0].set_title('Male vs Female ratio in 2014', size=16)
axes[0].legend(labels_mf, title="Gender", loc="center left", bbox_to_anchor=(1,␣
 ↪0, 0.5, 1))

axes[1].pie(data19, colors=color19, explode=(0.1,0.0), labels=labels_mf,␣
 ↪autopct='%1.1f%%',
            pctdistance=0.85, startangle=90, textprops={'color':"w", 'size':
 ↪15,'weight':'bold'})
axes[1].set_title('Male vs Female ratio in 2019', size=16)
axes[1].legend(labels_mf, title="Gender", loc="center left", bbox_to_anchor=(1,␣
 ↪0, 0.5, 1))

plt.show()
```


Male vs Female ratio in 2014
8.0%
92.0%
Gender
MALE
FEMALE


Male vs Female ratio in 2019
9.0%
91.0%
Gender
MALE
FEMALE