Let us analyze the dataset for US presidential election from 1976

This kernel/notebook does the following

1. *Performs EDA on US presidential election data consolidated from all states from 1976-2020*
2. *Does some analysis on various parties*
3. *Perfoems analysis at a state level*
4. *Uses animation from Plotly* and BokehJS

Before starting install Bokeh and Holoviews Libraries by:

pip install bokeh

pip install holoviews

Import the libraries

In [5]:
```
from bokeh.plotting import figure, output_file, show
from bokeh.io import output_notebook
from bokeh.models import ColumnDataSource, NumeralTickFormatter
from bokeh.models.tools import HoverTool
from bokeh.transform import dodge

import random
import math
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt


pd.set_option('display.max_columns', 100)
import matplotlib.pyplot as plt
import seaborn as sns
from scipy.stats import norm
import holoviews as hv
from holoviews import opts
hv.extension('bokeh')
import os
```

In [6]:
```

import plotly.express as px
import plotly.graph_objs as go
from plotly import tools
from plotly.offline import iplot, init_notebook_mode
init_notebook_mode()
```

In [7]:
```
#Let us define a random color function
def rand_color():
    return "#" + "".join(random.sample("0123456789abcdef", 6))
```

In [8]:
```
#Let us define the output to a notebook
output_notebook()
```

(https://bokeh.org) Loading BokehJS ...

Bokeh Case Study - US presidential elections data 1976-2020

- Using a freely available dataset at Harvard dataverse site.
- Leveraging the US presidential vote data set from 1976 to 2020 across various US States.
- Tabulating data for the top two parties across the years.

Load the dataset

In [9]:
```
#We are using the US Presidential vote data set from 1976 to 2016 across states
#The source file is available at Harvard Dataverse site

df  = pd.read_csv('1976-2020-president.csv')
#Dropping the irrelevant columns notes and version
df.drop(['notes', 'version'],axis=1, inplace=True)
df['party'] = df['party_detailed'].str.lower()
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4287 entries, 0 to 4286
Data columns (total 14 columns):
 #   Column            Non-Null Count  Dtype 
---  ------            --------------  ----- 
 0   year              4287 non-null   int64 
 1   state             4287 non-null   object
 2   state_po          4287 non-null   object
 3   state_fips        4287 non-null   int64 
 4   state_cen         4287 non-null   int64 
 5   state_ic          4287 non-null   int64 
 6   office            4287 non-null   object
 7   candidate         4000 non-null   object
 8   party_detailed    3831 non-null   object
 9   writein           4284 non-null   object
 10  candidatevotes    4287 non-null   int64 
 11  totalvotes        4287 non-null   int64 
 12  party_simplified  4287 non-null   object
 13  party             3831 non-null   object
dtypes: int64(6), object(8)
memory usage: 469.0+ KB
```

In [10]:
```
#Printing top 5 values
df.head()
```

Out[10]:

	year	state	state_po	state_fips	state_cen	state_ic	office	candidate	party_detailed	writein	candidatevotes	totalvotes	party_simplified	
0	1976	ALABAMA	AL	1	63	41	US PRESIDENT	CARTER, JIMMY	DEMOCRAT	False	659170	1182850	DEMOCRAT	den
1	1976	ALABAMA	AL	1	63	41	US PRESIDENT	FORD, GERALD	REPUBLICAN	False	504070	1182850	REPUBLICAN	repu
2	1976	ALABAMA	AL	1	63	41	US PRESIDENT	MADDOX, LESTER	AMERICAN INDEPENDENT PARTY	False	9198	1182850	OTHER	ame indepe
3	1976	ALABAMA	AL	1	63	41	US PRESIDENT	BUBAR, BENJAMIN ""BEN""	PROHIBITION	False	6669	1182850	OTHER	proh
4	1976	ALABAMA	AL	1	63	41	US PRESIDENT	HALL, GUS	COMMUNIST PARTY USE	False	1954	1182850	OTHER	comr par

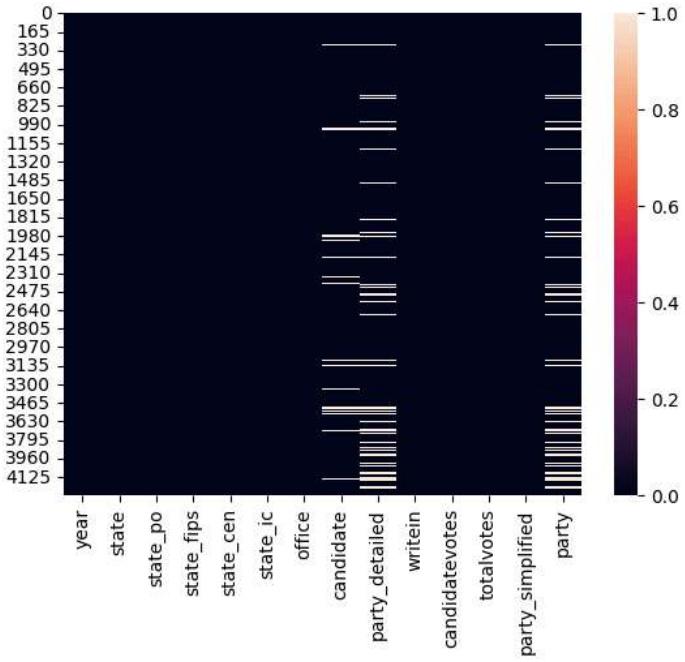
In [11]:
```
#Printing unique values from two columns as specified
print(df['party'].unique())
print(df['party_simplified'].unique())
```

```
['democrat' 'republican' 'american independent party' 'prohibition'
 'communist party use' 'libertarian' nan 'independent' 'socialist workers'
 'american' 'peace & freedom' 'u.s. labor' 'no party affiliation'
 'socialist labor' 'american party of iowa' 'socialist u.s.a.'
 'conservative' 'human rights' "mccarthy '76" "people's"
 'international development bank' 'industrial government party'
 'socialist' 'liberal party' 'free libertarian' 'labor'
 'constitution party' 'concerned citizens' 'statesman' 'citizens'
 'workers world' 'national unity campaign' 'anderson coalition'
 'nominated by petition' 'respect for life' 'right-to-life'
 'middle class candidate' 'down with lawyers' "natural people's league"
 'populist' 'alliance' 'united sovereign citizens' 'workers league'
 'big deal party' 'national unity' 'new alliance'
 'national economic recovery' 'third world assembly' 'solidarity'
 'patriotic party' 'other' 'progressive' 'grassroots' 'consumer'
 'write-in' 'united citizens' 'liberty union party' 'america first'
 'independents for economic recovery' 'natural law' 'taxpayers party'
 'democrat/republican' 'unaffiliated' 'campaign for a new tomorrow'
 'equal justice and opportunity' 'more perfect democracy'
 'justice, industry, and agriculture' 'independent voters'
 'larouche for president party' 'socialist party usa'
 'tisch independent citizens' 'independent american' '6 million jobs'
 'ron daniels independent' 'america first populist'
 'independents for larouche' 'freedom for larouche'
 'labor-farm-laborista-agrario' 'third party' 'reform party' 'green'
 'u.s. taxpayers party' 'looking back party' 'liberty, ecology, community'
 'socialist equality party' 'independent grassroots' 'independence'
 'freedom' 'independent nomination' 'patriot party' 'unenrolled'
 'democratic-farmer-labor' 'reform party minnesota' 'citizens first'
 'working families' 'progressive/green' 'vermont grassroots'
 'alaskan independence party' 'american constitution party'
 'concerns of people' 'petitioning candidate' 'd.c. statehood green'
 'constitution party of florida' 'socialist party of florida'
 'protecting working families' 'green-rainbow' 'better life'
 'christian freedom party' 'nebraska party' 'peace and justice'
 'pacific green' 'nonpartisan' 'personal choice' 'wisconsin green'
 'socialism and liberation party' "america's independent party"
 'boston tea party' "heartquake '08" 'objectivist party'
 'u.s. pacifist party' 'ecology party of florida' 'new'
 'louisiana taxpayers party' 'vote here' 'peace party' 'independent green'
 'mountain party' 'we the people' 'justice' "america's party"
 'american third position' 'american independent'
 'constitutional government' 'nsa did 911' 'new mexico independent party'
 'american delta party' 'better for america' 'veterans party of america'
 'independent people of colorado' 'american solidarity party'
 'nutrition party' 'kotlikoff for president'
 'nonviolent resistance/pacifist' 'approval voting party'
 'new independent party iowa' 'legal marijuana now' 'workers world party'
 "women's equality" 'party for socialism and liberation'
 'life and liberty party' 'unity party' 'prohibition party'
 'progressive party' 'socialist workers party'
 'independent american party' 'non-affiliated' 'dc statehood green'
 'american shopping party' 'geneology know your family history party'
 'becoming one nation' 'c.u.p' 'freedom and prosperity'
 'life , liberty, constitution' 'the birthday party' 'bread and roses'
 'us taxpayers party' 'grumpy old patriots' 'american solidarity'
 'constitution' 'liberty union' 'boiling frog' 'bull moose'
 'approval voting']
['DEMOCRAT' 'REPUBLICAN' 'OTHER' 'LIBERTARIAN']
```

Checking for a heatmap on Null values

In [12]:
```
import seaborn as sns
#Checking null values and plotting them
sns.heatmap(df.isnull())
```

Out[12]: <AxesSubplot: >



In [13]:
```
#Printing datatypes of each columns
df.dtypes
```

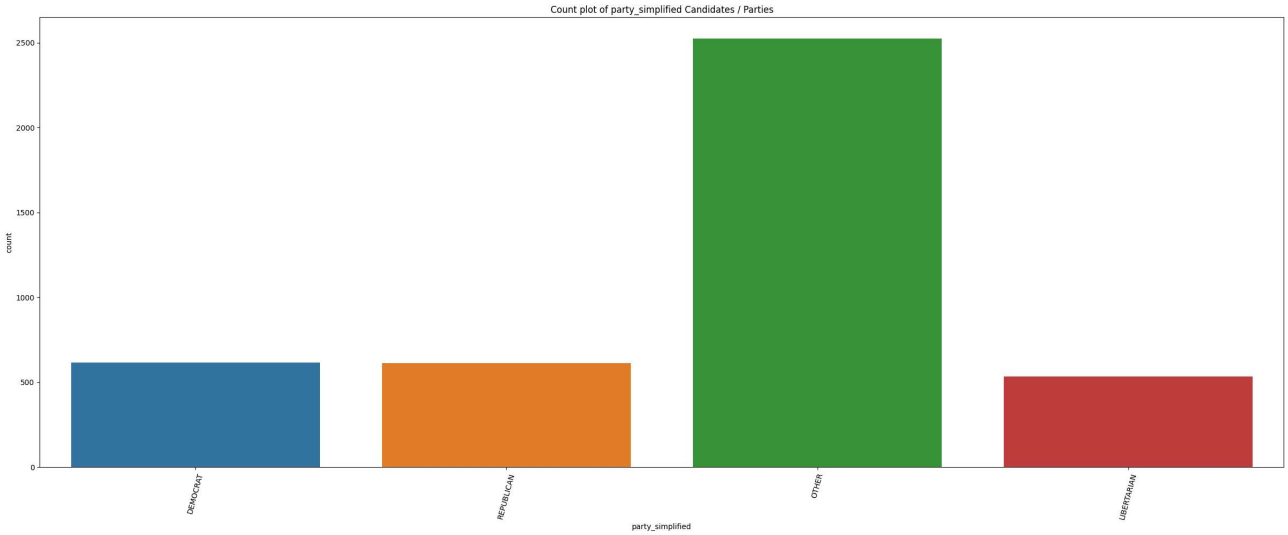
Out[13]:
```
year                int64
state              object
state_po           object
state_fips          int64
state_cen           int64
state_ic            int64
office             object
candidate          object
party_detailed     object
writein            object
candidatevotes      int64
totalvotes          int64
party_simplified   object
party              object
dtype: object
```

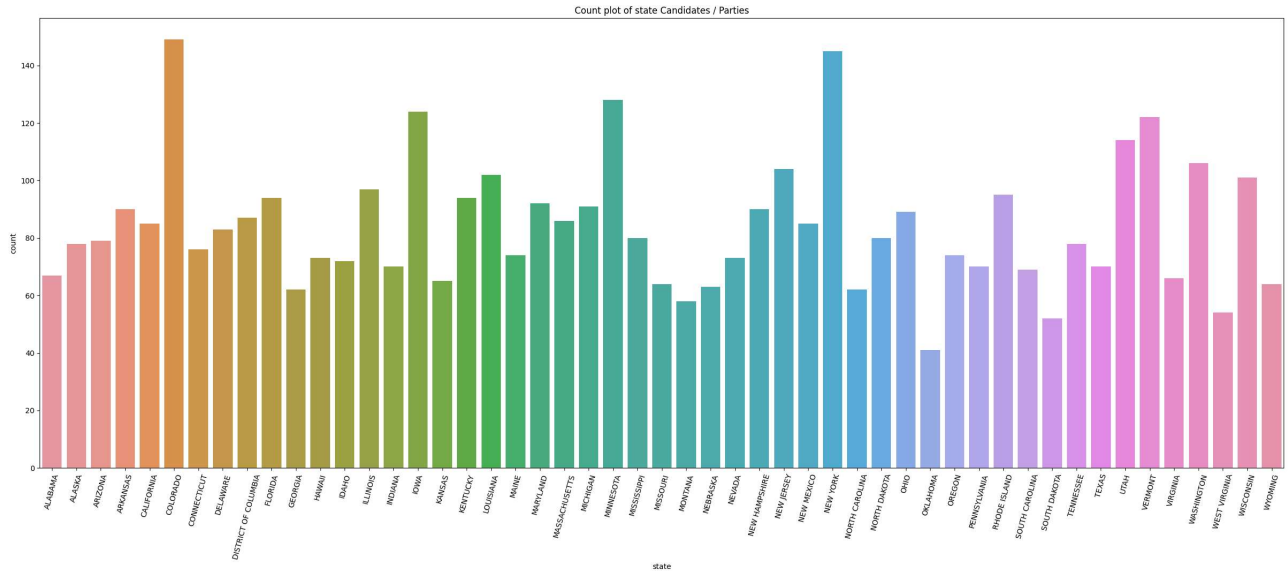
In [14]:
```
#Printing unique values in state, year and party columns
cols=["state","year","party"]
for i in cols:
    print("Number of unique values in ", i ," are : ",len(df[i].unique()), " : " ,df[i].unique())
```

```
Number of unique values in  state  are :  51  :  ['ALABAMA' 'ALASKA' 'ARIZONA' 'ARKANSAS' 'CALIFORNIA' 'COLORADO'
 'CONNECTICUT' 'DELAWARE' 'DISTRICT OF COLUMBIA' 'FLORIDA' 'GEORGIA'
 'HAWAII' 'IDAHO' 'ILLINOIS' 'INDIANA' 'IOWA' 'KANSAS' 'KENTUCKY'
 'LOUISIANA' 'MAINE' 'MARYLAND' 'MASSACHUSETTS' 'MICHIGAN' 'MINNESOTA'
 'MISSISSIPPI' 'MISSOURI' 'MONTANA' 'NEBRASKA' 'NEVADA' 'NEW HAMPSHIRE'
 'NEW JERSEY' 'NEW MEXICO' 'NEW YORK' 'NORTH CAROLINA' 'NORTH DAKOTA'
 'OHIO' 'OKLAHOMA' 'OREGON' 'PENNSYLVANIA' 'RHODE ISLAND' 'SOUTH CAROLINA'
 'SOUTH DAKOTA' 'TENNESSEE' 'TEXAS' 'UTAH' 'VERMONT' 'VIRGINIA'
 'WASHINGTON' 'WEST VIRGINIA' 'WISCONSIN' 'WYOMING']
Number of unique values in  year  are :  12  :  [1976 1980 1984 1988 1992 1996 2000 2004 2008 2012 2016 2020]
Number of unique values in  party  are :  173  :  ['democrat' 'republican' 'american independent party' 'prohibition'
 'communist party use' 'libertarian' nan 'independent' 'socialist workers'
 'american' 'peace & freedom' 'u.s. labor' 'no party affiliation'
 'socialist labor' 'american party of iowa' 'socialist u.s.a.'
 'conservative' 'human rights' "mccarthy '76" "people's"
 'international development bank' 'industrial government party'
 'socialist' 'liberal party' 'free libertarian' 'labor'
 'constitution party' 'concerned citizens' 'statesman' 'citizens'
 'workers world' 'national unity campaign' 'anderson coalition'
 'nominated by petition' 'respect for life' 'right-to-life'
 'middle class candidate' 'down with lawyers' "natural people's league"
 'populist' 'alliance' 'united sovereign citizens' 'workers league'
 'big deal party' 'national unity' 'new alliance'
 'national economic recovery' 'third world assembly' 'solidarity'
 'patriotic party' 'other' 'progressive' 'grassroots' 'consumer'
 'write-in' 'united citizens' 'liberty union party' 'america first'
 'independents for economic recovery' 'natural law' 'taxpayers party'
 'democrat/republican' 'unaffiliated' 'campaign for a new tomorrow'
 'equal justice and opportunity' 'more perfect democracy'
 'justice, industry, and agriculture' 'independent voters'
 'larouche for president party' 'socialist party usa'
 'tisch independent citizens' 'independent american' '6 million jobs'
 'ron daniels independent' 'america first populist'
 'independents for larouche' 'freedom for larouche'
 'labor-farm-laborista-agrario' 'third party' 'reform party' 'green'
 'u.s. taxpayers party' 'looking back party' 'liberty, ecology, community'
 'socialist equality party' 'independent grassroots' 'independence'
 'freedom' 'independent nomination' 'patriot party' 'unenrolled'
 'democratic-farmer-labor' 'reform party minnesota' 'citizens first'
 'working families' 'progressive/green' 'vermont grassroots'
 'alaskan independence party' 'american constitution party'
 'concerns of people' 'petitioning candidate' 'd.c. statehood green'
 'constitution party of florida' 'socialist party of florida'
 'protecting working families' 'green-rainbow' 'better life'
 'christian freedom party' 'nebraska party' 'peace and justice'
 'pacific green' 'nonpartisan' 'personal choice' 'wisconsin green'
 'socialism and liberation party' "america's independent party"
 'boston tea party' "heartquake '08" 'objectivist party'
 'u.s. pacifist party' 'ecology party of florida' 'new'
 'louisiana taxpayers party' 'vote here' 'peace party' 'independent green'
 'mountain party' 'we the people' 'justice' "america's party"
 'american third position' 'american independent'
 'constitutional government' 'nsa did 911' 'new mexico independent party'
 'american delta party' 'better for america' 'veterans party of america'
 'independent people of colorado' 'american solidarity party'
 'nutrition party' 'kotlikoff for president'
 'nonviolent resistance/pacifist' 'approval voting party'
 'new independent party iowa' 'legal marijuana now' 'workers world party'
 "women's equality" 'party for socialism and liberation'
 'life and liberty party' 'unity party' 'prohibition party'
 'progressive party' 'socialist workers party'
 'independent american party' 'non-affiliated' 'dc statehood green'
 'american shopping party' 'geneology know your family history party'
 'becoming one nation' 'c.u.p' 'freedom and prosperity'
 'life , liberty, constitution' 'the birthday party' 'bread and roses'
 'us taxpayers party' 'grumpy old patriots' 'american solidarity'
 'constitution' 'liberty union' 'boiling frog' 'bull moose'
 'approval voting']
```

In [15]:
```
cols = ["party_simplified","state"]
fig,axes=plt.subplots(nrows=2,ncols=1,figsize=[30,24])
for i in range(0,len(cols)):
    axes[i]=sns.countplot(x = cols[i],data = df,ax=axes[i])
    axes[i].set_xticklabels(axes[i].get_xticklabels(), rotation=75)
    axes[i].set_title("Count plot of "+cols[i] + " Candidates / Parties")
    print("*"*50)
```

```
**************************************************
**************************************************
```

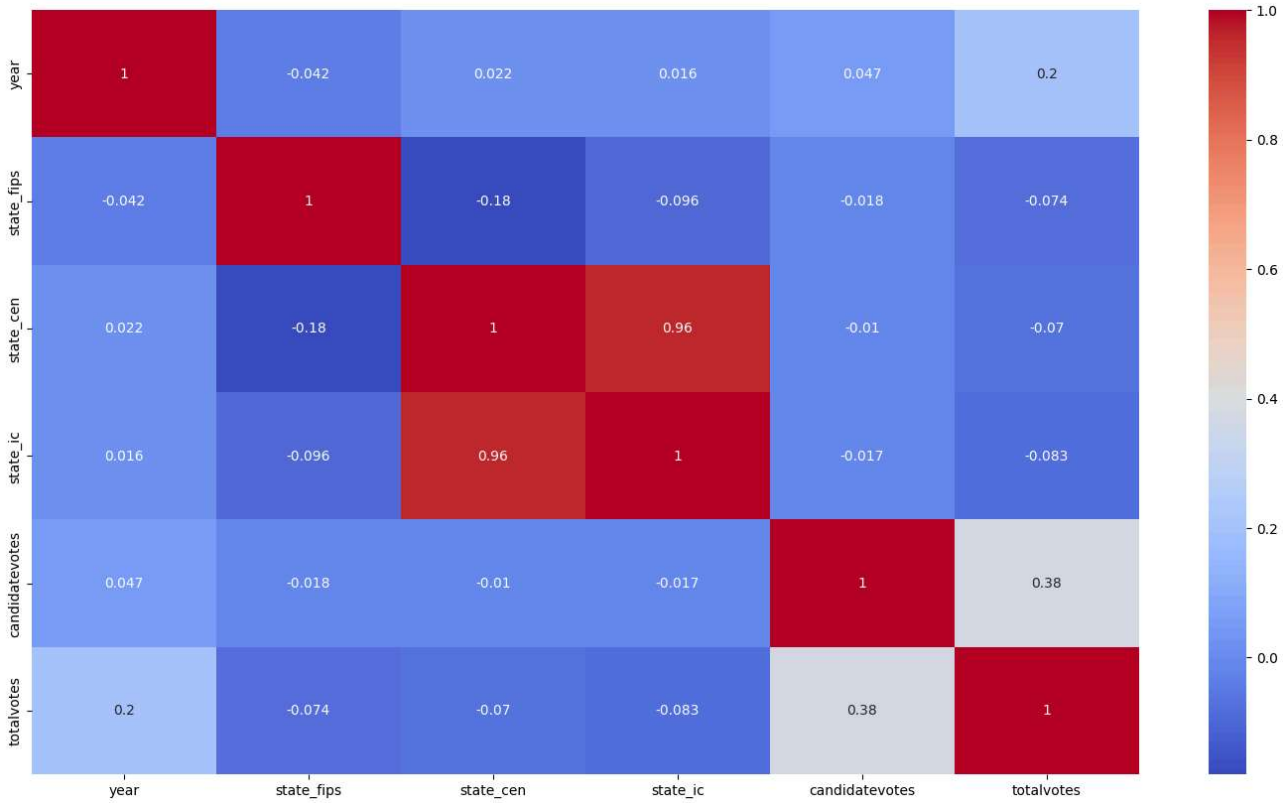




In [16]:
```
#Plotting a heatmap to check most correlated columns
plt.figure(figsize=(18,10))
sns.heatmap(df.corr(),cmap='coolwarm',annot=True)
```

```
/var/folders/md/bwhknjsx4t3fc85j8f04l_w40000gn/T/ipykernel_24345/238214810.py:3: FutureWarning:

The default value of numeric_only in DataFrame.corr is deprecated. In a future version, it will default to False. Select only va
lid columns or specify the value of numeric_only to silence this warning.
```

Out[16]: <AxesSubplot: >



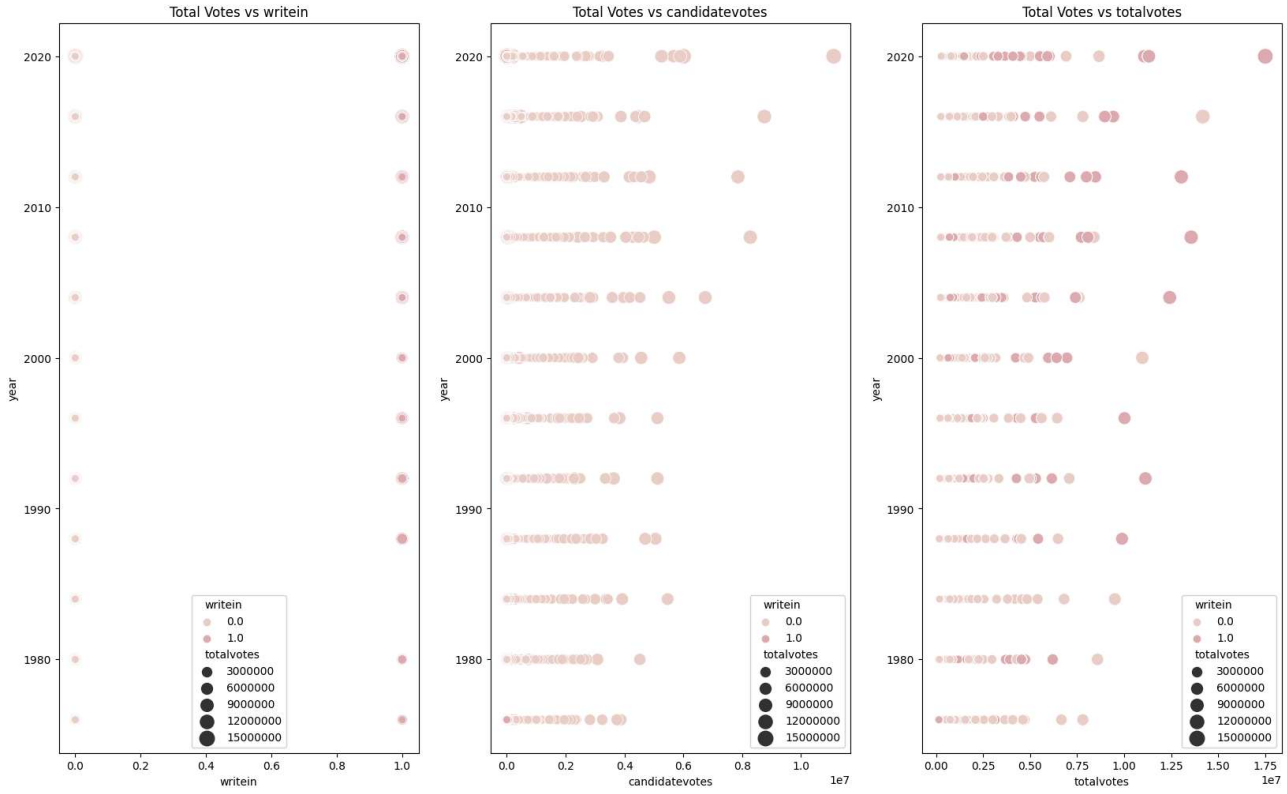
Bivariate Analysis

In [17]:
```
df.columns
```

Out[17]:
```
Index(['year', 'state', 'state_po', 'state_fips', 'state_cen', 'state_ic',
       'office', 'candidate', 'party_detailed', 'writein', 'candidatevotes',
       'totalvotes', 'party_simplified', 'party'],
      dtype='object')
```

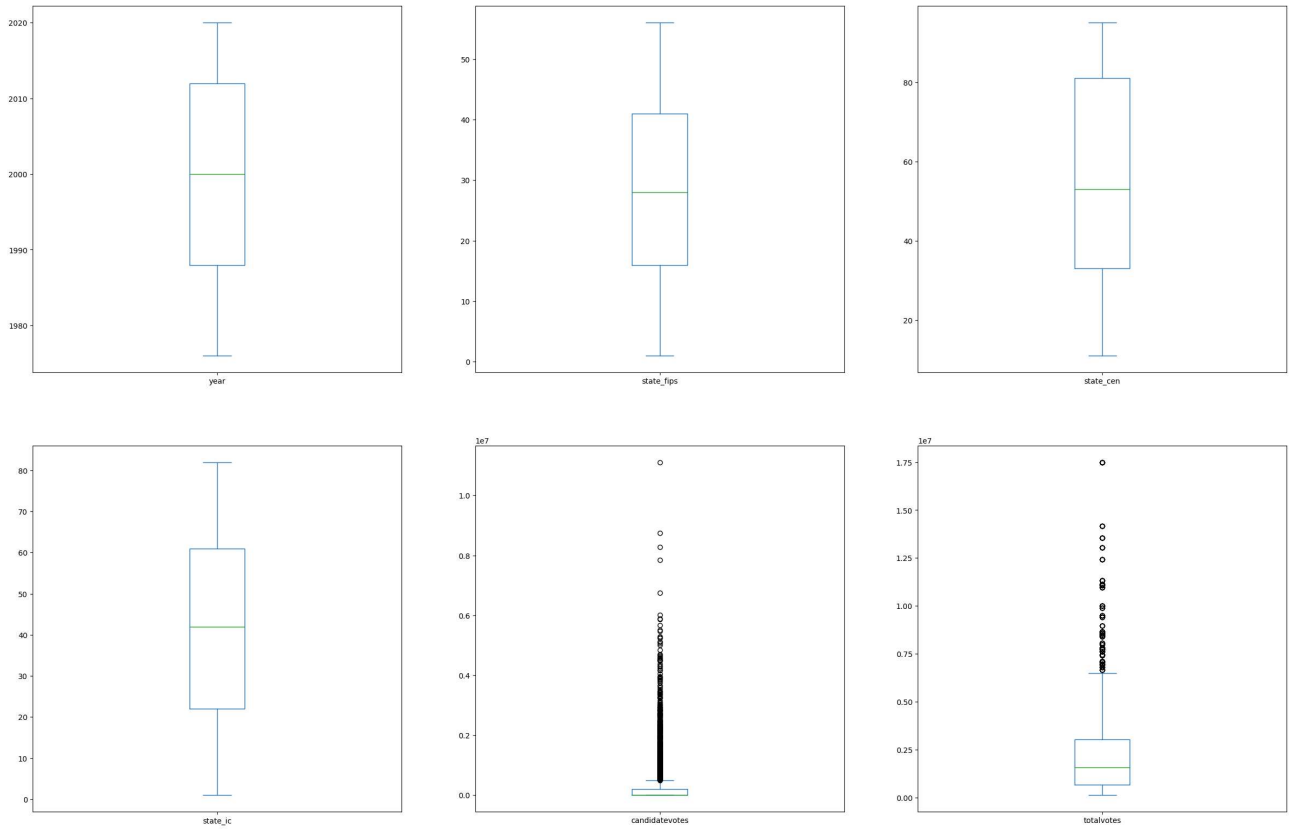
In [18]:
```
#Plotting scatter plots for voting method
cols=['writein', 'candidatevotes',
      'totalvotes']
#Creating a figure and axes for subplots, with 1 row and 3 columns, and a specific size
fig, axes = plt.subplots(nrows=1,ncols=3,figsize=[20,12])
#Iteration through each column for the column list keeping cols on x axis and year on y axis respectively in each plot
for i in range(0,len(cols)):
    axes[i]=sns.scatterplot( x= cols[i], y="year",
                            data = df,hue="writein",
                            size = "totalvotes",
                            sizes=(50,200),
                            hue_norm=(0, 6),
                            cmap="viridis",
                            ax=axes[i])
#Setting up titles for subplots
    axes[i].set_title("Total Votes vs "+cols[i])
```

```
/Library/Frameworks/Python.framework/Versions/3.11/lib/python3.11/site-packages/seaborn/relational.py:573: UserWarning:

No data for colormapping provided via 'c'. Parameters 'cmap' will be ignored

/Library/Frameworks/Python.framework/Versions/3.11/lib/python3.11/site-packages/seaborn/relational.py:573: UserWarning:

No data for colormapping provided via 'c'. Parameters 'cmap' will be ignored

/Library/Frameworks/Python.framework/Versions/3.11/lib/python3.11/site-packages/seaborn/relational.py:573: UserWarning:

No data for colormapping provided via 'c'. Parameters 'cmap' will be ignored
```



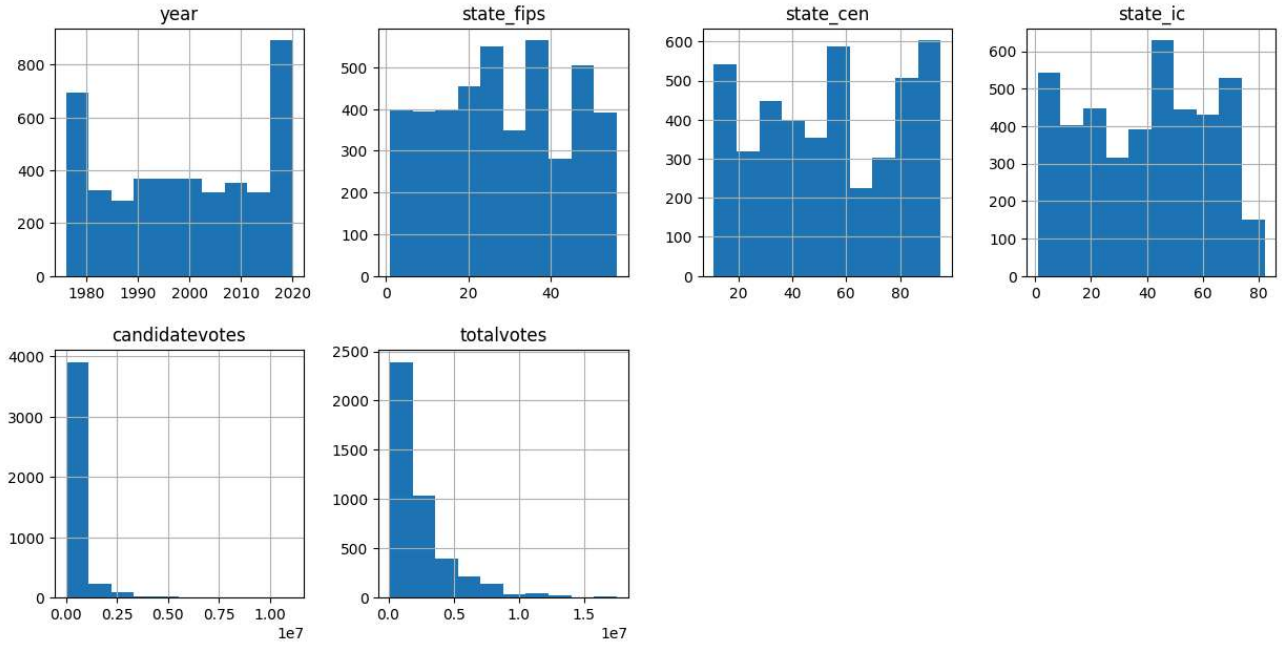
In [19]:
```
#Plotting Boxplots for checking mathematical values and outliers for each numerical value in the dataframe
df.plot(kind="box",subplots=True,layout=(3,3),figsize=(30,30))
```

Out[19]:
```
year                AxesSubplot(0.125,0.653529;0.227941x0.226471)
state_fips       AxesSubplot(0.398529,0.653529;0.227941x0.226471)
state_cen        AxesSubplot(0.672059,0.653529;0.227941x0.226471)
state_ic            AxesSubplot(0.125,0.381765;0.227941x0.226471)
candidatevotes   AxesSubplot(0.398529,0.381765;0.227941x0.226471)
totalvotes       AxesSubplot(0.672059,0.381765;0.227941x0.226471)
dtype: object
```



In [20]:
```
#Plotting histograms to see spread of various columns
df.hist(figsize=(15,15), layout=(4,4), bins=10)
```

Out[20]:
```
array([[<AxesSubplot: title={'center': 'year'}>,
        <AxesSubplot: title={'center': 'state_fips'}>,
        <AxesSubplot: title={'center': 'state_cen'}>,
        <AxesSubplot: title={'center': 'state_ic'}>],
       [<AxesSubplot: title={'center': 'candidatevotes'}>,
        <AxesSubplot: title={'center': 'totalvotes'}>, <AxesSubplot: >,
        <AxesSubplot: >],
       [<AxesSubplot: >, <AxesSubplot: >, <AxesSubplot: >,
        <AxesSubplot: >],
       [<AxesSubplot: >, <AxesSubplot: >, <AxesSubplot: >,
        <AxesSubplot: >]], dtype=object)
```



In [21]:
```
df.skew()
```

```
/var/folders/md/bwhknjsx4t3fc85j8f04l_w40000gn/T/ipykernel_24345/1665899112.py:1: FutureWarning:

The default value of numeric_only in DataFrame.skew is deprecated. In a future version, it will default to False. In addition, s
pecifying 'numeric_only=None' is deprecated. Select only valid columns or specify the value of numeric_only to silence this warn
ing.
```

Out[21]:
```
year             -0.048871
state_fips        0.029350
state_cen        -0.026119
state_ic         -0.080905
writein           2.471984
candidatevotes    4.506062
totalvotes        2.216780
dtype: float64
```

Let us see how many parties have contested in each state since 1976 elections

In [22]:
```
#Grouping the DataFrame by state and counting the number of unique parties per state
parties_per_state = df.groupby('state')['party_detailed'].nunique().reset_index().sort_values('party_detailed',ascending = False)
#Creating a bar plot using Plotly Express (px) to visualize the number of unique parties per state
fig = px.bar(parties_per_state, x='state', y='party_detailed', color='party_detailed', height=600)
#Displaying the plot
fig.show()
```

Let us see how many votes have been polled by 3rd to 20th parties since 1976 elections

Top-5 major parties

In [23]:
```
#Groupby dataframe by party_detailed and calculated sum of candidate votes for each party
vote_per_party= df.groupby('party_detailed')['candidatevotes'].sum().reset_index().sort_values('candidatevotes',ascending = False
#Plotting a bar graph keeping party name on x axis and total votes on y axis with the color scheme
fig = px.bar(vote_per_party.head(5), x='party_detailed', y='candidatevotes', color='candidatevotes', height=600)
#Plotting the bar graph using plotly express
fig.show()
```

Top 20 non major parties

In [24]:
```
# Filtering out rows corresponding to major parties (DEMOCRAT, REPUBLICAN, INDEPENDENT, LIBERTARIAN)
# "~" is used to negate the condition, keeping rows where 'party_detailed' is not in the specified list
vote_per_party_nodemrep= vote_per_party[~vote_per_party["party_detailed"].isin(["DEMOCRAT","REPUBLICAN","INDEPENDENT","LIBERTARIA
#Selecting top 20 parties according to highest number of candidate votes among non major parties
fig = px.bar(vote_per_party_nodemrep.head(20), x='party_detailed', y='candidatevotes', color='candidatevotes', height=600)
#Plotting the bar graph using plotly express
fig.show()
```

Let us see top-25 vote getters across 40 years

In [25]:
```
#Groupby DataFrame 'df' by 'candidate' and calculate the sum of 'candidatevotes' for each candidate
vote_per_candidate= df.groupby('candidate')['candidatevotes'].sum().reset_index().sort_values('candidatevotes',ascending = False)
#Selecting top 25 candidates by the highest number of candidate votes
fig = px.bar(vote_per_candidate.head(25), x='candidate', y='candidatevotes', color='candidatevotes', height=600)
#Plotting the bar graph using plotly express
fig.show()
```

Trying a pie chart for visualising states contribution

In [26]:
```
#Grouping the dataframe 'df' by state and calculating sum of total votes for each state
df2=df.groupby('state')['totalvotes'].sum().reset_index().sort_values('totalvotes',ascending = False)
# Representing only large states keeping states less than 200 million votes to 'other states' category
df2.loc[df2['totalvotes'] < 2.e8, 'state'] = 'Other States'
#Creating a pie chart to see the distribution of votes across states
fig = px.pie(df2, values='totalvotes', names='state', title='Total Votes')
#Plotting the pie chart using plotly express
fig.show()
```

In [27]:
```
#Creating a distribution plot using Holoviews for the 'totalvotes' column of DataFrame 'df2'
#Setting the plot variables which are customisable to appearance
pr = hv.Distribution(df2['totalvotes']).opts(title="Statewide Vote Distribution", color="purple", xlabel="State Vote size", ylabe
                            .opts(opts.Distribution(width=400, height=300,tools=['hover'],show_grid=True))
#Displaying the plot using holoviews
pr
```

Out[27]:

Let us try some more plotly charts

In [28]:
```
#Plotting a bar plot for each state showing total number of votes according to year given by a color configuration
fig = px.histogram(df, x='state', y='totalvotes', color='year')
fig
```

In [29]:
```
fig = px.histogram(df, x='state', y='totalvotes', color='party_simplified')
fig
```

In [30]:
```
fig = px.histogram(df, x='state', y='totalvotes', color='year', facet_row='party_simplified', height=3600, hover_name='year')
fig
```

In [31]:
```
#Creating a plotly express plot for parallel_categories year and parties
fig = px.parallel_categories(df, dimensions=['year', 'party_simplified'], color='year', color_continuous_scale='armyrose')
#Updating layout of the plot to enable autosizing
fig.update_layout(autosize=True)
#Displaying the plot
fig
```

In [32]:
```
#Plotting a density contour plot using plotly express
#This plot provides a visual representation of the density of data points across different states ('state') and years ('year'), w
#The color of the contour lines indicates the party affiliation ('party_simplified'). Hovering over the plot reveals additional i
fig = px.density_contour(df, x='state', y='year', z='candidatevotes', color='party_simplified', hover_name='candidatevotes')
#Displaying the plot
fig
```

Let us try some Maps

States and Total votes

In [33]:
```
#Creating a choropleth map using Plotly Express
#locations: Column specifying the location codes or names ('state_po' - State postal codes)
#color: Column specifying the values to be represented by color ('totalvotes' - Total votes)
#range_color: Range of values to map to the color scale (0 to 8,000,000)
#locationmode: Specify the location mode ('USA-states' for US states)
#scope: Scope of the map ('usa' for USA)
#title: Title of the choropleth map
fig = px.choropleth(df, locations='state_po', color="totalvotes",
                            range_color=(0, 8000000),
                            locationmode = 'USA-states',
                            scope="usa",
                            title='USA Presidential Vote Counts'
                           )
#Updating the layout of plot to adjust margins
fig.update_layout(margin={"r":0,"t":0,"l":0,"b":0})
#Showing the choropleth map
fig.show()
```

Top 5 political parties and states

In [34]:
```
#Group the DataFrame by 'party' and calculate the sum of 'candidatevotes' for each party
vote_per_party= df.groupby('party')['candidatevotes'].sum().reset_index().sort_values('candidatevotes',ascending = False)
#Iterating over the top 5 parties
for index, row in vote_per_party.head(5).iterrows():
    party_name = row['party']
    title_head = 'USA Presidential Vote Counts - ' + party_name
    print(title_head)
    df_r = df.loc[df['party'] == party_name]
    fig = px.choropleth(df_r,
                        locations='state_po',
                        color="candidatevotes",
                        range_color=(0, 8000000),
                        locationmode = 'USA-states',
                        title=title_head,
                        scope="usa")
    fig.update_layout(margin={"r":0,"t":0,"l":0,"b":0})
    fig.show()
```

```
USA Presidential Vote Counts - democrat
```

Democratic party across several states with timestamp

In [66]:
```
#Creating a copy of the dataframe to avoid modifying the original
df_temp = df.copy()

#Filtering the dataframe to only include rows where 'party' is in the specified list
df_temp = df_temp[df_temp.party.isin(['democrat', 'republican', 'independent',
                                      'reform', 'libertarian', 'alliance'])]

#Grouping the data by 'state', 'state_po', 'party', and 'year'
#and sum the 'candidatevotes' for each group
df_temp = df_temp.groupby(['state', 'state_po', 'party', 'year'])["candidatevotes"].sum()

#Resetting the index to create new columns from the previous index
df_temp = df_temp.reset_index()

#Filtering the data to only include rows where 'party' is 'democrat'
datadump = df_temp[df_temp['party'] == 'democrat']

#Creating a choropleth using plotly express
px.choropleth(datadump,
              locations='state_po',  # Use 'state_po' for locations
              color="candidatevotes",  # Color based on 'candidatevotes'
              animation_frame="year",  # Animate by 'year'
              color_continuous_scale="Inferno",  # Use 'Inferno' color scale
              locationmode='USA-states',  # Set location mode to US states
              scope="usa",              # Set scope to USA
              range_color=(100000, 5000000),  # Color range from 100,000 to 5,000,000
              title='Total Votes by Party - Democrats',  # Set title
              height=600                # Set chart height
)
```

Independent parties across several states

In [36]:
```
#Filtering data for independent candidates and sort by year:
datadump = df_temp[df_temp['party'] == 'independent'].sort_values('year', ascending=True)
#Creating an animated choropleth map using Plotly Express:
px.choropleth(datadump,
              locations = 'state_po',
              color="candidatevotes",
              animation_frame="year",
              color_continuous_scale="Inferno",
              locationmode='USA-states',
              scope="usa",
              range_color=(1000, 100000),
              title='Total Votes by Party - Independents',
              height=600
             )
```

Libertarian party across several states across each year span

In [37]:
```
#Filtering data for the Libertarian party and sort by year:
datadump = df_temp[df_temp['party'] == 'libertarian'].sort_values('year', ascending=True)
#Creating an animated choropleth map using Plotly Express:
px.choropleth(datadump,
              locations = 'state_po',
              color="candidatevotes",
              animation_frame="year",
              color_continuous_scale="Inferno",
              locationmode='USA-states',
              scope="usa",
              range_color=(1000, 100000),
              title='Total Votes by Party - Libertarian Party',
              height=600
             )
```

Republican party across several states for each year

In [38]:
```
#Filtering data for Republican party and sort by year
datadump = df_temp[df_temp['party'] == 'republican'].sort_values('year', ascending=True)
#Creating an animated choropleth map using Plotly Express
px.choropleth(datadump,
              locations = 'state_po',
              color="candidatevotes",
              animation_frame="year",
              color_continuous_scale="Inferno",
              locationmode='USA-states',
              scope="usa",
              range_color=(100000, 5000000),
              title='Total Votes by Party - Republican',
              height=600
             )
```

Alliance party across several states for each year

In [39]:
```
#Filtering data for 'alliance' party and sort by 'year':
datadump = df_temp[df_temp['party'] == 'alliance'].sort_values('year', ascending=True)
#Creating an animated choropleth map:
px.choropleth(datadump,
              locations = 'state_po',
              color="candidatevotes",
              animation_frame="year",
              color_continuous_scale="Inferno",
              locationmode='USA-states',
              scope="usa",
              range_color=(1000, 50000),
              title='Total Votes by Party - Alliance Party',
              height=600
             )
```

Let us try other visualizations

In [40]:
```
df_temp = df
state_group = df_temp.groupby(['year','state','state_po', 'party','candidate']).agg({'candidatevotes': 'sum'})
state_pcts = state_group.groupby(level=0).apply(lambda x:
                                                100 * x / float(x.sum()))
state_pcts = state_pcts.reset_index()
```

```
/var/folders/md/bwhknjsx4t3fc85j8f04l_w40000gn/T/ipykernel_24345/3929514380.py:3: FutureWarning:

Not prepending group keys to the result index of transform-like apply. In the future, the group keys will be included in the ind
ex, regardless of whether the applied function returns a like-indexed object.
To preserve the previous behavior, use

        >>> .groupby(..., group_keys=False)

To adopt the future behavior and silence this warning, use

        >>> .groupby(..., group_keys=True)
```

In [41]:
```
#Filtering data for Democrat party
datadump = state_pcts[state_pcts['party'] == 'democrat']
#Creating an animated choropleth map using Plotly Express
px.choropleth(datadump,
              locations = 'state_po',
              color="candidatevotes",
              animation_frame="year",
              color_continuous_scale="Inferno",
              locationmode='USA-states',
              scope="usa",
              range_color=(0.01, 0.90),
              title='Total Votes by Party - Democrat Party',
              height=600
             )
```

In [42]:
```
#Let us define parties we want to track - We will pick the top-2 parties
parties = ['democrat', 'republican','libertarian','independent']
top2_df=df.loc[df['party'].isin(parties)]
#Let us build pivot tables we shall use for various examples
#Pivot-1 indexed on year and state on the aggregated sum on party votes
table = pd.pivot_table(top2_df, values='candidatevotes', index=['year', 'state'],
                       columns=['party'], aggfunc=np.sum)
#Pivot-2 indexed on year for the aggregated sum on party votes
table2 = pd.pivot_table(top2_df, values='candidatevotes', index=['year'],
                       columns=['party'], aggfunc=np.sum)
#Pivot-3 indexed on state for the aggregated sum on party votes
table3 = pd.pivot_table(top2_df, values='candidatevotes', index=['state'],
                       columns=['party'], aggfunc=np.sum)
source = ColumnDataSource(df)
```

In [43]:
```
#Let us build a line graph for republican and democrat votes
p = figure()
p.line(x='year', y='republican', source=table2,
         line_width=2, color=rand_color(),legend_label='Republican')
p.circle_dot(x='year', y='republican', source=table2,
         size=10, color=rand_color(),legend_label='Republican')
p.line(x='year', y='democrat', source=table2,
         line_width=2, color=rand_color(),legend_label='Democrat')
p.diamond_cross(x='year', y='democrat', source=table2,
         size=10, color=rand_color(),legend_label='Democrat')
p.line(x='year', y='libertarian', source=table2,
         line_width=2, color=rand_color(),legend_label='libertarian')
p.diamond(x='year', y='libertarian', source=table2,
         size=10, color=rand_color(),legend_label='libertarian')
p.line(x='year', y='independent', source=table2,
         line_width=2, color=rand_color(),legend_label='Independents')
p.diamond(x='year', y='independent', source=table2,
         size=10, color=rand_color(),legend_label='Independents')
p.title.text = 'A Sample Line Chart of total votes colllected by Republicans , Democrats, Green Party and Independents in the US
p.xaxis.axis_label = 'Year'
p.yaxis.axis_label = 'Votes'
p.legend.location = 'top_left'
p.legend.title ='Parties'
#Let us remove the scientific formatting
p.yaxis.formatter=NumeralTickFormatter(format="00")
#Let us add a hovering tool
hover = HoverTool()
hover.tooltips=[
    ('Year', '@year')
]
p.add_tools(hover)
#show the plot
show(p)
```

```
/var/folders/md/bwhknjsx4t3fc85j8f04l_w40000gn/T/ipykernel_24345/2471642404.py:5: BokehDeprecationWarning:

'circle_dot() method' was deprecated in Bokeh 3.4.0 and will be removed, use "scatter(marker='circle_dot', ...) instead" instea
d.

/var/folders/md/bwhknjsx4t3fc85j8f04l_w40000gn/T/ipykernel_24345/2471642404.py:9: BokehDeprecationWarning:

'diamond_cross() method' was deprecated in Bokeh 3.4.0 and will be removed, use "scatter(marker='diamond_cross', ...) instead" i
nstead.

/var/folders/md/bwhknjsx4t3fc85j8f04l_w40000gn/T/ipykernel_24345/2471642404.py:13: BokehDeprecationWarning:

'diamond() method' was deprecated in Bokeh 3.4.0 and will be removed, use "scatter(marker='diamond', ...) instead" instead.

/var/folders/md/bwhknjsx4t3fc85j8f04l_w40000gn/T/ipykernel_24345/2471642404.py:17: BokehDeprecationWarning:

'diamond() method' was deprecated in Bokeh 3.4.0 and will be removed, use "scatter(marker='diamond', ...) instead" instead.
```

- For this, we shall build a pivot table on the data and plot the trends. Bar Chart and Difference in Data
- Following program leverages the power of pandas and builds a new column for difference in votes and uses it for plotting the vertical bar chart to show the trend over the years.

In [44]:
```
#Defining a function to calculate absolute difference
def abs_min(a, b): # a, b are input arrays
    return np.abs(a[:,None]-b).min(axis=0)
#Defining a function to calculate difference
def diff_min(a, b): # a, b are input arrays
    return (a-b)
```

In [45]:
```
#Converting the pivot table to a pandas datafrmae
table31_df = pd.DataFrame(table3.to_records())
#Finding the difference between democrats and republicans
diffs = diff_min(table31_df.republican.values, table31_df.democrat.values)
#Creating a new column with difference in votes
table31_df.insert(3, "difference", diffs, True)
#Let us choose the top Republican states
table3_df = table31_df.sort_values(by='republican', ascending=False).head(15)
states = table3_df['state']
#Converting the vots as multiples of millions
republican = table3_df['republican']/1000000
democrat = table3_df['democrat'] / 1000000
difference = table3_df['difference'] / 1000000
```

In [46]:
```
#Building a dataset for plotting
data = {'states' : states, 'republican' : republican,
        'democrat' : democrat, 'difference' : difference }
source = ColumnDataSource(data=data)
#Plot a vertical bar chart with dodge by a parameter
p2 = figure(height=1500, width=1200,x_range=states,
            y_range=(difference.min(),max(republican.max(), democrat.max())),
            title="State wise Votes - vote size in millions")
p2.vbar(x=dodge('states', -0.25, range=p2.x_range), top='republican', width=0.2,
        source=source, color="#ff0011", legend_label="Republican")
p2.vbar(x=dodge('states', +0.0, range=p2.x_range), top='democrat', width=0.2,
        source=source, color="#1100ff", legend_label="Democrat")
p2.vbar(x=dodge('states', +0.25, range=p2.x_range), top='difference', width=0.2,
        source=source, color="gold", legend_label="Difference")
#Plot a line plots
p2.line(x=dodge('states', -0.25, range=p2.x_range), y='republican',
         source=source, line_width=2, color='red',legend_label='Republican')
p2.circle_dot(x=dodge('states', -0.25, range=p2.x_range), y='republican',
         source=source, size=4, color=rand_color(),legend_label='Republican')
p2.line(x='states', y='democrat',
         source=source, line_width=2, color='navy',legend_label='Democrat')
p2.diamond_cross(x='states', y='democrat',
         source=source, size=4, color=rand_color(),legend_label='Democrat')
p2.line(x=dodge('states', +0.25, range=p2.x_range), y='difference',
         source=source, line_width=2, color='gold',legend_label='Difference')
p2.diamond_dot(x=dodge('states', +0.25, range=p2.x_range), y='difference',
         source=source, size=4, color=rand_color(),legend_label='Difference')
#Add Formatting aspects
p2.x_range.range_padding = 0.1
p2.xgrid.grid_line_color = None
p2.legend.location = "top_right"
p2.legend.orientation = "vertical"
p2.yaxis.formatter=NumeralTickFormatter(format="00")
p2.xaxis.major_label_orientation = math.pi/2
#Add Hover
hover = HoverTool()
hover.tooltips=[('States', '@states')]
p2.add_tools(hover)
#Show the plot
show(p2)
```

```
/var/folders/md/bwhknjsx4t3fc85j8f04l_w40000gn/T/ipykernel_24345/642709768.py:17: BokehDeprecationWarning:

'circle_dot() method' was deprecated in Bokeh 3.4.0 and will be removed, use "scatter(marker='circle_dot', ...) instead" instea
d.

/var/folders/md/bwhknjsx4t3fc85j8f04l_w40000gn/T/ipykernel_24345/642709768.py:21: BokehDeprecationWarning:

'diamond_cross() method' was deprecated in Bokeh 3.4.0 and will be removed, use "scatter(marker='diamond_cross', ...) instead" i
nstead.

/var/folders/md/bwhknjsx4t3fc85j8f04l_w40000gn/T/ipykernel_24345/642709768.py:25: BokehDeprecationWarning:

'diamond_dot() method' was deprecated in Bokeh 3.4.0 and will be removed, use "scatter(marker='diamond_dot', ...) instead" inste
ad.
```

- For the this, let us see how both the parties performed in one of their bellwether states over the years.
- We shall take one state for each party to plot the performance and show the trend.

In [47]:
```
from bokeh.models import FixedTicker
from bokeh.palettes import Turbo256
table41_df = pd.DataFrame(table.to_records())
diffs = abs_min(table41_df.republican.values, table41_df.democrat.values)
table41_df.insert(3, "difference", diffs, True)
table4_df = table41_df.sort_values(by='democrat', ascending=False)
states = table4_df['state']
#Change the values in 1000s of vote
republican = table4_df['republican']/1000
democrat = table4_df['democrat'] / 1000
difference = table4_df['difference'] / 1000
year = table4_df['year'].sort_values(ascending=True).unique()
table4_df.republican.fillna(0)
table4_df.difference.fillna(0)
table4_df.democrat.fillna(0)
tab4_pivot = pd.pivot_table(table4_df, values=['republican','democrat','difference'],
                            index=['year'], columns=['state'], aggfunc=np.sum, margins=True)
flat_tab4_df = pd.DataFrame(tab4_pivot.to_records())
tabcols = [flat_tab4_df.columns]
years = table4_df['year']
states = table4_df['state']
republican = table4_df['republican']/1000
democrat = table4_df['democrat'] / 1000
difference = table4_df['difference'] / 1000
votegroup = ['democrat', 'republican','difference']
source = ColumnDataSource(data=dict(x=tabcols, democrat=democrat, republican=republican, difference=difference,))
p4 = figure(width=900, height=800) #, x_axis_type="datetime")
years = flat_tab4_df.year
values = flat_tab4_df["('democrat', 'CALIFORNIA')"]
rvalues = flat_tab4_df["('republican', 'CALIFORNIA')"]
#Plotting for a democrat state - California
p4.vbar(years, top = values, width = .9, fill_alpha = .5,line_alpha = .5,
        fill_color = rand_color(), line_color=rand_color(), line_dash='dashed')
p4.line(years,rvalues,line_width=4,line_color="red",line_dash="dotted")
p4.circle(years,rvalues,radius=.2,fill_color='yellow',line_color=rand_color())
hover = HoverTool()
hover.tooltips=[('Votes', '@top'),('Year',  '@x')]
p4.x_range.range_padding = 0.1
p4.xgrid.grid_line_color = None
p4.yaxis.formatter=NumeralTickFormatter(format="00")
p4.xaxis.major_label_orientation = math.pi/2
p4.add_tools(hover)
show(p4)

p5 = figure(width=900, height=800)
years = flat_tab4_df.year
#Plotting for a republican state - Texas
values = flat_tab4_df["('republican', 'TEXAS')"]
dvalues = flat_tab4_df["('democrat', 'TEXAS')"]
divalues = flat_tab4_df["('difference', 'TEXAS')"]
p5.vbar(years, top = values, width = .9, fill_alpha = .5,line_alpha = .5,
        fill_color = rand_color(), line_color=rand_color(), line_dash='dotted')
p5.line(years,dvalues,line_width=4,line_color="navy",line_dash="dotted")
p5.circle(years,dvalues,radius=.2,fill_color='yellow',line_color=rand_color())
p5.line(years,divalues,line_width=2,line_color=rand_color(),line_dash="dashdot")
hover = HoverTool()
hover.tooltips=[('Votes', '@top'),('Year',  '@x')]
p5.x_range.range_padding = 0.1
p5.xgrid.grid_line_color = None
p5.yaxis.formatter=NumeralTickFormatter(format="00")
p5.xaxis.major_label_orientation = math.pi/2
p5.add_tools(hover)
show(p5)
```

```
/var/folders/md/bwhknjsx4t3fc85j8f04l_w40000gn/T/ipykernel_24345/427574933.py:26: BokehUserWarning:

ColumnDataSource's columns must be of the same length. Current lengths: ('democrat', 612), ('difference', 612), ('republican', 6
12), ('x', 1)
```

In [65]:
```
#Preparing the data for the plot
data = [go.Bar(
    x=df['year'].unique(),
    y=df.groupby(['year','state'])['candidate'].count(),
    textposition = 'auto',
    marker=dict(
        color=df['totalvotes'],
                line=dict(
                    color='rgb(8,48,107)',
                    width=1.5),
            ),
            opacity=0.6
    )]
#Defining the layout of the plot
layout = {
  'xaxis': {'title': 'Year'},
  'yaxis': {'title': 'No. of Candidates'},
  'barmode': 'relative',
  'title': 'Total Number of Candidates'
};
#Creating and displaying the plot
iplot({'data': data, 'layout': layout})
```

In [62]:
```
#Data for the chart is defined as a list of go.Bar objects
data = [go.Bar(
    #X-axis data: unique state values from the 'df' dataframe's 'state' column
    x=df['state'].unique(),

    #Y-axis data: sum of 'totalvotes' grouped by 'year' and 'party' from 'df'
    y=df.groupby(['year', 'party'])['totalvotes'].sum(),

    #Text positioning for data labels on bars (automatic positioning)
    textposition='auto',

    #Defining bar appearance
    marker=dict(
        color='mediumvioletred',  #Bar color
        line=dict(  #Line around bars
            color='rgb(8,48,107)',  #Line color
            width=1.5  #Line width
        )
    ),

    #Bar transparency
    opacity=0.6
)]

#Layout for the chart is (titles, mode, etc.)
layout = {
    'xaxis': {'title': 'Year'},  #X-axis title
    'yaxis': {'title': 'Total Votes'},  #Y-axis title
    'barmode': 'relative',  #Stacking bars on top of each other (proportionally)
    'title': 'Total Number of Candidates' #Chart title
};
#Generating the chart using plotly's iplot function
iplot({'data': data, 'layout': layout})
```

In [60]:
```
#Creating a new pandas DataFrame with election data
df_simple = df[['year','state','state_po','candidate','candidatevotes','totalvotes','party_simplified','party']].copy()
```

In [61]:
```
#Creating a new column 'party' and copy values from 'party_simplified'
df_simple['party'] = df_simple['party_simplified']
#Deleting the original 'party_simplified' column
del df_simple['party_simplified']
#Calculating the percentage of votes for each candidate
df_simple['percentage'] = round((df_simple['candidatevotes'] / df_simple['totalvotes'])*100,2)
df_simple.head()
```

Out[61]:

	year	state	state_po	candidate	candidatevotes	totalvotes	party	percentage
0	1976	ALABAMA	AL	CARTER, JIMMY	659170	1182850	DEMOCRAT	55.73
1	1976	ALABAMA	AL	FORD, GERALD	504070	1182850	REPUBLICAN	42.61
2	1976	ALABAMA	AL	MADDOX, LESTER	9198	1182850	OTHER	0.78
3	1976	ALABAMA	AL	BUBAR, BENJAMIN ""BEN""	6669	1182850	OTHER	0.56
4	1976	ALABAMA	AL	HALL, GUS	1954	1182850	OTHER	0.17

In [52]:
```
import warnings
warnings.filterwarnings('ignore')

#Making a new dataframe and printing relevant columns needed for further analysis
df_simple2 = df_simple.groupby(['state','year','candidate','percentage','party'])['candidatevotes'].sum().to_frame('candidatevote
print(df_simple2.head())
```

```
     state  year                candidate  percentage        party  \
0  ALABAMA  1976  BUBAR, BENJAMIN ""BEN""        0.56        OTHER
1  ALABAMA  1976            CARTER, JIMMY       55.73     DEMOCRAT
2  ALABAMA  1976              FORD, GERALD       42.61   REPUBLICAN
3  ALABAMA  1976                HALL, GUS        0.17        OTHER
4  ALABAMA  1976          MACBRIDE, ROGER        0.13  LIBERTARIAN

   candidatevotes
0            6669
1          659170
2          504070
3            1954
4            1481
```

In [53]:
```
#Creating a colormap using the "tab10" palette, specifically for mapping a continuous variable
sns.color_palette("tab10", as_cmap=True)
```

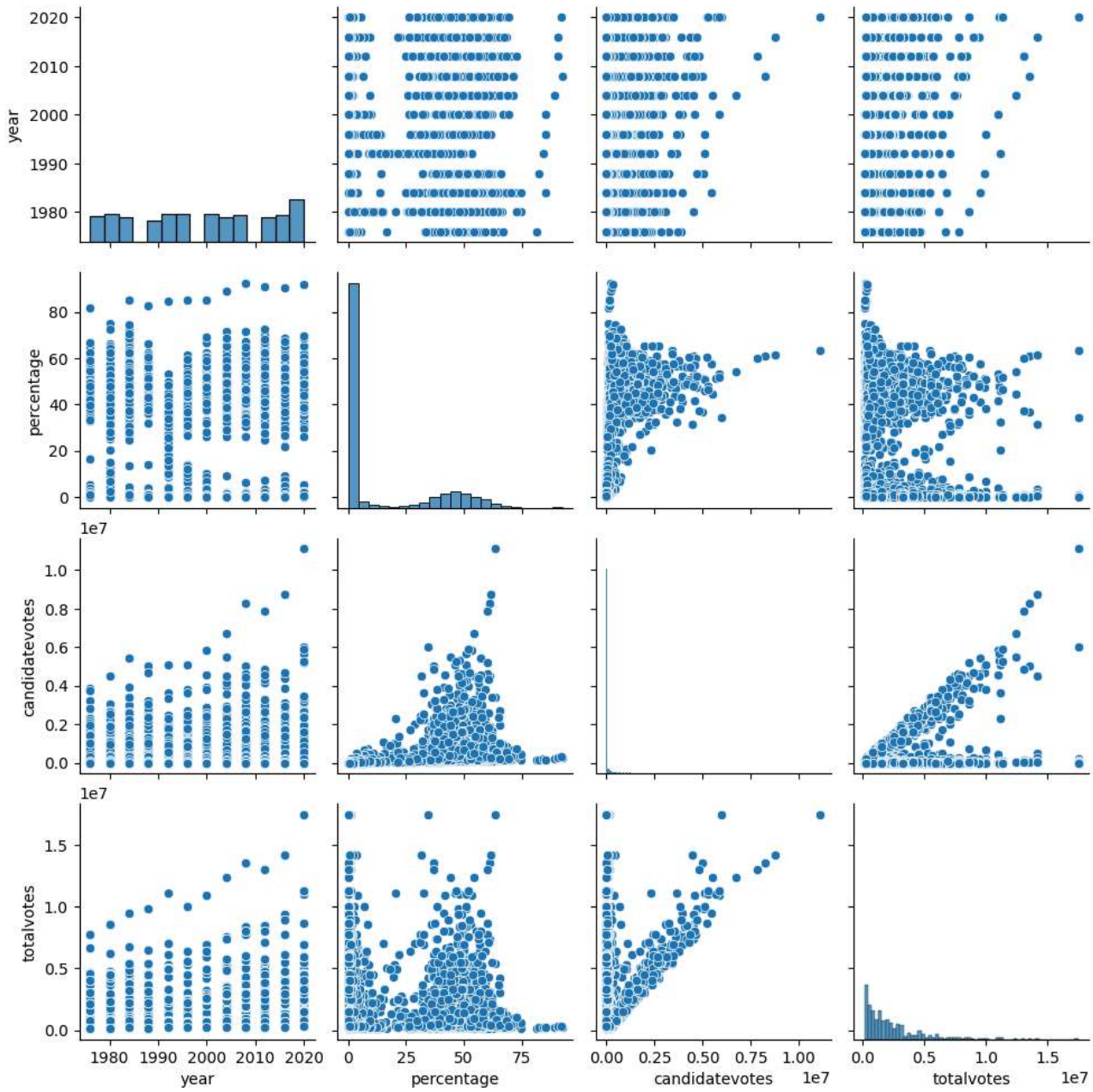
Out[53]:

tab10

under bad over

In [54]:
```
#Creating a pair plot using seaborn
sns.pairplot(df_simple[['state','year', 'party','percentage', 'candidatevotes','totalvotes']])
```

Out[54]: <seaborn.axisgrid.PairGrid at 0x31219b7d0>



In [55]:
```
dft = df_simple[df_simple['party'].isin(['DEMOCRAT', 'REPUBLICAN'])]

#Choosing the years that had a change in leadership
dft = dft[dft['year'].isin([1976,1980,1992, 2000, 2008, 2016, 2020])]
```

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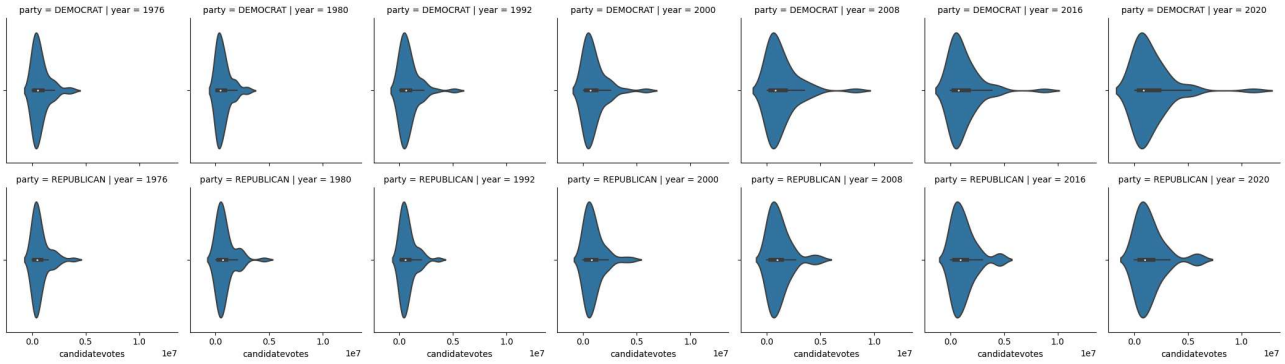
In [56]:
```
g = sns.FacetGrid(dft, row="party", col="year")
g.map(sns.violinplot, "candidatevotes")

#g2 = sns.FacetGrid(dft, row="year", col="state")
#g2.map(sns.boxenplot, x=dft["state"].head(5), y=dft["candidatevotes"], width=0.05)
```

Out[56]: <seaborn.axisgrid.FacetGrid at 0x312b5e390>



In [57]:
```
#Importing the Plotly Express library for creating interactive visualizations
import plotly.express as px

#Creating a scatter plot using Plotly Express
fig = px.scatter(df_simple,  # DataFrame containing election data
                 x="candidatevotes",  # X-axis: Number of votes for the candidate
                 y="percentage",  # Y-axis: Percentage of votes for the candidate
                 color="party",  # Color the dots based on the party of the candidate
                 animation_frame="year",  # Animate the plot by year
                 animation_group="state",  # Group the animation by state
                 size="candidatevotes",  # Resize the dots based on the number of votes
                 hover_name="state",  # Display the state name on hover
                 log_x=True,  # Use a logarithmic scale for the x-axis
                 size_max=55,  # Set a maximum size for the dots
                 range_x=[10000, 10000000],  # Limit the x-axis range to 10,000 to 10,000,000 votes
                 range_y=[0, 80],  # Limit the y-axis range to 0 to 80 percent
                 color_continuous_scale=px.colors.sequential.Viridis  # Use the Viridis color scale
                 )
#Displaying the interactive plot
fig.show()
```