In [1]:

```
# Dependencies
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import scipy
import seaborn as sns
```

In [2]:

```
# Read CSV
df = pd.read_csv("raw_data/FI_Case_Data.csv")
#display the whole dataframe
df.head()
```

Out[2]:

	Data	Year	Month	Value
0	Consumer Price Index	1947	1	21.48
1	Consumer Price Index	1947	2	21.62
2	Consumer Price Index	1947	3	22.00
3	Consumer Price Index	1947	4	22.00
4	Consumer Price Index	1947	5	21.95

Data cleaning

In [3]:

```
#number of records and columns
df.shape
```

Out[3]:

```
(1948, 4)
```

In [4]:

```
# strip the white space from the dataframe headers
print(df.columns)
df.columns=df.columns.str.strip()
print(df.columns)
```

```
Index(['Data', 'Year', 'Month ', 'Value'], dtype='object')
Index(['Data', 'Year', 'Month', 'Value'], dtype='object')
```

In [5]:

```
#unique counts of data
df.Data.value_counts()
```

Out[5]:

```
Unemployment Level      830
Consumer Price Index    804
Civilian Labor Force    276
CPI                      38
Name: Data, dtype: int64
```

In [6]:

```
# displaying the whole dataframe
df.head()
```

Out[6]:

	Data	Year	Month	Value
0	Consumer Price Index	1947	1	21.48
1	Consumer Price Index	1947	2	21.62
2	Consumer Price Index	1947	3	22.00
3	Consumer Price Index	1947	4	22.00
4	Consumer Price Index	1947	5	21.95

In [7]:

```
# df.Data[df["Data"]=="CPI"]="Consumer Price Index"
df.loc[df.Data=="CPI","Data"]="Consumer Price Index"
df.loc[df.Data=="CPI",:]
```

Out[7]:

	Data	Year	Month	Value

In [8]:

```
#unique counts of data
df.Data.value_counts()
```

Out[8]:

```
Consumer Price Index    842
Unemployment Level      830
Civilian Labor Force    276
Name: Data, dtype: int64
```

In [9]:

```
#detecting missing values
df[pd.isnull(df).any(axis=1)]
```

Out[9]:

	Data	Year	Month	Value

Unemployment rate , Inflation rate, and decade calculations

In [10]:

```
#selecting the data of Consumer Price Index, unemployment level and Civilian Lab
or Force  and put in separate dataframes
labor_df=df.loc[df.Data=='Civilian Labor Force',['Year', 'Month', 'Value']]
unemploy_df=df.loc[df.Data=='Unemployment Level',:]
CPI_df=df.loc[df.Data=='Consumer Price Index',['Year', 'Month', 'Value']]

print("unemp level record:",unemploy_df.shape,"labor force record:",labor_df.sha
pe,"CPI record :",\
      CPI_df.shape)
```

```
unemp level record: (830, 4) labor force record: (276, 3) CPI record
: (842, 3)
```

In [11]:

```
#renaming the value headings for the different dataframes
labor_df.rename(columns={"Value":"civilian_labor_force"},inplace=True )
unemploy_df.rename(columns={"Value":"unemployment_level"},inplace=True )
CPI_df.rename(columns={"Value":"inflation_level"},inplace=True )

#displya labor force dataframe
labor_df.head()
```

```
/Users/Shemelis/anaconda/lib/python3.6/site-packages/pandas/core/fra
me.py:3027: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
  return super(DataFrame, self).rename(**kwargs)
```

Out[11]:

	Year	Month	civilian_labor_force
36	1948	1	60230.0
37	1948	4	60535.0
38	1948	7	60934.0
39	1948	10	60839.0
64	1949	1	60967.0

In [ ]:

```

```

In [12]:

```
#merge the  unemploy_df and labor_df dataframes
# unemployment_df=unemploy_df.merge(labor_df,how='left', left_on = [unemploy_df.
Year,unemploy_df.Month], right_on=[labor_df.Year, labor_df.Month])
unemployment_df=pd.merge(unemploy_df, labor_df,how='left', on = ["Year","Month"]
)

print(unemployment_df.shape)
print(type(unemployment_df))
unemployment_df.head(15)
```

```
(830, 5)
<class 'pandas.core.frame.DataFrame'>
```

Out[12]:

	Data	Year	Month	unemployment_level	civilian_labor_force
0	Unemployment Level	1948	1	2034.0	60230.0
1	Unemployment Level	1948	2	2328.0	NaN
2	Unemployment Level	1948	3	2399.0	NaN
3	Unemployment Level	1948	4	2386.0	60535.0
4	Unemployment Level	1948	5	2118.0	NaN
5	Unemployment Level	1948	6	2214.0	NaN
6	Unemployment Level	1948	7	2213.0	60934.0
7	Unemployment Level	1948	8	2350.0	NaN
8	Unemployment Level	1948	9	2302.0	NaN
9	Unemployment Level	1948	10	2259.0	60839.0
10	Unemployment Level	1948	11	2285.0	NaN
11	Unemployment Level	1948	12	2429.0	NaN
12	Unemployment Level	1949	1	2596.0	60967.0
13	Unemployment Level	1949	2	2849.0	NaN
14	Unemployment Level	1949	3	3030.0	NaN

In [15]:

```
#merge the  unemploy_df and labor_df dataframes
# unemployment_df=unemploy_df.merge(labor_df,how='left', left_on = [unemploy_df.
Year,unemploy_df.Month], right_on=[labor_df.Year, labor_df.Month])
unempl_infl_df=pd.merge(unemployment_df, CPI_df,how='right', on = ["Year","Month
"])
#drop the Data column
unempl_infl_df.drop(labels='Data',axis=1,inplace=True)
print(unempl_infl_df.shape)
print(type(unempl_infl_df))
unempl_infl_df.head(15)
```

```
(842, 5)
<class 'pandas.core.frame.DataFrame'>
```

Out[15]:

	Year	Month	unemployment_level	civilian_labor_force	inflation_level
0	1948	1	2034.0	60230.0	23.68
1	1948	2	2328.0	NaN	23.67
2	1948	3	2399.0	NaN	23.50
3	1948	4	2386.0	60535.0	23.82
4	1948	5	2118.0	NaN	24.01
5	1948	6	2214.0	NaN	24.15
6	1948	7	2213.0	60934.0	24.40
7	1948	8	2350.0	NaN	24.43
8	1948	9	2302.0	NaN	24.36
9	1948	10	2259.0	60839.0	24.31
10	1948	11	2285.0	NaN	24.16
11	1948	12	2429.0	NaN	24.05
12	1949	1	2596.0	60967.0	24.01
13	1949	2	2849.0	NaN	23.91
14	1949	3	3030.0	NaN	23.91

In [28]:

```
# Itterating through rows to fill the civilian_labor_force with the correspondin
g values of the same quarter
i=0
for r in range(len(unempl_infl_df.civilian_labor_force)-1):
    if i<len(unempl_infl_df.civilian_labor_force) :
        unempl_infl_df.iloc[i+1,3]=unempl_infl_df.iloc[i,3]
#         unempl_infl_df.iloc[i+2,3]=unempl_infl_df.iloc[i,3]

        i=i+3

unempl_infl_df.head(10)
```

Out[28]:

	Year	Month	unemployment_level	civilian_labor_force	inflation_level
0	1948	1	2034.0	60230.0	23.68
1	1948	2	2328.0	60230.0	23.67
2	1948	3	2399.0	60230.0	23.50
3	1948	4	2386.0	60535.0	23.82
4	1948	5	2118.0	60535.0	24.01
5	1948	6	2214.0	60535.0	24.15
6	1948	7	2213.0	60934.0	24.40
7	1948	8	2350.0	60934.0	24.43
8	1948	9	2302.0	60934.0	24.36
9	1948	10	2259.0	60839.0	24.31

In [29]:

```
#creating columns for inflation, unemployment and decade
unempl_infl_df["unemployment"]=""
unempl_infl_df["inflation"]=""
unempl_infl_df["decade"]=""
```

In [36]:

```
#Calculaate decades and assign to decade column
unempl_infl_df.decade=((df.Year//10)*10)
# len(df.decade)
unempl_infl_df.head()
```

Out[36]:

	Year	Month	unemployment_level	civilian_labor_force	inflation_level	unemployme
0	1948	1	2034.0	60230.0	23.68	
1	1948	2	2328.0	60230.0	23.67	
2	1948	3	2399.0	60230.0	23.50	
3	1948	4	2386.0	60535.0	23.82	
4	1948	5	2118.0	60535.0	24.01	

In [50]:

```
# CALCULATE inflation rate and unemployment rate
for r in range(len(unempl_infl_df.civilian_labor_force)):

    #Unemployment rate
    unempl_infl_df.iloc[r,5]=(unempl_infl_df.iloc[r,2]/unempl_infl_df.iloc[r,3])
*100

    #inflation rate
    unempl_infl_df.iloc[r,6]=((unempl_infl_df.iloc[r,4]-unempl_infl_df.iloc[r-1,
4])/unempl_infl_df.iloc[r-1,4])*100

unempl_infl_df.head()
```

Out[50]:

	Year	Month	unemployment_level	civilian_labor_force	inflation_level	unemployn
0	1948	1	2034.0	60230.0	23.68	3.37705
1	1948	2	2328.0	60230.0	23.67	3.86518
2	1948	3	2399.0	60230.0	23.50	3.98306
3	1948	4	2386.0	60535.0	23.82	3.94152
4	1948	5	2118.0	60535.0	24.01	3.4988

In [51]:

```
#output the result
unempl_infl_df.to_csv("output/inflation_unemployment2.csv")
```

In [400]:

```
#reload
unempl_infl_df = pd.read_csv("output/inflation_unemployment.csv")
```

Visualization

Box Plots for unmployment rate in decades

The box plot of unemployment rate in different decades (code is available below and the interactive plot in the link below) Please click the Link to the see the interactive plot https://plot.ly/~sheelis/1 (https://plot.ly/~sheelis/1)

In [453]:

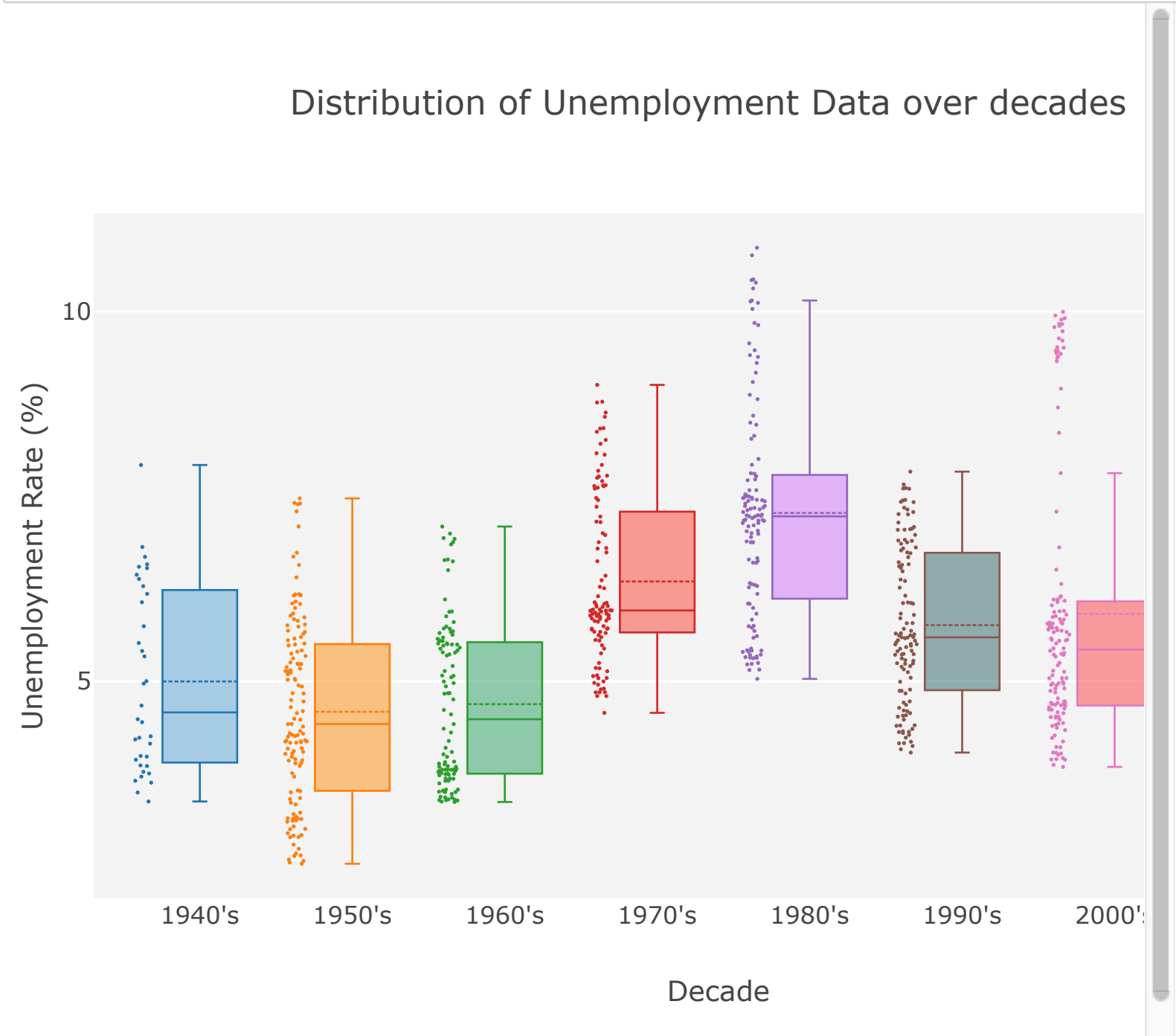
```
# Import the relevant libraries
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import plotly.offline as py
py.init_notebook_mode(connected=True)
import plotly.graph_objs as go
import plotly.tools as tls
import seaborn as sns
import warnings
warnings.filterwarnings('ignore')
import plotly
plotly.tools.set_credentials_file(username='sheelis', api_key='sGooOiRGRz1umLG16
yt3')

%matplotlib inline
```

In [454]:

```
x_data = ["1940\'s", "1950\'s", "1960\'s", "1970\'s","1980\'s", "1990\'s","2000\
's", "2010\'s"]#unempl_infl_df.decade.unique().tolist()

y0 = unempl_infl_df.loc[unempl_infl_df.decade==1940,'unemployment']
y1 = unempl_infl_df.loc[unempl_infl_df.decade==1950,'unemployment']
y2 = unempl_infl_df.loc[unempl_infl_df.decade==1960,'unemployment']
y3 = unempl_infl_df.loc[unempl_infl_df.decade==1970,'unemployment']
y4 = unempl_infl_df.loc[unempl_infl_df.decade==1980,'unemployment']
```

```
y5 = unempl_infl_df.loc[unempl_infl_df.decade==1990,'unemployment']
y6 = unempl_infl_df.loc[unempl_infl_df.decade==2000,'unemployment']
y7 = unempl_infl_df.loc[unempl_infl_df.decade==2010,'unemployment']

y_data = [y0,y1,y2,y3,y4,y5,y6,y7]

colors = ['rgba(93, 164, 214, 0.5)', 'rgba(255, 144, 14, 0.5)', 'rgba(44, 160, 1
01, 0.5)',
          'rgba(255, 65, 54, 0.5)', 'rgba(207, 114, 255, 0.5)', 'rgba(44, 100, 1
01, 0.5)',
          'rgba(255, 65, 67, 0.5)', 'rgba(207, 87, 255, 0.5)']


traces = []

for xd, yd, color in zip(x_data, y_data, colors):
        traces.append(go.Box(
            y=yd,
            name=xd,
            boxpoints='all',
            whiskerwidth=0.2,
            fillcolor=color,
            marker=dict(
                size=2,
            ),
            boxmean=True,
            line=dict(width=1),
        ))

layout = go.Layout(
    title='Distribution of Unemployment Data over decades',
    xaxis=dict(
        title='Decade'
    ),
    yaxis=dict(
        title='Unemployment Rate (%)',
        autorange=True,
        showgrid=True,
        zeroline=False,
        dtick=5,
        gridcolor='rgb(255, 255, 255)',
        gridwidth=1,
#         zerolinecolor='rgb(255, 255, 255)',
#         zerolinewidth=2,
    ),
    margin=dict(
        l=40,
        r=30,
        b=80,
        t=100,
    ),
    paper_bgcolor='rgb(243, 243, 243)',
    plot_bgcolor='rgb(243, 243, 243)',
```

```
    showlegend=False

)

fig = go.Figure(data=traces, layout=layout)
py.iplot(fig)
```



Box Plots for inflation rate in decades

The box plot of inflation rate in different decades(the code is available below and the interactive plot in the link below)

Please click the Link to the see the interactive plot : https://plot.ly/create/?fid=sheelis:3 (https://plot.ly/create/?fid=sheelis:3)

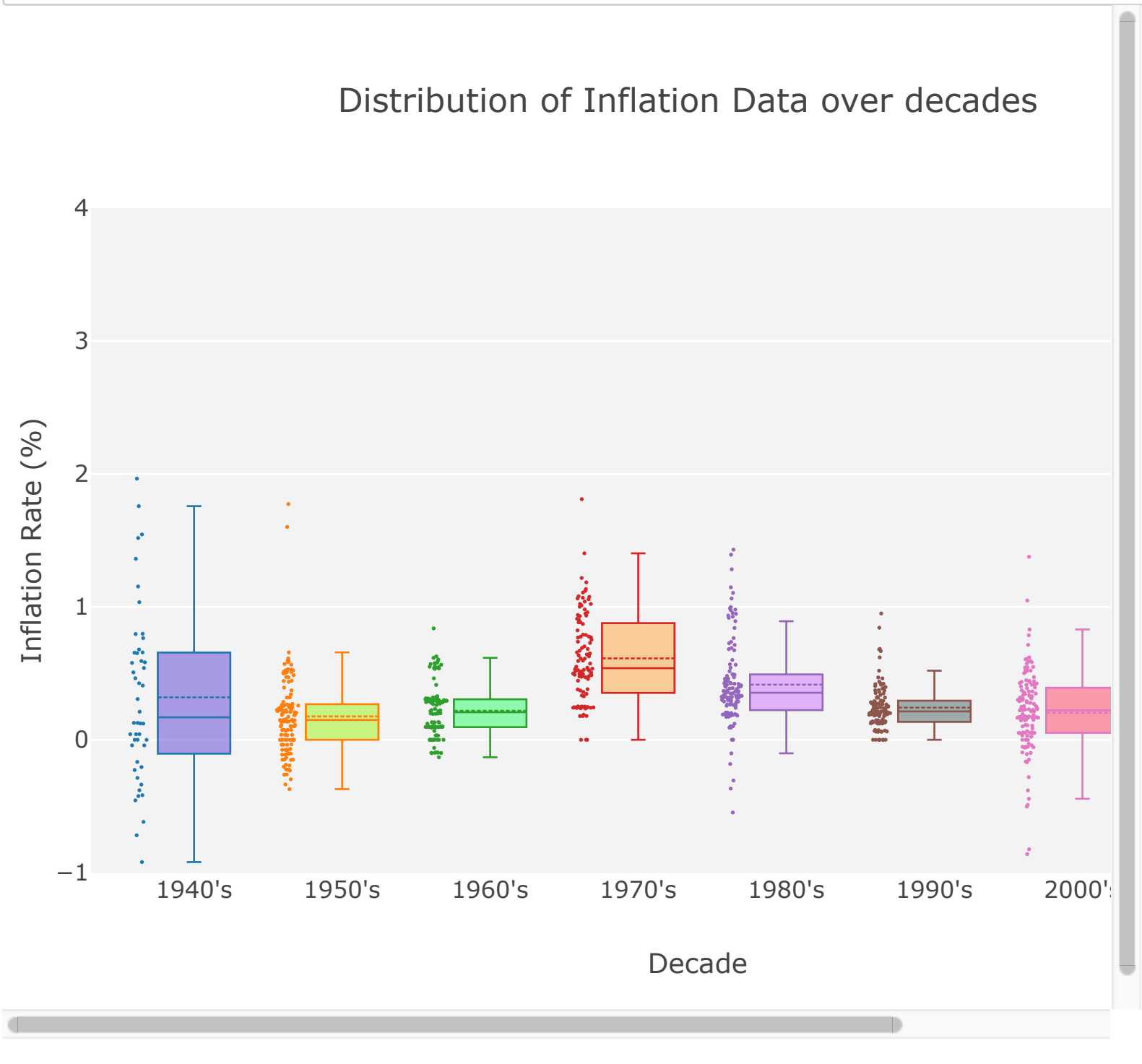
In [ ]:

```
```

In [452]:

```
x_data = ["1940\'s", "1950\'s", "1960\'s", "1970\'s","1980\'s", "1990\'s","2000\
's", "2010\'s"]#unempl_infl_df.decade.unique().tolist()

y0 = unempl_infl_df.loc[unempl_infl_df.decade==1940,'inflation']
y1 = unempl_infl_df.loc[unempl_infl_df.decade==1950,'inflation']
y2 = unempl_infl_df.loc[unempl_infl_df.decade==1960,'inflation']
y3 = unempl_infl_df.loc[unempl_infl_df.decade==1970,'inflation']
y4 = unempl_infl_df.loc[unempl_infl_df.decade==1980,'inflation']
y5 = unempl_infl_df.loc[unempl_infl_df.decade==1990,'inflation']
y6 = unempl_infl_df.loc[unempl_infl_df.decade==2000,'inflation']
y7 = unempl_infl_df.loc[unempl_infl_df.decade==2010,'inflation']

y_data = [y0,y1,y2,y3,y4,y5,y6,y7]

colors = ['rgba(93, 64, 214, 0.5)', 'rgba(155, 244, 14, 0.5)', 'rgba(44, 260, 10
1, 0.5)',
          'rgba(255, 165, 54, 0.5)', 'rgba(207, 114, 255, 0.5)', 'rgba(74, 100,
101, 0.5)',
          'rgba(255, 65, 97, 0.5)', 'rgba(207, 87, 155, 0.5)']

traces = []

for xd, yd, color in zip(x_data, y_data, colors):
        traces.append(go.Box(
            y=yd,
            name=xd,
            boxpoints='all',
            whiskerwidth=0.2,
            fillcolor=color,
            marker=dict(
                size=2,
            ),
            boxmean=True,
            line=dict(width=1),
        ))

layout = go.Layout(
    title='Distribution of Inflation Data over decades',
    xaxis=dict(
        title='Decade'
    ),
    yaxis=dict(
        title='Inflation Rate (%)',
        autorange=False,
        showgrid=True,
        zeroline=False,
```

```
        dtick=1,
        gridcolor='rgb(255, 255, 255)',
        gridwidth=1,
#         zerolinecolor='rgb(255, 255, 255)',
#         zerolinewidth=2,
    ),
    margin=dict(
        l=40,
        r=30,
        b=80,
        t=100,
    ),
    paper_bgcolor='rgb(243, 243, 243)',
    plot_bgcolor='rgb(243, 243, 243)',
    showlegend=False
)

fig = go.Figure(data=traces, layout=layout)
py.iplot(fig)
```



Scatter Plots of unemployment rate vs inflation rate in decades

Link to the plot : https://plot.ly/create/?fid=sheelis:9 (https://plot.ly/create/?fid=sheelis:9)

Critique on William Phillips's theory

US Phillips Curve (1947 – 2017): The data points in this graph span from 1947 until 2017. After 1980's they do not form the classic L-shape the short-run Phillips curve would predict. Although it was shown to be stable until the 1960's, the Phillips curve inverse relationship between unemployment and inflation became unstable – after the 1970's.

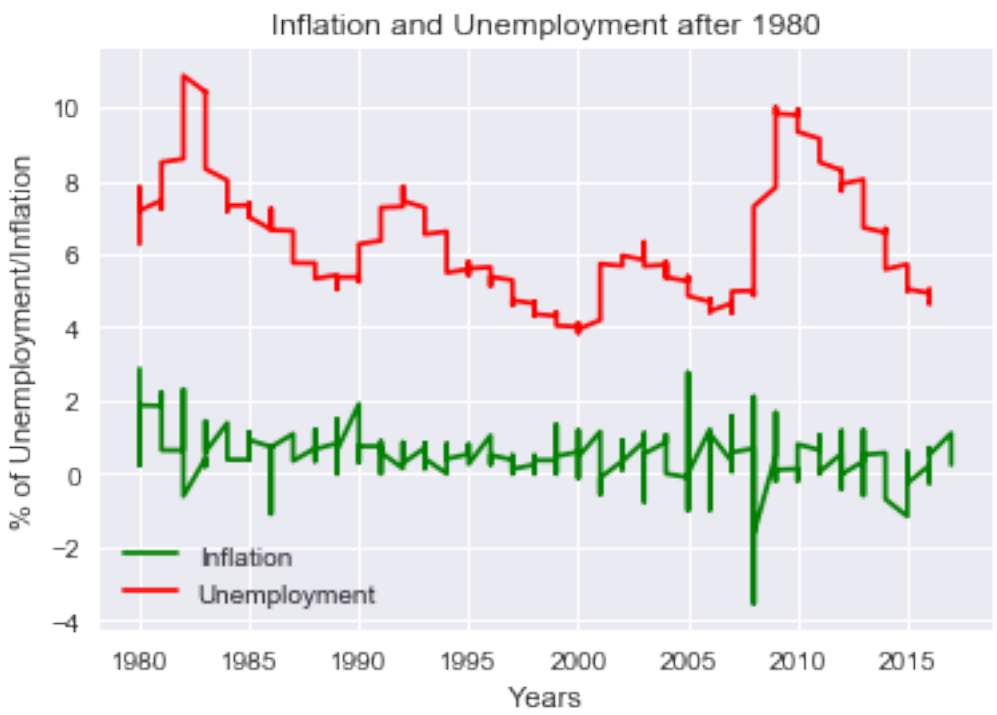
Line Graph of unemployment rate vs inflation rate after 1980s

Critique on William Phillips's theory

What happens after the 80s was there are periods when unemployment increased but inflation didn't decrease meaning there was no inverse relationship (in Philip theory unemployment should have increased to satisfy an inverse relationship).

In [286]:

```
year_var=1980

#Data after 1980
y_df=unempl_infl_df.loc[unempl_infl_df.Year>=year_var,:]

# list of the years that we will use as our x axis
years = y_df.Year

# line that will be used to track inflation over the years (magnified 3 times to
magnify the variablity)
plt.plot(years, y_df.inflation*2, color="green", label="Inflation")

# line that will be used to track unemployment over the years
plt.plot(years, y_df.unemployment, color="red", label="Unemployment")

# legend on the chart in what matplotlib believes to be the "best" location
plt.legend(loc="best")

plt.title( "Inflation and Unemployment after %s" %(year_var))
plt.xlabel("Years")
plt.ylabel("% of Unemployment/Inflation")

# Print our chart to the screen
plt.show()
#Save the chart
plt.savefig("Output/Unemployment and infl over years.png",dpi=200,format='png')
```

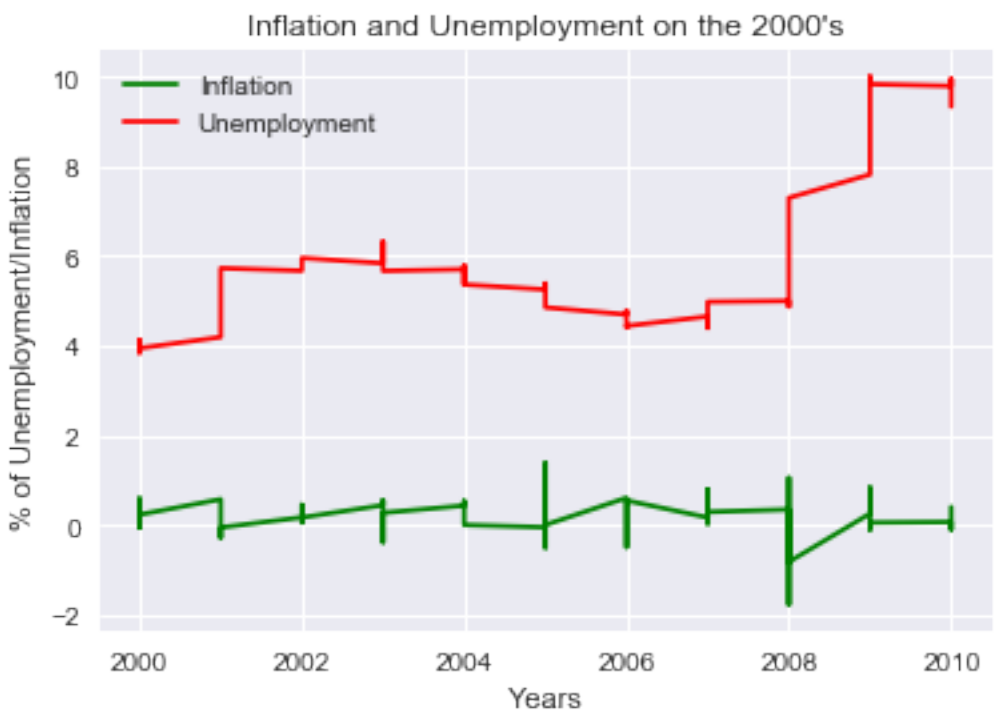



```
<matplotlib.figure.Figure at 0x10da2dc50>
```

Line Graph of unemployment rate vs inflation rate on decades

In [295]:

```
deacde_var=2000

#Data in decade
d_df=unempl_infl_df.loc[unempl_infl_df.decade==deacde_var,:]


# list of the years that we will use as our x axis
years = d_df.Year

# line that will be used to track inflation over the years (magnified 3 times to
magnify the variablity)
plt.plot(years, d_df.inflation, color="green", label="Inflation")

# line that will be used to track unemployment over the years
plt.plot(years, d_df.unemployment, color="red", label="Unemployment")

# legend on the chart in what matplotlib believes to be the "best" location
plt.legend(loc="best")

plt.title( "Inflation and Unemployment on the %s's" %(deacde_var))
plt.xlabel("Years")
plt.ylabel("% of Unemployment/Inflation")

# Print our chart to the screen
plt.show()
#Save the chart
plt.savefig("Output/Unemployment and infl over years.png",dpi=200,format='png')
```



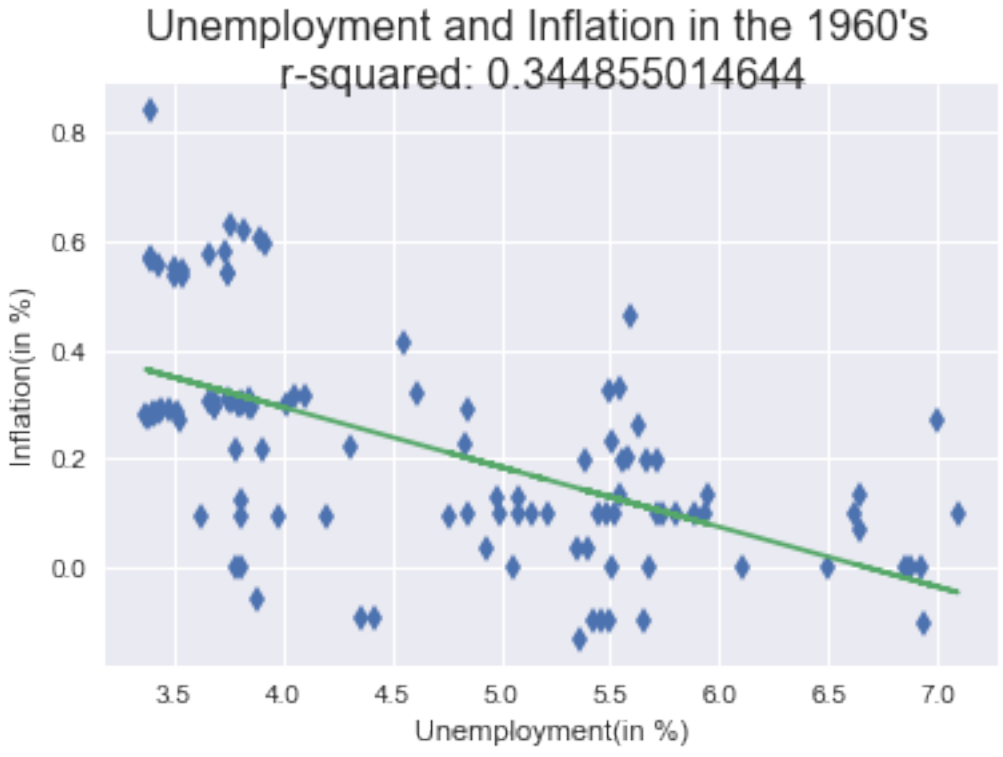
<matplotlib.figure.Figure at 0x1a16750780>

Linear regression of unemployment rate vs inflation rate on decades

R-square in 1960s is 0.344855014644 and R-square in 1980s is 0.00995878867512

In [334]:

```
from scipy.stats import linregress

deacde_var=1960

#Data in decade
d_df=unempl_infl_df.loc[unempl_infl_df.decade==deacde_var,:]


x_axis = d_df.unemployment
y_axis =  d_df.inflation

(slope, intercept, rvalue, _, _) = linregress(x_axis, y_axis)
fit = slope * x_axis + intercept
# print(x_axis,'\n',slope,'\n', intercept,'\n',fit,'\n')
#plot
fig, ax = plt.subplots()

fig.suptitle("Unemployment and Inflation in the %s's\n r-squared: %s"%(deacde_va
r,rvalue**2), fontsize=16 )

ax.set_xlabel("Unemployment(in %)")
ax.set_ylabel("Inflation(in %)")

ax.plot(x_axis, y_axis, linewidth=0, marker='d')
ax.plot(x_axis, fit)
plt.show()
# plt.savefig("Output/Regression Unemp and infl2 in the %s's.png"%(deacde_var),d
pi=200,format='png')
print("r-squared:", rvalue**2)
```




```
r-squared: 0.344855014644
```

Exploring the relationship between inflation and the unemployment rate from a unique perspective not previously explored by William Phillips

Downloaded data on Personal Consumption Expenditure (PCE) index and Real GDP data provided on the Bureau of Economic Analysis(BEA). I already checked to accesses the PCE and Real GDP using BEA Data API, but they were not available in the list to be provided by the API services

I calculated the inflation using the PCE excluding food and energy

In [504]:

```
# Read csv of  Real GDP data
GDP_df = pd.read_csv("raw_data/ Real Gross Domestic Product, Quantity Indexes.csv")
#display the whole dataframe
GDP_df.head()
```

Out[504]:

	Year	Gross domestic product	Personal consumption expenditures	Goods	Services	Gross private domestic investment	Fixed investment	Exports	Fe
0	1947	13.451	12.353	13.314	10.981	11.528	11.644	5.381	19
1	1948	14.009	12.632	13.582	11.271	14.530	12.743	4.238	20
2	1949	13.933	12.983	13.993	11.542	11.228	11.685	4.199	22
3	1950	15.147	13.816	15.078	12.047	15.640	13.884	3.677	21
4	1951	16.368	14.032	14.898	12.758	15.678	13.321	4.506	35

In [505]:

```
# Read CSV of PCE index
PCE_df = pd.read_csv("raw_data/PCEI by Major Type of Product, Monthly.csv")
#display the whole dataframe
PCE_df.head()
```

Out[505]:

	Year_Month	Personal consumption expenditures (PCE)	PCE excluding food and energy
0	1959M01	17.124	17.597
1	1959M02	17.138	17.609
2	1959M03	17.149	17.627
3	1959M04	17.183	17.670
4	1959M05	17.191	17.690

In [506]:

```
#create new Year and Month column in PCE_df
PCE_df["Year"]=""
PCE_df["Month"]=""

#split the the Year_month column
PCE_df.Year=(PCE_df.Year_Month.str.split(pat='M',expand=True)[0]).astype(int)
PCE_df.Month=PCE_df.Year_Month.str.split(pat='M',expand=True)[1].astype(int)
```

In [507]:

```
PCE_df.head()
```

Out[507]:

	Year_Month	Personal consumption expenditures (PCE)	PCE excluding food and energy	Year	Month
0	1959M01	17.124	17.597	1959	1
1	1959M02	17.138	17.609	1959	2
2	1959M03	17.149	17.627	1959	3
3	1959M04	17.183	17.670	1959	4
4	1959M05	17.191	17.690	1959	5

In [508]:

```
#check the data dtypes
PCE_df.dtypes
```

Out[508]:

```
Year_Month                                 object
    Personal consumption expenditures (PCE)    float64
  PCE excluding food and energy                float64
Year                                           int64
Month                                          int64
dtype: object
```

In [509]:

```
#merge the dataframes GDP_df and PCE_df  with the unemploymet and inflation data
in the data frame unempl_infl_df
GDP_Unemp_inf_df=pd.merge(unempl_infl_df, GDP_df,how='left', on = "Year")
PCE_GDP_Unemp_inf_df=pd.merge(GDP_Unemp_inf_df, PCE_df,how='left', on = ["Year",
"Month"])

#check the count
print(PCE_GDP_Unemp_inf_df.shape)
print(type(PCE_GDP_Unemp_inf_df))

#display the data frame
PCE_GDP_Unemp_inf_df.head()
```

```
(842, 23)
<class 'pandas.core.frame.DataFrame'>
```

Out[509]:

	Unnamed: 0	Year	Month	unemployment_level	civilian_labor_force	inflation_level	u
0	0	1948	1	2034.0	60230.0	23.68	3.
1	1	1948	2	2328.0	60230.0	23.67	3.
2	2	1948	3	2399.0	60230.0	23.50	3.
3	3	1948	4	2386.0	60535.0	23.82	3.
4	4	1948	5	2118.0	60535.0	24.01	3.

5 rows × 23 columns

In [510]:

```
#output the merged dataframe
# PCE_GDP_Unemp_inf_df.to_csv("output/merged_additional_data2.csv")
```

In [537]:

```
#realod  the merged dataframe
Allmerged_additional_df=pd.read_csv("output/merged_additional_data.csv")
Allmerged_additional_df.head()
```

Out[537]:

	Unnamed: 0	Unnamed: 0.1	Year	Month	unemployment_level	civilian_labor_force	inflat
0	0	0	1948	1	2034.0	60230.0	23.68
1	1	1	1948	2	2328.0	60230.0	23.67
2	2	2	1948	3	2399.0	60230.0	23.50
3	3	3	1948	4	2386.0	60535.0	23.82
4	4	4	1948	5	2118.0	60535.0	24.01

5 rows × 25 columns

In [538]:

```
# Check data type
Allmerged_additional_df.dtypes
```

Out[538]:

```
Unnamed: 0                                      int64
Unnamed: 0.1                                    int64
Year                                            int64
Month                                           int64
unemployment_level                            float64
civilian_labor_force                          float64
inflation_level                               float64
unemployment                                  float64
inflation                                     float64
decade                                          int64
        Gross domestic product                float64
Personal consumption expenditures             float64
    Goods                                     float64
    Services                                  float64
Gross private domestic investment             float64
    Fixed investment                          float64
    Exports                                   float64
    Federal                                   float64
        National defense                      float64
        Nondefense                            float64
    State and local                           float64
Year_Month                                     object
    Personal consumption expenditures (PCE)   float64
  PCE excluding food and energy               float64
inflation_PCE                                 float64
dtype: object
```

In [545]:

```
# CALCULATE inflation rate based on PCE excluding food and energy
for i in range(len(Allmerged_additional_df.Month)):

    #inflation rate based on PCE index
    Allmerged_additional_df.iloc[i,24]=((Allmerged_additional_df.iloc[i,23]-Allm
erged_additional_df.iloc[i-1,23])\
                                        /Allmerged_additional_df.iloc[i-1,23])*1
00

# Allmerged_additional_df.loc[Allmerged_additional_df.inflation_PCE>0,: ]
Allmerged_additional_df.head()
```

Out[545]:

	Unnamed: 0	Unnamed: 0.1	Year	Month	unemployment_level	civilian_labor_force	inflat
0	0	0	1948	1	2034.0	60230.0	23.68
1	1	1	1948	2	2328.0	60230.0	23.67
2	2	2	1948	3	2399.0	60230.0	23.50
3	3	3	1948	4	2386.0	60535.0	23.82
4	4	4	1948	5	2118.0	60535.0	24.01

5 rows × 25 columns

Scatter plots showing the relationship of unemployment and PCE_inflation

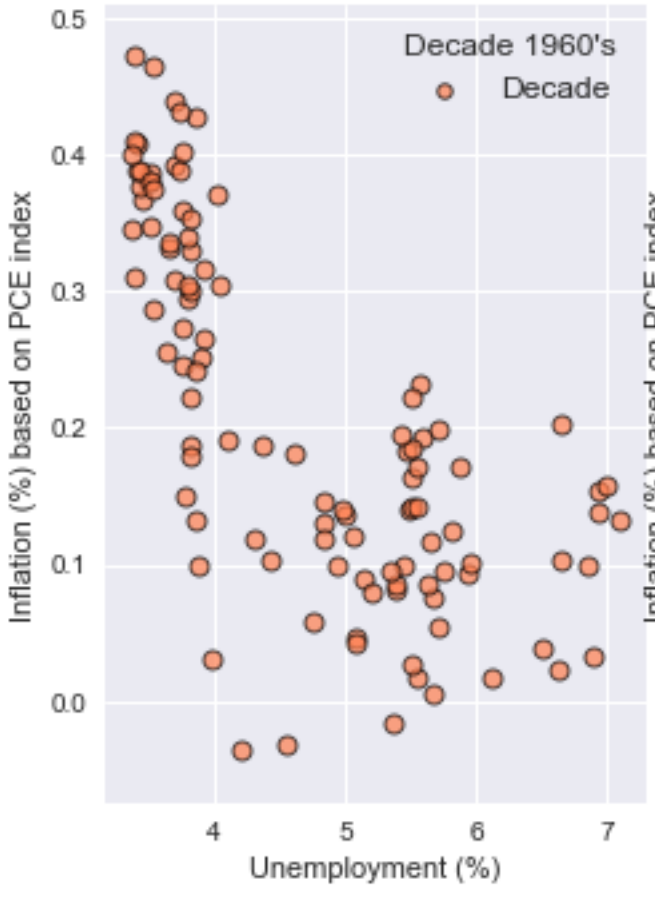
The 1960's plot showed there is clear inverse relationship between unemployment and PCE_inflation as stated in the Philips curve theory. But this doesn't hold true for the 1980s data.

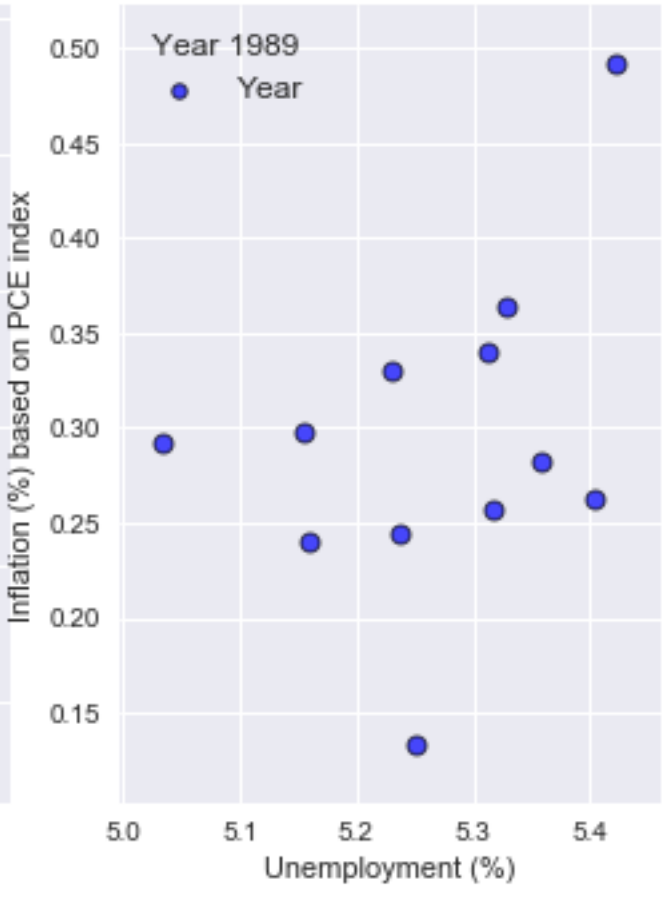
Note: 1-Please change the decades of the variable deacde_var to explore the relationship between PCE_inflation and unemployment in different decades 2- Please change the year of the variable year_var to explore the relationship between PCE_inflation and unemploymentin different decades

In [590]:

```
#ploting the unemployment and the PCE index_Inflation
fig,ax=plt.subplots(1,2)
```

```
#variable to hold the decade and the year
deacde_var=1960
year_var=1989

#Data in decade and year

d_df=Allmerged_additional_df.loc[Allmerged_additional_df.decade==deacde_var,:]

y_df=Allmerged_additional_df.loc[Allmerged_additional_df.Year==year_var,:]

#assign data to axes
x_axis = d_df.unemployment
y_axis =  d_df.inflation_PCE

x2_axis = y_df.unemployment
y2_axis =  y_df.inflation_PCE

#create the scatter plot
ax[0].scatter(x_axis,y_axis,c='coral',edgecolors='black',lw=1,alpha=0.7,marker='
o',label='Decade')#,s=urbanDriverCount*7

ax[1].scatter(x2_axis,y2_axis,c='blue',edgecolors='black',lw=1,alpha=0.7,marker=
'o',label='Year')#,s=urbanDriverCount*7

#titles and axes labels
# plt[0].title=('Inflation versus unemployment for decade (%s)year (%s)'%(deacde
_var,year_var))

ax[0].set_xlabel('Unemployment (%)')
ax[0].set_ylabel('Inflation (%) based on PCE index')

ax[1].set_xlabel('Unemployment (%)')
ax[1].set_ylabel('Inflation (%) based on PCE index')

#legend and legend handling
lgnd=ax[0].legend(fontsize="medium", mode="Expanded",
                  numpoints=1, scatterpoints=1,title="Decade %s's"%(deacde_var),
                  labelspacing=0.5)
lgnd.legendHandles[0]._sizes = [30]

lgnd=ax[1].legend(fontsize="medium", mode="Expanded",
                  numpoints=1, scatterpoints=1,title="Year %s"%(year_var),
                  labelspacing=0.5)
lgnd.legendHandles[0]._sizes = [30]

#add grids
sns.set(style="darkgrid", color_codes=True)
# ax.grid(True,color='white',fillstyle='bottom')
# # fig.tight_layout()
# ax.set_facecolor('brown')
plt.show()
# plt.savefig("output/unemp vs inlation for %'s and year=%s.png"%(deacde_var,yea
r_var),format=png)
```


Decade 1960's
Decade
Inflation (%) based on PCE index
Unemployment (%)
0.5
0.4
0.3
0.2
0.1
0.0
4
5
6
7


Year 1989
Year
Inflation (%) based on PCE index
Unemployment (%)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
5.0
5.1
5.2
5.3
5.4

In [ ]: