Final Project

Dylan Xia Kevin Yao Yuqing Wen

2024-12-01

- Partner 1 : Dylan Xia; dizhexia
- Partner 2 : Kevin Yao; qiyin
- Partner 3 : Yuqing Wen, wyuqing

```
import pandas as pd
import geopandas as gpd
import matplotlib.pyplot as plt
from shapely.geometry import shape
import requests
import altair as alt
import seaborn as sns

import warnings
warnings.filterwarnings('ignore')
alt.renderers.enable("png")
```

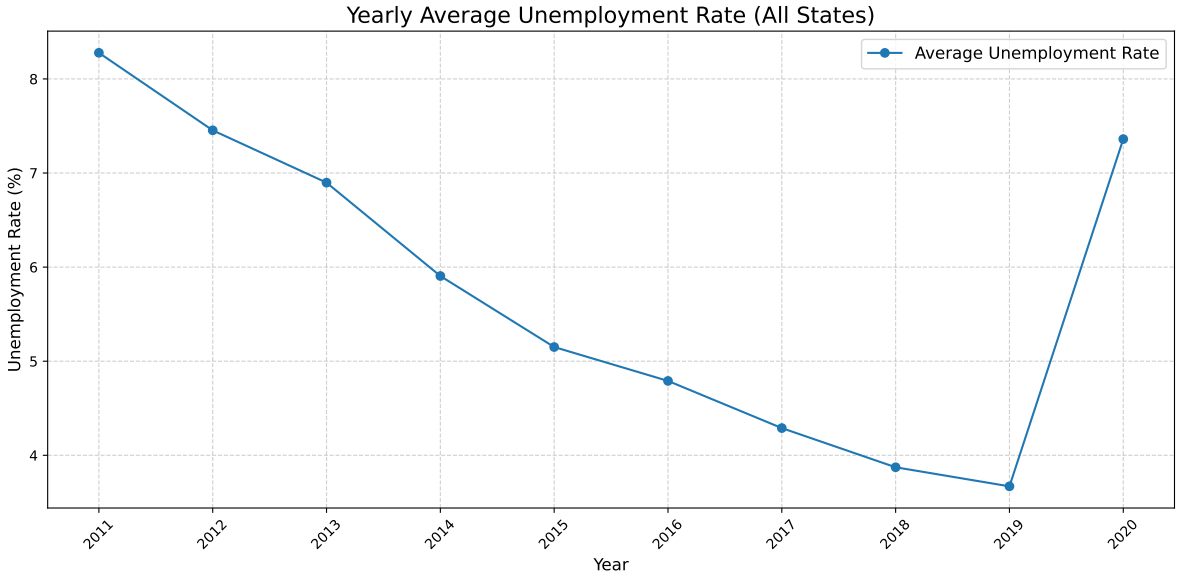
```
RendererRegistry.enable('png')
```

Step 1: Plot data based on Unemployment Rate

Unemployment Rate General Trend (2011~2020)

```
import pandas as pd
import matplotlib.pyplot as plt

# Step 1: Load the unemployment data
data_path = "state_yearly_unemployment_rate_with_state_name.csv"
unemployment_data = pd.read_csv(data_path)
```

```
# Step 2: Calculate the average unemployment rate by year
# Assuming the dataset contains columns: 'year', 'unemployment_rate'
yearly_avg_unemployment = (
    unemployment_data.groupby('year')['unemployment_rate']
    .mean()
    .reset_index()
)

# Convert unemployment rate to percentage
yearly_avg_unemployment['unemployment_rate'] =
 ↪  yearly_avg_unemployment['unemployment_rate'] * 100

# Step 3: Plot the line chart
plt.figure(figsize=(12, 6))

plt.plot(
    yearly_avg_unemployment['year'],
    yearly_avg_unemployment['unemployment_rate'],
    marker='o',
    linestyle='-',
    label='Average Unemployment Rate'
)

# Add labels and title
plt.xlabel('Year', fontsize=12)
plt.ylabel('Unemployment Rate (%)', fontsize=12)
plt.title('Yearly Average Unemployment Rate (All States)', fontsize=16)

# Customize grid and legend
plt.grid(visible=True, linestyle='--', alpha=0.6)
plt.legend(fontsize=12)
plt.xticks(yearly_avg_unemployment['year'], rotation=45)
plt.tight_layout()

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

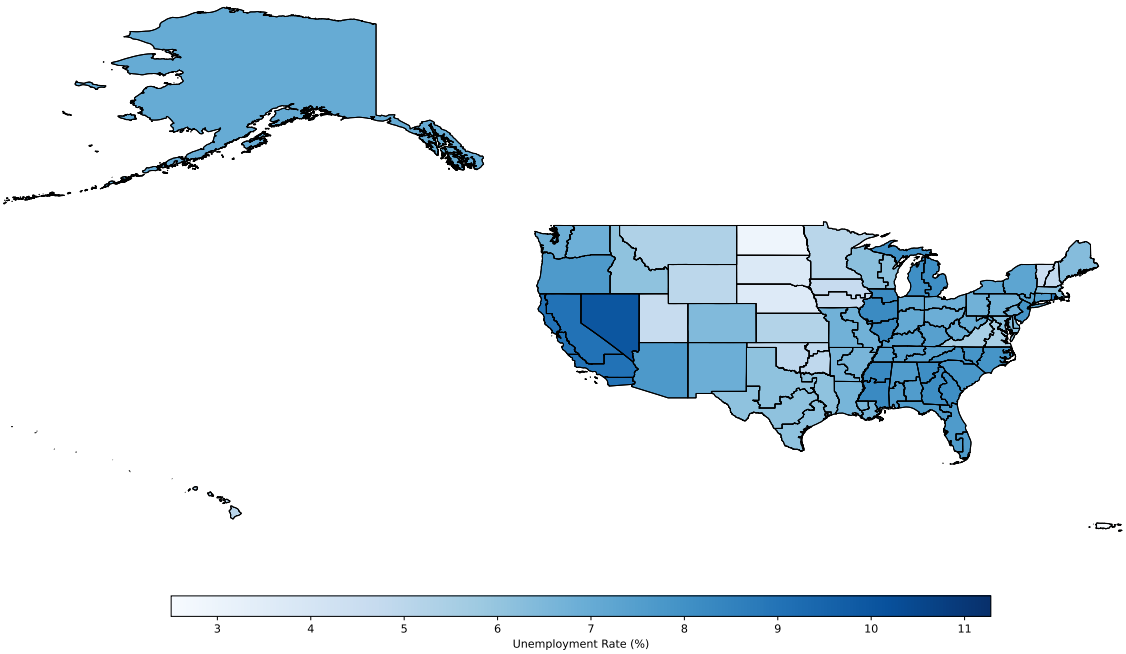


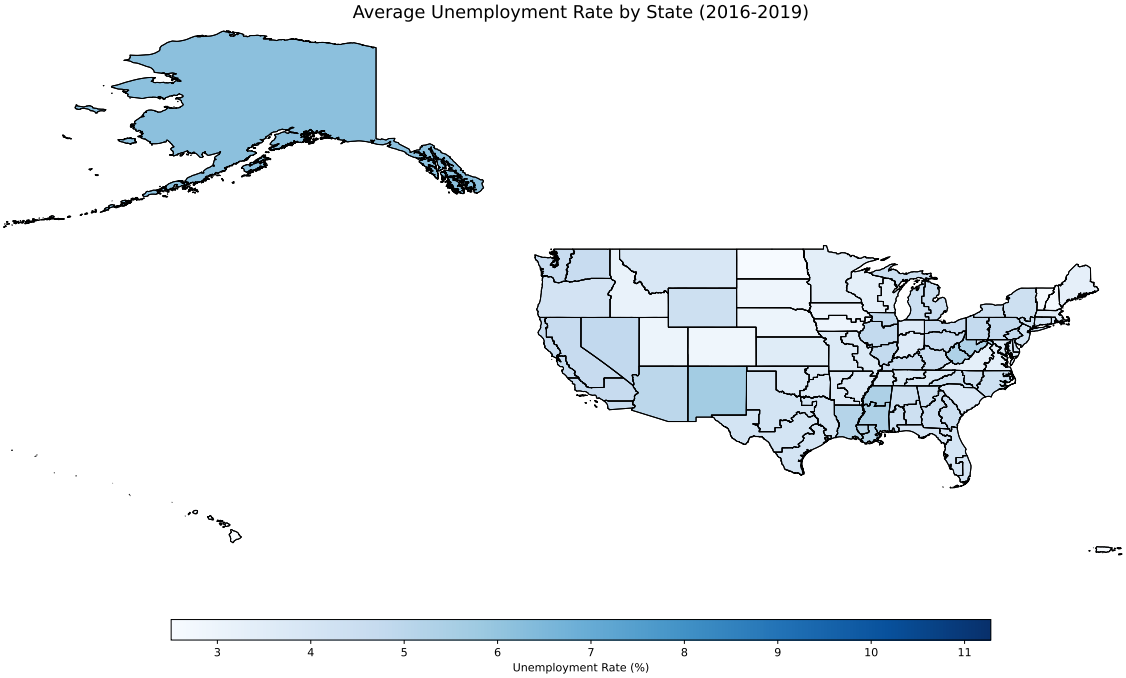
Unemployment Rate (2011~2015) & Unemployment Rate (2016~2020), Map by State

```
import pandas as pd
import geopandas as gpd
import matplotlib.pyplot as plt
from shapely.geometry import shape
import requests

# Step 1: Load the unemployment data
data_path = "state_yearly_unemployment_rate_with_state_name.csv"
unemployment_data = pd.read_csv(data_path)

# Calculate average unemployment rates for 2011-2015
unemployment_avg_2011_2015 = (
    unemployment_data[(unemployment_data['year'] >= 2011) &
 ↪  (unemployment_data['year'] <= 2015)]
    .groupby('state_name')['unemployment_rate']
    .mean()
    .reset_index()
)
unemployment_avg_2011_2015['unemployment_rate'] =
 ↪  unemployment_avg_2011_2015['unemployment_rate'] * 100
```

```
# Calculate average unemployment rates for 2016-2019
unemployment_avg_2016_2019 = (
    unemployment_data[(unemployment_data['year'] >= 2016) &
 ↪  (unemployment_data['year'] <= 2019)]
    .groupby('state_name')['unemployment_rate']
    .mean()
    .reset_index()
)
unemployment_avg_2016_2019['unemployment_rate'] =
 ↪  unemployment_avg_2016_2019['unemployment_rate'] * 100

# Find global vmin and vmax for consistent coloring
all_data = pd.concat([unemployment_avg_2011_2015,
 ↪  unemployment_avg_2016_2019])
vmin = all_data['unemployment_rate'].min()
vmax = all_data['unemployment_rate'].max()

# Load GeoJSON data
shape_url = 'https://data.ojp.usdoj.gov/resource/5fdt-n5ne.json'
response = requests.get(shape_url)

if response.status_code == 200:
    geo_data = response.json()
else:
    raise ValueError(f"Failed to fetch GeoJSON data. HTTP Status Code:
     ↪  {response.status_code}")

geometries = [shape(feature["the_geom"]) for feature in geo_data]
properties = [{key: feature[key] for key in feature if key != "the_geom"} for
 ↪  feature in geo_data]
shape_data = gpd.GeoDataFrame(properties, geometry=geometries)

# Function to plot a map with specified data
def plot_map(data, title):
    data['state_name'] = data['state_name'].str.strip()
    merged_data = shape_data.merge(data, left_on='state',
 ↪  right_on='state_name', how='left')
    merged_data['unemployment_rate'] =
 ↪  merged_data['unemployment_rate'].fillna(0)

    # Plot map
```

```
    fig, ax = plt.subplots(1, 1, figsize=(15, 10))
    merged_data.plot(
        column='unemployment_rate',
        cmap='Blues',
        linewidth=0.8,
        ax=ax,
        edgecolor='black',
        legend=True,
        legend_kwds={
            'shrink': 0.7,
            'orientation': "horizontal",
            'pad': 0.05,
            'aspect': 40,
            'label': "Unemployment Rate (%)"
        },
        vmin=vmin,  # Set global min
        vmax=vmax   # Set global max
    )
    merged_data.boundary.plot(ax=ax, linewidth=0.8, color="black")
    ax.set_xlim([-180, -60])  # Extends to cover Alaska and Hawaii
    ax.set_ylim([15, 72])     # Adjusted for both Hawaii and Alaska latitudes
    ax.set_title(title, fontsize=16)
    ax.set_axis_off()
    plt.tight_layout()
    plt.show()

# Plot maps for 2011-2015 and 2016-2019
plot_map(unemployment_avg_2011_2015, 'Average Unemployment Rate by State
 ↪  (2011-2015)')
plot_map(unemployment_avg_2016_2019, 'Average Unemployment Rate by State
 ↪  (2016-2019)')
```


Average Unemployment Rate by State (2011-2015)
3
4
5
6
7
8
9
10
11
Unemployment Rate (%)

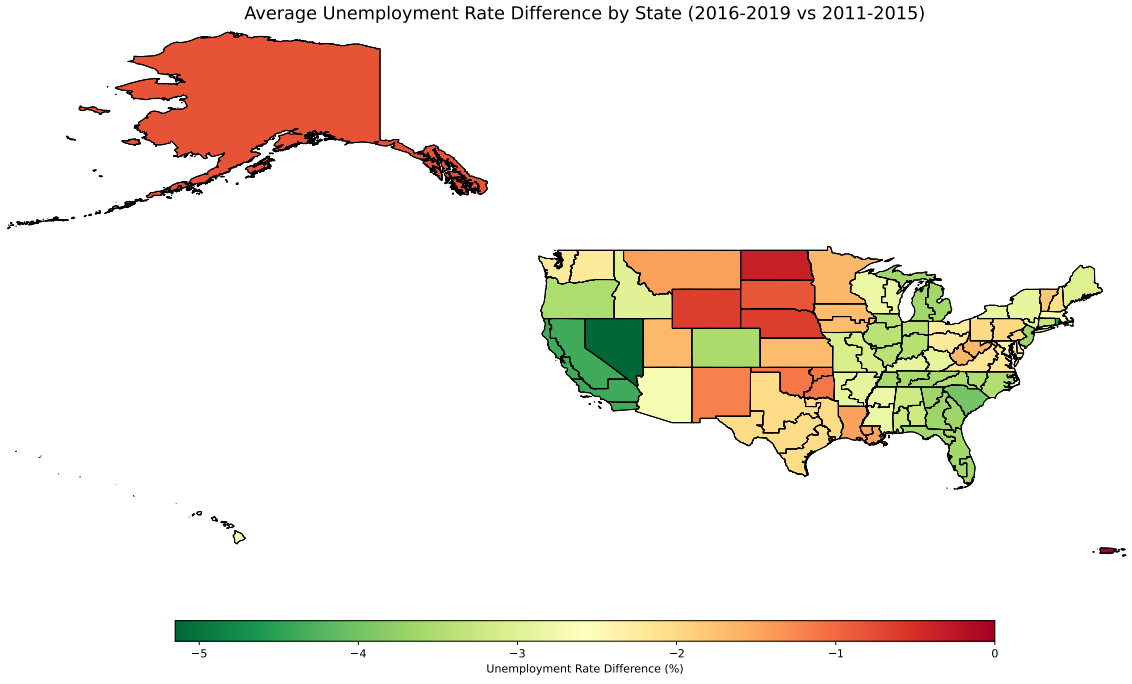

Average Unemployment Rate by State (2016-2019)
3
4
5
6
7
8
9
10
11
Unemployment Rate (%)

Unemployment Rate (Difference), Map by State

```
import pandas as pd
import geopandas as gpd
import matplotlib.pyplot as plt
from shapely.geometry import shape
import requests

# Step 1: Load the unemployment data
data_path = "state_yearly_unemployment_rate_with_state_name.csv"
unemployment_data = pd.read_csv(data_path)

# Step 2: Calculate average unemployment rates for 2011-2015 and 2016-2019 by
 ↪  state
unemployment_avg_2011_2015 = (
    unemployment_data[(unemployment_data['year'] >= 2011) &
 ↪  (unemployment_data['year'] <= 2015)]
    .groupby('state_name')['unemployment_rate']
    .mean()
    .reset_index()
)
unemployment_avg_2016_2019 = (
    unemployment_data[(unemployment_data['year'] >= 2016) &
 ↪  (unemployment_data['year'] <= 2019)]
    .groupby('state_name')['unemployment_rate']
    .mean()
    .reset_index()
)

# Convert to percentage
unemployment_avg_2011_2015['unemployment_rate'] =
 ↪  unemployment_avg_2011_2015['unemployment_rate'] * 100
unemployment_avg_2016_2019['unemployment_rate'] =
 ↪  unemployment_avg_2016_2019['unemployment_rate'] * 100

# Step 3: Calculate the difference between 2016-2019 and 2011-2015
unemployment_diff = pd.merge(
    unemployment_avg_2016_2019,
    unemployment_avg_2011_2015,
    on='state_name',
    suffixes=('_2016_2019', '_2011_2015')
```

```
)
unemployment_diff['rate_difference'] = (
    unemployment_diff['unemployment_rate_2016_2019'] -
 ↪  unemployment_diff['unemployment_rate_2011_2015']
)

# Step 4: Load the JSON data from the API endpoint for state boundaries
shape_url = 'https://data.ojp.usdoj.gov/resource/5fdt-n5ne.json'
response = requests.get(shape_url)

if response.status_code == 200:
    geo_data = response.json()
else:
    raise ValueError(f"Failed to fetch GeoJSON data. HTTP Status Code:
     ↪  {response.status_code}")

# Step 5: Convert JSON data to a GeoDataFrame
geometries = [shape(feature["the_geom"]) for feature in geo_data]
properties = [{key: feature[key] for key in feature if key != "the_geom"} for
 ↪  feature in geo_data]
shape_data = gpd.GeoDataFrame(properties, geometry=geometries)

# Step 6: Merge shape data with unemployment difference data
unemployment_diff['state_name'] = unemployment_diff['state_name'].str.strip()
merged_data = shape_data.merge(unemployment_diff, left_on='state',
 ↪  right_on='state_name', how='left')

# Fill missing values for states with no data
merged_data['rate_difference'] = merged_data['rate_difference'].fillna(0)

# Step 7: Plot the unemployment difference map
fig, ax = plt.subplots(1, 1, figsize=(15, 10))

# Plot unemployment difference using a diverging colormap
merged_data.plot(
    column='rate_difference',
    cmap='RdYlGn_r',  # Red-White-Green reversed color map
    linewidth=0.8,
    ax=ax,
    edgecolor='black',
    legend=True,
    legend_kwds={
```

```
        'shrink': 0.7,
        'orientation': "horizontal",
        'pad': 0.05,
        'aspect': 40,
        'label': "Unemployment Rate Difference (%)"
    }
)

# Add state boundaries
merged_data.boundary.plot(ax=ax, linewidth=0.8, color="black")

# Adjust map extent to include Alaska and Hawaii
ax.set_xlim([-180, -60])  # Extends to cover Alaska and Hawaii
ax.set_ylim([15, 72])     # Adjusted for both Hawaii and Alaska latitudes

# Customize the plot further for better visualization
ax.set_title('Average Unemployment Rate Difference by State (2016-2019 vs
↪  2011-2015)', fontsize=16)
ax.set_axis_off()
plt.tight_layout()

plt.show()
```

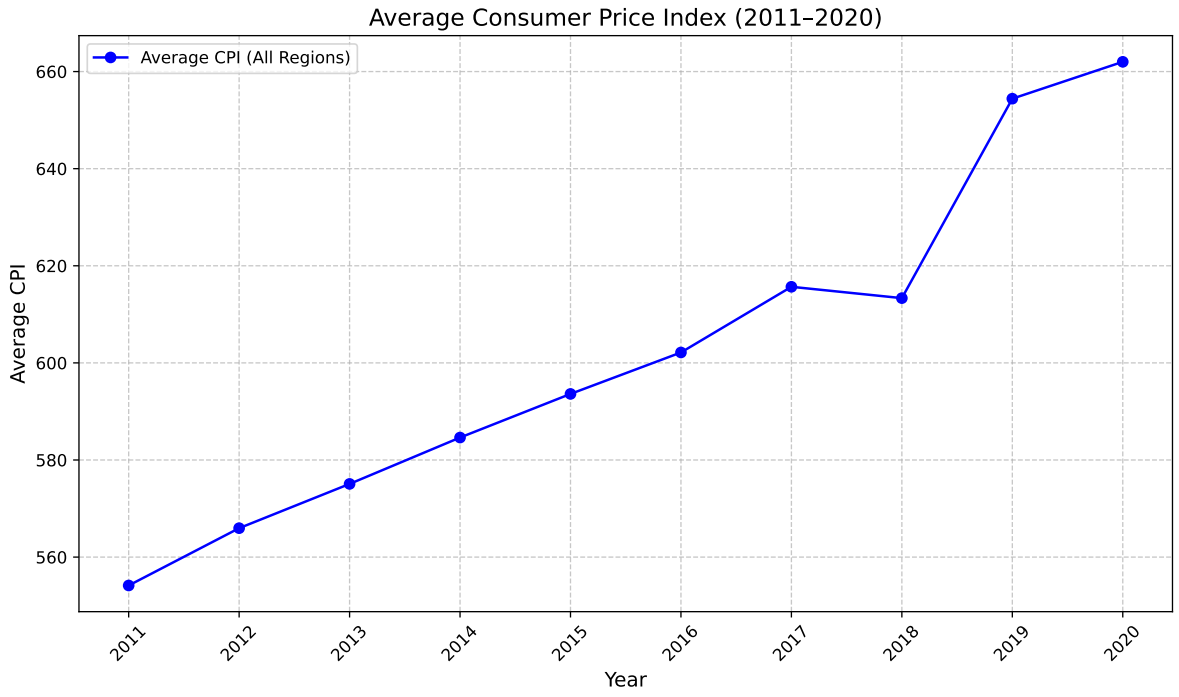


Step 2: Plot data based on CPI

CPI Rate General Trend (2011~2020)

```
# Load the CPI data from the Excel file
file_path = 'CPI_urban_2011-2020_2.0.xlsx'
cpi_data = pd.ExcelFile(file_path)

# Parse the relevant sheet
cpi_sheet = cpi_data.parse('BLS Data Series')

# Step 1: Clean the CPI data
# Skip the initial rows to extract relevant data
cpi_cleaned = cpi_sheet.iloc[3:]

# Rename columns for clarity
cpi_cleaned.columns = ['Series ID', 'Area Description'] + [f'Annual_{year}'
 ↪  for year in range(2011, 2021)]

# Keep only relevant columns (Area Description and CPI values)
cpi_cleaned = cpi_cleaned[['Area Description'] + [f'Annual_{year}' for year
 ↪  in range(2011, 2021)]]

# Drop rows with missing Area Description (e.g., aggregated regions or
 ↪  unrelated data)
cpi_cleaned = cpi_cleaned.dropna(subset=['Area Description'])

# Step 2: Calculate the average CPI for all regions for each year
average_cpi_by_year = cpi_cleaned[[f'Annual_{year}' for year in range(2011,
 ↪  2021)]].mean()

# Prepare data for plotting
years = list(range(2011, 2021))
average_cpi = average_cpi_by_year.values

# Step 3: Plot the line chart
plt.figure(figsize=(10, 6))
plt.plot(years, average_cpi, marker='o', linestyle='-', color='blue',
 ↪  label='Average CPI (All Regions)')

# Add labels, title, and legend
```

```
plt.xlabel('Year', fontsize=12)
plt.ylabel('Average CPI', fontsize=12)
plt.title('Average Consumer Price Index (2011-2020)', fontsize=14)
plt.grid(True, linestyle='--', alpha=0.7)
plt.legend()
plt.xticks(years, rotation=45)
plt.tight_layout()

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



CPI Rate Scatter (Self-Regression)

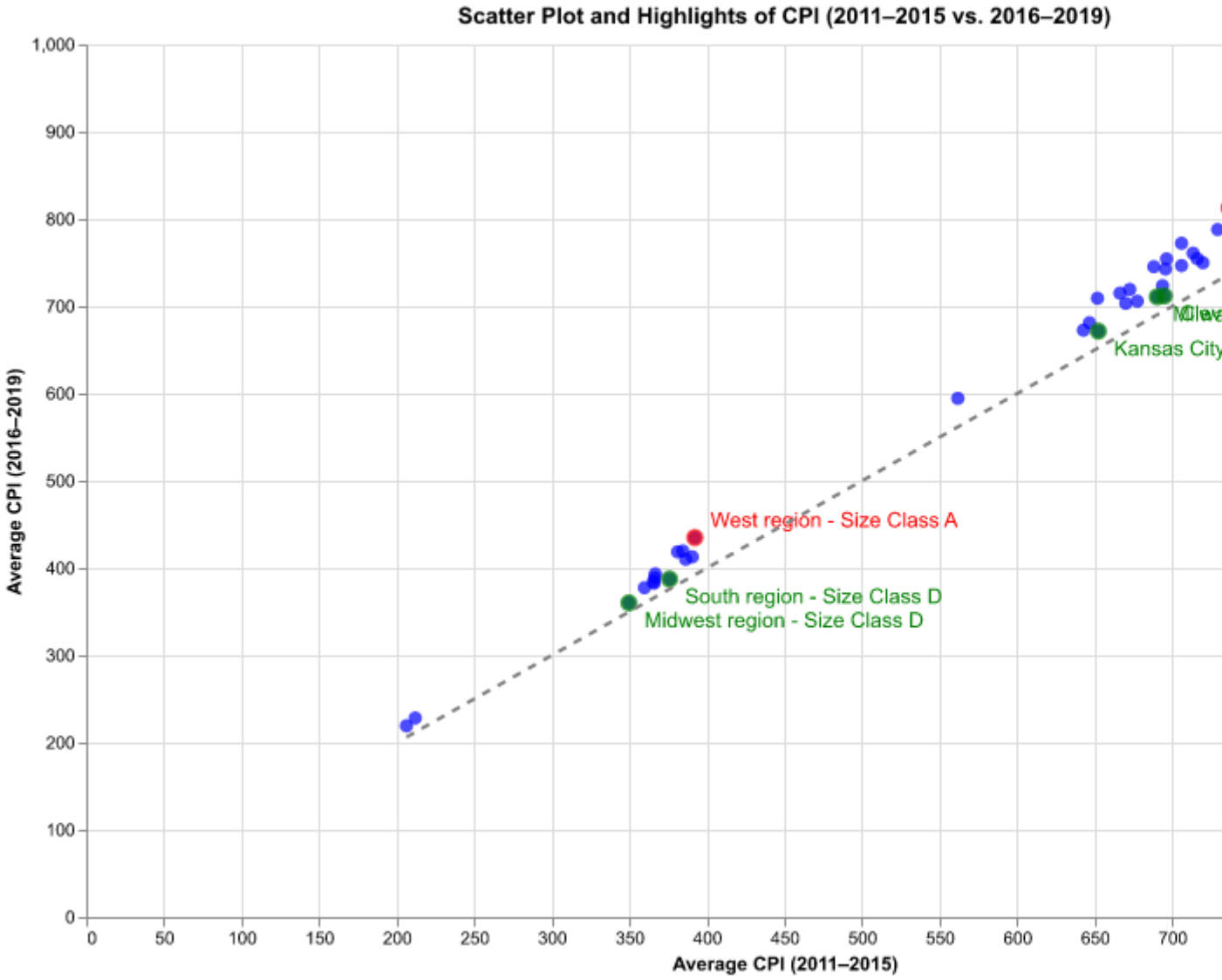
```
# Load the CPI data
file_path = 'CPI_urban_2011-2020_2.0.xlsx'  # Update this to your local file
 ↪  path
cpi_data = pd.ExcelFile(file_path)
cpi_sheet = cpi_data.parse('BLS Data Series')
```

```
# Clean the data
cpi_cleaned = cpi_sheet.iloc[3:]
cpi_cleaned.columns = ['Series ID', 'Area Description'] + [f'Annual_{year}'
 ↪  for year in range(2011, 2021)]
cpi_cleaned = cpi_cleaned[['Area Description'] + [f'Annual_{year}' for year
 ↪  in range(2011, 2021)]]
cpi_cleaned = cpi_cleaned.dropna(subset=['Area Description'])

# Convert annual columns to numeric
for year in range(2011, 2021):
    cpi_cleaned[f'Annual_{year}'] =
 ↪  pd.to_numeric(cpi_cleaned[f'Annual_{year}'], errors='coerce')

# Calculate average CPI for 2011-2015 and 2016-2019
cpi_cleaned['CPI_2011_2015'] = cpi_cleaned[[f'Annual_{year}' for year in
 ↪  range(2011, 2016)]].mean(axis=1)
cpi_cleaned['CPI_2016_2019'] = cpi_cleaned[[f'Annual_{year}' for year in
 ↪  range(2016, 2020)]].mean(axis=1)

# Drop rows where averages could not be computed
cpi_cleaned = cpi_cleaned.dropna(subset=['CPI_2011_2015', 'CPI_2016_2019'])

# Calculate percentage change
cpi_cleaned['CPI_Percent_Change'] = ((cpi_cleaned['CPI_2016_2019'] -
 ↪  cpi_cleaned['CPI_2011_2015']) / cpi_cleaned['CPI_2011_2015']) * 100

# Identify top 5 and bottom 5 areas
top5_changes = cpi_cleaned.nlargest(5, 'CPI_Percent_Change')
bottom5_changes = cpi_cleaned.nsmallest(5, 'CPI_Percent_Change')

# Add jittered labels for visualization
top5_changes['Label'] = top5_changes['Area Description']
top5_changes['Jitter_X'] = top5_changes['CPI_2011_2015'] + 10
top5_changes['Jitter_Y'] = top5_changes['CPI_2016_2019'] + 20

bottom5_changes['Label'] = bottom5_changes['Area Description']
bottom5_changes['Jitter_X'] = bottom5_changes['CPI_2011_2015'] + 10
bottom5_changes['Jitter_Y'] = bottom5_changes['CPI_2016_2019'] - 20

# Create diagonal y=x line
diagonal_data = pd.DataFrame({
    'x': [cpi_cleaned['CPI_2011_2015'].min(),
     ↪  cpi_cleaned['CPI_2011_2015'].max()],
```

```
    'y': [cpi_cleaned['CPI_2011_2015'].min(),
     ↪  cpi_cleaned['CPI_2011_2015'].max()]
})

diagonal_line = alt.Chart(diagonal_data).mark_line(strokeDash=[5, 5],
 ↪  color='gray').encode(
    x='x',
    y='y'
)

# Scatter plot for all areas
scatter = alt.Chart(cpi_cleaned).mark_circle(size=60, color='blue').encode(
    x=alt.X('CPI_2011_2015', title='Average CPI (2011-2015)'),
    y=alt.Y('CPI_2016_2019', title='Average CPI (2016-2019)'),
    tooltip=['Area Description', 'CPI_2011_2015', 'CPI_2016_2019',
 ↪  'CPI_Percent_Change']
)

# Highlight top 5 areas
top5 = alt.Chart(top5_changes).mark_circle(size=100, color='red').encode(
    x='CPI_2011_2015',
    y='CPI_2016_2019',
    tooltip=['Area Description', 'CPI_2011_2015', 'CPI_2016_2019',
 ↪  'CPI_Percent_Change']
)

top5_labels = alt.Chart(top5_changes).mark_text(align='left', fontSize=12,
 ↪  color='red').encode(
    x='Jitter_X',
    y='Jitter_Y',
    text='Label'
)

# Highlight bottom 5 areas
bottom5 = alt.Chart(bottom5_changes).mark_circle(size=100,
 ↪  color='green').encode(
    x='CPI_2011_2015',
    y='CPI_2016_2019',
    tooltip=['Area Description', 'CPI_2011_2015', 'CPI_2016_2019',
 ↪  'CPI_Percent_Change']
)
```

```
bottom5_labels = alt.Chart(bottom5_changes).mark_text(align='left',
 ↪  fontSize=12, color='green').encode(
    x='Jitter_X',
    y='Jitter_Y',
    text='Label'
)

# Tables for top 5 and bottom 5 areas
top5_table = alt.Chart(top5_changes).mark_text(align='left', fontSize=12,
 ↪  color='red').encode(
    y=alt.Y('row_number:O', axis=None),
    text='Label:N'
).transform_window(
    row_number='row_number()'
).properties(
    title='Top 5 Areas by Percentage Change',
    width=300
)

bottom5_table = alt.Chart(bottom5_changes).mark_text(align='left',
 ↪  fontSize=12, color='green').encode(
    y=alt.Y('row_number:O', axis=None),
    text='Label:N'
).transform_window(
    row_number='row_number()'
).properties(
    title='Bottom 5 Areas by Percentage Change',
    width=300
)

# Combine scatter plot with updated tables
scatter_chart = (scatter + top5 + top5_labels + bottom5 + bottom5_labels +
 ↪  diagonal_line).properties(
    title='Scatter Plot and Highlights of CPI (2011-2015 vs. 2016-2019)',
    width=800,
    height=500
)

final_chart = alt.hconcat(
    scatter_chart,
    alt.vconcat(top5_table, bottom5_table).properties(title='Top and Bottom 5
 ↪  Areas (Colored)')
```

```
)

# Display the final chart
final_chart
```



Shiny app

```
from shiny import App, ui, render
import pandas as pd
import altair as alt

# Define UI
app_ui = ui.page_fluid(
    # Dropdown for Time Period Selection
    ui.input_select(
        "time_period",
        "Select a Time Period:",
        choices=["2011-2015", "2016-2020"]
    ),
    # Dropdown for Visualization Selection
    ui.input_select(
        "visualization_type",
        "Select Visualization Type:",
        choices=["Plots", "NLP Analysis"]
    ),
    # Conditional rendering for data type (only for "Plots")
    ui.output_ui("data_type_buttons"),

    # Conditional rendering for CPI plots
    ui.panel_conditional(
        "input.visualization_type === 'Plots' && input.data_type === 'CPI'",
        ui.output_image("cpi_plot", width="100%", height="600px"),
    ),
    # Conditional rendering for unemployment maps
    ui.panel_conditional(
        "input.visualization_type === 'Plots' && input.data_type ===
         ↪  'Unemployment rate'",
        ui.output_image("unemployment_map", width="100%", height="600px")
    ),
    # Conditional rendering for difference plot
    ui.panel_conditional(
        "input.visualization_type === 'Plots' && input.data_type ===
         ↪  'Differences'",
        ui.output_image("difference_plot", width="100%", height="600px")
    ),
    # Conditional rendering for NLP Analysis
```

```
    ui.panel_conditional(
        "input.visualization_type === 'NLP Analysis'",
        ui.output_image("nlp_plot1", width="100%", height="600px"),
        ui.br(),
        ui.output_image("nlp_plot2", width="100%", height="600px")
    ),
    # Outputs for selected dropdown and visualization type
    ui.output_text_verbatim("dropdown_total"),
    ui.output_text_verbatim("visualization_type_output")
)


# Define Server Logic
def server(input, output, session):
    @output
    @render.ui
    def data_type_buttons():
        # Render radio buttons dynamically for "Plots"
        if input.visualization_type() == "Plots":
            return ui.input_radio_buttons(
                "data_type",
                "Select Data Type:",
                choices=["Unemployment rate", "CPI", "Differences"]
            )
        return None

    @output
    @render.image
    def unemployment_map():
        # Render unemployment map based on time period
        if input.visualization_type() == "Plots" and input.data_type() ==
         ↪  "Unemployment rate":
            if input.time_period() == "2011-2015":
                return {
                    "src":
                     ↪  "/Users/alina./Desktop/Final-Project_Dylan-Kevin-Yuqing-main/Graph/U
                     ↪  Rate 2011-2015.png",
                    "alt": "Unemployment Map (2011-2015)"
                }
            elif input.time_period() == "2016-2020":
                return {
                    "src":
                     ↪  "/Users/alina./Desktop/Final-Project_Dylan-Kevin-Yuqing-main/Graph/U
                     ↪  Rate 2016-2019.png",
```

```
                "alt": "Unemployment Map (2016-2019)"
            }
    return None

@output
@render.image
def difference_plot():
    # Render difference plot
    if input.visualization_type() == "Plots" and input.data_type() ==
     ↪  "Differences":
        return {
            "src":
             ↪  "/Users/alina./Desktop/Final-Project_Dylan-Kevin-Yuqing-main/Graph/Differ
            "alt": "Differences in Unemployment Rate"
        }
    return None

@output
@render.image
def cpi_plot():
    # Render CPI Analysis plot
    if input.visualization_type() == "Plots" and input.data_type() ==
     ↪  "CPI":
        return {
            "src":
             ↪  "/Users/alina./Desktop/Final-Project_Dylan-Kevin-Yuqing-main/Graph/CPI_an
            "alt": "CPI Analysis"
        }
    return None

@output
@render.image
def nlp_plot1():
    # Render first NLP plot
    if input.visualization_type() == "NLP Analysis":
        return {
            "src":
             ↪  "/Users/alina./Desktop/Final-Project_Dylan-Kevin-Yuqing-main/Graph/Polian
            "alt": "FOMC Announcement Polarity"
        }
    return None
```

```
    @output
    @render.image
    def nlp_plot2():
        # Render second NLP plot
        if input.visualization_type() == "NLP Analysis":
            return {
                "src":
                 ↪  "/Users/alina./Desktop/Final-Project_Dylan-Kevin-Yuqing-main/Graph/Polari
                "alt": "Fed Chair Speech Polarity"
            }
        return None

    @output
    @render.text
    def dropdown_total():
        return f"You selected: {input.time_period()}"

    @output
    @render.text
    def visualization_type_output():
        return f"Visualization Type: {input.visualization_type()}"

app = App(app_ui, server)
```