Methods of Advanced Data Engineering

Project analysis report

MD FIROZUR RAHMAN

Matrikel Number: 22975954

Machine Learning
Data Analytics

Unemployment Ratio in the Americas Based on Population Growth (2020–2023)
Source: United States Census Bureau, Department of Labor and Training, and Iowa State University of Science and Technology

1 Introduction

The COVID-19 pandemic caused widespread disruptions in the U.S., impacting the economy and labor market as millions lost their jobs due to business closures and restricted mobility. Despite these challenges, population growth remained steady, with some states experiencing notable increases. This study analyzes the relationship between population growth and unemployment trends from 2020 to 2023, using state-level data to identify patterns and regional responses to these dual challenges. By highlighting key trends and disparities, the findings aim to provide insights for policies that promote economic resilience and workforce stability in future crises.

2 Description

This analysis explores the economic and demographic shifts in the U.S. during the COVID-19 pandemic (2020–2023). Millions of people faced unemployment as businesses closed and operations were reduced, with health risks and public restrictions further limiting work opportunities. Despite these disruptions, population growth remained steady, with some states experiencing increases driven by migration and higher birth rates. The study relies on data from two trusted government sources to examine these trends and their interplay, providing insights into how population dynamics and unemployment shaped recovery efforts.

Population Data:

- Provided by **the U.S. Census Bureau**, this dataset includes annual population estimates for all U.S. states and regions from 2020 to 2023. The CSV-format dataset details state names and yearly population counts, offering a comprehensive view of demographic trends across the country.

Unemployment Data:

- Sourced from **the U.S. Department of Labor and Iowa State University**, this dataset contains annual unemployment rates for U.S. states during the same period. Provided in Excel format, it includes state names and yearly unemployment percentages, facilitating a detailed exploration of employment trends at both state and national levels.Both datasets are publicly available and fall under open data guidelines, ensuring ethical and compliant usage. By combining these datasets, the analysis explores whether unemployment rates increased faster than population growth during the pandemic and identifies disparities across states. This approach provides a foundation for understanding the complex interplay between economic and demographic factors during one of the most challenging periods in recent history.

3 Analysis

The analysis shows that the total population in the United States increased from approximately 331.5 million in 2020 to 334.9 million in 2023, indicating steady growth over the years. Meanwhile, unemployment rates decreased significantly, dropping from 8.1

After sorting, filtering, and validating the data, I derived insights that highlight regional disparities and recovery patterns. These findings provide valuable perspectives for guiding future economic policy and workforce planning. Below, the table showcases state-level data for population and unemployment trends across the years.

Here, I present data for a few states obtained from **Population Data** (CSV file) and **Unemployment Data** (Excel file), covering all 50 states in North, Middle, and South America.

Population table data:

	state	2020	2021	2022	2023
0	United States	331526933	332048977	333271411	334914895
1	Northeast Region	57430477	57243423	57026847	56983517
2	New England	15057898	15106108	15120739	15159777
3	Middle Atlantic	42372579	42137315	41906108	41823740
4	Midwest Region	68969794	68850246	68783028	68909283

Unemployment rate table data:

	state	rate_2023	rate_2022	rate_2021	rate_2020
0	United States	3.6	3.6	5.3	8.1
1	Alabama	2.5	2.5	3.4	6.4
2	Alaska	4.2	4.2	6.4	8.3
3	Arizona	3.9	3.8	5.1	7.8
4	Arkansas	3.3	3.2	4.0	6.2

Fig. 1: **This image** provides a summary of population trends and unemployment rates across the United States during the specified years.

4 Comparison

This chart compares population (blue bars) and unemployment rates (red line) across selected U.S. states in 2020, highlighting disparities between the two metrics. The United States as a whole shows a much larger population compared to individual states, with California, Texas, and Florida being the most populous. However, there is no direct correlation between population size and unemployment rates. For example, states like New York and Pennsylvania, despite having moderate populations, report higher unemployment rates, reflecting localized economic challenges during the pandemic. This visualization emphasizes how regional factors significantly influenced unemployment trends independently of population size, showcasing the varied impact of the pandemic across states.

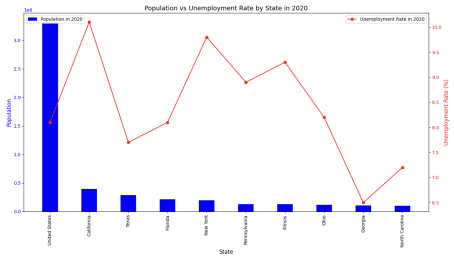

Fig. 2: **This image** compares the population and unemployment rates across states for the year 2020.

5 Visualization

The chart compares the top 5 states by population in 2023 with their respective unemployment rates. California leads in population, followed by Texas and Florida, both showing low unemployment rates. New York, despite its large population, reports a higher unemployment rate, highlighting regional economic disparities.

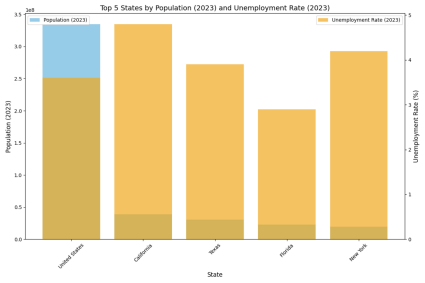

Fig. 3: **This image** Top 5 States by Population and Unemployment Rate in 2023.

6 Economic and Population Trends Analysis:(Top 10 States)

This analysis reviews the demographic and economic trends of the top 10 U.S. states from 2020 to 2023, focusing on population growth, unemployment rates, and their impacts on economic resilience and quality of life.

1. Economic Performance: Texas, Florida, and Georgia excelled with low unemployment and population growth, while California and New York faced challenges due to high costs of living and slower recovery.

2. Living Standards: States like North Carolina and Georgia attracted migration with affordable housing and job opportunities, unlike California and New York, which struggled with high living expenses.

3. Population Trends: Texas, Florida, and Georgia led in population growth, signaling a shift toward the South, while Alaska and Louisiana faced slow growth and unemployment challenges.

4. Social Impacts: Rapid growth in Florida and Texas boosted economies but raised concerns over infrastructure and housing, highlighting regional disparities.

5. Future Outlook: Southern states like Texas and Georgia are poised to dominate economically, while high-cost states may risk further migration outflows without policy adjustments.

6.1 Methodology

Population data (CSV) and unemployment data (Excel) for all 50 U.S. states from 2020 to 2023 were analyzed using Jupyter Notebook with the Python programming language. The tools and libraries used include Pandas for data processing, Matplotlib for creating visualizations, and SQLite3 for storing and managing cleaned data efficiently. Bar charts, line graphs, and combined visualizations were created to highlight key trends, with a focus on the top 10 states by population and their unemployment recovery patterns.

6.2 Limitations and Future Work

Limitations:

1. The analysis focuses only on 50 U.S. states, excluding territories and other regions.
2. Data is annual (2020–2023) and lacks finer time intervals like monthly or quarterly trends.
3. Key factors such as GDP, migration patterns, and industry-specific impacts are not included.
4. Regional policies and pandemic-specific effects were not explicitly analyzed.
5. Social and infrastructure factors, like healthcare and education, were not considered.

Future Work:

1. Incorporate additional datasets (e.g., GDP, migration, healthcare) for a more comprehensive analysis.
2. Include data from U.S. territories to broaden the scope.
3. Use finer time intervals (monthly or quarterly) to capture short-term trends.
4. Apply machine learning to predict future trends in population and unemployment.
5. Analyze the effects of regional policies and industries on recovery patterns.

7 Conclusion

This study provides an in-depth analysis of the interplay between population growth and unemployment trends across the 50 U.S. states from 2020 to 2023, offering critical insights into the socioeconomic impacts of the COVID-19 pandemic. The findings reveal a significant divergence in recovery trajectories among states. Economically resilient states such as Texas, Florida, and Georgia demonstrated robust population growth, low unemployment rates, and an ability to attract businesses and residents, emphasizing their role as emerging economic powerhouses. Conversely, states like New York and California, despite their economic prominence, faced prolonged challenges due to higher unemployment rates, urban density, and rising costs of living.

The study underscores the importance of understanding regional disparities in recovery. The migration trends toward states with lower costs of living and business-friendly environments highlight shifting economic power within the United States. These dynamics reflect broader implications for social equity, infrastructure demands, and the need for adaptive policy interventions.

This research provides a framework for evaluating state-level economic resilience and demographic shifts, with practical implications for policymakers and stakeholders. Future efforts must prioritize equitable growth by addressing structural challenges in lagging regions, investing in infrastructure, and fostering innovation. These actions are essential for ensuring balanced, sustainable development in an increasingly dynamic economic landscape.

8 Rrference

1. **U.S. Census Bureau. (2023). Population Estimates for U.S. States (2020–2023)**
2. **U.S. Department of Labor. (2023). State Unemployment Rates (2020–2023)**
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