



GeoStat: Visualizing Country-Level Data for Deeper Insights

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Contents

1 Project Description	2
1.1 Problem Statement	2
1.2 Possible Impact of Your Analysis	2
1.3 Dataset(s)	2
2 Project Scoping Document	4
2.1 Business Problem	4
2.2 Business Impact	4
2.3 Dataset(s)	4
2.4 Methods	5
2.5 Dashboard	7
2.6 Milestones	8
2.7 Timeline	9
3 References	10



1 | Project Description

1.1 | Problem Statement

The global landscape of countries presents a variety of challenges and opportunities across sectors such as economy, politics, and education. Understanding and analyzing key indicators like population, GDP, life expectancy, literacy rates, natural resources, and university rankings is crucial for policymakers, businesses, and researchers [1]. By exploring these variables, organizations can make informed decisions regarding investments, international relations, and sustainable development. This project aims to conduct an exploratory data analysis (EDA) of country-level data alongside university rankings to uncover patterns, correlations, and insights that can aid in understanding global dynamics [2].

The specific problem to be solved in this project is identifying and analyzing key patterns, correlations, and trends within country-level data and university rankings to understand global dynamics. Despite the availability of diverse datasets on various aspects of countries, there is a lack of comprehensive exploration that highlights how socio-economic, political, environmental, and educational factors interact across nations. By conducting an exploratory data analysis (EDA), the goal is to uncover hidden insights in areas like GDP, population, literacy rates, natural resources, and university performance. These insights can support better decision-making in global business strategies, policy formulation, and sustainable development practices [3].

1.2 | Possible Impact of Your Analysis

Exploring country-level data in conjunction with university rankings can have significant impacts across various domains, such as:

- **Guiding Strategic Decision-Making:** By analyzing global trends, socio-economic indicators, and academic performance, businesses and policymakers can identify high-growth markets, allocate resources more efficiently, and tailor strategies to specific regions. Understanding the link between a country's economic development and its universities' rankings can help prioritize investment in education and research [4].
- **Supporting Sustainable Development:** Understanding the interplay between environmental, economic, and social factors at the country level, as well as the academic contributions of universities, can help create policies that promote sustainability, innovation, and reduce inequality. Strong universities often contribute to national development through research, technology transfer, and human capital development [5].
- **Enhancing Investment and Trade Opportunities:** Identifying key patterns in GDP, literacy rates, natural resources, and university rankings can assist investors and trade organizations in spotting emerging markets and assessing the potential for economic growth. Universities in high-ranking countries may also be focal points for international collaborations and technological advancements, influencing global investment trends [6].

1.3 | Dataset(s)

The "**Countries of the World 2023**" dataset and the "**Global University Rankings Dataset 2023**" dataset from Kaggle provide valuable insights into global development, economic conditions, and higher education performance across countries. Both datasets are publicly available, offering a wealth of information that can be used for educational, research, and commercial purposes under open licenses, in accordance with Kaggle's terms of use.

- The "Countries of the World 2023" dataset includes a range of variables such as:
 - **Country:** Name of the country.
 - **Land Area (Km²):** Total land area of the country in square kilometers.
 - **Population:** The country's total population.
 - **GDP:** Gross Domestic Product, the total value of goods and services produced in the country.
 - **Life Expectancy:** Average number of years a newborn is expected to live.

- Gasoline Price:** Price of gasoline per liter in local currency.
 - Agricultural Land (%):** Percentage of land area used for agricultural purposes.
 - Unemployment Rate:** Percentage of the workforce unemployed but seeking work.
 - CPI:** Consumer Price Index, a measure of inflation and purchasing power.
 - CO2 Emissions:** Carbon dioxide emissions in tons.
- The "Global University Rankings Dataset 2023" dataset includes a range of variables such as:
- Rank:** The ranking position of the university in the global rankings.
 - University Name:** The name of the university, identifying each institution uniquely.
 - Location:** The geographical location of the university, indicating the country or region where it is situated.
 - Number of Students:** The total number of students enrolled in the university.
 - Number of Students per Staff:** The ratio of the total number of students to the total number of academic staff members, providing an indication of the student-to-faculty ratio.
 - International Student:** The proportion of international students studying at the university, offering insights into its global appeal and diversity.
 - Female - Male Ratio:** The gender distribution among the university's student body, presenting the ratio of female students to male students.

By combining these datasets, you can analyze the relationship between a country's socio-economic indicators (e.g., GDP, population, literacy rate) and the academic performance of universities within that country. This combination enables a deeper understanding of how national factors like economic stability, literacy, and public spending correlate with the performance and global ranking of universities. It also helps in identifying global trends in higher education and supports decision-making for students, policymakers, and businesses in both the education and economic sectors.



2 | Project Scoping Document

2.1 | Business Problem

The challenge in addressing global dynamics stems from the lack of a unified approach that combines key socio-economic indicators, environmental factors, and educational performance data to provide actionable insights for businesses and policymakers. Despite having access to diverse datasets, the analysis of how these variables influence each other and drive global trends remains limited. This lack of a comprehensive understanding makes it difficult for businesses to target high-growth markets, for policymakers to design effective and sustainable development strategies, and for governments to prioritize investments in areas like education and infrastructure. Additionally, universities, which are key drivers of innovation and socio-economic development, are often overlooked when evaluating a country's global standing, despite their pivotal role in national and international progress [7].

2.2 | Business Impact

The analysis of country-level data and university rankings provides several strategic advantages:

- **Enhanced Market Forecasting:** By identifying emerging economic and educational trends, businesses can more accurately forecast market changes and adapt their strategies to dynamic global conditions.
- **Policy Alignment with Global Trends:** Policymakers can leverage insights from the analysis to align national policies with broader global trends, improving the effectiveness of interventions in areas such as education, workforce development, and innovation.
- **Identification of Collaborative Opportunities:** By examining the intersection of university performance and national development, businesses can pinpoint opportunities for collaboration with academic institutions, enhancing innovation through joint research and technological advancements.
- **Data-Driven Investment:** Investors can use the insights to make data-driven decisions, identifying regions with the most promising socio-economic and educational conditions, thereby increasing the likelihood of high returns on investment.

This comprehensive analysis not only improves decision-making across various sectors but also empowers stakeholders to make proactive, informed decisions that contribute to both economic and social growth.

2.3 | Dataset(s)

Primary datasets

- **"Countries of the World 2023":** This dataset provides comprehensive socio-economic and political data for over 190 countries. It includes key indicators such as GDP, population, life expectancy, literacy rate, unemployment rate, and natural resources, offering a broad view of a country's economic and social landscape.
- **"Global University Rankings Dataset 2023":** This dataset contains rankings of universities worldwide, with indicators like teaching quality, research output, citations, industry income, and international outlook. It helps assess the role of educational institutions in national development and innovation.

Future Dataset Needs

- **Economic Indicators:** Additional datasets may be required that focus specifically on macroeconomic factors such as inflation rates, income inequality, and trade statistics for a more granular understanding of each country's economic standing.
- **Education & Research Data:** Further data on research spending, graduate employment rates, and university-industry collaborations may be explored to provide a more complete view of the impact of higher education on national economic performance.

2.4 | Methods

The Key Variables

■ Global Country Information Dataset 2023:

- Country:** Name of the country.
- Density (P/Km2):** Population density (persons per square kilometer).
- Abbreviation:** Country's abbreviation or code.
- Agricultural Land (%):** Percentage of land area used for agricultural purposes.
- Land Area (Km2):** Total land area of the country in square kilometers.
- Armed Forces Size:** Size of the country's armed forces.
- Birth Rate:** Number of births per 1,000 population per year.
- Calling Code:** International calling code for the country.
- Capital/Major City:** Name of the capital or major city.
- CO2 Emissions:** Carbon dioxide emissions in tons.
- CPI:** Consumer Price Index, a measure of inflation and purchasing power.
- CPI Change (%):** Percentage change in CPI from the previous year.
- Currency Code:** Currency code used in the country.
- Fertility Rate:** Average number of children born to a woman during her lifetime.
- Forested Area (%):** Percentage of land covered by forests.
- Gasoline Price:** Price of gasoline per liter in local currency.
- GDP:** Gross Domestic Product, the total value of goods and services produced in the country.
- Gross Primary Education Enrollment (%):** Gross enrollment ratio for primary education.
- Gross Tertiary Education Enrollment (%):** Gross enrollment ratio for tertiary education.
- Infant Mortality:** Number of deaths per 1,000 live births before age one.
- Largest City:** Name of the largest city.
- Life Expectancy:** Average number of years a newborn is expected to live.
- Maternal Mortality Ratio:** Number of maternal deaths per 100,000 live births.
- Minimum Wage:** Minimum wage level in local currency.
- Official Language:** Official language(s) spoken in the country.
- Out of Pocket Health Expenditure (%):** Percentage of total health expenditure paid out-of-pocket.
- Physicians per Thousand:** Number of physicians per thousand people.
- Population:** Total population of the country.
- Labor Force Participation (%):** Percentage of the population that is part of the labor force.
- Tax Revenue (%):** Tax revenue as a percentage of GDP.
- Total Tax Rate:** Overall tax burden as a percentage of commercial profits.
- Unemployment Rate:** Percentage of the labor force that is unemployed.
- Urban Population:** Percentage of the population living in urban areas.
- Latitude:** Latitude coordinate of the country.
- Longitude:** Longitude coordinate of the country.

■ Global University Rankings Dataset 2023:

- Rank:** The ranking position of the university globally.
- University Name:** Name of the university.
- Location:** The country or region where the university is located.
- Number of Students:** Total number of students enrolled.
- Number of Students per Staff:** Ratio of students to academic staff.
- International Student:** Percentage of international students.
- Female - Male Ratio:** Ratio of female students to male students.



Analysis Plan

The analysis will focus on identifying correlations and trends between socio-economic factors (such as GDP, life expectancy, and unemployment rate) and university rankings. Here's a plan for analyzing the data:

■ Descriptive Analysis:

- Begin by exploring basic statistics such as the mean, median, and standard deviation for variables like GDP, life expectancy, and university rank.
- Visualize distributions of key variables such as GDP, CO2 emissions, and university rank using histograms and box plots.

■ Correlation Analysis:

- Use Pearson's or Spearman's correlation coefficients to understand relationships between continuous variables, such as GDP and life expectancy, or CPI and university rankings.
- Investigate correlations between educational variables (e.g., Gross Primary Education Enrollment, Gross Tertiary Education Enrollment) and economic indicators like GDP and labor force participation.

■ Comparative Analysis:

- Compare the university rankings across different regions or income categories (e.g., low-income vs. high-income countries).
- Perform t-tests or ANOVA to check for significant differences in university rankings based on factors like the size of the armed forces, CO2 emissions, or minimum wage.

■ Clustering and Grouping:

- Apply clustering techniques (e.g., K-means clustering) to group countries based on similar socio-economic profiles and analyze if these groups correlate with university rankings.
- Investigate if countries with high university rankings tend to share common characteristics in terms of economic performance, education enrollment rates, and other variables.

■ Geospatial Analysis:

- Use latitude and longitude data to map countries and their respective university rankings, creating a geographical heatmap to see if certain regions show consistent patterns in educational performance and socio-economic conditions.

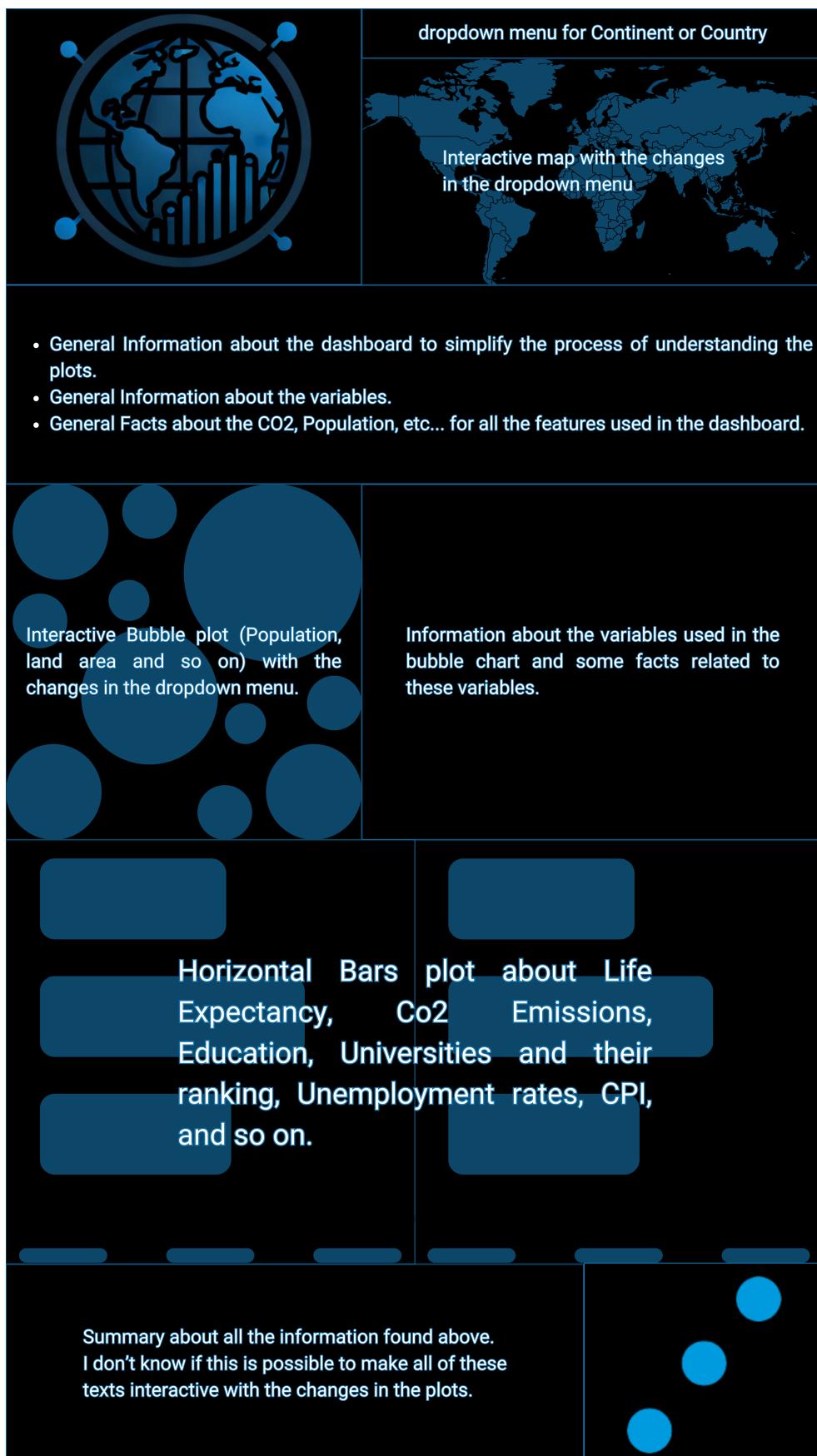
■ Tools and Techniques:

- This analysis will utilize a combination of tools such as **Python**, for statistical modeling and data manipulation, **Tableau**, for interactive data visualization and dashboard creation, and possibly **Excel** for initial data exploration and basic analysis.

By combining these analyses and tools, you can uncover valuable insights into how socio-economic and educational factors are related to university rankings and overall global dynamics. The results could inform strategies for businesses, policymakers, and educational institutions to target high-growth markets, improve global collaboration, and support sustainable development.



2.5 | Dashboard





2.6 | Milestones

To achieve success in this project, the goal will be to focus on thorough data analysis, clear reporting, insightful visualizations, and interactive dashboards. Success will be driven by a step-by-step approach to uncover valuable insights and effectively communicate those insights.

■ First Milestone – Exploratory Data Analysis (EDA):

- The first milestone will focus on Exploratory Data Analysis (EDA), which involves thoroughly examining the datasets to understand their structure, distributions, and key relationships between variables.

□ Key tasks include:

- **Data cleaning and preprocessing:** Ensuring the data is free from errors, dealing with missing values, and transforming variables as needed.
- **Descriptive statistics:** Analyzing basic statistical measures like mean, median, and standard deviation to understand the distribution of key variables.
- **Visualizations:** Generating visualizations like histograms, scatter plots, and box plots to explore the relationships between variables such as GDP, life expectancy, and university rankings.

■ Mid Milestones – Deeper Analysis and Insight Generation:

- Once EDA is complete, the next milestone will involve performing deeper correlation analysis to identify key patterns, trends, and relationships in the data.
- The focus will be on uncovering correlations between socio-economic indicators (such as GDP and unemployment rates) and educational variables (such as university rankings and enrollment rates).
- **Comparative analysis** will be done to examine differences between countries, regions, and income categories.
- Tools like Python will be used for statistical analysis (such as Pearson or Spearman correlation) and for creating visualizations in libraries like Matplotlib or Seaborn.

■ Final Milestone – Reporting, Dashboards, and Visualizations:

- The final milestone will center around synthesizing the analysis into a clear, informative report and creating interactive dashboards.
- **Reports** will summarize key findings, highlight trends and correlations, and offer actionable insights. The focus will be on presenting data in an understandable way that can inform decision-making.
- **Dashboards** created in Tableau will allow users to interact with the data and explore different variables and trends. These dashboards will present dynamic visualizations to showcase relationships between socio-economic factors and university rankings.
- The final report and dashboards will be packaged as a comprehensive deliverable, effectively communicating the insights from the data analysis.



2.7 | Timeline

Timeline	
Week	Tasks
Week 1	Project Description, Project Scoping
Week 2	Data Curation
Week 3	Exploratory Data Analysis
Week 4	Datafolio
Week 5	Dashboard
Week 6	Final Report

Table 2.1: Project Timeline



3 | References

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