Analysis of the Human Development Index (HDI)

A report on Data-Driven Exploration of Global and Regional Development Patterns

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Introduction to HDI

The Human Development Index (HDI) is a combined indicator created by economist Mahbub ul-Haq and widely recognized by the United Nations Development Programme (UNDP) to assess the overall progress of nations. It encompasses 3 key aspects: life expectancy (health), education (mean years of schooling and projected years of schooling), and Gross National Income per capita (living standards). HDI evaluates countries on a scale from 0 to 1, where a higher score signifies enhanced human development. This index highlights the importance of not just financial well-being but also access to education and healthcare, providing a more inclusive understanding of well-being beyond traditional economic measures like GDP.

Why HDI is Important

HDI is crucial for understanding the multifaceted nature of human development. Unlike conventional economic indicators like GDP, HDI includes aspects of health and education, making it a more comprehensive measure of a nation's advancement. It allows for meaningful global comparisons and assists in tracking changes over time, revealing areas where progress may be needed. HDI is essential for policy formulation, guiding governments in managing resources effectively. By integrating multiple factors, HDI encourages a broader approach to development, prioritizing the well-being and potential of individuals over solely focusing on economic growth.

Objectives of the Analysis

1. Evaluate the levels of human development across different countries and regions.
2. Identify key strengths and weaknesses in human development indicators.
3. Support policy formulation and decision-making with data-driven insights.
4. Conduct a comparative analysis of development across various countries and regions.
5. Track and analyze changes in human development over time.

Scope of the Report

This report applies exploratory data analysis (EDA) techniques to the Human Development Index (HDI) data, utilizing Python for data manipulation, analysis, and visualization. The focus is on examining global development patterns, exploring the relationships between health, education, and income. Through this analysis, the report aims to develop core skills in data processing and visualization, providing insights that are valuable for fields like data science, AI, and advanced analytics.

Problem-wise Analysis:

Single Year HDI Exploration

1. **Methods and approach**

- The dataset was filtered to include countries with HDI > 0.8, focusing on countries with high development.
- The mean, median, and standard deviation were calculated to summarize the HDI distribution.
- Countries were classified into HDI categories (Low, Moderate, High, Exceptional) to compare development levels.

2. **Visualizations and tables**

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Mean: 0.72
Median: 0.74
Standard Deviation: 0.15
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The mean HDI is 0.72, and the median is 0.74, indicating moderate variation in HDI values across countrie

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Top 10 countries with (HDI > 0.8) sorted by GNI per capita
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	country	year	hdi	gross_inc_percap	life_expectancy
3332	Liechtenstein	2022	0.942	146673.24150	84.656
4718	Qatar	2022	0.875	95944.37754	81.559
5213	Singapore	2022	0.949	88761.14559	84.133
2705	Ireland	2022	0.950	87467.51391	82.716
3398	Luxembourg	2022	0.927	78554.23640	82.591
6104	United Arab Emirates	2022	0.937	74103.71494	79.196
5609	Switzerland	2022	0.967	69432.78669	84.255
4322	Norway	2022	0.966	69189.76165	83.393
6170	United States	2022	0.927	65564.93798	78.203
1550	Denmark	2022	0.952	62018.95694	81.882

Countries with HDI > 0.8 generally fall into the Very High category, reflecting better life expectancy, healthcare, and education.

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HDI with its HDI Category Comparision
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5]:

	country	hdi	HDI_Category
32	Afghanistan	0.462	Low
65	Albania	0.789	High
98	Algeria	0.745	High
131	Andorra	0.884	Very High
164	Angola	0.591	Medium
197	Antigua and Barbuda	0.826	Very High
230	Argentina	0.849	Very High
263	Armenia	0.786	High
296	Australia	0.946	Very High
329	Austria	0.926	Very High

Afghanistan (HDI = 0.462) is in the Low category, while Andorra (HDI = 0.884) and Australia (HDI = 0.946) are in the Very High category, showing significant disparities.

3. Key results

- 69 countries are classified into the Exceptional HDI category, while 35 countries fall into the Very Low HDI category.
- Regions with higher GNI per capita show higher HDI scores.
- Europe and North America have the highest average HDI values, while South Asia and Sub-Saharan Africa lag behind

4. Interpretation and discussion

The analysis confirms that countries with higher GNI generally have better HDI scores, though exceptions exist. Afghanistan faces development challenges, reflected in its low HDI, while countries like Liechtenstein and Singapore show high HDI due to strong economies, healthcare, and education. The disparity between regions highlights the need for targeted strategies to address both economic and social factors.

HDI Trend Analysis (2020–2022)

1. Methods and approach

- The dataset was filtered for 2020–2022 and cleaned for missing values.
- Line chart: HDI trends for selected countries.
- Bar chart: Comparing average HDI across regions.
- Box plot: Displaying HDI distribution across years.
- Scatter plot: Investigating HDI vs. GNI per capita

2. Visualizations and tables

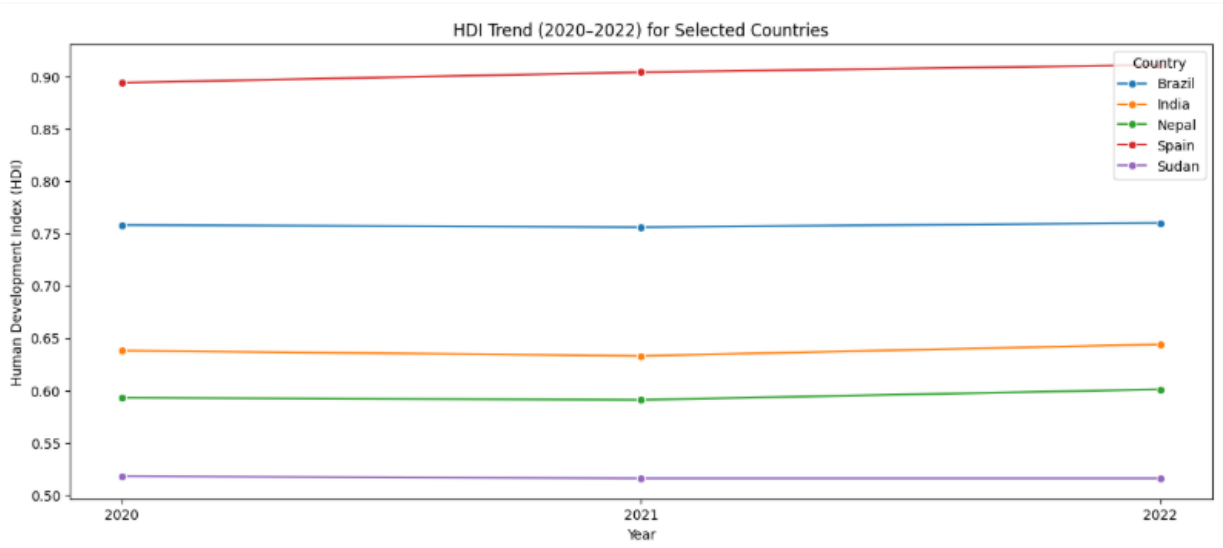
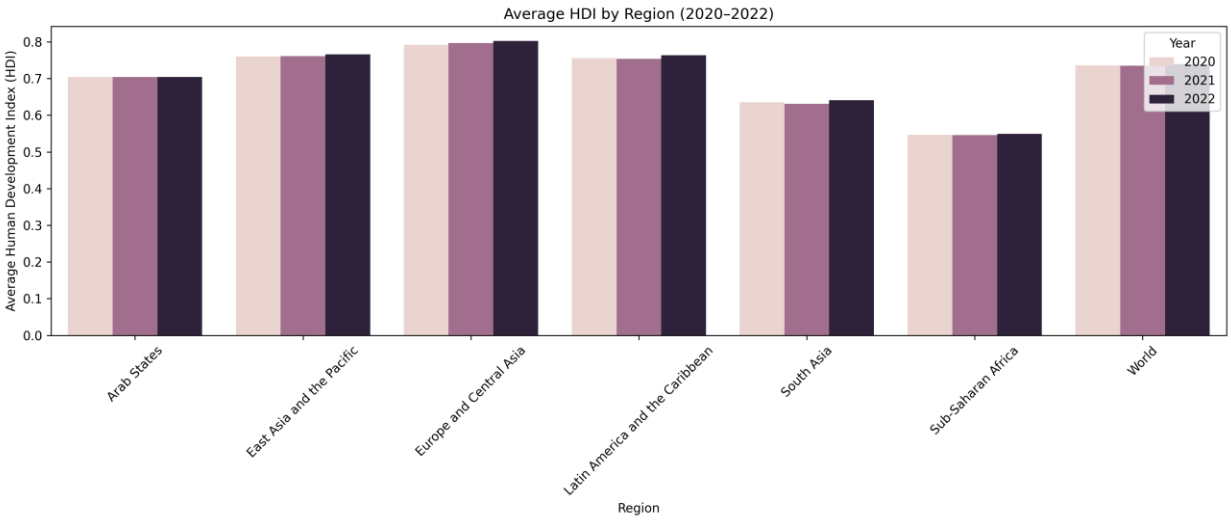
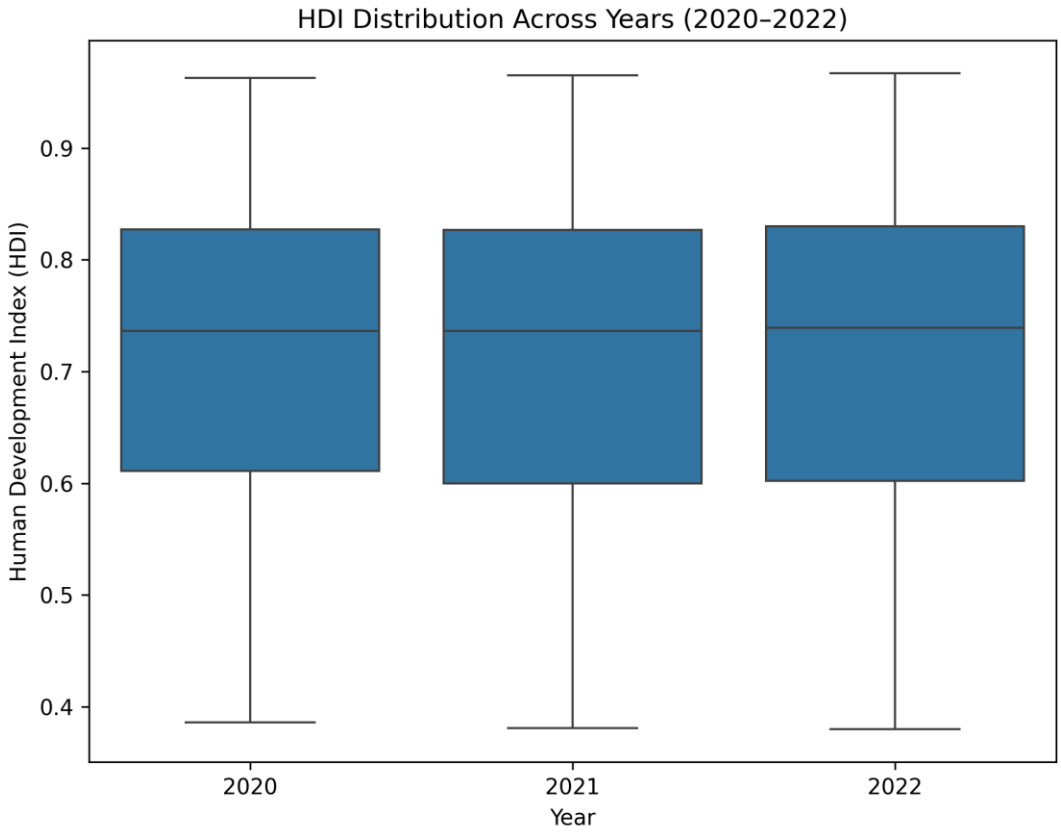


Figure: HDI trend across 2020–2022 shows progress or decline in human development.

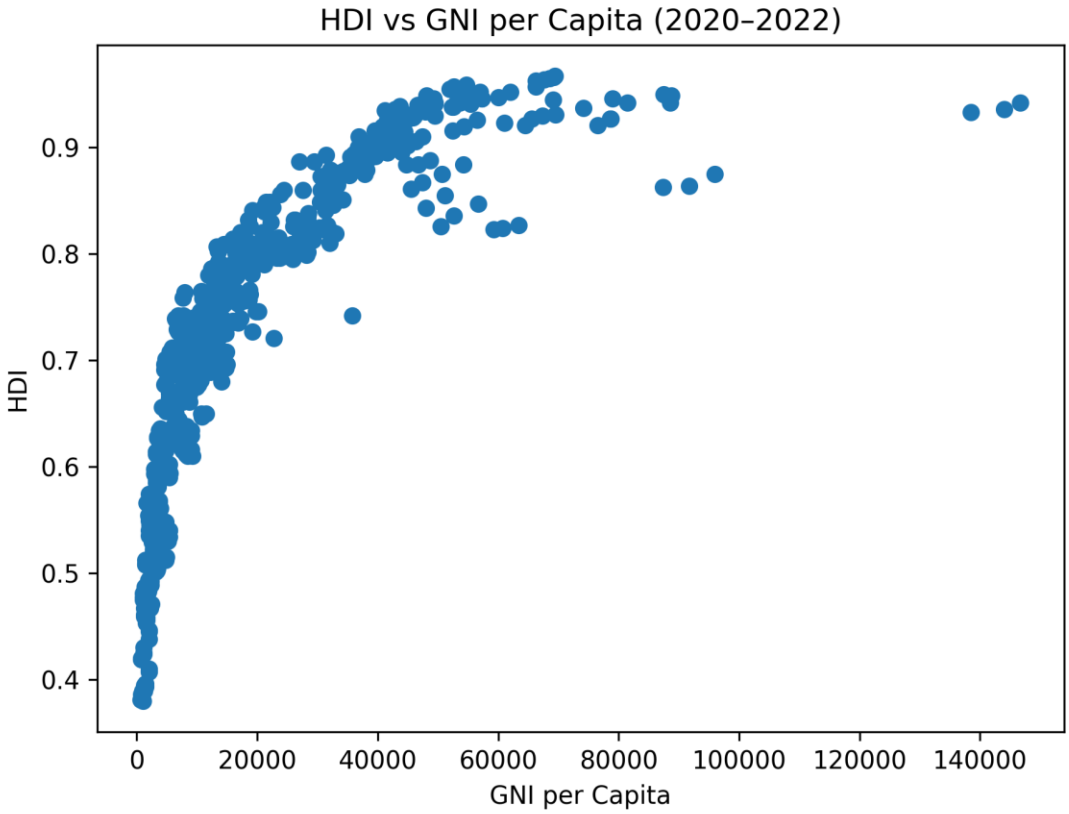
The HDI trend chart (2020–2022) shows stable HDI values for countries like Brazil and Spain, while India and Nepal show positive growth. Sudan has stagnated.



The Average HDI by Region chart shows that Europe and North America have the highest HDI, while Sub-Saharan Africa and South Asia remain low.



The box plot confirms that HDI values remain relatively consistent across 2020–2022, with minor fluctuations.



HDI vs GNI per Capita scatter plot. The shows a positive correlation, with wealthier countries generally having higher HDI, though some countries deviate from this trend.

3. Key results

- Positive correlation exists between HDI and GNI per capita, although some countries deviate.
- The COVID-19 pandemic negatively impacted HDI development.
- South Asia shows mixed HDI performance, while Middle Eastern countries tend to perform better on average due to higher GNI and gender development.

4. Interpretation and discussion

The analysis confirms that GNI and HDI are positively correlated, but regions like South Asia show more mixed performance due to lower income and development challenges. The COVID-19 pandemic significantly hindered global development, though some countries maintained or improved their HDI. The Middle East outperforms South Asia, primarily due to better GNI and gender development indicators. The scatter plot reveals that while GNI generally influences HDI, other factors such as healthcare and education play a key role in shaping human development.

Advanced HDI Exploration

1. Methods and approach

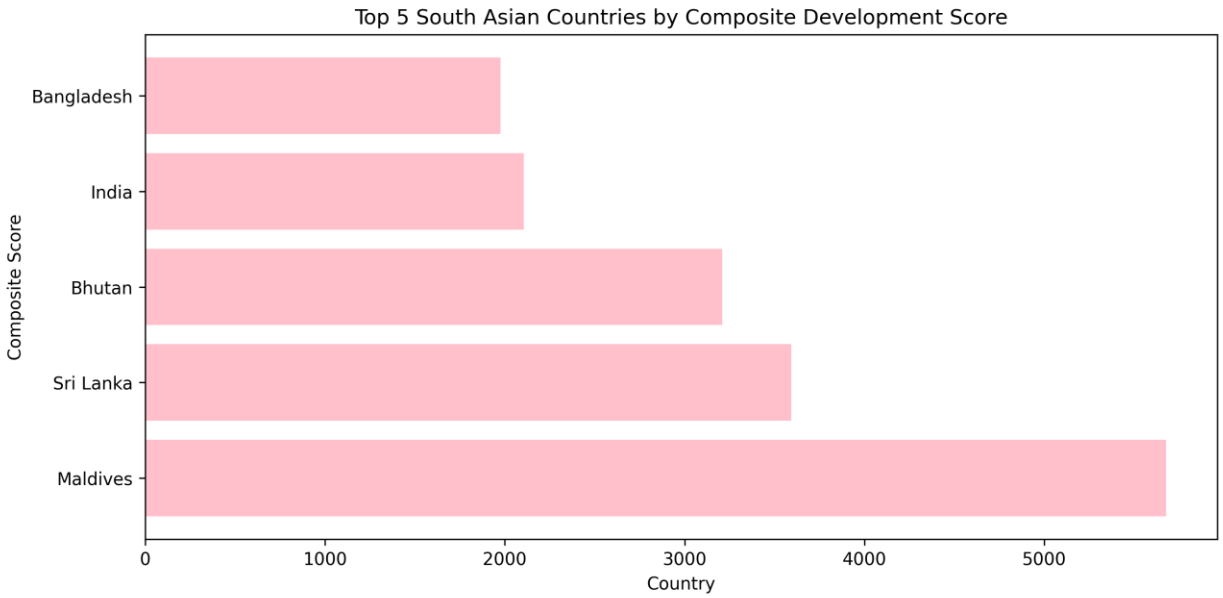
The HDI dataset for South Asian countries was cleaned and filtered. Bar charts visualized the top performers, and scatter plots identified outliers in HDI and GNI using the 1.5 × IQR rule. Pearson correlation analyzed relationships between HDI components, and a GNI-HDI Gap metric assessed income-development discrepancies. Various visualizations were used to highlight trends and disparities across the region.

2. Visualizations and tables

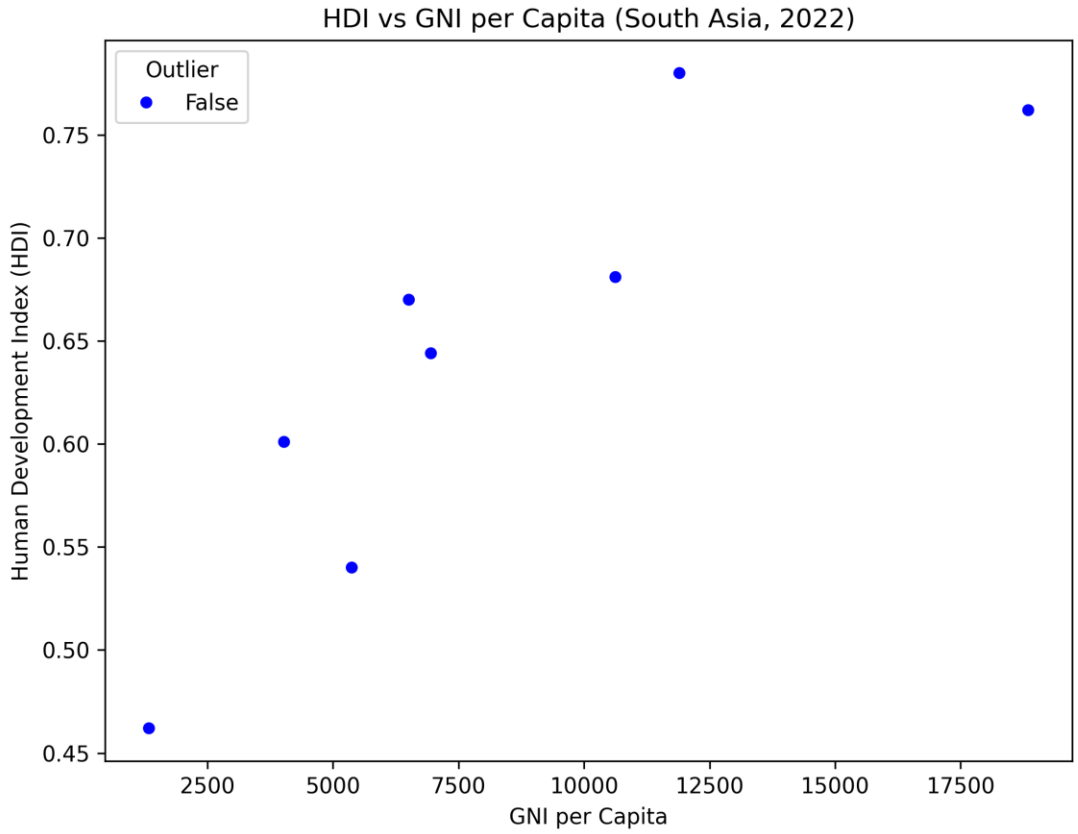
Top 5 South Asian Countries by Composite Development Score:

	country	Composite_Score	Composite_Rank	hdi
164	Maldives	5678.289357	1.0	0.762
263	Sri Lanka	3592.832541	2.0	0.780
98	Bhutan	3209.130864	3.0	0.681
131	India	2105.481239	4.0	0.644
65	Bangladesh	1975.446053	5.0	0.670

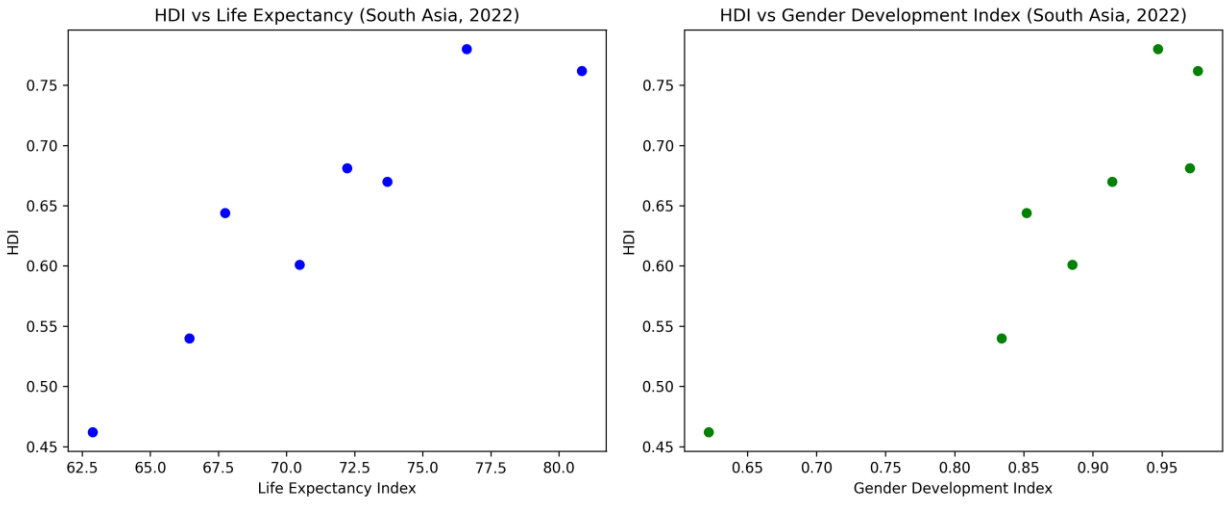
Maldives ranks highest with an HDI of 0.762, followed by Sri Lanka. India and Bangladesh show lower scores, indicating developmental gaps.



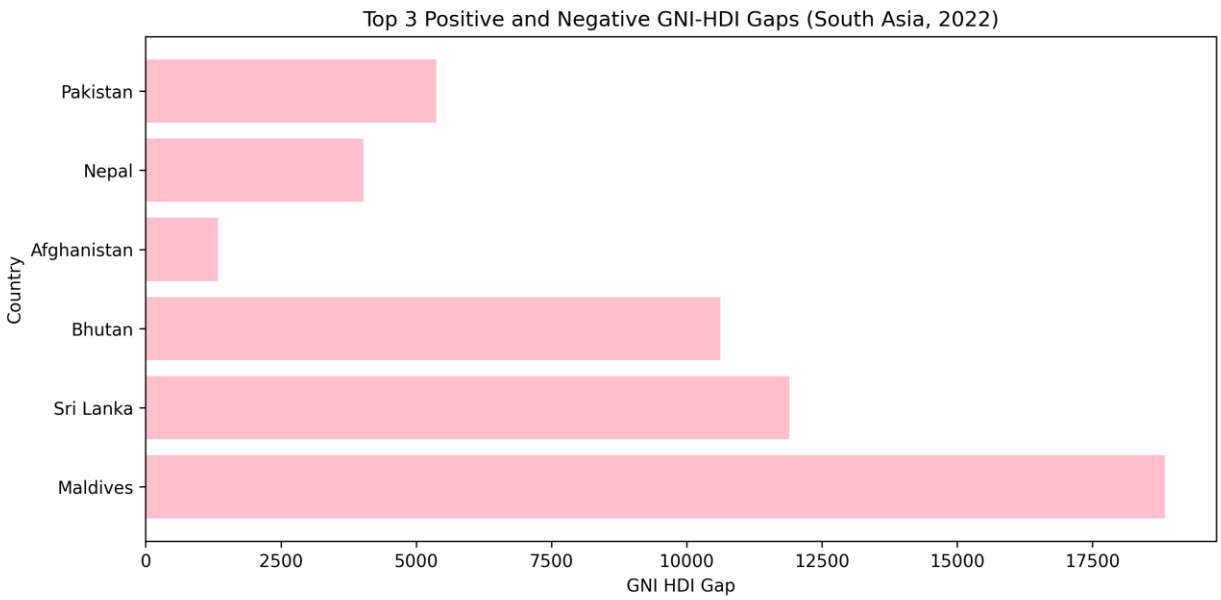
Bar chart highlights the gap between Maldives and other countries, emphasizing regional disparities in development.



The scatter plot shows a positive correlation between HDI and GNI, with some countries as outliers.



The scatter plots show the Strong positive correlation between HDI and both life expectancy and gender equality, showing their influence on development.



Strong positive correlation between HDI and both life expectancy and gender equality, showing their influence on development.

3. Key results

- Maldives has a high GNI but a lower HDI, indicating income doesn't fully reflect human development.
- Pakistan and Nepal have negative GNI-HDI gaps, showing better development than expected from income alone.
- Income alone doesn’t guarantee development; factors like healthcare and education matter.
- Sri Lanka and Bhutan show notable development disparities compared to their income levels.
- No outliers in either HDI or GNI per capita.

4. Interpretation and discussion

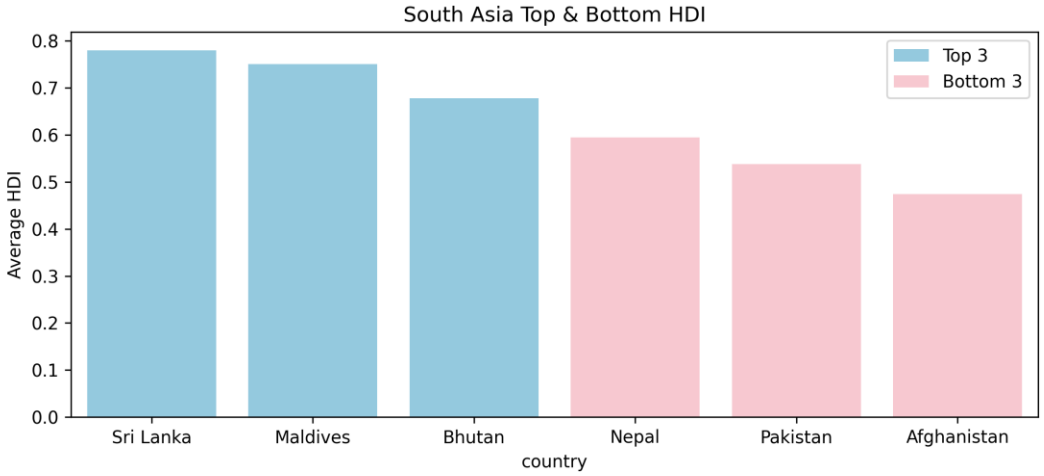
The analysis reveals that while there is a positive correlation between GNI and HDI, countries like Maldives have higher income but lower HDI, suggesting that factors such as education and healthcare are crucial for development. Pakistan and Nepal outperform their income levels, emphasizing the role of non-economic factors in driving human development. The GNI-HDI gaps highlight both the opportunities and challenges in translating income into development. Notably, no countries were identified as outliers, indicating that most countries align with expected development patterns based on their income levels.

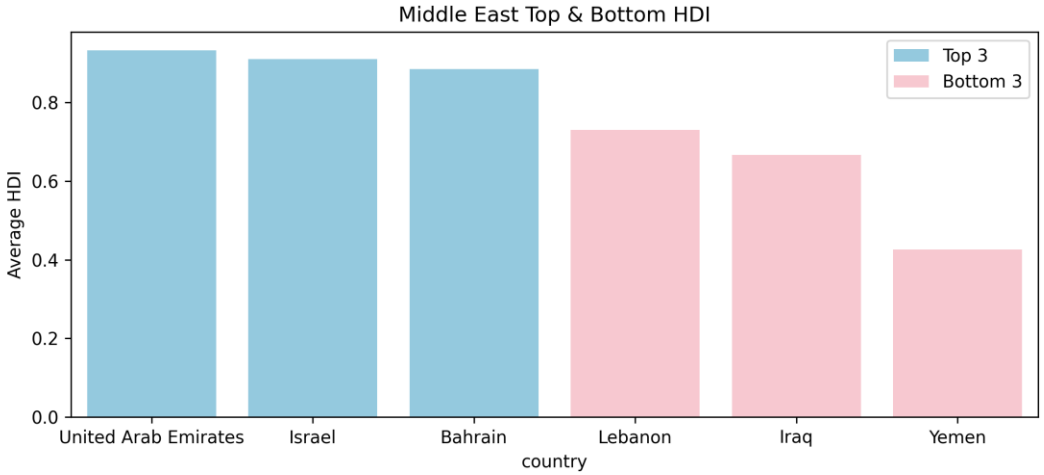
Regional Analysis between South Asia and Middle East

1. Methods and approach

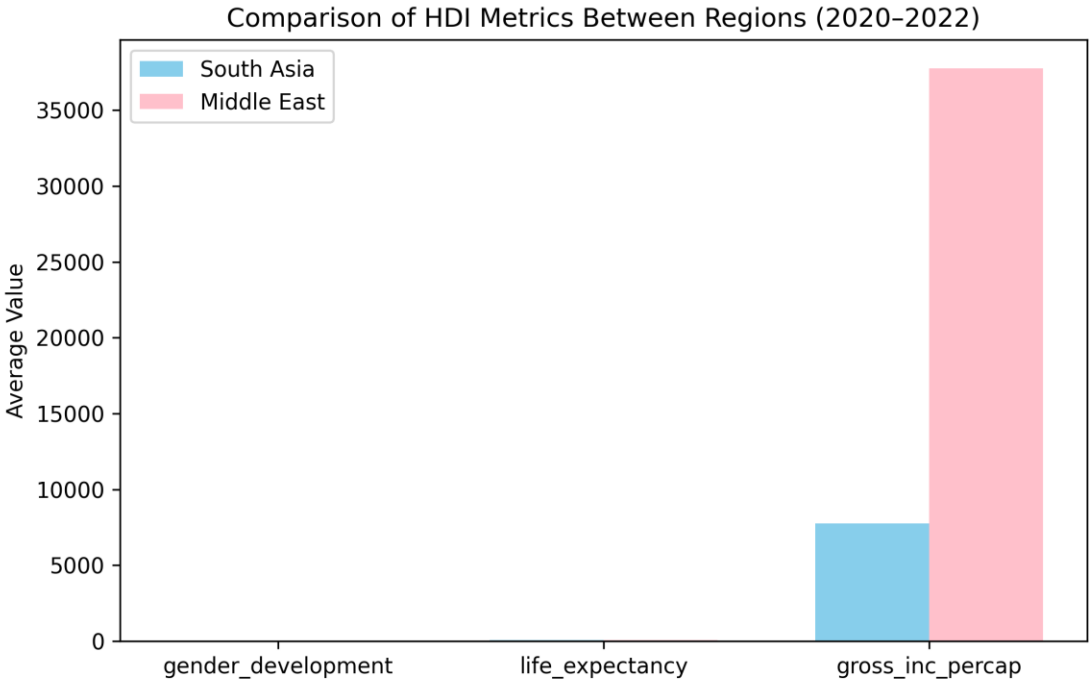
The HDI data for South Asia and the Middle East from 2020 to 2022 was cleaned and filtered to ensure accuracy. Descriptive statistics, including the mean and standard deviation, were calculated to summarize the data. Outlier detection was performed using the 1.5 × IQR criterion to identify extreme values. Bar charts and synchronic data were used to compare top and bottom performers across both regions. Correlation analysis was conducted to examine the relationship between HDI and its components, helping to understand factors driving development in each region. Various visualization techniques were employed to highlight trends and disparities, including scatter plots showing relationships between HDI, GNI per capita, life expectancy, and gender development.

2. Visualizations and tables

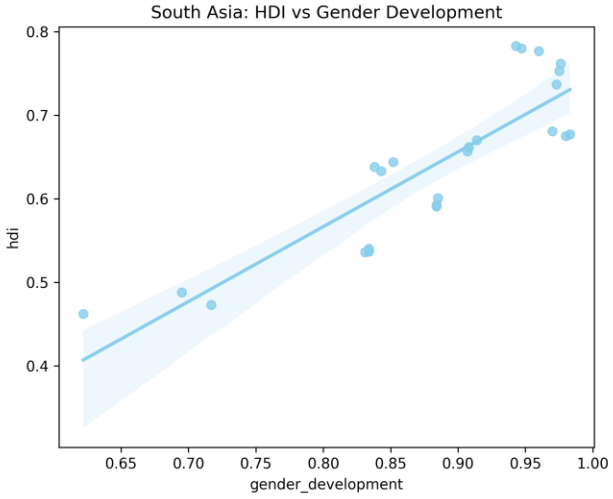


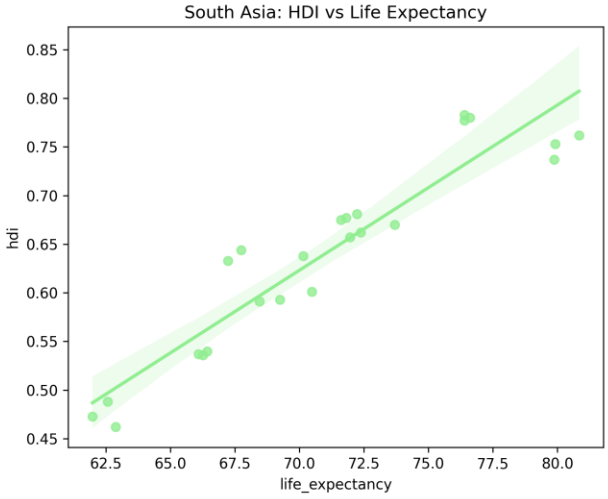


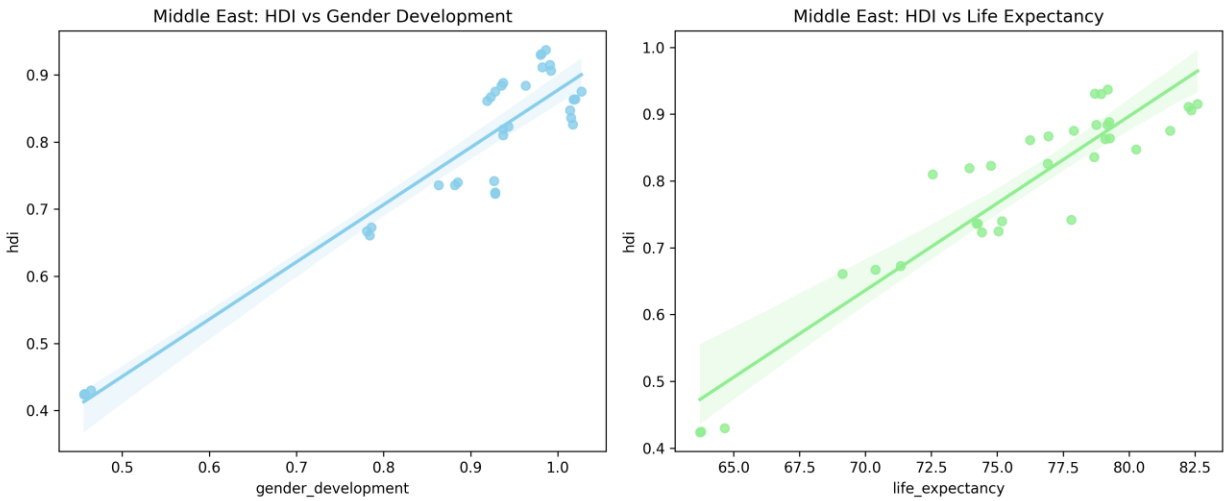
The bar charts compare the Top 3 and Bottom 3 HDI countries in both regions, highlighting disparities in development.



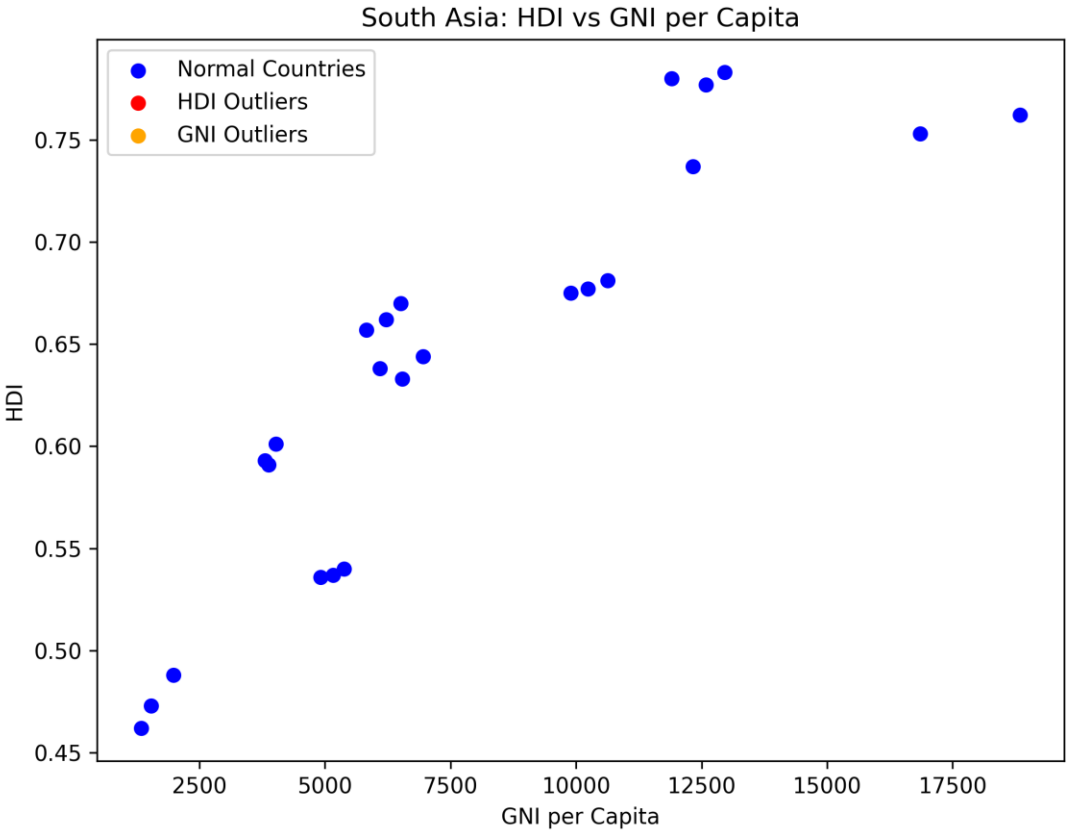
Compares gender development, life expectancy, and GNI per capita between South Asia and the Middle East.

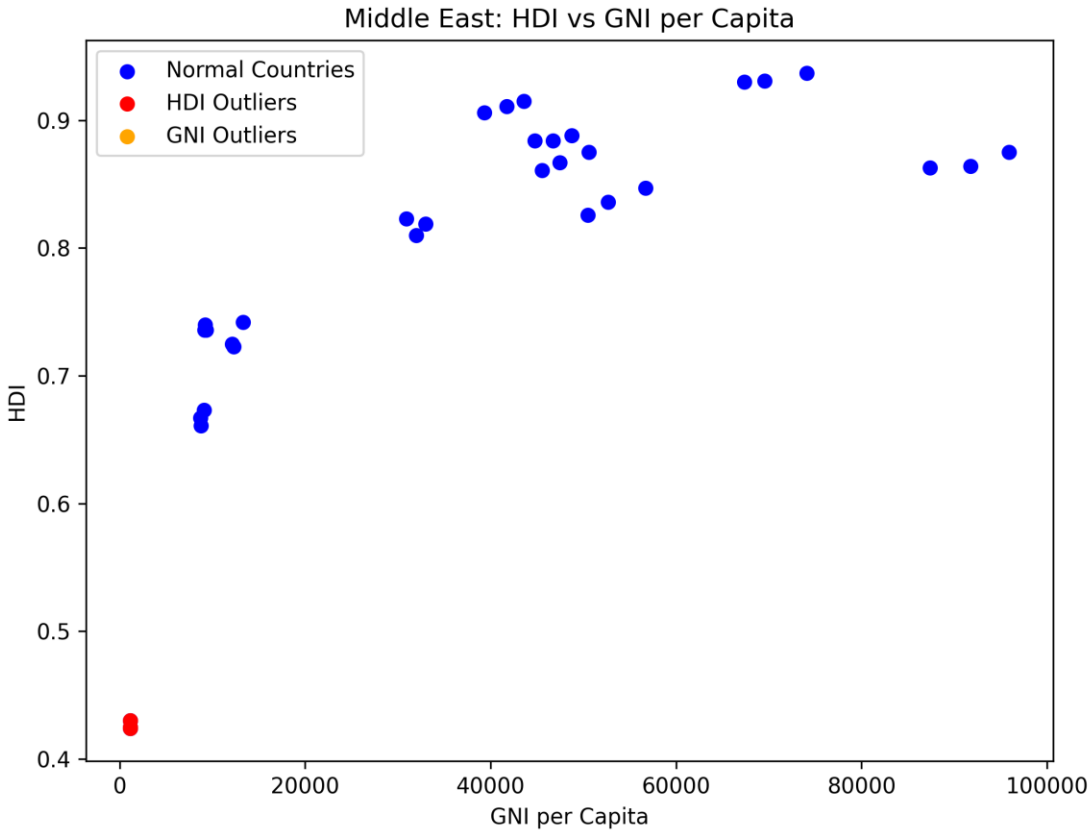






The scatter plots Show the positive relationship between HDI and these factors in both regions.





Displays the correlation between GNI and HDI for both regions, with some outliers.

3. Key results

- Middle Eastern countries generally show higher HDI values, indicating stronger development than South Asia.
- Yemen, Iraq, and Afghanistan have lower HDI, indicating developmental challenges.
- Positive correlation between GNI per capita and HDI in both regions.
- Outliers like Afghanistan and Yemen show gaps between income and human development.

4. Interpretation and discussion

The analysis shows significant differences in human development between South Asia and the Middle East. The Middle East generally performs better in HDI, driven by factors like higher GNI and gender development. In contrast, South Asia shows more variation, with countries like Sri Lanka and the Maldives performing better than Afghanistan and Pakistan. While GNI correlates with HDI, outliers like Afghanistan and Yemen highlight that wealth alone does not ensure human development. These findings emphasize the need for a more holistic approach to

development.

Conclusion

The analysis shows a positive correlation between HDI and GNI per capita, with wealthier nations generally exhibiting better development outcomes. The Middle East outperforms South Asia in HDI, driven by higher income and better gender equality. However, anomalies like Afghanistan and Yemen highlight that high income alone doesn't guarantee human development, with factors like healthcare, education, and governance also playing crucial roles. The COVID-19 pandemic disrupted development, particularly in health and education. The HDI Trend Analysis (2020–2022) reveals regional differences, with South Asia showing mixed performance and the Middle East generally maintaining or improving HDI. The Advanced HDI Exploration of South Asia indicates that countries like the Maldives have high income but lower HDI, while Pakistan and Nepal perform better than expected, emphasizing the importance of non-economic factors. This study highlights the need for a comprehensive approach to development, integrating both economic and social policies, with a focus on governance and data-driven decision-making to address disparities and foster sustainable development.

Limitations

- The analysis focuses on data from 2020–2022, which may not fully capture long-term trends or broader historical context.
- The dataset primarily reflects national averages and may not account for significant regional or local variations within countries.
- The COVID-19 impact may have skewed development trends, as the pandemic affected health, education, and income globally in unprecedented ways.
- Data gaps or missing values may have influenced the accuracy of some regional comparisons or statistical results.
- The use of HDI as a composite index may overlook other important factors contributing to development, such as human rights, political stability, and environmental sustainability.

References

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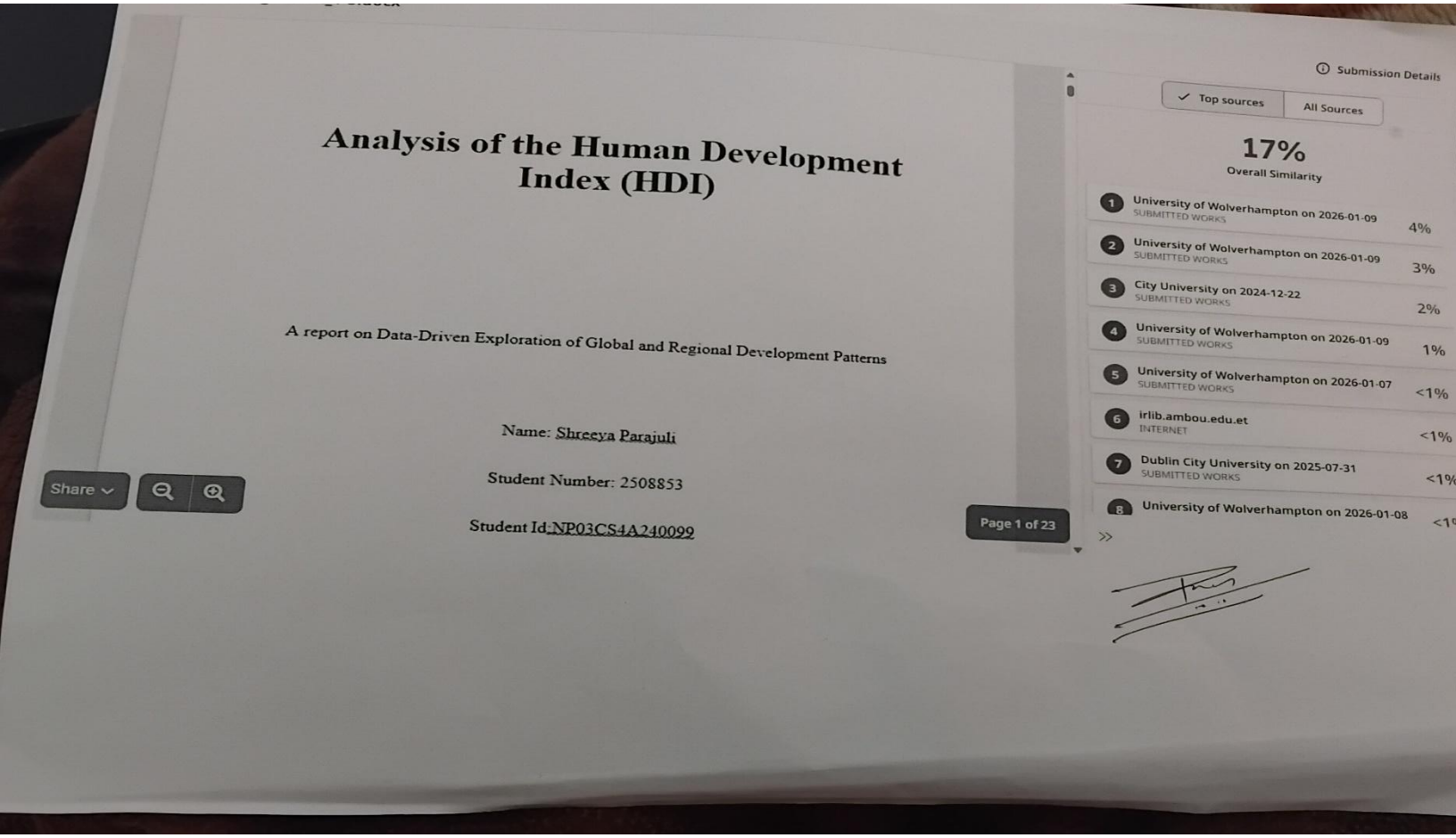
Assignment PDF / Guidelines

Assignment - 1 – Statistical Interpretation and Exploratory Data Analysis - 2025

Appendix



Github link:

https://github.com/shreeyap876-bit/2508853_ShreeyaParajuli_AI/tree/main/Assessment1