Concepts and Technologies of AI
5CS037

Title: *Analysis of the Human Development Index (1990-2022)*

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Course:5CS037
Date of submission: 9 jan
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INTRODUCTION:

Through many different variables, the Human Development Index (HDI) assesses development. Life expectancy at birth, average and expected years of schooling, and Gross National Product are three major indicators of HDI. The HDI offers a more holistic view of development than merely examining the economy.

The conclusions of HDI from 1990 to 2022 will provide insight into past, current and projected trends and gaps in HDI. This report will provide an assessment of these trends and gaps by leveraging an analytical approach within Python. Lucas Yukiolmafuko's data is the reference for the HDI and was obtained from a UNDP defined category.

Problem 1A: Single-Year HDI Exploration (2022)

Approach:

I made a new dataframe to simplify the browsing and focused on 2022, the most recent year. First, I looked at the structure of the data: This included the columns in my dataset and what nature (type) of information was stored there. I went on to look at the information. Duplicate and missing values were identified. I removed special characters which indicated na's, and converted numeric (saved as text).

Key Results:

The purpose of this report is to identify the trends and the gaps in the Human Development Index. The report will make use of the Python analysis. The data is sourced from Lucas Yukiolmafuko and is based on the Human Development categorization of the United Nations Development Programme. To see how the level of income relates to development outcomes, these

countries were then ranked by their GNI per capita.

Visualizations & Table:

Highest HDI Country

```
hdi_2022_df.loc[hdi_2022_df['hdi'].idxmax(),['country','hdi']]
```

```
                5609
country    Switzerland
hdi              0.967
dtype: object
```

Lowest HDI Country

```
hdi_2022_df.loc[hdi_2022_df['hdi'].idxmin(),['country','hdi']]
```

```
                5345
country      Somalia
hdi             0.38
dtype: object
```

Summary Statistics of HDI(2022):

```
Mean HDI for 2022: 0.7268333333333336
Median HDI for 2022: 0.7415
Standard Deviation of HDI for 2022: 0.15219828657299067
```

HDI Categorization:

A new column, HDI Category, was added on the basis of the definitions from the UNDP:

Low Human Development:	HDI < 0.550
Medium Human Development:	0.550 <= HDI < 0.700
High Human Development:	0.700 <=HDI <0.800
Very High Human Development:	HDI >= 0.800

Each country is classified into a group, and this facilitates comparison of the level of development.

Interpretation:

The result indicates that income is a significant factor in development, and countries with the same income levels may have different values of HDI due to variation in Health and Education indices. It again indicates that human development has various components.

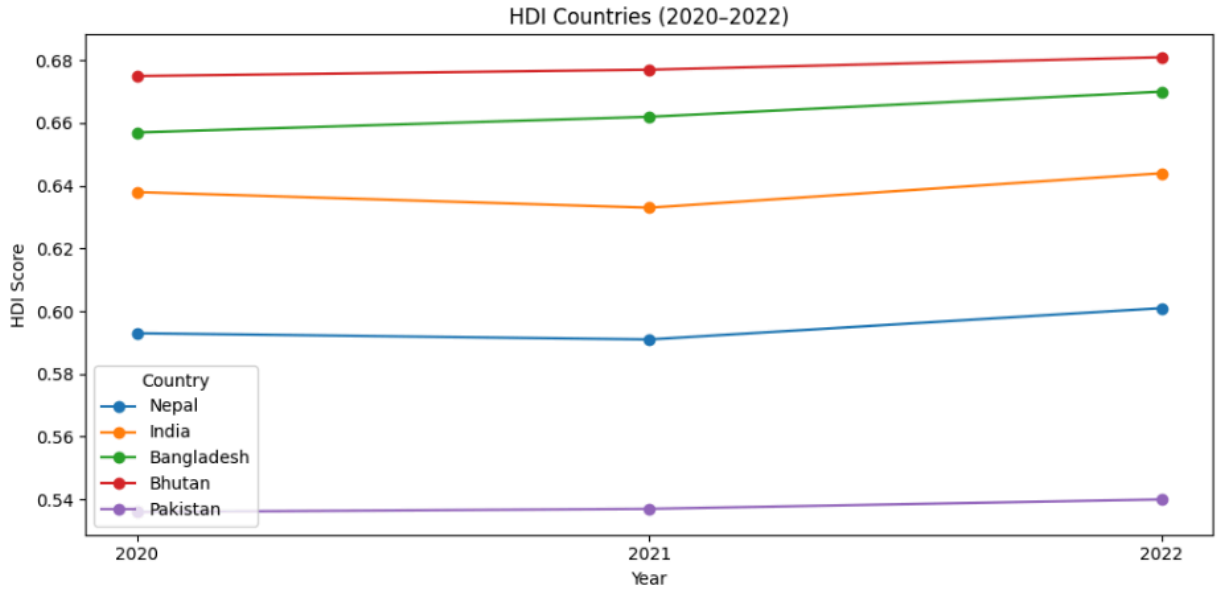
Problem 1B: HDI Trend Analysis(2020-2022)

Approach:

The data were from 2020 through 2022. Reconciling country names, correcting formatting of data and cleaning out riding data that did not include an HDI value we cleaned the data. Trends in the likelihood distributions of each variable were then visualised. The dataset was limited by year (2020, 2021 or 2022). Standardisation of country naming, proper data types and missing HDI value handling were achieved during the data cleaning process.

HDI Trends:

A line chart was used to monitor the changes occurring in five selected countries concerning HDI from 2020 to 2022. The result showed an increase for some while others stalled or experienced a slight decline.



Interpretation:

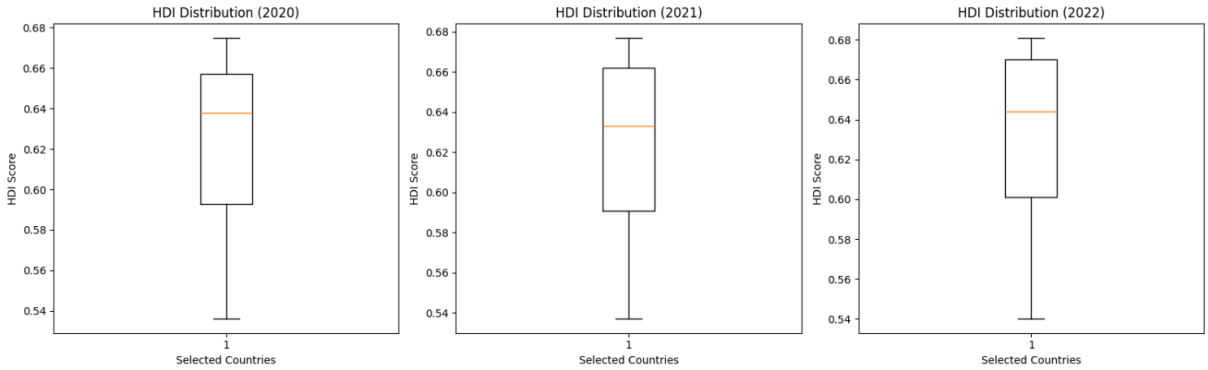
Between 2020 and 2022, the HDI scores trend slightly upwards for most countries. Bhutan retains the top rank, and Pakistan remains at the bottom. Bangladesh, India, and Nepal progress gradually, but the disparities between South Asian countries reflect the development imbalance that still exists.

Insights:

The gradual continuity in the value of HDI for most nations suggests a recovery in human development from the shortcomings posed by the COVID-19 pandemic.+

Distribution Analysis:

The dispersion of the HDI data was shown for 2020, 2021, and 2022 in box plots. Distributions showed little annual variation, although there were small displacements accounting for global events like the COVID-19 pandemic.



Box plot of HDI across selected countries from 2020 to 2022

Interpretation:

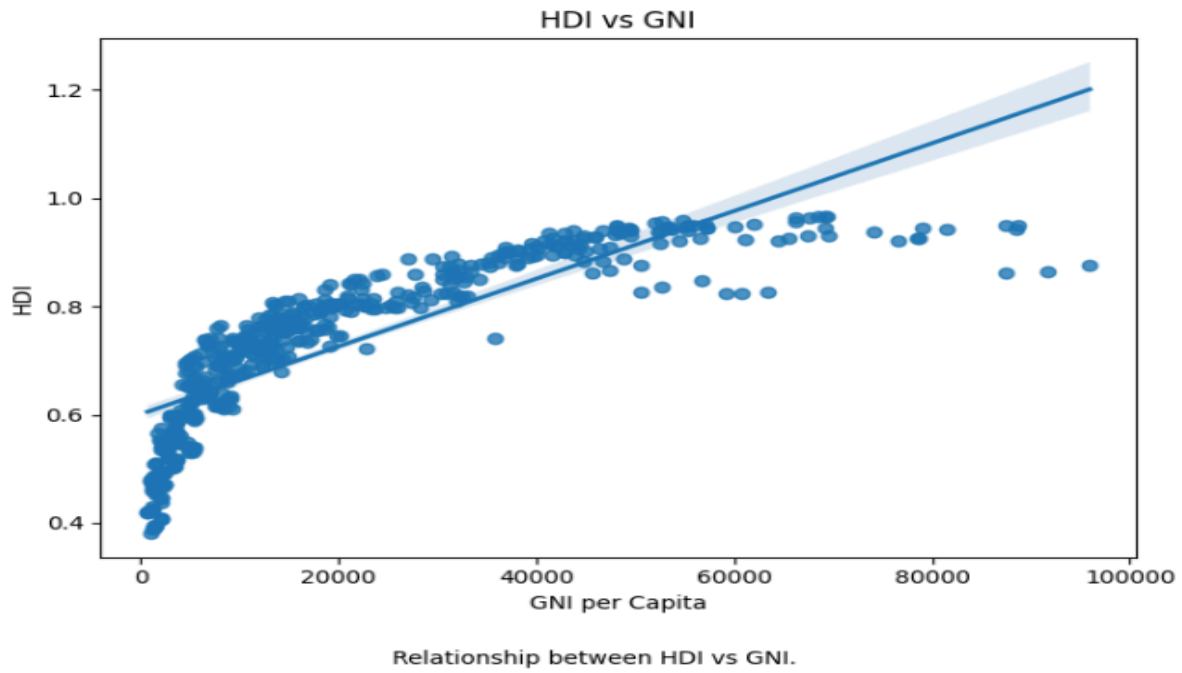
The box plots show that the median values for the HDI of the selected countries remain quite stable between 2020 and 2022, with a minor increase in 2022 that shows progress in human development levels.

Insights:

That the stable median and interquartile ranges for all three years show that the levels of overall human development changes slowly from 2020 to 2022.

HDI and GNI Relationship:

Scatter plot of GNI per capita and HDI indicates that more income usually means more human development. And important disparities, nonetheless, betrayed the way countries shine or struggle relative to their incomes.



Relationship between HDI vs GNI.

Interpretation:

This implies that income matters for development but countries with same income may not have the same level of HDI as health and education outcomes differ. This is evidence for the multidimensional aspect of human development.

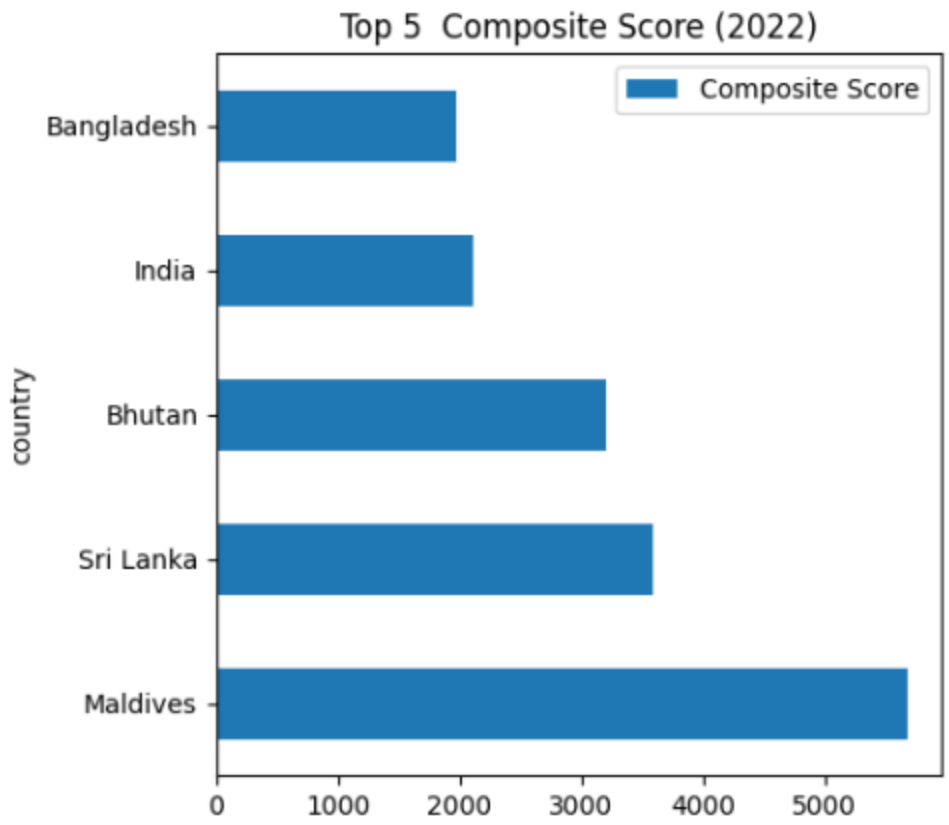
Problem 2:Advanced HDI Exploration (South Asia)

The South Asian:

The South Asian subset of the report addressed five nations from the South Asian region: Bangladesh, Bhutan, India, Maldives, and Sri Lanka.

Composite Development Scores:

Two indicators were utilized to create the composite scores: GNI per capita and life expectancy. The composite scores were then used to rank all countries and compare the rankings to their HDI rankings.



Interpretation:

From the graph, the comparison of the values of the composite scores for the five South Asian countries in the year 2022 is presented. The composite score is the average score, which is arrived at after taking various parameters based on the situation.

Insights:

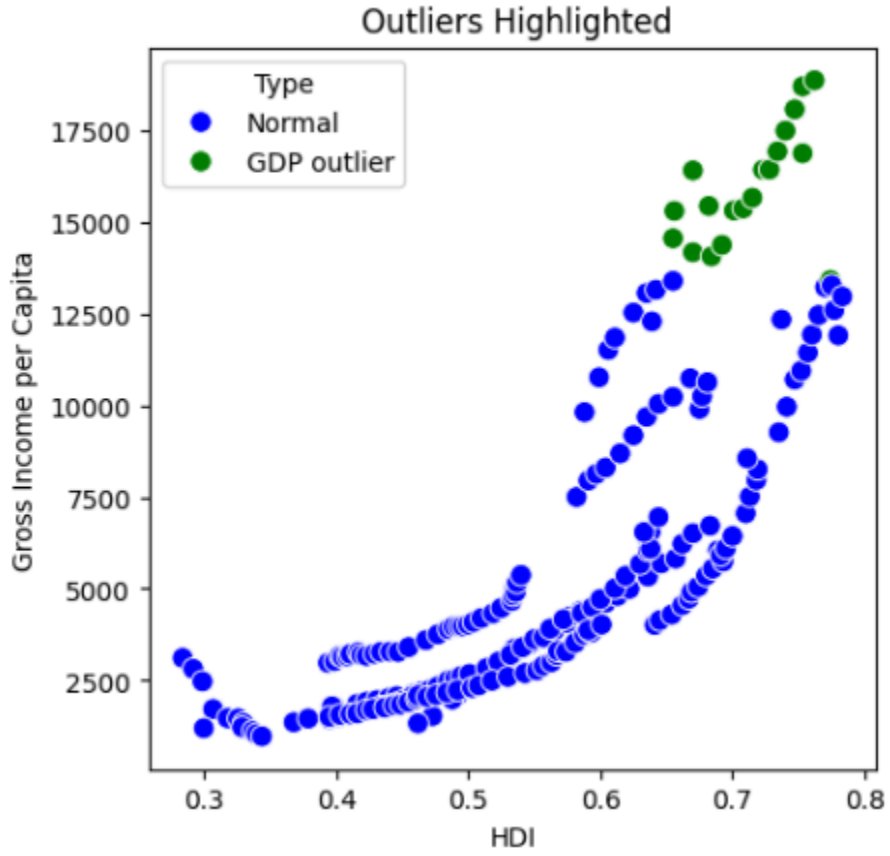
Regarding data from the five countries of South Asia for the year 2022, there is an apparent difference in the composite scores that show trends and levels of well-being. A higher composite score shows positive indicators on fundamental parameters.

Key Findings:

Some countries ranked higher in HDI than in Composite Score, suggesting strong education outcomes compensating for lower income levels. Others ranked higher in Composite Score due to higher income despite moderate HDI values.

Outlier Detection:

The 1.5×IQR method worked well in identifying outliers for both Human Development Index and GDP per capita. In general, the possible observation outliers were from countries having higher levels of income or development performance.



Interpretation:

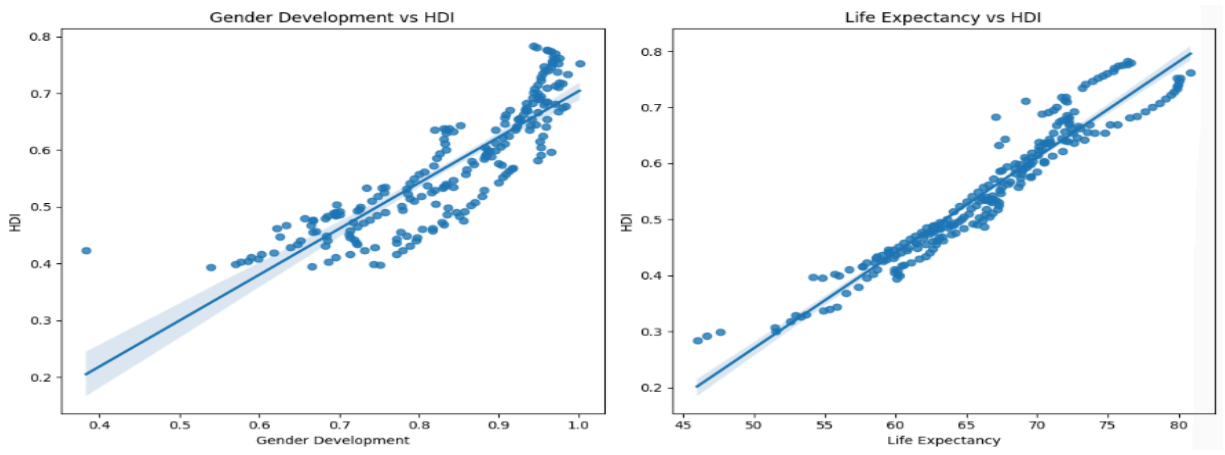
Outliers show that it is economic inequality: being a rich country is not a guaranteed ticket to human development. In some instances, the unequal distribution of wealth, concentration of profits in few privileged sectors, or unique policy choices result in poorer development in spite of high average income.

Insights:

There is a clear positive correlation between the Gross Income per Capita and HDI, as the major countries are plotted on the upwards-trending line in the graph. However, there are some GDP outliers that particularly reveal high income that is not consistent with its respective HDI value, thus suggesting the discrepancy between the GDP and overall human development of the country.

Correlation Analysis:

From the correlation analysis, longevity had a deeper relation to HDI than to income using the Pearson correlation. This further reiterates the importance that health outcomes have to human development.



Interpretation:

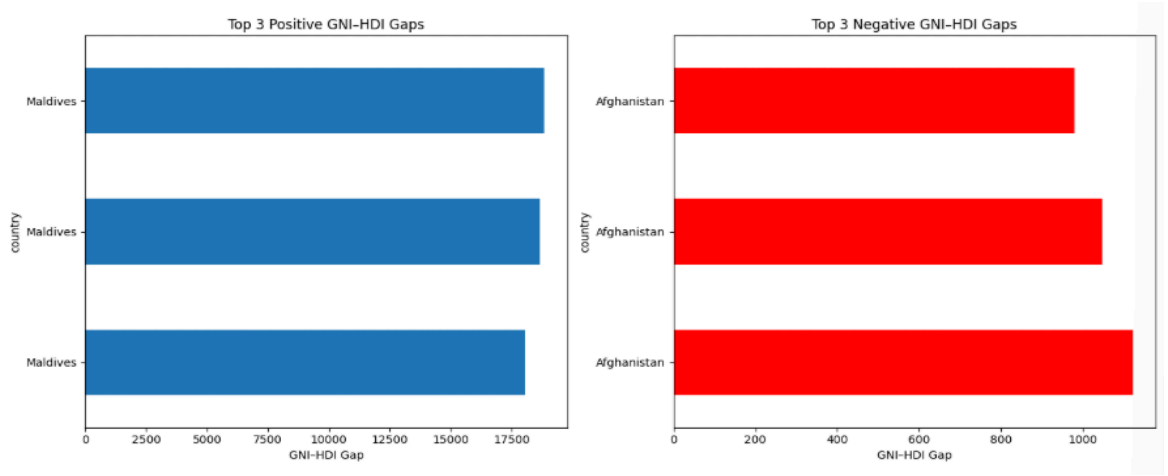
There is a strong positive correlation between GNI per capita and HDI in the scatter plot; that is, as GNI per capita increases, the level of human development also increases. This is supported by the regression line, where economic development has been identified as an important factor in upgrading the standard of living by advancing health and education levels.

Insights:

Looking at the scatter chart, it is evident that with the increase in GNI per capita, the value of HDI also rises, and this indicates that with more economic wealth, human development is normally supported. But there is a catch, and this is where the graph levels off once it reaches higher levels of GNI.

GNI–HDI Gap:

The GNI-HDI gap highlighted the emergence of areas wherein the increase in income did not reflect the increase in human development. Large positive gap nations mostly require more expenditure in the social sectors.



Interpretation:

For positive:
A positive gap indicates that GNI is greater than HDI, and therefore the nation's income levels exceed those that its citizens' development outcomes would suggest. In other words, the country has resources, but those resources are not converting into improved personal health and well-being to the degree one might expect.

For negative:
GNI and HDI discrepancies that are negative indicate that the human development achievement exceeds the country's expected level of income. This means that measures are likely in place that are contributing to human development rather than financial support.

Insights:

For positive:
Countries that have a gap wherein GNI is greater than HDI need to reassess their distribution of national income because it is not necessary that countries with greater income necessarily have improved living standards. The clear message is that greater expenditure on basic public services like education, public health care, and social security is imperative for inclusive development.

For negative:
Those countries having a negative gap between GNI and HDI levels prove that the strong institutions or apt social efforts or outside assistance can result in the enhancement of human development levels despite the lower level of income. They serve as an example for other countries to decide the future path for their development.

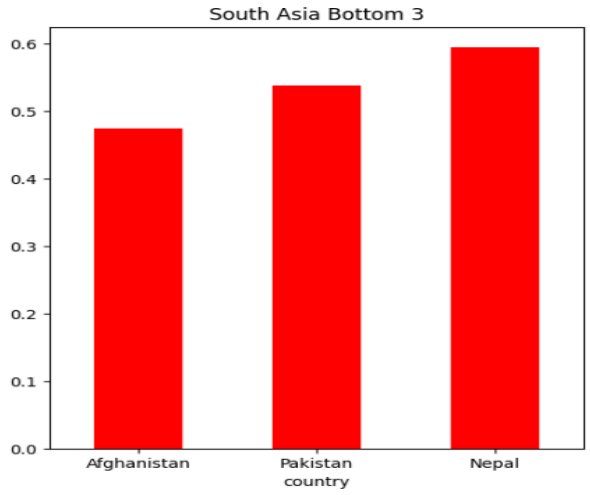
Problem 3: Comparative Regional Analysis (South Asia vs Middle East)

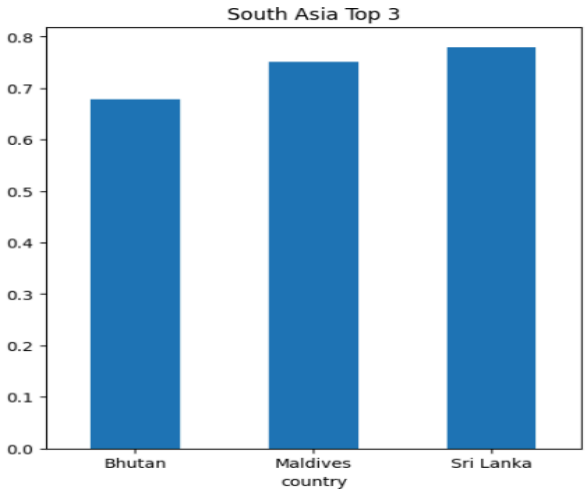
Descriptive Statistics:

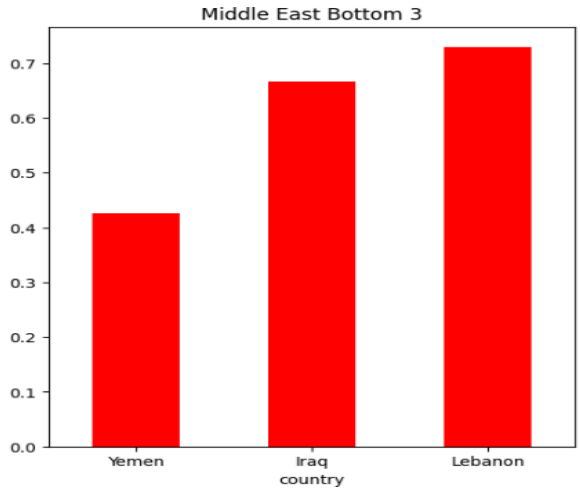
In all three years combined, the average HDI for the Middle East was greater than that of South Asia

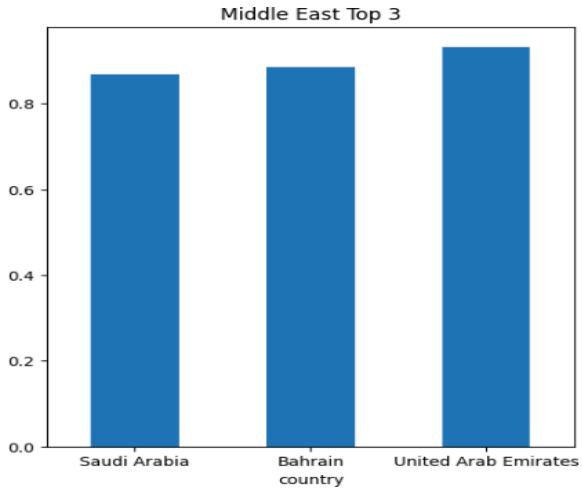
Top & Bottom Performers:

Grouped bar charts comparing life expectancy, gender development, and GNI per capita revealed that income-related indicators showed the largest disparity between the two regions.









Interpretation:

The data provided by the graphs shows gaps in the regions concerning the levels of human development. In South Asia, the countries that are at the lower end are Afghanistan, Pakistan, and Nepal, whereas Bhutan, the Maldives, and Sri Lanka are at the top end of the HDI rankings. In the Middle Eastern region, Yemen, Iraq, and Lebanon are at the lower end of the rankings compared to Saudi Arabia, Bahrain, and the UAE at the top end due to their better economic capacity.

Insights:

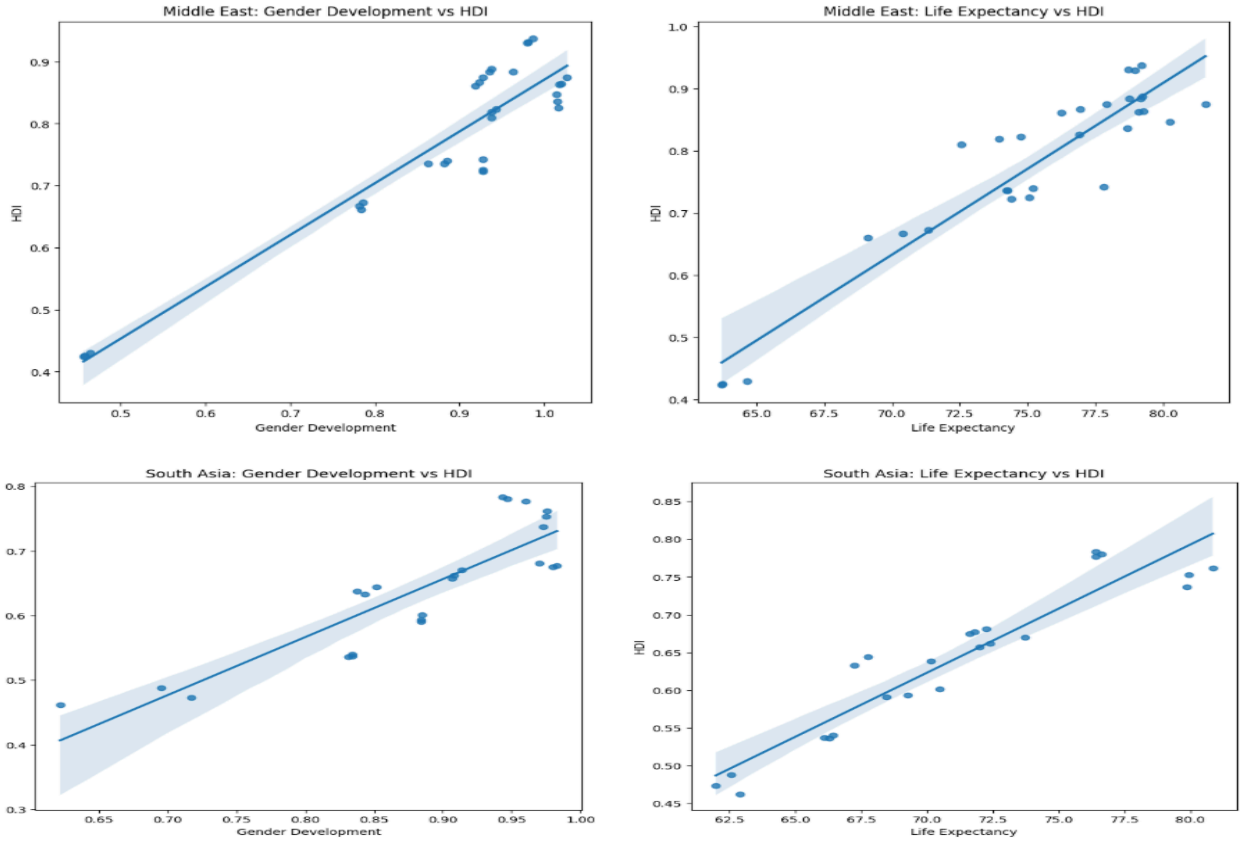
The difference between the highest and lowest countries in each region manifests as inequality in education opportunities, healthcare access, and economic opportunities. The message here is that a coordinated effort among regions can help improve the poorer performers without harming the nations that have a higher HDI.

Metric Comparisons:

Grouped bar charts comparing life expectancy, gender development, and GNI per capita revealed that income-related indicators showed the largest disparity between the two regions.

HDI Variation:

The coefficient of variation indicated greater inequality within South Asia, while the Middle East displayed more consistency among countries.



Interpretation:

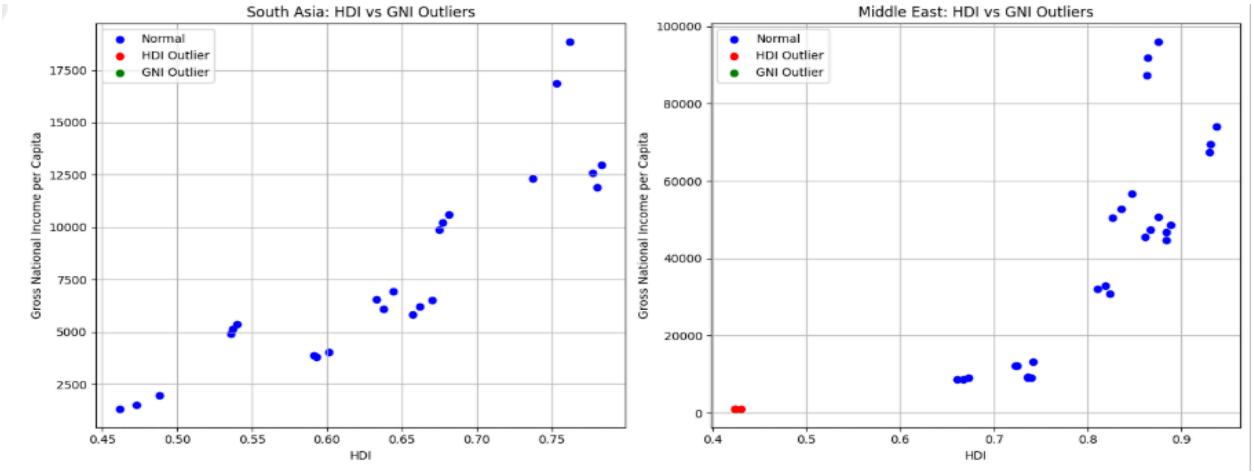
From the chart, one can conclude that there is a positive relationship between HDI and both gender development and life expectancy in the Middle East and South Asia. The trend has been more stable within the Middle East than in South Asia. This inconsistency is not a result of the socio-economic factors.

Insights:

With women making strides in the M East and South Asia, the HDI value increases, thus indicating that there is a positive correlation between gender equity and human development. In the Middle East, there is a clear relationship between gender equity and HDI, as against the situation in South Asia.

Correlation and Outliers:

Strong positive correlations between HDI and life expectancy were observed in both regions. Outliers were primarily high-income Middle Eastern countries and low-income South Asian countries.



Interpretation:

In South Asia, there is a positive relationship between HDI and GNI per capita, but the presence of outliers shows that higher income does not always translate into proportional human development. In the Middle East, wide dispersion and strong outliers indicate that very high incomes, often driven by resource-rich economies, do not consistently result in equally high human development outcomes.

Insights:

South Asia, as a region, has been learning that making policies more effective is vital so that economic growth leads to better human development outcomes. In the Middle East region, the lesson is that having a diversified economy and a better social safety net is required so that increased incomes lead to overall human development.

Interpretation:

The Middle East generally outperforms South Asia due to higher income levels and better health outcomes. However, internal disparities remain significant in both regions.

Conclusion:

What the analysis reveals: Human development does not just depend on income. Even if the average gross national income increases, thus raising the Human Development Index, better health and educational achievements are capable of creating stronger development, even in poorer countries

In the South Asian region, the progress made is to some extent offset by inequality and low per capita incomes. In the Middle East as a whole, there is considerably better development than in the subcontinent, though there are still vast domestic divergences. Global shocks, the COVID-19 pandemic being the latest instance, have temporarily held back the trend of HDI.

For future researchers, they may choose to include additional indicators, such as an inequality-adjusted HDI and/or environment indicators, to further elucidate sustainable human development.

Github:

https://github.com/Ghaitee/coursework_one_ai_nayannembang

References:

United Nations Development Programme (UNDP). *Human Development Reports*.

Lucas Yukiolmafuko. *Human Development Index Dataset (1990–2022)*