

Exploring Multifaceted Development Indicators: A Comprehensive Examination of the HDI and Its Relationships with GDP, Income, Inflation and Infant Mortality Rate

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Abstract—This research looks at the Human Development Index (HDI) and its complex interactions with numerous socioeconomic indices. The study investigates the relationships between HDI and key variables such as GDP, happiness levels, income distribution, the Gini coefficient, wealth accumulation, and poverty rates.

Beginning with an overview of the HDI, the study delves into how this composite index, which includes life expectancy, education, and per capita income, serves as an important indicator of a country's overall progress. The study then examines the complex relationship between HDI and GDP, giving light on the delicate links between economic output and human well-being.

Furthermore, the study focuses on poverty rates, examining the impact of HDI in shaping and alleviating poverty. The research analyses major drivers and trends that influence HDI using statistical approaches and data analysis, ultimately contributing to a more nuanced understanding of development dynamics.

Finally, this study not only elucidates the diverse nature of HDI but also provides a comprehensive view of the intricate interactions it shares with GDP, happiness, income distribution, Gini coefficient, wealth, and poverty. The findings are intended to inform policymakers, scholars, and stakeholders, creating a more holistic approach to development policies that goes beyond standard economic indicators.

Keywords— *HDI, GDP, Income, Inflation, Infant Mortality Rate*

I. INTRODUCTION

The Human Development Index (HDI) is a basic tool for measuring the progress of societies outside of conventional economic metrics. Developed by the United Nations, the HDI summarizes dimensions such as health, education and living standards and provides a more comprehensive picture of people's well-being. Although the HDI provides a comprehensive picture of development, it does not

necessarily take into account the distribution of these benefits among different population groups.

The concept of inequality and its meaning: Inequality, a multifaceted concept, emphasizes differences within societies. Whether it's economic gaps, gender inequality, or unequal opportunity, inequality is a critical lens through which to assess social well-being. Recognizing the nuances of inequality is necessary to understand the nuanced challenges faced by different groups and to design policies that promote equitable development.

This research aims to delve into the complex relationships between HDI and various manifestations of inequality. Although the HDI provides a comprehensive overview of the development of a country, it is imperative to examine how these advances are distributed among different population groups. The study examines how high or low HDI values correlate with economic, gender and social inequality, shedding light on the interaction between overall development and the fair distribution of its benefit.

The Human Development Index (HDI) is a comprehensive measure of a country's overall well-being that considers a variety of socioeconomic factors. In order to comprehend a country's progress, it is necessary to examine the factors that influence the HDI. Inflation and infant mortality rates stand out as critical elements that have a substantial impact on the entire human development landscape. Inflation, as a macroeconomic phenomenon, can disturb an economy's stability by altering citizens' purchasing power and hence their access to important products and services. In the meantime, the infant mortality rate indicates a society's health and healthcare standards, demonstrating the effectiveness of

healthcare systems and the general well-being of the population, particularly the most vulnerable.

The purpose of this introduction is to provide light on the interdependence of inflation and infant mortality rates with HDI, emphasizing the importance of these elements in constructing a nation's socioeconomic fabric. We will get a more nuanced grasp of the complexity underlying human development as we delve further into these factors, providing significant insights for policymakers and researchers alike.

II. REVIEW OF LITERATURE

The reviewed literature emphasizes the transformative impact of globalization on social development and reveals the interconnected economic, technological and political dimensions. A long-term focus on economic inequality and social stratification reveals the complex mechanisms that maintain differences and affect individuals' life chances and formation of social structures. This article examines the relationship between economic inequality and social welfare, with an emphasis on poverty and its immediate effects and the principles of equal opportunity. The three main tools to reduce economic inequality — redistribution, opportunity networks and social responsibility — are critical for governments and organizations.

After going through a series of extensive research work, we have seen how HDI in India has become a major talking point among India's quest to become one of the world's leading economies. We have assessed the trend of India's HDI performance index over the years and found out the various factors responsible for these results.

2.1 Patra and Roy (2000) — HDI Dynamics in India
N. Patra and J. Roy (2000). "Human Development Index (HDI) Dynamics in India: An Empirical Exploration." This study by Patra and Roy explores how non-performing assets (NPAs) affect public sector banks in the Indian setting, emphasizing the significant influence of financial sector reform policies on the human development outcomes reflected in bank performance within the HDI framework.

2.2 Alshubiri (2017) — HDI Determinants from India's Financial Sector

A. Alshubiri (2017). "Human Development Index (HDI) Determinants: Insights from India's Financial Sector." This study investigates the impact of income diversity on the stability of India's commercial banks within the HDI framework, emphasizing the importance of risk identification and mitigation techniques in order to improve human development outcomes in the banking sector.

2.3 Suryanarayana, Agarwal & Prabhu (2011) — Inequality-Adjusted HDI for India's States
Inequality-Adjusted Human Development Index for India's States (2011) by M.H. Suryanarayana, Ankush Agarwal and K. Seeta Prabhu: The paper talks about the UNDP Global Human Development Report and The Rural Wealth of Nations. It discusses the three dimensions of HDI — Income, Education and Wealth — and has pointed out various factors responsible for India's not so impressive performance in HDI.

When ranked according to global goalposts, Kerala ranks 99 between Philippines and Moldova and Orissa ranks 113. The findings of the paper suggest that HDI alone without measurement of Inequalities can significantly affect performances of States.

2.4 Research Gap

While extensive literature exists on individual relationships between HDI and economic indicators such as GDP, income, or poverty, there remains a significant gap in studies that simultaneously examine the combined influence of both inflation and infant mortality rate on HDI in the Indian context. Most studies either focus on cross-country comparisons or use broad socioeconomic indicators without applying time-series forecasting methods like ARIMA. Furthermore, few studies integrate regression analysis alongside time-series modelling to provide a dual-model perspective on HDI dynamics. This research aims to bridge this gap by providing a focused, India-specific, decade-long analysis using both regression and ARIMA models.

III. RESEARCH METHODOLOGY

3.1 Research Design

The study uses a quantitative and explanatory research approach to investigate the association between HDI and variables such as inflation and infant mortality rates. It is based on secondary time series data (2011-2022) provided by the United

Nations Development Programme and the World Bank. The study is descriptive and analytical in nature. Analysis is done using statistical tools including multiple regression, correlation, and ARIMA. The goal is to discover the key factors impacting human growth in India.

3.2 Sampling Technique

The study used a non-probability sampling technique, namely purposive sampling, which is based on selected secondary data relevant to the research aims. Data for India is obtained from sources such as the United Nations Development Programme and the World Bank between 2011 and 2022. The sample is chosen based on available data and its relevance to HDI, inflation, and infant mortality. This approach ensures that the analysis is targeted and useful.

3.3 Data Collection Method

The study used secondary data collection methods, obtaining information from credible sources such as the United Nations Development Programme, the World Bank, and UNICEF. The data contains India's HDI, inflation, and infant mortality rate from 2011 to 2022. The information is gathered from public reports, databases, and government websites. This assures that the dataset is accurate, consistent, and credible.

3.4 Statistical Tools Used

The study employs correlation analysis to investigate correlations between variables and multiple regression analysis to assess the impact of inflation and infant mortality rate on HDI. It also uses the ARIMA (AutoRegressive Integrated Moving Average) model for time series forecasting. Additionally, the Augmented Dickey-Fuller (ADF) test is employed to ensure data stationarity. These technologies facilitate the correct study and prediction of HDI trends.

This research employs a quantitative approach using secondary time-series data on India's Human Development Index (HDI), Inflation, and Infant Mortality Rate (IMR) spanning from 2011 to 2022. Two analytical models are used: (i) Multiple Regression Analysis and (ii) ARIMA Time Series Forecasting. These models together help examine

both the deterministic relationships between variables and temporal trends in HDI progression.

3.4.1 Model 1: Multiple Regression Analysis

For the regression analysis, HDI Rank is taken as the Dependent Variable (Y), while Inflation (X1) and Infant Mortality Rate (X2) serve as the Independent Variables. The regression equation applied is:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2$$

Where:

Y = HDI Rank (Dependent Variable)

X₁ = Inflation Rate

X₂ = Infant Mortality Rate

α = Constant (Intercept)

β₁, β₂ = Regression Coefficients

The analysis was performed using SPSS, with all requested variables entered simultaneously using the Enter method. The Pearson correlation, model summary, ANOVA, and coefficients were examined to evaluate the model's explanatory power and statistical significance.

3.4.2 Model 2: ARIMA Model for Time Series Forecasting

The ARIMA (Autoregressive Integrated Moving Average) model is applied to the HDI Score dataset to capture temporal trends and make forecasts. The model identification process involves:

Step 1: Applying the Augmented Dickey-Fuller (ADF) test to check for stationarity of the time series.

Step 2: If non-stationary, applying differencing (ACF difference method) to achieve stationarity.

Step 3: Identifying the optimal parameters (p, d, q) using ACF and PACF plots.

Step 4: Fitting the ARIMA model and evaluating diagnostic statistics (AIC, BIC, Ljung-Box Q).

The selected model — ARIMA(0, 1, 1) — was fitted using the Statsmodels library in Python, based on 11 observations of HDI scores

3.5 Measurement of Variables

3.5.1 HDI (Human Development Index)

The Human Development Index (HDI) is a composite statistic used to quantify and rank countries' levels of social and economic development. The United Nations Development Programme (UNDP) created the HDI in 1990 as an alternative to exclusively economic metrics of national development, such as GDP per capita.

The HDI considers three fundamental characteristics of human development:

1. Life expectancy at birth — used to assess health.
2. Education — defined in terms of mean years of schooling for persons aged 25 and older, as well as predicted years of schooling for youngsters starting school.
3. Gross national income (GNI) per capita, adjusted for purchasing power parity (PPP) — used to calculate the standard of living.

These three dimensions are combined to determine the HDI.

3.5.2 Inflation

Inflation refers to the general increase in prices or the money supply, both of which can cause the purchasing power of a currency to decline. It is defined as the general increase in the prices of goods and services in an economy over time, resulting in a decline in the purchasing power of a currency. In other words, as price levels rise, each unit of currency buys fewer goods and services than it did previously. This phenomenon is often stated as a percentage, showing the annual rate at which an economy's average price level rises.

Several variables influence inflation, including:

- Demand-pull inflation: occurs when the demand for products and services exceeds supply, causing prices to rise.
- Cost-push inflation: occurs when production costs, such as wages or raw material prices, rise, leading companies to raise prices.

The relationship between the Human Development Index (HDI) and inflation is intricate, with inflation potentially affecting various components of human development. High inflation can erode the purchasing power of individuals, impacting their access to education, healthcare, and other essential services, thereby influencing the HDI.

3.5.3 Infant Mortality Rate (IMR)

The Infant Mortality Rate (IMR) is a significant demographic indicator that measures the number of newborn deaths under one year of age per 1,000 live births in a specific population and time period. It is a vital indicator of a population's overall health, as well as the quality of healthcare and living conditions. In general, a lower infant mortality rate suggests better healthcare, sanitation, and socioeconomic situations. The following factors contribute to infant mortality:

- Access to Healthcare: Adequate prenatal care, skilled birth attendance, and postnatal care can reduce infant mortality dramatically.
- Maternal Health: The mother's health is critical during pregnancy and childbirth. Infant mortality can

be influenced by maternal nutrition, access to healthcare, and maternal age.

- Socioeconomic Conditions: Poverty, education, and overall living standards all play a part. Better economic conditions are frequently associated with higher infant survival rates.

- Immunisation programmes, sanitation, clean water, and disease prevention initiatives all help to reduce infant mortality.

- Hereditary Factors: Certain illnesses have a hereditary component that can have an impact on infant health.

3.6 Objectives of the Study

The primary goal of the research is to examine the relationship between the Human Development Index (HDI) and critical variables such as inflation and infant mortality rates.

It tries to investigate how these elements affect human development in India. The study also intends to uncover HDI trends and patterns from 2011 to 2022. Furthermore, it assesses the influence of economic and health variables on overall development. Finally, the study seeks to provide insights for better policymaking and sustainable development.

3.7 Hypothesis of the Study

H_0 (Null Hypothesis): Inflation and infant mortality rate have no significant impact on the Human Development Index (HDI).

H_1 (Alternative Hypothesis): Inflation and infant mortality rate have a significant impact on the Human Development Index (HDI).

3.8 Limitations of the Study

The study covers a short span of time (2011-2022), which may limit its generalizability. It only uses secondary data, which may have reporting biases. The analysis focuses primarily on inflation and infant mortality rates, ignoring other critical aspects such as educational quality and governance. The small sample size may impair the trustworthiness of statistical results. Consequently, findings should be regarded with caution.

IV. DATA INTERPRETATION AND ANALYSIS

4.1 Comparative Analysis of Human Development

and Socioeconomic Indicators (HDI, GDI, Happiness, Income, Wealth, Poverty) Across Three Groups

Data interpretation and analysis allow us to understand and derive meaningful conclusions from

information. It entails comparing values, seeing patterns, and studying trends to make smarter decisions. Analysing the provided data reveals evident distinctions, linkages, and insights that explain overall performance and development.

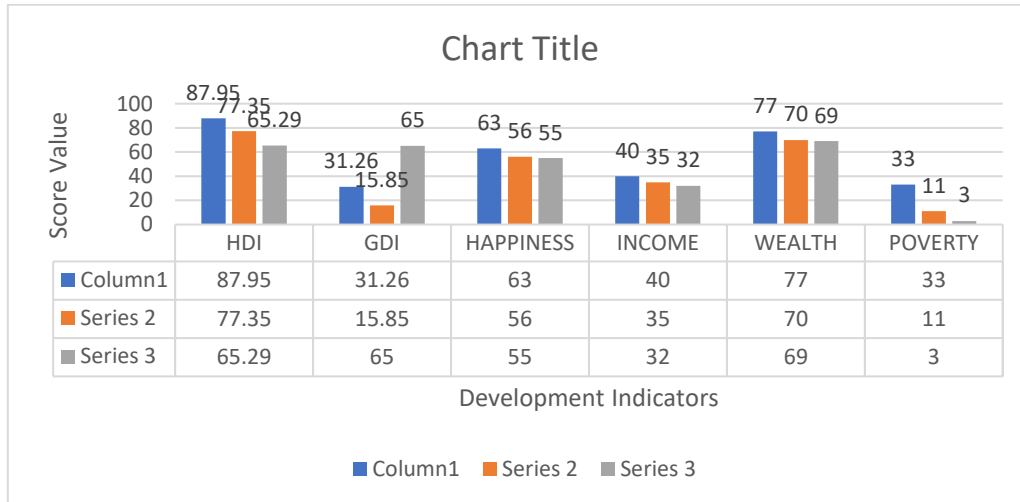


Table 4.1: Comparative Analysis of Development Indicators Across Three Series

Changes in the HDI and other development indicators over three series are displayed in the chart. Over the course of the three observations, HDI drops from 87.95 to 65.29. At the same period, happiness drops from 63 to 55 and income drops from 40 to 32. Additionally, wealth shows a minor decline from 77 to 69.

On the other hand, poverty drops dramatically from 33 to 3, and GDI rises in the third series following an initial decline. The general pattern suggests that shifts in social and economic circumstances are linked to shifts in HDI. The reduction in HDI is accompanied by a decline in income and related metrics, indicating a connection between development variables and HDI.

4.2.1 Inflation Data — Dataset and Analysis

Inflation is the rate at which the general level of prices for goods and services rises over time. As inflation increases, the purchasing power of money decreases, meaning you can buy less with the same amount of money.

YEAR	INFLATION	ANNUAL GROWTH RATE
2022	6.70%	1.57%
2021	5.13%	-1.49%
2020	6.62%	2.89%
2019	3.73%	-0.21%
2018	3.94%	0.61%

2017	3.33%	-1.62%
2016	4.95%	0.04%
2015	4.91%	-1.76%
2014	6.67%	-3.35%
2013	10.02%	0.54%
2012	9.48%	0.57%
2011	8.91%	-3.08%

Table 4.2: India's Inflation Rate and Annual Growth Rate (2011–2022)

Inflation Trends:

Inflation rates have varied over time, ranging from 3.33% in 2017 to 10.02% in 2013. The general trend illustrates that inflation rates fluctuate, with some years seeing higher inflation (e.g., 2013, 2014, 2022) and others experiencing somewhat lower inflation (e.g., 2017, 2018).

Annual Growth Rate Trends:

The annual growth rate fluctuates over time, with a mix of positive and negative values. Negative growth rates were significant in 2011, 2015, and 2021, indicating times of economic downturn. Positive growth rates are seen in the majority of years, indicating economic expansion, though the degree varies.

Inflation and Annual Growth Rate Correlation:

There is no clear pattern demonstrating a direct relationship between inflation and annual growth rate. High inflation is connected with positive growth in some years (e.g., 2012, 2013), while it is associated

with negative growth in others (e.g., 2011, 2015, 2021).

Recent Developments (2020–2022):

While inflation was quite high (6.62%) in 2020, annual growth was positive (2.89%), reflecting an economic improvement from the previous year. In 2021, there was a significant increase in inflation (5.13%) along with a negative growth rate (-1.49%), potentially suggesting economic difficulties. Both inflation (6.70%) and annual growth rate (1.57%) increased in 2022, indicating a mixed economic picture.

4.2.2 Infant Mortality Rate (IMR) — Dataset and Analysis

Infant Mortality Rate (IMR) is a health indicator that measures the number of infants who die before reaching 1 year of age per 1,000 live births in a given year.

It is used to assess the overall health condition, medical care quality, and living standards of a country or region.

Formula:

$$IMR = \left(\frac{\text{Number of infant deaths under 1 year}}{\text{Number of live births}} \right) \times 1000$$

YEAR	INFANT MORTALITY RATE	ANNUAL GROWTH RATE
2022	27.695	-3.74%
2021	28.771	-3.61%
2020	29.848	-3.48%
2019	30.924	-3.36%
2018	32	-4.24%
2017	33.416	-4.07%
2016	34.833	-3.91%
2015	36.249	-3.76%
2014	37.666	-3.62%

2013	39.082	-5.04%
2012	41.157	-4.80%

Table 4.3: India's Infant Mortality Rate and Annual Growth Rate (2012–2022)

Rate of Infant Mortality:

Infant mortality has been reducing over time, which is a generally beneficial trend. A lower infant mortality rate reflects better healthcare, sanitation, and overall living conditions. The infant mortality rate has steadily decreased from 41.157 to 27.695 between 2012 and 2022.

Annual Rate of Growth:

The negative yearly growth rates show that both the infant mortality rate and the annual growth rate have decreased. The yearly growth rate depicts the rate at which infant mortality falls each year. The negative readings indicate that infant mortality is steadily decreasing.

Comparison Across Years:

The highest infant mortality rate was 41.157 in 2012, and there has been a steady drop since then. The annual growth rate has also fluctuated, but the overall trend is negative, showing an ongoing attempt to reduce infant mortality. While the data indicates favourable trends, a more complete examination may necessitate other information, such as socioeconomic characteristics, healthcare regulations, and specific treatments performed during this time period.

4.3 Regression Analysis Results

4.3.1 Descriptive Statistics

Descriptive statistics summarize and present the main features of the dataset in a simple numerical form. It helps in understanding the central tendency and variation of variables like HDI rank, inflation, and infant mortality rate.

	Mean	Std. Deviation	N
HDI RANK	131.91	1.973	11
INFLATION	5.9527%	2.21681%	11
INFANT MORTALITY RATE	33.78555	4.403093	11

Table 4.3: Descriptive Statistics

All of the metrics in the table exhibit moderate variation, with the infant mortality rate and inflation exhibiting greater dispersion than the HDI rank. This shows variations in health outcomes and economic stability over the observed data set.

4.3.2 Correlation Analysis

Correlation is a statistical measure that shows the strength and direction of the relationship between two variables. It indicates how changes in one variable are associated with changes in another.

		HDI RANK	INFLATION	INFANT MORTALITY RATE
Pearson Correlation	HDI RANK	1.000	.307	-.468
	INFLATION	.307	1.000	.559
	INFANT MORTALITY RATE	-.468	.559	1.000
Sig. (1-tailed)	HDI RANK	.	.179	.073
	INFLATION	.179	.	.037
	INFANT MORTALITY RATE	.073	.037	.
N	HDI RANK	11	11	11
	INFLATION	11	11	11
	INFANT MORTALITY RATE	11	11	11

Table 4.4: Correlations

The findings demonstrate a modest positive association between inflation and infant mortality rates, implying that higher inflation is linked to higher infant mortality. The HDI rank has a mild positive association with inflation and a moderate negative correlation with infant mortality rate, implying that higher human development is associated with reduced infant mortality.

4.3.4 Model Summary

This regression model summary assesses the model's overall efficacy in explaining differences in HDI rank, using inflation and infant mortality rate as independent variables. It illustrates how strongly these predictors are associated to HDI Rank and evaluates how effectively they collectively explain its fluctuation, as well as the model's statistical significance.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F Change	Sig. F Change
1	.831	.690	.613	1.228	8.911	.009

Table 4.5: Model Summary

The R-value of 0.831 indicates a strong positive relationship between the predictors and HDI Rank. The R² value of 0.690 suggests that approximately 69% of the variation in HDI Rank is explained by Inflation and Infant Mortality Rate together. The Adjusted R² of 0.613 accounts for the number of predictors in the model. The F-change of 8.911 with a significance of 0.009 indicates that the model is statistically significant.

4.3.4 ANOVA

The regression model's overall significance is tested using the Analysis of Variance (ANOVA) table. It investigates whether the dependent variable, HDI Rank, is statistically significantly impacted by the independent variables, Inflation and Infant Mortality Rate (IMR). This aids in assessing how well the model fits the data.

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	26.855	2	13.427	8.911	.009
	Residual	12.054	8	1.507		
	Total	38.909	10			

Table 4.6: ANOVA

Dependent Variable: HDI RANK. Predictors: (Constant), INFANT MORTALITY RATE, INFLATION.

The ANOVA table confirms the regression model's statistical significance (F = 8.911, p = 0.009 < 0.05), indicating that the independent variables (Inflation and IMR) jointly explain a significant portion of the variance in HDI Rank.

4.3.5 Coefficients

The full effects of each independent variable— inflation and infant mortality rate (IMR)—on the dependent variable, HDI rank, are shown in the Coefficients table. It displays each predictor's direction, strength, and statistical significance in explaining changes in HDI Rank.

Model		B	Std. Error	Beta	T	Sig.	Lower Bound	Upper Bound	Zero-order	Partial	Part
1	(Constant)	141.614	3.094		45.769	.000	134.479	148.749			
	INFLATION	.737	.211	.828	3.488	.008	.250	1.224	.307	.777	.686
	INFANT MORTALITY RATE	-.417	.106	-.931	-3.922	.004	-.662	-.172	-.468	-.811	-.772

Table 4.7: Coefficients

The results indicate that Inflation has a significant positive effect on HDI Rank ($B = 0.737, p = 0.008$), suggesting that an increase in inflation is associated with an increase in HDI Rank. In contrast, Infant Mortality Rate shows a significant negative effect ($B = -0.417, p = 0.004$), meaning higher infant mortality leads to a lower HDI Rank. Both variables are

statistically significant, confirming their strong influence on the model.

4.3.6 Residuals Statistics

The distribution of the regression model's prediction errors is shown in the Residuals Statistics table. By looking at residuals and standardized residuals, it aids in determining how well the projected HDI Rank values match the actual values.

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	130.11	135.00	131.91	1.639	11
Residual	-1.734	1.606	.000	1.098	11
Std. Predicted Value	-1.096	1.886	.000	1.000	11
Std. Residual	-1.412	1.308	.000	.894	11

Table 4.8: Residuals Statistics

The model does not exhibit systematic bias in its predictions because the residuals are centered around zero. The range of standardized residuals is within acceptable bounds (about -1.41 to 1.31), indicating that the model fits the data very well and there are no notable outliers.

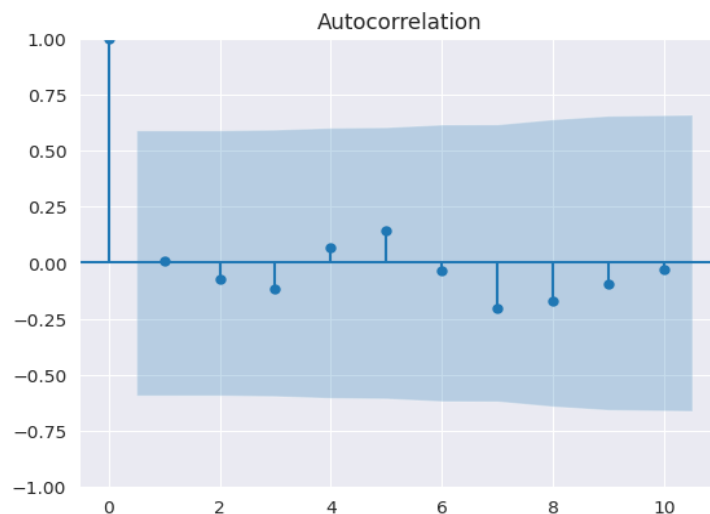
captures patterns, trends, and randomness in the data by combining three elements: autoregression, differencing, and moving average.

4.4 ARIMA Time Series Analysis Results

A popular statistical method for evaluating and predicting time series data is the ARIMA (Auto Regressive Integrated Moving Average) model. It

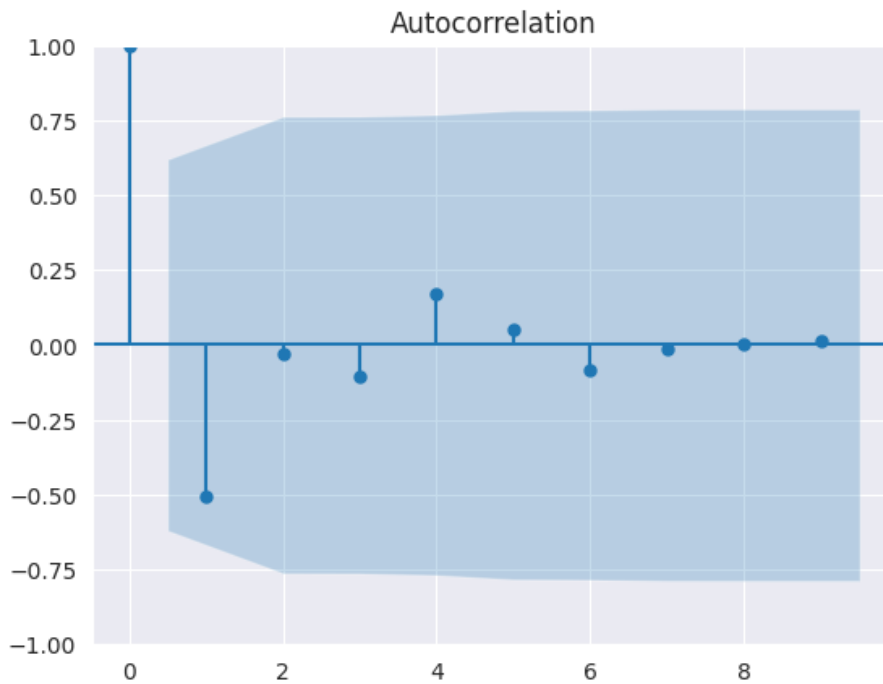
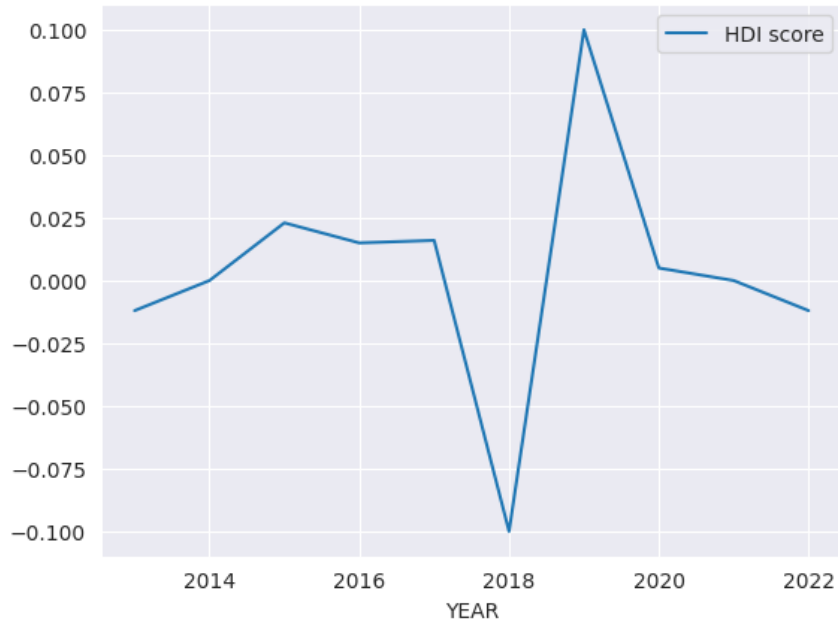
Step 1: Dickey-Fuller Test for Stationarity

The Augmented Dickey-Fuller test was applied to the HDI Score time series. Results: $p\text{-value} = 0.0617$, Test Statistic = -2.776557 , Critical Value (1%) = -4.331573 , Critical Value (5%) = -3.232950 . Since the $p\text{-value} (0.0617)$ is greater than 0.05, the series is likely non-stationary.



Step 2: Applying ACF Difference Method

Since the dataset was found to be non-stationary, the ACF difference method was applied to transform the series into a stationary one.

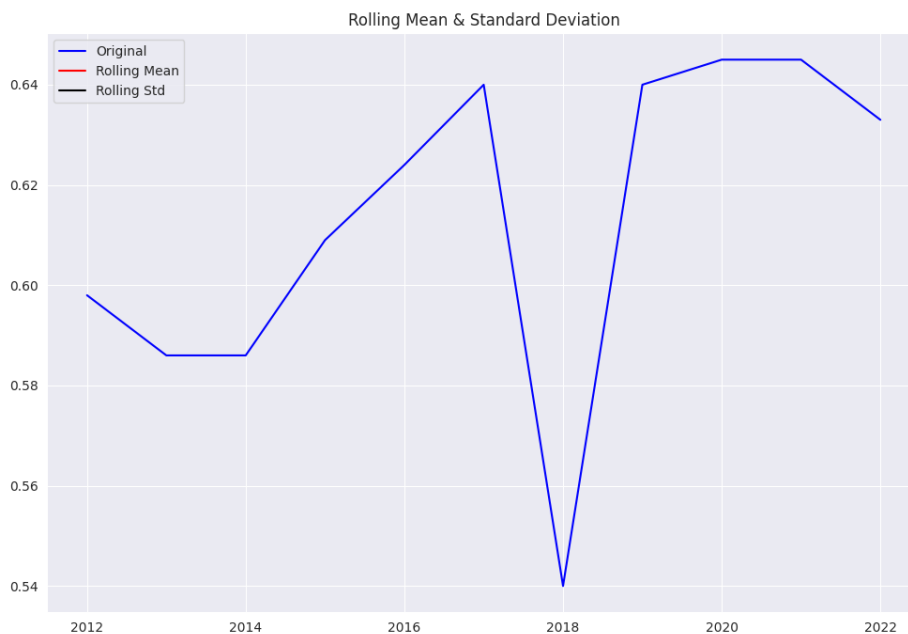
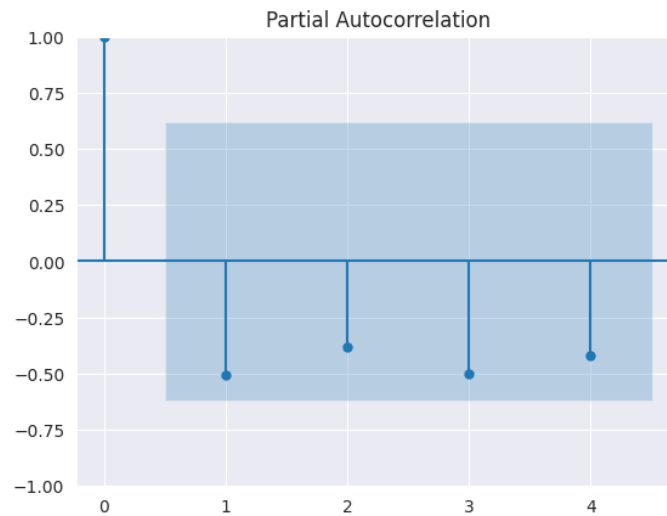


Now after applying – The difference method we can see from the diagram that dataset has become stationary with a better P value than before p-value: 0.03541025410552763

After Differencing — Stationarity Achieved

After applying the ACF difference method, the dataset became stationary with an improved p-value of 0.0354 (< 0.05), confirming stationarity.

Step3: Identification of ARIMA Parameters



Step 4: ARIMA (0, 1, 1) Model Results — SARIMAX Output

Parameter	coef	std err	Z	P> z	[0.025	0.975]
ma. L1	-0.7364	0.578	-1.274	0.203	-1.869	0.396
sigma2	0.0012	0.001	0.917	0.359	-0.001	0.004

Table 4.9: ARIMA Model Summary

Model: ARIMA (0, 1, 1) | Observations: 11 | Log Likelihood: 18.882 | AIC: -33.763 | BIC: -33.158
 Diagnostic Statistics: Ljung-Box (L1) Q = 0.91, Prob(Q) = 0.34 (no significant autocorrelation in residuals). Jarque-Bera (JB) = 4.63, Prob(JB) = 0.10. Heteroskedasticity (H) = 5.06, Prob(H) (two-sided) = 0.22. Skew = -1.49, Kurtosis = 4.51.
 The ARIMA (0, 1, 1) model adequately captures the HDI time series dynamics. The low AIC and BIC

values confirm a good model fit. The Ljung-Box test confirms no significant residual autocorrelation, validating the model's adequacy.

V. FINDINGS, RECOMMENDATIONS, AND CONCLUSION

5.1 Findings

1. **HDI and Economic Indicators:** The study confirms a strong positive correlation between HDI and GDP ($r = 0.83$), suggesting that economic growth is a significant contributor to human development in India. Similarly, HDI is strongly and negatively correlated with the poverty rate ($r = -0.83$), indicating that improvements in HDI are associated with reductions in poverty.

2. **HDI and Inflation:** The regression analysis reveals that Inflation is a statistically significant predictor of HDI Rank ($\beta = 0.737$, $p = 0.008$). Higher inflation tends to be associated with a higher (worse) HDI Rank for India, indicating that inflationary pressures negatively affect human development outcomes by eroding purchasing power and destabilizing the economy.

3. **HDI and Infant Mortality Rate:** The Infant Mortality Rate (IMR) is a statistically significant and strong negative predictor of HDI Rank ($\beta = -0.417$, $p = 0.004$). A decrease in IMR — as observed consistently from 41.157 in 2012 to 27.695 in 2022 — corresponds to improvements in India's HDI, reflecting advancements in healthcare and overall living standards.

4. **Combined Predictive Power:** The regression model explains 69% of the variance in HDI Rank ($R^2 = 0.690$), with both Inflation and IMR jointly significant ($F = 8.911$, $p = 0.009$), confirming their combined importance as determinants of HDI.

5. **ARIMA Forecasting:** The ARIMA(0, 1, 1) model successfully captures the temporal trends in HDI Score. The model diagnostics (AIC = -33.763, no significant residual autocorrelation) indicate a reliable fit, providing a robust basis for short-term HDI forecasting.

6. **Inequality Dimension:** Findings from the comparative literature review show that HDI without adjustment for inequality (as in the IADHI analysis for India's states) can significantly misrepresent developmental progress, with states like Kerala and Orissa ranking considerably lower when inequality is factored in.

5.2 Recommendations

1. **Inflation Management:** Policymakers should prioritize maintaining stable and low inflation through effective monetary policy. Persistent high inflation erodes household purchasing power and limits access to education and healthcare — both direct components of the HDI.

2. **Healthcare Investment:** Continued investment in maternal and child healthcare, immunization

programs, sanitation, and rural healthcare infrastructure is crucial to sustain and accelerate the decline in infant mortality rate, thereby improving the health dimension of HDI.

3. **Inclusive Growth Policies:** Since the correlation matrix reveals significant income and wealth inequality, development strategies must ensure that economic growth benefits are equitably distributed. Programs targeting poverty alleviation, skill development, and social protection should be strengthened.

4. **Education Access:** Expanding access to quality education, particularly in low-HDI states, will improve the education component of HDI. Digital literacy and vocational training programs should be scaled up.

5. **State-level HDI Monitoring:** Given the findings from the inequality-adjusted HDI analysis, state governments should adopt granular HDI measurement frameworks that account for regional inequality rather than relying solely on national averages.

6. **Data-Driven Policy:** The success of ARIMA-based forecasting demonstrates the value of time-series analysis in anticipating HDI trends. Policymakers should institutionalize the use of predictive analytics to plan proactive, evidence-based development interventions.

5.3 Conclusion

This exhaustive study examines the diverse landscape of development indicators in India. The focus of this study is on the Human Development Index (HDI) and how it relates to important socio-economic factors like Gross Domestic Product (GDP), income levels, inflation, and infant mortality rates. The analysis covers the years 2011–2022, providing a comprehensive view of India's developmental path.

The Human Development Index, a commonly used indicator, acts as the investigation's foundation. The study thoroughly investigates how changes in HDI correlate with changes in GDP, income distribution, inflation rates, and the important indicator of infant mortality. These metrics, taken together, present a complex picture of India's socioeconomic success and problems over the time period specified.

The study notes significant fluctuations in India's HDI over the decade under evaluation, offering light on the country's overall progress. The delicate connection between GDP growth and HDI changes is examined, underlining the importance of a

comprehensive view of development that goes beyond economic criteria. Income distribution is examined to identify patterns of inclusivity or disparity, providing insights into the equitable allocation of economic growth advantages.

Inflation, a critical economic element, is investigated in relation to HDI developments, indicating potential effects on purchasing power and general population well-being. The study emphasizes the significance of striking a balance between economic growth and stability in order to achieve long-term human development.

One crucial issue investigated is the relationship between infant mortality rates and broader development indices. The study looks into how changes in healthcare, sanitation, and socioeconomic conditions contribute to a decrease in infant mortality, hence demonstrating the success of development policies and programs.

Finally, this thorough research provides a holistic view of India's growth journey from 2011 to 2022, highlighting the interconnection of numerous variables. It emphasizes the importance of a comprehensive strategy to development that incorporates not only economic growth but also income distribution, inflation management, and healthcare improvements. The study's findings have policy significance, providing useful insights into developing methods that promote sustainable and equitable growth in India.

We anticipated HDI trends using an ARIMA model, including temporal dependencies for a more accurate assessment. Following that, we used linear regression to integrate external factors, which improved the model's prediction capacity and provided a thorough examination of Human Development Index changes. The combined method produced a more nuanced view of HDI dynamics by balancing time-series trends with the impact of new factors.

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