Original Article

Analyzing India's Gross Domestic Product (GDP) Through Machine Learning's Linear Regression Models for Sustainable Socio-Economic Growth in Atma Nirbhar

Ashok Mhaske

Department of Mathematics, Dada Patil Mahavidhyalaya, Karjat-Ahmednagar, India.

Corresponding Author : mhaske.math@gmail.com

Abstract - This study explores India's economic growth from 1993 to 2022 using online data. We focus on key factors like GDP, inflation-adjusted GDP, and GDP per capita. By applying simple linear regression models through Python programming, we aim to understand historical trends and patterns. Our analysis doesn't just look at the past; we use this data to predict future GDP. This predictive tool helps us estimate how India's economy might perform. We believe this approach can provide useful insights for decision-makers and contribute to building a self-reliant India.

Keywords - GDP, Economic Analysis, Machine Learning, Linear Regression, Python Programming.

1. Introduction

In the pursuit of a self-reliant and economically resilient India, this research embarks on a comprehensive analysis of the country's Gross Domestic Product (GDP) spanning the years 1993 to 2022. The intricate dynamics of India's economic landscape are explored by leveraging readily available online data. Our focus revolves around critical indicators such as GDP Nominal (Current USD), GDP Real (Inflation adj.), GDP Change, and GDP per Capita. Harnessing the power of machine learning, specifically linear regression models, and utilizing Python programming, we seek to unravel hidden patterns and trends within the historical GDP data. This approach allows us to discern the relationships between various economic indicators, offering valuable insights into the factors influencing India's economic growth. Beyond retrospective analysis, our research endeavors to contribute to the predictive understanding of India's economic future. By training our models with historical data, we aim to forecast upcoming GDP trends. This predictive tool holds the potential to empower policymakers, economists, and stakeholders with foresight, fostering informed decision-making in the pursuit of a self-reliant and prosperous nation. This study, at its core, represents a commitment to harnessing technological advancements for the betterment of India's economic trajectory.

2. Methodology

In this study, we conduct a comprehensive analysis of India's economic indicators, specifically focusing on GDP Nominal (Current USD), GDP Real (Inflation adj.), GDP change, and GDP per capita. The data spans from the year 1993 to 2022, creating a detailed chronological table that forms the foundation for our subsequent linear regression models and predictive analysis.

Table 1: Gross Domestic Product (GDP) of India

Year	GDP Nominal (Current USD)	GDP Real (Inflation adj.)	GDP change	GDP per capita
2022	$3,385,090,000,000	$2,954,980,000,000	7.00%	$2,085
2021	$3,150,310,000,000	$2,761,590,000,000	9.05%	$1,962
2020	$2,671,600,000,000	$2,532,400,000,000	-5.83%	$1,814
2019	$2,835,610,000,000	$2,689,210,000,000	3.87%	$1,944
2018	$2,702,930,000,000	$2,588,970,000,000	6.45%	$1,891
2017	$2,651,470,000,000	$2,432,020,000,000	6.80%	$1,796
2016	$2,294,800,000,000	$2,277,270,000,000	8.26%	$1,701
2015	$2,103,590,000,000	$2,103,590,000,000	8.00%	$1,590
2014	$2,039,130,000,000	$1,947,830,000,000	7.41%	$1,490

2013	$1,856,720,000,000	$1,813,450,000,000	6.39%	$1,405
2012	$1,827,640,000,000	$1,704,600,000,000	5.46%	$1,337
2011	$1,823,050,000,000	$1,616,400,000,000	5.24%	$1,285
2010	$1,675,620,000,000	$1,535,900,000,000	8.50%	$1,238
2009	$1,341,890,000,000	$1,415,610,000,000	7.86%	$1,157
2008	$1,198,900,000,000	$1,312,420,000,000	3.09%	$1,088
2007	$1,216,740,000,000	$1,273,130,000,000	7.66%	$1,070
2006	$940,260,000,000	$1,182,530,000,000	8.06%	$1,009
2005	$820,382,000,000	$1,094,320,000,000	7.92%	$948
2004	$709,149,000,000	$1,013,980,000,000	7.92%	$892
2003	$607,699,000,000	$939,543,000,000	7.86%	$841
2002	$514,938,000,000	$871,073,000,000	3.80%	$793
2001	$485,441,000,000	$839,152,000,000	4.82%	$778

2.1. Machine Learning: Training Models using Linear Regression in Python Programming

Python Program:

```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
df=pd.read_csv("gdp.csv")
x=df.iloc[:,0]
y1=df.iloc[:,1]
y2=df.iloc[:,2]
y3=df.iloc[:,3]
y4=df.iloc[:,4]
x=np.array(x)
y1=np.array(y1)
y2=np.array(y2)
y2=y2.reshape(-1,1)
from sklearn.linear_model
import LinearRegression
linreg=LinearRegression()
y3=np.array(y3)
y4=np.array(y4)
x=x.reshape(-1,1)
plt.subplot(1, 2, 1)
plt.plot(x,y1,".")
plt.title("GDP Nominal")
linreg.fit(x,y1)
xnew=np.array([[0],[2026]])
print(linreg.predict(xnew))
y1pred=linreg.predict(x)
plt.plot(x,y1pred,".r")
plt.subplot(1, 2, 2)
plt.plot(x,y2,".")
linreg.fit(x,y2
y2pred=linreg.predict(x)
xnew=np.array([[0],[2026]])
print(linreg.predict(xnew))
plt.plot(x,y2pred,".r")
plt.title("GDP Real")
plt.show()
plt.subplot(1, 2, 1)
plt.plot(x,y3,".")
linreg.fit(x,y3)
xnew=np.array([[0],[2026]])
print(linreg.predict(xnew))
y3pred=linreg.predict(x)
plt.plot(x,y3pred,".r")
plt.title("GDP change")
plt.subplot(1, 2, 2)
plt.plot(x,y4,".")
linreg.fit(x,y4)
xnew=np.array([[0],[2026]])
print(linreg.predict(xnew))
y4pred=linreg.predict(x)
plt.plot(x,y4pred,".r")
plt.title("GDP per capita")
plt.show()
```
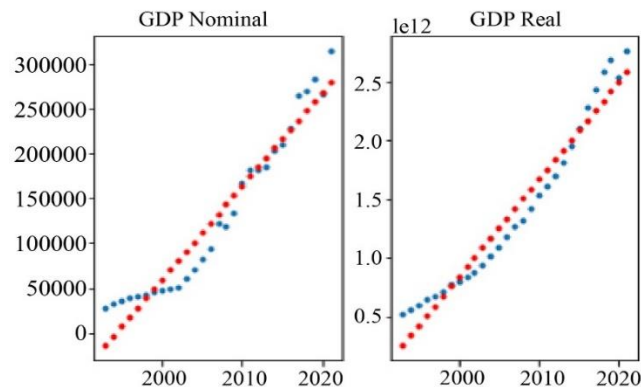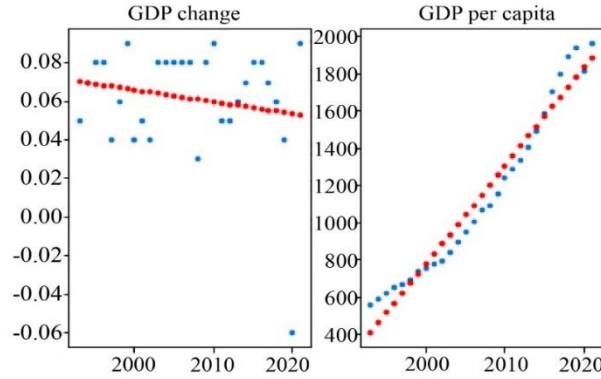
Fig. 1 Linear Regression Analysis

Table 2. Future predicted values using Machine Learning Regression Analysis.

Year	GDP Nominal (Current USD)	GDP Real (Inflation adj.)	GDP change	GDP per capita
2030	$3,744,163,344,827	$3,337,531,220,000	4.75%	$2,363.20
2029	$3,639,232,689,655	$3,254,193,930,000	4.81%	$2,310.38
2028	$3,534,302,034,482	$3,170,856,650,000	4.80%	$2,257.56
2027	$3,429,371,379,310	$3,087,519,300,000	4.90%	$2,204.73
2026	$3,324,440,724,137	$3,004,182,090,000	5.00%	$2,151.91
2025	$3,219,510,068,965	$2,920,844,800,000	5.064%	$ 2,099.09

3. Results and Discussion

Utilizing regression training analysis and machine learning through Python programming, we present predicted values for key economic indicators from 2025 to 2030. The forecasted data includes GDP Nominal (Current USD), GDP Real (Inflation adj.), GDP change, and GDP per capita. These projections offer valuable insights into the anticipated trajectory of India's economic landscape, contributing to informed decision-making for the upcoming years.

4. Conclusion

In conclusion, our study delves into the economic future of India by employing advanced tools like regression training analysis and machine learning through Python programming. By predicting key indicators, such as GDP Nominal, GDP Real, GDP change, and GDP per capita for the years 2025 to 2030, we provide valuable insights for shaping informed decisions.

This research contributes to a better understanding of India's economic trajectory, fostering a path towards sustainable growth and self-reliance in the coming years.

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