IMPACT OF CARBON DIOXIDE EMISSION FROM PETROLEUM FUEL COMBUSTION IN JHARKHAND

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***Abstract*- The most devastating environmental plague that human culture has faced in recent decades is global warming. The world's climate has changed significantly as a result of global warming and scientists, researchers, and academics around the world are living in a nightmare because of this change since it puts life on Earth in danger. The goal of this work is to create a model that would represent the pattern of greenhouse gas emissions (tonnes of CO_2 equivalent) in the Indian states of Jharkhand. An analytical third-degree polynomial model has been created using the least squares method based on past years carbon dioxide emission data. The retrofitting process, including regression analysis, residual analysis, R^2, adjusted R^2, and so on, justifies the quality of the suggested model. The developed model well represents the real situation of carbon dioxide (CO_2) emission from burning of petroleum fuels in Jharkhand.**

Keywords: **Green House Gas, Method of least square, Global Warming, Instantaneous Rate of Change (IROC), Residual analysis.**

1. INTRODUCTION

The impact of carbon dioxide (CO_2) emissions from petroleum fuel combustion in Jharkhand, can be significant and multifaceted. Here are several key impacts:

CO_2 is a greenhouse gas, meaning it contributes to global warming and climate change when released into the atmosphere. The combustion of petroleum fuels in Jharkhand, such as gasoline and diesel in vehicles, and coal in power plants, adds to the concentration of CO_2 in the atmosphere, exacerbating climate change. Besides CO_2, combustion of petroleum fuels also releases other pollutants such as nitrogen oxides (NOx), sulfur dioxide (SO2), and particulate matter (PM). These pollutants can have direct health impacts on humans, including respiratory problems, cardiovascular diseases, and even premature death. In places like Jharkhand, where industrial activities are prevalent, the combustion of petroleum fuels can worsen air quality, leading to adverse health effects for residents. Addressing the impacts of CO_2 emissions from petroleum fuel combustion in Jharkhand requires concerted efforts at both the local and global levels.

2. LITERATURE REVIEW

A range of studies have explored the issue of carbon dioxide emissions in India, particularly in the states of Assam, West Bengal, and Orissa. Mondal (2019, 2021) and Sangeetha (2018) have developed statistical and bio-inspired models to estimate and forecast CO_2 emissions in these states, with a focus on energy consumption and the combustion of fossil fuels. These studies highlight the need for effective strategies to reduce CO_2 emissions in the region. Nandi and Basak (2013) has also contributed to this area of research by developing a mathematical model based on different emission sources, such as solid, liquid, and gaseous fuels, and the cement industry. Dubey (2023) studied statistical evolutionary model to predict CO_2 emission in Indian states of Gujarat, Maharashtra and Madhya Pradesh. Pandit (2023) predicted rainfall distribution over Ranchi district, Jharkhand using ARIMA model. These studies collectively underscore the urgency of addressing CO_2 emissions in these states to mitigate the impact of global warming.

3. METHODOLOGY

Historical GHG emission data (tonnes of CO_2 equivalent) from petroleum fuel combustion collected from the Annual Survey of Industries (ASI) datasets from 2004-05 to 2015-16, obtained from the Ministry of Statistics and Programme Implementation (MOSPI). Utilizing Python software and the emission dataset third degree polynomial model developed by implementing method of least square. Here ‘emission’ and ‘year’ are considered as two parameters. Polynomial regression, evaluation of coefficients and polynomial equation are calculated by using python code scikit-learn. Performance of the model examined by R-squared, adjusted R-squared and residual analysis.

4. RESULT AND OBSERVATION

The article represents statistical analysis of CO_2 emission combusting of petroleum fuels from various industries in the Indian State of Jharkhand from the session of 2004-05 to 2015-16. Clearly the increasing emission trend observed in Figure 1.

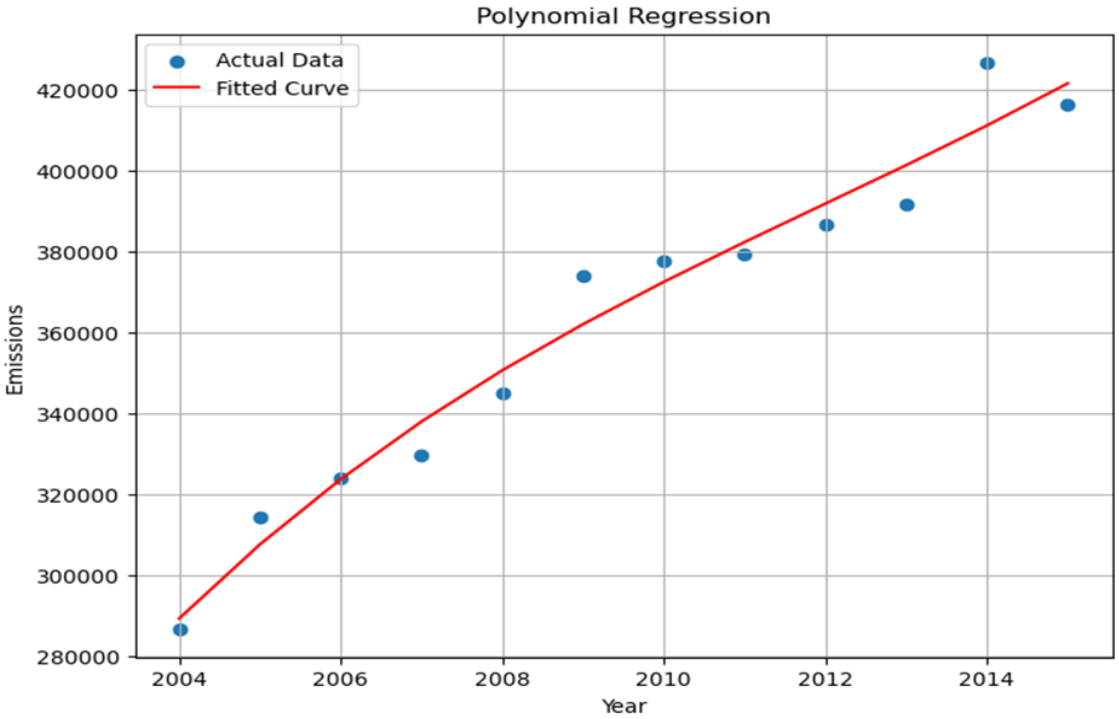

Figure 1. Actual CO_2 emission data and proposed model in Jharkhand

According to Figure 1, it is clear that the developed third-degree polynomial model of CO_2 emission in Jharkhand fitted well with the observed data of GHG emission (tonnes of CO_2 equivalent). The efficiency of the proposed model is measured by R squared and adjusted R squared. The numeric values of this measures are presented in Table 1.

Table 1. Values of R-squared and adjusted R-squared

Measures	R^2	Adjusted R^2
Values	0.9637	0.9501

The numeric value of R-squared suggest the proposed model covers nearly 96% variation of the observed data. Residual plots are given below in Figure 2.

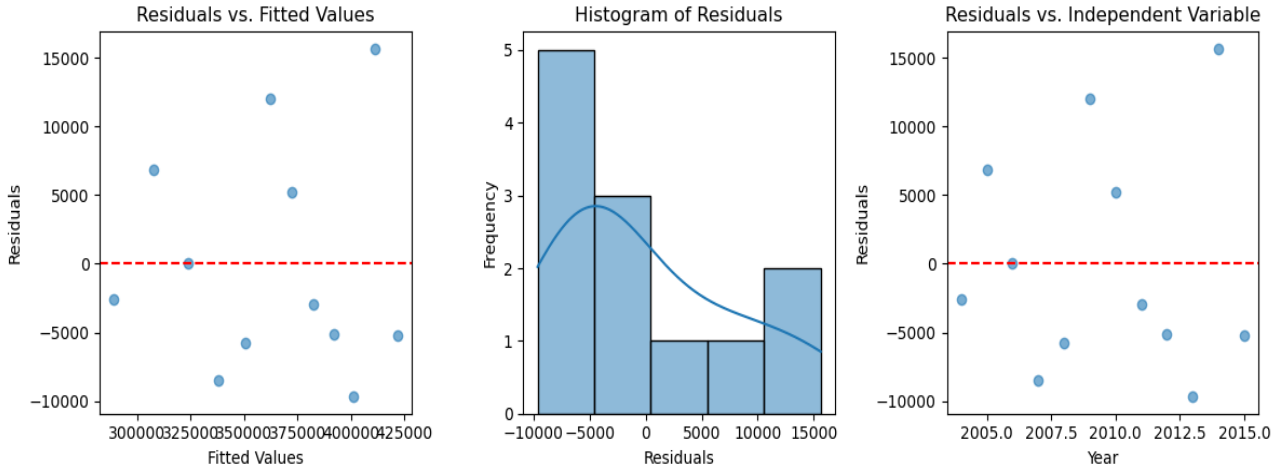

Figure 2. Interpretation of Residual Plots

Residuals vs. Fitted Values plot used to check for a random scatter around the horizontal line (y=0). A random scatter suggests that the residuals are not biased and the model captures the underlying patterns. Clearly, Figure 2 shows a random scatter plot. Histogram of Residuals plot used here to check for a normal distribution of residuals. Here, the distribution of residuals is not normal. Residuals vs. Independent Variable plot used to examine for a random scatter around the horizontal line (y=0). Here the scatter is random and it suggests that the residuals are not dependent on the independent variable, indicating that the model captures the relationship well.

5. CONCLUSION

This study suggest that third degree polynomial model is ideal to represent CO_2 emission pattern in Jharkhand. Effectiveness of model is justified by using different statistical tools like R-squared and adjusted R-squared and it assures that proposed model covers approximately 96% variability. Scatter plots of residuals shows that residuals are random and independent of time (in years). This developed model may be utilized for emissions from other fossil fuels combustion from various industries in Jharkhand. There are ample scopes for future researchers to use this model for study the emission characteristics of other GHGs not only in Jharkhand but also throughout in India.

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