Identification of Major Contributing Factors for the Increase of CO$_2$ at Dhaka City based on Multiple Linear Regression Analysis

Md Asan Ul Haque, Md. Mydul Islam

Abstract

Global warming is caused by increasing the green house gases. 72% of the totally discharge greenhouse gases is carbon dioxide (CO2), 18% Methane and 9% Nitrous oxide (NO). Carbon dioxide emissions therefore are the most important principle of global warming. CO$_2$ which is created by many factors like oil, natural gas, diesel, organic-diesel, petrol, organic-petrol, ethanol. The emissions of CO2 have been dramatically increased within the last 50 years and are still increasing by almost 3% each year which is alarming. Many developed countries scientist are working on various factors regarding this issue. In Dhaka city major factors which are responsible for increasing CO$_2$ is coal consumption, gas consumption, and number of vehicles etc. Various methods are used for identifying the factors. For this research, multiple linear regression model is used for conducting the analysis. Among many factors, major factors are identified for increasing CO$_2$ in Dhaka cities atmosphere.

Keywords

Vehicles number of Dhaka city, gas consumption, coal consumption, CO$_2$ emission, multiple regression analysis**.**

1. Introduction

The multiple regression analysis is used to get the best fit of a set of observation between dependent and independent variables by an equation of the form

$$Y = b_0 + \sum_i b_i x_i$$

Where Y is the dependent variable and x_i is the independent variables and b_i is the coefficient to be determined [1]. Collection of the temperature data from different places around the world by scientist and researchers reveals that the green house gas has been rising expeditiously. CO$_2$ gas is accountable for heating up the earth. Global temperature has been ascending 0.8 degree Celsius since 1880 [2]. From the past several hundred years, most phenomenal ingredient of the climate record is the strong coincide between temperature and the concentration of carbon dioxide in the atmosphere. When the amount of CO$_2$ goes up, temperature goes up. On the other hand, when the CO$_2$ amount goes down, temperature goes down. 72% of total emitted greenhouse gases consists of CO$_2$, whereas Methane is 18% and 9% is Nitrous oxide. For the current rate of CO$_2$ emissions, scientists expect an increase of between 1.5°C and 5.3°C in average temperature by 2100. If no proper action is taken, it would create unfavorable consequences to humanity and the biosphere. Dhaka is highly populated city with more than over 160 million people. CO2 is increasing day by day in Dhaka city and in this paper the factors responsible for increasing the CO2 in Dhaka city are identified and its effect in temperature rising are discussed. The massive amount of gas consumption and burning coal produce CO2 which is the most vital greenhouse gas in the atmosphere.

Nomenclature

X1 The Number of vehicles of last nine years

X2 Gas Consumption of Dhaka City last nine years

X3 Coal Consumption in Dhaka city [Metric Tons]

X4 CO2 emissions in Dhaka City [metric tons]

2. Methods:

First of all, the data is collected from BTRC[5] from previous nine years in Dhaka city and all the data are secondary data.Gas consumption and coal consumption data from previous nine years are collected from Bapex[a part of autonomous organization Petrobangla] and it is also secondary data. Pearson correlation coefficient and multiple linear regression model is used to identify which facotors are responsible to increase CO$_2$ in Dhaka city.
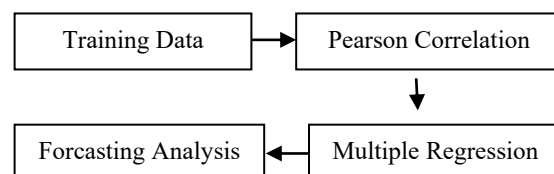

Figure 1 :(Flow Forecasting Analysis)

2.1 Pearson correlation Coefficient

The Pearson correlation coefficient is an appraise of the strength of a linear association between two variables and it is represented by *r*. A Pearson product-moment correlation seek to draw a line of best fit among the data of two variables, and the Pearson correlation coefficient *r*, indicates how far away all these data points are to this line of best fit .r can take a value ranges from +1 to -1. If the value is 0, it shows that there is no association between the two variables. A value greater than 0 indicates a positive association; and the value less than 0 shows that there is a negative association between two variables.

From Table 1 ,There is a good correlation between the coal consumption (X3) and gas consumption(X2),It also shows that there is highly correlation between the variable coal consumption and CO_2 emission in Dhaka city.
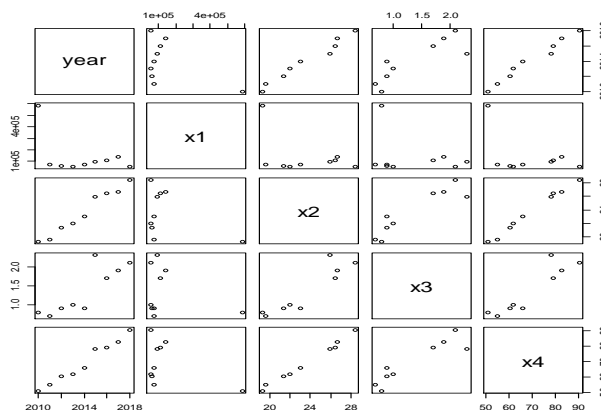

Figure: 02

Variable	X1	X2	X3	X4
X1	1.0000000	-0.4139806	-0.2593056	-0.4382672
X2	-0.4139806	1.0000000	0.9168214	0.9951991
X3	-0.2593056	0.9168214	1.0000000	0.9134075
X4	-0.4382672	0.9951991	0.9134075	1.0000000

Table: 01

From figure 02 , using the R statistical software, the graphical presentation shows the association of different variables which are correlated or not. From this view, it is preliminary an idea of which variable is correlated and which variables are not responsible for increasing the CO_2.

3. Results and Discussions

The Statistical technique of expanding the linear regression considering two or more variables are widely known as multiple linear regression analysis.It can be shown that

$Y= B_0+B_1x_1+B_2x_2+...+B_nx_n+e_i$..(1)

Coefficients	Estimate	Std. Error	t value	Pr(>|t|)
Intercept	-2.315e+01	8.666e+00	-2.671	0.044285
x2	3.888e+00	4.780e-01	8.135	0.000456 *
x3	7.376e-01	2.399e+00	0.307	0.770887
x1	-2.944e-06	3.878e-06	-0.759	0.482011

Where B_0 is the intercepts and $B_1,B_2,....Bn$ are regression coefficients.

Table: 2

 *Multiple R-squared: 0.9914,   ***Adjusted R- squared**: 0.9863

In multiple linear regression, the R square represents the correlation coefficient between the observed values of the outcome variable (y) and the fitted (i.e., predicted) values of y. For this reason, the value of r will always be positive and will range from zero to one.

R square represents the proportion of variance, in the outcome variable y, that may be predicted by knowing the value of the x variables. An R square value close to 1 indicates that the model explains a large portion of the variance in the outcome variable.

A problem with the R square is that, it will always increase when more variables are added to the model; even if those variables are only weakly associated with the response (James et al. 2014). A solution is to adjust the R^2 by taking into account the number of predictor variables.

The adjustment in the "Adjusted R Square" value in the summary output is a correction for the number of x variables included in the prediction model. From this table it is clearly said that gas consumption are mainly responsible for increasing the CO_2 and temperature is rising tremendously in Dhaka city which is considerable as Green House effect.

4. Conclusions:

CO_2 emission is a big challenge for the world now. Our research indicates that CO_2 is increasing due to gas consumption and other variables are associated largely [Table: 2]. CO_2 is highly responsible for increasing Dhaka city's temperature high. It is obviously said that coal consumption in Dhaka city and gas consumption makes the temperature high day by day. Further step may be taken for reducing the CO_2 by government and legislation.

References

1. Efroymson, M A 1964, Multiple regression analysis, Mathematical methods for digital computers , Newyork, J. Wiley, 191-204.
2. The Carbon Cycle - NASA Earth Observatory
3. James, Gareth, Daniela Witten, Trevor Hastie, and Robert Tibshirani. 2014. An Introduction to Statistical Learning: With Applications in R. Springer Publishing Company, Incorporated.
4. https://www.ncdc.noaa.gov/global-warming/temperature-change
5. www.btrc.gov.bd
6. LL Nathans, FL Oswald, K Nimon - Assessment, Research & 2012 - scholarship.rice.edu

Author Details:

1.Md Asan Ul Haque
Department Of Statistics
Jahangirnagar University
Savar, Dhaka-1342, Bangladesh

2. Md. Mydul Islam
Department of Environmental Sciences
Jahangirnagar University
Savar, Dhaka-1342, Bangladesh