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Regression Analysis of Child Mortality and Per Capital Income

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Abstract - Higher income may be a precondition for healthy environment and better health services. There is considerable evidence and academic debate regarding relationships between per capital income and various health indicators including child mortality. In this paper, we proposed a two variable reciprocal regression model to establish the relationship between child mortality and per capital income. The method of ordinary least squares and some statistical inference were employed to analyse critically and ascertain the relationships between the two variables. From the analysis, it was discovered by the test of significance of regression, that there exist a relationship between the child mortality and per capital income at 5percent level of significance.

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Regression Analysis of Child Mortality and Per Capital Income

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Abstract - Higher income may be a precondition for healthy environment and better health services. There is considerable evidence and academic debate regarding relationships between per capital income and various health indicators including child mortality. In this paper, we proposed a two-variable reciprocal regression model to establish the relationship between child mortality and per capital income. The method of ordinary least squares and some statistical inference were employed to analyse critically and ascertain the relationships between the two variables. From the analysis, it was discovered by the test of significance of regression, that there exist a relationship between the child mortality and per capital income at 5percent level of significance.

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I. Introduction

Child mortality is defined as the number of deaths of children under the age of five in a given year per one thousand children in this age group. Income is defined as the money that is received as the results of normal business activities of an individual.

The determinants of child mortality change in less developed countries are not easy to unravel. Improvements in health technology and education play an important role, but effects of these factors are difficult to identify. The variables tend to be collinear with each other and with many other aspects of development, making their isolation difficult.

Identifying the impact of factors which are directly associated with health, is worthwhile for purposes of policy formulation but it may not be critical for a description of child mortality changes in the process of development. Behind these specific variables, the overall economic status of individuals is likely to dominate health changes through nutrition and other aspects of consumption because economic status is a close correlate and determinant of many of the more specific variables noted above.

Higher income may be a precondition for healthier environment and better health services. Thus, for general empirical analysis, it is quite reasonable to propose a sequence of causation which goes from income to child mortality via a number of intermediate variables. This is what this paper attempts to do.

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II. Materials and Methods

The data used in this paper are in respect of child mortality and per capital income for 64 countries for 2005. The data is a secondary. The data collected was analyzed using the following technique:

a) Reciprocal Regression Model

We use the two-variable reciprocal regression model of the form

$$y_i = \beta_1 + \beta_2\left(\frac{1}{x_i}\right) + \varepsilon_i \quad , i = 1, 2 ,\ldots, n \qquad (1)$$

This model is non-linear in the variable x_i because it enters inversely or reciprocally but linear in parameters β_1 and β_2 which are the intercept and the slope respectively.

The model is therefore a linear regression model and has the feature that as x_i increases indefinitely, the term $\beta_2\left(\frac{1}{x_i}\right)$ approaches zero and y_i approaches the limiting or asymptotic value β_1

b) Parameter Estimation

The parameters of $y_i = \beta_1 + \beta_2\left(\frac{1}{x_i}\right) + \varepsilon_i$ in (1) above can be estimated using the least square method so that,

$$\beta_2 = \frac{n\sum\frac{y_i}{x_i} - \sum\left(\frac{1}{x_i}\right)\sum y_i}{n\sum_{i=1}^{n}\left(\frac{1}{x_i}\right)^2 - \left(\sum_{i=1}^{n}\frac{1}{x_i}\right)^2} \qquad (2)$$

And;

$$\beta_1 = \bar{y} - \beta_2\left(\frac{\sum\frac{1}{x}}{n}\right) \qquad (3)$$

c) Test of Significance of Linear Regression

This is used to test the significance of the linear relationship between child mortality y_i and per capital income x_i.

That is, testing the significance of the parameters. The null and alternative hypotheses are of the form

$H_0 : \beta_2 = 0$ and $H_1 : \beta_2 \neq 0$

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This is done using the analysis of variance (ANOVA) table below

Source of variation	Sum of Squares	d.f.	Mean Squares	$F_{calculated}$
Due to Regression	$\beta_2 S_{xy}$	1	$\beta_2 S_{xy}$	MSR / MSE
Due to residuals	$S_{yy} - \beta_2 S_{xy}$	n-2	$S_{yy} - \beta_2 S_{xy}$ / n-2	
Total	S_{yy}	n-1		

Where d.f. depicts the degrees of freedom and the critical value of F (called the tabulated value) is given by $F_\alpha(1, n-2)$ and α is the level of significance. We reject the null hypothesis if $F_{calculated} > F_\alpha(1, n-2)$ and conclude that there exists no significant relationship between the variables.

III. Results and Discussions

a) Reciprocal regression model and its Parameter Estimates

By using the reciprocal model (1) of y on x, we obtain

$\beta_2 = 1.92$ and $\beta_1 = 141.5$, therefore,

$$y_i = 141.5 - 192 \left(\frac{1}{x_i}\right)$$

$E(\varepsilon_i) = 0$ by the ordinary least square assumption. This shows that an increase in per capital income would cause a decrease in child mortality.

b) Test of Significance of Regression

In testing the statistical significance of regression, it is necessary to test the relationship between the concerned variables *x* and y. This is carried out and presented in the following ANOVA table.

Source of variation	Sum of Squares	d.f.	Mean Squares		$F_{0.05}(1, 62)$
Regression	36.66	1	36.66	0.008	3.84
Error	278236.34	62	4487.68		
Total	278273	63			

$F_{calculated} < F_\alpha(1, n-2)$ at five percent level of significance (0.008<3.84)

We accept the null hypothesis and conclude that per capital income affects child mortality. That is, there exists a relationship between the two variables.

IV. Conclusion

Based on the analysis carried out, we arrived at the following conclusions:

(i) An increase in per capital income would cause a decrease in child mortality .This we found from the regression analysis.

(ii) The test of hypothesis from the Analysis of Variance (ANOVA) shows that there is a significant relationship between child mortality and per capital income at 5percent level of significance.

V. Recommendation

Based on the above conclusions, the following recommendations were made:

(i) Government should provide free health care services so that low income earners would be able to access them.

(ii) Funds should also be made available by private organizations or firms in form of social development scheme to health sectors to improve medical facilities and personnel.

(iii) UNICEF and other organizations such as World Bank, UNDP should aim the provision of portable water supplies to rural populace of undeveloped and developing countries.

(iv) New findings and development in medicine which include introduction of vaccines for certain diseases should be encouraged to improve the health of infants and children especially in developing countries.

(v) Health extension programmes such as immunization should be extended from national to grassroot level. This will ensure infant survival rate.

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