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An Equation for the "Gini" Coefficient

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Abstract

Gini Coefficient is an index for measuring Income Inequality for a country. It was introduced by Italian Corrado Gini. The equivalent mathematical definition is due to Nobel Laureate Amartya Sen. Here in this paper, we describe two cases with respect to the state of Meghalaya, India. One is the personal experience of the author. Another is the opinion expressed recently with respect to Externally Aided Projects, in a local daily subeditorial by Mr. Anver Pariat. Motivated by these two cases, guided by the Newton's second law of motion, we propose an equation for the Income Inequality "Gini" Coefficient for a place in a developing country.

Keywords: Gini Coefficient, Equation, Definition, EAP, $(a+b)^2$.

Introduction

Corrado Gini [1], an Italian sociologist and statistician, following work of Max Lorenz and improving on work of Vilfredo Pareto, developed, [2], an index for income inequality for a country. Gini index [3], measures the extent to which the distribution of income among individuals or, households within an economy deviates from perfectly equal distribution. A Lorenz curve plots the cumulative percentage of total income received against the cumulative number of recipients starting with the poorest individual or, household. The Gini coefficient measures the ratio of the area between the Lorenz curve and a hypothetical line of absolute equality and the area below the hypothetical line of absolute equality. Equivalent mathematical definition, [4], of Gini coefficient or Sen representation of Gini coefficient is

$$G=\frac{\sum_{i=1}^{n}\sum_{j=1}^{n}|x_i-x_j|}{2(n-1)\sum_{j=1}^{n}x_j}$$

Where, n is the number of people of a country and income of j-th person is x_j. Gini coefficient of a country can vary from zero to one. If income of all the people of a country is the same, Gini coefficient is zero. If one person of a country has income, rest other income-less, Gini coefficient of that country is one. In u. k., for example, Gini coefficient is measured by Office of the National Statistics of u. k. UN (United Nations) quotes Gini coefficient as one of the important indices for measuring inequality.

In the next two sections, the author describes two cases, one his personal experience at NEHU, Shillong, Meghalaya, India and another a newspaper subeditorial. With these two cases in the backgound, in the section IV, we propose an equation for the temporal evolution of the "Gini" Coefficient for a place in a developing country.

$$(a+b)^2=a^2+2ab+b^2 :$$

Recently there was a gathering of local school boys in NEHU convocation hall, in a programme of the Chief Minister. The author was taking morning walk along the way. The author saw three boys loitering on the road, asked them what class do they study in? They told that they study in class X. Then the author asked one boy, tell me $(a+b)^2$. He said correctly $a^2+2ab+b^2$. Then the author asked him $(a+b)^3$.

He plainly told, "I do not know." Other two boys also told the same thing. As they were going away, one boy told "it's there in the book."

On one Saturday, while waiting to take food through the closed GATE 3 of NEHU, the author met few Ranger security boys. One boy is Mr. A. The author asked him "where from are you?" He replied "from Mawsynrum". Then the author asked him "kanno class? (meaning how far did you study?)" He replied "class X". Then the author asked him "Do you know Dr. A, from the Mathematics department?" He told "no." Then the author told, "can you tell me what is $(a+b)^2$?" He told "no." But interestingly, there was a boy standing nearby. He promptly entered into the conversation to add "$a^2+2ab+b^2$", staring towards the sky filling in one by one term. Then Mr. A exclaimed "he is B.A. pass!". Then the author started talking to the "B.A. pass" boy. He told that he is from Nongstoin. He is from St. Peter's school. But he did Arts in eleven-twelve and then B.A. Obviously, he had no use of $(a+b)^2$. But he still remembers it. It led the author to think what made this boy B.A. Pass and Mr. A class X dropout. Is this

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$(a+b)^2$=a^2+2ab+b^2 learning?

Another experience may be of relevance. The author met two boys, one class eight dropout and another class twelve arts dropout. Both speak English fluently. Both take to driving cabs, belonging to other people, as a way of profession. They earn around Rs. 12000., take home, per month. The author did not ask them $(a+b)^2$.

Here in Meghalaya, there are people with Phd degrees, serving. They are earning around one lakh. But their proportion is very less. Hence the author presumes income inequality Gini Coefficient is very high.

That has prodded the author to think what about imprinting on the boys $(a+b)^2$ i.e. making them learn $(a+b)^2$ formula compulsorily. That will make majority of the today's boys go to at least graduate level tomorrow. That will make them, on an average, earn three times more. That will reduce the Gini coefficient considerably.

EAPs:

On the other hand opinions expressed in the public domain are concerned that the Externally Aided Projects (EAP) have worsening the Income Inequality, thereby contributing to increasing Gini Coefficient for a place.

With these two sections in the background, we propose an equation for the time development of the Income Inequality "Gini" Coefficient, in the next section.

An Equation for the "Gini" Coefficient of a Place

Guided by the Newton's second law of motion, we propose an equation for the Income Inequality "Gini" Coefficient as below:

$$\frac{d}{dt}[MG]=F$$

Where,

G is the "Gini" Coefficient for a place at a particular time, t.

M equals number of educated people of working age divided by total number of people of working age.

F is the external factor.

For the case of Meghalaya, F is proportional to EAP funds inflow divided by total expenditure by the Government in a particular period of time. In other words, F equals k multiplied by EAP divided by total constructional expenditure by the Government, with k being a numerical constant with the dimension of time^{-1}, say in (100 year)$^{(-1)}$. Moreover, inflow today is positive, after some years will be negative. That will keep G bounded, once it is so initially.

Anisotropic Case: The equation, for the anisotropic case, will generalize to

$$\frac{d}{dt}[\vec{M}.\overrightarrow{"G"}]=\vec{F}$$

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