



## TN0903-1: Gini Index Made Simple

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### 1 Overview

The distribution of wealth or income over a population is of great interest to economists, sociologists, and politicians when advancing or defending various types of governance – e.g. capitalism, socialism, communism, etc. A widely adopted measure of such a distribution is called the Gini Index ([here](#) is a fairly comprehensive discussion of the GI). In this technical note we illustrate the Gini Index that measures income distribution over a population and reduces it to a single number.

To keep the arithmetic as simple as possible, we compute the GI for a hypothetical economy populated by only ten people each earning a different amount of annual income. The GI is calculated as a number ranging from zero to one. A GI = 0 indicates that there is perfect income equality over the entire population – every member earns exactly the same amount. On the opposite extreme, a GI = 1 indicates an economy of perfect inequality of incomes – every member except one person earns no income at all, and the one person gets all the income that the economy produces. Most real economies and/or nations may have values ranging from 0.2 to 0.8. For example, today the United States has a GI of approximately 0.42.

In the next section we use a spreadsheet model of the ten person economy to go through the steps required to calculate the GI. The spreadsheet model may be downloaded from [here](#) and its income inputs modified to see how they affect the GI. This is recommended to give an overall picture of the description that follows.

### 2 Gini Index Model Description

Table 1 is the part of the spreadsheet that contains all the numbers we need. In the first row the ten people are numbered and ordered left to right from lowest to highest income. The next row (of blue numbers) gives the actual annual incomes for the population in thousands of dollars or K\$. Person #1 gets \$15,000 and Person #10 gets \$2,000,000 a year.

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Then we compute the Cumulative Actual Incomes across the population by adding in turn to each person's income all the incomes of the people earning less than they do. This is spelled out in the triangular array of numbers below the Actual Income row. The dollar sums of the resulting columns then give the cumulative amounts starting with \$15,000 and going up to \$3,215,000 which, of course, represents the total annual income for this ten person economy.

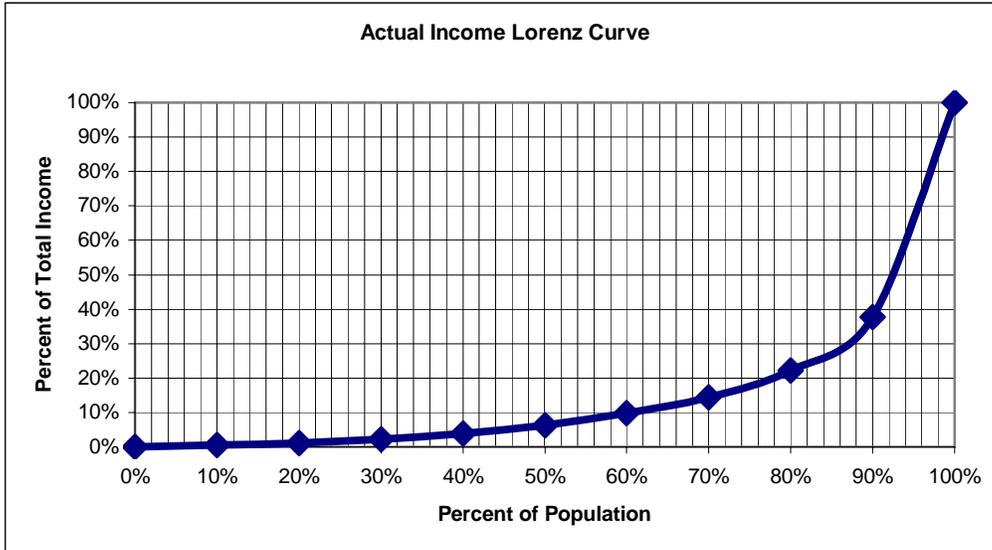
	<i>Lowest Income</i>										<b>Gini Index = 0.639</b>	<i>Highest Income</i>	
Person	1	2	3	4	5	6	7	8	9	10			
Annual Income (K\$)	\$ 15	\$ 20	\$ 35	\$ 55	\$ 80	\$ 110	\$ 150	\$ 250	\$ 500	\$ 2,000			
		\$ 15	\$ 20	\$ 35	\$ 55	\$ 80	\$ 110	\$ 150	\$ 250	\$ 500			
			\$ 15	\$ 20	\$ 35	\$ 55	\$ 80	\$ 110	\$ 150	\$ 250			
				\$ 15	\$ 20	\$ 35	\$ 55	\$ 80	\$ 110	\$ 150			
					\$ 15	\$ 20	\$ 35	\$ 55	\$ 80	\$ 110			
						\$ 15	\$ 20	\$ 35	\$ 55	\$ 80			
							\$ 15	\$ 20	\$ 35	\$ 55			
								\$ 15	\$ 20	\$ 35			
									\$ 15	\$ 20			
										\$ 15			
Cumulative Actual Incomes	\$ 15	\$ 35	\$ 70	\$ 125	\$ 205	\$ 315	\$ 465	\$ 715	\$ 1,215	\$ 3,215 = Total Income			
Cumulative Equal Incomes	\$ 321.5	\$ 643.0	\$ 964.5	\$ 1,286.0	\$ 1,607.5	\$ 1,929.0	\$ 2,250.5	\$ 2,572.0	\$ 2,893.5	\$ 3,215.0			
% of Tot Actual Incomes	0%	0.5%	1.1%	2.2%	3.9%	6.4%	9.8%	14.5%	22.2%	37.8%	100.0%	198.3%	
% of Tot Equal Incomes	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%		
% of Total Population	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	550%	

**Table 1.**

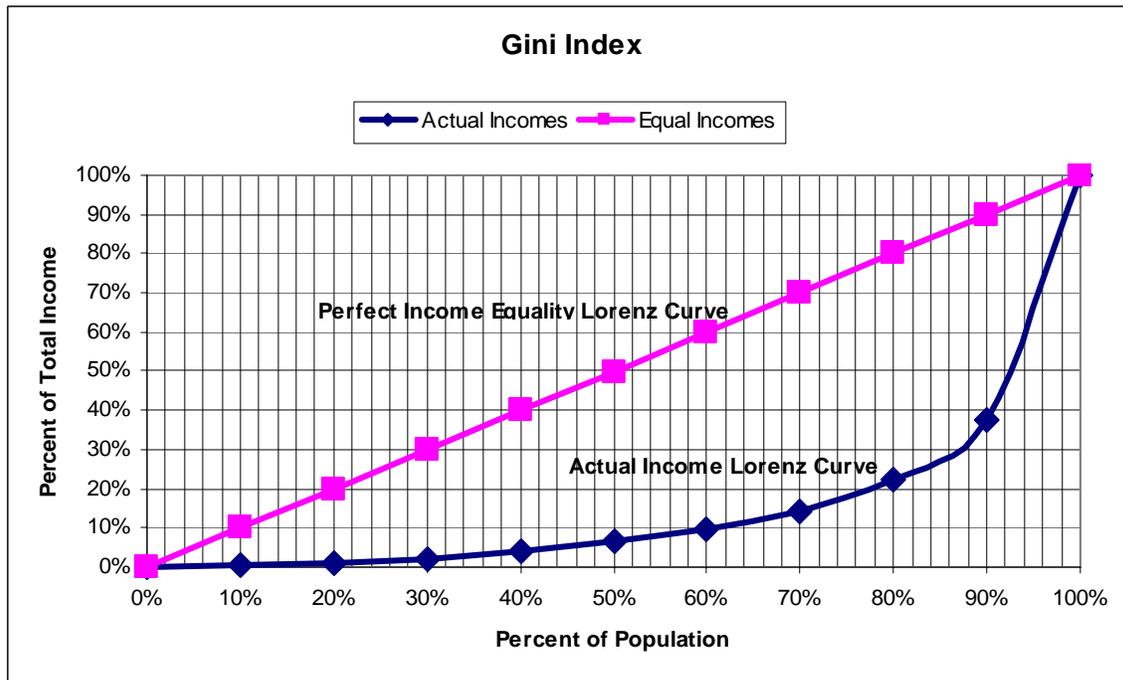
The next row contains the Cumulative Equal Incomes for the population if they were all to receive equal amounts of the economy's total income of \$3,215,000 or \$321,500 per year. The Cumulative Equal Income amounts are formed exactly the same way as are the Cumulative Actual Incomes just described. Since the Gini Index (GI) deals in percentages so that various economies and countries can be compared, the next three rows calculate the needed percentages from which the GI plots are drawn.

All the dollar amount percentages are computed as a percentage of \$3,215,000, the economy's total annual income. The first row of percentages - % of Tot Actual Incomes - is obtained by just dividing the Cumulative Actual Income amount by the total income. The second row of percentages - % of Tot Equal Incomes - is obtained by dividing the Cumulative Equal Incomes by the total income amount. It is, of course, equal to the third row - % of Total Population - since each cumulative population percentage must receive exactly its cumulative percentage share of the total income.

The plot of percent of total income received for every value of percent of total population is known as a Lorenz curve. When we plot '% of Tot Actual Incomes' against '% of Total Population' from the above table, we get the Actual Income Lorenz Curve shown below as can be verified by matching the table values at the blue diamonds.

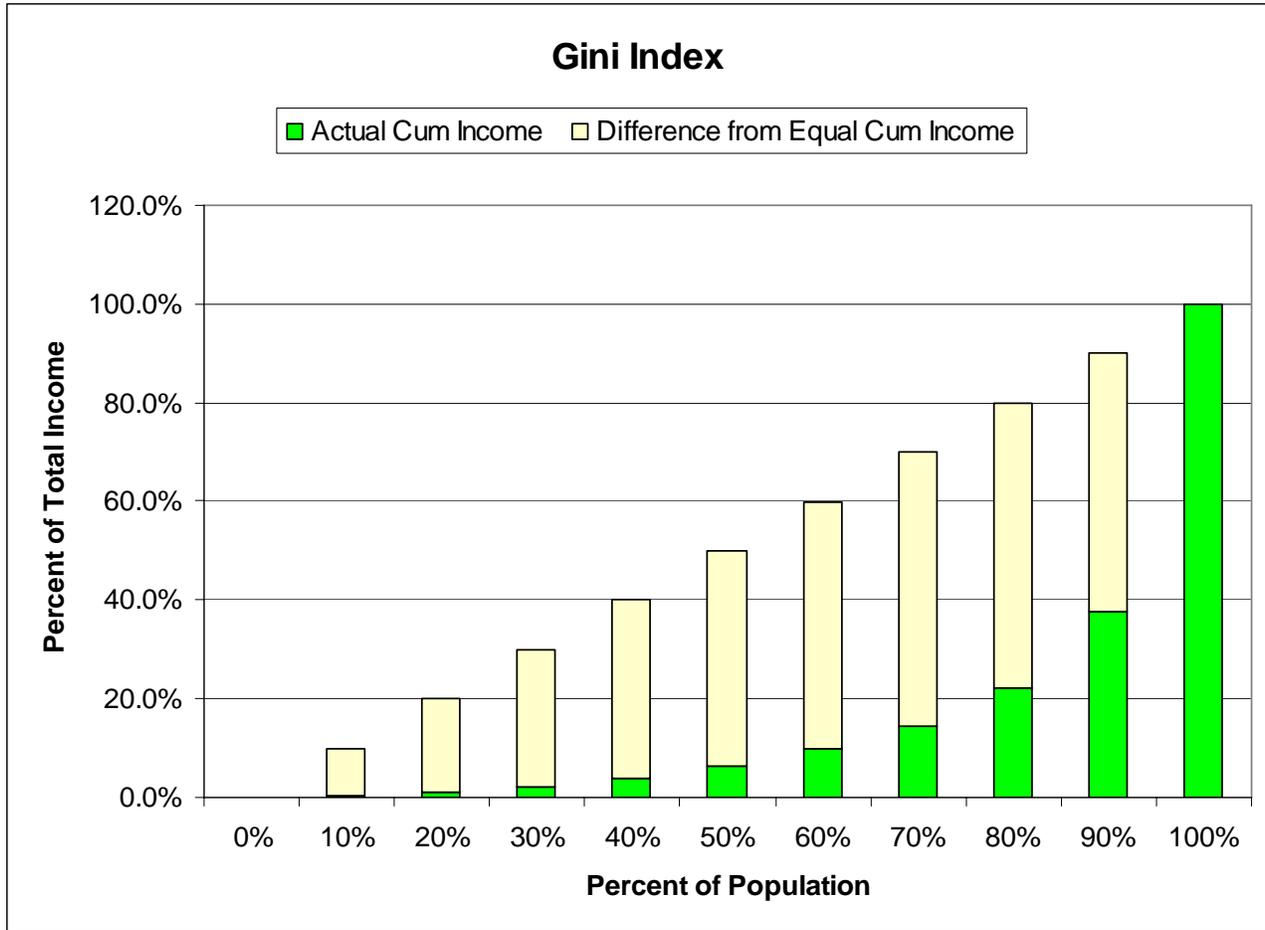


The Lorenz curve for the equal income distribution is, of course, a straight line going through the points of equal cumulative percent population and equal cumulative percent income. When we put both of these curves on to the same plot or graph, we get the well-known picture of the GI that is discussed in the literature. This plot is shown below.



The value of the GI is obtained from this plot as the ratio of the area between the two Lorenz curves to the triangular area under the Perfect Income Equality Lorenz Curve (the magenta straight line). The closer the actual Lorenz curve is to the straight line, then the smaller the area in between the curves, and the smaller the resulting value of the GI.

With our ‘toy population’ of only ten people, we can illustrate this calculation with an even simpler plot – actually the histogram shown below.



In the histogram we have shown the actual cumulative percent of income as the green bars which replicate the shape of the actual income Lorenz curve of the previous plot. The total height of the histogram bars is the straight line of the equally distributed income curve. The difference between the actual and perfectly equal curves is then highlighted in the yellow bars. The value of the GI is then the total ‘area’ (actually heights) of the yellow bars divided by the total ‘area’ (actually total heights) of the ‘yellow and green’ bars. These ‘areas’ (heights) on the histogram are simply the sums of the appropriate rows in Table 1 shown as the green numbers on the right (198.3 and 550). The 198.3 is the sum of the heights of the green bars representing the cumulative actual income, and the 550 is the sum of the total heights of the yellow and green bars representing cumulative equal income.

Recalling that the GI is computed as the ‘difference over the total’, we get the difference by the subtraction (550 – 198.2) and divide this by the total of 550 giving us the desired GI value as shown in red in the table – i.e.  $GI = ((550.0 - 198.2)/550 = 0.639$ . We recommend that the reader now change the blue numbers in the spreadsheet to see how the

GI is affected by various levels of income inequality. The only proviso is to make sure that the income numbers are either equal or always increase from left to right.

### **3 A Final Note**

Many people wonder why more economies are not operated under a form of governance that would make personal incomes more equal. The reality is that when the actual (blue) income line approaches the equal income (magenta) line and the GI value approaches zero, the total income produced by the economy (the red \$3,215,000) is not maintained – it goes down, thereby making the more equal distribution yield even less money to the low end wage earners. Of course, a high GI value will do the same thing as the blue line becomes flatter and a very high percentage of the income is accrued by the few and the wealthy. The debate continues on the ideal range for the GI, but we must always remember that public policies engineered to change the Gini Index also change the total income that is available for distribution within an economy or a nation.