# Lorenz curve and Gini Index

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## Introduction:

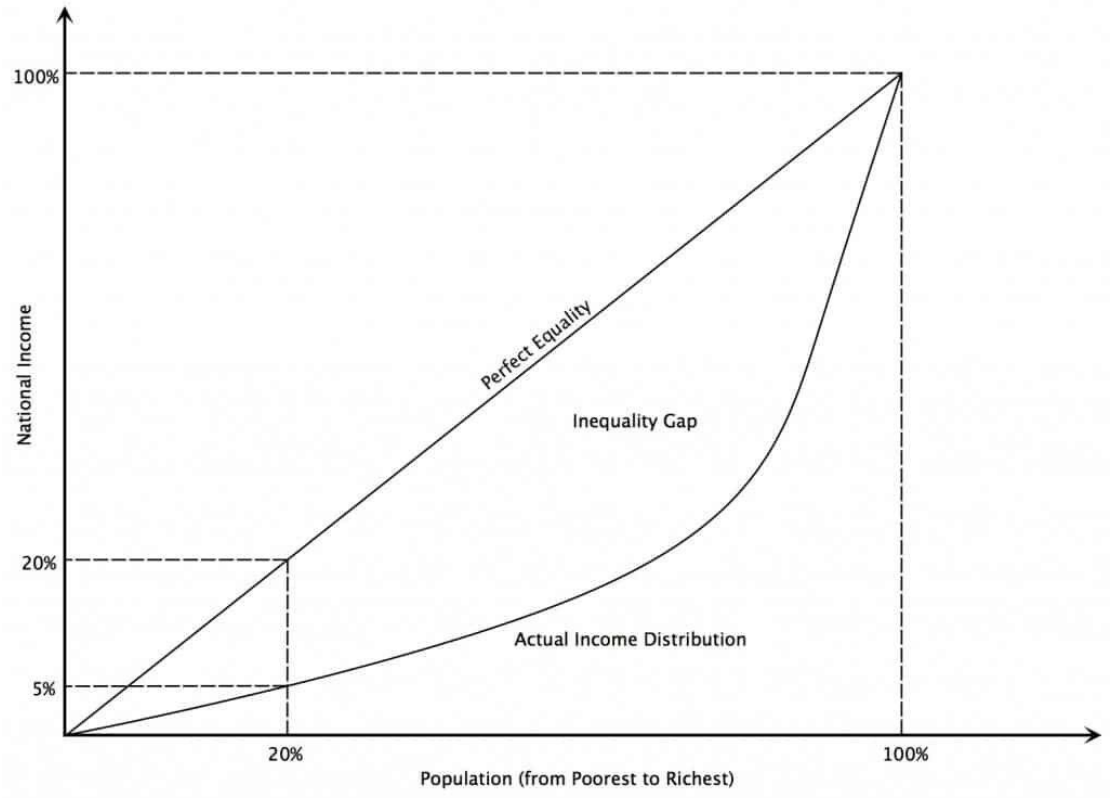
One of tools usually used by economists to visualize the income distribution in the population is Lorenz curves and Gini index.

To show the distribution of income graphically we use the" Lorenz curve", and to measured this degree if income inequality/equality we use the "Gini Index"

### I. Lorenz curve:

The Lorenz Curve is a graphical distribution of income, wealth developed by **Max Lorenz in 1906**, shows the proportion of income earned by any given percentage of the population. The line at the 45º angle shows perfectly equal income distribution (diagonal line), while the other line shows the actual distribution of income (Lorenz curve) as we see in the figure below

The Lorenz curve is a graphical representation of the degree of equality/inequality in the distribution of income.




- The *x-axis* is often denoted as the percentile, is the percentile of net worth ranking.
- The y-axis is often denoted as the cumulative percentage of occurrences, the percentages represent the cumulative amount of net worth of households.
- The *line of equality* is demonstrated by a 45-degree(perfect equality line)
- The *Lorenz curve* is demonstrated often by an upward-sloping but often exponentially rising curve

$\Rightarrow$ Each (x, y) point on the curve means that the bottom x% of the population owns y% of the wealth.

**II. Gini Index:**

The Gini index or Gini coefficient is a statistical measure of distribution; it measures the degree of income equality in a population.

The coefficient ranges from 0 (or 0%) to 1 (or 100%), with 0 representing perfect equality and 1 representing perfect inequality.

When the

- G=0⇒ the Lorenz curve is a diagonal line (equality line) ⇒ the perfect equality of the distribution of income.
- G increases and gets closer to 1⇒the Lorenz curve is far from diagonal line (equality line) ⇒the distribution of income becomes more unequal.

Mathematically, G is the ratio of the area between the wealth distribution curve (Lorenz curve) and the diagonal line (line of equal distribution) to the area under the equal distribution curve.

$$I_G = \frac{area\ of\ inequality\ gap}{area\ of\ triangle}$$

$Area\ of\ triangle = \frac{Base \times height}{2} = \frac{1}{2} \Rightarrow$ It is a right triangle

$Area\ if\ inequality\ gap = area\ of\ \ triangle -$ the sum of areas of trapezoids

The sum of areas of trapezoids

$$= \sum \frac{1}{2}\left[\boldsymbol{F(n_i x_i)^{\uparrow}_{i-1} - F(n_i x_i)^{\uparrow}_{i}}\right].\boldsymbol{f_i} = \frac{1}{2}\sum\left[\boldsymbol{F(n_i x_i)^{\uparrow}_{i-1} - F(n_i x_i)^{\uparrow}_{i}}\right].\boldsymbol{f_i}$$

So:

$$Area\ if\ inequality\ gap = \frac{1}{2} - \frac{1}{2}\sum\left[\boldsymbol{F(n_i x_i)^{\uparrow}_{i-1} - F(n_i x_i)^{\uparrow}_{i}}\right].\boldsymbol{f_i}$$

$$= \frac{1}{2}\left(1 - \sum\left[\boldsymbol{F(n_i x_i)^{\uparrow}_{i-1} - F(n_i x_i)^{\uparrow}_{i}}\right].\boldsymbol{f_i}\right)$$

So, $I_G$ becomes:

$$I_G = 1 - \sum\left[\boldsymbol{F(n_i x_i)^{\uparrow}_{i-1} - F(n_i x_i)^{\uparrow}_{i}}\right].\boldsymbol{f_i}$$