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ORIGINAL ARTICLE

A Measurement of Income Inequality Based on Ratio of Maximum Income to Mean Income

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ABSTRACT

In the literature some scholars tried to find measures for income inequality by taking ratio from mean income. In the present paper an attempt has been made to develop a measure of income inequality by taking ratio of maximum income to mean income. To establish show the computational process a hypothetical data has been used.

Key words: *Income Inequality, Geometric and Harmonic Mean*

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INTRODUCTION

In the previous paper Singh (2016) developed a measure of income inequality by using deviation from maximum income. Later, in the literature, it has been found that some scholars used the ratio in place of deviation so in the present paper an attempt has been made to develop a measure by using ratio in place of deviation.

MEASURES BASED ON RATIO OF MAXIMUM INCOME TO MEAN INCOME

In the paper Singh (2016) a measure of income inequality has been developed by taking deviation from maximum income as-

$$I_1 = (nR_n - n\bar{x})$$

Further, it has been improved index by assigning large weights to larger income deviations about R_n as

$$I_4 = \frac{1}{R_n}\left(1 - \frac{1}{n}\right)\sum_{i=1}^{n} \frac{(R_n - x_i)^2}{n(R_n - \bar{x})}$$

Now the single measure I_4 is:

$$I_4 = \frac{(n-1)}{n^2 R_n}\sum_{i=1}^{n} \frac{(R_n - x_i)^2}{(R_n - \bar{x})}$$

In case, R_n is replaced by $z_{(1-\alpha)}$ then the index becomes:

$$I_5 = \frac{(n-1)}{n^2 z_{(1-\alpha)}}\sum_{i=1}^{n} \frac{\left(z_{(1-\alpha)} - x_i\right)^2}{\left(z_{(1-\alpha)} - \bar{x}\right)}$$

In the above measures we have used deviation from maximum value to find income inequality. Some scholars used the ratio in place of deviation so we also take ratio in place of deviation. Then, we can consider an index as:

$$I_6 = \frac{R_n}{\bar{x}}$$

Here I_6, is an indicator or simple index of income inequality. If all observations have equal income i.e. $x_1 = x_2 = ... = x_n$ then $I_6 = 1$.

If, $x_1 = x_2 = ... = x_{n-1} = 0$ and last person get all income i.e. $R_n = x_n$.

$$I_6 = \frac{x_n}{x_n / n} = n$$

The range of this indicator is (1, n).

To compare the range with their standard measures, the modified measure is as follows:

$$I_7 = 1 - \frac{\bar{x}}{R_n}$$

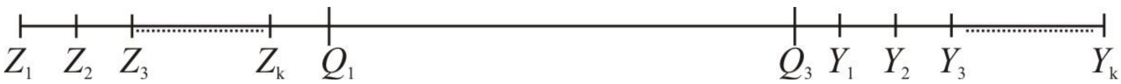
The range of this indicator is (0,1-1/n).

If the Arithmetic mean is replaced by geometric mean and Harmonic mean, then the proposed indices are:

$$I_8 = 1 - \frac{G.M.}{R_n}$$

$$I_9 = 1 - \frac{H.M.}{R_n}$$

Let the income be represented on real line as follows:



Here, the incomes $z_1, z_2, ..., z_k$ are below first quartile (Q_1) and $y_1, y_2, ..., y_k$ are the incomes above third quartile (Q_3). Clearly, the incomes $z_1, z_2, ..., z_k$ are usually much smaller than $y_1, y_2, ..., y_k$.

Now, we can define upper range and lower range as $R_n - Q_3$ and $Q_1 - R_1$, where R_1 is minimum income of the data.

In case of high inequality, $R_n - Q_3$ is sufficiently larger then $Q_1 - R_1$.

Therefore, the ratio-

$$I_{10} = \frac{R_n - Q_3}{Q_1 - R_1}$$

May be considered as a measure of inequality, I_{10} lies between o and ∞. The interpretation of I_{10} is as:

$$I_{10} = \frac{Range\ of\ upper\ 25\%}{Range\ of\ lower\ 25\%}$$

In general-

$$I_{10} = \frac{Range\ of\ upper\ \alpha\%}{Range\ of\ lower\ \alpha\%}$$

I_{10} is based on the extreme values i.e. R_1, R_n, Q_1 and Q_3. If the incomes in the upper range and lower range are also taken into account, then following will be the measure of income inequality:

$$I_{10} = \frac{\sum_{i=1}^{k} y_i}{\sum_{i=1}^{k} z_i} = \frac{Total\ income\ of\ upper\ 25\%}{Total\ income\ of\ lower\ 25\%}$$

The range of this indicator is $(1, \infty)$.

In general,

$$I_{10} = \frac{Total\ income\ of\ upper\ \alpha\%}{Total\ income\ of\ lower\ \alpha\%}$$

COMPUTATION FOR A HYPOTHETICAL DATA

Now, we consider the same hypothetical data to compute some proposed measures used in Singh (2016). Suppose there is a firm of 50 persons and the monthly salary of these employees are as follows:-

2300	2350	2200	2400	3000	3200
3500	2600	2800	2250	2500	3000
3500	5000	5200	2800	2700	3000
3200	2700	4500	5000	6000	5500
5800	10000	12000	13000	14000	13000
12000	18000	16000	15000	19000	17000
14000	13000	16000	16000	18000	5250
11000	13000	16000	30000	32000	35000
50000	3350				

Here the maximum value is-

$$R_n = 50000$$

And the mean income of the above data is-

$$\bar{x} = 10376$$

Then index I_1 is-

$$I_1 = 1981200$$

Further, $I_4 = \frac{(50-1)}{50^2 \times 50000} 2101556.38$

$= 0.823810101$

And,

$$I_7 = 0.479045$$

Now the proposed sixth indicator is-

$$I_6 = 50000/10376 = 4.818812644$$

and the seventh indicator is-

$$I_7 = 1 - (10376/50000)$$

Hence,

$$I_7 = 0.79248$$

The other index for the above data are-

$$I_8 = 0.999971$$

$$I_9 = 0.898787$$

To find the value of further indices we have to arrange the "data according to ascending order and then find the value of I[st] Quartile and III[rd] Quartile. Then the value of I[st] Quartile is-

$$Q_1 = 12.5^{th}\ term = 12^{th}\ term + 0.5\left(13^{th}\ term - 12^{th}\ term\right)$$

$$Q_1 = 3000 + 0.5 \times (3000\text{-}3000) = 3000$$

The value of III[rd] Quartile is-

$$Q_3 = 37.5^{th}\ term = 37^{th}\ term + 0.5\left(38^{th}\ term - 37^{th}\ term\right)$$

$$Q_1 = 14000 + 0.5 \times (15000 - 14000) = 14500$$

The minimum value is =2200

$$I_{10} = (50000\text{- }14500)/(3000\text{-}2200)$$

$$I_{10} = 35500/800 = 44.375$$

CONCLUSION

In the present paper measure of income inequality I_6 has been developed by taking ratio of maximum income to mean income instead of deviation. Further to make it more reliable and valid under different conditions the proposed measure has been modified by taking geometric mean and harmonic mean in place of arithmetic mean. Also, a measure based on lower and upper quartiles has been discussed.

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