[Frequently Asked Questions]

Index Numbers (Part – 1)

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Unit No. & Title:	Unit – 4 Index Numbers
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Frequently Asked Questions

Q1. What is an index number?

A1. An index number is a statistical measure, which reflects the relative changes in the level of a certain phenomenon, say, prices or wages in any given period, called the current period with respect to its value in some fixed period, called the base period. The reference base is expressed as having one selected situation as 100. Another year may have an index number, say, 138. This means that the magnitude in the second year is 138% of its level in the base year. The actual level is measured in neither of the years; only the change from one year to the other is given by the index. Here, the index number shows the increase of 38%.

Q2. Why there are different formulae for constructing index number?

A2. For constructing index numbers, a basket of items is selected for the study. All the items may not have same unit of measurement. Some are costly goods and others are cheap. Some are essential goods while others are luxury items. So to balance their importance of use and to construct an index number which is unit-less different authors have given different procedures of constructing index numbers. They have adopted different ways of assigning weights to the commodities.

Q3. What is Laspeyres price index number?

A3. In Laspayres price index number, the base year quantities are taken as weights. This method of computing price index is also called Base Year Method.

$$P_{01}^{La} = \frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100$$

P_{01} - price index for the current year with respect to the base year

p_0 - price of the commodity in the base year

p_1 - price of the commodity in the current year

q_0- quantity of the commodity in the base year

Q4. What is Paasche price index number

A4. In Paasche price index number the current year quantities are taken as weights.

$$P_{01}^{Pa} = \frac{\sum p_1 q_1}{\sum p_0 q_1} \times 100$$

P_{01} - price index for the current year with respect to the base year

p_0 - price of the commodity in the base year

p_1 - price of the commodity in the current year

q_1- quantity of the commodity in the current year

Q5. What is the relationship between Laspeyres and Paasche price index numbers?

A5. Relation Between Laspeyres and Paasche Index Numbers

(i) Paasche price index is V_{01} divided by the Laspeyres quantity index and the Paasche quantity index number similarly is V_{01} deflated by the Laspeyres price index.

i.e.

$$P_{01}^{Pa} = \frac{V_{01}}{Q_{01}^{La}}$$

and

$$Q_{01}^{Pa} = \frac{V_{01}}{P_{01}^{La}}$$

or $P_{01}^{Pa} \times Q_{01}^{La} = V_{01}$ and $P_{01}^{La} \times Q_{01}^{Pa} = V_{01}$

(ii) The Laspeyres and Paasche index forms are related so that the reciprocal of the forward Laspeyres index is the backward Paasche index and the reciprocal of the forward Paasche index is the backward Laspeyres index.

i.e.

$$P_{10}^{Pa} = \frac{1}{P_{01}^{La}}$$

and

$$P_{10}^{La} = \frac{1}{P_{01}^{Pa}}$$

or $P_{10}^{Pa} \times P_{01}^{La} = 1$ and $P_{10}^{La} \times P_{01}^{Pa} = 1$

(iii) From the first property we have

$$P_{01}^{Pa} \times Q_{01}^{La} = P_{01}^{La} \times Q_{01}^{Pa} = V_{01}$$

$$\Rightarrow \frac{P_{01}^{Pa}}{P_{01}^{La}} = \frac{Q_{01}^{Pa}}{Q_{01}^{La}}$$

It follows that the ratio of the Paasche to the Laspeyres form is same for price and for quantity index numbers. Using this property it has been statistically proved that the Paasche price index is greater than the Laspeyres if prices and quantities tend to move in the same direction between years 0 and 1. The Laspeyres index is greater if prices and quantities tend to go in opposite directions.

(iv) Laspeyres and Paasche price indices are based on the assumption that the quantities consumed in the base year and the current year are same. Thus Laspeyres index number over-estimates the true value and is expected to have 'an upward bias' and Paasche index number under-estimates the true value and is expected to have 'a downward bias'.

Q6. Apart from Laspeyres and Paasche price index numbers, are there any other ways of constructing index number?

A6. In search of perfect index number some compromises have been made and apart from Laspeyres and Paasche price indices, other formulae have been discovered.

(i) Marshall-Edgeworth Price Index Number: Here the weights attached to the commodities are taken as the arithmetic mean of the quantities in the base year and the current year, i.e. $w = \frac{q_0+q_1}{2}$

$$P_{01}^{ME} = \frac{\sum p_1\left(\frac{q_0+q_1}{2}\right)}{\sum p_0\left(\frac{q_0+q_1}{2}\right)} \times 100$$

$$= \frac{\sum p_1 q_0 + \sum p_1 q_1}{\sum p_0 q_0 + \sum p_0 q_1} \times 100$$

(ii) Dorbisch-Bowley Price Index Number: It is the arithmetic mean of Laspeyres and Paasche price index numbers.

$$P_{01}^{DB} = \frac{1}{2}[P_{01}^{La} + P_{01}^{Pa}]$$

$$= \frac{1}{2}\left[\frac{\sum p_1 q_0}{\sum p_0 q_0} + \frac{\sum p_1 q_1}{\sum p_0 q_1}\right] \times 100$$

(iii) Fisher Price Index Number: It is the geometric mean of the Laspeyres and Paasche price index numbers.

$$P_{01}^{F} = [P_{01}^{La} \times P_{01}^{Pa}]^{\frac{1}{2}}$$

$$= \left[\frac{\sum p_1 q_0}{\sum p_0 q_0} \times \frac{\sum p_1 q_1}{\sum p_0 q_1}\right]^{\frac{1}{2}} \times 100$$

Q7. Which formula of the index number should be used when?

A7. The Laspeyres index is probably more convenient to use since it uses fixed weights. But it is found that with the passage of time these weights become out of date. The Paasche index uses the current weights. But it is sometimes difficult to obtain up-to-date information and in that case Laspeyres formula is more advantageous.

Arithmetic mean is simple to calculate, understood by the majority of people and gives a bird's eye view of the data series. But, it uses all the data of the series and sometimes there are abnormal items in the series. So the true central value gets displaced due to the abnormal item. Geometric mean is smaller than the arithmetic mean of the same data set. It reduces the effect of large abnormalities. This is a major reason for its recommended use. But at the same time geometric mean gives more effect to small abnormalities which could be equally misleading. So one has to make a decision on the choice of index number formula based on the given data and convenience of application.

In general, the true value of the price index lies somewhere between the Laspeyres price index and the Paasche price index. Both Marshall-Edgeworth and Fisher index numbers lie between Laspeyres and Paasche indices. They have no bias in any known direction and provide a better estimate of the true price index.

Q8. Why Laspeyres price index number is expected to have 'an upward bias'?

A8. Laspeyres price index is based on the assumption that the quantities consumed in the base year and the current year are same. This assumption is not true in general. If the consumption of some of the commodities decreases in the current year due to rise in their prices or due to changes in the habits, tastes and customs of the people, then Laspeyres index gives relatively more weight-age to such commodities as it does not take into account falls in demand or changes in output. The numerator in the formula is relatively larger. Thus Laspeyres index number over-estimates the true value and is expected to have 'an upward bias'.

Q9. Why Paasche price index number is expected to have 'a downward bias'?

A9. Paasche price index is based on the assumption that the quantities consumed in the base year and the current year are same. This assumption is not true in general. If the consumption of some of the commodities decreases in the current year due to rise in their prices or due to changes in the habits, tastes and customs of the people, then those goods which have risen in price more than others will tend to have current quantities relatively smaller than the corresponding base quantities and they will thus have less weight in the Paasche index. The Paasche index number under-estimates the true value and is expected to have 'a downward bias'.

Q10. How fixed base index number differs from chain base index number?

A10. Fixed base index uses a specific base year for comparison of relative changes in a level of phenomenon whereas in chain base index method the relative changes in the level of phenomenon for any period are compared with that of the immediately preceding period and the process is continued till the comparison is made with the required base period.

$$Change\ Base\ Index\ Number\ for\ any\ Year$$

$$= \frac{Link\ Relative\ of\ Current\ Year\ \times\ Chain\ Base\ Index\ of\ the\ Preceding\ Year}{100}$$

where,

$$Link\ Relative\ of\ any\ Year = Price\ of\ that\ year\ as\ a\ percentage\ of\ its\ price\ in\ the\ preceding\ year$$

$$=> Link\ Relative\ for\ i^{th} year = \frac{p_i}{p_{i-1}} \times 100, \quad i = 1,2, \dots \dots \dots, n$$