

INDEX NUMBERS

- **Index Numbers**

"A relative number which indicates the relative change in a group of variables collected at different time". Index numbers is a device for estimating trend in Prices, Wages, Production and other economic variables. It is also known as economic barometer.

Or

An Index Number Is a number that measure a relative change in a variable or an average relative change in a group of related variable with respect to a base. A base may be that particular time, space professional class with whose reference change are to be measured .

- **Type of Index Numbers**

There are three types of index numbers which are commonly used.

- 1. Price Index Numbers**

A price index number is a number that measures the relative change in the price of a group of commodities with respect to base.

- 2. Quantity Index Numbers**

These index numbers measure the changing the volume or quantity of goods produced or consumed.

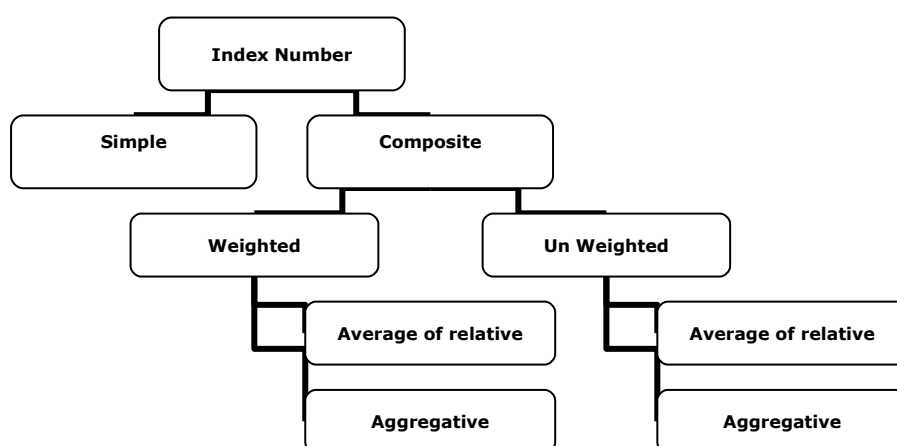
- 3. Aggregative Index Number**

These index numbers are used to measure changes in a phenomenon like cost of living, total industrial production etc.

- **Classification of Index Numbers**

Index number generally classified as

1. Simple index number.
2. Composite index number.



- 1. Simple index number**

A simple index numbers that measure a relative change in a single variable with respect to a base these variables are Prices, Quantity, Cost of Living etc.

Or

If an index is based on single variable only than it is know as simple index number. For example of index no prices of Banaspati Ghee, index number of carpets exported to the Middle East etc.

1.1. **Fixed Base Method**

Price Relative

They are obtained by dividing the price in a current year by the price in a base year and expressed as percentage.

$$\text{Price relative} = P_{on} = \frac{\text{Price in a current year}}{\text{Price in a base year}} \times 100$$

$$P_{on} = \frac{P_n}{P_o} \times 100$$

Where P_n = Current year prices , P_o = Base Year prices

Quantity Relative

They are obtained by dividing the quantity in a current year by the quantity in a base year and expressed as percentage.

$$\text{Quantity Relative} = Q_{on} = \frac{\text{Quantity in a current year}}{\text{Quantity in a base year}} \times 100$$

$$Q_{on} = \frac{q_n}{q_o} \times 100$$

Where q_n = Current year quantities , q_o = Base year quantities

1.2. **Chain Base Method**

In this method index number is computed in two steps. As a first step, we calculate link relative by dividing current period price/quantity/value by price/quantity/value of immediate previous period of current and expressing this ratio in percentage.

$$\text{Link Relative (Price)} = P_{(n-1,n)} = \frac{\text{Price in a current year}}{\text{Price in a preceding year}} \times 100 = \frac{P_n}{P_{n-1}} \times 100$$

$$\text{Link Relative (Quantity)} = Q_{(n-1,n)} = \frac{\text{Quantity in a current year}}{\text{Quantity in a preceding year}} \times 100 = \frac{q_n}{q_{n-1}} \times 100$$

In second step, we take just reverse step of step 1. Hence, to get chain indices we multiply the current period link relative by link relative of immediate previous period of current period and divide this product by 100.

$$\text{Chain Indices} = \frac{\text{Link Relative for current year} \times \text{Chain Index of previous year}}{100}$$

2. Composite Index Numbers

It is number that measures an average relative change in a group of related variables with respect to a base.

Composite Index number are further classified as

2.1.Un-weighted composite Index Number

2.2.Weighted Composite Index Number

2.1.Un-weighted composite Index Number

In un-weighted index numbers the weights are not assigned to various items. The following methods are generally used for the construction of un-weighted index number.

a. Simple Aggregative Price Index

As we are aware that in calculation of composite index number we are always given two or more commodities prices, quantities. So in simple aggregative method we take year wise total of the involved commodities and then adopt fixed base or chain base method as may be the case.

Fixed Base Method

Under this method to construct price/quantity index the total of current year prices/ quantities of various commodities in question is divided by total of base year prices/quantities and the result is expressed in percentage. Symbolically:

$$P_{on} = \frac{\sum P_n}{\sum P_o} \times 100 \quad \text{and} \quad Q_{on} = \frac{\sum q_n}{\sum q_o} \times 100$$

Chain Base Method

Under this method as first step we compute link relative for each year by dividing current year total of prices/quantities by the immediate previous year total of prices/quantities and expressing the result in percentage. To get chain indices we take the reverse procedure as we take in calculating link relative i.e. we multiply each year link relative by previous year link relative and divide this product by 100

b. Simple Average of Price Relatives

Simple Average of Relatives method is further sub-divided into two methods:

Fixed Base Method

Under simple average of relatives by fixed base method, first of all we find price/quantity/value relatives for each commodity given in the problem and then average these relatives by using arithmetic mean, median, and geometric mean. The resulted averages are known as index numbers by simple average of relative method.

Chain Base Method

Now, we will discuss simple average of relatives by chain base method. Under this method first of all we find link relatives for the given commodities, as a 2nd step, we take average (arithmetic mean, median, geometric mean) of link relatives. In 3rd step we find chain indices by adopting the same procedure as we take in chain indices for single commodity index number.

2.2.Weighted Composite Index Number

In weighted index numbers, the weights are assigned in proportion to the relative importance of different commodities included in the index. Weighted index numbers are of two types.

a. Weighted Aggregative Indices

These indices are just like the simple aggregative indices but which basic difference that weights are assigned to various commodities included in the index. There are

various methods of assigning weights. Various formulas for constructing index numbers have been devised of which some of the most important ones are given below.

Price Index Numbers

$$(1). \text{Laspeyre's Price Index} = P_{on} = \frac{\sum p_n q_o}{\sum p_o q_o} \times 100 \quad (\text{Base Year Weighted})$$

$$(2). \text{Paasche's Price Index} = P_{on} = \frac{\sum p_n q_n}{\sum p_o q_n} \times 100 \quad (\text{Current Year Weighted})$$

$$(3). \text{Marshall-Edgeworth Price Index} = P_{on} = \frac{\sum p_n q_o + \sum p_n q_n}{\sum p_o q_o + \sum p_o q_n} \times 100$$

$$(4). \text{Fisher's Ideal Price Index} = P_{on} = \sqrt{L \times P} \times 100 = \sqrt{\frac{\sum p_n q_o}{\sum p_o q_o} \times \frac{\sum p_n q_n}{\sum p_o q_n}} \times 100$$

$$(5). \text{Walsh Price Index} = P_{on} = \frac{\sum p_n \sqrt{q_o q_n}}{\sum p_o \sqrt{q_o q_n}} \times 100$$

Quantity Index Numbers

$$(1). \text{Laspeyre's Quantity Index} = Q_{on} = \frac{\sum q_n p_o}{\sum q_o p_o} \times 100 \quad (\text{Base Year Weighted})$$

$$(2). \text{Paasche's Quantity Index} = Q_{on} = \frac{\sum q_n p_n}{\sum q_o p_n} \times 100 \quad (\text{Current Year Weighted})$$

$$(3). \text{Marshall-Edgeworth Quantity Index} = Q_{on} = \frac{\sum q_n p_o + \sum q_n p_n}{\sum q_o p_o + \sum q_o p_n} \times 100$$

$$(4). \text{Fisher's Ideal Quantity Index} = Q_{on} = \sqrt{L \times P} \times 100 = \sqrt{\frac{\sum q_n p_o}{\sum q_o p_o} \times \frac{\sum q_n p_n}{\sum q_o p_n}} \times 100$$

$$(5). \text{Walsh Quantity Index} = Q_{on} = \frac{\sum q_n \sqrt{p_o p_n}}{\sum q_o \sqrt{p_o p_n}} \times 100$$

b. Weighted Average of Relative Indices

Under this method we attach weights to price relatives or quantity relative. Thus, first we find price or quantity relatives in the same way as we find simple average relatives but now we will take weighted average for averaging calculated relatives.

The important types of weighted average of relatives are given below:

Price Index Numbers

$$(1). \text{Laspeyre's Price Index} = P_{on} = \frac{\sum \left(\frac{p_n}{p_o} \right) p_o q_o}{\sum p_o q_o} \times 100 = \frac{\sum I \times W}{\sum W} \quad (\text{Base Year Weighted})$$

$$\text{Where Price Relative} = I = \frac{p_n}{p_o} \times 100, \quad W = p_o q_o$$

$$(2). \text{Paasche's Price Index} = P_{on} = \frac{\sum \left(\frac{p_n}{p_o} \right) p_o q_n}{\sum p_o q_n} \times 100 = \frac{\sum I \times W}{\sum W} \quad (\text{Current Year Weighted})$$

$$\text{Where Price Relative} = I = \frac{p_n}{p_o} \times 100, \quad W = p_o q_n$$

$$(3). \text{Palgrave's Price Index} = P_{on} = \frac{\sum \left(\frac{p_n}{p_o} \right) p_n q_n}{\sum p_n q_n} \times 100 = \frac{\sum I \times W}{\sum W}$$

$$\text{Where Price Relative} = I = \frac{p_n}{p_o} \times 100, \quad W = p_n q_n$$

Quantity Index Numbers

$$(1). \text{Laspeyre's Quantity Index} = Q_{on} = \frac{\sum \left(\frac{q_n}{q_o} \right) q_o p_o}{\sum q_o p_o} \times 100 = \frac{\sum I \times W}{\sum W} \quad (\text{Base Year Weighted})$$

$$\text{Where Quantity Relative} = I = \frac{q_n}{q_o} \times 100, \quad W = q_o p_o$$

$$(2). \text{Paasche's Quantity Index} = Q_{on} = \frac{\sum \left(\frac{q_n}{q_o} \right) q_o p_n}{\sum q_o p_n} \times 100 = \frac{\sum I \times W}{\sum W} \quad (\text{Current Year Weighted})$$

$$\text{Where Quantity Relative} = I = \frac{q_n}{q_o} \times 100, \quad W = q_o p_n$$

$$(3). \text{Palgrave's Quantity Index} = Q_{on} = \frac{\sum \left(\frac{q_n}{q_o} \right) q_n p_n}{\sum q_n p_n} \times 100 = \frac{\sum I \times W}{\sum W}$$

$$\text{Where Quantity Relative} = I = \frac{q_n}{q_o} \times 100, \quad W = q_n p_n$$

- **Uses of Index Numbers**

1. The price index numbers are used to measure change in the price of a commodities. It helps in comparing the changes in the prices of one commodity with another.
2. The quantity Index number is used to measure the change in quantities produced, Purchased, Sold etc.
3. The Index numbers of industrial production are used to measure the changes in the level of industrial production in the country.
4. The index number is used to measure the change in enrolment of performance etc.
5. The index numbers of import prices and export prices are used to measure the change in the terms of trade of a country.
6. The index numbers are used to measure seasonal variation and cyclical variation in a time series.
7. The index numbers measure the purchasing power of money and determine the real wages.

- **Limitations of Index Numbers**

1. All index numbers are not suitable for all purposes. They are suitable for the purpose for which they constructed.
2. Comparisons of changes in variables over long period are not reliable
3. Index numbers are subject to sampling error.
4. It is not possible to take into account all changes in quality or product.
5. The index numbers obtained by different methods of construction may give different results.

- **Consumer Price Index Numbers (CPI)**

“Consumer Price Index numbers are intended to measure the changes in the prices paid by the consumer for purchasing a specified “basket” of goods and services during the current year as compared to the base year”. The basket of goods and services will contain items like Food, House Rent, Clothing, Fuel and Light, Education, Miscellaneous like, Washing, Transport, Newspapers etc Consumers price index numbers are also called cost of living index numbers or Retail price index numbers.

- **Wholesale Price Index Numbers (CPI)**

Wholesale Price Index number is constructed to measure the change in prices of products produced by different sectors of an economy and traded in wholesale markets.

The sector covered under this index are agriculture, industry etc.

Federal Bureau of Statistics is also engaged in constructing this index by using weighted average of price relatives. Almost all the steps discussed in the topic of “*steps involved in the construction of an index number*” are taken into consideration for constructing this index

- **Construction of Consumer Price Index Numbers**

The following steps are involved in the construction of consumer price index numbers.

1. **Scope**

The first step is to clearly specify the class of people and locality where they reside. As far as possible a homogeneous group of persons regarding their income and consumption pattern are considered. These groups may be school teachers, industrial workers, Officers, etc residing in a particular well defined area.

2. **Household Budget Inquiry and Allocation of Weights**

The next step is to conduct a household budget inquiry of the category of people concerned. The object of conducting a family budget inquiry is to determine the goods and services to be included in the construction of index numbers.

This step has many practical problems as no two household have the same income and consumption pattern. Therefore, the inquiry should include questions on family size, number of earners, the quantity and quality of goods and services consumed and money spent on them under various headings, such as: clothing and footwear, fuel and lighting, housing, misc. etc. the weights are then assigned to various groups in proportion to the money spent on them.

3. **Collection of Consumer Prices**

The collection of retail is a very important and at the same time very difficult task because the prices may vary from place to place and from shop to shop. The prices of the selected items both for the given and base period are obtained from the locality where the people reside or from where they make their purchase.

4. **Method of Compilation of Consumer Price Index Numbers**

After construction of consumer price index number we compiled in any one of the following methods.

Aggregative Expenditure Method

In this method quantities are consumed as base year taken as weights. If p_o and q_o be the price and quantity of base period and p_n & q_n be the price and quantity of given year then

$$P_{on} = \frac{\sum p_n q_o}{\sum p_o q_o} \times 100$$

Where $\sum p_n q_o$ = Aggregative expenditure in the given year.

$\sum p_o q_o$ = Aggregative expenditure in the base year

Household Budget method Or Family Budget Method

In the method the amount of expenditure by the household on various items in the base period. If p_o and p_n be the prices of base and given year and weight $W = p_o q_o$ where q_o is quantity of base period then

$$P_{on} = \frac{\sum \left(\frac{p_n}{p_o} \right) p_o q_o}{\sum p_o q_o} \times 100 = \frac{\sum I \times W}{\sum W}$$

Where Price Relative = $I = \frac{p_n}{p_o} \times 100$, $W = p_o q_o$

• **Theoretical Tests for Index Numbers**

From a theoretical view point, a "good" index number formula is required to satisfy the following tests by Irving Fisher (1867-1947)

1. **Time Reversal Test**

This test may be stated as follows:-

"If the time subscripts of a price (or quantity) index number formula be interchanged, the resulting price (or quantity) index number formula should be the reciprocal of the original formula". i.e.

$$P_{on} = \frac{1}{P_{no}} \quad \text{or} \quad P_{on} \times P_{no} = 1$$

As we will just see,
Fisher's and Marshall-Edgeworth index numbers satisfy the Time Reversal Test.
Laspeyres's and Paasche's index numbers not satisfy the Time Reversal Test.

2. Factor Reversal Test

This test may be stated as follows:-

"If the factors prices and quantities occurring in a price (or quantity) index number formula be interchanged so that a quantity (or price) index formula is obtained, then the product of the index numbers should give the true value index number". i.e.

$$P_{on} \times Q_{on} = \text{Value index} = \frac{\sum P_n Q_n}{\sum P_o Q_o}$$

As we will just see,
Only Fisher's index number satisfies the Factor Reversal Test.
Laspeyres's , Paasche's and Marshall-Edgeworth index numbers not satisfy the Factor Reversal Test.

3. Circular Test

This test may be stated as follows:-

" If an index for the year 'b' based upon the year 'a' is P_{ab} and for the year 'c' based upon the year 'b' is P_{bc} , then the circular test requires that the index for the year 'c' based upon the year 'a', i.e., P_{ac} should be the same as if it were compounded of these two stages" i.e.

$$P_{ac} = P_{ab} \times P_{bc}$$

As we will just see,
Laspeyres's , Paasche's , Fisher's and Marshall-Edgeworth index numbers satisfy the Circular Test.