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Business Statistics

Unit 3

Q: Define index number. Mention the features of index number.

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Ans.:

An index number is a specialized average designed to measure the change in a variable or a group of relative variable with respect to time, geographical location or other characteristics such as income, profession etc. An index number is a number which is used as a device for comparison between the price, quantity or value of a group of articles in different situations.

According to **Prof. Croxton and Cowden**, "Index Numbers are devices for measuring differences in the magnitude of a group of related variable."

According to **Prof. Spiggel**, "An index number is a statistical measure designed to show changes in a variable or a group of related variable."

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From the above definitions, we can say that an index number is a ratio or an average of ratios expressed as percentage. In index number two or more time periods are involved, one of which is the base time period. The value of the base time period serves as the standard point of comparison. In other words, an index number is nothing more than a relative number or relative which expresses the relationship between two figures when one of the figures is used as a base.

CHARACTERISTICS/ FEATURES OF AN INDEX NUMBER:

- 1) Index numbers are specialized averages
- 2) Index numbers measure the net change in a group of related variables
- 3) Index numbers measure the effect of changes over a period of time
- 4) Index numbers are expressed in percentage
- 5) Index numbers are used to measure the changes in some quantity which we cannot observe directly.

Q: Mention the uses of Index Numbers. *(www.prepNext.com)*

Ans.:

Index numbers are indispensable tools of economics and business analysis. The importance of index number are:

1. **Index number helps in framing suitable policies:** Many of the economic and business policy are guided by index number. For example:- while deciding the increase in dearness allowance (DA) of the employees the employers have to depend upon the cost of living index.
2. **Index number reveals trends and tendencies:** Since index number are most widely used for measuring changes over a period of time, the time series so formed enables us to study the general trend of the phenomenon of the study. For example:- By examining the index numbers of industrial production, business activity, etc for the last few years we can conclude about the trend of production and business activity.

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3. **Useful in forecasting:** Index numbers are important in forecasting future economic activity. Index numbers are useful not only in studying the past and present working of our economy but they are also important for forecasting of future. For example:- Index numbers are used in time series analysis.
 4. **Useful in deflating:** Index number are useful in deflating in the sense that they are used to adjust the original data for price changes or to adjust wages for cost of living changes and thus transform nominal wages into real wages.
 5. Index Numbers facilitate study of the trends
 6. Index numbers facilitated measurement of the purchasing power of money
 7. Index Numbers help the business decision makers in the formulation of policies
 8. Index Numbers is the economic barometer. Index number can be used in measuring economic and business behaviour of the economy.
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Q: Explain the problems in constructing Index number.

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Ans.:

The main problems in the construction of index number are:

1) The purpose of the Index: It is necessary to define first the purpose for which the index is to be constructed since the data to be collected will depend to a large extent on it. The purpose can be to measure cost of living, to determine dearness allowance payable to industrial workers, to study the inflationary pressures in the economy.

2) Availability and Comparability of Data: The availability of data is a long term rather than a short term problem. Over a period of time,

some of the items that originally figured in an index may disappear from the market and new items may take their place. This problem of availability (or rather the non-availability) of data creates difficulties while constructing index numbers, and later on also affects the continuity of index numbers and makes it difficult to study their movement over a sufficiently long period of time.

3) Selection of Items: In case of constructions of a general purpose index like cost of living index or whole sale price index, the items to be included will be so many that it would be practically impossible to include them all. Only a small sample of items can be included. This poses a problem. Also, for calculating index number only standardized items are to be selected. If the items selected in the construction of index number are not standard one, it will also create problems in the construction of index numbers.

4) Selection of Base Period: The Base period of the index number refers to the period against which comparisons are made. It may be a year, a month or a day. The index of base period is always taken as 100. Base period should be a normal one and it should not be too distant in the past. There are two choices: Either to have a Fixed Base Period or to have a Chain Base Period.

5) Use of Average: Basically a choice has to be made between arithmetical mean and geometric mean. Arithmetic mean is popular because it is most simple to calculate than the Geometric mean. But, theoretically speaking, geometric mean is the best average in the construction of index number because:-

- (a) Index number is not affected by extremely high or low value of individual items.
- (b) It facilitates the index to satisfy time reversal test
- (c) It facilitates the easy base shifting of that index
- (d) It gives equal weight to equal ratio of change

6) Selection of Weights: The term weight refers to the relative importance of the different items in the construction of index. Since all the items included in the index are not of equal importance, it becomes necessary to select and assign suitable weights to different items included in the index. Weights are of two types: Quantity Weight and Value Weight. A quantity weight refers to the amount of commodity produced, distributed or commenced during a period. A Value Weight is the quantity produced multiplied by the price of the quantity.

7) Selection of Formula: Which formula to be used to construct the index depends upon the purpose of index and the nature of data available. There is no particular formula that could be considered best under all circumstances. Laspeyres' price index may be preferred to calculate price index when the quantity consumed in the base year alone is available. If prices and quantities of both the current year and the base year are available and wide fluctuations are evident, Fisher's Ideal Index might be used. To determine a quantity index when the prices prevailing in the current year alone are available, we can use Paasche's Quantity Index.

8) Selection of Number of Items: What should be the number and quantity of items to be included in an index depends upon the purpose for which the Index is constructed. For example, to construct the price index, only more standardized commodities which represent the taste, habits and customs of the people for whom the index is meant should be included.

9) Selection of price quotation:- Which price should be used or taken into account in the construction of index number. Whether, we should take wholesale prices or retail prices in the construction of index.

10) Choice of Variables: index numbers are constructed with regard to price or quantity or any other measure. Thus, it is important to decide the unit also.

LIMITATIONS OF INDEX NUMBERS:

(May add a few points from problems in constructing Index number)

- 1) Index Numbers suffer from the limitations associated with random sampling that is used in the selection of items.
- 2) Index Numbers are based on a few items only, and not on all the items
- 3) Index Numbers normally ignore changes in the quality of products
- 4) Index Numbers suffer from the problem of reliability and comparability
- 5) Index Numbers suffer from the limitation of the method that has been used in the construction of index numbers. Not a single individual method is suitable for all purposes and situations. Each method has its own sets of merits and limitations.
- 6) Index Numbers suffers from the problem of selection of abnormal base period
- 7) It is not possible to have international comparison of Index Numbers because the items of index differ from one country to another.

Q: Why index numbers are described as economic barometer?

(www.prepNext.com)

Ans.:

Though originally developed for measuring the effect of change in prices, index numbers have today become one of the most widely used statistical devices and there is hardly any field where they are not used.

Newspapers headline the fact that prices are going up or down, that industrial production is rising or falling, that imports are increasing or decreasing, that crimes are rising in a particular period compared to the previous period as disclosed by index numbers. They are used to feel the pulse of the economy and they have come to be used as indicators of inflationary or deflationary tendencies. In fact, they are described as "barometers of economic activity," that if one wants to get an idea as to what is happening to an economy, he should look to important indices like the index number of industrial production, agricultural production, business activity etc.

Q: What do you mean by time reversal test? Explain the proof of it.
(www.prepNext.com)

Ans.:

Time reversal test is a test to determine whether a given method will work both ways in time forward and backward.

According to **Prof. Fisher**, "The test is that the formula for calculating the index number should be such that it will give the same ratio between one point of comparison and the other, no matter which of the two taken as base."

In other words when the data for any 2 years are treated by the same method, but with the bases reversed the 2 index number secured should be reciprocal of each other so that their product is unity. Symbolically, the following relation should be satisfied.

$$P_{01} \times P_{10} = 1$$

Proof of the test:-

$$P_{01} = \sqrt{\left(\frac{\sum P_1 Q_0}{\sum P_0 Q_0} \times \frac{\sum P_1 Q_1}{\sum P_0 Q_1}\right)}$$

Changing time that is 0 to 1 and 1 to 0,

$$P_{10} = \sqrt{\left(\frac{\sum P_0 Q_1}{\sum P_1 Q_1} \times \frac{\sum P_0 Q_0}{\sum P_1 Q_0}\right)}$$

$$P_{01} \times P_{10} = \sqrt{\left[\frac{\sum P_1 Q_0}{\sum P_0 Q_0} \times \frac{\sum P_1 Q_1}{\sum P_0 Q_1} \times \frac{\sum P_0 Q_1}{\sum P_1 Q_1} \times \frac{\sum P_0 Q_0}{\sum P_1 Q_0} \right]} = \sqrt{1} = 1$$

Since, $P_{01} \times P_{10} = 1$, the Fishers Ideal Index satisfies the test.

There are 5 methods that satisfy this test:

1. The Fisher's Ideal formula
2. Simple geometric mean of price relatives
3. Aggregates with fixed weights
4. The weighted geometric mean of price relatives
5. Marshall Edge Worth method

Q: Why Fisher's Index Number is known as ideal index number?

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Ans.:

Fisher's Ideal Price Index is a weighted price index which is the geometric mean of the Laspeyre's and Paasche's price indices. The Fisher's ideal index is given by the formula.

$$P_{01} = \sqrt{\left[\frac{\sum P_1 Q_0}{\sum P_0 Q_0} \times \frac{\sum P_1 Q_1}{\sum P_0 Q_1} \right]} \times 100$$

Fisher's formula is known as ideal because of the following reasons:

1. It takes into account both current year as well as base year prices and quantity.
2. It satisfies both the time reversal test as well as the factor reversal test as suggested by Fisher
3. It is based on the geometric mean which is theoretically considered to be the best average for constructing index number
4. It is free from bias since there is complete cancellation of biases of the kinds revealed by time reversal and factor reversal test.

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Q: Differentiate between Laspeyre's method and Paasche's method.
(www.prepNext.com)

Ans.:

The main difference between Laspeyre's method and Paasche's method are:

LASPEYRE'S METHOD	PAASCHE'S METHOD
In Laspeyre's method weights are the base year quantities	In Paasche's method weights are the current year quantities
Weights do not change from one period to another period.	Weights change from one period to another period since new weights for each period are considered
In case of rise in prices it over estimates the rise in prices	In case of rise in prices it underestimates the rise in prices
The indices for different years can be compared with each other since weights are the same base year weights	The indices for different years can't be compared with each other since weights are not the same
It does not take into account the consumption pattern	It takes into account the consumption pattern

Q: What do you mean by Factor Reversal Test? Explain the proof of it.
(www.prepNext.com)

Ans.:

Factor reversal test was given by Prof. Fisher. It holds that the product of a price index and the quantity index should be equal to the corresponding value index.

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According to **Prof. Fisher**, " Just as each formula should permit the interchange of the two times without giving inconsistent result, so, it should permit interchanging the prices and quantities without giving inconsistent result, the two results multiplied together should give the true value ratio."

In other words, the test is that the change in price multiplied by the change in quantity should be equal to total change in value. The total value of a given quantity in a given year is the product of the quantity and price per unit. The test will be satisfied if:

$$P_{01} \times Q_{01} = \frac{\sum P_1 Q_1}{\sum P_0 Q_0}$$

Proof:

$$P_{01} = \sqrt{\left[\frac{\sum P_1 Q_0}{\sum P_0 Q_0} \times \frac{\sum P_1 Q_1}{\sum P_0 Q_1} \right]}$$

Changing P to Q and Q to P,

$$Q_{01} = \sqrt{\left[\frac{\sum Q_1 P_0}{\sum Q_0 P_0} \times \frac{\sum Q_1 P_1}{\sum Q_0 P_1} \right]}$$

$$\begin{aligned} P_{01} \times Q_{01} &= \sqrt{\left[\frac{\sum P_1 Q_0}{\sum P_0 Q_0} \times \frac{\sum P_1 Q_1}{\sum P_0 Q_1} \times \frac{\sum Q_1 P_0}{\sum Q_0 P_0} \times \frac{\sum Q_1 P_1}{\sum Q_0 P_1} \right]} \\ &= \sqrt{\left[\frac{(\sum Q_1 P_1)^2}{(\sum P_0 Q_0)^2} \right]} \\ &= \frac{(\sum Q_1 P_1)}{(\sum P_0 Q_0)} \end{aligned}$$

Hence Proved

Fisher's Index number satisfies this test.

Q: Write a short note on test of adequacy of index number formulae. (www.prepNext.com)

Ans.:

Several formulae have been suggested for constructing index number and the problem is that of selecting the most appropriate one in a given situation. The following tests are suggested for choosing an appropriate index:

1. Unit test
2. Time Reversal test
3. Factor reversal test
4. Circular test

- **Unit test:-** The unit test requires that the formula for constructing an index should be independent of the units in which prices and quantity are quoted.
- **Time Reversal test:** Explained earlier (*may omit the proof part*)
- **Factor reversal test:** Explained earlier (*may omit the proof part*)
- **Circular test:-** This test is just an extension of the time reversal test. The test requires that if an index is constructed for the year 'a' on base year 'b' and for the year 'b' on base year 'c', we should get the same result as if we calculated direct an index for 'a' on base year 'c' without going through 'b' as an intermediary.

Symbolically, if there are 3 indices P_{01} , P_{12} , P_{20} the circular test will be satisfied if $P_{01} \times P_{12} \times P_{20} = 1$.

Laspeyre's index does not satisfy this test.

Q: Define chain base index number.

(www.prepNext.com)

Ans.:

Chain Base Index Number is one in which the figures for each year are first expressed as percentages of the preceding year. These percentages are then chained together by successive multiplication to form a series of chain indices.

In chain base index method the base year changes from year to year. The immediate preceding year becomes the base year for the current year. For example:- for 2014, 2013 will be the base, for 2013, 2012 will be the base and so on.

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Q. Define Base Shifting. Mention the reasons for shifting the base.

(www.prepNext.com)

Ans.:

Base Shifting is a technique of changing the old base period to new base period. The reasons for shifting the base are:

1. To state the series in terms of a more recent time period
2. To compare various series computed on different base periods.

Q: Mention the merits of chain base index. *(www.prepNext.com)*

Ans.:

The merits of chain base index are:-

1. Chain base method permits the introduction of new items and the deletion of old ones without recalculation of entire series.
2. It permits the adjustment of weights as frequently as possible.
3. Index numbers calculated by this method are free to a greater extent from seasonal variation than those obtained by other method.
4. The chain base method is very useful in economy and business data where, comparisons are to be made with the previous period.

Q: Define splicing of index number.

(www.prepNext.com)

Ans.:

Splicing is a technique of linking two or more index number series with the same items and a common overlapping year but different base period in order to form continuous series.

Spliced index number =

$(\text{Index number of current year} \times \text{Old index of new base year}) / 100$

Forward Splicing =

(100 × Given index number of old series) / Overlapping year's index number of old series

Backward Splicing=

(Overlapping year's index number of old series × Given index number of new series) / 100

Q: Discuss the relative merits and demerits of Laspeyre's and Paasche's indices. *(www.prepNext.com)*

Ans.:

LASPEYRE'S METHOD:-

The Laspeyre's price index is a weighted aggregate price index where weights are the base period quantities.

$$P_{01} = (\sum P_1 Q_0 \times 100) / \sum P_0 Q_0$$

- **Merits:-** The indices for different years can be compared with each other since weights are the same base years weight.
- **Demerits:-** It does not take into account the consumption pattern in case of rising prices, it over estimates the rise in price.

PAASCHE'S METHOD:-

The Paasche's price index is a weighted aggregate price index where the weights are given current period quantities.

$$P_{01} = (\sum P_1 Q_1 \times 100) / \sum P_0 Q_1$$

- **Merits:-** It takes into consideration the consumption pattern
 - **Demerits:-** The indices for different years cannot be compared with each other since weights are not the same.
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Q: Define deflating indices.

(www.prepNext.com)

Ans.:

Deflating means making allowances for the effect of changing price level. The process of deflating enables us to determine real price.

Suppose the price of wheat rises from Rs. 12 per kg in 2012 to Rs.15 per kg in 2013, it means that in 2013 the price increases by 25% ($3/12*100$) and the price index is 1.25 (or 125%). It means that in 2013 one can buy 80% ($12/15*100$) of wheat if he spends the same amount which he was spending on wheat in 2012. In other words, the purchasing power of rupee has come down to 80%.

Q: Explain consumer price index number.

Or

Write a short note on cost of living index number.

(www.prepNext.com)

Ans.:

Consumer Price Index, also known as Cost of Living Price Index is the **country's principle measure of price change**. It measures average change over time in the prices paid by the consumer of a specific group of goods and services.

The general index number fails to give an exact idea of the effect of the changes in the general price level on the cost of living of different classes of people. Consequently, the consumer price index number are designed to measure the average change in the prices paid by the ultimate consumers for a specified quantities of goods and services over a period of time. The consumer price index helps us in determining the effect of rise and fall in prices on different classes of consumers living in different areas.

Q: Explain in brief utility/ uses/ importance of consumer price index number.

(www.prepNext.com)

Ans.:

- Consumer price index helps the government in formulating wage policy, price policy, taxation and general economic policies.
- The salaries and wages are fixed on the basis of consumer price index. So, it is very helpful to revise wage or dearness allowances.
- CPI is useful to measure the changes in purchasing power of currency and real income.
- Market price for a particular type of goods and services are analyzed by CPI.

Q: What are the limitations of consumer price index number?

(www.prepNext.com)

Ans.:

LIMITATIONS OF CPI

- CPI is the only approximate indicator of the relative measure of a phenomenon
- It does not tell us anything about variations in the standard of living at two different places.
- CPI which is good for one purpose may be unsuitable for the other.
- It is based on sample data, so it does not reflect the exact change in price level.
- It can be manipulated in such a manner so as to draw the desired conclusions.
- It does not take into account the changes in quantities of commodities over a period of time.

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Q: Distinguish between fixed base index and chain base index.

(www.prepNext.com)

Ans.: The main difference between Fixed Base Index and Chain Base Index are:

FIXED BASE INDEX	CHAIN BASE INDEX
In the fixed base method, the base period once selected remains fixed and does not change	In case of chain base method, the base period continues to shift for every subsequent year
The price changes in case of a fixed base are called price relatives	The price changes in case of chain base method are called link relatives
The formula used in fixed base method is Price relative (p) = $P_1/P_0 * 100$ Where, p_1 = Price in the current year P_0 = Price in the base year	The formula for chain base method is Link relative = $P_1/P_0 * 100$ Where, P_1 = Price in the current year P_0 = Price in the previous year
Fixed base index number does not provide any additional information related to present situation.	Chain base index number provides information related to the present situation.