CHAPTER
18 Index Number

INDEX NUMBER

An Index Number is a statistical measure that is used to track and represent changes in a variable or a collection of related variables over time, space, or other factors. It provides a way to summarize and compare data to understand the overall trend or performance.

In the context of financial markets, Indices play a crucial role in measuring the performance of stock markets. For example, the Bombay Stock Exchange (BSE) and the National Stock Exchange (NSE) in India provide indices such as the Sensex and Nifty, respectively. These indices represent the collective performance of a specific set of stocks listed on the respective exchanges.

Market Summary > NIFTY 50

Market Summary > BSE SENSEX

Definition

An Index number is a ratio of two or more time periods involved, one of which is the base time period. The value at the base time period serves as the standard point of comparison.

Types of Index Numbers

Types	Significance
Price Index Numbers	Shows Movements in the price levels between the base year and other periods. Increase in Price Level is called Inflation whereas decrease refers to Deflation.

Quantity Index Numbers	Shows the movement in Quantity levels between two periods. Used in Calculating Industrial Production Indices etc
Value Index Numbers	Shows the movement in value levels between two periods. Value = Price x Quantity It is used for computing Growth rate of an Economy etc.

Index Time Series: An Index Time Series is a list of index numbers for two or more periods of time, where each Index number employs the same base year.

- **Issues involved in Construction of Index Numbers:**
  I. **Selection of Data:** Choosing the right data is crucial. For instance, if you're making an index to measure the cost of living, you should focus on prices that directly affect living expenses while excluding prices for things like machinery.
  II. **Base Period:** The base period serves as your reference point. It should be a stable time, not influenced by unusual events like wars. A relatively recent base period is often better, and there are different methods for choosing it.
  III. **Selection of Weights:** Every variable in your index needs a weight based on its importance for your specific purpose. For example, if you're calculating a cost of living index, essentials like cereals might weigh more than non-essentials like sugar.
  IV. **Use of Averages:** Averages are vital. The type of average you pick, be it geometric or arithmetic, depends on the nature of your index.
  V. **Choice of Variables:** Deciding what variables to use, like price or quantity, is essential. For a price index, you need to choose between wholesale or retail prices and decide on the relevant time frame for prices.
  VI. **Selection of Formula:** The formula you use is critical. Different formulas applied to the same data can yield different results. So, it's important to choose the right one for your index.

- CONSTRUCTION OF INDEX NUMBERS:

Notation: If we have to take the prices of 3 different commodity for n^{th} period then it can be written as $P_n(1)$, $P_n(2)$, $P_n(3)$

While if we take price corresponding to base period for 3 different commodity, it will be written as $P_o(1)$, $P_o(2)$, $P_o(3)$

Now let's say we have commodity 'j' where j is variable and varying from 1 to k then:

Summation for all prices of nth period can be written as $\sum_{j=1}^{k} P_n(j)$ or $\sum P_n(j)$.

RELATIVES

1. **Price relative:** As we are discussing the prices, let's talk about relative prices which is called as price relative. Price relative can be defined as the ratio of Price of a single commodity in one time period to the price of base period or reference period.

   It is written as: Price relative $= \frac{P_n}{P_o}$

   If we have to express it in form of percentage, it can be multiplied by 100 :

Price relative $= \frac{P_n}{P_o} \times 100$

E.g.: Let's consider the price of a particular product, a smartphone, in two time periods: the base period (2010) and the current period (2021). In 2010. the smartphone was priced at ₹20,000. while in 2021, it was priced at ₹48,000. To calculate the price relative, we can use the formula:

$$\Rightarrow \text{Price Relative} = \frac{\text{Price in 2021}}{\text{Price in 2010}} \times 100 = \frac{48,000}{20,000} \times 100 = 2.4 \times 100 = 240\ \%$$

This indicates that the price of the smartphone has increased by 240 % from the base period to the current period in terms of Indian Rupees.

As we discussed for Price relative, the same discussion can happen in terms of quantity, volume of consumption etc.

Then, in that case relatives will be:

2. **Quantity Relative:** The quantity relative compares the quantity of a particular commodity in one time period to the quantity in a base or reference period.

Quantity Relative $= \frac{Q_n}{Q_o}$

3. **Value relative :** The value relative considers the value of a commodity by multiplying the price and quantity relatives together.

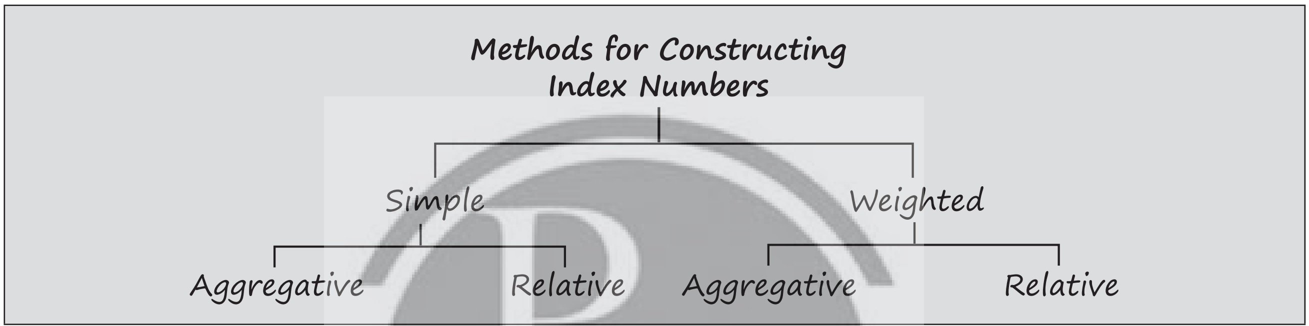
Value Relative $= \frac{V_n}{V_o} = \frac{P_n}{P_o} \times \frac{Q_n}{Q_o} = \frac{P_n Q_n}{P_o Q_o}$

Link Relative: When we take ratio of successive prices or quantities, then it is called the link relatives i.e., $\frac{P_1}{P_o}, \frac{P_2}{P_1}, \frac{P_3}{P_2}, \frac{P_n}{P_{n-1}}$

Commodity	Milk (per litre)	Link Relative
2005	50	$\frac{50}{50} \times 100 = 100$
2010	55	$\frac{55}{50} \times 100 = 110$
2015	60	$\frac{60}{55} \times 100 = 109.09$
2020	70	$\frac{70}{60} \times 100 = 116.67$

Chain Relative: When the ratio is taken in respect to base price then it is called the chain relatives i.e., $\frac{P_1}{P_o}, \frac{P_2}{P_o}, \frac{P_3}{P_o}, \frac{P_n}{P_o}$

Commodity	Milk (per litre)	Link Relative
2005	50	$\frac{50}{50} \times 100 = 100$
2010	55	$\frac{55}{50} \times 100 = 110$
2015	60	$\frac{60}{50} \times 100 = 120$
2020	70	$\frac{70}{50} \times 100 = 140$



Let's start our discussion by understanding methods:

SIMPLE AGGREGATIVE

In this method of computing a price index, we express the total of commodity prices in a given year as a percentage of total commodity price in the base year.

Simple Aggregative price index $= \frac{\sum P_n}{\sum P_o} \times 100$

where, $\sum P_n$ is the sum of all commodity prices in the current year and $\sum P_o$ is the sum of all commodity prices in the base year.

Example of Simple Aggregate

Commodity	2010	2015	2020
Milk (per litre)	50	60	70
Atta (per kg)	10	12	15
Banana (dozen)	30	45	50
Aggregate	90	117	135
Index	100	130	150

Simple Aggregative Index for 2015 over $2010 = \frac{117}{90} \times 100 = 130$ and for 2020 over $2010 = \frac{135}{90} \times 100 = 150$

DEMERITS OF ABOVE METHOD

- It shows that the first commodity exerts greater influence than the other two because the price of the first commodity is higher than that of the other two.
- Further, if units are changed then the Index numbers will also change.

SIMPLE RELATIVE OR SIMPLE AVERAGE

If we change the actual price for each variable into percentage of the base period. These percentages are called relatives because they are relative to the value for the base period and the index number formed is simple relative.

E.g.:

Commodity	2010 (P_0)	2015 (P_1)	2020 (P_2)
Milk (per litre)	50	60	70
Atta (per kg)	10	12	15
Potato (per kg)	20	30	30

will become

Commodity	2010 (P_0)	2015 (P_1)	2020 (P_2)
Milk (per litre)	$\frac{50}{50} \times 100 = 100$	$\frac{60}{50} \times 100 = 120$	$\frac{70}{50} \times 100 = 140$
Atta (per kg)	$\frac{10}{10} \times 100 = 100$	$\frac{12}{10} \times 100 = 120$	150
Banana (dozen)	$\frac{20}{20} \times 100 = 100$	$\frac{30}{20} \times 100 = 150$	150
Aggregate	300	390	440
Index	$\frac{300}{3} = 100$	$\frac{390}{3} = 130$	$\frac{440}{3} = 146.66$

ADVANTAGE OF SIMPLE RELATIVE METHOD

- Index number computed from relatives will remain the same regardless of the units by which the prices are quoted.

DISADVANTAGE OF SIMPLE RELATIVE METHOD

- This amounts to giving undue weight to a commodity which is used in a small quantity because the relatives which have no regard to the absolute quantity will give weight more than what is due from the quantity used.

WEIGHTED AGGREGATIVE INDEX

While calculating the index number we will take care of the number of quantities or portions of the commodity.

E.g.:

Commodity	Quantity for 2010	2010 (Price)	Quantity for 2020	2020 (Price)
Milk (per litre)	2 litres	50	2.5 litres	70
Atta (per kg)	1.5 kg	10	1 kg	15
Banana (per dozen)	3 dozen	30	4 dozen	50

SOME OF THE IMPORTANT FORMULA TO CALCULATE IT ARE:

- Laspeyre's Index number $= \frac{\sum P_n Q_o}{\sum P_o Q_o} \times 100$
- Paasche's Index number $= \frac{\sum P_n Q_n}{\sum P_o Q_n} \times 100$
- Marshall- Edgeworth Index number $= \frac{\sum P_n (Q_o + Q_n)}{\sum P_o (Q_o + Q_n)} \times 100$
- Fisher's Index number $= \sqrt{\frac{\sum P_n Q_o}{\sum P_o Q_o} \times \frac{\sum P_n Q_n}{\sum P_o Q_n}} \times 100$
- Dorbish and Bowley's Price Index $= \frac{\frac{\sum P_n Q_o}{\sum P_o Q_o} + \frac{\sum P_n Q_n'}{\sum P_o Q_n'}}{2} \times 100$

WEIGHTED AVERAGE OF RELATIVE METHOD

To overcome the disadvantage of a simple average of relative method, we can use weighted average of relative method.

Let's understand with same example:

Commodity	Quantity for 2010	2010 (Price)	Quantity for 2020	2020 (Price)
Milk (per litre)	2 litres	50	2.5 litres	70
Atta (per kg)	1.5 kg	10	1 kg	15
Banana (dozen)	3 dozen	30	4 dozen	50

We can solve it as:

Commodity	Quantity for 2010 (Q_0)	2010 (Price) (P_0)	Quantity for 2020 (Q_n)	2020 (Price) (P_n)	$P_0 Q_0$	$P_0 Q_n$	$P_n Q_0$	$P_n Q_n$
Milk (per litre)	2 litres	50	2.5 litres	70	100	125	140	175
Atta (per kg)	1.5 kg	10	1 kg	15	15	10	22.5	15
Banana (dozen)	3 dozen	30	4 dozen	50	90	120	150	200

Then,

- Laspeyre's Index number $= \frac{\Sigma P_n Q_0}{\Sigma P_0 Q_0} \times 100 = \frac{312.5}{205} \times 100 = 152.44$
- Paasche's Index number $= \frac{\Sigma P_n Q_n}{\Sigma P_0 Q_n} \times 100 = \frac{390}{255} \times 100 = 152.94$
- Marshall- Edgeworth Index number $= \frac{\Sigma P_n (Q_0 + Q_n)}{\Sigma P_0 (Q_0 + Q_n)} \times 100$

$$= \frac{312.5 + 390}{205 + 255} \times 100 = 152.71$$

- Fisher's Index number $r = \sqrt{\frac{\Sigma P_n Q_0}{\Sigma P_0 Q_0} \times \frac{\Sigma P_n Q_n}{\Sigma P_0 Q_n}} \times 100 = \sqrt{\frac{390}{255} \times \frac{312.5}{205}} \times 100 = 152.68$

Relationship between Fisher's Index, Paasche's Index number and Laspeyre's Index:

Fisher's Ideal Index Number $= \sqrt{\text{Paasche index number} \times \text{Laspeyre's index number}}$

Relationship between Dorbish and Bowley's Price Index, Paasche's Index number and Laspeyre's Index:

Dorbish and Bowley's Price Index Number $= \frac{\text{Laspeyre's Price index} + \text{Paasche's Price Index}}{2}$

PRICE AND QUANTITY INDEX

	Method	Price Index	Quantity Index
1.	Simple Aggregate	$\frac{\sum P_n}{\sum P_0}$	$\frac{\sum Q_n}{\sum Q_0}$
2.	Simple Average of Relative	$\frac{\frac{\sum P_n}{\sum P_0}}{n}$	$\frac{\frac{\sum Q_n}{\sum Q_0}}{n}$

		Method	Price Index	Quantity Index
3.		Weighted Aggregate		
	(a)	With base year weight (Laspeyre's index)	$\frac{\sum P_nQ_o}{\sum P_oQ_o}$	$\frac{\sum Q_nP_o}{\sum Q_oP_o}$
	(b)	With current year weight (Paasche's index)	$\frac{\sum P_nQ_n}{\sum P_oQ_n}$	$\frac{\sum Q_nP_n}{\sum Q_oP_n}$
	(c)	Fisher's Ideal [Geometric mean of Laspeyre's and Paasche's]	$\sqrt{\frac{\sum P_nQ_o}{\sum P_oQ_o} \times \frac{\sum P_nQ_n}{\sum P_oQ_n}}$	$\sqrt{\frac{\sum Q_nP_o}{\sum Q_oP} \times \frac{\sum Q_nP_n}{\sum Q_oP_n}}$
4.		Weighted Average of Relative W = Weights = Base Year or Current Year Price Weight	$\frac{\sum\left(\frac{P_n}{P_o}W\right)}{\sum W}$	$\frac{\sum\left(\frac{Q_n}{Q_o}\right)}{\sum W}$

CHAIN INDEX NUMBERS

- So far we concentrated on a fixed base but it does not suit when conditions change quite fast.
- Under this method the relatives of each year are first related to the preceding year called the link relatives and then they are chained together by successive multiplication to form a chain index.

$$\text{Chain Index} = \frac{\text{Link Re lative of current year} \times \text{Chain index of the previous year}}{100}$$

Let us understand from the below example:

Year	Price of commodity	Link relative	Chain index
2010	10	$\frac{10}{10} \times 100 = 100$	100
2012	12	$\frac{12}{10} \times 100 = 120$	$\frac{120 \times 100}{100} = 120$
2014	14	$\frac{14}{12} \times 100 = 116.67$	$\frac{116.67 \times 120}{100} = 140$
2016	15	$\frac{15}{14} \times 100 = 107.14$	$\frac{107.14 \times 140}{100} = 150$
2018	17	$\frac{17}{15} \times 100 = 113.33$	$\frac{113.33 \times 150}{100}$ 170

Year	Price of commodity	Link relative	Chain index
2020	20	$\frac{20}{17} \times 100 = 117.65$	$\frac{117.65 \times 170}{100} = 200$
2022	22	$\frac{22}{20} \times 100 = 110$	$\frac{200 \times 110}{100} = 220$

VALUE INDEX

We know, Value = Price × Quantity i.e., $\frac{\Sigma V_n}{\Sigma V_o} = \frac{\Sigma P_n \times Q_n}{\Sigma P_o \times Q_o} \times 100$

E.g.: The Value Index for the following data:

Commodity	Quantity (units)		Prince in (₹)	
	1995 Q_o	1999 Q_n	1995 P_o	1999 P_n
A	100	150	500	900
B	80	100	320	500
C	60	72	120	360
D	30	33	360	297

We have,

Commodity	Quantity (units)		Prince in (₹)			
	1995 Q_o	1999 Q_n	1995 P_o	1999 P_n	P_oQ_o	P_nQ_n
A	100	150	500	900	50000	135000
B	80	100	320	500	25600	50000
C	60	72	120	360	7200	25920
D	30	33	360	297	10800	9801
					93600	220721

We know, Value is Price multiplied by Quantity

Thus, $\frac{\Sigma V_n}{\Sigma V_o} = \frac{\Sigma P_n \times Q_n}{\Sigma P_o \times Q_o} \times 100$

$= \frac{220721}{93600} \times 100 = 235.813$

Deflating time series using Index: Deflated Value $= \frac{\text{Current value}}{\text{Price index of current year}}$

E.g.: From the table, compute the real GNP.

Year	Wholesale Price Index	GNP at current Prices
1970	113.1	7499
1971	116.3	7935

Year	Wholesale Price Index	GNP at current Prices
1972	121.2	8657
1973	127.7	9323

Thus, we have

Year	Wholesale Price Index	GNP at current Prices	GNP (Real)
1970	113.1	7499	$\frac{7499}{113.1} \times 100 = 6630$
1971	116.3	7935	$\frac{7935}{116.3} \times 100 = 6823$
1972	121.2	8657	$\frac{8657}{121.5} \times 100 = 7143$
1973	127.7	9323	$\frac{9323}{127.7} \times 100 = 7300$

SHIFTING AND SPLICING OF INDEX NUMBERS:

Shifting of Index number means that base period of the index has to be shifted:

$$\text{Shifted Price Index} = \frac{\text{Original Price index}}{\text{Price Index of the year on which it has to be shifted}} \times 100$$

From the following Index numbers with 1980 = 100 Shift the Index numbers to 1990 as the base:

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Original Price Index	100	104	106	108	110	112	115	117	125	131	140	147

Thus, on shifting the index number to 1990 as the base, we get

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Original Price Index	100	104	106	108	110	112	115	117	125	131	140	147
Shifting Base index (1990)	$\frac{100}{140} \times 100 = 71.4$	$\frac{104}{140} \times 100 = 74.28$	75.7	76.4	78.57	80	82.1	83.6	89.28	93.5	100	105

SPLICING OF INDEX NUMBERS

The following represent two series of index numbers:

1. One series with 1990 as base which is discontinued with the year 1995.
2. The second series with 1995 as the base is started from the year 1995, the year in which the old index is discontinued.

Year	Old Price Index [1990 = 100]	Revised Price Index [1995 = 100]
1990	100.00	—
1991	102.30	—
1992	105.30	—
1993	107.60	—
1994	111.90	—
1995	114.20	100.00
1996	—	102.50
1997	—	106.40
1998	—	108.30
1999	—	111.70
2000	—	117.80

LIMITATION OF INDEX NUMBER

1 As the index are constructed mostly from deliberate samples, chances of errors creeping in cannot be always avoided.

2. Since index numbers are based on some selected items, they simply depict the broad trend and not the real picture.
3. Since many methods are employed for constructing index numbers, the result gives different values and this at time create confusion

USEFULNESS OF INDEX NUMBERS

1. Framing suitable policies in economics and business. They provide guidelines to make decisions in measuring intelligence quotients, research etc.
2. They reveal trends and tendencies in making important conclusions in cyclical forces, irregular forces etc.
3. They are important in forecasting future economic activity. They are used in times series analysis to long term trends, seasonal variations and cyclical developments.
4. Index numbers are very useful in deflating i.e., they are used to adjust the original data for price changes and thus transform nominal wages into real wages.

TEST OF ADEQUACY

1. **Unit Test:** This test requires that the formula should be independent of the unit in which or for which prices and quantities are quoted. Except for the simple (weighted) aggregative index all other formulae satisfy this test.

2. **Time Reversal Test:** It means if periods are reversed and indices are multiplied it should result in unity. $P_{01} \times P_{10} = 1$ where P_{01} is the index for time 1 on 0 and P_{10} is the index for time 0 on 1. Laspeyre's method and Paasche's method do not satisfy this test, but Fisher's Ideal formula does.

   Proof :

   I. Laspeyre's Index:

   We know that, $P_{01} = \frac{\sum P_1Q_0}{\sum P_0Q_0} P_{10} = \frac{\sum P_0Q_1}{\sum P_1Q_1}$

   Thus, $P_{01} \times P_{10} = \frac{\sum P_1Q_0}{\sum P_0Q_0} \times \frac{\sum P_0Q_1}{\sum P_1Q_1} \neq 1$

   II. Paasche's Index:

   We know that, $P_{01} = \frac{\sum P_1Q_1}{\sum P_0Q_1}, P_{10} = \frac{\sum P_0Q_0}{\sum P_1Q_0}$

   $\therefore P_{01} \times P_{10} = \frac{\sum P_1Q_1}{\sum P_0Q_1} \times \frac{\sum P_0Q_0}{\sum P_1Q_0} \neq 1$

   III. Fisher's Index:

   We know, $P_{01} = \sqrt{\frac{\sum P_1Q_0}{\sum P_0Q_0} \times \frac{\sum P_1Q_1}{\sum P_0Q_1}}, P_{10} = \sqrt{\frac{\sum P_0Q_1}{\sum P_1Q_1} \times \frac{\sum P_0Q_0}{\sum P_1Q_0}}$

   $\therefore P_{01} \times P_{10} = \sqrt{\frac{\sum P_1Q_0}{\sum P_0Q_0} \times \frac{\sum P_1Q_1}{\sum P_0Q_1} \times \frac{\sum P_0Q_1}{\sum P_1Q_1} \times \frac{\sum P_0Q_0}{\sum P_1Q_0}} = 1$

3. **Factor Reversal Test:** This holds when the product of the price Index and the quantity index should be equal to the corresponding value index, i.e. $P_{01} \times Q_{01} = V_{01}$

   Proof:

   (I) Paasche's Index:

   To check:

   $P_{01} * Q_{01} = V_{01}$

   We know,

   $$P_{01} = \frac{\sum P_1Q_1}{\sum P_0Q_1}$$

   $$Q_{01} = \frac{\sum Q_1P_1}{\sum Q_0P_1}$$

$$P_{0,} \times Q_{01} = \frac{\sum P_1Q_1}{\sum P_0Q_1} \times \frac{\sum Q_1P_1}{\sum Q_0P_1} \neq V_{01}$$

Similarly, we can prove that Laspeyre's Index number do not satisfy the Factor Reversal test.

(II) Fisher's Index:

We know, $P_{0_1} = \sqrt{\frac{\sum P_1Q_0}{\sum P_0Q_0} \times \frac{\sum P_1Q_1}{\sum P_0Q_1}}$

$$Q_{01} = \sqrt{\frac{\sum P_1Q_0}{\sum P_0Q_0} \times \frac{\sum P_1Q_1}{\sum P_0Q_1}}$$

$$P_{01} \times Q_{01} = \sqrt{\frac{\sum P_1Q_0}{\sum P_0Q_0} \times \frac{\sum P_1Q_1}{\sum P_0Q_1} \times \frac{\sum P_1Q_0}{\sum P_0Q_0} \times \frac{\sum P_1Q_1}{\sum P_0Q_1}}$$

$$\Rightarrow \sqrt{\frac{\sum (P_1Q_1)^2}{\sum (P_0Q_0)^2}} = \frac{\sum P_1Q_1}{\sum P_0Q_0}$$

Fisher's Index satisfies Factor Reversal test.

Since, Fisher's Index number satisfies both the tests in (2) and (3), thus it is called an Ideal Index number.

Fisher's index is the Ideal Index Number.

4. ***Circular Test:*** It is concerned with the measurement of price changes over a period of years, when it is desirable to shift the base. i.e., $P_{01} \times P_{12} \times P_{20} = 1$

   It is satisfied by:

   (I) Weighted aggregative with fixed weighted average.

   (II) Simple geometric mean of price relatives.

Example 1. A series of numerical figures which show the relative position is called **(ICAI)**

(a) Index number (b) Relative number

(c) Absolute number (d) None of these

Sol. (a) An index number is a ratio of two or more time periods involved, one of which is the base time period. The value at the base time period serves as the standard point of comparison.

Hence, the correct option is (a).

Example 2. Index number for the base period is always taken as **(ICAI)**

(a) 200 (b) 50 (c) 1 (d) 100

Sol. (d) An Index Number is a statistical tool for determining the degree of changes in a set of connected variables.

Let $\sum P_1$ be the value of commodity in current period and $\sum P_0$ be the value of commodity in base period

Then. $P = \frac{\sum P_1}{\sum P_0} \times 100$

Base period = current period for determining the Index number in the base period.

$\Sigma P_1 = \Sigma P_0$

$\Rightarrow P = 1 \times 100 = 100$

Hence. Index Number for the base period is always taken as hundred.

Hence, the correct option is (d).

Example 3. Price relative is equal to **(ICAI)**

(a) $\frac{\text{Price in the given year} \times 100}{\text{Price in the base year}}$ (b) $\frac{\text{Price in the base year} \times 100}{\text{Price in the base year}}$

(c) Price in the given year $\times$ 100 (d) Price in the base year $\times$ 100

Sol. (a) The percentage difference between the current year's price and the base year's price is known as a price relative.

The approach uses the current-year price of each commodity as a percentage of the base-year price.

Price relative $= \frac{P_1}{P_0} \times 100$

Hence, the correct option is (a).

Example 4. _________is an extension of the time reversal test. **(ICAI)**

(a) Factor Reversal test (b) Circular test

(c) Both (d) None of these

Sol. (b) The circular test is a statistical technique in which the index of the later period on the earlier period is exactly the opposite of the index of the earlier period on the later period, however this test is applicable when there are more than two periods involved.

Hence, the correct option is (b).

Example 5. Index numbers show _________ changes rather than absolute amounts of change.

(a) Relative (b) Percentage (c) Both (d) None of these **(ICAI)**

Sol. (a) Instead of displaying exact quantities of change, index numbers are utilized to display relative changes. This implies that index numbers calculate the difference between a variable's current value and its base value. The Consumer Price Index (CPI), for instance, is used to track variations in the cost of products and services over time.

Hence, the correct option is (a).

Example 6. The ________ makes index numbers time-reversible. **(ICAI)**

(a) A.M. (b) G.M. (c) H.M. (d) None of these

Sol. (b) This test determines if the procedure is time-reversible in both directions. Prof. Fisher asserts that regardless of which of the two points of time is used as the base, the method for computing an index number should provide the same ratio between one point of time and the other.

In other words, if the base is inverted and the data for any two years are analysed using the same methodology7, the two index numbers should be the reciprocals of one another.

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

Hence, the correct option is (b).

Example 7. _______ play a very important part in the construction of index numbers.

(a) Weights (b) Classes (c) Estimations (d) None of these **(ICAI)**

Sol. (a) In conclusion, weights are very important when creating index numbers.

Each item's weight is allocated to indicate its relative importance, maintain correctness, allow for comparison, and aid in classifying the objects.

It is crucial for each of the factors in the composite index to have a unique impact on the index. As a result, the importance should extend to those factors that are crucial to an index's goal.

Hence, the correct option is (a).

Example 8. Index number is equal to **(ICAI)**

(a) Sum of price relatives (b) Average of the price relative

(c) Product of Price Relative (d) None of these

Sol. (b) The Index number is determined by dividing the total of the actual prices for the base year by the total of the prices for the year for which the index number is to be obtained.

In terms of percentages, Index numbers are expressed.

The base period is the time frame between the two that will be used for comparison.

The base period's index number is always set at 100.

$$\text{Price relative} = \frac{\text{Price in the given year}}{\text{Price in the base year}} \times 100$$

Hence, the correct option is (b).

Example 9. The __________ of group indices gives the General Index. **(ICAI)**

(a) H.M. (b) G.M. (c) A.M. (d) None of these

Sol. (c) A weighted average of the financial accounts of the group firms is used to construct group indices. Each firm is assigned a weight based on how big it is in comparison to the other companies in the group.

For instance, if Company B has $20 million in sales and Company A has $10 million, Company B would be given more weight for determining the group revenue index.

As a result, it is an average measure. In essence, it depicts change over time more precisely than a basic index number, making it more realistic.

Hence, the correct option is (c).

Example 10. In the price index, when a new commodity is required to be added, which of the following index is used?

(a) Shifted price index (b) Splicing price index

(c) Deflating price index (d) Value price index

Sol. (b) We know that,

When a new commodity is required to be added in the price index, the index used is called the Splicing price index. This involves combining the old and new data into a single index to maintain the continuity of the index while accounting for changes in the basket of goods and services used to calculate the index.

Hence, the correct option is (b).

Example 11. Circular Test is one of the tests of **(ICAI)**

(a) Index numbers (b) Hypothesis (c) Both (d) None of these

Sol. (a) The 'Circular Test' is one of the tests of Index Number.

Symbolically, the test is represented as $P_{01} \times P_{12} \times P_{20} = 1$

Hence, the correct option is (a).

Example 12. The cost of living index is always **(July 2021)**

(a) Price index number (b) Quantity index number

(c) Weighted Index number (d) value index number

Sol. (c) Cost of living Index Number is nothing but weighted Index Number.

Hence the correct answer is option(c) i.e., Weighted index number.

Example 13. __________ is particularly suitable for the construction of index numbers.

(a) H.M. (b) A.M. (c) G.M. (d) None of these **(ICAI)**

Sol. (c) The Geometric Mean (G.M.) is particularly suitable for constructing index numbers. This choice is justified because:

1. It reflects proportionate changes: G.M. accurately represents changes in a series, regardless of the size of those changes.
2. Less sensitivity to extreme values: G.M. is less influenced by extreme values, as it multiplies rather than adds data points.
3. Suitable for logarithmic series: It works well with logarithmic data, simplifying the calculation of the average.
4. Supports consumer behavior theory: G.M. helps analyze average price changes, a key element in predicting consumer behavior.

Overall, the G.M. is a strong and trustworthy central tendency measure that is especially well suited for the creation of index numbers. It is the perfect tool for analysing economic and financial data since it can handle logarithmic series, represent proportional changes, and lessen the impact of extreme values. Hence, the correct option is (c).

Example 14. Example. In the data group Bowley's and Laspeyre's index number is as follows:

Bowley's index number = 150, Laspeyre's index number = 180, then Paasche's index number

(a) 120 (b) 30 (c) 165 (d) None of these

Sol. (a) Given: Bowley's index number = 150

Laspeyre's index number = 180

As we know, Bowley's index number is expressed in the form of sum of Laspeyre's and Paasche's divided by 2.

So, Bowley s index number $= \dfrac{\text{Laspeyre's} + \text{Paasche's}}{2}$

Let Paasche's index number be x, then

$$\Rightarrow 150 = \frac{180 + x}{2} \Rightarrow 300 = 180 + x \Rightarrow x = 120$$

Hence, the correct answer is option (a) i.e., 120.

Example 15. Weighted G.M. of relative formula satisfy _________ test. **(ICAI)**

(a) Time Reversal Test (b) Circular test

(c) Factor Reversal Test (d) None of these

Sol. (a) We know that,

Weighted G.M. of relative formula satisfy Time Reversal test.

Hence, the correct option is (a).

Example 16. Factor Reversal test is satisfied by **(ICAI)**

(a) Fisher's Ideal Index (b) Laspeyre's Index

(c) Paasche's Index (d) None of these

Sol. (a) Factor Reversal test holds when the product of the price Index and the quantity index should be equal to the corresponding value index. i.e. $P_{01} \times Q_{01} = V_{01}$

This test is satisfied by Fisher's method .

Hence, the correct option is (a).

Example 17. G.M of Laspeyre's and Paasche's Price Index number is _________ price index number

(a) Kelly's (b) Fisher's (c) Bowley's (d) None of these

Sol. (b) We know that,

Fisher's Ideal Index is the geometric mean of Laspeyre's and Paasche's Price Index number. Hence, the correct option is (b).

Example 18. Laspeyre's formula does not satisfy **(ICAI)**

(a) Factor Reversal Test (b) Time Reversal Test

(c) Circular Test (d) All of the above

Sol. (d) We know that,

Laspeyre's formula do not satisfy Factor Reversal Test, Time Reversal Test and Circular Test. Hence, the correct option is (d).

Example 19. A ratio or an average of ratios expressed as a percentage is called **(ICAI)**

(a) A relative number (b) An absolute number

(c) An index number (d) None of these

Sol. (c) A ratio or an average of ratios stated as a percentage is called an index number. It involves two or more time periods, one of which is the base period.

Hence the correct option is (c).

Example 20. The consumer price index goes up from 120 to 180 when salary goes up from 240 to 540 , what is the increase in real terms? **(July 2021)**

(a) 80 (b) 150 (c) 120 (d) 240

Sol. (c) Given;

The consumer price index goes up from 120 to 180.

Salary goes up from 240 to 540

Actual salary $= \frac{180}{120} \times 240 = 360$

Salary increase in real terms $= 360 - 240 = 120$

Hence, the correct option is (c) i.e. 120.

Example 21. An index time series is a list of numbers for two or more periods of time.

(a) Index (b) Absolute (c) Relative (d) None of these **(ICAI)**

Sol. (a) A time series is a collection of data points that appear in a particular order over a certain amount of time. Cross-sectional data, which records a moment in time, can be compared to this.

A set of index numbers for two or more time periods that all use the same base years is known as an index time series.

Hence the correct option is (a).

Example 22. Index numbers are often constructed from the **(ICAI)**

(a) Frequency (b) Class (c) Sample (d) None of these

Sol. (c) (i) **Simple or Unweighted Index Numbers:** Unweighted index numbers are index numbers in which each item must have some weight even when no specific weight is given to any item. It may be created using two methods, namely the simple aggregate method and the simple average of price relatives method, and is also referred to as a simple index number.

(ii) **Simple Aggregative Method**: This approach expresses the aggregate price of all the selected commodities in the current year as the aggregate price of all the commodities in the base year. The following formula is used to create an index number:

$$\text{Index} = \frac{\sum P_1}{\sum P_0} \times 100$$

Hence, the correct option is (c).

Example 23. Fisher's index number is called as ideal index number because it satisfies

(a) Factor reversal test **(Dec 2022)**

(b) Time reversal test

(c) Both factor and time reversal test

(d) Circular test

Sol. (c) We know,

Fisher's index number is called the ideal index number because it satisfies both factor and time reversal test. Hence, the correct option is (c).

Example 24. Among the following index numbers, which one satisfies the circular test?

(a) Laspeyre's Index (b) Paasche's Index

(c) Fisher's Index (d) None of these

Sol. (d) We know that,

The circular test is satisfied if $P_{01} \times P_{12} \times P_{20} = 1$

Circular test is only satisfied by:

- Simple Aggressive method
- Simple Geometric mean of price relatives

Thus, Fisher's ideal index, Laspeyre's Index, Paasche's Index does not satisfy the Circular test. Hence, the correct answer is option (d) i.e., None of the above.

Example 25. If $\Sigma P_0Q_0 = 406, \Sigma P_0Q_1 = 451, \Sigma P_1Q_0 = 456, \Sigma P_1Q_1 = 506$, then Fisher's ideal index number is

(a) 184.50 (b) 112.26 (c) 118.66 (d) 120.50

Sol. (b) Given: $\Sigma P_0Q_0 = 406, \Sigma P_0Q_1 = 451, \Sigma P_1Q_0 = 456, \Sigma P_1Q_1 = 506$

As we know, Fisher's Ideal index is given by the formula,

$$\text{Fisher's Index Number} = \sqrt{\frac{\Sigma p_1q_0 \times \Sigma p_1q_1}{\Sigma p_0q_0 \times \Sigma p_0q_1}} \times 100$$

$$= \sqrt{\frac{456}{406} \times \frac{506}{451}} \times 100 = \sqrt{\frac{11349}{16240}} \times 100$$

$$= \sqrt{1.260122552} \times 100 = 112.26$$

Hence, the correct answer is option (b) i.e., 112. 26.

Example 26. __________ is a point of reference in comparing various data describing individual behavior.

(a) Sample (b) Base period (c) Estimation (d) None of these **(ICAI)**

Sol. (b) We know that,

Base period is a point of reference in comparing various data describing individual behavior.

Hence, the correct option is (b).

Example 27. The ratio of price of single commodity in a given period to its price in the preceding year price is called the **(ICAI)**

(a) Base period (b) Price ratio (c) Relative price (d) None of these

Sol. (c) The relative price is the ratio in the cost of a particular good in two different time periods. This idea is frequently applied in economics to compare the cost of an item or service over different time periods. Amount of Relative Price Matters

In order to compare the cost of products and services across time, relative pricing is crucial. Economists may establish how the cost of an item or service has changed over time by comparing the price of that good or service in one era to the price of that same good or service in another period.

E.g.: The relative price of milk in 2020 , for instance, would be $1.33 ($4 divided by $3), if the price of a gallon of milk was $3 in 2010 and $4 in 2020. Accordingly, milk will cost 33% higher in 2020 than it did in 2010 .

Hence, the correct option is (c).

Example 28. $\frac{\text{Sum of all commodity price in the current year} \times 100}{\text{Sum of all commodity price in the base year}}$

(a) Relative Price Index

(b) Simple Aggregative Price Index

(c) Both

(d) None of these

Sol. (b) In this method aggregate price of commodities in current year ΣP_1 are divided by the aggregate price of these commodities in the base year ΣP_0 and expressed in percentage

$$\Sigma P_0 = \frac{\Sigma P_1}{\Sigma P_0} \times 100$$

where ΣP_1 – Sum of prices of commodities of current year

ΣP_0 – Sum of prices of commodities of base year

Hence, the correct option is (b).

Example 29. Chain index is equal to **(ICAI)**

(a) $\frac{\text{Link relative of current year} \times \text{chain index of the current year}}{100}$

(b) $\frac{\text{Link relative of previous year} \times \text{chain index of the current year}}{100}$

(c) $\frac{\text{Link relative of Current year} \times \text{chain index of the Previous year}}{100}$

(d) $\frac{\text{Link relative of Previous year} \times \text{chain index of the Previous year}}{100}$

Sol. (b) The base is constant and unchanging throughout the series according to fixed base approaches. However, as time goes on, certain items in the series could be added while others might be taken out.

As a result, it is difficult to compare the outcome of the current circumstances with that of the previous one. With this approach, we first represent each year's numbers as a percentage of the year before. Link Relatives are what these are called. The next step is to multiply each one successively to link them together to create a chain index.

$$\text{Chain Index} = \frac{\text{Current Year Relative} \times \text{Previous Year Link Relative}}{100}$$

Hence, the correct option is (b).

Example 30. If Laspeyre's Index is 119 and Paasche's Index is 112. Then Fisher's index number will be **(Dec 2022)**

(a) 113.99 (b) 115.45 (c) 115.89 (d) 151.98

Sol. (b) Given: Laspeyre's Index number = 119

Paasche's Index Number = 112

As we know, Paasche's and Laspeyre's index numbers are combined to create the Fisher index, which is the square root of that product.

Fisher's ideal index number = $\sqrt{\text{Paasche's index number} \times \text{Laspeyre's index numbers}}$

$= \sqrt{112 \times 119} = 115.45$

Hence, the correct answer is option (b).

Example 31. P_{01} is the index for time **(ICAI)**

(a) 1 on 0 (b) 0 on 1 (c) 1 on 1 (d) 0 on 0

Sol. (a) A ratio of two or more time periods, one of which being the base time period, is called an index number. The standard point of comparison is the value from the base time period.

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

where P_{01} is the index for time 1 on 0 and P_{10} is the index for time 0 on 1 .

Hence, the correct option is (a).

Example 32. P_{10} is the index for time **(ICAI)**

(a) 1 on 0 (b) 0 on 1 (c) 1 on 1 (d) 0 on 0

Sol. (b) We know that, $P_{01} \times P_{10} = 1$

where P_{01} is the index for time 1 on 0 and P_{10} is the index for time 0 on 1 .

Hence, the correct option is (b).

Example 33. If $\sum P_0Q_0 = 240, \sum P_1Q_1 = 480, \sum P_1Q_0 = 600, \sum P_0Q_1 = 192$ then the Laspeyre's Index number is **(Nov 2018)**

(a) 250 (b) 300 (c) 350 (d) 200

Sol. (a) As we know, Laspeyre's Index number is formulated as,

Laspeyre's Index number

$$= \frac{\sum P_1Q_1}{\sum P_0Q_0} \times 100 = \frac{480}{192} \times 100 = 2.5 \times 100 = 250$$

Hence, the correct answer is option (a) i.e., 250.

Example 34. In the year 2010, the price index for a particular item is 150 with the base year 2005. What does this index value indicate?

(a) The prices of the item have decreased by 50% since 2005 .

(b) The prices of the item have increased by 50% since 2005 .

(c) The prices of the item have increased by 150% since 2005 .

(d) The prices of the item have increased by 50 units since 2005.

Sol. (b) Let the price of the base year (2005) be 100 .

Given as per the question,

Price of the current year (2010) = 150

Then, the percentage increase = 150-100 = 50%

Hence, the correct answer is option (b) i.e., the prices of the item have increased by 50% since 2005.

Example 35. When the product of price index and the quantity index is equal to the corresponding value index then the test that holds is **(ICAI)**

(a) Unit Test (b) Time Reversal Test
(c) Factor Reversal Test (d) None holds

Sol. (c) It states that the value index should equal the product of a price index and a quantity index. According to Fisher, each formula must allow for the interchange of two times without producing inconsistent results, and it must also allow for the interchange of prices and quantities without producing inconsistent results. This means that multiplying two results together should produce the true value ratio.

Hence, the correct option is (c) i.e., Factor Reversal Test.

Example 36. The Index number in wholesale prices is 152 for August 1999 compared to August 1998. During the year there is net increase in prices of wholesale commodities to the extent of

(a) 45% (b) 35% (c) 52% (d) 48%

Sol. (c) Let the base price be 100

Given: Current Price =152

Percentage Increase = (152 – 100)% = 52%

Hence, the correct answer is option (c) i.e., 52%.

Example 37. Laspeyre's method and Paasche's method do not satisfy **(ICAI)**

(a) Unit Test (b) Time Reversal Test
(c) Circular test (d) both (b) and (c)

Sol. (d) We know that,

Laspeyre's method and Paasche's method do not satisfy both Time Reversal Test and Circular test. Hence, the correct option is (d).

Example 38. An index number that can serve many purposes is known as a

(a) General purpose index (b) Special purpose index
(c) Both (a) and (b) are incorrect (d) Both (a) and (b) are correct

Sol. (a) To get the best results, it is important to make a clear decision on the index number's construction, its scope, and the variable it will be used to measure. choosing the base year: The reference year is another name for the base year. It serves as the baseline for comparisons.

Therefore, an index number that can serve many purposes is known as a General purpose index.

Hence the correct option is (a).

Example 39. Which of the following statements is true? **(Nov 2018)**

(a) Paasche's Index number is based on the base year quantity
(b) Fisher's Index number is the arithmetic mean of Laspeyre's Index number and Paasche's Index Numbers
(c) Arithmetic Mean is the most appropriate average for constructing the index number
(d) Fisher's Index number is an Ideal Index Number

Sol. (d) As we know, Paasche's and Laspeyre's index numbers are combined to create the Fisher index, which is the square root of that product.

Fisher's ideal index number= $\sqrt{\text{Paasche index number} \times \text{Laspeyre's index numbers}}$

Thus, The statement which is true is Fisher's Index number is an Ideal Index Number.

Hence, the correct answer is option (d) i.e., Fisher's Index number is an Ideal Index Number.

Example 40. The index number is a special type of average. **(ICAI)**

(a) False (b) True (c) Both (d) None of these

Sol. (b) An exclusive class of averages are index numbers. The technique of index numbers is used to measure the relative changes in the level of a phenomenon when the measurement of absolute change is not possible and the series are expressed in different types of items, whereas mean, median, and mode measure the absolute changes and are used to compare only those series which are expressed in the same units.

The use of index numbers allows for the measurement of changes in a single variable or set of linked variables. For instance, a set of variables may include the price of sugar, milk, and rice, whereas the price of wheat could be one of the variables.

Hence, the correct option is (b) i.e., True.

Example 41. The cost of living index numbers in years 2015 and 2018 were 97.5 and 115 respectively. The salary of a worker in 2015 was ₹19,500. How much additional salary was required for him in 2018 to maintain the same standard of living as in 2015 ?

(a) 3000 (b) 4000 (c) 3500 (d) 4500

Sol. (c) Let the salary in 2018 be x,

Make a data table according to the question,

Year	Cost of Living Index	Salary
2015	97.5	19500
2018	115	x

Now, Salary in 2018 will be given as,

$$= \frac{\text{Cost of Living Index in 2018}}{\text{Cost of Living Index in 2015}} \times \text{Salary in 2015} = \frac{115}{97.5} \times 19500$$

So, salary of the worker in 2015 was 19500 and the additional salary required will be given by,

= 23000-19500 = 3500

Hence, the correct option is (c).

Example 42. Fisher's Ideal Formula does not satisfy _______ **(July 2021)**

(a) Unit Test (b) Circular Test

(c) Time Reversal Test (d) Factor Reversal Test

Sol. (b) As we know, the circular test is not satisfied by Fisher's index number.

Each method has a unit test, with the exception of the simple aggregative method.

Thus, Fisher's Ideal Formula does not satisfy the Circular test.

Hence, the correct answer is option (b).

Example 43. __________ satisfies circular test. **(ICAI)**

(a) G.M. of price relatives or the weighted aggregate with fixed weights
(b) A.M. of price relatives or the weighted aggregate with fixed weights
(c) H.M. of price relatives or the weighted aggregate with fixed weights
(d) None of these

Sol. (a) It is well known, the circular test is satisfied by the weighted aggregate with fixed weights or the geometric mean of the price relatives but not by perfect indices.

As a result, the circular test is satisfied by G.M. of price relatives or the weighted aggregate with fixed weights.

Hence, the correct answer is option (a).

Example 44. Laspeyre's and Paasche's method ________ time reversal test. (ICAI)

(a) Satisfy (b) Do not satisfy
(c) Are (d) Are not

Sol. (b) The index for the later era based on the earlier period should equal the earlier period based on the later period's index, according to the time-reversal test.

i.e., $P_{01} \times P_{10} = 1$

As a result, the time-reversal test using Laspeyres and Paasche's technique is not satisfied.

Hence, the correct answer is option (b) i.e., do not satisfy.

Example 45. The number of test of Adequacy is **(ICAI)**

(a) 2 (b) 5 (c) 3 (d) 4

Sol. (d) We know, Test of Adequacy are as follow:

I. Unit Test
II. Time Reversal Test
III. Factor Reversal Test
IV. Circular Test

Thus, there are 4 test of Adequacy.

Hence, the correct answer is option (d).

Example 46. Theoretically, G.M. is the best average in the construction of index numbers but in practice, mostly the A.M. is used.

(a) False (b) True (c) Both (d) None of these

Sol. (b) Although the geometric mean is known to be more difficult to compute than the arithmetic mean, the outcomes it generates are more accurate and powerful.

Therefore, while it is true that, in theory, the G.M. is the optimum average for constructing index numbers, in practice, the A.M. is typically utilized.

Hence, the correct answer is option (b) i.e., True.

Example 47. Laspeyre's or Paasche's or the Fisher's ideal index do not satisfy **(ICAI)**

(a) Time Reversal Test
(b) Unit Test
(c) Circular Test
(d) None of these

Sol. (c) As we know,

The Laspeyre's, Paasche's, or Fisher's ideal index does not satisfy the Circular Test.

Hence, the correct answer is option (c).

Example 48._________ is concerned with the measurement of price changes over a period of years, when it is desirable to shift the base. **(ICAI)**

(a) Unit Test
(b) Circular Test
(c) Time Reversal Test
(d) None of these

Sol. (b) The Circular test can be used to gauge price changes over a period of years when the base has to be adjusted.

The measuring of price changes over a number of years when it is appropriate to relocate the base is thus the focus of the circular test.

Hence, the correct answer is option (b).

Example 49. The test of shifting the base is called **(ICAI)**

(a) Unit Test
(b) Time Reversal Test
(c) Circular Test
(d) None of these

Sol. (c) The Circular test can be used to gauge price changes over a period of years when the base has to be adjusted.

When index numbers are utilized, it is also possible to measure price changes over a longer period of time rather than only comparing prices over two years. In many cases, changing the foundation is desirable. Thus, the test of shifting the base is called the Circular test.

Hence, the correct answer is option (c).

Example 50. The formula for conversion to current value

(a) $\text{Deflated value} = \dfrac{\text{Price Index of the current year}}{\text{Previous value}}$

(b) $\text{Deflated value} = \dfrac{\text{Current value}}{\text{Price Index of the current year}}$

(c) $\text{Deflated value} = \dfrac{\text{Price Index of the Previous year}}{\text{previous value}}$

(d) $\text{Deflated value} = \dfrac{\text{Price Index of the Previous year}}{\text{previous value}}$

Sol. (b) As we know, the current value can be expressed mathematically as the result of the deflated value and the current year's price index.

It is formulated as, $\text{Deflated Value} = \dfrac{\text{Current value}}{\text{Price Index of the current year}}$

Hence, the correct answer is option (b).

Example 51. Shifted price Index = $\dfrac{\text{Original Price} \times 100}{\text{Price Index of the year on which it has to be shifted}}$

(a) True (b) False (c) Both (d) None of these

Sol. (a) The ratio of the original price and the price index of the year on which it must be shifted full, multiplied by 100 , is the formula for the "Shifted Price Index."

It is formulated as, Shifted Price Index

$$= \frac{\text{Original Price} \times 100}{\text{Price Index of the year on which it has to be shifted}}$$

Hence, the correct answer is option (a) i.e., True.

Example 52. The weighted aggregative price index numbers for 2001 with 2000 as the base year using Paasche's index number is **(July 2021)**

Commodity	Price in ₹		Quantities	
	2000	2001	2000	2001
A	10	12	20	22
B	8	8	16	18
C	5	6	10	11
D	4	4	7	8

(a) 112.32 (b) 112.38 (c) 112.26 (d) 112.20

Sol. (d) According to the data given,

Commodity	Price in (₹)		Quantities			
	2000	2001	2000	2001		
	P_0	P_1	Q_0	Q_1	P_1Q_1	P_0Q_1
A	10	12	20	22	264	220
B	8	8	16	18	144	144
C	5	6	10	11	66	55
D	4	4	7	8	32	32
					ΣP_1Q_1=506	ΣP_0Q_1= 451

We know that, Paasche's index number

$$P_{01} = \frac{\sum P_1Q_1}{\sum P_0Q_1} \times 100 = \frac{506}{451} \times 100 = 112.195 = 112.20$$

Hence, the correct option is (d).

Example 53. The weighted aggregative price index numbers for 2001 with 2000 as the base year using Marshal –Edgeworth Index number is **(July 2021)**

Commodity	Price in (₹)		Quantities	
	2000	2001	2000	2001
A	10	12	20	22
B	8	8	16	18
C	5	6	10	11
D	4	4	7	8

(a) 112.26 (b) 112.20 (c) 112.32 (d) 112.38

Sol. (a)

Commodity	Price in (₹)		Quantities			
	2000	2001	2000	2001		
	P_0	P_1	Q_0	Q_1	$P_1(Q_0 + Q_1)$	$P_0(Q_0 + Q_1)$
A	10	12	20	22	504	420
B	8	8	16	18	272	272
C	5	6	10	11	126	105
D	4	4	7	8	60	60
Total					962	557

Marshal –Edgeworth index number

$$= \frac{\sum P_1(Q_0 + Q_1)}{\sum P_0(Q_0 + Q_1)} \times 100 = \frac{962}{857} \times 100 = 112.25 = 112.26$$

Hence, the correct option is (a).

Example 54. From the following data

	Commodity	A	B	C	D
1992 Base year	Price	3	5	4	1
	Quantity	18	6	20	14
1993 Current year	Price	4	5	6	3
	Quantity	15	9	26	15

The Paasche's price index number is :

(a) 146.41 (b) 120.50 (c) 164.82 (d) None of these

Sol. (a) According to the data given,

Commodity	P_0	Q_0	P_1	Q_1	P_0Q_0	P_1Q_0	P_0Q_1	P_1Q_1
A	3	18	4	15	54	72	45	60
B	5	6	5	9	30	30	45	45

Commodity	P_0	Q_0	P_1	Q_1	P_0Q_0	P_1Q_0	P_0Q_1	P_1Q_1
C	4	20	6	26	80	120	104	156
D	1	14	3	15	14	42	15	45
					$\Sigma P_0Q_0 = 178$	$\Sigma P_1Q_0 = 264$	$\Sigma P_0Q_1 = 209$	$\Sigma P_1Q_1 = 306$

We know that,

Paasche's Price index $P_{02} = \frac{\sum P_1Q_1}{\sum P_0Q_1} \times 100 = \frac{306}{209} \times 100$

$\Rightarrow$ 1.46411 X 100 02

$\Rightarrow P_{02}$ = 146.41 02

Therefore, Paasche's Price index = 146.41

Hence, the correct answer is option (a) i.e., 146.41.

Example 55. The prices and quantities of 3 commodities in base and current years are as follows: **(June 2019)**

p_0	p_1	q_0	q_1
12	14	10	20
10	8	20	30
8	10	30	10

The Laspeyre's Index number is:

(a) 118.13 (b) 107.14 (c) 120.10 (d) None of these

Sol. (b) Make a data table according to question,

p_0	p_1	q_0	q_1	p_0q_0	p_1q_0
12	14	10	20	120	140
10	8	20	30	200	160
8	10	30	10	240	300
				$\Sigma p_0q_0 = 560$	$\Sigma p_1q_0 = 600$

As we know, Laspeyre's Index number is formulated as,

$$\text{Laspeyre's Index number} = \frac{\sum p_1q_0}{\sum p_0q_0} \times 100$$

Put the values in the formula and compute,

$$= \frac{600}{560} \times 100 = 107.14$$

Hence, the correct answer is option (b).

Example 56. With the base year 1960 the C.L.I in 1972 stood at 250. x was getting a monthly salary of ₹ 500 in 1960 and ₹750 in 1972. In 1972 to maintain his standard of living in 1960, x has to receive as extra allowances of

(a) ₹600 (b) ₹500 (c) ₹ 300 (d) None of these

Sol. (b) Given: Base Price = ₹500; Index Number = 250

Index number is given by the formula,

$$\text{Index number} = \frac{\text{Current Year Price}}{\text{Base Year Price}} \times 100$$

Put the values and compute for Current year price,

$$\text{Current Year Price} = \frac{250(500)}{100} = 1250$$

Now, D.A (x) will be given as,

D.A (x) = 1250-750 = 500

Hence, the correct answer is option (b) i.e., ₹500.

Example 57. If the ratio between Laspeyres index number and Paasche's index number is 28 : 27. Then the missing figure in the following table P is **(ICAI)**

Commodity	Base Year		Current Year	
	Price	Quantity	Price	Quantity
X	L	10	2	5
Y	L	5	P	2

(a) 1 (b) 4 (c) 3 (d) 0

Sol. (b)

Commodity	P_0	Q_0	P_1	Q_1	P_0Q_0	P_1Q_0	P_0Q_1	P_1Q_1
X	L	10	2	5	10L	20	5L	10
Y	L	5	P	2	5L	5P	2L	2P
					ΣP_0Q_0 = 15 L	ΣP_1Q_0 = 20 + 5P	ΣP_0Q_1 = 7 L	ΣP_1Q_1 = 10 + 2P

As we know, Laspeyre's index number is formulated as,

$$= \frac{\sum P_1Q_0}{\sum P_0Q_0} \times 100 = \frac{20 + 5P}{15L} \times 100$$

Paasche's index number is given by the formula,

$$= \frac{\sum P_1Q_1}{\sum P_0Q_1} \times 100 = \frac{10 + 2P}{7L} \times 100$$

Now, as per the question,

$$\Rightarrow \frac{28}{27} = \frac{\frac{20+5P}{15L}\times 100}{\frac{10+2P}{7L}\times 100}$$

$\Rightarrow 9(20 + 5P) = 20(10 + 2P) \Rightarrow 180 + 45P = 200 + 40P \Rightarrow 5P = 20 \Rightarrow P = 4$

Hence, the correct option is (b).

PRACTICE QUESTIONS (PART A)

1. The most commonly used mathematical method for finding secular trends is

(a) Moving (b) Simple average

(c) Exponential (d) None of these

2. For year 2015, price index was 267% with base year 2005. The percentage increase in price index over base year 2005 is

(a) 26% (b) 67% (c) 167% (d) None of these

3. The cost of living index numbers in 2015 and 2018 were 97.5 and 115 respectively. The salary of a worker in 2015 was ₹ 19500 . How much additional salary was required for him in 2018 to maintain the standard of living as in 2015 ?

(a) 3000 (b) 4000 (c) 3500 (d) 4500

4. The prices and quantities of 3 commodities in base and current years are as follows:

P_0	P_1	Q_0	Q_1
12	14	10	20
10	8	20	30
8	10	30	10

The Laspeyre price index is

(a) 118.13 (b) 107.14 (c) 120.10 (d) None of these

5. Which is not satisfied by fisher's ideal index number?

(a) Factor Reversal Test (b) Time Reversal Test

(c) Circular Test (d) None of the above

6. Which is called an ideal index number?

(a) Laspeyre's index numbers

(b) Pasche's index number

(c) Fisher's index number

(d) Marshall Edgeworth index number

7. If $\Sigma p_0q_0 = 240, \Sigma p_1q_1 = 480, \Sigma p_1q_0 = 600$ and $\Sigma p_0q_1 = 192$, then laspeyre's Index number is

(a) 250 (b) 300 (c) 350 (d) 200

8. If Laspeyre's index number is 250 and paasche's index number is 160 , then fisher's index number is

(a) 40000 (b) $\frac{25}{16}$ (c) 200 (d) $\frac{16}{25}$

9. Which of the following statements is true? **(Nov 2018)**

(a) Paasche's index number is based on the base year quantity

(b) Fisher's index number is the Arithmetic mean of Laspeyre's index number and Paasche's index number

(c) Arithmetic mean is the most appropriate average for constructing the index number

(d) Fisher's index number is an ideal index number

10. The number of test of Adequacy is **(May 2018)**

(a) 2 (b) 5 (c) 4 (d) 3

11. If the 1970 index with base with 1965 is 200 and 1965 index with base 1900. Is 150, the index 1970 on base 1960 will be:

(a) 700 (b) 300 (c) 500 (d) 600

12. Circular test is satisfied by

(a) Laspeyre's index number

(b) Paasche 's index number

(c) The simple geometric mean of price relatives and the weighted aggregative with fixed weights.

(d) None of these

13. Price relative is expressed in term of

(a) $p = \frac{P_n}{P_o}$ (b) $p = \frac{P_o}{P_n}$ (c) $p = \frac{P_n}{P_o} \times 100$ (d) $p = \frac{P_o}{P_n} \times 100$

14. The circular test is an extension of **(May 2018)**

(a) The time reversal test (b) The factor reversal test

(c) The unit test (d) None of these

15. If $\Sigma P_o Q_o = 1360, \Sigma P_n Q_o = 1900, \Sigma P_o Q_n = 1344, \Sigma P_n Q_n = 1880$, then Laspeyre's index number is **(May 2018)**

(a) 0.71 (b) 1.39 (c) 1.75 (d) None of these

16. The cost of living index is always

(a) Price index number (b) Quantity index number

(c) Weighted Index number (d) Value index number

17. P_{01} is the index for time **(May 2018)**

(a) 1 on 0 (b) 0 on 1 (c) 1 on 1 (d) 0 on 0

18. If Laspeyre's index number is 110 and Fisher's ideal number is 109 , then Paasche's index number is

(a) 108 (b) 110 (c) 109 (d) 18

19. When the prices for quantities consumed of all commodities are changing in the same ratio, then the index numbers due to Laspeyre's and Paasche's will be

(a) Equal

(b) Unequal

(c) Reciprocal of Marshall Edge worth index number

(d) Reciprocal of fisher index number

20. If $\Sigma P_0Q_0 = 116, \Sigma P_0Q_1 = 140, \Sigma P_1Q_0 = 97, \Sigma P_1Q_1 = 117$ then Fisher's ideal index number is

(a) 184 (b) 83.59 (c) 119.66 (d) 120

21. If the 1970 index with base 1965 in 200 and 1965 index with base 1960 is 150 , the index 1970 on the base 1960 will be:

(a) 700 (b) 300 (c) 500 (d) 600

22. The index number for the year 2012 taking 2011 as base using simple average of price relatives method from data given below is:

Commodity	A	B	C	D	E	
Price in 2011 (P_0)	115	108	95	80	90	$\Sigma P_0 = 488$
Price in 2012 (P_1)	125	117	108	95	95	$\Sigma P_1 = 540$

(a) 112 (b) 117 (c) 120 (d) 111

23. Bowley's index number is expressed in terms of

(a) $\frac{\text{Laspeyre's} + \text{Paasche's}}{2}$ (b) $\frac{\text{Laspeyre's} \times \text{Paasche's}}{2}$

(c) $\frac{\text{Laspeyre's} - \text{Paasche's}}{2}$ (d) None of these

24. Fisher's ideal formula for calculating index number satisfies the

(a) Unit Test (b) Factor Reversal Test

(c) Both (a) and (b) (d) None of these

25. Circular Test is satisfied by:

(a) Paasche's Index Number

(b) The simple geometric mean of price relatives and the weighted aggregative fixed weights

(c) Laspeyre's Index Number

(d) None of these

26. Cost of living index numbers are also used to find real wages by the process of'

(a) Base shifting (b) Splicing of index numbers

(c) Deflating of index numbers (d) None of these

27. The prices of a commodity in the years 1975 and 1980 were 25 and 30 respectively then Price relative of 1975 on 1980 is:

(a) 113.25 (b) 83.33 (c) 109.78 (d) None of these

28. Laspeyre's and Paasche's Method ______ Time Reversal Test.

(a) Do not satisfy (b) Satisfy

(c) Depends on the case (d) Can't say Time Reversal Test

29. Consumer Price Index number goes up from 100 to 200 and salary of a worker is also raised from 300 to 500 . The Real wage is

(a) 300 (b) 250 (c) 600 (d) 350

30. Paasche's price index is a weighted aggregate price index in which ___________quantities are taken as weights.

(a) Base year

(b) Current year

(c) Average of base year and current year

(d) None of these

31. From the following data, calculate price index number for 2010 with 2000 as base by Fisher's Index Number.

Commodity	2000		2010	
	Price	Quantity	Price	Quantity
A	20	8	40	6
B	50	10	60	5
C	40	15	50	15
D	20	20	20	25

(a) 150.50 (b) 123.24 (c) 130.65 (d) None of these

32. From the following data, calculate price index number for 2007 with 2006 as base by Marshall-Edgeworth method.

Commodity	2000		2010	
	Price	Quantity	Price	Quantity
A	10	100	12	150
B	8	80	10	100
C	5	60	10	72
D	24	30	18	33

(a) 118.64 (b) 132.40 (c) 140.75 (d) None of these

Answer Key									
1. (b)	2. (c)	3. (c)	4. (b)	5. (c)	6. (c)	7. (a)	8. (c)	9. (d)	10. (c)
11. (b)	12. (c)	13. (c)	14. (a)	15. (b)	16. (c)	17. (a)	18. (a)	19. (a)	20. (b)
21. (b)	22. (d)	23. (a)	24. (c)	25. (b)	26. (c)	27. (b)	28. (a)	29. (b)	30. (b)
31. (b)	32. (a)								

SUMMARY

Index numbers are the most important need in the study of statistics. If you were to modify the variable in the estimation of any particular statistics, just imagine how it would be without these data! The technique will be wholly ineffectual in and of itself. The measurement of any change in a variable or variables over a predetermined period is therefore done via index numbers. These figures represent a broad relative shift rather than a specific quantifiable value. A percentage is used to express an index number.

Learn more about the Index numbers so that we may explore their significance, traits, categories, and restrictions. Continue reading the material to learn more about the supplementary part that we have included.

IMPORTANCE OF INDEX NUMBER

In studies of a region's economic situation, index numbers are most frequently utilised. The level of a variable in relation to its level across a specific time period is defined by the index number, as was previously indicated. These index values are used to analyse how the impact of all the variables that cannot be directly measured or approximated vary over time.

Due to their effectiveness in determining the magnitude of economic changes over a given time period, index numbers therefore have a significant position. The impact of such changes owing to variables that cannot be assessed directly are studied.

THE FOLLOWING ARE SOME OF THE KEY DISTINGUISHING CHARACTERISTICS OF INDEX NUMBERS

- When absolute measurement cannot be done, this specific category of average is used to assess relative changes.
- Only speculative changes in variables that may not be immediately measurable are shown by index numbers. It provides a broad overview of the relative changes.
- The index number measurement technique varies from one connected variable to another.
- It facilitates comparing the levels of a phenomena on a given day to those from earlier dates.
- It serves as an example of an uncommon average, particularly for a weighted average.
- Index numbers are useful everywhere. You may also utilise the index that is used to determine price fluctuations.

SIMPLE AGGREGATE METHOD

This approach is predicated on the idea that different things and their pricing are given in the same units. Each thing is given the same importance. The following is the formula for a straightforward aggregative pricing index: $P_{01} = \frac{\sum P_1}{\sum P_0} \times 100$

where,

$\sum P_1$ is the total of current year's prices for the various items.

$\sum P_2$ is the total of base year's prices for the various items.

VARIOUS INDEX NUMBER TYPES

Different sorts of index numbers are used in certain ways. To understand the same, we shall study the various index numbers. The students will get an understanding of the significance of each form of Index number in relation to the assignment they are practising for from this lesson on the many sorts of Index numbers.

- **Price Index:** The ratio of the aggregate value for a given period to the aggregate value found in the base period yields a value index number. The value index is used, among other things, for inventory, sales, and international commerce.

  $$\text{Price relative} = \frac{P_n}{P_o} \times 100$$

- **Quantity Index:** When measuring changes in the volume or amount of items produced, consumed, and sold within a given time frame, a quantity index number is utilised. It displays the relative change over a time period for certain product quantities. An illustration of a quantity index is the Index of Industrial Production (IIP)

  $$\text{Quantity Relative} = \frac{Q_n}{Q_o} \times 100$$

- **Value relative :** The value relative considers the value of a commodity by multiplying the price and quantity relatives together.

  $$\text{Value Relative} = \frac{V_n}{V_o} = \frac{P_n}{P_o} \times \frac{Q_n}{Q_o} = \frac{P_n Q_n}{P_o Q_o}$$

USES OF INDEX NUMBER IN STATISTICS

In several straightforward to complex research, index numbers are helpful. Like it is used in the basic study of human population in a country and also it is used to determine the extinction rate of the rare animals in a particular region. There are many more applications for index numbers; here are some examples:

- It aids in gauging changes in both pricing levels and living standards.
- Regulation of wage rates is compatible with shifts in the level of prices. Wage rates may change when pricing levels are established.
- The index number of prices is used to frame government policy. Index numbers serve as the foundation for the built-in price stability of fiscal and economic policy.
- It provides a starting point for comparing many economic factors internationally, such as the living standards of two nations.

ADVANTAGES OF INDEX NUMBER

- Index numbers' benefits are closely related to how they are used. In conclusion, the benefits are as follows: It makes cost-effective adjustments to primary data, which is helpful for deflation. It makes the switch from nominal wage to real wage easier.
- In economics, index numbers are frequently used to aid in the formulation of effective policies. These results also aid in the development of research.
- It is useful for patterns like making conclusions for cyclical and irregular forces.
- In the event that economic activity develops in the future, index numbers can be useful. To identify patterns and cyclical processes, this time series analysis is used.
- The figure is helpful in gauging changes in living standards across various nations over a predetermined time frame.

ISSUES IN THE CONSTRUCTION OF INDEX NUMBERS

The following are some considerations for the development of an index number that should be made:

- Purpose of Index number
- Selection of Items
- Choice of Average
- Assignment of weights
- Choice of Base year

LASPEYRE'S METHOD: $= \left(\frac{\sum P_1Q_0}{\sum P_0Q_0}\right) \times 100$

Here, ΣP_1Q_0 represents the sum of prices for the current year times the base year's quantity weights, and ΣP_0Q_0 represents the sum of prices for the base year times the base year's quantity weights.

PAASCHE'S METHOD: $= \left(\frac{\sum P_1Q_1}{\sum P_0Q_1}\right) \times 100$

Here, ΣP_1Q_1 is the sum of current year prices multiplied by current year quantities taken as weights, and ΣP_0Q_1 is the sum of base year prices multiplied by current year quantities taken as weights.

MARSHALL- EDGEWORTH METHOD: $= \frac{\sum P_n(Q_0 + Q_n)}{\sum P_0(Q_0 + Q_n)} \times 100$

FISHER'S METHOD: $= \sqrt{\left[\left(\frac{\Sigma P_1Q_0}{\Sigma P_0Q_0}\right) \times \left(\frac{\Sigma P_1Q_1}{\Sigma P_0Q_1}\right)\right]} \times 100$

Fisher's ideal index number is an ideal index number.

DORBISH AND BOWLEY'S PRICE INDEX:

$$\text{Dorbish and Bowley's Price Index} = \frac{\frac{\sum P_n Q_o}{\sum P_o Q_o} \quad \frac{\sum P_n Q_n}{\sum P_o Q_n}}{2} \times 100$$

LIMITATIONS OF INDEX NUMBER:

We are aware that everything in the world has both benefits and drawbacks. Although index numbers offer many benefits, this is also where some of its drawbacks appear. The following are some index numbers' restrictions:

- Given that index numbers are generated from samples, there is a risk for inaccuracy. These samples are assembled after careful consideration, which increases the possibility of mistakes. It can also be found in base periods, weights, etc.
- It is always determined using the things. Items that are so carefully chosen may not accurately reflect current trends, which leads to erroneous analysis.
- The index numbers provide a rough idea of the relative changes that take place.
- The choice of representative goods could be biased.

MAIN CHARACTERISTICS OF INDEX NUMBERS

Index numbers are a particular kind of average that

1. give a measurement of relative changes in the frequency of a certain phenomena;
2. are stated in terms of percentages to demonstrate the magnitude of relative change
3. quantify relative changes.
4. They are also capable of measuring changes that are not readily quantifiable.

Economic barometers are index numbers. They aid in the creation of economic policy, planning, and other things. They are employed in the analysis of trends and patterns. Indicators like index numbers can be used to predict future economic activity. They gauge the value of money in terms of purchases.

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