INDEX NO.

- Simple Index No.
- Weighted " ".
- Unweighted " ".
- Value Index.
- Consumer Price Index.
- Advantages of Index No.
- Limitations " ".

⟹ Index:

An index expresses the relative change in a value from one period to another.

⟹ Index No:

A number that expresses the relative change in price, quantity or value compared to a base period

⟹ Uses of Index No:

- The index No.s are helpful in foreca-sting (پیشین گوئی) the future economic trends.

- The index numbers help the Govt. to formulate its policies to control the prices.

- Index No.s are helpful in forecasting business conditions.

- The export & import indices help to measure the changes in the ratio of exports & imports of the contry.

- The index numbers are helpful for the economists & the businessmen to describe the existing conditions & help plan near future.

⇒ Simple Index No:

An Index No. is called a simple index No. when it measures a relative change in a single variable with respect to a base year. ~~e.g.,~~

$$P = \frac{P_t}{P_o} \times 100$$

Example

According to the Bureau of Labor Statistics, in 2000 the average hourly earnings of production workers was \$14.02. In 2009, it was \$18.62. What is the index of hourly earnings of production workers for 2009 based on 2000 data?

Solution

It is 132.81, found by:

$$P = \frac{\text{Average hourly earnings in 2009}}{\text{Average hourly earnings in 2000}}(100) = \frac{\$18.62}{\$14.02}(100) = 132.81$$

Example

An index can also compare one item with another. The population of the Canadian province of British Columbia in 2010 was 4,494,232, and for Ontario it was 13,069,182. What is the population index of British Columbia compared to Ontario?

Solution

The index of population for British Columbia is 34.4, found by:

$$P = \frac{\text{Population of British Columbia}}{\text{Population of Ontario}}(100) = \frac{4{,}494{,}232}{13{,}069{,}182}(100) = 34.4$$

Suppose the price of a fall weekend package (including lodging and all meals) at Tryon Mountain Lodge in western North Carolina in 2000 was $450. The price rose to $795 in 2010. What is the price index for 2010 using 2000 as the base period and 100 as the base value? It is 176.7, found by:

$$P = \frac{p_t}{p_0}(100) = \frac{\$795}{\$450}(100) = 176.7$$

Interpreting this result, the price of the fall weekend package increased 76.7 percent from 2000 to 2010.

→ Example # 1 :

The data given below is available about the price of wheat for the years 1989 to 1994. Compare the price of wheat in ~~these~~ these years taking 1989 as the base year.

Year	Price	Price Index (1989 Base Year)
1989	85	(85/85) x 100 = 100
1990	96	(96/85) x 100 = 112.94
1991	112	(112/85) x 100 = 131.76
1992	124	(124/85) x 100 = 145.88
1993	130	(130/85) x 100 = 152.94
1994	160	(160/85) x 100 = 188.24

Base Year = 1989.

⟹ Example #02 :

Compare the daily wages of unskilled labourers in Lahore over the time period 1988-93 where the following data is available from the Pakistan Economic Survey 1993 taking 1988 as base year. Wages are in rupees.

Year	Wages	Wages Index
1988	46	$(46/46) \times 100 = 100$
1989	51	$(51/46) \times 100 = 110.87$
1990	58	$(58/46) \times 100 = 126.09$
1991	71	$(71/46) \times 100 = 154.35$
1992	71	$(71/46) \times 100 = 154.35$
1993	86	$(86/46) \times 100 = 186.96$

→ Example # 03 :

Following are the prices of a commodity for the ten years ending with 1957. Calculate Index numbers with

1 → 1948 as a base.

2 → average of first five years as a base.

Years	Prices	1) Index No.	2) Index No.
1948	5.25	$(5.25/5.25)\times100 = 100$	$(5.25/5.8)\times100 = 90.5$
1949	5.87	$(5.87/5.25)\times100 = 111.80$	$(5.87/5.8)\times100 = 101.2$
1950	6.12	116.6	$(6.12/5.8)\times100 = 105.5$
1951	5.50	104.8	$(5.50/5.8)\times100 = 94.8$
1952	6.25	119.04	$(6.25/5.8)\times100 = 107.7$
1953	6.62	126.1	$(6.62/5.8)\times100 = 114.1$
1954	6.75	128.6	= 116.4
1955	7.12	135.6	= 122.7
1956	6.50	123.8	= 112.1
1957	7.50	142.8	= 129.3

$$\bar{X} = (5.25 + 5.87 + 6.12 + 5.50 + 6.25)/5 = \boxed{5.8}$$

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⟹ Example #04

Following are the prices of stapler for five years. Calculate Index No. with

1) 2000 as a base.
2) Average of 2000 & 2001 as a base
3) " " 2000, 2001 & 2002 as a base.

Years	Prices of stapler	1) Price Index	2) Price Index $\bar{X} = 21$	3) Price Index. $\bar{X} = 21.67$
1995	\$ 18	$(18/20) \times 100 = 90$	$(18/21) \times 100 = 85.7$	$(18/21.67) \times 100 = 83.1$
2000	20	$(20/20) \times 100 = 100$	95.2	92.3
2001	22	$(22/20) \times 100 = 110$	104.8	101.5
2002	23	115	109.5	106.1
2010	38	190	180.952	175.4

5.7 **Find the index number of price from the following data taking average price of all years as the base.**

Years	1970	1971	1972	1973	1974	1975	1976	1977
Prices	15	19	21	30	37	38	40	48

5.9 Find index number using:

i. 1977 as base

ii. average of the price as base:

Years	Prices	Years	Prices	Years	Prices
1977	22.5	1980	30	1983	37.5
1978	25	1981	35	1984	47.5
1979	27.5	1982	32.5	1985	45

5.10 For the following data, find index numbers taking:

i. 1930 as base

ii. Average of 1st 3 years as base

iii. the year 1935 as base

Years	Prices	Years	Prices	Years	Prices
1930	4	1933	7	1936	9
1931	5	1934	8	1937	10
1932	6	1935	10	1938	11

5.12 **Construct index numbers of prices for the following data taking 1960 as base:**

Years	Prices	Years	Prices
1960	50	1965	72
1961	52	1966	73
1962	55	1967	75
1963	57	1968	71
1964	62	1969	70

5.13 **The prices in Rs. Per maund of coal sold during the year 1953-58 as given below:**

Years	Prices	Years	Prices	Years	Prices
1953	14.95	1955	15.10	1957	16.28
1954	14.95	1956	15.65	1958	16.28

Compute index number of price for the year 1953 as base.

⟹ Unweighted Indices:

- Simple Average of Price indices.
- Simple Aggregate Price Index.

The index No. which measures the relative change in a group of related variables with respect to base without taking the relative importance of the variables into account is called unweighted Index No. In an unweighted Index No. we do not consider the quantities.

There are two methods to find un-weighted Index No. i.e.,

1) Simple Average of Price Indexes.
2) Simple Aggregate Index.

→ Simple Average of Price Indexes:
In the simple average of price indexes, we add the simple indexes for each item & divide by the No. of items.

$$P = \frac{\Sigma P_i}{n}$$

→ Simple Aggregate Price Index:
It is the percentage ratio of the sum of prices of different items for a given period to the sum of prices in base period.

$$P = \frac{\Sigma P_t}{\Sigma P_0} \times 100$$

⟹ Example # 1

Compute Simple average of the price Indexes for each item, using 1999 as the base year & 2009 as the given year. Also find Simple aggregate index.

Items	1999 price	2009 price	Simple Index
Bread	\$ 0.87	\$ 1.28	$(1.28/0.87)\times100 = 147.1$
Eggs	1.05	2.17	206.7
Milk	2.94	3.87	131.6
Apples	0.86	1.16	134.9
Orange Juice	1.75	2.54	145.1
Coffee	3.43	3.68	107.3
Total	\$ 10.90	\$ 14.70	872.7

$$P = \frac{\sum P_i}{n} = \frac{872.7}{6} = 145.5$$

→ Simple Aggregate Index:

$$P = \frac{\Sigma P_t}{\Sigma P_0} \times 100$$

$$= \frac{\$14.70}{\$10.90} \times 100$$

$$\boxed{P = 134.9}$$

⟹ Example #02:

Calculate the unweighted price Index for 1994.

Commodity	1980 Price	1994 Price	Simple Index
Wheat	58	160	275.86
Rice	118	360	305.08
Potato	27	19	70.37
Onion	80	84	105
Total	283	623	756.31

1 ⟹ Simple Average of Price Index:

$$P = \frac{\Sum P_i}{n}$$

$$= \frac{756.31}{4} = \boxed{189.08}$$

2) Simple Aggregate Price Index:

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

$$= \frac{623}{283} \times 100$$

$$\boxed{P = 220.14}$$

⇒ Weighted Index No:

The index No. that measure the relative chang in a group of items when the relative importance of items are also to be included is called weighted Index No. In a weighted index No. we consider quantities.

Weighted Index No.
- Laspeyres Price Index.
- Paasche Price Index.
- Fisher's Ideal Index.

⇒ Laspeyres Price Index:

In Laspeyres method, the base period quantities are used in both the base period & the given period.

$$P = \frac{\sum P_t q_0}{\sum P_0 q_0} \times 100$$

Here;

P = Price Index.
P_t = current price
P_0 = Price in base period
q_0 = quantity used in the base period

⟹ Paasche Index No:

In the paasche method, current period quantity are used.

$$P = \frac{\Sigma P_t q_t}{\Sigma P_o q_t} \times 100$$

Here;

q_t = quantity used in current period.

→ Fisher's Ideal Index:

It is the geometric mean of the Laspeyres & Paasche Index.

Fisher's Ideal Index $= \sqrt{(\text{Laspeyres Index})(\text{Paasche's Index})}$.

Fisher's Index seems to be theoratically ideal because it combines the best features of both Laspeyres & Paasche's.

→ Example #01

The prices for the six food items are given below. Also included is the number of units of each consumed by a typical family in 1999 & 2009.

Item	1999 Price (P_0)	1999 Quantity (q_0)	2009 Price (P_t)	2009 Quantity (q_t)
Bread	$0.87	50	$1.28	~~55~~ 55
Eggs	1.05	26	2.17	20
Milk	2.94	102	3.87	130
Apples	0.86	30	1.16	40
Orange Juice	1.75	40	2.54	41
Coffee	3.43	12	3.68	12

1) Determin Weighted price index using Laspeyres method

2) Determine the Paasche Index.

3) Determine Fisher's Ideal Index.

Item	$P_t q_t$	$P_o q_o$	$P_t q_o$	$P_o q_t$
Bread	70.40	43.50	64.00	47.85
Eggs	43.40	27.30	56.42	21.00
Milk	503.10	299.88	394.74	382.20
Apples	46.40	25.80	34.80	34.40
Orange Juice	104.14	70.00	101.60	71.75
Coffee	44.16	41.16	44.16	41.16
Total	811.60	507.64	695.72	598.36

1) $$P = \frac{\sum P_t q_o}{\sum P_o q_o} \times 100$$

$$= \frac{695.72}{507.64} \times 100$$

$$\boxed{P = 137.0}$$

2) $$P = \frac{\sum P_t q_t}{\sum P_0 q_t} \times 100$$

$$= \frac{811.60}{598.36} \times 100$$

$$\boxed{P = 135.6}$$

3) Fisher's Ideal Index $= \sqrt{(\text{Laspeyres Index}) \times (\text{Paasche's Index})}$

$$= \sqrt{(137.0)(135.6)}$$

$$= 136.3$$

→ Example #02

For the following data, Compute

1) Laspeyre's Index.

2) Paasche "

3) Fisher's Ideal ".

Items	1964 Price (P_0)	1964 Quantity (q_0)	1967 Price (P_t)	1967 Quantity (q_t)
A	10	12	12	15
B	9	15	5	20
C	5	24	9	20
D	10	5	14	5

Items	$P_0 q_0$	$P_t q_t$	$P_0 q_t$	$P_t q_0$
A	120	180	150	144
B	135	100	180	75
C	120	180	100	216
D	50	70	50	70
	425	530	480	505

1) $$P = \frac{\sum P_t q_0}{\sum P_0 q_0} \times 100$$

$$= \frac{505}{425} \times 100$$

$$\boxed{P = 118.82}$$

2) $$P = \frac{\sum P_t q_t}{\sum P_0 q_t} \times 100$$

$$P = \frac{530}{480} \times 100$$

$$\boxed{P = 110.5}$$

3) Fisher's Ideal Index $= \sqrt{(\text{Laspeyre's Index})(\text{Paasche's Index})}$

$$= \sqrt{(118.82)(110.5)}$$

$$= 114.4$$

Construct index numbers for 1963 assuming 1953 as base period by

i) Laspeyre's formula

ii) Paasche's formula

Commodities	1953		1963	
	Price	Quantity	Price	Quantity
A	2	50	10	40
B	3	10	8	5
C	4	5	4	5

Compute the weighted index numbers for 1964 from the following data with 1960 as base.

Commodities	Years			
	1960	1964	1960	1964
Milk	3.95	4.25	97.75	104.36
Cheese	34.80	38.90	78	83
Butter	61.56	59.70	118	116

Compute Fisher's index number for the following data.

Commodities	Base Year		Current Year	
	Price	Quantity	Price	Quantity
A	7	70	5	49
B	5	27	7	28
C	10	35	9	29
D	9	50	4	42
E	3	16	10	25

Calculate Fisher's Ideal index from the following data.

Commodities	1965		1970	
	Price	Quantity	Price	Quantity
A	4.6	102	9.50	96
B	3.7	15	7.36	28
C	10.2	17	8.42	21
D	8.9	19	9.87	13

Calculate Laspeyre's, Paache's and Fisher's ideal index for the following data.

Item	Average Price (Rs)		Quantity (Units)	
	1992	1993	1992	1993
Wheat flour	4.38	4.57	20Kg	16Kg
Rice	14.15	15.58	10Kg	12Kg
Moong pulse	18.67	17.28	1Kg	1Kg
Gram pulse	10.41	16.36	1Kg	1Kg

⇒ Value Index:

A value index measures changes in both the price & quantities involved

OR

value index measures percent change in the value.

~~P =~~

$$V = \frac{\sum P_t q_t}{\sum P_0 q_0} \times 100.$$

⟹ Example :

The prices & quantities sold at the Waleska Clothing Emporium for various items of apparel for May 2000 & May 2009 are:

Items	2000 Price	2000 Quantity	2009 Price	2009 Quantity
Ties (each)	$ 1	1000	$ 2	900
Suits (")	30	100	40	120
Shoes (Pair)	10	500	8	500

What is the index of value for May 2009 using May 2000 as the base period?

Items	$P_0 q_0$	$P_t q_t$
Ties	$ 1000	$1800
Suits	3000	4800
Shoes	5000	4000
	$ 9000	$ 10600

$$V = \frac{\sum P_1 q_1}{\sum P_0 q_0} \times 100$$

$$V = \frac{10600}{9000} \times 100$$

$$\boxed{V = 117.8}$$

→ Consumer Price Index No. (CPI):

These Index number are also called cost of living Index No.

"These Index No. measures the relative change in purchasing a basket of goods & services b/w two periods of time for fixed Income group of people."

The basket of goods & services contains:

- Food
- clothing
- Education
- House-rent
- Misc. etc.

There are two methods to find CPI

1 → Aggregative Expenditure Method:

It is equal to Laspeyres Index No.

$$CPI = \frac{\Sigma P_t q_0}{\Sigma P_0 q_0} \times 100$$

2 → Family Budget Method:

$$CPI = \frac{\Sigma WI}{\Sigma W}$$

where;

$I = \left(P_t / P_o\right) \times 100$ & $W = P_o q_o$

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→ **Example**

An inquiry into the budgets of the middle class families in a city of England gave the following information.

Expenses	Price (1928)	Price (1929)
Food (35 %)	150	145
Rent (15 %)	30	30
Clothing (20 %)	75	65
Fuel (10 %)	25	23
Misc. (20 %)	40	45
Total		

What changes in cost of living the figures of 1929 show as compared to 1928?

Item	W	Price (1928)	Price (1929)	I	IW
Food	35	150	145	96.7	3384.5
Rent	15	30	30	100	1500
Clothing	20	75	65	86.7	1734
Fuel	10	25	23	92	920
Misc.	20	40	45	112.5	2250
Total	100				9788.5

$$CPI = \frac{\Sigma IW}{\Sigma W}$$

$$= \frac{9788.5}{100}$$

$$\boxed{CPI = 97.9}$$

⟹ Example.

The following table gives average annual prices of ten commodities during the years 1990 & 1994. Calculate CPI Index No. for 1994 on the basis of 1990.

Commodity	Quantity Consumed	Price in 1990	Price in 1994.
Wheat	25 kgs	1.25	1.50
Rice	10 "	3.00	3.75
Pulse	12 "	2.50	3.00
Sugar	4 "	2.00	3.25
Ghee	3 "	3.75	4.00
Milk	30 Liters	0.50	0.75
Vegetables	35 kgs	0.25	0.40
Fuel	200 "	0.50	0.75
Cloth	22 meters	1.50	2.10
House Rent.	1 unit	30.00	60.00

Commodity	$I = \frac{P_t}{P_o} \times 100$	$W = p_o q_o$	WI
Wheat	120	(1.25)(25) = 31.25	3750
Rice	125	30	3750
Pulse	120	30	3600
Sugar	162.5	8	1300
Ghee	106.7	11.25	1200.4
Milk	150	15	2250
Veg.	160	8.75	1400
Fuel	150	100	15000
Cloth	140	33	4620
House Rent	200	30	6000
		297.25	42870.4

$$CPI = \frac{\Sigma WI}{\Sigma W}$$

$$= \frac{42870.4}{297.25} = 144.2$$

→ Limitations of Index No:

- All index numbers are not suitable for all purposes.

- There may be errors in the choice of base periods.

- These are simply rough indication of the relative changes.

- Comparisons over long periods are not possible.

- Different methods of construction of index numbers give different results.