Index numbers

Q1. What is index numbers?

Sol. Index number are device for measuring difference in the magnitude of a group of related variables.

Problems in the construction of index numbers.

(1) The purpose of the index
(2) Selection for Base Period
(3) Price Quotations
(4) Choice of an Average
(5) Selection of appropriate weights

Methods of construction index numbers.

(1) Unweighted
   (a) Simple Aggregative Method
   (b) Simple Average of Relatives
(2) Weighted
   (a) weighted average
   (b) weighted average of Relatives

I Unweighted formula for Index numbers

$$P_0 = \frac{\Sigma p_1}{\Sigma p_0} \times 100$$

or $P_0 = \frac{\text{current year}}{\text{base year}} \times 100$

eg: Calculate the index number for 2012 and 2011 as base are 300 and 360.

∴ 2012 is current
2011 is base yr.

Sol: Given $\Sigma p_1 = 360$
$\Sigma p_0 = 300$

formula $P_0 = \frac{\Sigma p_1}{\Sigma p_0} \times 100$

$= \frac{360}{100} \times 100$

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Eg From the following data construct an index for 2012 taking 2011 as base.

Commodity	price in 2011 (Rs)	price in 2012 (Rs)
A	50	70
B	40	70
C	80	90
D	110	120
E	40	40

Solution

Commodity	price in 2011 (p_0)	Price in 2012 (p_1)
A	50	70
B	40	70
C	80	90
D	110	120
E	40	40
	$\Sigma p_0 = 320$	$\Sigma p_1 = 380$

$$\therefore P_{01} = \frac{\Sigma p_1}{\Sigma p_0} \times 100$$

$$= \frac{380}{320} \times 100$$

$$= 118.75\%$$

∴ To compare to 2011, in 2012 there is a net increase in the price of commodity included in the index to the extent of 118.75% - 18%.

II Weighted index Number

Under weighted index number we have certain formula as:

(1) Laspeyres Index $P_{01} = \frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} \times 100$

(2) Passche index $P_{01} = \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1}$

(3) Drobish-Bowley index $P_{01} = \left[\frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} + \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1}\right] \times 100 \div 2$

(4) Walsch's index $P_{01} = \frac{\Sigma p_1 \sqrt{q_0 q_1}}{\Sigma p_0 \sqrt{q_0 q_1}} \times 100$

(5) Fisher index $P_{01} = \sqrt{\frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} \times \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1}} \times 100$

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(8)

Q:1. The Price and Quantity of 4 commodities in the year 1982 and 1982. Construct the following index number of Price for the year 1983 by using as the base year

Commodities	1982		1983	
	Price	Quantity	Price	Quantity
A	5	100	6	150
B	4	80	5	100
C	2.5	60	5	72
D	12.0	30	9	33

Solution

commodities

	Quantity P_0	Quantity q_0	Price P_1	Quantity q_1	P_1q_0	P_0q_0	P_1q_1	P_0q_1
A	5	100	6	150	600	500	900	750
B	4	80	5	100	400	320	500	400
C	2.5	60	5	72	300	150	360	180
D	12	30	9	33	270	360	297	396
					ΣP_1q_0 = 1570	ΣP_0q_0 = 1330	ΣP_1q_1 = 2057	ΣP_0q_1 = 1726

(A) Laspeyre Index $P_{01} = \frac{\Sigma P_1q_0}{\Sigma P_0q_0} \times 100 = \frac{1570}{1330} \times 100 = 118.05$

(B) Passche's Index $P_{01} = \frac{\Sigma P_1q_1}{\Sigma P_0q_1} \times 100 = \frac{2057}{1726} \times 100 = 119.18$

(C) Drobish-Bowley Index $P_{01} = \frac{\left[\frac{\Sigma P_1q_0}{\Sigma P_0q_0} + \frac{\Sigma P_1q_1}{\Sigma P_0q_1}\right]}{2} \times 100$

$= \frac{\frac{1570}{1330} + \frac{2057}{1726}}{2} \times 100$

$= \frac{1.18045 + 1.19178}{2} \times 100$

$= \frac{2.37223}{2} \times 100$

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$= \frac{237.223}{2}$

$= 118.61$ //

(D) Walsch's index $P_{01} = \frac{\Sigma P_1 \sqrt{q_0 q_1}}{\Sigma P_0 \sqrt{q_1 q_1}} \times 100$

$P_1 = 25$

$P_0 = 23.5$

$P_{01} = \frac{1793.81}{1511.96} \times 100$

$= 1.1864 \times 100$

$= 118.64$ //

$\Sigma P_1 \sqrt{q_0 q_1} = 1793.2$

$P_1 \sqrt{28310}$

$\Sigma P_0 \sqrt{q_1 q_1}$

$23.5 \sqrt{3209.10}$

$= 1511.96$

Price relative in chain base (Link Relative)

formula link Relative of the year

$= \frac{\text{current year}}{\text{previous year}} \times 100$ or $\frac{\Sigma P_1}{\Sigma P_0} \times 100$

eg.! Calculate the index & link Relative

year	1970	1971	1972	1973	1974	1975	1976	1977	1978
price	7.37	8.56	9.06	9.62	9.94	10.37	11.00	10.50	9.37

year	1979	1980	1981
price	10.12	10.62	10.00

Solution:

$\frac{\Sigma P_1}{\Sigma P_0} \times 100$ Link Relative

year	price	Calculated Link Relative price
1970	7.37	
1971	8.56	$\frac{8.56}{7.37} \times 100$
1972	9.06	$\frac{9.06}{9.06} \times 100$
1973	9.62	$\frac{9.94}{9.62} \times 100$
1974	9.94	$\frac{10.37}{9.94} \times 100$
1975	10.37	$\frac{11.00}{10.37} \times 100$
1976	11.00	$\frac{10.50}{11.00} \times 100$
1977	10.50	$\frac{9.37}{10.52} \times 100$
1978	9.37	$\frac{10.12}{10.62} \times 100$
1979	10.12	$\frac{10.62}{10.62}$
1980	10.62	
1981	10.00	

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Price Relative in chain base (Link Relative)

formula for link Relative of the year

$= \frac{\text{Current year}}{\text{Previous year}} \times 100$ or $\frac{\Sigma p_1}{\Sigma p_0} \times 100$

eg 1. Calculate the index of link Relative

year	Price	year	price
1970	7.37	1975	10.37
1971	8.56	1976	11.00
1972	9.06	1977	10.50
1973	9.62	1978	9.37
1974	9.94	1979	10.12
		1980	10.62
		1981	10.00

Note:
(1) B calculate link Relative first we need calculate link Relative Price with base and current year, eg. shown in eg:

Solution

year	Price	Calculated Link Relative Price	$\frac{\Sigma p_1}{\Sigma p_0} \times 100$ Link Relative
1970	7.37	—	100
1971	8.56	$\frac{8.56}{7.37} \times 100$	116
1972	9.06	$\frac{9.06}{9.06} \times 100$	106
1973	9.62	$\frac{9.94}{9.62} \times 100$	106
1974	9.94	$\frac{10.37}{9.94} \times 100$	103
1975	10.37	$\frac{11.00}{10.37} \times 100$	104
1976	11.00	$\frac{10.50}{11.00} \times 100$	106
1977	10.50	$\frac{9.37}{10.50} \times 100$	95
1978	9.37	$\frac{10.12}{9.37} \times 100$	89
1979	10.12	$\frac{10.62}{10.12} \times 100$	105
1980	10.62	$\frac{10.00}{10.62} \times 100$	105
1981	10.00		

~~94~~

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Chain Index Number (6)

formula

Chain index for current year =

$$= \frac{\text{link relative of current year} \times \text{chain index of base year}}{100}$$

eg: Construct an index number with 1985 base and by chain base

year	1975	1976	1977	1978	1979	1980
price	50	60	62	65	70	78

Notes:
1. To calculate chain index base, first calculate index relative
2. index value divided by base and current year.

Solution

year	price	index relative	chain index base
1975	50	—	100
1976	60	$\frac{60}{50} \times 100 = 120$	$= \frac{120 \times 100}{100} = 120$
1977	62	$\frac{62}{60} \times 100 = 103.33$	$= \frac{103.33 \times 120}{100} = 124$
1978	65	$\frac{65}{62} \times 100 = 104.84$	$= \frac{104.84 \times 124}{100} = 130$
1979	70	$\frac{70}{65} \times 100 = 107.69$	$= \frac{107.69 \times 130}{100} = 140$
1980	78	$\frac{78}{70} \times 100 = 111.43$	$= \frac{111.42 \times 140}{100} = 156$ //

Home work

2. Construct an index number taking as 1980 as base year by chain base only.

H.W

year	1977	1978	1979	1980	1981	1982
price	60	70	72	75	80	82

3. Calculate price relative in chain base

year	1961	1962	1963	1964	1965	1966
price	6.37	9.60	10.07	10.62	11.27	12.00
year	1967	1968	1969	1970	1971	1972
price	12.14	9.37	10.12	11.50	10.62	12.00

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Cost of living index

Cost of living index is also known by different names as

1. Consumer price index number
2. Retail price index number
3. cost of living price index
4. Price of living index

Definition

① What is the cost of living?

definition:

The cost of living is the amount of money needed to sustain a certain standard of living by affording basic expenses such as housing, food, taxes and healthcare. It is also to compare how expensive it is to live in one place to another.

② What is the cost of living index?

A cost of living index is a theoretical price index that measures relative cost of living over time or regions. It is an index that measure differences in the price of goods and services.

Step to construct the cost of living index or (consumer price index)

The following are the step in constructing a consumer price index

1. To determing the scope of the index
2. To conduct a family budget enquiry
3. To Average price quotation
4. To obtain price quotation
5. To weighting of index number.

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(8) Method of construction of cost of living index

The two method are used for the construction of consumer price index are:

(i) Aggregative Expenditure Method

formula

$$P_{01} = \frac{\Sigma P_1 q_0}{\Sigma P_0 q_0} \times 100$$

(ii) Family Budget Method

formula

$$P_{01} = \frac{\Sigma IV}{\Sigma V} \text{ or } \frac{\Sigma\left(\frac{P_1}{P_0} \times 100\right) \times P_0 q_0}{\Sigma P_0 q_0}$$

Here P_{01} = is current year

I denotes $\frac{P_1}{P_0} \times 100$, V denote base year as $P_0 q_0$

eg: 1. Construct the index using Aggregative Expenditure Method

Commodity	Qty consumed	Unit of price	Price 2004	Price 2006
Wheat	250 kg	Rs 10 kg	120	150
Rice	100 kg	Rs 40/kg	800	1120
Sugar	18 kg	Rs 40/kg	440	1200
Milk	57 kg	Rs 1/kg	18	32
Tea	14 kg	Rs 100/kg	17800	18000
Salt	1 kg	Rs. 1/kg	1	5

Solution

Commodity	Quantity consumed	Q_0	Price P_0	Price q_1	Aggregative Expenditure $P_0 q_0$	Aggregative Expenditure $P_0 q_1$
Wheat	250 kg	25 bags	120	150	3000	3750
Rice	100 kg	2.5 bags	800	1120	2000	2800
Sugar	18 kg	0.45 bag	440	1200	198	540
Milk	57 kg	57 kg	18	32	1026	1824
Tea	14 kg	0.14 kg	17800	18000	2492	2520
Salt	1 kg	1 kg	1	5	1	5
					8717	11439

formula Family Budget Expenditure $P_E = \frac{\Sigma P_1 q_0}{\Sigma P_0 q_0} \times 1000$

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$= \frac{11439}{8717} \times 100$

$= 131.23\%$

eg.2. Construct the index using Aggregative Expenditure Method.

Commodities	price 1960 (Rs)	price 1973	Quantity
A	8.00	12.00	100
B	6.00	7.50	25
C	5.00	5.25	10
D	48.00	52.00	20
E	15.00	16.00	25
F	9.00	27.00	30

Solution

Commodity	price 1960 (P_0)	1973 P_1	Quantity q_0	Aggregative Expenditure P_0q_0	P_1q_1
A	8.00	12.00	100	800	1200.00
B	6.00	7.50	25	150	187.50
C	5.00	5.25	10	50	52.50
D	48.00	52.00	20	960	1040.00
E	15.00	16.00	25	375	412.50
F	9.00	27.00	30	270	810.00
				$\Sigma P_0q_0 = 2605$	$\Sigma P_1q_1 = 3702.00$

∴ Aggregative Expenditure for current year index $= \frac{\Sigma P_1q_0}{\Sigma P_0q_0} \times 100$

$= \frac{3702.5}{2605} \times 100$

$= 1.4213 \times 100$

$= 142.13$ //

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Family Budget Method

eg:1. construct Family Budget Method for the following

Goods	Price 1960	Price Relatives 1973
A	1960	1973
B	8.00	12.00
C	6.00	7.50
D	5.00	5.25
E	48.00	52.00
F	15.00	16.00
	9.00	27.00

Notes:

① Here we need to find out I values & index

∴ $I = \frac{P_1}{P_0} \times 100$ base on given data

Solution

Goods	price 1960	Price Relatives 1973	$I = \frac{P_1}{P_0} \times 100$	Weight (V) value in base year P_0V_0	IV
A	1960	1973			
B	8.00	12.00	150.00	800.00	120.00
C	6.00	7.50	125.00	150	18.750
D	5.00	5.25	105.00	50	5.250
E	48.00	52.00	108.00	960	103996.80
F	15.00	16.00	110.00	375	41.250
	9.00	27.00	300.00	270	81.00
				$\Sigma V = 2605$	$\Sigma IV = 370246.8$

∴ Family Budget Method formula

$$E_{fm} = \frac{\Sigma IV}{\Sigma V} = \frac{370246.8}{2605}$$

$$= 142.123 \text{ //}$$

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