

## TOPIC 3: Index numbers

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An index number is a statistical measure that shows a change in a variable or group of variables with respect to time. The period can be in days, week, months, years. Variables include prices in commodities, wages, salaries, e.t.c

Terms used:

Base year (b): This is a year against which all other years are compared when getting index numbers.

Current year(c): This is the year for which the index number is being calculated

**Price relative/ relative index numbers:**

If  $P_c$  denotes price of the commodity in the current year and  $P_b$ , denotes price of the commodity in the base year, then

Simple relative index/price relative,  $P_r = \frac{P_c}{P_b} \times 100$

**Example 1:** An article was at a cost of 500/= in 1970 and 800/= in 1990. Using 1970 as the base year, find the price relative in 1990.

**Solution**

$$P_r = \frac{P_c}{P_b} \times 100 = \frac{800}{500} \times 100 = 160$$

**Note:** The value is written without a percentage sign because it just a number.

Interpretation: The price of a this article increased by 60%

**Example 2:**

In 1970, the price relative of the commodity using 1986 as the base year was 112, that of the same commodity in 1996 using 1990 as the base year was 85.

What would have been the index/ price relative, in 1996 using 1986 as the base year.

Let  $P_0 \rightarrow 1986, P_1 \rightarrow 1990, P_2 \rightarrow 1996$

$$\text{Required is } \frac{P_2}{P_0} \times 100 = \frac{P_2}{P_1} \times \frac{P_1}{P_0} = \frac{85}{100} \times \frac{112}{100} \times 100 = 95.2$$

### A group of commodities

1. **Simple price index/Simple average price relative:** A single price index number for a group of commodities can be calculated using the average of price relatives. i.e

$$\text{Simple average of price relatives} = \frac{\sum P_r}{n}$$

Where  $\sum P_r$  = summation of price relatives,  $n$  = number of commodities.

It does not take into account the relative importance of the commodities

2. **Simple aggregate price index**

$$\text{Simple aggregate price index} = \frac{\sum P_c}{\sum P_b} \times 100$$

Where  $\sum P_c$  = summation of prices of commodities in the current year

$\sum P_b$  = summation of the prices of the commodities in the base year

It does not take into account the relative importance of commodities.

It ignores units of commodities.

**Example 3:** Given the information below

Commodity	Price in the year 2000	Price in the year 2003
A	600	800
B	500	600
C	700	1000
D	1200	1600
E	1000	1500

Calculate the simple aggregate price index for 2003 taking 2000 as the base year.

**Solution**

$$\text{Simple aggregate price index} = \frac{\sum P_c}{\sum P_b} \times 100$$

$$= \frac{800 + 600 + 1000 + 1600 + 1500}{600 + 500 + 700 + 1200 + 1000} = 137.5$$

**Note:** simple average and simple aggregate price index ignore the relative importance of commodities. Weighing is used to reflect the importance of each item hence we can use weighted index numbers.

### WEIGHTED INDEX NUMBERS

a) The weighted average of price relative =  $\frac{\sum (wP_r)}{\sum w}$

$P_r$  = price relative for each item

W = weight

b) The weighted aggregate price index =  $\frac{\sum wP_c}{\sum wP_b} \times 100$

### Example 3:

The table below shows expenditure in a certain home

commodity	Cost in shs		weight
	1997	1998	
Fish(1kg)	1200	1600	4
Beans(1 cup)	800	1200	3
Rice (1kg)	400	500	2
Salt (1kg)	600	300	1

Calculate:

- Price relatives for each item for 1998 using 1997 as the base year
- Weighted average of price relatives. Comment on your result
- The weighted aggregate of price index
- If the cost of these items in a certain home in 1997 was 1200/= find the cost in 1998 using the index in iii) above

**Solution:**

Item	Base price $P_b$	Current price $P_c$	$P_r = \frac{P_c}{P_b} \times 100$	Weight (w)	$w P_r$	$w P_b$	$w P_c$
Fish	1200	1600	133.33	4	533.32	4800	6400
Beans	800	1200	150	3	450	2400	3600
Rice	400	500	125	2	250	800	1000
Salt	600	300	50	1	50	600	300
				$\sum w$ = 10	$\sum w P_r$ = 1283.32	$\sum w P_b$ = 8600	$\sum w P_c$ = 11300

- Price relatives for Fish=133.33, for beans=150, for rice=125, for salt=50
- Weighted average of price relatives =  $\frac{1283.32}{10} = 128.32$ . The cost of these items increased by 28.32% between 1997 and 1998
- Weighted aggregate price index =  $\frac{11300}{8600} \times 100 = 131.395$
- Let C be the cost of these items in 1998  

$$\frac{C}{12000} \times 100 = 131.395$$

$$C = 15767.74\%$$

Sometimes we are given weights of different periods; the base period and the current period. In such a case, the methods that can be used include:

Paasche aggregate price index =  $\frac{\sum W_c P_c}{\sum W_c P_b} \times 100$ , where  $W_c$  is the price in the current year

Laspeyre aggregate price index =  $\frac{\sum W_b P_c}{\sum W_b P_b}$ , where  $W_b$  is the price in the base year.

**Note:**

- In cases where quantities are used instead of weights the formulas are the same but for weight 'W' we use quantity 'Q'
- Quantity index,  $Q_r = \frac{\sum Q_c}{\sum Q_b} \times 100$
- Simple average quantity index =  $\frac{\sum Q_r}{n}$
- Value index =  $\frac{\sum P_c Q_c}{\sum P_b Q_b} \times 100$

### Assignment 3.1.3

1. The table below shows the prices of items (in ug shs) during 2010 and 2011

ITEM	PRICE PER kg		WEIGHT
	IN 2010	IN 2011	
A	2400	3600	5
B	1500	1800	2
C	1,200	1500	4

Taking prices in 2010 as the base year calculate the:

- i) Price relative for each of the item in 2011, hence obtain the simple price relative for items in 2011
- ii) Simple aggregate price index for items in 2011

- iii) Weighted average price index for items in 2011
- iv) Weighted aggregate price index for items in 2011
- 2. The price relatives of items for the tear 2011, 2012 and 2013 based on 2010 are 120, 95 and 110 respectively. Compute the new price relatives for 2010, 2011 and 2013 taking 2012 as the base year
- 3. The price relatives for 5 items with their respective weights are as follows.

Items	A	B	C	D	E
Price relatives	120	y	130	120	125
weights	5	2	4	1	3

Given that the weighted average price index for the items is 127. Find the:

- i) Value of y
- ii) Simple price index for the items
- 4. The prices of three items and quantities sold for two periods are as follows:

ITEMS	2012		2013	
	PRICE	QUANTITY	PRICE	QUANTITY
A	2500	5	3000	3
B	3000	2	3500	4
C	4000	3	5000	3

Using 2012 as the base year, calculate the value index of the items sold in 2013