UNIT-IV

Index numbers: Definition, uses, Problems in the construction of index numbers- Laspeyre’s, Paasche, Marshall Edge worth and Fisher’s Ideal Index Numbers- Test for Index Number *group of related variables over time*

- *Index numbers are expressed in terms of percentage*
- *Of the two periods, the period with which the comparison is to be made is known as the base period.*
- *Index number for base period is always taken as 100.*
- *Therefore the study of index numbers helps us to know percentage change in the values of different variables over a period of time with reference to the base year*

specialised averages	variables which have different units
Index numbers are measures of relative changes	Index numbers measures the relative (percentage) changes in the variables over a period of time. They are expressed in percentage.
They measure changes in composite and complex phenomenon	Index numbers are used to measure changes in magnitude of certain phenomenon which are not capable of direct measurement.
Basis of comparison	• They are constructed to make comparison over different time periods with reference some base year. Index numbers measure changes and compare economic conditions of different business units, different places in relation to some base year

formulatio
n of
policies

measuring
inflation
and
defiation

Helpful in
knowing the
changes in
standard of
living

Useful to
businessme
n. Important
device of
business
world

Useful to
assess
exports
and
imports

Useful to
government
in studying
changes in
trend.

construction of index numbers

- The purpose of construction must be rigidly defined. Its not for all purpose. Every index numbers have specific use
- If the purpose of construction is not clearly defined it will be wastage of time and effort

base year

- The base year must be normal year that is without abnormalities like war earthquake inflation etc. It should not be very distant from current year.
- The base year period should be clearly defined.

number of items

- It refers to collection of data which should be determined by the purpose for which the index numbers is constructed
- Only standardised or graded items should be included so that reasonable standard of accuracy can be maintained

sources of data

ensure the reliability of data which is to ensure that data is reliable and comparable

Price quotations

- We require unbiased price quotations so that adequate accuracy can be maintained.
- To ensure uniformity two methods of quoting should be adopted- money prices (prices quoted is per unit commodity) and quantity prices (prices are quoted per unit of money)

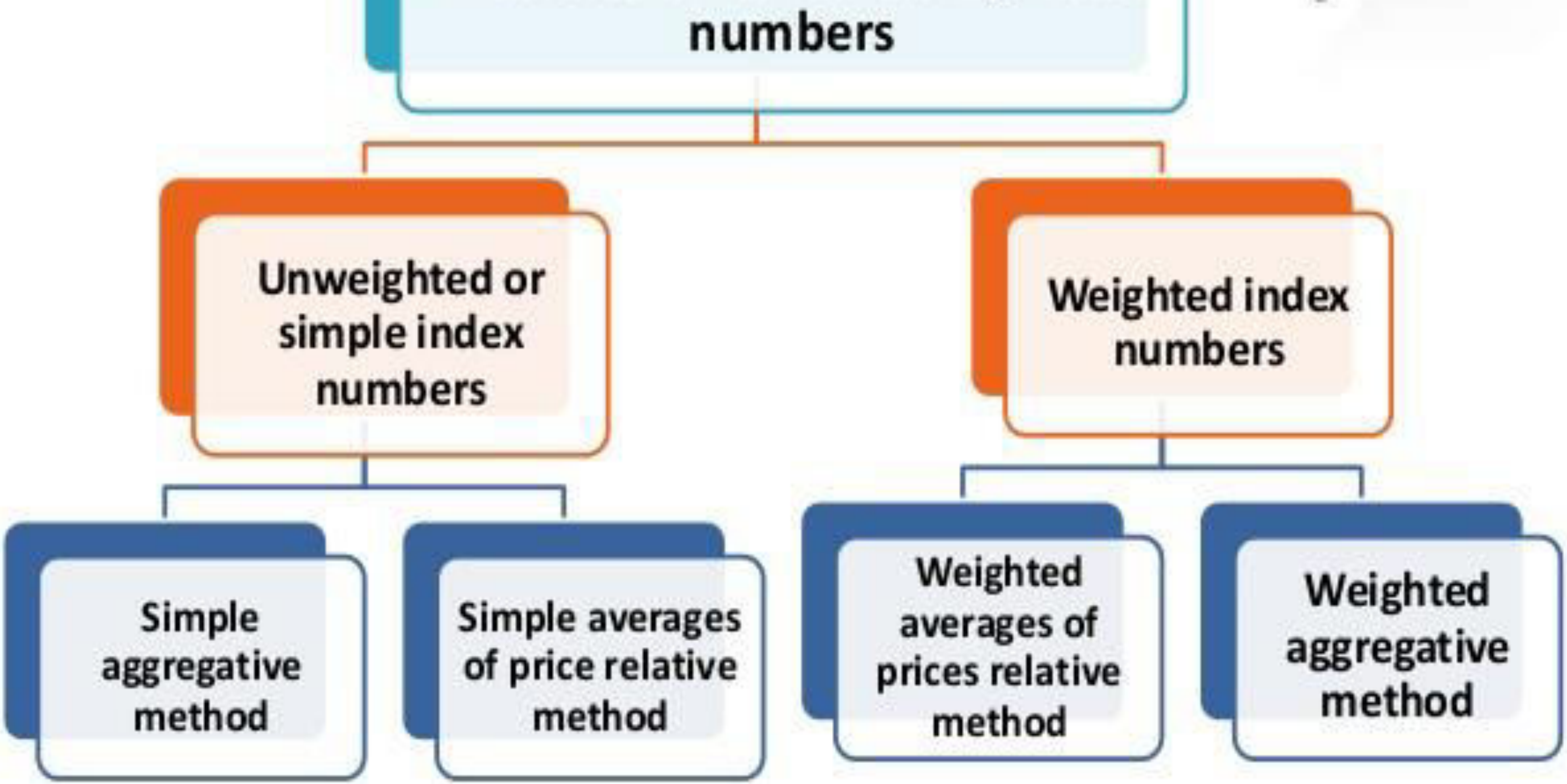
Selection of an average

- Index numbers are specialised averages. We need to select from various averaged. Median and mode can't be used because of their limitations.
- We need to select arithmetic mean or geometric mean.

- *It refers to assigning relative importance to different items included in the construction of index numbers*
- *Their are two types of indices weighted and. unweighted . Weighted all commodities are given equal Importance*
- *Unweighted include quantity weights (commodities are given importance according to the amount of quantity) and value weight (importance is given according to amount of expenditure (P * Q)*

Selection of appropriate formula

- Selection of formulae from laspeyre's method, paasche's method, fisher's method etc
- We can't depend on one formulae and selection depends upon type and purpose of index numbers


numbers
Unweighted or simple index numbers
Weighted index numbers
Simple aggregative method
Simple averages of price relative method
Weighted averages of prices relative method
Weighted aggregative method

- In this method aggregate price of commodities in current year ($\sum P1$) are divided by the aggregate price of these commodities in the base year($\sum P0$) and expressed in percentage

symbolically

$$P_{01} = \frac{\sum P1}{\sum P0} * 100$$

P_1 - price index of current year

$\sum P1$ -sum of prices of commodities of current year

$\sum P0$ - sum of prices of commodities of base year

Commodities	A	B	C	D	E
Prices in 2000	16	40	35	9	2
Prices in 2008	20	60	70	18	1.50

Solution

Commodities	Prices in 2000 (P0)	Prices in 2008(P1)
A	16	20
B	40	60
C	35	70
D	9	18
E	2	1.50
total	102	169.5

$$P_{01} = \frac{\sum P1}{\sum P0} * 100$$

$$P_{01} = \frac{169.5}{102} X \ 100$$

$$= 166.18$$

relative is the price for current year expressed as percentage of the period of base year.

- Symbolically

$$P_{01} = \frac{\sum \left(\frac{P1}{P0} * 100\right)}{N} \quad \text{or} \quad P_{01} = \frac{\sum PR}{N}$$

P1- prices of current year **P0- prices of base year**

N- number of commodities

R or $\sum PR$ - price relative

$$\sum PR = \frac{\sum \left(\frac{P1}{P0} * 100\right)}{N}$$

Example:

- Construct index numbers for following data using average of relative price method

Commodities	P	Q	R	S	T
Prices in 1998	40	28	12.5	10	30
Prices in 2004	50	35	15	20	90

Solution:

commodities	Prices in 1998	Prices in 2004	Price relative (PR)
P	40	5	125
Q	28	35	125
R	12.5	15	120
S	10	20	200
T	30	90	300
Total	120.5	210	870

$$P_{01} = \frac{\Sigma \left(\frac{P1}{P0} * 100\right)}{N}$$

$$P_{01} = \frac{\frac{210}{120.5}}{5} X\ 100 \quad = 174$$

Or

$$P_{01} = \frac{\Sigma PR}{N}$$

$$P_{01} = \frac{870}{5} \quad = 174$$

$$PR = P_1 / P_0 \times 100$$

50/40x100=125
35/28x100=125
15/12.5x100=120
20/10x100=200
90/30x100=300

of the commodities in the base year.

- Formulae is

$$P_{01} = \frac{\sum p_1 q_0}{\sum p_0 q_0} * 100$$

p_1 - prices of current year

p_0 - prices of base year

q_0 -Quantities of base year

$\sum p_1 q_0$- sum total of the product of prices of current year (p_1) and quantities of the base year(q_0)

$\sum p_0 q_0$- sum total of the product of prices of base year (p_0) and quantities of base year (q_0)

Commodities	1997		2008	
	prices	quantity	prices	quantity
A	20	4	40	6
B	50	3	60	5
C	40	5	50	10
D	20	10	40	20

	es	y	s	y		
A	20	4	40	6	160	80
B	50	3	60	5	180	150
C	40	5	50	10	250	200
D	20	10	40	20	400	200
Total					990	630

$$P_{01} = \frac{\sum p_1 q_0}{\sum p_0 q_0} * 100$$

$$= \frac{990}{630} \times 100$$

$$= 157.26$$

commodities in their current year.

- Formulae

$$P_{01} = \frac{\sum p_1 q_1}{\sum p_0 q_1} * 100$$

p_1 *-Prices of current year*

p_0 *-prices of base year*

q_1 *-Quantities of the current year*

$\sum p_1 q_1$ *- sum of total of the product of price of the current year (* p_1 *) and quantities of the current year (* q_1 *)*

$\sum p_0 q_1$ *- sum of total of the product of price of base year (* p_0 *) and quantities of the current year (* q_1 *)*

Fisher's method-

- This method was introduced by Prof.Irving fisher. This method combines the techniques of both Laspeyre's method and paasche's method.
- In other words in fisher's method weights are represented by quantities of both base and current year.
- Formulae

$$P_{01} = \sqrt{\frac{\sum p_1 q_0}{\sum p_0 q_0} * \frac{\sum p_1 q_1}{\sum p_0 q_1}} * 100$$

$$P_{01} = \sqrt{L * P}$$

p_1 *-Prices of current year*

p_0 *-prices of base year*

q_1 *-Quantities of the current year*

q_0 - **Quantities of base year**

L- Laspeyre's method and
P- paasche's method

Commodities	Base year 1998		Current year 2009	
	prices	quantities	prices	quantities
A	2	100	3	100
B	8	200	10	50
C	10	300	15	100
D	6	400	10	50

A	2	100	3	100	300	200	300	200
B	8	200	10	50	2000	1600	500	400
C	10	300	15	100	4500	3000	1500	1000
D	6	400	10	50	4000	2400	500	300
Total					10800	7200	2800	1900

$$P_{01} = \sqrt{\frac{\sum p_1 q_0}{\sum p_0 q_0} * \frac{\sum p_1 q_1}{\sum p_0 q_1}} * 100 \quad P_{01} = \sqrt{\frac{10800}{7200} X \frac{2800}{1900}} X\ 100$$

$$P_{01} = \sqrt{1.5\ X\ 1.437} X\ 100 = \sqrt{2.2105} X\ 100 = 148.7$$

Find- (1) Laspeyers Index (2) Paasche's Index (3)Fisher Ideal Index.

	2002		2007	
ITEMS	PRICE	PRODUCTION	PRICE	PRODUCTION
BEEF	15	500	20	600
MUTTON	18	590	23	640
CHICKEN	22	450	24	500

				(q_1)				
BEEF	15	500	20	600	10000	7500	12000	9000
MUTTON	18	590	23	640	13570	10620	14720	11520
CHICKEN	22	450	24	500	10800	9900	12000	11000
TOTAL					34370	28020	38720	31520

$$p_{01} = \frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100 = \frac{34370}{28020} \times 100 = 122.66$$

2. Paasche's Index :

$$p_{01} = \frac{\sum p_1 q_1}{\sum p_0 q_1} \times 100 = \frac{38720}{31520} \times 100 = 122.84$$

3. Fisher Ideal Index

$$P_{01} = \sqrt{\frac{\sum p_1 q_0}{\sum p_0 q_0} \times \frac{\sum p_1 q_1}{\sum p_0 q_1}} \times 100 = \sqrt{\frac{34370}{28020} \times \frac{38720}{31520}} \times 100 = 122.69$$

$$p_{01} = \frac{\sum p_1 q_0 + \sum p_1 q_1}{\sum p_0 q_0 + \sum p_0 q_1} \times 100$$

Kelly's Method.

Kelly thinks that a ratio of aggregates with selected weights (not necessarily of base year or current year) gives the base index number.

$$p_{01} = \frac{\sum p_1 q}{\sum p_0 q} \times 100$$

q refers to the quantities of the year which is selected as the base. It may be any year, either base year or current year.

TEST FOR

IDEAL INDEX NUMBERS

Time Reversal Test:

This test was suggested by Irving Fisher as one of the two tests of consistency of an index number.

According to Fisher,

If the time script of any index number be interchanged, then the resulting index should be reciprocal of the original index.

That is, $P_{0n} = \dfrac{1}{P_{n0}}$

$$\Rightarrow P_{0n} \times P_{0n} = 1$$

$$P_{on} = \sqrt{\frac{\sum P_n q_0}{\sum P_0 q_0} \times \frac{\sum P_n q_n}{\sum P_0 q_n}}$$

$$\text{And } P_{no} = \sqrt{\frac{\sum P_o q_n}{\sum P_n q_n} \times \frac{\sum P_o q_o}{\sum P_n q_o}}$$

$$Now, P_{0n} \times P_{n0} = \left(\frac{\sum P_n q_0}{\sum P_0 q_0} \times \frac{\sum P_n q_n}{\sum P_0 q_n} \times \frac{\sum P_o q_n}{\sum P_n q_n} \times \frac{\sum P_o q_o}{\sum P_n q_o}\right)^{\frac{1}{2}} = 1$$

Therefore, Fisher's index satisfy the time reversal test.

This test was suggested by Irving Fisher. According to this test, the formula for calculating an index number should permit the interchanging of prices and quantities without providing inconsistent result, that is , the product of these two results should give the value index except any constant of proportionality.

That is, $$P_{0n} \times q_{0n} = v_{0n} = \frac{\sum p_n q_n}{\sum p_0 q_0}$$

$$P_{on} = \sqrt{\frac{\sum P_n q_0}{\sum P_0 q_0} \times \frac{\sum P_n q_n}{\sum P_0 q_n}}$$

$$\text{And } q_{0n} = \sqrt{\frac{\sum q_n P_0}{\sum q_0 P_0} \times \frac{\sum q_n P_n}{\sum q_0 P_n}}$$

$$\text{Now, } P_{0n} \times q_{0n} = \left(\frac{\sum P_n q_0}{\sum P_0 q_0} \times \frac{\sum P_n q_n}{\sum P_0 q_n} \times \frac{\sum q_n P_0}{\sum q_0 P_0} \times \frac{\sum q_n P_n}{\sum q_0 P_n}\right)^{\frac{1}{2}} = \frac{\sum p_n q_n}{\sum p_0 q_0} = v_{0n}$$

Therefore, Fisher's index satisfy the factor reversal test.

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