INDEX NUMBERS

Price Index Questions :-

Compute: (i) Laspeyre's, (ii) Paasche's, (iii) Fisher's, (iv) Bowley's and (v) Marshall Edgeworth's index numbers from the following table:

Commodity	Base Year		Current Year	
	Qty	Price	Qty	Price
A	12	10	15	12
B	15	7	20	5
C	24	5	20	9
D	5	16	5	14

[B.Com (P); D.U; 1993]

Calculate Laspeyre's, Paasche's and Fisher's index numbers from the following data:

Commodity	Base Year Price (₹)	Base Year Quantity	Current Year Price (₹)	Current Year Quantity
A	10	30	12	50
B	8	15	10	25
C	6	20	6	30
D	4	10	6	20

[B.Com (P); D.U; 1977]

You are given the following information:

Commodity	2010		2013	
	Price (₹)	Expenditure (₹)	Price (₹)	Quantity (₹)
A	25	1000	40	50
B	22	396	40	30
C	54	864	30	44
D	20	800	30	45
E	18	540	42	15

Compute price index for 2013 by Fisher's Method. *[B.Com (P); D.U; 2015]*

From the following data calculate price index number for current year by:

(i) Laspeyre's method
(ii) Paasche's method
(iii) Marshall Edgeworth method
(iv) Dorbish and Bowley's method
(v) Fisher's ideal method, and
(vi) Walsch's method

Items	Base Year		Current Year	
	Quantity	Price (₹)	Quantity	Price (₹)
A	15	4	10	6
B	20	3	25	4
C	10	6	20	5
D	30	5	25	5

Calculate Kelly's Price Index from the following data.

Commodity	Quantity Consumed	Price (₹)	
		Base year	Current year
A	10	140	180
B	7	400	550
C	6	100	250
D	8	125	150
E	4	200	300

If the ratio between Laspeyre's (L) and Passache's (P) index numbers is 28.27, find the missing figure in the following table:

Commodity	Base Year		Current Year	
	Price	Quantity	Price	Quantity
A	1	10	2	5
B	1	5	x	2

Example 9:

Given that $\Sigma p_1 q_1 = 250$, $\Sigma p_0 q_0 = 150$, Paasche's index number = 150 and Dorbish and Bowley's index number = 145 Find out (i) Fishers ideal index number and (ii) Marshal Edgeworth index number.

Compute price index by applying weighted average of price relatives:

Commodities	p_0	q_0	p_1 (₹)
Sugar	10	6 kg	15
Rice	20	10 kg	25
Milk	10	8 lt	14

Solutions :-

Solution:

[B.Com (P); D.U; 1993]

Computation of Price Index Numbers

Commodity	p_0	q_0	p_1	q_1	p_1q_0	p_0q_0	p_1q_1	p_0q_1
A	10	12	12	15	144	120	180	150
B	7	15	5	20	75	105	100	140
C	5	24	9	20	216	120	180	100
D	16	5	14	5	70	80	70	80
					$\Sigma p_1q_0 =$ 505	$\Sigma p_0q_0 =$ 425	$\Sigma p_1q_1 =$ 530	$\Sigma p_0q_1 =$ 470

(i) Laspeyre's Price Index

$$P_{01}^{La} = \frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} \times 100 = \frac{505}{425} \times 100 = 118.82$$

(ii) Paache's Price Index

$$P_{01}^{Pa} = \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1} \times 100 = \frac{530}{470} \times 100 = 112.76$$

(iii) Fisher's Price Index

$$P_{o1}^{F} = \sqrt{\frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} \times \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1}}$$

$$= \sqrt{\frac{505}{425} \times \frac{530}{470}} \times 100$$

$$= \sqrt{\frac{267650}{199750}} \times 100$$

$$= \sqrt{1.3399} \times 100$$

$$= 1.1575 \times 100$$

$$= 115.75$$

(iv) Bowley's Price Index

$$P_{o1}^{B} = \frac{\frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} + \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1}}{2} \times 100$$

$$= \frac{\frac{505}{425} + \frac{530}{470}}{2} \times 100$$

$$= \frac{1.1882 + 1.1276}{2} \times 100$$

$$= \frac{2.3158}{2} \times 100$$

$$= 1.1579 \times 100$$

$$= 115.79$$

(v) Marshall Edgeworth's Price Index

$$P_{01}^{ME} = \frac{\Sigma p_1 q_0 + \Sigma p_1 q_1}{\Sigma p_0 q_0 + \Sigma p_0 q_1} \times 100$$

$$= \frac{505 + 530}{425 + 470} \times 100 = \frac{1035}{895} \times 100$$

$$= 1.1564 \times 100 = 115.64$$

Solution:

Computation of Price Index Numbers

Commodity	p_0	q_0	p_1	q_1	p_1q_0	p_1q_1	p_0q_0	p_0q_1
A	10	30	12	50	360	600	300	500
B	8	15	10	25	150	250	120	200
C	6	20	6	30	120	180	120	180
D	4	10	6	20	60	120	40	80
					$\Sigma p_1q_0 =$ 690	$\Sigma p_1q_1 =$ 1150	$\Sigma p_0q_0 =$ 580	$\Sigma p_0q_1 =$ 960

(i) Laspcyre's Method:

$$P_{01}^{La} = \frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} \times 100 = \frac{690}{580} \times 100 = 118.96$$

(ii) Paasche's Method:

$$P_{01}^{Pa} = \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1} \times 100 = \frac{1150}{960} \times 100 = 119.79$$

(iii) Fisher's Ideal Method:

$$P_{01}^{F} = \sqrt{\frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} \times \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1}} \times 100$$

$$= \sqrt{\frac{690}{580} \times \frac{1150}{960}} \times 100$$

$$= \sqrt{1.189 \times 1.197} \times 100$$

$$= \sqrt{1.4232} \times 100$$

$$= 1.1929 \times 100$$

$$= 119.29$$

Solution:

In this problem, we are given the price and expenditure for each commodity in the base year. We know that

$$\text{Expenditure} = \text{Price} \times \text{Quantity}$$

$$\Rightarrow \quad \text{Quantity} = \frac{\text{Expenditure}}{\text{Price}}$$

By using the above formula, we can obtain the quantity consumed of each commodity in the base year as shown in the following table.

Computation of Fisher's Index Number

Commodity	p_0	p_0q_0	q_0	p_1	q_1	p_0q_1	p_1q_0	p_1q_1
A	25	1000	40	40	50	1250	1600	2000
B	22	396	18	40	30	660	720	1200
C	54	864	16	30	44	2376	480	1320
D	20	800	40	30	45	900	1200	1350
E	18	540	30	42	15	270	1260	630
		$\Sigma p_0q_0 =$ 3600				$\Sigma p_0q_1 =$ 5456	$\Sigma p_1q_0 =$ 5260	$\Sigma p_1q_1 =$ 6500

$$P_{01} = \sqrt{\frac{\Sigma p_1q_0}{\Sigma p_0q_0} \times \frac{\Sigma p_1q_1}{\Sigma p_0q_1}} \times 100$$

$$= \sqrt{\frac{5260}{3600} \times \frac{6500}{5456}} \times 100$$

$$= \sqrt{1.4611 \times 1.1913} \times 100$$

$$= \sqrt{1.7461 \times 100}$$

$$= 1.31 \times 100$$

$$= 131$$

Solution:

Calculation for Various Price Index Numbers

Items	p_0	q_0	p_1	q_1	p_0q_0	p_0q_1	p_1q_1	p_1q_0	$\sqrt{q_0q_1}$	$p_1\sqrt{q_0q_1}$	$p_0\sqrt{q_0q_1}$
A	4	15	6	10	60	40	60	90	12.247	73.482	48.988
B	3	20	4	25	60	75	100	80	22.360	89.44	67.08
C	6	10	5	20	60	120	100	50	14.142	70.71	84.852
D	5	30	5	25	150	125	125	150	27.386	136.93	136.93
					Σp_0q_0 = 330	Σp_0q_1 = 360	Σp_1q_1 = 385	Σp_1q_0 = 370		$\Sigma p_1\sqrt{q_0q_1}$ = 370.562	$\Sigma p_0\sqrt{q_0q_1}$ = 337.85

(i) Laspeyre's Price Index

$$P_{01} = \frac{\Sigma p_1q_0}{\Sigma p_0q_0} \times 100 = \frac{370}{330} \times 100$$

$$= 1.1212 \times 100 = 112.12$$

(ii) Paasche's Price Index

$$P_{01} = \frac{\Sigma p_1q_1}{\Sigma p_0q_1} \times 100 = \frac{385}{360} \times 100$$

$$= 1.0694 \times 100 = 106.94$$

(iii) Marshall Edgeworth's Price Index

$$P_{01} = \frac{\Sigma p_1q_0 + \Sigma p_1q_1}{\Sigma p_0q_0 + \Sigma p_0q_1} \times 100$$

$$= \frac{370 + 385}{330 + 360} \times 100$$

$$= \frac{755}{690} \times 100 = 1.0942 \times 100 = 109.42$$

(iv) Dorbish and Bowley's Price Index

$$P_{01} = \frac{L + P}{2}$$

where, L = Laspeyre's Price Index

P = Paasche's Price Index

$$= \frac{112.12 + 106.94}{2} = \frac{219.06}{2} = 109.53$$

(v) Fisher's Price Index

$$P_{01} = \sqrt{\frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} \times \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1}} \times 100$$

$$= \sqrt{L \times P}$$

where, L = Laspeyre's Price Index

P = Passche's Price Index

$$= \sqrt{112.12 \times 106.94} = \sqrt{11990.1128} = 109.49$$

(vi) Walsch's Price Index

$$P_{01} = \frac{\Sigma p_1 \sqrt{q_0 q_1}}{\Sigma p_0 \sqrt{q_0 q_1}} \times 100$$

$$= \frac{370.562}{337.85} \times 100 = 1.0968 \times 100 = 109.68$$

Solution:

Calculation of Kelly's Price Index

Commodity	Quantity Consumed (q)	Price (₹)			
		Base Year (p_0)	Current Year (p_1)	p_0q	p_1q
A	10	140	180	1400	1800
B	7	400	550	2800	3850
C	6	100	250	600	1500
D	8	125	150	1000	1200
E	4	200	300	800	1200
				$\Sigma p_0q = 6600$	$\Sigma p_1q = 9550$

Kelly's Price Index is given by:

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

$$= \frac{9550}{6600} \times 100 = 144.7$$

Solution:

Calculation of Laspeyre's and Paasche's Index Numbers

Commodity	Base Year		Current Year					
	Price p_0	Quantity q_0	Price p_1	Quantity q_1	p_0q_0	p_0q_1	p_1q_0	p_1q_1
A	1	10	2	5	10	5	20	10
B	1	5	x	2	5	2	$5x$	$2x$
					$\Sigma p_0q_0 = 15$	$\Sigma p_0q_1 = 7$	$\Sigma p_1q_0 = 20 + 5x$	$\Sigma p_1q_0 = 10 + 2x$

(i) Laspeyre's Index Number:

$$L = \frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} \times 100 = \frac{20+5x}{15} \times 100 = \frac{4+x}{3} \times 100$$

(ii) Paasche's Index Number:

$$P = \frac{\Sigma p_1 q_1}{\Sigma p_0 q_0} \times 100 = \frac{10+2x}{7} \times 100$$

We are given $\frac{L}{P} = \frac{28}{27}$

$$\Rightarrow \quad \frac{\left(\frac{4+x}{3}\right)}{\left(\frac{10+2x}{7}\right)} = \frac{28}{27} \Rightarrow \frac{7(4+x)}{3(10+2x)} = \frac{28}{27}$$

$$\Rightarrow \quad \frac{4+x}{10+2x} = \frac{28}{27} \times \frac{3}{7} \Rightarrow \frac{4+x}{10+2x} = \frac{4}{9}$$

$$\Rightarrow \quad 9(4+x) = 4(10+2x)$$

$$\Rightarrow \quad 36 + 9x = 40 + 8x$$

$$\Rightarrow \quad x = 4$$

Hence the missing figure is 4.

Solution:

We are given: Paasche's index number = 150

i.e. $$\frac{\Sigma p_1 q_1}{\Sigma p_0 q_1} \times 100 = 150$$

$\Rightarrow$ $$\frac{250}{\Sigma p_0 q_1} \times 100 = 150 \qquad (\because \Sigma p_1 q_1 = 250)$$

$\Rightarrow$ $$\Sigma p_0 q_1 = \frac{250 \times 100}{150} = \frac{500}{3}$$

Also Dorbish Bowley's index number = 145

i.e. $$\frac{L+P}{2} = 145$$

where, L = Laspeyre's Price Index number

P = Paasche's Price Index number

$$\frac{L+150}{2} = 145 \qquad (\because P = 150)$$

$\Rightarrow$ $$L + 150 = 145 \times 2 \Rightarrow L + 150 = 290$$

$\Rightarrow$ $$L = 290 - 150 = 140$$

$$\frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} \times 100 = 140 \text{ or } \frac{\Sigma p_1 q_0}{150} \times 100 = 140 \qquad (\because \Sigma p_0 q_0 = 150)$$

$\Rightarrow$ $$\Sigma p_1 q_0 = \frac{140 \times 150}{100} = 210$$

(i) Fisher's Ideal Index Number is given by:

$$P_{01}^F = \sqrt{\frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} \times \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1}} \times 100$$

$$= \sqrt{\frac{210}{150} \times \frac{250}{500} \times 3} \times 100$$

$$= 1.4491 \times 100$$

$$= 144.91$$

(iii) Marshall Edgeworth's Index Number is given by:

$$P_{01} = \frac{\Sigma p_1 q_0 + \Sigma p_1 q_1}{\Sigma p_0 q_0 + \Sigma p_0 q_1} \times 100$$

$$= \frac{210 + 250}{150 + \frac{500}{3}} \times 100$$

$$= \frac{3(460)}{450 + 500} \times 100 = \frac{1380}{950} \times 100$$

$$= 1.4526 \times 100 = 145.26$$

Solution:

Calculation of Price Index by using Weighted Average of Price Relatives (A.M. and G.M)

Price Relative

Commodities	p_0	p_1	q_0 or W	$P = \frac{p_1}{p_0} \times 100$	WP	$\log P$	$W \log P$
Sugar	10	15	6	$\frac{15}{10} \times 100 = 150$	900	2.1761	13.0566
Rice	20	25	10	$\frac{25}{20} \times 100 = 125$	1250	2.0969	20.969
Milk	10	14	8	$\frac{14}{10} \times 100 = 140$	1120	2.1461	17.1688
			$\Sigma W = 24$		$\Sigma WP = 3270$		$\Sigma W \log P = 51.1944$

Price index number based on the weighted arithmetic mean of price relatives is given by

$$P_{01} = \frac{\Sigma WP}{\Sigma W} = \frac{3270}{24} = 136.25$$

Price index number based on the weighted geometric mean of price relatives is given by:

$$P_{01} = AL\left(\frac{\Sigma W \log P}{\Sigma W}\right)$$

$$= AL\left(\frac{51.1944}{24}\right) = AL\,(2.1331) = 135.8$$

Quantity Index Questions :-

From the following data, compute quantity index number for the current year by Fisher's Method:

Commodity	Base Year		Current Year	
	Price (₹)	Quantity (units)	Price (₹)	Quantity (units)
A	1	6	5	8
B	2	7	4	7
C	3	8	3	6
D	4	7	2	5

[B.Com (P); D.U; 2015 (Non-collegiate)]

Compute quantity index number by:

(i) Marshall Edgeworth's Method

(ii) Bowley's Method

(iii) Fisher's Method

Commodity	Base Year		Current Year	
	Price (in ₹)	Total Value (in ₹)	Price (in ₹)	Total Value (in ₹)
A	6	300	10	560
B	2	200	2	240
C	4	240	6	360
D	10	300	12	288
E	8	320	12	432

Solutions :-

Solution:

Computation of Quantity Index Number by Fisher's Method

Commodity	Base Year		Current Year		q_1p_0	q_0p_0	q_1p_1	q_0p_1
	p_0	q_0	p_1	q_1				
A	1	6	5	8	8	6	40	30
B	2	7	4	7	14	14	28	28
C	3	8	3	6	18	24	18	24
D	4	7	2	5	20	28	10	14
					Σq_1p_0 = 60	Σq_0p_0 = 72	Σq_1p_1 = 96	Σq_0p_1 = 96

$$Q_{01} = \sqrt{\frac{\Sigma q_1 p_0}{\Sigma q_o p_o} \times \frac{\Sigma q_1 p_1}{\Sigma q_o p_1}} \times 100$$

$$= \sqrt{\frac{60}{72} \times \frac{96}{96}} \times 100$$

$$= \sqrt{0.833 \times 100}$$

$$= 0.9129 \times 100$$

$$= 91.29 \text{ (approx.)}$$

Solution:

Computation of Quantity Index

Commodity	Base Year			Current Year			q_1p_0	q_0p_1
	Price	Value	Qty.	Price	Value	Qty.		
	p_0	p_0q_0	q_0	p_1	p_1q_1	q_1		
A	6	300	50	10	560	56	336	500
B	2	200	100	2	240	120	240	200
C	4	240	60	6	360	60	240	360
D	10	300	30	12	288	24	240	360
E	8	320	40	12	432	36	288	480
		Σp_0q_0 = 1360			Σq_1p_1 = 1880		Σq_1p_0 = 1344	Σq_0p_1 = 1900

(i) Marshall Edgeworth's Method:

$$Q_{01}^{ME} = \frac{\Sigma q_1 p_0 + \Sigma q_1 p_1}{\Sigma q_0 p_0 + \Sigma q_0 p_1} \times 100$$

$$= \frac{1344 + 1880}{1360 + 1900} \times 100$$

$$= \frac{3224}{3260} \times 100 = 0.98895 \times 100 = 98.89$$

(ii) Bowley's Method:

$$Q_{01}^{B} = \frac{\frac{\Sigma q_1 p_0}{\Sigma q_0 p_0} + \frac{\Sigma q_1 p_1}{\Sigma q_0 p_1}}{2} \times 100$$

$$= \frac{\frac{1344}{1360} + \frac{1880}{1900}}{2} \times 100$$

$$= \frac{0.9882 + 0.9894}{2} \times 100 = 0.9888 \times 100 = 98.88$$

(iii) Fisher's Method:

$$Q_{01} = \sqrt{\frac{\Sigma q_1 p_0}{\Sigma q_0 p_0} \times \frac{\Sigma q_1 p_1}{\Sigma q_0 p_1}} \times 100$$

$$= \sqrt{\frac{1344}{1360} \times \frac{1880}{1900}} \times 100$$

$$= \sqrt{0.9882 \times 0.9894} \times 100 = 0.9887 \times 100 = 98.87$$

Value Index Questions :-

From the following data, compute value index number for the current year:

Commodity	Base Year		Current Year	
	Price (₹) P_0	Quantity (₹) q_0	Price (₹)	Quantity (₹)
A	1	6	5	8
B	2	7	4	7
C	3	8	3	6
D	4	9	2	5

Example 14:

The simple price index and simple quantity index of a commodity were 120 and 110 respectively in 2015 with base 2014. Find its value index number in 2015 with base 2014.

Solution:

Solutions :-

Solution:

Computation of Value Index

Commodity	p_0	q_0	p_1	q_1	p_0q_0	p_1q_1
A	1	6	5	8	6	40
B	2	7	4	7	14	28
C	3	8	3	6	24	18
D	4	9	2	5	36	10
					$\Sigma p_0q_0 = 80$	$\Sigma p_1q_1 = 96$

$$V_{01} = \frac{\Sigma p_1q_1}{\Sigma p_0q_0} \times 100 = \frac{96}{80} \times 100 = 120$$

Solution:

In terms of usual notations, we are given

$$P_{01} = \frac{p_1}{p_0} \times 100 = 120$$

$$\Rightarrow \quad \frac{p_1}{p_0} = 1.2$$

$$Q_{01} = \frac{q_1}{q_o} \times 100 = 110$$

$$\Rightarrow \quad \frac{q_1}{q_0} = 1.1$$

The index numbers of the commodity for 2015 with 2014 as base is:

$$\frac{p_1 q_1}{p_0 q_0} \times 100 = \left(\frac{p_1}{p_0}\right)\left(\frac{q_1}{q_0}\right) \times 100$$

$$= 1.2 \times 1.1 \times 100$$

$$= 132$$

Adequacy Test Questions :-

Compute Fisher's Ideal Index and show that it satisfies 'time reversal test':

Item	1996		1999	
	Price (₹)	Value (₹)	Price (₹)	Value (₹)
A	10	30	12	48
B	15	60	15	75
C	5	50	8	96
D	2	10	3	15

[B.Com (P); D.U., 2008 (Corres)]

Calculate the Fisher's Ideal Price Index from the following data and show that it satisfies both Time Reversal Test and Factor Reversal Test:

Commodity	Base Year		Current Year	
	Price (₹)	Total value (₹)	Price (₹)	Total Value (₹)
A	6	300	10	560
B	2	200	2	240
C	4	240	6	360
D	10	300	12	288
E	8	320	12	432

[B.Com(P); D.U. 2010 (Corres)]

Solutions :-

Solution:

In this case, we are given price and value for each item in the base year 1996 and the current year 1999. To get the quantity, we divide the value by the price:

$$\text{Value} = \text{Price} \times \text{Quantity}$$

$$\text{Quantity} = \frac{\text{Value}}{\text{Price}}$$

Calculation of Fisher's Index Number

Item	1996		1999		$\frac{p_0q_0}{p_0}$	$\frac{p_1q_1}{p_1}$		
	Price (₹)	Value (₹)	Price (₹)	Value (₹)				
	p_0	p_0q_0	p_1	p_1q_1	q_0	q_1	p_0q_1	p_1q_0
A	10	30	12	48	3	4	40	36
B	15	60	15	75	4	5	75	60
C	5	50	8	96	10	12	60	80
D	2	10	3	15	5	5	10	15
		Σp_0q_0 = 150		Σp_1q_1 = 234			Σp_0q_1 = 185	Σp_1q_0 = 191

Fisher's Index Number:

$$P_{01} = \sqrt{\frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} \times \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1}} \times 100$$

$$= \sqrt{\frac{191}{150} \times \frac{234}{185}} \times 100 = 1.2691 \times 100 = 126.91$$

Time Reversal Test: While applying test we have omitted the factor 100

$$P_{01} = \sqrt{\frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} \times \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1}}$$

$$= \sqrt{\frac{191}{150} \times \frac{234}{185}}$$

$$P_{10} = \sqrt{\frac{\Sigma p_0 q_1}{\Sigma p_1 q_1} \times \frac{\Sigma p_0 q_0}{\Sigma p_1 q_0}}$$

$$= \sqrt{\frac{185}{234} \times \frac{150}{191}}$$

$$P_{01} \times P_{10} = \sqrt{\frac{191}{150} \times \frac{234}{185}} \times \sqrt{\frac{185}{234} \times \frac{150}{191}} = \sqrt{1} = 1$$

Since $P_{01} \times P_{10} = 1$ therefore, Fisher's ideal index satisfies 'time reversal test'.

[B.Com(P); D.U. 2010 (Corres)]

Solution:

In this example, we have given price and total value. To get the quantity we divide the value by the price.

$$\text{Value} = \text{Price} \times \text{Quantity}$$

$$\text{Quantity} = \frac{\text{Value}}{\text{Price}}$$

Calculation of Fisher's Index Number

Commodity	Base Year			Current Year				
	Price (₹)	Total value (₹)	Quantity	Price (₹)	Total Value (₹)	Quantity		
	p_0	p_0q_0	q_0	p_1	p_1q_1	q_1	p_1q_0	p_0q_1
A	6	300	50	10	560	56	500	336
B	2	200	100	2	240	120	200	240
C	4	240	60	6	360	60	360	240
D	10	300	30	12	288	24	360	240
E	8	320	40	12	432	36	480	288
		$\Sigma p_0q_0 =$ 1360			Σp_1q_1 = 1880		Σp_1q_0 = 1900	Σp_0q_1 = 1344

$$P_{01} = \sqrt{\frac{\Sigma p_1q_0}{\Sigma p_0q_0} \times \frac{\Sigma p_1q_1}{\Sigma p_0q_1}} \times 100 = \sqrt{\frac{1900}{1360} \times \frac{1880}{1344}} \times 100$$

$$= \sqrt{\frac{3572000}{1827840}} \times 100 = \sqrt{1.9542} \times 100$$

$$= 1.3979 \times 100 = 139.79$$

Time Reversal Test: While applying test we have omitted the factor 100

$$P_{01} = \sqrt{\frac{\Sigma p_1q_0}{\Sigma p_0q_0} \times \frac{\Sigma p_1q_1}{\Sigma p_0q_1}} = \sqrt{\frac{1900}{1360} \times \frac{1880}{1344}}$$

$$P_{10} = \sqrt{\frac{\Sigma p_0q_1}{\Sigma p_1q_1} \times \frac{\Sigma p_0q_0}{\Sigma p_1q_0}} = \sqrt{\frac{1344}{1880} \times \frac{1360}{1900}}$$

$$P_{01} \times P_{10} = \sqrt{\frac{1900}{1360} \times \frac{1880}{1344} \times \frac{1344}{1880} \times \frac{1360}{1900}} = 1$$

Since $P_{01} \times P_{10} = 1$ therefore , Fisher's ideal index satisfies time reversal test

Factor Reversal Test = While applying test we have omitted the factor 100

$$P_{01} \times Q_{01} = V_{01}$$

L.H.S.

$$P_{01} = \sqrt{\frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} \times \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1}} = \sqrt{\frac{1900}{1360} \times \frac{1880}{1344}}$$

$$Q_{01} = \sqrt{\frac{\Sigma q_1 p_0}{\Sigma q_0 p_0} \times \frac{\Sigma q_1 p_1}{\Sigma q_0 p_1}} = \sqrt{\frac{1344}{1360} \times \frac{1880}{1900}}$$

$$P_{01} \times Q_{01} = \sqrt{\frac{1900}{1360} \times \frac{1880}{1344} \times \frac{1344}{1360} \times \frac{1880}{1900}}$$

$$= \sqrt{\left(\frac{1880}{1360}\right)^2} = \frac{1880}{1360}$$

R.H.S.

$$V_{01} = \frac{\Sigma p_1 q_1}{\Sigma p_0 q_0} = \frac{1880}{1360} = \text{L.H.S.}$$

i.e. $P_{01} \times Q_{01} = V_{01}$

Therefore, Fisher's ideal index satisfies factor reversal test.

Consumer Price Index Questions :-

An enquiry into the budgets of middle class families gave the following information:

Expenses on :	Food	Rent	Clothing	Fuel	Others
	30%	15%	20%	10%	25%
Price (₹) 2010	100	20	70	20	40
Price (₹) 2011	90	20	140	15	60

Compute the cost of living index number from the above information.

[B.Com(P); D.U., 2013 (Corres)]

For the following data, calculate consumer price index by:

(i) Aggregate Expenditure Method, and

(ii) Family Budget Method.

Commodity	A	B	C	D	E	F	G
Quantity	2	25	10	5	25	40	1
Price (2008)	75	13	12	10	4.5	10	25
Price (2013)	125	16	16	15	5	12	40

[B.Com (P); D.U., 2013 (Non-collegiate)]

The following are the group index numbers and the group weights of on average working class family's budget. Construct the cost of living index number by assigning the given weights

Group	Index Number for 1988	Weights
Food	352	48
Fuel and lighting	220	10
Clothing	230	8
House Rent	160	12
Miscellaneous	190	15

[B.Com(P); D.U., 1991]

In calculating a certain cost of living index number the following weights were used. Food 15, Clothing 3, Rent 4, Fuel and Light 2, Miscellaneous1. Calculate the index for a data when the average percentage increase in prices of items in the various groups over the base period were 32, 54, 47, 78 and 58 respectively.

Suppose a business executive was earning ₹2050/- in the base period, what should be his salary in the current period if his standard of living is to remains the same? *[B.Com (P); D.U; 1998]*

Solutions :-

Solution:

Computation of Cost of Living Index

Items	Expense (W)	Price 2010 (₹) P_0	Price 2011 (₹) P_1	$P = \frac{P_1}{P_0} \times 100$	PW
Food	30	100	90	90	2700
Rent	15	20	20	100	1500
Clothing	20	70	140	200	4000
Fuel	10	20	15	75	750
Others	25	40	60	150	3750
	$\Sigma W = 100$				$\Sigma PW = 12700$

$$\text{Cost of Living Index} = \frac{\Sigma PW}{\Sigma W} = \frac{12700}{100} = 127$$

Solution:

Calculations of Consumer Price Index

Commodity	Quantity	Price 2008	Price 2013			$P = \frac{P_1}{P_0} \times 100$	
	q_0	P_0	P_1	P_1q_0	P_0q_0 (V)		PV
A	2	75	125	250	150	166.67	25000
B	25	13	16	400	325	123.08	40000
C	10	12	16	160	120	133.33	16000
D	5	10	15	75	50	150	7500
E	25	4.5	5	125	112.5	111.11	12500
F	40	10	12	480	400	120	48000
G	1	25	40	40	25	160	4000
				Σp_1q_0 = 1530	Σp_0q_0 = 1182.5		ΣPV = 153000

(i) Aggregate Expenditure Method:

$$\text{Consumer Price Index} = \frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} \times 100$$

$$= \frac{1530}{1182.5} \times 100 = 129.39 \text{ (approx.)}$$

(ii) Family Budget Method:

$$\text{Consumer Price Index} = \frac{\Sigma PV}{\Sigma V} \times 100 = \frac{153{,}000}{1182.5} = 129.39 \text{ (approx.)}$$

Solution:

Calculation of Cost of Living Index

Group	Index *(I)*	Weights *(W)*	*IW*
Food	352	48	16896
Fuel and lighting	220	10	2200
Clothing	230	8	1840
House Rent	160	12	1920
Miscellaneous	190	15	2850
		$\Sigma W = 93$	$\Sigma IW = 25706$

$$\text{Cost of living Index} = \frac{\Sigma IW}{\Sigma W} = \frac{25706}{93} = 276.41$$

Solution:

Calculation of Cost of Living Index

Group	Average % Increase in Price	Group Index *(I)*	Weight *(W)*	*IW*
Food	32	132	15	1980
Clothing	54	154	3	462
Rent	47	147	4	588
Fuel and Light	78	178	2	356
Miscellaneous	58	158	1	158
			$\Sigma W = 25$	$\Sigma I\, W = 3544$

* To get the group index, we add 100 to the average % increase in price i.e. for food, it is 100 + 32 = 132.

$$\text{Cost of Living Index} = \frac{\Sigma IW}{\Sigma W} = \frac{3544}{25} = 141.76$$

For maintaining the same standard of living, the business executive should get

$$2050 \times \frac{141.76}{100} = ₹2906.08$$