Index Numbers

An index is a statistical measure, a measure designed to show changes in one variable or a group of related variables over time, with respect to geographical location or other characteristics

Types of Index Numbers — Simple Index No. Composit Index No.

A Simple Index Numbers

1. Fixed base method (FBM)

$$\text{Price Realtive } PR = \frac{P_n}{P_0} \times 100$$

where, P_n: Price of current year, P_0: Price of base year

Question 1: The follwiong table shows annual average prices of potatoes for the year 1980 - 1987. Compute Simple Index Numbers by taking (i) 1980 as base year (ii) Average of given prices as base

Years	Prices	Simple Index Numbers			
		1980 as base	Average as Base		
1980	58.8	100.00	76.99	100	
1981	96.54	164.18	126.40	37.74	64.18
1982	49.74	84.59	65.13	-9.06	-15.41
1983	60.92	103.61	79.77		
1984	84.38	143.50	110.48		
1985	80.63	137.13	105.57		
1986	61.56	104.69	80.60		
1987	118.42	201.39	155.05	201.3945578	
Average	76.37				

2. Chain base method (CBM)

$$\text{Link Realtive } LR = P_n/P_{n-1} \times 100$$

where, P_n: Price of current year, P_{n-1}: Price of previous year

Question 2: From the following table compute Chain Index Numbers for 1980 to 1987 by taking 1980 as base year.

Years	Prices	Simple Index Numbers		
		LR	Chain Indicies	
1980	58.8	100.00	100.00	100
1981	96.54	164.18	164.18	100*164.18/100
1982	49.74	51.52	84.59	164.18*51.52/100
1983	60.92	122.48	103.61	84.59*122.48/100
1984	84.38	138.51	143.50	130.61*138.51*100
1985	80.63	95.56	137.13	143.50*95.56/100
1986	61.56	76.35	104.69	137.13*76.35/100
1987	118.42	192.37	201.39	104.69*192.37/100

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B Composit Index Numbers

1 Un-weighted Index No.

I. Aggregative Method (AM)

FBM: $P_{0,n} = \frac{\sum P_n}{\sum P_0} \times 100$

CBM: $P_{n-1,n} = \frac{\sum P_n}{\sum P_{n-1}} \times 100 \rightarrow$ Chin Indicies

Question 1: From the following table construct index numbers for 1991 - 1995 taking 1991 as base year using Aggrigative Method

Years	Prices			$\sum P_n$	$P_{0,n} = \frac{\sum P_n}{\sum P_0} \times 100$
	Sugar	Tea	Cofee		
1991	20	80	60	160	100.00
1992	18	85	52	155	96.88
1993	22	76	62	160	100.00
1994	28	80	65	173	108.13
1995	30	95	80	205	128.13

Question 2: Compute Chain indices for for 1991 - 1995 by Simple Aggrigative method by taking 1991 as base period.

Years	Prices			$\sum P_n$	LR $P_{n-1,n} = \frac{\sum P_n}{\sum P_{n-1}} \times 100$	Chain Indicies	
	Sugar	Tea	Cofee				
1991	20	80	60	160	100.00	100.00	100
1992	18	85	52	155	96.88	96.88	100*96.88/100
1993	22	76	62	160	103.23	100.00	96.88*103.23/100
1994	28	80	65	173	108.13	108.13	100*108.13/100
1995	30	95	80	205	118.50	128.13	108.13*118.50/100

II. Aaverage of Relatives Method (ARM)

FBM: $PR = \frac{P_n}{P_0} \times 100 \begin{cases} Mean \\ Median \\ GM \end{cases}$

CBM: $LR = \frac{P_n}{P_{n-1}} \times 100 \begin{cases} Mean \\ Median \\ GM \end{cases} \rightarrow$ Chain Indices

Question 1: From the following table construct Index numbers for 1991 - 1995 taking 1991 as base year using Average of Relative Method

Years	Prices		
	Sugar	Tea	Cofee
1991	20	80	60
1992	18	85	52
1993	22	76	62
1994	28	80	65
1995	30	95	80

Question 2: From the following table construct Chain index numbers for 1991 - 1995 taking 1991 as base year by Simple Average of Relative Method.

Years	Prices		
	Sugar	Tea	Cofee
1991	20	80	60
1992	18	85	52
1993	22	76	62
1994	28	80	65
1995	30	95	80

Solution

Years	Price Realtive $PR = P_n/P_0 \times 100$			Index Numbers		
	Sugar	Tea	Cofee	Mean	Median	GM
1991	100.00	100.00	100.00	100.00	100.00	100.00
1992	90.00	106.25	86.67	94.31	90.00	93.93
1993	110.00	95.00	103.33	102.78	103.33	102.59
1994	140.00	100.00	108.33	116.11	108.33	114.89
1995	150.00	118.75	133.33	134.03	133.33	133.42

Years	Link Realtive $LR = P_n/P_{n-1} \times 100$			Mean	Chain Indices	Median	Chain Indices	GM	Chain Indices
	Sugar	Tea	Cofee						
1991	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1992	90.00	106.25	86.67	94.31	94.31	90.00	90.00	93.93	93.93
1993	122.22	89.41	119.23	110.29	104.01	119.23	107.31	109.22	102.59
1994	127.27	105.26	104.84	112.46	116.97	105.26	112.96	111.99	114.89
1995	107.14	118.75	123.08	116.32	136.06	118.75	134.13	116.12	133.42

2 Weight Index Numbers

I. Weight Aggregative Method (WAM)

Lasperyre's Method $P_{0n} = \frac{\sum P_n Q_0}{\sum P_0 Q_0} \times 100$ (Base year as Weight)

Paasche's Method $P_{0n} = \frac{\sum P_n Q_n}{\sum P_0 Q_n} \times 100$ (Current year as Weight)

Fisher's Method $P_{0n} = \sqrt{\frac{\sum P_n Q_0}{\sum P_0 Q_0} \times \frac{\sum P_n Q_n}{\sum P_0 Q_n}} \times 100$

Marshal's Method $P_{0n} = \frac{\sum P_n Q_0 + \sum P_n Q_n}{\sum P_0 Q_0 + \sum P_0 Q_n} \times 100$

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Question 1: Construct index number of price and quantity (Weighted aggregative index) for 1986 and 1987 taking 1985 as base year Lasperyr's, Paasche's, Fisher's and Marshall's Methods

Year	Wheat		Rice		Grams	
	Price	Qty.	Price	Qty.	Price	Qty.
1985	15.3	15	20.2	15	14	10
1986	22.3	12	27.4	14	17	18
1987	25.2	10	24.6	13	15	12

Solution

Year	1985		1986		1987		P_0Q_0	P_1Q_0	P_2Q_0	P_0Q_1	P_0Q_2	P_1Q_1	P_2Q_2
	Price P_0	Qty. Q_0	Price P_1	Qty. Q_1	Price P_2	Qty. Q_2							
Wheat	15.3	15	22.3	12	25.2	10	229.5	334.5	378	183.6	153	267.6	252
Rice	20.2	15	27.4	14	24.6	13	303	411	369	282.8	262.6	383.6	319.8
Grams	14	10	17	18	15	12	140	170	150	252	168	306	180
TOTALS							$\sum P_0Q_0$	$\sum P_1Q_0$	$\sum P_2Q_0$	$\sum P_0Q_1$	$\sum P_0Q_2$	$\sum P_1Q_1$	$\sum P_2Q_2$
							672.5	915.5	897	718.4	583.6	957.2	751.8

I Lasperyre's Method $P_{0n} = \frac{\sum P_n Q_0}{\sum P_0 Q_0} \times 100$

For 1986 $P_{01} = \frac{\sum P_1 Q_0}{\sum P_0 Q_0} \times 100 = \frac{915.5}{672.5}$ **136.13**

For 1987 $P_{02} = \frac{\sum P_2 Q_0}{\sum P_0 Q_0} \times 100 = \frac{897}{672.5}$ **133.38**

II Paasche's Method $P_{0n} = \frac{\sum P_n Q_n}{\sum P_0 Q_n} \times 100$

For 1986 $P_{01} = \frac{\sum P_1 Q_1}{\sum P_0 Q_1} \times 100 = \frac{957.2}{718.4}$ **133.24**

For 1987 $P_{02} = \frac{\sum P_2 Q_2}{\sum P_0 Q_2} \times 100 = \frac{751.8}{583.6}$ **128.82**

III Fisher's Method $P_{0n} = \sqrt{\frac{\sum P_n Q_0}{\sum P_0 Q_0} \times \frac{\sum P_n Q_n}{\sum P_0 Q_n}} \times 100$

For 1986 $P_{01} = \sqrt{\frac{\sum P_1 Q_0}{\sum P_0 Q_0} \times \frac{\sum P_1 Q_1}{\sum P_0 Q_1}} \times 100 = \frac{936.1178345}{695.0712134}$ **134.68**

For 1987 $P_{02} = \sqrt{\frac{\sum P_2 Q_0}{\sum P_0 Q_0} \times \frac{\sum P_2 Q_2}{\sum P_0 Q_2}} \times 100 = \frac{662.3824273}{626.4750534}$ **105.73**

IV Marshal's Method $P_{0n} = \frac{\sum P_n Q_0 + \sum P_n Q_n}{\sum P_0 Q_0 + \sum P_0 Q_n} \times 100$

For 1986 $P_{01} = \frac{\sum P_1 Q_0 + \sum P_1 Q_1}{\sum P_0 Q_0 + \sum P_0 Q_1} \times 100 = \frac{1872.7}{1390.9}$ **134.64**

For 1987 $P_{02} = \frac{\sum P_2 Q_0 + \sum P_2 Q_2}{\sum P_0 Q_0 + \sum P_0 Q_2} \times 100 = \frac{1335.4}{1256.1}$ **106.31**

II. Weight Average of Relatives Method (WARM)

Lasperyre's Method $P_{0n} = \frac{\sum I_n W_0}{\sum W_0} \quad (I_n = P_n/P_0 \times 100, \quad W_0 = P_0 Q_0)$

Paasche's Method $P_{0n} = \frac{\sum I_n W_n}{\sum W_n} \quad (I_n = P_n/P_0 \times 100, \quad W_n = P_0 Q_n)$

Question 1: Construct index number of price and quantity index (Weighted average of relaitves index) for 1986 and 1987 taking 1985 as base year Lasperyr's and Paasche's Methods

Year	Wheat		Rice		Grams	
	Price	Qty.	Price	Qty.	Price	Qty.
1985	15.3	15	20.2	15	14	10
1986	22.3	12	27.4	14	17	18
1987	25.2	10	24.6	13	15	12

Solution

Year	1985		1986		1987		$I_1 = \frac{P_1}{P_0} \times 100$	$I_2 = \frac{P_2}{P_0} \times 100$	$W_0 = P_0 Q_0$	$W_1 = P_0 Q_1$	$W_2 = P_0 Q_2$	$I_1 W_0$	$I_2 W_0$	$I_1 W_1$	$I_2 W_2$
	Price P_0	Qty. Q_0	Price P_1	Qty. Q_1	Price P_2	Qty. Q_2									
Wheat	15.3	15	22.3	12	25.2	10	145.75	164.71	229.5	183.6	153	33450	37800	26760	25200
Rice	20.2	15	27.4	14	24.6	13	135.64	121.78	303	282.8	262.6	41100	36900	38360	31980
Grams	14	10	17	18	15	12	121.43	107.14	140	252	168	17000	15000	30600	18000
TOTALS									$\sum W_0$	$\sum W_1$	$\sum W_2$	$\sum I_1 W_0$	$\sum I_2 W_0$	$\sum I_1 W_1$	$\sum I_2 W_2$
									672.5	718.4	583.6	91550	89700	95720	75180

Lasperyre's Method $P_{0n} = \frac{\sum I_n W_0}{\sum W_0} \quad (I_n = P_n/P_0 \times 100, \quad W_0 = P_0 Q_0)$

For 1986 $P_{01} = \frac{\sum I_1 W_0}{\sum W_0} = \frac{91550}{672.5} = 136.13$

For 1987 $P_{02} = \frac{\sum I_2 W_0}{\sum W_0} = \frac{89700}{672.5} = 133.38$

Paasche's Method $P_{0n} = \frac{\sum I_n W_n}{\sum W_n} \quad (I_n = P_n/P_0 \times 100, \quad W_n = P_0 Q_n)$

For 1986 $P_{01} = \frac{\sum I_1 W_1}{\sum W_1} = \frac{95720}{718.4} = 133.24$

For 1987 $P_{02} = \frac{\sum I_2 W_2}{\sum W_2} = \frac{75180}{583.6} = 128.82$

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