STATISTICS

Index calculation (1)

Questions to be answered during index calculation

- How has the **output value**, **sales revenue** and **sales turnover** changed?
- How has the **volume of production and sales** changed?
- How has the price of products and the price level changed?

Basic concepts, unique indices

Index calculation

- Index calculation expresses joint average change of quantities / comparable ratios that cannot be aggregated directly.

Purpose:

- Analysis of the production, service, trade, consumption and use, as socio-economic categories by a joint examination of populations representing different quality.

Dynamic ratios:

- ❑ analysis of the price and quantity of only 1-1 product;

Index calculation:

- ❑ analysis of the simultaneous impact of price and quantity change of several products;

Change can be expressed, as

- ✓**relative change (I = index)**,
- ✓**absolute change (K = difference)**.

- Recently, enterprises produce and sell not only one type of goods $\Rightarrow$ aggregated indicators for
  - examining of the temporal evolution of their activities,
  - comparing their data with those of other businesses and areas.

- The simplest solution for a joint investigation of the volume and price changes of products is comparing of the production values.

- The units are the same $\Rightarrow$ the production values

  $\Rightarrow$ can be aggregated,

  $\Rightarrow$ can be comparable

  in the form of both quotient and difference.

The comparison can be made:

- ✓ In space: I compare data of 2 countries, or 2 companies,
- ✓ In time: I compare data of 2 years.

Comparison in values is called aggregation, while the cumulative value data are called aggregates.

Notations:

- q_i = volume (quantity)
- p_i = price
- v_i = value $\qquad \mathbf{v_i = q_i \cdot p_i}$
- I_v = value index
- K_v = value difference
- I_p = price index
- K_p = value differences arising from differences in prices
- I_q = volume index
- K_q = value differences arising from differences in quantities
- i = custom indices
- k = specific derogations

Index calculation

Index numbers serve to compare **quantity (q)**, **price (p)** and the **value of data (v)** over time, or in space for an aggregate population being coherent, but disparate (different units).
The value of a commodity (group) is determined by the quantity and unit price $\rightarrow$ v = q · p

Non-summarizable products (having different measures) can be analyzed on their value amount. The total value of a product group of being coherent but consisiting of disparate products (i.e., heterogenous product group) is called **aggregate value (A)**:

$$A = \sum_{i=1}^{n} q_i p_i = \sum_{i=1}^{n} v_i$$

Indices: quotients of two aggregates that are different either in time or space, concerning the same range of products.

Individual value index and individual value difference

- It shows the rate of change in the value of individual products (i_v), or deviation (k_v) that is, how the production value for a given product (traffic) changed, from the base period to the current period.

$$i_v = \frac{v_1}{v_0} = \frac{q_1 * p_1}{q_0 * p_0} = i_q * i_p$$

$$k_v = v_1 - v_0$$

- Changes in the value of the products examined are due to the change in prices and/or the change in volumes.

Individual price index and individual price difference

- It shows price changes of an individual product.

$$i_p = \frac{p_1}{p_0}$$

$$k_p = p_1 - p_0$$

Individual volume index and individual volume difference

$$i_q = \frac{q_1}{q_0}$$

$$k_q = q_1 - q_0$$

- If we present the impact of both prices and volumes in the form of value, the following relationships can be written:
- The impact of the current period price and the base period price to the **changes in the value**:

$$q_1 p_1 - q_1 p_0$$

$$q_0 p_1 - q_0 p_0$$

- **the impact of** the current period volume, and the base period **volume to the changes in the value** :

$$q_1 p_1 - q_0 p_1$$

$$q_1 p_0 - q_0 p_0$$

Individual indices (indices, i.e. ratios for a given type of product

Individual price index:

$$i_p = \frac{p_1}{p_0}$$

where:
p_1: unit price of the current period
p_0: unit price of the base period

$$i_p$$

Individual volume index:

$$i_q = \frac{q_1}{q_0}$$

where:
q_1: unit volume of the current period
q_0: unit volume of the base period

$$i_v = i_q \cdot i_p$$

Individual value index:

$$i_v = \frac{v_1}{v_0} = \frac{q_1 p_1}{q_0 p_0}$$

where:
v_1: value of the product in the current period
v_0: value of the product in the base period

Aggregate value data

Four kinds of aggregates are used in index calculation*

1. $\sum q_0 p_0$ real aggregate
2. $\sum q_1 p_0$ fictive aggregate
3. $\sum q_0 p_1$ fictive aggregate
4. $\sum q_1 p_1$ real aggregate

***Aggregation:** value summation of a heterogeneous group of products. The current aggregate value (aggregate) is called nominal value data.

Indices for various products - heterogeneous commodity groups. Aggregate forms of combined indices

Value index:

$$I_v = \frac{\sum v_1}{\sum v_0} = \frac{\sum q_1 p_1}{\sum q_0 p_0}$$

$$I_v = I_q^0 \cdot I_p^1$$

$$I_v = I_q^1 \cdot I_p^0$$

Price index (volumes, i.e. q data are constant)

$$I_p = \frac{\sum q_s p_1}{\sum q_s p_0} \quad I_p^0 = \frac{\sum q_0 p_1}{\sum q_0 p_0} \quad I_p^1 = \frac{\sum q_1 p_1}{\sum q_1 p_0}$$

Volume index (prices, i.e. p data are constant)

$$I_q = \frac{\sum q_1 p_s}{\sum q_0 p_s} \quad I_q^0 = \frac{\sum q_1 p_0}{\sum q_0 p_0} \quad I_q^1 = \frac{\sum q_1 p_1}{\sum q_0 p_1}$$

Value index and value difference

It shows the simultaneous and average change in the value of production, sales and consumption, namely it is a quotient of two aggregates that differ from each other in both volume and price data.

$$I_v = \frac{\Sigma q_{1i} * p_{1i}}{\Sigma q_{0i} * p_{0i}}$$

$$K_v = \Sigma q_{1i} * p_{1i} - \Sigma q_{0i} * p_{0i}$$

That is, the value index shows that in the case of simultaneous changes of volume and price, how many times the value has changed, taking into account of all the products. At the same time, the value difference shows that how much the value has changed.

Task:

Sales of a market seller

Products	December 2008		December 2009	
	Sales volume	Unit price	Sales volume	Unit price
A-product (db)	1200	20	1250	25
B-product (kg)	250	160	280	210
C-product (kg)	700	150	500	280

1. How has the turnover changed?

Value index and value difference

$$I_v = \frac{\Sigma q_{1i} * p_{1i}}{\Sigma q_{0i} * p_{0i}} = \frac{31250 + 58800 + 140000}{24000 + 40000 + 105000} = \frac{230050}{169000} = 1{,}3612 = 136{,}12\%$$

$$K_v = \Sigma q_{1i} * p_{1i} - \Sigma q_{0i} * p_{0i} = 230050 - 169000 = 61050 Ft$$

Price index and price difference

- When examining the effect of price changes, the volume is assumed to be constant. Different statisticians use different weighting, so we can calculate in the following way.

  - **Current year weighting: Paashe price index:**

$$I_p^1 = I_p^P = \frac{\Sigma q_{1i} * p_{1i}}{\Sigma q_{1i} * p_{0i}}$$

  - **Base year weighting: Laspeyres price index:**

$$I_p^0 = I_p^L = \frac{\Sigma q_{0i} * p_{1i}}{\Sigma q_{0i} * p_{0i}}$$

  - **The geometric mean of two price indices: Fisher's price index:**

$$I_p^F = \sqrt{I_p^1 * I_p^0}$$

- **Price differences:**

$$K_p^{1} = \Sigma q_{1i} p_{1i} - \Sigma q_{1i} p_{0i}$$

$$K_p^{0} = \Sigma q_{0i} p_{1i} - \Sigma q_{0i} p_{0i}$$

Price index: how many times the value changes exclusively on the effect of price change;

Price difference: how much the value changes;

The sum of multiplications in the formulae $q_{0i}p_{1i}$ and $q_{1i}p_{0i}$ are **fictitious aggregates**.

Task (continuation of the previous task):

$$I_p^1 = I_p^P = \frac{\Sigma q_{1i} * p_{1i}}{\Sigma q_{1i} * p_{0i}} = \frac{230050}{1250 * 20 + 280 * 160 + 500 * 150} =$$

$$= \frac{230050}{144800} = 1,5887$$

$$I_p^0 = I_p^L = \frac{\Sigma q_{0i} * p_{1i}}{\Sigma q_{0i} * p_{0i}} = \frac{1200 * 25 + 250 * 210 + 700 * 280}{169000} =$$

$$= \frac{278500}{169000} = 1,6479$$

$$I_p^F = \sqrt{I_p^1 * I_p^0} = \sqrt{1{,}5887 * 1{,}6479} = 1{,}6180 = 161{,}80\%$$

$$K_p^1 = \Sigma q_{1i} p_{1i} - \Sigma q_{1i} p_{0i} = 230050 - 144800 = 85250Ft$$

$$K_p^0 = \Sigma q_{0i} p_{1i} - \Sigma q_{0i} p_{0i} = 278500 - 169000 = 109500F$$

Volume index and volume difference

- In this case, the price is considered to be constant, so it is also possible two weightings.

  - **Current year weighting: Paashe volume index:**

$$I_q^1 = I_q^P = \frac{\Sigma q_{1i} * p_{1i}}{\Sigma q_{0i} * p_{1i}}$$

  - **Base year weighting: Laspeyres volume index:**

$$I_q^0 = I_q^L = \frac{\Sigma q_{1i} * p_{0i}}{\Sigma q_{0i} * p_{0i}}$$

  - **The geometric mean of two volume indices: Fisher's volume index:**

$$I_q^F = \sqrt{I_q^1 * I_q^0}$$

- **Volume differences:**

$$K_q^1 = \Sigma q_{1i} p_{1i} - \Sigma q_{0i} p_{1i}$$

$$K_q^0 = \Sigma q_{1i} p_{0i} - \Sigma q_{0i} p_{0i}$$

Volume index: how many times the value changes exclusively on the effect of volume change;

Volume difference: how much the value changes.

Task (continuation of the previous task):

- Volume index and volume difference:

$$I_q^1 = I_q^P = \frac{\Sigma q_{1i} * p_{1i}}{\Sigma q_{0i} * p_{1i}} = \frac{230050}{267500} = 0,8260$$

$$I_q^0 = I_q^L = \frac{\Sigma q_{1i} * p_{0i}}{\Sigma q_{0i} * p_{0i}} = \frac{144800}{169000} = 0,8568$$

$$I_q^F = \sqrt{I_q^1 * I_q^0} = \sqrt{0{,}8260 \quad * \; 0{,}8568} = 0{,}8413 \quad = 84{,}13\%$$

$$K_q^1 = \Sigma q_{1i} p_{1i} - \Sigma q_{0i} p_{1i} = 230050 - 267500 = -48450Ft$$

$$K_q^0 = \Sigma q_{1i} p_{0i} - \Sigma q_{0i} p_{0i} = 144800 - 169000 = 24200Ft$$

Textual analysis of the indicators that have been calculated (1):

Analysis of the turnover of a market seller by comparing data of December 2008 and December 2009.

- ✓ Prices of all three products increased, unit price of C-product showed the greatest increase by 86.67%, while unit price of B-product and A-product increased the smallest degree and by 25%, respectively.
- ✓ The unit price of B-product increased by HUF 31255.
- ✓ Sales volume of A-product was only 4.15% higher in December 2009, however the B-products have been sold more than 12%.
- ✓ Sales volume of C-product decresead by 28,57%, compared to 2008.

Textual analysis of the indicators that have been calculated (2):

An examination of market sales of a merchant by comparing his data for December 2008 and December 2009.

- ✓ The growth from revenues from each product is the highest for B-product, namely 47%.
- ✓ Revenue from sales of A- and C-products was by 30.21%, and 32.33% higher in 2009 than in 2008, respectively.
- ✓ Due to the changes in unit prices and quantities sold, turnover of the merchant in 2009 was by 36.12% higher than in 2008, which corresponds to HUF 61 050.
- ✓ The average price change was 61.80%, while sales volumes decreased by an average of 15.78%.

Associations between indices

- Given the price index and the volume index expresses the change of only one factor, while their multiplication provides the value index, because this index shows the joint change of price and volume effect.

$$\mathrm{I}_v = I_p^0 * I_q^1 = I_p^1 * I_q^0 = I_p^F * I_q^F$$

$$K_v = K_p^1 + K_q^0 = K_p^0 + K_q^1$$

$$\mathrm{I}_\mathrm{v} = \frac{\sum_i q_{0i} \cdot p_{1i}}{\sum_i q_{0i} \cdot p_{0i}} \cdot \frac{\sum_i q_{1i} \cdot p_{1i}}{\sum_i q_{0i} \cdot p_{1i}} = \frac{\sum_i q_{1i} \cdot p_{1i}}{\sum_i q_{1i} \cdot p_{0i}} \cdot \frac{\sum_i q_{1i} \cdot p_{0i}}{\sum_i q_{0i} \cdot p_{0i}}$$

$$\mathrm{K}_\mathrm{v} = \sum_i q_{1i} \cdot p_{1i} - \sum_i q_{1i} \cdot p_{0i} + \sum_i q_{1i} \cdot p_{0i} - \sum_i q_{0i} \cdot p_{0i} = \sum_i q_{0i} \cdot p_{1i} - \sum_i q_{0i} \cdot p_{0i} + \sum_i q_{1i} \cdot p_{1i} - \sum_i q_{0i} \cdot p_{1i}$$

Calculating averages with indices

- **Indices can be calculated not only in aggregate form, but also in average of the individual indices.** In this case, any of the aggregates or their quantitative ratios represent as weight in the index. The way of the weighting depends on whether the given aggregate occurs in the numerator or denominator of the index.

- If the value of the amount is available only for the base period, or the current period, then the indices can be calculated in average form**.**

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Average forms of the value index

- If **only the base year price data and volume data are known, as well as the unique value index of the individual product groups**, then **the aggregate value index can be calculated as a weighted arithmetic average**. The **weight** in this case, is the **aggregate of the base period**.

$$I_v = \frac{\Sigma q_{0i} p_{0i} * i_{vi}}{\Sigma q_{0i} p_{0i}}$$

$$\mathrm{I_v} = \frac{\sum_i \mathrm{v_{0i}} \cdot \mathrm{i_{vi}}}{\sum_i \mathrm{v_{0i}}} = \frac{\sum_i \mathrm{q_{0i} p_{0i}} \cdot \frac{\mathrm{v_{1i}}}{\mathrm{v_{0i}}}}{\sum_i \mathrm{q_{0i} p_{0i}}} = \frac{\sum_i \mathrm{q_{0i} p_{0i}} \cdot \frac{\mathrm{q_{1i} p_{1i}}}{\mathrm{q_{0i} p_{0i}}}}{\sum_i \mathrm{q_{0i} p_{0i}}} = \frac{\sum_i \mathrm{q_{1i} p_{1i}}}{\sum_i \mathrm{q_{0i} p_{0i}}}$$

- If only the **current period price data and volume data are known**, **as well as the unique value index of the individual product groups**, then the aggregate value index can be calculated in a harmonic mean form. The **weight** in this case, is the **aggregate of the current period**.

$$I_v = \frac{\Sigma q_{1i} p_{1i}}{\Sigma \frac{q_{1i} p_{1i}}{i_{vi}}}$$

$$I_v = \frac{\sum_i v_{1i}}{\sum_i \frac{v_{1i}}{i_{vi}}} = \frac{\sum_i v_{1i}}{\sum_i \frac{v_{1i}}{\frac{v_{1i}}{v_{0i}}}} = \frac{\sum_i q_{1i} p_{1i}}{\sum_i \frac{q_{1i} p_{1i}}{\frac{q_{1i} p_{1i}}{q_{0i} p_{0i}}}} = \frac{\sum_i q_{1i} p_{1i}}{\sum_i q_{0i} p_{0i}}$$

Average forms of the price index

- Similarly to the value index, two kinds of calculations can be performed in this case, as well:

In the form of arithmetic average:

$$I_p^0 = \frac{\Sigma q_{0i} p_{0i} * i_{pi}}{\Sigma q_{0i} p_{0i}} \qquad I_p^1 = \frac{\Sigma q_{1i} p_{0i} * i_{pi}}{\Sigma q_{1i} p_{0i}}$$

In the form of harmonic mean:

$$I_p^0 = \frac{\Sigma q_{0i} p_{1i}}{\Sigma \frac{q_{0i} p_{1i}}{i_{pi}}} \qquad I_p^1 = \frac{\Sigma q_{1i} p_{1i}}{\Sigma \frac{q_{1i} p_{1i}}{i_{pi}}}$$

Average forms of the volume index

- Volume index can also be calculated by both kinds of averaging:

In the form of arithmetic average :

$$I_q^0 = \frac{\Sigma q_{0i} p_{0i} * i_{qi}}{\Sigma q_{0i} p_{0i}} \qquad I_q^1 = \frac{\Sigma q_{0i} p_{1i} * i_{qi}}{\Sigma q_{0i} p_{1i}}$$

In the form of harmonic mean:

$$I_q^0 = \frac{\Sigma q_{1i} p_{0i}}{\Sigma \frac{q_{1i} p_{0i}}{i_{qi}}} \qquad I_q^1 = \frac{\Sigma q_{1i} p_{1i}}{\Sigma \frac{q_{1i} p_{1i}}{i_{qi}}}$$

Example:

- Data on the commercial activity of a company :

Product group	Turnover in 2007 (thousand HUF)	Sales volume	Turnover
		in 2008, as percentage of that in 2007	
A	4.000	115.00	145.00
B	9.000	110.00	125.00
C	3.000	125.00	140.00
D	12.000	98.00	120.00

Task:
Calculate the value-, price- and volume indices for the four product categories!
Revenues in 2007 are the base-year data, namely $q_{0i} \cdot p_{0i}$ are known to every product category.
i_q is the **sold volume change,** while i_v is the **change in turnover**.

$$I_v = \frac{\Sigma q_{0i} p_{0i} * i_{vi}}{\Sigma q_{0i} p_{0i}} = \frac{4000*1.45+9000*1.25+3000*1.40+12000*1.20}{4000+9000+3000+12000} =$$

$$= 1,2732 = 127.32\%$$

$$I_q^0 = \frac{\Sigma q_{0i} p_{0i} * i_{qi}}{\Sigma q_{0i} p_{0i}} = \frac{4000*1.15+9000*1.10+3000*1.25+12000*0.98}{4000+9000+3000+12000} =$$

$$= 1.0718 = 107.18\%$$

The individual price indices can be calculated as follows:

i_{pA} = 1.45/1.15 = 1.26

i_{pB} = 1.25/1.1 = 1.14

i_{pC} = 1.4/1.25 = 1.12

i_{pD} = 1.2/0.98 = 1.02

$$i_p = \frac{i_v}{i_q} = \frac{\frac{q_1 p_1}{q_0 p_0}}{\frac{q_1 p_0}{q_0 p_0}} = \frac{q_1 p_1}{q_1 p_0} = \frac{p_1}{p_0}$$

$$I_p^0 = \frac{\Sigma q_{0i} p_{0i} * i_{pi}}{\Sigma q_{0i} p_{0i}} = \frac{4000*1.26+9000*1.14+3000*1.12+12000*1.02}{4000+9000+3000+12000} =$$

$$= 1.1036 = 110.36\%$$

$$I_q^1 = \frac{1{,}2732}{1{,}1036} = 1{,}1537 \longrightarrow I_q^1 = \frac{I_v}{I_p^0} = \frac{\frac{\sum_i q_{1i} p_{1i}}{\sum_i q_{0i} p_{0i}}}{\frac{\sum_i q_{0i} p_{1i}}{\sum_i q_{0i} p_{0i}}} = \frac{\sum_i q_{1i} p_{1i}}{\sum_i q_{0i} p_{1i}}$$

$$I_p^1 = \frac{1{,}2732}{1{,}0718} = 1{,}1879$$

We prove that: $I_p^1 = \frac{I_v}{I_q^0}$

Then Fisher's price index and volume index can be calculated easily:

$$I_p^F = \sqrt{I_p^1 * I_p^0} \qquad I_q^F = \sqrt{I_q^1 * I_q^0}$$

Use of aggregate indices in case of areal comparison

Aggregate type indices can also be used for *i* areal comparison. However, only in the case, if:

- we compare data for identical date or identical period.
- the base of the comparison depends on the study, or it is decided by the analyser.
- when drafting the numerical results, the expressions ”increase” or ”decrease” can not be used. Instead, the ”larger”, ”smaller”, ”higher”, ”different” words are used.

- **The specific case of regional comparison** is comparison and analysis of data of different currencies of two countries.
- **<u>Value index</u> has no meaning**, since currencies are included in the numerator and the denominator.
- **For <u>price index and volume index</u> only the Fisher's formulae are interpreted**, since large differences can occur both in prices and the volumes.
- The meaning of **price index** and its form of expression changes. Price levels are compared here, so it cannot be described in percentage, but it appears as **the ratio of the analyzed currencies**. The currencies are used by their international signs, e.g. Hungarian Forint is marked by HUF.
- The **volume index** keeps its original meaning, as **the consumption quotient of the study products of the people in the two countries**.

Task:

Food consumption of two countries is characterized by the following data:

Product	q_{0i} D country p_{0i}		q_{1i} G country p_{1i}	
	Per capita consumption	Sale price (in delta currency)	Per capita consumption	Sale price (in gamma currency)
1. product	20	3	40	8
2. product	30	4	10	9

Compare

1) per capita consumption of the two countries and

2) purchasing power of the currencies of the two countries.

Benchmark is D country.

1) $$I_q^D(G/D) = \frac{\sum_i q_{1i} \cdot p_{0i}}{\sum_i q_{0i} \cdot p_{0i}} \qquad I_q^G(G/D) = \frac{\sum_i q_{1i} \cdot p_{1i}}{\sum_i q_{0i} \cdot p_{1i}}$$

2) $$I_p^G(G/D) = \frac{\sum_i q_{1i} \cdot p_{1i}}{\sum_i q_{1i} \cdot p_{0i}} \qquad I_p^D(G/D) = \frac{\sum_i q_{0i} \cdot p_{1i}}{\sum_i q_{0i} \cdot p_{0i}}$$

$$I_q^D(G/D) = \frac{40*3+10*4}{20*3+30*4} = \frac{160}{180} = 0,8889$$

$$I_q^G(G/D) = \frac{40*8+10*9}{20*8+30*9} = \frac{410}{430} = 0,9535$$

$$I_q^F(G/D) = \sqrt{0,9535*0,8889} = 0,9206 = 92,60$$

Looking at the range of the products, **per capita consumption** in G country was 7.4% smaller than in D country.

$$I_p^G(G/D) = \frac{40*8+10*9}{40*3+10*4} = \frac{410}{160} = 2{,}5625$$

$$I_p^D(G/D) = \frac{20*8+30*9}{20*3+30*4} = \frac{430}{180} = 2{,}3889$$

$$I_p^F(G/D) = \sqrt{2{,}5625*2{,}3889} = 2{,}4742G/D$$

Purchasing power of the delta currency of D country equals to 2.4742 times the purchasing power of the gamma currency of G country.

Index series

- ✓ It is often necessary to compare data of not two, but several periods (time). Then, the indices should be calculated for each period (time). Values obtained in this way form a index series.
- ✓ Depending on the comparisons, we can speak of base index series and chain index series, similarly to the dynamic ratios.
- ✓ According to the weighting, the price index series and the volume index series can be
    - fixed-weighted index series
    - variable weighted index series.

Base value index series:

$$\frac{\Sigma q_{0i} p_{0i}}{\Sigma q_{0i} p_{0i}};\frac{\Sigma q_{1i} p_{1i}}{\Sigma q_{0i} p_{0i}};\frac{\Sigma q_{2i} p_{2i}}{\Sigma q_{0i} p_{0i}};\ldots\ldots\frac{\Sigma q_{ni} p_{ni}}{\Sigma q_{0i} p_{0i}}$$

Chain value index series:

$$-;\frac{\Sigma q_{1i} p_{1i}}{\Sigma q_{0i} p_{0i}};\frac{\Sigma q_{2i} p_{2i}}{\Sigma q_{1i} p_{1i}};\ldots\ldots\frac{\Sigma q_{ni} p_{ni}}{\Sigma q_{n-1,i} p_{n-1,i}}$$

Base price index series with fixed-weighting

- According to Paasche (current year weighting):

$$\frac{\Sigma q_{ni} p_{0i}}{\Sigma q_{ni} p_{0i}}; \frac{\Sigma q_{ni} p_{1i}}{\Sigma q_{ni} p_{0i}}; \frac{\Sigma q_{ni} p_{2i}}{\Sigma q_{ni} p_{0i}}; \ldots\ldots \frac{\Sigma q_{ni} p_{ni}}{\Sigma q_{ni} p_{0i}}$$

- According to Laspeyres (base year weighting):

$$\frac{\Sigma q_{0i} p_{0i}}{\Sigma q_{0i} p_{0i}}; \frac{\Sigma q_{0i} p_{1i}}{\Sigma q_{0i} p_{0i}}; \frac{\Sigma q_{0i} p_{2i}}{\Sigma q_{0i} p_{0i}}; \ldots\ldots \frac{\Sigma q_{0i} p_{ni}}{\Sigma q_{0i} p_{0i}}$$

Base price index series with variable weighting

$$\frac{\Sigma q_{0i} p_{0i}}{\Sigma q_{0i} p_{0i}};\frac{\Sigma q_{1i} p_{1i}}{\Sigma q_{1i} p_{0i}};\frac{\Sigma q_{2i} p_{2i}}{\Sigma q_{2i} p_{0i}};\ldots\ldots\frac{\Sigma q_{ni} p_{ni}}{\Sigma q_{ni} p_{0i}}$$

Chain price index series with fixed-weighting

- According to Paasche (current year weighting):

$$-;\frac{\Sigma q_{ni}p_{1i}}{\Sigma q_{ni}p_{0i}};\frac{\Sigma q_{ni}p_{2i}}{\Sigma q_{ni}p_{1i}};\ldots\ldots\frac{\Sigma q_{ni}p_{ni}}{\Sigma q_{ni}p_{n-1,i}}$$

- According to Laspeyres (base year weighting):

$$-;\frac{\Sigma q_{0i}p_{1i}}{\Sigma q_{0i}p_{0i}};\frac{\Sigma q_{0i}p_{2i}}{\Sigma q_{0i}p_{1i}};\ldots\ldots\frac{\Sigma q_{0i}p_{ni}}{\Sigma q_{0i}p_{n-1,i}}$$

Chain price index series with variable weighting

$$-;\frac{\Sigma q_{1i}p_{1i}}{\Sigma q_{1i}p_{0i}};\frac{\Sigma q_{2i}p_{2i}}{\Sigma q_{2i}p_{1i}};\ldots\ldots\frac{\Sigma q_{ni}p_{ni}}{\Sigma q_{ni}p_{n-1,i}}$$

Base volume index series with fixed-weighting

- According to Paasche (current year weighting):

$$\frac{\Sigma q_{0i} p_{ni}}{\Sigma q_{0i} p_{ni}}; \frac{\Sigma q_{1i} p_{ni}}{\Sigma q_{0i} p_{ni}}; \frac{\Sigma q_{2i} p_{ni}}{\Sigma q_{0i} p_{ni}}; \ldots\ldots \frac{\Sigma q_{ni} p_{ni}}{\Sigma q_{0i} p_{ni}}$$

- According to Laspeyres (base year weighting):

$$\frac{\Sigma q_{0i} p_{0i}}{\Sigma q_{0i} p_{0i}}; \frac{\Sigma q_{1i} p_{0i}}{\Sigma q_{0i} p_{0i}}; \frac{\Sigma q_{2i} p_{0i}}{\Sigma q_{0i} p_{0i}}; \ldots\ldots \frac{\Sigma q_{ni} p_{0i}}{\Sigma q_{0i} p_{0i}}$$

Base volume index series with variable weighting

$$\frac{\Sigma q_{0i} p_{0i}}{\Sigma q_{0i} p_{0i}}; \frac{\Sigma q_{1i} p_{1i}}{\Sigma q_{0i} p_{1i}}; \frac{\Sigma q_{2i} p_{2i}}{\Sigma q_{0i} p_{2i}}; \ldots\ldots \frac{\Sigma q_{ni} p_{ni}}{\Sigma q_{0i} p_{ni}}$$

Chain volume index series with fixed-weighting

- According to Paasche (current year weighting):

$$-;\ \frac{\Sigma q_{1i}p_{ni}}{\Sigma q_{0i}p_{ni}};\ \frac{\Sigma q_{2i}p_{ni}}{\Sigma q_{1i}p_{ni}};\ldots\ldots\frac{\Sigma q_{ni}p_{ni}}{\Sigma q_{n-1,i}p_{ni}}$$

- According to Laspeyres (base year weighting):

$$-;\ \frac{\Sigma q_{1i}p_{0i}}{\Sigma q_{0i}p_{0i}};\ \frac{\Sigma q_{2i}p_{0i}}{\Sigma q_{1i}p_{0i}};\ldots\ldots\frac{\Sigma q_{ni}p_{0i}}{\Sigma q_{n-1,i}p_{0i}}$$

Chain volume index series with variable weighting

$$-;\frac{\Sigma q_{1i}p_{1i}}{\Sigma q_{0i}p_{1i}};\frac{\Sigma q_{2i}p_{2i}}{\Sigma q_{1i}p_{2i}};\ldots\ldots\frac{\Sigma q_{ni}p_{ni}}{\Sigma q_{n-1,i}p_{ni}}$$

Task:

Sales data of a haberdashery store

Product	2008		2009	
	Sales volume	Unit price	Sales volume	Unit price
Sewing thread (kg)	560	900	500	1100
Knitting yarn (piece)	3528	135	3612	145
Zipper (piece)	565	80	560	95

Task:
Analyse the changes of the store revenue, and determine how much the revenue changed due to the changes in price and in volume sold!

Task:

Data of three sections of a department store

Section	Percentage of revenues in 2009	Prices	Turnover
		in 2009, as percentage of 2008	
Slopwork	35	124.3	109.4
Piece goods	41	113.9	146.4
Shoes	24	120.0	120.0
Total	100	-	-

Task:

Calculate the percentage change in sales of the store!
Calculate the price index and the volume index!

Task:

Some data on accommodation

Type	Győr-Moson-Sopron county		Veszprém county	
	No. of nights (piece)	Price (HUF/night)	No. of nights (piece)	Price (HUF/night)
Commercial accommodation	4287	2573	11505	2060
Non-commercial accommodation	158294	1390	36696	1600

Task:

Compare two counties using aggregate type index calculation!

Task:

Turnover data of a shoe store

Product	Breakdown of turnover (%)		Price index (%)
	2008	2009	
women's shoes	50	48	119.0
men's shoes	22	22	113.0
children's shoes	28	30	107.0

The turnover increased by HUF 12 million, i.e. by 20% from 2008 to 2009.

Analyse revenue changes and its factors using index calculation!

Always look on the bright side of things!

We finished for today, goodbye!

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талыг нь үргэлж олж харцгаая

өнөөдөртөө ингээд дуусгацгаая, баяртай

让我们总是从光明的一面来看待事物吧！

今天的课程到此结束，谢谢！

دعونا ننظر دائما إلى الجانب المشرق من الأشياء!

انتهينا لهذا اليوم، وداعا!