STATISTICS

RATIOS

Statistical analysis with ratios

Ratios

- Concept of ratios
- Types of ratios
- Distribution and coordination ratios
- Dynamic ratios
- Associations between ratios
- Intensity ratios

Ratios

Ratio (V): quotient of two statistical data being associated

$$V = \frac{A}{B},$$

where A: object of comparison (data to be related)

B: base of comparison (benchmark)

- from identical data (%, or coefficient)
- from different data (intensity)

Types of ratios

- From grouping rows (series)
  - Distribution ratio (Vm)
  - Coordination ratio (Vk)
- From comparative rows (series)
  - Dynamic ratio (Vd: Vdl and Vdb)
  - Task- and performance indicator ratio (Vf and Vt)
  - Areal comparative ratio (Vö)
- From descriptive rows (series)
  - Intensity ratio (Vi)

Types of ratios

- Distribution ratio (Vm): ratio of the part and the whole
- Coordination ratio: ratio of two parts of the population
- Dynamic ratio: a quotient calculated from the individual data of the time series

$$V = \frac{\text{A (data of the actual period)}}{\text{B (data of the base period)}}$$

- Intensity ratio: a ratio calculated from data of a population of different types and different units; however, being associated with each other

Types of ratios

- Distribution ratio (Vm):

$$Vm = \frac{A \text{ (a part of the population)}}{B \text{ (the whole population)}}$$

E.g.: a group of students comprises 26 boys and 32 girls, altogether 58 students (100%).

$$Vm = \frac{26}{58} = 0{,}45 \rightarrow 45\ \%$$ ratio of boys

$$Vm = \frac{32}{58} = 0{,}55 \rightarrow 55\%$$ ratio of girls

Total: 100%

Types of ratios

- Coordination ratio (Vk):

$$Vk = \frac{A \text{ (actual ratio of the population)}}{B \text{ (base ratio of the population)}}$$

E.g.: movie-visitor females: 1942 women; movie-visitor males: 1876 men;

$$Vk = \frac{1942}{1876} = 1{,}035$$

1035 movie-visitor women get to 1000 movie-visitor men;

$$Vk = \frac{1876}{1942} = 0{,}966$$

966 movie-visitor men get to 1000 movie-visitor women;

Types of ratios

- Distribution ratios can be calculated from coordination ratios even without the knowledge of the original data

Ratio of men:

$$Vm = \frac{1000}{1000+1035} = 49{,}14 \qquad Vm = \frac{966}{1000+966} = 49{,}14$$

Ratio of women:

$$Vm = \frac{1035}{1000+1035} = 50{,}85 \qquad Vm = \frac{1000}{1000+966} = 50{,}86$$

Dynamic ratios

- Base ratio

$$Vdb / b = \frac{y_t}{y_b}$$

- Chain ratio

$$Vdl / l = \frac{y_i}{y_{i-1}}$$

Task 1.

Data on tourism, 2000-2005

yr	foreigners arriving to Hungary	Hungarians going abroad
	thousand people	thousand people
2000	31 141	11 065
2001	30 679	11 167
2002	31 739	12 966
2003	31 412	14 283
2004	36 635	17 558
2005	38 555	18 622

❑ Analyze the number of foreigners arriving to Hungary and the number of Hungarians going abroad using base ratios and chain ratios!

Solution

yr	Base ratios (2000 = 100%)	
	foreigners arriving to Hungary	Hungarians going abroad
2000	100	100
2001	$\frac{30679}{31141} \cdot 100 = 98,52$	$\frac{11167}{11065} \cdot 100 = 100,92$
2002	$\frac{31739}{31141} \cdot 100 = 101,92$	$\frac{12966}{11065} \cdot 100 = 117,18$
2003	$\frac{31412}{31141} \cdot 100 = 100,87$	$\frac{14283}{11065} \cdot 100 = 129,08$
2004	$\frac{36635}{31141} \cdot 100 = 117,64$	$\frac{17558}{11065} \cdot 100 = 158,68$
2005	$\frac{38555}{31141} \cdot 100 = 123,81$	$\frac{18622}{11065} \cdot 100 = 168,30$

Solution

Yr	Chain ratios (previous year = 100%)	
	foreigners arriving to Hungary	Hungarians going abroad
2000	-	-
2001	$\frac{30679}{31141}\cdot 100 = 98,52$	$\frac{11167}{11065}\cdot 100 = 100,92$
2002	$\frac{31739}{30679}\cdot 100 = 103,46$	$\frac{12966}{11167}\cdot 100 = 116,11$
2003	$\frac{31412}{31739}\cdot 100 = 98,97$	$\frac{14283}{12966}\cdot 100 = 110,16$
2004	$\frac{36635}{31412}\cdot 100 = 116,63$	$\frac{17558}{14283}\cdot 100 = 122,93$
2005	$\frac{38555}{36635}\cdot 100 = 105,24$	$\frac{18622}{17558}\cdot 100 = 106,06$

Dynamic ratios

Relationships between ratios

1. For the 1st (0th) period chain ratio cannot be provided
2. For the period selected as permanent base, the value of base ratio is 1, namely 100%
3. In the period following the permanent base period, base ratio and chain ratio equal.
4. **From chain to base:** base ratio of a given period can be calculated as a multiplication of the chain ratios of the actual period and the previous period

$$l_2 \cdot l_3 \ldots \cdot l_k = b_k \rightarrow \prod_{i=2}^{k} l_i = b_i$$

5. **From base to chain:** chain ratio of a given period can be calculated as a quotient of the base ratios of the actual period and the previous period

$$\frac{b_i}{b_{i-1}} = l_i$$

Associations between ratios

In case of foreigners arriving to Hungary:

E.g.: $$l_{2002} = \frac{b_{2002}}{b_{2001}} = \frac{1,0192}{0,9852} = 1,0345$$

In case of Hungarians going abroad:

E.g.: $$b_{2003} = l_{2001} \cdot l_{2002} \cdot l_{2003} = 1,0092 \cdot 1,1611 \cdot 1,1016 = 1,2908$$

Relationship between distribution ratio and dynamic ratio

Site	Price income (MFt)		Price income (%)		Dynamic ratio (%)
	t_{0i}	t_{1i}	$t_{0i\ (\%)}$	$t_{1i\ (\%)}$	
A	30	36	20	19	120
B	40	60	27	32	150
C	70	77	47	41	110
D	10	14,5	6	8	145
Total:	150	187,5	100	100	125

$$\overline{V} = \frac{\sum_i t_{1i}}{\sum_i t_{0i}} = \frac{187,5}{150} = \frac{187,5}{150} = 1,25$$

$$\overline{V} = \frac{\sum_i t_{0i} \cdot \frac{t_{1i}}{t_{0i}}}{\sum_i t_{0i}} = \frac{30 \cdot 1.2 + 40 \cdot 1,5 + 70 \cdot 1,1 + 10 \cdot 1,45}{150} = \frac{187,5}{150} = 1,25$$

$$\overline{V} = \frac{\sum_i \frac{t_{0i}}{\sum_i t_{0i}} \cdot \frac{t_{1i}}{t_{0i}}}{\sum_i \frac{t_{0i}}{\sum_i t_{0i}}} = \frac{0,2 \cdot 1,2 + 0,27 \cdot 1,5 + 0,47 \cdot 1,1 + 0,06 \cdot 1,45}{1} = 1,25$$

$$\overline{V} = \frac{\sum_i t_{1i}}{\sum_i \frac{t_{1i}}{\frac{t_{1i}}{t_{0i}}}} = \frac{187,5}{\frac{36}{1,2} + \frac{60}{1,5} + \frac{77}{1,1} + \frac{14,5}{1,4}} = 1,25$$

Types of ratios

E.g., in the base year (last year) I assembled 100 cars, while I planned 120 for this year, but only 110 have.

- Task indicator ratio (Vf):

$$Vf = \frac{\text{Planned data in the actual period}}{\text{Data in the base period}} \qquad Vf = \frac{120}{100} = 1{,}2$$

- Performance indicator ratio (Vt):

$$Vt = \frac{\text{Actual data in the actual period}}{\text{Planned performance for the actual period}} \qquad Vt = \frac{110}{120} = 91{,}66$$

Types of ratios

- Areal comparative ratio (Vö):

$$Vö = \frac{\text{Data of the area}}{\text{Data of the base area}}$$

E.g.: comparison of the population of Heves county and **B**orsd-**A**bauj-**Z**emplén county:

$$Vö = \frac{\text{Population of Heves county}}{\text{Population of BAZ county}} = \frac{328000}{739143} = 0{,}4437$$

Intensity ratio

Vi = A/B shows that by which intensity the examined pehomenon occurs near some other pehnomena.

- Density index:

  E.g. population, namely: number of people per 1 square km

- Index expressing supply:

  E.g. supply with physicians

- Indices of standard:

  E.g. mean salary per person, value of production per employee, GDP per person,

- Ratios:

  E.g. birth numbers per 100 people; mortality ratio;

Intensity ratio

- Straight intensity ratio:

  The level of the index coincides with the increase of the intensity ratio.

  E.g. number of physicians / number of inhabitants (1000 people) (number of people per 1000 inhabitants)

- Inverse intensity ratio:

  When the level of the phenomenon improves, then the inverse intensity ratio decreases.

  E.g. number of inhabitants (1000 people) / number of physicians (1000 people) (number of inhabitants per 1 physician)

Intensity ratio

- Raw intensity ratio:

  (Base is the whole population)
  E.g. yield of milk / number of cows
  workers / students

- Cleaned intensity ratio:

  (Base of comparison is only the part being in strong connection with the phenomenon)
  E.g. yield of milk / number of dairy cows
  teachers / students

Practice on ratios

The following data come from the statistical book of year 1998.

- The GDP / person in 1998 was 4694 USD in Hungary, 5.1% higher than a year before.
- In building industry, the number of blue collar workers per 100 labourers was 29 people, while the ratio of the labourers was 77.4% in 1998.
- In 1998, the number of births per 1000 inhabitants was 9.6;
- In higher education, 12.1 students got to one teacher in 1998.
- In PSZF, 61.9% of the students graduated in 1998 were women.
- Population of Budapest since 1990 until 1999 (based on the data of January 1) decreased by 8.8%.
- In 1998, fruit consumption per person was 62.9 kg.

<u>Task:</u> Identify the types of the above ratios and indicate the methods for calculating!

Practice on ratios

The following data come from the statistical book of year 1998.

- The GDP / person in 1998 was 4694 USD in Hungary, 5.1% higher than a year before.

Base ratio, chain ratio:

$$b_1 = l_1 = \frac{y_1}{y_0} = \frac{4694}{x} = 1{,}051$$

<u>Task:</u> Identify the types of the above ratios and indicate the methods for calculating!

Practice on ratios

The following data come from the statistical book of year 1998.

- In building industry, the number of blue collar workers per 100 labourers was 29 people, while the ratio of the labourers was 77.4% in 1998.

Distribution ratio: $\frac{29}{100+29} = \frac{29}{129} = 0{,}225$

Coordination ratio: $\frac{29}{100}$

Distribution ratio: Ratio of labourers: 77,4%

<u>Task:</u> Identify the types of the above ratios and indicate the methods for calculating!

Practice on ratios

The following data come from the statistical book of year 1998.

- In 1998, the number of births per 1000 inhabitants was 9.6

Straight intensity ratio: the number of newborns / number of inhabitants (1000 people)

<u>Task:</u> Identify the types of the above ratios and indicate the methods for calculating!

Practice on ratios

The following data come from the statistical book of year 1998.

- In higher education, 12.1 students got to one teacher in 1998.

Cleaned intensity ratio:

<u>Task:</u> Identify the types of the above ratios and indicate the methods for calculating!

Practice on ratios

The following data come from the statistical book of year 1998.

- In PSZF, 61.9% of the students graduated in 1998 were women.

Distribution ratio: 61,9% of the students are women

<u>Task:</u> Identify the types of the above ratios and indicate the methods for calculating!

Practice on ratios

The following data come from the statistical book of year 1998.

- Population of Budapest since 1990 until 1999 (based on the data of January 1) decreased by 8.8%.

Base ratio: $$b_1 = \frac{y_1}{y_0} = 0{,}912$$

<u>Task:</u> Identify the types of the above ratios and indicate the methods for calculating!

Practice on ratios

The following data come from the statistical book of year 1998.

- In 1998, fruit consumption per person was 62.9 kg.

Straight intensity ratio, index expressing supply, index of standard

<u>Task:</u> Identify the types of the above ratios and indicate the methods for calculating!

Always look on the bright side of things!

We finished for today, goodbye!

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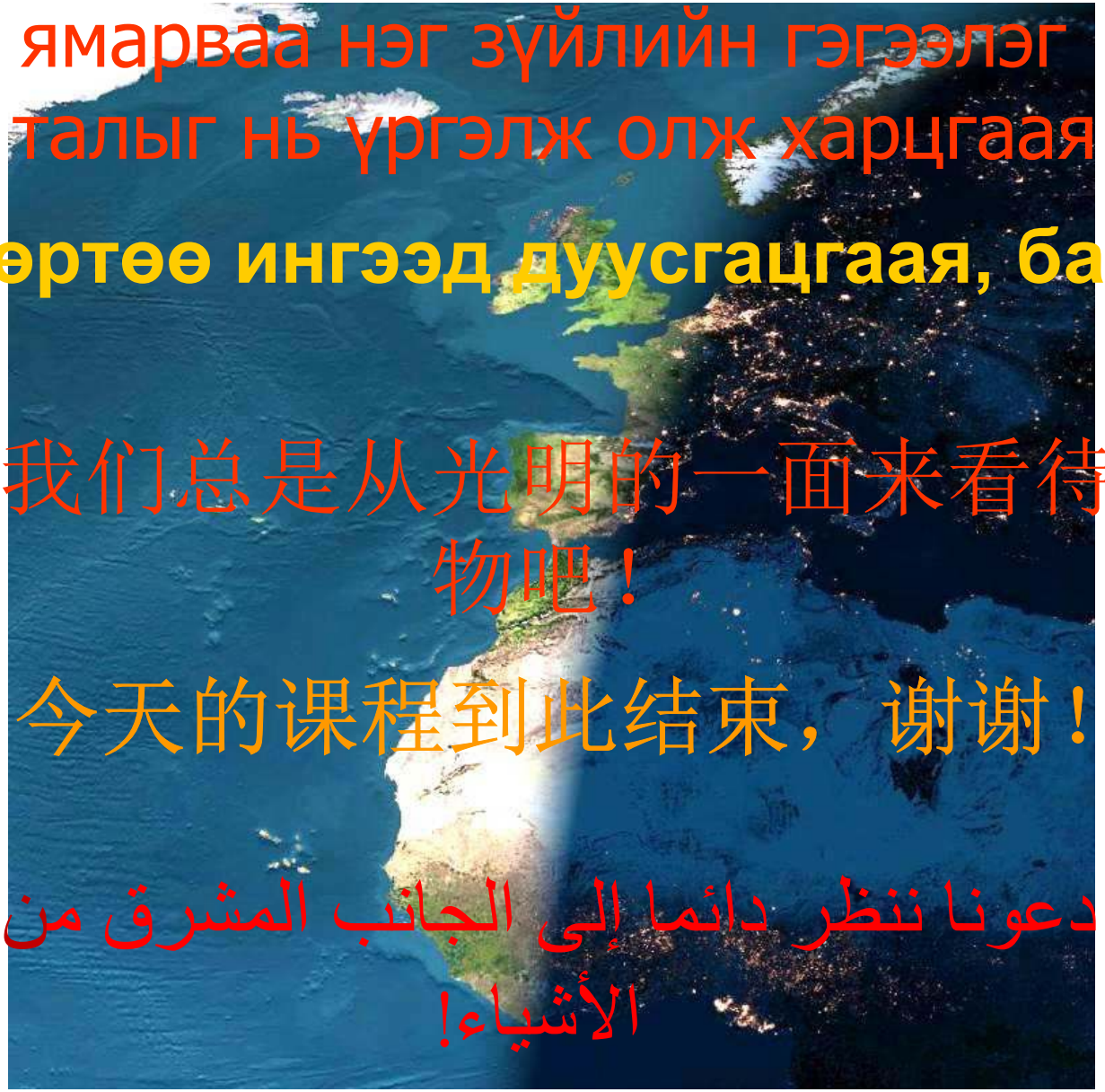
让我们总是从光明的一面来看待事物吧！

今天的课程到此结束，谢谢！

دعونا ننظر دائما إلى الجانب المشرق من الأشياء!



انتهينا لهذا اليوم، وداعا!