ANNEX 68

The statistical indicators and methods of data analysis

September, 2015

Statistical indicators

- System of statistical indicators – set of related indicators, who have one level and crossover structure and concrete task.
- Statistical indicators are split by 2 groups:
  - Individual indicators
  - Summary indicators

Examples?

Statistical indicators

- According to the form of expression:
  - Absolute indicators
  - Relative indicators
  - Average indicators
- According to the time factor:
  - In concrete time moment - Moment indicators;
  - For defined time period (for longer period) – Interval indicators

Examples????

Statistical indicators

- According to the defined territory:
  - Whole territorial indicators
  - Regional indicators
  - Local indicators
- Statistical indicators also are split:
  - Accounting – valuation indicators
  - Analytical indicators

Absolute quantities

Absolute quantities

- Initial expression of data is in form of **absolute quantities**
  - Absolute quantities define sizes of fact, direct sizes, number of units, spread in concrete time and place.
  - Absolute quantities have a certain unit of measure.

- Absolute quantities split by:
  - Individual

    amount of set, for example., salary of 1 employee, import from the Russia

  - Summary

    wage bill in enterprise, number of cares in enterprise, etc.

Absolute quantities

Methods of calculation of absolute quantities:

- Balance method
- Method of economically functional connection
- Normative method
- Method of sampling
- Experts method

Balance method

Initial situation	+	increase	-	decrease	=	Situation in the end

If we know 3 of variables we can calculate the fourth

Method of economically functional connection

- Variable are calculated by formula (equation), which includes economically linked quantities.

  Example, turnover of goods, in EUR

Price of good x sold units = Turnover

If we know the price and the number of sold goods, then can calculate the turnover of goods in financial terms for the concrete period of time. Not need to make the direct observation.

Normative method

Variable are calculated, used multiplication with linked quantity by defined coefficient.

- Coefficients can be results of previous period calculations or in nature existing connection.

For example, to calculate the weight of animal , based on changes in size.

Method of sampling

Data have been gotten to survey a part of group. This part have been selected, based on defined parameters.

For example, to get position of society about some process or thing , usually survey 1000 people.

Experts method

Data have been getting, based on opinion of competent people from the corresponding industry, to observe the absolute quantities.

Units of measure of absolute quantities

- **Natural units of measures**

  natural quantity – number, mass, volume, power etc.

  - *Can be several units of measures, for example m un m^2*
  - *Can be complex units of measures, for example. milliontonnkilometers*

- **Money units of measure**

  Union of natural un value, only in financial terms– GDP, profit, turnover etc.

- **Working units of measure**

  work consumption in man-hours, person-days, with number of employed + other unit of measure

Relative quantities

Relative quantities

Relative quantities express the numeric relation of things, they characterize the level of things. They let to rate the qualitative character of things. More stabile in comparing with absolute quantities

- Easer memorizing
- Correspond to measurement and characterization of development speed of things

Relative quantities

Without relative quantities we can not to measure:

- Composition of researched thing
- Development intensity of researched thing in time
- To rate the level of development of one thing on the background of linked thing
- To make the territorial comparison, included international

Conditions of formation of relative quantities:

- Base must be stabile (quantity come in normal conditions)
- Opposite quantities must be correlative
- Sessional things must be taken in account
- Comparability of territorial subordination must be provided
- Consistent unit of measure must be provided (EUR, kg, etc.)

Relative quantities are expressed:

- In coefficients;
- In percentages
- In per miles;
- In per decimals;
- In percentage points.

- Ratio of two numbers= k, times
- k * 100 = %
- k * 1000 = ‰
- k * 10 000 = ‰0
- x% - y% = %p

For example, coefficient 2,543 is the same as:

- 2,5 times,
- 254,3 %,
- 2543 ‰
- 25430 $‰_0$.

Forms of Relative quantities

- Relative quantities of dynamics;
- Relative quantities of projections (task) and realization of projection
- Relative quantities of structure
- Relative quantities of coordination
- Relative quantities of comparison
- Relative quantities of intensity

Relative quantities of dynamics

The Development of things in time is Expressed (dynamic)

Fact in reporting period has been divided by quantity of the same indicator in the base period.

- If quantity expressed by coefficient, that it is increasing coefficient **(k)**, if expressed by percentage – **growth rate(T).**

$$k * 100\ \% = T,\ \%$$

- Changes of relative quantity of dynamics – **rate of increase (T_p).**

$$T\ \% - 100\ \% = T_p,\ \%$$

Rate of increase can be negative

Relative quantities of dynamics

- **Example** : GDP value in actual prices in 2011 3rd quarter was 3 608 993 thous. EUR, but in 2012 3rd quarter was 3 901 152 thous. EUR.

T = 3 901 152 : 3 608 993 = 1.08 * 100 % = 108 %

T p = 108 % - 100 % = 8 %

We can conclude, that GDP in actual prices was increased by 8 %.

Relative quantities of dynamics

<u>Example</u> : The number of socially insurance persons in 2008 was 940 000 persons, but in 2009 was 890 000 persons.

T = 890 000 : 940 000 = 0,947 * 100 = 94,7 %

T p = 94.7 % - 100 % = - 5.3 %

We can conclude, that number of socially insurance persons during the year decreased by 5.3 %.

940 000:890 000 = 1,056 or 105,6% or by 5,6%

Relative quantities of projections and realization of projection

- Used in market economy.
- Relative quantity of projection shows for how many times or by how many percentage we have to increase or decrease the indicator in projection.

Relative quantities of projections and realization of projection

Example:

Latvias export to the country N in the base year was EUR 528 thous. There were projection to increase the export in the reporting year for the EUR 63 thous. The actual value of export in reporting year was 544 thous EUR.

Relative quantity of task of projection = (528+63) : 528 = 591:528 = 1,119 x 100 = 111.9%

The amount of export was projected to increase by 11.9% (111.9% -100%)

Relative quantity of the realization of projection = 544 :591 = 0.920 x 100 = 92.0%

Calculation shows that projection is not realized by 8% (92,0% – 100,0%)

Relative quantities of projections and realization of projection

Continuation of Example:

Between the slide showed indicators we can see the connection:

- **Coefficient of growth** (relative quantity of dynamics) = task of projection x realization of projection: 1.119 *0.920 = 1,030
- **The growth rate** (relative quantity of dynamics) = 544 : 528 = 1.030 x 100 = 103%
- **Testing of connection**: 1.030 = 1.119 x 0.920

The correlation between these two indicators give the possibility to calculate the third:

- **Relative quantity of task of projection** = growth rate : relative quantity of realization of projection = 1.030 :0.920 = 1.119
- **Relative quantity of the realization of projection** = growth rate : relative quantity of task of projection = 1.030 : 1.119 = 0.920

Relative quantities of projections and realization of projection

If we would like to **project the growth of the current level**, than we have divided the actual level by the projected level (in the reviewed period)

Example:

Ministry of Welfare projected to increase the average amount of pensions by 2%. Actually the average amount of pensions increased by 2,5%.

Realization of projection in percentage = (102,5 : 102,0) x 100 = 100,5%

Relative quantities of projections and realization of projection

If we would like to project the **relative decrease of the current level**, than we have the projected level divide by the actual level (in the reviewed period)

Example:

Ministry of Welfare projected decrease the number of old age pensioners by 0,4%. Actually the number of pensioners decreased by 0,6%.

Realization of projection in percentage = (99,6 : 99,4) x 100 = 100,2%

Relative quantities of projections and realization of projection

The level of realization of projection are calculated with precision one tenth (0,1%), but if realization of projection is in interval 99,0-100% (for example, 99,86%), then – with precision hundredth (0,01%). Not to allowed to approximate till full 100,0%.

Relative quantities of structure

- Structure – placement and connection of elements of statistical set.
- Relative quantities have been calculated from the grouped data and they characterize the proportion of the separate parts of researched things in the same tings total.
- Relative quantities of structure have been calculated as absolute quantities of separate element of researched thing divided by total of the researched thing.
- Usually relative quantities of structure have been expressed in percentage. Sum of relative quantities of all elements = 100%

Relative quantities of structure

Example

Pension expenditures, in mln. EUR

Type of pensions	Code	In actual prices, 2015, I half of year	In percentage from the total
Old age	A	787.4	89.4%
Disability	B	14.3	1.6%
Survival	C	6.4	0.7%
Service	D	73.0	8.3%
Total		881.1	100.0%

Relative quantities of structure

Continuation of Example

A = 787.4 : 881.1 x 100 = 89.4%

B = 14.3 : 881.1 x 100 = 1.6%

C = 6.4 : 881.1 x 100 = 0.7%

D = 73.0 : 881.1 x 100 = 8.3%

89.4% + 1.6% + 0.7% + 8.3% = 100%

Relative quantities of coordination

- Relative quantities of coordination characterize the relation between two elements of the same set.
- Relative quantities of coordination have been calculated as one element of set divided by the other element in the same absolute or relative set. Elements are related between each other.

Relative quantities of coordination

Example

The amount of LV export in December 2013 was 810,1 mln.EUR; amount of import – 993,5 mln. EUR

(810,1 : 993,5) x 100% = 81.5% - export was 81,5% of import

993,5 : 810,1 = 1.2 – amount of import was 1,2 times higher as amount of export

Relative quantities of comparison

- Relative quantities of comparison characterize relation between two or more monotone objects in the fixed moment or period of time.
- Relative quantities of comparison are calculated as ratio between two absolute or relative quantities

Relative quantities of comparison

Example

- Territory of Latvia – 64,6 thous. km^2; of US – 9363,5 thous. $km^{2;}$ of Russia – 17075,4 thous. Km
- 9363,5 : 64,6 = 144,9 – US territory is 144.9 times larger as Latvias
- 17075,5 : 64,6 = 264,3 - Russia territory is 264,3 times larger as Latvias
- Or
- (64,6 : 9363,5)x 100 = 0,7% _Latvias territory is 0,7% of US territory and (64,6% : 17075,4) x 100 = 0,4% or Latvias territory is 0,4% of Russia territory

Relative quantities of intensity

- Relative quantities of intensity characterize spread of one thing in other related thing.
- Relative quantities of intensity have been calculated as dividing the absolute quantity of researched thing by absolute quantity of the environment where thing developed or spread.

Relative quantities of intensity

Example

- Realization of Industry production in LV in 2006 I quarter in actual prices was 1240 mln. EUR; number of inhabitants was 2294,6 thous. People
- Relative quantities of intensity (amount of industry production per one inhabitant) =

1 240 000 : 2 294.6 = 540,40 EUR

Absolute differences of relative quantities

- Differences of relative quantities showed importance of absolute differences of relative characteristics, have an analytic importance.
- The form of expression of absolute differences of relative quantities are points, which can be percentages points %p (% -%); promiles points $^{0}/_{00}$p ($^{0}/_{00}$ - $^{0}/_{00}$); prodecimales points $^{0}/_{000}$p ($^{0}/_{00}$ - $^{0}/_{000}$)

Absolute differences of relative quantities

Example

Realization of projection of Realization of projection of average number of pensioners

Type of pensions	Average number of pensioners, thous		Realization of projection, %
	projected	In fact	
Old age	472,0	474,3	100.5%
Disability	72,0	73,2	101.7%
Total	544	547.5	100.6%

101,7 – 100,5 = 1,2

101,7% : 100,5% = 1,01

Distribution orders

Distribution orders

- Distribution order consists of two elements:
  - Numeral meaning of indication
  - References for how many units have that or other indication of distribution or how significant is frequency of variants
- Variant – numeral indication of meaning
- Ranging
  - In increasing sequence (direct range)
  - In decreasing sequence (turned range)

Distribution orders

Example

Distribution orders which are used for the direct range (increasing sequence)

Age , in years	Number of employees in enterprise, persons
18 - 30	100
30 - 50	250
50 and older	86

Distribution orders which are used for the turned range (reducing sequence)

Number of employees, persons	Number of enterprises
200 – 150	54
150 – 100	267
100 and less	589

Indicators of distribution orders

The main characterized indicators:

– variant, marked as ***x***;

– frequency of variants:

- Absolute quantities, marked as ***f***; *f*= x1 + x2+ .... + xn
- Relative quantities, marked as ***w***. Equivalent to relative quantities of structure

$$w = \frac{f}{\sum f}$$

– Density of intervals, marked by ***f(b)*** and ***w(b)*.**

Indicators of distribution orders

Example

Distribution of employed by the loads

Load (x)	**0.50**	**0.75**	**1.00**
Employed (f), persons	25	102	78
Relative frequency (w)	0.12	0.50	0.38

How to calculate the relative frequency?

Indicators of distribution orders

- In addition to the direct frequency ($\boldsymbol{f}$ un $\boldsymbol{w}$) in distribution orders also **accumulated frequencies** are used :
  - the accumulated absolute frequencies of variants marks as $\boldsymbol{S_f}$
  - the accumulated relative frequencies of variants marks as $\boldsymbol{S_w}$

  The accumulated frequencies = consecutive sum of absolute or relative frequencies.

- **The accumulated relative and absolute densities are** *getting as division between accumulated frequencies and accumulated lengths of intervals* **,** Δ

Example of distribution order: age structure of divorce people in 2009

Variants (years) x	**Frequencies**			
	Direct		Accumulated	
	Absolute *f*	Relative *w, %*	Absolute *Sf*	Relative *Sw*
20 – 24	140	2.2	140	2.2
25 -29	745	11.7	885	13.9
30 -34	1 358	21.4	2 243	35.3
35 - 39	1 352	21.3	3 595	56.6
40 - 49	1 842	29.1	5 437	85.7
50 - 59	690	10.9	6 127	96.6
60 and more	214	3.4	6 341	100.0
Total:	**6 341**	**100.0**	**x**	**x**

Indicators of distribution orders

- **The accumulated relative and absolute density are** *getting as division between accumulated frequencies and accumulated lengths of intervals* **,** Δ

Example of distribution order: age structure of divorce people in 2009

Variants (years) x	**Length of Interval**	**Frequencies**		**Densities of Interval**	
		Absolute *f*	Relative *w*	*f(b)*	*w(b)*
20 – 24	4	140	2.2	35	0.55
25 -29	4	745	11.7	186	2.93
30 -34	4	1358	21.4	340	5.35
35 - 39	4	1352	21.3	338	5.36
40 - 49	9	1842	29.1	205	3.23
50 - 59	9	690	10.9	77	1.21
60 and more	9	214	3.4	23.78	0.38
Total:		6341	100.0	x	x

Example of distribution order: age structure of divorce people in 2009

Variants (years) x	Length of Interval	Accumulated length of Interval	Accumulated		Accumulated densities	
			Absolute *Sf*	Relative *Sw*	*Sf(b)*	*Sw(b)*
20 – 24	4	4	140	2.2	35	0.55
25 -29	4	8	885	13.9	111	1.74
30 -34	4	12	2243	35.3	187	2.94
35 - 39	4	16	3595	56.6	225	3.53
40 - 49	9	25	5437	85.7	218	3.43
50 - 59	9	34	6127	96.6	180	2.84
60 and more	9	43	6341	100.0	147	2.33

Average quantities of distribution order

- The most important and widely used in practice average quantities are as follows:
  - arithmetic average
  - geometric average
  - square average
- Depending on the specific characters of processed average quantities are as follows:
  - unweighted (simple) averages, calculated from the ungrouped data;
  - weighted averages, calculated by the grouped data.

Unweighted averages

The simple arithmetic average shall be calculated using the formula:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_1}{n} = \frac{X_1 + X_2 + \cdots . X_n}{n}$$

where X_1 - variant;

n – number of units in set

Unweighted averages

The harmonious average shall be calculated using the formula:

$$\bar{X}\text{ h} = \frac{n}{\sum_{i=1}^{n}\frac{1}{X_1}} = \frac{n}{\frac{1}{X_1}+\frac{1}{X_2}+\cdots+\frac{1}{X_n}}$$

where X_1 - variant;

n – number of units in set

Unweighted averages

Example – harmonious average.

5 employees make one kind of product, but with different working usage for making one product. The first employee use 2,1 h, second – 1,5 h, third – 2 h, fourth – 1,6 h, fifth – 2,3 h.

The average labour intensity (t) =

$$h = \frac{1+1+1+1+1}{\frac{1}{2.1}+\frac{1}{1.5}+\frac{1}{2.0}+\frac{1}{1.6}+\frac{1}{2.3}} = \frac{5}{0.48+0.67+0.5+0.63+0.77} =$$

$$= \frac{5}{3.05} = 1.64 \text{ h}$$

Unweighted averages

Square average formula:

$$\overline{X}_{squ} = \sqrt{\frac{\sum_{i=1}^{n} x_i^2}{n}} = \sqrt{\frac{X_1^2 + X_2^2 + X_3^2 + \ldots X_n^2}{n}}$$

Unweighted averages

Geometric average formula:

$$\bar{X}_{geom} = \sqrt[n]{\prod_{i=1}^{n} X_i} = \sqrt[n]{X_1 * X_2 * X_3 * ... X_n}$$

Unweighted averages

Example

Latvias inflation in February 2006 compared to January was 126.9%; in March compared with February 127.2%; in April compared with March 127.9%; in May compared with April 129.5%.

Average monthly inflation:

$$\overline{X}_{\text{inf}} = \sqrt[4]{1{,}269 * 1{,}272 * 1{,}279 * 1{,}295} = 127{,}9\%$$

Weighted averages

- If the data is grouped, then use the **weighted averages**
- They are calculated by taking in account of each variant repetition quantity (statistical weights)
- In statistics the weighing is called as variants multiplication with their frequencies

Weighted averages

Weighted arithmetical average formula:

$$\overline{X} = \frac{\sum_{i=1}^{n} x_i f_i}{\sum_{i=1}^{n} f_i} = \frac{x_1 f_1 + x_2 f_2 + ... + x_n f_n}{f_1 + f_2 + ... + f_n}$$

Where f –frequencies of variants

Weighted averages

Example

Number of employees, people, (f)	**1**	**2**	**6**	**5**	**3**	**2**	**1**
Average wage, EUR (X)	280	355	475	540	690	780	960

$$\overline{X} = \frac{1*280 + 2*355 + 6*475 + 5*540 + 3*690 + 2*780 + 1*960}{20} = 556{,}50$$

Weighted averages

In calculating the **weighted arithmetic average** instead of absolute values can use the **proportions** of variants or **relative frequencies** of variants (w).

$$\overline{X} = \frac{\sum X_i W_i}{\sum W_i}$$

Where $\sum Wi$ = 100,0%

Weighted averages

Example:

Apartment house has such division of apartments:

22% - one room flat

50% - two rooms ...

19% - three rooms ...

9% - four rooms ...

$$\overline{X} = \frac{1*22 + 2*50 + 3*19 + 4*9}{22 + 50 + 19 + 9} = 2{,}15 rooms$$

Weighted averages

Averages can be calculated from the variants which are themselves already averages:

$$\overline{X} = \frac{\sum_{i=1}^{n} \overline{X}_i f_i}{\sum_{i=1}^{n} f_i}$$

Where $\overline{X}_i$ - weighted arithmetical average of group i

f_i - statistical weight of group i

Weighted averages

Example:

Companies	I	II	III
Average wage, EUR	574	618	821
Number of employed, people	202	135	49

$$\overline{X} = \frac{574*202+618*135+821*49}{202+135+49} = 620{,}74 EUR$$

Calculation of arithmetic average for the interval distribution order

The **arithmetic average for the interval distribution order** is calculated using the formula:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i' f_i}{\sum_{i=1}^{n} f_i}$$

Where X' - the average meaning of interval

Calculation of arithmetic average for the interval distribution order

Example:

Age, years (X)	Number of employees, people (f)	Structure of employed, % (W)	Centers of intervals $(X_i'$
until 25	6	7,7	22,5
25-30	20	25,6	27,5
30-35	16	20,5	32,5
35-40	30	38,5	37,5
40-45	4	5,1	42,5
45 and more	2	2,6	47,5
	78	100,0	

How to calculate the average age of all employees?

Calculation of arithmetic average for the interval distribution order

Example

Average age of employed by absolute quantities:

$$\overline{X} = \frac{6*22,5+20*27,5+16*32,5+30*37,5+4*42,5+2*47,5}{6+20+16+3+4+4} = \frac{2595}{78} = 33,3 years$$

Average age of employed by relative quantities:

$$\overline{X} = \frac{7,7*22,+25,6*27,5+20,5*32,5+38,5*37,5+5,0*42,5+2,6*47,5}{7,7+25,6+20,5+38,5+5,1+2,6} = \frac{3327,5}{100,0} = 33,3 years$$

Average quantities of distribution order

Indicators of distribution center are:

- Arithmetical average
- Mode
- Median

Average quantities of distribution order

- Average quantities **of discrete distribution** order is calculated by the weighted arithmetic average formula:

$$\overline{X} = \frac{\sum_{i=1}^{n} x_i f_i}{\sum_{i=1}^{n} f_i} = \frac{x_1 f_1 + x_2 f_2 + ... + x_n f_n}{f_1 + f_2 + ... + f_n}$$

Average quantities of distribution order

- Average quantities **of interval distribution order** is calculated by the formula:

$$\overline{X} = \frac{\sum_{i=1}^{n} x_i f_i}{\sum_{i=1}^{n} f_i} = \frac{x'_1 f_1 + x'_2 f_2 + ... + x'_n f_n}{f_1 + f_2 + ... + f_n}$$

Where x'_1 - average meaning of interval

Average quantities of distribution order

Mode in the **discrete** distribution order is the highest frequently met number in the number group

Example: mode in the number group: 2, 3, 3, 5, 7 and 10 is 3

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Average quantities of distribution order

Mode in the **interval** distribution order is calculated by formula:

$$M_0 = X_0 + \Delta * \frac{f_{mo} - f_{mo-1}}{(f_{mo} - f_{mo-1}) + (f_{mo} - f_{mo+1})}$$

Where M_0 - mode

X_0 - the lowest border of the modal interval

Δ - the space of the modal interval

f_{mo} - the frequency of the modal interval

f_{mo-1} - prior modal interval frequency

f_{mo+1} - after modal interval frequency

Average quantities of distribution order

- **Median** is the statistical quantity of indication of the unit placed in the center of ranged distribution order.
- **Ranged** is the distribution order containing all the units listed in increasing or reducing order.

Average quantities of distribution order

Median **unit serial number** is found by increasing the number of members per one unit and the result obtained by dividing with number two.

$$M_{e(No)} = \frac{n+1}{2} \quad \text{or} \quad M_{e(No)} = \frac{\sum f + 1}{2}$$

Average quantities of distribution order

Median in the **interval** distribution order is calculated by formula:

$$Me = X_0 + \Delta * \frac{\frac{\sum f}{2} - S_{fme-1}}{f_{me}}$$

Where Me - median

X_0 - the lowest border of the median interval

Δ - the space of the median interval

$\sum f$ - the sum of distribution order members

S_{fme-1} - prior median interval accumulated frequencies

f_{me} - median interval frequency

Average quantities of distribution order

Example

Average wage, EUR (X)	Number of employed, people (f)	Structure of employed, % (W)	Accumulated frequencies	
			Absolute(Sf)	Relative (Sw)
180-220	10	10.3	10	10.3
220-350	28	28.9	38	39.2
350-450	25	25.8	63	64.9
450-600	18	18.6	81	83.5
600-800	13	13.4	94	96.9
800 and more	3	3.1	97	100.0

Average quantities of distribution order

Mode of average wage per month

- Calculated used absolute indicators:

$$M_o = 220 + 130 * \frac{28 - 10}{(28 - 10) + (28 - 25)} = 220 + 130 * \frac{18}{21} = 331{,}43 EUR$$

- Calculated used relative indicators:

$$M_o = 220 + 130 * \frac{28{,}9 - 10{,}3}{(28{,}9 - 10{,}3) + (28{,}9 - 25{,}8)} = 331{,}43 EUR$$

Average quantities of distribution order

Median of average wage per month

- Calculated used absolute indicators:

$$Me = 350 + 100 * \frac{48{,}5 - 38}{25} = 350 + 100 * \frac{10{,}5}{25} = 392{,}0EUR$$

- Calculated used relative indicators:

$$Me = 350 + 100 * \frac{50 - 39{,}2}{25{,}8} = 391{,}86EUR$$

Indicators of variations

Indicators of variations

- The main absolute indicators of variations are:
  - Amplitude
  - Average linear error/deviation
  - Dispersion
  - Average quadratic error/deviation (standard error)
- The main relative indicators of variations
  - Coefficient of variation
  - Oscillation coefficient
  - Relative linear error

Absolute indicators of variations

Amplitude is the difference between maximal and minimal border of variable and calculated by formula:

$$Rv = Xmax – Xmin ,$$

where Rv – amplitude;

Xmax – the maximal value of indication;

Xmin – the minimum value of indication.

Absolute indicators of variations

Average linear error calculated by formula:

$$\alpha = \frac{\sum \left| X - \bar{X} \right| f}{\sum f}$$

Where f – frequency of variant

$\sum f$ - number of units of set

$\bar{X}$ - arithmetical average of indication

Absolute indicators of variations

Dispersion calculated by formula:

$$S^2 = \delta^2 = \frac{\sum (X - \bar{X})^2 f}{\sum f}$$

Absolute indicators of variations

Average quadratic error/deviation (standard error) calculated by formula:

$$S = \delta = \sqrt{\frac{\sum \left(X - \bar{X}\right)^2 f}{\sum f}}$$

Relative indicators of variations

Coefficient of variation calculated by formula:

$$K_{\text{var}} = \frac{\delta}{\overline{\overline{X}}} * 100$$

Relative indicators of variations

Oscillation coefficient calculated by formula:

$$K_{osc} = \frac{R_v}{\overline{\overline{X}}} * 100$$

Relative indicators of variations

Relative linear error calculated by formula:

$$\alpha_{rel} = \frac{\alpha}{\overline{\overline{X}}} * 100$$

Thank you