KHARKIV NATIONAL MEDICAL UNIVERSITY



DYNAMIC ROWS (TIME SERIES)
AND THEIR ANALYSIS

Methodical instructions

for students to the practical lesson

on the course ***“Social medicine, public health (biostatistics)”***

forstudents in the specialty:

– 222 “Medicine”

– 228 “Pediatrics”,

– 221 “Dentistry”.

Kharkiv

2019

MINISTRY OF PUBLIC HEALTH OF UKRAINE

KHARKIV NATIONAL MEDICAL UNIVERSITY

DEPARTMENT OF PUBLIC HEALTH AND HEALTHCARE MANAGEMENT

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*Затверджено вченою радою Харківського національного медичного університету.*

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Dynamic rows (time series) and their analysis: methodical instructions for students to the practical lesson on the course “Social medicine, public health (biostatistics)” for students in the specialty 222 “Medicine”, 228 “Pediatrics, 221 “Dentistry” / V.A. Ognev, K.G. Pomogaybo, I.A. Chukhno. – Kharkiv : KhNMU, 2019. – 16 p.

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**RECOMMENDATIONS FOR STUDYING THE TOPIC**

**The aim of the class:** to get acquainted with possibilities, conditions and a technique of the analysis of the dynamic rows (time series).

**Need to know:**

* ***program questions:***
* basic rules for constructing and analysis of dynamic rows (time series) during studying dynamics of medico-biological phenomena;
* levels of the dynamic rows (time series);
* types of the time series: *simple, complex, interval and moment*;
* basic indicators of the analysis of dynamic rows (time series): absolute growth (increase or decrease), growth rate (decrease), rate of increase;
* basic methods of processing the dynamic rows (time series) in order to determine the direction of changes (trend);
* methods of equalization the time series: the least squares, the moving average, group average, integration of intervals of the dynamic rows (time series);
* study and measurement of seasonal fluctuations in the dynamic rows (time series);
* ratio of dynamic rows (time series);
* interpolation and extrapolation in the dynamics series. Forecasting based on extrapolation of the dynamic rows (time series).

**Need to be able to:**

– calculate and evaluate the indicators of the time series;

– carry out the transformation and alignment of the time series using different methods.

**Recommended literature**

**Basis literature**

1. Біостатистика / за заг. ред. чл.-кор. АМН України, проф. В.Ф. Москаленка. – К. : Книга плюс, 2009. − С. 12-31.

2. Социальная медицина и организация здравоохранения / под общ. ред. Ю.В. Вороненка, В.Ф. Москаленко. – Тернополь : Укрмедкнига. 2000. –
С. 23-32.

3. Социальная гигиена и организация здравоохранения / под ред. Н.Ф. Серенко, В.В. Ермакова. – М. : Медицина, 1984. – С. 102-104.

4. Тестовые задачи по социальной медицине, организации здравоохранения и биостатистике : учеб.пособ. для студентов мед. ф-тов / под ред. В.А. Огнева. – Харьков : Майдан, 2005. – С. 9-14.

5.Лекционный курс кафедры.

**Additional literature**

1. Альбом А. Введение в современную эпидемиологию / А. Альбом, С. Норелл. – Таллинн, 1996. – 122 с.

2. Власов В.В. Введение в доказательную медицину / В.В. Власов. – М. : Медиа Сфера, 2001. – 392 с.

3. Герасимов А. Н. Медицинская статистика / А.Н. Герасимов. – М. : ООО «Мед.информ. агентство», 2007. – 480 с.

4. Зайцев В.М. Прикладная медицинская статистика / В.М. Зайцев, В.Г. Лифляндский, В.И. Маринкин. – СПб. : ООО «Изд-во ФОЛИАНТ», 2003. – 432 с.

5. Общая теория статистики: учебник / под ред. чл.-корр. РАН И.И. Елисеевой. − 4-е изд., перераб. и доп. − М. : Финансы и Статистика, 2000. − 480 с.

6. Основы доказательноймедицины / под ред. М. П. Скакун. – Тернополь : Укрмедкнига, 2005. – 244 с.

7. Реброва О.Ю. Статистический анализ медицинских данных. Применение пакета прикладных программ STATISTICA / О.Ю. Реброва.–М. : Медиа Сфера, 2002. – 312с.

8. Сергиенко В.И. Математическая статистика в клинических исследованиях / В.И. Сергиенко, И.Б. Бондарева. – М. : ГЭОТАР-МЕД, 2001. – 256 с.

**Information resources**

1.Население Украины. Демографический ежегодник. – К. : Госкомстат Украины –[www.ukrstat.gov.ua](http://www.ukrstat.gov.ua)

2.U.S. National Library of Medicine –Национальная медицинская библиотека США– <http://www.nlm.nih.gov/>

3.Государственная научно-педагогическая библиотека Украины им. В.О. Сухомлинского–<http://www.dnpb.gov.ua/>

4.Научная библиотека Харьковского національного медицинского университета – <http://libr.knmu.edu.ua/index.php/biblioteki>

5.Научная педагогическая библиотека им. К.Д. Ушинского Российской академии образования – <http://www.gnpbu.ru/>

6.Национальная библиотека Украины им. В.И. Вернадского –<http://www.nbuv.gov.ua/>

7.Национальная научная медицинская библиотека Украины –<http://www.library.gov.ua/>

8.Харковская государственная научная библиотека им. В.Г. Короленка – http://korolenko.kharkov.com

9.Центральная библиотека Пущинского научного центра РАН –<http://cbp.iteb.psn.ru/library/default.html>

10.Центральная научная медицинская библиотека Первого Московского государственного медицинского университетаим. И.М. Сеченова–<http://elibrary.ru/defaultx.asp>

**BASIC THEORETICAL MATERIAL**

**FOR PREPARATION FOR THE LESSON**

**1. Dynamic rows (time series) and its types**

**Dynamic rows (time series) –** is a series consisting of homogeneous comparable quantities characterizing the changes in a certain phenomenon at certain intervals of time and arranged in chronological order at specific intervals.

The components of the dynamic rows (time series) are levels of the time series and time indicators (years, quarters, months, etc.)

**Levels of the dynamic rows (time series)** – are the quantities out of which the dynamic series consists. This is the size of a particular phenomenon, achieved over a certain period or at a certain point in time.

**There are two types of the levels based on the fact what levels reflect the state of the phenomenon:**

**1. Moment** – the values of the series characterize the phenomenon **at a certain point in time** (staffs, beds at the end of the calendar year, identified patients at the medical examination).

**2. Interval** – the levels of the series are determined **for a certain period of time** (the number of hospitalization cases at hospital, the number of lethal cases throughout the year, the number of emergency calls during the day).

There are some features for various types of interval and moment dynamic rows (time series). Since the levels of the interval series are the total size of the phenomenon over a certain period of time, they depend on the duration of a certain period of time and can be represented as a final total. In the time series, the levels contain elements for recounting (for example, the population of Ukraine according to census data), so it is impossible to summarize.

**The values that are studied in dynamics (the levels of the series) can be represented in the form:**

– absolute numbers;

– relative (intensive indexes, ratio);

– mean values.

According to these criteria, the dynamic rows (time series) can be divided into series of absolute, relative and mean values.

It is not always possible to use absolute values for analyzing the dynamic since the changes of absolute values are often associated with changes in the number of the environment or the basis for formation.

For example, a reduction in the number of inpatient hospital admissions may be associated with a reduction in bed capacity over a certain period of time, rather than with actual health indicators of the population. Consideration in the dynamics of extensive indicators (structures) in most cases is inappropriate and can be carried out only in special cases, provided a clear interpretation and with the mandatory account of changes in the structure of the whole population.

**Depending on the distance between levels**, dynamic rows (time series) can be divided into **equidistant** (even intervals between dates) and non-**equidistant/incomplete** (uneven time intervals or variable periods).

**The nature of the main trend** of the studied processes, represented in the form of dynamic rows (time series), divides them into ***stationary and nonstationary/time-varying ones***. If mathematically expected (predicted) values of characteristics and parameters of their stability (mean square deviation, coefficient of variation) are constant, independent from time, then such process is a stationary one. These series are also called **stationary**.

**Medico-social processes in time**, as a rule, **are not stationary**, since each of them contains a certain tendency for development. Such dynamic rows (time series) are **non-stationary**.

The possibility of comparing individual levels of the dynamic rows (time series) is an important condition for the correct construction of the time series and its further characterization. It is necessary to remember about the territorial and qualitative comparison of the results over the comparing the data in dynamics.

**The main reasons that make it difficult or impossible to compare the levels of the dynamic rows (time series) are:**

– changes in the unit of measure or methodic of calculations (evaluation of the economic efficiency of the work of medical institutions in different monetary equivalents for these periods – rubles, coupons, hryvnia, foreign currencies);

– uneven periodization of dynamics (quantitative – by years, qualitative – by socio-economic periods, changes in the priority of different types of institutions in the structure of medical and preventive care);

– changes in the list of objects of analysis (the transition of a number of medical and preventive institutions from one subordination to another one);

– changes in the territorial boundaries of regions, districts, etc.

These problems are usually can be solved on the stage of collecting and processing data or by recounting them.

Methods of medical statistics allow to measure the size of changes that have occurred over a period of time and quantify the direction of their development. For this purpose, the following indicators are used: absolute growth, growth rate, rate of increase.

#### **2. Alignment of the levels of the dynamic rows (time series)**

Time series do not always consist of levels that consistently change decreasingly or increasingly. Quite often, the values of the levels of the dynamic rows (time series) fluctuate significantly. In this case it is difficult to reveal the regularity of the phenomenon. For this situation alignment/equalization of the levels are used.

**There are several ways to solve the problem.**

1. Increase of intervals of a dynamic rows (time series).

2. Smoothing the dynamic rows (time series) using the group average.

3. Smoothing the dynamic rows (time series) with the moving average and others.

**1. Increase of intervals of a dynamic rows (time series)** is done by summing the data of the series adjacent levels.

**For example:**

**Seasonal fluctuations
of infectious diseases among the population in the city А**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Months**  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **total** |
| **Number of cases** | 130 | 210 | 122 | 166 | 227 | 160 | 184 | 240 | 156 | 233 | 240 | 199 | 2267 |
| **Increase of levels** | 462 | 553 | 580 | 672 |  |

**Calculation** for 1,2 and 3 months: 130+210+122 = 462 cases in 3 months.

**Calculation** for 4,5 and 6 months: 166+227+160 = 553 cases in 3 months.

**Calculation** for 7,8 and 9 months: 184+240+156 = 580 cases in 3 months.

**Calculation** for 10,11 and 12 months: 233+240+199 = 672 cases in 3 months.

**Conclusion:** There is a tendency of infectious diseases’ increasing from month to month.

**2. Smoothing the dynamic rows (time series) using the group average** is made by summing the adjacent levels of neighboring periods, and then the resulting sum is divided by the number of sums.

**Seasonal fluctuations
of infectious diseases among the population in the city А**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Months**  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **total** |
| **Number of cases** | 130 | 210 | 122 | 166 | 227 | 160 | 184 | 240 | 156 | 233 | 240 | 199 | 2267 |
| **Increase of levels** | **154** | **184** | **193** | **224** |  |

**Calculation** for 1,2 and 3 months: (130+210+12)/3 = 154 cases.

**Calculation** for 4,5 and 6 months: (166+227+160)/3 = 184 cases.

**Calculation** for 7,8 and 9 months: (184+240+156)/3 = 193 cases.

**Calculation** for 10,11 and 12 months: (233+240+199)/3 = 224 cases.

**Conclusion:** There is a tendency of infectious diseases’ increasing from month to month.

**3. Smoothing the dynamic rows (time series) with the moving average.** The moving average allows each level to be replaced by an average value from the level data and two adjacent ones.

**For example:**

**Calculation** for 1,2 and 3 months: (130+210+122)/3 = 154 cases.

**Calculation** for 2,3 and 4 months: (210+122+166)/3 = 166 cases.

**Calculation** for 3,4 and 5 months: (122+166+227)/3 = 172 cases.

**Calculation** for 4,5 and 6 months: (166+227+160)/3 = 184 cases.

**Calculation** for 5,6 and 7 months: (227+160+184)/3 = 190 cases.

**Calculation** for 6,7 and 8 months: (160+184+240)/3 = 194 cases.

**Seasonal fluctuations
of infectious diseases among the population in the city А**

| **Month** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **total** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Number of cases** | 130 | 210 | 122 | 166 | 227 | 160 | 184 | 240 | 156 | 233 | 240 | 199 | 2267 |
| **Moving average**  | 154 |  |  |  |  |  |  |  |  |  |  |
| **Moving average** |  | 166 |  |  |  |  |  |  |  |  |  |
| **Moving average** |  |  | 172 |  |  |  |  |  |  |  |  |
| **Moving average** |  |  |  | 184 |  |  |  |  |  |  |  |
| **Moving average** |  |  |  |  | 190 |  |  |  |  |  |  |
| **Moving average** |  |  |  |  |  | 194 |  |  |  |  |  |
| **Moving average** |  |  |  |  |  |  | 193 |  |  |  |  |
| **Moving average** |  |  |  |  |  |  |  |  | 209 |  |  |  |
| **Moving average** |  |  |  |  |  |  |  |  |  | 209 |  |  |
| **Moving average**  |  |  |  |  |  |  |  |  |  |  | 224 |  |

**Calculation** for 7,8 and 9 months: (184+240+156)/3 = 193 cases.

**Calculation** for 8,9 and 10 months: (240+156+223)/3 = 209 cases.

**Calculation** for 9,10 and 11 months: (156+233+240)/3 = 209 cases.

**Calculation** for 10,11 and 12 months: (233+240+199)/3 = 224 cases.

**Conclusion:** There is a tendency of infectious diseases’ increasing from month to month.

#### **3. Parameters for analyzing the dynamic rows (time series)**

For the analysis of time series there used a number of indicators that characterize the changes in the phenomenon for certain periods of time:

1. absolute grows (increase or decrease);
2. rate of increase (or decrease);
3. growth rate;
4. absolute value of one percent increase (decrease).

**Absolute grows (increase** **or decrease)** is the difference between a certain level of the series and the previous one. It shows how the level of a particular period has changed in comparison with the previous one.

**Growth rate** is ratio of this level of the series to the level that is taken as the basis, expressed in percent. Indicates the percentage increase or decrease in the level of the series over a given period.

**Rate of increase** is ratio of absolute growth for a given period to the absolute level of the previous period, expressed in percent.

**Absolute value** of one percent increase (decrease) isratio of absolute growth to growth rate. In certain situations, (including for this example), despite the decrease in the rate of growth, simultaneously there is an increase of the value by 1%.

**For example:**

**Number of population in the city N. for the period 1985-2005 on January 1**

|  Year  | Number of population, thousands | Absolute growth | Growth rate in % | Rate of increase or decrease in % | Value of 1 % of increase |
| --- | --- | --- | --- | --- | --- |
| 19851990199520002005 | 90.296.6109.0116.3121.3 | -+6,4+12,4+7,3+5,0 | -107,1112,8106,7104,3 | -+7,1+12,8+6,7+4,3 | -0,91 0,97 1,09 1,16  |
| Total for 20 years | 31,1 |  |

**Absolute growth (or decrease):**

– for the period 1985-1990 is 96,6 – 90,2 = +6,4 thousand;

– for the period 1990-1995 – 109,0 – 96,6 = +12,4 thousand;

– for the period 1995-2000 – 116,3 – 109,0 = +7,3 thousand;

– for the period 2000-2005 – 121,3 – 116,3 = +5,0 thousand.

**Rate of increase:**

– for the period 1985-1990 is: (6,4\*100)/90,2= +7,1%;

– for the period 1990-1995 – (12,4\*100)/96,6= +12,8%;

– for the period 1995-2000 – (7,3\*100)/109,0= +6,7%;

– for the period 2000-2005 – (5,0\*100)/116,3= +4,3%.

**Growth rate:**

– for the period 1985-1990 is: (96,6\*100)/90,2= +107,1%;

– for the period 1990-1995 – (109,0\*100)/96,6= +112,8%;

– for the period 1995-2000 – (116,3\*100)/109,0= +106,7%;

– for the period 2000-2005 – (121,3\*100)/116,3= +104,3%.

**Absolute value of 1% growth (decrease):**

– for the period 1985-1990 is: 6,4/7,1= 0,9;

– for the period 1990-1995 – 12,4/12,8= 0,97;

– for the period 1995-2000 – 7,3/6,7= 1,09;

– for the period 2000-2005 – 5,0/4,3= 1,16.

**Conclusions:**

1.  The population of the city of N. increased by 31.1 thousand persons, or by 34.5% over 20 years.

2. The growth rate of the population for five-year periods varied unevenly: the most significant this rate was from 1985 to 1990.

3. The value of 1 % growth gradually increases from 0.9 thousand to 1.16 thousand of people.

**PRACTICAL TASK**

Based on the given situational tasks:

* calculate the indicators of the time series (p. 69-71);
* align the time series with the help of the moving average (p. 72-73);
* present the obtained as a table;
* make a conclusion.

In progress of independent work of students, the teacher answers the questions that arise and monitors the correctness of the task. After finishing the independent work, the teacher checks the task.

**TEST TASKS**

|  |  |
| --- | --- |
| 1. | The birth rate in one of the regions of Ukraine over the past 5 years was: 8,3‰, 7,8‰, 7,8‰, 8,5‰, 9,0‰. Which dynamic row (time series) is presented? |
|  | A | Discrete |
|  | B | Grouped |
|  | \* C | Interval |
|  | D | Moment |
|  | E | Open |
| 2. | The level of chronic bronchitis in a few years: 60‰, 80‰, 76‰, 74‰, 76‰, 88‰, 78‰, 88‰. Which method can be used to align this series? |
|  | A | Calculation of the arithmetic mean |
|  | B | “Chi-square” method |
|  | C | Determination of a sufficient number of observations |
|  | \* D | Increase of the interval of observations |
|  | E | Standardization method |
| 3. | A particular importance for practical health care has the information on the changes that are inherent in demographic processes, disease rate of the population, activities of health care institutions, etc. What from the mentioned below gives an opportunity to analyze these phenomena? |
|  | A | Assessment of the reliability of indicators |
|  | B | Correlation analysis |
|  | C | Dispersion analysis |
|  | \* D | Dynamic rows (time series) |
|  | E | Variation series evaluation |
| 4. | The dynamic rows (time series) is characterized by a number of indicators. Which of the following corresponds to the notion of an absolute increase of the time series? |
|  | A | The difference between each level of the series and the arithmetic mean |
|  | B | The difference between each level of the series and the mode of the series |
|  | C | The difference between the given level of the series and the level taken as a basis |
|  | D | The difference between the first and last level of the series |
|  | \* E | The difference between this level and the previous one |
| 5. | For the purpose of analyzing the dynamic rows (time series), its indicators are calculated. Which of the statements below correspond to the notion of the growth rate of the dynamic row (time series)? |
|  | A | The difference between each level of the series and the arithmetic mean |
|  | B | The difference between this level and the previous one |
|  | C | The ratio of absolute growth to the level of the previous period in percent |
|  | \* D | The ratio of the next level of the series to the previous level in percent |
|  | E | The ratio of this level of the series to the level taken as a basis |
| 6. | For the purpose of analyzing the dynamic rows (time series), its indicators are calculated. Which of the statements below corresponds to the concept of the rate of growth of the dynamic rows (time series)? |
|  | A | The difference between each level of the series and the arithmetic mean |
|  | B | The difference between this level and the previous one |
|  | \* C | The ratio of absolute growth to the level of the previous period in percent |
|  | D | The ratio of the next level of the series to the previous level in percent |
|  | E | The ratio of this level of the series to the level taken as a basis |
| 7. | The birth rate in one of the regions of Ukraine over the past 5 years was 8,3‰, 8,1‰, 7,8‰, 7,8‰, 9,0‰. What kind of the dynamic rows (time series) is presented? |
|  | \* A | Complex |
|  | B | Discrete |
|  | C | Increte |
|  | D | Moment |
|  | E | Simple |
| 8. | The number of population in one of the regions of Ukraine for the last 5 years as of January 1 was (absolute data in thousand) 2900, 2895, 2790, 2710, 2600. What kind of the dynamic rows (time series) is presented? |
|  | A | Complex |
|  | B | Discrete |
|  | C | Increte |
|  | D | Moment |
|  | \* E | Simple |
| 9. | The rate of chronic bronchitis over several years was: 60‰, 80‰, 76‰, 74‰, 76‰, 88‰, 78‰. 88‰. Which kind of the dynamic rows (time series) alignment can be used in this situation? |
|  | A | Arithmetic mean calculation |
|  | B |  “Chi-square” method |
|  | C | Determination of a sufficient number |
|  | \* D | Method of moving average observations |
|  | E | Standardization method |
| 10. | In practical public health services, time series are used to assess trends that occur when the population is diseased. Which of the following statements corresponds to the notion of “time series” or “dynamic rows”? |
|  | \*A | A number of statistical variables that recreate the phenomenon in time for certain periods |
|  | B | A set of indicators that characterize the phenomenon in adjacent territories |
|  | C | Distribution of the phenomenon into its component parts |
|  | D | Level of the phenomenon in adjacent territories  |
|  | E | The structure of the phenomenon for separate periods of time |
| 11. | The dynamic rows (time series) consists of statistical quantities. What are the values of the levels of a simple series? |
|  | \*A | Absolute values |
|  | B | Intensive indicators |
|  | C | Clarity indicators |
|  | D | Ratio indicators |
|  | E | Standardized indicators |
| 12. | The dynamic rows (time series) consists of statistical quantities. What are the values of the levels of a complex series? |
|  | A | Absolute values |
|  | B | Clarity indicators |
|  | \* C | Mean values |
|  | D | Median |
|  | E | Mode |
| 13. | The dynamic rows (time series) consists of statistical quantities. What are the values of the levels of a complex series levels? |
|  | A | Absolute values |
|  | B | Clarity indicators |
|  | \* C | Relative indicators |
|  | D | Standardized indicators |
|  | E | Variation series structure  |
| 14. | Data on the number of calls for emergency medical care per day are presented. What kind of dynamic rows (time series) do they represent? |
|  | A | Complex |
|  | B | Discrete |
|  | C | Increte |
|  | \* D | Moment |
|  | E | Simple |
| 15. | The dynamic rows (time series), in which its levels fluctuate within significant limits, is subject to alignment. Which of the above concepts is a method of alignment of a time series? |
|  | A | Arithmetic mean calculation |
|  | B |  “Chi-square” method |
|  | C | Determination of a sufficient number |
|  | \* D | Intervals’ increase |
|  | E | Standardization method |
| 16. | Before analyzing the data of the dynamic series, in which its levels fluctuate within significant limits, it is necessary to align the series. Determine which of the above concepts is the method of aligning the series? |
|  | A | Absolute growth |
|  | B | Arithmetic mean calculation |
|  | C | Calculation of the group arithmetic mean  |
|  | \*D | Median calculation |
|  | E | Standardization method |
| 17. | In order to analyze the dynamic rows (time series), in which its levels fluctuate within significant limits, it is necessary to align the series. Which of the above concepts is a method of aligning a time series? |
|  | A | Absolute growth |
|  | B | Graphics preparation methods |
|  | \* C | Intervals increase |
|  | D | The least squares method |
|  | E | Standardization method |
| 18. | In order to analyze the dynamic rows (time series), in which its levels fluctuate within significant limits, it is necessary to align the series. Which of the above concepts is a method of aligning a time series? |
|  | A | Arithmetic mean calculation |
|  | B |  “Chi-square” method |
|  | C | Determination of a sufficient number |
|  | \* D | Method of moving average observations |
|  | E | Standardization method |

**CONTROL QUESTIONS**

1. Dynamic rows (time series) determination.

2. What types of values can the dynamic rows (time series) levels be represented by?

3. Types of dynamic rows (time series).

4. In what cases the alignment of the dynamic rows (time series) is performed?

5. Methods of alignment of the dynamic rows (time series).

6. Indicators of the dynamic rows (time series), the methodology of their calculation and the significance for the analysis of the phenomenon.

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*Educational publication*

**DYNAMIC ROWS (TIME SERIES)**

**AND THEIR ANALYSIS**

Methodical instructions

for students to the practical lesson on the course:

***“Social medicine, public health (biostatistics)”***

for students in the specialty:

222 “Medicine”, 228 “Pediatrics, 221 “Dentistry”.

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