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MEDICAL STATISTICS

Bishkek 2022

STATE EDUCATIONAL INSTITUTION
OF HIGHER PROFESSIONAL EDUCATION
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named after the first President
of the Russian Federation B.N. Yeltsin

MEDICAL FACULTY

Department of public health and health care

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MEDICAL STATISTICS

**Textbook for students
of Foreign Citizens**

Bishkek 2022

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M 42

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Proposed Study Guide “Medical Statistics” intended for medical students. Compiled taking into account the volume of the study load, plan and program in medical statistics. The manual presents in an accessible form the concepts and methods for calculating the basic statistical quantities. Along with the presentation of classical statistical methods, new methods are applied that necessary in the practice of a doctor. The need for a textbook is proven by the modern development of medicine, since knowledge of the basics of medical statistics is necessary for any doctor not only in practical but also in research work.

It is intended for the students of faculty of foreign citizens.

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FOREWORD

In clinical and experimental medical research, statistical methods contribute to the establishment of patterns inherent in the pathological process, allow the use of quantitative criteria to assess individual types of treatment. All this requires a significant increase in the number of doctors who are proficient in statistical methods to such an extent that they can independently conduct research, analyze medical and statistical data concerning not only the health of the population, but also indicators used in medicine.

Therefore, knowledge of the basics of medical statistics is necessary for a doctor, regardless of specialty, both in practice and in research work.

The manual pays sufficient attention to the theoretical and practical provisions of medical statistics, which contributes to the deep assimilation of the material.

**Thematic plan of seminars
for students of a specialty general medicine**

№	Themes for seminars	Hours
1	Subject and content of medical statistics.	2
2	Organization of statistical research.	2
3	Relative values.	2
4	Variation series and average values.	2
5	Selective method and assessment of validity research results.	2
6	Standardized indicators. Dynamic series.	2
7	Correlation.	2
8	Regression coefficient.	2
9	Medico-demographic indicators.	2
10	Incidence and disability indicators.	2
11	Evidence medicine. Graphic images.	2
	Total:	22

Theme 1

SUBJECT AND CONTENT OF MEDICAL STATISTICS

Purpose of studying the topic

The student must *know*:

- sections of medical statistics;
- statistical population, its types.

The student should *be able to*:

- determine the volume and type of statistical population, unit and signs of observation.

Study plan of the topic

1. Analysis of the topic on educational issues

- Statistics, medical statistics: definitions, tasks and sections.
- Health and health indicators.
- Statistical population: definition, unit and characteristics of observation.
- Types of statistical population, content, requirements.
- Types of distribution of characteristics, statistical values.

2. Problem solving

3. Consolidation of material on control questions and tests

The beginning of the formation of statistics was laid by the emergence of economic accounting and is associated with the formation of the state. Throughout the statistics, it was determined by the socio-economic needs of society and the state. The statistical method was formed gradually as the accumulation of accounting data, experience in their processing and analysis. The achievements of socio-economic statistics are the result of historical development. The term "statistics" comes from the Latin word status - "position", "state of phenomena." It was first used by the German scientist G. Achenval in 1749. The term, in his view, meant the amount of knowledge needed by merchants, politicians, military men and all cultured people. They represented any information about individual states, their economic power and were expressed mainly in verbal and text form. Reliable numerical data were still little used at that time. History has preserved to this day the experience of various economic accounting in the states of antiquity. In Ancient Egypt, Mesopotamia, Judea, developed systems of economic and administrative accounting were formed. Strictly, at the level of the possibilities of that time, the use of land, products, labor, building materials was controlled, estimates of expenses and income were drawn up. The book of Confucius (551-479 BC) "Shu-King" mentions a census in China in 2238 BC. State registration in Ancient Rome had a high level for its time. In 550 BC. a special organization was created there to conduct censuses of free citizens. Initially, censuses were carried out every 5 years, and then every 10 years. According to Tacitus (58-117 AD), the founder of the Roman Empire,

Octavian Augustus, created a special account of the estimated appropriations, information about the state of finances, the army, the navy, the number of citizens and other data necessary to manage the huge empire. The term "statistics" appeared in the middle of the 18th century. Means "state studies". Got spread in monasteries. Gradually acquired a collective meaning. On the one hand, statistics is a set of numerical indicators characterizing social phenomena and processes (labor statistics, transport statistics). On the other hand, statistics are understood as practical activities for the collection, processing, and analysis of data in various areas of public life. On the third hand, statistics are the results of mass accounting, published in various collections. Finally, in the natural sciences, statistics are methods and methods for assessing the compliance of mass observation data with mathematical formulas.

Scientists Contributing to the Development of Statistics

- William Petty - Founder of Statistics. His merit is that he was the first to apply the numerical method to analyze the laws of social life. Work - "Political arithmetic".
- Adolphe Quetelet is a Belgian statistician. He proved that even the seeming accidents of social life have an internal lawfulness and necessity.
- K.F. Herman is a Russian statistician ("General theory of statistics").
- V.I. Lenin - the theory of groupings, the theory of statistical observation.
- A number of other scientists.

Statistics is a science that studies the quantitative side of mass social phenomena and processes in close connection with their qualitative side. This is a universal science covering all branches of human activity.

Biomedical statistics a - statistical information, as well as methods that use specific guidelines for the study of health and social issues. Biostatistics covers, overlaps, and to some extent is analogous to vital statistics (fertility, mortality) and demography. Consequently, biostatistics studies both non-social phenomena (biology) and social or social phenomena (public health, health care). The section of biostatistics that deals with issues related to the health of the population is called medical statistics, which deals with issues of both social phenomena (health indicators, health indicators) and non-social phenomena (the state of the human body, biochemical processes in the human body). It should be noted that the non-social processes of the human body can be called conditional, since these processes are ultimately determined by social factors. For example, biochemical processes in the body largely depend on the social environment in which a person is.

Medical (sanitary) statistics is a branch of statistics that studies quantitative patterns, the state and dynamics of the population and the health care system, and also develops methods for statistical analysis of clinical and laboratory data. Medical statistics is a method of social diagnostics, since it makes it possible to assess the state of health of the population of a country, region and, on this basis, develop measures aimed at improving public health. The most important principle of statistics is to use it to study not individual, single, but mass

phenomena, in order to identify their general patterns. These patterns appear, as a rule, in the mass of observations, that is, when studying the statistical population.

The purpose of medical statistics is as follows:

- to learn the basic rules of statistical research;
- master the methodology of conducting statistical research;
- be able to correctly use and interpret the data obtained to assess the state of health and health care.

Tasks of medical statistics:

- identification of the state of health of the population and the factors that determine it;
- training of personnel and activities of the health care organization ;
- application of medical statistics methods in experimental clinical and laboratory research.

Medical statistics consists of three sections:

1. Theoretical and methodological foundations, including:

- mathematics, including:
 - the theory of probability;
 - the law of large numbers;
 - the theory of sampling;
 - the theory of small samples.
- About general Statistics.
- special medical research methods.

2. Statistics of population health examines the following indicators:

- physical development;
- medical and demographic;
- morbidity and injury rate;
- disability.

3. Health Statistics examines the activities of bodies and institutions of the health of the following key indicators:

- volume of work performed;
- quantitative and qualitative characteristics of employees (category of doctor, academic degree, etc.);
- quality indicator of work;
- norms and standards of health care;
- organizational forms of work;
- financial activities.

For statistical research, first of all, it is necessary to choose a statistical population or an object of research.

Statistical population is a group of homogeneous elements taken together within known boundaries of time and space. (For example, patients of a given hospital on a certain day). A statistical population consists of *observation units* - these are the primary elements of a given population. (For example, patients of this hospital). Each observation unit has credentials (gender, age, profession, and

so on). Study those signs that are necessary for this study. *Credentials are* differences between primary elements. (For example, the difference between patients by sex, age, profession, nationality, etc.).

Accounting signs *by nature* are:

- quantitative, expressed in numbers (for example: age, body weight, average daily body temperature, blood pressure, etc.);
- qualitative or attributive, expressed verbally and having a certain character, content (for example: gender, profession, nationality, diagnosis).

According to their role in the aggregate, accounting signs are divided into:

- factorial, which affect the change in another sign;
- effective, which change depending on the change in the factor sign (For example, the age of a woman and the interval between births affects the complication of pregnancy and perinatal pathology).

Types of statistical population

There are two types of statistical population - general and selective (Scheme 1).

The general population consists of all observation units subject to research. (For example, if it were possible to study all sick children with leukemia living on the globe, then these patients would make up the general population). Naturally, this is practically impossible. When studying the health of the population, the general population is considered within specific boundaries (territory, plant, institution, and so on). In connection with the inappropriate and the difficulty of the analysis of all observation units of the total population, often a study limited to a certain part of the units of the population, that is, *the total sample* - it's part of the population (for example, some patients with leukemia hospital undergoing research, and the results of which are applicable to all patients hospital, i.e., for the general population).

The selective method has several advantages:

- **less financial costs.** The cost of obtaining data for only a relatively small fraction of the total population is less than for a full census;
- **short deadlines.** For the same reasons, sample survey data can be collected and summarized more quickly than with a full census. This is especially important when information is urgently needed;
- **world of applications.** Some types of surveys require the use of highly trained personnel or specialized equipment to collect data; as a rule, both are limited. In these cases, a complete survey is impossible. Sample surveys have a wider field of application and provide a greater opportunity to obtain information of the most diverse nature;
- **higher reliability.** This statement may seem paradoxical, however, if the total volume of work is less, then more qualified personnel can be attracted, better trained, more closely monitoring the conduct of the survey and the processing of its results. Therefore, a sample survey can provide more reliable information than a corresponding blanket survey.

The volume of the population is the number of elements of the population taken for the study.

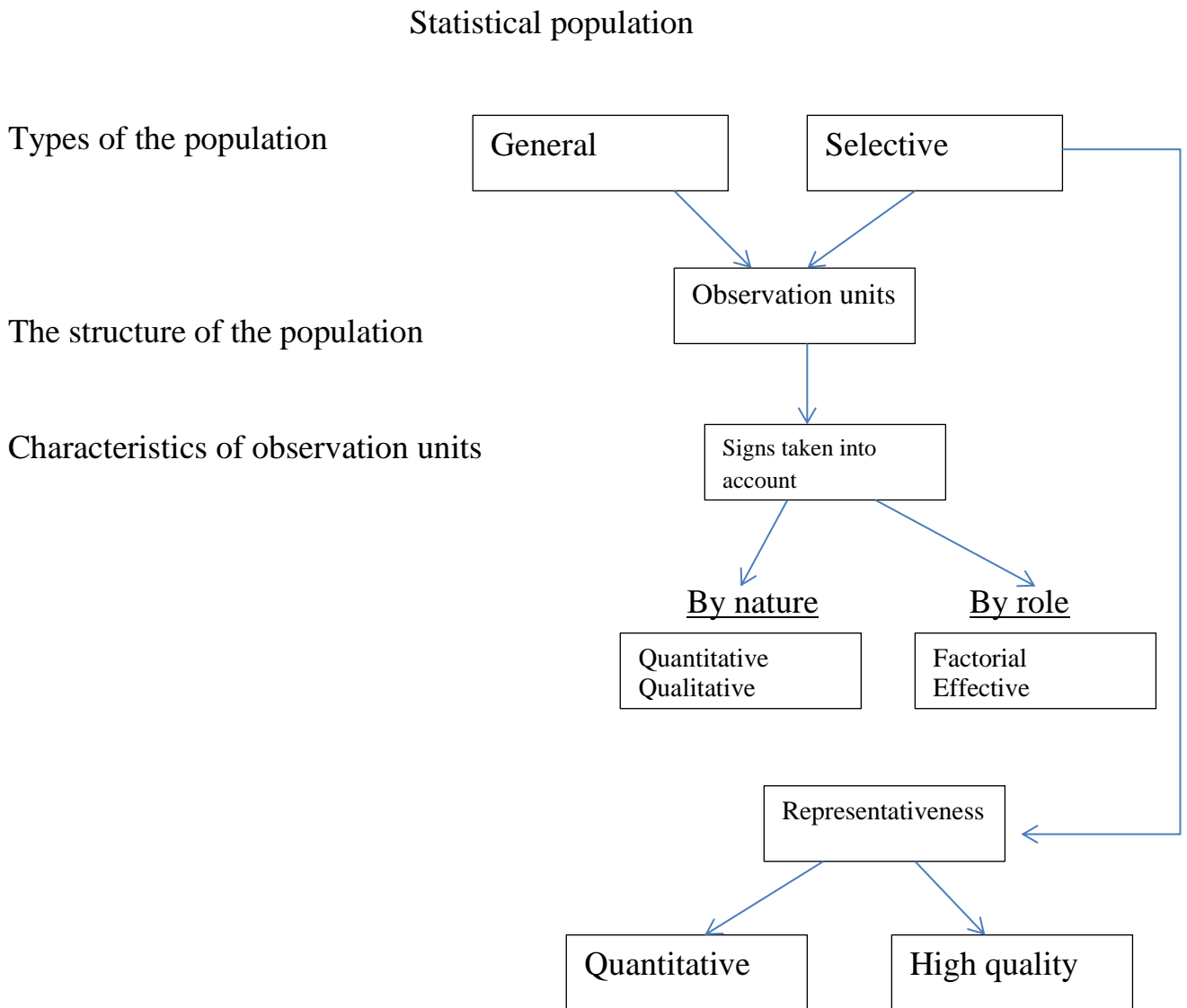
Types of distribution of characteristics in the statistical population:

- alternative, that is, the opposite value (yes, no). (For example, the outcome of treatment: died, survived);
- normal or symmetrical, when the largest number of cases occurs in the middle of the row. (For example, the largest number of patients in the hospital (in days) falls on the middle of the week);
- asymmetric, when the greatest number of cases is shifted to the side: right-sided, left-sided. Or the row has two peaks - two-humped or bimodal.

Statistical quantities are:

- absolute (numerical characteristics);
- relative (comparison result);
- average (generalizing characteristics of the statistical population).

Scheme 1



Note: quantitative representativeness is based on the law of large numbers and means a sufficient number of elements in the sample.

Qualitative is based on the law of probability.

Objectives

Example of implementation 1000 children are treated in the children's hospital, incl. in the department of traumatology 200, of which 50 have fractures of the upper extremities. An analysis was carried out to identify the causes of the fracture of the upper extremities, depending on the age of the children. It was revealed that among children aged 1-5 years – 20 cases of fractures, and in children aged 6-10 years - 30. Determine: the volume of the population, the type of population, the unit of observation, signs of observation. *The volume of the population* is 1000, i.e. all children undergoing treatment. *The type of population* is selective, since part of the children in the traumatology department was examined, namely 200 people. *The unit of observation* is children, as the primary element of this set. *Signs of observation* - age of children, trauma of the upper limb.

Task 1

In the city of M in 2010, the growth of newborns was studied. There were 343 firstborns, their height ranged from 51 to 54 cm. Children from the second birth were 62, their height ranged from 52 to 55 cm. Determine: the unit of observation, the signs taken into account and the volume of the population.

Task 2

And relapses were studied after a complex method of treatment in a hospital in 400 patients with angina pectoris. A year after the course of treatment, 125 patients who smoked again had chest pain (relapses), and the rest - nonsmokers - had no complaints.

Determine: the unit of observation, the signs taken into account and the volume of the population.

Task 3

School doctor T. studied the prevalence of oral diseases in children from school No. 1 and No. 2 in N. Research results: out of 80 children, 12 people complained of bleeding gums in school No. 1, and out of 300 children in school No. 2 complained of deep caries 58 people. Determine: the volume of the population, the type of population, the unit of observation, signs of observation.

Task 4

A cardiologist studied the long-term effects of treatment of 200 patients with ischemic disease (of which 100 patients are under 50 years old and 100 - over 50 years old). The results of the study showed that a year after the first heart attack, a relapse occurred in 20 patients under the age of 50 and in 30 patients over the

age of 50. Determine: the volume of the population, the type of population, the unit of observation, signs of observation.

Task 5

A group of pediatric dentists during the planned rehabilitation of schoolchildren from two schools in N. revealed that out of 150 schoolchildren who underwent planned sanitation at school No. 1, 50 had dental caries. Out of 400 schoolchildren who underwent planned sanitation at school # 2, 200 had dental caries. Determine: the volume of the population, the type of population, the unit of observation, signs of observation.

Test questions

1. Definition of statistics as a science.
2. The tasks of medical statistics.
3. List the sections of medical statistics.
4. Theoretical and methodological foundations of medical statistics.
5. Indicators of public health.
6. Indicators of health statistics.
7. Statistical population, definition.
8. Unit of observation, definition.
9. Registration signs.
10. Types of statistical aggregate.
11. Advantages of the sample.
12. Types of distribution of characteristics in the statistical population.
13. Types of statistical quantities.

Tests

1. The following words are key word in defining statistics as a science: a) social, b) methodical, c) quantitative, d) qualitative.
2. Tasks of medical statistics: a) analysis of quality indicators of work, b) study of morbidity and traumatism, c) study of data on the network, activities and personnel in health care authorities and institutions, d) study of registration signs.
3. Sections of medical statistics: a) statistics of population health, b) physical development, c) theoretical foundations, d) norms and standards of health care.
4. Indicators studying the health of the population: a) quality of life, b) medico-demographic, c) lifestyle, d) individual.
5. Indicators of health statistics: a) volume of planned work, b) quality of workers, c) norms and standards of health care, d) morbidity and disability.
6. A statistical population is: a) a group of homogeneous elements taken within the known boundaries of time and space, b) a group of accounting attributes

taken in time and space, c) differences between attributes, d) attributive attributes affecting quantitative attributes.

7. Accounting signs by nature are: a) quantitative, qualitative, b) qualitative, factorial, c) statistical, d) multiple.

8. Types of statistical population: a) general, b) sample, c) partial, d) general.

9. Types of distribution of signs in a statistical population: a) front, b) alternative, c) normal, d) asymmetric.

10. Statistical values are: a) absolute, b) numerical, c) digital, d) relative. 20

11. Accounting attributes in a statistical population are: a) similarity between primary elements, b) difference between aggregates, c) similarity between aggregates, d) differences between primary elements.

12. The unit of observation is: a) the primary elements of the population, b) the change in the attribute, c) the difference between the primary elements, d) the representativeness of the attribute.

Theme 2
ORGANIZATION OF STATISTICAL RESEARCH
Purpose of studying the topic

The student must *know*:

- stages of statistical research and their content;
- main types of errors in the analysis of the material;
- features of conducting social, medical and clinical research.

The student should *be able to*:

- develop the stages of statistical research;
- group statistical material;
- create layouts of statistical tables.

Study plan of the topic

1. Analysis of the material on educational issues

- Stages of statistical research, the content of the first stage.
- Content of the research plan (second stage).
- Content of the research program (second stage).
- Methods of forming a statistical population.
- Content of the fourth stage (material processing).
- Methods for selecting the phenomenon under study.
- The main types of errors in the analysis of material and features in social, medical and clinical research.

2. Problem solving

3. Consolidation of material on control questions and tests

Statistical studies are carried out in 5 stages

1. Formulation of the goal and objectives of the study.
2. Organizational.
3. Collecting material.
4. Material handling.
5. Analysis of the material, conclusions, suggestions.

Stage 1. Formulation of the goal and objectives of the research

Purpose is the final desired result that the researcher seeks to achieve .

The purpose of the study should be relevant for medical science and health care practice, to determine ways to solve the selected problem. For example: improving the health of the population, improving medical care for the population, improving the quality of disease prevention, etc. The goal answers the question, why is this study being conducted? The goal must be clear and unambiguous.

A task is the prescribed work to achieve a given goal. Specified, expanded and refined definition of the goal. The task answers the question - "What to do?"

For example: to improve the state of health it is necessary to study:

1. indicators of the population's health;
2. negative factors affecting health status;
3. positive factors affecting the health of the population

Example: the purpose of the study is to develop measures for the prevention of gastritis among medical students

Research objectives:

1. To study the prevalence of gastritis among medical students at the beginning and at the end of training;
2. to identify the factors that influence the prevalence of gastritis among students;
3. to propose measures to reduce the spread and prevention of gastritis.

Stage 2. Organizational

It consists of 2 sections: drawing up a research plan and drawing up a research program.

1. The plan reflects the organizational elements of the work:

1.1. Characteristics of the research object, i.e. a set of phenomena, objects about which statistical information should be collected. For example, the population of the city, sick persons, personnel, etc. The object of research (population) must be defined in space (territory), in time (period), in the volume (number) of observations (n).

1.2. Methods for forming a statistical population.

By the completeness of observation coverage:

- continuous;
- selective.

By time:

- current;
- one-time.

By appearance:

- direct;
- copying of information;
- anamnestic (questionnaire and questionnaire).

1.3. Terms of work.

1.4. Performers.

1.5. Financial questions.

1.6. Conducting instructions, seminars for performers.

With a sample population, a selection method is provided studied phenomena:

Random selection method - all units of the general population have equal opportunity to get into the sample. The most common type this method is a drawing of lots, in which for each unit observation, a special card is prepared, where serial number according to the list or medical history number. Then all made cards are

shuffled in a closed box and in a random order (at random) a certain number of cards is selected, according to which in turn, primary documents are selected (outpatient cards, histories childbirth, etc.)

Mechanical selection - a method in which the units of observation distributed according to some feature (the first letter of the alphabet in the surname; from each group are selected at a certain interval every fourth or every tenth medical history, etc.) Mechanical interval the selection is pre-calculated. Moreover, the total number of units the general population is divided by the number to be selected. For instance, general population - 1000 case histories. It is necessary to select 500. In this case $\left(\frac{1000}{500}\right) = 2$, the value of the interval is 2, i.e. every second case history.

Typological selection is a method that allows selection of observation units from typical groups of the entire general population. To do this, first within the general population, all units are divided into typical groups (*for example*: by age, sex, profession, nationality, 25th place of residence, etc.). From each such group, the required number of units is selected (randomly or mechanically). In this case, it is necessary to strictly observe that the ratio of age groups in the sample population corresponds to those in the general population.

Serial (cluster) selection is a method in which a sample is made not from the entire general population, but from its individual "nests" (village, city, district, health care institutions), which are most characteristic of the general population. Within each selected "nest", the sampling of units is carried out according to the principle of mechanical sampling, if the region under study ("nest") has a significant territory with a large population. If the "nest" is small in territory, with an insignificant population size, then all research units go into development, that is, the sampling is carried out according to the continuous method.

This method is used in cases where it is not possible to sample from the entire population, for example, due to the very large survey area. They make a selection of certain "nests" in this territory, trying to select the most typical regions for a given region, districts, settlements, etc. For example, to conduct a study to identify risk factors for the rural population of the republic for the detection of tuberculosis. It would take a long time, large financial costs, etc. to conduct a survey of the entire rural population. To avoid this, one of the sampling methods is used - serial-nested, in which one of the regions is selected. At the same time, 1-2 rural areas are selected within the selected region. In the selected areas ("nests"), the population is surveyed using a continuous method or within the "nests" the selection of observation units is carried out by mechanical selection.

The method of control groups, or pairings, is the interpenetrating two or more independent samples from the same general population. This method consists in the fact that each observation unit in the study group is selected an alternative copy-pair in the control group. Allows you to form an experimental and control group, equal in size and homogeneous in one or more

characteristics. This method makes it possible to carry out an in-depth study on a relatively small material.

The method of cohort selection - allows you to make a kind of cut in the place of the studied phenomenon, in which one or another pattern is most clearly manifested.

It is customary to call a cohort a statistical population, which consists of relatively homogeneous elements, united by certain features, tracked over the same time interval.

For example, in order to determine the number of children born in a family (or the number of pregnancies, childbirth, abortions), a cohort of persons is studied that has a single term of marriage and a single duration of married life. Taking as a unit of observation a married couple under the age of 30, living in city A, who entered into their first marriage during a certain period (year), and tracing the reproductive function for 5 years of their married life, we obtain a cohort consisting of observation units that are homogeneous at once according to a certain number of signs (for example: by age, parity of pregnancy, childbirth, number of children born, etc.).

The method of copying data from primary medical records (outpatient card, medical history, statistical coupon), while taking only the information provided by the research program in accordance with the goal and objectives. The copy is made on special forms developed by the researcher, which indicates age, gender, nationality, diagnosis of the disease, etc.

The survey method is a conversation between a doctor and a patient or his relatives on a certain range of issues, depending on the purpose of the study (self-assessment of health). For these purposes, questionnaires are being developed.

2. The program reflected the methodological elements of the work.

2.1. The program for collecting material: determining the unit of observation, a list of accounting signs, sources of obtaining material, drawing up a map, questionnaires for filling out information, drawing up instructions for filling them out, cipher code, material processing methods (manual, machine).

2.2. Material development program: it is necessary to outline the grouping of the material. Grouping refers to the distribution of a set of observation units into homogeneous groups according to one or several characteristics (for example, by age, educational groups). The grouping must be scientifically sound. Incorrect grouping can lead to erroneous conclusions. The same material with different groupings also lead to different conclusions. Then they start drawing up layouts of statistical tables for their subsequent filling. The table should have a clear and concise title. The table distinguishes between the subject (what is being said) and the predicate (explains the subject). The subject is placed on the left (row), the predicate is placed on top (columns) and they answer the questions "What?", "Where?", "When?"

Tables are:

- simple;

- group;
- combinational.

In a simple table, the subject contains a list of observation units (for example, the name of diseases), and in the predicate, the number of cases (for example, the number of patients) (example).

Simple table

Distribution of students with diseases of the digestive system, by faculty in 2012 (in% of the total)

№	Diseases of the digestive system	Faculty				Total:
		medical	Medical prophylactic	Pharmaceutical	Higher nursing education	
1.	Gastritis					
2.	Peptic ulcer disease of the stomach					
3.	Peptic ulcer 12-duodenal ulcer					
4.	Others					
	Total:					100%

In the group table, the subject is also a list of observation units (names of diseases), and predicates are signs that characterize the subject (gender, age, nationality, etc.).

Group table

Distribution of students with diseases of the digestive system, by sex and age in 2012 (in% of the total)

№	Diseases	Sex		Age				Total
		Male	Female	up to 20 years	21-22 years old	23-24 years old	25 years and more	
1.	Gastritis							
2.	Peptic ulcer							
3.	Peptic ulcer disease 12 duodenal ulcer							
4.	Others							
	Total:							100%

Combination table by content as a group, however, all data on the predicate are interrelated and more voluminous (see Example).

Combination table

Distribution of students with diseases of the digestive system, by sex and age (in% of the total)

№	Diseases	Medical		Medical prophylactic	Pharmaceutical	Higher nursing education	Total				
		Male	Female	wives	both sexes	husband.	wives	both sexes	husband	wives	both sexes
1.	Gastritis										
2.	Peptic ulcer										
3.	Peptic ulcer disease 12 duodenal ulcer										
4.	Others										
	Total:										100%

Tables should not be cumbersome: no more than 3-4 features.

Stage 3. Collecting material

Collecting material is carried out according to the plan and research program to obtain the necessary information.

Stage 4. Material handling

1. Quality control of the collected material.
2. Encryption of the material (if the material is large).
3. Grouping of material.
4. Summary of material (filling in tables).
5. Calculation of statistical indicators.
6. Graphic representation of the material.

Stage 5. Material analysis

The conditions for its implementation are:

- comprehensive knowledge of the essence of the studied phenomenon by the researcher;
- Possession of the methodology of statistical research, including the methodology of statistical analysis;
- Correct implementation of the previous stages of statistical research.

The main types of errors in the analysis of material

1. Methodological: insufficient number of observations, incorrect definition of the unit of observation, incorrect grouping.
2. Incorrect assessment of statistical values: judgment about the dynamics of the phenomenon based on extensive indicators, assessment of the growth rate without taking into account the initial level, the use of averages in heterogeneous groups, insufficient or incorrect statistical processing of the material, extreme enthusiasm for "mathematization".
3. Logical: comparison of data without taking into account their qualitative characteristics, mixing of cause and effect, underestimation of the connections of the phenomenon, poor knowledge of the essence of the phenomenon.

Features of statistical research

In social medical research	In clinical and statistical research
1. Studied mainly social and medical issues	1. Studied mainly clinical issues
2. As a rule, there is no observation control group	2. Need a control group observations
3. Requires a large number of observation units	3. A sufficiently small number of observation units
4. The material is collected by way of copies, anamnesis (questionnaire, survey);	4. The material is collected through direct observation of patients and copies
5. The unit of observation is a healthy	5. The unit of observation is the

and sick person.	patient
------------------	---------

Tasks

Execution example

Task for the compilation of the first two stages of a statistical study on the topic "Studying the spread of gastritis disease among students of the medical faculty of KRSU".

Stage 1	
1. Purpose of the study	Recommendations for reducing the incidence of gastritis among students
2. Research objectives	Study the spread of gastritis. Identify the main causes of gastritis disease.
Stage 2	
1. Research plan <ul style="list-style-type: none"> • Research object or statistical population. • Methods of forming a statistical population. • Method of material selection. 	<p>Students of the medical faculty of KRSU</p> <p>By coverage – selective P about type - copying of information</p> <p>Serial (examine one group from each course with a continuous method)</p>
2. Research program <ul style="list-style-type: none"> • Material collection program. <p>- Observation unit - Registration signs</p>	<p>Case of gastritis disease</p> <p>Age, gender, nationality, course of study, type of study, with whom</p>

<p>- Mapping</p>	<p>Survey map Full name Age Sex Nationality Course of Study Type of training: budget, contract (underline the necessary) Living conditions: in an apartment with parents, in an apartment without parents (underline the necessary) Diagnosis</p>
<p>Material Development Program - Grouping material - Drawing up table layouts</p>	<p>Age: under 20, 20 and over Gender: male / female Nationality: Kyrgyz , Russian, etc. Course of study: 1-3, 4-6 Diagnosis: gastritis</p>

Task 1

Research topic - to study the spread of smoking among medical students.

The goal of the study is to recommend interventions to reduce the prevalence of smoking among medical students.

In accordance with the goal:

1. to form the main objectives of the research;
2. determine the unit and signs of observation;
3. draw up:
 - survey card;
 - grouping of material;
 - table layouts.

Task 2

Research topic - to study the spread of peptic ulcer disease among medical students.

The goal of the study is to recommend ways to reduce the spread of peptic ulcer disease among medical students.

In accordance with the goal:

1. to form the main objectives of the research;
2. determine the unit and signs of observation;
3. draw up:
 - survey card;
 - grouping of material;
 - table layouts.

Task 3

Research topic - to study the level of awareness of students on healthy lifestyles.

The purpose of the study is to outline measures to improve students' knowledge about the spread of bad habits.

In accordance with the goal:

1. to form the main objectives of the research;
2. determine the unit and signs of observation;
3. draw up:
 - survey card;
 - grouping of material;
 - table layouts.

Task 4

Questionnaire for studying the morbidity of the population

1. Full name.
2. Age.
3. Gender.
4. Nationality.
5. Diagnosis.

Create table layouts:simple, group, combination.

Task 5

Questionnaire for studying the mortality of the population

1. Full name.
2. Age.
3. Gender.
4. Place of death.
5. Diagnosis.

Create table layouts:simple, group, combination.

Task 6

Questionnaire for studying the morbidity of students

1. Full name.
2. Faculty.
3. Course.
4. Type of training.
5. Diagnosis.

Create table layouts:simple, group, combination.

Control questions

1. Stages of statistical research.
2. Content of the first stage.
3. Sections of the second stage.
4. Characteristics of the research object.
5. Methods of forming a statistical population.
6. Methods for selecting a unit of observation in a sample population.
7. Content of the collection program.
8. Content of the material development program.
9. Content of the fourth stage (material processing).
10. The main types of errors in the analysis of material.

11. Features in the conduct of socio-medical and clinical statistical research.

Tests

1. The stage of statistical research includes: a) drawing up a plan, b) collecting material, c) drawing up tables, d) drawing up a program.

2. The second, organizational stage includes: a) drawing up layouts of tables, b) drawing up research tasks, c) drawing up research instructions, d) drawing up a research program.

3. The research plan reflects (second stage): a) characteristics of material collection, b) characteristics of material processing, c) characteristics of the research object, d) characteristics of material calculation.

4. The research program reflects (second stage): a) the program of the object of research, b) the program for the development of the material, c) the program of the volume of the research, d) the program of the method of forming the statistical population.

5. Statistical tables are: a) combinational, b) complex, c) combined, d) primary.

6. The stage "material processing" includes: a) drawing up a layout of tables, b) a material processing plan, c) a material processing program, d) material grouping.

7. The main type of error in the analysis of the material: a) technical, b) methodological, c) technological.

Theme 3
RELATIVE VALUES

The purpose of studying the topic

The student should *know* :

- types of relative values;
- intensive and extensive indicators, their differences;
- indicators of coordination, likelihood, correlation, visibility.

The student should *be able to*:

- calculate intensive and extensive indicators;
- calculate indicators of coordination, likelihood, ratio, clarity.

Topic study plan

1. Analysis of the topic on educational issues

- Types of relative values.
- Intensive indicators, calculation methodology.
- Extensive indicators, calculation method.
- Difference between intensive and extensive indicators.
- Ratios, calculation method.
- Indicators of visibility, calculation methodology.
- Indicators of coordination, likelihood, calculation method.

2. Solving problems

3. Consolidation of material on control questions and tests

Absolute values in medicine give great information about size, strength of the phenomenon or signs. For example, age, height, weight, size human blood pressure, etc. However, in many cases, the absolute the quantity does not indicate the size, strength of the phenomenon or feature. Absolute quantities are not very suitable for comparing them with other quantities, characterizing the phenomenon. They are needed only as an intermediate stage for obtaining relative indicators.

For example, in the city A. 2000 children fell ill, and in the city B. - 1500. This is not means that in city A. they get sick more often than in city B. In order to determine the size of the phenomenon, it is necessary to take into account the differences in numbers the population of these cities, i.e. take into account the size of the environment (number of children), in which the phenomenon occurs (number of patients). The number of children in the city A. is equal to 8000 people, and in the city of B. - 3000. Hence, despite the greater number patients in the city of A., they make up about a quarter of the total number of children (2000: 8000). And in the city of B., with a smaller number of patients, they make up half the number of children (1500: 3000). Thus, in many cases compare not absolute values, but the so-called relative magnitudes.

Relative values are the result of comparison (relations, division) of two absolute values.

Types of relative values:

- intensive;
- extensive (structures);
- coordination;
- likelihood;
- ratio;
- clarity.

Intensive indicators characterize the distribution or frequency studied phenomenon or feature in the environment. (For example, the population in city of N (the value of the environment in which the phenomenon occurs) - 5000, the number of patients (event size) - 250). The intensive indicator answers the question: "how often occurs in the environment?"

Calculation method:

$$P = \frac{\text{Whole phenomenon} \times 1000}{\text{environment}}$$

P - intensive indicator

The whole phenomenon is the number of patients

Environment - population

1. Composing the proportion:

Population - number of patients

5000 - 250

1000 - x

1000 - x

2. Calculation of the indicator:

$$x = \frac{250 \times 1000}{5000} = 50\text{‰} \text{ (or 50 patients per 1000 population)}$$

Conclusion: in the city of N., there are 50 patients per 1000 population (50 ‰)

Base value of intensive indicators

The base size is usually chosen - 100, 1000, 10000, 100000 (with calculating fertility, mortality, natural population growth, general morbidity - 1000 people are usually taken as the basis. population; calculating the size of mortality or morbidity in relation to any an individual disease or group of diseases is produced per 10,000 or 100,000 population, the calculation of indicators of temporary disability due to diseases per 100 workers). Maternal mortality calculated per 100,000 live births. Accordingly, the coefficient intensity is expressed as a percentage - 100 (%), ppm - 1000 (‰), prodecymille - 10,000 (‰‰), prosantimille - 100,000 (‰‰‰).

It is better to denote the indicator not by mathematical signs (‰‰), but figures - per 10,000, 100,000 population.

The extensive indicator characterizes the composition or structure of the phenomenon, the ratio of the sizes of the parts of the phenomenon to the whole (shows the proportion or specific gravity). The extensive indicator answers the question: "which part?" The extensive indicator shows how the studied phenomenon is distributed among its constituent parts, what is the specific weight of this phenomenon in relation to its entire size (the ratio of a part to a whole). (For example, the number of diseases (whole phenomenon) - 250, of which patients with respiratory diseases (part whole) - 125.

Calculation method:

$$\text{Extensive index} = \frac{\text{Part phenomena} \times 100}{\text{Whole phenomenon}}$$

Part of the phenomenon is patients with respiratory diseases

The whole phenomenon is the total number of diseases

1. Drawing up proportions.

The whole phenomenon - part of the phenomenon

$$100 - x$$

$$250 - 125$$

$$100 - x$$

2. Calculation of the indicator.

$$x = \frac{125 \times 100}{250} = 50\%$$

Conclusion: from the total number of diseases, the proportion of patients with the disease respiratory organs is 50%.

To calculate the extensive indicator, the base value taken for 100 and expressed as a percentage - 100 (%).

When calculating several extensive measures, the sum of all indicators must necessarily be equal to 100 (For example, organ diseases respiration account for - 50%, infectious and parasitic - 25%, diseases genitourinary system - 25%).

Differences between intensive and extensive rates

(these two indicators differ significantly in their content)

<i>Intensive indicator</i>	<i>Extensive indicator</i>
1. Compare with each other	1. Do not compare, or compare with great care, deeply knowing essence of the compared phenomena
2. You must have an environment (population size) and the phenomenon what happened in this environment (number sick with certain disease).	2. One must have a whole phenomenon (general number of diseases) without environment and part it (the number of diseases of a certain nosology).

3.Changes in the environment phenomenon	With a change in the whole phenomenon of it part may not change.
4. The phenomenon is associated with the environment.	The phenomenon is not related to the environment.
5. Answers the question: “ How often? ”	Answers the question: “ What part? ”

Note: the extensive indicator cannot be used for establishing the dynamics of the studied phenomenon in time or for comparison the degree of its distribution in two or more population groups.

Coordination indicators characterize the ratio of parts of a whole between themselves. For example, in city H, the number of doctors is 200, the number of average medical workers - 600.

Calculation method:

$$\tilde{\delta} = \frac{600}{200} = 3$$

Conclusion: compliance of doctors and nurses relates as 1: 3, i.e. for 1 doctor there are 3 average medical workers.

Likelihood ratios are numerical ratios structure indicators of the same name, calculated for two different aggregates. Table 3.1 in column 6 shows the coefficients likelihood when the indicators of the structure of c. A are divided by the indicators structures in B.

Table 3.1

Calculation of likelihood coefficients of mumps disease in children

<i>Age mothers (years)</i>	<i>City A</i>		<i>City B</i>		<i>Coefficient plausibility</i>
	<i>Number cases</i>	<i>Structures (in%)</i>	<i>Number cases</i>	<i>Structures (in%)</i>	
	Up to 2	20	10	12	
3-5	40	20	80	40	$\frac{20}{40} = 0,5$
6-8	60	30	60	30	$\frac{30}{30} = 1,0$
9-12	60	30	40	20	$\frac{30}{20} = 1,5$
13-15	20	10	8	4	$\frac{10}{4} = 2,5$
Total	200	100	200	100	1,0

Conclusion: in city A compared to city B, the proportion of mumps higher in the age group 13-15 years and older (2.5 times) and lower in the age group group 3-5 years (0.5 times). The likelihood ratio is usually applied, when it is not possible to compare intensive indicators (how many times one phenomenon is greater than the other).

Index ratios characterizes relationship between heterogeneous values (provision of the population with hospital beds, doctors, medicines). Usually calculated on 10,000 (For example, population - 5000, number of hospital beds - 250). Calculate provision of hospital beds per 10,000 population.

Calculation method:

$$x = \frac{\text{Number of beds} \times 10000}{\text{population}}$$

1. Drawing up proportions.

$$\frac{\text{Population} - \text{number of beds}}{10,000 - x} = \frac{5000 - 250}{10,000 - x}$$

2. Calculation of the indicator.

$$x = \frac{250 \times 10000}{5000} = 50$$

Conclusion: there are 50 beds per 10,000 population.

The visibility indicator characterizes the attitude of each of compared values to the initial level, which is taken as conventional value (usually over 100).

Table 3.2 shows the indicators of clarity.

Table 3.2

The number of pediatricians in the city of N. in 2007-2012

Years	Number of doctors	Index visibility
2007	1300	100
2008	1350	104
2009	1250	96
2010	1290	99
2011	1510	116
2012	1300	100

Calculate visibility indicators.

Calculation method for 2007

1. Drawing up proportions.

$$\frac{1300 - 100}{1350 - \delta}$$

$$1350 - \delta$$

2. Calculation of the indicator.

$$x = \frac{1350 \times 100}{1300} = 104\%$$

Calculation method for 2008

1. Composing proportions.

$$\frac{1300 - 100}{1250 - \delta}$$

2. Calculation of the indicator.

$$x = \frac{1250 \times 100}{1300} = 96\%$$

Calculation method for 2009

1. Composing proportions.

$$\frac{1300 - 100}{1290 - \delta}$$

2. Calculation of the indicator.

$$x = \frac{1290 \times 100}{1300} = 99\%$$

Note:

- relative indicators are indicated by the letter **P**;
- when taking into account the gradation of the characteristic, the indicator is indicated respectively **P₁**, **P₂**, **P₃**, etc .;
- for greater clarity, the content of the attribute is also indicated: **P₂₀₁₂**- calculated on the basis of materials from 2012; **P₆₀₋₆₄**- indicator for age 60-64 year, **R_g**- designed for urban population, etc.

To exclude random fluctuations, an intensive indicator was adopted to calculate when the number of phenomena or signs is at least 20, and when the structure phenomena (extensive indicator) - with a number of at least 100. In other cases it is better to give absolute values or not to single out the phenomenon in a separate group.

- visibility indicators are indicated by 100;
- indicators of ratios per 10,000.

Tasks

Task 1

Routine BCG vaccination of children in the N. area by year

<i>Year</i>	<i>Total children</i>	<i>Number vaccinated</i>
2010	5500	1203

2011	5050	1016
2012	7000	1540
Total:	17500	3759

Calculate intensive and extensive conduction rate vaccinations by years.

Task 2

Morbidity of the child population (0-14 years old) of the Kyrgyz Republic for 2012 for some classes of diseases

<i>Disease class</i>	<i>Number of diseases</i>
Some infectious and parasitic diseases	89718
Diseases of the ear and mastoid	36679
Neoplasms	618
Diseases of the blood, hematopoietic org., impaired immune mechanisms.	64274
Endocrine system diseases, eating disorders	41681
Total:	168696

The number of children is 1,718,200.

Calculate the frequency and structure of diseases among children.

Task 3

Causes of mortality among children (0-15 years old) by disease class for 2012 in city N.

<i>Disease class</i>	<i>Number of deaths</i>
Respiratory diseases	340
Diseases of the digestive system	120
Diseases of the blood and circulation	50
Diseases of the genitourinary system	25
Total:	535

The number of children is 26,000. Calculate frequency and structure morbidity.

Task 4

Revealed respiratory diseases in children aged 0-5 years in the city of N.

<i>Nosological form</i>	<i>Number of diagnosed diseases</i>
Bronchitis	245
Pharyngitis	315
Pneumonia	735
Other diseases	1240

Total:	2535
--------	------

Number of children - 5375. Calculate the frequency and structure of morbidity.

Task 5
Number of paramedical workers by region in 2012

<i>Region</i>	<i>Population</i>	<i>Average number health workers</i>
Republic of Kyrgyzstan	5607500	31081
Chui area	830500	2990
Issyk-Kul region	45700	1971
Naryn region	266500	1505
Talas region	237400	1207
Osh region	1160500	6834
Jalal-Abad region	1065500	5684
Batken region	453800	3292
Bishkek city	884500	3141
Osh city	258100	1331

Calculate the ratio, coordination.

Task 6
Number of specialists with higher medical education by regions of the Kyrgyz Republic for 2012

<i>Region</i>	<i>Population</i>	<i>Number of doctors</i>
Republic of Kyrgyzstan	5607500	12718
Chui area	830500	1229
Issyk-Kul region	45700	689
Naryn region	266500	373
Talas region	237400	316
Osh region	1160500	1863
Jalal-Abad region	1065500	1496
Batken region	453800	707

Calculate the ratio, coordination.

Task 7
Natural movement indicators in the Kyrgyz Republic (by 1000 people)

<i>2005</i>	<i>2006</i>	<i>2007</i>	<i>2008</i>	<i>2009</i>	<i>2010</i>	<i>2011</i>	<i>2012</i>
14.2	15.9	16.2	17.0	18.5	20.2	20.6	18.5

Calculate the visibility indicator by year.

Task 8

Perinatal mortality in children depending on the age of the mother

<i>Age (years old)</i>	<i>Locality</i>			
	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
under 19 years old	10	6	8	15
20-24	20	40	38	15
25-29	30	30	25	35
30-34	30	20	25	25
35 and more	10	4	4	10
Total	100	100	100	100

Calculate and analyze the likelihood ratios between points A and B, C and D, A and C, A and D, B and C, B and D.

Task 9

Structure of infant mortality in cities of A. and B. for 2012 (in% of total)

<i>Cause</i>	<i>city A</i>	<i>city B</i>
Diseases of the nervous system and organs feelings	0.8	0.9
Infectious and parasitic diseases	1.8	4.1
Respiratory diseases	6.4	7.0
Congenital anomalies	17.8	13.7
Conditions arising in perinatal period	71.3	67.5
Injury and poisoning	0.8	5.6
Others	1.1	1,2
Total	100.0	100.0

Calculate the likelihood ratio.

Task 10

The number of specialists with higher and secondary medical education by years in the Kyrgyz Republic

<i>Specialty</i>	<i>2010</i>	<i>2011 r.</i>	<i>2012 r.</i>
Specialists with higher	12225	12614	12718

medical education			
Nursing staff	28570	30148	31081

Calculate the coordination score.

test questions

1. Types of relative values.
2. Intensive indicators, calculation method.
3. Extensive indicator, calculation method.
4. The difference between intensive and extensive indicators.
5. Indicators of coordination, calculation method.
6. Likelihood indices, calculation method.
7. Indicators of the ratio, calculation method.
8. Indicators of visibility, calculation methodology.
9. Designation of intensive indicators.
10. The minimum absolute numbers for calculating intensive and extensive indicators.

Tests

1. The relative value is: a) extensive indicator, b) intensive indicator, d) ratio indicator, e) fashion and medicine.
2. The extensive indicator characterizes: a) the composition of the phenomenon, b) the frequency phenomena, c) the ratio of the part to the whole, d) the structure of the phenomenon.
3. The intensive indicator characterizes: a) the frequency of the phenomenon, b) the prevalence of the phenomenon, c) a phenomenon in the environment, d) a part of the phenomenon to the whole.
4. The ratio indicator characterizes: a) relations between dissimilar quantities, b) relations between homogeneous quantities, c) composition of the phenomenon, d) the structure of the phenomenon.
5. The visibility indicator characterizes: a) the composition of the phenomenon, b) the relation of the phenomenon to the environment, c) the ratio of each of the compared quantities to initial quantities, d) the ratio between dissimilar quantities.
6. Visibility indicators are usually calculated: a) per 1000, b) per 10000, c) 100000, d) per 100.
7. Indicators of the ratio are calculated: a) per 100, b) 1000, c) 10000, d) per 100,000.
8. The indicator of coordination characterizes: a) the ratio of parts and whole among themselves, b) specific gravity, c) the ratio between dissimilar quantities, d) intensity.

9. The proportion of hypertension of the total number of diseases refers to: a) to extensive indicator, b) to the part as a whole, c) to the ratio indicator, d) to the indicator of the frequency of occurrence of the phenomenon.
10. The likelihood index is: a) numerical ratios structure indicators of the same name, calculated for two different aggregates, b) the relationship between dissimilar quantities, c) the specific weight phenomenon, d) the prevalence of the phenomenon in the environment.
11. Relative values include: a) the frequency of propagation, b) structure of the phenomenon, c) mode, d) median.

Theme 4

VARIATION SERIES AND AVERAGE VALUES

The purpose of studying the topic

The student should *know* :

- variation range, its characteristics and types;
- average values, their types, application;
- value of the standard deviation (σ) and the coefficient variations (**C r**) .

The student should *be able to*:

- compose a simple and grouped variation series;
- calculate average values (**M**);
- calculate the standard deviation and coefficient variations.

Topic study plan

1. Analysis of the topic on educational issues

- Variation series and its characteristics, the difference between simple and grouped in series of variations.
 - Definition, types of average (**M**).
 - Methods for calculating the arithmetic mean, weighted.
 - Geometric mean, applications.
 - Characteristic of the standard deviation (σ) and methodology calculations.
 - The value of the coefficient of variation (**C r**), calculation method and criteria for evaluation.

2. Task solving

3. Consolidation of material on control questions and tests

To calculate the average, it is necessary to construct a variational row.

Variations are numerical features that differ in value and arranged in rank order.

Characteristics of the variation series:

- **variant** (**V**) - the numerical value of the studied attribute;
- **frequency** (**P**) - a number indicating how many times this option;
- (**n**) - total number of observations.

Types of variation series:

- simple row - when each option occurs once;
- grouped row - where options can occur two or more times or combined into groups indicating the frequency of occurrence of all variants, included in this group.

An example of constructing a simple variation series :

Height (cm) 14 year old boys: 143, 143, 146, 148, 149, 142, 142, 142, 142, 140, 146, 148, 148, 149, 149, 149, 150.

- In the column "Height (**V**)" put down the numerical values of growth by rank in side to increase. In the column "Number (**P**)" put down the number of boys

appropriate growth. Then the number of boys is added to give the total number of observations (n).

- A simple variation series will look like this (tab. 4.1).

Table 4.1

Growth rates (see) 14 year old boys

Height, V (cm.)	Number of boys, P
140	1
142	4
143	2
146	2
148	3
149	4
150	1
Total	$n = 17$

Table 4.2 shows an example of a grouped variation series.

Table 4.2

Duration of treatment of patients

Duration of treatment, day V	Number of patients R
3-5	5
6-8	8
9-11	15
Total:	$n = 28$

Average values are a generalizing characteristic of a feature in statistical population.

Types of average values:

- Mode (M o);
- median (M e),
- arithmetic mean (M).

Medium property:

- occupies a middle position;
- has an abstract character;
- sum of deviations of all variants from the average is equal to 0.

Mode is the most common variation in the lineup.

Median - a variation that divides the variation series into two equal parts by observation number.

From table. 4.3 shows that the mode is the number 143, since the number occurs more often than others $P = 6$.

Table 4.3

Growth rates of boys aged 14

Height, cm V	The number of boys P
140	2
142	4
143	6
146	2
148	3
149	4
150	2
Total	n = 23

The arithmetic mean has several calculation methods.

Simple arithmetic mean is applied when the frequency options is equal to one, i.e. each option occurs only once ($P = 1$).

Formula:

$$M = \frac{\sum V}{n}$$

Where,

\sum - amount;

V - options;

n is the number of observations.

For example, the height (cm) of five patients: 166, 167, 168, 169, 170.

$$M = \frac{166 + 167 + 168 + 169 + 170}{5} = \frac{840}{5} = 168cm$$

Weighted arithmetic average, is applied when the frequency variants occur 2 or more times ($P > 1$).

Formula:

$$M = \frac{\sum VP}{n}$$

Where

\sum - sum;

V - options;

P - frequency;

n is the number of observations.

Table 4.4

Growth rates of adolescents

Height, cm V	Number of persons P	VP
166	3	498
167	2	334
168	6	1008

169	3	507
170	2	340
<i>Total:</i>	$n = 16$	$\Sigma 2687$

$$M = \frac{2687}{16} = 167,9cm$$

To simplify calculations, the arithmetic mean is used weighted by the method of moments (see special literature).

Calculation average arithmetic for grouped variation series:

To do this, find the central variants (the middle of the interval) as the half-sum of the initial and final values of this interval. Further calculation goes according to the formula weighted arithmetic mean.

Geometric mean is calculated when quantitative the sign is expressed in fractional numbers (Table 4.5).

Table 4.5

Time spent on examining patients

No.	Time (hour) V	Number of patients P
1	0.2	1
2	0.3	6
3	0.5	9
4	1.0	2
	Total:	n = 18

Formula:

$$M = \frac{\sum n}{\sum \frac{1}{V} n} = \frac{1 + 6 + 9 + 2}{\frac{1}{0.2} + \frac{1}{0.3} \times 6 + \frac{1}{0.5} \times 9 + \frac{1}{1.0} \times 2} = \frac{18}{45} = 0,4$$

Criteria for the diversity of a trait in the variation series:

Limit is the ratio of the extreme values of the variation series.

Formula:

$$Lim = Vmax \div Vmin$$

For example, the variation series is 166, 167, 168, 169, 170.

$$Lim = 170 \div 166 = 1.02$$

Amplitude is the difference between the extreme values of the variation series.

Formula:

$$Am = Vmax - Vmin$$

From here

$$Am = 170 - 166 = 4$$

Standard deviation - sigma (σ) (see topic №5).

Standard deviation (sigma - σ) – characterizes scattering variant (V) around the arithmetic mean (M). The less value of σ , the more densely the options are concentrated around the average arithmetic.

$$\sigma = \frac{Am}{K}$$

Am - amplitude,

K is the span factor (see Appendix 3).

The coefficient of variation (C V) is the percentage standard deviation (σ) to arithmetic mean (M).

The value of σ depends on the value of the amplitude of the series. The larger the amplitude, the greater than σ . Hence it follows that the same mean values can have

different σ , their percentage is called the coefficient of variation.

The formula for calculating the coefficient of variation:

$$Cv = \frac{\sigma}{M} \times 100$$

It is considered to be:

- at $C_v < 10\%$ - weak variety of the trait;
- at $C_v = 10 - 20\%$ - average variety of the trait;
- at $C_v > 20\%$ - a strong variety of traits.

The less the variety of the trait, the closer the options are to the arithmetic mean.

Tasks

Task 1

The number of teeth affected by caries in adolescents

<i>Option caries (by the number of teeth)</i> V	<i>Number of cases caries</i> P	<i>Option caries (by the number of teeth)</i> V	<i>Number cases caries</i> P
1	2	5	5
2	3	6	3
3	5	7	2
4	10		
		Total:	30

Calculate arithmetic mean, root mean square deviation and coefficient of variation.

Task 2

The number of persons examined in the order of preventive examinations schoolchildren as pediatricians in the city of N. for 2004-2012

<i>2004</i>	<i>2005</i>	<i>2006</i>	<i>2007</i>	<i>2008</i>	<i>2009</i>	<i>2010</i>	<i>2011</i>	<i>2012</i>
649346	811311	826627	850406	730836	966971	74564	86364	98313

Calculate the average, sigma.

Questions

1. Variational series: definition, characteristics.
2. Difference between simple and grouped variation series.
3. Average value: definition, types.
4. Properties of average size.
5. Mode and medicine: concept.
6. Arithmetic mean: concept, types.
7. Simple arithmetic mean: concept, calculation method.
8. Weighted arithmetic mean: concept, calculation method.
9. The arithmetic mean for a grouped whole series: concept, calculation technique.
10. Criteria for the diversity of the characteristic of the variation series.
11. Limit: concept, calculation method.
12. Amplitude: concept, calculation method.

Tests

1. The definition of the variation series includes the following key word: a) quantity, b) quality. c) the same size. d) ranked.
2. The characteristic of the variation series includes: a) the ratio, b) quality, c) number, d) total number of observations.
3. Type of variation series: a) complex, b) combinational, c) grouped, d) chronological.
4. Distinguish the following type of average: a) limit, b) mode, c) summed, d) amplitude.
5. The median is: a) the most common variant in variation series, b) a variant that divides the variation series into two equal parts, c) the difference between the extreme values of the variation series, d) the border of each option.
6. Method for calculating the arithmetic mean: a) solid, b) simple, c) combined, d) group.
7. The property of the average value includes: a) has a specific character, b) takes a central place, c) the sum of deviations of all options from the average value is equal to zero, d) does not occupy the middle position.
8. The criteria for the diversity of a trait in the variation series include: a) limit, b) median, c) average value, d) frequency.
9. A strong degree of diversity of the trait according to the coefficient of variation (Cv) is: a) <30%, b) 10-20%, c) 20-30%, d) > 20%.

Theme 5
SELECTIVE METHOD AND ASSESSMENT OF VALIDITY
RESEARCH RESULTS

The purpose of studying the topic

The student should *know* :

- concept and essence of reliability assessment;
- concept required to assess the reliability;
- determination of confidence limits of relative and average quantities;
- essence of the concepts of reliability of average and relative values, "Criterion of reliability" of research results;
- essence of the criterion of compliance (X_2).

The student should *be able to* :

- calculate the error of representativeness of relative and average quantities;
- own the methodology for calculating the reliability of the difference between the mean and relative values;
- evaluate the reliability of research results.

Topic study plan

1. Analysis of the topic on educational issues

- Assessment of the reliability of average and relative values, error representativeness, concept, calculation technique.
- Confidence limits of average and relative values, concept.
- Marginal error, probability of an error-free forecast, concept.
- Reliability of the difference between average and relative values, confidence coefficient (t), concept, calculation method.
- Compliance criterion (X_2) and its application.

2. Task solving

3. Consolidation of material on control questions and tests

Assessment of the reliability of the difference in indicators

To assess the reliability of the research results means to determine with what probability is it possible to transfer the results of the study of features with sample population for the entire general population.

The assessment of reliability allows the doctor to reasonably enough to characterize the patterns revealed by him. In medical studies, the doctor has to deal with a part of the studied phenomenon, and the conclusions from the results of such a study can be applied to the entire phenomenon in the whole, i.e. on the general population. Thus, the estimate certainty is necessary in order for the part of the phenomenon to be to judge the phenomenon as a whole, about its laws.

To assess the reliability of the research results, the following concepts:

- error of representativeness of relative or average values (m);
- confidence limits of relative or average values general population;
- reliability of the difference of relative or average values (validity criterion t);
- reliability of the difference between the compared groups (according to the criterion correspondence X_2).

Determination of the error of representativeness (m)

Representative error (m) shows how much the results obtained in a sample study differ from the results which could be obtained by conducting a continuous study (general population).

Relationship between sample size and representativeness

- Representativeness does not depend on sample size. Representativeness is achieved only when objects from different groups, provided that their shares in the general and sample population are equal. The representativeness of the sample depends only on the selection method units from the general population to the sample population and not depends on the volume. Of course, the larger the sample size, the higher it is accuracy, however, a misallocated 5,000 sample is much worse than a well-distributed sample of 500.
- The more homogeneous the general population, the less a sample population will be required to obtain accurate results. If, for example, in the general population, all respondents have the same income, then it will be enough to interview one respondent, to find out the average income for the population. To determine the taste of porridge it is enough to eat one spoon, and not the whole plate, of course, provided that the porridge is well mixed.

With a correctly compiled sample population, you can get a fairly complete understanding of the laws inherent in all general population. The basic rule for drawing up a sample the set is to ensure its representativeness, i.e. conformity data of the sample and general population.

The sample must be representative or representative (ability be reflection general aggregate), which requires the following requirements :

- have the characteristic features of the general population, i.e. by the composition to be as similar as possible to her;
- sufficient in volume, i.e. by the number of observations.

Representativeness error formula (m) for relative values:

$m = \pm \sqrt{\frac{P \times q}{n}}$ or $m = \pm \sqrt{\frac{(P \times q)}{n-1}}$, if the number of observations is less than 30 cases.

Where:

P is the value of the indicator;

q = 100 – P, if the indicator is calculated for 100;

q = 1000 – P, if the indicator is calculated per 1000, etc .;

n is the number of observations.

For example: employees at the enterprise - 1400 people (**n**) who have hypertension (HD) - 44 people.

HD incidence rate

$P = \pm \sqrt{\frac{44 \times 100}{1400}} = 3,1$ per 100 workers, then we calculate by the formula

$q = 100 - 3,1 = 96,9$

$$m = \pm \sqrt{\frac{3,1 \times 96,9}{1400}} = \pm \sqrt{0,21} = \pm 0,46$$

Conclusion: the results of the sample by the definition of HB on enterprises differ from the general population by ± 0.46 (average error ± 0.46).

Formula (**m**) for the mean:

$m = \pm \frac{\sigma}{\sqrt{n}}$ or $m = \pm \frac{\sigma}{\sqrt{n-1}}$, if a the number of observations is less than 30.

For example , in 49 patients with (n) gastritis, the pepsin level is **M** = 1.0 g%, $\sigma = \pm 0.35$ g%

$$m_M = \frac{0,35}{\sqrt{49}} = \pm 0,05 \text{ g\%}$$

Conclusion: the results of the sample for determining the level pepsin in 49 patients with gastritis differ from the general population (if the studies were carried out in all patients with gastritis) by ± 0.05 (mean error ± 0.05).

Note: the standard deviation (**σ**) characterizes degree of dispersion variant around the arithmetic mean (see topic No. 3).

Calculated by the formula:

$$\sigma = \frac{\text{Row amplitude}}{K}$$

The amplitude of the series (see topic number 4)

K - "coefficient K", (see Appendix No. 3).

Confidence limits (M, P) of mean and relative values -

these are the boundaries of the relative or average values of the size of the attribute going beyond the limits of which, due to random fluctuations, has a slight probability.

Confidence limits for the average by the formula:

$M_{\text{gene.}} = M_{\text{select.}} \pm tm$, where:

$M_{\text{gene., Select.}}$ - confidence limits of the average value of the general and sample population,

t - confidence criterion (established by the researcher, but must be at least 2, see below),

m - representativeness error.

Confidence limits for the relative value by the formula:

$P_{\text{gene.}} = P_{\text{select.}} \pm tm$, where:

$P_{\text{gene., Select.}}$ - confidence limits of the relative value of the general and sample population;

t - confidence criterion (established by the researcher, but must be at least 2, see below);

m - representativeness error.

Marginal error (Δ - delta) is the maximum mean error indicator (m) is calculated by the formula:

$\Delta = tm$ (maximum possible error in estimating the general population) ,

Where:

t - confidence criterion (established by the researcher, but must be at least 2, see below);

m - representativeness error.

The probability of an error-free prediction (p) is the probability with which

it can be argued that in the general population of relative or average values (P, M) indicators will be within $\pm tm$. For medical research the degree of probability of an error-free prediction (p) must be at least 95%, that is, reflect objective reality of conducted research by 95%, then $t = 2$ (see below).

The dependence of the confidence criterion on the degree of probability error-free prediction p (for $n > 30$)

Table 5.1

Probability (p)	Confidant criterion (t)
95.0%	2
99.0%	3
<95%	1

For example, to determine the confidence limits of the average level of pepsin at $M = 1.0 \text{ g\%}$ in 49 patients with gastritis with the probability of an error-free prognosis equal to 95%

$n = 49$, $p = 95\%$ ($t = 2$), $M = 1.0 \text{ g\%}$, $m = \pm 0.05\%$

Confidence limits $M_{\text{gene.}} = M_{\text{select.}} \pm tm$, hence $M_{\text{gen}} = 1 + 2 \times 0.05$

→no more than $1 \text{ g\%} + 0.1\% = 1.1 \text{ g\%}$

M →not less than $1 \text{ g\%} - 0.1 \text{ g\%} = 0.9\%$

Conclusion: Established with a 95% error-free forecast probability the average level of pepsin in the general population in patients with gastritis is not exceeds 1.1 g% and not less than 0.9 g%.

When comparing two compared quantities, it is necessary not only determine their difference, but also assess the reliability, i.e. reliable or accidentally their difference.

The assessment of the reliability of the difference in indicators is carried out according to criterion or confidence factor (t).

Formula for relative indicators:

$$t = \frac{P_1 - P_2}{\sqrt{m_1^2 + m_2^2}}$$

Where:

P_1 and P_2 - compared indicators;

m_1 and m_2 are the average errors of the compared indicators.

For example (table 5.2)

Table 5.2

The incidence of bronchitis in schools No. 1 and No. 2 of the city of N.

<i>Indicators</i>	<i>School number 1</i>	<i>School number 2</i>
P	13%	9%
m	0.9	0.7

Assess the reliability of research results

$$t = \frac{13 - 9}{\sqrt{0,9^2 + 0,7^2}} = 3$$

Conclusion: the results of the study are reliable, since $t > 3$, probability unerring forecast $P = 99\%$.

Formula for calculating the significance of the difference between means quantities:

$$t = \frac{M_1 - M_2}{\sqrt{m_1^2 + m_2^2}}$$

Where:

M_1 and M_2 - compared averages;

m_1 and m_2 are their average errors.

For example (table 5.3)

Table 5.3

Average height (cm) of 16 year olds in two schools

<i>Indicators</i>	<i>School № 1</i>	<i>School number 2</i>
M	170	168
± m	± 0.6	± 0.5

Assess the reliability of research results

$$t = \frac{170 - 168}{\sqrt{0,6^2 + 0,5^2}} = 2,6$$

Conclusion: the results of the study are reliable, since $t > 2$, probability unerring forecast **P = 95%**.

Confidence coefficient estimate (t)

For a large number of observations (30 or more), statistically reliable in the difference between the two indicators, t is considered to be at least **2**. With a small number observations (less than 30), the value of t is found from the table (see Appendix 4).

When the value of the reliability criterion is $t < 2$, the degree of probability the unerring forecast is **P < 95%**. With this degree of probability the obtained difference in indicators is not reliable. In this case, the researcher needs additional data - to increase the number of observations.

Assessment of reliability by the criterion of compliance X^2 (chi-square)

Compliance criterion X^2 is calculated to compare 3 or more indicators or absolute numbers, based on the technique of proving from the opposite (null hypothesis), i.e. presumably in the compared groups do not differ in numbers. Is a measure of evaluation the reliability of the difference between samples by determining the correspondence between empirical and theoretical research.

Formula for calculating the criterion of compliance X^2 :

$$X^2 = \frac{\sum(F-F_1)^2}{F_1}$$

Where:

X^2 (chi-square) - the criterion of compliance;

F - actual data;

F_1 - expected data calculated based on the null hypothesis;

Σ - summation sign.

The calculation method is available in the specialized literature.

Tasks

Task 1

The incidence of rheumatism among schoolchildren in the city of K.

<i>Schools</i>	<i>Amount of children</i>	<i>Number of patients</i>
№1	570	12
№2	600	17

Determine whether the differences in the incidence rates of rheumatism among schoolchildren are significant.

Task 2

The results of deworming children in outpatient and inpatient treatment

<i>Place of treatment</i>	<i>Number of children</i>	<i>Deworming</i>
Outpatient clinic	730	631
In the hospital	70	84

Determine if there are significant differences in outpatient and inpatient outcome rates.

Test questions

1. Definition of the concept of "reliability".
2. Criterion of reliability (t).
3. Error of representativeness of relative and average values.

4. Confidence limits of relative and average values.
5. Probability of error-free forecast (p), concept.
6. Evaluation of the reliability criterion (p).
7. Compliance criterion (X_2).

Tests

1. With the probability of an error-free forecast $P = 95$, the reliability criterion should be equal to: a) 1, b) 2, c) 2.5, d) .3.
2. There are the following concepts that characterize the reliability of the research results: a) standardized indicator, b) error of representativeness, c) standard deviation, d) confidence limits.
3. Confidence limits are: a) the limits of relative and average values beyond which there is little probability, b) the limits of standardized indicators, c) the probability of an error-free forecast, d) the standard deviation.
4. The criterion of compliance (X_2) is used to compare: a) three or more indicators, b) one indicator, c) two indicators, d) for four.
5. The error of representativeness (m) shows: a) how much the results of a sample study differ from the general population, b) the boundaries of relative and average values, c) the maximum possible error in assessing the general population, d) the dependence of the confidence criterion on the degree of probability of an error-free forecast (p).
6. The marginal error is: a) the maximum possible error in the assessment of the general population, b) the dependence of the confidence criterion on the error-free forecast, c) the border of standardized indicators, d) the error of representativeness.

Theme 6

STANDARDIZED INDICATORS. DYNAMIC SERIES

The purpose of studying the topic

The student should *know* :

- basic provisions of the method of standardizing statistical indicators;
- stages of the direct method of standardization;
- role of time series in the analysis of scientific research;
- ways of smoothing time series and their importance for analysis material.

The student should *be able to* :

- calculate standardized indicators;
- calculate and analyze indicators of time series;
- align (transform) and smooth time series.

Topic study plan

1. Analysis of the topic on educational issues

- The concept of standardized indicators, methods of standardization.
- Methods for choosing (or calculating) a standard.
- Definition of time series, types and types of time series.
- Indicators characterizing the time series.
- Methods for smoothing time series.
- Measurement of seasonal fluctuations, the principle of calculation.

2. Task solving

3. Consolidation of material on control questions and tests

Standardized ratio

Standardization - a method of calculating conditional (standardized) indicators replacing the general intensive (average) values in cases, when their comparison is difficult due to the incomparability of the composition of the groups.

Standardized metrics indicate what the overall the coefficients of the compared groups, if the groups had the same composition.

Therefore, the standardized coefficients are calculated if knowingly it is known that the composition of the population is different in the compared groups.

Standardized indicators are conditional and are used only for purposes comparisons.

Methods for calculating standardized indicators:

1. *The direct method* is applied provided that materials are available to calculate indicators by groups (age, educational, etc.).

2. *The indirect method* is applied when numerical data are small, therefore, the calculated indicator for the groups is not reliable.

3. **The reverse method** is calculated when there is no composition of the population (it is impossible to calculate the indicators of the phenomenon), but there is only the composition of the dead or sick (absolute numbers).

List of required data for calculating standardized indicators by different methods

Method	Environment	Phenomenon	Standard
Direct	Distributed by the trait under study	Distributed by the trait under study	Distribution of the environment over the trait under study
Indirect	Distributed by the trait under study	1) Not distributed for the studied sign 2) Phenomenon by the trait under study expressed by small figures	Group indicators studied phenomenon (incidence, mortality, mortality)
Reverse	Not distributed across the trait under study, there is only general numbers	Distributed by the trait under study	Group indicators (incidence, mortality, mortality)

It is used if there is complete information about the composition of the compared aggregates, and about the distribution of phenomena in them.

Direct method of standardization

- is used when comparing intensive indicators in aggregates, differing in composition (for example, by age, gender, profession, etc.).
- allows you to eliminate (eliminate) the possible impact of differences in the composition of the populations for any criterion by the value of the compared intensive indicators. For this purpose, the compositions of the populations for this the attribute are equalized, which later allows you to calculate standardized indicators.

Calculation stages:

Stage I. Calculation of general and specific intensive indicators:

- general - by aggregates as a whole;
- private - based on differences (gender, age, length of service, etc.).

Stage II. Definition of the standard, i.e. selection of the same size environment for a given attribute (age, gender, etc.) for the compared aggregates. The standard is the sum or half of the numbers compositions of the respective groups. At the same time, the composition can become the standard any of the compared populations, as well as the composition for a similar a sign of some other set. For example, when comparing mortality in a specific hospital in two emergency departments for standard can be selected by the composition of patients of any other emergency hospital help. Thus, one way or another, the environmental conditions are equalized, which gives the ability to calculate new numbers of the phenomenon, called "expected values".

Stage III. Calculation of expected absolute values in groups of the standard for based on group intensive indicators calculated at stage I. The totals for the compared populations are the sum of the expected values in groups.

Stage IV. Calculation of standardized indicators for compared aggregates.

Stage V. Comparison of the ratios of standardized and intensive indicators, formulation of the conclusion.

Example task

Using a standardization method when comparing mortality rates in hospitals A and B, draw the appropriate conclusions

Age sick (in years)	Hospital A		Hospital B	
	Discharged patients	of them died	Discharged patients	of them died
Up to 40	600	12	1400	42
40 to 59	200	8	200	10
From 60 and older	1200	60	400	24
Total:	2000	80	2000	76

Stages of calculating standardized indicators

Stage I. Determine the overall mortality rates in hospitals A and B.

Hospital A: $80 \times 100/2000 = 4$ per 100 dropped out patients;

Hospital B: $76 \times 100/2000 = 3.8$ per 100 dropouts.

Then mortality rates are found depending on the age of the patients.

For example, in hospital A in patients under the age of 40, the mortality rate is

$12 \times 100/600 = 2\%$, and in hospital B, respectively, $42 \times 100/1400 = 3\%$.

Calculations are carried out in the same way in other age groups (see summary

table - I stage).

Stage II. The standard is the sum of dropped out patients for each age group in both hospitals.

Table № 1

Patient age (in years)	Number of patients in hospitals A and B	Standard
Up to 40	600 + 1400	2000
40 to 59	200 + 200	400
60 and older	1200 + 400	1600
Total:	2000 + 2000	4000

Stage III. Determine the expected number of deaths in the standard for each age group in hospitals A and B, taking into account the corresponding indicators lethality:

	Age under 40:	Age 40 to 59: Age 60 and over:	
Hospital	100 - 2 2000 - X $X = 2 \times 2000/100 = 40$	100 - 4 400-X $X = 4 \times 400/100 = 16$	100 - 5 1600 - X $X = 5 \times 1600/100 = 80$
Hospital	100 - 3 2000-X $X = 3 \times 2000/100 = 60$	100 - 5 400-X $X = 5 \times 400/100 = 20$	100 - 6 1600 - X $X = 6 \times 1600/100 = 96$

Find the sum of the expected deaths in the standard at hospital A ($40 + 16 + 80 = 136$) and Hospital B ($60 + 20 + 96 = 176$).

Stage IV. Determine general standardized injury rates in hospitals A and B.

Hospital A. $136 \times 100/4000 = 3.4$ per 100 retired patients;

Hospital B. $176 \times 100/4000 = 4.4$ per 100 retired patients.

Results of the step-by-step calculation of standardized mortality rates drawn up in the form of a table:

Age of patients in years	Hospital A		Hospital B		Stage I		Stage II Standard(the sum of the compositions of all patients)	Stage III	
	Discharged patients	of them died	Discharged patients	of them died	Mortality per 100 discharged patients			Expected deaths in standard	
					Hospital A	Hospital B		Hospital	Hospital

								A	B
Up to 40 years old	600	12	1400	42	2	3	2000	40	60
From 40 up to 59	200	8	200	10	4	5	400	16	20
60 and older	1200	60	400	24	5	6	1600	80	96
Total:	2000	80	2000	76	4.5	3.8	4000	136	176
Stage IV. Definition of standardized indicators							100	3.4	4.4

Stage V. Comparison of the ratio of intensive and standard indicators mortality in hospitals A and B.

Indicators:	Hospital A	Hospital B	Ratio of A and B
Intensive	4.0	3.8	A > B
Standard	3.4	4.4	A < B

Conclusions

1. The mortality rate in hospital A is higher than in hospital B.
2. However, if the age composition of the discharged patients in these hospitals was the same, then the lethality would have been higher in hospital B.
3. Consequently, differences in mortality rates (in particular, at its "overestimation" in hospital A and "underestimation" in hospital B) provided the influence of the heterogeneity of the age composition of patients, namely, prevalence of elderly patients in hospital A (60 years and more) with a relatively high mortality rate, and vice versa, in a hospital B - patients under the age of 40 with low rates lethality.

Indirect method of standardization

Calculations are carried out in the following sequence:

- Choice of standard
- Calculation of the "expected" number of sick deaths according to the standard
- Determination of a standardized indicator according to the formula:
 - *the actual number of patients;*
 - *general indicator of the standard;*
 - *"Expected" number of patients.*

Example 2.

Postoperative mortality over two years

Condition	2003 year	2012 year	Standard mortality, %	"Expected" number of deaths by standard			

	number of operated	number of deaths	number of operated	number of deaths		2003	2012
	1	2	3	4	5	6	7
Satisfactory	250	2	130	-	0.5	1.25	0.65
Medium	180	3	100	1	1.4	2.52	1.4
Heavy	70	7	200	14	7.8	5.46	15.6
Total	500	12	430	15	2.9	9.4	17.5

Typical rates: 2003 - 2.4 ($12 * 100/500$)

2012 - 3.5 ($15 * 100/430$)

Standardized rates: 2003 - 3.8 ($12 * 2.9 / 9.4$)

2012 - 2.4 ($15 * 2.9 / 17.5$)

Conclusion : if the composition of patients according to the severity of the disease in 2003 and 2012 year would be the same, then in 2003 the postoperative lethality would have been lower than in 2012.

The order of calculating standardized indicators inverse method.

For the standard of morbidity, mortality, and so on, some or a population group. The number of sick or dead is divided by age-appropriate morbidity or mortality rates, accepted as the standard of the population. Received expected population numbers the corresponding ages are summed up and divided by the actual population size adopted as the standard. The quotient of this division indicates how many times the incidence or mortality is higher or lower morbidity or mortality of the population adopted as the standard, and gives the ability to calculate a standardized indicator (see special lit.).

Time series and its indicators

The study of dynamic processes is of great importance for correct analysis of socio-medical, clinical phenomena, forecasting and planning treatment-and-prophylactic and organizational measures.

Dynamic nearby called aggregate homogeneous statistical quantities showing the change in a phenomenon in time.

The level of the series is the numbers that make up the time series.

Applications :

- to characterize changes in the health status of the general population or its individual groups, as well as the activities of institutions health care and their changes over time;
- to establish trends and patterns of changes in phenomena, in-depth analysis of the dynamic process (speeds, time characteristics of current and strategic planning;
- to predict levels of public health events and health care.

Time series types

Momentary - values that characterize the size of the phenomenon on a certain moment or date. *For example, the number of children in the Kyrgyz Republic at the end the corresponding year.* Their values cannot be divided or added currently.

Interval - the magnitude of the phenomenon over a certain time interval. *For example, the number of births by year.* Within each year, the values can be split by quarter, month, etc. Also, annual values can be sum up over three, five-year plans, etc.

Time series can consist of absolute and derivatives values (relative and average) and, accordingly, is called *simple* and *complex* dynamic series.

Time series indicators

To analyze time series, the indicators are calculated: absolute growth, growth rate, growth rate, value of 1% growth.

An example of calculating the indicators of a time series (Table 6.4).

Table 6.4

Year	2008	2009	2010	2011	2012
Fertility on 1000 population	28.6	26.1	24.6	26.0	23.6

Calculate absolute growth, growth rate, growth rate, value 1% gain.

1. Absolute gain - equal to the difference between each subsequent (studied) and the previous level.

Calculation:

For 2009: $26.1 - 28.9 = - 2.8$;

For 2010: $24.6 - 26.1 = - 1.5$, etc.

2. Growth rate - represents the percentage of each the next (studied) level to the previous one.

Calculation technique:

1. Composing the proportion:

For 2009:

Previous level - 100

28.6 - 100

Subsequent level - X or

26.1 -X

2. Calculation of the indicator:

$$x = \frac{26,1 \times 100}{28,6} = 91,3\%$$

For 2010:

$$x = \frac{24,6 \times 100}{26,1} = 94,3\% \text{ etc.}$$

3. Rate of increase is the percentage of subsequent (studied) absolute increase to the previous level and shows how many percent the phenomenon has changed.

Calculation technique:

1. Composing proportion

For 2009:

Previous level -100

28.6 - 100

Subsequent absolute growth - X or 2.8 - X.

2. Calculation of the indicator

$$x = \frac{-2,8 \times 100}{28,6} = 9,8\%$$

For 2010:

$$x = \frac{-1,5 \times 100}{26,1} = 5,7\% \text{ etc.}$$

3. The value of 1% growth is the ratio of the absolute growth to the pace gain.

For 2009:

$$x = \frac{-2,8}{9,8} = -0,3$$

For 2010:

$$x = \frac{-1,5}{5,7} = -0,3 \text{ etc.}$$

Table 6.5. the indicators of the time series are presented in final form.

Table 6.5

Indicators of the dynamic series of fertility in the city of K for 2008-2012

Year	Fertility on 1000 population	Absolute growth on 1000 population	Growth rate in%	Rate of increase in %	The value of 1% growth
2008	28.6	-	100	-	-
2009	26.1	-2.8	91.3	9.8	0.3
2010	24.6	-1.5	94.3	5.7	- 0.3
2011	26.0	1.4	105.7	5.7	0.24

2012	23.6	-2.4	90.8	-9.2	0.26
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Time series smoothing

Time series does not always consist of levels, sequentially changing in the direction of decrease or increase, which makes it difficult the ability to trace a pattern, makes the series not sufficiently visual. In such cases, the time series is smoothed.

Time series smoothing methods

- aggregation of intervals is performed by summing the data for a certain period of time.
- Calculation of the group average - by calculating the average values for a certain period of time.
- Calculation of the moving average - by calculating the average level given time and adjacent to it.
- By the method of least squares - by a special formula.

Example : strengthening the interval by summing data for a certain period of time (Table 6.6).

Table 6.6

Months	1	2	3	4	5	6	7	8	9	10	11	12
Before enlargement	11	15	16	19	20	30	22	14	12	16	15	14
After enlargement	42 (11 + 15 + 16)			69			48			45		

Example : Calculating the Group Average by Finding the Average for a certain period of time (Table 6.7).

Table 6.7

Years	2005	2006	2007	2008	2009	2010	2011	2012
Before enlargement	60	64	62	68	56	66	58	62
After enlargement	$(\frac{60+64}{2})=62$		65		58		60	

An example of calculating a moving average by finding the average the level of a given time and adjacent to it (Table 6.8).

Table 6.8

Years	2004	2005	2006	2007	2008	2009	2010	2011	2012
Before	20	23	21	25	24	20	21	23	22

enlargement									
After enlargement	-	21.3*	23.0	23.3	23.0	21.7	21.3	22.0	-

$$* - \frac{20+23+21}{3} = 21,3$$

$$- \frac{23+21+25}{3} = 23,0 \text{ etc.}$$

Seasonal Measurement

It is often found that morbidity (mortality) from individual disease exhibits significant "seasonality", i.e. increases in one month years and decreases in others. For example, colds - in cold months, and intestinal diseases - in the hot months.

To determine seasonality, use the relation the average daily number of diseases (deaths) in each month the average daily number of diseases. This attitude is for convenience expressed as a percentage.

An example of calculating the seasonality of morbidity (Table 6.9).

Table 6.9

Illness by month average daily number

Months	Number diseases	Number average daily diseases	Average daily number diseases in% to average annual number
January	750	750: 31* = 24.2	62.8
February	1250	1250: 28* = 44.6	115.8
March	1550	1550: 31 = 50.0	129.9
April	1500	1500: 30 = 50.0	129.9
May	1200	1200: 31 = 38.7	100.5
June	900	900: 30 = 30.0	77.9
July	850	850: 31 = 27.4	71.2
August	950	950: 31 = 30.6	79.5
September	1250	1250: 30 = 41.7	108.3
October	1400	1400: 31 = 45.1	117.1
November	1550	1550: 30 = 51.7	134.3
December	900	900: 31 = 29.0	75.3
Total:	14050	14050: 365 = 38.5	100

* - number of days in a month.

Calculation technique:

Determination of the average daily number of diseases in each month.

Example: January month $\frac{750}{31} = 24,2$

February month $\frac{1250}{28} = 44,6$ etc.

Determination of the average daily number of diseases per year.

Example:

$\frac{\text{number of diseases per year}}{\text{number of days in a year}}$

$$\frac{14050}{365} = 38,5$$

Find the percentage of the average daily number of diseases of each month to the average daily disease number of the year.

For example: for the month of January.

38.5 – 100

$$x = \frac{24,2 \times 100}{38,5} = 62,8$$

24.2 – x

February

38.5 – 100

$$x = \frac{44,6 \times 100}{38,5} = 115,8 \text{ etc.}$$

44.6 – x

Tasks

Task 1

Sex and age dependence of cases of intestinal infection among children

<i>Age (years)</i>	<i>Boys</i>		<i>Girls</i>	
	<i>Number of autopsies</i>	<i>Intestinal infection number</i>	<i>Number of autopsies</i>	<i>Intestinal infection number</i>
2-3	260	-	256	-
4-5	381	3	325	12
6-7	440	24	345	12
8-9	658	95	450	33

10-11	578	104	431	70
12-13	311	69	246	49
14 and older	92	13	77	10
Total	2720	308	2130	186

Calculate simple and standardized rates of intestinal infection prevalence by gender and draw conclusions. Take the half-sum of the age composition of both sexes as a standard.

Task 2

Distribution of schoolchildren by grade and measles cases

<i>Classes</i>	<i>School A</i>		<i>School B</i>	
	<i>Total</i>	<i>Got sick</i>	<i>Total</i>	<i>Got sick</i>
1-2	255	41	124	22
3-4	153	11	215	19
5-6	111	5	364	23
7-8	100	4	200	30
9-11	150	6	100	10
Total	779	67	1003	104

Calculate simple and standardized incidence rates in two schools. To conclude. Take the class composition of students in both schools as a standard.

Test questions

1. Concept of standardization, conditions for calculating standardized coefficients.
2. Methods for calculating standardized coefficients and cases of their application.
3. The procedure for calculating the standardized coefficients by the direct method.
4. Methods for choosing a standard.

5. Definition of time series, types and types of time series.
6. Determination of the moment and interval dynamic series, their applications.
7. Indicators characterizing the time series.
8. Absolute gain, calculation method.
9. Growth rate, calculation method.
10. Growth rate, calculation technique.
11. The value of 1% gain, calculation method.
12. Methods of smoothing the dynamic range.
13. Technique for calculating the seasonality of morbidity.

Tests

1. The method of calculating the standardized indicator: a) reverse, b) direct, c) symmetric, d) asymmetric.
2. The first stage of standardization is: a) calculation of partial indicators, b) calculation of partial and general indicators, c) calculation of a standard, d) calculation of standardized indicators.
3. Standardized indicators are calculated if: a) the compared groups are the same, b) the compared groups differ significantly c) the compared groups are identical, d) the compared groups do not differ.
4. Calculation of the standard is the stage of calculating standardized indicators: a) the first, b) the second, c) the third, d) the fourth.
5. The definition of the time series includes a key word: a) relative values, b) heterogeneous values, c) a change in the phenomenon during time, d) constants.
6. A dynamic series by type is: a) simple, b) complicated, c) momentary, d) homogeneous.
7. A dynamic series can consist of values: a) concrete, b) abstract, c) parallel, d) relative.
8. Indicator characterizing the time series: a) natural growth, b) absolute growth, c) average growth, d) value of 1% growth.
9. Absolute growth is: a) the difference between the next and the previous level, b) the ratio of the absolute level to the growth rate, c) the ratio of the next level to the previous one, d) the difference between the growth rates.
10. The growth rate is: a) the difference between the next and the previous level ”, b) the ratio of the absolute growth to the previous level, c) the ratio of the absolute level to the growth rate, d) the ratio of the next level to the previous one.
11. The value of 1% increase - a) the difference between the next and the previous level, b)% the ratio of the absolute increase to the previous level, c)%

the ratio of the absolute level to the growth rate, d)% the ratio of the next level to the previous one.

12. The growth rate is: a) the difference between the next and the previous level, b)% of the ratio of the absolute growth to the previous level, c)% of the ratio of the absolute level to the growth rate, d)% of the ratio of the next level to the previous one.

Theme 7

CORRELATION

The purpose of studying the topic

The student should *know* :

- essence of the correlation between the features;
- assessment of the reliability of the correlation coefficient;
- essence of the coefficient of determination;
- application of the regression method in the practice of a doctor;
- principles of constructing a regression cycle.

The student should *be able to* :

- own the technique of calculating the correlation coefficient by the method

ranks and assessments of the nature, strength and reliability of the connection;

- calculate the coefficient of determination;
- calculate the regression coefficient;
- build a regression graph.

Topic study plan

1. Analysis of the topic on educational issues

- Definition of the concept of "correlation".
- Correlation coefficient: concept, calculation method.
- Coefficient of determination: application, calculation method.
- Regression coefficient: concept, calculation method.

2. Task solving

3. Consolidation of material on control questions and tests

Correlation coefficient

All phenomena in nature and society are interconnected.

Correlation - a change in any feature is associated mainly, but not exclusively with a change in another phenomenon or sign.

For example, a person's weight mainly depends on his height, however, in addition to height by weight is also influenced by other factors (nutrition, health, occupation sports, etc.). Therefore, people of the same height have different weights for rare exception. In addition to the *correlation connection*, there is a *functional connection* - this is strict dependence of phenomena. For example, the larger the radius of the ball, the larger volume, the longer the day, the shorter the night. With functional communication a change in any phenomenon necessarily causes strictly defined changes in another phenomenon.

In medicine, we often come across correlations.

With a positive (direct) connection, when a change in one phenomenon goes in the same direction as changing another phenomenon. Coefficient correlation takes on a value in the range from 0 to +1. In cases negative

(feedback) relationship when a change in one phenomenon accompanied by a change in another phenomenon in the opposite direction, the correlation coefficient takes on a value in the range from 0 to -1. The more the correlation coefficient approaches 1 (-1), the greater the relationship studied phenomena. The value of the correlation coefficient equal to 0 indicates no connection, and equal to 1 (-1), indicates a complete connection.

Methods for calculating the correlation coefficient:

- rank correlation (Spearman's method - P), less accurate;
- method of squares (Pearson's method - r), more accurate, is used for small sample.

The formula for calculating the rank correlation coefficient (method Spearman):

$$P = 1 - \frac{6 \times \sum d^2}{n \times (n^2 - 1)}$$

Where:

6 - constant;

d is the difference between the serial numbers of the rows;

n is the number of correlation series.

An example of calculating the rank correlation coefficient (Spearman's method) (Table 7.1).

Table 7.1

Indicators of the content of the level of leukocytes in the blood, depending on age

Age X	Leukocytes in 10^9 / L. Y	Ranks to the side increase		Rank difference (X - Y)	Square range difference d^2
		age X	leukocytes Y		
20-29	193.3	1	1	0	0
30-39	222.5	2	4	-2	4
40-49	224.4	3	5	-2	4
50-59	220.0	4	3	1	1
60-69	218.8	5	2	3	9
70 years and older	229.7	6	6	0	0
					$\Sigma d^2=18$

Calculation method.

1. Determination of serial numbers (ranks) of age and size leukocytes in order of increasing values (column **x** and **y**).
2. Calculation of the difference of ranks **d**: (**x-y**).

3. Influence of the difference of ranks on the square d and determination of their sum $\sum d^2$

4. The data represent the formula:

$$\check{d} = 1 - \frac{6 \times 18}{6(36-1)} = +0,5$$

5. The indicator is assessed on a scale (Table 7.2)

Table 7.2

Scale for assessing the direction and strength of the correlation coefficient

The power of correlation	The nature of the connection	
Weak	0-0.29	0 - (- 0.29)
Average	0.3-0.69	-0.3 - (- 0.69)
Strong	0.7-1	-0.7 - (- 1)

In this example, the relationship is direct (+ sign), medium (0.5).

Calculation of the coefficient of determination showing the proportion of influence reasons for effect (in our case, age for the number of leukocytes), produced by the formula : $R = P^2 \times 100 = 0,5^2 \times 100 = 25\%$

Calculation of the coefficient by the method of squares (Pearson) is available in relevant literature.

Tasks

Task 1

Influence of fluoride level in water on the incidence of caries in children

<i>Area</i>	<i>Average concentration of fluorine, mg / l</i>	<i>Number of identified</i>
1 zone	0,29±0,01	631
2 zone	0,60±0,02	448
3 zone	1,18±0,07	252

Determine the correlation coefficient between fluoride content and dental caries.

Task 2

Influence of fluoride level in water on fluorosis in children

<i>Area</i>	<i>Number of identified</i>	<i>Fluorine concentration, mg / l</i>
A	1635	1,8
B	1835	2,5
C	2010	2,9
D	1600	1,7

Determine the correlation coefficient between fluorine content and fluorosis.

Theme 8

REGRESSION COEFFICIENT

Regression is a function that allows for the value of one correlated of a (linked) characteristic determine the average values of another characteristic. With the help of regression, the task is to find out how to quantify one quantity changes when another quantity changes. For example, how much on average, the weight of the child will increase with an increase in his height by a certain magnitude. Given the local standard, for example, the child's parents can correlate his weight according to the increase in height. To determine the size of this change, a factor is applied regression. The formula for determining the regression coefficient

$$R_{\frac{x}{y}} = r_{xy} \times \frac{\sigma_y}{\sigma_x}$$

Where:

r_{xy} is the correlation coefficient;

y is the first compared value;

x is the second compared value;

σ_x and σ_y - standard deviation for the series of the first and second magnitudes.

The regression coefficient can be used to determine the value of one from signs (body weight knowing the value of another (height)). This is possible by linear regression equation: formula

$$y = M_y + R_{\frac{y}{x}} \times (x - M_x)$$

Where:

y is the required value (body weight);

x is the known growth rate;

$R(y/x)$ - coefficient of regression of body weight by height;

M_y - the average value of body weight;

M_x - average value of growth.

In life, people of the same height can have different weights. Measure individual diversity characterizes sigma regression. Formula:

$$\sigma R_{\frac{y}{x}} = \sigma_y \times \sqrt{1 - r_{xy}^2}$$

Where:

σ is the standard deviation of the trait under study;

r_{xy} - correlation coefficient.

Regression sigma data can be plotted (regression scale), by which it is possible by height to find both the average weight and the individual fluctuation in weight.

The technique for calculating these coefficients is given in the corresponding literature.

Task 1

Results of measuring the levels of systolic and diastolic pressure in 9 healthy adolescents of 14 years

<i>Systolic pressure levels</i>	80	90	95	100	110	115	120	120	120
<i>Diastolic pressure levels</i>	40	50	55	60	60	60	65	70	75

Calculate the coefficient of regression of the level of systolic pressure by diastolic. Determine the expected level of systolic pressure at diastolic pressure equal to 82, 90 and 95 mm Hg. Art. Draw the regression line.

Task 2

Results of determining the daily protein requirement in 8-year-old girls

<i>Weight of girls (kg)</i>	20	22	23	25	26	27	28
<i>Daily protein requirement (gr.)</i>	62,0	66,0	62,0	75,0	75,0	78,0	82,0

Calculate the regression coefficient of the daily protein requirement by weight in girls. Determine the daily protein requirement for girls weighing 21, 24 and 29 kg. Draw the regression line.

Test questions

1. Types of correlation and their essence.
2. Methods for calculating the correlation coefficient.
3. Estimation of the correlation coefficient.
4. Coefficient of determination: concept.

5. Regression coefficient: concept.

Tests

1. The form of communication between phenomena or signs: a) functional, b) standardized, c) quantitative d) qualitative.
2. The strength of the correlation connection: a) normal, b) strong, c) normal, d) averaged.
3. There are directions of correlation: a) solid, b) discontinuous, c) reverse, d) curve.
4. There is a way to calculate the correlation coefficient: a) Fisher, b) Pearson, d) Student, e) Ermolova.
5. Correlation means: a) direct connection, b) proportional connection, c) complete connection, d) interconnection.
6. Regression is called: a) a change in two quantities, b) a change in several quantities, c) a change in the average of one quantity with a corresponding change in another, d) interchange of several quantities.

Theme 9

MEDICO-DEMOGRAPHIC INDICATORS

The purpose of studying the topic

The student should *know* :

- content of demography, medical demography, sections demography;
- general and special medical and demographic indicators, their content;
- mortality rates at different periods of fetal life and deaths under the age of 1 year.

The student should *be able to*:

- calculate, evaluate and analyze general and special medical demographic indicators;
- calculate, evaluate and analyze mortality rates in different periods of the life of the fetus and deaths before the age of 1 year.

Topic study plan

1. Analysis of the topic on educational issues

- Concepts demography, medical demography, sections of demography.
- General medical and demographic indicators, their content.
- Special medical and demographic indicators, their content.
- Mortality rates at different periods of fetal life and deaths under the age of 1 year, their content.

2. Task solving

3. Consolidation of material on control questions and tests

In assessing public health, indicators are important, characterizing medical and demographic processes.

Demography (from the Greek demos - people and grapho - to write, depict) - the science of the population in its social development.

Population (population) - a set of people united community of residence within a country, part of its territory, a group of countries, all over the world.

Medical demography - studies the relationship of reproduction population with medical and social factors and develops on this basis measures to ensure the most favorable development demographic processes and improvement of public health.

Population reproduction - changes in the number, composition and distribution of the population due to fertility, mortality, marriages and divorces.

Sections of demography

- Population statistics.
- Population dynamics.

Structure of sections of medical demography

DEMOGRAPHY		
STATICS	DYNAMICS (population movement)	
<ul style="list-style-type: none"> • Population • Composition of the population by sex, age and other featured • Density of settlement on the territory (population movement) 	Migration (mechanical motion) <ul style="list-style-type: none"> • Emigration • Immigration • Urbanization • Population movement in socio-political and other motives (refugees, forced migrants) • Pendulum migration • Shuttle migration 	Reproduction (natural movement) <ul style="list-style-type: none"> • Fertility • Fertility (general and age-specific) • Mortality (general and age-specific) • Natural growth (decrease) • Infant mortality • Expected duration life ahead

1. Population statistics - studies the size and composition of the population by

gender, age, nationality, professions, etc. at a certain point time.

The indicators characterizing the statics of the population have a large importance in practical health care. They are necessary for:

- calculation of indicators of natural movement;
- planning the entire health care system;
- calculating the need for medical care;
- determining the required amount of financial resources, allocated to health care;
- calculation quantitative indicators, characterizing activities of health authorities and institutions.

Main indicators of population statics

Age structure of the population - population distribution by age groups (0-14 years old, 15-49 years old, 50 years old and older);

- ❖ if the proportion of children (0-14 years old) exceeds the group aged 50 and older, then the structure of the population is characterized as **progressive** (the population is young);
- ❖ if the proportion of children (0-14 years old) and persons aged 50 years and older are equal, then the structure of the population is called **stationary**;
- ❖ if the proportion of people aged 50 and over prevails over the number of children (0-14 years old), then this type is called **regressive**.

Sex structure of the population - population distribution by sex (proportion of men and women).

Population distribution by sex and age in combination with other characteristics are necessary to determine the prospects for population growth, reproduction of labor resources, an objective assessment of sanitary state of the country, analysis and forecast of data on morbidity and mortality.

2. Dynamics (movement) of the population - studies the processes of change

the size and composition of the population over time.

Population dynamics or movement is divided into:

- mechanical movement - change in the size and composition of the population as a result of migration processes (migration, emigration, immigration);
- natural movement - change in the size and composition of the population due to changes in fertility and mortality rates.

Mechanical movement occurs as a result of migration processes. Migration (from Lat. Migratio, migro - I move, I move) is territorial movements of the population for the purpose of permanent or temporary change of residence. There are many reasons for migration: wars, natural disasters, socio-economic, political motives and much more.

In Kyrgyzstan, over the years of sovereignty, many emigrated for its limits for socio-economic, national and other reasons, and within the country - from rural areas to the city, where there is more opportunity to find work. It is mainly the young able-bodied population that migrates.

Population migration is subdivided into:

- irrevocable - permanent change of permanent residence;
- temporary - relocation for a long, but limited period;
- seasonal - moving at certain times of the year;
- pendulum - regular trips to the place of work or study outside your locality.

Urbanization (Latin urbo - city) is the process of increasing the role of cities in

development of society. The main social significance of urbanization is special "urban relations" covering the population, its way of life, culture, distribution of productive forces, resettlement.

The urbanization process changes the ecological situation, requires revision planned standards of medical care, changes in the network of medical organizations, changes the structure of morbidity and mortality of the population, affects on the epidemic situation in the region.

Accounting for the number and composition of the population is carried out by

periodically conducted population censuses, which are usually carried out every 10 years. In Kyrgyzstan, the first census was carried out in 1897, and the last - in 2009 (about 600 thousand and 5 million 362 thousand, respectively). person).

Indicators of the natural movement of the population.

1. General indicators.
2. Special indicators.

General indicators

1. **Fertility** - the number of live births per 1000 population.

$$\text{Total fertility rate} = \frac{\text{Number of live births} \times 1000}{\text{Population}}$$

2. **Mortality** - the number of deaths per 1000 population.

$$\text{Overall mortality rate} = \frac{\text{Number of deaths} \times 1000}{\text{Population}}$$

3. **The indicator of natural growth** - the number of natural growth, per 1000 population or the difference between the indicator fertility and mortality.

Natural growth rate =

$$1 \text{ method} = \frac{(\text{number of births} - \text{number of deaths}) \times 1000}{\text{population}}$$

$$2 \text{ method} = (\text{number of births} - \text{number of deaths})$$

4. **Average life expectancy** is the number of years which, on average, this generation of those born in given year, provided that throughout their life age-specific mortality rates for a given year.

Special indicators of population reproduction

1. **Fertility (fertility)** - the number of children born alive, per 1000 women aged 15-49 years (childbearing age).

2. **Age-specific fertility** is the number of children born alive in women of fertile age, referring to the number of women of a given age.

3. **Marital fertility** - the number of births per 1000 married women aged 15-49.

4. **Age-specific marital fertility** - the number of children born alive in women of a given age, to the number of women of a given age, consisting of marriage.

$$\text{Fertility} = \frac{\text{Number of live births} \times 1000}{\text{Number of women aged 15 – 49}}$$

$$\begin{aligned} & \text{Age – specific fertility rate} \\ & = \frac{\text{The number of live births to women aged 20 – 29} \times 1000}{\text{The number of women aged 20 – 29}} \end{aligned}$$

$$\begin{aligned} & \text{Marital fertility rate} \\ & = \frac{\text{Number of live births among married women} \times 1000}{\text{Number of married women aged 20 years}} \end{aligned}$$

$$\begin{aligned} & \text{Indicator of age – specific marital fertility} \\ & = \frac{\text{The number of live births among women of a given age who are married} \times 1000}{\text{Number of women of a given age who are married}} \end{aligned}$$

Note: A live birth is a child born who has after birth, at least one of the signs is determined: independent breathing, palpitations, pulsation of the umbilical cord, voluntary muscle contraction.

A viable child (WHO) is considered a child born with a term of 20-22 week pregnancy and later with a body weight of 500 g and above, in which after

birth is determined by at least one of the signs of live birth.

In the departments of the registry office, all newborns, born with a body weight of 500-900 g, if they have lived for 168 hours or more.

Special indicators of child mortality

Infant mortality - the number of deaths under the age of 1 year, per 1000 births (or 1/3 in the previous year + 2/3 in this year).

To mortality rates at different periods of fetal life and deaths under the age of 1 year include:

Antenatal mortality - the number of those born dead from 22 weeks of pregnancy before the onset of labor, per 1000 live or dead births from 22 weeks of gestation to the beginning of labor.

Intranatal mortality - the number of those born dead during labor activity per 1000 live and dead births during labor.

Postnatal or early neonatal mortality – number deaths at the age of 0-6 days (168 hours) per 1000 live births.

Late neonatal mortality - the number of deaths aged 7 days up to 1 month (27 days) per 1000 live births.

Neonatal or early infant mortality - number of deaths children in the first month of life, per 1000 live births.

Postneonatal mortality - the number of deaths of children from 1 month to 1 year of life per 1000 live births.

Stillbirth is the number of fetal deaths from 22 weeks pregnancy before birth, per 1000 live births.

Perinatal mortality is the number of stillbirths and deaths in the first week of life per 1000 live births and stillborn.

Separate study of mortality in the perinatal period and in the 1st year life does not provide a complete picture of the loss of all viable children. In this regard, the WHO introduced the concept of "**fetal infantile losses**" (FIP). The FIP indicator includes stillbirth and infant mortality by 1st year of life.

\

Annual infant mortality rate (1 method)

$$= \frac{\text{The number of deaths of children under 1 year of age in a given calendar year} \times 1000}{\text{Number of births in a given year}}$$

Annual infant mortality rate (2 method)

$$= \frac{\text{The number of deaths of children under 1 year of age in a given calendar year} \times 1000}{2/3 \text{ born this year} + 1/3 \text{ born in the previous year}}$$

Early neonatal or postnatal mortality (in the first week of a child's life)

$$= \frac{\text{The number of children who died at the age of 0 – 6 days (168 h.)} \times 1000}{\text{Number of live births}}$$

Neonatal mortality (in the first month of life) or late neonatal mortality

$$= \frac{\text{Number of children who died at the age 0 – 27 days} \times 1000}{\text{Number of live births}}$$

Postneonatal mortality (mortality of children older than days up to a year)

$$= \frac{\text{The number of children who died over the age of 1 month (27 days and older)} \times 1000}{\text{Number of live births}}$$

Perinatal mortality (stillbirth and mortality in the first week of a child's life)

$$= \frac{(\text{number of children born dead} \times \text{number of children who died at the age of 0 – 6 days}) \times 1000}{\text{The number of born alive and dead}}$$

$$\text{Stillbirth} = \frac{\text{Stillbirths} \times 1000}{\text{The number of those born alive and dead}}$$

Age structure of deaths in the first year of life (by age)

$$= \frac{\text{the number of children who died in 2 (3, 4, etc.) months of life} \times 100}{\text{the number of children who died under the age of 1 year}}$$

Infant mortality from selected diseases

$$= \frac{\text{the number of children under 1 year old who died from any disease} \times 1000}{\text{number of births}}$$

$$\begin{aligned} & \text{The structure of causes of death of children in the first year of life} \\ & = \frac{\text{the number of children under 1 year old who died from any disease} \times 100}{\text{number of all children who died}} \end{aligned}$$

Example

In area A in 2012, the population was 51,068 people, born - 1520 children, (born in 2011 - 1611), died - 406, including including under the age of 1 year - 38, of which under the age of 1 month - 20, including first week of life - 12. Total stillborns - 5. Total died from respiratory diseases - 150, including children under 1 year old - 27.

Calculate fertility, total mortality, natural increase, infant mortality, neonatal mortality, early non-malignant mortality, stillbirth, perinatal mortality, mortality from respiratory diseases infant mortality from diseases respiratory organs.

Sample calculation:

$$1. \text{ Fertility} = \frac{1520 \times 1000}{51068} = 29,8\text{‰}$$

$$2. \text{ Mortality} = \frac{406 \times 1000}{51068} = 8\text{‰}$$

$$3. \text{ Indicator of natural growth} = \frac{(1520 - 406) \times 1000}{51068} = 21,8\text{‰}$$

$$4. \text{ Infant mortality} = \frac{38 \times 1000}{\frac{2}{3} \times 1520 + \frac{1}{3} \times 1611} = 24,5\text{‰}$$

$$5. \text{ Neonatal mortality} = \frac{20 \times 1000}{1520} = 13,2\text{‰}$$

$$6. \text{ Early neonatal mortality} = \frac{12 \times 1000}{1520} = 7,9\text{‰}$$

$$7. \text{ Stillbirth} = \frac{5 \times 1000}{1520 + 5} = 3,3\text{‰}$$

$$8. \text{ Perinatal mortality} = \frac{(12 + 5) \times 1000}{1520 + 5} = 11,1\text{‰}$$

$$9. \text{ Mortality from respiratory diseases} = \frac{150 \times 1000}{51068} = 3,3\text{‰}$$

$$10. \text{ Infant mortality from respiratory diseases} = \frac{27 \times 1000}{1520} = 17,7\text{‰}$$

Conclusions: the birth rate is 29.8 (per 1000 population), which is, according to the level, above average, mortality in this city was 8.0 (per 1000 population), which corresponds to a low level. This the trend characterizes positive population reproduction (progressive structure of reproduction). Infant mortality was 24.5 (per 1000 live births), which corresponds to a high infant mortality rate, especially on first days and weeks of a child's life.

Maternal mortality is the number of women who die due to reasons related to pregnancy and childbirth, per 100,000 births alive.

Special mortality rates

$$\text{Mortality rates by sex} = \frac{\text{Number of men who died} \times 1000}{\text{Male population}}$$

Note: men or women

Mortality from certain diseases

$$= \frac{\text{The number of deaths from a particular disease} \times 1000}{\text{Population}}$$

$$\text{Age – specific mortality} = \frac{\text{The number of deaths at a given age} \times 1000}{\text{Average population of a given age}}$$

$$\text{Structure of mortality by causes} = \frac{\text{The number of deaths from this disease} \times 100}{\text{Total number of deaths}}$$

$$\text{Mortality} = \frac{\text{The number of deaths from any disease} \times 100}{\text{Number of patients}}$$

Tasks

Population, number of births, deaths in 2012

<i>City</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>
1. Population size	159810	17676	26312	111532	232059
2. Was born	4517	2352	768	3110	6530
3. Born in 2011	4605	2393	792	3202	6670
4. Died	1285	622	211	821	2091
5. Including under the age of 1 year	104	58	17	74	137
6. Of these, up to 1 month of life	61	31	9	39	85
7. Including in the first 6 days after birth	42	19	7	26	61
8. Stillborn	17	8	3	11	19

9. Died from respiratory diseases	598	340	89	372	757
10. Including under the age of 1 year	83	39	14	56	123

Calculate the indicators of fertility, total mortality, natural increase, infant mortality, neonatal mortality, early neonatal mortality, stillbirth, perinatal mortality, mortality from respiratory diseases, infant mortality from respiratory diseases.

Test questions

1. Demography is a concept.
2. Medical demography is a concept.
3. Sections of demography.
4. Population statistics - concept.
5. Population dynamics concept.
6. Types of movement of the population and their essence.
7. General indicators of the natural movement of the population.
8. Special indicators of the vital movement of the population.
9. Fertility rates, calculation.
10. Mortality rates, calculation.
11. Indicators of natural population growth.
12. Average life expectancy - concept.
13. Fertility, calculation.
14. Marital fertility, calculation.
15. Infant mortality, calculation
16. Stillbirth, calculation.
17. Anti-natal mortality, calculation
18. Intranatal mortality, calculation
19. Postnatal or early neonatal mortality, calculation
20. Perinatal mortality, calculation
21. Neonatal or early infant mortality, calculation
22. Postneonatal mortality, calculation
23. Lethality, calculation

Tests

1. Sections of demography: a) Mortality and population statics, b) Mortality and birth rate of the population; c) Population statistics and dynamics, d) mechanical and natural movement of the population.
2. Types of population movement: a) general and special, b) mechanical and natural, c) static and dynamic, d) social and mechanical.
3. Indicators of natural movement are divided into: a) general and special, b) general and particular, c) natural and mechanical, d) static and dynamic.
4. The general indicator of natural movement includes: a) fertility, b) fertility, c) marital fertility, d) infant mortality.
5. A special indicator of natural movement includes: a) fertility b) fertility c) mortality d) average life expectancy.
6. Mortality is calculated in relation to: a) born, b) deceased, d) population, d) sick.
7. Infant mortality is calculated in relation to: a) population, b) deceased, c) born, d) stillborn and live births.
8. Maternal mortality is calculated in relation to: a) population, b) deceased women, c) female population, d) live births.
9. Stillbirths include dead children: a) in the antenatal period, b) in the internatal period, c) up to 22 weeks of pregnancy d) in the ante-andinternatal periods
10. Perinatal mortality consists of: a) ante-, intra- and postnatal periods b) ante- and intranatal periods c) the beginning of pregnancy before the end of labor d) ante- and postnatal periods
11. Early neonatal mortality is called differently: a) perinatal b) postnatal c) neonatal d) postneonatal

Theme 10

INCIDENCE AND DISABILITY INDICATORS

The purpose of studying the topic

The student should know:

- value of studying the incidence of the population and methods of its study;
- types of morbidity by referral and their content;
- morbidity with temporary disability and its indicators;
- disability, content and indicators.

The student should be able to:

- calculate and analyze incidence rates;
- calculate and analyze incidence rates from a time disability;
- calculate and analyze indicators of disability.

Study topic plan

1. Analysis of the topic on educational issues

- Indicators of morbidity, sources of study.
- Morbidity according to the data of appealability, types of attendance.
- Indicators of morbidity with temporary disability.
- Disability, groups, reasons, indicators.
- Values of the basis for calculating the indicators.

2. Task solving

3. Consolidation of material on control questions and tests

The incidence rate is the level and structure of diseases among the population.

Incidence rates are used for:

- comprehensive assessment of the health status of the population;
- justification of the need for various types of medical care and resources;
- evaluating the performance of medical institutions.

Morbidity concept:

Intrinsic (primary) morbidity - this is the first time this year identified diseases among a certain number of the population.

Soreness (prevalence) of diseases is everything diseases for which patients applied this year in medical organizations for a certain number of the population.

Pathological affection is the number of pathologies identified in medical examinations for a certain number of examined.

The true incidence is all diseases for which patients turned to medical and preventive organizations and additionally identified during medical examinations.

Methods (sources) for studying morbidity

1. According to the data on the number of people applying to medical organizations:

- The main source of information on acute and chronic diseases;
- not completeness of requests for medical help (not severity symptoms, lack of access to medical care, low incidence qualifications of doctors, a low level in relation to their health).

2. According to medical examinations (preliminary on admission for work and periodic certain contingents of the population):

- allows you to reveal the initial stages or hidden forms diseases;
- application of the method is limited due to insufficient material technical base, insufficient funding.

3. According to the data on the causes of death - the frequency of cases of diseases detected among the deceased and caused death (a unit of observation is each death, the record is "Medical death certificate"):

- The main source of information on diseases and health problems fatal;
- allows you to compare information about some diseases.

4. According to the population survey:

- allows you to identify diseases that the population has not treated in medical organizations, but their identification depends on the level of sanitary culture of the population and the timeliness of seeking medical attention.

Types of morbidity by referral

1. General morbidity.

2. Special incidence:

- incidence of acute infectious diseases, acute food poisoning;
- incidence of major non-epidemic diseases (tuberculosis, sexually transmitted diseases, cancer, etc.);
- morbidity with temporary disability;
- hospitalized morbidity;
- occupational morbidity;
- injuries.

Referral is the first visit of a patient to a doctor about any disease.

Attendance is all visits by a patient to a doctor about any or diseases (first and repeated).

The main indicators of morbidity

1. Indicators of the incidence of diseases:

Primary (proper) morbidity

$$= \frac{\text{The number of newly diagnosed diseases per year} \times 1000}{\text{Population}}$$

Morbidity (prevalence of diseases)

$$= \frac{\text{The number of all existing diseases in the population per year} \times 1000}{\text{Population}}$$

Pathological affection

$$= \frac{\text{The number of diseases detected during medical examinations} \times 100}{\text{The number of examined population}}$$

Special indicators of diseases by groups (age)

$$= \frac{\text{The number of diseases in persons 20 – 29 years} \times 1000}{\text{Population by 20 – 29 years}}$$

Morbidity structure (the proportion of each disease among other diseases)

$$= \frac{\text{The number of cases of angina} \times 100}{\text{The number of all diseases during the year}}$$

Example

In the city "A" in 2012, the population is 46,068, the number existing diseases 13173, incl. newly diagnosed diseases - 6434.

Medical examination covered - 30313, while diseases were detected - 62233.

Number persons who have never applied to honey. institutions during the year 34895.

Calculate prevalence rates, primary incidence rates, pathological affection.

Calculation methods

1. *Disease prevalence* = $\frac{13173 \times 1000}{46068} = 286\text{‰}$

2. *Primary morbidity* = $\frac{6434 \times 1000}{46068} = 139,7\text{‰}$

3. *Pathological affection* = $\frac{62233 \times 100}{30313} = 205,3 \text{ per } 100 \text{ examined}$

4. *The indicator of persons who have never applied to medical organizations during the year* =

$$= \frac{34895 \times 1000}{46068} = 758\text{‰}$$

Conclusions: the prevalence of diseases in city A is 286 per 1000 population, the primary incidence, respectively, 139.7 per 1000 population.

The number of pathologies detected during medical examinations is 205.3 per 100. For every 1000 people. living in city A do not apply to medical organizations of 758 people.

General morbidity

- *The incidence of acute infectious diseases, acute food poisoning (epidemic incidence) - the frequency of all cases infectious diseases registered in the population during a certain period of time.*
- *Unit of observation - each case of a registered infectious diseases.*

- *Accounting document* - "Emergency notification of infectious disease, food poisoning "(filled in by a doctor within 12 hours and served by state bodies. san.epid. supervision).

Infectious morbidity indicators - structure and frequency morbidity.

The structure of infectious diseases (in%)

$$= \frac{\text{The number of cases of diseases of one nosology} \times 100}{\text{Number of cases of all infectious diseases}}$$

$$\text{Frequency of infectious diseases} = \frac{\text{Number of cases} \times 1000}{\text{mid year population}}$$

The incidence of major non-epidemic diseases (tuberculosis, venereal, skin diseases, psychiatric, oncological diseases)

Is the incidence of non-epidemic diseases in the population.

Observation unit - each diagnosis established for the first time in life non-epidemic disease and reported in a given year.

Accounting documents - "Patient notice".

Indicators of non-epidemic morbidity - structure and frequency morbidity.

Structure of noncommunicable morbidity(in%)

$$= \frac{\text{The number of cases of diseases of one nosology} \times 100}{\text{Cases of all noncommunicable diseases}}$$

Frequency of noncommunicable morbidity

$$= \frac{\text{Number of cases} \times 1000}{\text{mid year population}}$$

Incidence rates with temporary disability – frequency all cases and days of disability due to illness, injury among the working contingent.

$$1. \text{ Number of incidents of incapacity for work at workers} = \frac{\text{Number of incidents of incapacity for work} \times 100}{\text{Number of employees}}$$

$$2. \text{ Number of days of incapacity for work per 100 employees} = \frac{\text{Number of days of incapacity for work} \times 100}{\text{Number of employees}}$$

$$3. \text{ Average duration of a disability event} = \frac{\text{Number of days of incapacity for work}}{\text{Number of incidents of incapacity for work}}$$

$$4. \text{ The number of cases (days) of incapacity for work for this disease at 100 workers} = \frac{\text{The number of cases of incapacity for work for this disease} \times 100}{\text{Number of employees}}$$

$$5. \text{ Average duration of cases of disability for this disease} = \frac{\text{Number of days of incapacity for work for this disease}}{\text{The number of cases of incapacity for work for this disease}}$$

$$6. \text{ Indicators of the morbidity structure} = \frac{\text{The proportion of cases (days) of disability for this disease} \times 100}{\text{All cases (days) of incapacity for work}}$$

The unit of observation is a case of temporary incapacity for work during the year working due to illness or injury.

Accounting documents - a certificate of incapacity for work.

Example

At plant A in 2012, the number of employees was 310, the number of cases incapacity for work - 186, incl. from diseases of the circulatory system - 48.

Total days of incapacity for work - 1753, incl. from organ diseases blood circulation - 720.

Calculate the number of incidents of incapacity for work per 100 employees, incl. with diseases of the circulatory system, the average duration of 1 case disability, incl. with diseases of the circulatory system.

Sample calculation:

1. The number of incidents of incapacity for work per 100 employees
 $= \frac{186 \times 100}{310} = 59,9$ per 100 employees

2. The number of days of incapacity for work per 100 employees =
 $\frac{1753 \times 100}{310} = 565,5$ per 100 employees

3. Average duration of one case of disability
 $= \frac{1753}{186} = 9,4$ days

4. The number of cases of disability due to organ diseases circulation per 100 workers =
 $\frac{48 \times 100}{310} = 15,5$ per 100 employees

5. The number of days of disability for diseases of the circulatory system per 100 employees =
 $\frac{720 \times 100}{310} = 232,3$ per 100 employees

6. Average duration of 1 case of disability due to diseases circulatory organs =
 $\frac{720}{48} = 15$ days

Conclusions: for every 100 employees, there are 15 cases of disease organs of blood circulation and 226 days that entailed not going to work.

The average duration of one incapacity for work was 15 days.

Hospitalized morbidity - the incidence of all cases of diseases, registered in patients who left the hospital for a given year (by 1000 population).

The unit of observation is a case of the main disease of a retired patient from hospital (discharged or deceased).

Accounting documents - "Statistical card of a patient who left the hospital", "Disease history".

Structure of hospitalized morbidity (in%)

$$= \frac{\text{The number of cases of diseases of one nosology} \times 100}{\text{Number of cases of hospitalized morbidity}}$$

$$\text{Hospitalized morbidity rate} = \frac{\text{Number of Cases} \times 1000}{\text{mid year population}}$$

Occupational morbidity is the incidence of all occupational diseases registered during the year among workers, passed a medical examination.

The unit of observation is a case of acute and chronic occupational diseases.

Accounting documents - "Emergency notification" (sent by the doctor to the authorities state dignity epid. supervision), "Disease history".

2.0. Disability

Disability is a permanent (or long-term) loss or significant disability

Disability groups:

- Group I - persons with complete disability
- Group II - persons with significant disability
- Group III - persons with limited labor functions.

Causes of disability: general disease, occupational illness, work injury, disability from childhood, disability before labor activity, injury and illness in military service.

Disability indicators

Primary disability (contingent)

$$= \frac{\text{number of first time recognized as disabled} \times 10000}{\text{number of employees}}$$

The structure of primary disability by disease, age, social status, etc.

$$= \frac{\text{Number of people recognized as disabled from diseases of the circulatory system} \times 100}{\text{Number of recognized disabled}}$$

Primary disability rate by disability group =

$$= \frac{\text{The number of persons recognized as disabled of the 1st group} \times 10000}{\text{Number of employees}}$$

Structure of primary disability by disability group

$$= \frac{\text{The number of persons recognized as disabled of the 1st group} \times 10000}{\text{Number of people first recognized as disabled}}$$

$$\text{General disability (contingent)} = \frac{\text{number of disabled} \times 10000}{\text{number of employees}}$$

Disability structure (calculated by diseases, age, sex, etc.)

$$= \frac{\text{Number of persons with disabilities for diseases of the circulatory system} \times 10000}{\text{Total number of disabled people}}$$

Example

In 2012, in area A, the number of employees was 15 115 people, for the first time recognized as disabled - 66, incl. 1 group - 15. The number of disabled people, consisting registered - 302, incl. for diseases of the circulatory system - 98.

Calculate indicators of primary disability, incl. 1 group, total disability (contingent), incl. for diseases of the circulatory system Calculation methods

1. Primary disability = $\frac{66 \times 10000}{15115} = 43,7$ per 10,000 employees

2. Primary disability group 1 = $\frac{15 \times 10000}{15115} = 9,9$ per 10,000 employees

3. General disability (contingent) = $\frac{302 \times 10000}{15115} = 199,8$ per 10,000 employees

4. Disability contingent for diseases of the circulatory system = $\frac{98 \times 10000}{15115} = 64,8$ per 10,000 employees

Conclusions: In area A, for the first time, 43.7 per 10,000 were recognized as disabled working people, of which the disabled of the 1st group amounted to - 9.9 with a total disability -199.8 and diseases of the circulatory system -64.8.

Tasks

Task 1

<i>Locality</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
1. Population size	93115	139508	185272	93143
2. Covered by medical examination	60527	89193	123152	6150
3. Newly diagnosed diseases	13256	21303	26851	33180
4. All existing diseases	27015	38519	53705	66860
5. Diseases detected during medical examinations	123475	185314	247517	30171
6. The number of people who have never applied to medical institutions during the year	64116	105111	130517	18150

Calculate and analyze indicators of primary morbidity, prevalence, pathological

incidence, indicators of persons who have never applied to a medical organization during the year.

Task 2

<i>In 2012</i>	<i>Plant</i>			
	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
1. Number of employees	473	615	151	78
2. Number of incidents of incapacity for work	275	373	98	41
3. Number of days of incapacity for work	2910	4010	105	79
4. Incidence of incapacity for work from inflammatory diseases of the genitourinary system	72	101	28	9
5. Number of days of incapacity for work from inflammatory diseases of the genitourinary system	1150	1713	451	125

Calculate the number of incidents and days of disability, the average duration of disability for all diseases and from inflammatory diseases of the genitourinary system.

Test questions

1. Definition of "morbidity".
2. Concepts of morbidity.
3. Own or primary morbidity, calculation method.
4. Soreness or prevalence of the disease, calculation method.
5. Pathological affection, calculation method.
6. Methods for studying morbidity.
7. Types of morbidity by referral.
8. The difference between traffic and attendance.

9. Morbidity with temporary disability - concept.
10. List the incidence rates with temporary disability.
11. Methodology for calculating the number of cases (days) of incapacity for work.
12. Methodology for calculating the duration of one case of disability.
13. Disability - Definition.
14. Groups of disabilities and their content.
15. Causes of disability.
16. Primary disability, calculation method.
17. General disability or a contingent of disabled people, calculation method.

Tests

1. The concept of incidence includes: a) prevalence, b) level, c) frequency, d) structure
2. The method of studying morbidity includes: a) according to the report; b) according to the accounting data; c) according to medical examinations; d) according to survey data.
3. The type of morbidity includes: a) partial, b) private, c) compacted, d) selective.
4. Private morbidity includes: a) disability, b) pathological damage, c) hospitalized morbidity, d) morbidity detected during medical examinations.
5. The indicator of morbidity with temporary disability includes: a) the incidence rate, b) the average duration of a case of disability, c) the incidence rate, d) the outcome of morbidity.
6. The disability indicator includes a) primary disability, b) simple disability, c) repeated disability, d) secondary disability.

Theme 11

EVIDENCE MEDICINE. GRAPHIC IMAGES

The purpose of studying the topic

The student should *know* :

- content of evidence-based medicine;
- types of research and their content;
- purpose of using graphical images in statistical research and general rules for their construction, types of graphic images.

The student should *be able to* :

- select experimental and control groups for research in compliance with the requirements of evidence-based medicine;
- build graphic images.

Topic study plan

1. Analysis of the topic on educational issues

- The concept and purpose of evidence-based medicine, types of group selection.
- Types of errors, school of evidence.
- Types of research, their content.
- Graphic images: concept, application.
- Basic types of graphic images, types of diagrams.
- Requirements for the construction of graphic images.

2. Task solving

3. Consolidation of material on control questions and tests

Evidence-based medicine - conscientious, accurate and meaningful the use of various clinical trials for treatment selection specific patient.

Evidence-based medicine is a new approach and direction in medicine, including technology for collecting, analyzing, generalizing and interpreting scientific information.

Objectives of Evidence-Based Medicine:

- proof or refutation of the assumption of effectiveness any therapeutic or diagnostic method in this group sick.

What is evidence-based medicine for?

1. With the help of evidence-based medicine, it can be applied in clinical practice of intervention for which there are confirmed scientific evidence.

2. With the help of evidence-based medicine, the patient is better oriented in information flow and can choose the necessary methods together with the doctor diagnostics, treatment, etc.

3. A doctor who is poorly oriented in a large amount of information can harm the patient with their unskilled actions.

The causes of evidence-based medicine

- Increased volume of scientific information.

- Facilitating access to scientific information (Internet).
- New drugs are being introduced into clinical practice at a rapid pace, methods of treatment, etc.
- Many clinical trials are controversial and require interpretation of results.
- Increase in Internet users and access to scientific literature.
- Lack of funds allocated for health care leads to the fact that it is impossible to independently conduct well-organized scientific research (using scientific data from other researchers).
- Selecting scientific evidence that is most effective and proven with large molasses of information.

Elements of evidence-based medicine

1. Identifying the problem and formulating a clear clinical question (relevance, purpose, task, scientific novelty, practical significance).
2. Search for literature on this issue.
3. Evaluation (critical assessment) of the evidence used in the study any question, its reliability and applicability in medicine.
4. Implementation of evidence-based literature data into clinical practice.

Information search principles:

- economical and comprehensive search of up-to-date information thanks to the use of electronic means (Internet sites);
- new literature - International Journal of Medical Practice;
- thematic and universal catalogs;
- electronic database.

Resource types:

1.
 - magazines;
 - e-books;
 - clinical practice guidelines;
 - mailing lists, news.
2.
 - websites of project organizations;
 - thematic websites;
3. electronic versions of databases;
4. Library search (as important articles may be missed in electronic version).

Research methods

Meta - analysis - allows you to summarize information obtained from various sources (scientifically based).

Randomized controlled trials - studies with controlled group, the probability of error in which is minimized with using a statistical randomization method.

Implementation of the found data into clinical practice

- Transformation of research results for doctors

- methodological developments are aimed at helping doctors in solving specific clinical problems.

- According to researchers, guidelines lead to significant changes in clinical practice (in 9 of 11 studies leads to better results).

Graphic images

The results of a statistical study are presented as series numbers summarized in a statistical table. For greater clarity and better assimilation, these results can be presented in the form of graphical images. Graphics not only help the learning process statistical material, but also facilitate scientific analysis.

Requirements for the construction of graphic images

- Must have an inscription that clearly, concisely indicates the time, the place to which the data belongs. The word "drawing" is written before the inscription and his number.
- graphic image is built on a certain scale, with indication of the unit of measurement (% , cm, kg, etc.).
- It must be stated what each shading or color means, those. conventions.

Types of graphic images:

- diagrams;
- cartograms;
- cartodiagrams.

Ways to display diagrams:

- linear;
- columnar;
- sector;
- radial;
- curly.

Building diagrams

- **Linear** (dynamic, chronological) - these are charts, on which numerical values are depicted by curved lines, allowing trace the dynamics of the phenomenon in time or identify the dependence of one a sign from another. Are built on a rectangular coordinate system. Axis abscissa "X" (horizontal line) is a numeric value time, on the ordinate "Y" (vertical line) - the value of another phenomenon.

All points of their intersection are connected by a line, which gives an idea of dynamics of the studied phenomenon.

Line chart example

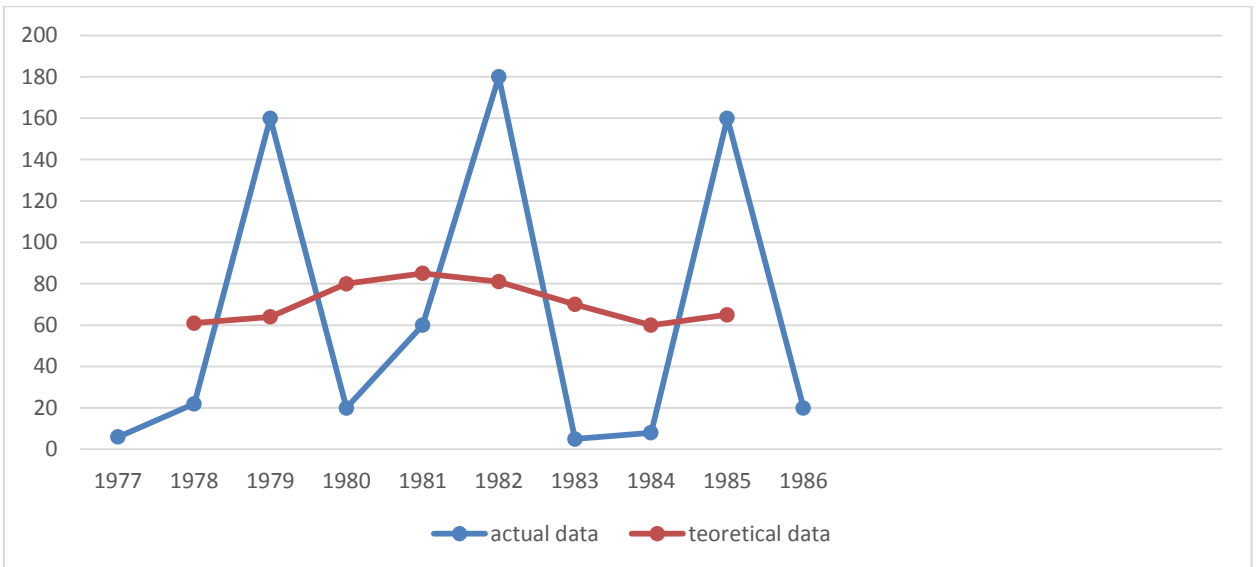


Figure: 1.

Several line graphs can be plotted on one chart at the same time.

diagrams, which allows their visual comparison (not it is recommended to build more than 4 diagrams, since more of them complicates perception).

- **Bar** charts are plotted in the form of horizontal or vertical columns. The height of the rectangle corresponds to the value indicator. Thus, it is advisable to portray intense performance or indicators of the ratio, for one period of time, but for different territories, collectives.

Bar chart example

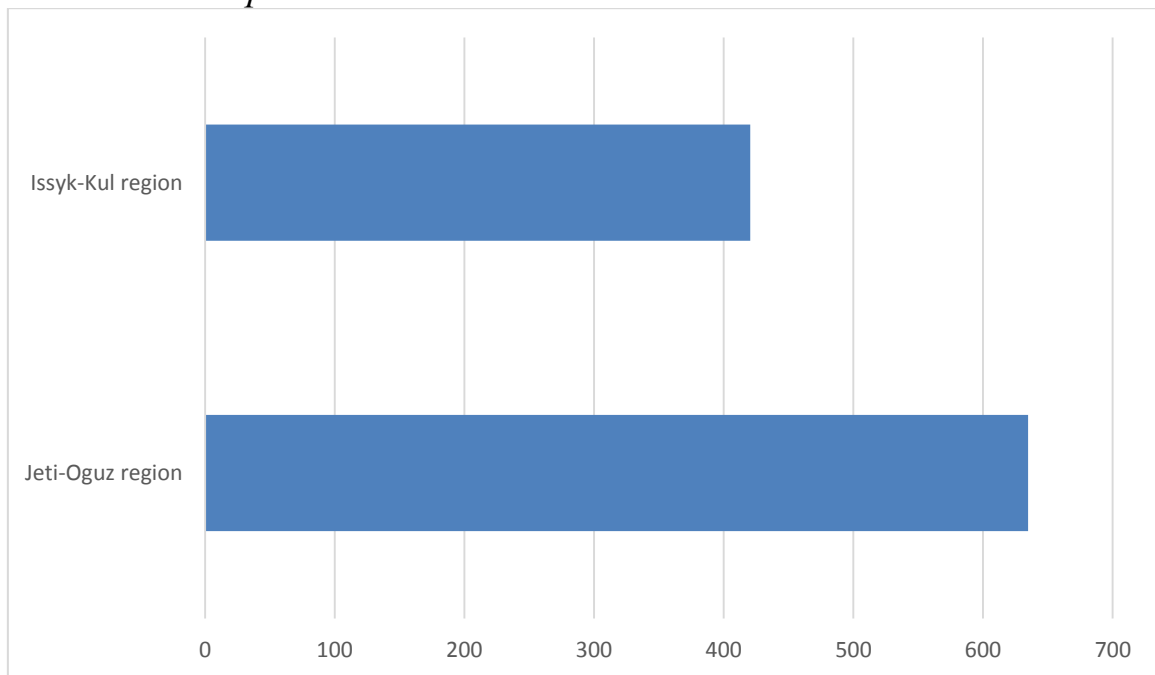


Figure: 2. Diseases of the blood and blood-forming organs among children under 14 years old (per 100 thousand population), Kyrgyz Republic, 2003

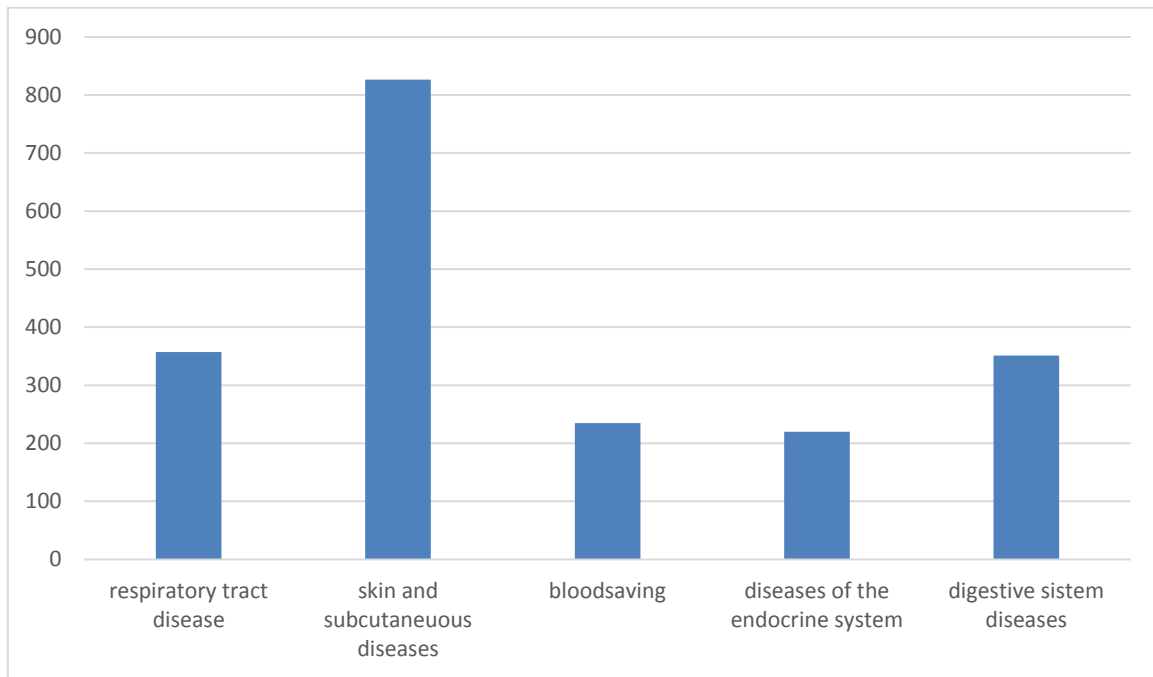


Figure: 3. Frequency of morbidity by referral among adults and adolescents Zhety-Oguz district of Issyk-Kul region in 2000 (per 100 thous. population)

- **Pie charts** can be *circular* and *bumps* .

Usually used to depict extensive indicators. When in the pie chart, 1% is taken as 3.6 degrees, so the integer (100%) taken as 360 degrees, and the corresponding parts of the structure of the phenomenon as the corresponding part of the circle, expressed in degrees.

- **Pie chart** is a circle, separate sectors which correspond to the parts of the depicted phenomenon as a percentage.

Pie chart example

- 31.8
- 22.7
- 11.4
- 6.8
- 27.3
- Bleeding
- Gestosis
- Sepsis
- Ruptured uterus
- Others

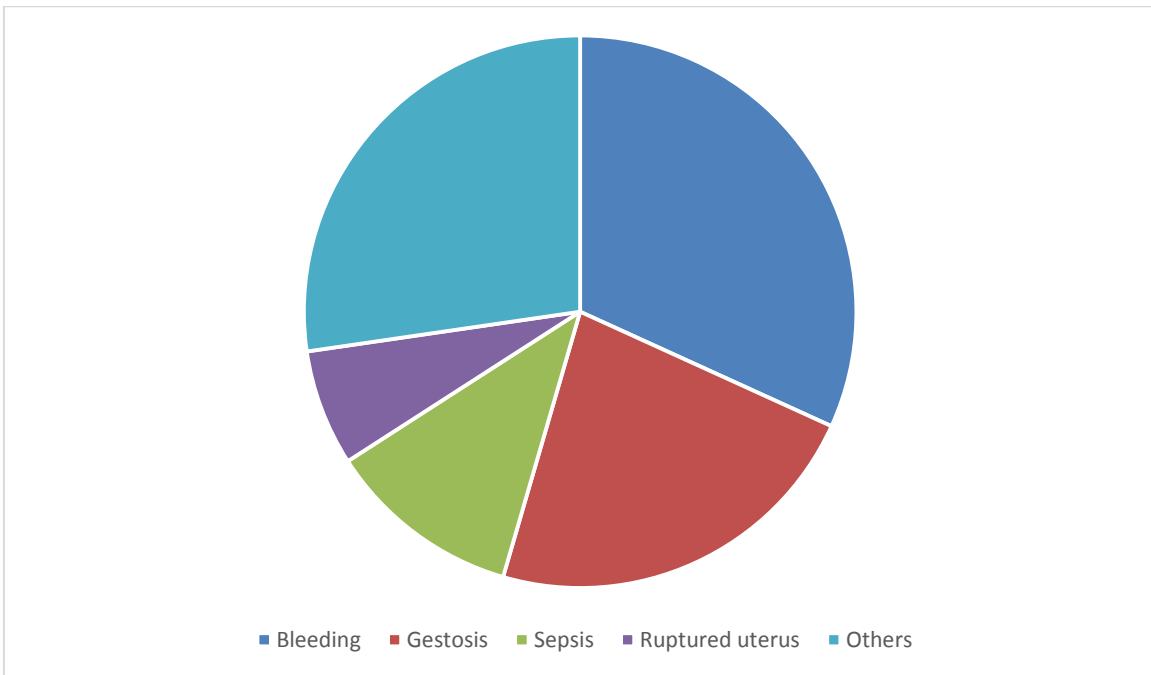


Figure: 4. Structure of the causes of maternal mortality in the Kyrgyz Republic for 2004

- **Radial** (coordinate system) typically depicts seasonal fluctuations of the phenomenon. The circle is divided into as many sectors as it is divided into year (12 months, 4 quarters, etc.). The length of the radius of the circle corresponds to the average annual level. At each radius, clockwise mark point the value corresponding to the level of the phenomenon in the given month (quarter etc.). The marked points are connected by lines.

Radial chart example

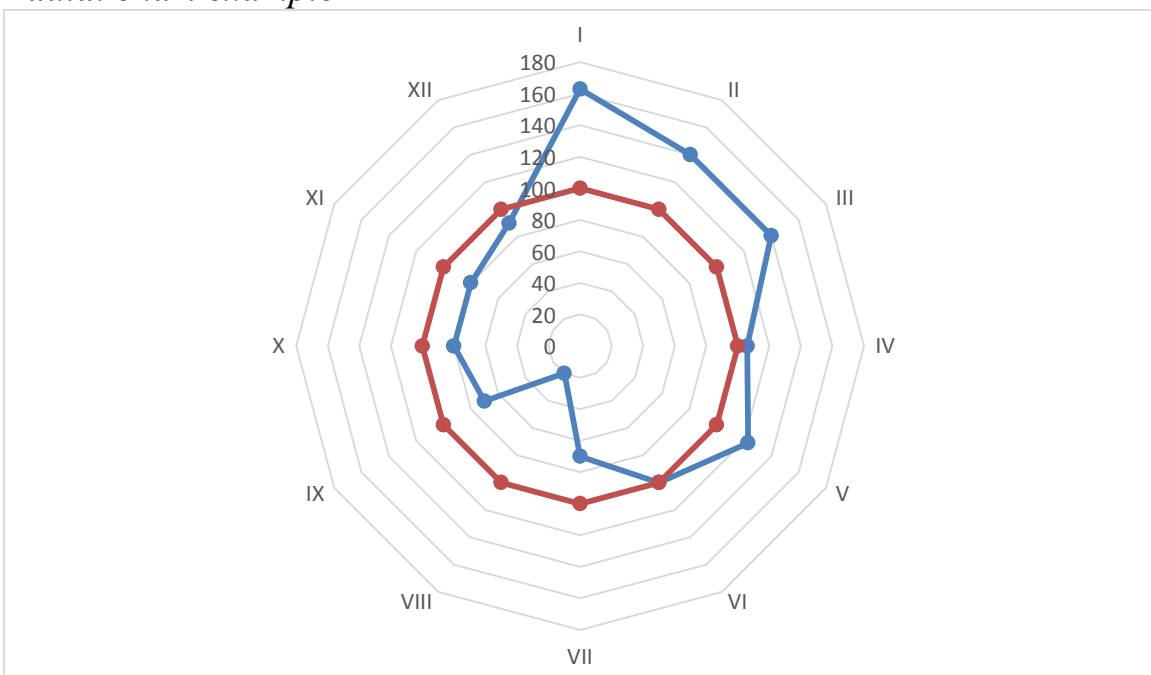


Figure: 5. Typical curve of intra-annual morbidity dynamics of mumps in the city of "O" in 1985 - 1992. (according to seasonal hesitation)

- **Shape** diagrams are depicted as geometric shapes people or objects (beds), etc. Each of these shapes corresponds to conditional number of phenomena.

Example of a shape chart

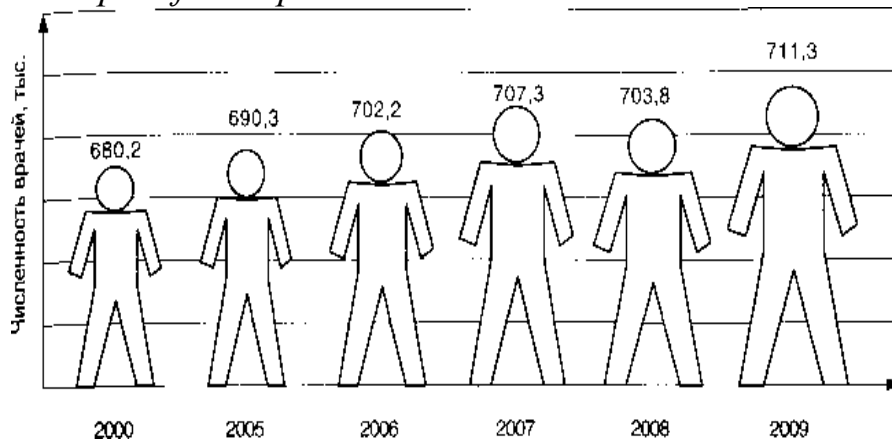


Figure: 6. Dynamics of the number of doctors in the Russian Federation (2000-2009)

- **Cartogram** - on a geographic map (specific area) phenomena are depicted in the form of various coloring or shading in depending on the frequency of the displayed phenomenon.

Distinguish:

1. *background cartograms* - where are the differences in the magnitude of the statistic in different areas are expressed by the peculiarity of the background given to each territory. In monochromatic - the degree of density of shading, in color - the degree of color intensity, and they use only one color, but different shades - from the lightest to the darkest.

Example of a background cartogram



Fig. 7.

2) *point cartograms* - where the value of the statistical indicator depicted by the number of points placed on the contour map of a particular territory. Each dot denotes some (conditional) number of units of this attribute (for example, 1000 inhabitants).

An example of a point cartogram.

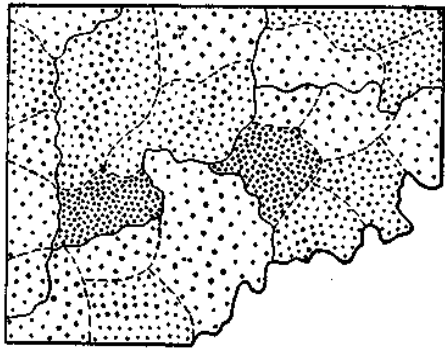


Fig. 8.

Chart diagram - such a graphic image is called when on a geographic map or its schema statistical data are plotted in the form bar, pie, figure and other charts.

Task 1

The structure of time spent on admitting one child to pediatricians

<i>Elements of work</i>	<i>Time spent in minutes (in% of total)</i>
Preparation and familiarization with the documentation	10,6
Patient interview	15,1
Examination and examination of the patient	25,9
Other work elements	48,4
Total	100,0

Draw up a graphic image.

Task 2

The contingent of children with rheumatic diseases (per 1000 children of the corresponding age)

<i>Age (years)</i>	До 1	1-3	4-5	6-7	8-9	10-11	12-14
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<i>Number of patients</i>	6,3	23,5	32,5	26,4	26,1	30,5	37,6
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Draw up a graphic image.

Test questions

1. Evidence-based medicine: definition.
2. Elements of evidence-based medicine.
3. Types of resources.
4. Research methods used in evidence-based medicine.
5. Graphic images: concept, application.
6. Requirements for the construction of graphic images.
7. Types of graphic images,
8. Types of diagrams.
9. Cartogram - concepts
10. Cartogram - concepts.

Tests

1. Definition of evidence-based medicine: a) a set of methodological approaches to conducting clinical trials, evaluating results, b) a set of organizational approaches to conducting clinical trials, evaluating results, c) the use of various clinical trials to select the treatment of patients, d) a set of scientific approaches to conducting clinical trials, evaluating the results.
2. One of the types of group selection in evidence-based medicine: a) randomization, b) standardization, c) correlation, d) regression.
3. The purpose of evidence-based medicine: a) proof or refutation of the assumption about the effectiveness of any therapeutic or diagnostic method in a given population of patients, b) refutation of the assumption about the effectiveness of any therapeutic or diagnostic method in a given population of patients, c) proof assumptions about the effectiveness of any medical or diagnostic method in a given population of patients, d) an assumption about the effectiveness of any medical or diagnostic method in a given population of patients.
4. Requirements for the construction of a graphic image: a) an inscription, b) built according to scale, c) the symbols are indicated, d) where the data was taken from.
5. The inscription of the graphic image indicates: a) duration, b) content, c) time, d) place.
6. The graphic image is built according to the values: a) absolute, b) relative, c) parallel, d) average.
7. There are types of graphic images: a) cartography, b) diapanorama, c) diagram, d) cartogram.
8. Linear diagrams are used to depict: a) phenomena in time, b) phenomena in the environment, c) interrelation with space, d) seasonal fluctuations.

9. The pie chart is divided into: a) linear, b) chronological, c) planar, d) bar.

ANSWERS TO TESTS ON THEMES

Topic 1: Subject and content of medical statistics

1.a, c, d; 2. c; 3. a, c; 4. a, b, d; 5. c; 6. a; 7.a; 8. a, b; 9.b, c, d; 10. a, d; 11.g, 12. a; 13. a, c; 14.a.

Topic 2: Organization of statistical research

1. b; 2. g; 3. c; 4.b; 5. a; 6.b; 7.b.

Topic 3: Relative values

1.a, b, d; 2. a, c, d; 3. a, b, c; 4. a; 5. c, d; 6.g; 7.c; 8. c; 9.a, b; 10. a; 11. a, b; 12.a.

Topic 4: Variation series and average values

1.g; 2. g; 3. c; 4.b; 5 B; 6.b; 7.c; 8. a; 9. g.

Topic 5: Selective method and assessment of validity research results

1. b; 2. b, d; 3. a; 4. a, d; 5. a; 6 a.

Topic 6: Standardized indicators. Dynamic series

1. a, b; 2.b; 3.b; 4 c; 5. c; 6. c; 7.g; 8. g; 9.a; 10.b; 11.c; 12. g.

Topic 7,8: Correlation. Regression

1. a; 2.b; 3. c; 4.b; 5. g; 6.c.

Topic 9: Medico-demographic indicators

1.c; 2.b; 3. a; 4. a; 5 B; 6.g; 7.c; 8. g; 9. g; 10. a; 11.b.

Topic 10: Incidence and disability indicators

1. a; 2. c; 3.b; 4. c; 5 B; 6.a.

Topic 11: Evidence medicine. Graphic images.

1.c; 2. a; 3. a; 4. a, b, c; 5. b, c, d; 6. a, b, d; 7.c. g; 8. a; 9. c, g.

QUESTIONS TO THE MODULAR-RATING KNOWLEDGE ASSESSMENT STUDENTS

1. Definition of statistics as a science.
2. The tasks of medical statistics.
3. Sections of medical statistics.
4. Theoretical and methodological foundations of medical statistics.
5. Indicators of public health.
6. Indicators of health statistics.
7. Statistical population, definition.

8. Unit of observation, definition.
9. Registration signs.
10. Types of statistical aggregate. 11. Requirements for the sample.
12. Types of distribution of signs in the statistical population. 13. Statistical quantities.
14. Stages of statistical research. 15. Contents of the first stage.
16. Sections of the second stage. 17. Characteristics of the research object.
18. Methods of forming a statistical population.
19. Methods for selecting a unit of observation in the sample population.
20. Content of the collection program.
21. The content of the material development program.
22. Content of the fourth stage (material processing).
23. The main types of errors in the analysis of material.
24. Features in conducting social, medical and clinical research.
25. Types of relative values.
26. Intensive indicators, calculation methodology.
27. Extensive indicator, calculation method.
28. Difference between intensive and extensive indicators.
29. Coordination indicators, calculation method.
30. Likelihood indices, calculation method.
31. Indicators of the ratio, calculation method.
32. Indicators of clarity, calculation method.
33. Designation of intensive indicators.
34. Minimum absolute numbers for calculating intensive and extensive indicators.
35. Variational series: definition, characteristics.
36. Difference between simple and grouped variation series.
37. Average value: definition, types.
38. Properties of average size.
39. Mode and medicine: concept.
40. Average arithmetic: concept, types.
41. Simple arithmetic mean: concept, calculation method.
42. Weighted arithmetic mean: concept, calculation method.
43. The arithmetic mean for a grouped whole series: concept, calculation technique.
44. Criteria for the diversity of the characteristic of the variation series.
45. Limit: concept, calculation method.
46. Amplitude: concept, calculation method.
47. Definition of the concept of "authenticity".
48. Criterion of reliability (t) - formula.
49. Error of representativeness of relative and average values - concept.
50. Confidence limits of relative and average values - concept.
51. Probability of an error-free forecast (p), concept.
52. Evaluation of the reliability criterion (p) - concept.

53. Compliance criterion (X2) - concept.
54. The concept of standardization, conditions for calculating standardized coefficients.
55. Methods for calculating standardized coefficients and cases of their application.
56. The procedure for calculating the standardized coefficients by the direct method.
57. Methods for choosing a standard.
58. Determination of the time series, types and types of time series.
59. Determination of the moment and interval time series, their applications.
60. Indicators characterizing the dynamic range.
61. Absolute gain, calculation method.
62. Growth rate, calculation method.
63. Growth rate, calculation technique.
64. The value of 1% increase, calculation method.
65. Methods of smoothing the dynamic range.
66. Technique for calculating the seasonality of morbidity.
67. Types of correlation and their essence.
68. Methods for calculating the correlation coefficient.
69. Estimation of the correlation coefficient.
70. Coefficient of determination: concept.
71. Regression coefficient: concept.
72. Demography is a concept.
73. Medical demography - concept.
74. Sections of demography.
75. Population statistics - concept.
76. Population dynamics - concept.
77. Types of movement of the population and their essence.
78. General indicators of the natural movement of the population.
79. Special indicators of the vital movement of the population.
80. Fertility rates, calculation.
81. Mortality rates, calculation.
82. Indicators of natural population growth.
83. Average life expectancy - concept.
84. Fertility is a concept.
85. Marital fertility is a concept.
86. Infant mortality - concept
87. Stillbirth, calculation.
88. Antenatal mortality, calculation.
89. Intranatal mortality, calculation.
90. Postnatal or early neonatal mortality, calculation.
91. Perinatal mortality, calculation.
92. Neonatal or early infant mortality, calculation.
93. Postneonatal mortality, calculation.

94. Fetoinfantile loss index, calculation.
95. Lethality is a concept.
96. Definition of "morbidity".
97. Concepts about morbidity.
98. Proper or primary morbidity, calculation method.
99. Sickness or prevalence of the disease, calculation method.
100. Pathological affection, calculation method.
101. Methods for studying morbidity.
102. Types of morbidity by referral.
103. The difference between appeal and attendance.
104. Morbidity with temporary disability - concept.
105. List the incidence rates with temporary disability.
106. Methodology for calculating the number of cases (days) of incapacity for work per 100 workers.
107. Methodology for calculating the duration of one case of disability.
108. Disability - definition.
109. Groups of disabilities and their content.
110. Causes of disability.
111. Primary disability, calculation method.
112. General disability or the contingent of disabled people, calculation method.
113. Indicators taken to be calculated per 100.
114. Indicators accepted to calculate per 1000.
115. Indicators taken to be calculated per 10,000.
116. Indicators accepted to calculate per 100000.
117. Evidence-based medicine: definition.
118. Elements of evidence-based medicine.
119. Research methods used in evidence-based medicine.
120. Graphic images: concept, application.
121. Requirements for the construction of graphic images.
122. Types of graphic images.
123. Types of diagrams.
124. Line charts, application.
125. Bar charts, application.
126. Radial diagrams, application.
127. Cartogram - concepts.
128. Kartodiagram - concepts.

**Tickets for the module-rating survey of students on the topic
"Medical statistics"**

Ticket 1

1. Statistics, medical statistics - definitions, issues studied.
2. Stages of statistical research.

3. Types of relative values, base size.
4. The concept of a variation series and its characteristics, the difference between simple and grouped variation series.
5. Types of statistical observation, sampling method and sampling methods.

Ticket 2

1. Tasks and sections of medical statistics.
2. Content of the 1st stage of statistical research
3. Intensive indicators, their application, calculation methodology.
4. Types of medium size.
5. Types of morbidity by referral.

Ticket 3

1. Indicators of health and health care.
2. Content of the research plan (stage 2) of statistical research
3. The values of the base of intensive indicators.
4. Methods for calculating the arithmetic mean.
5. The concept of standardized indicators, methods of standardization.

Ticket 4

1. Statistical population, types, requirements for the sample,
2. Content of the research program (stage 2) of statistical research
3. Coordination index, calculation method.
4. Average error of relative values.
5. Sources of morbidity study, their characteristics.

Ticket 5

1. The essence of the third and fourth stages of statistical research.
2. Extensive indicators, coordination indicators, likelihood indicators, their application, calculation method.
3. The characteristic of the standard deviation (σ), and the method of calculation
4. Demography, medical demography: concepts.
5. Morbidity: concepts.

Ticket 6

1. The main types of errors in the analysis of material.
2. Definition of time series, types and types of time series.
3. Methods for choosing (or calculating) the standard.
4. Methods for calculating rank correlation (t).
5. Sections of demography.

Ticket 7

1. Features of social, medical and clinical and statistical research.
2. The value of the coefficient of variation (Cr), assessment criteria, calculation method
3. Types of communication between phenomena and signs and their characteristics.
4. Methods for smoothing the dynamic range.
5. Sources of morbidity study and their characteristics.

Ticket 8

1. General demographic indicators, calculation method.
2. Definition of the concept of "correlation".
3. Ways of smoothing the dynamic range.
4. Stages of statistical research.
5. Types of morbidity by referral.

Ticket 9

1. The difference between intensive and extensive indicators.
2. Essence of the error of representativeness (m).
3. Reliability of mean and relative values, confidence criterion.
4. Coefficient of determination, application and calculation method.
5. Special demographic indicators.

Ticket 10

1. Indicators of the ratio, indicators of visibility, application, calculation method.
2. Methodology for calculating the error of representativeness for mean values (m).
3. Measurement of seasonal fluctuations, the principle of calculation.
4. General medical and demographic indicators.
5. The main indicators of the overall morbidity according to the data of appealability

Ticket 11

1. Intensive indicator, calculation method.
2. The essence and technique of calculating the marginal error of the indicator (Δ - delta).
3. Compliance criterion (X₂) and its application
4. Graphic images - concepts, applications, statistical quantities used to construct graphic images.
5. The incidence rate according to medical examinations.

Ticket 12

1. The concept of regression and the regression coefficient, calculation method.
2. Methods for smoothing the dynamic range.
3. The main types of graphic images, types of diagrams.
4. Average life expectancy: concept and meaning.
5. Special types of morbidity.

Ticket 13

1. Statistics, medical statistics - definitions.
2. Infant mortality, types, calculation method.
3. The main types of graphic images, types of diagrams.
4. Special medical and demographic indicators.
5. Disability, calculation method.

Ticket 14

1. Tasks and sections of medical statistics.
2. The essence and method of calculating the marginal error of the indicator (\square - delta).
3. Indicators characterizing the time series.
4. Infant mortality rate: concept, calculation method.
5. Indicators of disability, calculation method.

Ticket 15

1. Indicators of health and health care.
2. The characteristic of the standard deviation (\square), and the method of calculation
3. Methods for calculating the arithmetic mean - formula.
4. Definition of time series, types and types of time series.
5. Groups of disabilities and their essence.

Applications

Appendix 1

Assessment of the level of fertility and mortality rates

<i>Indicator level</i>	<i>Fertility rate (in ‰)</i>	<i>Overall mortality rate (in ‰)</i>
Very low	До 10	-
Low	10-14,9	До 10
Below the average	15-19,9	-
Average	20-24,9	10-14,9
Above average	25-29,9	-
High	30-39,9	15-34,9
Very high	40 and more	25-34,9
Extremely high	-	35 and more

Appendix 2

Assessment of the level of indicators of infant mortality

<i>Infant mortality rate (in ‰)</i>	<i>Level assessment</i>
To 10	Low
10-19,9	Average
20 and more	High

Appendix 3

Calculation of the coefficient K by span (according to S.I. Ermolova)

n	0	1	2	3	4	5	6	7	8	9
0			1,13	1,69	2,06	2,33	2,53	2,70	2,85	2,97
10	3,08	3,17	3,26	3,34	3,41	3,47	3,53	3,59	3,64	3,69
20	3,73	3,78	3,82	3,86	3,90	3,93	3,96	4,00	4,03	4,06
30	4,09	4,11	4,14	4,16	4,19	4,21	4,24	4,26	4,28	4,30
40	4,32	4,34	4,36	4,38	4,40	4,42	4,43	4,45	4,47	4,48
50	4,50	4,51	4,53	4,54	4,56	4,57	4,59	4,60	4,61	4,63
60	4,64	4,65	4,66	4,68	4,69	4,70	4,71	4,72	4,73	4,74
70	4,75	4,77	4,78	4,79	4,80	4,81	4,82	4,83	4,83	4,84
80	4,85	4,86	4,87	4,88	4,89	4,90	4,91	4,91	4,92	4,93
90	4,94	4,95	4,96	4,96	4,97	4,98	4,99	4,99	5,00	5,01
n	100	200	300	400	500	600	700	800	900	1000
K	5,02	5,49	5,76	5,94	6,07	6,18	6,28	6,42	6,42	6,48

Appendix 4

Table of values of criterion t (Student's) and probability criterion error-free forecast – p

<i>Error probability (P)</i>			
<i>Number of degrees of freedom</i>	<i>0,05=95%</i>	<i>0,01=99%</i>	<i>0,001=99,9%</i>

<i>n-1</i>			
	12,7	63,6	636,6
2	3,1	5,8	12,9
3	2,7	4,6	8,6
4	2,5	4,0	6,8
5	2,4	3,7	5,9
6	2,3	3,5	5,4
7	2,3	3,3	5,1
8	2,2	3,2	4,7
9	2,2	3,1	4,6
10	2,2	3,1	4,4
11	2,2	3,0	4,3
12	2,1	3,0	4,2
13	2,1	2,9	4,1
14	2,1	2,9	4,0
15	2,1	2,9	4,0
16	2,1	2,9	4,0
17	2,1	2,8	3,9
18	2,1	2,8	3,9
19	2,0	2,8	3,8
20	2,0	2,8	3,8
21	2,0	2,8	3,8
22	2,0	2,8	3,7

23	2,0	2,8	3,7
24	2,0	2,7	3,7
25	2,0	2,7	3,7
26	2,0	2,7	3,7
27	2,0	2,7	3,6
28	2,0	2,7	3,6
29	2,0	2,7	3,6
30	2,0	2,7	3,6
00	1,9	2,5	3,2

Appendix 5

The value of the correlation coefficient (r_{xy}) by the method of squares

<i>Number of degrees of freedom n-2</i>	<i>Probability level P(in percents)</i>		
	<i>95,0</i>	<i>99,0</i>	<i>99,9</i>
1	0,99692	0,9988	0,999988
2	0,9500	0,9800	0,9990
3	0,878	0,9587	0,9911
4	0,811	0,9172	0,9741
5	0,754	0,875	0,9509
6	0,707	0,834	0,9249
7	0,666	0,798	0,898
8	0,632	0,765	0,872
9	0,602	0,735	0,847
10	0,676	0,708	0,823
11	0,553	0,684	0,801
12	0,532	0,661	0,780
13	0,514	0,641	0,760
14	0,497	0,623	0,742
15	0,482	0,606	0,725
16	0,468	0,590	0,708

17	0,456	0,575	0,693
18	0,444	0,561	0,679
19	0,433	0,549	0,665
20	0,423	0,537	0,652
25	0,381	0,487	0,597
30	0,349	0,449	0,554
35	0,325	0,418	0,519
40	0,304	0,393	0,490
45	0,288	0,372	0,465
50	0,273	0,354	0,443
60	0,250	0,325	0,408
70	0,232	0,302	0,408
80	0,217	0,283	0,357
90	0,205	0,267	0,338
100	0,195	0,254	0,321

Appendix 6

The value of the correlation coefficient of Spearman's ranks (P)

(according to V.Yu. Urbakh)

P n	0,05	0,01	P n	0,05	0,01
5	0,94	-	23	0,42	0,53
6	0,85	-	24	0,41	0,52
7	0,78	0,94	25	0,40	0,51
8	0,72	0,88	26	0,39	0,50
9	0,68	0,83	27	0,38	0,49
10	0,64	0,79	28	0,38	0,48
11	0,61	0,76	29	0,37	0,48
12	0,58	0,73	30	0,36	0,47

13	0,56	0,70	31	0,36	0,46
14	0,54	0,68	32	0,36	0,45
15	0,52	0,66	33	0,34	0,45
16	0,50	0,64	34	0,34	0,44
17	0,48	0,62	35	0,33	0,43
18	0,47	0,60	36	0,33	0,43
19	0,46	0,58	37	0,33	0,42
20	0,45	0,57	38	0,32	0,41
21	0,44	0,56	39	0,32	0,41
22	0,43	0,54	40	0,31	0,40

The correlation coefficient is insignificant at $p < 0.05$

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