KHARKIV NATIONAL MEDICAL UNIVERSITY



SOCIAL MEDICINE, PUBLIC HEALTH (BIOSTATISTICS)

Methodical developments

for teachers to conduct a practical lesson

on the topic ***“History of formation and development***

 ***of biostatistics as an independent science”***

for the preparation of students in the specialty:

– 222 “Medicine”

– 228 “Pediatrics”,

– 221 “Dentistry”.

Kharkiv

2018

MINISTRY OF PUBLIC HEALTH OF UKRAINE

KHARKIV NATIONAL MEDICAL UNIVERSITY

DEPARTMENT OF PUBLIC HEALTH AND HEALTHCARE MANAGEMENT

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*Затверджено вченою радою Харківського національного медичного університету.*

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Social medicine, public health (biostatistics) : methodical developments for teachers to conduct a practical lesson on the topic “History of formation and development of biostatistics as an independent science” for the preparation of students in the specialty 222 “Medicine”, 228 “Pediatrics, 221 “Dentistry” / V.A. Ognev, А.А. Podrpyadovа, I.A. Chukhno, G.V. Lisova. – Kharkiv : KhNMU, 2018. – 20 p.

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**GUIDELINES FOR TOPIC TRAINING**

**The aim of the class:** to learn origin of terminology in biostatistics and to study establishment and development of biostatistics as a discipline with definition of its role in the healthcare system.

**Need to know:**

* ***program questions:***
* history of origin and development of biostatistics;
* stages of Biostatistics development and their general characteristics;
* main representatives of each stage of Biostatistics development;
* contribution of Ukrainian scientists in development of Biostatistics;
* role of biostatistics in medical education and medical practitioner’s work.

**Need to be able to:**

* be guided in development of Biostatistics;
* define stages of Biostatistics formation;
* debate about scientists contribution to development of biostatistics at different stages of its formation.

**The form of classes:** independent work.

**The place of classes:** training room of department.

**Methodical equipment of class:**

* methodical guidelines to classes;
* guidance literature: student’s workbook (basis preparation);
* presentation materials;
* summary of lectures;
* tasks for test.

**The algorithm of the class:** After verifying presence of students teacher announces topic and goal of class, explains relevance of it’s study and ability to use in practice.

Using educational materials provided by teacher students learn material on their own topics and perform specified tasks. At the end of class teacher will ask student what issues have arisen in preparation of topic and helps to ensure a sufficient understanding of them. Then teacher moves to control students' knowledge on basic theory material.

*Applicable forms of control:* oral questioning of students, theoretical or problematic discussion, prompt controls on options-time to complete 5–7 minutes, daily control of theoretical knowledge – individual tasks or task for several options, including 3–4 theoretical questions (time to complete not more than 20 min.), execution of tests followed by analysis of answers.

After control of theoretical knowledge teacher makes general conclusion on studied subject, sums up control of theoretical knowledge of students, as well as announcing to students their received assessment and homework.

**Plan of the lesson timing duration of occupation percentage:**

|  |  |  |
| --- | --- | --- |
| 1 | Introduction into class | up to 5% |
| 2 | Studying of key themes and issues control of theoretical knowledge | 90% |
| 3 | Summarizing and announcement homework theoretical knowledge | up to 5% |
|  | **Total** | 100% |

**Recommended literature**

**Basis literature**

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

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

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

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

5.Лекционный курс кафедры.

**Additional literature**

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

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

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

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

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

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

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

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

**Information resources**

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

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

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

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

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

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

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

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

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

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

**BASIC THEORETICAL MATERIAL**

**FOR PREPARATION FOR THE LESSON**

**1. Statistics as a science**

Statistics has ancient and rich history as a science. Biological statistics as a scientific method of biomedicine has come a long and difficult path in its historical development. It was a way from verbal descriptions of biological objects – to their measurement, from simple statistical data and tables – to a system statistical analysis of mass phenomena in Biology and Medicine. Biostatistics wasn’t a separate science in initial stages of its formation. It has evolved over time from general statistics. It obtained right for independent existence only in the XIX century.

It must be emphasized that the first statistical studies were carried out not for the sake of science, but they had practical purpose. However, statistical methods in medicine have been used relatively recently – from the 30-ies of XX century. Statistical and quantitative approach dominated in description and analysis of the clinical events. Biostatistics has played a key role in medical research transition from the description of individual observations and series of cases to the conduction of experimental studies with control groups and large-scale randomized controlled trials. They have become new standard of the quality of the research. In the middle of the XX century deep knowledge of Biostatistics principles was not available for all medical scientists. The number of the clinical trials increased and use of statistical methods spread quickly.

**2. Origin of terminology**

“Statistics” as a term is derived from the Latin word “status”, which originally meant “certain things” or “state of things”. Then there was formed Italian word “stato” (state), and person who owned knowledge of European states, called “statista”, which means “statesman”, “an expert of state”. In the XVII – XVIII century from word “statista” was formed adjective “statisticus”, which became the basis for the name of a new scientific discipline “Country studies”. For the first time this word as a scientific term was applied in lectures of *Hermann Conring* (1606-1681). As a noun this word was described *Gottfried Achenwall* (1719–1772) in 1743 in “Notitia politica vulgo statistica”. Thus, term “statistics” was first formulated in German universities.

In 1889 English scientist *Francis Galton* (1822–1911) offered to science term “biometrics” (from Bios – life and metron – Measure). So he called new trend in biology and anthropology, associated with the use of mathematical methods in biological research. In 1899 *Hermann Ludwig Rudolph Duncker* (1874–1960) offered other title – “variative statistics” (from lat. Variato – Changing, fluctuations and status – state of things).

It can also be found in literature a term “biomathematics”, but it was renamed as “biological statistics”, which has received international recognition. Thus transformation of term “biostatistics” shows the evolution of scientific concept in the historical aspect, which was formed on the basis of biometric science and the results of its practical application.

**3**. **Stages of formation and development of Biostatistics**

It is necessary to take into account the information about history of statistics as a science in general, while exploring the history of appearance and development of the biological statistics in modern medicine.

There are 7 stages of the formation and development of biometrics:

– elementary;

– descriptive;

– defining;

– fundamental;

– formalistic;

– rationalistic;

– classical.

**The first stage of Biostatistics development (Elementary).** Statistics has ancient roots. It is characterized initially by carrying out the first population censuses, their property and lands in ancient and medieval times. These studies had great practical importance, as a rule, military or tax.

It is known that in China has been carrying out a census for this purpose 550 years BC. This is evidenced by a collection of “Shu-King”, created by Confucius. It provides information about the number of population (its distribution depending on sex, age), the land profitability, the progress of trade, etc.

It can be found an information about statistical observations in Herodotus works as well. There is data that describes different aspects of state activity.

There is also information about existence of administrative statistics in ancient Egypt.

Similar statistical surveys were conducted in ancient Greece. Greeks understood that without statistical accounting it is impossible to provide the highest level of the development of the state. The well-known reform of Lycurgus and Solomon has been carried out with the same purpose well-known. It was based on the distribution of the population into classes. There were official lists of all free-born children, those who reached 18 years of age (lists of the suitable for war) and reached 20 years (list of fully legitimate) in this historical period. The first attempt of statistical processing of the material was carried out also in Greece. In particular, *Aristotels* (384–322gg BC) gave a broad demographic description of 157 different states-cities in Greece.

In this regard, Romans also had practical structure of mind, and drew attention to the need to collect different information about population. They formed a statistical organization, so-called qualification, for this purpose introduced by *Servius Tullius* (550 BC). Organization of qualification had its own strict rules: each independent Roman citizen was obliged to inform censor his full name, community (tribe), which he belonged to, name and age of father or lord (who released him into freedom), name, sex, age of members of his families. All these data were sealed. Such qualifications were regularly held every 5 years. There were also other qualifications, such as property. Along with it there were land register started in order to recover land tax in Rome. In addition to the periodic conduct of census and inventories, Romans carried out current census as official records of birth, and later - registration of deaths.

We have much less information about statistical observations from Middle Ages than from ancient times. Because fragmentation of states which existied at the time limited the development of statistics. At the same time Charlemagne wrote popular statistical work “Breviaris rerum fiscalium”. It contained a detailed description of the royal and feudal estates (buildings, land, profitability, working cattle, etc.). Such accounting was established by William the Conqueror in England (between 1083 and 1086 gg.), known as “Doomsday-Book”. Noteworthy is the fact that clergy played an important role in the development of the social and demographic statistics. Churches traditionally held a regular account of burial, baptism and marriage. Certain statistical analyzes were performed in ancient Rus. In the XIII century, a population census was carried out twice by Tatars and at the end of the XIV century – Russian princes.

In the Middle Ages, a special attention was paid to a certain systematization of statistical material. In particular, there were collections of demographic descriptions of modern states in Italy in the fifteenth century (collection Piccolomini – later – Pope Pius II, a collection of Sansovino). Last collection withstood 5 editions and had a great popularity for 40 years, it has been translated into many languages.

It should be noted that all of these statistical studies were unsystematic on methodology and content, uncomfortable, and from scientific point of view, had little value, so it is not possible to call them scientific in modern sense and to talk about statistics as a science.

**The second stage of development of Biostatistics (descriptive).** At this stage of statistics development, events, traditions, customs were described in words.

Methods of descriptive statistics stay relevant even today, since many biological researches have clearly expressed descriptive character. Thus, plants and animals are characterized by their shape, size, color, behavior, prevalence, similarity to other organisms or their difference in the same way as many years ago. Such description has mainly had verbal character in its simplest form.

Descriptive statistics as science of country studies originated in Germany. German researchers raised studies of the country from a simple description states to the level of true science by developing a method. They suggested it as a compulsory university teaching.

Representatives of descriptive school statistics were German scientists *Hermann Conring* (1606–1681) and *Gottfried Achenwall*, (1719–1772). Hermann Conring – polyhystorian famous German doctor, historian, political scientist, was a professor of Medicine and Politics (1636). He obtained medical education at University of Leiden (the Netherlands).

Exactly H. Conring in the second half of the XVII and early XVIIІ century, formed from word statista adjective statisticus, which became basis for formation of a new scientific discipline called country studies – which refers to statistics. G. Konring formulated a goal of his lectures on country studies – to teach politicians to understand the causes of important state events:

– material description of state;

– political structure;

– state welfare;

– administration.

Conring preached doctrine of Harvey on blood circulation, struggled with alchemists and Hermetic treatments, as well as emphasized importance of chemistry for pharmacy.

*Gotfrit Ahenval* for the first time after H. Conring suggested word “statistica” in its modern sense. It was common phrase “disciplina statistica” – statistical discipline at that time in Germany. In 1746, he continued to teach discipline, which had name “Statistics – country studies” at Marburg and Göttingen Universities.

Comparing Conring H. and G. Ahenval roles in statistical development, the advantage should be given to H. Conring, though his works were less known and available, because they were published in Latin, 50 years after his death. G. Ahenval published his works in German and this predisposed a large circle of readers. But G. Ahenval merit lies in fact that he was the first to introduce the term statistics and made it popular.

**The third stage of development of Biostatistics (defining).** This period related to use of quantitative data for description of states. This became a basis for formation of a new trend in overall statistics – mathematical statistics or political arithmetic. The cradle of Mathematics Statistics and probability theory in the seventeenth century became advanced countries with merchant capital and manufacture – England, Holland, France.

Far in 1662 English merchant, then Lord - Mayor of London *John Graunt* (1622–1674) published in London his famous book “Natural and political observations of dead lists in London”. In this work, D. Graunt first determined that boys are born more often than girls, using data from church records of newborns and dead. Also the age of population mortality was analyzed. At the same time attention was drown to the high mortality rate of children under the age of 6 years, which accounted for 36% of mortality. In his demographic paper the role of diseases in population mortality was described. At the same time, it was pointed out that London's population grew due to migration processes, as the mortality rate at that time exceeded the birth rate. Thus, D. Graunt first showed specific demographic patterns of population recovery. His works regarding to demographic problems withstood several reprints and had great success.

*William Petty* is an another representative of this trend (1623–1687). In his famous work “Several Essays in Political Arithmetic” (“The experience of political arithmetic”), he gave a new name of Statistics directions – political arithmetic, where the methodology of D. Graunt was used. Work of W. Petty was a first attempt to give a consistently reasonable resolution of common problems of economy with the help of statistics. Unlike D. Graunt, W. Petty widely used numbers and different methods of calculation. William Petty, in particular, has collected a large statistical material about important European countries. Quantitative characteristics of socio-demographic phenomena of each state lied at the center of D. Graunt and William Petty works. “I choose, - said William Petty, - the language of numbers, measures and weight ... taking into account only those factors that are obviously based only on the nature of things, as opposite to others who depend on changeable thoughts, inclinations and preferences of individuals”. Social phenomena characterizing the life of each state were the subject of their statistical studies. Statistics continued to develop in the writings of scientists F. Galton, Pearson, R. Fisher, W. Gosset and etc.

**The fourth stage of development of Biostatistics (fundamental).** This stage began to form in the middle of the XIX century. It was marked by the works of Belgian astronomer, mathematics, physics and statistics *Lombre Adolphe Jacques Quetelet* (1796–1874). Exactly his works laid foundations of biometrics science. A. Quetelet has played a significant role in development of statistics, he called Statistics a queen of all sciences, and he is considered a father of modern statistics. In his «Letters about theory of probability» a scientist widely developed practical application of theory of probability with respect to social sciences, primarily with respect to study of socio-demographic events. A. Quetelet was the first who combined methods of anthropology and social statistics with conclusions of probability theory and mathematical statistics. In 1835 he published his work “About man and development of his abilities, experience, or social physics” (2nd ed. 1869), where he showed that different physical characteristics of a person, including behavioral, obey to law of probability distribution. In another work “About social system and laws that govern it” (1848), he described a society not as a collection of people, but as separately taken system, which is totally dependent on laws of nature and is not subjected to the will of population. In 1871, A. Quetelet published following work “Anthropology”, which proved that statistical regularities significantly affect not only the human society, but also all living things. Thus, foundations of biological statistics were laid by A. Quetelet. They have received independent development, especially in English school of biometrics.

A. Quetelet put forward the theory of average person, which is a kind of statistical projection. It combines physical, intellectual and moral qualities. It's kind of type of person of any country. The average person, in his opinion – is a center around which all social phenomena are formed. A. Quetelet indicated that identify patterns that occur in society possible only based on statistical observations of mass. In this case, the effect of random variables will disappear. He proposed to introduce a special value received per unit to measure a large number of observations. This standardized value became the average value. A criminal, moral and biological statistics was successfully formed through his work.

**The fifth stage of Biostatistics (formalistic).** It is characterized by formation and development of English biometrical school. The use of statistics in biology developed in the XIX century. The leading role in it played, first of all, the English school of biologists *Francis Galton* and *Karl Pearson*. This school was influenced by Charles Darwin’s work (1808–1882) «Origin of Species» (1859), which has made a revolution in biological sciences. It should be noticed that Reaumur tried to find the mathematical laws of building bee honeycombs back in the XVIII century. And 30 years before Reaumur Borelli had made mathematical calculations of the movement of animals. But the quantitative analysis of wildlife phenomena using mathematical methods became real only at the end of the XIX century. Thus, in biology, statistical methods started to be used purposefully much more later than in physics and chemistry. Biology had been developing on the basis of a qualitative analysis of nature phenomena for a long time.

Transition in biology from descriptive method to experiment served a serious rise to biological statistics as a scientific methodology. Because an experiment needed to have objectively compared quantitative characteristics. The obligatory recognition of the fact that many biological phenomena inherent clearly expressed statistical regularities is also an important factor. *Francis Galton* (1822–1911), was a cousin of Charles Darwin, and participated in discussion of Darwin’s research results. A. Quetelet’s work gave F. Galton's a strong impression. Especially “Social physics” and “Anthropology”, which was the basis for the first time using of statistical methods in the study of human heredity. F. Galton has published several works on anthropology and genetics since 1865. He confirmed A. Quetelet’s conclusion that not only the physical but also the mental abilities of a man are distributed according to the law of probability, described by the formula of the Laplace-Gauss. Thus, he instilled in a British biologists interested in statistical methods.

Another representative of British biological statistics was *Carl Pearson* (1858–1936), University of London professor (Head of Department of Applied Mathematics and Mechanics). He has founded a scientific school of biology for developing questions using statistical method. Pearson has shown himself as a talented mathematician and statistician. He united students, who continued his research in various fields of science. He successfully studied problems of heredity and variation of organisms. Pearson published magazine “Biometrica” (1901) to promote his ideas, especially for statistical study of biological processes. He remained an editor of this magazine until the last days of his life. Developed by F. Galton and Karl Pearson biometric techniques entered to golden fund of mathematical statistics. However, attempts to solve problems of heredity organisms only by means of a statistical method proved unsuccessful. They had mistakenly thoughts that the extent of relatives’ relationship could be judged on the resemblance between them. Not taking into account the errors, Francis Galton and Karl Pearson were founders of new school statistics – biometrics (in modern terminology – of biostatistics) on combination of their ideas, attitudes, approaches.

**The sixth stage of the formation of biological statistics (rationalist).** It started in the 1902 with classic studies of *Wilhelm Ludvig Johannsen* (1857–1927). He showed that the first place in the field of biomedical research should belong to biological experiment, not to mathematics. He believed that mathematical methods must be used as an auxiliary device in systemic treatment of experimental data. He reached this conclusion experimenting over beans. Otherwise obtained results can twist real picture and lead to errors. Mathematics should provide targeted assistance, and not being served as a guiding idea.

**The seventh stage in the development of biometrics (classical).** It wasformed by Englishmen William Sealy Gosset and Ronald Fisher works. *William Sealy Gosset* (1876–1937) was a disciple of Carl Pearson. He has been published in magazine “Biometrics” (1908) under the pseudonym Student. The work was dedicated to small sample theory. V. Gosset (Student) was a pioneer in this field. The foundations of small sampling theory, experimental design theory were created then and introduced into content of biometrics.

*Ronald Aylmer Fisher* (1890–1962) is the famous scientist of the XX century in Biostatistics area. He made an enormous contribution to biometrics, enriching it with new methods of statistical analysis. Mr. Fischer was born and lived in England. R. Fischer was noted for his work in mathematical statistics, he enriched evolutionary genetics. His first book, “The genetic theory of natural selection” (1930) was devoted to synthesis of Darwin's theory of selection and genetics. Fisher’s theoretical and practical contributions to genetics are huge. He put forward concept of progressive selection and inbreeding, tried to unify doctrine of evolution. G. Fischer productively worked from 1912 to 1962. Much of his research had a positive impact on development of statistics, including the biological. For a long time, R. Fisher worked as a researcher at the Rothamsted agricultural research station, and since 1933 – as a professor of Applied Mathematics Department at London University. Later (1943–1957) Robert Fisher became Head of Genetics Department at Cambridge. Successfully combining biologist experimenter and mathematics-statistics, Fisher brought in biometrics not only new methods and new ideas. He laid the foundations of design of experiments theory. In our time it has been further developed and became an independent section of biometrics. All these innovations are associated with revolution in biology, with destruction of outdated principles and concepts in the field of research, with strengthening of process of mathematization in biology. More remarkable specialization of biometrics is happening as well as targeted use of its methods in different branches of biology, medicine, anthropology, and other neighboring sciences.

**4. The contribution
of Ukrainian scientists to the development of Biostatistics**

Considering the history of biometrics, it should be noted the great contribution in the development of biological statistics, which is made by such Ukrainian scientists as A.V. Korchak-Chepurkovsky, S.G. Igumnov, S.A. Tomilin A.M. Merkov, E.G. Kagan, S.S. Kagan, I.I. Ovsiyenko, K.F. Duplenko, O.Y. Belitskaya, L.G. Lekarev, P.T. Petrov, S.M. Ekel, L.S. Kaminskiy and many others.

*O.V. Korchak-Chepurkovsky* (1857–1947) was an outstanding Ukrainian scientist, epidemiologist, hygienist, head of the Institute of Demography and Health Statistics. The main directions of his research were related to the problems of epidemiology and public health.

He highlighted the epidemiology as a separate scientific discipline based on his experience as sanitary doctor and taking into account the scientific developments of that time. He devoted a major role to “epidemic issues on the system study of public health”, according to the time and nature of development epidemics of smallpox, scarlet fever, diphtheria and the risk of plague in Moldova. According to Korchak-Chepurkovsky, epidemiological problem must be solved as components of the sanitary condition. O.V. Korchak-Chepurkovsky combined practical work with teaching. He gave lectures on epidemiology and health statistics at the St. Vladimir University.

*S.A. Tomilin* (1877–1952) is an outstanding Ukrainian social hygienist, health statistics, demographer, historian of medicine, herbalist. His scientific heritage is many works about social hygiene, health statistics, demography, epidemiology, history of medicine and herbal medicine. S.A. Tomilin researched problem of birth, marriage and family, public health and medical care improving, the problems of morbidity and mortality, the social aspects of human genetics. S.A. Tomilin is the first doctor-statistic who was the head of the Department of Statistics in Ukraine in 1918 and 1922–1930, he laid the organizational and methodological principles of its formation and development. He was the organizer of the departmental health statistics in Ukraine. He took the most active part in the development of its methodological principles and in series of sanitary-statistical research.

*A.M. Merkov* (1899–1971) was a famous national statistic, a specialist in social hygiene, and medical demography. He started his work in Kharkiv, and later worked in Russia. A big number of his works were devoted to questions of theory, methodology and history of health statistics, also it was the main theme of his scientific work. A.M. Merkov was very knowledgeable and talented teacher. Participants of his course – doctors of different specialties had skepticism to “dry and boring” subjects like health statistics, but due to his brilliant lectures they have changed their attitude to the subject. And many of them became his disciples and followers. Demographic statistics was an independent scientific direction of Merkov’s work. He wrote over 200 papers about the problems of social hygiene, health statistics, public health and demography, including 20 monographs and textbooks. The teaching of medical statistics was conducting as a kind of biological statistics at the higher medical school for many years. A great work in the sphere of higher education reforming, improving curricula, teaching technology, introducing new disciplines is undergoing today. Most of the work in this direction is conducted by well-known experts in the field of social medicine, public health and Health Organization, especially in its formation as a teaching discipline in the higher medical school. Among them were corresponding members of National Academy of Sciences of Ukraine prof. V.F. Moskalenko, prof. Y. Voronenko, prof. V.M. Ponomarenko.

Publishing of the first Ukrainian specialized books had played an important role in the development of biostatistics as a science. Most of them were prepared by scientists of Kharkiv Medical Institute: “Working medical statistics” (E.G. Kagan, 1923), “Mortality in Russia and in Ukraine” (M.V . Ptuha, 1928), «The General theory of health statistics» (A.M. Merkov, 1935), “Practical work on health statistics” (L.A. Abramovich, Mikhail Kaminsky, P.T. Petrov, 1940), “General theory and Methods of sanitary-statistical research” (A.M. Merkov, 1960, 1963), “Demographic statistics” (A.M. Merkov, 1959, 1965), “Treatment of clinical and laboratory data (using statistics in medical work )” (L.S. Kaminski, 1959, 1964) and others.

Thus, the historical development of biological statistics shows that in Ukraine this field needs to be improved and developed, taking into account the latest achievements in science and reform of health and higher education. Undoubtedly, biostatistics must take an appropriate place in the biological and medical science as well as in programs of university education, taking into account the prospects of Ukraine's entry into the single European scientific and educational space.

**TEST TASKS**

|  |  |
| --- | --- |
| 1. | The course “Foundations of Social Hygiene and Public Health” was opened in 1906, at Kyiv University. It had a great importance for the development of social care in Ukraine. Who was the teacher of this course? |
|  | \*A | A.V. Korchak-Chepurkovsky |
|  | B | A.M. Merkov |
|  | C | S. Kagan |
|  | D | S.A. Tomilin |
|  | E | S.M. Igumnov |
| 2. | The first Ukrainian textbooks on social hygiene had a great contribution to the development of the social care in Ukraine in the 30 years of the XX century. Among them was the first textbook of S. Kagan, published in 1932. Specify the title of this textbook: |
|  | A | All answers are correct |
|  | B | Practicum on health statistics |
|  | \*C | Social hygiene theory  |
|  | D | Social Hygiene |
|  | E | The general theory of health statistics |
| 3. | Statistics has ancient roots. There is some evidence that the population census was conducted in ancient China, but the research had a haphazard, chaotic character. Specify in what century statistics became an independent science: |
|  | A | XVI century |
|  | \*B | XVII century |
|  | C | XVIII century |
|  | D | XIX century |
|  | E | XX century |
| 4. | Statistics as an independent science began forming in the XVII century. The important role in its formation had German researchers G. Konring and G. Ahenval. What direction in statistics was founded by them? |
|  | A | Common Statistics |
|  | \*B | Descriptive |
|  | C | Mathematical |
|  | D | Medical Statistics |
|  | E | Political arithmetic |
| 5. | Statistics as an independent science began to form in the second half of the XVII century, at the same time it was divided into two directions, one of which was founded in England. What direction in statistics was formed in England? |
|  | A | Descriptive |
|  | B | Economic statistics |
|  | C | General statistic |
|  | \*D | Mathematical |
|  | E | Medical statistics |
| 6. | Statistics as an independent science began to form in the second half of the XVII century, at the same time it was divided into two directions: a descriptive and mathematical (political arithmetic). Specify the founder of the school of mathematical statistics:  |
|  | \*A | G. Ahenval |
|  | B | G. Konring |
|  | C | F. Galton |
|  | D | F. Osterlen |
|  | E | V. Petty |
| 7. | Statistics as an independent science began to form in the second half of the XVII century, at the same time it was divided into two directions: a descriptive and mathematical (political arithmetic). Specify the founder of the school of mathematical statistics: |
|  | A | G. Ahenval |
|  | B | G. Konring |
|  | C | F. Galton |
|  | D | F. Osterlen |
|  | \*E | V. Petty |
| 8. | In medicine and biology, mathematical methods began to be used considerably later than in physics and chemistry. Medicine and biology developed only on the basis of a qualitative analysis of phenomena. And only at the end of the XIX century have been developed foundations of a new science - biometrics (biostatistics). Who was the founder of this science? |
|  | A | G. Ahenval |
|  | B | J. Graunt |
|  | \*C | F. Galton |
|  | D | V. Petty |
|  | E | Y. Bernoulli |
| 9. | The first statistical research carried out not for the science, but for practical purposes, most often for determining military and tax population abilities. There is some evidence about holding the first statistical research in China, ancient Egypt and ancient Greece. It should be noted that all statistical researches at that time were haphazard and disordered, so we cannot call them science in the modern sense. Identify stage of Biostatistics development which is characterized by these features |
|  | A | Defining |
|  | B | Descriptive |
|  | C | Fundamental |
|  | \*D | Initial |
|  | E | Rationalistic |
| 10. | Statistic, as the science of country studies, appeared in Germany at the end of XVII - beginning of XVIII century. The founder of this statistic was German scientist G. Konring. He introduced the series of lectures on country studies. Later G. Ahenval continued to develop this direction. Identify stage of development of Biostatistics, which is characterized by the features mentioned above. |
|  | A | Classical |
|  | B | Defining |
|  | \*C | Descriptive |
|  | D | Fundamental |
|  | E | Rationalistic |
| 11. | At the end of XVII - beginning of the XIX century, the development of biostatistics has been associated with the use of quantitative data to describe the states that led to the formation of a new direction in the overall statistics, – mathematical statistics. The main representatives of this direction were John Graunt, William Petty, Edmond Halley, Jacob Bernoulli. Identify stage of development of Biostatistics, which is characterized by the features mentioned above. |
|  | A | Classical |
|  | \*B | Defining |
|  | C | Descriptive |
|  | D | Fundamental |
|  | E | Rationalistic |
| 12. | The middle of the XVIII century was marked by the works of the Belgian astronomer, mathematics, physics and statistics Lambert Adolphe Jacques Quetelet, who was the first to combine the methods of anthropology and social statistics with the conclusions of the theory of probability and mathematical statistics. His work became the basis for the development of biostatistics. Identify stage of Biostatistics development which is characterized by these features. |
|  | A | Classical |
|  | B | Descriptive |
|  | C | Defining |
|  | \*D | Fundamental |
|  | E | Rationalistic |
| 13. | The middle of XIX - early XX century is characterized by the emergence and development of the English biometrical school. Exactly in this century, the use of statistics to biology has developed significantly. The leading role belonged to the English school of biologists Francis Galton and Karl Pearson, who revolutionized biological science. Identify stage of Biostatistics development which is characterized by these features |
|  | A | Classical |
|  | B | Defining |
|  | C | Descriptive |
|  | \*D | Formalistic |
|  | E | Fundamental |
| 14. | In the middle of the XX century B. Yogansen held a classic research, which showed that in the field of biological research first place should belong to the biological experiment, not mathematics. Mathematical methods should be used as an auxiliary device in the processing of experimental data. It was a new, realistic approach in biological research. Identify stage of Biostatistics development which is characterized by these features |
|  | A | Classical |
|  | B | Defining |
|  | C | Descriptive |
|  | D | Fundamental |
|  | \*E | Rationalistic |
| 15. | In the middle of the XX century the development of biometrics was contributed by scientific work of British scientists V. Gosset and R. Fischer, They became the founders of a small sample theory, the theory of planning experiments, introduced the contents of biometrics new terms and concepts. R. Fischer proved that biometrics was the science with the statistical analysis of mass phenomena in biology. Identify stage of development of Biostatistics, which is characterized by the features mentioned above. |
|  | \*A | Classical |
|  | B | Defining |
|  | C | Descriptive |
|  | D | Fundamental |
|  | E | Rationalistic |

**CONTROL QUESTIONS**

1. The origin of the term “biostatistics”.

2. Development of Statistics in ancient Greece.

3. What are the stages of Biostatistics now?

4. What are the main characteristics of the first phase of the biostatistics formation?

5. What are the main characteristics of the period the descriptive statistics development?

6. What is the contribution of Ahenval G. and G. Konring to the development of biostatistics?

7. What are the main characteristics of definitive stage in the development of biostatistics?

8. John Graunt's contribution in the development of biostatistics.

9. Give a general characteristic of the main stage of development of biostatistics.

10. Give a general characteristic of formalist stage of Biostatistics

11. A. Quetelet contribution to the development of biostatistics.

12. Who are the representatives of the main stage classical of development of biostatistics?

13. Contribution of G. Fischer in the development of biostatistics.

14. Who are the Ukrainian scientists participated in the development of biostatistics?

15. Name of the first Ukrainian textbooks about biostatistics.

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*Educational publication*

**SOCIAL MEDICINE, PUBLIC HEALTH**

**(BIOSTATISTICS)**

Methodical developments for teachers
to conduct a practical lesson on the topic :

***“History of formation and development of biostatistics as an independent science”***

for the preparation of students in the specialty:

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

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