"APPROVED"
Depute Head
(vice-rector for scientific and pedagogical work)

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M. V. Afanasiev

DATA VISUALIZATION AND VISUAL ANALYTICS
syllabus of the discipline

Area of Education	**all**
Speciality	**all**
Educational level	**second (master's)**
Educational program	**all**

Type of discipline	**selective**
Language of teaching, training and evaluation	**English**

Head of department of statistics and
economic forecasting   O. Rayevnyeva

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The syllabus has been approved by the Department of Statistics and Economic Forecasting

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**Letter of renewal and re-approval of the syllabus
of the academic discipline**

Academic year	Date of the session of the department -developer of syllabus	Protocol number	The signature of the head of the department

Annotation of the discipline

The field of visualization of information was the result of research on the interaction between man and computer, computer science, graphs, design, psychology and business methods. It is increasingly used as the most important component of research, digital libraries, for intellectual and financial data analysis, market research, production control, and more. Visualization of information is aimed at creating new and more visible approaches to the transmission of abstract information in intuitive ways.

One of the most pressing challenges faced by leading companies today is the processing and analysis of large volumes of structured and unstructured data in order to improve the quality of business decisions made. Data analysis is an integral part of all applied research and problem solving in the economy. Among the most fundamental approaches to data analysis, a special focus is given to visualization of information, or, in other words, visual analysis of data, which relies mainly on cognitive skills of analysts, and also contributes to the disclosure of unstructured effective ideas that are limited only by human imagination and creativity. The analyst must apply various sophisticated techniques in order to be able to interpret any socioeconomic process through data visualization.

Visual analysis is a fast-growing, promising area that combines the benefits of graphical visualization and the power of analytical computing when working with large masses of digital information. Data visualization allows you to identify patterns, trends, and correlations that may otherwise remain unnoticed in traditional reports or spreadsheets.

The discipline "Data visualization and visual analytics" is a selective discipline of the second (master's) level and its mastering will allow to use modern analytical tools and infographics for the analysis of complex, mass social and economic phenomena and processes. Students will learn to make informed decisions based on pre-processing data and their interactive visualization.

The object of the discipline is business processes and phenomena.

The subject of the discipline is theoretical and practical questions regarding the economic interpretation of the results of the analysis of business processes and their interactive visualization on the basis of the use of modern analytical methods and tools of infographics.

Purpose of the discipline: there is expansion and deepening of theoretical knowledge and acquisition of professional competences in the field of visual analytics of business processes and making effective decisions using analytical methods and data visualization tools.

Course	**1M**
Semester	**1,2**
Number of ECTS credits	**5**
Form of final control	**test**

Structural-logical scheme of studying the discipline:

Prerequisites	Post requisites
Economic theory	Business analytics
Microeconomics	Trainings
Macroeconomics	Writing of master's diploma works
Computer Science	
Statistics	

Competence and outcomes of studying in a discipline:

Competence	Results of studying
Ability to acquire theoretical knowledge on data visualization and to acquire the skills of formation of information space of research	- Ability to navigate the information space in order to create a qualitative information base of the study - Ability to conduct a primary analysis of the information space of research; - Ability to prepare information for processing by modern methods of business analytics
Ability of rational use of modern data visualization tools	- Ability to rational use of the tool base of business analysis for solving specific business tasks; - Get a view through the info design
Ability to use methods of analytical data processing and trend detection	- Understanding the essence of solvable tasks using analytical data processing methods; - Ability to model the interconnections between economic processes and phenomena; - Ability to choose analytical and expert methods of information processing under conditions of changing information environment
Ability to qualitative presentation of the results of analytical research for their further effective use	- Ability to visualize the results of analysis of business processes; - Ability to use tools of infographics rationally; - Ability to compile analytical reports.

Program of the academic discipline

Content module 1. The theoretical basis for data visualization

Topic 1. Visual information in the information society
1.1. Task, process and result of visualization. Use rendering to find ideas.
1.2. Stages of data visualization.
1.3. Graphics Grammar.
1.4. Basic principles of data visualization.
1.5. Types of visualization for different types of data. A table, a sparkline, a chart with columns, a circular diagram, a thermal map. scatter card, cartogram, graph, memory card.
1.6. Standard visualization errors. Examples of visualization. Detection and correction of errors.
Laboratory work 1 "Formation of information space for visualization. Overview of sources of information. Visualization of data in MS Excel".
Task 1. To acquire the skills of searching for information in accordance with the purpose of the study.
Task 2. To get acquainted with domestic and foreign sources of statistical information and to form an informational space on the chosen research topic.
Task 3. To acquire the skills of visualization of statistical information using MS Excel and to learn to graphically present statistical data using the MS Excel charts wizard. To master the

skills of using conditional formatting and sparklines.

Topic 2. Modern data visualization tools. Infodesign

2.1. Overview of tools that do not require programming to visualize data. The main advantages and disadvantages of data visualization tools. Areas of their use and types of tasks.

2.2. An overview of tools that require programming to visualize data. Graphical libraries, packages and their capabilities. The main advantages and disadvantages of tools. Areas of use and types of tasks.

2.3. Fundamentals of Infodesign. Typography, Applied Linguistics, Applied ergonomics, Graphic Design, Applied Psychology.

2.4. Selection of preparatory visual attributes.

2.5. Recommendations for choosing color palettes.

Laboratory work 2 "Visualization of text information. Building mental maps".

Task 1. To acquire the skills of constructing mental maps.

Task 2. To get acquainted with the software products for the construction of mental maps and to create a mental map of the research object.

Content module 2. Using modern methods of analytical data processing

Topic 3. Planning, collecting and preparing data for visualization. Methods of collecting analytical information

3.1. Stages of data planning and analysis. Research hypothesis formulation. Determination of testing hypotheses. The choice of statistical methods for testing the hypothesis.

3.2. Methods of data collection. Overview of the main methods of data collection and their application. Advantages and disadvantages of data collection methods.

3.3. Analytical information. Her species. Overview of sources of analytical information and rules for its visualization.

Laboratory work 3. Infodesign: features and possibilities of use in analytics.

Task 1. To acquire skills of visualization of data using cartographic tools.

Task 2. Using the software application Datawrapper to build two types of cards (Choropleth and Symbol) according to the chosen topic of research.

Theme 4. Basics of business analytics. Basic methods for processing digital information.

4.1. Analytical methods of data processing. Methods of modeling and forecasting.

4.2. Expert methods of data processing. Delphi method. Method of risk assessment. The method of "scenarios". The method of "brainstorming". Business games. SWOT analysis.

4.3. Features, limitations and recommendations for using analytical and expert methods of business analytics.

Laboratory work 4 "Analytical and expert methods of digital information processing".

Task 1. To get acquainted with the basics of business analysis, to get practical skills of using analytical and expert methods of data analysis

Task 2. To learn to apply analytical methods of processing digital information in accordance with the available data and to master the foundations of digital information visualization.

Task 3. To learn to apply expert methods of processing digital information according to available data.

Topic 5. Economic interpretation of visual analysis of data. Preparation of reports.

5.1. Analysis of socio-economic data. The main features of socio-economic data. Task and purpose of the analysis of socio-economic data.

5.2. Non-traditional sources of social and economic data. Types of data sources.

5.3 Types of reports. Different Types of Analytical Reports. Formation of the structure of the report. The purpose of the report is to match the characteristics of the target audience.

5.4. Develop a single style of analytical report. Reports of international organizations.

Laboratory work 5 "Analytical report: structure and features of construction".

Task 1. To get acquainted with the rules of the preparation of the analytical report, to get knowledge about the structure and main elements of the analytical report

Task 2: Make an analytical report on the study of the chosen industry (sphere) of the economy.

Teaching and learning methods

When teaching the discipline "Data Visualization and Visual Analytics" to enhance the educational and cognitive activities of students provides for the use of such educational technologies as problem lectures; case method; presentations; self-esteem; visual support banks.

Teaching and learning methods those contribute to the achievement of expected learning outcomes

Methods of activating the learning process	Practical application of educational technologies
Problem lectures and discussions	Problem lecture on "The place and role of visual analytics in the modern economy" (topic 1)
	Problem lecture on "Problems of forming an information base for business process research" (topic 3)
	Problem lecture on "Criteria for choosing sources of information" (topic 3)
	Discussion on the topic: "Advantages and disadvantages of using modern methods of digital information processing" (topic 4)
	Problem lecture on "Expert methods of data visualization" (topic 4)
Case study	Discussion of features of practical use of various tools of data visualization according to tasks of the analyst.
	Discussion of features of infodesign and bases of its use in analytical work
Individual and group projects	Implementation of group projects to identify the advantages and disadvantages of using specialized applications, online resources, and software products for data visualization
	Preparation and defense of individual research work (IRW)
Presentations	Demonstration and discussion of the results of laboratory work and theoretical preparation for their implementation
	Demonstration and discussion of the results of independent preparation of IDPs
Banks of visual support	Presentation of lecture material using PowerPoint
	Presentation of stages of performing laboratory works

The order of assessment of the results of training

The system of assessment of formed competencies in students takes into account the types of classes, which following the curriculum of the discipline include lectures, laboratory classes, as well as independent work. Assessment of the formed competencies of students is carried out according to the accumulative 100-point system. Control measures include:

current control, which is carried out during the semester during lectures, laboratory classes and is estimated by the number of accumulated points (maximum amount - 100 points; the minimum amount that allows a student to get credit - 60 points);

modular control, conducted in the form of a colloquium as an intermediate mini-exam at the initiative of the teacher, taking into account the current control for the relevant content module and aims at an integrated assessment of student learning outcomes after studying material from the logically completed part of the discipline - content module;

final / semester control, which is carried out in the form of a test, according to the schedule of the educational process.

The test is set as the total amount of points scored on the results of the current control.

The current control of this discipline is carried out in the following forms:
1. Active work in lectures;
2. Protection of laboratory work;
3. Homework protection;
4. Conducting current testing;
5. Protection of IRW.

The work for the lecture is evaluated in 2 points, from them:
0.5 points - attendance at lectures;
1.5 points - active participation in the discussion, answers to the lecturer's questions.

Laboratory work is estimated at 4 points, of which:
1 point - the correctness of the answers on the topic of work. The teacher orally tests the student's theoretical knowledge on the topic and practical skills of their use;
1.5 points - knowledge of software products and computer technology for analytical and visual data processing. The student must know the basic modules of applications used in laboratory work, be able to interpret the results of calculations and features of construction of different types of infographics in them.
1 point - work with Internet resources and selection of statistical data. The student must independently and correctly choose statistics for laboratory work, be able to interpret the results of calculations by the selected object of study.
0.5 points - high-quality report on laboratory work.

When evaluating the performance of laboratory work, attention is also paid to the quality, independence, and timeliness of delivery of completed tasks to the teacher (according to the schedule of the educational process). In case of late delivery, the score is 70% of the result.

The test task contains 15 questions to test the knowledge of the main categories of the discipline depending on the topic. The test task is evaluated in 3 points, from them:
25% of correct answers - 0.75 points;
50% correct answers - 1.5 points;
75% of correct answers - 2.25 points;
100% correct answers - 3 points.

Homework is estimated at 2 points:
1 point - the presence of insignificant errors in the calculations, lack of economic

interpretation, non-performance of some elements of the task, or late performance;

2 points - in the case of a correct solution of the problem, ie full implementation of all elements of the problem, the correct use of statistical information and appropriate means of data visualization, the availability of economic interpretation of the results of calculations.

In the case of late homework, the score is 70% of the result.

The final control of knowledge and competences of students in the academic discipline "Visualization of data and visual analytics" is carried out in the form of protection of an individual research work (IRW). The IRW covers the program of discipline and involves determining the level of knowledge and the degree of mastery of competences by students.

Each student chooses a field of study forms an information space and defines methods (techniques, methods) for processing digital information. The result of the implementation of the IRW is the preparation of an analytical report and its protection. The IRW is rated by 17 points out of them:

1 – 3 points - only the informational space of research is formed;

4 – 6 points - the correct information base has been formed, the justification and rational use of modern methods of business analytics and data visualization have been provided;

7 – 10 points - the information base has been correctly formed, the justification and rational use of modern methods of business analytics and data visualization have been provided, but some elements of infographics and information design are inaccurate;

11 – 15 points - the information base has been correctly formed, the justification and rational use of modern methods of business analytics and data visualization have been provided; however, there is no economic interpretation of the results of the analysis;

16 – 17 points - the analytical report has been prepared methodically correct, the sustained structure, the information base has been correctly formed, the justification and rational use of modern methods of business analytics and data visualization are provided, and the economic interpretation of the results of the analysis is correct.

The task of the IRW is to test the student's understanding of the program material in general, the logic and interrelations between the individual sections, the ability to use the accumulated knowledge creatively, the ability to formulate their attitude to a particular problem of academic discipline, etc. In the conditions of the implementation of the competent approach, the IRW assesses the level of mastering the competences provided by the qualification requirements.

The general criteria for evaluating non-auditing independent work of students are: the depth and strength of knowledge, the level of thinking, the ability to systematize knowledge on specific topics, the ability to make sound conclusions, the possession of categorical apparatus, skills and techniques for the implementation of practical tasks, the ability to find the necessary information, carry out its systematization and processing, self-realization on laboratory works.

The student can't be admitted to the assembly offset if the number of points obtained in the audit progress during the current control according to the semantic module throughout the semester, the amount has not reached 60 points. After the exam session, the dean of the faculty issues an order to liquidate academic debt. In due time the student gets score points.

Student should be considered qualified if the sum of points obtained by the results of final / semester verify performance, equal to or greater than 60. The minimum number of points for the current and the control module during the semester is 60, and the maximum - 100 points.

Forms of assessment and distribution of points are given in the table "Rating-plan of the discipline".

Rating plan of the discipline

Topic	Forms and types of education		Forms of assessing	Maximum score
	Content module 1. The theoretical basis for data visualization			
Topic 1.	*Classroom work*			
	Lecture	Problem lecture: "Visual information in the information society"	Work on lectures	4
	Laboratory lesson	Laboratory work 1.1. Formation of information space for visualization. Overview of information sources. Choice of an area (sphere) of research. Laboratory work 1. 2. Visualization of data in MS Excel.	Active participation in the performance of tasks and defense of the report of laboratory work	8
	Independent work			
	Questions and tasks for self-assessment	Search, selection, and review literary sources on a given topic. Fulfillment of practical tasks.	Homework check. Test fulfillment	5
		Questions for independent work of students: 1. What is information? 2. What is the classification of modern information? 3. The essential requirements for the presentation of digital information. 4. What place does information take in modern society? 5. What is the knowledge economy? 6. The features of the knowledge economy and its place in the information society. 7. Disclose the essence of the main stages of data visualization. 8. What is grammar graphics? 9. Describe the relevance of data visualization for the knowledge economy. 10. What approaches exist to the interpretation of the term "visualization"?		
Topic 2.	*Classroom work*			
	Lecture	Lecture «Modern data visualization tools. Infodesign»	Work on lectures	4
	Laboratory lesson	Laboratory work 2 .Visualization of text information. Building mental maps.	Active participation in the performance of tasks and defense of the report of laboratory work	8
	Independent work			
	Questions and tasks for self-assessment	Search, selection, and review literary sources on a given topic. Fulfillment of practical tasks.	Homework check. Test fulfillment	5

		Questions for independent work of students: 1. What is visualization of information? 2. What is the object and subject of visual analytics? 3. In which areas is visualization information used? 4. What are the basic stages of formation of information space for visualization? 5. Name the modern methods of visual analysis. 6. List the tools of each of the methods of business analytics. 7. What is info design? 8. What are the practical benefits and limitations of using the info design? 9. Describe the modern toolbars of business analytics. 10. Make a comparative analysis of two or three of the current tools for data visualization.		

Змістовий модуль 2. Використання сучасних методів аналітичної обробки даних

		Classroom work		
Topic 3	Lecture	Lecture «Planning, collecting and preparing data for visualization. Methods of collecting analytical information»	Work on lectures	4
	Laboratory lesson	Laboratory work 3. Infodesign: features and possibilities of use in analytics	Active participation in the performance of tasks and defense of the report of laboratory work	8
		Independent work		
	Questions and tasks for self-assessment	Search, selection, and review literary sources on a given topic. Fulfillment of practical tasks.	Homework check. Test fulfillment	5

			Questions for independent work of students: 1. Describe the current toolbase of business analytics. 2. How is the source of information reviewed? 3. Name the criteria for choosing the sources of information. 4. Describe the processes of planning, collecting and preparing data for visualization. 5. What are the main mistakes of a business analyst when rendering data? 6. Name the basic methods of processing the digital information. 7. Describe the analytical methods of data processing. 8. Describe the expert methods of data processing. 9. Compare the advantages and disadvantages of using analytical and expert methods for processing the digital information. 10. Name the main reasons that lead to inaccurate expert assessments.		
			Classroom work		
	Lecture		Lecture «Basics of business analytics. Basic methods for processing digital information »	Work on lectures	4
	Laboratory lesson		Laboratory work 4. Analytical and expert methods of digital information processing.	Active participation in the performance of tasks and defense of the report of laboratory work	8
			Independent work		
Topic 4	Questions and tasks for self-assessment		Search, selection, and review literary sources on a given topic. Fulfillment of practical tasks.	Homework check. Test fulfillment	5
			Questions for independent work of students: 1. Name the main analytical methods of data processing. 2. What expert data processing methods do you know? 3. Name the basic methods of processing digital information. 4. Describe the analytical methods of data processing. 5. Describe the expert methods of data processing. 6. Compare the advantages and disadvantages of using the analytical and expert methods for processing the digital information. 7. What are the main reasons that lead to inaccurate expert assessments?		

		8. What software products are used to visualize digital information? 9. List the shortcomings (limited) in the application of expert methods. 10. What are the features of a combination of analytical and expert methods?		
		Classroom work		
	Lecture	Lecture «Economic interpretation of visual analysis of data. Preparation of reports »	Work on lectures	4
	Laboratory lesson	Laboratory work 5. Analytical report: structure and features of construction.	Active participation in the performance of tasks and defense of the report of laboratory work	4
		Independent work		
Topic 5	Questions and tasks for self-assessment	Search, selection, and review literary sources on a given topic. Fulfillment of practical tasks.	Homework check. Test fulfillment	7
		Questions for independent work of students: 1. Name the most common ways to visualize data. 2. Name the basic methods and methods of processing the text and digital information. 3. What is the essence and main stages visualization of digital information? 4. List the properties of digital information. 5. Name the features and difficulties that an analyst encounters when interpreting the results of a visual analysis of data. 6. What are the features of economic interpretation of the results? 7. What is an analytical report? 8. What are the stages of the preparation of the analytical report? 9. What major mistakes are made during the preparation of the analytical report? 10. What visual effects may improve the visibility of the perception of the analytical report?	Defence of IRW	17

The final score of the discipline is calculated on the basis of scores obtained during IRW defense and points earned during the current control of a memory system. The total score in the points for the semester is: "60 and more points are counted", "59 and less points are not counted" and entered in the "Record of success" of the academic discipline.

Grading scale: national and ECTS

Assessment of the S. Kuznets KhNUE according to Economics scale	ECTS assessing scale		Assessment according to national scale
90-100	A	excellent performance	Excellent
82-89	B	above average	
74-81	C	work at all correct, but with a number of errors from	Good
64-73	D	not bad, but many drawbacks	Satisfactory
60-63	E	performance meets the minimum criteria	
35-59	FX	need to re-take	Unsatisfactory
1-34	F	repeat the discipline	

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