



Syllabus Course Program



Models and Data Visualization

Specialty

113 Applied mathematics

Educational program

Intelligent Data Analysis

Level of education

Bachelor's level

Semester

6

Institute

Educational and Scientific Institute of Computer Science and Information Technology

Department

Computer Mathematics and Data Analysis

Course type

Special (professional), Selective

Language of instruction

Ukrainian

Lecturers and course developers



Stanislav POHORIELOV

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Doctor of Science in Physics and Mathematics, professor, professor

Work experience - 22 years. Author of more than 160 scientific and educational and methodological works. Lecturer in the disciplines: "Higher mathematics", "Random processes and stochastic systems", "Social network models", "Data models and visualization", "Probability models", "Fuzzy logic".

Google Scholar:

<https://scholar.google.com/citations?hl=en&user=UE0HQSUAAAAJ>

ORCID: <https://orcid.org/0000-0002-0189-8655>

Scopus: <https://www.scopus.com/authid/detail.uri?authorId=9270293800>

Web of Science: <https://www.webofscience.com/wos/author/record/AAA-7891-2019>

[More about the lecturer on the department's website](#)

General information

Summary

The discipline is aimed at developing knowledge and skills in building data models and using visualization tools for research, analysis and presentation of various information.

Course objectives and goals

Acquisition of knowledge and skills in the field of model building, visual representation and analysis of both numerical and non-numerical data; presentation of research results and the use of visualizations in the process of managerial decision-making. Particular attention is paid to the formation of information culture and students' understanding of the possibilities of using data models and visual information technologies in the process of solving applied problems.

Format of classes

Lectures, laboratory classes, calculation tasks, consultations. Final control – credit test.

Competencies

GC 1. Ability to learn and master modern knowledge.

GC 2. Ability to apply knowledge in practical situations.

GC 3. Ability to generate new ideas (creativity).

GC 6. Capability to abstract thinking, analysis and synthesis.

GC 7. Ability to search, process and analyse information from various sources.

GC 8. Knowledge and understanding of the subject area and understanding of professional activities.

SC 3. Ability to choose and apply mathematical methods to solve applied problems, modeling, analysis, design, management, forecasting, decision-making.

SC 5. Ability to develop algorithms and data structures, software tools and program documentation

SC 7. Ability to solve professional problems with the help of computer equipment, computer networks and the Internet, in the environment of modern operating systems, using standard office applications.

SC 8. Ability to operate and maintain software of automated and information systems for various purposes.

SC 10. Ability to conduct mathematical and computer modeling, data analysis and processing, computational experiment, solving formalized problems using specialized software.

SC 14. Ability to understand the task statement formulated in the language of a particular subject area, to search and collect the necessary initial data.

SC 20. Ability to develop and operate software tools for intelligent analysis of measurement and observation data, texts, signals and images.

Learning outcomes

LO 2. To know the basic principles and methods of mathematical, complex and functional analysis, linear algebra and theory numbers, analytic geometry, theory of differential equations, in particular partial differential equations, probability theory, mathematical statistics and random processes, and numerical methods.

LO 14. Demonstrate the ability to self-learn and continue professional development.

LO 15. Be able to organize your own activities and get results within a limited time frame.

LO 24. Be able to apply existing and develop new algorithms and software tools for processing measurement and observation data, texts, signals and images.

LO 25. Be able to apply modern information technologies and software for processing large amounts of data based on distributed and cloud services.

Student workload

The total volume of the course is 150 hours (5 ECTS credits): lectures - 32 hours, laboratory classes - 32 hours, self-study - 86 hours.

Course prerequisites

"Mathematical Analysis", "Linear Algebra", "Analytic Geometry", "Mathematical Statistics", "Computer Discrete Mathematics", "Computational Geometry and Computer Graphics".

Features of the course, teaching and learning methods, and technologies

Lectures are held in an interactive mode using multimedia technologies. Laboratory classes focus on the application of computer modeling and data visualization methods.

Program of the course

Topics of the lectures

Topic 1. Visualization & Infographics.

- Areas of application of visualization

- Benefits of visual representation of information
- Comparative analysis of visualization and infographics. Visuals
- Visualization Methods in Applied Problems
- Types of signs. Scaling. Application of visualization in applied problems

Topic 2. Data Models

- Data Models and Their Classification
- Relational data model
- Infological data model. Dialogic model. Inverted list model.
- Multidimensional Model

Topic 3. Means of visualization of non-numerical information.

- Classification of non-numerical information analysis tools. Time Management Tools
- Mind maps. Block and card models. Strategic planning matrices
- Building a timeline

Topic 4. Visual analysis of processes over time

- Timeline Applications
- Life cycle models
- Writing text accompaniment for a presentation

Topic 5. Presentation as a form of reporting.

- Appointment. Classification. Rules for creating presentations
- Crosstabulation. Analyze data with pivot tables
- Apply conditional formatting

Topic 6. Visualization of numerical information.

- Stages of data analysis. Raw data sources. Preparing data for analysis
- BI Analysis Programs
- Tables as a result of data visualization.
- Search the Internet and analyze selections of top charts

Topic 7. Visual analytics.

- Basic Visualization Functions
- Chart classification. Principles of diagram construction and formatting

Topic 8. Visualization rules and errors

- Visualization and perceptual mechanisms

Topic 9. Reports and dashboards

- Evolution of reports: classic report, presentation, dashboard
- Purpose and classification of dashboards
- Application of dashboards

Topics of the workshops

Not provided for in the curriculum.

Topics of the laboratory classes

Topic 1. Visualization & Infographics

- Development of a plan for collecting and researching marketing data
- Data collection and preparation for research

Topic 2. Data Models

- Definition of valid structures and selection of a data model
- Building a data model structure

Topic 3. Means of visualization of non-numerical information

- Development and construction of schemes
- Construction and analysis of time series
- Constructing a Gantt Chart
- Building a timeline

Topic 4. Visual analysis of processes over time

- Preparation of visualizations for presentation
- Slide design

Topic 5. Presentation as a form of reporting.

- Building data tables. Data aggregation and grouping
- Crosstabulation. Analyze data with pivot tables
- Building heatmaps using conditional formatting

Topic 6. Visualization of numerical information

- Principles of table construction and formatting
- Plotting basic charts

Topic 7. Visual analytics

- Construction of combined graphs and charts.

Topic 8. Visualization rules and errors

- Construction of alternative visualizations and their analysis

Topic 9. Reports and dashboards

- Principles of dashboard construction. Stages of creating a dashboard. Application of dashboards
- Presentation of the results.

Self-study

During independent work, students study lecture material, do individual homework (IHW), prepare for tests and credit. Correctly executed IHW are counted, incorrectly - returned for revision. IHWs are evaluated as completed after errors are corrected

Course materials and recommended reading

References

1. Mulyar, V. P. Data visualization and infographics. Kharkiv: FOP Panov A. M. 2020. 200 p. (in Ukrainian).
2. Sidorova, A. V., Bilenko, D. V., and Burkina, N. V. Business Analytics: Educational and Methodological Manual. Vinnytsia: DonNU named after Vasyl Stus. 2019. 104 p.
<https://drive.google.com/drive/folders/1RXVdoZfZl3knaOZwhslxU0fGgOtps7Cj>
3. Open Guide to Open Data.
URL: [/\[electronic resource\] https://socialdata.org.ua/manual0/](https://socialdata.org.ua/manual0/)
4. Visualization. URL: [/\[electronic resource\] https://socialdata.org.ua/manual5/](https://socialdata.org.ua/manual5/)
5. Types of charts and graphs in Google Sheets.
URL: [/\[electronic resource\] https://support.google.com/docs/answer/190718?hl=ru&ref_topic=1361474](https://support.google.com/docs/answer/190718?hl=ru&ref_topic=1361474)
- 6 What is Data Visualization?
[electronic resource] <https://www.microsoft.com/uk-ua/microsoft-365/visio/data-visualization>

Additional references

7. What Is Data Visualization? Definition, Examples, And Learning Resources.
[електронний ресурс] <https://www.tableau.com/learn/articles/data-visualization>

8. A Complete Overview of the Best Data Visualization Tools.
[електронний ресурс] <https://www.toptal.com/designers/data-visualization/data-visualization-tools>
9. What Is Data Visualization and Why Is It Important? A Complete Introduction.
[електронний ресурс] <https://careerfoundry.com/en/blog/data-analytics/what-is-data-visualization/>
10. Data visualization for marketers: 6 steps to present data visually.
[електронний ресурс] <https://supermetrics.com/blog/data-visualization-for-marketers>
11. A Comprehensive Guide to Data Visualization.
[електронний ресурс] <https://www.netquest.com/hubfs/docs/ebook-data-visualization-EN.pdf>
12. Why Data Visualization is Important for Digital Marketing.
[електронний ресурс] <https://www.investisdigital.com/blog/reporting-and-analytics/why-data-visualization-important-digital-marketing>
13. An Introduction To Marketing Data Visualization.
[електронний ресурс] <https://www.ninjacat.io/blog/an-introduction-to-marketing-data-visualization>
14. Excel help & learning / [електронний ресурс] <https://support.microsoft.com/en-us/excel>
15. Кукушкін С.Н. Внутрішньфірмове планування / [електронний ресурс]
https://stud.com.ua/115689/ekonomika/vnutrishnofirmove_planuvannya
16. Гайд по презентаціях: які бувають, для чого потрібні і як правильно оформляти.
<https://aggr.university/gajd-po-prezentaciyah-yaki-buvayut-dlya-chogo-potribni-i-yak-pravilno-oformlyati/>
17. UML для бізнес-моделювання: для чого потрібні діаграми процесів.
<https://evergreens.com.ua/ua/articles/uml-diagrams.html>
18. Простий посібник зі схем UML і моделювання баз даних.
<https://www.microsoft.com/uk-ua/microsoft-365/business-insights-ideas/resources/guide-to-uml-diagramming-and-database-modeling>
18. Статичні та динамічні діаграми. Навіщо та як використовувати їх під час документування архітектури.
<https://dou.ua/lenta/columns/static-and-dynamic-diagrams/>

Assessment and grading

Criteria for assessment of student performance, and the final score structure

The student is recommended to attend both lectures and practical classes. Performing calculation work is a prerequisite for obtaining an assessment. Tests are mandatory. The student's points in the discipline are awarded according to the following ratio:

- tests: 40% of the semester grade;
- independent work: 20% of the semester grade;
- Credit test: 40% of the semester grade.

Grading scale

Total points	National	ECTS
90-100	Excellent	A
82-89	Good	B
75-81	Good	C
64-74	Satisfactory	D
60-63	Satisfactory	E
35-59	Unsatisfactory (requires additional learning)	FX
1-34	Unsatisfactory (requires repetition of the course)	F

Norms of academic integrity and course policy

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": to demonstrate discipline, good manners, kindness, honesty, and responsibility. Conflict situations should be openly discussed in academic groups with a lecturer, and if it is impossible to resolve the conflict, they should be brought to the attention of the Institute's management.

Regulatory and legal documents related to the implementation of the principles of academic integrity at NTU "KhPI" are available on the website: <http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/>

Approval

Approved by

Date, signature
29.08.2024



Head of the department
Olena AKHIEZER

Date, signature
29.08.2024



Guarantor of the educational
program
Olena AKHIEZER