Appendix 1

Ministry of Science and Higher Education of the Russian Federation

NATIONAL RESEARCH

TOMSK STATE UNIVERSITY (NR TSU)

Institute of Applied Mathematics and Computer Science

APPROVE:
Director
_____ A. V. Zamyatin

Evaluation materials of the current control and intermediate certification in the discipline

(Evaluation tools by discipline)

Data Visualization

in the major of training

01.04.02 Applied mathematics and informatics

Orientation (profile) of training:

Big Data and Data Science

Tomsk – 2025

ET was implemented:
cand. tech. sciences,
Associate Professor of the Department
of Theoretical Foundations of Informatics O.V. Marukhina

Reviewer:
cand. tech. sciences,
Associate Professor of the Department
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Evaluation tools were approved at a meeting of the educational and methodological commission of the Institute of Applied Mathematics and Computer Science (EMC IAMCS).

Protocol dated 22.05.2025 № 1

Chairman of the EMC IAMCS,
Dr. tech. Sciences, Professor S.P. Sushchenko

Evaluation tools (ET) are an element of the system for assessing the formation of competencies among students in general or at a certain stage of its formation.

The ET is developed in accordance with the work program (WP) of the discipline.

1. Competencies and training outcomes, obtained upon the discipline mastery

Competencies	**Competence indicator**	**Code and name of planned training outcomes that characterize the stages of competency formation**	**Criteria for evaluating training outcomes**			
			Excellent	Good	Satisfactory	Unsatisfactory
UK-1. Able to develop and apply mathematical methods, algorithms, software to solve problems in research and design activities.	IUK-1.3 Develops new methods, models, algorithms and software for solving problems in the field of professional activity.	MR-1.3.1. The student will know the place and role of visualization tools and methods in scientific and applied research. MR-1.3.2. The student will know the relationship between visualization methods and corresponding mathematical models. MR-1.3.3. The student will be able to analyze the results of scientific research in order to wisely select methods and means of visualizing the obtained data and knowledge. MR-1.3.4. The student will be able to interpret visualization results and correctly describe them. MR-1.3.5. The student will have the skills to use libraries of modern scripting languages (Python) to visualize data and knowledge MR-1.3.6. The student will have the skills to solve applied professional problems using methods and tools for visualizing data and knowledge.	90-100 points	70-89 points	55-69 points	0-54 points

2. Stages of competency formation and types of evaluation tools

№	Stages of competency formation (discipline sections)	Code and name of training outcomes	Type of evaluation tool (tests, assignments, cases, questions, etc.)
1	Topic 1. Introduction to Visualization with Python – Basic and Customized Plotting. Reading Data from Files, Observing and Describing Data, Plotting with pandas and seaborn, Creating Simple Plots to Visualize a Distribution of Variables, Plotting and Analyzing a Histogram, Creating a Bar Plot and Calculating the Mean Price Distribution, Creating Bar Plots Grouped by a Specific Feature, Tweaking the Plot Parameters of a Grouped Bar Plot, Annotating a Bar Plot. Lab 1. Basic and Customized Plotting	MR-1.3.1, MR-1.3.2, MR-1.3.3, MR-1.3.4.	Questions for colloquia, assignments for laboratory work Public defense: Activity 1: Analyzing Different Scenarios and Generating the Appropriate Visualization
2	Topic 2. Static Visualization – Global Patterns and Summary Statistics. Creating Plots that Present Global Patterns in Data, Scatter Plots, Creating a Static Scatter Plot, Creating a Static Hexagonal Binning Plot, Creating a Static Contour Plot, Creating a Static Line Plot, Presenting Data across Time with multiple Line Plots. Creating and Exploring a Static Heatmap, Creating Plots That Present Summary Statistics of Your Data, Creating and Exploring a Static Box Plot, Creating a Static Violin Plot). Lab 2. Static Visualization	MR-1.3.1, MR-1.3.2, MR-1.3.3, MR-1.3.4.	Questions for colloquia, assignments for laboratory work Public defense: Activity 2: Design Static Visualization to Present Global Patterns and Summary Statistics
3	Applications of Interactive Data Visualizations, Getting Started with Interactive Data Visualizations, Interactive Data Visualization with Plotly Express, Creating an Interactive Scatter Plot. Lab 3. Interactive Visualization Activity 3: Creating Different Interactive Visualizations Using Plotly Express	MR-1.3.3, MR-1.3.4, MR-1.3.5, MR-1.3.6.	Questions for colloquia, assignments for laboratory work Public defense: Activity 3: Creating Different Interactive Visualizations Using Plotly Express
4	Topic 4. Interactive Visualization of Geographical Data (Choropleth Maps, Worldwide Choropleth Maps, Creating a Worldwide Choropleth Map, Adding Animation to a Choropleth, Plots on Geographical Maps, Creating a Scatter Plot on a Geographical Map, Creating a Bubble Plot on a Geographical Map, Line Plots on Geographical Maps. Creating Line Plots on a Geographical Map) Lab 4. Interactive Visualization of Geographical Data	MR-1.3.3, MR-1.3.4, MR-1.3.5, MR-1.3.6.	Questions for colloquia, assignments for laboratory work Public defense: Activity 4: Creating a Choropleth Map to Represent Total Renewable Energy Production and Consumption across the World

3. Typical control tasks or other materials necessary for the assessment of educational training outcomes

3.1. Typical tasks for conducting ongoing monitoring of progress in the discipline

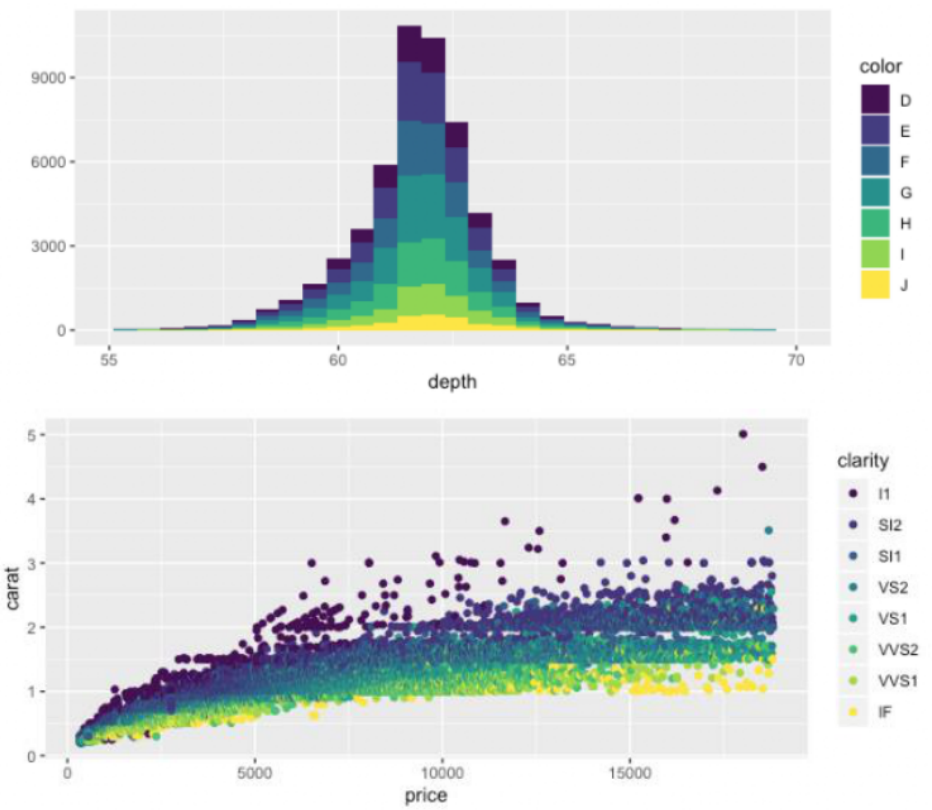
Topics of surveys in class:

Connected with the material of previous lectures, as well as the personal experience of students. Students can propose solutions to the problem posed by the teacher, as well as solution tools. Examples of questions:

1) What type of visualization is best suited for a forecasting task?
2) How would you justify choosing a library for visualization?
3) How else can you visualize the presented dependence in the data?

Task 1.

Using any of the studied libraries, write a program code that builds the following graphs based on the diamonds data set.



Task 2.

Progress

1. A description of the data of all datasets can be found by following the link: https://vincentarelbundock.github.io/Rdatasets/datasets.html

Select for further analysis a dataset containing at least 10 features (Cols) and at least 500 records (Rows).

2. Is the data multidimensional? Why? Prepare a data description – what is your data about? Use the information contained in the DOC and also look for information in other sources.

3. Print the first and last 5 records.

4. Derive and describe the data structure. Describe the type of each trait, on what scale is each trait measured?

5. Are there missing values in the data? If so, what will you do?
6. Draw conclusions. Make assumptions about further exploration of your data. What could they be “hiding”? What further research can you recommend for your variant data?

3.2. Typical tasks for conducting intermediate certification in the discipline.
Credit is awarded based on the presentation and defense of an individual project.
The student makes a presentation and also demonstrates the program code. Questions based on the results can be asked by all students in the group, not just the teacher.

4. Methodological materials that determine the procedures for evaluating training outcomes

4.1. Methodological materials for assessing the current control of progress in the discipline.
The current control takes into account the student's performance of laboratory work and answers to questions at colloquia. The points scored on a 100-point scale are taken into account during the intermediate certification.

Grading system

Scoring	Traditional scoring
96 - 100	Excellent
90 - 95	
80 - 89	Good
70 - 79	
65 - 69	Satisfactory
55 - 64	
55 - 100	Passed
0 - 54	Unsatisfactory/failed

4.2. Methodological materials for conducting intermediate certification in the discipline.
Scheme for determining the final point-rating assessment

	Types of educational activities	**Types of assessment (scores)**				
1	Studying the discipline (form of control - **pass, differential pass**)	Current control activities in the semester Maximum 100 points			=	Final rating score
2	Study of disciplines (form of control - **exam**)	Activities of current control in the semester Maximum 80 points	+	Activities of intermediate certification (exam) Maximum 20 points	=	Final rating score