The 7th International Team
Mathematical Modeling Tournament
for high-school students (MMT-2024)

MMC/Mammoth-2024 Rules

RULES OF MMC/MAMMOTH COMPETITION (MATHEMATICAL MODELING CONTEST), REQUIREMENTS FOR TEAMS, AND RECOMMENDATIONS ON WRITING THE PAPER

General rules:

1. The MMC problem is issued on the opening day of the Tournament (25 Oct 2024, 16:00). Solutions in PDF format must be submitted via the DLC system by 16:00, 30 Oct 2024 (Moscow time, UTC+3); as an exception, a paper can be sent to the Tournament's e-mail *turnir@internat.msu.ru*. The entire time interval between the moments the problem is issued and submitted (120 h) can be devoted to writing your paper. After submitting the solution, during the time free from other Tournament events, the teams prepare presentations of their work, which are presented to the Jury during the conference, starting at 10:00 a.m. on 01.11.2024.

2. Each team must work independently. When working on the problem, teams can use any inanimate sources of information: databases, reference books, books and other materials, websites, as well as computers, software, etc. The ability to find and use such sources positively characterizes the team's work. Receiving consultations, getting hints and other help from any people other than the team members is strictly prohibited. The team's advisor is responsible for meeting this requirement. **The advisor is not a member of the team and cannot give hints to the team while working on the task!**

3. The work is submitted in **two separate documents in PDF format**:

a) The title page with information about the team, including the team's ID, name, school, advisor's name, and the list of team members with classes (grades) indicated (the template is provided);

b) The paper with solution.

Important: The main part of the paper should not contain any information revealing the identity of the team. Before judging, papers will be randomly numbered.

Beginning the work:

1. Read the problem in full.

2. Plan the approaches and methods for solving the problems. Determine what methods and data you need.

3. Try to effectively distribute tasks among the team members. Try to specify subtasks that can be solved independently and simultaneously.

4. It is possible to ask the Jury to clarify the statement of the contest problem. To this end, send your question by email to the Tournament mailbox *turnir@internat.msu.ru* with the subject line "Question on the Mammoth problem" and your question in the email body. Questions and the Jury's answers will be openly published on the Tournament website. Therefore, be careful in their formulations to avoid providing hints to other teams!

During the work:

1. The proposed problem is an open research problem and, like real mathematical modeling problems, does not have a predetermined clear mathematical formulation. One of the most important stages of solving such problems is to reformulate the problem more clearly, which then allows you to formulate the problem quantitatively (that is, to create a "mathematical model"). Often this requires a preliminary study and the solution of self-posed nested tasks. The description of this process and, thus, the reasons and assumptions on which your mathematical model is based, are no less important than the computational algorithm and the final quantitative result.

2. Almost any real problem can be endlessly explored "in depth", taking into account ever finer details. It is the “modeler’s” task to decide at what “depth” to stop and either disregard some details or replace them with simplifying assumptions (both should be described explicitly and, preferably, justified).

3. Estimate the time-span of your work! If a certain stage of your work is getting too slow, try to assess whether it can be performed at a simpler level (albeit at the cost of reducing the "quality" of the result). An ill-working model is almost always better than one that does not work at all.

4. Answering all the questions of the problem is not necessary, but recommended. It is allowed to change the order of answers to questions. The judges are primarily interested in approaches to solutions and research methods.

Result:

1. The results of your work should be presented in the form of a paper of reasonable length.

2. The paper should contain a description of all stages and elements of your work that have any influence on the final result. This, in particular, means that the negative results of the stages, on the basis of which any conclusions were made that affect other stages or the final result, must also be described.

3. The description should be detailed enough to allow the logic of the solution to be understood and verified, but it should not be overloaded with insignificant, self-evident and well-known details. The structural clarity of the paper and the consistency of presentation are extremely important. “Jumps” between different issues make it very difficult to understand the essence of your paper. Sections or fragments that contain answers to specific questions of the task must be clearly indicated. For example, at the end of the section title you can put a reference to the question it answers, e.g., “(question 4.2).”

4. It is recommended to discuss in the paper the strengths and weaknesses of the approach used to solve it and of the model or algorithm constructed. First of all, it is important to analyze the so-called "limitations of the model," i.e. the conditions of its applicability.

5. The paper must clearly formulate the assumptions and presuppositions used, and provide definitions for all variables and constants used.

6. When using graphs and tables in the paper, standard rules for their design should be followed, allowing the reader to easily "read" the material: graphs should be in a sufficiently high resolution, coordinate axes should be labeled, captions should be made in a font that does not differ greatly in size from the one used in the text of the paper (so that the graphs can be read without magnification), several graphs plotted in the same axes should have explanatory legends, all columns and rows in a table should be clearly labeled (non-obvious notations, which need “decoding” by looking for them in the main text of the paper, can significantly reduce the rating of the work).

7. All sources of additional information (articles, books, Internet resources) used in the work should be referenced in your paper. There is no need to provide references to the sources of well-known information (for example, contained in school textbooks). References should be listed at the end of the paper.

8. At the end of the paper, there should be a paragraph titled ‘Use of Artificial Intelligence (AI).’ It should state whether you have used AI in your research or in writing the paper. The use of AI is not encouraged, but it is not prohibited. If AI was used, a separate appendix to the paper should include the following information:

- what AI tools were used and for what purpose;

- what AI query strings were used;

- how the results of the AI were checked (because AI can “hallucinate”).

9. The number of pages in the paper is not an indicator of its quality. You should not specifically seek to either reduce or increase the volume of the paper. However, an excessive amount of “padding” (that is, a text that does not communicate anything essentially relevant to the problem being solved) usually greatly impairs the reader’s ability to keep track of the thread of reasoning. One should adhere to the following

general restriction on the main paper without appendices: **15 A4 pages in 12 pt font with reasonable margins and 1.5 line spacing.**

10. Although you can attach your program code as an appendix to the article, it will not be directly studied and judged.
On the other hand, the source code may serve as a proof of implementation of the mathematical model and it can also be useful for an interested reader.