



THE CONSORTIUM FOR
MATHEMATICS AND
ITS APPLICATIONS

2019 ICM Problem F **Triage Judging Guidelines**

Purpose and Background

The Mathematical Contest in Modeling (MCM) and *The Interdisciplinary Contest in Modeling (ICM)* both rely on a Triage Judging and Final Judging process to identify seven classes of participant performance – Disqualified, Unsuccessful Participant, Successful Participant, Honorable Mention, Meritorious, Finalist, and Outstanding – based on the technical reports submitted under the MCM/ICM contest rules

(<http://www.comap.com/undergraduate/contests/mcm/instructions.php>).

Final Judging is the culminating process whose purpose is to identify the papers that will be designated as Finalist or Outstanding. Prior to this event, Triage Judging in the United States and China efficiently ranks and categorizes each MCM/ICM submission based on desirable characteristics and content established over years of MCM/ICM operations, and upon the peculiarities of each problem.

Overall, the MCM/ICM supports and advocates an iterative mathematical modeling process consisting of major elements that include:

- Problem Restatement,
- Assumptions & Justifications,
- Model Construction and Application,
- Model Testing and/or Sensitivity Analysis,
- Analysis of Strengths & Weaknesses.

Papers that contain major elements in sufficient detail to address the problem posed receive higher recognition from judges.

The triage process relies on the professional expertise, experience, and judgment of academic faculty and industry professionals supporting the administration of the MCM/ICM to read and recognize key quality indicators in team papers – proper applications of mathematics and science, depth of exploration, completeness of a recognized modeling process, proper reliance upon and documentation of supporting research, innovative and insightful modeling approaches, and clear and concise exposition, among others. As noted frequently in UMAP Journal articles, elements such as these are universally valued among modelers, and are hallmark ingredients expected of top papers,.

While it is impossible to list all potential contributors to such quality, it is possible to note items that, if not present, will limit a paper's quality from the viewpoint of the MCM/ICM. While not claiming to be all-encompassing in its attempt to identify such limiting criteria, this memo will hopefully provide enough information to create a consistency in judgment despite extreme geographical and temporal separation of triage sites.

Triage Judging

In the Triage round we seek to cull out papers that do not have a chance at being Meritorious or Outstanding. In general we have percentage target levels we are planning to keep for final judging, but we always have to make some adjustments as we go through the process.

The judging of student team submissions uses seven paper classifications: Disqualified, Unsuccessful Participant, Successful Participant, Honorable Mention, Meritorious, Finalist, and Outstanding. The classification for each MCM/ICM paper is relative to the pool of papers received each year.

General guidelines and percentages for each category are as follows.

Disqualified (DQ) (% as warranted): the team's paper was found to be in violation of the contest rules. The rule violation should be noted in the comment column (e.g. "plagiarism," "same as paper xxx") and scored as 0. The MCM/ICM contest directors will review and verify all papers designated as disqualified (DQ).

Unsuccessful Participant (UN) (% as warranted): the team's paper did not respond to any of the requirements of the contest problem, but did not violate any of the contest rules. A simple explanation of the failings should be noted in the comment column (e.g. "No modeling") and scored as 0. The MCM/ICM contest directors will review and verify all papers designated as unsuccessful (UN).

Successful Participant (P) (% as warranted): the team made an attempt at the problem and successfully submitted their paper. However, their overall paper is best described as fair to average, and possibly contains an incomplete modeling process or solution, and mathematical or logical errors. Scored as a 1 or 2.

Honorable Mention (HM) (% as warranted): the team submitted a complete, acceptable modeling approach and solution, but their solution contains at least one detractor, deficiency, or error that prevents it from being classified as Meritorious or Outstanding. Scored as 3, 4 or 5.

Meritorious (M) (10%): the team's paper represents an exemplary modeling approach, but their solution may contain minor errors or issues in logic, calculation, modeling, or assumptions. Scored as a 6 or 7.

Finalist (F)/Outstanding (O)(<1%): the team's paper represents an excellent modeling approach and a solid solution, including demonstrating an ability to clearly and concisely communicate their process, results, and conclusions. Scored as a 7.

7	}	Possibly Outstanding or Meritorious
6		
5	}	Probably Honorable Mention
4		
3		
2	}	Successful
1		

Triage judging sessions are designed to accomplish a crude categorization of the papers. In the time allotted to each paper (no more than 15-20 minutes and 10-15 minutes on average), judges assess whether the required elements of the modeling process are addressed, and whether the teams have answered the questions posed in the problem statement. Judging during the triage sessions use a 7-point scale shown to the left to achieve the desired categorization. What makes this possible is the mindset of triage judges to primarily

look for the very top papers and not try to fully evaluate every part of every paper. Don't be afraid to establish separations between quality levels with these numerical scores. Each paper is given 2 reads during the triage judging, so each judge is responsible for half the triage decision to have the paper forwarded to final judging or not.

The head judge culls approximately 60-80% of the papers after the triage round and take the remaining papers to final judging.

Triage Judging Notes

If you find a paper you are assigned to read is missing, damaged or incorrect, note the paper number and notify your head judge so that COMAP can check for the correct paper.

If you find that a team included any distinguishing information such as school name or student names, read the paper as normal and grade as normal, but add a note to the comment column (e.g. “includes school name on page xxx,” “includes student name on page yyy”).

If you find that a paper has gone over the assigned paged limit, read the paper as normal and grade as normal, but add a note to the comment column (e.g. “paper exceeded the assigned page limit”).

Triage judges are encouraged, but not required, to include comments on their grading sheet. It could be as simple as a few words (e.g. “great assumptions”), or a sentence justifying the papers score (e.g. “fatal logic flaw on page zzz”).

Problem Specific Guidance: Problem F (2019):

The main thrust of ICM problem-grading is judging the team’s performance of basic modeling that uses good science and leads to measurable outcomes and analysis. In this year’s problem, you should see measures and models for the viability and effects of a global decentralized currency system. A model of such a currency must be constructed and analyzed. Some of the issues to consider as you read and grade:

- 1) One grading issue is the need for well thought-out measures of security and stability of such a currency. Teams should identify the key factors that will be important as they plan out their model and conduct their analysis. Do they build a good basic model for a global currency and does their model provide results and data for analysis? And most importantly, does their one-page summary convey their modeling work and results and does their one-page policy model provide recommendations and rationale?
- 2) Do they discuss and analyze factors such as effects of financial growth, oversight and access for citizens needing currency for various financial transactions?
- 3) Do they consider individual, national, and global (world economy) issues?
- 4) Do they consider both start up and long-term effects?
- 5) Some of the **optional** questions they could consider, even though not required, but could show good interdisciplinary modeling, are:
 - What are the main factors that will determine whether an individual citizen will join the digital market? What are the factors that determine whether nations officially adopt such a system?
 - How will a digital currency effect traditional markets and economies? Can they co-exist?
 - How can current national currencies be exchanged in the new digital currency?
 - What are the sales and income tax implications of assets sold using the new global currency?
 - What are the factors that could cause volatility in this market? How can they be reduced?
 - What are the factors that could affect the value of the currency?
 - In traditional markets with physical currency, the government creates or destroys money to manage fluctuations in value. Should currency value be added or removed from the system to stabilize the market in a similar way? How should future monetary events be decided and controlled, if needed?
 - What role, if any, should the United Nations, International Monetary Fund, World Bank, World Trade Organization, and national governments play in regulating digital currency? Can there ever be trust in one universal international world currency?
 - What are the security issues, and can they be ameliorated? Is blockchain an adequate system to build trust in a global digital currency?

- What would be the major differences of the global digital market in developed versus undeveloped nations? How can these be minimized? Are there ethical considerations for adopting a system that may benefit citizens of some countries over others?
- What are the ethical considerations of having governments get involved in the regulation the new market?
- What would be the long-term effects if traditional banking were to become obsolete?
- Could there be an event that damaged the entire digital market destroying the world's digital currency? What would happen to the global markets if that occurred?

6) Do they discuss basic elements of modeling: assumptions, measures, strengths/ weaknesses, and sensitivity of their models? If appropriate, do they find, create, or use data in any way for their measures and models?

7) Is their report less than or equal to 20 pages (not including their cover sheet with summary, 1-page policy memo, references and appendices)?

After a quick (10-15 minute) read, assign a score (1-7), 1 is poor (low potential for outstanding), 7 is excellent (high potential for outstanding). When appropriate, please add a one sentence comment to explain the grade. Plagiarized papers will be disqualified with a 0 score and papers with essentially no relevant work will be given a score of 0 for unsuccessful participation. Please explain why a 0 score was given – plagiarism or little to no good work.

We will be much more careful to evaluate the student work of the surviving papers during the final judging, but your roles in triage grading make our system work well. Thank you for performing this grading and contributing to the success of the ICM

The Final Judging Sessions (for information only for triage graders)

The final judges develop a rubric for each problem and customize it to the problem being judged and the set of papers present. After the triage event, judges have a better idea of how the top papers they have read are addressing the problem and what elements are evolving to set papers apart from each other. This knowledge provides the basis for refining the rubric prior to the last judging session to pick the Outstanding papers. We usually have 4 or 5 rounds of final judging where approximately 50% of the papers are culled in each round.



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