



SCORING GUIDELINES

Teams should:

- Use mathematical models **either developed originally or discovered through research.**
- Provide **additional insight** if their solution is drawn from sources.
- **Demonstrate a depth of understanding** of their solution.

For each of questions 1 through 3, teams should ***create a mathematical model***, which means:

- Define all variables and parameters (with units).
- Justify assumptions.
- Describe the mathematical approach(es) used to develop the model and find a solution.
- Answer the questions provided, which may include demonstrating how your model works.
- Discuss implications of the result(s).

Guidance on the parts of the problem is below; one of the solution paper templates can be downloaded for more direction.

Solution Component	Considerations	Value
Executive Summary	<ul style="list-style-type: none"> • Overview of the problem (all three parts). • Brief description of the mathematical approaches that were used. • Provide and discuss a summary of the results (even if they are incorrect). 	Up to 20%
Question 1	<ul style="list-style-type: none"> • An accessible entry point to a larger problem. • A warm-up—it is anticipated that most teams will develop a solution for this question. 	Up to 20%
Question 2	<ul style="list-style-type: none"> • Investigation of essential issues underlying this real-world problem. • The main event—every team can have some success and many teams will cover it well. 	Up to 25%
Question 3	<ul style="list-style-type: none"> • A challenging aspect; requires broader and/or deeper perspective. • The discriminator—many teams will do something, while only a few will have striking results. 	Up to 15%
Discretionary points	<ul style="list-style-type: none"> • Team examined a wider set of circumstances. • Team used a creative problem solving perspective. • Team made connections between all three parts and the overall driving question. • Paper is exceptionally well written/organized. • Detailed sensitivity analysis is presented. • Model verification is performed. • Strengths and weaknesses are addressed. • Effective and well-motivated use of technical computing. 	Up to 20%

More on reverse

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Basic Modeling and Writing Guidelines:

- Check that the units are consistent.
- Figures and graphs should have a title, label, and caption, and the axes should be labeled.
- Tables should have a title, header, label, and caption.
- Variables and parameters should be clearly defined.
- Help judges understand the decisions you made by explaining the use of any complicated mathematical expressions.
- When citing outside sources, clearly explain what statistics, models, equations, or insights you took from each source.

For Teams Planning to Submit Code to be Eligible for the MATLAB Technical Computing Awards

If a team uses MATLAB, either on its own or paired with other software, they are eligible for MATLAB Technical Computing Awards, which recognize teams for their outstanding use of MATLAB in solving the Challenge problem. Solutions must demonstrate how the team's use of computing advances the model and/or reveals its implications.

Code is not required to compete in M3 Challenge, but if included, it must be formatted to make it easy for judges to understand what the program is doing and how the algorithm is executed¹. This means:

- Code must include comments that describe how the code works.
- Variables should have meaningful names.
- Code should use consistent indentation to allow for easy readability.

Equally important—teams must also discuss their program **in the paper**:

- Teams must justify the use of technical computing. That is, it must be clear why the team leveraged a computer program instead of just a calculator.
- Teams should include a brief summary of the purpose and key features of their code.
- If a “built-in” function is used:
 - it should be clear that the team knows what the underlying function does and why it was chosen, and
 - the input parameters should be clearly provided and justified.
 - For example, the following would be considered a weak explanation.

We fit an AR model in MATLAB to the time series and got the plot below.

This could be improved as follows.

Since the time series did not appear to follow a simple linear or logistic trend, we chose to fit it with an Autoregressive (AR) model. This model approximates a time series using the equation..... To fit the model to our time series, we used MATLAB's built-in “arima” function. This function can actually fit more general ARIMA models, so to fit an AR model, we set the input parameters D and q to 0. The other parameter p was chosen to equal 5 because....

- Teams must include an explanation or demonstration of how the code was tested for accuracy or correctness.

¹See Appendix B of the handbook *Math Modeling: Computing & Communicating* for examples.