

What is Mathematical Modelling?

- Framing questions in/about the real world in mathematical terms. Building a mathematical model (representation) of the real world.
- Studying the mathematical model using known mathematical tools and techniques.
- Interpreting the results of the mathematical investigations in terms of the original real-world problem.

Why Mathematical Modelling?

- To solve real-world problems (industrial/business settings).
- To gain insight into real-world phenomena (research settings).

Solving Problems Using Mathematical Modelling: The Five-Step Method

1. Ask the question.
2. Select the modelling approach.
3. Formulate the model.
4. Solve the model.
5. Answer the question.

Step 1: Ask the question

- Make a list of all the variables in the problem, including appropriate units.
- Be careful not to confuse variables and constants (model parameters).
- State any assumptions you are making.
- State the objective of the problem in precise mathematical terms.

Step 2: Select the modelling approach

- Choose a general solution procedure to be followed in solving this problem.
- Generally speaking, success in this step requires experience, skill, and familiarity with the relevant literature. In this course, we usually will specify the modelling approach to be used.

Step 3: Formulate the model

- Restate the question posed in step 1 in terms of the modelling approach specified in step 2.
- You may need to relabel some of the variables specified in step 1 in order to agree with the notation generally used with the modelling approach chosen.
- Note any additional assumptions made in order to fit the problem described in step 1 into the mathematical structure specified in step 2.

Step 4: Solve the model

- Apply the general solution procedure specified in step 2 to the problem formulated in step 3.
- Be careful in your mathematics. Check your work for math errors. Does your answer make sense?
- Use appropriate technology. Computer algebra systems, graphics, and numerical software will increase the range of problems within your grasp, and they also reduce math errors.

Step 5: Answer the question

- Rephrase the results of step 4 in nontechnical terms.
- Avoid mathematical symbols and jargon.
- Anyone who can understand the statement of the question as it was presented to you originally should be able to understand your answer.

An Additional Iterative Step

- Models rarely are perfect and complete representations of the real-world problem.
- Simplifying assumptions often have been made in order to make some progress.
- After the completion of the five-step method, one should assess the accomplishments. How relevant is the solution to the original problem statement? Can some of the simplifying assumptions be relaxed? Can the model be improved?
- Repeat the 5-step process as necessary ...