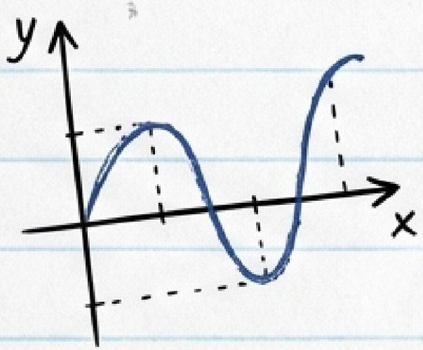
Date: October 26, 2023

Mathematical Modelling

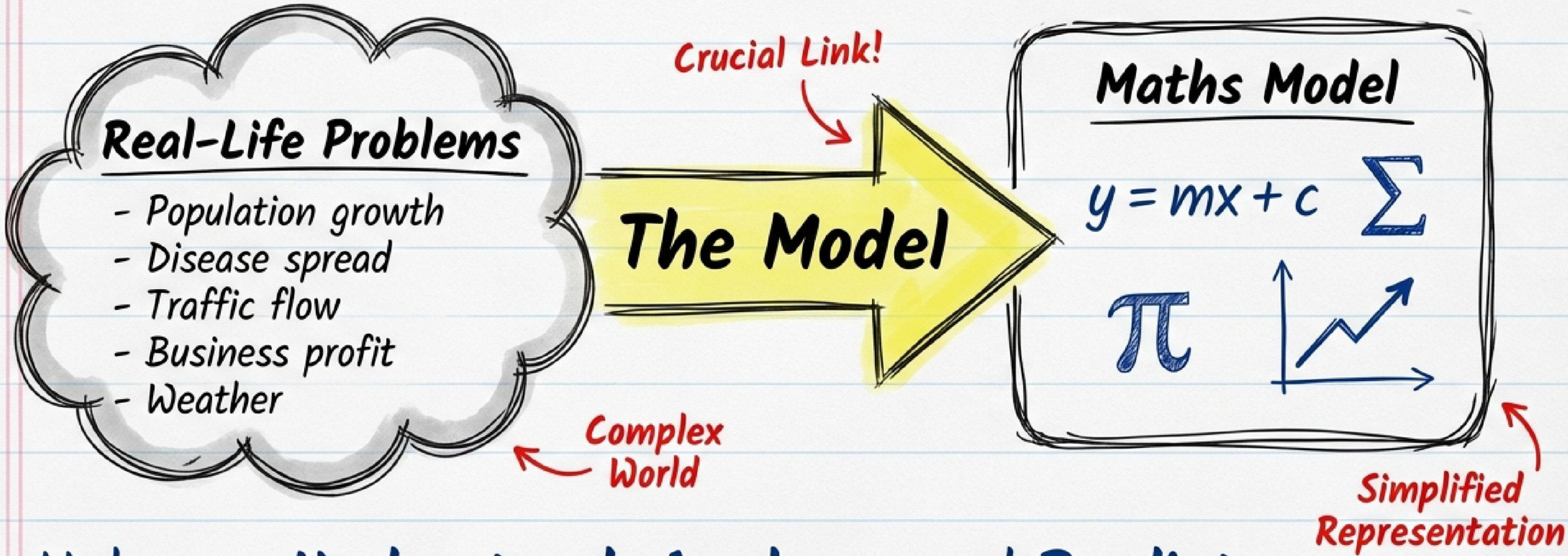


Brief Study Notes

Goal:
Turn Real World
-> Maths World

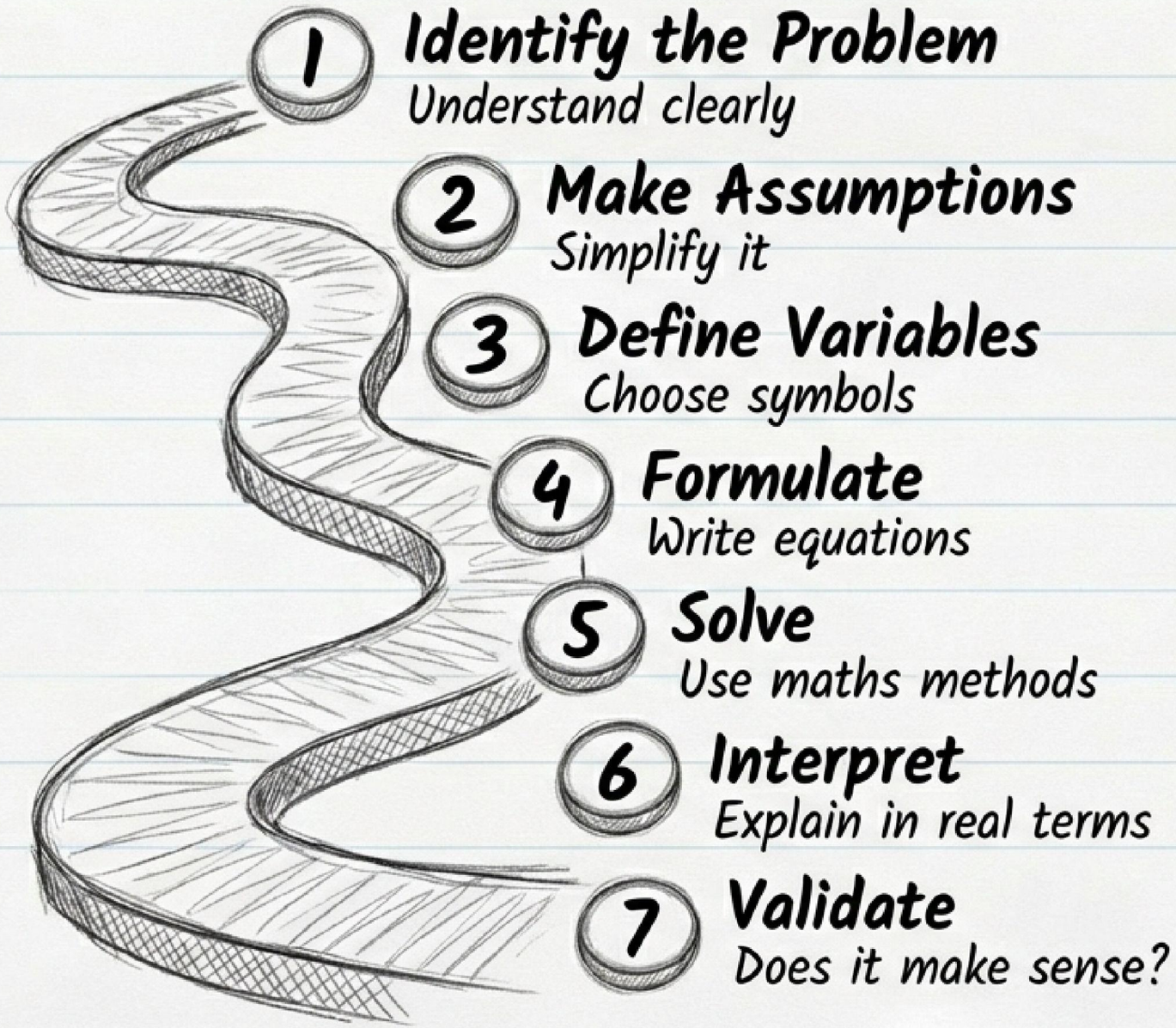
I. Introduction: What is it?

The process of representing real-life situations using mathematical concepts, symbols, equations, graphs, and formulas.



*Helps us **Understand**, **Analyse**, and **Predict**.*

3. The 7-Step Roadmap



1. **Identify the Problem**
   Understand clearly
2. **Make Assumptions**
   Simplify it
3. **Define Variables**
   Choose symbols
4. **Formulate**
   Write equations
5. **Solve**
   Use maths methods
6. **Interpret**
   Explain in real terms
7. **Validate**
   Does it make sense?

Don't skip steps!

Phase 1: Setting Up

Step 1: Identify the Problem

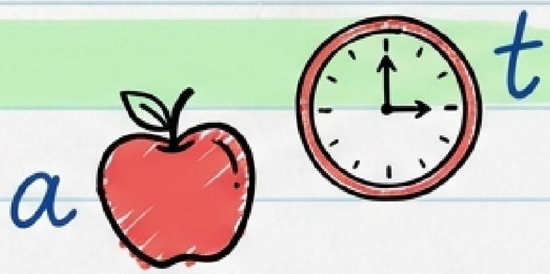
Understand the real-life situation clearly. (e.g., How much will the taxi cost?)

Step 2: Make Assumptions

Simplify the problem. Real life is messy; assumptions make it solvable.

Step 3: Define Variables

Choose symbols for unknown quantities.



Phase 2: Solving & Checking

- **Step 4: Formulate**
  Write equations or inequalities using mathematical concepts.
- **Step 5: Solve**
  Find the mathematical solution.
- **Step 6: Interpret**
  Translate the math answer back into real-life words.
- **Step 7: Validate**
  Check: Is the result reasonable? Does it make sense?

5. Example: The Taxi Ride

Real-life example!

The Problem:

- A taxi charges a fixed fare of ₹50.
- Plus ₹10 per km.
- Question: How do we model the total fare?

Identify: We need to find the cost based on distance.

Assume: The rate doesn't change; no waiting time charges.

Solving the Taxi Model

Step 3 (Define Variables):

- Let x = distance travelled (in km)
- Let y = total fare (in ₹)

Step 4 (Formulate):

Equation: $y = 50 + 10x$

Step 5 (Solve):

If distance is 5 km...

$y = 50 + 10(5)$

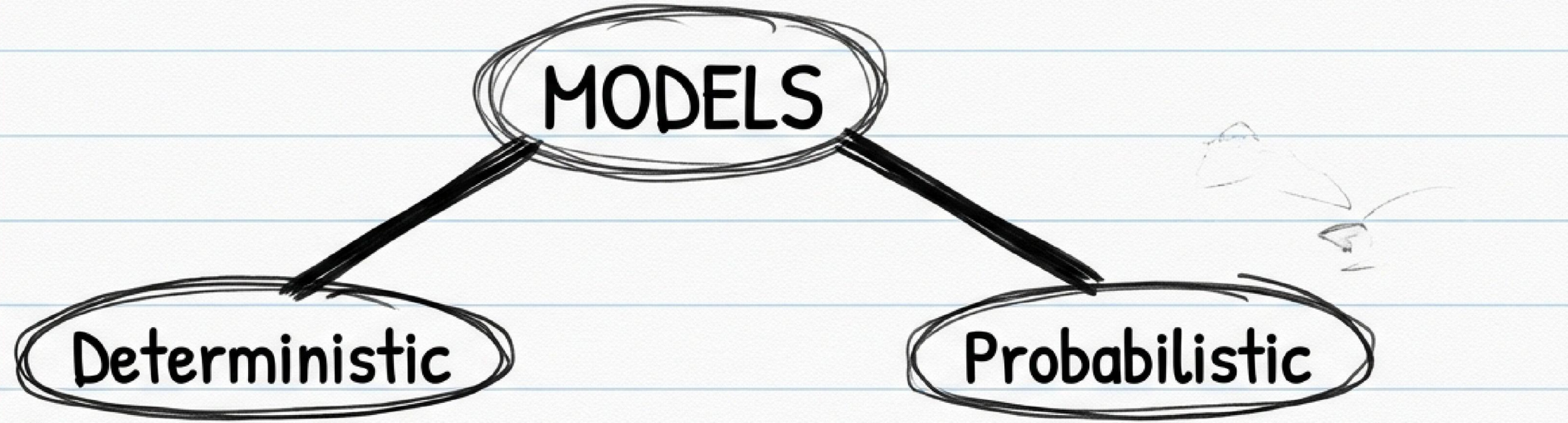
$y = 50 + 50$

$y = ₹100$

Step 6 & 7 (Interpret & Validate):

The fare for 5km is ₹100. Looks reasonable for a short trip!

4. Types of Models



Gives fixed outcomes.

Outcomes depend on chance.

Simple Interest ($I = P \times R \times T$)

Weather forecasting, rolling dice.

Also: Linear (straight lines) vs. Non-linear (curves).

Is it Useful? (Pros & Cons)

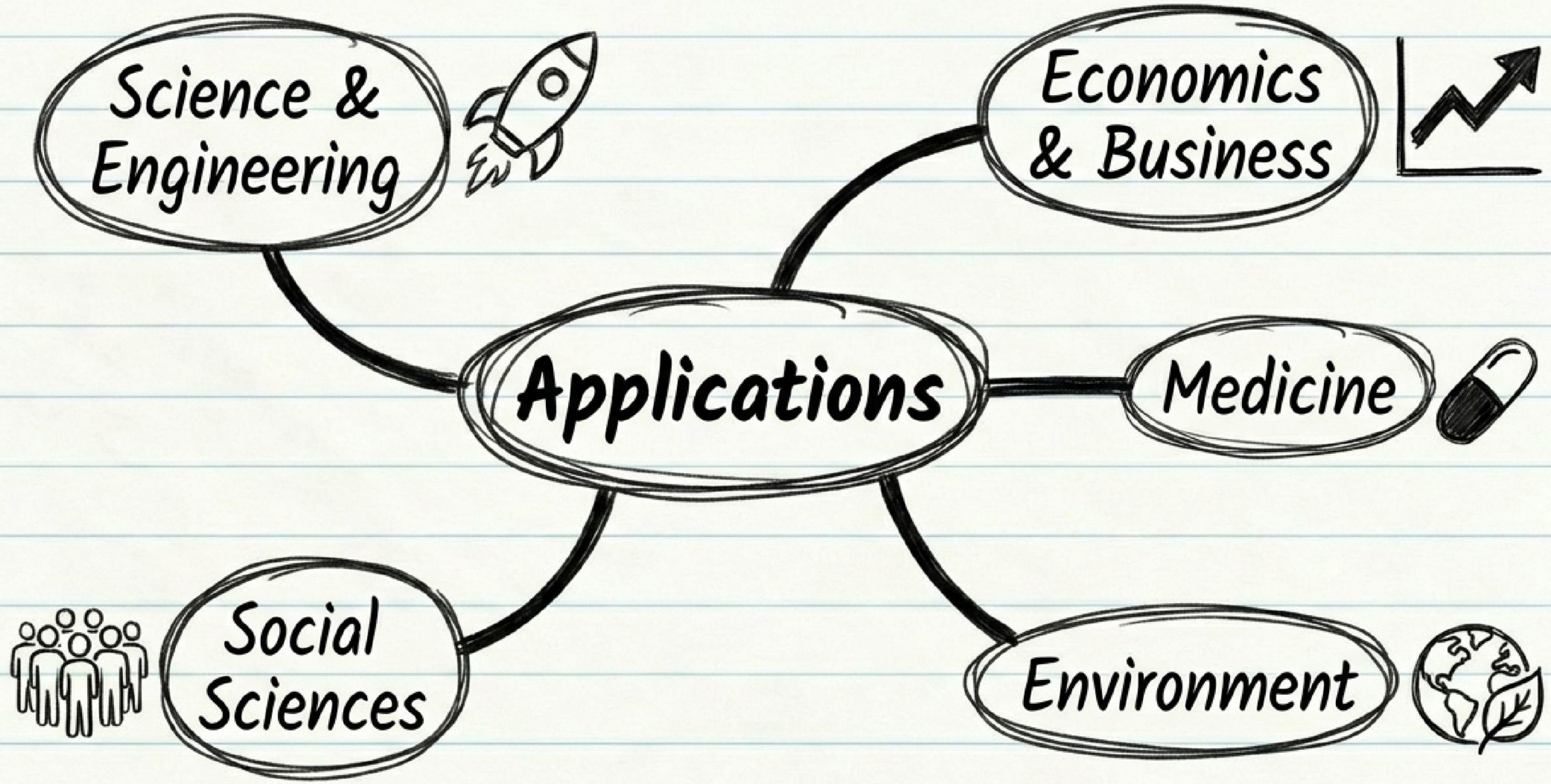
Advantages

- Simplifies complex real-life problems.
- Helps in prediction & decision-making.
- Saves time and cost.
- Improves understanding of systems.

Limitations

- Models depend heavily on assumptions.
- Results may not be exact.
- Real-life situations are often more complex than the maths.

8. Where is this used?



Pop Quiz! (Part 1)

Q1. Mathematical modelling deals with:

a) Only numbers
b) Only equations
c) Representation of real-life problems ✓
d) Geometry

Q2. Which is the first step in mathematical modelling?

a) Solving equations
b) Identifying the problem
c) Making graphs
d) Validation

Pop Quiz! (Part 2)

Q3. Which model gives fixed outcomes?

a) Probabilistic
b) Random
c) Deterministic ✓
d) Non-linear

Q4. In the model $y = 50 + 10x$, x represents:

a) Fare
b) Distance ✓
c) Speed
d) Time

Good luck with the exam!