

Mathematical Model and its Classifications

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Perspective

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DESCRIPTION

A mathematical model is a language and mathematical concepts-based description of a system. Mathematic modeling is the process of creating a computational formula. Mathematical models are utilized in natural sciences (physics, biology, earth science, chemistry), engineering disciplines (computer science, electrical engineering), and non-physical systems (such as the social sciences) (such as economics, psychology, sociology, political science). A big element of operational research involves the use of mathematical models to solve problems in business or military operations. Music, psychology, and philosophy all use statistical formulas (for example, intensively in analytic philosophy). A model may help in the description of a system, the study of the impacts of various components, and the prediction of behavior.

Elements of a mathematical model

Dynamical systems, statistical models, difference equations, and game-theoretic models are all examples of mathematical models. These and other types of models can mix up, with a single model including a wide range of abstract structures. In general, philosophical models could be included in mathematical models. In many cases, the quality of a scientific topic is determined by how well mathematical model models accord with the results of repeated experiments. As better theories are developed, a lack of concordance among mathematical model models and experimental observations frequently leads to major advancements.

A classic mathematical model in the physical sciences has the bulk of the following elements:

- Governing equations

- Supplementary sub-models
- Defining equations
- Constitutive equations
- Assumptions and constraints
- Initial and boundary conditions
- Classical constraints and kinematic equations

Classifications

Interactions and parameters are common elements of mathematical models. Operators such as algebraic operators, functions, dual operators, and others can be used to define relationships. Variables are quantifiable abstractions of system parameters of interest. According to their design, mathematical models can be classified using a variety of criteria:

Linear vs. nonlinear: If all of the operations in a mathematical formula are linear, the mathematical formalism is said to be linear. Otherwise, a model is deemed nonlinear. Linearity and non-linearity are defined differently depending on context, and linear models can contain nonlinear expressions. In a statistical linear model, for example, a connection is considered to be linear in the parameters but irregular in the predictors. Similarly, if a differential equation can be expressed using linear differential operators, it is said to be linear it can still include nonlinear expressions. If all of objective functions and restrictions in a mathematical programming are represented by linear equations, the model called a linear model. A nonlinear model is one in which one or more of the optimal solutions or constraints are represented by a system of equations.

Dynamic vs. static: A dynamical model accounts for changes in the state of the system over time, whereas a stable (or steady-state) model calculates the system in balance and is thus time-invariant. Differential equations or difference equations are commonly used to represent dynamic models.

Explicit vs. implicit: The model is said to be explicit if all of the input parameters are known and the outcome variables can be computed using a finite sequence of computations. Nevertheless, there are times when just the output parameters are known, and the matching inputs must be solved by using an iterative procedure like Newton's or Broyden's method. The model is said to be implicit in this scenario. For example, given a design thermodynamic process (air and fuel flow rates, pressures, and temperatures) at a specific flight condition and power setting, a jet engine's physical properties such as turbine and nozzle throat areas can be explicitly calculated, but the engine's operating cycles at other flight conditions and power settings cannot.

Discrete vs. continuous: A discrete model treats objects as discrete, such as particles in a molecular model or states in a statistical model, even though a continuous model represents objects as continuous, such as the velocity field of fluid in pipe flows, temperatures, and stresses in a solid, and an electric field that applies consistently over the entire model due to a point charge.