Overview

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Big Ideas

A **deterministic model** always produces the same output for the same initial conditions. In other words, a deterministic model does not include randomness. There are many different kind of deterministic models. Our study of deterministic models focuses solely on **systems of differe** Print to PDF **ons**.

We apply general **physical laws** to construct systems of differential equations. For example, we apply **Newton's second law of motion** to model objects in motion, we apply the **law of conservation of mass** to model chemical reactions, and we apply the **law of conservation of energy** to construct climate models.

The systems of differential equations we derive usually involve many **parameters** such as the mass of an object in motion or the heat capacity of a substance being heated. We apply the **nondimensionalization** procedure to scale the model variables to simply the model and provide insight into the system's behaviour in terms of the parameters.

Most systems of differential equations cannot be solved analytically in terms of explicit elementary functions therefore we use **numerical methods** to approximate solutions. We use **SciPy** to compute and visualize numerical solutions of differential equations.

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Learning Goals

- Apply physical laws to construct a deterministic model consisting of a system of differential equations
- Apply nondimensionalization procedure to differential equations and interpret dimensionless parameters
- Numerically approximate solutions of systems of differential equations