

Differential Equations

Master's degree in economics



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1. Introduction to Differential Equations
2. First-Order Ordinary Differential Equations (ODEs)

Introduction to Differential Equations

Definition of a Differential Equation

A differential equation is a mathematical equation that relates one or more functions and their derivatives. In other words, it describes the relationship between a function and its rate of change. The general form of a differential equation is:

$$F(x, y, y', y'', \dots, y^{(n)}) \quad (1)$$

Here:

- x is the independent variable.
- y is the dependent variable.
- y' is the first derivative of y with respect to x .
- y'' is the second derivative, and so on, up to the n -th derivative.

Types of Differential Equations

- **Ordinary Differential Equations (ODEs):** Ordinary Differential Equations (ODEs) can be classified into various types based on their properties, structure, and characteristics.
- **Partial Differential Equations (PDEs):** Partial Differential Equations (PDEs) are a type of differential equation that involves multiple independent variables and their partial derivatives with respect to those variables.

First-Order Ordinary Differential Equations (ODEs)

Separable Equations

A separable ordinary differential equation (ODE) is a specific type of differential equation where the variables and their derivatives can be "separated" on each side of the equation. This type of equation can be expressed as:

$$\frac{dy}{dx} = g(x)h(y) \quad (2)$$

Here, y is the unknown function of x , $\frac{dy}{dx}$ is its derivative with respect to x , and $g(x)$ and $h(y)$ are known functions.

Linear Equations

A linear ordinary differential equation (ODE) is an ODE where the dependent variable and its derivatives appear as linear terms. The general form of a linear first-order ODE is:

$$\frac{dy}{dx} + P(x)y = Q(x) \quad (3)$$

Where y is the dependent variable, $\frac{dy}{dx}$ is its first derivative with respect to x , $P(x)$ and $Q(x)$ are known functions of x .



Zill, D. G. (2012).

A first course in differential equations with modeling applications.

Cengage Learning.

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