

Chapter 1

Differential Equations

A **differential equation** is any equation that contains a derivative. Differential equations are often used to describe the flow of current or fluids as well as understand problems where the rates of change matter. [-2cm]

Differential equations that describe some physical process are often called **mathematical models**

1.1 Direction Fields

A **direction field** is a graphical way to show the rate of change (i.e. the derivative) at each point on a grid, done by evaluating the derivative at each point and drawing a short line to illustrate the result.

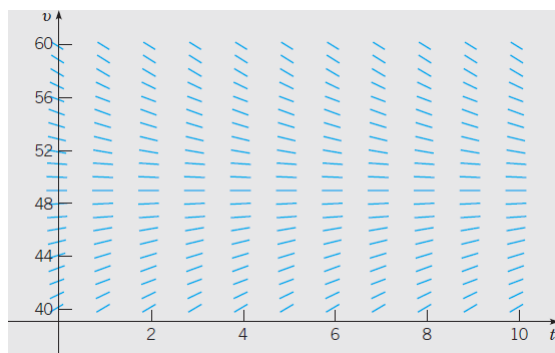


Figure 1.1: Example of a Direction Field

Source: Elementary Differential Equations 9th ed.

The fields are sometimes written in the form

$$\frac{dy}{dt} = f(t, y) \tag{1.1}$$

where f is the given function of the two variables t and y , sometimes called a **rate function**

The equation does not need to be solved, it must simply be evaluated for the various values of t and y to construct a direction field. This is best done on a computer