AMATH 250 — Lecture 1

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1.1   Introduction

What are differential equations? An informal definition is: *a differential equation (DE) is an equation that relates an unknown function to its own derivative(s).*

DEs are the language of science and engineering. Fundamental laws are expressed as DEs.

Example 1.1.1. *Classical mechanics*

$$v(t) = \frac{dx}{dt} \tag{1.1}$$

$$a(t) = \frac{dv}{dt} = \frac{d^2x}{dt^2} \tag{1.2}$$

$$\implies F(x) = m\frac{d^2x}{dt^2} \tag{1.3}$$

Example 1.1.2. *Lotka-Volterra equation*

Let $x(t)$ = number of prey. Let $y(t)$ = number of predators.

$$\frac{dx}{dt} = \alpha x - \beta xy \tag{1.4}$$

$$\frac{dy}{dt} = \delta xy - \gamma y \tag{1.5}$$