Day 3: June 30th

- Homework

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Differential Equations

- An equation for a missing function involving the derivative of the function
  - $$\frac{dy}{dt} = \sin(t) \cdot y^2$$
  - $$\frac{dy}{dt} = \sin(t)$$
  - $$\frac{dy}{dt} = y^2$$

First Order Equations

$$\frac{dy}{dt} = F(y, t)$$

Second Order Equations

$$\frac{d^2y}{dt^2} = F(y, \frac{dy}{dt}, t)$$

System of ODEs

$$F' = -\beta F + R \cdot F$$
$$R' = \alpha R - R \cdot F$$

$$\frac{dx}{dt} = F_1(x, y, z, t)$$
$$\frac{dy}{dt} = F_2(x, y, z, t)$$
$$\frac{dz}{dt} = F_3(x, y, z, t)$$

Solutions

Solution to $\dfrac{dy}{dt} = F(y, t)$

is a function that “works”.

Example: $\dfrac{dy}{dt} = \sin(t)$

Solutions:

$$y_1(t) = -\cos(t)$$

$$y_2(t) = -\cos(t) + 5$$

$$y_3(t) = -\cos(t) + k$$

NOT $y_4(t) = \cos(t)$

Verify Solutions

You can always check solution

Example: $$\frac{dy}{dt} = y(1-y)$$

Joe Schmoe hands you solution $$y(t) = \frac{e^t}{e^t - 1}$$

Plug in and see if "=" holds

You solve using integration

Special Cases

what to do?

- case 1: $$\frac{dy}{dt} = F(t)$$ integrate

- case 2: $$\frac{dy}{dt} = F(y)$$ autonomous

  separate and integrate

- case 3: $$\frac{dy}{dt} = F(y, t)$$ depends!

General Solution

"Family" of functions that may be used to solve <u>any</u> initial value problem

i.e. <u>all</u> possible solutions

Initial value problem: $y(t_0) = y_0$

Examples

$$\frac{dy}{dt} = y - 3 = F(y)$$

$$\frac{dy}{dt} = \sin(t) \cdot y^2 \qquad y(0) = 1 \quad y(0) = 0$$

$$\frac{dy}{dt} = 1 + y^2 = F(y) \qquad y(0) = \alpha$$

$$\frac{dy}{dt} = y^2$$

Homework

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	1.3	Page 48 #1, 7, 9, 11, 13, 15, 17.