

# SCALING OF DIFFERENTIAL EQUATIONS

DFHE

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## 1. REAL WORLD PROBLEM

## 2. ASSUMPTIONS

## 3. PROBLEM FORMULATION

Consider a decaying substance. Let  $\hat{m} = \hat{m}[\hat{t}]$  represent <sup>1</sup> the mass of the substance at any time  $\hat{t}$ . If we hypothesise that the mass temporal change is proportional to the present amount of mass and add the condition that, at the beginning, mass equals the initial mass, then we have that

$$\begin{cases} -\frac{d\hat{m}}{d\hat{t}} = k\hat{m}, \\ \hat{m}[0] = \hat{m}_0. \end{cases} \quad (1)$$

## 4. SOLUTION

### 4.1. Guessing.

### 4.2. Dimensional analysis.

### 4.3. Extreme cases.

### 4.4. Analytic solution.

#### 4.4.1. Non-dimensionalization.

#### 4.4.2. Normalization.

#### 4.4.3. Analytical solution.

#### 4.4.4. Dimensional solution.

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*Date:* 2014.12.16.

<sup>1</sup> Hats are used to represent *dimensional* quantities.

## 5. SOLUTION PLOT

## 6. INTERPRETATION OF THE SOLUTION

## 7. MODEL VERIFICATION

## 8. REPORT

8.1. **Report.**

8.2. **Explain.**

8.3. **Predict.**