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# **Example 1:**

# **Mass-Spring-Damper System**

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# Case 1

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**Ideal Model:**

$$m\ddot{x} + c\dot{x} + kx = 0 \quad \begin{cases} m &= 1.0 \\ c &= 0.5 \\ k &= 3.0 \end{cases}$$
$$\begin{cases} x(0) = 4.0 \\ \dot{x}(0) = 0.0 \end{cases}$$

To the clean data points, we might add the noise  $\epsilon \sim \mathcal{N}(0, \sigma_N^2)$

**Computational Model:**

$$m\ddot{x} + c\dot{x} + kx = 0 \quad \begin{cases} m &= 1.0 \\ c &= ? \\ k &= ? \end{cases}$$
$$\begin{cases} x(0) = 4.0 \\ \dot{x}(0) = 0.0 \end{cases}$$

**Case 1.1:**  $\sigma_N = 0.0$      $\sigma_L = 0.01$

**Case 1.2:**  $\sigma_N = 0.0$      $\sigma_L = ?$

**Case 1.3:**  $\sigma_N = 0.1$      $\sigma_L = ?$

Likelihood Function is a Gaussian with  $\sigma_L$