

# Assignment for Research and Development/AI

## 1) L1 Distance (uniformly sampled $t \in [6, 60]$ )

- Total L1 = 37865.095535
- Average L1 per point = 25.243397

## 2) Explanation of Process

**Goal:** Estimate unknowns  $\theta$ ,  $M$ ,  $X$

$$x(t) = t \cos \theta - e^M t \sin(0.3t) \sin \theta + X$$

$$y(t) = 42 + t \sin \theta + e^M |t| \sin(0.3t) \cos \theta.$$

**Data:** The CSV contains only (x,y) points. Following the prompt ("uniformly sampled points"), we reconstruct  $t$  via:

$$t_i = 6 + i \cdot \frac{60-6}{N-1}, \quad i=0, \dots, N-1.$$

**Metric:** Minimize **L1 distance**

$$L1 = \sum_i (|x_i - x(t_i)| + |y_i - y(t_i)|).$$

**Method:**

1. Load CSV, set uniform  $t \in [6, 60]$ .
2. Define model  $x(t)$ ,  $y(t)$  as above.
3. Use bounded optimization (respecting ranges:  $\theta \in (0, 50^\circ)$ ,  $M \in (-0.05, 0.05)$ ,  $X \in (0, 100)$ ) to minimize L1.
4. Converged parameters:
  - $\theta = 0.490777338$  rad  $\approx 28.13^\circ$
  - $M = 0.0213825022$
  - $X = 54.8999932$

### Resulting curve (LaTeX)

$$\begin{aligned} & \$\left( t \cos(0.490777338) - e^{0.0213825022} |t| \sin(0.3t) \sin(0.490777338) + 54.8999932, \right. \\ & \quad \left. 42 + t \sin(0.490777338) + e^{0.0213825022} |t| \sin(0.3t) \cos(0.490777338) \right) \$ \end{aligned}$$