Assignment: Weighted Least Squares Fitting of Silver Grade vs. Zinc Grade

Introduction

In this assignment you will fit a dataset of **silver grade vs. zinc grade** using a **straight line**, a **second-order polynomial**, and an **exponential function**. The zinc grade is treated as the independent variable and the silver grade as the dependent variable.

Data

Data is provided in the CSV file

Part A — Normal Equations Approach for Weighted Least Squares (L2)

Let the weights be defined as

$$w_i = \frac{1}{\sigma_i^2},$$

where σ_i is the error in the silver grade measurement.

A1) Weighted Straight Line Fit

Fit the straight line model

$$y = a + bx$$

using the weighted normal equations.

- Report the fitted parameters a and b.

- Compute and report the RMS error of the residuals.

- Compute and report the coefficient of determination R^2.

A2) Weighted Quadratic Fit

Fit the second-order polynomial model

$$y = a + bx + cx^2$$

using the weighted normal equations.

- Report the fitted parameters a, b, and c.

- Compute and report the RMS error of the residuals.

- Compute and report the coefficient of determination R^2.

A3) Plot and Model Comparison

Create a plot that includes:

- the data points with error bars in silver grade,

- the fitted straight line,

- the fitted quadratic curve.

Answer the following questions:

1. Which model provides the better fit based on RMS error and R^2?

2. Are there regions where either model appears invalid or physically unrealistic?