Numerical Practice Worksheet: Regression

Problem 1: Manual Prediction with Given Coefficients

You are given a linear regression model:

$$y = 4x_1 + 2x_2 + 3$$

Data points:

x1	x2
1	2
0	3
2	1

Tasks:

- Calculate the predicted value (y) for each data point.

- What is the interpretation of the coefficient 4 for x1?

Problem 2: Calculate Regression Error Metrics

Given:

Actual values: y = [10, 20, 30, 40]

Predicted values: y = [12, 18, 33, 35]

Tasks:

1. Compute Mean Absolute Error (MAE)

2. Compute Mean Squared Error (MSE)

3. Compute Root Mean Squared Error (RMSE)

4. Compute R2 Score using the formula:

$$R2 = 1 - [(yi - yi)2 / (yi - y)2]$$

Problem 3: Estimate Coefficients using Least Squares

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Given dataset:

x	y
1	2
2	4
3	5
4	4
5	5

Tasks:

- Compute slope (m) and intercept (c) using:

$$m = [nxy - xy] / [nx2 - (x)2]$$
$$c = [y - mx] / n$$

- Write the regression equation y = mx + c

- Predict y for x = 6

Problem 4: Overfitting with Polynomial Regression

Dataset:

x	y
1	2
2	4
3	6
4	8
5	50

Tasks:

- Fit a Linear Regression model and calculate RMSE.

- Fit a Polynomial model (degree 4) that fits all points exactly.

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- Predict for x = 6 and discuss how overfitting affects generalization.

Problem 5: Lasso vs Ridge Penalty Calculation

Given coefficients: = [10, -2, 4]

 = 0.5

Formulas:

- Ridge Penalty: L2 = * (i2)
- Lasso Penalty: L1 = * |i|

Tasks:

- Compute Ridge and Lasso penalties.
- Discuss which penalty affects large coefficients more and why.