Least Square Method

Key Formulas

1. **Regression Line Equation**

   Y = mx + b

   m: slope

   b: intercept

2. **Slope(m):**

$$m = \frac{n\sum(x_i y_i) - \sum x_i \sum y_i}{n\sum(x_i^2) - (\sum x_i)^2}$$

3. **Intercept(b):**

$$b = \frac{\sum y_i - m\sum x_i}{n}$$

4. **Prediction:**

$$\hat{y} = mx + b$$

5. **Residuals (Error):**

$$e_i = y_i - \hat{y}_i$$

6. **Mean Squared Error (MSE):**

$$\text{MSE} = \frac{1}{n}\sum(y_i - \hat{y}_i)^2$$

Gradient Descent

Key Formulas

1. **Regression Line Equation:**

   y=mx+b

2. **Cost Function (Mean Squared Error):**

$$J(m,b) = \frac{1}{n}\sum_{i=1}^{n}(y_i - (mx_i + b))^2$$

3. **Gradients (Partial Derivatives):**

   - For Slope (m):

$$\frac{\partial J}{\partial m} = -\frac{2}{n}\sum_{i=1}^{n} x_i \cdot (y_i - (mx_i + b))$$

   - For Intercept (b):

$$\frac{\partial J}{\partial b} = -\frac{2}{n}\sum_{i=1}^{n}(y_i - (mx_i + b))$$

4. **Update Rules:**
   - Update m:

$$m = m - \alpha \cdot \frac{\partial J}{\partial m}$$

   - Update b:

$$b = b - \alpha \cdot \frac{\partial J}{\partial b}$$

Where α is the learning rate.

Normal Equation

$$\mathbf{w} = (\mathbf{X}^\top \mathbf{X})^{-1} \mathbf{X}^\top \mathbf{y}$$