Lecture: Motivation behind the MSE
Learning objectives

In this lecture we will...

• Present the most common evaluation measures used for regression models (the Mean Squared Error)
• Motivate the choice of this particular error measure using statistics and probability
Q: How should we evaluate our regression model?
Q: Can we find a line that (approximately) fits the data?

\[ y_i - X_i \cdot \theta \]

Error between correct value and prediction.
Concept: Mean Squared Error

Mean-squared error (MSE)

\[ \frac{1}{N} \| y - X \theta \|_2^2 \]

\[ = \frac{1}{N} \sum_{i=1}^{N} (y_i - X_i \cdot \theta)^2 \]
Q: Why MSE (and not mean-absolute-error or something else)
Regression diagnostics

\[ y_i - X_i \cdot \theta \]

label = prediction + error

\[ y_i = X_i \cdot \theta + \mathcal{N}(0, \sigma) \]
Regression diagnostics

\[ p_\theta(y|X) = \prod_i \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(y_i - X_i \cdot \theta)^2}{2\sigma^2}} \]

\[
\max_\theta p_\theta(y|X) = \max_\theta \prod_i e^{-(y_i - X_i \cdot \theta)^2} = \min_\theta \sum_i (y_i - X_i \cdot \theta)^2
\]
Summary of concepts

• Understand the motivation behind the MSE in terms of probability
• Understand the notion of "error distributions"
• (at a high level) understand the relationship between likelihood (probability) and error (prediction)

On your own...

• Compute MSE and related statistics (like Mean Absolute Error) and compare cases where the errors are high and low