Closed-Form

20CP401T

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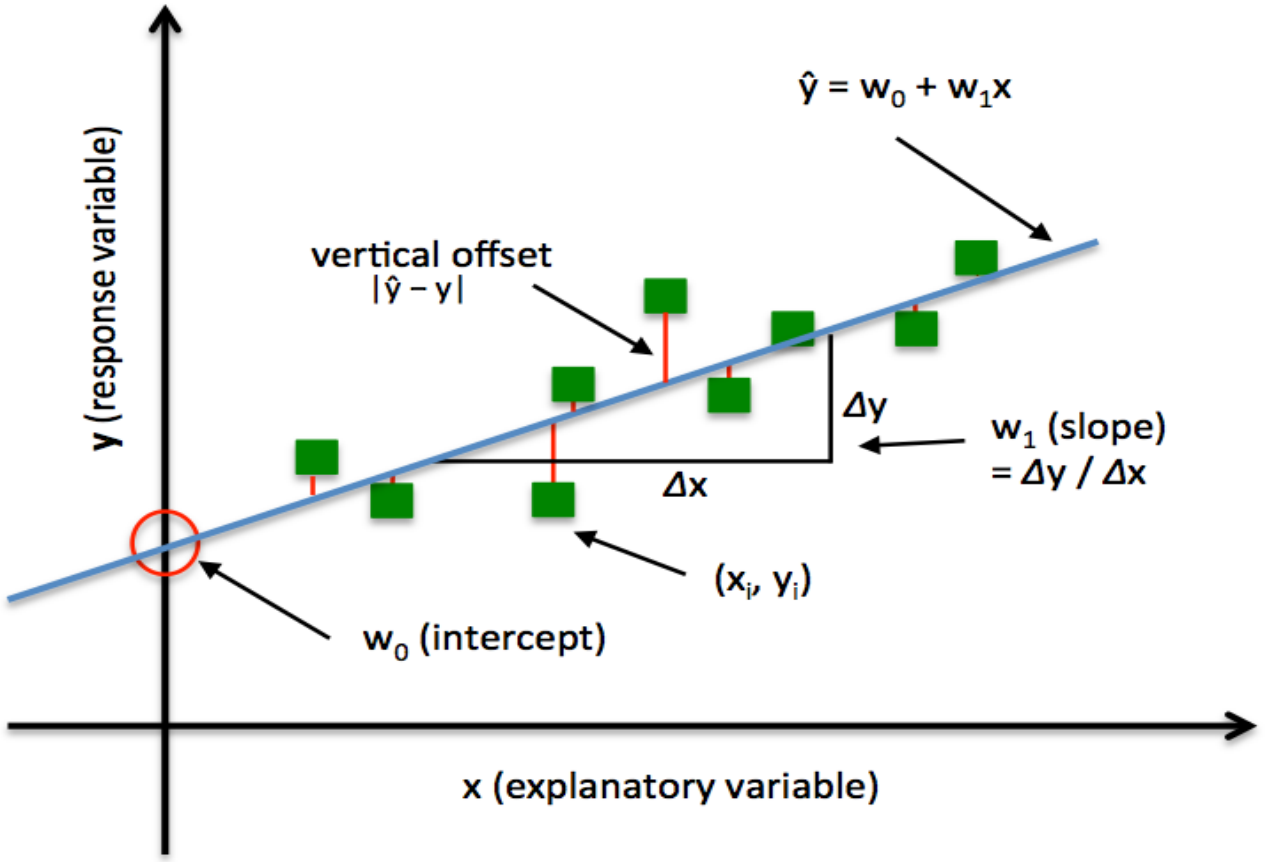
Closed-Form Solution to Linear Regression

- Closed-form solutions should always be used instead of iterative algorithms if they're available, as it's the most direct way to find the optimal solution.



What is a closed-form solution?

- A closed-form solution is an equation which can be solved in terms of functions and mathematical operations.
- Solving the model parameters analytically (closed-form equations).
- Closed-form solutions are desirable because they often provide an efficient and exact way to solve certain problems.
- One of the most well-known examples of a closed-form solution in linear regression, where the goal is to find the best-fitting line through a set of data points.
- The closed-form solution can be computed using the least squares method, and the formula for calculating the coefficients is

$$W = (X^T X)^{-1} X^T Y$$

What is a closed-form solution?

- W is the vector of coefficients (including the intercept and slope) that define the linear relationship.
- X is the design matrix that includes the input features (each row corresponds to a data point, and each column corresponds to a feature).
- Y is the vector of target values.
- Using the closed-form solution, you can directly compute the coefficients W without needing to use iterative optimization algorithms like gradient descent.

What is a closed-form solution?

- However, closed-form solutions are not always possible or practical for more complex machine learning models, especially when dealing with deep neural networks and non-linear models.

Advantages of closed-form solutions:

- They provide an exact solution without the need for iterative optimization.
- They can be computationally efficient for small to moderate-sized datasets and simple models.
- They might offer insights into the problem's structure and relationships.

What is a closed-form solution?

Disadvantages of closed-form solutions:

- They might not exist for more complex models or non-linear problems.
- Computationally intensive for large datasets or high-dimensional problems.
- They can be sensitive to issues like multicollinearity or numerical instability.