Advance Proofs (Only for curious)

They are not usually asked, but for PhD roles, research or applied scientist roles, mathematical understanding is important. Not relevant or intuitive in industry

Derivation of the Ordinary Least Squares (OLS) Estimates

Interviewer's Expectation: Understanding how the coefficients in a linear regression model are calculated.

Mathematical Explanation:
The goal of OLS is to minimize the sum of the squared residuals. If we have a model:
$Y=X\beta+\epsilon$
Y=Xβ+ϵ
Where:

- YY is the dependent variable vector.
- XX is the matrix of independent variables (including a column of ones for the intercept).
- $\beta\beta$ is the vector of coefficients.
- $\epsilon\epsilon$ is the vector of errors.
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The sum of squared residuals (SSR) is given by
$SSR=(Y-X\beta)^T(Y-X\beta)$

To find the minimum SSR, we take the derivative of SSR with respect to β, set it to zero, and solve for β:

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$$\frac{\partial SSR}{\partial \beta} = -2X^T(Y - X\beta) = 0$$
$$X^TY = X^TX\beta$$
$$\beta = (X^TX)^{-1}X^TY$$

This result, $\beta = (X^TX)^{-1}X^TY$, is known as the OLS estimator.

This result, β=(XTX)−1$XTY\beta$=(XTX)−1XTY, is known as the OLS estimator