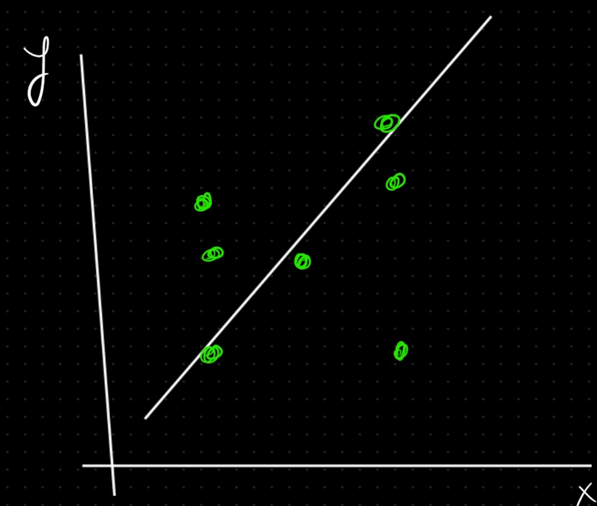
Performance Metrics

Mean Squared Error (MSE), Mean Absolute Error (MAE), and Root Mean Squared Error (RMSE) are commonly used metrics to evaluate the performance of regression models.

cost Function
[Error]

① Mean Squared Error (MSE):



$$\boxed{M.S.E = \frac{1}{n} \sum_{i=1}^{n} (y_i - \hat{y}_i)^2}$$

n = number of data points

y_i = Actual value of data point

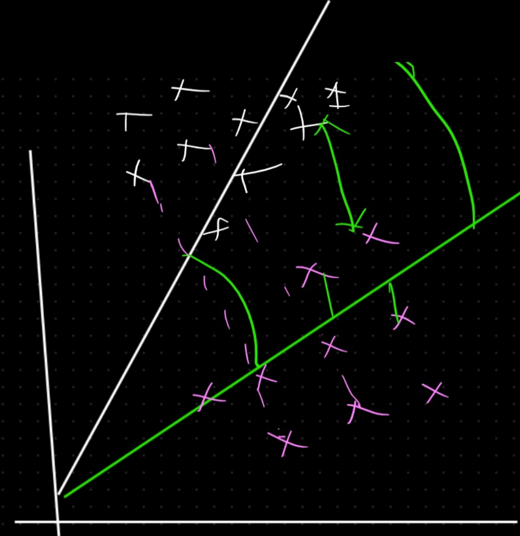
$\hat{y}$ = predicted value of data points

1. MSE measures the average squared difference between the actual and predicted values.

2. It penalizes larger errors more heavily than smaller ones because of the squaring operation.

outlier

Outliers [1, 2, 3, 4, 5, 100]



② Mean Absolute Error

$$MAE = \frac{1}{n} \sum_{i=1}^{n} |y_i - \hat{y}_i|$$

1. MAE measures the average absolute difference between the actual and predicted values.

2. It doesn't penalize larger errors as heavily as MSE since it doesn't involve squaring the errors.

↑

outliers (MAE)

III) Root Mean Squared Error

(RSME)

$$RSE = \sqrt{MSE}$$

→ It's often used to interpret the error in the same units as the target variable.

Eg: House Price Prediction

Price (INR)

↓

unit

MSE → unit → $(INR)^2$

RSME → $\sqrt{INR^2} = INR$

↓

same unit

	outliers	unit	Error
MSE			
MAE	✓		✓
RSME		✓	

Differences:

Penalty for Errors: MSE penalizes larger errors more heavily due to squaring, while MAE treats all errors equally.
Magnitude: MSE typically yields higher values than MAE because of the squaring operation.
Interpretability: RMSE is interpretable in the same units as the target variable, whereas MSE and MAE are not because they involve squaring and absolute values, respectively.

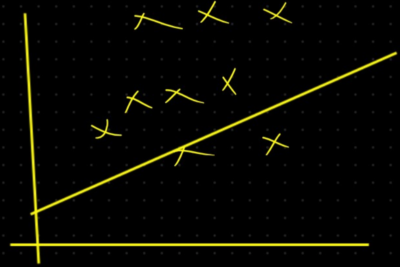
In summary, MSE, MAE, and RMSE are all measures of the error between actual and predicted values in a regression model, with each having its own characteristics and use cases.

R^2 and Adjusted R^2

Goodness of Fit

↓

Accuracy



1. R-squared (R^2) and Adjusted R-squared (Adjusted R^2) are both metrics used to evaluate the goodness of fit of a regression model.

$$\boxed{R^2 = 1 - \frac{SS_{res}}{SS_{total}}}$$

→ Res (Error)

They quantify the proportion of the variance in the dependent variable that is predictable from the independent variables.

$$SS_{res} = SSE = \sum (y_i - \hat{y})^2$$

$$SS_{Total} = \frac{1}{n} \sum_{i=1}^{n} (y_i - \hat{y})^2$$

$$R^2 = [0, 1]$$

size → Model → price

Accuracy → 80% → $R^2 = 0.8$

Size	No. of Rooms	Location	Gender	Price
f1	f2	f3		

Importanu

Accuracy → 90% = $R^2 = 0.90$

Accuracy → 92% = $R^2 = 0.92$

Adjusted R^2

$$= 1 - \frac{(1-R^2)(n-1)}{n-K-1}$$

n = no of data points

R^2 = R Squared

K = No of Independent feature

92%　　　　90%

R^2 = 80%　　　　Adjusted R^2 = 75%

Example of R^2

Suppose we have a simple linear regression model and the calculated R-squared value is 0.75. It means that 75% of the variance in the dependent variable is explained by the independent variable(s) in the model, and the remaining 25% is unexplained.

Example of Adjusted R^2

Example:
If we have an adjusted R-squared value of 0.70, it means that 70% of the variance in the dependent variable is explained by the independent variables in the model, adjusted for the number of predictors. The remaining 30% is unexplained or accounted for by factors not included in the model.

Differences:

Adjustment for Model Complexity: Adjusted R-squared penalizes the addition of unnecessary predictors, whereas R-squared does not.
Interpretation: Adjusted R-squared may be more appropriate when comparing models with different numbers of predictors, as it accounts for model complexity.
Value Range: R-squared and Adjusted R-squared have the same interpretation range (0 to 1), with higher values indicating better fit, but Adjusted R-squared may be lower than R-squared when additional predictors do not improve the model significantly.

$95 \rightarrow 0.95 \rightarrow$ Goodness of Fit

$R^2 >$ Adjusted R^2

$R^2 \rightarrow 95\%$
Adjusted $R^2 \rightarrow 90\%$

In summary, R-squared and Adjusted R-squared are both useful metrics for assessing the goodness of fit of regression models, with Adjusted R-squared being more appropriate when comparing models with different numbers of predictors.