Types of Regression

Linear Regression: Predict a continuous outcome using a single independent variable.

$$y = mx + b + \epsilon$$

- y: Dependent variable.
- x: Independent variable.
- m: Slope (indicates the rate of change of y with respect to x).
- b: Intercept (value of y when $x = 0$).
- ϵ: Error term.

Multiple Linear Regression: Predict a continuous outcome using multiple independent variables.

$$y = b_0 + b_1x_1 + b_2x_2 + \cdots + b_nx_n + \epsilon$$

- y: Dependent variable.
- $x_1, x_2, \ldots, x_n$: Independent variables (features).
- b_0: Intercept.
- $b_1, b_2, \ldots, b_n$: Coefficients (indicating the effect of each independent variable on y).
- ϵ: Error term.

Logistic Regression: Predict a binary outcome (classification) instead of a continuous value.

$$P(y = 1|x) = \frac{1}{1 + e^{-(b_0 + b_1x_1 + b_2x_2 + \cdots + b_nx_n)}}$$

- $P(y = 1|x)$: Probability that the target outcome is 1 given the features.
- The output is transformed into a binary prediction using a threshold (e.g., $P > 0.5$).

When to Use Regression Analysis

Use Linear or Multiple Linear Regression When:
You want to predict a continuous dependent variable.
The relationship between dependent and independent variables is approximately linear.

Use Logistic Regression When: Your dependent variable is categorical (binary or multiclass).

Type of Regression	Target Variable	Use Case	Output
Linear Regression	Continuous	Predicting house prices, sales, etc.	A numeric value (e.g., $100,000).
Multiple Linear Regression	Continuous	Predicting with multiple factors (e.g., house price based on size and location).	A numeric value.
Logistic Regression	Binary/Categorical	Predicting pass/fail, churn, etc.	A probability (thresholded to 0/1).