Lesson 9: The Cost Function

◇ Introduction

Welcome to Lesson 9!
So far, we've learned how linear regression finds the best line to fit the data. But how does it know which line is the "best"?
That's where the cost function comes in — it's the heart of how machine learning models learn.
In this lesson, you'll:

- Understand what a cost function is
- Learn why it's essential in training models
- Explore one of the most common cost functions: Mean Squared Error (MSE)
- Visualize and implement it in Python

◇ What is a Cost Function?

A cost function is a mathematical formula that tells us how wrong our model's predictions are.
In simple terms, it measures the error between the predicted output and the actual output.
👉 The smaller the cost, the better the model is performing.

◇ Why Do We Need It?

Every time we make predictions, we need a way to judge their quality.
The model adjusts its internal parameters (like weights w and bias b) to minimize the cost — this is the learning process.

◇ The Mean Squared Error (MSE)

In linear regression, the most common cost function is:
Where:

$$MSE = (1/n) * SUM(Y_i - \hat{y}:)^2$$

- Y_i : Actual value
- $\hat{y}$: Predicted value
- n: Number of data points

◇ Visual Intuition

Imagine a curved bowl.

- The bottom of the bowl represents the lowest cost.
- Your model starts somewhere on the slope and slides down using an algorithm like gradient descent to find the lowest point.

◇ Summary Table

Term	Meaning
Cost Function	**A function that measures model prediction error**
MSE	**Average squared difference between actual and predicted values**
Lower Cost	**Indicates a better model**
Goal of Training	**Minimize the cost to improve predictions**

🧠 Mini Exercise (Optional)

Try changing the predicted values in the code above and see how the MSE changes.
Can you find predictions that give a lower cost?

◇ Outro

Awesome! You just learned:

- ✅ What a cost function is
- ✅ Why it's important
- ✅ How to compute Mean Squared Error
- ✅ How it connects to the learning process