📊 Voting Ensemble – Regression (Part 3)

1. Core Idea

- Just like classification, we can combine multiple regression models.
- Instead of voting for classes, we **average the predictions of regressors**.
- Goal: Reduce error by balancing the weaknesses of individual models.

2. How It Works

Suppose we want to predict **house prices**.

- **Model A (Linear Regression)** predicts: 250k
- **Model B (Decision Tree Regressor)** predicts: 270k
- **Model C (Random Forest)** predicts: 260k

👉 **Simple Voting (Average)** = (250k + 270k + 260k)/3 = **260k**.

So, the final prediction is the **mean** of all model predictions.

3. Types of Voting in Regression

Unlike classification (hard vs soft), regression has:

1. **Simple Averaging**
    1. Each regressor's prediction is equally weighted.
    2. ***Formula:***

$$\hat{y} = \frac{1}{n}\sum_{i=1}^{n}\hat{y}_i$$

2. **Weighted Averaging**
    1. Some models perform better, so we give them higher weight.
    2. ***Formula:***

$$\hat{y} = \frac{\sum_{i=1}^{n} w_i \cdot \hat{y}_i}{\sum_{i=1}^{n} w_i}$$

    3. **Example:** If Random Forest is stronger, weight it more.

4. When to Use Voting Regressor?

❖ Works well when:

- Models are **diverse** (e.g., linear + tree-based + ensemble).

- Each model captures different parts of the pattern.

❖ Be careful:

- If all models are **weak** → averaging won't help much.
- If one model is much better than others → use **weighted averaging**.

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5. Intuition (Easy Analogy)

Imagine you want to guess someone's age from a photo:

- Person A (Linear thinker) says: 25.
- Person B (Tree thinker) says: 30.
- Person C (Random guesser but usually good) says: 28.

Final guess = average = 27.6 → usually closer to the truth than relying on a single person.

✓ Final Takeaway:

- **Voting in regression = averaging predictions.**
- **Simple averaging** = all models equal.
- **Weighted averaging** = stronger models get more say.
- It reduces variance, increases robustness, and usually improves performance.
