

Project: Predicting Energy Efficiency of Buildings

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1. Project Overview

For this project, I explored how building design features influence heating energy consumption. I used the **UCI Energy Efficiency dataset**, which contains 768 simulated buildings with features such as surface area, roof area, compactness, and orientation.

The goals of this project were:

- Predict heating energy (Heating Load) using machine learning models.
 - Identify which building features have the biggest impact on energy consumption.
 - Suggest practical ways to design buildings more energy-efficiently.
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2. Model Training and Evaluation

I trained **Linear Regression** and **Random Forest** models. The results on the test set:

Model	R ²	RMSE
Linear Regression	0.921	2.87
Random Forest	0.997	0.53

My thoughts:

- Linear Regression is already quite good, explaining about 92% of the variation in heating load.

- Random Forest is more accurate and reliable, so I used it to analyze feature importance.

3. Most Important Features

From the Random Forest model, the top 5 features affecting heating load:

Rank	Feature	Importance	My interpretation
1	X1	0.390	Relative Compactness – more compact buildings lose less heat
2	X2	0.239	Surface Area – larger buildings need more heating
3	X5	0.123	Roof Area – bigger roofs increase heating needs
4	X4	0.116	Overall Height – taller buildings can lose more heat
5	X7	0.089	Orientation – affects sunlight exposure

4. My Business Recommendations

Based on the model insights, I suggest the following:

1. Increase building compactness (X1)

- More compact buildings consume less energy.
- **Recommendation:** design buildings with a lower perimeter-to-area ratio.

2. Optimize total surface area (X2)

- Less external surface reduces heat loss.
- **Recommendation:** minimize walls and roof surfaces where possible.

3. Optimize roof area (X5)

- Roof size and insulation significantly influence heating load.
- **Recommendation:** use compact roof designs or better insulation materials.

Expected impact:

- Implementing these suggestions can reduce heating energy consumption and save costs for building owners.
- These changes also contribute to lower CO₂ emissions and more sustainable building designs.