

Report Summary

Key Patterns in the Dataset

- The dataset comprises 768 rows and 10 columns, with no missing values.
- Features include variables like X1 (Relative Compactness), X2 (Surface Area), X3 (Wall Area), and target variables Y1 (Heating Load) and Y2 (Cooling Load).
- Significant correlations:
 - X5 (Roof Area) has the highest positive correlation with both Y1 and Y2.
 - X4 (Overall Height) has a strong negative correlation with both energy loads.

Preliminary Insights

- Heating and Cooling Loads by Feature Groups:
 - X1 (Relative Compactness): Higher compactness leads to increased energy loads.
 - X2 (Surface Area): Larger surface areas are associated with lower energy loads.
 - X5 (Roof Area): Higher roof areas significantly increase energy loads.
 - Window-to-Wall Ratio: A moderate positive influence on energy loads is observed.

Cleaning and Feature Engineering

- Added WindowToWallRatio as a new feature by dividing X7 (Glazing Area) by X3 (Wall Area).
 - Justification: This ratio quantifies the glazing's contribution to energy efficiency, a critical factor in sustainable design.

Model Selection and Evaluation

- Linear Regression - y1: MAE=2.2953992214890038, RMSE=3.094244651236173, R2=0.9081442132281958
- Random Forest - y1: MAE=0.37550541324851044, RMSE=0.5024884823420074, R2=0.9975775799808709
- Linear Regression - y2: MAE=2.2168877472257376, RMSE=3.1803512146674215, R2=0.8908381666480136
- Random Forest - y2: MAE=2.3609662626553622, RMSE=1.7478174561674973, R2=0.9670304666563787

Performance Comparison

- Feature Importance (Random Forest):
 - Top predictors for Y1 and Y2: X5 (Roof Area), X1 (Compactness), and X4 (Overall Height).
 - Feature importance aligns with correlation analysis.

Key Findings

1. Roof area (X5) is the most influential factor, positively impacting energy loads.
2. Increasing building compactness (X1) and wall area (X3) reduces energy loads.
3. Window-to-Wall ratio has a minor but notable influence.

Recommendations for Sustainable Building Design

- Optimize roof area and glazing-to-wall ratio to reduce heating and cooling requirements.
- Design compact buildings with moderate height to minimize energy consumption.
- Incorporate energy-efficient glazing and insulation strategies.