Evaluating High-Voltage Battery Performance in the BMW i3 (60 Ah)

Group 8

2024/12/17

Project Overview

- Objective: Predict battery performance of electric vehicles
  - Data: Information on 72 driving trips of a BMW i3
  - Outcome: Battery consumption (difference between the start and end battery levels)
  - Features:
    a) **Environment:** weather, route, area
    b) **Vehicle:** distance, speed, battery temperature, cabin temperature
- Questions
  - Which models predict battery consumption better: **Linear Models** or **Tree-Based Models**?
  - Which features are more important for predicting battery usage: **Environment** or **Vehicle**?
- Approach
  - Test/training data split
  - Models: **Linear Models** and **Tree-Based Models**

Model Performance Summary

1. Outcome variable: Battery consumption
   1) MSE

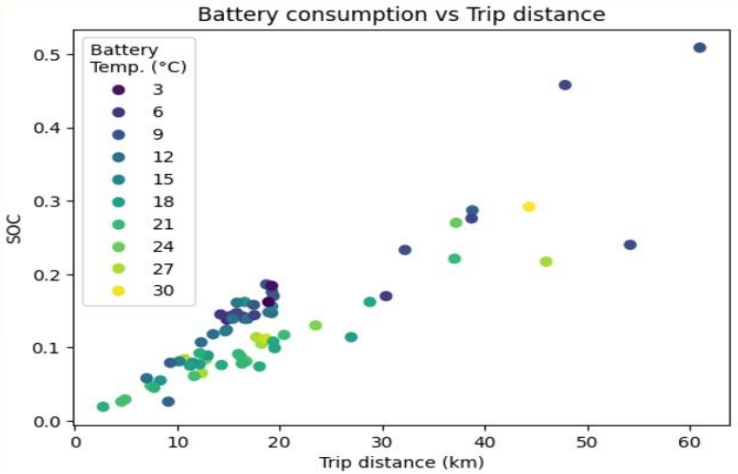
	Training MSE	Test MSE
OLS	0.4	6
Lasso	1.4	3
Ridge	0.5	4
Decision tree	0	6.4
Random forest	0.2	18

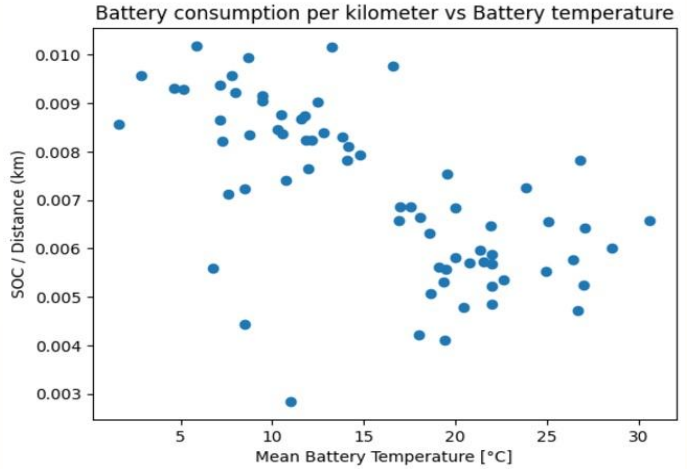
   2) Feature importance: Distance (>0.90), battery/ambient temperature (~0.05), others (< 0.01)

2. Outcome variable: Battery consumption / distance

	Training MSE	Test MSE
OLS	1.14	2.76
Lasso	1.18	2.13
Ridge	1.18	2.07
Decision tree	0	2.16
Random forest	0.21	1.89

3. Graph the results





Discussions

1. Implications
   - Tree models perform worse for linear relationships but better for non-linear relationships compared to linear models
   - Temperature (and distance) is the most important feature in predicting battery usage
2. Limitations
   - Small sample size
     - Cannot use cross-validation for model selection
   - Lack of other important features
     - Acceleration, brake usage, etc.
3. Further research
   - Granular data is needed to analyze time series effectively

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Thank you for your attention!
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