Data Science Project Report

Data Science Project Report: Analysis of Weather Conditions on EV Battery Performance

Title Page

- **Project Title:** Analysis of Weather Conditions on EV Battery Performance
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- **Course Title:** Data Science for Sustainable Energy
- **Institution Name:** City University of Science
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Abstract

This project explores how different weather conditions affect the performance of electric vehicle batteries. Using data from over 1,000 EVs across North America, we applied machine learning models to predict battery degradation under varying temperatures and humidity levels. Key findings suggest that extreme cold significantly impacts battery efficiency and lifespan. This report outlines our methodology, data analysis, model performance, and conclusions about the implications of weather on EV battery technology.

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Introduction

- **Background Information:** Interest in electric vehicles is growing; however, battery performance under different environmental conditions remains a concern.
- **Problem Statement:** There is limited understanding of how weather conditions, specifically temperature and humidity, affect EV battery life and performance.
- **Objectives:** To analyze existing data to predict how weather impacts EV battery efficiency and lifespan.
- **Scope of the Project:** This study focuses on temperature and humidity data from North America over the past five years.

Data Collection

- **Data Sources:** Battery performance data was sourced from a major EV manufacturer's database, which included telemetry from vehicles.
- **Data Description:** The dataset includes daily weather conditions, battery charge levels, and mileage for 1,000 EVs from 2019 to 2024.

Data Preparation

- **Data Cleaning:** Removed entries with missing battery performance metrics.

- **Feature Engineering:** Created new variables for average daily temperature and humidity.

Exploratory Data Analysis (EDA)

- **Statistical Analysis:** Computed mean, median, and standard deviation of battery efficiencies.
- **Visualization:** Produced scatter plots to observe the relationship between battery efficiency and temperature ranges.

Methodology

- **Model Selection:** Chose linear regression and random forest models for initial predictions.
- **Model Building:** Developed models using Python's scikit-learn library.
- **Validation Techniques:** Employed k-fold cross-validation to validate model accuracy.

Results

- **Model Performance:** Random forest model had an R-squared of 0.82, indicating a strong fit.
- **Interpretation of Results:** Clear trend showing decreased battery performance in temperatures below -10°C.

Discussion

- **Key Findings:** Extreme cold has a detrimental effect on battery performance, reducing efficiency by up to 20%.
- **Implications:** These results could influence future EV battery designs and consumer information systems.
- **Limitations and Assumptions:** Analysis assumes uniform battery age and usage patterns, which may not hold universally.

Conclusion

Our analysis confirms that lower temperatures adversely affect EV battery performance. This insight is crucial for manufacturers and consumers, particularly in colder climates.

Future Work

Future studies could expand to global data and incorporate other factors like wind speed and solar exposure.

References

- Johnson, E., & Patel, R. (2024). Journal of Sustainable Energy.
- Thompson, A. (2024). Data Science Applications in Renewable Energy.

Appendices

- Appendix A: Code for Data Analysis and Models
- Appendix B: Extended Data Tables and Graphs

This detailed example provides a clear framework for reporting on a Data Science project, covering all essential aspects from data collection to conclusions and future directions. If you need help with specific parts or more examples, just let me know!