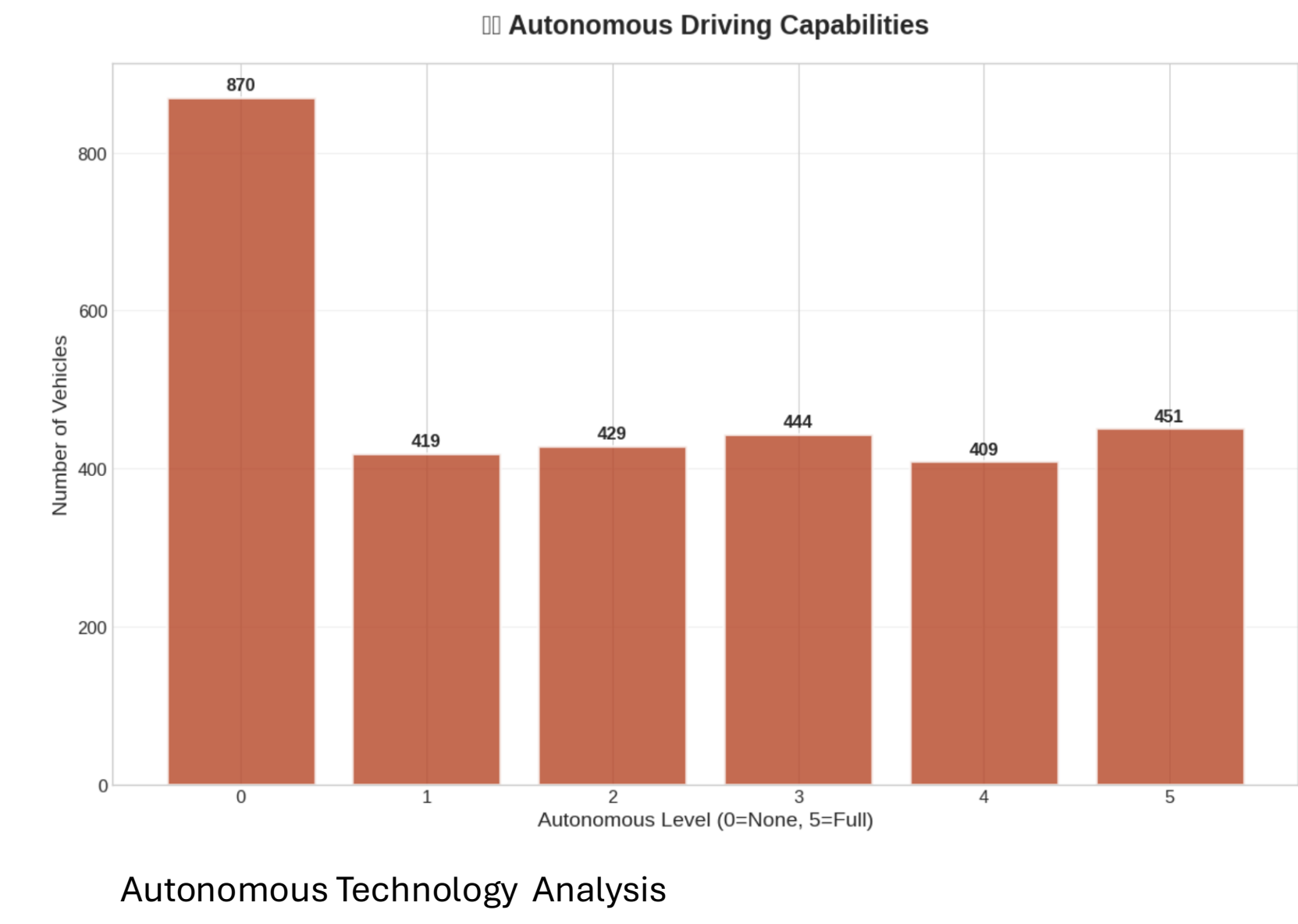


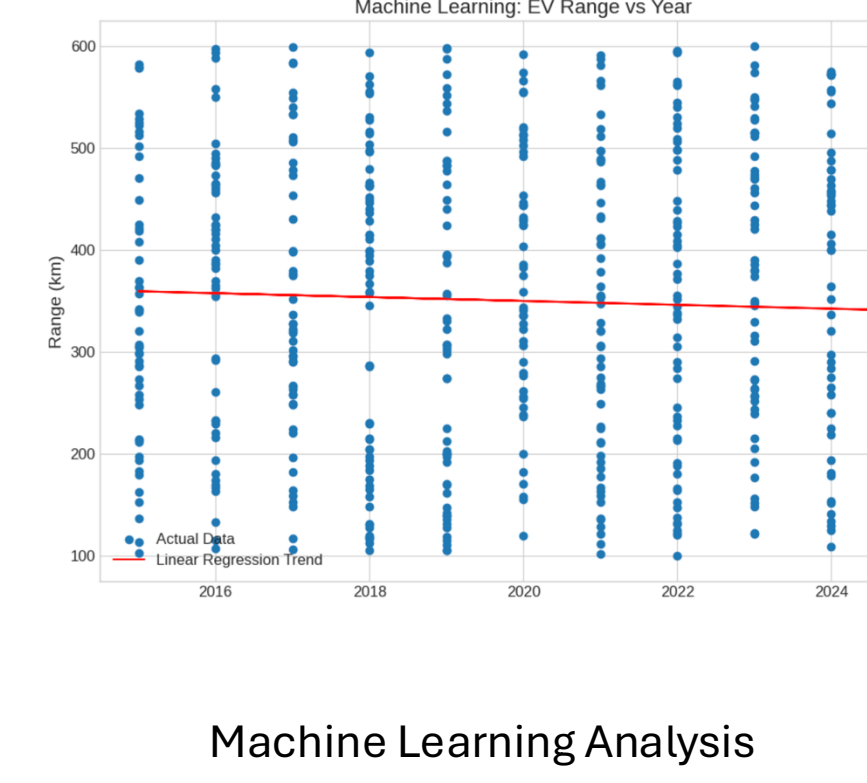
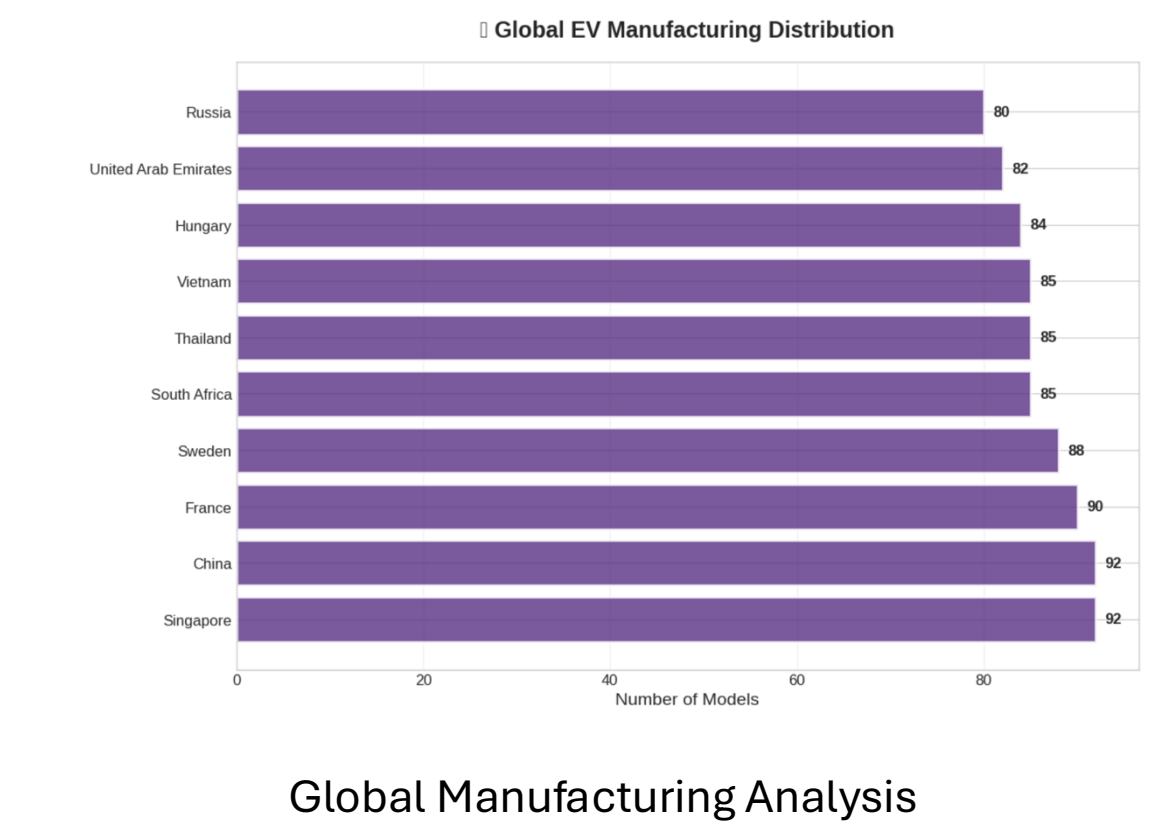
Smart Grids + Artificial Intelligence: Powering the Future with Data and Machine Learning

Electrical and Computer Engineering

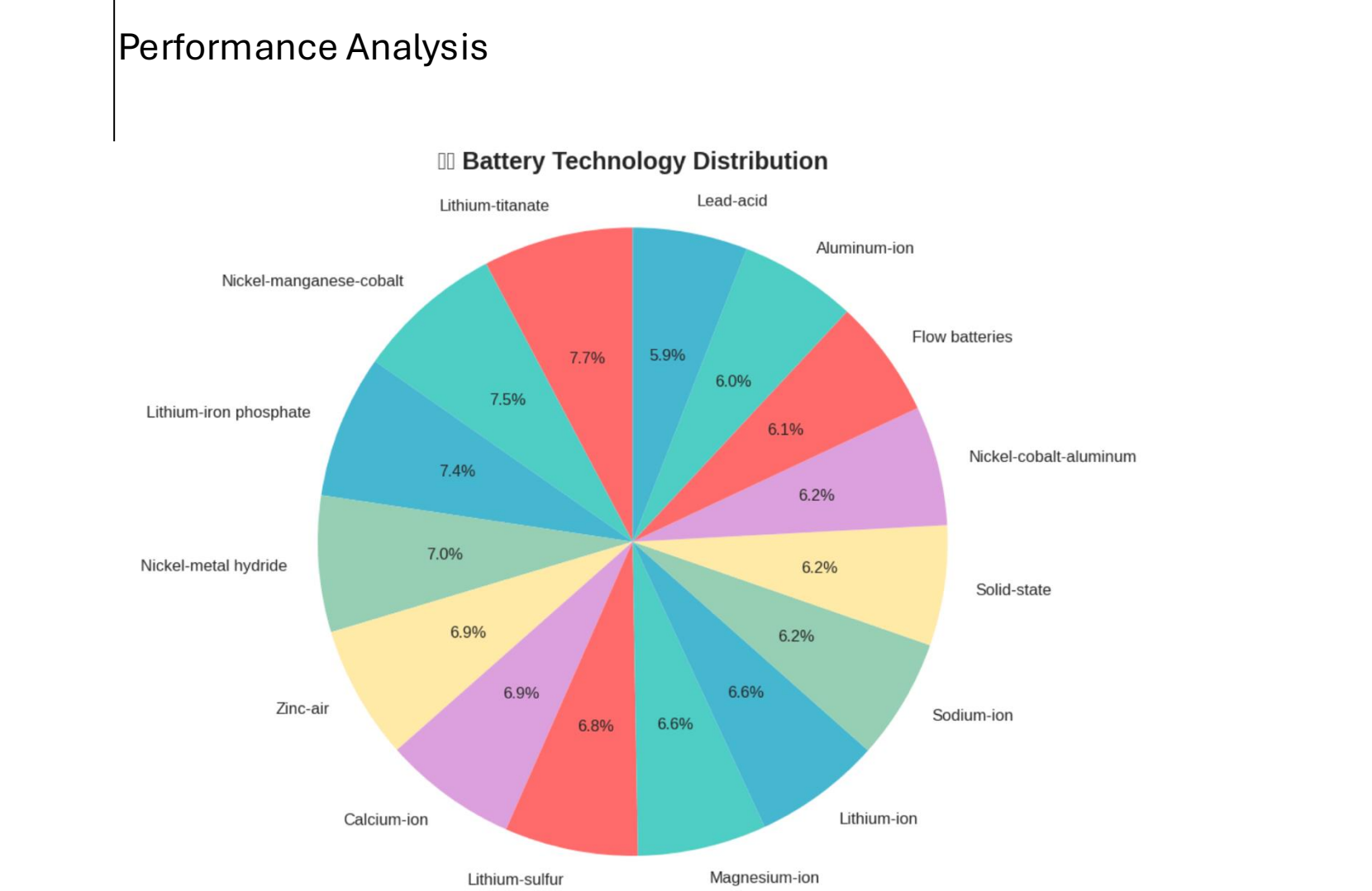
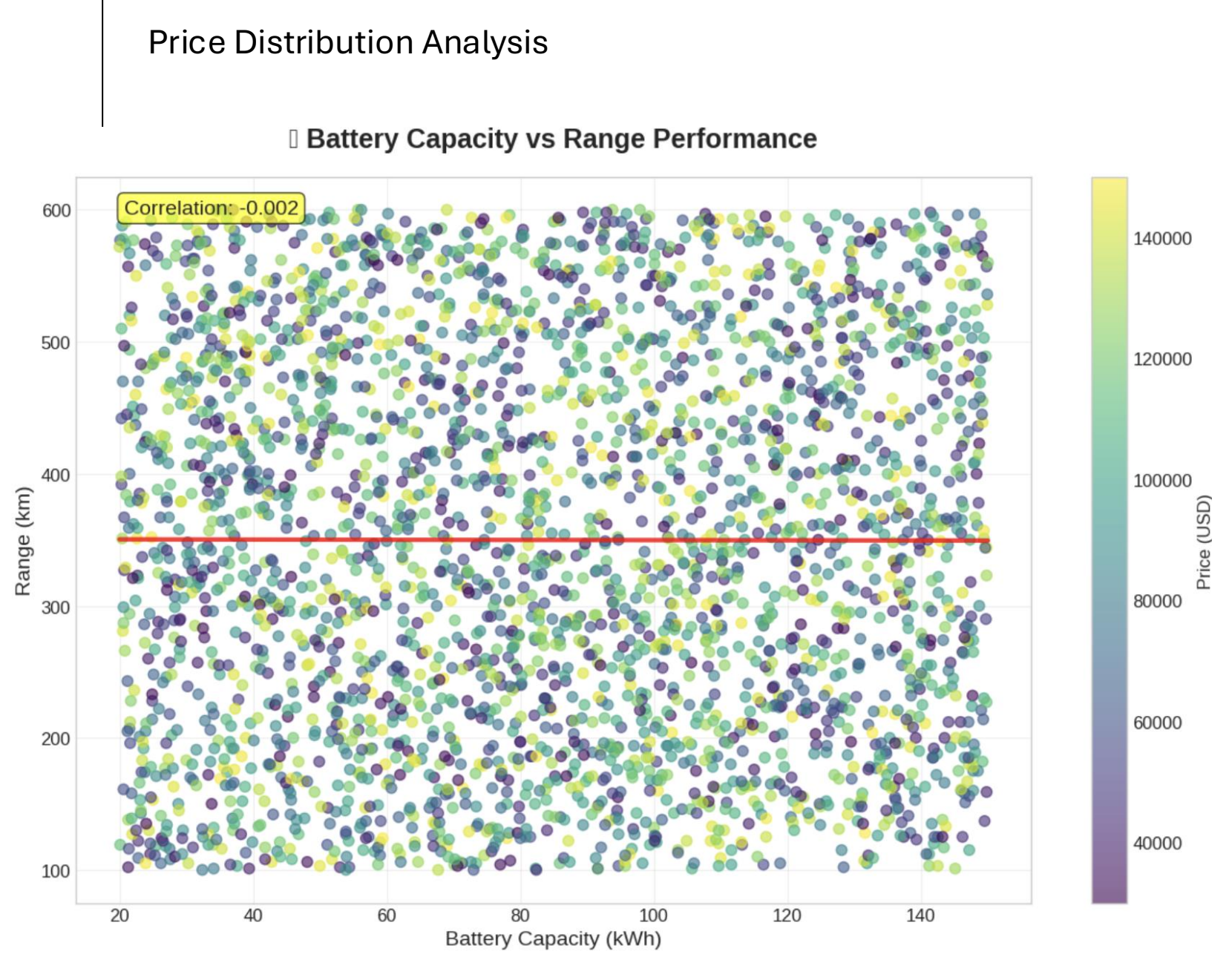
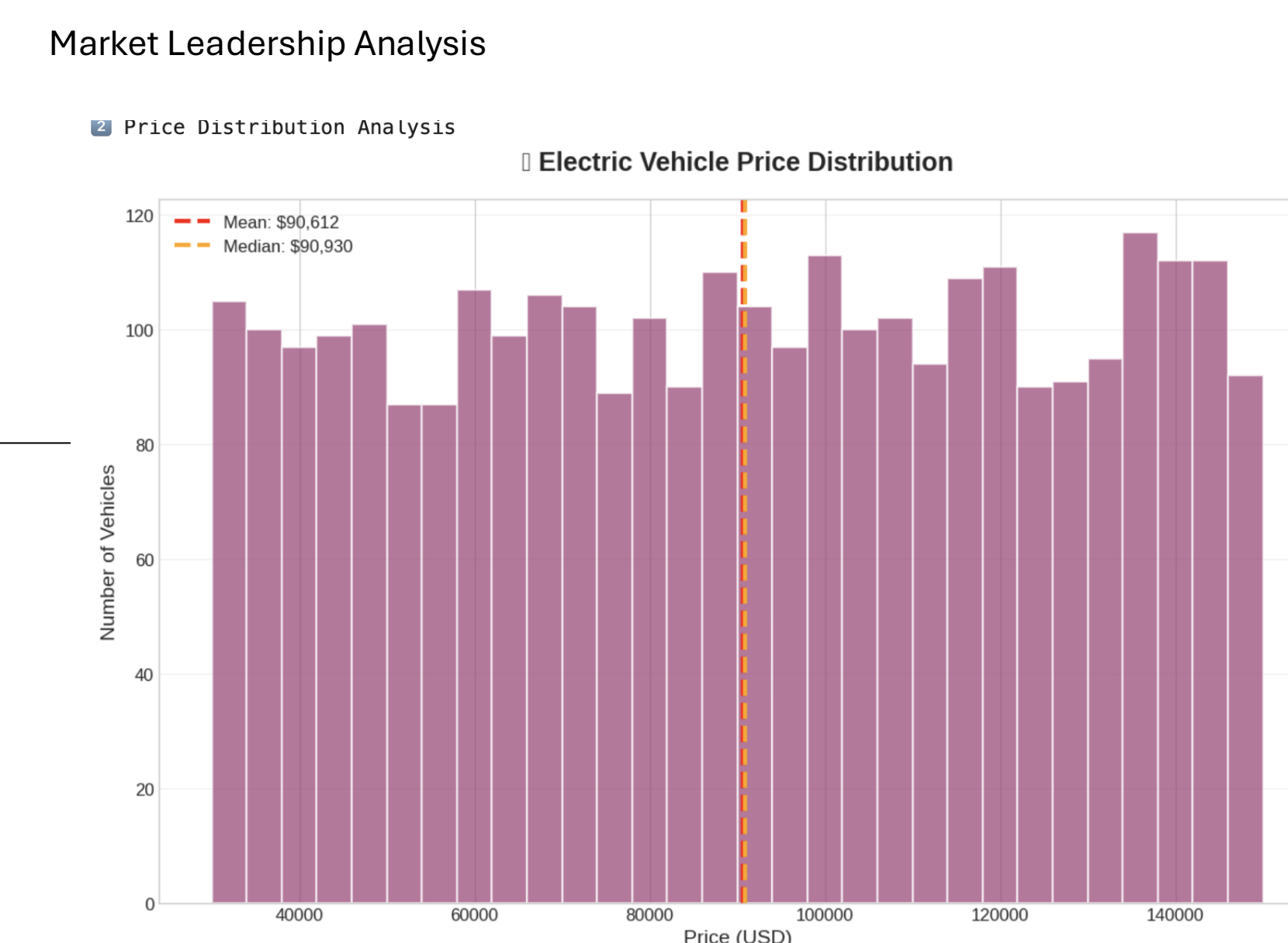
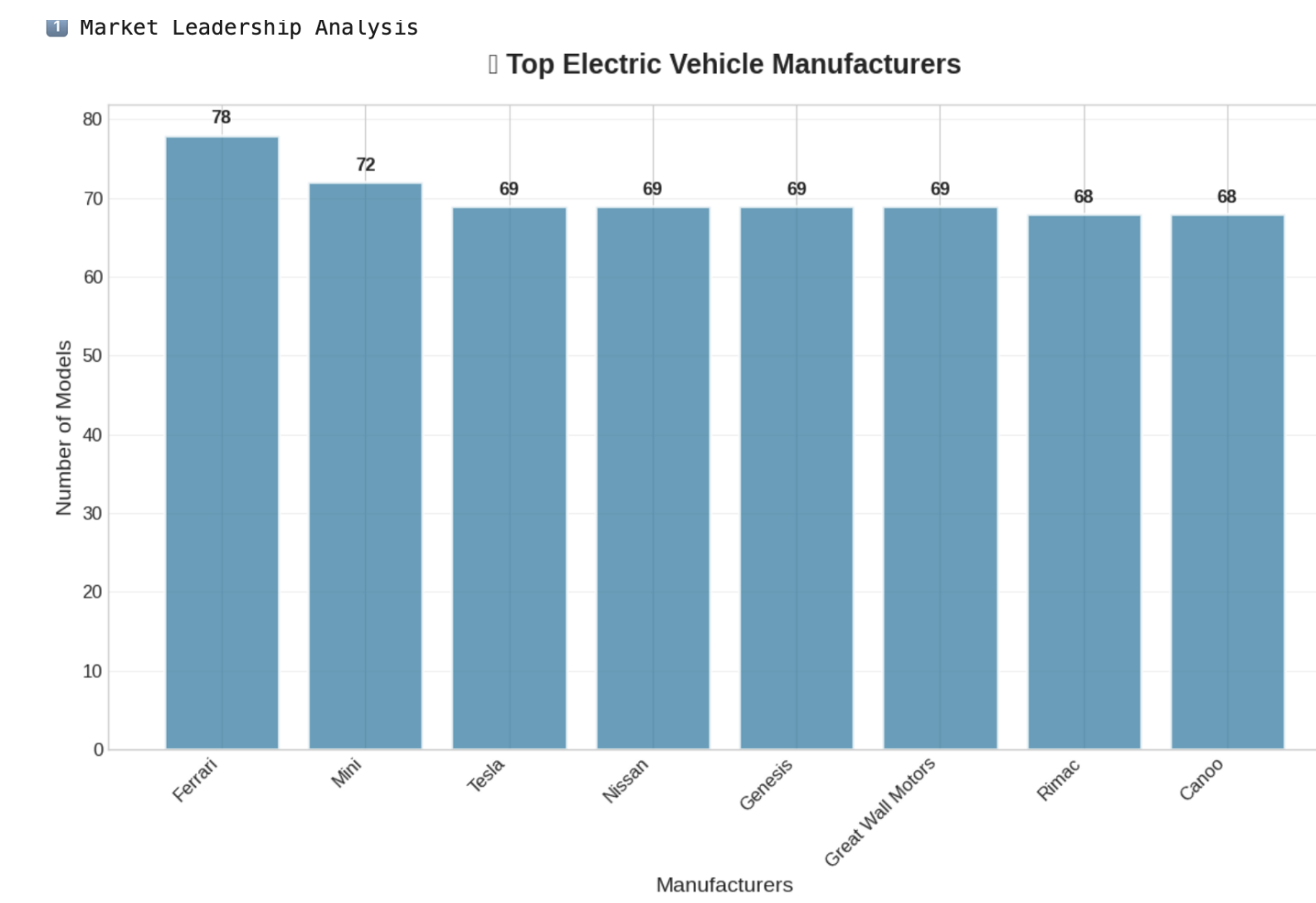


Smart Grids + Artificial Intelligence: Powering the Future with Data and Machine Learning

Electrical and Computer Engineering



Nina Hamlin and Dr. Ravikumar Gelli



Battery Technology Analysis

Results:

- Key findings
 - Mean EV price= \$90,612
 - Median EV price= \$90,930
 - Broad distribution across manufactures and global production regions
 - Battery capacity vs. range correlation = -0.002 (no significant relationship)
 - Linear regression (model year vs driving range)
 - Very weak relationship (not statistically significant)
- Interpretation:
 - Large diversity:
 - Battery technologies
 - Manufacturing distribution
 - Autonomous capability levels
- Performance is improved when:
 - Design of vehicle improves
 - Efficacy advancements
 - Not necessary battery capacity or year
- Results indicate that improvements in several factors of EV will improve performance and predictions
- Strengths
 - Integration of literature analysis
 - Real-world EV dataset
 - Descriptive and ML analysis
 - Addresses a global energy problem that is relevant to all of society
- Limitations
 - Linear regression model only utilized one variable to predict the model
 - Not utilized on real-time grid
 - Data not collected from live grids
 - Dataset does not fully represent the power supply changes
- Future work:
 - Incorporate real-world smart grid
 - Apply more advance ML models
 - Include multiple variables and real-time charging demand

Conclusion:

- Descriptive analysis was performed to analyze the variability in EV pricing, manufacturing distribution, and battery technologies
- The analysis showed no significant relationship between battery capacity and driving range (correlation= -0.002)
- The current findings of this study align with the findings of previous studies, as seen in the literature analysis
- The findings indicate the EV performance is based on multiple interacting variables rather than just one factor
- While a real-time ML application to a smart grid was not performed, the results support the hypothesized, that the application of AI and ML will significantly increase the accuracy of EV demand predictions
- Improvements in energy efficiency and distribution accuracy may be seen as implications rather than outcomes of this dataset
- Further research may look into utilizing real-time datasets and grids to improve the predictions and practical applications of AI and ML
- This is an ongoing study, and further research is being performed to assess these limitations

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- Appreciation is also extended to the authors of Kaggle EV dataset for providing publicly accessible data used in this analysis

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Introduction:

- Global electricity demand is increasing, challenging power grids to balance and deliver power
- A large portion of the power demand is from Electric vehicle (EV) charging
- Artificial Intelligent (AI) and Machine Learning (ML) can be applied to power grids to:
 - Predict electricity demand patterns
 - Improve energy distributions
- Prior studies (Shern et al; Arevalo et al.) found that applying ML to power grid models has been proven to improve:
 - Increase energy output efficiency
 - Improve EV charging performance
 - Enhance grid optimization
- Research gap:
 - Many existing research studies rely on theoretical models or simulated environments
- Limited data has shown that ML has been tested on real-world power grids
- Purpose of this Study:
 - Apply Machine Learning models to real-world power grid and EV charging dataset
 - This will allow improvement in:
 - Efficient
 - Reliability
 - Energy distribution performance
- Research question:
 - Will the addition of ML and AI in power grids improve EV charging prediction and grid efficiency when tested on real-world datasets?
- This study aims to discover the practical implications and performance of ML and AI applications rather than utilizing theoretical models

Methods:

- Literature Review
 - Searched FSU Library database (Google Scholar)
- Keywords used:
 - Machine Learning power grids
 - EV charging
 - AI and ML applications to EV charging
- Date range: recent peer-reviewed articles (last 5-10 years)
 - Relevance to EV charging and grid optimization
 - Use of ML
 - Performance evaluation
- Common themes:
 - Demand forecasting improves grid stability
 - ML provides more accurate models for EV charging
 - All based on theoretical models
- Dataset
 - Dataset: EV Data" by Alaba Hasan
 - Source: Kaggle, an online data science and machine learning community <https://www.kaggle.com/code/albab12/ev-dataset-analysis>
 - Accessed: January 6, 2026
 - Dataset Details:
 - Number of EV records: 3,022
 - Year range: 2015-2015
 - Manufactured 53
 - Countries: 40 period covered:
 - Features:
 - Manufacture
 - Model Year
 - Driving Range
 - Battery efficiency
 - Price
 - Vehicle category
- Machine Learning Model
 - Algorithm: Linear Regression
 - Programming language: Python
 - Libraries used:
 - Pandas- data cleaning and preprocessing
 - NumPy- numerical computations
 - Matplotlib/ Seaborn- data visualization
 - Scikit-learn- Machine Learning Model
 - SciPy- correlational calculations
 - Hyperparameters: default Sklearn Linear Regression settings
 - Independent variable: model year
 - Dependent Variable: driving range
 - Statistical tests
 - R²
 - Mean Squared Error
- Descriptive Statistics and Visualization
 - Calculated
 - Mean driving range
 - Median price
 - Standard deviation
 - Correlation between year and range
 - Graphs
 - Scatterplot (year vs. make and battery capacity vs range)
 - Histogram (price distribution)
 - Bar chart (manufacturer distribution, autonomy levels, and global manufacture)
 - Pie chart (battery technology distribution)
- Analytical Objective
 - Evaluate relationship between EV technological advancement (year) and range
 - Allow the improvements to measure
 - EV charging perditions