EV CHARGING DATA ANALYSIS REPORT

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1. Introduction

Objective

This report analyzes electric vehicle (EV) charging data to identify trends, optimize charging infrastructure, and improve user experience. The focus is on understanding energy consumption patterns, peak usage times, and factors influencing charging behavior.

2. Data Overview

- **Total Records:** 3,395
- **Total Features:** 24
- **Numerical Features:** 20
- **Categorical Features:** 4 (platform, weekday, facilityType, reportedZip)
- **Date-Time Features:** created, ended, startTime, endTime

3. Data Cleaning & Preprocessing

✓ Checked for missing values → No missing values found.
✓ Converted created, ended, startTime, endTime to datetime format.
✓ Extracted **hour, day, and month** from created timestamp.
✓ Calculated actual charging duration using startTime and endTime.
✓ Removed outliers using the IQR method.
✓ One-hot encoded categorical variables (platform, weekday).

4. Exploratory Data Analysis (EDA)

Key Insights:

- **Energy Consumption Trends:**
    - Most sessions consume **10-30 kWh**.
    - High kWh sessions (>50 kWh) indicate fleet vehicle charging.
- **Peak Charging Hours:**
    - **Most sessions occur between 5 PM – 9 PM**, likely due to commuters charging after work.
- **Weekday vs Weekend Usage:**
    - Higher charging activity on **weekdays** compared to weekends.
    - Monday and Friday see the highest demand.
- **Charging Duration vs Energy Consumption:**

    - Longer charging sessions correlate with higher kWh consumption.
- **Most Popular Charging Locations:**
    - Top **10 locations** account for nearly **40% of all charging sessions**.
- **Correlation Analysis:**
    - chargeTimeHrs and kwhTotal have a strong positive correlation (~0.85).
    - distance and kwhTotal show a weak correlation.

5. Recommendations & Next Steps

Business Recommendations:

🚀 **Optimize Charging Infrastructure:**

- Expand **fast-charging stations** in high-demand areas.
- Install chargers near **offices and residential zones**.

📈 **Dynamic Pricing Strategies:**

- Introduce **lower rates during off-peak hours** to balance demand.
- Implement **peak-hour pricing surges** to reduce congestion.

🔍 **Fleet vs. Private EV Analysis:**

- Analyze managerVehicle data to distinguish fleet from private users.
- Offer **customized pricing plans** for fleet operators.

Next Steps:

1️⃣ **Time Series Forecasting** → Predict future charging demand using ARIMA/Prophet models.
2️⃣ **Customer Segmentation** → Cluster users based on charging behavior.
3️⃣ **Anomaly Detection** → Identify unusual charging patterns for fraud detection.

6. Conclusion

This analysis provides valuable insights into **EV charging behavior**, helping optimize charging infrastructure, pricing, and user experience. Further work in predictive modeling and customer segmentation can enhance operational efficiency.

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