IBM Data Science Capstone Project

- SpaceX Falcon 9 Launch Analysis

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Executive Summary

- • Objective: Analyze SpaceX Falcon 9 launch data to predict landing success.
- • Methods: Data collection via API & web scraping, EDA, visualization, and ML.
- • Key Insight: Falcon 9 has high success rates, reducing launch costs.

Introduction

- • SpaceX aims to reduce rocket launch costs by reusing first-stage boosters.
- • Goal: Predict likelihood of successful landing.
- • Tools: Python, Pandas, SQL, Folium, Plotly Dash, and Scikit-learn.

Data Collection & Wrangling

- • Data sources: SpaceX REST API & Wikipedia.
- • Performed API calls and web scraping.
- • Cleaned data: handled missing values, filtered Falcon 9 launches, one-hot encoded categorical variables.

EDA with SQL

- • Loaded data into SQLite.
- • Queries answered:
- - Launch counts per site
- - Payload mass statistics
- - Mission outcomes and orbits
- • Key Findings: CCAFS SLC-40 is the most active launch site.

EDA with Visualization

- • Visualized launch success trends by flight number and payload mass.
- • Scatterplots, bar charts, and categorical plots were used.
- • Observations: Higher payload mass shows better landing success.

Interactive Map – Folium

- • Created a Folium map to visualize launch site locations.
- • Used MarkerCluster for multiple launches.
- • Integrated success/failure indicators for landing outcomes.

Plotly Dash Dashboard

- • Built an interactive dashboard for:
- - Launch success trends
- - Payload vs. success probability
- - Orbit-wise performance.
- • Features: Dropdown filters, responsive design.

Predictive Analysis Methodology

- • Applied classification models: Logistic Regression, SVM, Decision Tree, and KNN.
- • Evaluated using accuracy, precision, recall, and F1-score.
- • Cross-validation to avoid overfitting.

Predictive Analysis Results

- • Best model: Decision Tree Classifier (accuracy > 85%).
- • Predicted high probability of successful landings for most recent launches.
- • Insights: Booster reuse significantly improves success.

Conclusion

- • Falcon 9 achieves consistent landing success.
- • Reusable rockets drastically reduce launch costs.
- • Predictive model supports future mission planning.
- • Further work: Integrate real-time launch telemetry data.

Creative & Innovative Insights

- • Added interactive dashboard and animated maps.
- • Derived insight: Heavier payloads are not a strong deterrent to landing success.
- • Potential business impact: Improved cost forecasting and mission planning.