Space Missions Analysis – Project Report

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Tools: Python, Pandas, Matplotlib, Seaborn, Jupyter Notebooks

1. Introduction

This project analyzes historical data on global space missions using Python. The goal is to identify trends and extract insights about the frequency, cost, timing, and outcomes of space launches conducted by different organizations over time.

2. Research Questions

The analysis focuses on answering the following key questions:

1. Which organization launched the most space missions in a given year?
2. How many launches were carried out per year?
3. How has the cost of space missions varied over time?
4. Which months are the most popular for launches?
5. Have space missions become safer, or have failure rates remained constant?

3. Dataset Overview

- Source: https://www.kaggle.com/datasets/sefercanapaydn/mission-launches
- Fields: Organization, Location, Date, Detail, Rocket Status, Price, Mission status,
- Period Covered: 1957–2023

4. Technologies Used

- Programming Language: Python 3
- Data Manipulation: Pandas
- Visualization: Matplotlib, Seaborn
- Environment: Jupyter Notebooks

5. Methodology

1. Data Cleaning:
  - Converted the Date column to datetime format and extracted Year and ordered Month for temporal analysis.
  - Cleaned and renamed columns (id, removed Unnamed: 0) for clarity.
  - Split the Detail column into Rocket and Mission, then removed the original
  - Converted the Price column to numeric and applied a multi-step imputation strategy using group means and median values.
  - Rounded all price values to two decimal places for consistency.

2. Exploratory Data Analysis (EDA):
  - Grouped data by year, organization, and outcome
  - Generated visualizations to identify trends and anomalies

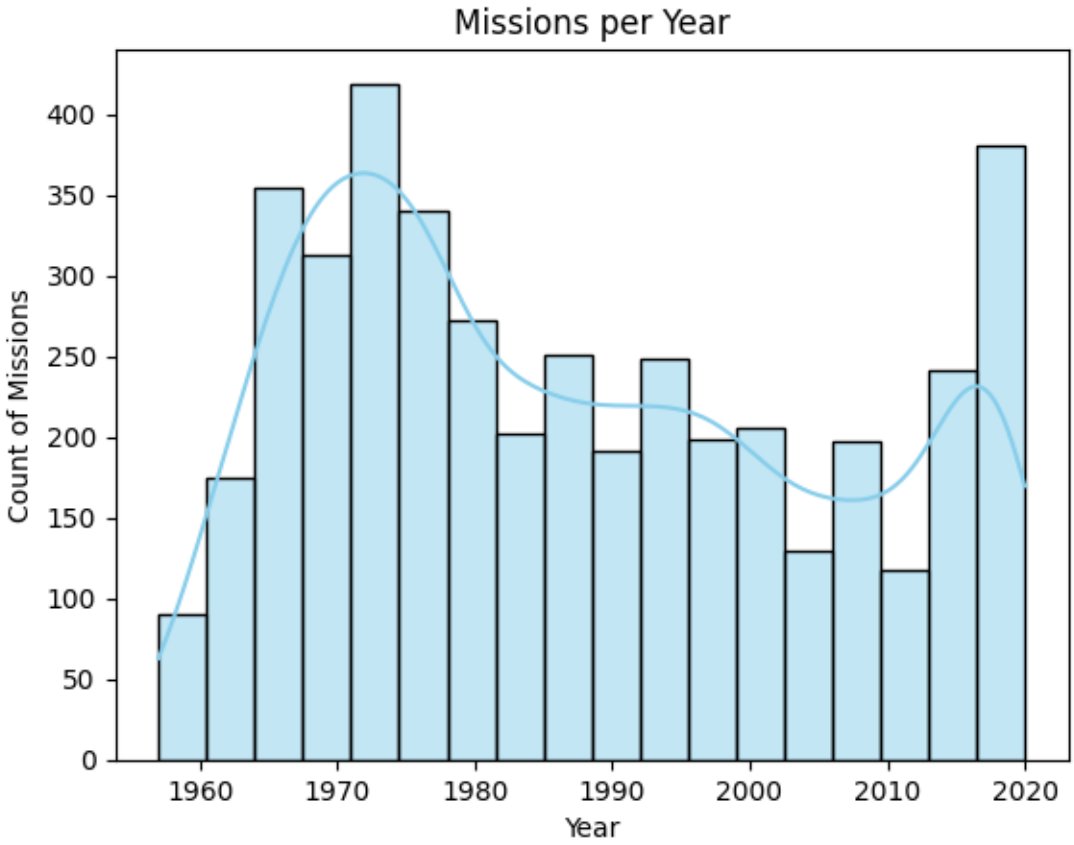
3. Visualization:
  - Bar charts, time series to visualize insights

6. Key Findings

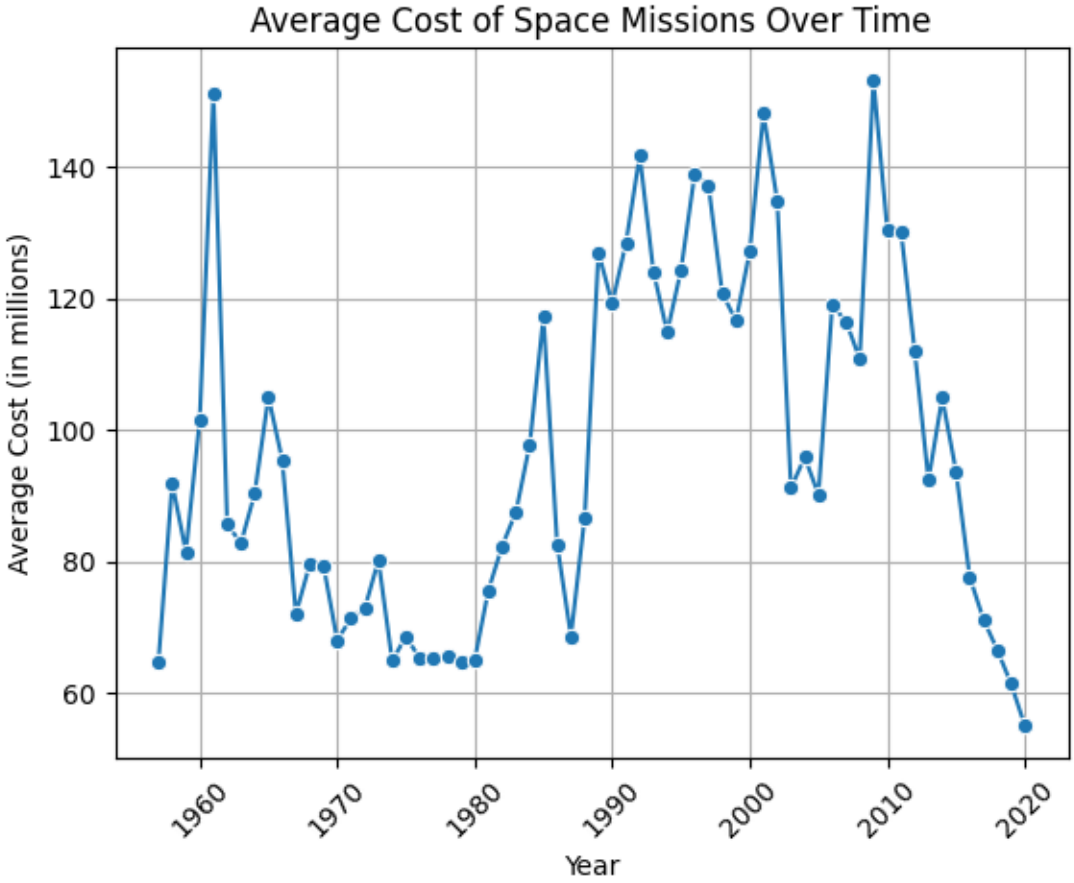
- 🚀 Top Organizations by Launch Count: RVSN USSR, Arianespace, General Dynamics
- 📈 Launch Trends Over Time: Consistent growth since 1967.
- 💰 Cost Evolution: Early missions were highly expensive; some modern launches are more cost-effective.
- 🗓️ Seasonality: Launches tend to peak in December and June
- 🛡️ Mission Reliability: Failure rates have decreased over time, indicating improved safety and technology.

7. Visual Highlights

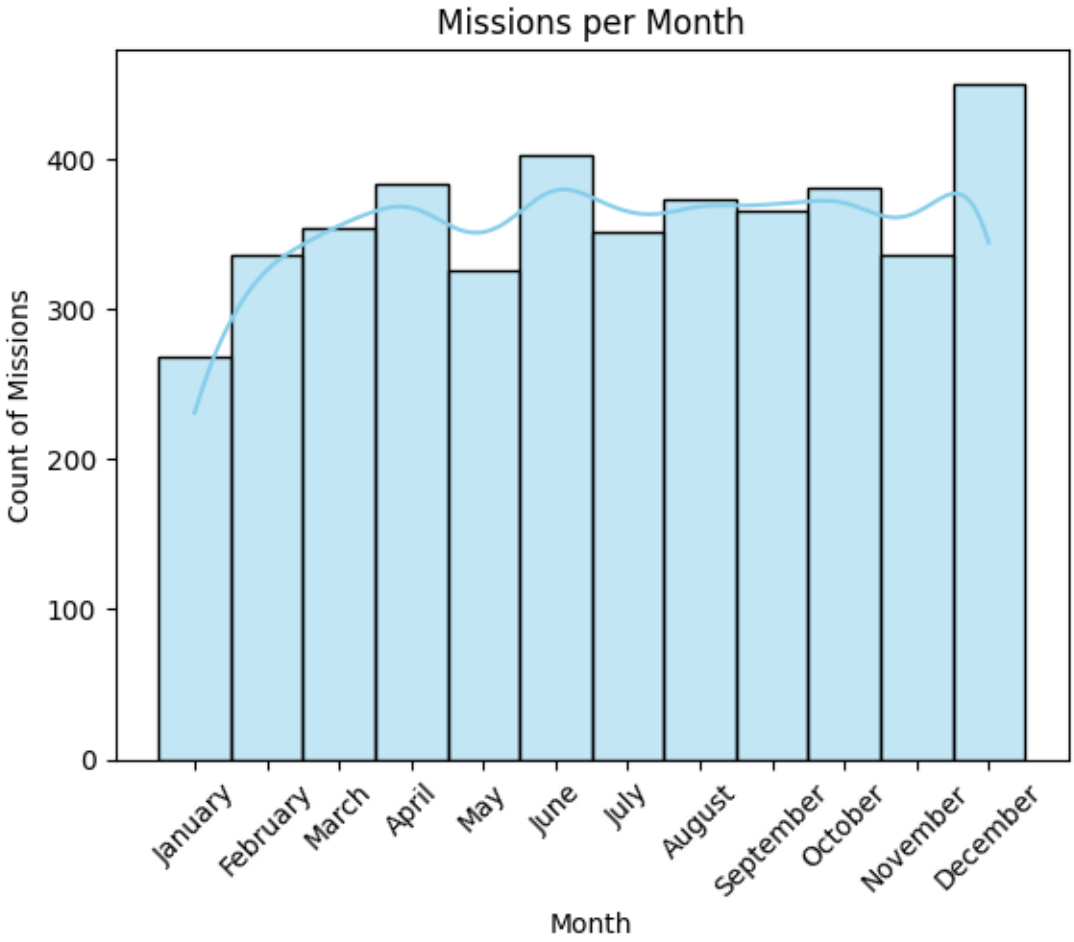
- Yearly launch frequency per organization



- Cost trends over time



- Monthly launch distribution



- Mission outcome comparison by decade

8. Conclusion

The analysis reveals important patterns in the history of space missions, including increasing frequency, better safety, and cost-reduction over time. Understanding these trends can provide strategic insights for space agencies, investors, and researchers.