

Health Care Data Exploration

**A PROJECT REPORT
for
Introduction to AI (ID201B)
Session (2024-25)**

Submitted by

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1. Introduction

In today's fast-paced healthcare environment, data-driven decision-making plays a crucial role in improving patient care, optimizing hospital resources, and enhancing overall efficiency. With the increasing availability of electronic health records (EHRs) and hospital management systems, healthcare institutions have access to vast amounts of patient data. However, making sense of this data requires systematic analysis and visualization to extract meaningful insights.

This project, "Healthcare Data Exploration," aims to analyze a hospital dataset to uncover key patterns related to patient demographics, medical conditions, treatment costs, and hospital utilization metrics. By performing exploratory data analysis (EDA) and visualization, we seek to answer essential questions such as:

- What are the most common medical conditions and procedures?
- How does age, gender, and medical history impact hospital stay duration and treatment costs?
- What are the trends in readmission rates and patient satisfaction?
- Are there any correlations between treatment costs, length of stay, and patient outcomes?

To achieve these objectives, this project follows a structured methodology, starting with data preprocessing to ensure quality, followed by EDA and visualization to derive actionable insights. The findings from this analysis can be valuable for hospital administrators, policymakers, and healthcare professionals to enhance patient care strategies and optimize hospital operations.

By leveraging Python and its powerful data science libraries (Pandas, Matplotlib, Seaborn, etc.), this project demonstrates how healthcare data analytics can help improve decision-making and patient outcomes in the medical field.

2. Methodology

The project follows a structured data exploration methodology, ensuring a systematic approach to analyzing the healthcare dataset. The methodology consists of the following steps:

Step 1: Data Collection

- The dataset is sourced from Kaggle's "Hospital Dataset for Practice", containing patient information, medical conditions, and treatment details.
- The dataset is in CSV format, making it suitable for direct processing using Pandas in Python.

Step 2: Data Preprocessing

To ensure data quality and reliability, preprocessing steps are applied:

1. Handling Missing Data:
 - Numerical missing values (e.g., Cost, Length_of_Stay) are filled with the median value to maintain data consistency.
 - Categorical missing values (e.g., Gender, Condition) are replaced with "Unknown".
2. Data Type Conversion:
 - Convert categorical variables (Gender, Readmission, Outcome) into the appropriate format for analysis.
 - Ensure numerical columns are stored correctly to perform mathematical operations.
3. Feature Engineering:
 - Create an Age Group column to categorize patients into predefined age ranges (e.g., 0-18, 19-35).

Step 3: Exploratory Data Analysis (EDA)

EDA helps uncover patterns, trends, and relationships in the data:

- Summary Statistics:
 - Use describe() to compute mean, median, and standard deviation.
- Demographic Analysis:
 - Explore the distribution of Age, Gender, and Conditions.
- Hospital Utilization:
 - Analyze Length_of_Stay, Readmission rates, and Cost variations.
- Outcome Analysis: Study the relationship between conditions and patient outcomes.

Step 4: Data Visualization

Visualization helps in understanding key trends and correlations:

1. Bar Plots & Count Plots:

- Used for Gender distribution, Condition frequency, and Readmission rates.

2. Histograms:

- Show the distribution of Age and Length of Stay.

3. Scatter Plots:

- Reveal relationships between Cost and Length of Stay.

4. Heatmaps:

- Display correlations between numerical variables.

Step 5: Insights & Interpretation

- Extract key patterns and observations from the analysis.
- Identify high-risk conditions, costly treatments, and patient satisfaction trends.
- Provide recommendations for improving hospital efficiency and patient care.

2. Project Implementation

```
import pandas as pd
df = pd.read_csv("hospital data analysis.csv")
```

```
# Display basic dataset information
print(df.info())
```

```

#print first 5 rows
print(df.head())

#find if there are any missing values
print(df.isnull().sum())

# Summary statistics
print(df.describe())

# Distribution of age groups
df["Age_Group"] = pd.cut(df["Age"], bins=[0, 18, 35, 50, 65, 100], labels=['0-18',
'19-35', '36-50', '51-65', '65+'])
print(df["Age_Group"].value_counts())

# Count patients by gender
print(df["Gender"].value_counts())

df.value_counts()

print(df["Condition"].value_counts())

import matplotlib.pyplot as plt
import seaborn as sns

plt.figure(figsize=(10, 6))
sns.countplot(y=df["Condition"], order=df["Condition"].value_counts().index,
palette='coolwarm')
plt.xlabel("Count")
plt.ylabel("Disease Type")
plt.title("Distribution of Diseases in Patients")
plt.show()

plt.figure(figsize=(10, 6))
sns.countplot(x=df["Age_Group"], palette='viridis')
plt.xlabel("Age Group")
plt.ylabel("Count")
plt.title("Distribution of Patients Across Age Groups")
plt.show()

plt.figure(figsize=(10, 6))
sns.histplot(df["Length_of_Stay"], bins=20, kde=True, color='purple')
plt.xlabel("Hospital Stay Duration (Days)")
plt.ylabel("Frequency")
plt.title("Distribution of Hospital Stay Durations")
plt.show()

plt.figure(figsize=(10, 6))

```

```
sns.heatmap(df.corr(numeric_only=True), annot=True, cmap='coolwarm',
linewidths=0.5)
plt.title("Correlation Matrix of Healthcare Data")
plt.show()
```

3. Output

```
# Display basic dataset information
print(df.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 984 entries, 0 to 983
Data columns (total 10 columns):
#   Column                Non-Null Count  Dtype
---  -
0   Patient_ID            984 non-null    int64
1   Age                   984 non-null    int64
2   Gender                984 non-null    object
3   Condition              984 non-null    object
4   Procedure              984 non-null    object
5   Cost                  984 non-null    int64
6   Length_of_Stay        984 non-null    int64
7   Readmission           984 non-null    object
8   Outcome                984 non-null    object
9   Satisfaction          984 non-null    int64
dtypes: int64(5), object(5)
memory usage: 77.0+ KB
```

```
# Show the first few rows
df.head()
```

	Patient_ID	Age	Gender	Condition	Procedure	Cost	Length_of_Stay	Readmission	Outcome	Satisfaction	Age_Group
0	1	45	Female	Heart Disease	Angioplasty	15000	5	No	Recovered	4	36-50
1	2	60	Male	Diabetes	Insulin Therapy	2000	3	Yes	Stable	3	51-65
2	3	32	Female	Fractured Arm	X-Ray and Splint	500	1	No	Recovered	5	19-35
3	4	75	Male	Stroke	CT Scan and Medication	10000	7	Yes	Stable	2	65+
4	5	50	Female	Cancer	Surgery and Chemotherapy	25000	10	No	Recovered	4	36-50

df.value_counts()

											count
Patient_ID	Age	Gender	Condition	Procedure	Cost	Length_of_Stay	Readmission	Outcome	Satisfaction	Age_Group	
1000	25	Male	Allergic Reaction	Epinephrine Injection	100	68	No	Recovered	5	19-35	1
1	45	Female	Heart Disease	Angioplasty	15000	5	No	Recovered	4	36-50	1
2	60	Male	Diabetes	Insulin Therapy	2000	3	Yes	Stable	3	51-65	1
3	32	Female	Fractured Arm	X-Ray and Splint	500	1	No	Recovered	5	19-35	1
4	75	Male	Stroke	CT Scan and Medication	10000	7	Yes	Stable	2	65+	1
...
13	30	Female	Childbirth	Delivery and Postnatal Care	12000	3	No	Recovered	4	19-35	1
12	65	Male	Prostate Cancer	Radiation Therapy	20000	9	No	Recovered	3	51-65	1
11	48	Female	Respiratory Infection	Antibiotics and Rest	800	2	No	Stable	4	36-50	1
10	25	Male	Allergic Reaction	Epinephrine Injection	100	1	No	Recovered	5	19-35	1
9	70	Female	Heart Attack	Cardiac Catheterization	18000	8	Yes	Stable	2	65+	1

984 rows x 11 columns

```
# Summary statistics
print(df.describe())

# Distribution of age groups
df["Age_Group"] = pd.cut(df["Age"], bins=[0, 18, 35, 50, 65, 100], labels=['0-18', '19-35', '36-50', '51-65', '65+'])
print(df["Age_Group"].value_counts())
```

```
count      Patient_ID      Age      Cost  Length_of_Stay  Satisfaction
mean      500.329268    53.754065  8367.479675    37.663618    3.598577
std       288.979531    14.941135  7761.990976    19.595805    0.883002
min        1.000000    25.000000   100.000000     1.000000    2.000000
25%       250.750000    45.000000  1000.000000    21.000000    3.000000
50%       500.500000    55.000000  6000.000000    38.000000    4.000000
75%       750.250000    65.000000 15000.000000    54.250000    4.000000
max      1000.000000    78.000000 25000.000000    76.000000    5.000000
Age_Group
51-65      391
65+        231
19-35      197
36-50      165
0-18         0
Name: count, dtype: int64
```

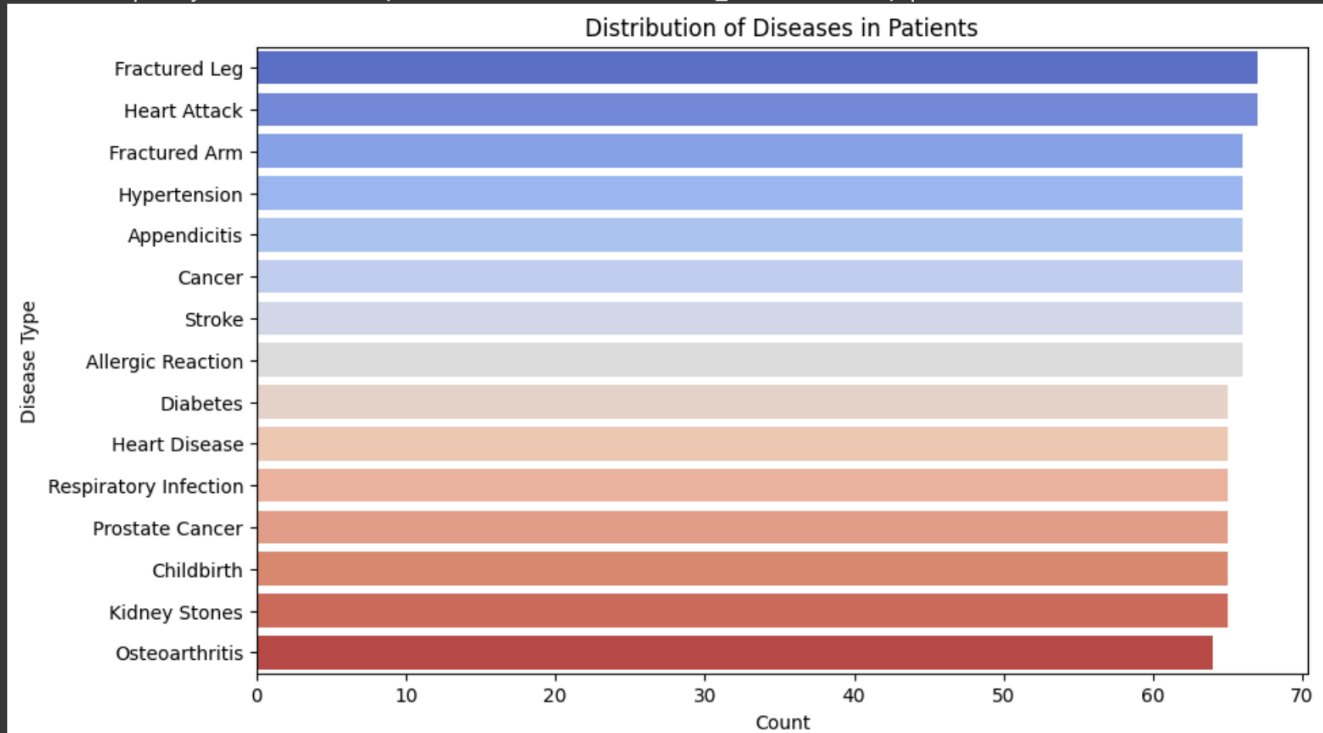
```
print(df["Condition"].value_counts())
```

```
Condition
Fractured Leg      67
Heart Attack       67
Fractured Arm      66
Hypertension       66
Appendicitis       66
Cancer             66
Stroke            66
Allergic Reaction  66
Diabetes           65
Heart Disease      65
Respiratory Infection 65
Prostate Cancer    65
Childbirth         65
Kidney Stones      65
Osteoarthritis     64
Name: count, dtype: int64
```

```
plt.figure(figsize=(10, 6))
sns.countplot(y=df["Condition"], order=df["Condition"].value_counts().index, palette='coolwarm')
plt.xlabel("Count")
plt.ylabel("Disease Type")
plt.title("Distribution of Diseases in Patients")
plt.show()
```

<ipython-input-17-41142e243604>:6: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `y` variable to `hue` and
 sns.countplot(y=df["Condition"], order=df["Condition"].value_counts().index, palette='coolwarm')

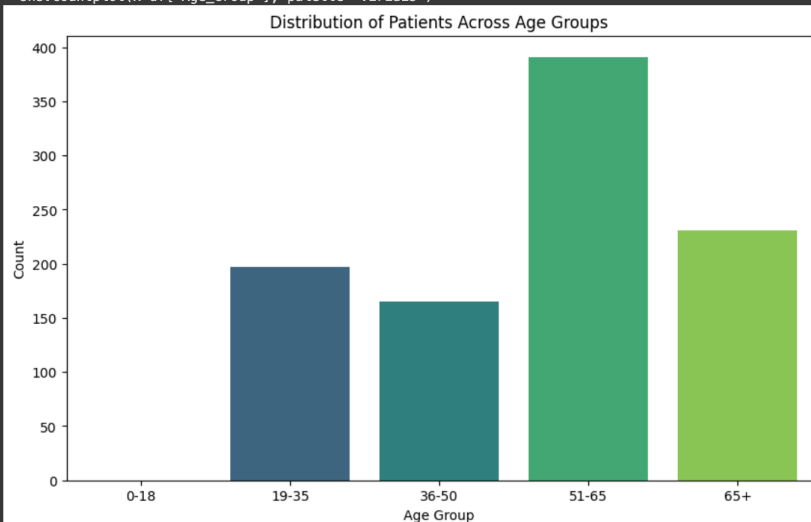


```
plt.figure(figsize=(10, 6))
sns.countplot(x=df["Age_Group"], palette='viridis')
plt.xlabel("Age_Group")
plt.ylabel("Count")
plt.title("Distribution of Patients Across Age Groups")
plt.show()
```

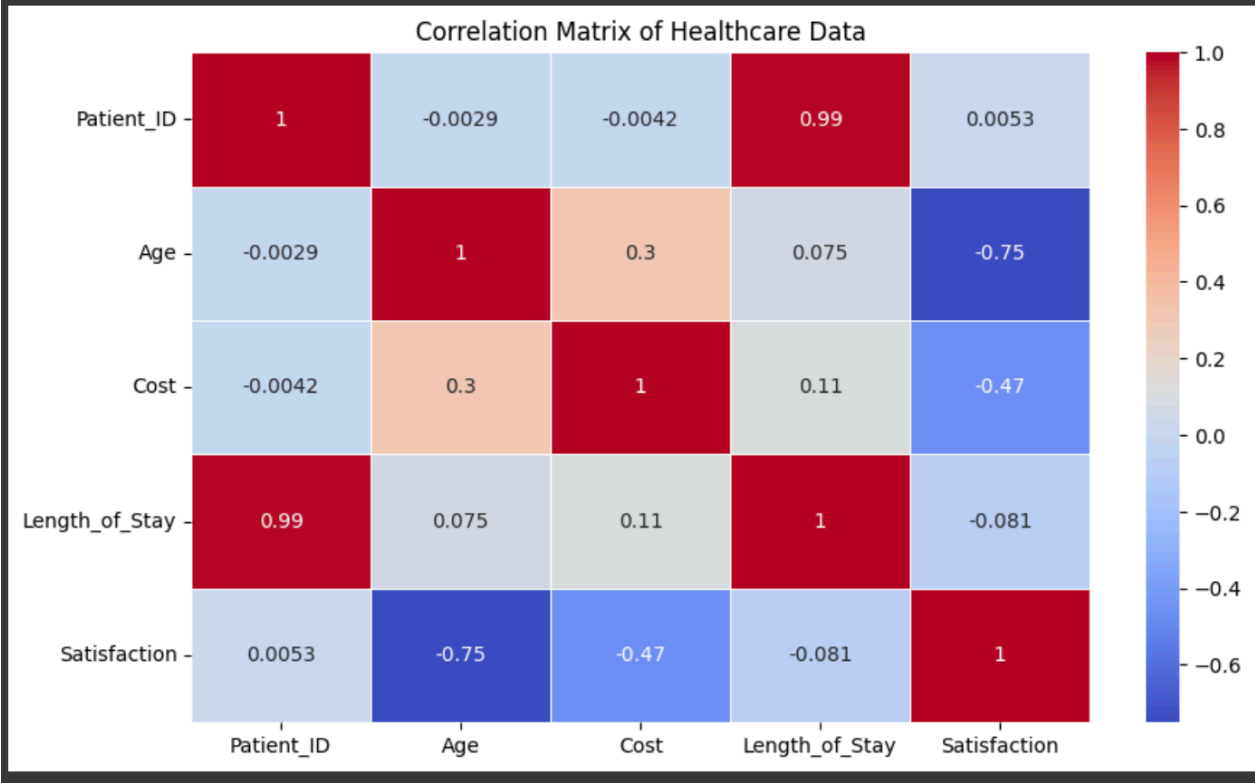
<ipython-input-13-669ae8b2fd6d>:2: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effect.

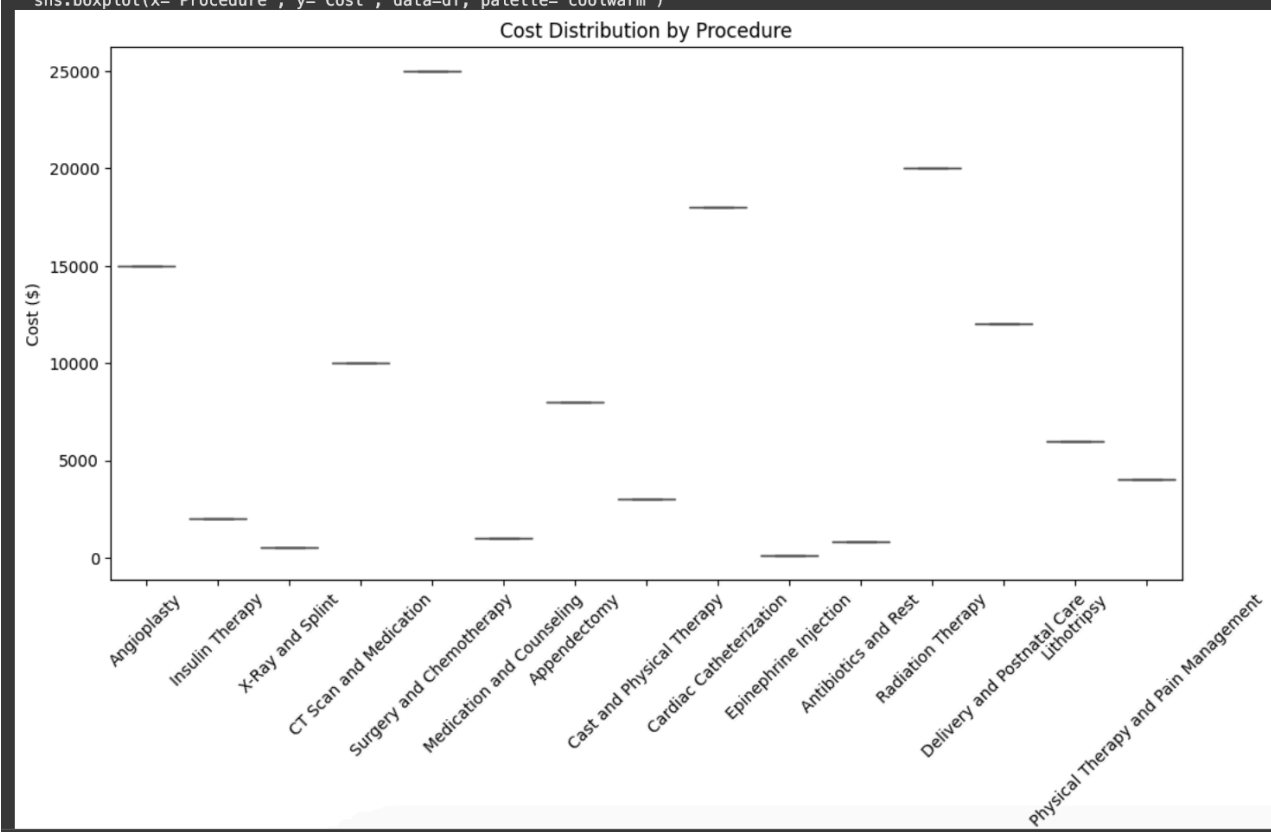
sns.countplot(x=df["Age_Group"], palette='viridis')



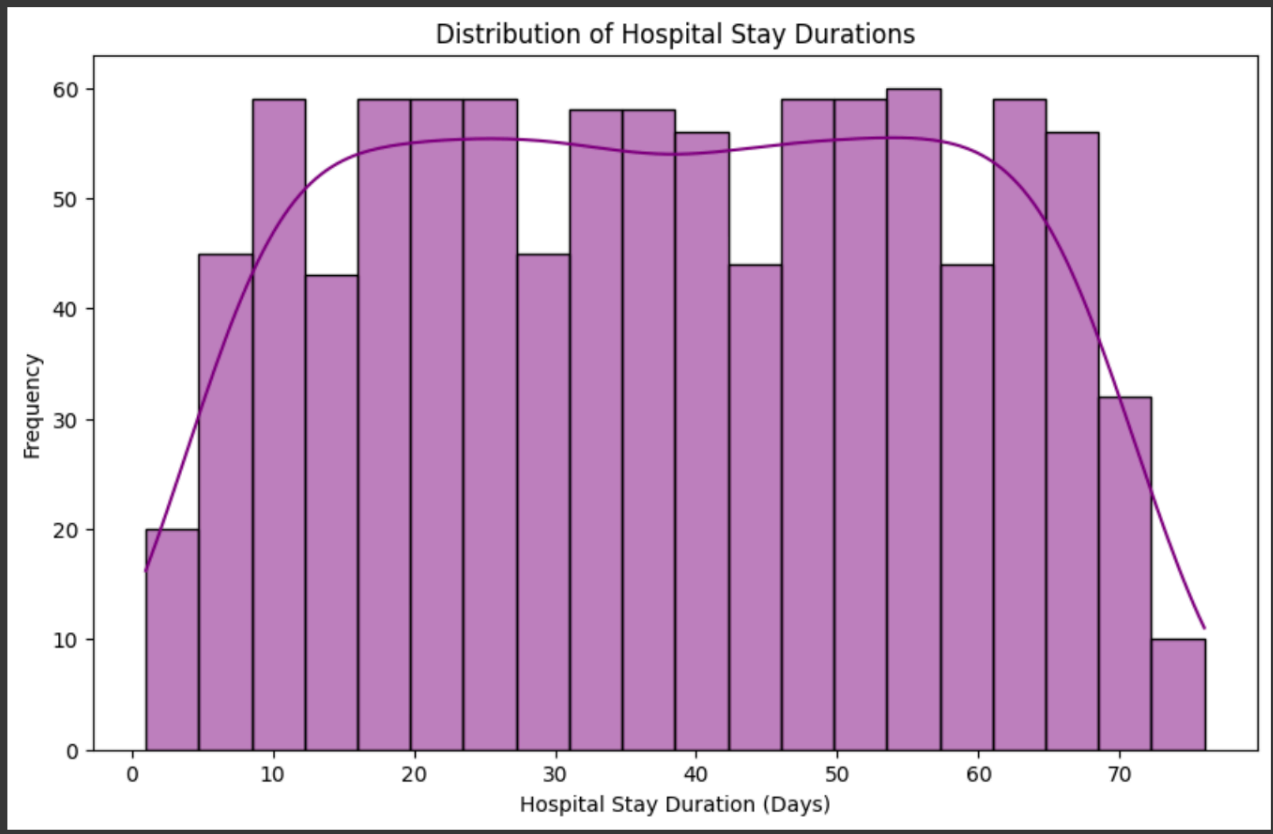

```
plt.figure(figsize=(10, 6))
sns.heatmap(df.corr(numeric_only=True), annot=True, cmap='coolwarm', linewidths=0.5)
plt.title("Correlation Matrix of Healthcare Data")
plt.show()
```



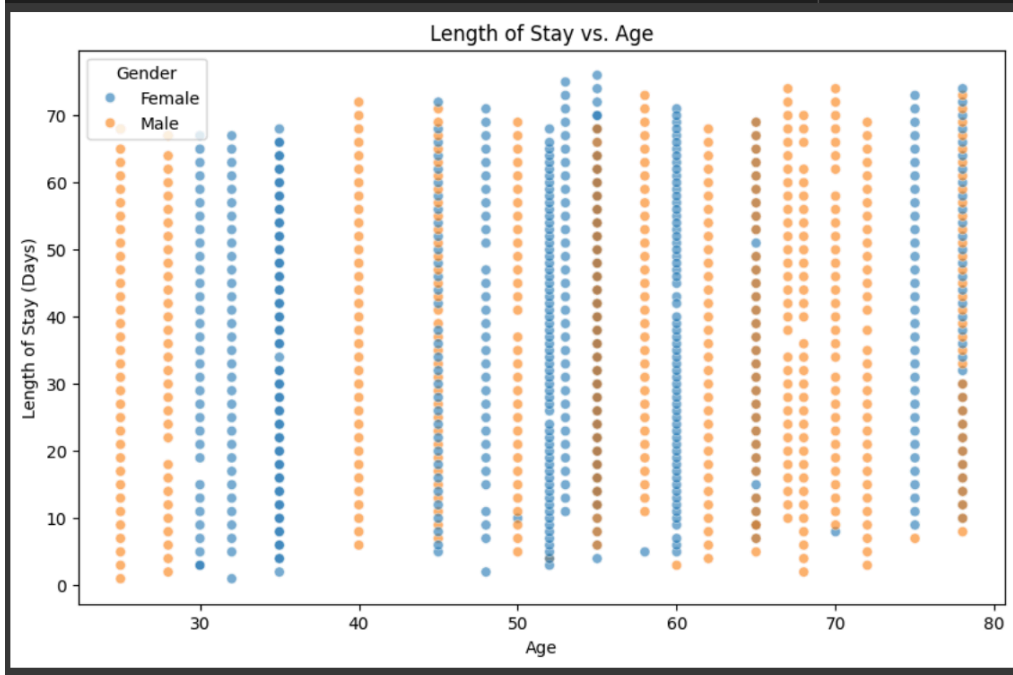
```
sns.boxplot(x="Procedure", y="Cost", data=df, palette="coolwarm")
```



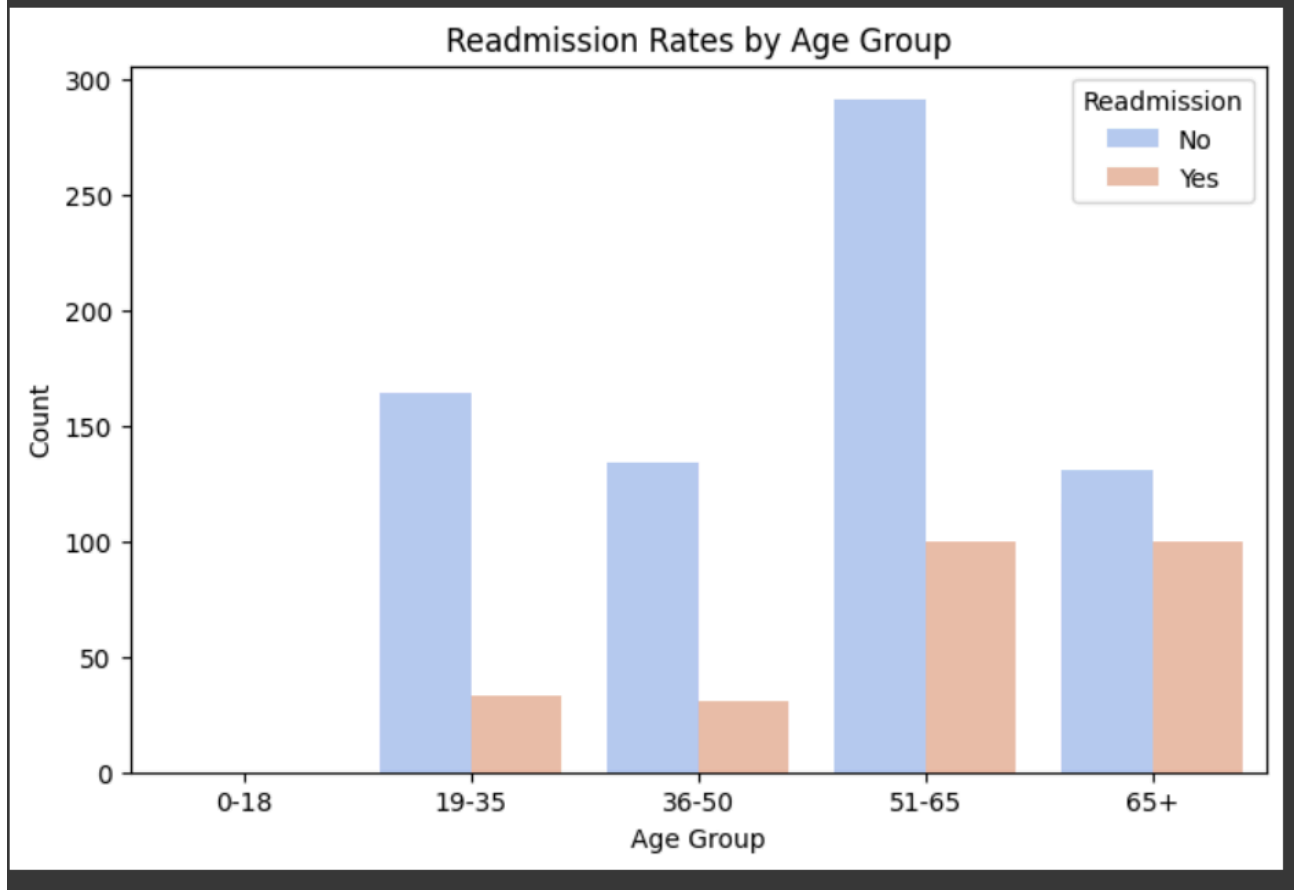
```
plt.figure(figsize=(10, 6))
sns.histplot(df["Length_of_Stay"], bins=20, kde=True, color='purple')
plt.xlabel("Hospital Stay Duration (Days)")
plt.ylabel("Frequency")
plt.title("Distribution of Hospital Stay Durations")
plt.show()
```



```
# Visualization 5: Length of Stay vs. Age
plt.figure(figsize=(10, 6))
sns.scatterplot(x="Age", y="Length_of_Stay", hue="Gender", data=df, alpha=0.6)
plt.title("Length of Stay vs. Age")
plt.xlabel("Age")
plt.ylabel("Length of Stay (Days)")
plt.legend(title="Gender")
plt.show()
```



```
# Visualization 6: Readmission Rates by Age Group
plt.figure(figsize=(8, 5))
sns.countplot(x="Age_Group", hue="Readmission", data=df, palette="coolwarm")
plt.title("Readmission Rates by Age Group")
plt.xlabel("Age Group")
plt.ylabel("Count")
plt.show()
```

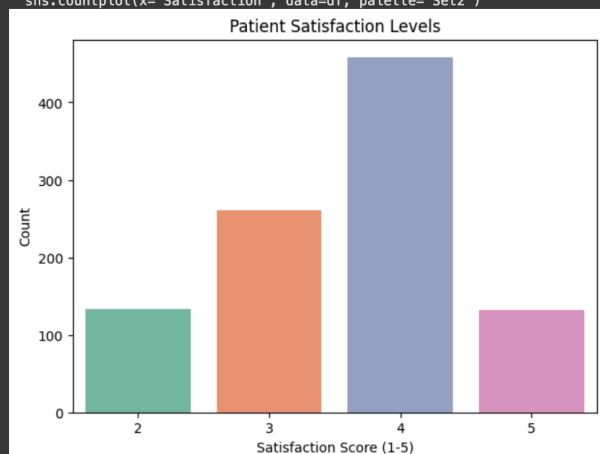


```
# Visualization 7: Satisfaction Level Distribution
plt.figure(figsize=(7, 5))
sns.countplot(x="Satisfaction", data=df, palette="Set2")
plt.title("Patient Satisfaction Levels")
plt.xlabel("Satisfaction Score (1-5)")
plt.ylabel("Count")
plt.show()
```

<ipython-input-22-5af79c0a4fe2>:3: FutureWarning:

Passing 'palette' without assigning 'hue' is deprecated and will be removed in v0.14.0. Assign the 'x' variable to 'hue' and set 'legend=False' for the same effect.

```
sns.countplot(x="Satisfaction", data=df, palette="Set2")
```

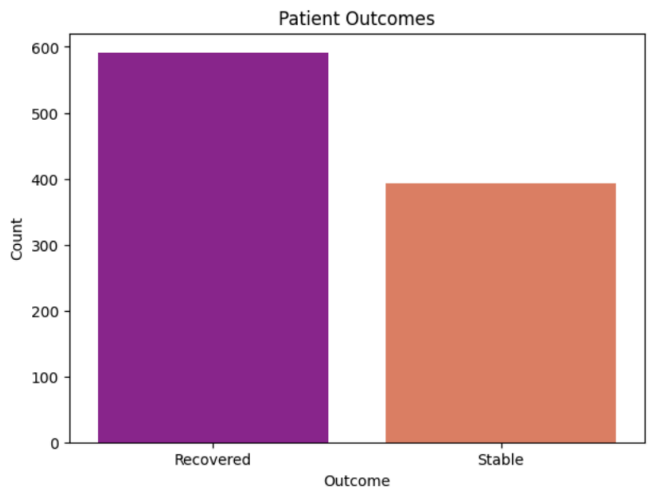


```
# Visualization 8: Outcome Distribution
plt.figure(figsize=(7, 5))
sns.countplot(x="Outcome", data=df, palette="plasma")
plt.title("Patient Outcomes")
plt.xlabel("Outcome")
plt.ylabel("Count")
plt.show()
```

<ipython-input-23-146143c2c988>:3: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same

```
sns.countplot(x="Outcome", data=df, palette="plasma")
```



```
# Visualization 10: Cost vs. Length of Stay
plt.figure(figsize=(10, 6))
sns.scatterplot(x="Length_of_Stay", y="Cost", hue="Outcome", data=df, alpha=0.7)
plt.title("Cost vs. Length of Stay")
plt.xlabel("Length of Stay (Days)")
plt.ylabel("Cost ($)")
plt.legend(title="Outcome")
plt.show()
```

