TEACHER’S ASSESSMENT 1

Course:Tools For Data Science)
Date-23-02-24 to 27-02-24

1.Data Analysis with Pandas and Matplotlib.

Objective: Perform data analysis on a given dataset using Pandas and visualize the results using Matplotlib.

Explanation:

- Loading the Dataset: We use Pandas' read_csv() function to load the dataset into a DataFrame named df.
- Displaying Data: We print the first few rows of the DataFrame using the head() method to get an overview of the data structure and contents.
- Basic Statistical Analysis: We calculate the mean, median, and standard deviation of the sale prices of houses in the dataset using the mean(), median(), and std() methods on the 'SalePrice' column.
- Visualization: We create a histogram using Matplotlib to visualize the distribution of house sale prices. The histogram divides the range of sale prices into bins and shows the frequency of houses falling into each bin.

Insights and Interpretations:

- Statistical analysis and visualization play essential roles in data analysis by providing insights into the data's characteristics, guiding decision-making processes, supporting hypothesis testing, and facilitating effective communication of results.
- Basic statistical measures for Data Summarization, such as mean, median, and standard deviation provide concise summaries of the dataset's central tendency, variability, and distribution. These summaries help analysts quickly grasp essential characteristics of the data. Based on the mean and median values, we can infer that the sepal lengths of iris flowers tend to cluster around a certain range, but there is some variability in lengths.
- The standard deviation indicates the degree of variability in sepal lengths, suggesting that there might be some outliers or distinct subgroups within the dataset.
- Visualizations like histograms help identify patterns and trends within the data. For instance, in the case of the Iris dataset, the histogram of sepal lengths reveals the distribution of lengths and potential clusters or groups within the dataset.
- Further analysis, such as comparing sepal lengths across different species of iris or exploring correlations with other features, could provide additional insights into the characteristics of iris flowers and their variations.

In [42]:
```
import pandas as pd
import matplotlib.pyplot as plt
```

In [43]:
```
df = pd.read_csv(r'C:/Users/shrav/OneDrive/Desktop/semIV/oe/iris.csv')  # Usin
```

In [44]:
```
print(df.head())
```

```
   sepal.length  sepal.width  petal.length  petal.width variety
0           5.1          3.5           1.4          0.2  Setosa
1           4.9          3.0           1.4          0.2  Setosa
2           4.7          3.2           1.3          0.2  Setosa
3           4.6          3.1           1.5          0.2  Setosa
4           5.0          3.6           1.4          0.2  Setosa
```

In [45]:
```
print(df.columns)
```

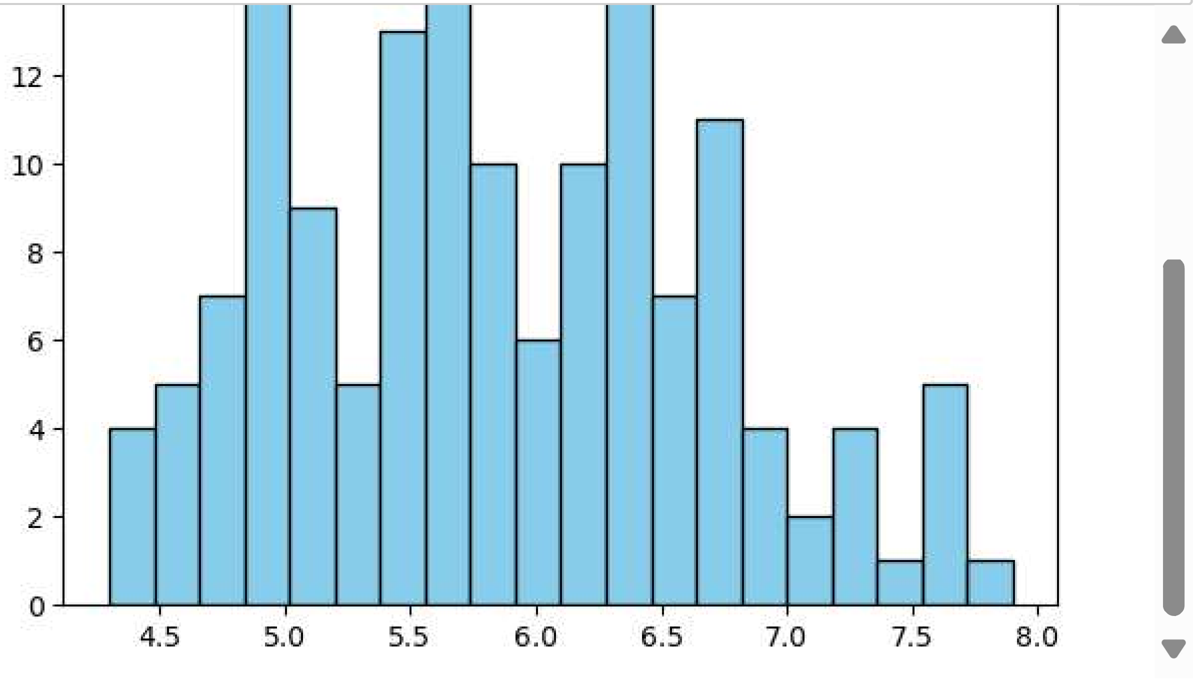
```
Index(['sepal.length', 'sepal.width', 'petal.length', 'petal.width',
       'variety'],
      dtype='object')
```

In [46]:
```
#Discriptive analysis:
```

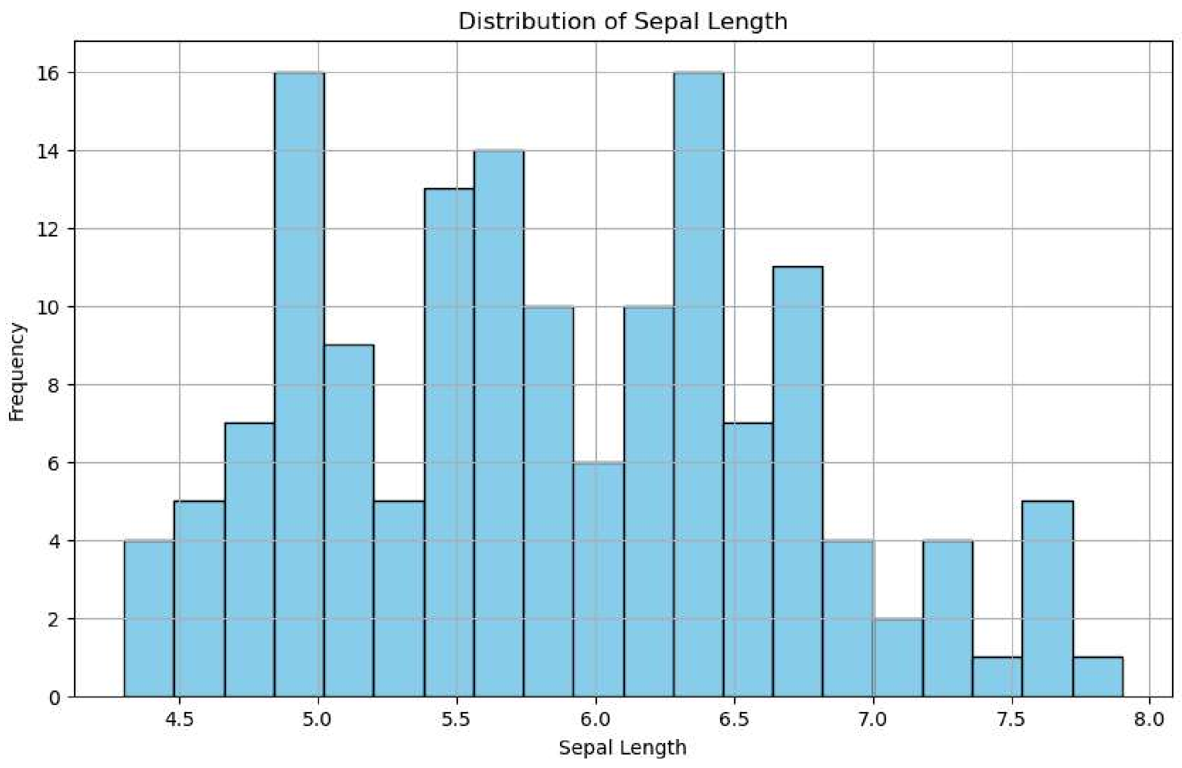
In [47]:
```

print("Mean Sepal Length:", df['sepal.length'].mean())
print("Median Sepal Length:", df['sepal.length'].median())
print("Standard Deviation of Sepal Length:", df['sepal.length'].std())
```

```
Mean Sepal Length: 5.843333333333334
Median Sepal Length: 5.8
Standard Deviation of Sepal Length: 0.8280661279778629
```

In [48]:
```
plt.hist(df['sepal.length'], bins=20, color='skyblue', edgecolor='black')
```



In [49]:
```
plt.figure(figsize=(10,6))
plt.hist(df['sepal.length'], bins=20, color='skyblue', edgecolor='black')
plt.title('Distribution of Sepal Length')
plt.xlabel('Sepal Length')
plt.ylabel('Frequency')
plt.grid(True)
plt.show()
```



2. Statistical Analysis with R

Objective: Perform statistical analysis on a dataset using R's built-in statistical functions.

Explanation:

- Descriptive analysis:
  - ➔ We load the iris dataset, which is built into R.
  - ➔ We use sapply() to apply the mean(), median(), and sd() functions to each numeric column (1:4) of the iris dataset.
  - ➔ The resulting matrix descriptive_stats contains the mean, median, and standard deviation for each relevant variable (sepal length, sepal width, petal length, petal width) of the iris dataset.
- Hypothesis Testing or Confidence Intervals:
  - ➔ We subset the sepal length data for two species, setosa and versicolor.
  - ➔ We use the t.test() function to perform a two-sample t-test comparing the sepal lengths of the two species.
  - ➔ The result t_test_result includes the test statistic, p-value, and confidence interval for the difference in means.
- Visualization:
  - ➔ We use par() to set up a grid for two plots in a single window.
  - ➔ We use hist() to create histograms of sepal lengths for each species, with different colors for better visualization.

R-script:

```
#Loading dataset
data(iris)
str(iris)
head(iris)

# Summary statistics for the dataset
summary(iris)

# Calculate mean, median, and standard
deviation for relevant variables
mean_sepal_length <- mean(iris$Sepal.Length)
median_sepal_length <-
median(iris$Sepal.Length)
sd_sepal_length <- sd(iris$Sepal.Length)

mean_sepal_width <- mean(iris$Sepal.Width)
median_sepal_width <-
median(iris$Sepal.Width)
sd_sepal_width <- sd(iris$Sepal.Width)

mean_petal_length <- mean(iris$Petal.Length)
median_petal_length <-
median(iris$Petal.Length)
sd_petal_length <- sd(iris$Petal.Length)

mean_petal_width <- mean(iris$Petal.Width)
median_petal_width <-
median(iris$Petal.Width)
sd_petal_width <- sd(iris$Petal.Width)
```

```
# Print descriptive statistics
cat("Descriptive Statistics for Sepal Length:\n")
cat("Mean:", mean_sepal_length, "\n")
cat("Median:", median_sepal_length, "\n")
cat("Standard Deviation:", sd_sepal_length,
"\n\n")

cat("Descriptive Statistics for Sepal Width:\n")
cat("Mean:", mean_sepal_width, "\n")
cat("Median:", median_sepal_width, "\n")
cat("Standard Deviation:", sd_sepal_width,
"\n\n")

cat("Descriptive Statistics for Petal Length:\n")
cat("Mean:", mean_petal_length, "\n")
cat("Median:", median_petal_length, "\n")
cat("Standard Deviation:", sd_petal_length,
"\n\n")

cat("Descriptive Statistics for Petal Width:\n")
cat("Mean:", mean_petal_width, "\n")
cat("Median:", median_petal_width, "\n")
cat("Standard Deviation:", sd_petal_width,
"\n\n")

# Conduct hypothesis testing or create
confidence intervals
# Subset the data for setosa and versicolor
species
setosa_sepal_length <-
iris$Sepal.Length[iris$Species == "setosa"]
versicolor_sepal_length <-
iris$Sepal.Length[iris$Species == "versicolor"]

# Conduct t-test
t_test_result <- t.test(setosa_sepal_length,
versicolor_sepal_length)

# Print t-test results
print("T-Test Results:")
print(t_test_result)


# Create histograms to visualize the distribution
of sepal lengths for each species
par(mfrow=c(1,3)) # Set up a 1x3 grid for plots
hist(iris$Sepal.Length[iris$Species == "setosa"],
main = "Sepal Length - Setosa", xlab = "Sepal
Length", col = "skyblue")
hist(iris$Sepal.Length[iris$Species ==
"versicolor"], main = "Sepal Length -
Versicolor", xlab = "Sepal Length", col =
"lightgreen")
hist(iris$Sepal.Length[iris$Species ==
"virginica"], main = "Sepal Length - Virginica",
xlab = "Sepal Length", col = "salmon")
```

Interpretations and Conclusions:

Based on the statistical analysis conducted on the `iris` dataset, we can draw several interpretations and conclusions:

- Descriptive Statistics: The descriptive statistics provide insights into the characteristics of the dataset. For example, we found that the mean sepal length of all iris flowers is approximately 5.84 cm, with a median of 5.8 cm and a standard deviation of approximately 0.83 cm. Similar descriptive statistics were calculated for other variables such as sepal width, petal length, and petal width.
- Hypothesis Testing: The t-test comparing the mean sepal length between two species revealed whether there is a statistically significant difference in sepal length between the two species. If the p-value is less than the chosen significance level (e.g., 0.05), we reject

the null hypothesis and conclude that there is a significant difference in the mean sepal length between the two species.

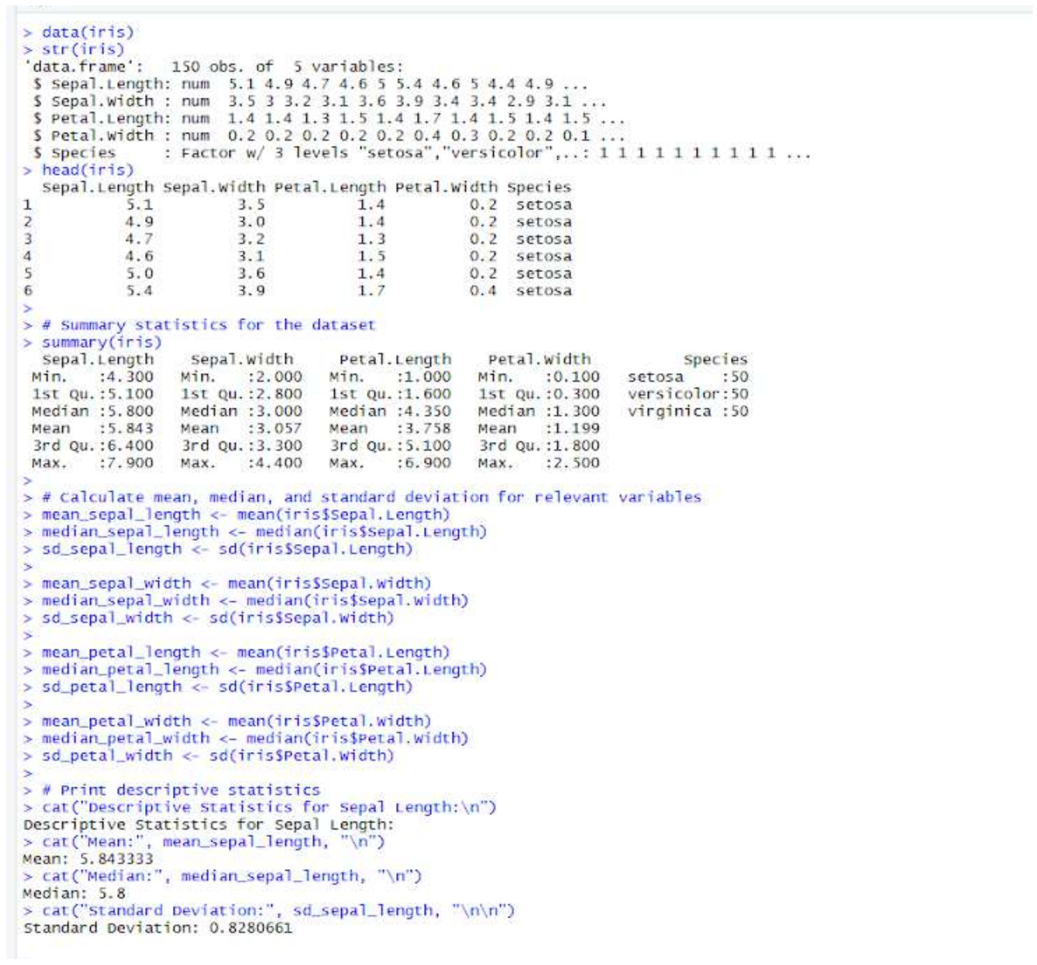
- Visualizations (Histograms): Histograms provide graphical representations of the distribution of sepal length across different species. They show the frequency distribution of sepal lengths for each species. These visualizations help identify any differences or similarities in sepal length distribution among different species.
- Interpretations:

  - Based on the t-test results, if the p-value is less than 0.05, we can conclude that there is a significant difference in the mean sepal length between the compared species. This information can be valuable for distinguishing different species based on sepal length.

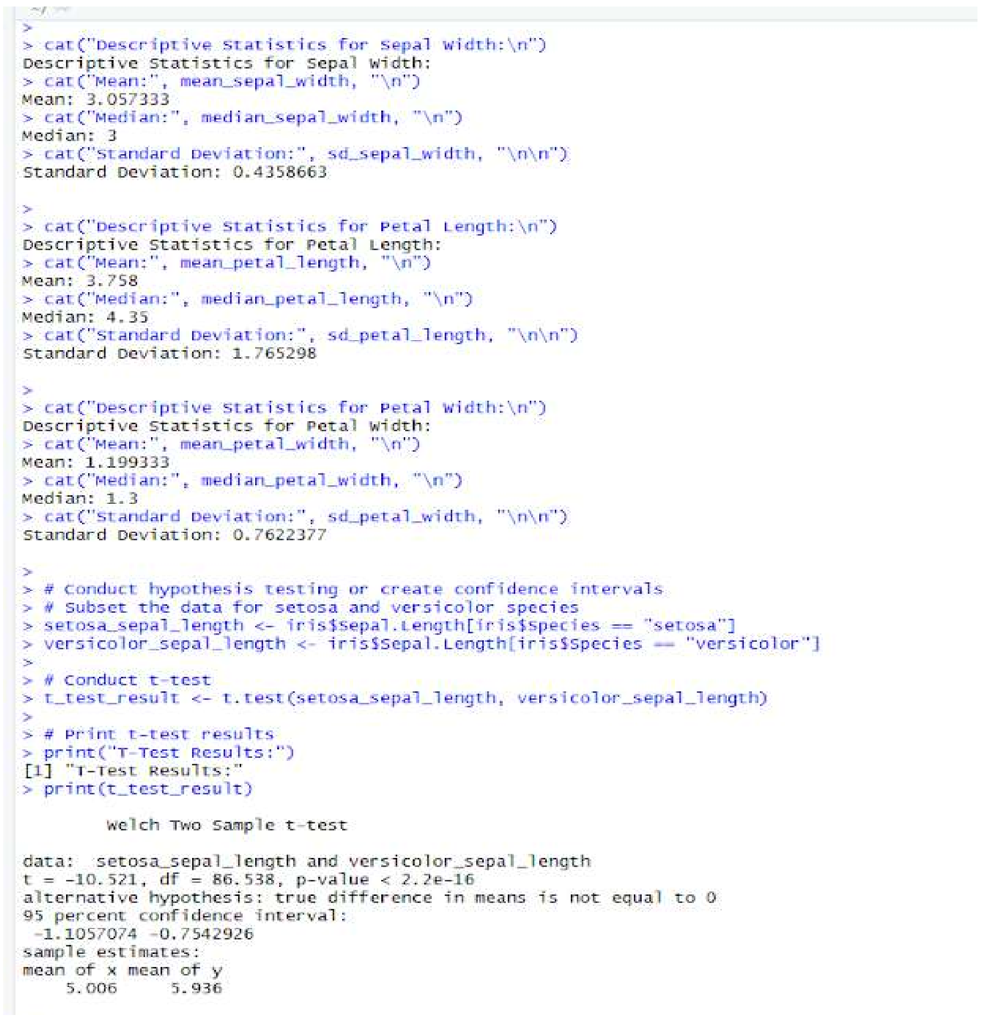
  - Visual inspections of boxplots and histograms can reveal potential patterns or clusters in the data. For example, if one species consistently has longer sepal lengths compared to others, it may indicate a distinct characteristic of that species.

  - Overall, the statistical analysis provides insights into the relationship between sepal length and species in the iris dataset, contributing to our understanding of iris flower characteristics and potentially aiding in species classification or botanical studies.

Terminal output:

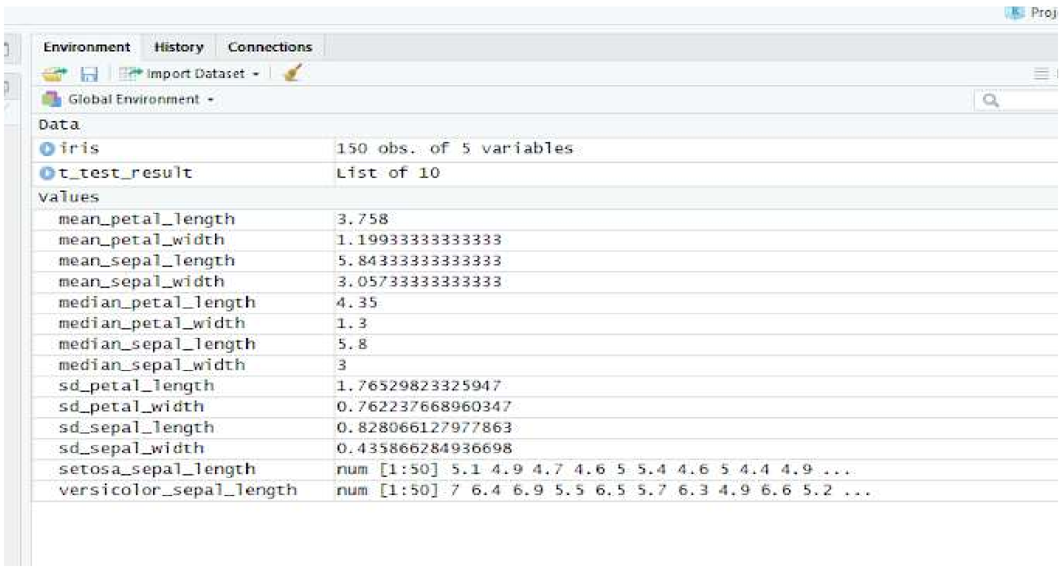


```
> data(iris)
> str(iris)
'data.frame':   150 obs. of  5 variables:
 $ Sepal.Length: num  5.1 4.9 4.7 4.6 5 5.4 4.6 5 4.4 4.9 ...
 $ Sepal.Width : num  3.5 3 3.2 3.1 3.6 3.9 3.4 3.4 2.9 3.1 ...
 $ Petal.Length: num  1.4 1.4 1.3 1.5 1.4 1.7 1.4 1.5 1.4 1.5 ...
 $ Petal.Width : num  0.2 0.2 0.2 0.2 0.2 0.4 0.3 0.2 0.2 0.1 ...
 $ Species     : Factor w/ 3 levels "setosa","versicolor",..: 1 1 1 1 1 1 1 1 1 1 ...
> head(iris)
  Sepal.Length Sepal.Width Petal.Length Petal.Width Species
1          5.1         3.5          1.4         0.2  setosa
2          4.9         3.0          1.4         0.2  setosa
3          4.7         3.2          1.3         0.2  setosa
4          4.6         3.1          1.5         0.2  setosa
5          5.0         3.6          1.4         0.2  setosa
6          5.4         3.9          1.7         0.4  setosa
>
> # Summary statistics for the dataset
> summary(iris)
  Sepal.Length    Sepal.Width     Petal.Length    Petal.Width          Species
 Min.   :4.300   Min.   :2.000   Min.   :1.000   Min.   :0.100   setosa    :50
 1st Qu.:5.100   1st Qu.:2.800   1st Qu.:1.600   1st Qu.:0.300   versicolor:50
 Median :5.800   Median :3.000   Median :4.350   Median :1.300   virginica :50
 Mean   :5.843   Mean   :3.057   Mean   :3.758   Mean   :1.199
 3rd Qu.:6.400   3rd Qu.:3.300   3rd Qu.:5.100   3rd Qu.:1.800
 Max.   :7.900   Max.   :4.400   Max.   :6.900   Max.   :2.500
>
> # Calculate mean, median, and standard deviation for relevant variables
> mean_sepal_length <- mean(iris$Sepal.Length)
> median_sepal_length <- median(iris$Sepal.Length)
> sd_sepal_length <- sd(iris$Sepal.Length)
>
> mean_sepal_width <- mean(iris$Sepal.Width)
> median_sepal_width <- median(iris$Sepal.Width)
> sd_sepal_width <- sd(iris$Sepal.Width)
>
> mean_petal_length <- mean(iris$Petal.Length)
> median_petal_length <- median(iris$Petal.Length)
> sd_petal_length <- sd(iris$Petal.Length)
>
> mean_petal_width <- mean(iris$Petal.Width)
> median_petal_width <- median(iris$Petal.Width)
> sd_petal_width <- sd(iris$Petal.Width)
>
> # Print descriptive statistics
> cat("Descriptive Statistics for Sepal Length:\n")
Descriptive Statistics for Sepal Length:
> cat("Mean:", mean_sepal_length, "\n")
Mean: 5.843333
> cat("Median:", median_sepal_length, "\n")
Median: 5.8
> cat("Standard Deviation:", sd_sepal_length, "\n\n")
Standard Deviation: 0.8280661
```



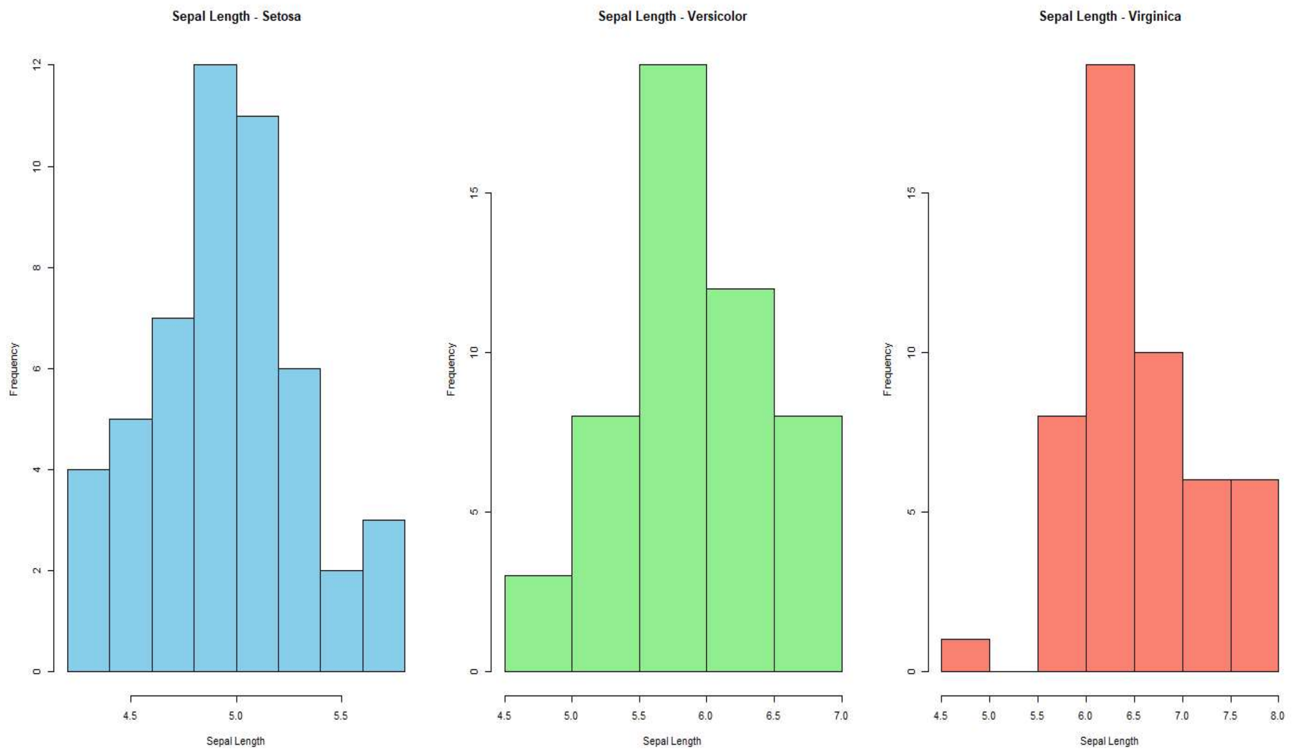
```
>
> cat("Descriptive Statistics for Sepal Width:\n")
Descriptive Statistics for Sepal Width:
> cat("Mean:", mean_sepal_width, "\n")
Mean: 3.057333
> cat("Median:", median_sepal_width, "\n")
Median: 3
> cat("Standard Deviation:", sd_sepal_width, "\n\n")
Standard Deviation: 0.4358663

>
> cat("Descriptive Statistics for Petal Length:\n")
Descriptive Statistics for Petal Length:
> cat("Mean:", mean_petal_length, "\n")
Mean: 3.758
> cat("Median:", median_petal_length, "\n")
Median: 4.35
> cat("Standard Deviation:", sd_petal_length, "\n\n")
Standard Deviation: 1.765298

>
> cat("Descriptive Statistics for Petal Width:\n")
Descriptive Statistics for Petal Width:
> cat("Mean:", mean_petal_width, "\n")
Mean: 1.199333
> cat("Median:", median_petal_width, "\n")
Median: 1.3
> cat("Standard Deviation:", sd_petal_width, "\n\n")
Standard Deviation: 0.7622377

>
> # Conduct hypothesis testing or create confidence intervals
> # Subset the data for setosa and versicolor species
> setosa_sepal_length <- iris$Sepal.Length[iris$Species == "setosa"]
> versicolor_sepal_length <- iris$Sepal.Length[iris$Species == "versicolor"]
>
> # Conduct t-test
> t_test_result <- t.test(setosa_sepal_length, versicolor_sepal_length)
>
> # Print t-test results
> print("T-Test Results:")
[1] "T-Test Results:"
> print(t_test_result)

        Welch Two Sample t-test

data:  setosa_sepal_length and versicolor_sepal_length
t = -10.521, df = 86.538, p-value < 2.2e-16
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -1.1057074 -0.7542926
sample estimates:
mean of x mean of y 
    5.006     5.936 
```

Environment:



```
Data
iris                       150 obs. of 5 variables
t_test_result              List of 10
Values
  mean_petal_length        3.758
  mean_petal_width         1.19933333333333
  mean_sepal_length        5.84333333333333
  mean_sepal_width         3.05733333333333
  median_petal_length      4.35
  median_petal_width       1.3
  median_sepal_length      5.8
  median_sepal_width       3
  sd_petal_length          1.76529823325947
  sd_petal_width           0.762237668960347
  sd_sepal_length          0.828066127977863
  sd_sepal_width           0.435866284936698
  setosa_sepal_length      num [1:50] 5.1 4.9 4.7 4.6 5 5.4 4.6 5 4.4 4.9 ...
  versicolor_sepal_length  num [1:50] 7 6.4 6.9 5.5 6.5 5.7 6.3 4.9 6.6 5.2 ...
```

Histogram:



3. Data Analysis with Pandas and NumPy(2)

Problem: You are given a dataset containing information about a fictional company's employees. The dataset (employee_data.csv) has the following columns:

Employee_ID: Unique identifier for each employee.

First_Name: First name of the employee.

Last_Name: Last name of the employee.

Department: Department in which the employee works.

Salary: Salary of the employee.

Joining_Date: Date when the employee joined the company.

Data Loading:Load the dataset (employee_data.csv) into a Pandas DataFrame.Display the first 5 rows to get an overview of the data.

Data Cleaning:Check for and handle any missing values in the dataset.Convert the Joining_Date column to a datetime format.

Data Exploration:Calculate and display the average salary of employees in each department.Identify the employee with the highest salary and display their information.

Time-based Analysis:Create a new column Years_Worked representing the number of years each employee has worked in the company.Calculate the average salary for employees based on the number of years they have worked (grouped by years).

Data Visualization:Create a histogram of the distribution of employee salaries.

3.Data Analysis with Pandas and NumPy(2)

In [52]:
```
import pandas as pd
```

In [53]:
```
#Creating csv from dictionary
data = {
    'Employee_ID': [101, 102, 103, 104, 105, 106, 107],
    'First_Name': ['John', 'Emma', 'Michael', 'Sophia', 'James', 'Emily', 'Dan
    'Last_Name': ['Doe', 'Smith', 'Johnson', 'Williams', 'Brown', 'Jones', 'Ta
    'Department': ['HR', 'Finance', 'IT', 'Marketing', 'Operations', 'HR', 'IT
    'Salary': [60000, 70000, 80000, 75000, 65000, 62000, 78000],
    'Joining_Date': ['2022-01-10', '2021-11-15', '2022-02-20', '2021-09-05', '
}

df = pd.DataFrame(data)
print(df)
df.to_csv('employee_data.csv', index=False)
```

```
   Employee_ID First_Name Last_Name  Department  Salary Joining_Date
0          101       John       Doe          HR   60000   2022-01-10
1          102       Emma     Smith     Finance   70000   2021-11-15
2          103    Michael   Johnson          IT   80000   2022-02-20
3          104     Sophia  Williams   Marketing   75000   2021-09-05
4          105      James     Brown  Operations   65000   2022-03-01
5          106      Emily     Jones          HR   62000   2021-12-10
6          107     Daniel    Taylor          IT   78000   2022-01-20
```

In [54]:
```
#Data loading:
df = pd.read_csv('employee_data.csv')
print(df.head())
```

```
   Employee_ID First_Name Last_Name  Department  Salary Joining_Date
0          101       John       Doe          HR   60000   2022-01-10
1          102       Emma     Smith     Finance   70000   2021-11-15
2          103    Michael   Johnson          IT   80000   2022-02-20
3          104     Sophia  Williams   Marketing   75000   2021-09-05
4          105      James     Brown  Operations   65000   2022-03-01
```

In [55]:
```
# Check for missing values
print("\nMissing values before handling:")
print(df.isnull().sum())
```

```

Missing values before handling:
Employee_ID     0
First_Name      0
Last_Name       0
Department      0
Salary          0
Joining_Date    0
dtype: int64
```

In [56]:
```
# Convert 'Joining_Date' column to datetime format
df['Joining_Date'] = pd.to_datetime(df['Joining_Date'])
print(df.head())
```

```
   Employee_ID First_Name Last_Name  Department  Salary Joining_Date
0          101       John       Doe          HR   60000   2022-01-10
1          102       Emma     Smith     Finance   70000   2021-11-15
2          103    Michael   Johnson          IT   80000   2022-02-20
3          104     Sophia  Williams   Marketing   75000   2021-09-05
4          105      James     Brown  Operations   65000   2022-03-01
```

In [57]:
```
# Calculate and display the average salary of employees in each department
average_salary_by_department = df.groupby('Department')['Salary'].mean()
print("Average salary of employees in each department:")
print(average_salary_by_department)
```

```
Average salary of employees in each department:
Department
Finance       70000.0
HR            61000.0
IT            79000.0
Marketing     75000.0
Operations    65000.0
Name: Salary, dtype: float64
```

In [58]:
```
# Identify the employee with the highest salary
employee_highest_salary = df[df['Salary'] == df['Salary'].max()]
print("\nEmployee with the highest salary:")
print(employee_highest_salary)
```

```

Employee with the highest salary:
   Employee_ID First_Name Last_Name Department  Salary Joining_Date
2          103    Michael   Johnson         IT   80000   2022-02-20
```

In [59]:
```
#Time analysis:
from datetime import datetime
```

In [60]:
```
df['Joining_Date'] = pd.to_datetime(df['Joining_Date'])
# Calculate the number of years each employee has worked
current_date = datetime.now()
df['Years_Worked'] = (current_date - df['Joining_Date']).dt.days // 365
```

In [61]:
```
column_order = ['Employee_ID', 'First_Name', 'Last_Name', 'Department', 'Salar
df = df.reindex(columns=column_order)
```

In [62]:
```
print("DataFrame with Years_Worked column:")
print(df.head())
```

```
DataFrame with Years_Worked column:
   Employee_ID First_Name Last_Name  Department  Salary Joining_Date  \
0          101       John       Doe          HR   60000   2022-01-10
1          102       Emma     Smith     Finance   70000   2021-11-15
2          103    Michael   Johnson          IT   80000   2022-02-20
3          104     Sophia  Williams   Marketing   75000   2021-09-05
4          105      James     Brown  Operations   65000   2022-03-01

   Years_Worked
0             2
1             2
2             2
3             2
4             1
```

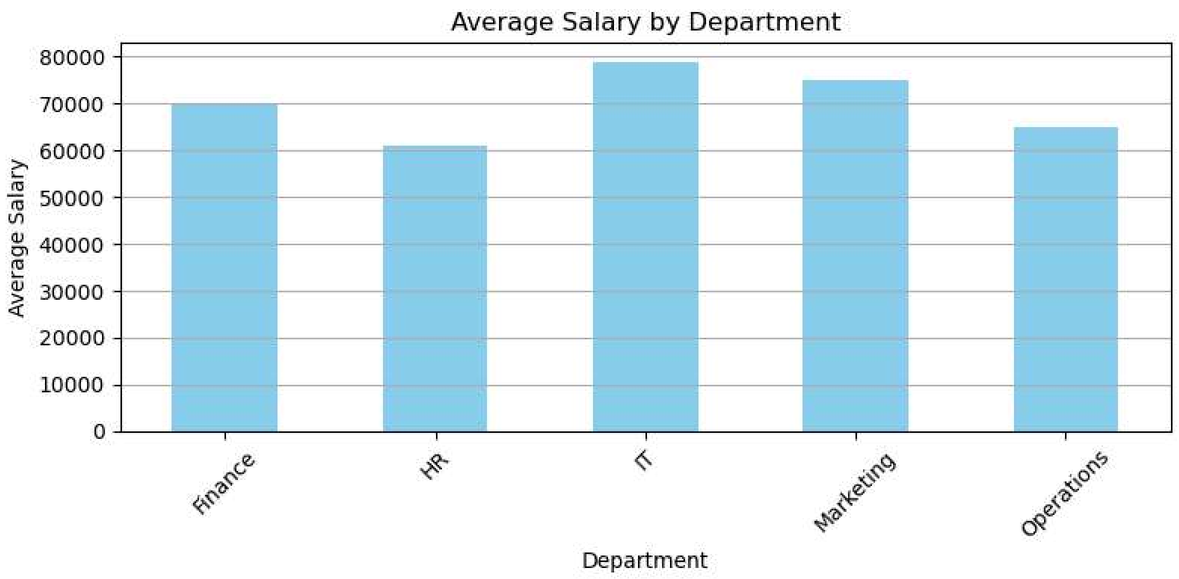
In [63]:
```
average_salary_by_years_worked = df.groupby('Years_Worked')['Salary'].mean()
print("\nAverage salary for employees based on the number of years they have wo
print(average_salary_by_years_worked)
```

```

Average salary for employees based on the number of years they have worked:
Years_Worked
1    65000.000000
2    70833.333333
Name: Salary, dtype: float64
```

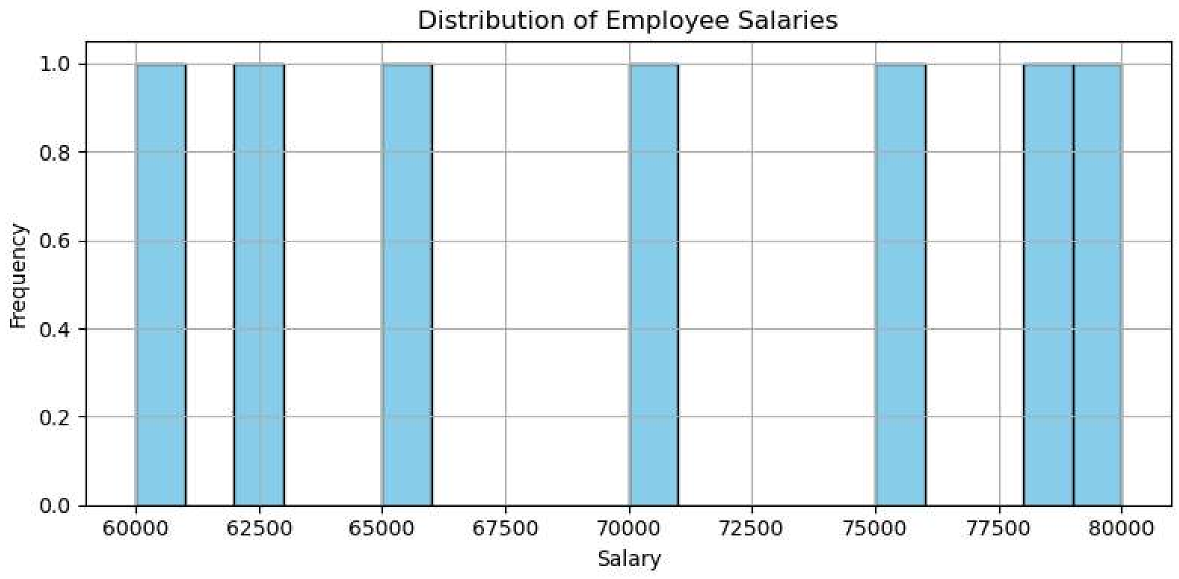
In [64]:
```
#Data Visualization:
```

In [65]:
```
# Calculate the average salary for each department
average_salary_by_department = df.groupby('Department')['Salary'].mean()
```

In [66]:
```
plt.figure(figsize=(8, 4))
average_salary_by_department.plot(kind='bar', color='skyblue')
plt.title('Average Salary by Department')
plt.xlabel('Department')
plt.ylabel('Average Salary')
plt.xticks(rotation=45)
plt.grid(axis='y')
plt.tight_layout()
plt.show()
```



In [67]:
```
# Histogram of the distribution of employee salaries
plt.figure(figsize=(8, 4))
plt.hist(df['Salary'], bins=20, color='skyblue', edgecolor='black')
plt.title('Distribution of Employee Salaries')
plt.xlabel('Salary')
plt.ylabel('Frequency')
plt.grid(True)
plt.tight_layout()
plt.show()
```


Distribution of Employee Salaries
Frequency
Salary