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## **From Sepals to Petals: A Boxplot Journey Through Iris Species**

**Aim :** The aim of this project is to perform exploratory data analysis (EDA) on the **Iris dataset** to visualize the distribution, spread, and presence of outliers in the sepal and petal measurements. This includes the use of boxplots and other visualizations to understand the relationships between the variables.

### **Task to be done:**

- Load and explore the structure of the Iris dataset.
- Visualize the distribution of sepal and petal measurements using histograms.
- Create boxplots for each variable to detect outliers and assess data spread.
- Analyze relationships between variables using scatter plots.
- Label axes and provide descriptive titles for all plots and visualizations.
- Summarize key findings from the visualizations and statistics.

### **Question :**

Choose a dataset from a repository like Kaggle or UCI Machine Learning Repository and perform exploratory data analysis using R. Explore the distribution of variables, identify outliers, and visualize relationships between variables using plots like histograms, scatter plots, and boxplots.

### **Code/Implementation :**

#### **Step 1: Choose a Dataset**

- Go to **Kaggle** or the **UCI Machine Learning Repository**.
- Pick a dataset that interests you. For this guide, let's use the **Iris dataset** (a popular dataset with four numerical variables: sepal length, sepal width, petal length, petal width, and one categorical variable: species).

## Step 2:

- Set the working directory where your dataset is saved.
- Install and Load necessary packages:

```
> setwd("C:\\Users\\HP\\Downloads")
Error: '\U' used without hex digits in character string (<input>:1:11)
> setwd("C:\\\\Users\\\\HP\\\\Downloads")
> install.packages("tidyverse") # For data manipulation and visualization
Installing package into 'C:/Users/HP/AppData/Local/R/win-library/4.4'
(as 'lib' is unspecified)
--- Please select a CRAN mirror for use in this session ---
trying URL 'https://cran.icts.res.in/bin/windows/contrib/4.4/tidyverse_2.0.0.zip'
Content type 'application/zip' length 431251 bytes (421 KB)
downloaded 421 KB

package 'tidyverse' successfully unpacked and MD5 sums checked

The downloaded binary packages are in
      C:\Users\HP\AppData\Local\Temp\RtmpgbgoD6\downloaded_packages
> install.packages("ggplot2") # For data visualization
Installing package into 'C:/Users/HP/AppData/Local/R/win-library/4.4'
(as 'lib' is unspecified)
trying URL 'https://cran.icts.res.in/bin/windows/contrib/4.4/ggplot2_3.5.1.zip'
Content type 'application/zip' length 5009017 bytes (4.8 MB)
downloaded 4.8 MB

package 'ggplot2' successfully unpacked and MD5 sums checked
```

The downloaded binary packages are in

C:\Users\HP\AppData\Local\Temp\RtmpgbgoD6\downloaded\_packages

```
> install.packages("dplyr") # For data manipulation
```

Installing package into 'C:/Users/HP/AppData/Local/R/win-library/4.4'

(as 'lib' is unspecified)

trying URL 'https://cran.icts.res.in/bin/windows/contrib/4.4/dplyr\_1.1.4.zip'

Content type 'application/zip' length 1582782 bytes (1.5 MB)

downloaded 1.5 MB

package 'dplyr' successfully unpacked and MD5 sums checked

The downloaded binary packages are in

C:\Users\HP\AppData\Local\Temp\RtmpgbgoD6\downloaded\_packages

```
> |
```

### Step 3: Load the Dataset

Load the dataset into R using the read.csv() function.

```
> iris_data<-unzip("C:\\Users\\HP\\Downloads\\iris dataset csv.zip",exdir="C:\\Users\\HP\\Downloads\\iris $
> iris_files<-list.files("C:\\Users\\HP\\Downloads\\iris dataset csv")
> iris_files
[1] "Iris.csv"
> iris_files<-list.files("C:\\Users\\HP\\Downloads\\iris dataset csv",full.names=TRUE)
> iris_files
[1] "C:\\Users\\HP\\Downloads\\iris dataset csv/Iris.csv"
>
> iris_data <- read.csv("C:\\Users\\HP\\Downloads\\iris dataset csv/Iris.csv")
Error: unexpected symbol in "iris_data <- read.csv("C"
> iris_data <- read.csv("C:\\Users\\HP\\Downloads\\iris dataset csv/Iris.csv")
> |
```

Check the first few rows to ensure the data has been loaded properly:

```
> head(iris_data)
  Id SepalLengthCm SepalWidthCm PetalLengthCm PetalWidthCm Species
1  1           5.1           3.5           1.4           0.2 Iris-setosa
2  2           4.9           3.0           1.4           0.2 Iris-setosa
3  3           4.7           3.2           1.3           0.2 Iris-setosa
4  4           4.6           3.1           1.5           0.2 Iris-setosa
5  5           5.0           3.6           1.4           0.2 Iris-setosa
6  6           5.4           3.9           1.7           0.4 Iris-setosa
> |
```



## Step 4: Exploratory Data Analysis

- `str()` gives you information about data types and structure.
- `summary()` provides descriptive statistics (mean, median, min, max, etc.).

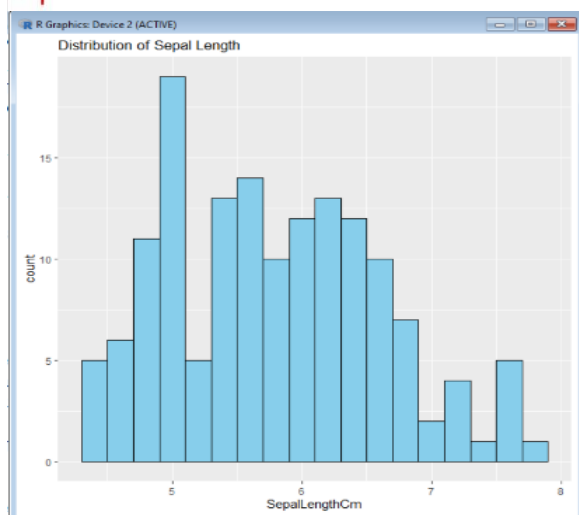
```
> # Structure of the dataset
> str(iris_data)
'data.frame': 150 obs. of 6 variables:
 $ Id      : int  1 2 3 4 5 6 7 8 9 10 ...
 $ SepalLengthCm: num  5.1 4.9 4.7 4.6 5 5.4 4.6 5 4.4 4.9 ...
 $ SepalWidthCm : num  3.5 3 3.2 3.1 3.6 3.9 3.4 3.4 2.9 3.1 ...
 $ PetalLengthCm: num  1.4 1.4 1.3 1.5 1.4 1.7 1.4 1.5 1.4 1.5 ...
 $ PetalWidthCm : num  0.2 0.2 0.2 0.2 0.2 0.4 0.3 0.2 0.2 0.1 ...
 $ Species      : chr  "Iris-setosa" "Iris-setosa" "Iris-setosa" "Iris-setosa" ...
> # Summary statistics
> summary(iris_data)
      Id      SepalLengthCm      SepalWidthCm      PetalLengthCm      PetalWidthCm      Species
Min.   : 1.00      Min.   :4.300      Min.   :2.000      Min.   :1.000      Min.   :0.100      Length:150
1st Qu.: 38.25     1st Qu.:5.100      1st Qu.:2.800      1st Qu.:1.600      1st Qu.:0.300      Class :character
Median : 75.50     Median :5.800      Median :3.000      Median :4.350      Median :1.300      Mode  :character
Mean   : 75.50     Mean   :5.843      Mean   :3.054      Mean   :3.759      Mean   :1.199
3rd Qu.:112.75     3rd Qu.:6.400      3rd Qu.:3.300      3rd Qu.:5.100      3rd Qu.:1.800
Max.   :150.00     Max.   :7.900      Max.   :4.400      Max.   :6.900      Max.   :2.500
> |
```

## Step 5 : Distribution of Variables :

Start with histograms to visualize the distribution of numerical variables:

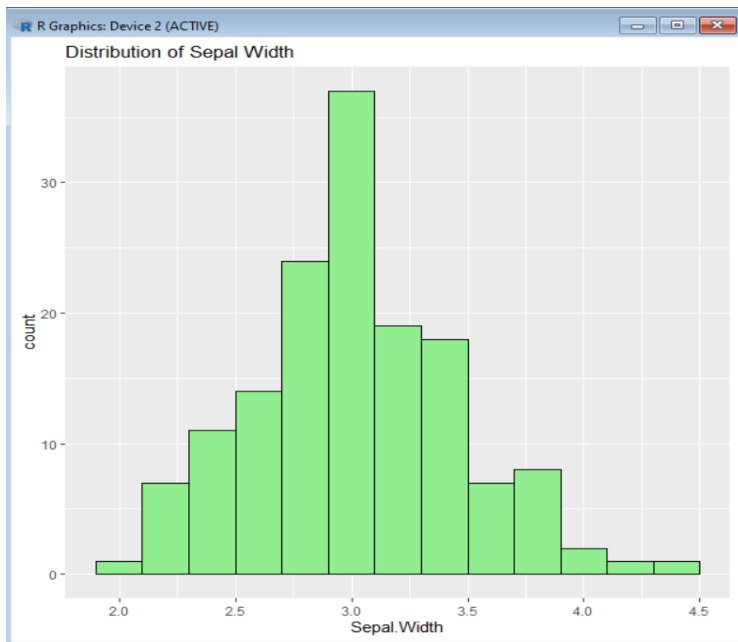
i. Histogram for Sepal Length:

```
> ggplot(iris_data, aes(x = `SepalLengthCm`)) +
+   geom_histogram(binwidth = 0.2, fill = "skyblue", color = "black") +
+   labs(title = "Distribution of Sepal Length")
> |
```



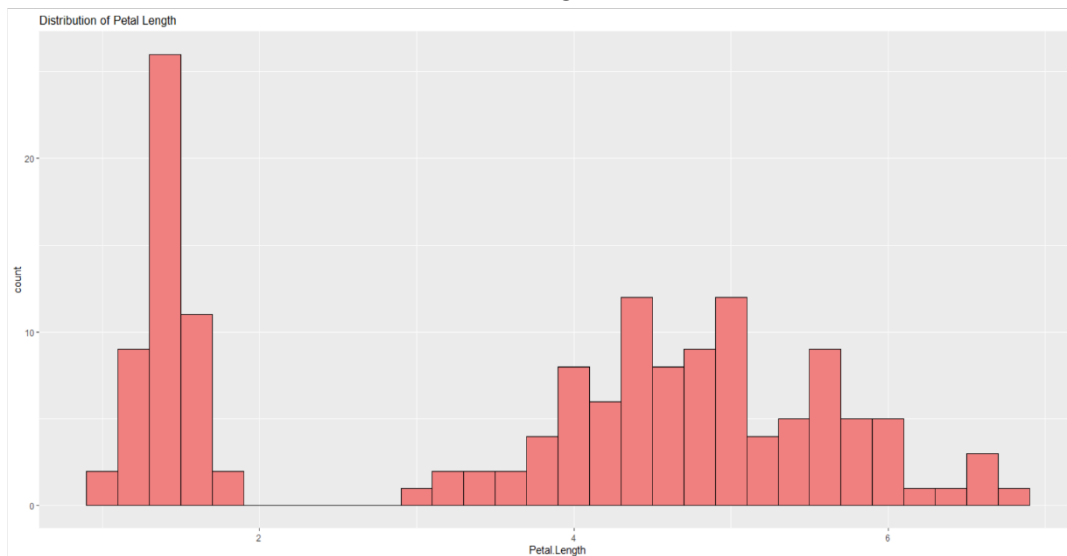
## ii. Histogram of Sepal Width :

```
> ggplot(iris, aes(x = Sepal.Width)) +  
+   geom_histogram(binwidth = 0.2, fill = "lightgreen", color = "black") +  
+   labs(title = "Distribution of Sepal Width")  
> |
```



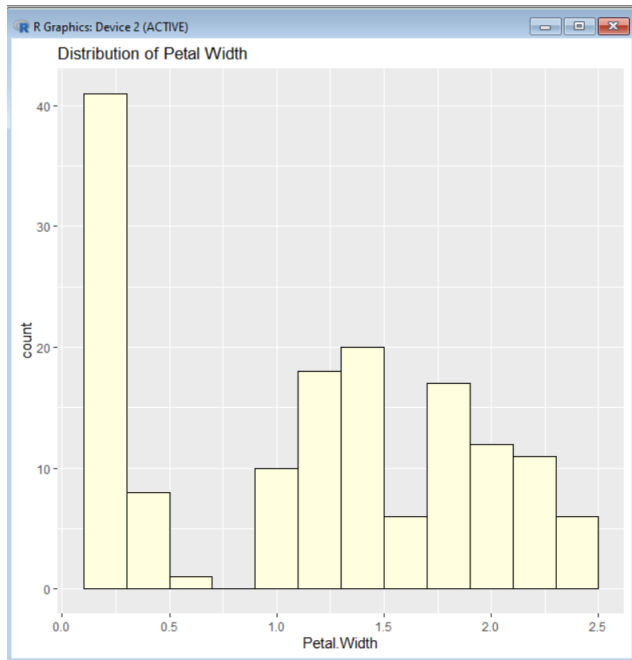
## iii. Histogram of Petal Length :

```
ggplot(iris, aes(x = Petal.Length)) +  
+   geom_histogram(binwidth = 0.2, fill = "lightcoral", color = "black") +  
+   labs(title = "Distribution of Petal Length")
```



#### iv. Histogram of Petal Width :

```
ggplot(iris, aes(x = Petal.Width)) +  
+ geom_histogram(binwidth = 0.2, fill = "lightyellow", color = "black") +  
+ labs(title = "Distribution of Petal Width")
```

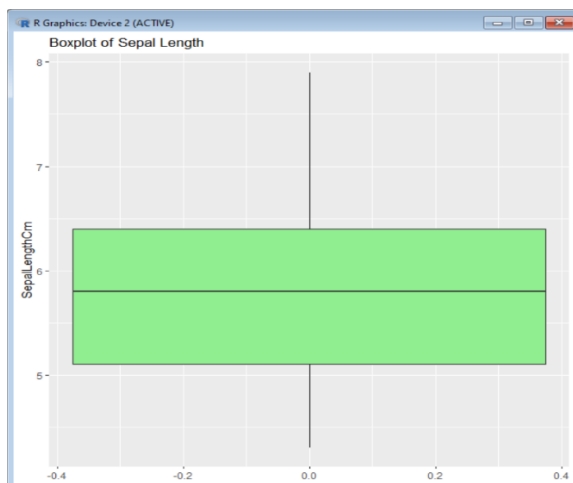


#### Step 6: Boxplot to Identify Outliers:

Boxplots are useful to identify outliers in the dataset.

##### Boxplot for Sepal Length :

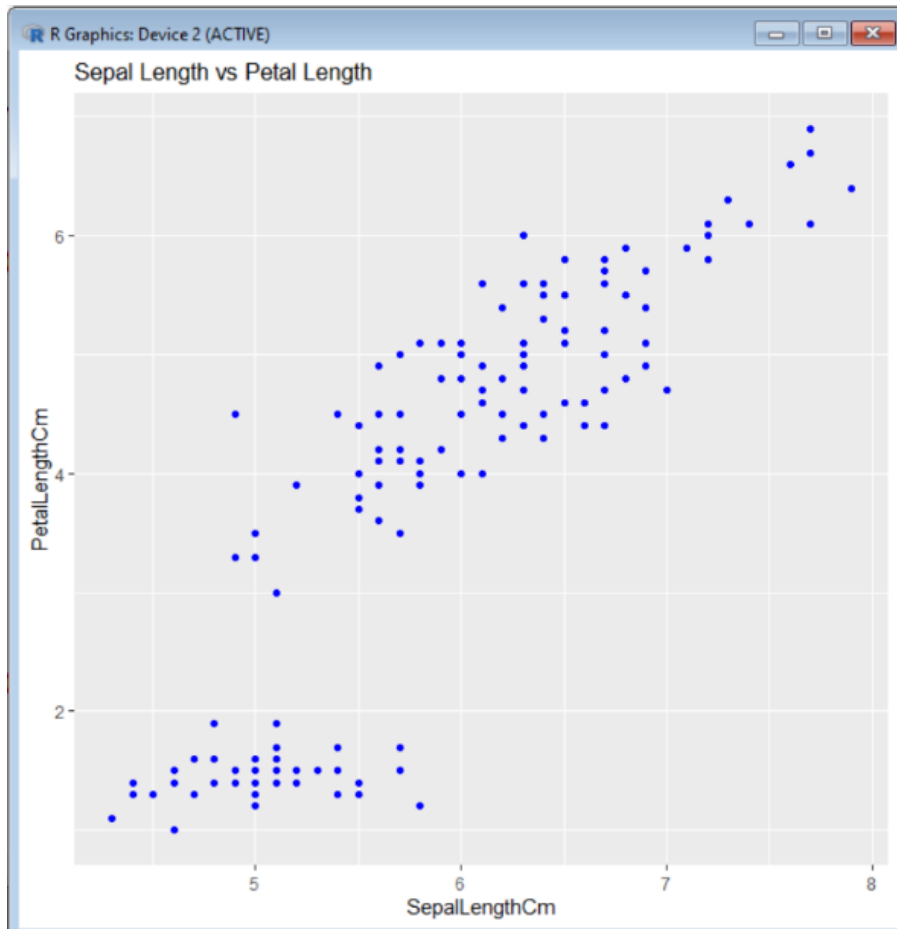
```
ggplot(iris_data, aes(y = SepalLengthCm)) +  
+ geom_boxplot(fill = "lightgreen") +  
+ labs(title = "Boxplot of Sepal Length")
```



## Step 7: Relationship Between Variables:

Scatter plots help visualize relationships between variables.

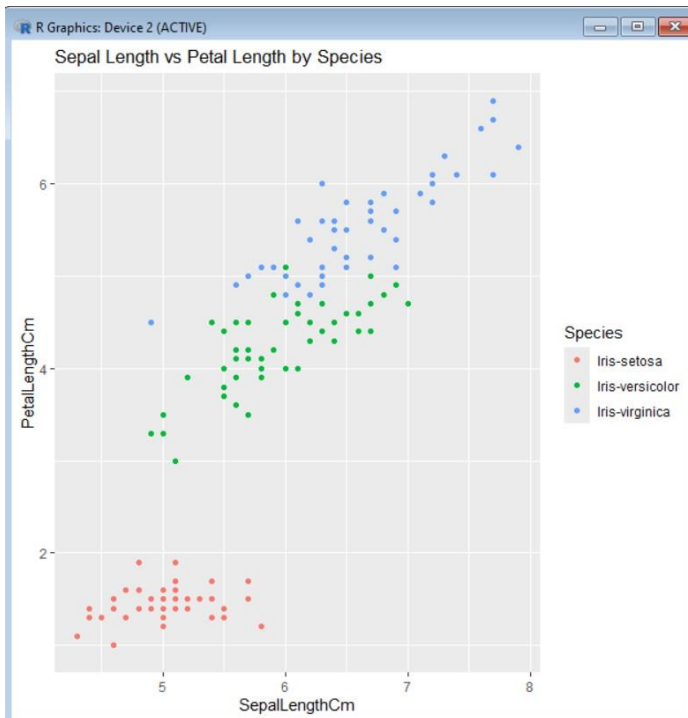
```
ggplot(iris_data, aes(x = SepalLengthCm, y = PetalLengthCm)) +  
+ geom_point(color = "blue") +  
+ labs(title = "Sepal Length vs Petal Length")
```



**Color points by species to see patterns across different classes:**

# Scatter plot colored by species

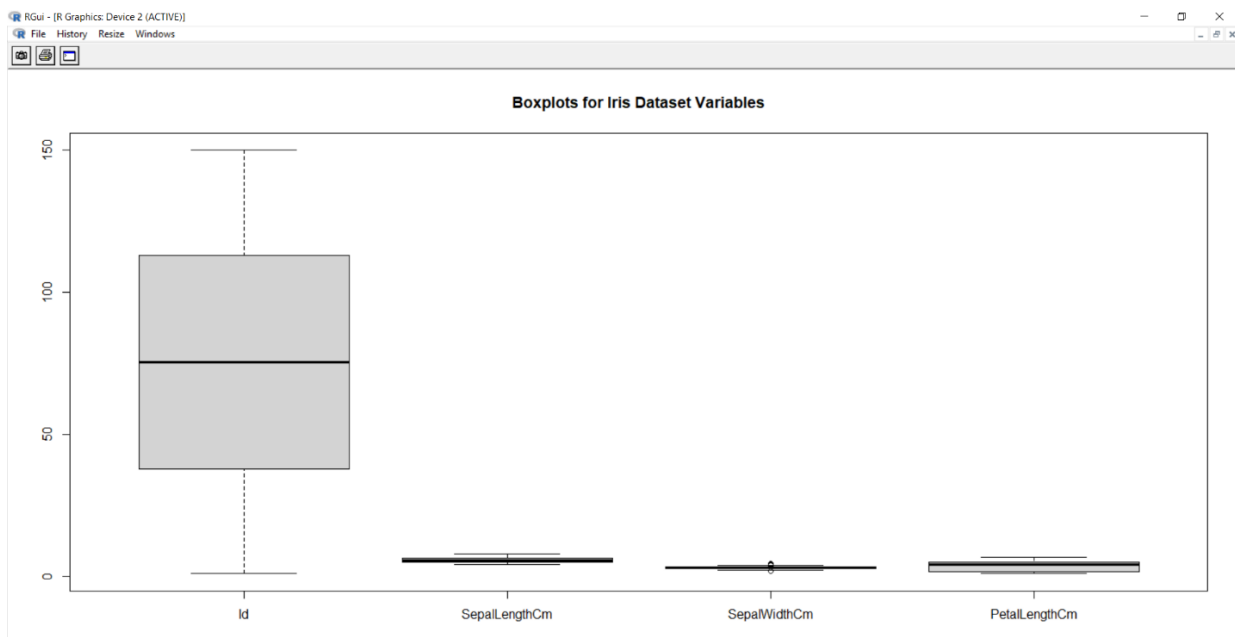
```
ggplot(iris_data, aes(x = Sepal.Length, y = Petal.Length, color =  
Species)) +geom_point()  
+ labs(title = "Sepal Length vs Petal Length by Species")
```



## Step 8: Detecting Outliers:

Use boxplots for multiple variables to identify outliers. Look for points that are significantly above or below the whiskers:

**`boxplot(iris_data[, 1:4], main = "Boxplots for Iris Dataset Variables")`**





## Learning Outcomes :

1. Understand how to perform exploratory data analysis (EDA) on a dataset.
2. Learn how to visualize data distributions using histograms and boxplots.
3. Gain skills in detecting outliers and analyzing data spread.
4. Develop proficiency in using scatter plots to identify relationships between variables.
5. Gain experience in handling datasets and creating clear visual representations.
6. Improve the ability to draw insights from data visualizations and summary statistics.
7. Learn to use libraries such as **ggplot2** for advanced data visualization.