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Data Visualization

Agenda

- Visualization using Seaborn
- Visualization using Plotly

Data visualization

- Representation of the data in a pictorial or graphical format
- First step of data analysis
- Allow us to get the intuitive understanding of the data
- Helps to visualize the patterns in the data

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Visualization using Seaborn

Introduction

- Seaborn is used for data visualization
- It is based on the matplotlib
- It provides a high-level interface for drawing attractive and informative statistical graphics

Functionalities of seaborn

- Allows comparison between multiple variables
- Supports multi-plot grids
- Univariate and bivariate visualization
- Availability of different color palettes
- Estimates and plots linear regression line

Installation

Open terminal program (for Mac user) or command line (for Windows) and install it using following command:

```
conda install seaborn
```

Or

```
pip install seaborn
```

Installation

- Alternatively, you can install seaborn in a jupyter notebook using below code:

```
!pip install seaborn
```

- To import the library, use the command:

```
Import seaborn as sns
```

Strip plot

- It is similar to the scatter plot with one categorical variable
- It is used to understand the underlying distribution of the data
- One axis represents the categorical variable and another represents the value corresponding to the categories

Read the data

Load the titanic data to create a strip plot

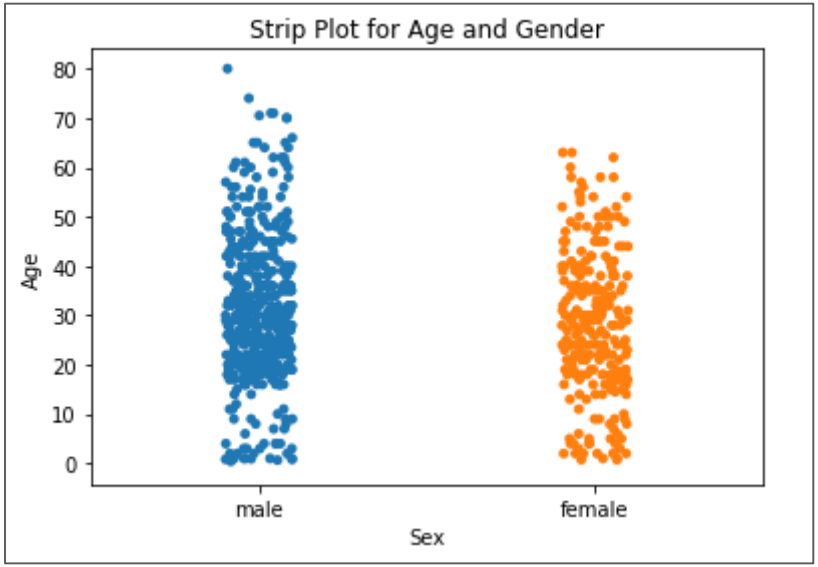
```
# load the csv file 'Titanic_data.csv'
df_titanic = pd.read_csv('Titanic_data.csv')

# display first five rows
df_titanic.head()
```

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500	NaN	S
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833	C85	C
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250	NaN	S
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000	C123	S
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500	NaN	S

Strip plot

Check the distribution of age based on gender

```
# plot a strip plot
# 'x' represents variable on x-axis
# 'y' represents variable on y-axis
# 'data' represents the DataFrame
sns.stripplot(x = 'Sex', y = 'Age', data = df_titanic)

# add the plot label
plt.title('Strip Plot for Age and Gender')

# display the plot
plt.show()
```



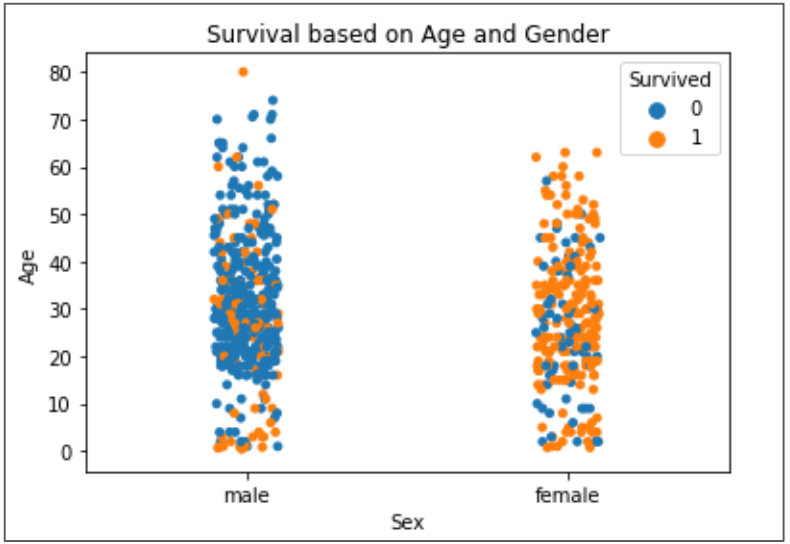
The plot shows that, the maximum age of males is higher than of females

Strip plot

Add the one more categorical variable to strip plot using the parameter, ‘hue’

```
# plot a strip plot
# 'x' represents variable on x-axis
# 'y' represents variable on y-axis
# 'hue' adds one more variable to the plot
# 'data' represents the DataFrame
sns.stripplot(x = 'Sex', y = 'Age', hue = 'Survived' , data = df_titanic)

# add the plot label
plt.title('Survival based on Age and Gender')

# display the plot
plt.show()
```

Add a categorical variable



Proportion of female survivors is higher than males

Violin plot

- It is similar to a boxplot, that displays the kernel density estimator of the underlying distribution
- It shows the distribution of the quantitative data across categorical variables such that those distributions can be compared

Read the data

Load the titanic data to create a violin plot

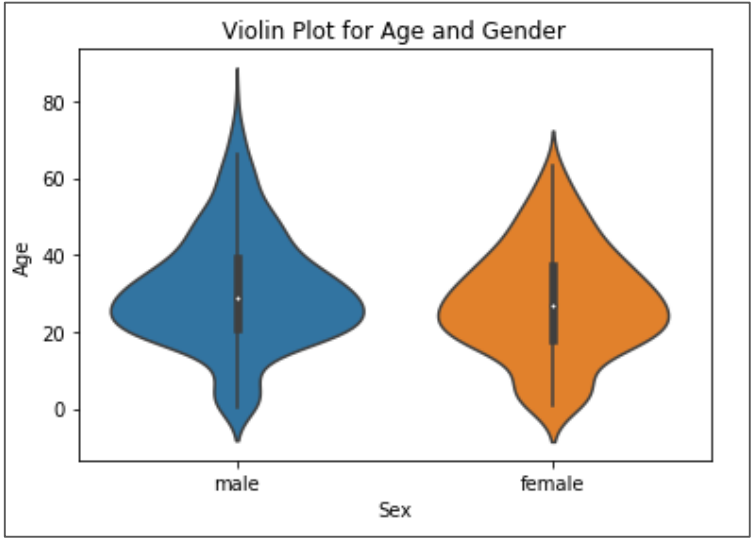
```
# load the csv file 'Titanic_data.csv'
df_titanic = pd.read_csv('Titanic_data.csv')

# display first five rows
df_titanic.head()
```

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500	NaN	S
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833	C85	C
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250	NaN	S
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000	C123	S
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500	NaN	S

Violin plot

Plot the violin plot to compare the distribution of age based on gender

```
# plot a violin plot
# 'x' represents variable on x-axis
# 'y' represents variable on y-axis
# 'data' represents the DataFrame
sns.violinplot(x = 'Sex', y = 'Age', data = df_titanic)

# add the plot label
plt.title('Violin Plot for Age and Gender')

# display the plot
plt.show()
```



The box plot is plotted inside the violin plot

Violin plot

Violin plot can be divided into two halves, where one half represents surviving while other half represents the non-surviving passenger

```
# plot a violin plot
# 'x' represents variable on x-axis
# 'y' represents variable on y-axis
# 'hue' adds one more variable to the plot
# 'data' represents the DataFrame
# 'split' returns the plot splitted in two halves
sns.violinplot(x='Sex', y='Age', data=df_titanic, hue='Survived', split=True)

# add the plot label
plt.title('Survival based on Age and Gender')

# display the plot
plt.show()
```

Pass ‘True’ as value for the split parameter

Swarm plot

- It is the combination of strip and violin plots
- The points are adjusted in such a way that they don't overlap, which gives the better representation of the data

Read the data

Load the titanic data to create a swarm plot

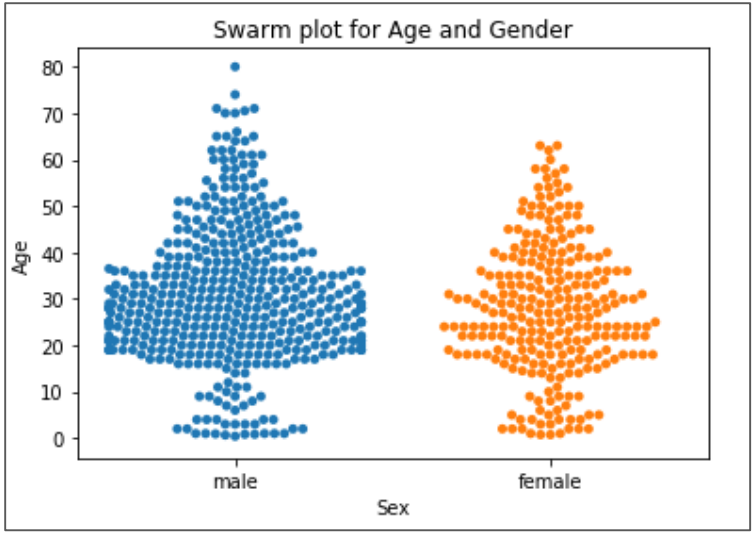
```
# load the csv file 'Titanic_data.csv'
df_titanic = pd.read_csv('Titanic_data.csv')

# display first five rows
df_titanic.head()
```

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500	NaN	S
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833	C85	C
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250	NaN	S
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000	C123	S
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500	NaN	S

Swarm plot

Create a swarm plot for the distribution of age based on gender

```
# plot a swarm plot
# 'x' represents variable on x-axis
# 'y' represents variable on y-axis
# 'data' represents the DataFrame
sns.swarmplot(x = 'Sex', y = 'Age', data = df_titanic)

# add the plot label
plt.title('Swarm plot for Age and Gender')

# display the plot
plt.show()
```

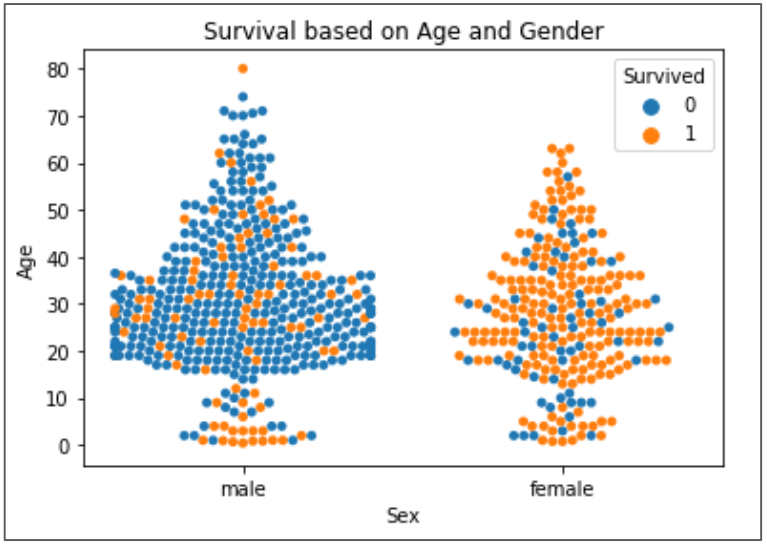


High proportion of males are in the age range 20 - 40

Swarm plot

Add one more categorical variable ‘Survived’ to the swarm plot using the parameter, ‘hue’

```
# plot a swarm plot
# 'x' represents variable on x-axis
# 'y' represents variable on y-axis
# 'hue' adds one more variable to the plot
# 'data' represents the DataFrame
sns.swarmplot(x = 'Sex', y = 'Age', data = df_titanic, hue = 'Survived')

# add the plot label
plt.title('Survival based on Age and Gender')

# display the plot
plt.show()
```



Pair plot

- It displays the pairwise relationship between the numeric variables
- The pairplot() method creates a matrix; where the diagonal plots represent the univariate distribution of each variable and the off-diagonal plots represent the scatter plot of the pair of variables

Read the data

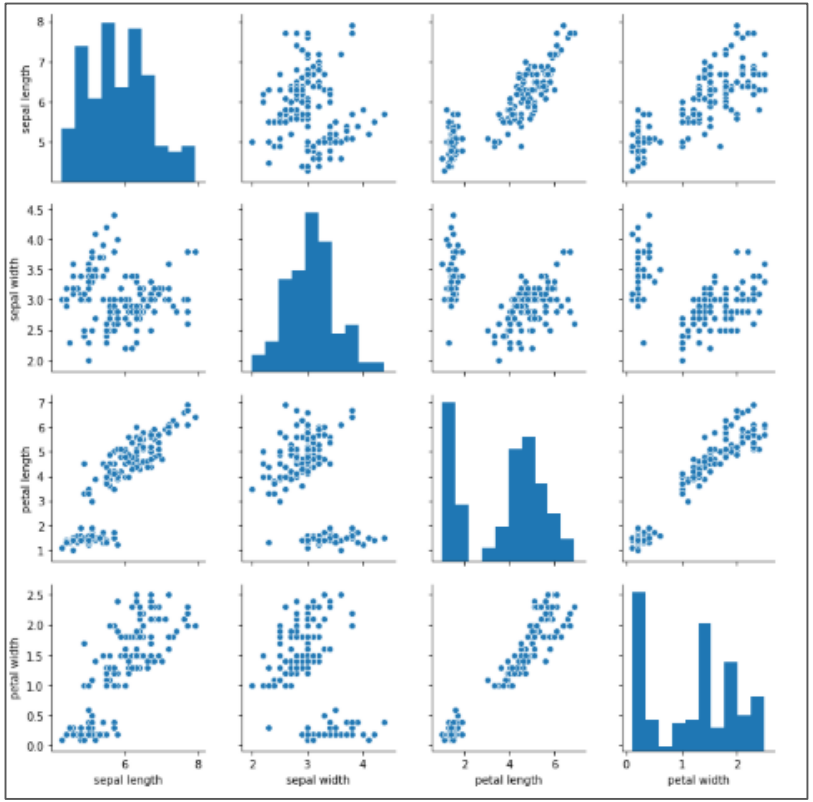
Use the iris data to create the pair plot

```
# load the csv file 'iris.csv'
df_iris = pd.read_csv('iris.csv')

# display first five rows
df_iris.head()
```

	sepal length	sepal width	petal length	petal width	class
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

Pair plot

```
# plot a pair plot
# 'data' represents the data to plot the pair plot
sns.pairplot(data = df_iris)

# display the plot
plt.show()
```



Distribution plot

- It displays the distribution of the data
- It is a variation of histogram that uses kernel smoothing to plot values, allowing for smoother distributions by smoothing out the noise

Read the data

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Load the titanic data to create a distribution plot

```
# load the csv file 'Titanic_data.csv'
df_titanic = pd.read_csv('Titanic_data.csv')

# display first five rows
df_titanic.head()
```

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500	NaN	S
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833	C85	C
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250	NaN	S
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000	C123	S
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500	NaN	S

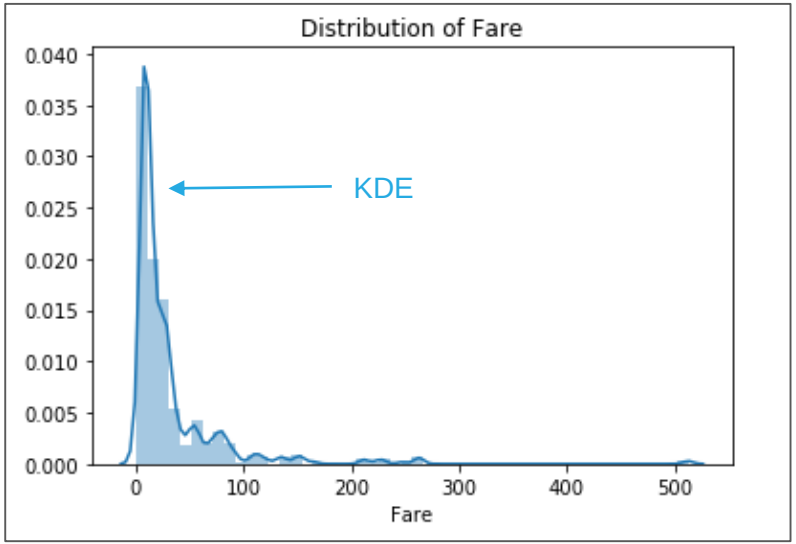
Distribution plot

The distplot() method plots the histogram with a Kernel Density Estimator (KDE), which is a used to estimate the probability distribution function of a random variable

```
# plot a distribution plot
# 'a' represents variable to plot a distribution plot
sns.distplot(a = df_titanic['Fare'])

# add the plot label
plt.title('Distribution of Fare')

# display the plot
plt.show()
```



The plot shows the positive skewness of the ‘Fare’

Distribution plot

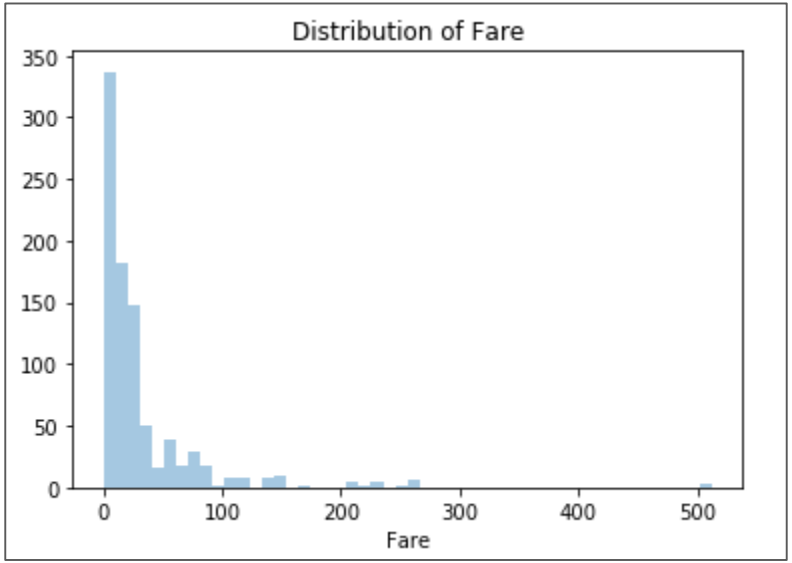
Plot the distribution of ‘Fare’ without the kernel density estimator (KDE)

```
# plot a distribution plot
# 'a' represents variable to plot a distribution plot
sns.distplot(a = df_titanic['Fare'], kde = False)

# add the plot label
plt.title('Distribution of Fare')

# display the plot
plt.show()
```

Returns the plot without kde



Count plot

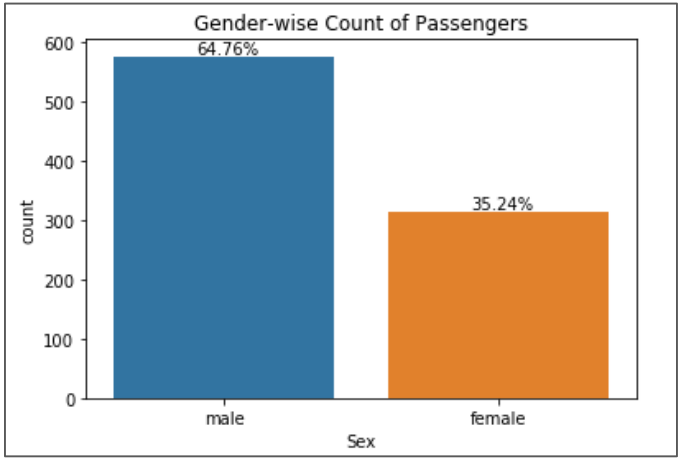
It is similar to the bar plot. However, it shows the count of the categories in a specific variable

```
# plot a count plot
# 'x' represents variable on x-axis
# 'data' represents the DataFrame
sns.countplot(x = 'Sex', data = df_titanic)

# add text on the plot
# 'x' and 'y' represents the position of the text
# 's' represents the text
plt.text(x = -0.1, y = 580, s = str(round(df_titanic.Sex.value_counts()[0]/len(df_titanic)*100, 2)) + '%')
plt.text(x = 0.9, y = 320, s = str(round(df_titanic.Sex.value_counts()[1]/len(df_titanic)*100, 2)) + '%')

# add the plot label
plt.title('Gender-wise Count of Passengers')

# display the plot
plt.show()
```



Calculate the gender-wise percentage upto 2 decimals

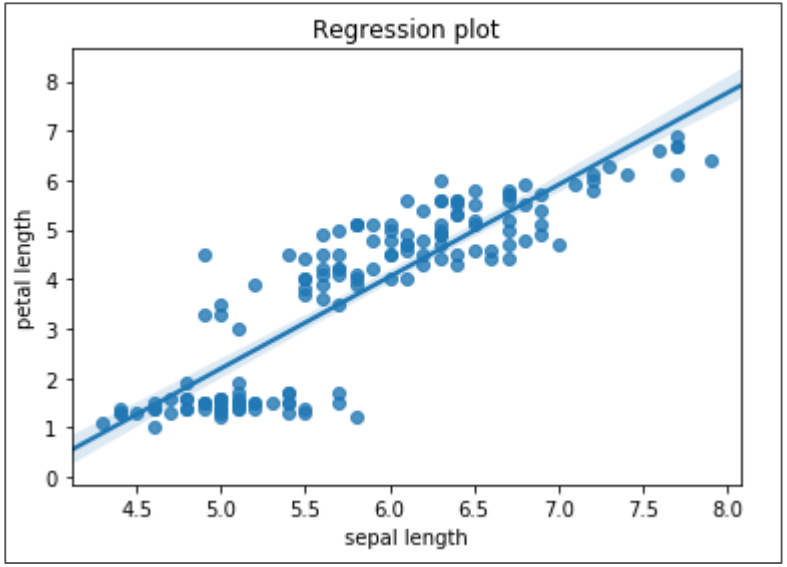
Regression plot

It is used to study the relationship between the two variables with the regression line

```
# plot a regression plot
# 'x' represents variable on x-axis
# 'y' represents variable on y-axis
# 'data' represents the DataFrame
sns.regplot(x = 'sepal length', y = 'petal length', data = df_iris)

# add the plot label
plt.title('Regression plot')

# display the plot
plt.show()
```



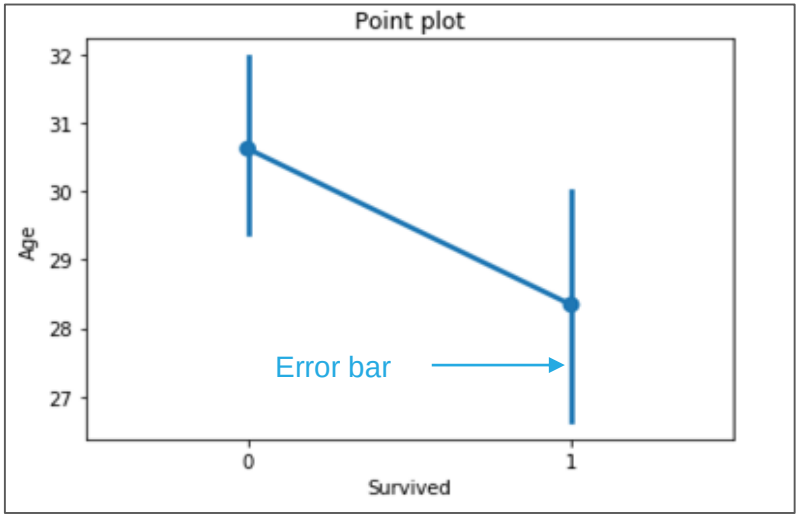
Point plot

It represents an estimate of central tendency (by default, mean) by position of scatter points and provides the indication of the uncertainty around that estimate using error bars

```
# plot a point plot
# 'x' represents variable on x-axis
# 'y' represents variable on y-axis
# 'data' represents the DataFrame
sns.pointplot(x = 'Survived', y = 'Age', data = df_titanic)

# add the plot label
plt.title('Point plot')

# display the plot
plt.show()
```

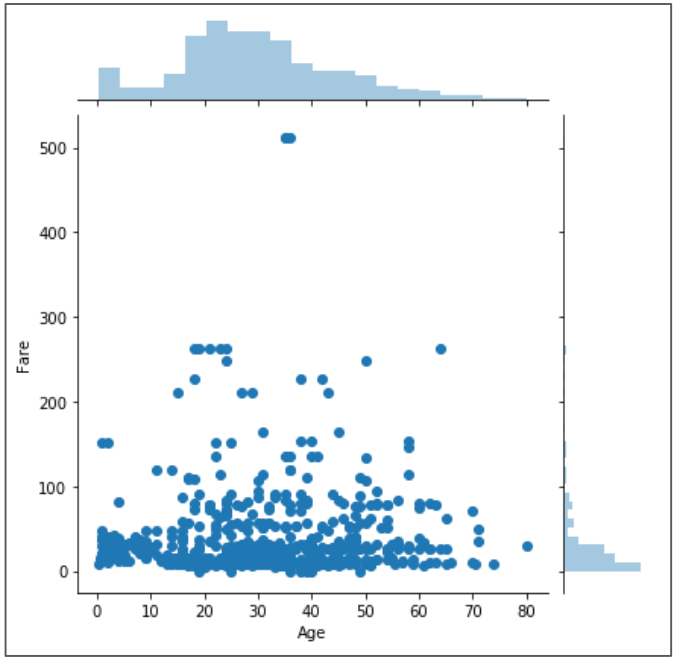


Joint plot

A joint plot is a bivariate plot along with the distribution plot along the margins

```
# plot a joint plot
# 'x' represents variable on x-axis
# 'y' represents variable on y-axis
# 'data' represents the DataFrame
sns.jointplot(x = 'Age', y = 'Fare', data = df_titanic)

# display the plot
plt.show()
```



Heatmap

- A heatmap is a two-dimensional graphical representation of data where the individual values that are contained in a matrix are represented by the different colors

- Heatmap for correlation shows the correlation between the variables on each axis

Read the data

Use the iris data to create the heatmap

```
# load the csv file 'iris.csv'
df_iris = pd.read_csv('iris.csv')

# display first five rows
df_iris.head()
```

	sepal length	sepal width	petal length	petal width	class
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

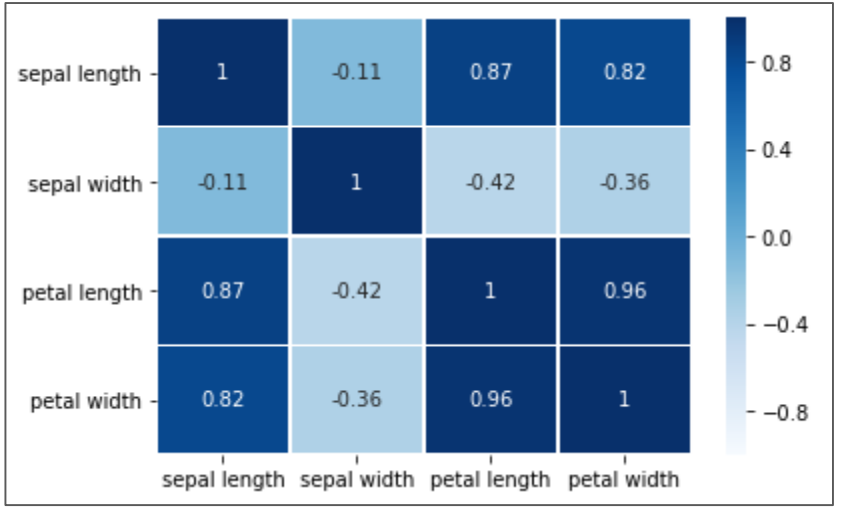
Heatmap

```
# plot heatmap to study correlation
# 'data' returns the data for heatmap
# 'annot' returns the correlation values on heatmap
# 'linewidth' add lines between each cells
# 'cmap' assigns the colors to each cell
# 'cbar' returns the color bar beside the heatmap
# 'vmin' and 'vmax' assigns the minimum and maximum values to anchor the color bar
sns.heatmap(data = df_iris.corr(), annot = True, linewidth=0.5,
            cmap = 'Blues', cbar = True, vmin = -1, vmax = 1 )

# display the plot
plt.show()
```

Assigns color to each cell

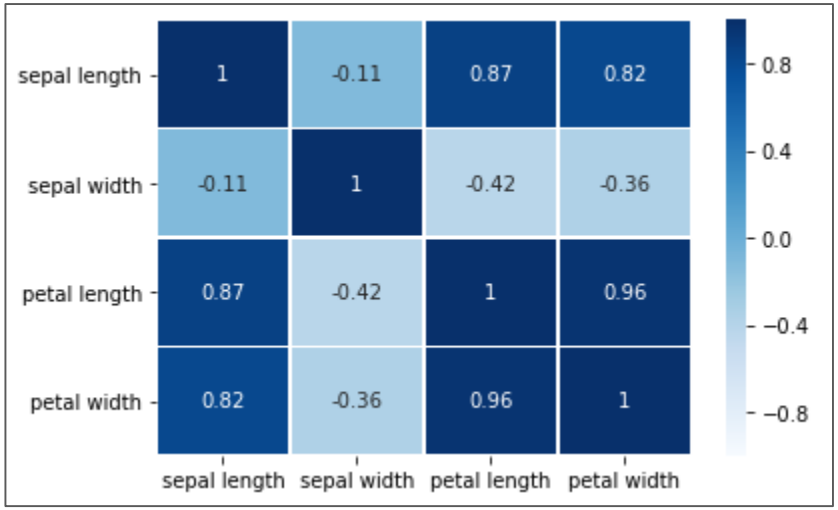
Add values to the heatmap



The variables ‘petal width’ and ‘petal length’ are highly positively correlated

Heatmap

- Diagonal cells represent the correlation of the variable with itself; thus, the value will always equal to 1
- The off-diagonal entries represent the correlation between the pair of variables
- The color bar beside the heatmap shows that the dark blue color represents the positive correlation (near to +1) and light blue color represent the negative correlation (near to -1)



Visualization using Plotly

Plotly

- Plotly allows us to make beautiful, interactive, explorable charts
- It is an open-source and browser-based graphing library
- We can get the values on the graph by hovering over the graph

Plotly

- Import the offline version of plotly as:

```
import plotly
plotly.offline.init_notebook_mode(connected=True)
```

- Import the subpackage ‘express’ as:

```
# import the library
import plotly.express as px
```

Read the data

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Load the titanic data for further manipulations:

```
# load the csv file 'Titanic_data.csv'
df_titanic = pd.read_csv('Titanic_data.csv')

# display first five rows
df_titanic.head()
```

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500	NaN	S
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833	C85	C
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250	NaN	S
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000	C123	S
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500	NaN	S

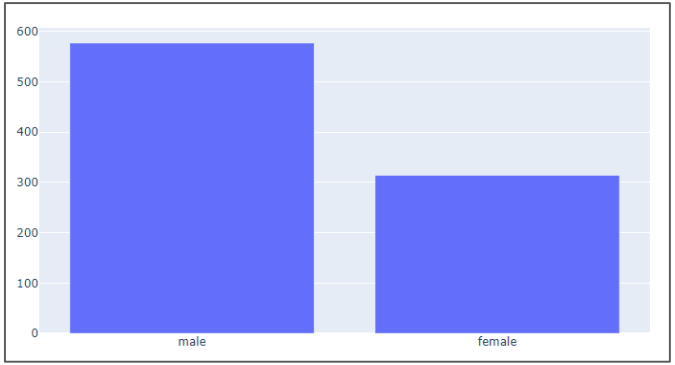
Bar plot

Plot a bar plot to get the gender-wise count of passengers

```
# import the required subpackage
import plotly.graph_objs as go

# instantiate the plot object
# set the size of plot
fig = go.Figure(layout={'autosize':False, 'height':500, 'width':800})

# plot the bar plot
# 'add_trace' adds the trace to the plot
# 'name' sets the trace name
fig.add_trace(go.Bar(x = df_titanic['Sex'], y = df_titanic.Sex.value_counts(), name = 'Sex'))
```



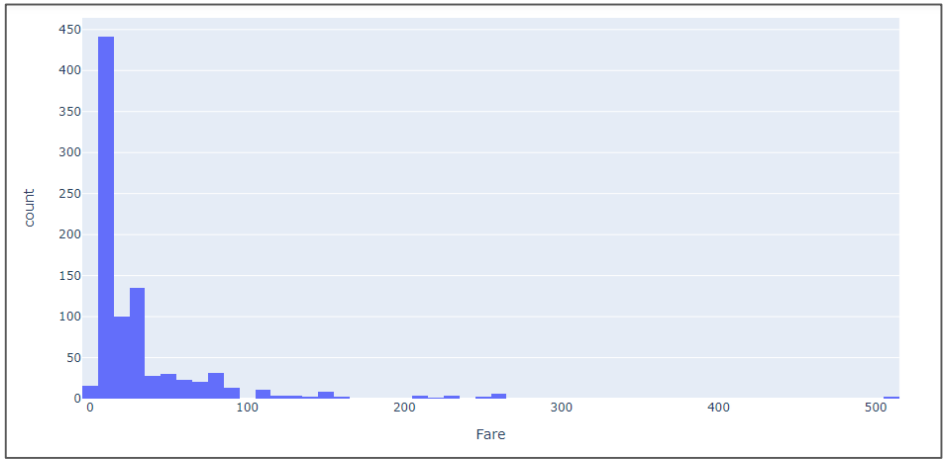
Male population is more in the data than female population

Histogram

Plot a distribution of fare of the passengers

```
# plot the histogram to check the distribution of fare
# 'x' assigns the variable to plot a histogram
fig = px.histogram(data_frame = df_titanic, x="Fare")

# display the plot
fig.show()
```



The histogram shows the positive skewness in the ‘Fare’. There are few extreme points near to Fare = 500

Read the data

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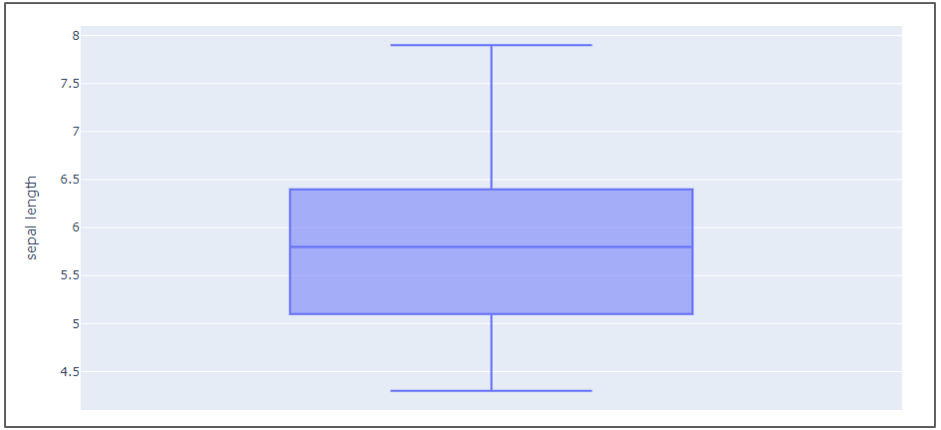
Use the iris data for further manipulations:

```
# load the csv file 'iris.csv'
df_iris = pd.read_csv('iris.csv')

# display first five rows
df_iris.head()
```

	sepal length	sepal width	petal length	petal width	class
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

Boxplot

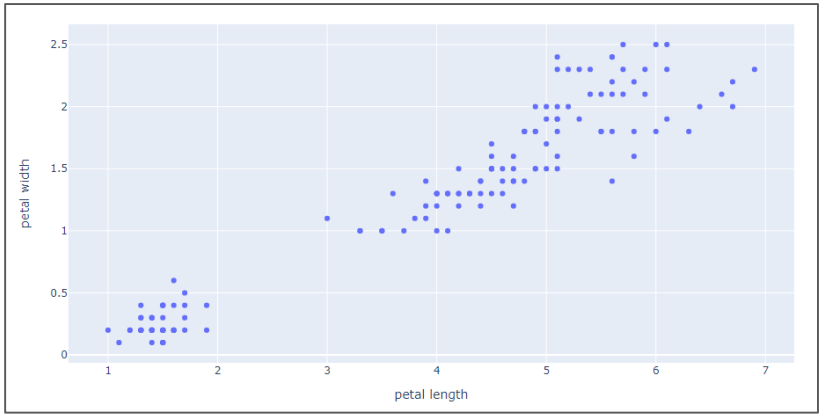
```
# plot a boxplot
# 'y' assigns the variable to plot a boxplot
fig = px.box(df_iris, y ='sepal length')

# display the plot
fig.show()
```



The boxplot shows that, the ‘sepal length’ is not significantly skewed

Scatter plot

```
# plot a boxplot
# 'data' assigns the DataFrame
# 'x' assigns the variable on x-axis
# 'y' assigns the variable on y-axis
fig = px.scatter(df_iris, x = 'petal length', y = 'petal width')

# display the plot
fig.show()
```



The plot shows that, the variables ‘petal length’ and ‘petal width’ are positively correlated

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Thank You