

# 230701400 - FDS LAB EXPERIMENTS

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## Experiment-1a- Basic Practice Experiments

```
[2]: import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
```

```
[3]: data=pd.read_csv('Iris.csv')
data
```

```
[3]:
```

	Id	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm	\
0	1	5.1	3.5	1.4	0.2	
1	2	4.9	3.0	1.4	0.2	
2	3	4.7	3.2	1.3	0.2	
3	4	4.6	3.1	1.5	0.2	
4	5	5.0	3.6	1.4	0.2	
..	...	...	...	...	...	
145	146	6.7	3.0	5.2	2.3	
146	147	6.3	2.5	5.0	1.9	
147	148	6.5	3.0	5.2	2.0	
148	149	6.2	3.4	5.4	2.3	
149	150	5.9	3.0	5.1	1.8	

```
Species
0      Iris-setosa
1      Iris-setosa
2      Iris-setosa
3      Iris-setosa
4      Iris-setosa
..      ...
145    Iris-virginica
```

```
146 Iris-virginica
147 Iris-virginica
148 Iris-virginica
149 Iris-virginica
```

```
[150 rows x 6 columns]
```

```
[4]: data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150 entries, 0 to 149
Data columns (total 6 columns):
 #   Column          Non-Null Count  Dtype  
---  -
 0   Id              150 non-null   int64   
 1   SepalLengthCm   150 non-null   float64  
 2   SepalWidthCm    150 non-null   float64  
 3   PetalLengthCm   150 non-null   float64  
 4   PetalWidthCm    150 non-null   float64  
 5   Species         150 non-null   object  
dtypes: float64(4), int64(1), object(1)
memory usage: 7.2+ KB
```

```
[5]: data.describe()
```

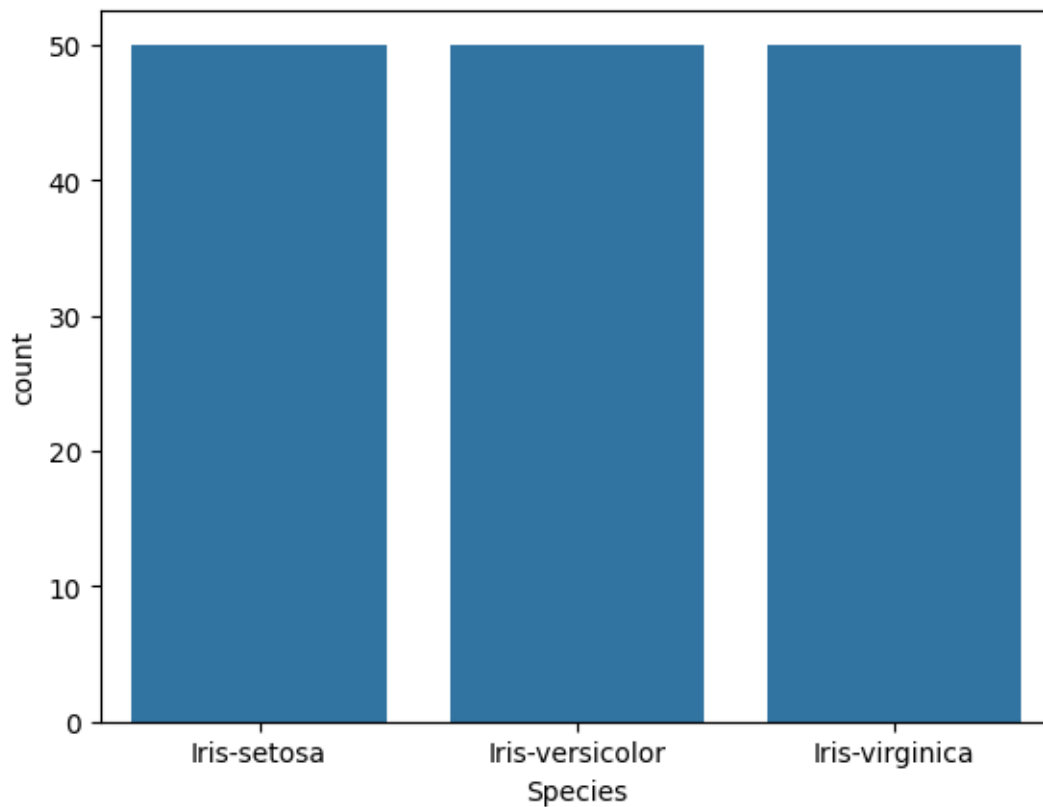
```
[5]:
```

	Id	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm
count	150.000000	150.000000	150.000000	150.000000	150.000000
mean	75.500000	5.843333	3.054000	3.758667	1.198667
std	43.445368	0.828066	0.433594	1.764420	0.763161
min	1.000000	4.300000	2.000000	1.000000	0.100000
25%	38.250000	5.100000	2.800000	1.600000	0.300000
50%	75.500000	5.800000	3.000000	4.350000	1.300000
75%	112.750000	6.400000	3.300000	5.100000	1.800000
max	150.000000	7.900000	4.400000	6.900000	2.500000

```
[6]: data.value_counts('Species')
```

```
[6]: Species
Iris-setosa      50
Iris-versicolor  50
Iris-virginica   50
Name: count, dtype: int64
```

```
[7]: sns.countplot(x='Species',data=data,)
plt.show()
```



```
[8]: dummies=pd.get_dummies(data.Species)
```

```
[9]: FinalDataset=pd.concat([pd.get_dummies(data.Species),data.iloc[:
↪ , [0,1,2,3]]],axis=1)
```

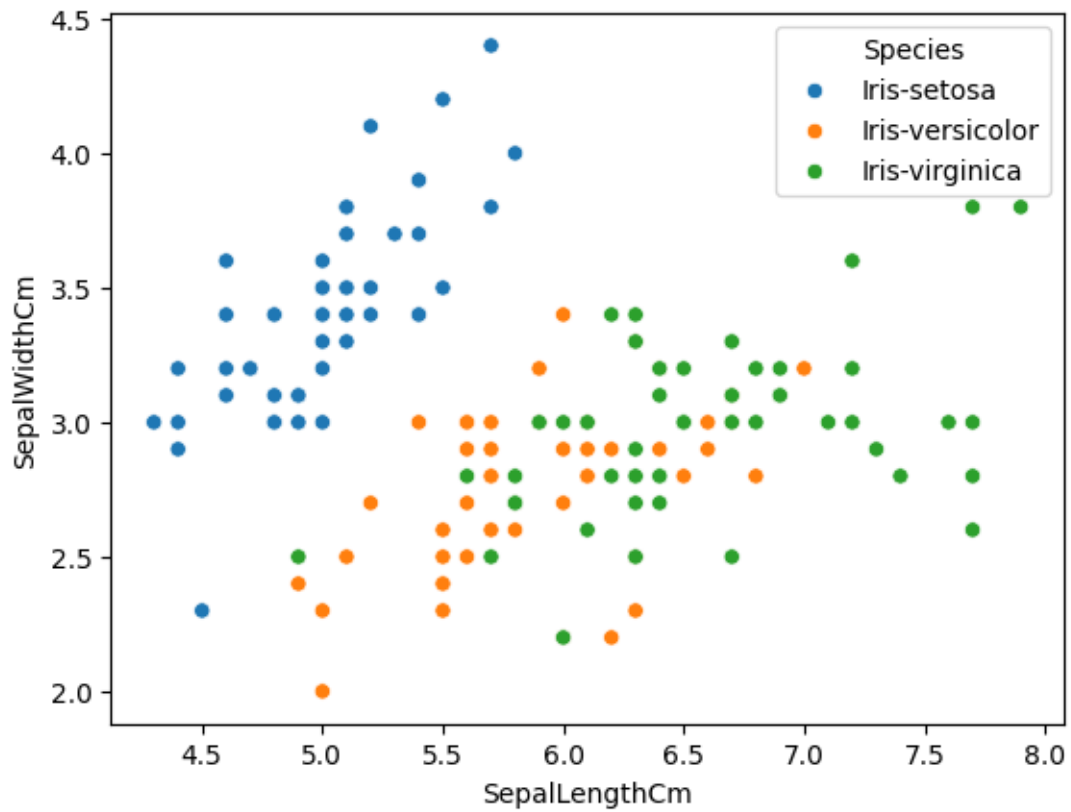
```
[10]: FinalDataset.head()
```

```
[10]:   Iris-setosa  Iris-versicolor  Iris-virginica  Id  SepalLengthCm  \
0         True             False             False   1           5.1
1         True             False             False   2           4.9
2         True             False             False   3           4.7
3         True             False             False   4           4.6
4         True             False             False   5           5.0

      SepalWidthCm  PetalLengthCm
0             3.5             1.4
1             3.0             1.4
2             3.2             1.3
3             3.1             1.5
4             3.6             1.4
```

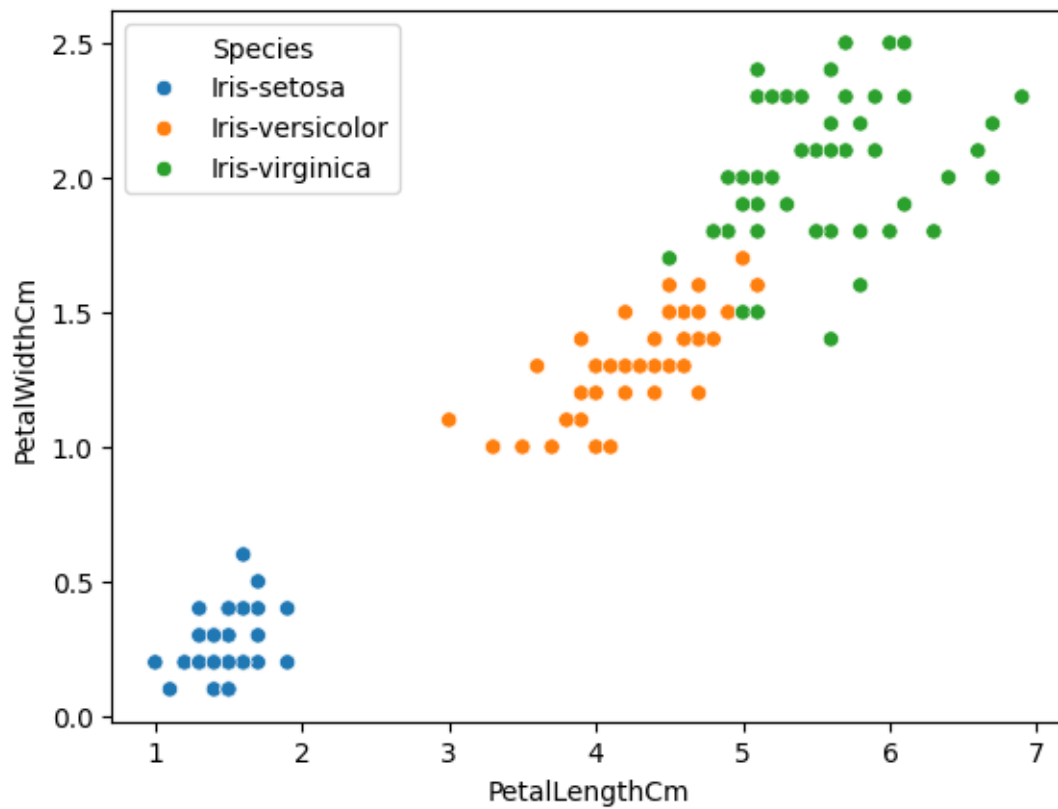
```
[11]: sns.scatterplot(x='SepalLengthCm',y='SepalWidthCm',hue='Species',data=data,)
```

```
[11]: <Axes: xlabel='SepalLengthCm', ylabel='SepalWidthCm'>
```

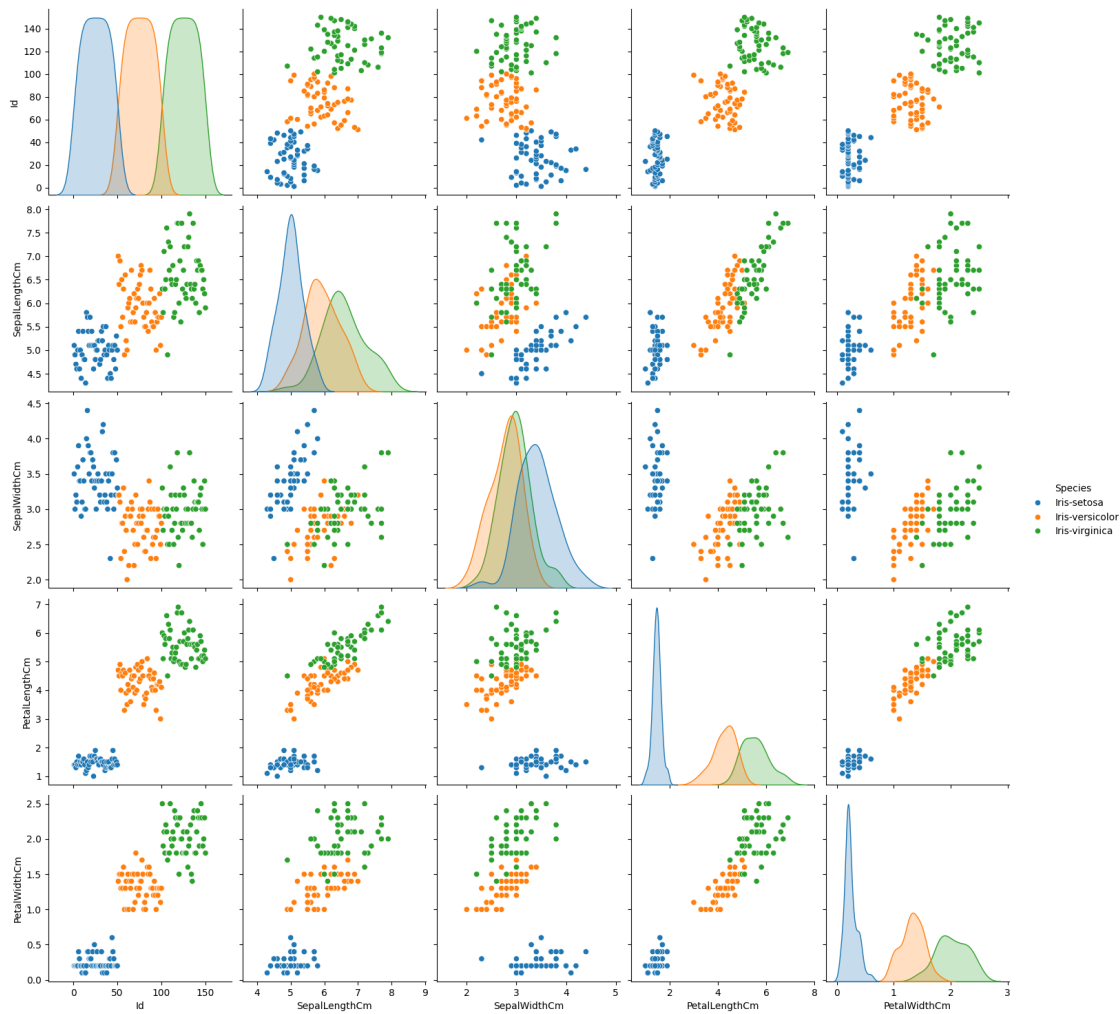


```
[12]: sns.scatterplot(x='PetalLengthCm',y='PetalWidthCm',hue='Species',data=data,)
```

```
[12]: <Axes: xlabel='PetalLengthCm', ylabel='PetalWidthCm'>
```

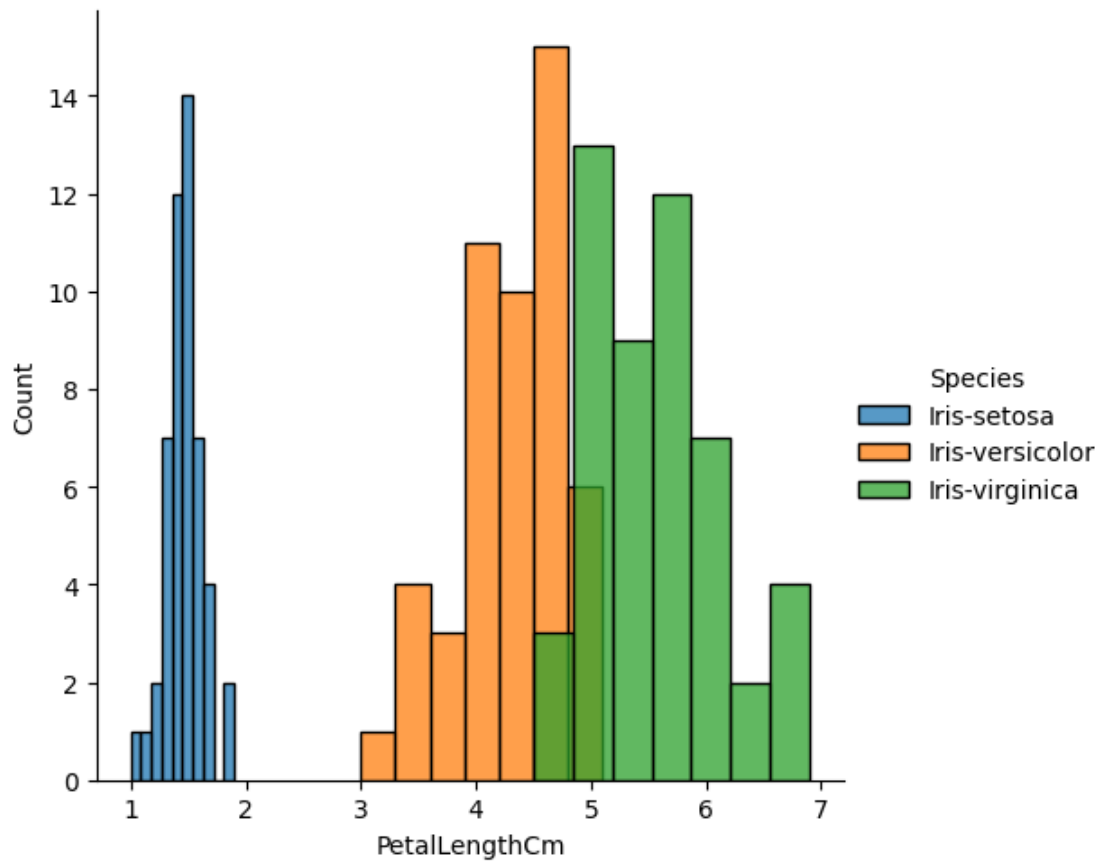


```
[13]: sns.pairplot(data,hue='Species',height=3);
```

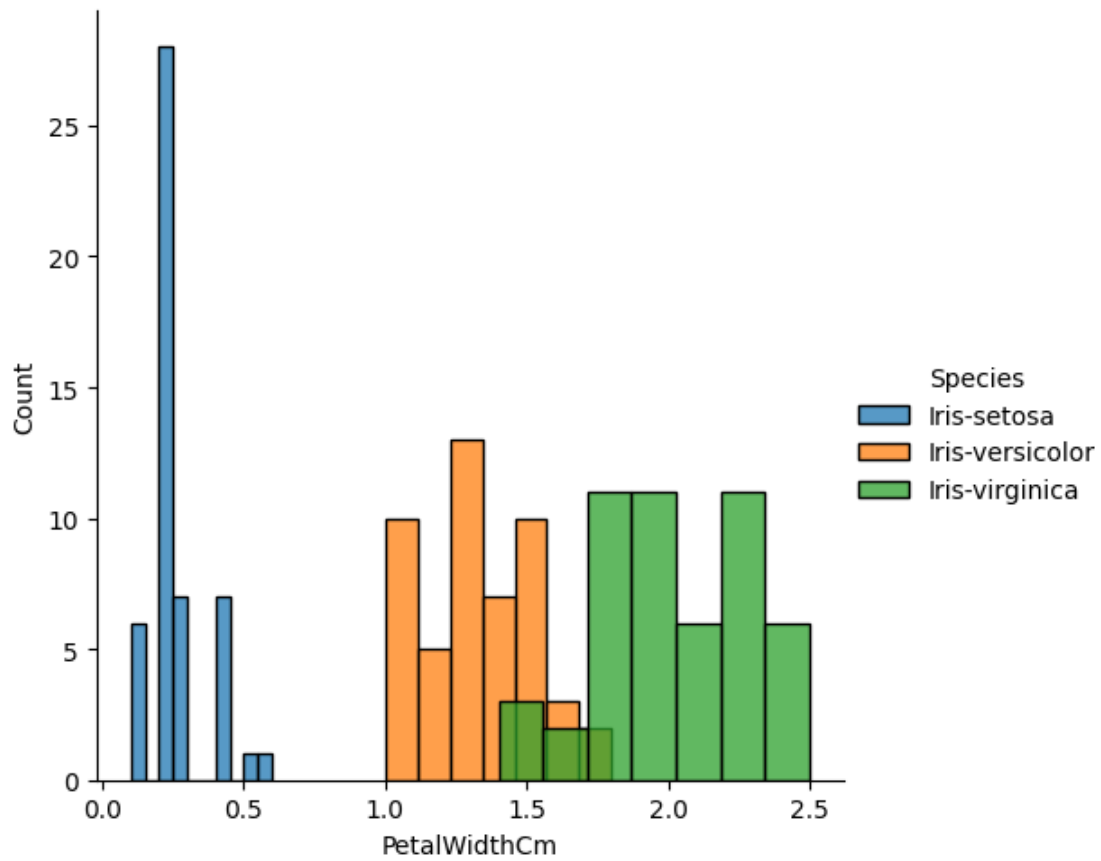


```
[14]: plt.show()
```

```
[15]: sns.FacetGrid(data,hue='Species',height=5).map(sns.histplot,'PetalLengthCm').
      ↪add_legend();
      plt.show();
```

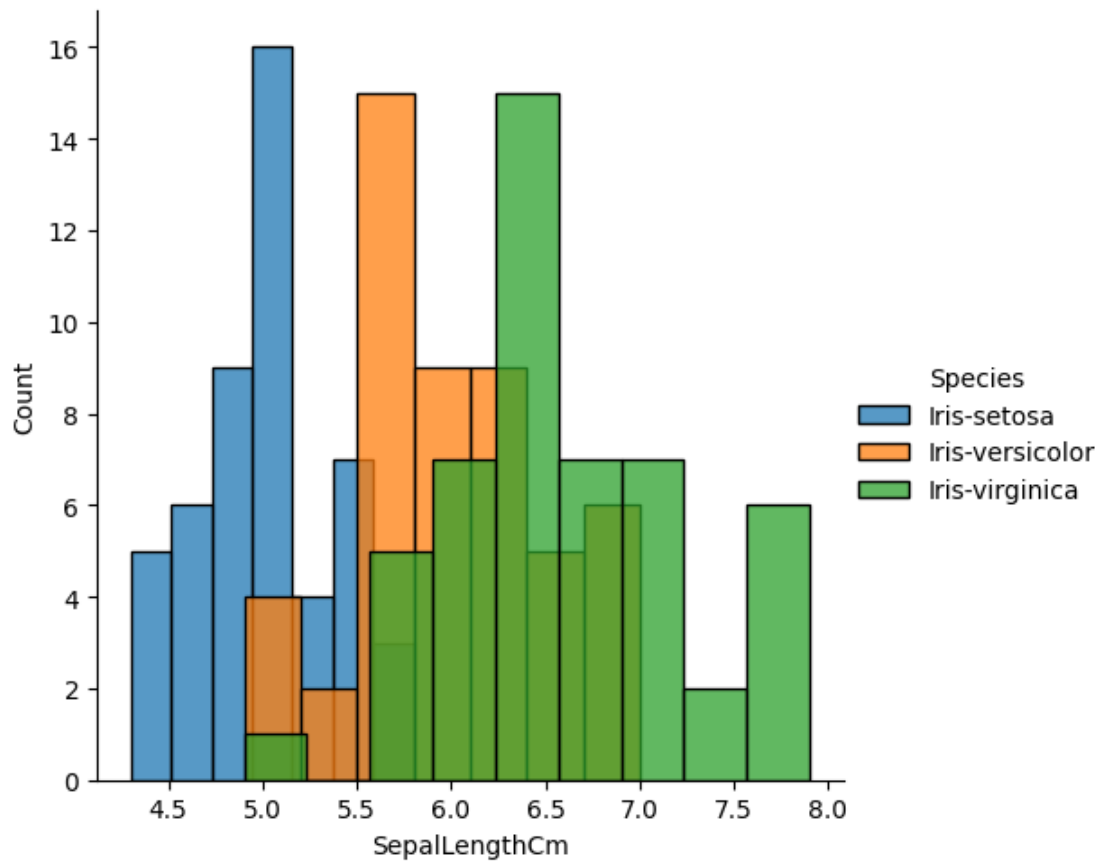


```
[16]: sns.FacetGrid(data,hue='Species',height=5).map(sns.histplot,'PetalWidthCm').  
      ↪add_legend();  
      plt.show();
```

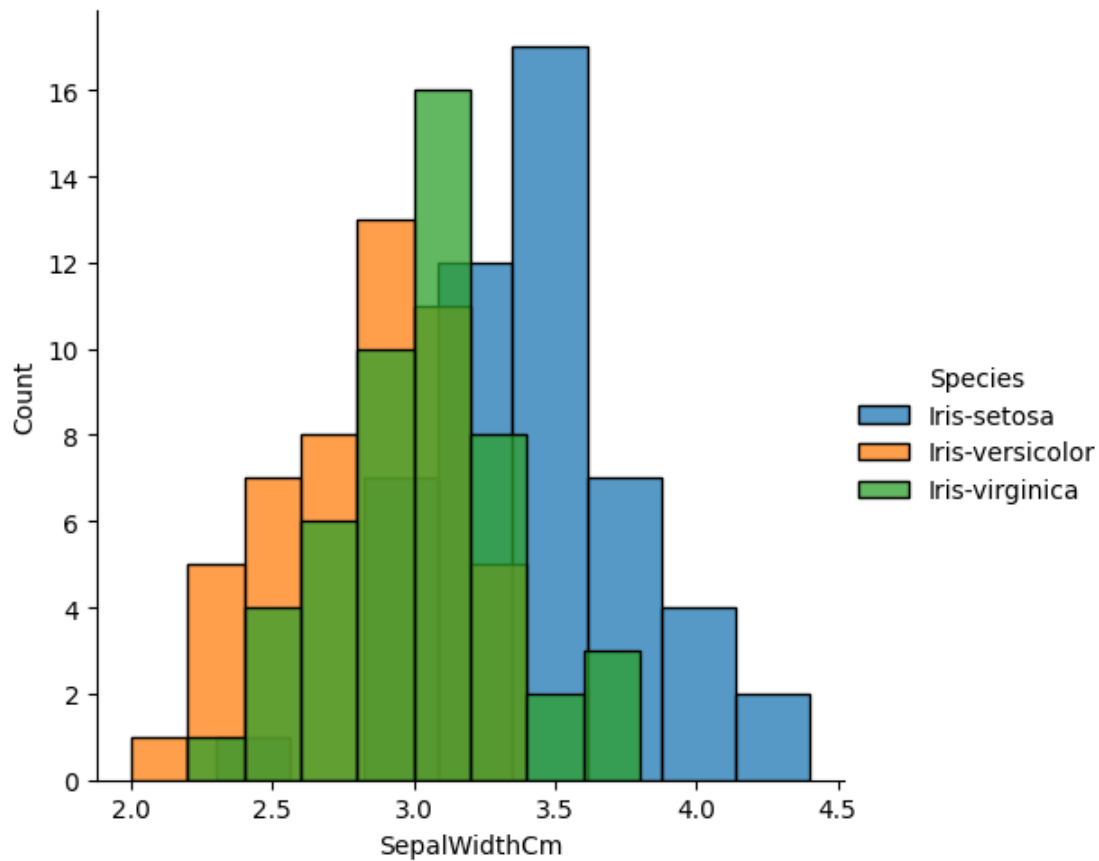


```
[17]: sns.FacetGrid(data,hue='Species',height=5).map(sns.histplot,'SepalLengthCm').  
      ↪add_legend();  
      plt.show();
```





```
[18]: sns.FacetGrid(data,hue='Species',height=5).map(sns.histplot,'SepalWidthCm').  
      ↪add_legend();  
      plt.show();
```



Experiment 1b- Pandas Built in function. Numpy Built in function- Array slicing,

```
[20]: import numpy as np
      array=np.random.randint(1,100,9)
      array
```

```
[20]: array([39, 97, 88, 58, 29, 87, 27, 88, 91])
```

```
[21]: np.sqrt(array)
```

```
[21]: array([6.244998 , 9.8488578 , 9.38083152, 7.61577311, 5.38516481,
          9.32737905, 5.19615242, 9.38083152, 9.53939201])
```

```
[22]: array.ndim
```

```
[22]: 1
```

```
[23]: new_array=array.reshape(3,3)
```

```
[24]: new_array
```

```
[24]: array([[39, 97, 88],
          [58, 29, 87],
          [27, 88, 91]])
```

```
[25]: new_array.ndim
```

```
[25]: 2
```

```
[26]: new_array.ravel()
```

```
[26]: array([39, 97, 88, 58, 29, 87, 27, 88, 91])
```

```
[27]: newm=new_array.reshape(3,3)
```

```
[28]: newm
```

```
[28]: array([[39, 97, 88],
          [58, 29, 87],
          [27, 88, 91]])
```

```
[29]: newm[2,1:3]
```

```
[29]: array([88, 91])
```

```
[30]: newm[1:2,1:3]
```

```
[30]: array([[29, 87]])
```

```
[31]: new_array[0:3,0:0]
```

```
[31]: array([], shape=(3, 0), dtype=int32)
```

```
[32]: new_array[1:3]
```

```
[32]: array([[58, 29, 87],
          [27, 88, 91]])
```

## Experiment 2- Outlier detection

```
[34]: import numpy as np
import warnings
warnings.filterwarnings('ignore')
array=np.random.randint(1,100,16)
array
```

```
[34]: array([37, 15, 49, 89, 30, 47,  2, 86, 53, 63, 41, 46, 42, 27,  5, 97])
```

```
[35]: array.mean()
```

```
[35]: 45.5625
```

```
[36]: np.percentile(array,25)
```

```
[36]: 29.25
```

```
[37]: np.percentile(array,50)
```

```
[37]: 44.0
```

```
[38]: np.percentile(array,75)
```

```
[38]: 55.5
```

```
[39]: np.percentile(array,100)
```

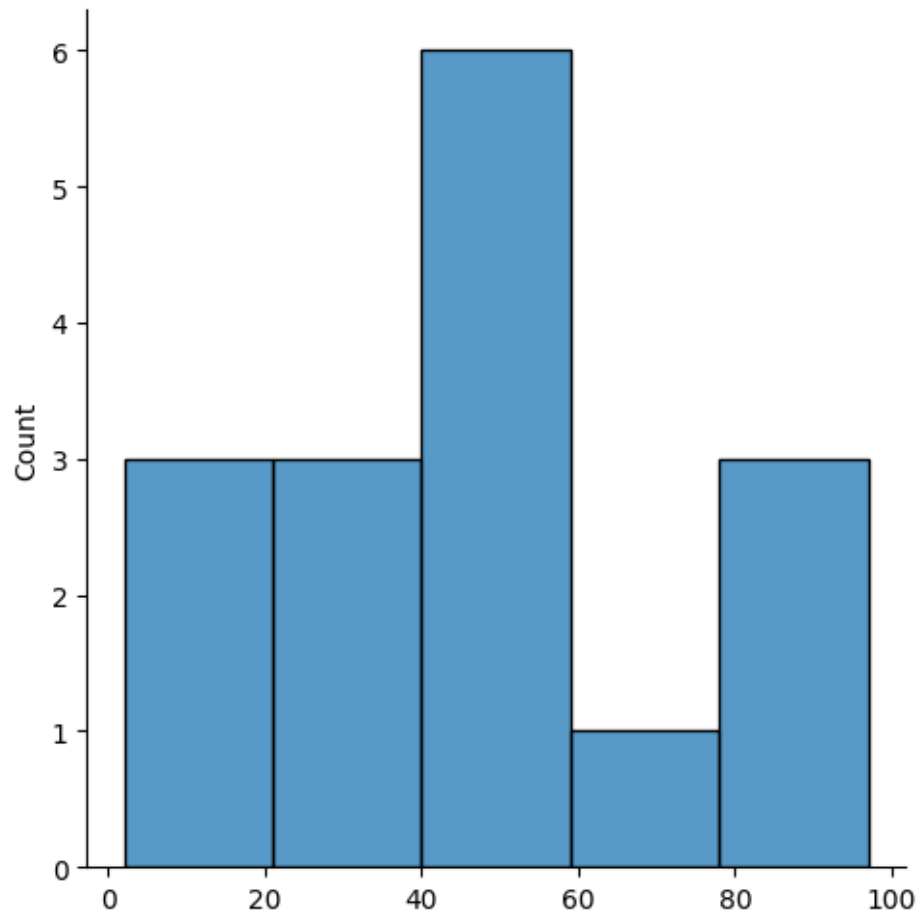
```
[39]: 97.0
```

```
[40]: #outliers detection
def outDetection(array):
    sorted(array)
    Q1,Q3=np.percentile(array,[25,75])
    IQR=Q3-Q1
    lr=Q1-(1.5*IQR)
    ur=Q3+(1.5*IQR)
    return lr,ur
lr,ur=outDetection(array)
lr,ur
```

```
[40]: (-10.125, 94.875)
```

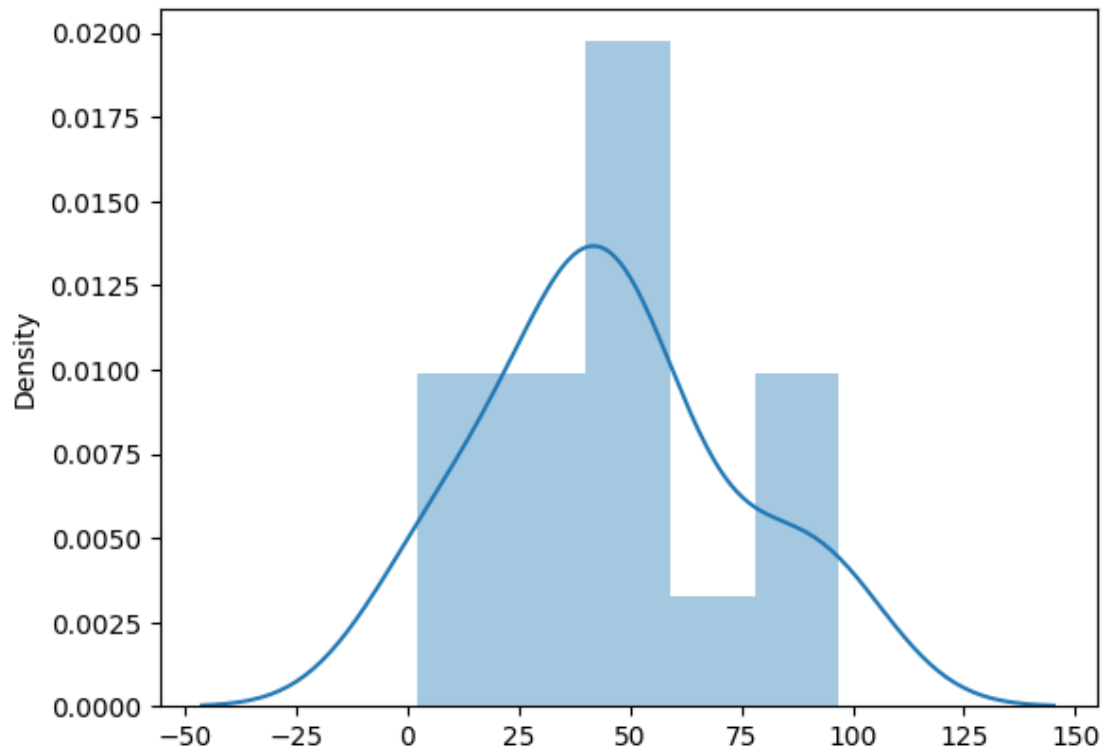
```
[41]: import seaborn as sns
      %matplotlib inline
      sns.displot(array)
```

```
[41]: <seaborn.axisgrid.FacetGrid at 0x20d7cda3b50>
```



```
[42]: sns.distplot(array)
```

```
[42]: <Axes: ylabel='Density'>
```

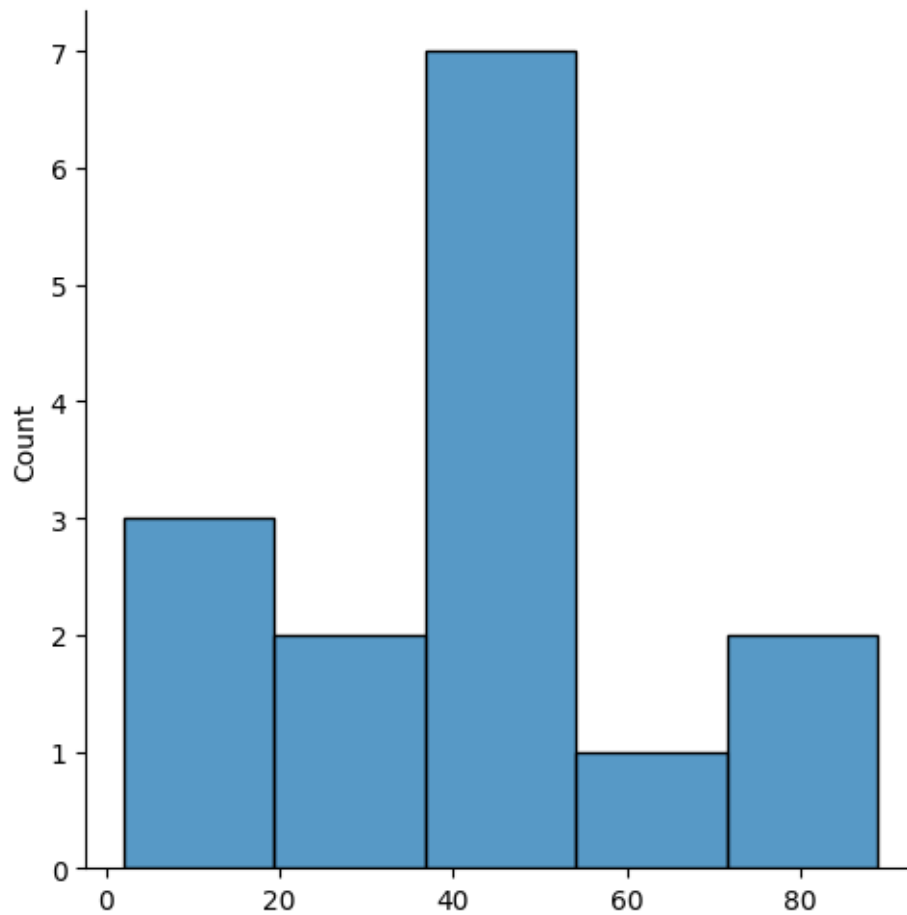


```
[43]: new_array=array[(array>lr) & (array<ur)]  
new_array
```

```
[43]: array([37, 15, 49, 89, 30, 47,  2, 86, 53, 63, 41, 46, 42, 27,  5])
```

```
[44]: sns.displot(new_array)
```

```
[44]: <seaborn.axisgrid.FacetGrid at 0x20d7d02d950>
```



```
[45]: lr1,ur1=outDetection(new_array)
      lr1,ur1
```

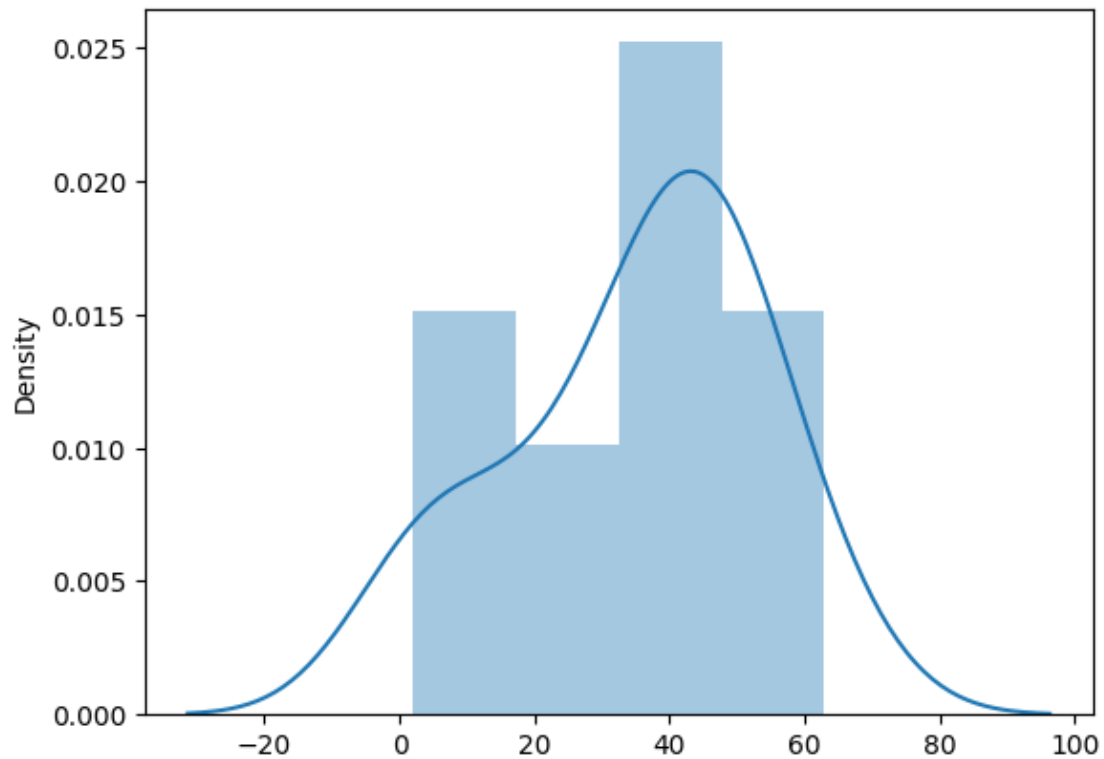
```
[45]: (-5.25, 84.75)
```

```
[46]: final_array=new_array[(new_array>lr1) & (new_array<ur1)]
      final_array
```

```
[46]: array([37, 15, 49, 30, 47,  2, 53, 63, 41, 46, 42, 27,  5])
```

```
[47]: sns.distplot(final_array)
```

```
[47]: <Axes: ylabel='Density'>
```



### Experiment 3 - Missing and inappropriate data

```
[49]: import numpy as np
import pandas as pd
import warnings
warnings.filterwarnings('ignore')
df=pd.read_csv("Hotel_Dataset.csv")
df
```

```
[49]:
```

	CustomerID	Age_Group	Rating(1-5)	Hotel	FoodPreference	Bill \
0	1	20-25	4	Ibis	veg	1300
1	2	30-35	5	LemonTree	Non-Veg	2000
2	3	25-30	6	RedFox	Veg	1322
3	4	20-25	-1	LemonTree	Veg	1234
4	5	35+	3	Ibis	Vegetarian	989
5	6	35+	3	Ibys	Non-Veg	1909
6	7	35+	4	RedFox	Vegetarian	1000



7	8	20-25	7	LemonTree	Veg	2999
8	9	25-30	2	Ibis	Non-Veg	3456
9	9	25-30	2	Ibis	Non-Veg	3456
10	10	30-35	5	RedFox	non-Veg	-6755

	NoOfPax	EstimatedSalary	Age_Group.1
0	2	40000	20-25
1	3	59000	30-35
2	2	30000	25-30
3	2	120000	20-25
4	2	45000	35+
5	2	122220	35+
6	-1	21122	35+
7	-10	345673	20-25
8	3	-99999	25-30
9	3	-99999	25-30
10	4	87777	30-35

```
[50]: df.duplicated()
```

```
[50]: 0    False
      1    False
      2    False
      3    False
      4    False
      5    False
      6    False
      7    False
      8    False
      9     True
     10    False
      dtype: bool
```

```
[51]: df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 11 entries, 0 to 10
Data columns (total 9 columns):
#   Column                Non-Null Count  Dtype
---  -
0   CustomerID            11 non-null    int64
1   Age_Group              11 non-null    object
2   Rating(1-5)           11 non-null    int64
3   Hotel                  11 non-null    object
4   FoodPreference         11 non-null    object
5   Bill                   11 non-null    int64
6   NoOfPax                11 non-null    int64
```

```

7   EstimatedSalary  11 non-null    int64
8   Age_Group.1      11 non-null    object
dtypes: int64(5), object(4)
memory usage: 924.0+ bytes

```

```
[52]: df.drop_duplicates(inplace=True)
df
```

```
[52]:
```

	CustomerID	Age_Group	Rating(1-5)	Hotel	FoodPreference	Bill	\
0	1	20-25	4	Ibis	veg	1300	
1	2	30-35	5	LemonTree	Non-Veg	2000	
2	3	25-30	6	RedFox	Veg	1322	
3	4	20-25	-1	LemonTree	Veg	1234	
4	5	35+	3	Ibis	Vegetarian	989	
5	6	35+	3	Ibys	Non-Veg	1909	
6	7	35+	4	RedFox	Vegetarian	1000	
7	8	20-25	7	LemonTree	Veg	2999	
8	9	25-30	2	Ibis	Non-Veg	3456	
10	10	30-35	5	RedFox	non-Veg	-6755	

	NoOfPax	EstimatedSalary	Age_Group.1
0	2	40000	20-25
1	3	59000	30-35
2	2	30000	25-30
3	2	120000	20-25
4	2	45000	35+
5	2	122220	35+
6	-1	21122	35+
7	-10	345673	20-25
8	3	-99999	25-30
10	4	87777	30-35

```
[53]: len(df)
```

```
[53]: 10
```

```
[54]: index=np.array(list(range(0,len(df))))
df.set_index(index,inplace=True)
index
```

```
[54]: array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

```
[55]: df
```

```
[55]:
```

	CustomerID	Age_Group	Rating(1-5)	Hotel	FoodPreference	Bill	NoOfPax	\
0	1	20-25	4	Ibis	veg	1300	2	
1	2	30-35	5	LemonTree	Non-Veg	2000	3	

2	3	25-30	6	RedFox	Veg	1322	2
3	4	20-25	-1	LemonTree	Veg	1234	2
4	5	35+	3	Ibis	Vegetarian	989	2
5	6	35+	3	Ibys	Non-Veg	1909	2
6	7	35+	4	RedFox	Vegetarian	1000	-1
7	8	20-25	7	LemonTree	Veg	2999	-10
8	9	25-30	2	Ibis	Non-Veg	3456	3
9	10	30-35	5	RedFox	non-Veg	-6755	4

	EstimatedSalary	Age_Group.1
0	40000	20-25
1	59000	30-35
2	30000	25-30
3	120000	20-25
4	45000	35+
5	122220	35+
6	21122	35+
7	345673	20-25
8	-99999	25-30
9	87777	30-35

```
[56]: df.drop(['Age_Group.1'],axis=1,inplace=True)
df
```

	CustomerID	Age_Group	Rating(1-5)	Hotel	FoodPreference	Bill	NoOfPax	\
0	1	20-25	4	Ibis	veg	1300	2	
1	2	30-35	5	LemonTree	Non-Veg	2000	3	
2	3	25-30	6	RedFox	Veg	1322	2	
3	4	20-25	-1	LemonTree	Veg	1234	2	
4	5	35+	3	Ibis	Vegetarian	989	2	
5	6	35+	3	Ibys	Non-Veg	1909	2	
6	7	35+	4	RedFox	Vegetarian	1000	-1	
7	8	20-25	7	LemonTree	Veg	2999	-10	
8	9	25-30	2	Ibis	Non-Veg	3456	3	
9	10	30-35	5	RedFox	non-Veg	-6755	4	

	EstimatedSalary
0	40000
1	59000
2	30000
3	120000
4	45000
5	122220
6	21122
7	345673
8	-99999
9	87777

```
[57]: df.CustomerID.loc[df.CustomerID<0]=np.nan
df.Bill.loc[df.Bill<0]=np.nan
df.EstimatedSalary.loc[df.EstimatedSalary<0]=np.nan
df
```

```
[57]:
```

	CustomerID	Age_Group	Rating(1-5)	Hotel	FoodPreference	Bill	\
0	1.0	20-25	4	Ibis	veg	1300.0	
1	2.0	30-35	5	LemonTree	Non-Veg	2000.0	
2	3.0	25-30	6	RedFox	Veg	1322.0	
3	4.0	20-25	-1	LemonTree	Veg	1234.0	
4	5.0	35+	3	Ibis	Vegetarian	989.0	
5	6.0	35+	3	Ibys	Non-Veg	1909.0	
6	7.0	35+	4	RedFox	Vegetarian	1000.0	
7	8.0	20-25	7	LemonTree	Veg	2999.0	
8	9.0	25-30	2	Ibis	Non-Veg	3456.0	
9	10.0	30-35	5	RedFox	non-Veg	NaN	

	NoOfPax	EstimatedSalary
0	2	40000.0
1	3	59000.0
2	2	30000.0
3	2	120000.0
4	2	45000.0
5	2	122220.0
6	-1	21122.0
7	-10	345673.0
8	3	NaN
9	4	87777.0

```
[58]: df['NoOfPax'].loc[(df['NoOfPax']<1) | (df['NoOfPax']>20)]=np.nan
df
```

```
[58]:
```

	CustomerID	Age_Group	Rating(1-5)	Hotel	FoodPreference	Bill	\
0	1.0	20-25	4	Ibis	veg	1300.0	
1	2.0	30-35	5	LemonTree	Non-Veg	2000.0	
2	3.0	25-30	6	RedFox	Veg	1322.0	
3	4.0	20-25	-1	LemonTree	Veg	1234.0	
4	5.0	35+	3	Ibis	Vegetarian	989.0	
5	6.0	35+	3	Ibys	Non-Veg	1909.0	
6	7.0	35+	4	RedFox	Vegetarian	1000.0	
7	8.0	20-25	7	LemonTree	Veg	2999.0	
8	9.0	25-30	2	Ibis	Non-Veg	3456.0	
9	10.0	30-35	5	RedFox	non-Veg	NaN	

	NoOfPax	EstimatedSalary
0	2.0	40000.0
1	3.0	59000.0

2	2.0	30000.0
3	2.0	120000.0
4	2.0	45000.0
5	2.0	122220.0
6	NaN	21122.0
7	NaN	345673.0
8	3.0	NaN
9	4.0	87777.0

```
[59]: df.Age_Group.unique()
```

```
[59]: array(['20-25', '30-35', '25-30', '35+'], dtype=object)
```

```
[60]: df.Hotel.unique()
```

```
[60]: array(['Ibis', 'LemonTree', 'RedFox', 'Ibys'], dtype=object)
```

```
[61]: df.Hotel.replace(['Ibys'],'Ibis',inplace=True)
df.FoodPreference.unique
```

```
[61]: <bound method Series.unique of 0          veg
1          Non-Veg
2           Veg
3           Veg
4    Vegetarian
5          Non-Veg
6    Vegetarian
7           Veg
8          Non-Veg
9          non-Veg
Name: FoodPreference, dtype: object>
```

```
[62]: df.FoodPreference.replace(['Vegetarian','veg'],'Veg',inplace=True)
df.FoodPreference.replace(['non-Veg'],'Non-Veg',inplace=True)
```

```
[63]: df.EstimatedSalary.fillna(round(df.EstimatedSalary.mean()),inplace=True)
df.NoOfPax.fillna(round(df.NoOfPax.median()),inplace=True)
df['Rating(1-5)'].fillna(round(df['Rating(1-5)'].median()), inplace=True)
df.Bill.fillna(round(df.Bill.mean()),inplace=True)
df
```

```
[63]:
```

	CustomerID	Age_Group	Rating(1-5)	Hotel	FoodPreference	Bill	\
0	1.0	20-25	4	Ibis	Veg	1300.0	
1	2.0	30-35	5	LemonTree	Non-Veg	2000.0	
2	3.0	25-30	6	RedFox	Veg	1322.0	
3	4.0	20-25	-1	LemonTree	Veg	1234.0	
4	5.0	35+	3	Ibis	Veg	989.0	

5	6.0	35+	3	Ibis	Non-Veg	1909.0
6	7.0	35+	4	RedFox	Veg	1000.0
7	8.0	20-25	7	LemonTree	Veg	2999.0
8	9.0	25-30	2	Ibis	Non-Veg	3456.0
9	10.0	30-35	5	RedFox	Non-Veg	1801.0

	NoOfPax	EstimatedSalary
0	2.0	40000.0
1	3.0	59000.0
2	2.0	30000.0
3	2.0	120000.0
4	2.0	45000.0
5	2.0	122220.0
6	2.0	21122.0
7	2.0	345673.0
8	3.0	96755.0
9	4.0	87777.0

#### Experiment 4- Data Preprocessing

```
[65]: import numpy as np
import pandas as pd
import warnings
warnings.filterwarnings('ignore')
df=pd.read_csv("pre_process_datasample.csv")
df
```

```
[65]: Country  Age  Salary Purchased
0  France  44.0  72000.0         No
1  Spain   27.0  48000.0         Yes
2  Germany 30.0  54000.0         No
3  Spain   38.0  61000.0         No
4  Germany 40.0      NaN         Yes
5  France  35.0  58000.0         Yes
6  Spain   NaN  52000.0         No
7  France  48.0  79000.0         Yes
8  Germany 50.0  83000.0         No
9  France  37.0  67000.0         Yes
```

```
[66]: df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
```

```

RangeIndex: 10 entries, 0 to 9
Data columns (total 4 columns):
#   Column      Non-Null Count  Dtype
---  -
0   Country     10 non-null    object
1   Age         9 non-null     float64
2   Salary      9 non-null     float64
3   Purchased   10 non-null    object
dtypes: float64(2), object(2)
memory usage: 452.0+ bytes

```

```
[67]: df.Country.mode()
```

```
[67]: 0    France
      Name: Country, dtype: object
```

```
[68]: df.Country.mode()[0]
```

```
[68]: 'France'
```

```
[69]: type(df.Country.mode())
```

```
[69]: pandas.core.series.Series
```

```
[70]: df.Country.fillna(df.Country.mode()[0],inplace=True)
      df.Age.fillna(df.Age.median(),inplace=True)
      df.Salary.fillna(round(df.Salary.mean()),inplace=True)
      df
```

```
[70]:
```

	Country	Age	Salary	Purchased
0	France	44.0	72000.0	No
1	Spain	27.0	48000.0	Yes
2	Germany	30.0	54000.0	No
3	Spain	38.0	61000.0	No
4	Germany	40.0	63778.0	Yes
5	France	35.0	58000.0	Yes
6	Spain	38.0	52000.0	No
7	France	48.0	79000.0	Yes
8	Germany	50.0	83000.0	No
9	France	37.0	67000.0	Yes

```
[71]: pd.get_dummies(df.Country)
```

```
[71]:
```

	France	Germany	Spain
0	True	False	False
1	False	False	True
2	False	True	False

```

3  False    False    True
4  False     True   False
5   True    False   False
6  False    False    True
7   True    False   False
8  False     True   False
9   True    False   False

```

```
[72]: updated_dataset=pd.concat([pd.get_dummies(df.Country),df.iloc[:
↪, [1,2,3]]],axis=1)
```

```
[73]: df.info()
```

```

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10 entries, 0 to 9
Data columns (total 4 columns):
#   Column      Non-Null Count  Dtype
---  -
0   Country     10 non-null     object
1   Age         10 non-null     float64
2   Salary      10 non-null     float64
3   Purchased   10 non-null     object
dtypes: float64(2), object(2)
memory usage: 452.0+ bytes

```

```
[74]: updated_dataset.Purchased.replace(['No','Yes'],[0,1],inplace=True)
```

## Experiment 5- EDA-Quantitative and Qualitative plots

```

[76]: import numpy as np
import pandas as pd
import warnings
warnings.filterwarnings('ignore')
df=pd.read_csv("pre_process_datasample.csv")
df

```

```

[76]:   Country  Age  Salary  Purchased
0  France  44.0  72000.0         No
1   Spain  27.0  48000.0         Yes
2  Germany  30.0  54000.0         No
3   Spain  38.0  61000.0         No
4  Germany  40.0      NaN         Yes

```



5	France	35.0	58000.0	Yes
6	Spain	NaN	52000.0	No
7	France	48.0	79000.0	Yes
8	Germany	50.0	83000.0	No
9	France	37.0	67000.0	Yes

```
[77]: df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10 entries, 0 to 9
Data columns (total 4 columns):
#   Column      Non-Null Count  Dtype
---  -
0   Country     10 non-null     object
1   Age         9 non-null      float64
2   Salary      9 non-null      float64
3   Purchased   10 non-null     object
dtypes: float64(2), object(2)
memory usage: 452.0+ bytes
```

```
[78]: df.Country.mode()
```

```
[78]: 0    France
      Name: Country, dtype: object
```

```
[79]: df.Country.mode()[0]
```

```
[79]: 'France'
```

```
[80]: type(df.Country.mode())
```

```
[80]: pandas.core.series.Series
```

```
[81]: df.Country.fillna(df.Country.mode()[0],inplace=True)
      df.Age.fillna(df.Age.median(),inplace=True)
      df.Salary.fillna(round(df.Salary.mean()),inplace=True)
      df
```

```
[81]:
```

	Country	Age	Salary	Purchased
0	France	44.0	72000.0	No
1	Spain	27.0	48000.0	Yes
2	Germany	30.0	54000.0	No
3	Spain	38.0	61000.0	No
4	Germany	40.0	63778.0	Yes
5	France	35.0	58000.0	Yes
6	Spain	38.0	52000.0	No
7	France	48.0	79000.0	Yes

8	Germany	50.0	83000.0	No
9	France	37.0	67000.0	Yes

```
[82]: pd.get_dummies(df.Country)
```

```
[82]:
```

	France	Germany	Spain
0	True	False	False
1	False	False	True
2	False	True	False
3	False	False	True
4	False	True	False
5	True	False	False
6	False	False	True
7	True	False	False
8	False	True	False
9	True	False	False

```
[83]: updated_dataset=pd.concat([pd.get_dummies(df.Country),df.iloc[:
↪, [1,2,3]]],axis=1)
updated_dataset
```

```
[83]:
```

	France	Germany	Spain	Age	Salary	Purchased
0	True	False	False	44.0	72000.0	No
1	False	False	True	27.0	48000.0	Yes
2	False	True	False	30.0	54000.0	No
3	False	False	True	38.0	61000.0	No
4	False	True	False	40.0	63778.0	Yes
5	True	False	False	35.0	58000.0	Yes
6	False	False	True	38.0	52000.0	No
7	True	False	False	48.0	79000.0	Yes
8	False	True	False	50.0	83000.0	No
9	True	False	False	37.0	67000.0	Yes

```
[84]: df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10 entries, 0 to 9
Data columns (total 4 columns):
#   Column      Non-Null Count  Dtype
---  -
0   Country     10 non-null    object
1   Age         10 non-null    float64
2   Salary      10 non-null    float64
3   Purchased   10 non-null    object
dtypes: float64(2), object(2)
memory usage: 452.0+ bytes
```

```
[85]: updated_dataset
```

```
[85]:
```

	France	Germany	Spain	Age	Salary	Purchased
0	True	False	False	44.0	72000.0	No
1	False	False	True	27.0	48000.0	Yes
2	False	True	False	30.0	54000.0	No
3	False	False	True	38.0	61000.0	No
4	False	True	False	40.0	63778.0	Yes
5	True	False	False	35.0	58000.0	Yes
6	False	False	True	38.0	52000.0	No
7	True	False	False	48.0	79000.0	Yes
8	False	True	False	50.0	83000.0	No
9	True	False	False	37.0	67000.0	Yes

```
[87]: import seaborn as sns
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
```

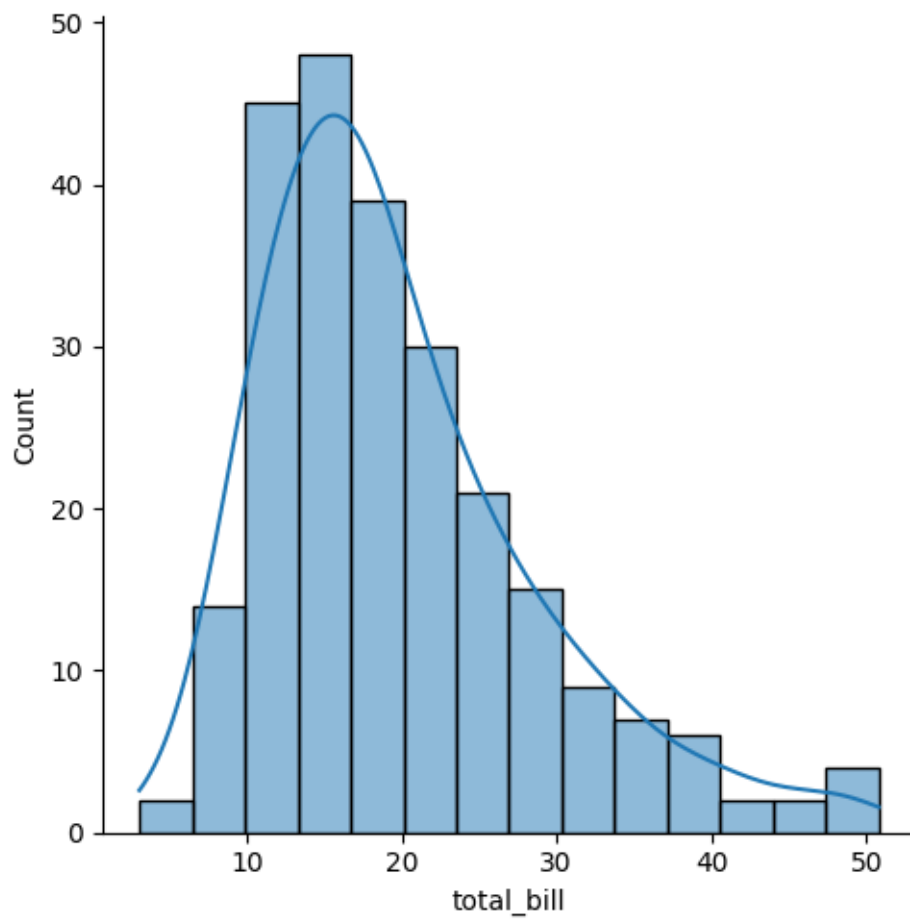
```
[88]: tips=sns.load_dataset('tips')
tips.head()
```

```
[88]:
```

	total_bill	tip	sex	smoker	day	time	size
0	16.99	1.01	Female	No	Sun	Dinner	2
1	10.34	1.66	Male	No	Sun	Dinner	3
2	21.01	3.50	Male	No	Sun	Dinner	3
3	23.68	3.31	Male	No	Sun	Dinner	2
4	24.59	3.61	Female	No	Sun	Dinner	4

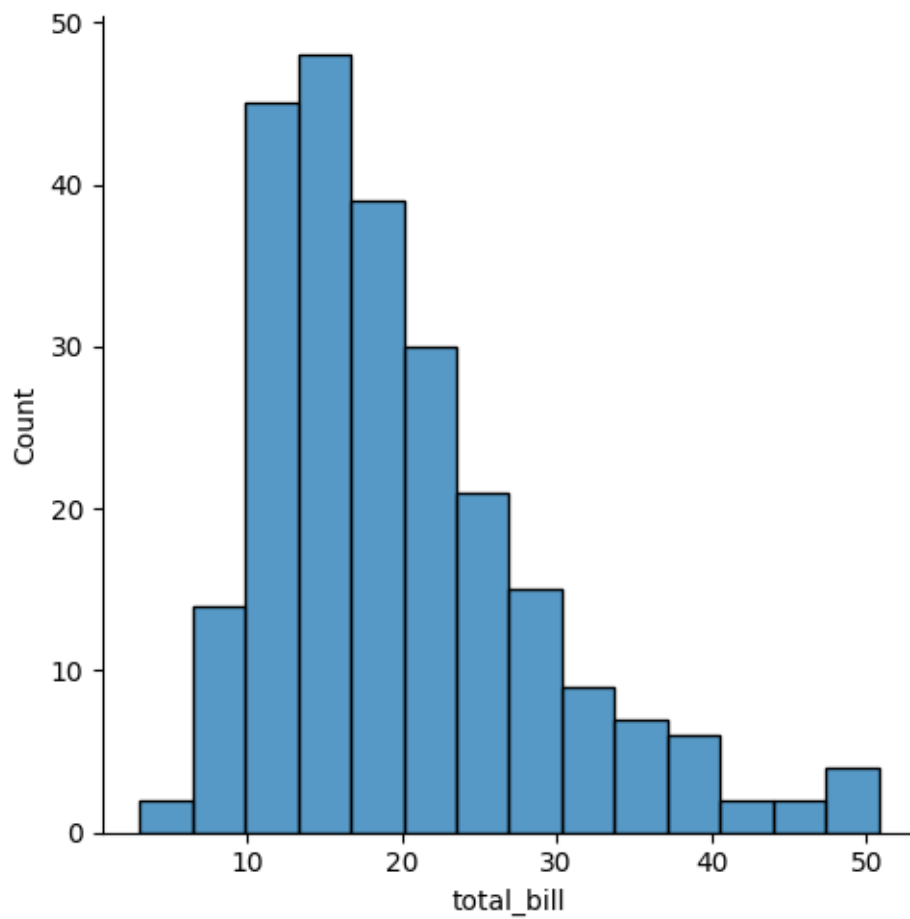
```
[89]: sns.displot(tips.total_bill,kde=True)
```

```
[89]: <seaborn.axisgrid.FacetGrid at 0x20d7dc69390>
```



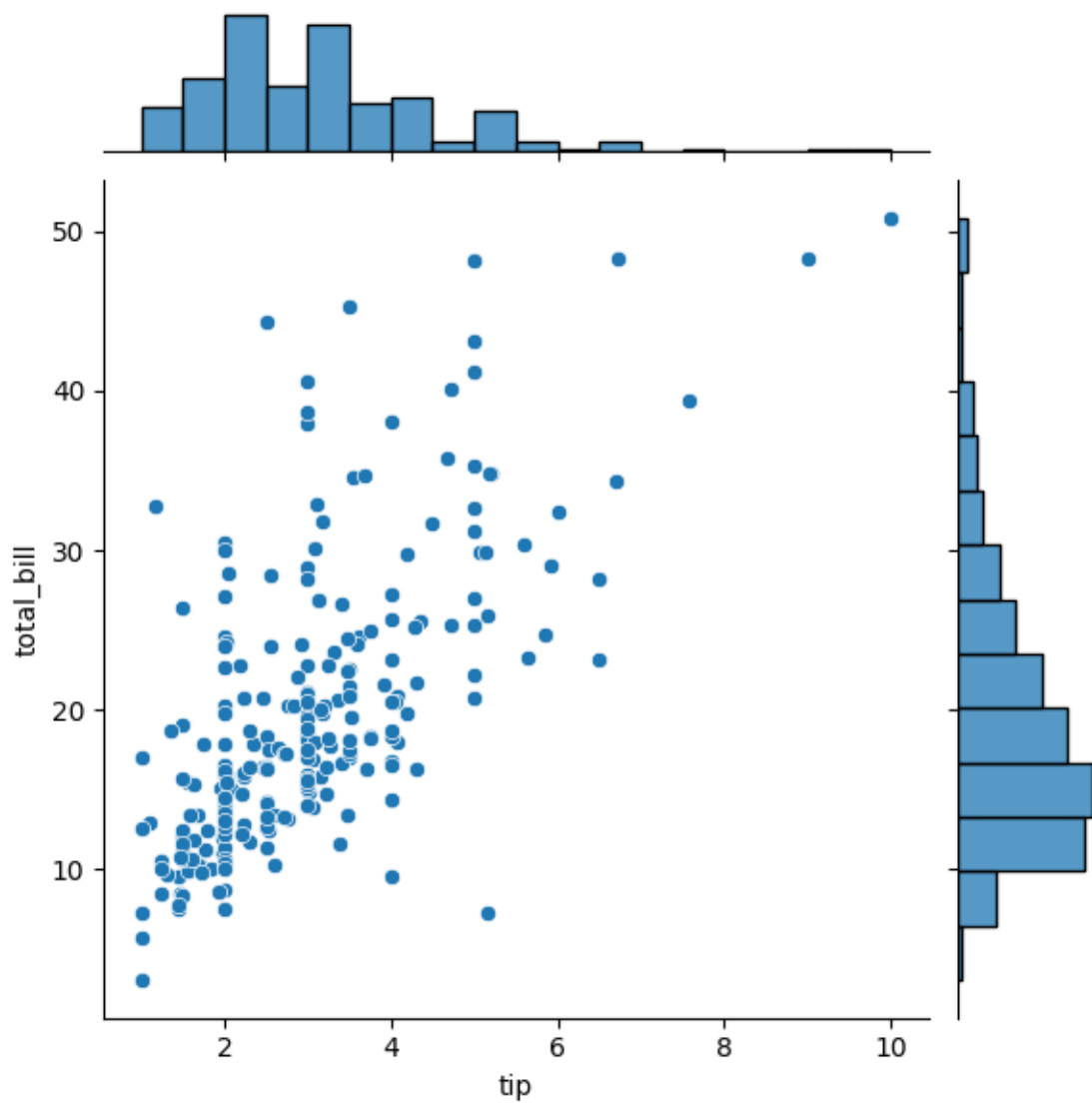
```
[90]: sns.displot(tips.total_bill,kde=False)
```

```
[90]: <seaborn.axisgrid.FacetGrid at 0x20d7dc22790>
```



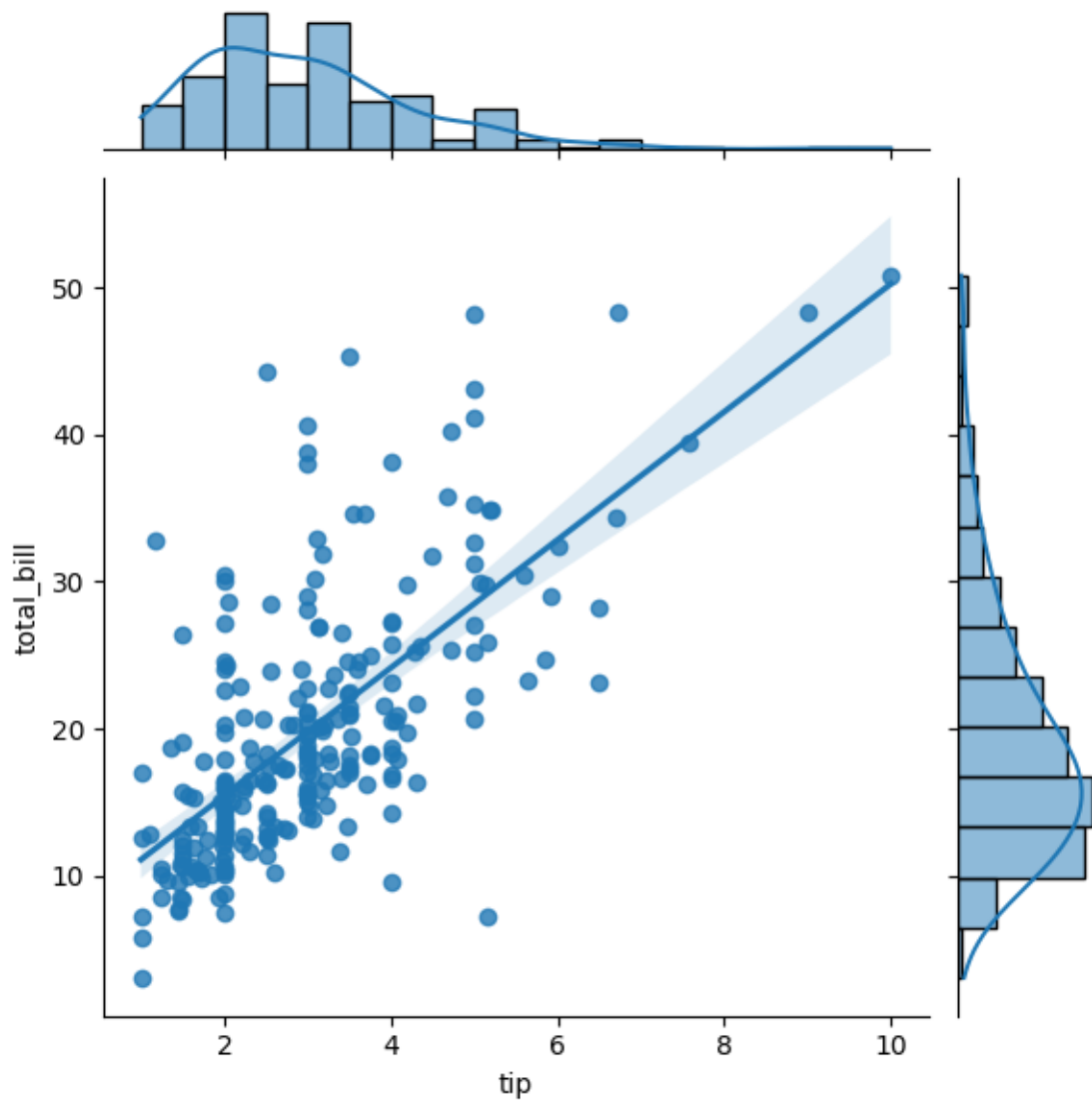
```
[91]: sns.jointplot(x=tips.tip,y=tips.total_bill)
```

```
[91]: <seaborn.axisgrid.JointGrid at 0x20d7dc2f2d0>
```



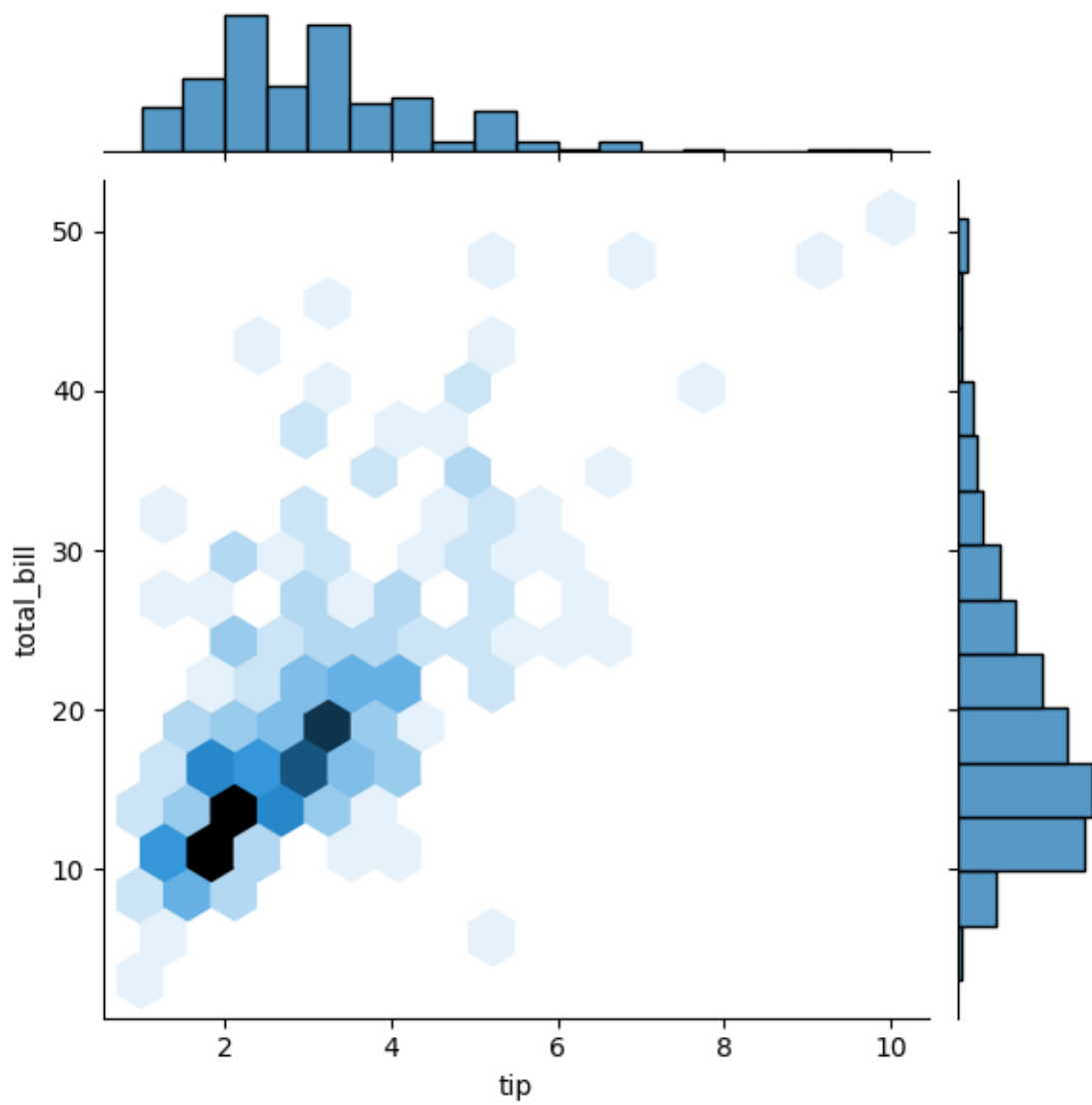
```
[92]: sns.jointplot(x=tips.tip,y=tips.total_bill,kind="reg")
```

```
[92]: <seaborn.axisgrid.JointGrid at 0x20d7ed32450>
```



```
[93]: sns.jointplot(x=tips.tip,y=tips.total_bill,kind="hex")
```

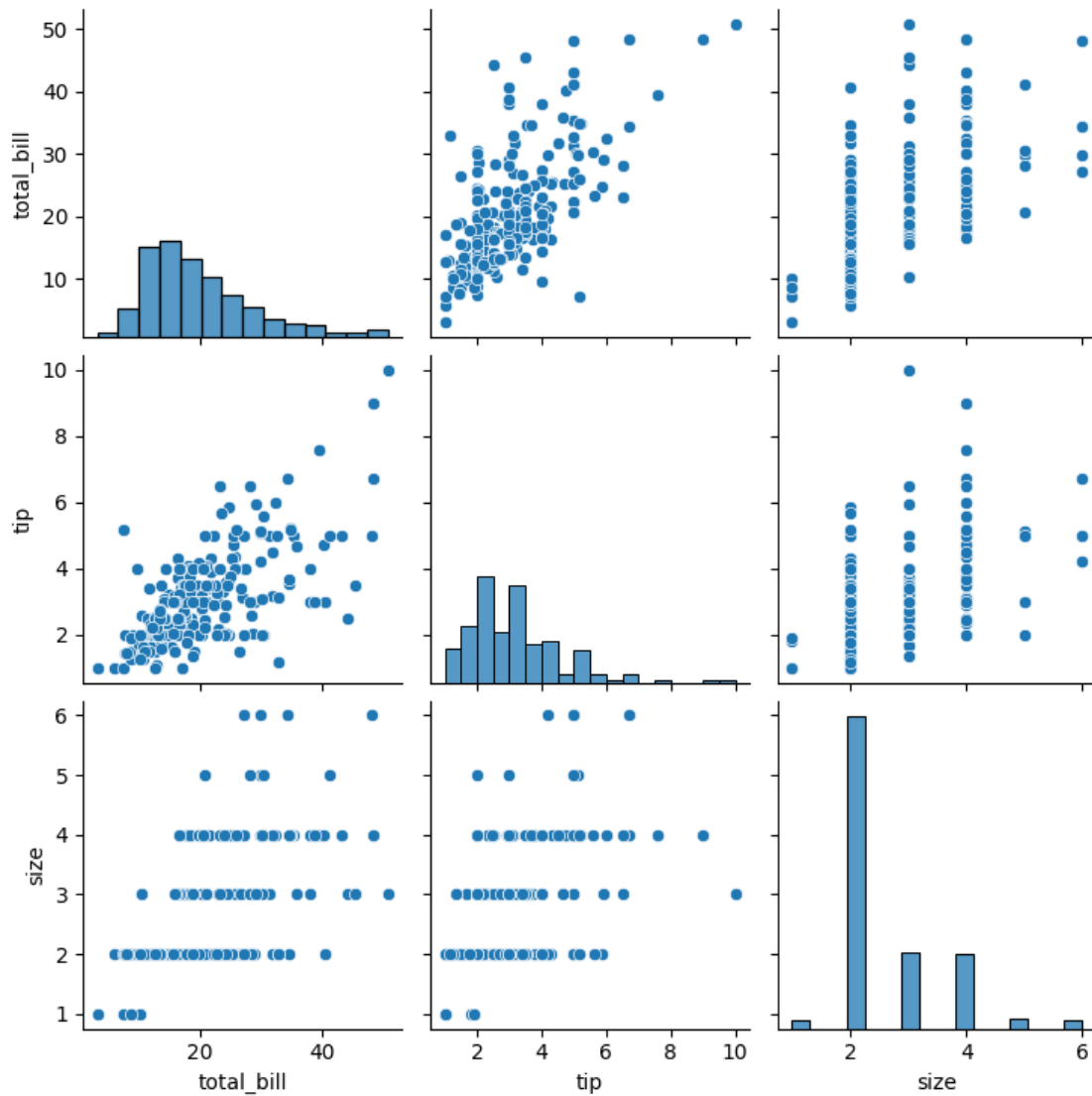
```
[93]: <seaborn.axisgrid.JointGrid at 0x20d7ed7d350>
```



```
[94]: sns.pairplot(tips)
```

```
[94]: <seaborn.axisgrid.PairGrid at 0x20d7f1c9cd0>
```



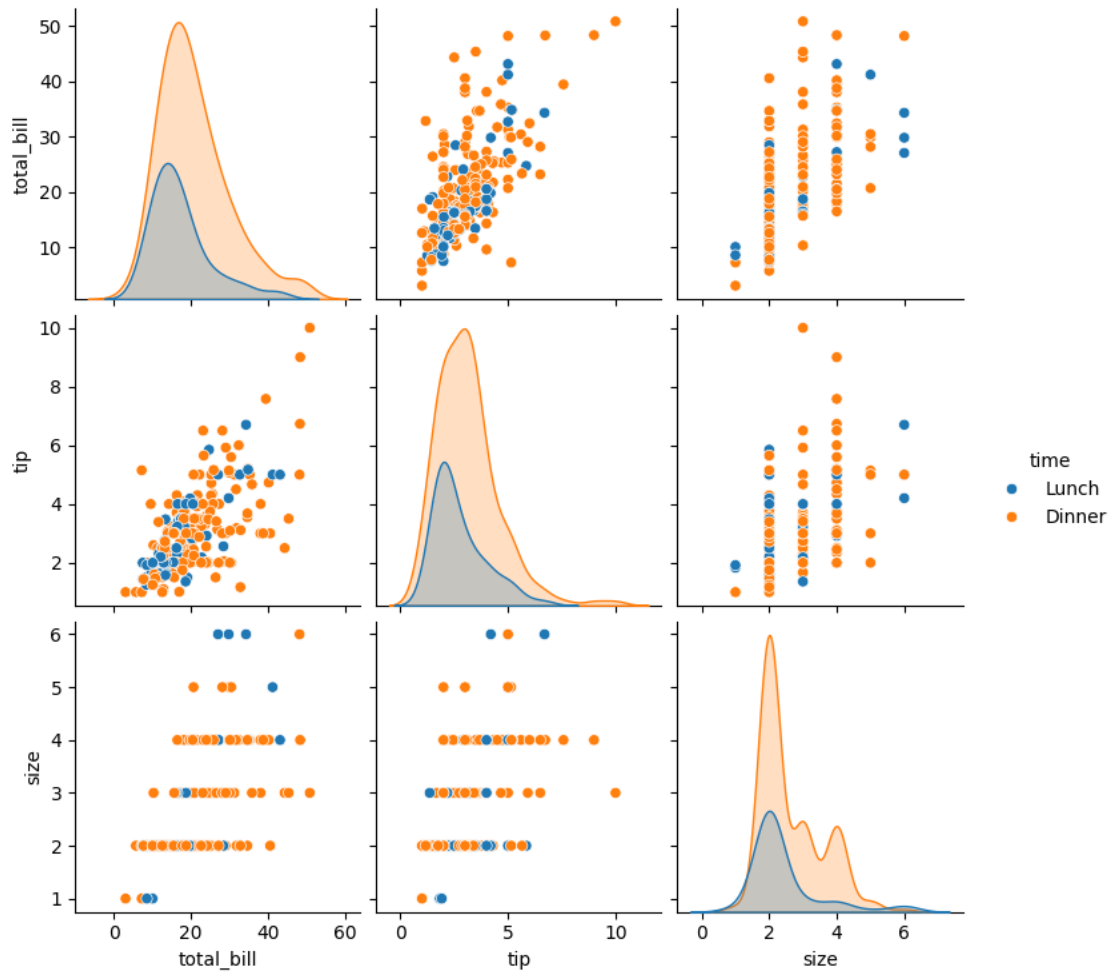


```
[95]: tips.time.value_counts()
```

```
[95]: time
Dinner    176
Lunch      68
Name: count, dtype: int64
```

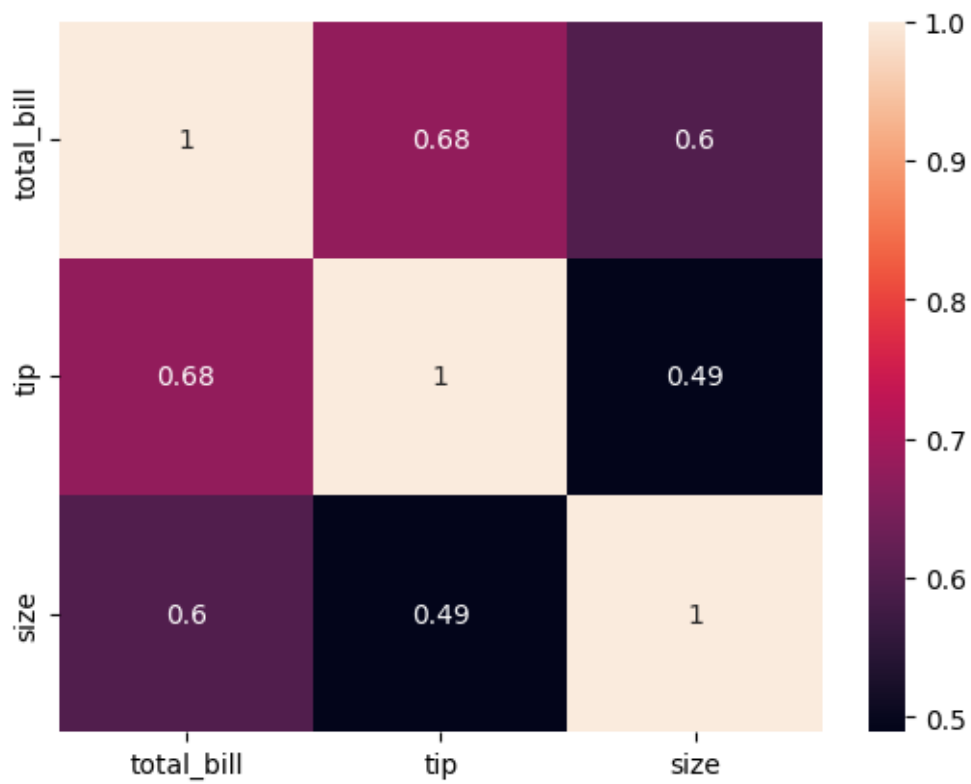
```
[96]: sns.pairplot(tips,hue='time')
```

```
[96]: <seaborn.axisgrid.PairGrid at 0x20d7cc27990>
```



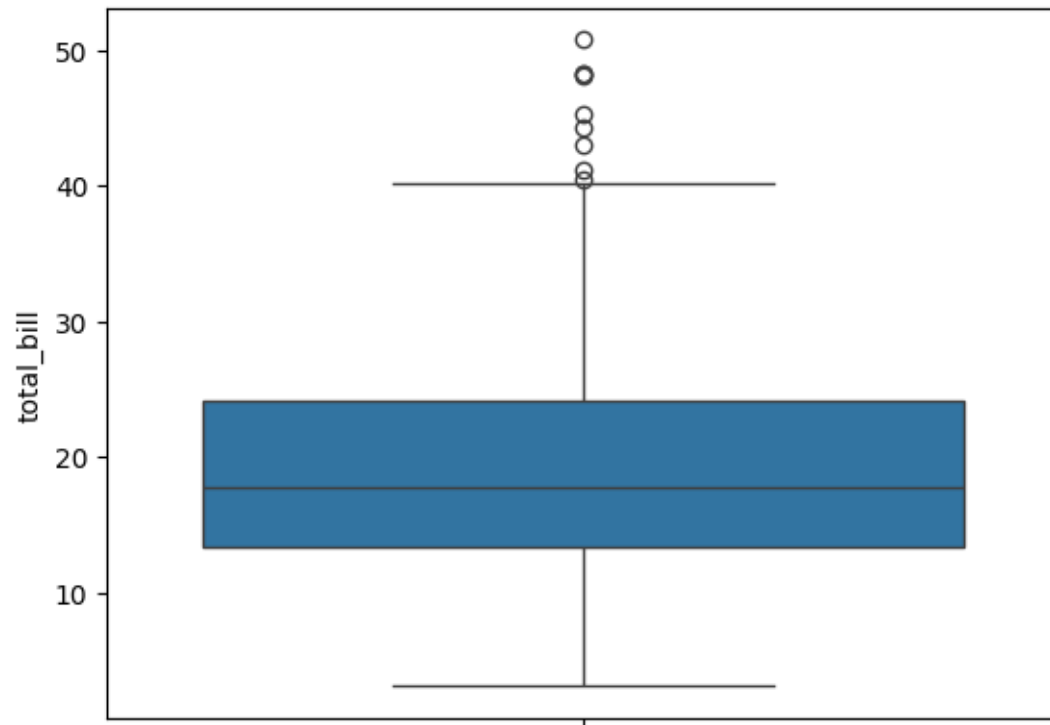
```
[97]: sns.heatmap(tips.corr(numeric_only=True),annot=True)
```

```
[97]: <Axes: >
```



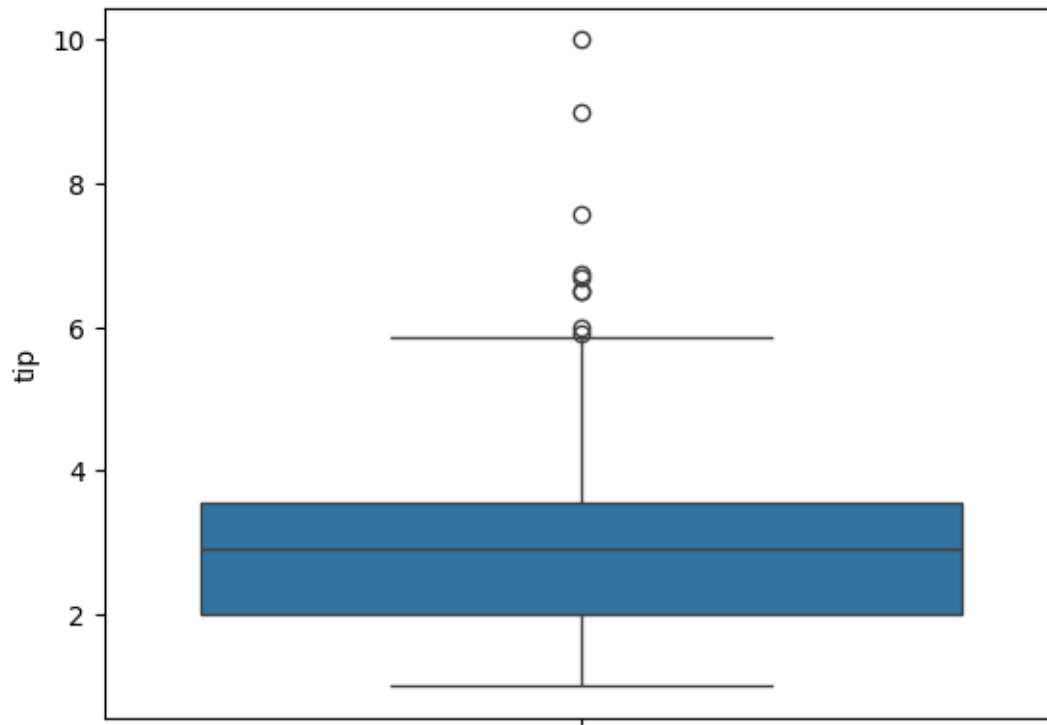
```
[98]: sns.boxplot(tips.total_bill)
```

```
[98]: <Axes: ylabel='total_bill'>
```



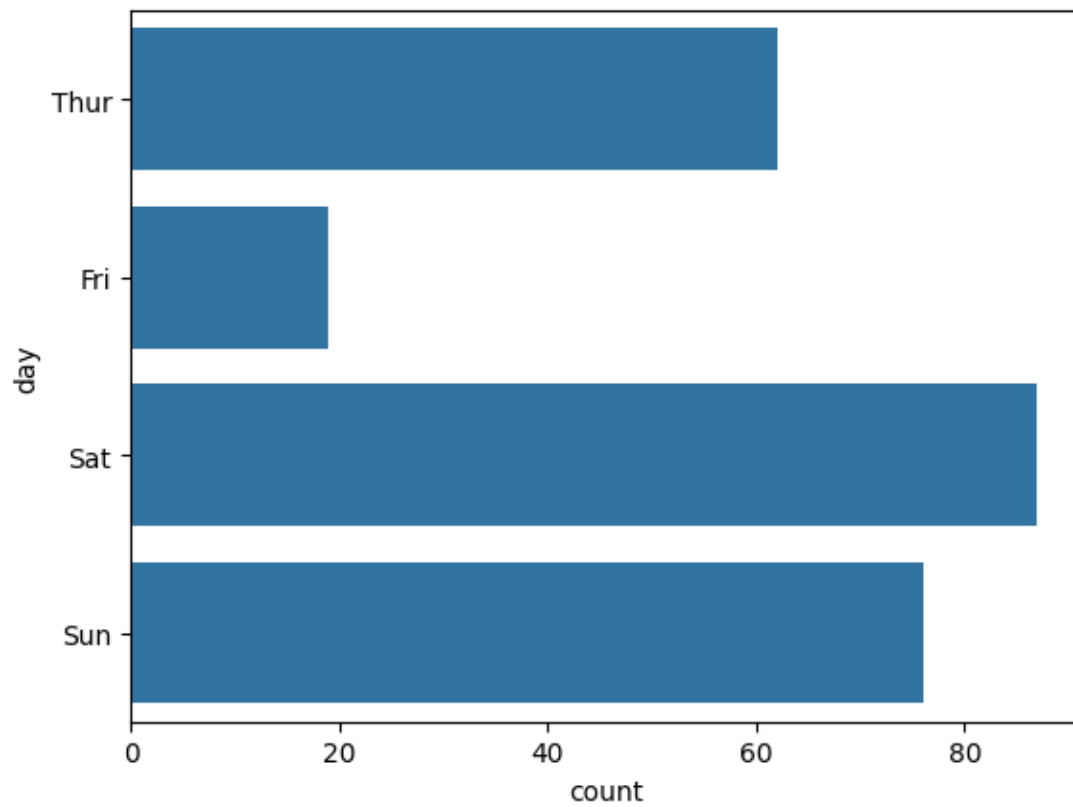
```
[99]: sns.boxplot(tips.tip)
```

```
[99]: <Axes: ylabel='tip'>
```



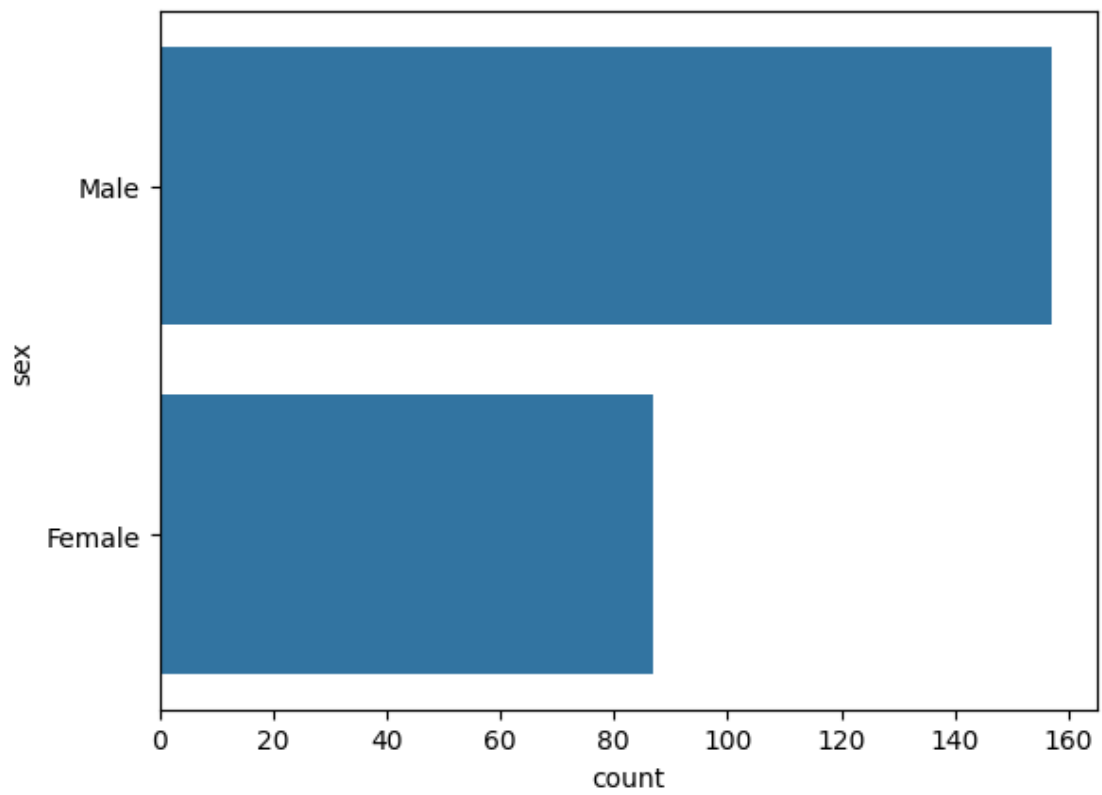
```
[100]: sns.countplot(tips.day)
```

```
[100]: <Axes: xlabel='count', ylabel='day'>
```



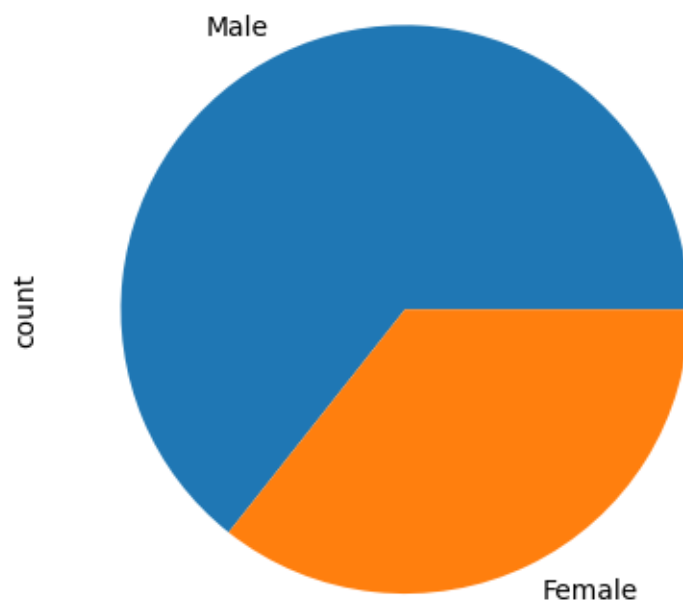
```
[101]: sns.countplot(tips.sex)
```

```
[101]: <Axes: xlabel='count', ylabel='sex'>
```



```
[102]: tips.sex.value_counts().plot(kind='pie')
```

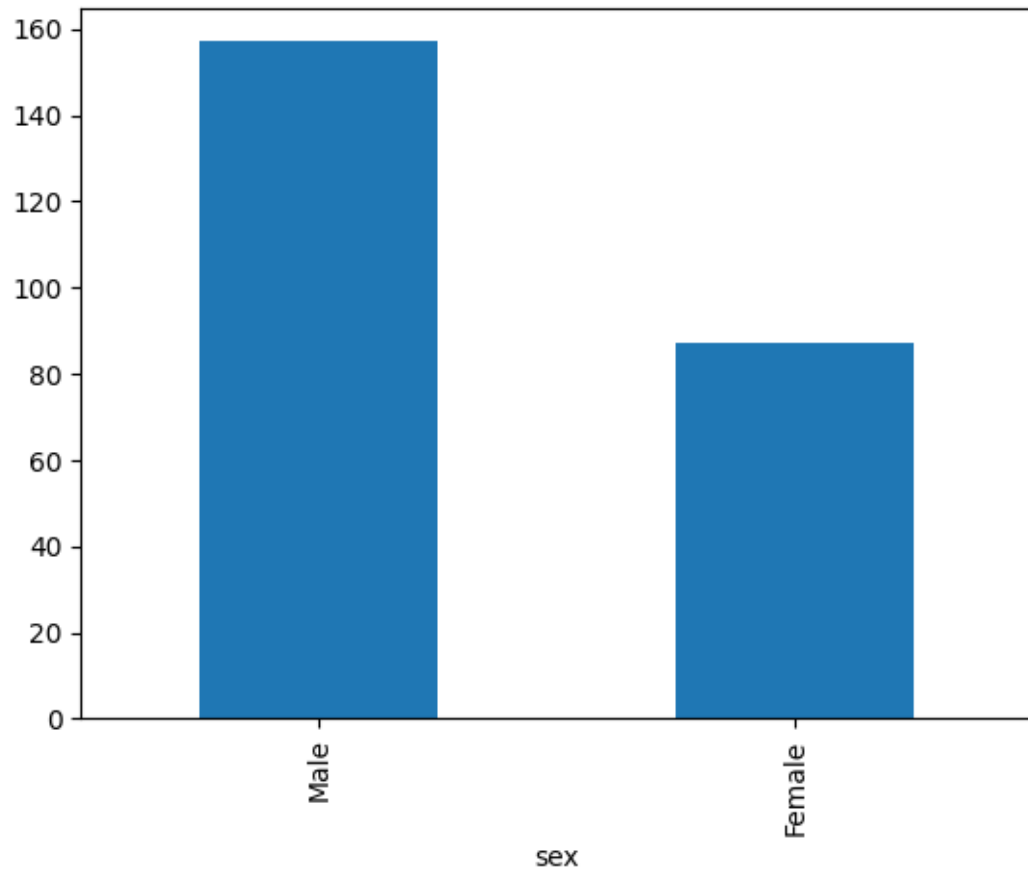
```
[102]: <Axes: ylabel='count'>
```



```
[103]: tips.sex.value_counts().plot(kind='bar')
```

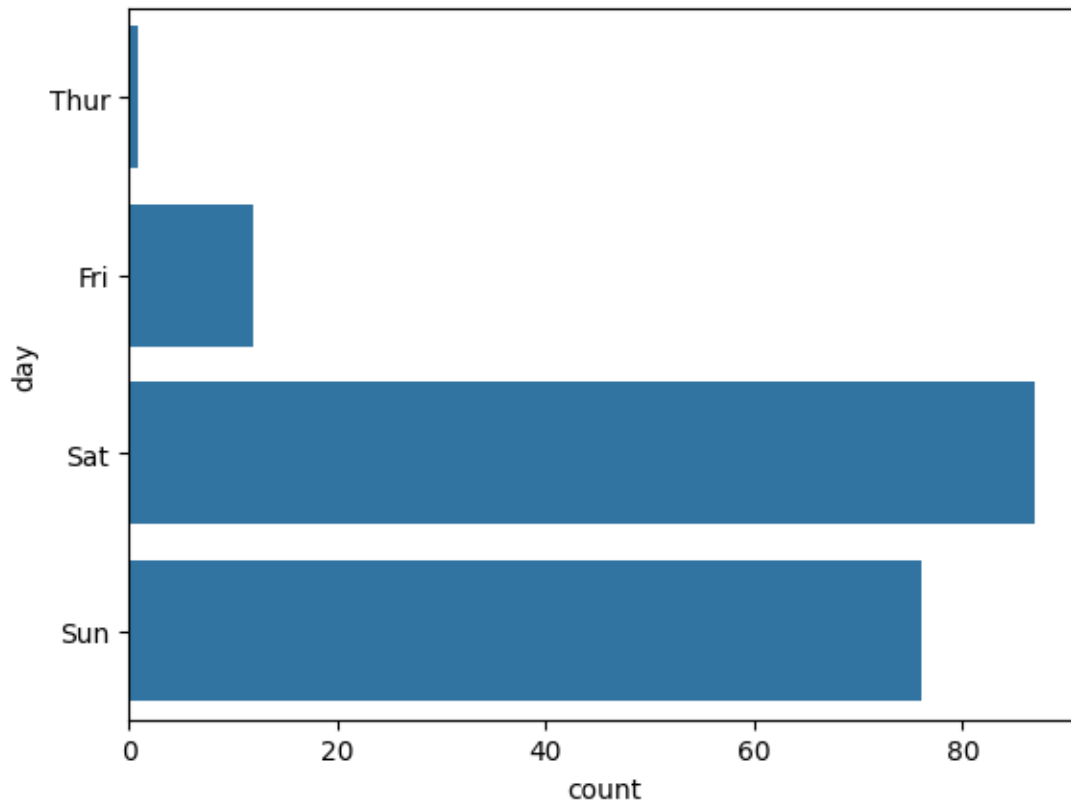
```
[103]: <Axes: xlabel='sex'>
```





```
[104]: sns.countplot(tips[tips.time=='Dinner']['day'])
```

```
[104]: <Axes: xlabel='count', ylabel='day'>
```



### Experiment- 6 - Random Sampling and Sampling Distribution

```
[106]: import numpy as np
import matplotlib.pyplot as plt
```

```
[107]: population_mean = 50
population_std = 10
population_size = 100000
population = np.random.normal(population_mean, population_std, population_size)
```

```
[108]: sample_sizes = [30, 50, 100]
num_samples = 1000
```

```
[109]: sample_means = {}
for size in sample_sizes:
    sample_means[size] = []
```

```

for _ in range(num_samples):
    sample = np.random.choice(population, size=size, replace=False)
    sample_means[size].append(np.mean(sample))

```

```
[110]: plt.figure(figsize=(12, 8))
```

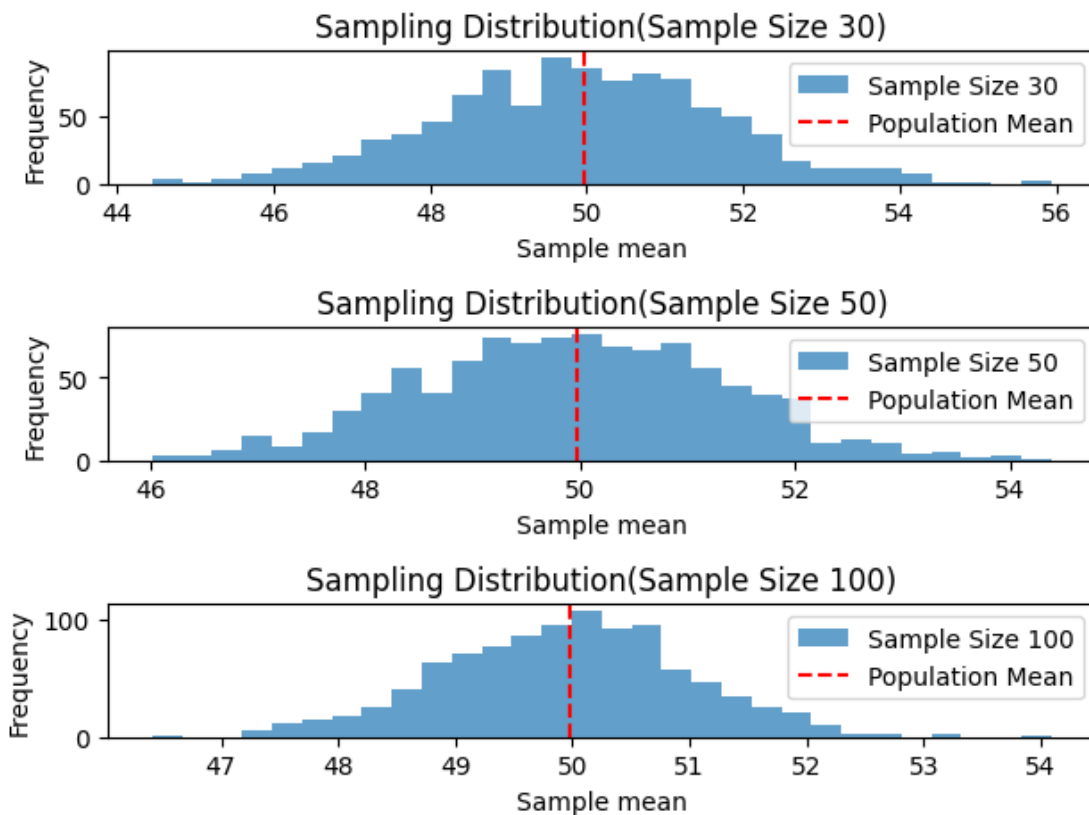
```
[110]: <Figure size 1200x800 with 0 Axes>
```

```
<Figure size 1200x800 with 0 Axes>
```

```

[111]: for i, size in enumerate(sample_sizes):
    plt.subplot(len(sample_sizes), 1, i+1)
    plt.hist(sample_means[size], bins=30, alpha=0.7, label=f'Sample Size {size}')
    plt.axvline(np.mean(population), color='red', linestyle='dashed',
    ↪ linewidth=1.5,
    label= 'Population Mean')
    plt.title(f'Sampling Distribution(Sample Size {size})')
    plt.xlabel('Sample mean')
    plt.ylabel('Frequency')
    plt.legend()
plt.tight_layout()
plt.show()

```



## Experiment-7- Z-Test

```
[113]: import numpy as np
import scipy.stats as stats

[114]: sample_data = np.array([152, 148, 151, 149, 147, 153, 150, 148, 152,
149,151, 150, 149, 152, 151, 148, 150, 152, 149, 150,148, 153, 151,
150, 149, 152, 148, 151, 150, 153])

[115]: population_mean = 150
sample_mean = np.mean(sample_data)
sample_std = np.std(sample_data, ddof=1)

[116]: n = len(sample_data)
z_statistic = (sample_mean - population_mean) / (sample_std / np.sqrt(n))
p_value = 2 * (1 - stats.norm.cdf(np.abs(z_statistic)))

[117]: # Assuming sample_mean, z_statistic, and p_value have already been calculated:
print(f"Sample Mean: {sample_mean:.2f}\n")
print(f"Z-Statistic: {z_statistic:.4f}\n")
print(f"P-Value: {p_value:.4f}\n")

# Significance level
alpha = 0.05

# Decision based on p-value
if p_value < alpha:
    print("Reject the null hypothesis: The average weight is significantly_
    ↪different from 150 grams.")
else:
    print("Fail to reject the null hypothesis: There is no significant_
    ↪difference in average weight from 150 grams.")
```

Sample Mean: 150.20

Z-Statistic: 0.6406

P-Value: 0.5218

Fail to reject the null hypothesis: There is no significant difference in average weight from 150 grams.

## Experiment 8: T-Test

```
[119]: import numpy as np
import scipy.stats as stats
np.random.seed(42)
sample_size = 25
sample_data = np.random.normal(loc=102, scale=15, size=sample_size)

[120]: population_mean = 100
sample_mean = np.mean(sample_data)
sample_std = np.std(sample_data, ddof=1)

[121]: n = len(sample_data)
t_statistic, p_value = stats.ttest_1samp(sample_data, population_mean)

[122]: # Assuming sample_mean, t_statistic, and p_value have already been calculated:
print(f"Sample Mean: {sample_mean:.2f}\n")
print(f"T-Statistic: {t_statistic:.4f}\n")
print(f"P-Value: {p_value:.4f}\n")

# Significance level
alpha = 0.05

# Decision based on p-value
if p_value < alpha:
    print("Reject the null hypothesis: The average IQ score is significantly_
    ↪different from 100.")
else:
    print("Fail to reject the null hypothesis: There is no significant_
    ↪difference in average IQ score from 100.")
```

Sample Mean: 99.55

T-Statistic: -0.1577

P-Value: 0.8760

Fail to reject the null hypothesis: There is no significant difference in average IQ score from 100.

## EX.NO :9 Annova TEST

```
[124]: import numpy as np
import scipy.stats as stats
from statsmodels.stats.multicomp import pairwise_tukeyhsd

np.random.seed(42)
n_plants = 25

[125]: growth_A = np.random.normal(loc=10, scale=2, size=n_plants)
growth_B = np.random.normal(loc=12, scale=3, size=n_plants)
growth_C = np.random.normal(loc=15, scale=2.5, size=n_plants)

[126]: all_data = np.concatenate([growth_A, growth_B, growth_C])

[127]: treatment_labels = ['A'] * n_plants + ['B'] * n_plants + ['C'] * n_plants
f_statistic, p_value = stats.f_oneway(growth_A, growth_B, growth_C)

[128]: mean_A = np.mean(growth_A)
mean_B = np.mean(growth_B)
mean_C = np.mean(growth_C)
print(f"Treatment A Mean Growth: {mean_A:.4f}")
print(f"Treatment B Mean Growth: {mean_B:.4f}")
print(f"Treatment C Mean Growth: {mean_C:.4f}")
print(f"F-Statistic: {f_statistic:.4f}")
print(f"P-Value: {p_value:.4f}")

alpha = 0.05
if p_value < alpha:
    print("Reject the null hypothesis: There is a significant difference in_
    ↪mean growth rates among the three treatments.")
else:
    print("Fail to reject the null hypothesis: There is no significant_
    ↪difference in mean growth rates among the three treatments.")

if p_value < alpha:

    tukey_results = pairwise_tukeyhsd(all_data, treatment_labels, alpha=0.05)

    print("\nTukey's HSD Post-hoc Test:")
    print(tukey_results)
```

Treatment A Mean Growth: 9.6730

Treatment B Mean Growth: 11.1377  
 Treatment C Mean Growth: 15.2652  
 F-Statistic: 36.1214  
 P-Value: 0.0000  
 Reject the null hypothesis: There is a significant difference in mean growth rates among the three treatments.

Tukey's HSD Post-hoc Test:

Multiple Comparison of Means - Tukey HSD, FWER=0.05

```
=====
group1 group2 meandiff p-adj  lower  upper  reject
-----
      A      B   1.4647 0.0877 -0.1683 3.0977  False
      A      C   5.5923   0.0  3.9593 7.2252   True
      B      C   4.1276   0.0  2.4946 5.7605   True
-----
```

## EX.NO :10 Feature Scaling

```
[130]: import numpy as np
import pandas as pd
import warnings
warnings.filterwarnings('ignore')
df=pd.read_csv('pre_process_datasample.csv')
```

```
[131]: df.head()
```

```
[131]:   Country  Age  Salary Purchased
0  France  44.0  72000.0         No
1   Spain  27.0  48000.0         Yes
2  Germany  30.0  54000.0         No
3   Spain  38.0  61000.0         No
4  Germany  40.0      NaN         Yes
```

```
[132]: df.Country.fillna(df.Country.mode()[0],inplace=True)
features=df.iloc[:, :-1].values
features
```

```
[132]: array([[ 'France', 44.0, 72000.0],
       [ 'Spain', 27.0, 48000.0],
       [ 'Germany', 30.0, 54000.0],
       [ 'Spain', 38.0, 61000.0],
```

```

['Germany', 40.0, nan],
['France', 35.0, 58000.0],
['Spain', nan, 52000.0],
['France', 48.0, 79000.0],
['Germany', 50.0, 83000.0],
['France', 37.0, 67000.0]], dtype=object)

```

```
[133]: label=df.iloc[:,-1].values
```

```
[134]: from sklearn.impute import SimpleImputer
age=SimpleImputer(strategy="mean",missing_values=np.nan)
Salary=SimpleImputer(strategy="mean",missing_values=np.nan)
age.fit(features[:,[1]])
```

```
[134]: SimpleImputer()
```

```
[135]: Salary.fit(features[:,[2]])
```

```
[135]: SimpleImputer()
```

```
[136]: SimpleImputer()
```

```
[136]: SimpleImputer()
```

```
[137]: features[:,[1]]=age.transform(features[:,[1]])
features[:,[2]]=Salary.transform(features[:,[2]])
features
```

```
[137]: array([[ 'France', 44.0, 72000.0],
 [ 'Spain', 27.0, 48000.0],
 [ 'Germany', 30.0, 54000.0],
 [ 'Spain', 38.0, 61000.0],
 [ 'Germany', 40.0, 63777.77777777778],
 [ 'France', 35.0, 58000.0],
 [ 'Spain', 38.77777777777778, 52000.0],
 [ 'France', 48.0, 79000.0],
 [ 'Germany', 50.0, 83000.0],
 [ 'France', 37.0, 67000.0]], dtype=object)
```

```
[138]: from sklearn.preprocessing import OneHotEncoder
oh = OneHotEncoder(sparse_output=False)
Country=oh.fit_transform(features[:,[0]])
Country
```

```
[138]: array([[1., 0., 0.],
 [0., 0., 1.],
 [0., 1., 0.]])
```



```
[0., 0., 1.],
[0., 1., 0.],
[1., 0., 0.],
[0., 0., 1.],
[1., 0., 0.],
[0., 1., 0.],
[1., 0., 0.]])
```

```
[139]: final_set=np.concatenate((Country,features[:,[1,2]]),axis=1)
final_set
```

```
[139]: array([[1.0, 0.0, 0.0, 44.0, 72000.0],
[0.0, 0.0, 1.0, 27.0, 48000.0],
[0.0, 1.0, 0.0, 30.0, 54000.0],
[0.0, 0.0, 1.0, 38.0, 61000.0],
[0.0, 1.0, 0.0, 40.0, 63777.77777777778],
[1.0, 0.0, 0.0, 35.0, 58000.0],
[0.0, 0.0, 1.0, 38.77777777777778, 52000.0],
[1.0, 0.0, 0.0, 48.0, 79000.0],
[0.0, 1.0, 0.0, 50.0, 83000.0],
[1.0, 0.0, 0.0, 37.0, 67000.0]], dtype=object)
```

```
[140]: from sklearn.preprocessing import StandardScaler
sc=StandardScaler()
sc.fit(final_set)
feat_standard_scaler=sc.transform(final_set)
```

```
[141]: feat_standard_scaler
```

```
[141]: array([[ 1.22474487e+00, -6.54653671e-01, -6.54653671e-01,
 7.58874362e-01,  7.49473254e-01],
[-8.16496581e-01, -6.54653671e-01,  1.52752523e+00,
-1.71150388e+00, -1.43817841e+00],
[-8.16496581e-01,  1.52752523e+00, -6.54653671e-01,
-1.27555478e+00, -8.91265492e-01],
[-8.16496581e-01, -6.54653671e-01,  1.52752523e+00,
-1.13023841e-01, -2.53200424e-01],
[-8.16496581e-01,  1.52752523e+00, -6.54653671e-01,
 1.77608893e-01,  6.63219199e-16],
[ 1.22474487e+00, -6.54653671e-01, -6.54653671e-01,
-5.48972942e-01, -5.26656882e-01],
[-8.16496581e-01, -6.54653671e-01,  1.52752523e+00,
 0.00000000e+00, -1.07356980e+00],
[ 1.22474487e+00, -6.54653671e-01, -6.54653671e-01,
 1.34013983e+00,  1.38753832e+00],
[-8.16496581e-01,  1.52752523e+00, -6.54653671e-01,
 1.63077256e+00,  1.75214693e+00],
```

```
[ 1.22474487e+00, -6.54653671e-01, -6.54653671e-01,
 -2.58340208e-01,  2.93712492e-01]])
```

```
[142]: from sklearn.preprocessing import MinMaxScaler
mms=MinMaxScaler(feature_range=(0,1))
mms.fit(final_set)
feat_minmax_scaler=mms.transform(final_set)
feat_minmax_scaler
```

```
[142]: array([[1.          , 0.          , 0.          , 0.73913043, 0.68571429],
 [0.          , 0.          , 1.          , 0.          , 0.          ],
 [0.          , 1.          , 0.          , 0.13043478, 0.17142857],
 [0.          , 0.          , 1.          , 0.47826087, 0.37142857],
 [0.          , 1.          , 0.          , 0.56521739, 0.45079365],
 [1.          , 0.          , 0.          , 0.34782609, 0.28571429],
 [0.          , 0.          , 1.          , 0.51207729, 0.11428571],
 [1.          , 0.          , 0.          , 0.91304348, 0.88571429],
 [0.          , 1.          , 0.          , 1.          , 1.          ],
 [1.          , 0.          , 0.          , 0.43478261, 0.54285714]])
```

## EX.NO :11 Linear Regression

```
[144]: import numpy as np
import pandas as pd
df = pd.read_csv('Salary_data.csv')
df
```

```
[144]:
```

	YearsExperience	Salary
0	1.1	39343
1	1.3	46205
2	1.5	37731
3	2.0	43525
4	2.2	39891
5	2.9	56642
6	3.0	60150
7	3.2	54445
8	3.2	64445
9	3.7	57189
10	3.9	63218
11	4.0	55794
12	4.0	56957
13	4.1	57081

14	4.5	61111
15	4.9	67938
16	5.1	66029
17	5.3	83088
18	5.9	81363
19	6.0	93940
20	6.8	91738
21	7.1	98273
22	7.9	101302
23	8.2	113812
24	8.7	109431
25	9.0	105582
26	9.5	116969
27	9.6	112635
28	10.3	122391
29	10.5	121872

```
[145]: df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 30 entries, 0 to 29
Data columns (total 2 columns):
#   Column          Non-Null Count  Dtype
---  -
0   YearsExperience  30 non-null    float64
1   Salary          30 non-null    int64
dtypes: float64(1), int64(1)
memory usage: 612.0 bytes
```

```
[146]: df.dropna(inplace=True);
df
```

```
[146]:
```

	YearsExperience	Salary
0	1.1	39343
1	1.3	46205
2	1.5	37731
3	2.0	43525
4	2.2	39891
5	2.9	56642
6	3.0	60150
7	3.2	54445
8	3.2	64445
9	3.7	57189
10	3.9	63218
11	4.0	55794
12	4.0	56957
13	4.1	57081

14	4.5	61111
15	4.9	67938
16	5.1	66029
17	5.3	83088
18	5.9	81363
19	6.0	93940
20	6.8	91738
21	7.1	98273
22	7.9	101302
23	8.2	113812
24	8.7	109431
25	9.0	105582
26	9.5	116969
27	9.6	112635
28	10.3	122391
29	10.5	121872

```
[147]: df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 30 entries, 0 to 29
Data columns (total 2 columns):
#   Column          Non-Null Count  Dtype
---  -
0   YearsExperience  30 non-null    float64
1   Salary          30 non-null    int64
dtypes: float64(1), int64(1)
memory usage: 612.0 bytes
```

```
[148]: df.describe() #descripte statical report
# find out lYER FOR BELOW META DATA
```

```
[148]:
```

	YearsExperience	Salary
count	30.000000	30.000000
mean	5.313333	76003.000000
std	2.837888	27414.429785
min	1.100000	37731.000000
25%	3.200000	56720.750000
50%	4.700000	65237.000000
75%	7.700000	100544.750000
max	10.500000	122391.000000

```
[149]: features = df.iloc[:,[0]].values # : - > all row , 0 -> first column

#iloc index based selection loc location based sentence

label = df.iloc[:,[1]].values
```

```
features
```

```
[149]: array([[ 1.1],
               [ 1.3],
               [ 1.5],
               [ 2. ],
               [ 2.2],
               [ 2.9],
               [ 3. ],
               [ 3.2],
               [ 3.2],
               [ 3.7],
               [ 3.9],
               [ 4. ],
               [ 4. ],
               [ 4.1],
               [ 4.5],
               [ 4.9],
               [ 5.1],
               [ 5.3],
               [ 5.9],
               [ 6. ],
               [ 6.8],
               [ 7.1],
               [ 7.9],
               [ 8.2],
               [ 8.7],
               [ 9. ],
               [ 9.5],
               [ 9.6],
               [10.3],
               [10.5]])
```

```
[150]: label
```

```
[150]: array([[ 39343],
               [ 46205],
               [ 37731],
               [ 43525],
               [ 39891],
               [ 56642],
               [ 60150],
               [ 54445],
               [ 64445],
               [ 57189],
               [ 63218],
```

```
[ 55794],
[ 56957],
[ 57081],
[ 61111],
[ 67938],
[ 66029],
[ 83088],
[ 81363],
[ 93940],
[ 91738],
[ 98273],
[101302],
[113812],
[109431],
[105582],
[116969],
[112635],
[122391],
[121872]], dtype=int64)
```

```
[151]: from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test = train_test_split(features,label,test_size=0.
↳2,random_state=23)
# x independent input  train 80 % test 20 %
'''
y is depenent ouput
0.2 allocate test for 20 % automatically train for 80 %
'''
```

```
[151]: '\ny is depenent ouput\n0.2 allocate test for 20 % automatically train for 80
%\n'
```

```
[152]: from sklearn.linear_model import LinearRegression
model = LinearRegression()
model.fit(x_train,y_train)
'''
sk - size kit
linear means using linear regression
fit means add data
'''
```

```
[152]: '\nsk - size kit \nlinear means using linear regression \nfit means add data \n'
```

```
[153]: model.score(x_train,y_train)
'''
accuracy calculating
96 %
```

```
'''
```

```
[153]: '\naccuracy calculating\n96 %\n'
```

```
[154]: model.score(x_test,y_test)
'''
accuracy calculating
91 %
'''
```

```
[154]: '\naccuracy calculating\n91 %\n'
```

```
[155]: model.coef_
```

```
[155]: array([[9281.30847068]])
```

```
[156]: model.intercept_
```

```
[156]: array([27166.73682891])
```

```
[157]: import pickle
pickle.dump(model,open('SalaryPred.model','wb'))
'''
pickle momory obj to file
'''
```

```
[157]: '\npickle momory obj to file\n\n'
```

```
[158]: model = pickle.load(open('SalaryPred.model','rb'))
```

```
[159]: yr_of_exp = float(input("Enter years of expreience: "))
yr_of_exp_NP = np.array([[yr_of_exp]])
salary = model.predict(yr_of_exp_NP)
print("Estimated salary for {} years of expreience is {} . ".
      ↪format(yr_of_exp,salary))
```

Enter years of expreience: 24

Estimated salary for 24.0 years of expreience is [[249918.14012525]] .

```
[160]: print(f" Estimated salary for {yr_of_exp} years of expreience is {salary} . ")
```

Estimated salary for 24.0 years of expreience is [[249918.14012525]] .

## EX.NO :12 Logistic Regression

```
[162]: import numpy as np
import pandas as pd
import warnings
warnings.filterwarnings('ignore')
df=pd.read_csv('Social_Network_Ads.csv')
df
```

```
[162]:
```

	User ID	Gender	Age	EstimatedSalary	Purchased
0	15624510	Male	19	19000	0
1	15810944	Male	35	20000	0
2	15668575	Female	26	43000	0
3	15603246	Female	27	57000	0
4	15804002	Male	19	76000	0
..	...	...	...	...	...
395	15691863	Female	46	41000	1
396	15706071	Male	51	23000	1
397	15654296	Female	50	20000	1
398	15755018	Male	36	33000	0
399	15594041	Female	49	36000	1

[400 rows x 5 columns]

```
[163]: df.tail(20)
```

```
[163]:
```

	User ID	Gender	Age	EstimatedSalary	Purchased
380	15683758	Male	42	64000	0
381	15670615	Male	48	33000	1
382	15715622	Female	44	139000	1
383	15707634	Male	49	28000	1
384	15806901	Female	57	33000	1
385	15775335	Male	56	60000	1
386	15724150	Female	49	39000	1
387	15627220	Male	39	71000	0
388	15672330	Male	47	34000	1
389	15668521	Female	48	35000	1
390	15807837	Male	48	33000	1
391	15592570	Male	47	23000	1
392	15748589	Female	45	45000	1
393	15635893	Male	60	42000	1
394	15757632	Female	39	59000	0
395	15691863	Female	46	41000	1
396	15706071	Male	51	23000	1
397	15654296	Female	50	20000	1



398	15755018	Male	36	33000	0
399	15594041	Female	49	36000	1

```
[164]: df.head(25)
```

```
[164]:
```

	User ID	Gender	Age	EstimatedSalary	Purchased
0	15624510	Male	19	19000	0
1	15810944	Male	35	20000	0
2	15668575	Female	26	43000	0
3	15603246	Female	27	57000	0
4	15804002	Male	19	76000	0
5	15728773	Male	27	58000	0
6	15598044	Female	27	84000	0
7	15694829	Female	32	150000	1
8	15600575	Male	25	33000	0
9	15727311	Female	35	65000	0
10	15570769	Female	26	80000	0
11	15606274	Female	26	52000	0
12	15746139	Male	20	86000	0
13	15704987	Male	32	18000	0
14	15628972	Male	18	82000	0
15	15697686	Male	29	80000	0
16	15733883	Male	47	25000	1
17	15617482	Male	45	26000	1
18	15704583	Male	46	28000	1
19	15621083	Female	48	29000	1
20	15649487	Male	45	22000	1
21	15736760	Female	47	49000	1
22	15714658	Male	48	41000	1
23	15599081	Female	45	22000	1
24	15705113	Male	46	23000	1

```
[165]: features = df.iloc[:,[2,3]].values
label = df.iloc[:,4].values
features
```

```
[165]: array([[ 19, 19000],
[ 35, 20000],
[ 26, 43000],
[ 27, 57000],
[ 19, 76000],
[ 27, 58000],
[ 27, 84000],
[ 32, 150000],
[ 25, 33000],
[ 35, 65000],
[ 26, 80000],
```

```

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```

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[ 36, 99000],  
[ 60, 34000],  
[ 54, 70000],  
[ 41, 72000],  
[ 40, 71000],  
[ 42, 54000],  
[ 43, 129000],  
[ 53, 34000],  
[ 47, 50000],  
[ 42, 79000],  
[ 42, 104000],  
[ 59, 29000],  
[ 58, 47000],  
[ 46, 88000],  
[ 38, 71000],  
[ 54, 26000],  
[ 60, 46000],  
[ 60, 83000],  
[ 39, 73000],  
[ 59, 130000],  
[ 37, 80000],  
[ 46, 32000],  
[ 46, 74000],  
[ 42, 53000],  
[ 41, 87000],  
[ 58, 23000],  
[ 42, 64000],  
[ 48, 33000],  
[ 44, 139000],  
[ 49, 28000],  
[ 57, 33000],  
[ 56, 60000],  
[ 49, 39000],

```
[ 39, 71000],
[ 47, 34000],
[ 48, 35000],
[ 48, 33000],
[ 47, 23000],
[ 45, 45000],
[ 60, 42000],
[ 39, 59000],
[ 46, 41000],
[ 51, 23000],
[ 50, 20000],
[ 36, 33000],
[ 49, 36000]], dtype=int64)
```

```
[166]: label
```

```
[166]: array([0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1,
1, 1, 1, 1, 1, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 0, 0, 0, 1, 0, 0, 0, 1,
0, 1, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 0, 0, 0, 1, 1, 0,
1, 1, 0, 1, 0, 1, 0, 1, 0, 0, 1, 1, 0, 1, 0, 0, 1, 1, 0, 1, 1, 0,
1, 1, 0, 0, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 0, 1,
0, 1, 0, 1, 1, 1, 1, 0, 0, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 0, 0, 1,
1, 0, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 0, 1, 1, 0, 0, 0, 1, 1,
0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0, 0, 1, 0,
1, 0, 1, 1, 1, 0, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1,
0, 1, 0, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1,
1, 1, 0, 1], dtype=int64)
```

```
[167]: from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
```

```
[168]: # Assuming `features` and `label` are already defined

for i in range(1, 401):
    x_train, x_test, y_train, y_test = train_test_split(features, label,
↳test_size=0.2, random_state=i)
    model = LogisticRegression()
    model.fit(x_train, y_train)
```

```

train_score = model.score(x_train, y_train)
test_score = model.score(x_test, y_test)

if test_score > train_score:
    print(f"Test Score: {test_score:.4f} | Train Score: {train_score:.4f} | Random State: {i}")

'''
'''

```

```

Test Score: 0.9000 | Train Score: 0.8406 | Random State: 4
Test Score: 0.8625 | Train Score: 0.8500 | Random State: 5
Test Score: 0.8625 | Train Score: 0.8594 | Random State: 6
Test Score: 0.8875 | Train Score: 0.8375 | Random State: 7
Test Score: 0.8625 | Train Score: 0.8375 | Random State: 9
Test Score: 0.9000 | Train Score: 0.8406 | Random State: 10
Test Score: 0.8625 | Train Score: 0.8562 | Random State: 14
Test Score: 0.8500 | Train Score: 0.8438 | Random State: 15
Test Score: 0.8625 | Train Score: 0.8562 | Random State: 16
Test Score: 0.8750 | Train Score: 0.8344 | Random State: 18
Test Score: 0.8500 | Train Score: 0.8438 | Random State: 19
Test Score: 0.8750 | Train Score: 0.8438 | Random State: 20
Test Score: 0.8625 | Train Score: 0.8344 | Random State: 21
Test Score: 0.8750 | Train Score: 0.8406 | Random State: 22
Test Score: 0.8750 | Train Score: 0.8406 | Random State: 24
Test Score: 0.8500 | Train Score: 0.8344 | Random State: 26
Test Score: 0.8500 | Train Score: 0.8406 | Random State: 27
Test Score: 0.8625 | Train Score: 0.8344 | Random State: 30
Test Score: 0.8625 | Train Score: 0.8562 | Random State: 31
Test Score: 0.8750 | Train Score: 0.8531 | Random State: 32
Test Score: 0.8625 | Train Score: 0.8438 | Random State: 33
Test Score: 0.8750 | Train Score: 0.8313 | Random State: 35
Test Score: 0.8625 | Train Score: 0.8531 | Random State: 36
Test Score: 0.8875 | Train Score: 0.8406 | Random State: 38
Test Score: 0.8750 | Train Score: 0.8375 | Random State: 39
Test Score: 0.8875 | Train Score: 0.8375 | Random State: 42
Test Score: 0.8750 | Train Score: 0.8469 | Random State: 46
Test Score: 0.9125 | Train Score: 0.8313 | Random State: 47
Test Score: 0.8750 | Train Score: 0.8313 | Random State: 51
Test Score: 0.9000 | Train Score: 0.8438 | Random State: 54
Test Score: 0.8500 | Train Score: 0.8438 | Random State: 57
Test Score: 0.8750 | Train Score: 0.8438 | Random State: 58
Test Score: 0.9250 | Train Score: 0.8375 | Random State: 61
Test Score: 0.8875 | Train Score: 0.8344 | Random State: 65
Test Score: 0.8875 | Train Score: 0.8406 | Random State: 68

```

Test Score: 0.9000 | Train Score: 0.8313 | Random State: 72  
Test Score: 0.8875 | Train Score: 0.8375 | Random State: 75  
Test Score: 0.9250 | Train Score: 0.8250 | Random State: 76  
Test Score: 0.8625 | Train Score: 0.8406 | Random State: 77  
Test Score: 0.8625 | Train Score: 0.8594 | Random State: 81  
Test Score: 0.8750 | Train Score: 0.8375 | Random State: 82  
Test Score: 0.8875 | Train Score: 0.8375 | Random State: 83  
Test Score: 0.8625 | Train Score: 0.8531 | Random State: 84  
Test Score: 0.8625 | Train Score: 0.8406 | Random State: 85  
Test Score: 0.8625 | Train Score: 0.8406 | Random State: 87  
Test Score: 0.8750 | Train Score: 0.8469 | Random State: 88  
Test Score: 0.9125 | Train Score: 0.8375 | Random State: 90  
Test Score: 0.8625 | Train Score: 0.8500 | Random State: 95  
Test Score: 0.8750 | Train Score: 0.8500 | Random State: 99  
Test Score: 0.8500 | Train Score: 0.8406 | Random State: 101  
Test Score: 0.8500 | Train Score: 0.8406 | Random State: 102  
Test Score: 0.9000 | Train Score: 0.8250 | Random State: 106  
Test Score: 0.8625 | Train Score: 0.8406 | Random State: 107  
Test Score: 0.8500 | Train Score: 0.8344 | Random State: 109  
Test Score: 0.8500 | Train Score: 0.8406 | Random State: 111  
Test Score: 0.9125 | Train Score: 0.8406 | Random State: 112  
Test Score: 0.8625 | Train Score: 0.8500 | Random State: 115  
Test Score: 0.8625 | Train Score: 0.8406 | Random State: 116  
Test Score: 0.8750 | Train Score: 0.8344 | Random State: 119  
Test Score: 0.9125 | Train Score: 0.8281 | Random State: 120  
Test Score: 0.8625 | Train Score: 0.8594 | Random State: 125  
Test Score: 0.8500 | Train Score: 0.8469 | Random State: 128  
Test Score: 0.8750 | Train Score: 0.8500 | Random State: 130  
Test Score: 0.9000 | Train Score: 0.8438 | Random State: 133  
Test Score: 0.9250 | Train Score: 0.8344 | Random State: 134  
Test Score: 0.8625 | Train Score: 0.8500 | Random State: 135  
Test Score: 0.8750 | Train Score: 0.8313 | Random State: 138  
Test Score: 0.8625 | Train Score: 0.8500 | Random State: 141  
Test Score: 0.8500 | Train Score: 0.8469 | Random State: 143  
Test Score: 0.8500 | Train Score: 0.8469 | Random State: 146  
Test Score: 0.8500 | Train Score: 0.8438 | Random State: 147  
Test Score: 0.8625 | Train Score: 0.8500 | Random State: 148  
Test Score: 0.8750 | Train Score: 0.8375 | Random State: 150  
Test Score: 0.8875 | Train Score: 0.8313 | Random State: 151  
Test Score: 0.9250 | Train Score: 0.8438 | Random State: 152  
Test Score: 0.8500 | Train Score: 0.8406 | Random State: 153  
Test Score: 0.9000 | Train Score: 0.8438 | Random State: 154  
Test Score: 0.9000 | Train Score: 0.8406 | Random State: 155  
Test Score: 0.8875 | Train Score: 0.8469 | Random State: 156  
Test Score: 0.8875 | Train Score: 0.8344 | Random State: 158  
Test Score: 0.8750 | Train Score: 0.8281 | Random State: 159  
Test Score: 0.9000 | Train Score: 0.8313 | Random State: 161  
Test Score: 0.8500 | Train Score: 0.8375 | Random State: 163

Test Score: 0.8750 | Train Score: 0.8313 | Random State: 164  
Test Score: 0.8625 | Train Score: 0.8500 | Random State: 169  
Test Score: 0.8750 | Train Score: 0.8406 | Random State: 171  
Test Score: 0.8500 | Train Score: 0.8406 | Random State: 172  
Test Score: 0.9000 | Train Score: 0.8250 | Random State: 180  
Test Score: 0.8500 | Train Score: 0.8344 | Random State: 184  
Test Score: 0.9250 | Train Score: 0.8219 | Random State: 186  
Test Score: 0.9000 | Train Score: 0.8313 | Random State: 193  
Test Score: 0.8625 | Train Score: 0.8500 | Random State: 195  
Test Score: 0.8625 | Train Score: 0.8406 | Random State: 196  
Test Score: 0.8625 | Train Score: 0.8375 | Random State: 197  
Test Score: 0.8750 | Train Score: 0.8406 | Random State: 198  
Test Score: 0.8875 | Train Score: 0.8375 | Random State: 199  
Test Score: 0.8875 | Train Score: 0.8438 | Random State: 200  
Test Score: 0.8625 | Train Score: 0.8375 | Random State: 202  
Test Score: 0.8625 | Train Score: 0.8406 | Random State: 203  
Test Score: 0.8875 | Train Score: 0.8313 | Random State: 206  
Test Score: 0.8625 | Train Score: 0.8344 | Random State: 211  
Test Score: 0.8500 | Train Score: 0.8438 | Random State: 212  
Test Score: 0.8625 | Train Score: 0.8344 | Random State: 214  
Test Score: 0.8750 | Train Score: 0.8313 | Random State: 217  
Test Score: 0.9625 | Train Score: 0.8187 | Random State: 220  
Test Score: 0.8750 | Train Score: 0.8438 | Random State: 221  
Test Score: 0.8500 | Train Score: 0.8406 | Random State: 222  
Test Score: 0.9000 | Train Score: 0.8438 | Random State: 223  
Test Score: 0.8625 | Train Score: 0.8531 | Random State: 227  
Test Score: 0.8625 | Train Score: 0.8344 | Random State: 228  
Test Score: 0.9000 | Train Score: 0.8406 | Random State: 229  
Test Score: 0.8500 | Train Score: 0.8438 | Random State: 232  
Test Score: 0.8750 | Train Score: 0.8469 | Random State: 233  
Test Score: 0.9125 | Train Score: 0.8406 | Random State: 234  
Test Score: 0.8625 | Train Score: 0.8406 | Random State: 235  
Test Score: 0.8500 | Train Score: 0.8469 | Random State: 236  
Test Score: 0.8750 | Train Score: 0.8469 | Random State: 239  
Test Score: 0.8500 | Train Score: 0.8438 | Random State: 241  
Test Score: 0.8875 | Train Score: 0.8500 | Random State: 242  
Test Score: 0.8875 | Train Score: 0.8250 | Random State: 243  
Test Score: 0.8750 | Train Score: 0.8469 | Random State: 244  
Test Score: 0.8750 | Train Score: 0.8406 | Random State: 245  
Test Score: 0.8750 | Train Score: 0.8469 | Random State: 246  
Test Score: 0.8625 | Train Score: 0.8594 | Random State: 247  
Test Score: 0.8875 | Train Score: 0.8438 | Random State: 248  
Test Score: 0.8625 | Train Score: 0.8500 | Random State: 250  
Test Score: 0.8750 | Train Score: 0.8313 | Random State: 251  
Test Score: 0.8875 | Train Score: 0.8438 | Random State: 252  
Test Score: 0.8625 | Train Score: 0.8469 | Random State: 255  
Test Score: 0.9000 | Train Score: 0.8406 | Random State: 257  
Test Score: 0.8625 | Train Score: 0.8562 | Random State: 260

Test Score: 0.8625 | Train Score: 0.8406 | Random State: 266  
Test Score: 0.8625 | Train Score: 0.8375 | Random State: 268  
Test Score: 0.8750 | Train Score: 0.8406 | Random State: 275  
Test Score: 0.8625 | Train Score: 0.8500 | Random State: 276  
Test Score: 0.9250 | Train Score: 0.8375 | Random State: 277  
Test Score: 0.8750 | Train Score: 0.8469 | Random State: 282  
Test Score: 0.8500 | Train Score: 0.8469 | Random State: 283  
Test Score: 0.8500 | Train Score: 0.8438 | Random State: 285  
Test Score: 0.9125 | Train Score: 0.8344 | Random State: 286  
Test Score: 0.8500 | Train Score: 0.8406 | Random State: 290  
Test Score: 0.8500 | Train Score: 0.8406 | Random State: 291  
Test Score: 0.8500 | Train Score: 0.8469 | Random State: 292  
Test Score: 0.8625 | Train Score: 0.8375 | Random State: 294  
Test Score: 0.8875 | Train Score: 0.8281 | Random State: 297  
Test Score: 0.8625 | Train Score: 0.8344 | Random State: 300  
Test Score: 0.8625 | Train Score: 0.8500 | Random State: 301  
Test Score: 0.8875 | Train Score: 0.8500 | Random State: 302  
Test Score: 0.8750 | Train Score: 0.8469 | Random State: 303  
Test Score: 0.8625 | Train Score: 0.8344 | Random State: 305  
Test Score: 0.9125 | Train Score: 0.8375 | Random State: 306  
Test Score: 0.8750 | Train Score: 0.8469 | Random State: 308  
Test Score: 0.9000 | Train Score: 0.8438 | Random State: 311  
Test Score: 0.8625 | Train Score: 0.8344 | Random State: 313  
Test Score: 0.9125 | Train Score: 0.8344 | Random State: 314  
Test Score: 0.8750 | Train Score: 0.8375 | Random State: 315  
Test Score: 0.9000 | Train Score: 0.8469 | Random State: 317  
Test Score: 0.9125 | Train Score: 0.8219 | Random State: 319  
Test Score: 0.8625 | Train Score: 0.8500 | Random State: 321  
Test Score: 0.9125 | Train Score: 0.8281 | Random State: 322  
Test Score: 0.8500 | Train Score: 0.8469 | Random State: 328  
Test Score: 0.8500 | Train Score: 0.8375 | Random State: 332  
Test Score: 0.8875 | Train Score: 0.8531 | Random State: 336  
Test Score: 0.8500 | Train Score: 0.8375 | Random State: 337  
Test Score: 0.8750 | Train Score: 0.8406 | Random State: 343  
Test Score: 0.8625 | Train Score: 0.8438 | Random State: 346  
Test Score: 0.8875 | Train Score: 0.8313 | Random State: 351  
Test Score: 0.8625 | Train Score: 0.8500 | Random State: 352  
Test Score: 0.9500 | Train Score: 0.8187 | Random State: 354  
Test Score: 0.8625 | Train Score: 0.8500 | Random State: 356  
Test Score: 0.9125 | Train Score: 0.8406 | Random State: 357  
Test Score: 0.8625 | Train Score: 0.8375 | Random State: 358  
Test Score: 0.8500 | Train Score: 0.8406 | Random State: 362  
Test Score: 0.9000 | Train Score: 0.8438 | Random State: 363  
Test Score: 0.8625 | Train Score: 0.8531 | Random State: 364  
Test Score: 0.9375 | Train Score: 0.8219 | Random State: 366  
Test Score: 0.9125 | Train Score: 0.8406 | Random State: 369  
Test Score: 0.8625 | Train Score: 0.8531 | Random State: 371  
Test Score: 0.9250 | Train Score: 0.8344 | Random State: 376

```

Test Score: 0.9125 | Train Score: 0.8281 | Random State: 377
Test Score: 0.8875 | Train Score: 0.8500 | Random State: 378
Test Score: 0.8875 | Train Score: 0.8500 | Random State: 379
Test Score: 0.8625 | Train Score: 0.8406 | Random State: 382
Test Score: 0.8625 | Train Score: 0.8594 | Random State: 386
Test Score: 0.8500 | Train Score: 0.8375 | Random State: 387
Test Score: 0.8750 | Train Score: 0.8281 | Random State: 388
Test Score: 0.8500 | Train Score: 0.8438 | Random State: 394
Test Score: 0.8625 | Train Score: 0.8375 | Random State: 395
Test Score: 0.9000 | Train Score: 0.8438 | Random State: 397
Test Score: 0.8625 | Train Score: 0.8438 | Random State: 400

```

[168]: '\n\n\n'

```

[169]: x_train,x_test,y_train,y_test=train_test_split(features,label,test_size=0.
      ↪2,random_state=209)
      finalModel=LogisticRegression()
      finalModel.fit(x_train,y_train)

```

[169]: LogisticRegression()

```

[170]: print(finalModel.score(x_train,y_train))
      print(finalModel.score(x_train,y_train))

```

0.85

0.85

```

[171]: from sklearn.metrics import classification_report
      print(classification_report(label,finalModel.predict(features)))

```

	precision	recall	f1-score	support
0	0.86	0.91	0.89	257
1	0.83	0.73	0.77	143
accuracy			0.85	400
macro avg	0.84	0.82	0.83	400
weighted avg	0.85	0.85	0.85	400