230701521
JABARAJ E
“A”

1.MATPLOT SEABORN

In [16]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import warnings
warnings.filterwarnings('ignore')
```

In [2]:
```
data=pd.read_csv('Iris.csv')
data
```

Out[2]:

	sepal.length	sepal.width	petal.length	petal.width	variety
0	5.1	3.5	1.4	0.2	Setosa
1	4.9	3.0	1.4	0.2	Setosa
2	4.7	3.2	1.3	0.2	Setosa
3	4.6	3.1	1.5	0.2	Setosa
4	5.0	3.6	1.4	0.2	Setosa
...	...	...	...	...	...
145	6.7	3.0	5.2	2.3	Virginica
146	6.3	2.5	5.0	1.9	Virginica
147	6.5	3.0	5.2	2.0	Virginica
148	6.2	3.4	5.4	2.3	Virginica
149	5.9	3.0	5.1	1.8	Virginica

150 rows × 5 columns

In [3]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150 entries, 0 to 149
Data columns (total 5 columns):
 #   Column        Non-Null Count  Dtype
---  ------        --------------  -----
 0   sepal.length  150 non-null    float64
 1   sepal.width   150 non-null    float64
 2   petal.length  150 non-null    float64
 3   petal.width   150 non-null    float64
 4   variety       150 non-null    object
dtypes: float64(4), object(1)
memory usage: 6.0+ KB
```

In [4]:
```
data.describe()
```

Out[4]:

	sepal.length	sepal.width	petal.length	petal.width
count	150.000000	150.000000	150.000000	150.000000
mean	5.843333	3.057333	3.758000	1.199333
std	0.828066	0.435866	1.765298	0.762238
min	4.300000	2.000000	1.000000	0.100000
25%	5.100000	2.800000	1.600000	0.300000
50%	5.800000	3.000000	4.350000	1.300000
75%	6.400000	3.300000	5.100000	1.800000
max	7.900000	4.400000	6.900000	2.500000

In [5]:
```
data.value_counts('variety')
```

Out[5]:
```
variety
Setosa        50
Versicolor    50
Virginica     50
Name: count, dtype: int64
```

In [6]:
```
sns.countplot(x='variety',data=data,)
plt.show()
```

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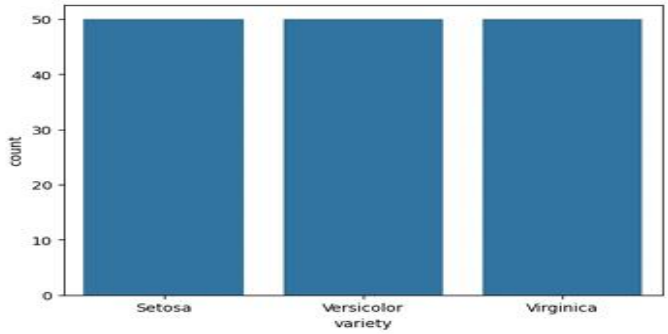


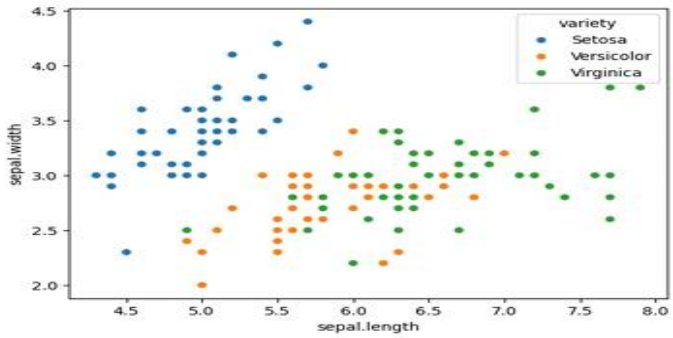
In [7]:
```
dummies=pd.get_dummies(data.variety)
FinalDataset=pd.concat([pd.get_dummies(data.variety),data.iloc[:,[0,1,2,3]]],axis=1)
FinalDataset.head()
```

Out[7]:

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

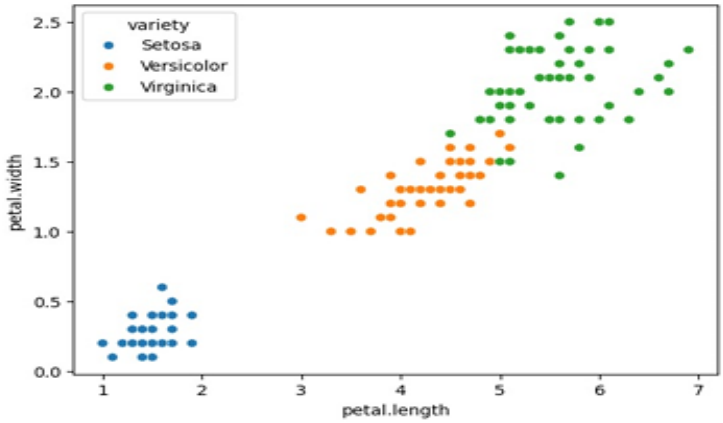
In [8]:
```
sns.scatterplot(x='sepal.length',y='sepal.width',hue='variety',data=data,)
```

Out[8]:
```
<Axes: xlabel='sepal.length', ylabel='sepal.width'>
```



In [9]:
```
sns.scatterplot(x='petal.length',y='petal.width',hue='variety',data=data,)
```

Out[9]:
```
<Axes: xlabel='petal.length', ylabel='petal.width'>
```



In [10]:
```
sns.pairplot(data,hue='variety',height=3);
```

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2. NUMPY BUILT IN FUNCTION

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Code JupyterLab Python 3 (ipykernel)

```
[9]: newm

[9]: array([[39, 65,  7],
            [84, 27, 80],
            [18,  2, 78]])

[10]: newm[2,1:3]

[10]: array([ 2, 78])

[11]: newm[1:2,1:3]

[11]: array([[27, 80]])

[12]: new_array[0:3,0:0]

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

[13]: new_array[0:2,0:1]

[13]: array([[39],
             [84]])

[14]: new_array[0:3,0:1]

[14]: array([[39],
             [84],
             [18]])

[15]: new_array[1:3]

[15]: array([[84, 27, 80],
             [18,  2, 78]])
```

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Code JupyterLab Python 3 (ipykernel)

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

[1]: array([39, 65,  7, 84, 27, 80, 18,  2, 78])

[2]: np.sqrt(array)

[2]: array([6.244998  , 8.06225775, 2.64575131, 9.16515139, 5.19615242,
            8.94427191, 4.24264069, 1.41421356, 8.83176087])

[3]: array.ndim

[3]: 1

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

[5]: new_array

[5]: array([[39, 65,  7],
            [84, 27, 80],
            [18,  2, 78]])

[6]: new_array.ndim

[6]: 2

[7]: new_array.ravel()

[7]: array([39, 65,  7, 84, 27, 80, 18,  2, 78])

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

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3.PANDAS

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Code JupyterLab Python 3 (ipykernel)

[10]:
```
import numpy as np
import pandas as pd
list=[[1,'Smith',50000],[2,'Jones',60000]]
import warnings
warnings.filterwarnings('ignore')
```

[2]:
```
df=pd.DataFrame(list)
df
```

[2]:

	0	1	2
0	1	Smith	50000
1	2	Jones	60000

[3]:
```
df.columns=['Empd','Name','Salary']
df
```

[3]:

	Empd	Name	Salary
0	1	Smith	50000
1	2	Jones	60000

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

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2 entries, 0 to 1
Data columns (total 3 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   Empd    2 non-null      int64
 1   Name    2 non-null      object
 2   Salary  2 non-null      int64
```

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Code JupyterLab Python 3 (ipykernel)

[5]:
```
df=pd.read_csv('50_Startups.csv')
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 50 entries, 0 to 49
Data columns (total 5 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   R&D Spend        50 non-null     float64
 1   Administration   50 non-null     float64
 2   Marketing Spend  50 non-null     float64
 3   State            50 non-null     object
 4   Profit           50 non-null     float64
dtypes: float64(4), object(1)
memory usage: 2.1+ KB
```

[6]:
```
df.head(5)
```

[6]:

	R&D Spend	Administration	Marketing Spend	State	Profit
0	165349.20	136897.80	471784.10	New York	192261.83
1	162597.70	151377.59	443898.53	California	191792.06
2	153441.51	101145.55	407934.54	Florida	191050.39
3	144372.41	118671.85	383199.62	New York	182901.99
4	142107.34	91391.77	366168.42	Florida	166187.94

[7]:
```
df.tail(5)
```

[7]:

	R&D Spend	Administration	Marketing Spend	State	Profit
45	1000.23	124153.04	1903.93	New York	64926.08
46	1315.46	115816.21	297114.46	Florida	49490.75

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4.OUTLIER DETECTION

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Code JupyterLab Python 3 (ipykernel)

[1]:
```
import numpy as np
array=np.random.randint(1,100,16) # randomly generate 16 numbers between 1 to 100
array
```

[1]:
```
array([74, 55, 49, 22, 93, 39, 39, 23, 62, 33, 48,  7, 76,  7, 30, 38])
```

[2]:
```
array.mean()
```

[2]:
```
43.4375
```

[3]:
```
np.percentile(array,25)
```

[3]:
```
28.25
```

[4]:
```
np.percentile(array,50)
```

[4]:
```
39.0
```

[5]:
```
np.percentile(array,75)
```

[5]:
```
56.75
```

[6]:
```
np.percentile(array,100)
```

[6]:
```
93.0
```

[7]:
```
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)
```

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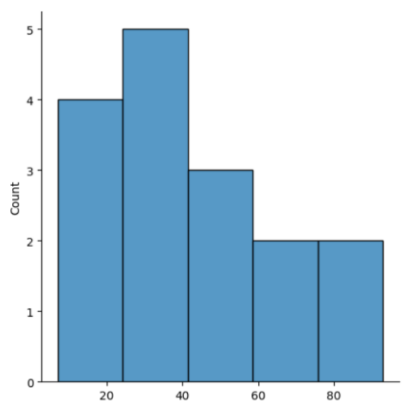
Code JupyterLab Python 3 (ipykernel)

[8]:
```
(-14.5, 99.5)
```

[9]:
```
import seaborn as sns
%matplotlib inline
sns.displot(array)
```

[9]:
```
<seaborn.axisgrid.FacetGrid at 0x23692df7520>
```



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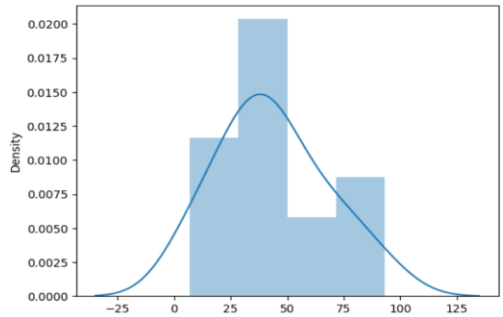
Code

JupyterLab Python 3 (ipykernel)

[10]: <Axes: ylabel='Density'>



[11]:
```
new_array=array[(array>lr) & (array<ur)]
new_array
```

[11]: array([74, 55, 49, 22, 93, 39, 39, 23, 62, 33, 48, 7, 76, 7, 30, 38])

[12]:
```
lr1,ur1=outDetection(new_array)
lr1,ur1
```

[12]: (-14.5, 99.5)

[11]:
```
new_array=array[(array>lr) & (array<ur)]
new_array
```

[11]: array([74, 55, 49, 22, 93, 39, 39, 23, 62, 33, 48, 7, 76, 7, 30, 38])

[12]:
```
lr1,ur1=outDetection(new_array)
lr1,ur1
```

[12]: (-14.5, 99.5)

[13]:
```
final_array=new_array[(new_array>lr1) & (new_array<ur1)]
final_array
```

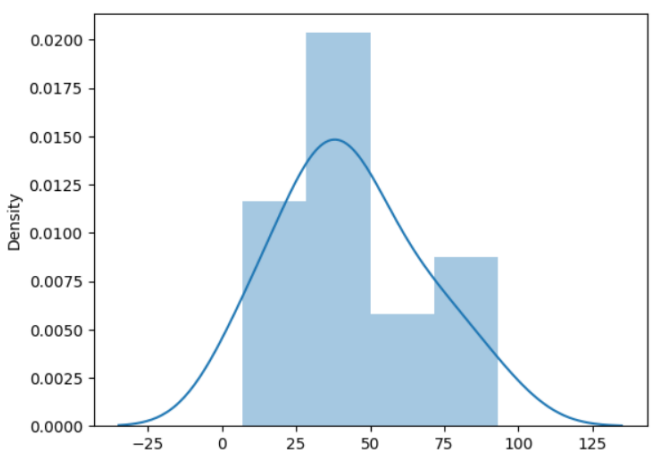
[13]: array([74, 55, 49, 22, 93, 39, 39, 23, 62, 33, 48, 7, 76, 7, 30, 38])

[14]:
```
sns.distplot(final_array)
```

```
C:\Users\selva\AppData\Local\Temp\ipykernel_35820\209491988.py:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(final_array)
```

[14]: <Axes: ylabel='Density'>

[14]: <Axes: ylabel='Density'>



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5.MISSING AND INAPPROPRIATE DATA

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Code

JupyterLab Python 3 (ipykernel)

[16]:
```python
import numpy as np
import pandas as pd
import warnings
warnings.filterwarnings('ignore')
df=pd.read_csv("Hotel_Dataset.csv")
df
```

[16]:

	CustomerID	Age_Group	Rating(1-5)	Hotel	FoodPreference	Bill	NoOfPax	EstimatedSalary	Age_Group.1
0	1	20-25	4	Ibis	veg	1300	2	40000	20-25
1	2	30-35	5	LemonTree	Non-Veg	2000	3	59000	30-35
2	3	25-30	6	RedFox	Veg	1322	2	30000	25-30
3	4	20-25	-1	LemonTree	Veg	1234	2	120000	20-25
4	5	35+	3	Ibis	Vegetarian	989	2	45000	35+
5	6	35+	3	Ibys	Non-Veg	1909	2	122220	35+
6	7	35+	4	RedFox	Vegetarian	1000	-1	21122	35+
7	8	20-25	7	LemonTree	Veg	2999	-10	345673	20-25
8	9	25-30	2	Ibis	Non-Veg	3456	3	-99999	25-30
9	9	25-30	2	Ibis	Non-Veg	3456	3	-99999	25-30
10	10	30-35	5	RedFox	non-Veg	-6755	4	87777	30-35

[2]:
```python
df.duplicated()
```

[2]:
```
0    False
1    False
2    False
```

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Code

JupyterLab Python 3 (ipykernel)

[3]:
```
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: 920.0+ bytes
```

[4]:
```
df.drop_duplicates(inplace=True)
df
```

[4]:

	CustomerID	Age_Group	Rating(1-5)	Hotel	FoodPreference	Bill	NoOfPax	EstimatedSalary	Age_Group.1
0	1	20-25	4	Ibis	veg	1300	2	40000	20-25
1	2	30-35	5	LemonTree	Non-Veg	2000	3	59000	30-35
2	3	25-30	6	RedFox	Veg	1322	2	30000	25-30
3	4	20-25	-1	LemonTree	Veg	1234	2	120000	20-25
4	5	35+	3	Ibis	Vegetarian	989	2	45000	35+
5	6	35+	3	Ibys	Non-Veg	1909	2	122220	35+
6	7	35+	4	RedFox	Vegetarian	1000	-1	21122	35+

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Code

JupyterLab Python 3 (ipykernel)

[14]:
```
df.FoodPreference.replace(['Vegetarian','veg'],'Veg',inplace=True)
df.FoodPreference.replace(['non-Veg'],'Non-Veg',inplace=True)
```

[15]:
```
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
```

```
C:\Users\selva\AppData\Local\Temp\ipykernel_27116\3711388855.py:3: FutureWarning: A value is trying to be set on a copy of a DataFrame or Series through
chained assignment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which we are setting values always behaves
as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or df[col] = df[col].method(value) inste
ad, to perform the operation inplace on the original object.


  df['Rating(1-5)'].fillna(round(df['Rating(1-5)'].median()), inplace=True)
```

[15]:

	CustomerID	Age_Group	Rating(1-5)	Hotel	FoodPreference	Bill	NoOfPax	EstimatedSalary
0	1.0	20-25	4	Ibis	Veg	1300.0	2.0	40000.0
1	2.0	30-35	5	LemonTree	Non-Veg	2000.0	3.0	59000.0
2	3.0	25-30	6	RedFox	Veg	1322.0	2.0	30000.0
3	4.0	20-25	-1	LemonTree	Veg	1234.0	2.0	120000.0
4	5.0	35+	3	Ibis	Veg	989.0	2.0	45000.0
5	6.0	35+	3	Ibis	Non-Veg	1909.0	2.0	122220.0
6	7.0	35+	4	RedFox	Veg	1000.0	2.0	21122.0
7	8.0	20-25	7	LemonTree	Veg	2999.0	2.0	345673.0

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Code

JupyterLab Python 3 (ipykernel)

[14]:
```
df.FoodPreference.replace(['Vegetarian','veg'],'Veg',inplace=True)
df.FoodPreference.replace(['non-Veg'],'Non-Veg',inplace=True)
```

[15]:
```
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
```

```
C:\Users\selva\AppData\Local\Temp\ipykernel_27116\3711388855.py:3: FutureWarning: A value is trying to be set on a copy of a DataFrame or Series through
chained assignment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which we are setting values always behaves
as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or df[col] = df[col].method(value) inste
ad, to perform the operation inplace on the original object.


  df['Rating(1-5)'].fillna(round(df['Rating(1-5)'].median()), inplace=True)
```

[15]:

	CustomerID	Age_Group	Rating(1-5)	Hotel	FoodPreference	Bill	NoOfPax	EstimatedSalary
0	1.0	20-25	4	Ibis	Veg	1300.0	2.0	40000.0
1	2.0	30-35	5	LemonTree	Non-Veg	2000.0	3.0	59000.0
2	3.0	25-30	6	RedFox	Veg	1322.0	2.0	30000.0
3	4.0	20-25	-1	LemonTree	Veg	1234.0	2.0	120000.0
4	5.0	35+	3	Ibis	Veg	989.0	2.0	45000.0
5	6.0	35+	3	Ibis	Non-Veg	1909.0	2.0	122220.0
6	7.0	35+	4	RedFox	Veg	1000.0	2.0	21122.0
7	8.0	20-25	7	LemonTree	Veg	2999.0	2.0	345673.0

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Code

JupyterLab Python 3 (ipykernel)

```
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  df['NoOfPax'].loc[(df['NoOfPax']<1) | (df['NoOfPax']>20)]=np.nan
```

[10]:

	CustomerID	Age_Group	Rating(1-5)	Hotel	FoodPreference	Bill	NoOfPax	EstimatedSalary
0	1.0	20-25	4	Ibis	veg	1300.0	2.0	40000.0
1	2.0	30-35	5	LemonTree	Non-Veg	2000.0	3.0	59000.0
2	3.0	25-30	6	RedFox	Veg	1322.0	2.0	30000.0
3	4.0	20-25	-1	LemonTree	Veg	1234.0	2.0	120000.0
4	5.0	35+	3	Ibis	Vegetarian	989.0	2.0	45000.0
5	6.0	35+	3	Ibys	Non-Veg	1909.0	2.0	122220.0
6	7.0	35+	4	RedFox	Vegetarian	1000.0	NaN	21122.0
7	8.0	20-25	7	LemonTree	Veg	2999.0	NaN	345673.0
8	9.0	25-30	2	Ibis	Non-Veg	3456.0	3.0	NaN
9	10.0	30-35	5	RedFox	non-Veg	NaN	4.0	87777.0

[11]:
```
df.Age_Group.unique()
```

[11]:
```
array(['20-25', '30-35', '25-30', '35+'], dtype=object)
```

[12]:
```
df.Hotel.unique()
```

[12]:
```
array(['Ibis', 'LemonTree', 'RedFox', 'Ibys'], dtype=object)
```

[13]:
```
df.Hotel.replace(['Ibys'],'Ibis',inplace=True)
df.FoodPreference.unique
```

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Code JupyterLab Python 3 (ipykernel)

```
C:\Users\selva\AppData\Local\Temp\ipykernel_27116\2080958306.py:3: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  df.EstimatedSalary.loc[df.EstimatedSalary<0]=np.nan
```

[9]:

	CustomerID	Age_Group	Rating(1-5)	Hotel	FoodPreference	Bill	NoOfPax	EstimatedSalary
0	1.0	20-25	4	Ibis	veg	1300.0	2	40000.0
1	2.0	30-35	5	LemonTree	Non-Veg	2000.0	3	59000.0
2	3.0	25-30	6	RedFox	Veg	1322.0	2	30000.0
3	4.0	20-25	-1	LemonTree	Veg	1234.0	2	120000.0
4	5.0	35+	3	Ibis	Vegetarian	989.0	2	45000.0
5	6.0	35+	3	Ibys	Non-Veg	1909.0	2	122220.0
6	7.0	35+	4	RedFox	Vegetarian	1000.0	-1	21122.0
7	8.0	20-25	7	LemonTree	Veg	2999.0	-10	345673.0
8	9.0	25-30	2	Ibis	Non-Veg	3456.0	3	NaN
9	10.0	30-35	5	RedFox	non-Veg	NaN	4	87777.0

[10]:

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

```
C:\Users\selva\AppData\Local\Temp\ipykernel_27116\2129877948.py:1: FutureWarning: ChainedAssignmentError: behaviour will change in pandas 3.0!
You are setting values through chained assignment. Currently this works in certain cases, but when using Copy-on-Write (which will become the default beh
aviour in pandas 3.0) this will never work to update the original DataFrame or Series, because the intermediate object on which we are setting values wil
l behave as a copy.
A typical example is when you are setting values in a column of a DataFrame, like:
```

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Code

JupyterLab Python 3 (ipykernel)

[5]:
```
df.drop_duplicates(inplace=True)
df
```

[5]:

	CustomerID	Age_Group	Rating(1-5)	Hotel	FoodPreference	Bill	NoOfPax	EstimatedSalary	Age_Group.1
0	1	20-25	4	Ibis	veg	1300	2	40000	20-25
1	2	30-35	5	LemonTree	Non-Veg	2000	3	59000	30-35
2	3	25-30	6	RedFox	Veg	1322	2	30000	25-30
3	4	20-25	-1	LemonTree	Veg	1234	2	120000	20-25
4	5	35+	3	Ibis	Vegetarian	989	2	45000	35+
5	6	35+	3	Ibys	Non-Veg	1909	2	122220	35+
6	7	35+	4	RedFox	Vegetarian	1000	-1	21122	35+
7	8	20-25	7	LemonTree	Veg	2999	-10	345673	20-25
8	9	25-30	2	Ibis	Non-Veg	3456	3	-99999	25-30
10	10	30-35	5	RedFox	non-Veg	-6755	4	87777	30-35

[6]:
```
index=np.array(list(range(0,len(df))))
df.set_index(index,inplace=True)
index
```

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

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Code

JupyterLab Python 3 (ipykernel)

[7]:

	CustomerID	Age_Group	Rating(1-5)	Hotel	FoodPreference	Bill	NoOfPax	EstimatedSalary	Age_Group.1
0	1	20-25	4	Ibis	veg	1300	2	40000	20-25
1	2	30-35	5	LemonTree	Non-Veg	2000	3	59000	30-35
2	3	25-30	6	RedFox	Veg	1322	2	30000	25-30
3	4	20-25	-1	LemonTree	Veg	1234	2	120000	20-25
4	5	35+	3	Ibis	Vegetarian	989	2	45000	35+
5	6	35+	3	Ibys	Non-Veg	1909	2	122220	35+
6	7	35+	4	RedFox	Vegetarian	1000	-1	21122	35+
7	8	20-25	7	LemonTree	Veg	2999	-10	345673	20-25
8	9	25-30	2	Ibis	Non-Veg	3456	3	-99999	25-30
9	10	30-35	5	RedFox	non-Veg	-6755	4	87777	30-35

[8]:
```
df.drop(['Age_Group.1'],axis=1,inplace=True)
df
```

[8]:

	CustomerID	Age_Group	Rating(1-5)	Hotel	FoodPreference	Bill	NoOfPax	EstimatedSalary
0	1	20-25	4	Ibis	veg	1300	2	40000
1	2	30-35	5	LemonTree	Non-Veg	2000	3	59000
2	3	25-30	6	RedFox	Veg	1322	2	30000
3	4	20-25	-1	LemonTree	Veg	1234	2	120000
4	5	35+	3	Ibis	Vegetarian	989	2	45000

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6. RANDOM SAMPLING AND DISTRIBUTION

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Code JupyterLab Python 3 (ipykernel)

[1]:
```
import numpy as np
import matplotlib.pyplot as plt
```

[2]:
```
population_mean = 50
population_std = 10
population_size = 100000
population = np.random.normal(population_mean, population_std, population_size)
```

[3]:
```
sample_sizes = [30, 50, 100]
num_samples = 1000
```

[4]:
```
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))
```

[5]:
```
plt.figure(figsize=(12, 8))
```

[5]:
```
<Figure size 1200x800 with 0 Axes>
<Figure size 1200x800 with 0 Axes>
```

[6]:
```
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()
```

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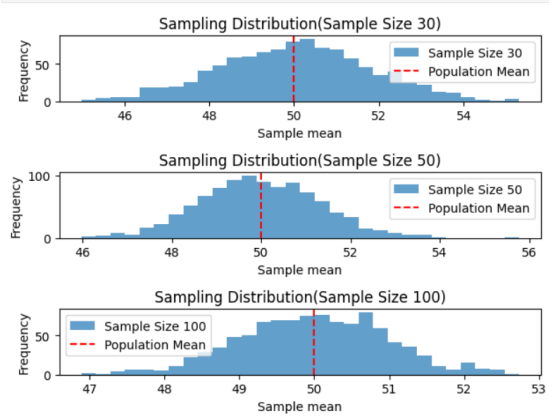
Code JupyterLab Python 3 (ipykernel)

```
    plt.legend()
plt.tight_layout()
plt.show()
```



[ ]:

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7. Z TEST

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Code JupyterLab Python 3 (ipykernel)

[1]:
```
import numpy as np
import scipy.stats as stats
```

[2]:
```
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])
```

[3]:
```
population_mean = 150
sample_mean = np.mean(sample_data)
sample_std = np.std(sample_data, ddof=1)
```

[4]:
```
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)))
```

[5]:
```
print(f"Sample Mean: {sample_mean:.2f}\n")
print(f"Z-Statistic: {z_statistic:.4f}\n")
print(f"P-Value: {p_value:.4f}\n")
```

```
Sample Mean: 150.20

Z-Statistic: 0.6406

P-Value: 0.5218
```

[6]:
```
alpha = 0.05
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.")
```

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

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8. T- TEST

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Code JupyterLab Python 3 (ipykernel)

[1]:
```
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)
```

[2]:
```
population_mean = 100
sample_mean = np.mean(sample_data)
sample_std = np.std(sample_data, ddof=1)
```

[3]:
```
n = len(sample_data)
t_statistic, p_value = stats.ttest_1samp(sample_data,population_mean)
```

[5]:
```
print(f"Sample Mean: {sample_mean:.2f}\n")
print(f"T-Statistic: {t_statistic:.4f}\n")
print(f"P-Value: {p_value:.4f}\n")
alpha = 0.05
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.
```

[ ]:

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9.ANNOVA TEST

```python
import numpy as np
import scipy.stats as stats
from statsmodels.stats.multicomp import pairwise_tukeyhsd

np.random.seed(42)
n_plants = 25
```

[124]

```python
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)
```

[125]

```python
all_data = np.concatenate([growth_A, growth_B, growth_C])
```

[126]

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

[127]

```python
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}")
```

[128]

```python
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)
```

[128]

```
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
-----------------------------------------------------
```

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10. DATA PRE PROCESSING

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Code

JupyterLab Python 3 (ipykernel)

[1]:
```
import numpy as np
import pandas as pd
import warnings
warnings.filterwarnings('ignore')
df=pd.read_csv('pre_process_datasample.csv')
```

```
C:\Users\selva\AppData\Local\Temp\ipykernel_15992\2818045197.py:2: DeprecationWarning:
Pyarrow will become a required dependency of pandas in the next major release of pandas (pandas 3.0),
(to allow more performant data types, such as the Arrow string type, and better interoperability with other libraries)
but was not found to be installed on your system.
If this would cause problems for you,
please provide us feedback at https://github.com/pandas-dev/pandas/issues/54466

  import pandas as pd
```

[2]:
```
df.head()
```

[2]:

	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

[3]:
```
df.Country.fillna(df.Country.mode()[0],inplace=True)
features=df.iloc[:,:-1].values
features
```

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Code

JupyterLab Python 3 (ipykernel)

[7]:
```
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)
```

[8]:
```
from sklearn.preprocessing import OneHotEncoder
oh = OneHotEncoder(sparse_output=False)
Country=oh.fit_transform(features[:,[0]])
Country
```

[8]:
```
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.]])
```

[9]:
```
final_set=np.concatenate((Country,features[:,[1,2]]),axis=1)
final_set
```

[9]:
```
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],
```

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Code JupyterLab Python 3 (ipykernel)

[3]:
```
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)
```

[4]:
```
label=df.iloc[:,-1].values
```

[5]:
```
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]])
```

[5]:
```
SimpleImputer
SimpleImputer()
```

[6]:
```
Salary.fit(features[:,[2]])
```

[6]:
```
SimpleImputer
SimpleImputer()
```

[7]:
```
features[:,[1]]=age.transform(features[:,[1]])
features[:,[2]]=Salary.transform(features[:,[2]])
features
```

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Code JupyterLab Python 3 (ipykernel)

```
       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]])
```

[12]:
```
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
```

[12]:
```
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]])
```

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11. LINEAR REGRESSION

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Code

JupyterLab Python 3 (ipykernel)

[1]:
```
import numpy as np
import pandas as pd
df = pd.read_csv('Salary_data.csv')
df
```

```
C:\Users\selva\AppData\Local\Temp\ipykernel_35980\978986724.py:2: DeprecationWarning:
Pyarrow will become a required dependency of pandas in the next major release of pandas (pandas 3.0),
(to allow more performant data types, such as the Arrow string type, and better interoperability with other libraries)
but was not found to be installed on your system.
If this would cause problems for you,
please provide us feedback at https://github.com/pandas-dev/pandas/issues/54466

  import pandas as pd
```

[1]:

	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

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Code

JupyterLab Python 3 (ipykernel)

[4]:
```
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: 608.0 bytes
```

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

[5]:

	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

[6]:
```
features = df.iloc[:,[0]].values
label = df.iloc[:,[1]].values
features
```

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Code JupyterLab Python 3 (ipykernel)

[2]:
```
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: 608.0 bytes
```

[3]:
```
df.dropna(inplace=True);
df
```

[3]:

	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

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Code JupyterLab Python 3 (ipykernel)

```
       [ 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],
```

[7]:
```
label
```

[7]:
```
array([[ 39343],
       [ 46205],
       [ 37731],
       [ 43525],
       [ 39891],
       [ 56642],
       [ 60150],
       [ 54445],
       [ 64445],
       [ 57189],
       [ 63218],
       [ 55794],
       [ 56957],
       [ 57081],
       [ 61111],
```

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Code JupyterLab Python 3 (ipykernel)

[11]:
```
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)
```

[9]:
```
from sklearn.linear_model import LinearRegression
model = LinearRegression()
model.fit(x_train,y_train)
```

[9]:
```
LinearRegression
LinearRegression()
```

[12]:
```
model.score(x_train,y_train)
```

[12]:
```
0.9603182547438908
```

[13]:
```
model.score(x_test,y_test)
```

[13]:
```
0.9184170849214232
```

[14]:
```
model.coef_
```

[14]:
```
array([[9281.30847068]])
```

[15]:
```
model.intercept_
```

[15]:
```
array([27166.73682891])
```

[16]:
```
import pickle
pickle.dump(model,open('SalaryPred.model','wb'))
```

[17]:
```
model = pickle.load(open('SalaryPred.model','rb'))
```

[18]:
```
yr_of_exp = float(input("Enter years of expreience: "))
```

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12. LOGISTIC REGRESSION

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Code

JupyterLab Python 3 (ipykernel)

[1]:
```
import numpy as np
import pandas as pd
import warnings
warnings.filterwarnings('ignore')
df=pd.read_csv('Social_Network_Ads.csv.csv')
df
```

```
C:\Users\selva\AppData\Local\Temp\ipykernel_26828\2834319537.py:2: DeprecationWarning:
Pyarrow will become a required dependency of pandas in the next major release of pandas (pandas 3.0),
(to allow more performant data types, such as the Arrow string type, and better interoperability with other libraries)
but was not found to be installed on your system.
If this would cause problems for you,
please provide us feedback at https://github.com/pandas-dev/pandas/issues/54466

  import pandas as pd
```

[1]:

	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

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Code

JupyterLab Python 3 (ipykernel)

[2]:
```
df.tail(5)
```

[2]:

	User ID	Gender	Age	EstimatedSalary	Purchased
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

[3]:
```
df.head(5)
```

[3]:

	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

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

[4]:
```
array([[    19,  19000],
       [    35,  20000],
       [    26,  43000],
```

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Code JupyterLab Python 3 (ipykernel)

[5]:
```
label
```

[5]:
```
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, 1, 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, 1, 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, 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, 1, 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, 1, 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, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 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, 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, 0, 1,
       1, 1, 0, 1], dtype=int64)
```

[6]:
```
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
```

[7]:
```
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_train, y_test)

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

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Code JupyterLab Python 3 (ipykernel)

```
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
```

[8]:
```
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)
```

[8]:
```
LogisticRegression
LogisticRegression()
```

[9]:
```
print(finalModel.score(x_train,y_train))
print(finalModel.score(x_train,y_train))
```

```
0.85
0.85
```

[10]:
```
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
```