In [146...

```
## importing python liabraries
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import plotly.express as px
```

In [147...

```
## extract data and Load
data=pd.read_csv(r'C:\Users\pv11379\OneDrive - Deere & Co\Desktop\Personal folder\Data science\Database/delivery_time.cs
```

In [148...

```
## copy the data
df=data.copy()
```

understanding data

In [149...

```
df.head(2) ## top 2 rows of dataset
```

Out[149]:

	Delivery Time	Sorting Time
0	21.0	10
1	13.5	4

In [150...

```
df.tail(2) ## bottom 2 rows of dataset
```

Out[150]:

	Delivery Time	Sorting Time
19	17.83	7
20	21.50	5

In [151...

```
## shape of data
print("total rows in data is - ",df.shape[0])
print("total columns in data is - ", df.shape[1])
```

```
total rows in data is -  21
total columns in data is -  2
```

In [152...

```
df.info() ## data information
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 21 entries, 0 to 20
Data columns (total 2 columns):
 #   Column         Non-Null Count  Dtype  
---  ------         --------------  -----  
 0   Delivery Time  21 non-null     float64
 1   Sorting Time   21 non-null     int64  
dtypes: float64(1), int64(1)
memory usage: 468.0 bytes
```

In [153…

```
## inference - 21 rows and 2 columns. delivery time is float data type and sorting time is integer data type.
```

In [154…

```
df.isna().sum()
```

Out[154]:

```
Delivery Time    0
Sorting Time     0
dtype: int64
```

In [155…

```
df.isna().any()
```

Out[155]:

```
Delivery Time    False
Sorting Time     False
dtype: bool
```

In [156…

```
## No any null values in dataset
```

In [157…

```
df.index
```

Out[157]:

```
RangeIndex(start=0, stop=21, step=1)
```

In [158…

```
df.columns ## columns in dataset
```

Out[158]:

```
Index(['Delivery Time', 'Sorting Time'], dtype='object')
```

In [159…

```
df.describe() ## statistical details of dataset
```

Out[159]:

	Delivery Time	Sorting Time
count	21.000000	21.000000
mean	16.790952	6.190476
std	5.074901	2.542028
min	8.000000	2.000000
25%	13.500000	4.000000
50%	17.830000	6.000000
75%	19.750000	8.000000
max	29.000000	10.000000

In [160…

```
## inference - no more gap in min and max data. so variation is less. STD is also low.
```

In [161…

```
df.nunique() ## number of unique values in columns
```

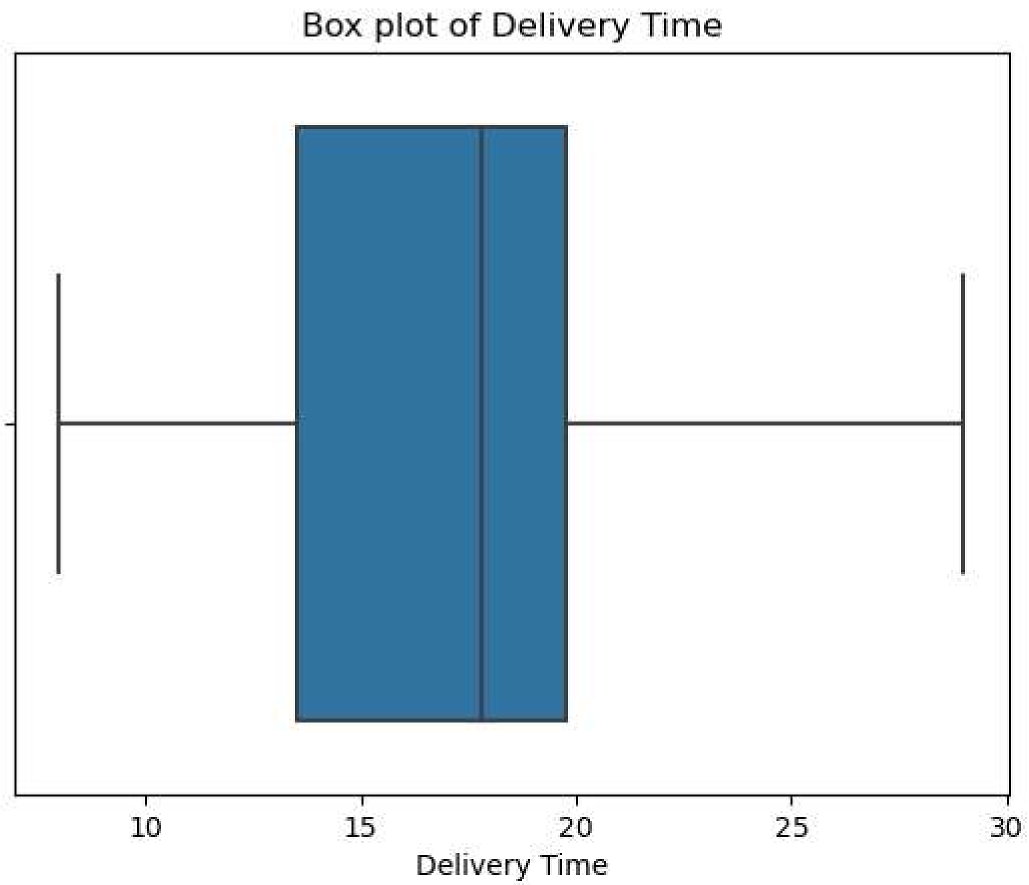
Out[161]:

```
Delivery Time    21
Sorting Time      9
dtype: int64
```

cheking of outliers in dataset

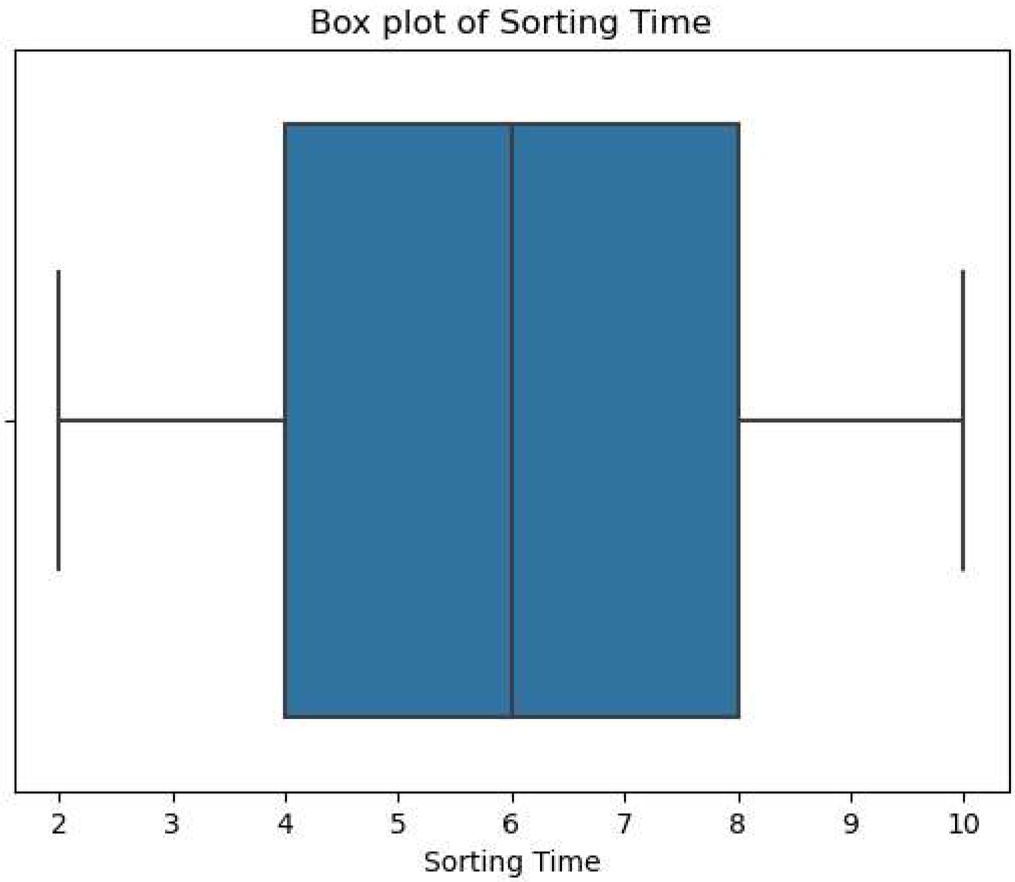
In [162…

```
sns.boxplot(x=df['Delivery Time'])
plt.title("Box plot of Delivery Time")
plt.show()
```



In [163…

```
sns.boxplot(x=df['Sorting Time'])
plt.title("Box plot of Sorting Time")
plt.show()
```



In [164...

```
## inference - No outliers in dataset.
```

In [165...

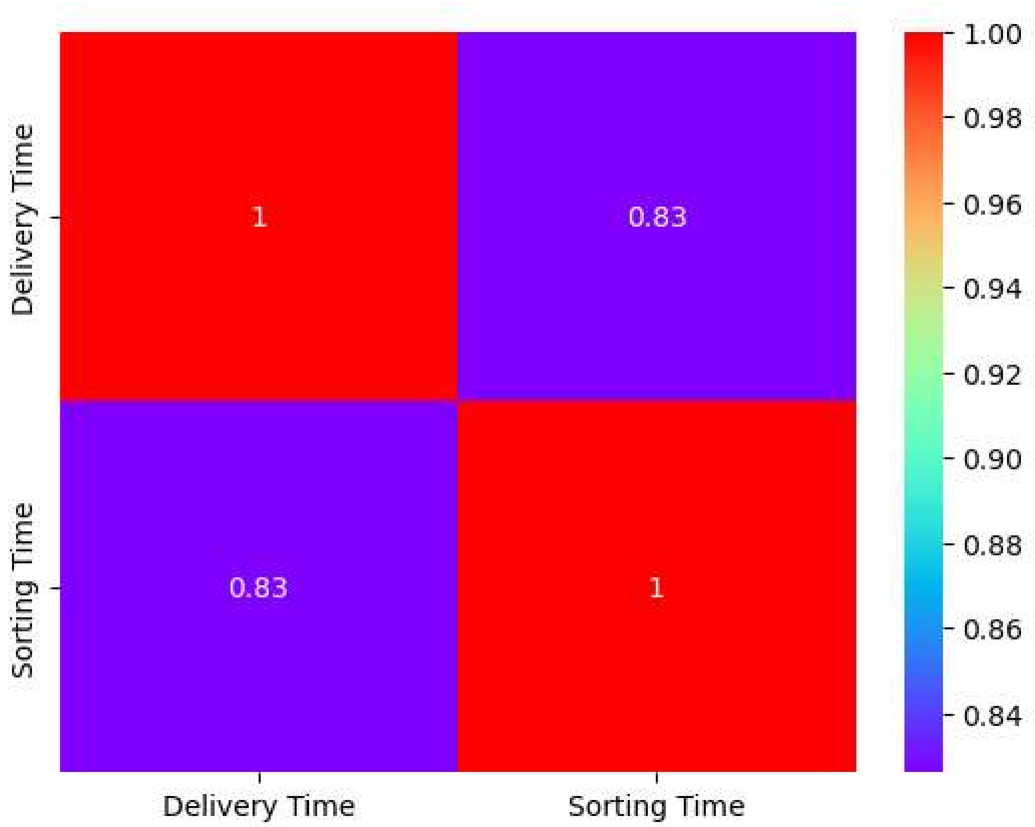
```
## correlation in dataset
corr= df.corr()
corr
```

Out[165]:

	Delivery Time	Sorting Time
Delivery Time	1.000000	0.825997
Sorting Time	0.825997	1.000000

In [166...

```
sns.heatmap(corr,annot=True,cmap='rainbow')
plt.show()
```



In [167…

```
## inference - correlation co-efficient is more, so they have strong correlation with each other.
```

exploratory data analysis

In [168…

```
## average delivery time
print("Average delivery time is - ",round(df['Delivery Time'].mean(),0))
```

```
Average delivery time is -  17.0
```

In [169…

```
## Max delivery time
print("Max delivery time is - ",round(df['Delivery Time'].max(),0))
```

```
Max delivery time is -  29.0
```

In [170…

```
## Min delivery time
print("Min delivery time is - ",round(df['Delivery Time'].min(),0))
```

```
Min delivery time is -  8.0
```

In [171…

```
## Max sorting time
print("Max sorting time is - ",round(df['Sorting Time'].max(),0))
```

```
Max sorting time is -  10
```

In [172…

```
## Min sorting time
print("Min sorting time is - ",round(df['Sorting Time'].min(),0))
```

```
Min sorting time is -  2
```

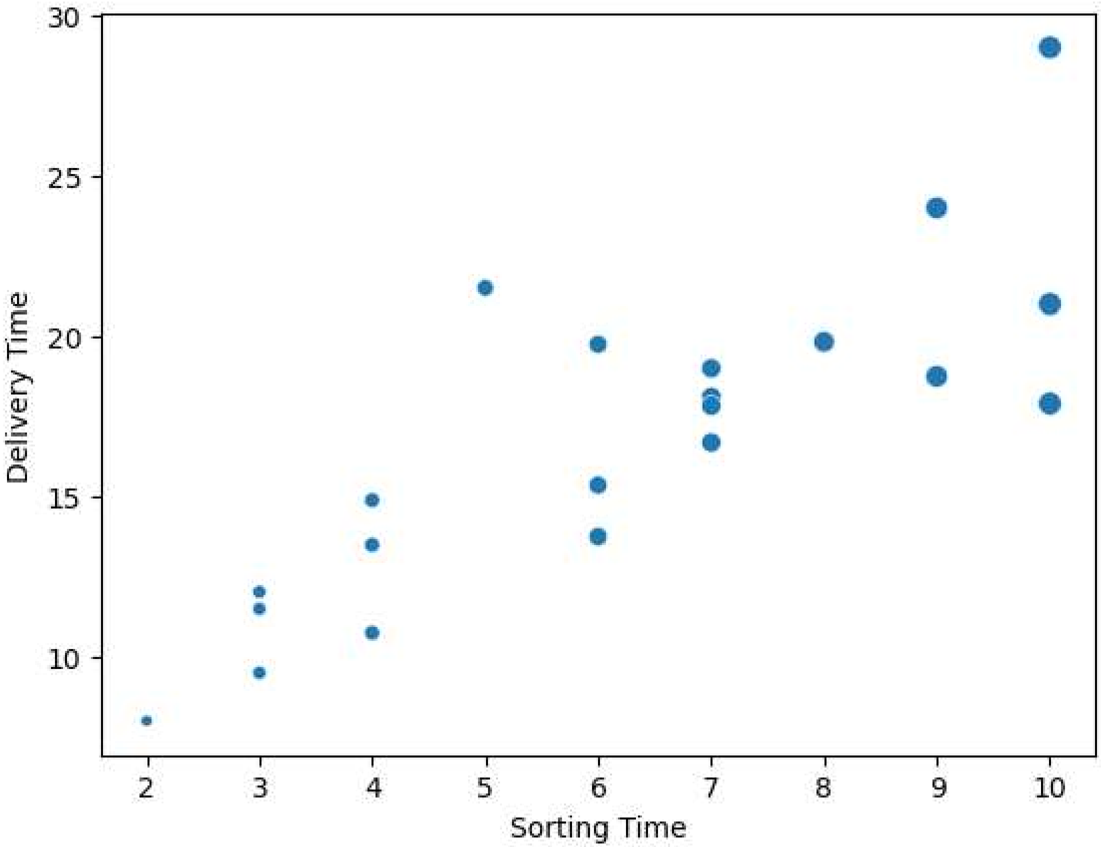
In [173…

```
## average sorting time
print("Average sorting time is - ",round(df['Sorting Time'].mean(),0))
```

```
Average sorting time is -  6.0
```

In [174…

```
sns.scatterplot(data=df,y='Delivery Time',x='Sorting Time',markers='o',size='Sorting Time',legend=None)
plt.show()
```

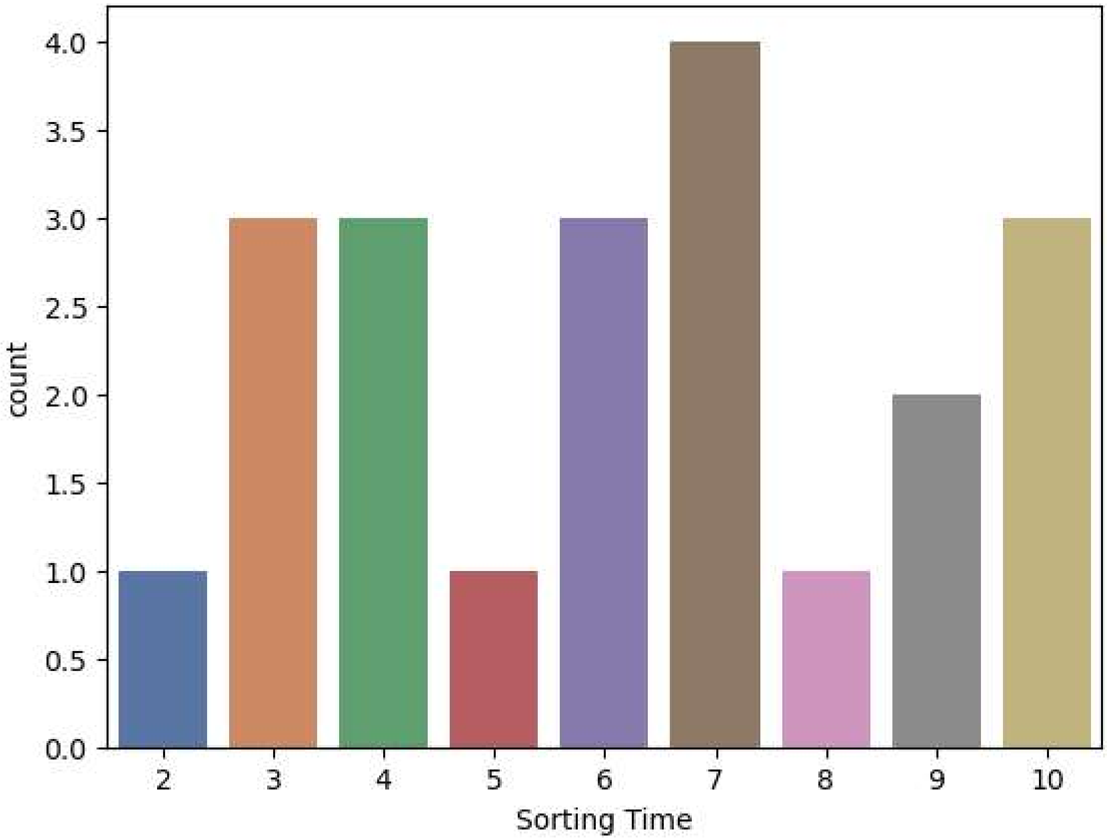


In [175…

```
## Inference - Sorting time is highly corelated with delivery time. Delivery time and sorting time is directly propotio
## if delivery time increases then sorting time also increases.
```

In [176…

```
sns.countplot(data=df,x='Sorting Time',palette='deep')
plt.show()
```



In [177…

```
## Inference - Sorting time 7 is occur max times so maximum number of sorting is at 7.
```

Feature Engineering and machine learing model

In [178…

```
## dataset is having one input to predit output & linear plot is straight, so we will build simple linear regression  mo
```

In [179…

```
## importing scikit library
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import r2_score,mean_absolute_error,mean_squared_error
```

In [180…

```
## set input and output of dataset
## x - independent varibale i.e delivery time
## y - dependent variable i.e sorting time
```

```
y=df['Delivery Time']
x=df['Sorting Time']
```

In [181…

```
x_train,x_test,y_train,y_test=train_test_split(x,y,train_size=0.8,random_state=1234)
```

In [182…

```
x_train.shape,y_train.shape
```

Out[182]:

```
((16,), (16,))
```

In [183…

```
x_test.shape,y_test.shape
```

Out[183]:

```
((5,), (5,))
```

In [184…

```
x_train=x_train.values.reshape(-1,1)
y_train=y_train.values.reshape(-1,1)
x_test=x_test.values.reshape(-1,1)
```

In [185…

```
lr_model=LinearRegression()
```

In [186…

```
lr_model_fit=lr_model.fit(x_train,y_train)
```

In [187…

```
## intercept of model
print(lr_model_fit.intercept_)
```

```
[6.66384615]
```

In [188…

```
## coef of model
print(lr_model_fit.coef_)
```

```
[[1.60153846]]
```

In [189…

```
y_pred=lr_model_fit.predict(x_test)
```

In [190…

```
df_y_pred=pd.DataFrame(y_pred,columns=['pred'])
```

In [191…

```
df_y_pred['actual']=y_test.values
```

In [192…

```
print(df_y_pred)
```

```
        pred  actual
0  21.077692   24.00
1  11.468462   11.50
2  16.273077   19.75
3  16.273077   13.75
4  11.468462   12.03
```

In [193…

```
r2_score(df_y_pred['pred'],df_y_pred['actual'])
```

Out[193]:

```
0.577463605342888
```

In [194…

```
## r2_score is 0.57, so build model is towards 1 so it is good model.
```

In [195…

```
mean_absolute_error(df_y_pred['pred'],df_y_pred['actual'])
```

Out[195]:

```
1.9030769230769233
```

In [196…

```
mean_squared_error(df_y_pred['pred'],df_y_pred['actual'])
```

Out[196]:

```
5.462222721893498
```

In [197…

```
from math import sqrt
```

In [198…

```
sqrt(mean_squared_error(df_y_pred['pred'],df_y_pred['actual']))
```

Out[198]:

```
2.3371398592924426
```

In [199…

```
## save the model
import joblib
```

In [200…

```
file='delivery_sorting_lrmodel.sav'
joblib.dump(lr_model_fit,file)
```

Out[200]:

```
['delivery_sorting_lrmodel.sav']
```

In [201…

```
## load the model
loaded_model=joblib.load(file)
print(loaded_model)
```

```
LinearRegression()
```

In [202…

```
y_pred_=loaded_model.predict(x_test)
y_pred_
```

Out[202]:

```
array([[21.07769231],
       [11.46846154],
       [16.27307692],
       [16.27307692],
       [11.46846154]])
```

Project insights and conclusion

In [203…

```
# In above project we have dataset of delivery time and sorting time.
# It is observed that delivery time and sorting time is strongly correlate with each other.
# max delivery time is 29, min delivery time is 8, average delivery time is 17
# max sorting time is 10, min sorting time is 2, average sorting time is 6. max sorting time count is 7.
# Then i have build simple linear regression machine learning model to predit delivery time based on sorting time.
# model coefficient of determination is 0.57, so model is good.
```

In [ ]:

```
```