In [1]:

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import statsmodels.formula.api as smf
```

In [2]:

```
df = pd.DataFrame(data= {'Delivery Time':[21,13.5,19.75,24,29,15.35,19,9.5,17.9,18.75,19.83,10.75,16.68,1
                                          12.03,14.88,13.75,18.11,8,17.83,21.5],
                         'Sorting Time':[10,4,6,9,10,6,7,3,10,9,8,4,7,3,3,4,6,7,2,7,5]})
```

In [3]:

```
df.head()
```

Out[3]:

	Delivery Time	Sorting Time
0	21.00	10
1	13.50	4
2	19.75	6
3	24.00	9
4	29.00	10

In [4]:

```
df1= df.rename({'Delivery Time':'DT','Sorting Time':'ST'}, axis=1)
```

In [5]:

```
df1.corr()
```

Out[5]:

	DT	ST
DT	1.000000	0.825997
ST	0.825997	1.000000

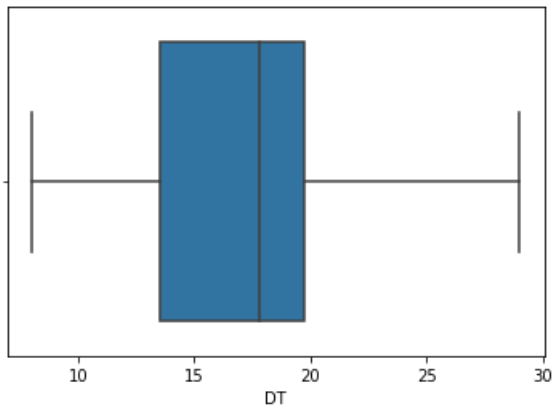
Cheking for outliers

In [6]:

```
sns.boxplot(x='DT', data=df1)
```

Out[6]:

```
<AxesSubplot:xlabel='DT'>
```

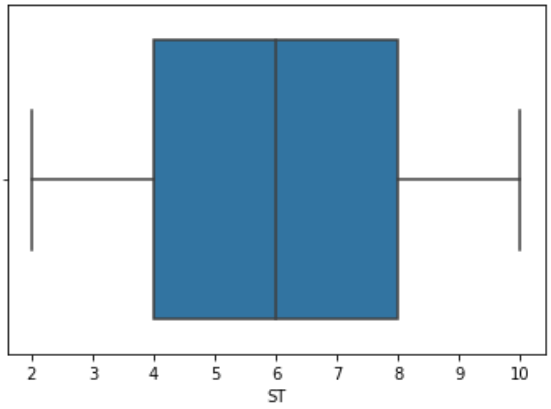


In [7]:

```
sns.boxplot(x='ST', data=df1)
```

Out[7]:

```
<AxesSubplot:xlabel='ST'>
```

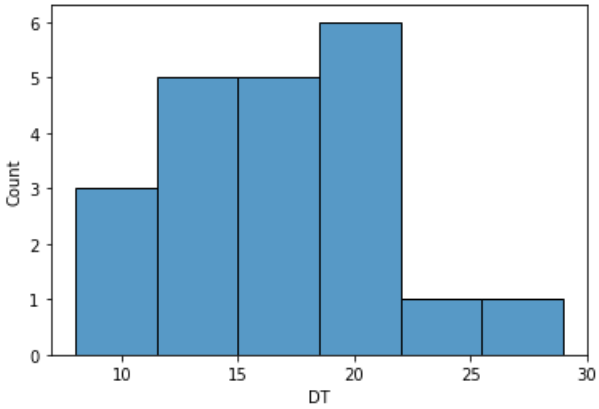


In [8]:

```
sns.histplot(df1.DT)
```

Out[8]:

```
<AxesSubplot:xlabel='DT', ylabel='Count'>
```

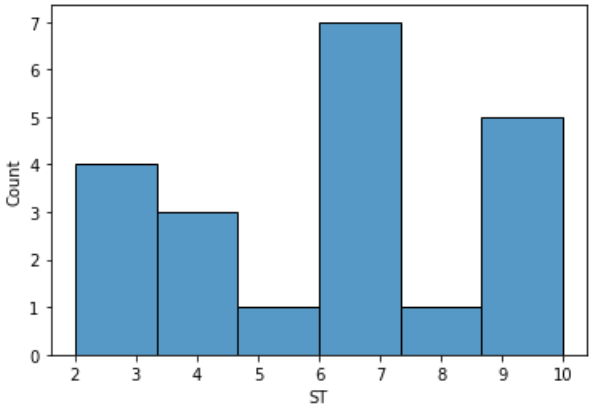


In [9]:

```
sns.histplot(df1.ST)
```

Out[9]:

```
<AxesSubplot:xlabel='ST', ylabel='Count'>
```



Checking for duplicated rows

In [10]:

```
df1[df1.duplicated()].shape
```

Out[10]:

```
(0, 2)
```

Building the model

In [11]:

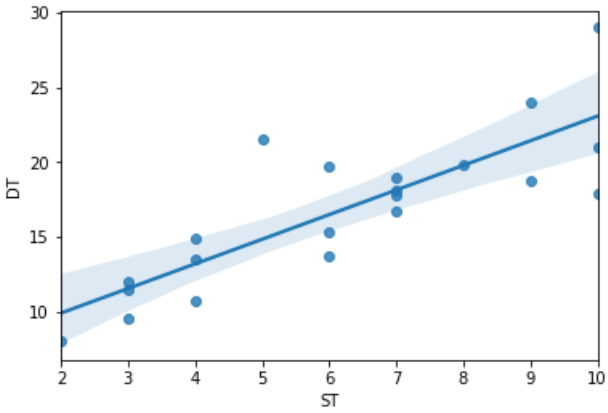
```
model = smf.ols("DT~ST", data=df1).fit()
```

In [12]:

```
sns.regplot(x='ST', y='DT', data=df1)
```

Out[12]:

```
<AxesSubplot:xlabel='ST', ylabel='DT'>
```



In [13]:

```
print('P value is:', model.pvalues, '\n', '\n', 'Rsquared value is:',model.rsquared,
      '\n', '\n','Adjusted Rsquared value is:', model.rsquared )
```

```
P value is: Intercept    0.001147
ST           0.000004
dtype: float64

 Rsquared value is: 0.6822714748417231

 Adjusted Rsquared value is: 0.6822714748417231
```

In [14]:

```
#Since the rsquared value is less, we need to try some transformations
```

Iteration 1

In [15]:

```
df1['ST2'] = df1['ST']**2
```

In [16]:

```
df1.head(3)
```

Out[16]:

	DT	ST	ST2
0	21.00	10	100
1	13.50	4	16
2	19.75	6	36

In [17]:

```
model1= smf.ols('DT~ST2', data=df1).fit()
```

In [18]:

```
print('P value is:', model1.pvalues, '\n', '\n', 'Rsquared value is:',model1.rsquared,
      '\n', '\n','Adjusted Rsquared value is:', model1.rsquared )
```

```
P value is: Intercept    1.415704e-08
ST2          1.739194e-05
dtype: float64

 Rsquared value is: 0.6302871815826637

 Adjusted Rsquared value is: 0.6302871815826637
```

In [19]:

```
#Since R squared value is again less, trying another alternative
```

In [20]:

```
model2= smf.ols('DT~ST+ST2', data=df1).fit()
```

In [21]:

```
print('P value is:', model2.pvalues, '\n', '\n', 'Rsquared value is:',model2.rsquared,
      '\n', '\n','Adjusted Rsquared value is:', model2.rsquared )
```

```
P value is: Intercept    0.408248
ST           0.070097
ST2          0.428641
dtype: float64

 Rsquared value is: 0.6934396274520247

 Adjusted Rsquared value is: 0.6934396274520247
```

In [22]:

```
#R squared value is still less.
```

Iteration 2

In [23]:

```
df1['logST'] = np.log(df1['ST'])
```

In [24]:

```
df1.head(3)
```

Out[24]:

	DT	ST	ST2	logST
0	21.00	10	100	2.302585
1	13.50	4	16	1.386294
2	19.75	6	36	1.791759

In [25]:

```
model3= smf.ols('DT~logST', data=df1).fit()
```

In [26]:

```
print('P value is:', model3.pvalues, '\n', '\n', 'Rsquared value is:',model3.rsquared,
      '\n', '\n','Adjusted Rsquared value is:', model3.rsquared )
```

```
P value is: Intercept    0.641980
logST        0.000003
dtype: float64

 Rsquared value is: 0.6954434611324223

 Adjusted Rsquared value is: 0.6954434611324223
```

In [27]:

```
#R squared value is still less.
```

Iteration 3

In [28]:

```
df1['sqrtST'] = df1['ST']**(1/2)
```

In [29]:

```
df1.head()
```

Out[29]:

	DT	ST	ST2	logST	sqrtST
0	21.00	10	100	2.302585	3.162278
1	13.50	4	16	1.386294	2.000000
2	19.75	6	36	1.791759	2.449490
3	24.00	9	81	2.197225	3.000000
4	29.00	10	100	2.302585	3.162278

In [30]:

```
model4= smf.ols('DT~sqrtST', data=df1).fit()
```

In [31]:

```
print('P value is:', model4.pvalues, '\n', '\n', 'Rsquared value is:',model4.rsquared,
      '\n', '\n','Adjusted Rsquared value is:', model4.rsquared )
```

```
P value is: Intercept    0.410857
sqrtST       0.000003
dtype: float64

 Rsquared value is: 0.695806227630867

 Adjusted Rsquared value is: 0.695806227630867
```

In [32]:

```
#R squared value is still less.
```

In [33]:

```
#Since the variable transformation doesn't seem to show enough improvement on r squared value, hence, we
#try for model deletion diagnostics
```

Model deletion diagnostics

Cook's distance

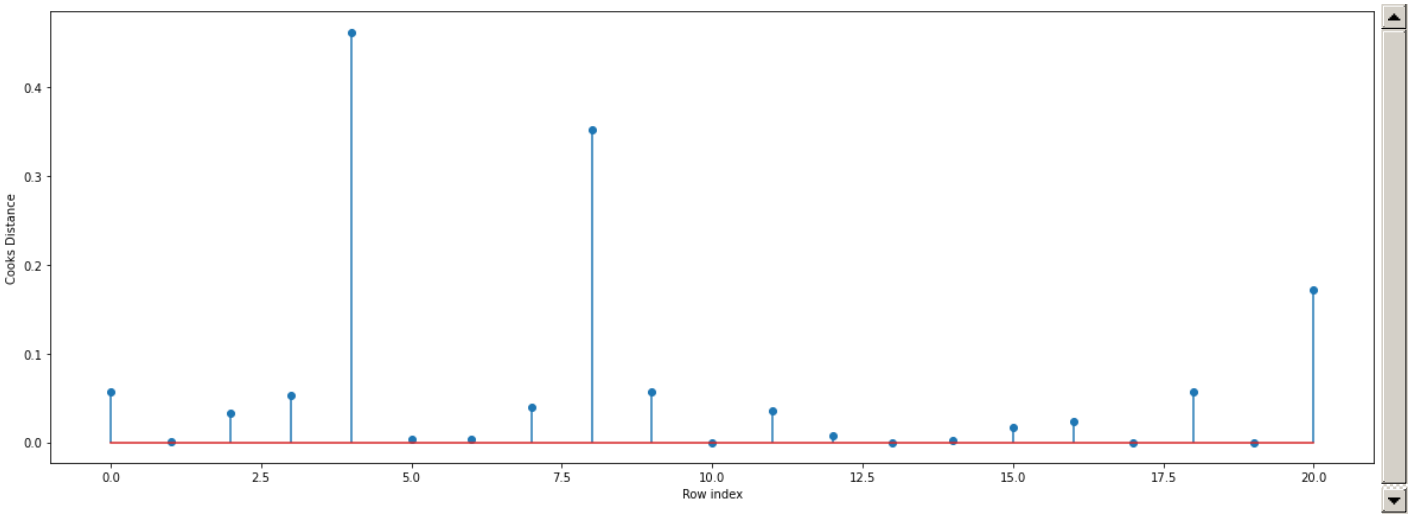
Iteration 4

In [34]:

```
model_influence = model.get_influence()
(c, _) = model_influence.cooks_distance
```

In [35]:

```
#Plot the influencers values using stem plot
fig = plt.subplots(figsize=(20, 7))
plt.stem(np.arange(len(df1)), np.round(c, 3))
plt.xlabel('Row index')
plt.ylabel('Cooks Distance')
plt.show()
```



In [36]:

```
np.argmax(c), np.max(c)
```

Out[36]:

```
(4, 0.4620530412650316)
```

In [37]:

```
df2= df1.drop([4],axis=0)
```

In [38]:

```
df3 = df2.reset_index()
```

In [39]:

```
df4 = df3.drop(['index'],axis=1)
```

In [40]:

```
model5 = smf.ols('DT~ST', data=df4).fit()
```

In [41]:

```
print('P value is:', model5.pvalues, '\n', '\n', 'Rsquared value is:',model5.rsquared,
      '\n', '\n','Adjusted Rsquared value is:', model5.rsquared )
```

```
P value is: Intercept    0.000147
ST           0.000013
dtype: float64

 Rsquared value is: 0.660207261776224

 Adjusted Rsquared value is: 0.660207261776224
```

In [ ]: