In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

In [2]:
```
df=pd.read_csv("6_Salesworkload1.csv")
df
```

Out[2]:

	MonthYear	Time index	Country	StoreID	City	Dept_ID	Dept. Name	HoursOwn	HoursLease	
0	10.2016	1.0	United Kingdom	88253.0	London (I)	1.0	Dry	3184.764	0.0	
1	10.2016	1.0	United Kingdom	88253.0	London (I)	2.0	Frozen	1582.941	0.0	
2	10.2016	1.0	United Kingdom	88253.0	London (I)	3.0	other	47.205	0.0	
3	10.2016	1.0	United Kingdom	88253.0	London (I)	4.0	Fish	1623.852	0.0	
4	10.2016	1.0	United Kingdom	88253.0	London (I)	5.0	Fruits & Vegetables	1759.173	0.0	
...	...	...	...	...	...	...	...	...	...	
7653	06.2017	9.0	Sweden	29650.0	Gothenburg	12.0	Checkout	6322.323	0.0	3
7654	06.2017	9.0	Sweden	29650.0	Gothenburg	16.0	Customer Services	4270.479	0.0	
7655	06.2017	9.0	Sweden	29650.0	Gothenburg	11.0	Delivery	0	0.0	
7656	06.2017	9.0	Sweden	29650.0	Gothenburg	17.0	others	2224.929	0.0	
7657	06.2017	9.0	Sweden	29650.0	Gothenburg	18.0	all	39652.2	0.0	3

7658 rows × 14 columns

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

Out[3]:

	MonthYear	Time index	Country	StoreID	City	Dept_ID	Dept. Name	HoursOwn	HoursLease	Sales units
0	10.2016	1.0	United Kingdom	88253.0	London (I)	1.0	Dry	3184.764	0.0	398560.0
1	10.2016	1.0	United Kingdom	88253.0	London (I)	2.0	Frozen	1582.941	0.0	82725.0
2	10.2016	1.0	United Kingdom	88253.0	London (I)	3.0	other	47.205	0.0	438400.0
3	10.2016	1.0	United Kingdom	88253.0	London (I)	4.0	Fish	1623.852	0.0	309425.0

	MonthYear	Time index	Country	StoreID	City	Dept_ID	Dept. Name	HoursOwn	HoursLease	Sales units
4	10.2016	1.0	United Kingdom	88253.0	London (I)	5.0	Fruits & Vegetables	1759.173	0.0	165515.0

DATA CLEANING AND DATA PREPROCESSING

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

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 7658 entries, 0 to 7657
Data columns (total 14 columns):
 #   Column         Non-Null Count  Dtype  
---  ------         --------------  -----  
 0   MonthYear      7658 non-null   object 
 1   Time index     7650 non-null   float64
 2   Country        7650 non-null   object 
 3   StoreID        7650 non-null   float64
 4   City           7650 non-null   object 
 5   Dept_ID        7650 non-null   float64
 6   Dept. Name     7650 non-null   object 
 7   HoursOwn       7650 non-null   object 
 8   HoursLease     7650 non-null   float64
 9   Sales units    7650 non-null   float64
 10  Turnover       7650 non-null   float64
 11  Customer       0 non-null      float64
 12  Area (m2)      7650 non-null   object 
 13  Opening hours  7650 non-null   object 
dtypes: float64(7), object(7)
memory usage: 837.7+ KB
```

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

Out[5]:

	Time index	StoreID	Dept_ID	HoursLease	Sales units	Turnover	Customer
count	7650.000000	7650.000000	7650.000000	7650.000000	7.650000e+03	7.650000e+03	0.0
mean	5.000000	61995.220000	9.470588	22.036078	1.076471e+06	3.721393e+06	NaN
std	2.582158	29924.581631	5.337429	133.299513	1.728113e+06	6.003380e+06	NaN
min	1.000000	12227.000000	1.000000	0.000000	0.000000e+00	0.000000e+00	NaN
25%	3.000000	29650.000000	5.000000	0.000000	5.457125e+04	2.726798e+05	NaN
50%	5.000000	75400.500000	9.000000	0.000000	2.932300e+05	9.319575e+05	NaN
75%	7.000000	87703.000000	14.000000	0.000000	9.175075e+05	3.264432e+06	NaN
max	9.000000	98422.000000	18.000000	3984.000000	1.124296e+07	4.271739e+07	NaN

In [6]:
```
df.columns
```

Out[6]:
```
Index(['MonthYear', 'Time index', 'Country', 'StoreID', 'City', 'Dept_ID',
       'Dept. Name', 'HoursOwn', 'HoursLease', 'Sales units', 'Turnover',
```

```
       'Customer', 'Area (m2)', 'Opening hours'],
      dtype='object')
```

In [7]:

```
df1=df.fillna(1)
df1
```

Out[7]:

	MonthYear	Time index	Country	StoreID	City	Dept_ID	Dept. Name	HoursOwn	HoursLease
0	10.2016	1.0	United Kingdom	88253.0	London (l)	1.0	Dry	3184.764	0.0
1	10.2016	1.0	United Kingdom	88253.0	London (l)	2.0	Frozen	1582.941	0.0
2	10.2016	1.0	United Kingdom	88253.0	London (l)	3.0	other	47.205	0.0
3	10.2016	1.0	United Kingdom	88253.0	London (l)	4.0	Fish	1623.852	0.0
4	10.2016	1.0	United Kingdom	88253.0	London (l)	5.0	Fruits & Vegetables	1759.173	0.0
...	...	...	...	...	...	...	...	...	...
7653	06.2017	9.0	Sweden	29650.0	Gothenburg	12.0	Checkout	6322.323	0.0
7654	06.2017	9.0	Sweden	29650.0	Gothenburg	16.0	Customer Services	4270.479	0.0
7655	06.2017	9.0	Sweden	29650.0	Gothenburg	11.0	Delivery	0	0.0
7656	06.2017	9.0	Sweden	29650.0	Gothenburg	17.0	others	2224.929	0.0
7657	06.2017	9.0	Sweden	29650.0	Gothenburg	18.0	all	39652.2	0.0

7658 rows × 14 columns

In [8]:

```
df1=df1.replace('#NV',1)
df1
```

Out[8]:

	MonthYear	Time index	Country	StoreID	City	Dept_ID	Dept. Name	HoursOwn	HoursLease
0	10.2016	1.0	United Kingdom	88253.0	London (l)	1.0	Dry	3184.764	0.0
1	10.2016	1.0	United Kingdom	88253.0	London (l)	2.0	Frozen	1582.941	0.0
2	10.2016	1.0	United Kingdom	88253.0	London (l)	3.0	other	47.205	0.0
3	10.2016	1.0	United Kingdom	88253.0	London (l)	4.0	Fish	1623.852	0.0
4	10.2016	1.0	United Kingdom	88253.0	London (l)	5.0	Fruits & Vegetables	1759.173	0.0

	MonthYear	Time index	Country	StoreID	City	Dept_ID	Dept. Name	HoursOwn	HoursLease	
...	...	...	...	...	...	...	...	...	...	
7653	06.2017	9.0	Sweden	29650.0	Gothenburg	12.0	Checkout	6322.323	0.0	3
7654	06.2017	9.0	Sweden	29650.0	Gothenburg	16.0	Customer Services	4270.479	0.0	
7655	06.2017	9.0	Sweden	29650.0	Gothenburg	11.0	Delivery	0	0.0	
7656	06.2017	9.0	Sweden	29650.0	Gothenburg	17.0	others	2224.929	0.0	
7657	06.2017	9.0	Sweden	29650.0	Gothenburg	18.0	all	39652.2	0.0	3

7658 rows × 14 columns

In [9]:
```
df1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 7658 entries, 0 to 7657
Data columns (total 14 columns):
 #   Column         Non-Null Count  Dtype  
---  ------         --------------  -----  
 0   MonthYear      7658 non-null   object 
 1   Time index     7658 non-null   float64
 2   Country        7658 non-null   object 
 3   StoreID        7658 non-null   float64
 4   City           7658 non-null   object 
 5   Dept_ID        7658 non-null   float64
 6   Dept. Name     7658 non-null   object 
 7   HoursOwn       7658 non-null   object 
 8   HoursLease     7658 non-null   float64
 9   Sales units    7658 non-null   float64
 10  Turnover       7658 non-null   float64
 11  Customer       7658 non-null   float64
 12  Area (m2)      7658 non-null   object 
 13  Opening hours  7658 non-null   object 
dtypes: float64(7), object(7)
memory usage: 837.7+ KB
```

In [10]:
```
df1.columns
```

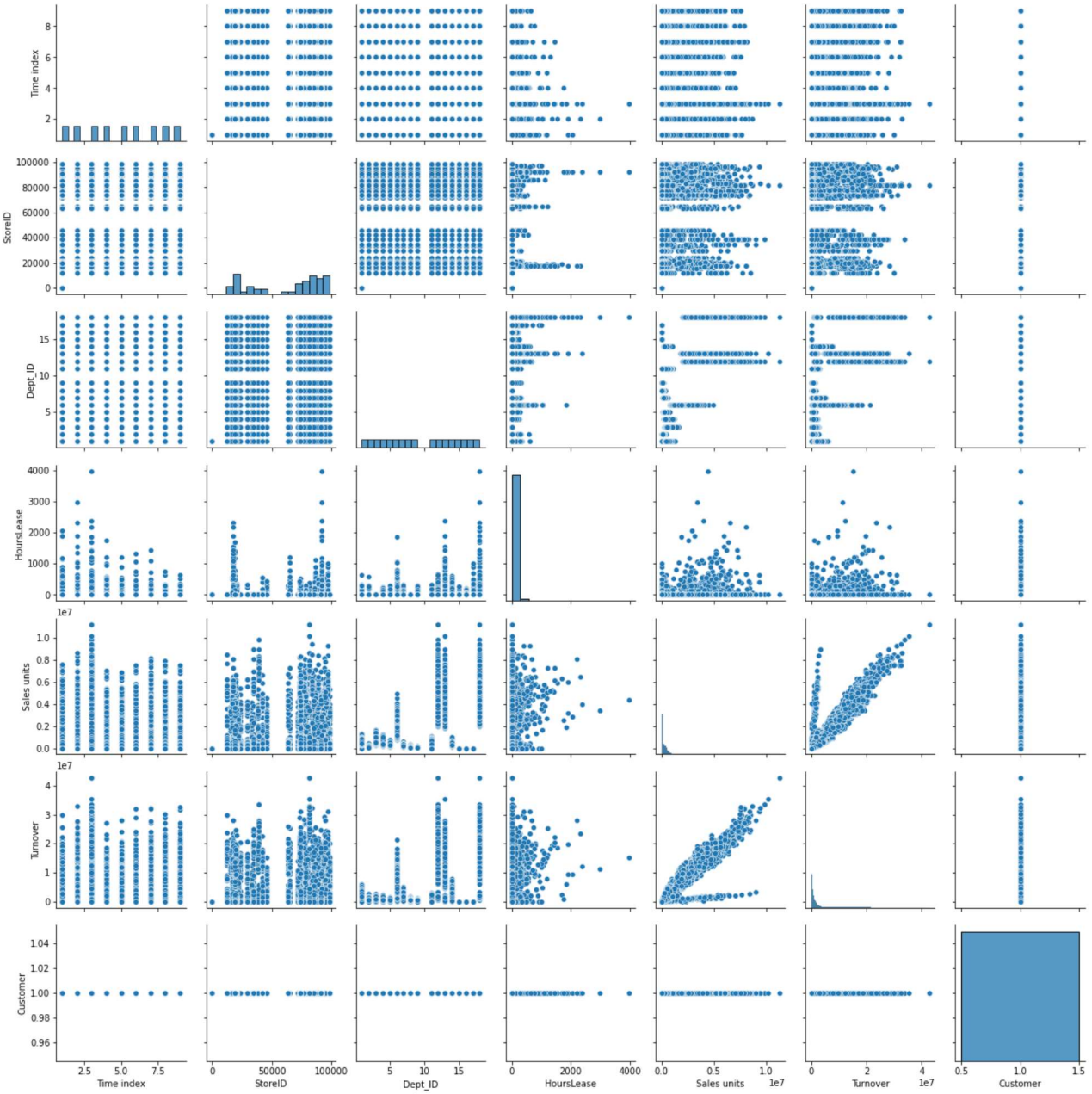
Out[10]:
```
Index(['MonthYear', 'Time index', 'Country', 'StoreID', 'City', 'Dept_ID',
       'Dept. Name', 'HoursOwn', 'HoursLease', 'Sales units', 'Turnover',
       'Customer', 'Area (m2)', 'Opening hours'],
      dtype='object')
```

In [11]:
```
df1=df1[[ 'Time index', 'StoreID', 'Dept_ID', 'HoursLease', 'Sales units', 'Turnover','
```

EDA AND VISUALIZATION

In [12]:
```
sns.pairplot(df1)
```

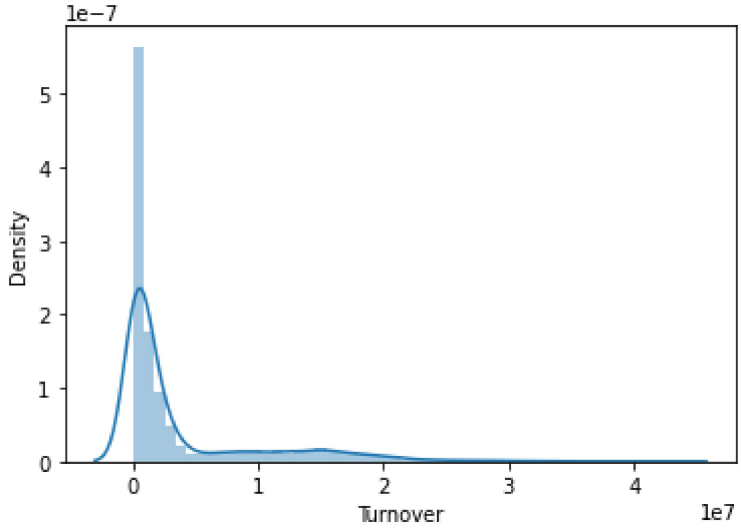
Out[12]: <seaborn.axisgrid.PairGrid at 0x1e08ebc7040>



In [13]:
```
sns.distplot(df1['Turnover'])
```

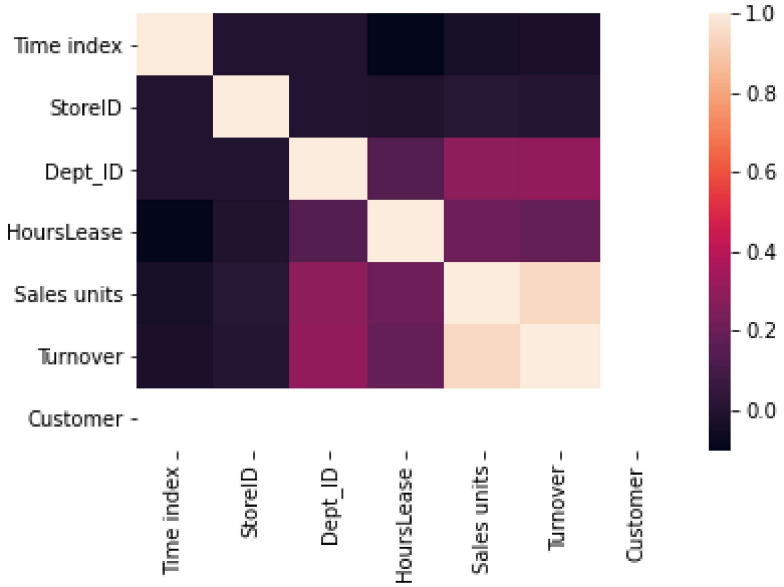
```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\distributions.py:2557: FutureWarning:
`distplot` is a deprecated function and will be removed in a future version. Please adap
t your code to use either `displot` (a figure-level function with similar flexibility) o
r `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```

Out[13]: <AxesSubplot:xlabel='Turnover', ylabel='Density'>



In [14]:
```
sns.heatmap(df1.corr())
```

Out[14]: <AxesSubplot:>



TO TRAIN THE MODEL AND MODEL BULDING

In [15]:
```
df1
```

Out[15]:

	Time index	StoreID	Dept_ID	HoursLease	Sales units	Turnover	Customer
0	1.0	88253.0	1.0	0.0	398560.0	1226244.0	1.0
1	1.0	88253.0	2.0	0.0	82725.0	387810.0	1.0
2	1.0	88253.0	3.0	0.0	438400.0	654657.0	1.0
3	1.0	88253.0	4.0	0.0	309425.0	499434.0	1.0
4	1.0	88253.0	5.0	0.0	165515.0	329397.0	1.0

	Time index	StoreID	Dept_ID	HoursLease	Sales units	Turnover	Customer
...	...	...	...	...	...	...	...
7653	9.0	29650.0	12.0	0.0	3886530.0	14538825.0	1.0
7654	9.0	29650.0	16.0	0.0	245.0	0.0	1.0
7655	9.0	29650.0	11.0	0.0	0.0	0.0	1.0
7656	9.0	29650.0	17.0	0.0	245.0	0.0	1.0
7657	9.0	29650.0	18.0	0.0	3886530.0	15056214.0	1.0

7658 rows × 7 columns

In [16]:
```
x=df1[[ 'Time index', 'StoreID', 'Dept_ID', 'HoursLease', 'Sales units','Customer']]
y=df1['Turnover']
```

In [17]:
```
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.3)
```

In [18]:
```
from sklearn.linear_model import LinearRegression
lr=LinearRegression()
lr.fit(x_train,y_train)
```

Out[18]:
```
LinearRegression()
```

In [19]:
```
lr.intercept_
```

Out[19]:
```
-184322.0455693463
```

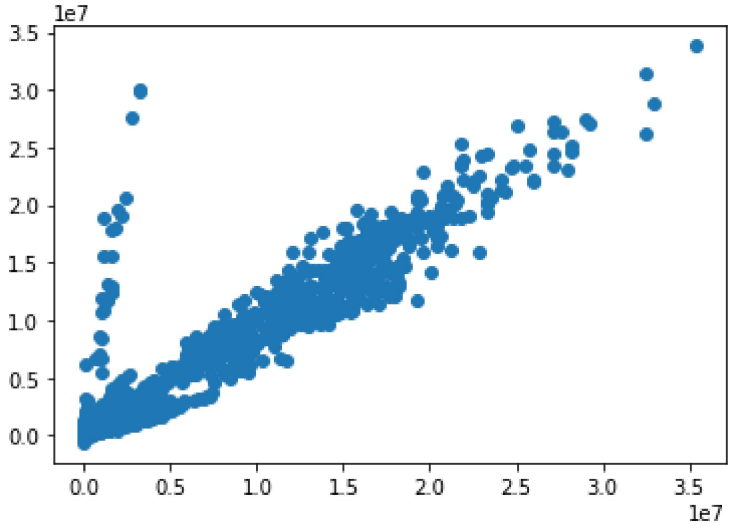
In [20]:
```
coeff=pd.DataFrame(lr.coef_,x.columns,columns=['Co-efficient'])
coeff
```

Out[20]:

	Co-efficient
Time index	24949.118625
StoreID	-0.864384
Dept_ID	32745.606460
HoursLease	-1020.986438
Sales units	3.289956
Customer	0.000000

In [21]:
```
prediction =lr.predict(x_test)
plt.scatter(y_test,prediction)
```

Out[21]:
```
<matplotlib.collections.PathCollection at 0x1e092d378e0>
```



ACCURACY

In [22]:
```
lr.score(x_test,y_test)
```

Out[22]: 0.8886147466981473

In [23]:
```
lr.score(x_train,y_train)
```

Out[23]: 0.9033288862617053

In [24]:
```
from sklearn.linear_model import Ridge,Lasso
rr=Ridge(alpha=10)
rr.fit(x_train,y_train)
```

Out[24]: Ridge(alpha=10)

In [25]:
```
rr.score(x_train,y_train)
```

Out[25]: 0.9033288862487421

In [26]:
```
rr.score(x_test,y_test)
```

Out[26]: 0.8886147038565694

In [27]:
```
la=Lasso(alpha=10)
la.fit(x_train,y_train)
```

Out[27]: Lasso(alpha=10)

In [28]:
```
la.score(x_train,y_train)
```

Out[28]: 0.9033288862611828

In [29]:
```
la.score(x_test,y_test)
```

Out[29]: 0.8886147402021392