Assignment -2

Python Programming

Assignment Date	19 September 2022
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Student Roll Number	2019115048
Maximum Marks	2 Marks

import required libraries

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from matplotlib import rcParams
```

loading dataset

```
import pandas as pd
df=pd.read_csv('water.csv',encoding='latin-1')
df.head()
```

```
In [12]: ## loading dataset

         import pandas as pd
         df=pd.read_csv('water.csv',encoding='latin-1')
         df.head()
```

Out[12]:

	Station_code	Locations	State	Temp	Do	Ph	Conductivity	Bod	NITRATENAN N+ NITRITENANN	Fecal_coliform	Total_coliform	year
0	1393	DAMANGANGA AT D/S OF MADHUBAN, DAMAN	DAMAN & DIU	30.6	6.7	7.5	203	NAN	0.1	11	27	2014
1	1399	ZUARI AT D/S OF PT. WHERE KUMBARJRIA CANAL JOI...	GOA	29.8	5.7	7.2	189	2	0.2	4953	8391	2014
2	1475	ZUARI AT PANCHAWADI	GOA	29.5	6.3	6.9	179	1.7	0.1	3243	5330	2014
3	3181	RIVER ZUARI AT BORIM BRIDGE	GOA	29.7	5.8	6.9	64	3.8	0.5	5382	8443	2014
4	3182	RIVER ZUARI AT MARCAIM JETTY	GOA	29.5	5.8	7.3	83	1.9	0.4	3428	5500	2014

```
df.shape
```

```
In [13]: df.shape

Out[13]: (1991, 12)
```

```
df.info()
```

```
In [14]: df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1991 entries, 0 to 1990
Data columns (total 12 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   Station_code                1991 non-null   object
 1   Locations                   1991 non-null   object
 2   State                       1991 non-null   object
 3   Temp                        1991 non-null   object
 4   Do                          1991 non-null   object
 5   Ph                          1991 non-null   object
 6   Conductivity                1991 non-null   object
 7   Bod                         1991 non-null   object
 8   NITRATENAN N+ NITRITENANN   1991 non-null   object
 9   Fecal_coliform              1991 non-null   object
 10  Total_coliform              1991 non-null   object
 11  year                        1991 non-null   int64
dtypes: int64(1), object(11)
memory usage: 186.8+ KB
```

df.isnull().any()

```
In [15]: df.isnull().any()
```

```
Out[15]: Station_code                False
         Locations                   False
         State                       False
         Temp                        False
         Do                          False
         Ph                          False
         Conductivity                False
         Bod                         False
         NITRATENAN N+ NITRITENANN   False
         Fecal_coliform              False
         Total_coliform              False
         year                        False
         dtype: bool
```

df.Temp.value_counts()

```
In [16]: df.Temp.value_counts()
```

```
Out[16]: 28        241
         29        163
         27        161
         26        102
         NAN        88
                   ...
         25.667      1
         21.2        1
         31.1        1
         27.714      1
         14          1
         Name: Temp, Length: 179, dtype: int64
```

df.Ph.value_counts()

```
In [17]: df.Ph.value_counts()
```

```
Out[17]: 7.2     138
         7.4     127
         7.3     126
         7.1     118
         7       112
                ...
         7.22      1
         8.11      1
         8.07      1
         7.98      1
         110       1
         Name: Ph, Length: 266, dtype: int64
```

df.year.value_counts()

```
In [18]: df.year.value_counts()
```

```
Out[18]: 2012    292
         2013    261
         2014    245
         2011    231
         2010    188
         2009    181
         2008    159
         2007    120
         2005    119
         2006    105
         2003     88
         2004      2
         Name: year, dtype: int64
```

df.describe()

```
In [19]: df.describe()
```

Out[19]:

	year
count	1991.000000
mean	2010.038172
std	3.057333
min	2003.000000
25%	2008.000000
50%	2011.000000
75%	2013.000000
max	2014.000000

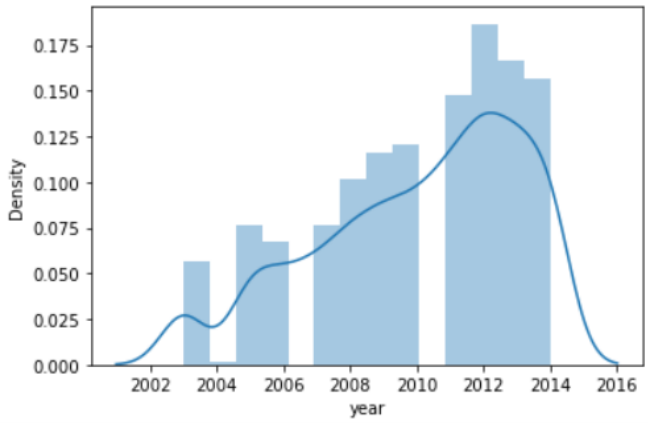
import seaborn as sns

sns.distplot(df.year) # univariate analysis

```
In [20]: import seaborn as sns
         sns.distplot(df.year) # univariate analysis
```

```
  warnings.warn(msg, FutureWarning)
```

```
Out[20]: <AxesSubplot:xlabel='year', ylabel='Density'>
```

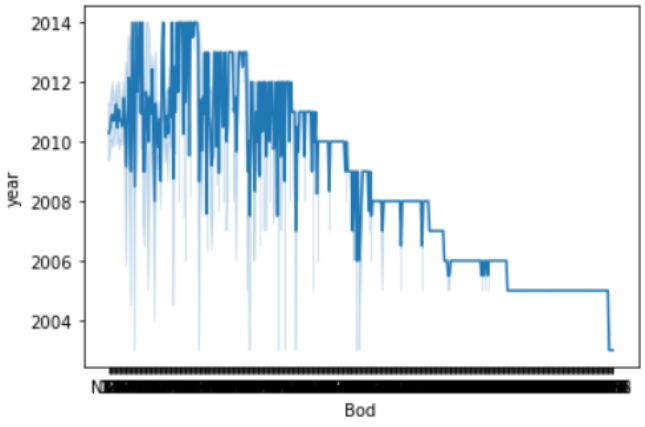


sns.lineplot(df.Bod,df.year) # bivariate analysis.

```
In [21]: sns.lineplot(df.Bod,df.year) # bivariate analysis.
```

```
  warnings.warn(
```

```
Out[21]: <AxesSubplot:xlabel='Bod', ylabel='year'>
```

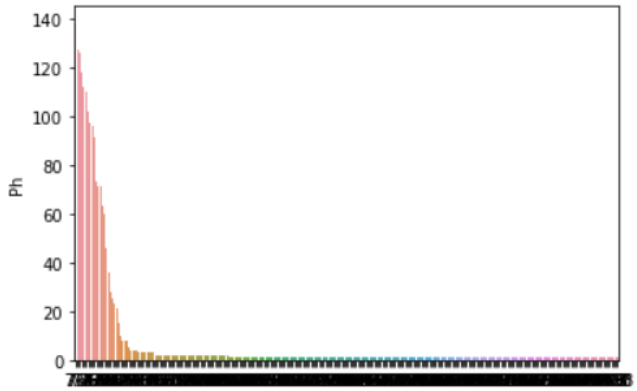


sns.barplot(df.Ph.value_counts().index, df.Ph.value_counts())

In [24]:
```
sns.barplot(df.Ph.value_counts().index, df.Ph.value_counts())
```

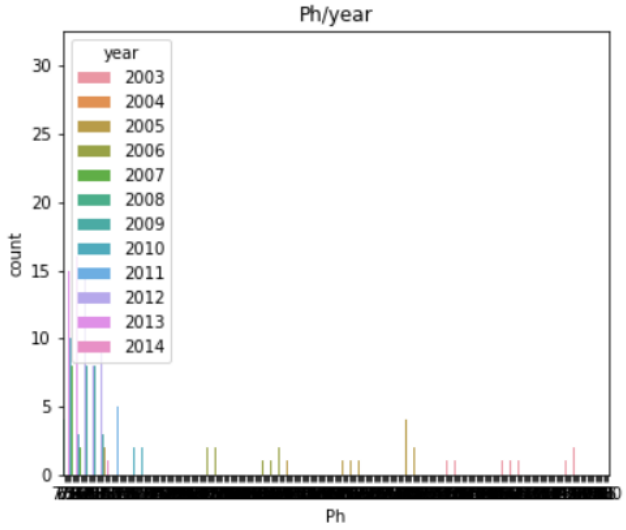
```
D:\anaconda\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass
the following variables as keyword args: x, y. From version 0.12, the only va
lid positional argument will be `data`, and passing other arguments without a
n explicit keyword will result in an error or misinterpretation.
  warnings.warn(
```

Out[24]:
```
<AxesSubplot:ylabel='Ph'>
```



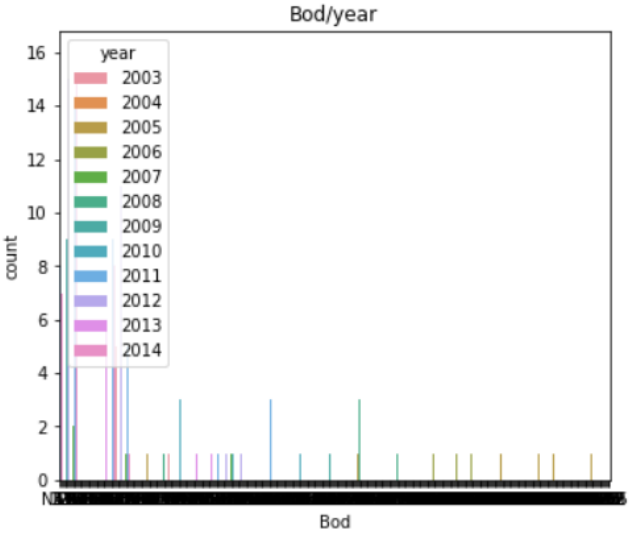

```
## countplot

import seaborn as sns

import matplotlib.pyplot as plt

def countplot_of_2(x,hue,title=None,figsize=(6,5)):

    plt.figure(figsize=figsize)

    sns.countplot(data=df[[x,hue]],x=x,hue=hue)

    plt.title(title)

    plt.show()


countplot_of_2('Ph','year','Ph/year')
```

```
In [15]: countplot_of_2('Ph','year','Ph/year')
```



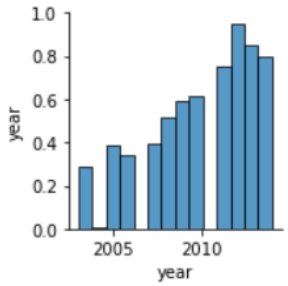
countplot_of_2('Bod','year','Bod/year')

```
In [26]: countplot_of_2('Bod','year','Bod/year')
```



sns.pairplot(df)

```
In [28]: sns.pairplot(df)
Out[28]: <seaborn.axisgrid.PairGrid at 0x202b8ec27c0>
```



df.corr()

```
In [29]: df.corr()
Out[29]:
```

	year
year	1.0

sns.heatmap(df.corr())

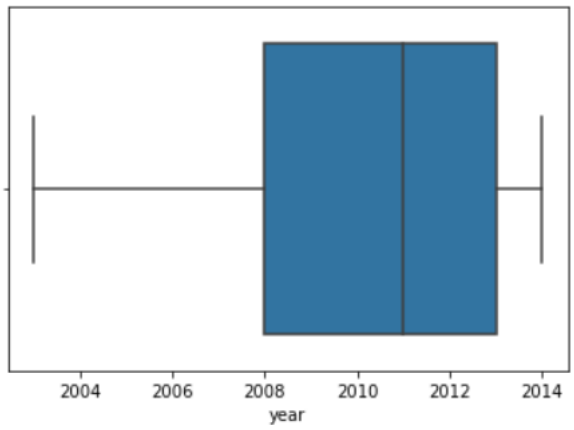
```
In [30]: sns.heatmap(df.corr())
Out[30]: <AxesSubplot:>
```

sns.heatmap(df.corr(),annot=True)

```
In [31]: sns.heatmap(df.corr(),annot=True)
Out[31]: <AxesSubplot:>
```

sns.boxplot(df.year)

```
In [32]: sns.boxplot(df.year)
D:\anaconda\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.
  warnings.warn(
Out[32]: <AxesSubplot:xlabel='year'>
```



outlier removal- IQR method

Q1= df.year.quantile(0.25)

Q3=df.year.quantile(0.75)

IQR=Q3-Q1

upper_limit =Q3 + 1.5*IQR

lower_limit =Q1 - 1.5*IQR

upper_limit

```
In [36]: upper_limit
Out[36]: 2020.5
```

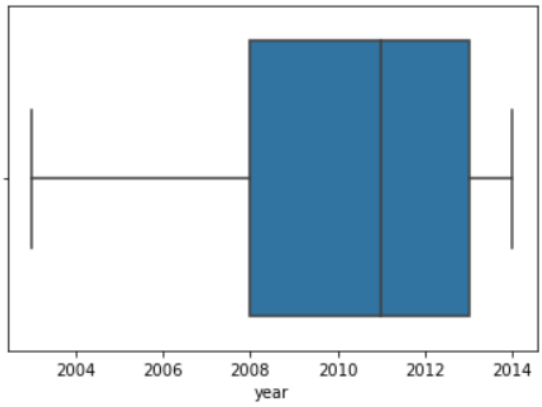
df=df[df.year<upper_limit]

sns.boxplot(df.year)

```
In [38]: sns.boxplot(df.year)
```

```
D:\anaconda\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass
the following variable as a keyword arg: x. From version 0.12, the only valid
positional argument will be `data`, and passing other arguments without an ex
plicit keyword will result in an error or misinterpretation.
  warnings.warn(
```

```
Out[38]: <AxesSubplot:xlabel='year'>
```



df.shape

```
In [39]: df.shape
Out[39]: (1991, 12)
```

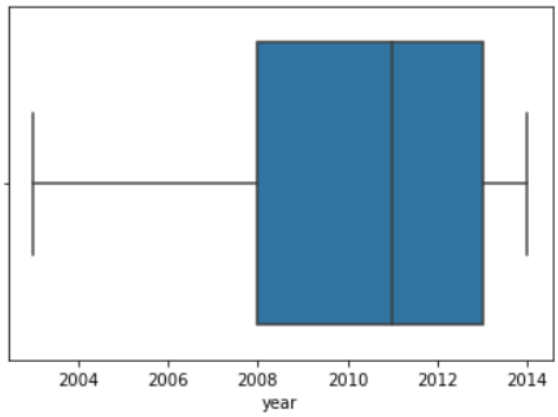
Outlier replacement using median

sns.boxplot(df.year)

```
In [40]: sns.boxplot(df.year)
```

```
D:\anaconda\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass
the following variable as a keyword arg: x. From version 0.12, the only valid
positional argument will be `data`, and passing other arguments without an ex
plicit keyword will result in an error or misinterpretation.
  warnings.warn(
```

```
Out[40]: <AxesSubplot:xlabel='year'>
```



df.median()

```
In [41]: df.median()
```

```
C:\Users\KRISHN~1\AppData\Local\Temp/ipykernel_3196/530051474.py:1: FutureWar
ning: Dropping of nuisance columns in DataFrame reductions (with 'numeric_onl
y=None') is deprecated; in a future version this will raise TypeError.  Selec
t only valid columns before calling the reduction.
  df.median()
```

```
Out[41]: Station_code     1861.0
         Do                  6.7
         Ph                  7.3
         Conductivity      183.0
         year             2011.0
         dtype: float64
```

Q1= df.year.quantile(0.25)

Q3=df.year.quantile(0.75)

IQR=Q3-Q1

upper_limit =Q3 + 1.5*IQR

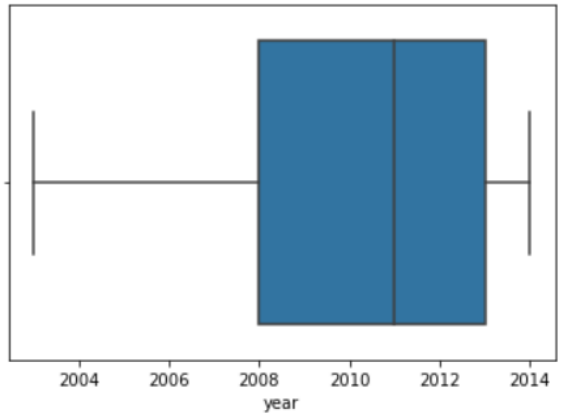
lower_limit =Q1 - 1.5*IQR

sns.boxplot(df.year)

```
In [45]: sns.boxplot(df.year)
```

```
D:\anaconda\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass
the following variable as a keyword arg: x. From version 0.12, the only valid
positional argument will be `data`, and passing other arguments without an ex
plicit keyword will result in an error or misinterpretation.
  warnings.warn(
```

```
Out[45]: <AxesSubplot:xlabel='year'>
```



df.shape

```
In [46]: df.shape
```

```
Out[46]: (1991, 12)
```

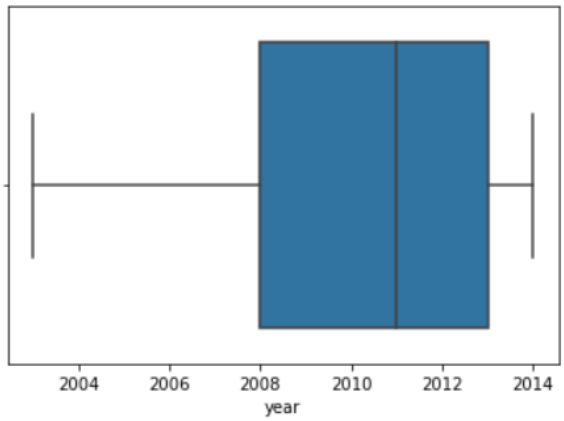
outlier removal- Percentile method

sns.boxplot(df.year)

```
In [47]: sns.boxplot(df.year)
```

```
D:\anaconda\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass
the following variable as a keyword arg: x. From version 0.12, the only valid
positional argument will be `data`, and passing other arguments without an ex
plicit keyword will result in an error or misinterpretation.
  warnings.warn(
```

```
Out[47]: <AxesSubplot:xlabel='year'>
```



p99= df.year.quantile(0.99)

p99

```
In [48]: p99= df.year.quantile(0.99)
         p99
```

```
Out[48]: 2014.0
```

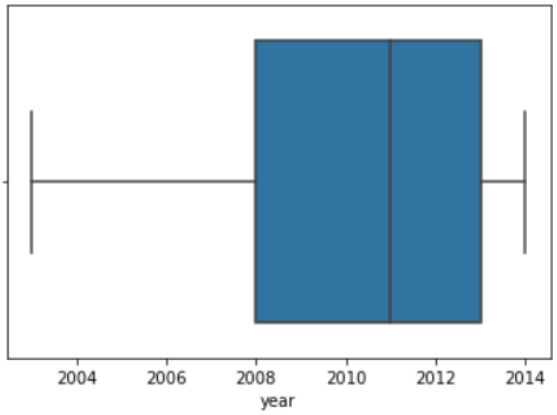
df = df[df.year<=p99]

sns.boxplot(df.year)

```
In [51]: sns.boxplot(df.year)
```

```
D:\anaconda\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass
the following variable as a keyword arg: x. From version 0.12, the only valid
positional argument will be `data`, and passing other arguments without an ex
plicit keyword will result in an error or misinterpretation.
  warnings.warn(
```

```
Out[51]: <AxesSubplot:xlabel='year'>
```



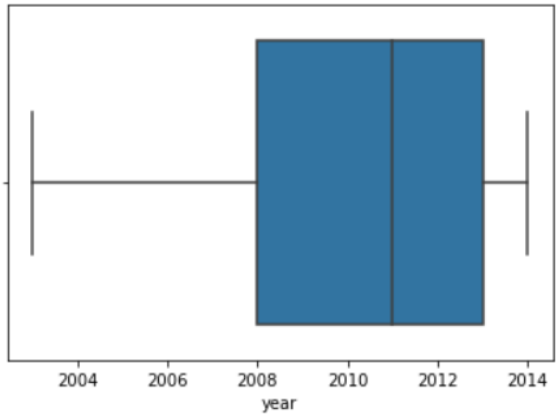
outlier removal- z-score

sns.boxplot(df.year)

```
In [52]: sns.boxplot(df.year)
```

```
D:\anaconda\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass
the following variable as a keyword arg: x. From version 0.12, the only valid
positional argument will be `data`, and passing other arguments without an ex
plicit keyword will result in an error or misinterpretation.
  warnings.warn(
```

```
Out[52]: <AxesSubplot:xlabel='year'>
```



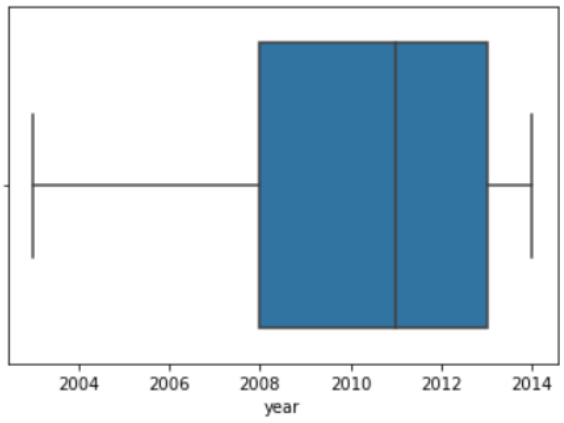
from scipy import stats

```
from scipy import stats

year_zscore = stats.zscore(df.year)

year_zscore
```

```
In [55]: year_zscore

Out[55]: 0       1.296170
         1       1.296170
         2       1.296170
         3       1.296170
         4       1.296170
                   ...
         1986   -2.302641
         1987   -2.302641
         1988   -2.302641
         1989   -2.302641
         1990   -2.302641
         Name: year, Length: 1991, dtype: float64
```

```
df_z = df[np.abs(year_zscore)<=3]

sns.boxplot(df_z.year)
```

```
In [57]: sns.boxplot(df_z.year)

         D:\anaconda\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass
         the following variable as a keyword arg: x. From version 0.12, the only valid
         positional argument will be `data`, and passing other arguments without an ex
         plicit keyword will result in an error or misinterpretation.
           warnings.warn(

Out[57]: <AxesSubplot:xlabel='year'>
```




```
df.head()
```

```
In [58]: df.head()
```

Out[58]:

	Station_code	Locations	State	Temp	Do	Ph	Conductivity	Bod	NITRATENAN N+ NITRITENANN	Fec
0	1393	DAMANGANGA AT D/S OF MADHUBAN, DAMAN	DAMAN & DIU	30.6	6.7	7.5	203	NAN	0.1	
1	1399	ZUARI AT D/S OF PT. WHERE KUMBARJRIA CANAL JOI...	GOA	29.8	5.7	7.2	189	2	0.2	
2	1475	ZUARI AT PANCHAWADI	GOA	29.5	6.3	6.9	179	1.7	0.1	
3	3181	RIVER ZUARI AT BORIM BRIDGE	GOA	29.7	5.8	6.9	64	3.8	0.5	
4	3182	RIVER ZUARI AT MARCAIM JETTY	GOA	29.5	5.8	7.3	83	1.9	0.4	

Encoding Techniques

1.Label Encoding¶

```
from sklearn.preprocessing import LabelEncoder

le=LabelEncoder()

df.head()
```

```
In [61]: df.head()
```

Out[61]:

	Station_code	Locations	State	Temp	Do	Ph	Conductivity	Bod	NITRATENAN N+ NITRITENANN	Fec
0	1393	DAMANGANGA AT D/S OF MADHUBAN, DAMAN	DAMAN & DIU	30.6	6.7	7.5	203	NAN	0.1	
1	1399	ZUARI AT D/S OF PT. WHERE KUMBARJRIA CANAL JOI...	GOA	29.8	5.7	7.2	189	2	0.2	
2	1475	ZUARI AT PANCHAWADI	GOA	29.5	6.3	6.9	179	1.7	0.1	
3	3181	RIVER ZUARI AT BORIM BRIDGE	GOA	29.7	5.8	6.9	64	3.8	0.5	
4	3182	RIVER ZUARI AT MARCAIM JETTY	GOA	29.5	5.8	7.3	83	1.9	0.4	

2.One hot Encoding¶

df_main=pd.get_dummies(df,columns=['Station_code'])

df_main.head()

```
In [62]: df_main=pd.get_dummies(df,columns=['Station_code'])
         df_main.head()
```

Out[62]:

	Locations	State	Temp	Do	Ph	Conductivity	Bod	NITRATENAN N+ NITRITENANN	Fecal_coliform	Tc
0	DAMANGANGA AT D/S OF MADHUBAN, DAMAN	DAMAN & DIU	30.6	6.7	7.5	203	NAN	0.1	11	
1	ZUARI AT D/S OF PT. WHERE KUMBARJRIA CANAL JOI...	GOA	29.8	5.7	7.2	189	2	0.2	4953	
2	ZUARI AT PANCHAWADI	GOA	29.5	6.3	6.9	179	1.7	0.1	3243	
3	RIVER ZUARI AT BORIM BRIDGE	GOA	29.7	5.8	6.9	64	3.8	0.5	5382	
4	RIVER ZUARI AT MARCAIM JETTY	GOA	29.5	5.8	7.3	83	1.9	0.4	3428	

5 rows × 332 columns

df_main.describe()

```
In [63]: df_main.describe()
```

Out[63]:

	year	Station_code_1023	Station_code_1024	Station_code_1025	Station_code_102
count	1991.000000	1991.000000	1991.000000	1991.000000	1991.00000(
mean	2010.038172	0.004520	0.004520	0.004520	0.00452(
std	3.057333	0.067098	0.067098	0.067098	0.06709{
min	2003.000000	0.000000	0.000000	0.000000	0.00000(
25%	2008.000000	0.000000	0.000000	0.000000	0.00000(
50%	2011.000000	0.000000	0.000000	0.000000	0.00000(
75%	2013.000000	0.000000	0.000000	0.000000	0.00000(
max	2014.000000	1.000000	1.000000	1.000000	1.00000(

8 rows × 322 columns

df_main.corr()

In [64]:
```
df_main.corr()
```

Out[64]:

	year	Station_code_1023	Station_code_1024	Station_code_1025	Station_
year	1.000000	-0.000842	-0.000842	-0.000842	
Station_code_1023	-0.000842	1.000000	-0.004541	-0.004541	
Station_code_1024	-0.000842	-0.004541	1.000000	-0.004541	
Station_code_1025	-0.000842	-0.004541	-0.004541	1.000000	
Station_code_1026	-0.000842	-0.004541	-0.004541	-0.004541	
...	...	...	...	...	
Station_code_3471	0.037643	-0.002618	-0.002618	-0.002618	
Station_code_3473	0.037643	-0.002618	-0.002618	-0.002618	
Station_code_42	-0.017159	-0.004788	-0.004788	-0.004788	
Station_code_43	-0.017159	-0.004788	-0.004788	-0.004788	
Station_code_NAN	-0.411536	-0.017216	-0.017216	-0.017216	

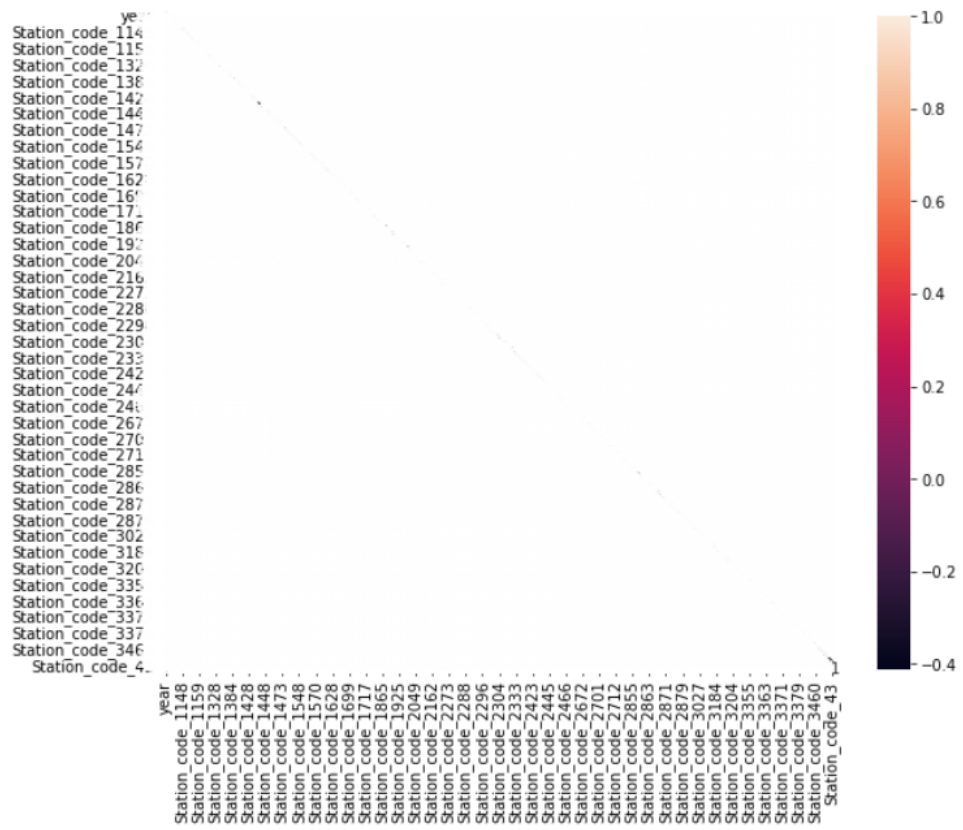
322 rows × 322 columns

plt.figure(figsize=(10,8))

sns.heatmap(df_main.corr(),annot=True)

```
In [74]: plt.figure(figsize=(10,8))
         sns.heatmap(df_main.corr(),annot=True)
```

```
Out[74]: <AxesSubplot:>
```



df_main.corr().year.sort_values(ascending=False)

```
In [66]: df_main.corr().year.sort_values(ascending=False)
```

```
Out[66]: year                1.000000
         Station_code_3182    0.037643
         Station_code_3186    0.037643
         Station_code_3187    0.037643
         Station_code_3181    0.037643
                                 ...
         Station_code_1246   -0.036832
         Station_code_1438   -0.045161
         Station_code_1861   -0.045161
         Station_code_1435   -0.049874
         Station_code_NAN    -0.411536
         Name: year, Length: 322, dtype: float64
```

df_main.head()

In [67]:
```
df_main.head()
```

Out[67]:

	Locations	State	Temp	Do	Ph	Conductivity	Bod	NITRATENAN N+ NITRITENANN	Fecal_coliform	Tc
0	DAMANGANGA AT D/S OF MADHUBAN, DAMAN	DAMAN & DIU	30.6	6.7	7.5	203	NAN	0.1	11	
1	ZUARI AT D/S OF PT. WHERE KUMBARJRIA CANAL JOI...	GOA	29.8	5.7	7.2	189	2	0.2	4953	
2	ZUARI AT PANCHAWADI	GOA	29.5	6.3	6.9	179	1.7	0.1	3243	
3	RIVER ZUARI AT BORIM BRIDGE	GOA	29.7	5.8	6.9	64	3.8	0.5	5382	
4	RIVER ZUARI AT MARCAIM JETTY	GOA	29.5	5.8	7.3	83	1.9	0.4	3428	

5 rows × 332 columns

X and y split

```
# independent varibles-X


X=df_main.drop(columns=['Bod'],axis=1)

X.head()
```

In [75]:
```
# independent varibles-X

X=df_main.drop(columns=['Bod'],axis=1)
X.head()
```

Out[75]:

	Locations	State	Temp	Do	Ph	Conductivity	NITRATENAN N+ NITRITENANN	Fecal_coliform	Total_cc
0	DAMANGANGA AT D/S OF MADHUBAN, DAMAN	DAMAN & DIU	30.6	6.7	7.5	203	0.1	11	
1	ZUARI AT D/S OF PT. WHERE KUMBARJRIA CANAL JOI...	GOA	29.8	5.7	7.2	189	0.2	4953	
2	ZUARI AT PANCHAWADI	GOA	29.5	6.3	6.9	179	0.1	3243	
3	RIVER ZUARI AT BORIM BRIDGE	GOA	29.7	5.8	6.9	64	0.5	5382	
4	RIVER ZUARI AT MARCAIM JETTY	GOA	29.5	5.8	7.3	83	0.4	3428	

5 rows × 331 columns

y target-dependent variable

y=df_main.Bod

In [69]:
```
# y target-dependent variable


y=df_main.Bod
y
```

Out[69]:
```
0        NAN
1          2
2        1.7
3        3.8
4        1.9
       ...
1986     2.7
1987     2.6
1988     1.2
1989     1.3
1990     1.1
Name: Bod, Length: 1991, dtype: object
```

X.head()

In [71]:
```
X.head()
```

Out[71]:

	Locations	State	Temp	Do	Ph	Conductivity	NITRATENAN N+ NITRITENANN	Fecal_coliform	Total_cc
0	DAMANGANGA AT D/S OF MADHUBAN, DAMAN	DAMAN & DIU	30.6	6.7	7.5	203	0.1	11	
1	ZUARI AT D/S OF PT. WHERE KUMBARJRIA CANAL JOI...	GOA	29.8	5.7	7.2	189	0.2	4953	
2	ZUARI AT PANCHAWADI	GOA	29.5	6.3	6.9	179	0.1	3243	
3	RIVER ZUARI AT BORIM BRIDGE	GOA	29.7	5.8	6.9	64	0.5	5382	
4	RIVER ZUARI AT MARCAIM JETTY	GOA	29.5	5.8	7.3	83	0.4	3428	

5 rows × 331 columns

scaling

```
from sklearn.preprocessing import scale
```

```
from sklearn.preprocessing import scale
```

```
X=pd.DataFrame(scale(X),columns=X.columns)
```

```
X.head()
```

Train test split

```
from sklearn.preprocessing import scale
```

```
from sklearn.model_selection import train_test_split
```

```
X_train,X_test,y_train,y_test =train_test_split(X_scaled,y, test_size=0.3,random_state=0)
```

```
X_train
```

```
X_train.shape
```

```
y_train.shape
```

```
X_test
```

```
X_test.shape
```