b-2-air

March 4, 2025

0.0.1 Operations:

a. Data cleaning
b. Data integration
c. Data transformation
d. Error correcting

[1]:
```
import pandas as pd
import numpy as np
```

[2]:
```
df = pd.read_csv('airquality_data.csv', encoding='cp1252')
```

```
C:\Users\Kumbh\AppData\Local\Temp\ipykernel_692\2182913842.py:1: DtypeWarning:
Columns (0) have mixed types. Specify dtype option on import or set
low_memory=False.
  df = pd.read_csv('airquality_data.csv', encoding='cp1252')
```

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

[3]:

	stn_code	sampling_date	state	location	agency	type	so2	no2	rspm	spm	location_monitoring_station	pm2_5	date
0	150.0	February - M021990	Andhra Pradesh	Hyderabad	NaN	Residential, Rural and other Areas	4.8	17.4	NaN	NaN	NaN	NaN	1990-02-01
1	151.0	February - M021990	Andhra Pradesh	Hyderabad	NaN	Industrial Area	3.1	7.0	NaN	NaN	NaN	NaN	1990-02-01
2	152.0	February - M021990	Andhra Pradesh	Hyderabad	NaN	Residential, Rural and other Areas	6.2	28.5	NaN	NaN	NaN	NaN	1990-02-01
3	150.0	March - M031990	Andhra Pradesh	Hyderabad	NaN	Residential, Rural and other Areas	6.3	14.7	NaN	NaN	NaN	NaN	1990-03-01
4	151.0	March - M031990	Andhra Pradesh	Hyderabad	NaN	Industrial Area	4.7	7.5	NaN	NaN	NaN	NaN	1990-03-01

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

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 435742 entries, 0 to 435741
Data columns (total 13 columns):
 #   Column                        Non-Null Count   Dtype  
---  ------                        --------------   -----  
 0   stn_code                      291665 non-null  object 
 1   sampling_date                 435739 non-null  object 
 2   state                         435742 non-null  object 
 3   location                      435739 non-null  object 
 4   agency                        286261 non-null  object 
 5   type                          430349 non-null  object 
 6   so2                           401096 non-null  float64
 7   no2                           419509 non-null  float64
 8   rspm                          395520 non-null  float64
 9   spm                           198355 non-null  float64
 10  location_monitoring_station   408251 non-null  object 
 11  pm2_5                         9314 non-null    float64
 12  date                          435735 non-null  object 
dtypes: float64(5), object(8)
memory usage: 43.2+ MB
```

[5]:
```
df.columns
```

[5]:
```
Index(['stn_code', 'sampling_date', 'state', 'location', 'agency', 'type',
       'so2', 'no2', 'rspm', 'spm', 'location_monitoring_station', 'pm2_5',
       'date'],
      dtype='object')
```

0.0.2 Data Cleaning

[6]:
```
# Change data type from float64 to float32 for Space Complexity
df['so2'] = df['so2'].astype('float32')
df['no2'] = df['no2'].astype('float32')
df['rspm'] = df['rspm'].astype('float32')
df['spm'] = df['spm'].astype('float32')
df['date'] = df['date'].astype('string')

df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 435742 entries, 0 to 435741
Data columns (total 13 columns):
 #   Column                        Non-Null Count   Dtype  
---  ------                        --------------   -----  
 0   stn_code                      291665 non-null  object 
```

```
 1   sampling_date                435739 non-null  object
 2   state                        435742 non-null  object
 3   location                     435739 non-null  object
 4   agency                       286261 non-null  object
 5   type                         430349 non-null  object
 6   so2                          401096 non-null  float32
 7   no2                          419509 non-null  float32
 8   rspm                         395520 non-null  float32
 9   spm                          198355 non-null  float32
 10  location_monitoring_station  408251 non-null  object
 11  pm2_5                        9314 non-null    float64
 12  date                         435735 non-null  string
dtypes: float32(4), float64(1), object(7), string(1)
memory usage: 36.6+ MB
```

[7]:
```
df=df.drop_duplicates()
```

[8]:
```
df.isna().sum()
```

[8]:
```
stn_code                     144077
sampling_date                     3
state                             0
location                          3
agency                       149466
type                           5357
so2                           34632
no2                           16222
rspm                          40035
spm                          236908
location_monitoring_station   27303
pm2_5                        425754
date                              7
dtype: int64
```

[9]:
```
percent_missing = df.isnull().sum() * 100 / len(df)
```

[10]:
```
percent_missing.sort_values(ascending=False)
```

[10]:
```
pm2_5                        97.859185
spm                          54.453097
agency                       34.354630
stn_code                     33.115973
rspm                          9.202010
so2                           7.960135
location_monitoring_station   6.275571
no2                           3.728613
type                          1.231302
```

```
date                            0.001609
sampling_date                   0.000690
location                        0.000690
state                           0.000000
dtype: float64
```

[11]:
```
df=df.drop(['stn_code',␣
 ↪'agency','sampling_date','location_monitoring_station','pm2_5'], axis = 1)
```

[12]:
```
df.head()
```

[12]:

	state	location	type	so2	no2	rspm	spm	date
0	Andhra Pradesh	Hyderabad	Residential, Rural and other Areas	4.8	17.4	NaN	NaN	1990-02-01
1	Andhra Pradesh	Hyderabad	Industrial Area	3.1	7.0	NaN	NaN	1990-02-01
2	Andhra Pradesh	Hyderabad	Residential, Rural and other Areas	6.2	28.5	NaN	NaN	1990-02-01
3	Andhra Pradesh	Hyderabad	Residential, Rural and other Areas	6.3	14.7	NaN	NaN	1990-03-01
4	Andhra Pradesh	Hyderabad	Industrial Area	4.7	7.5	NaN	NaN	1990-03-01

[13]:
```
df.columns
```

[13]:
```
Index(['state', 'location', 'type', 'so2', 'no2', 'rspm', 'spm', 'date'],
dtype='object')
```

[14]:
```
col_var = ['state', 'location', 'type','date']
col_num = ['so2','no2','rspm','spm']
```

[15]:
```
for col in df.columns:
    if df[col].dtype == 'object' or df[col].dtype == 'string':
        df[col] = df[col].fillna(df[col].mode()[0])
    else:
        df[col] = df[col].fillna(df[col].mean())
```

[16]:
```
df.isna().sum()
```

[16]:
```
state       0
location    0
type        0
so2         0
no2         0
rspm        0
```

```
spm         0
date        0
dtype: int64
```

[17]:
```
df
```

[17]:
```
                             state   location  \
0                   Andhra Pradesh  Hyderabad
1                   Andhra Pradesh  Hyderabad
2                   Andhra Pradesh  Hyderabad
3                   Andhra Pradesh  Hyderabad
4                   Andhra Pradesh  Hyderabad
…                                 …         …
435737                 West Bengal   ULUBERIA
435738                 West Bengal   ULUBERIA
435739  andaman-and-nicobar-islands   Guwahati
435740                 Lakshadweep   Guwahati
435741                     Tripura   Guwahati

                                      type        so2        no2        rspm  \
0       Residential, Rural and other Areas   4.800000  17.400000  108.871712
1                           Industrial Area   3.100000   7.000000  108.871712
2       Residential, Rural and other Areas   6.200000  28.500000  108.871712
3       Residential, Rural and other Areas   6.300000  14.700000  108.871712
4                           Industrial Area   4.700000   7.500000  108.871712
…                                       …         …          …          …
435737                                RIRUO  22.000000  50.000000  143.000000
435738                                RIRUO  20.000000  46.000000  171.000000
435739  Residential, Rural and other Areas  10.830467  25.823299  108.871712
435740  Residential, Rural and other Areas  10.830467  25.823299  108.871712
435741  Residential, Rural and other Areas  10.830467  25.823299  108.871712

              spm        date
0       220.774796  1990-02-01
1       220.774796  1990-02-01
2       220.774796  1990-02-01
3       220.774796  1990-03-01
4       220.774796  1990-03-01
…              …           …
435737  220.774796  2015-12-24
435738  220.774796  2015-12-29
435739  220.774796  2015-03-19
435740  220.774796  2015-03-19
435741  220.774796  2015-03-19

[435068 rows x 8 columns]
```

[18]:
```
df.isna().sum()
```

[18]:
```
state       0
location    0
type        0
so2         0
no2         0
rspm        0
spm         0
date        0
dtype: int64
```

1 Data integration

[19]:
```
subSet1 = df[['state', 'type']]
subSet2 = df[['state','location']]
```

[20]:
```
subSet1.head()
```

[20]:

	state	type
0	Andhra Pradesh	Residential, Rural and other Areas
1	Andhra Pradesh	Industrial Area
2	Andhra Pradesh	Residential, Rural and other Areas
3	Andhra Pradesh	Residential, Rural and other Areas
4	Andhra Pradesh	Industrial Area

[21]:
```
subSet2.head()
```

[21]:

	state	location
0	Andhra Pradesh	Hyderabad
1	Andhra Pradesh	Hyderabad
2	Andhra Pradesh	Hyderabad
3	Andhra Pradesh	Hyderabad
4	Andhra Pradesh	Hyderabad

[22]:
```
concatenated_df = pd.concat([subSet1, subSet2], axis=1)
```

[23]:
```
concatenated_df
```

[23]:

	state	type	\
0	Andhra Pradesh	Residential, Rural and other Areas	
1	Andhra Pradesh	Industrial Area	
2	Andhra Pradesh	Residential, Rural and other Areas	
3	Andhra Pradesh	Residential, Rural and other Areas	
4	Andhra Pradesh	Industrial Area	
…	…	…	

```
435737                  West Bengal                                RIRUO
435738                  West Bengal                                RIRUO
435739  andaman-and-nicobar-islands  Residential, Rural and other Areas
435740                  Lakshadweep  Residential, Rural and other Areas
435741                      Tripura  Residential, Rural and other Areas

                             state   location
0                    Andhra Pradesh  Hyderabad
1                    Andhra Pradesh  Hyderabad
2                    Andhra Pradesh  Hyderabad
3                    Andhra Pradesh  Hyderabad
4                    Andhra Pradesh  Hyderabad
…                               …        …
435737                  West Bengal   ULUBERIA
435738                  West Bengal   ULUBERIA
435739  andaman-and-nicobar-islands   Guwahati
435740                  Lakshadweep   Guwahati
435741                      Tripura   Guwahati

[435068 rows x 4 columns]
```

1.0.1 Error Correcting

[24]:
```python
def remove_outliers(column):
    Q1 = column.quantile(0.25)
    Q3 = column.quantile(0.75)
    IQR = Q3 - Q1
    threshold = 1.5 * IQR
    outlier_mask = (column < Q1 - threshold) | (column > Q3 + threshold)
    return column[~outlier_mask]
```

[25]:
```python
df.columns
```

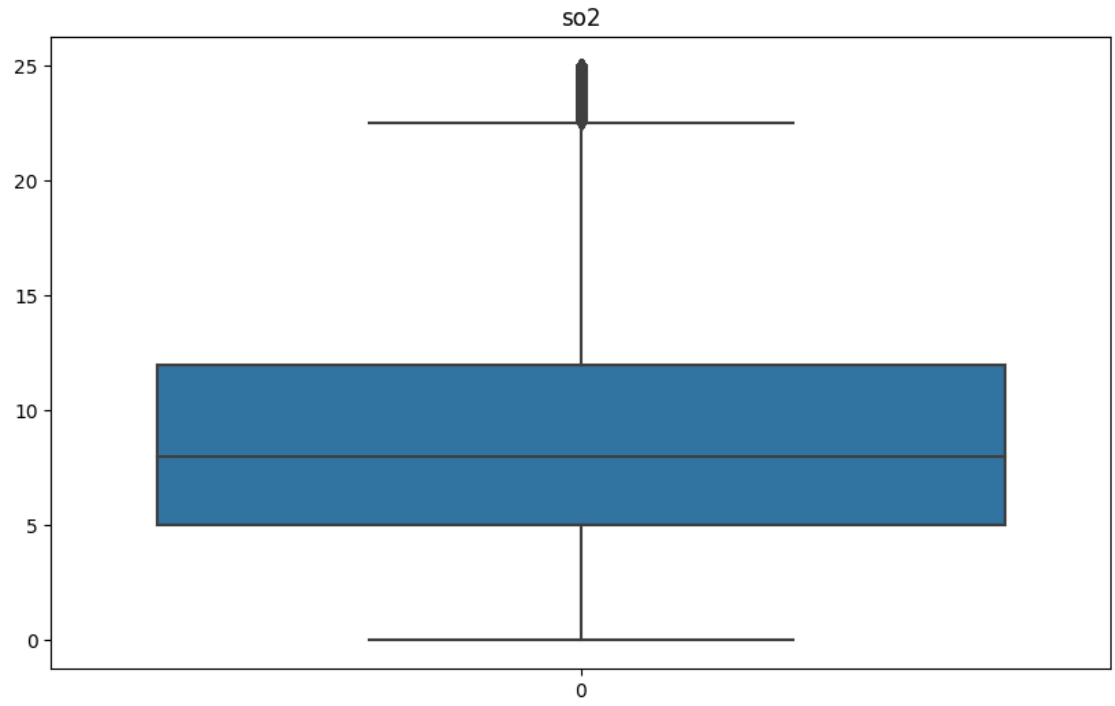
[25]:
```
Index(['state', 'location', 'type', 'so2', 'no2', 'rspm', 'spm', 'date'],
dtype='object')
```

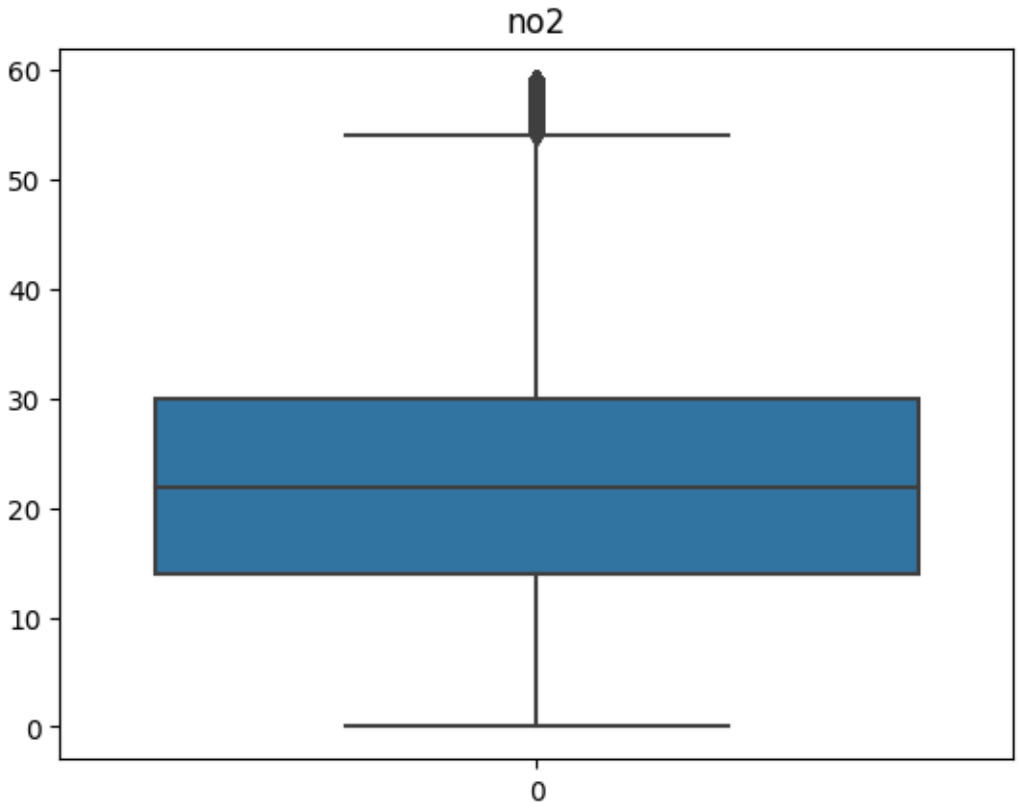
[26]:
```python
# Remove outliers for each column using a loop
col_name = ['so2', 'no2', 'rspm', 'spm']
for col in col_name:
    df[col] = remove_outliers(df[col])
```

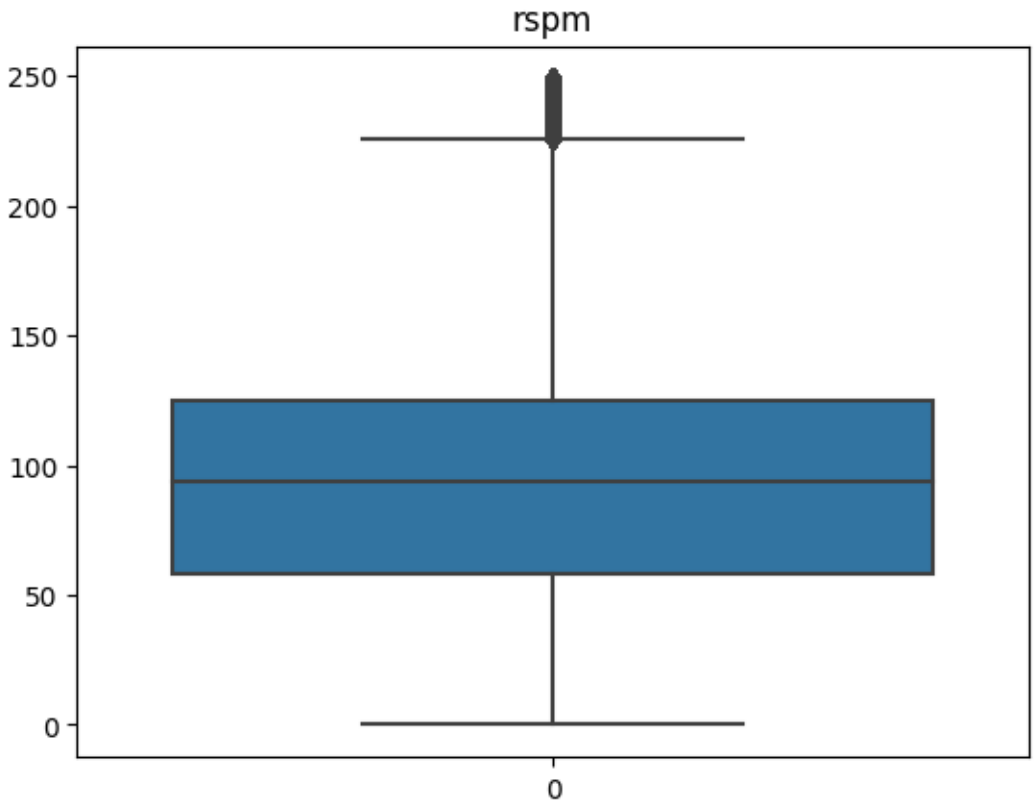
[27]:
```python
import seaborn as sns
import matplotlib.pyplot as plt
```

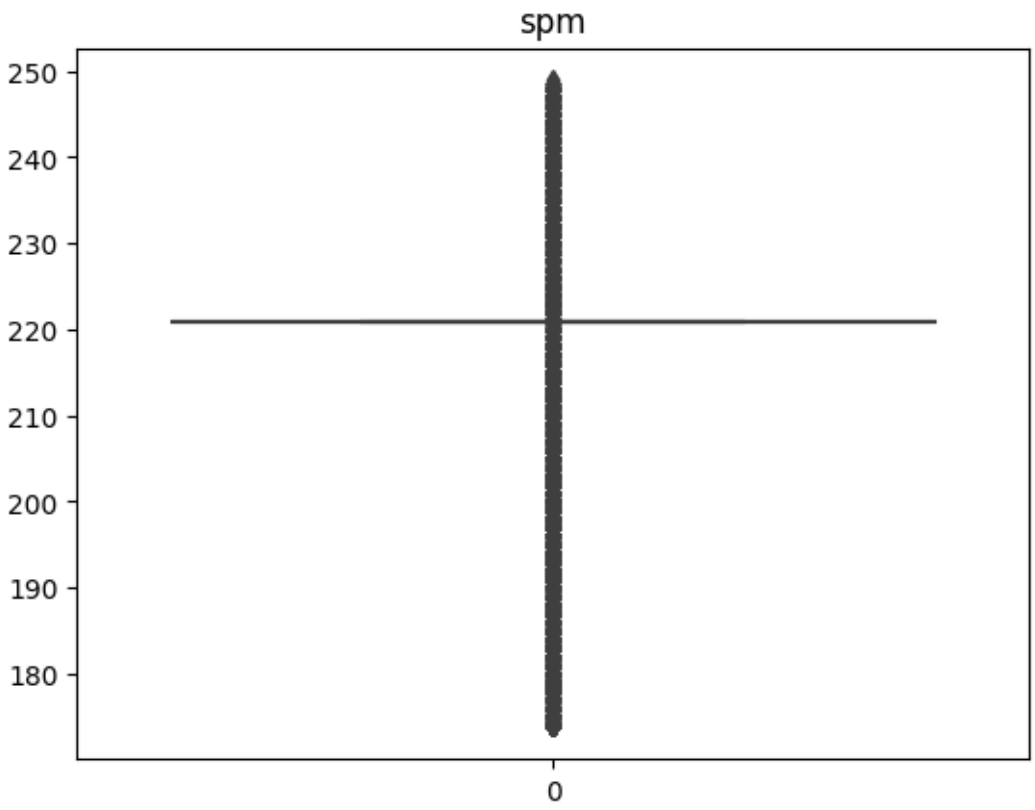
[28]:
```python
plt.figure(figsize=(10, 6))  # Adjust the figure size if needed

for col in col_name:
```

```
    sns.boxplot(data=df[col])
    plt.title(col)
    plt.show()
```




no2
60
50
40
30
20
10
0
0


rspm
250
200
150
100
50
0
0



1.1 Data Transform

[29]:
```
from sklearn.preprocessing import LabelEncoder

col_label= ['state','location','type']
# Initialize LabelEncoder

encoder = LabelEncoder()
# Iterate over columns
for col in df.columns:
        # Fit and transform the column
        df[col] = encoder.fit_transform(df[col])
```

[30]:
```
df
```

[30]:

	state	location	type	so2	no2	rspm	spm	date
0	0	114	6	446	1489	2030	464	213
1	0	114	1	197	250	2030	464	213
2	0	114	6	790	3096	2030	464	213
3	0	114	6	823	1144	2030	464	214
4	0	114	1	427	301	2030	464	214

```
…        …        …    …    …    …    …   …    …
435737     35       282     3  2888  5307  2534  464  5059
435738     35       282     3  2809  5113  3098  464  5064
435739     36       100     6  1638  2696  2030  464  4779
435740     17       100     6  1638  2696  2030  464  4779
435741     31       100     6  1638  2696  2030  464  4779

[435068 rows x 8 columns]
```

[ ]: