IC 272: DATA SCIENCE - III
LAB ASSIGNMENT - II
Data cleaning – handling missing values and outlier analyses

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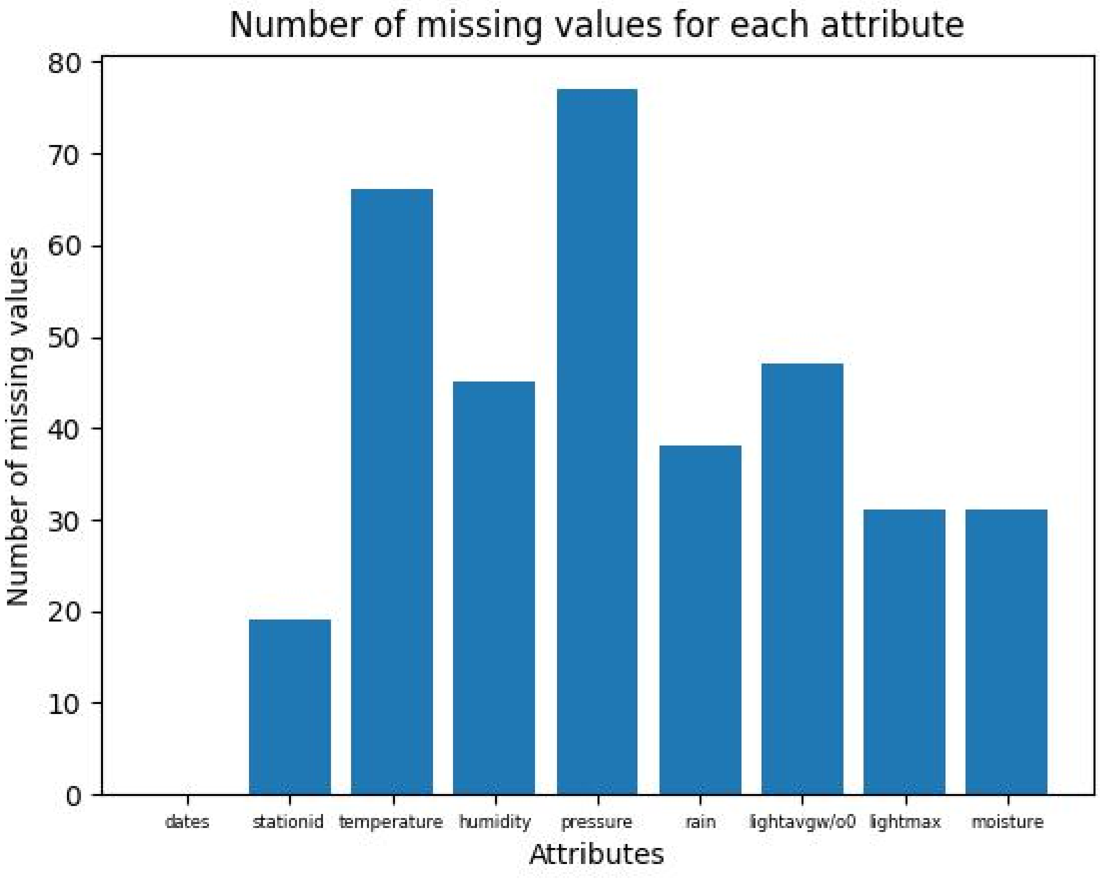


Figure 1 Number of missing values vs. attributes

Inferences:

1. The attribute ‘pressure’ has the highest number of missing values while the attribute ‘dates’ has the lowest number of missing values.

2. We see that temperature and pressure have high number of missing values (66 and 77 respectively). Humidity. Rain, ghtavgw/o0, ghtmax and moisture have moderate number of missing values (45,38,47,31 and 31 respectively) while dates and stationid have low number of missing values (0 and 19 respectively)

2 a.

Inferences:

1. We usually delete the tuples with missing value of the target attribute because our main concern in data is of this attribute. So if any row has missing value in this attribute, there is no point in doing calculations and taking that row into consideration.
2. A total of 19 tuples had to be deleted from the data-set.
3. 2% of the total number of tuples have been deleted

b.

Inferences:

1. 35 tuples have been deleted in this step.
2. 3.78% of the total number of tuples have been deleted.
3. Comment on the data loss
4. Since these rows contained very low amount of data, they are almost useless, as taking them into consideration will change the net properties of non missing attributes in these and also require extra time for computation. So we delete these kind of rows

3

Table 1 Number of missing values per attribute after removing missing values

S. No	Attribute	Number of missing values	Percentage of missing values
1	dates	0	0%
2	stationid	0	0%
3	temperature (in °C)	34	3.6%
4	humidity (in g.m^{-3})	13	1.37%
5	pressure (in mb)	41	4.334%

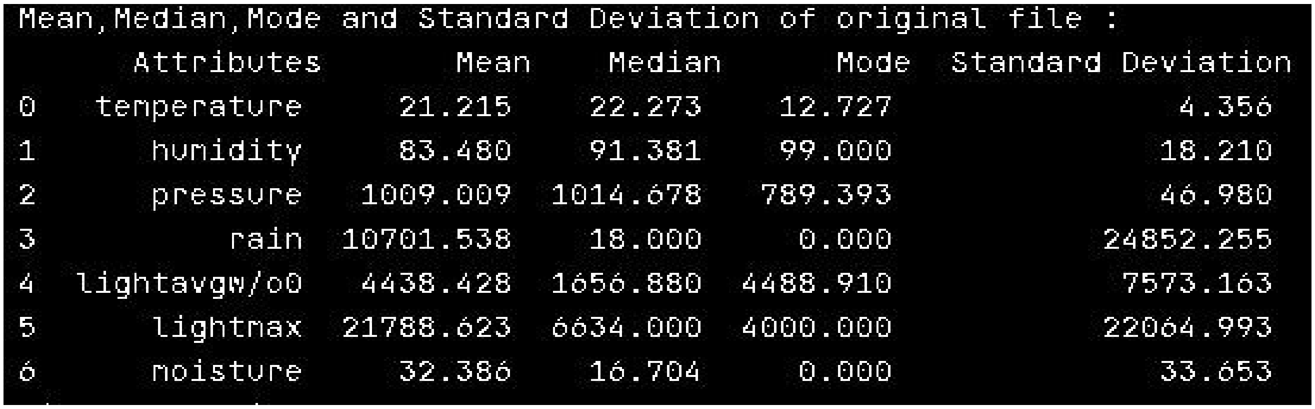
6	rain (in ml)	6	0.634%
7	lightavgw/o0 (in lux)	15	1.585%
8	lightmax (in lux)	1	0.1%
9	moisture (in %)	6	0.634%

Inferences:

1. ‘pressure’ has maximum number of missing values. ‘dates’ and ‘stationid’ have minimum number of missing values.
2. The file has 116 missing values.

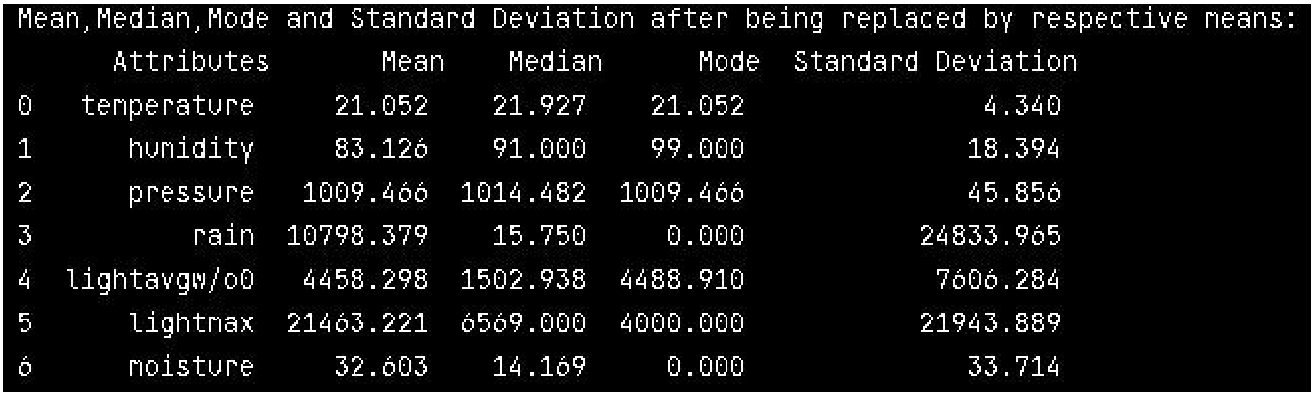
4 a. i.

Table 2 Mean, mode, median and standard deviation before and after replacing missing values by mean



```
Mean,Median,Mode and Standard Deviation of original file :
      Attributes       Mean     Median       Mode  Standard Deviation
0    temperature     21.215     22.273     12.727               4.356
1       humidity     83.480     91.381     99.000              18.210
2       pressure   1009.009   1014.678    789.393              46.980
3           rain  10701.538     18.000      0.000           24852.255
4    lightavgw/o0   4438.428   1656.880   4488.910            7573.163
5       lightmax  21788.623   6634.000   4000.000           22064.993
6       moisture     32.386     16.704      0.000              33.653
```

Before

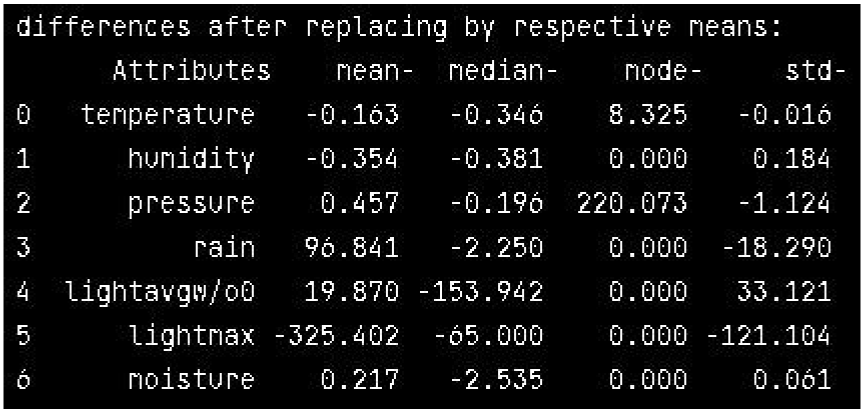


```
Mean,Median,Mode and Standard Deviation after being replaced by respective means:
      Attributes        Mean     Median       Mode  Standard Deviation
0   temperature     21.052     21.927     21.052               4.340
1      humidity     83.126     91.000     99.000              18.394
2      pressure   1009.466   1014.482   1009.466              45.856
3          rain  10798.379     15.750      0.000           24833.965
4  lightavgw/o0   4458.298   1502.938   4488.910            7606.284
5      lightmax  21463.221   6569.000   4000.000           21943.889
6      moisture     32.603     14.169      0.000              33.714
```

After

Inferences:

Differences in the properties after replacing the missing values by respective means:



```
differences after replacing by respective means:
      Attributes    mean-   median-    mode-     std-
0   temperature   -0.163   -0.346    8.325   -0.016
1      humidity   -0.354   -0.381    0.000    0.184
2      pressure    0.457   -0.196  220.073   -1.124
3          rain   96.841   -2.250    0.000  -18.290
4  lightavgw/o0   19.870 -153.942    0.000   33.121
5      lightmax -325.402  -65.000    0.000 -121.104
6      moisture    0.217   -2.535    0.000    0.061
```

1. Attributes having the maximum and the minimum change :

Property	Attribute having max change	Attribute having min change
Mean	lightmax	temperature
Median	lightavgw/o0	pressure
Mode	pressure	All except temperature
Standard Deviation	lightmax	temperature

2. Pressure had most number of missing values and it showed minimum change in median and maximum change in mode. Lightmax had least number of missing values and it showed maximum

change in mean and standard deviation and minimum change in mode. It doesn't seem a good relation.

3. The change observed in almost all attribute is significantly high for at least one property so the data is not fully reliable for further experimental analysis.

ii.

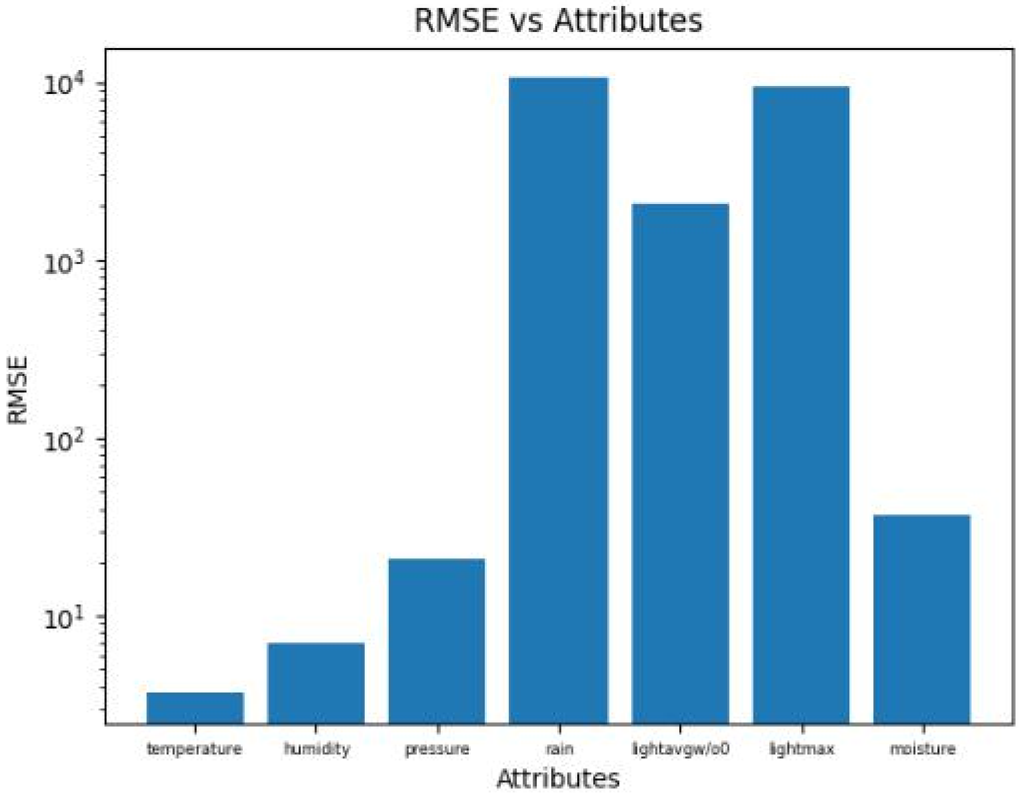


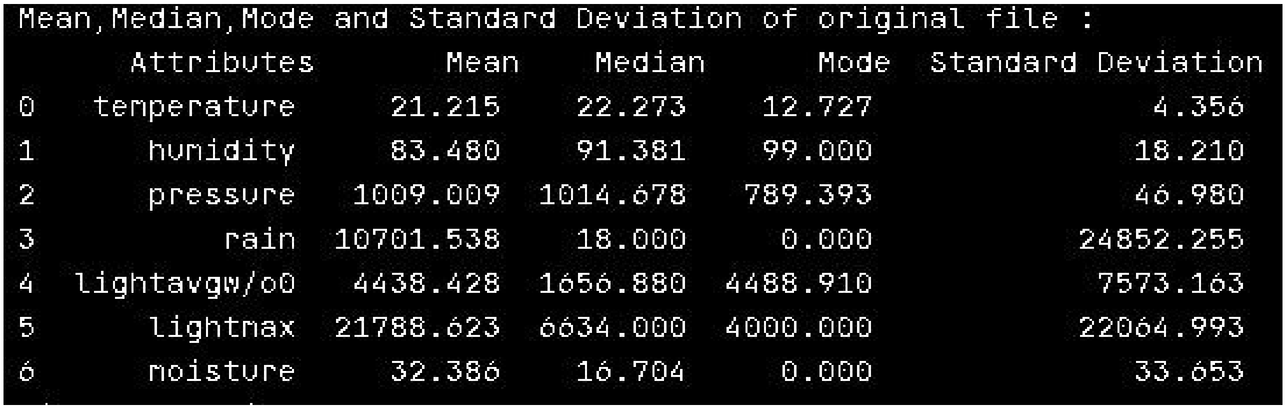
Figure 2 RMSE vs. attributes

Inferences:

1. The attributes rain and temperature have maximum and minimum RMSE values respectively.
2. Rain had neither any maximum nor minimum change in any property but here it shows maximum RMSE value. Some attributes like pressure had highest change in some properties but they show very less change in RMSE. Pressure had most missing value but very less change in RMSE. So there is no appreciable relation.
3. Since many attributes show high RMSE values, the data is not so reliable for further analysis.

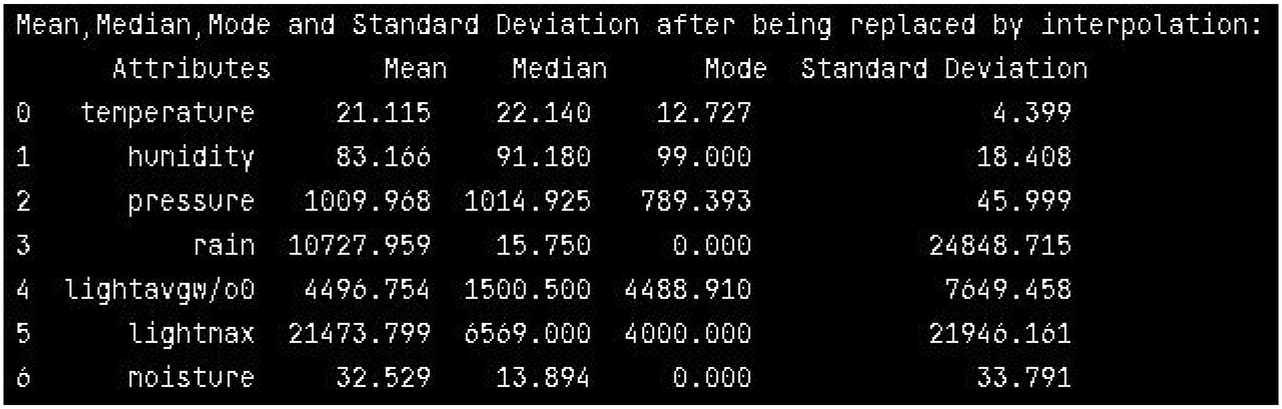
b. i.

Table 3 Mean, mode, median and standard deviation before and after replacing missing values by linear interpolation technique



```
Mean,Median,Mode and Standard Deviation of original file :
       Attributes       Mean     Median       Mode  Standard Deviation
0   temperature     21.215     22.273     12.727               4.356
1      humidity     83.480     91.381     99.000              18.210
2      pressure   1009.009   1014.678    789.393              46.980
3          rain  10701.538     18.000      0.000           24852.255
4  lightavgw/o0   4438.428   1656.880   4488.910            7573.163
5      lightmax  21788.623   6634.000   4000.000           22064.993
6      moisture     32.386     16.704      0.000              33.653
```

Before

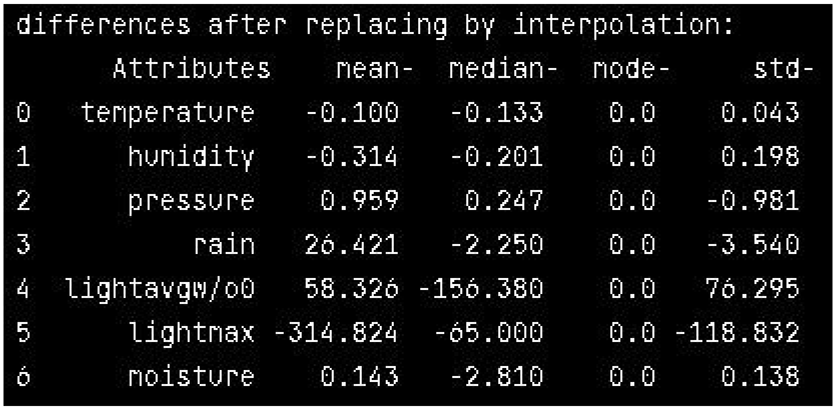


```
Mean,Median,Mode and Standard Deviation after being replaced by interpolation:
       Attributes       Mean     Median       Mode  Standard Deviation
0   temperature     21.115     22.140     12.727               4.399
1      humidity     83.166     91.180     99.000              18.408
2      pressure   1009.968   1014.925    789.393              45.999
3          rain  10727.959     15.750      0.000           24848.715
4  lightavgw/o0   4496.754   1500.500   4488.910            7649.458
5      lightmax  21473.799   6569.000   4000.000           21946.161
6      moisture     32.529     13.894      0.000              33.791
```

After

Inferences:

Differences in the properties after replacing the missing values by interpolation:



```
differences after replacing by interpolation:
      Attributes    mean-  median-  mode-     std-
0    temperature   -0.100   -0.133    0.0    0.043
1       humidity   -0.314   -0.201    0.0    0.198
2       pressure    0.959    0.247    0.0   -0.981
3           rain   26.421   -2.250    0.0   -3.540
4  lightavgw/o0    58.326 -156.380    0.0   76.295
5       lightmax -314.824  -65.000    0.0 -118.832
6       moisture    0.143   -2.810    0.0    0.138
```

1. Attributes having the maximum and the minimum change :

Property	**Attribute having max change**	**Attribute having min change**
Mean	lightmax	temperature
Median	lightavgw/o0	temperature
Mode	All show no change	All show no change
Standard Deviation	lightmax	temperature

1. Temperature shows least change in all properties and it has 2nd highest number of missing values, but pressure, which has most number of missing values shows a significant amount of change in all the attributes. This shows that there is no appreciable relation.
2. The change observed in properties is low as compared to mean for most of the attributes, and that’s why it can be taken as a little reliable for further investigation.
3. Almost all attributes except lightavgw/o0 show less change in the properties than the previous case.
4. Inference 5(You may add or delete the number of inferences)

ii.

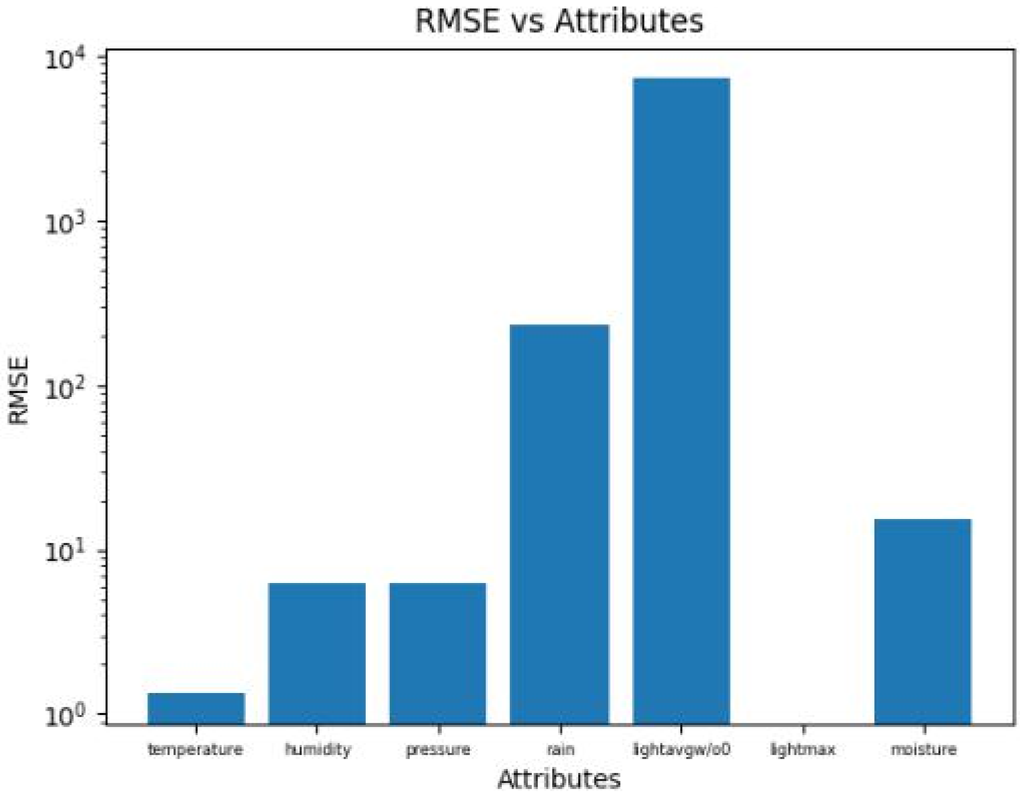


Figure 3 RMSE vs. attributes

Inferences:

1. The attributes lightavgw/o0 and lightmax have maximum and minimum values of RMSE respectively.
2. The RMSE and missing values do not show any following trend. But lightavgw/o0 has highest RMSE and also shows high difference in properties, same is with rain, it has 2nd highest RMSE and also shows high difference in properties. Temperature has low RMSE and shows very less differences in properties. Hence there is an appreciable relation between RMSE and difference in properties.
3. Since RMSE is significantly high for most attributes, this is not reliable for further experimental analysis.
4. For most attributes(except humidity and lightavgw/o0), RMSE was higher when replaced by mean than when replaced by interpolation.

5 a.

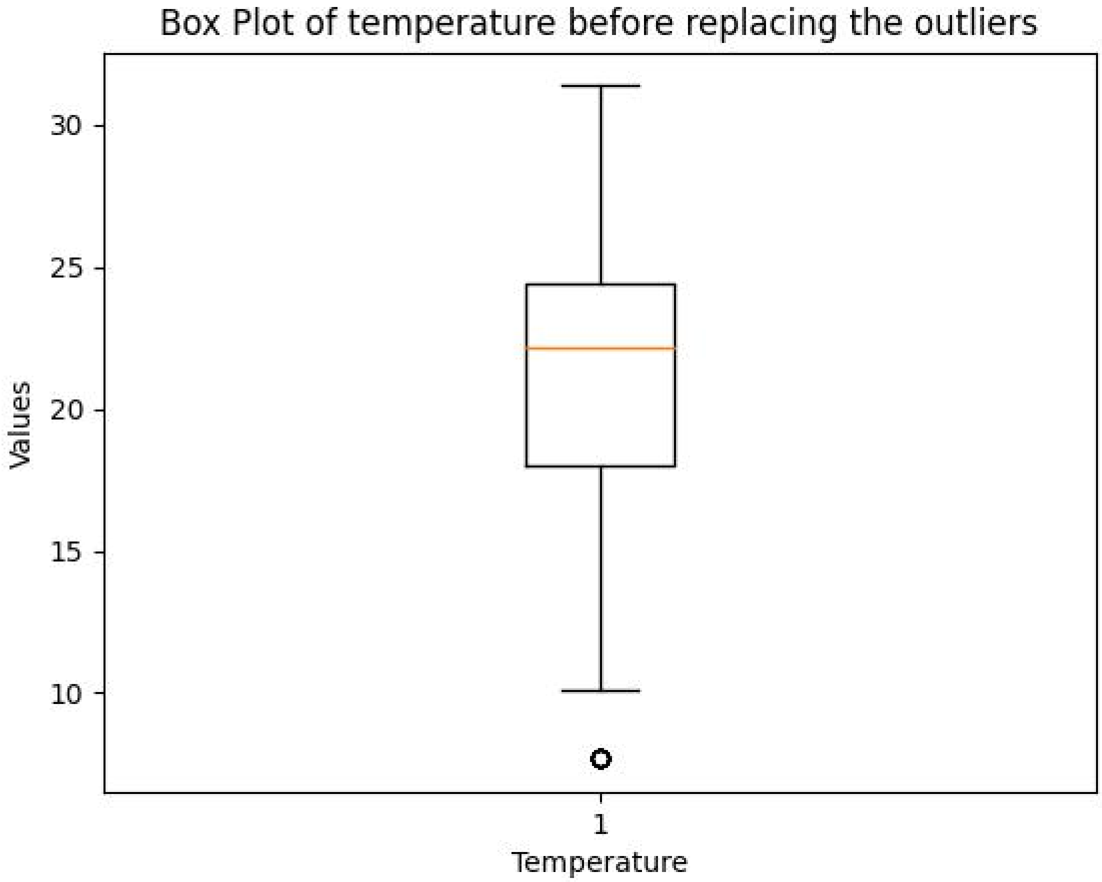


Figure 4 Boxplot for attribute temperature (in °C)

Inferences:

1. There is 1 outlier with value nearly 7.7.
2. The Inter quartile range is 24.5-18 = 6.
3. The data has maximum value 31.33 and minimum value 7.7. The first quartile lies at temperature 18, the second quartile(median) lies at temperature 22 and the third quartile lies at temperature 24.5. The mode of the data lies between the 2nd and 3rd quartile.
4. Since median is smaller than the mode, the data is left(negative) skewed.

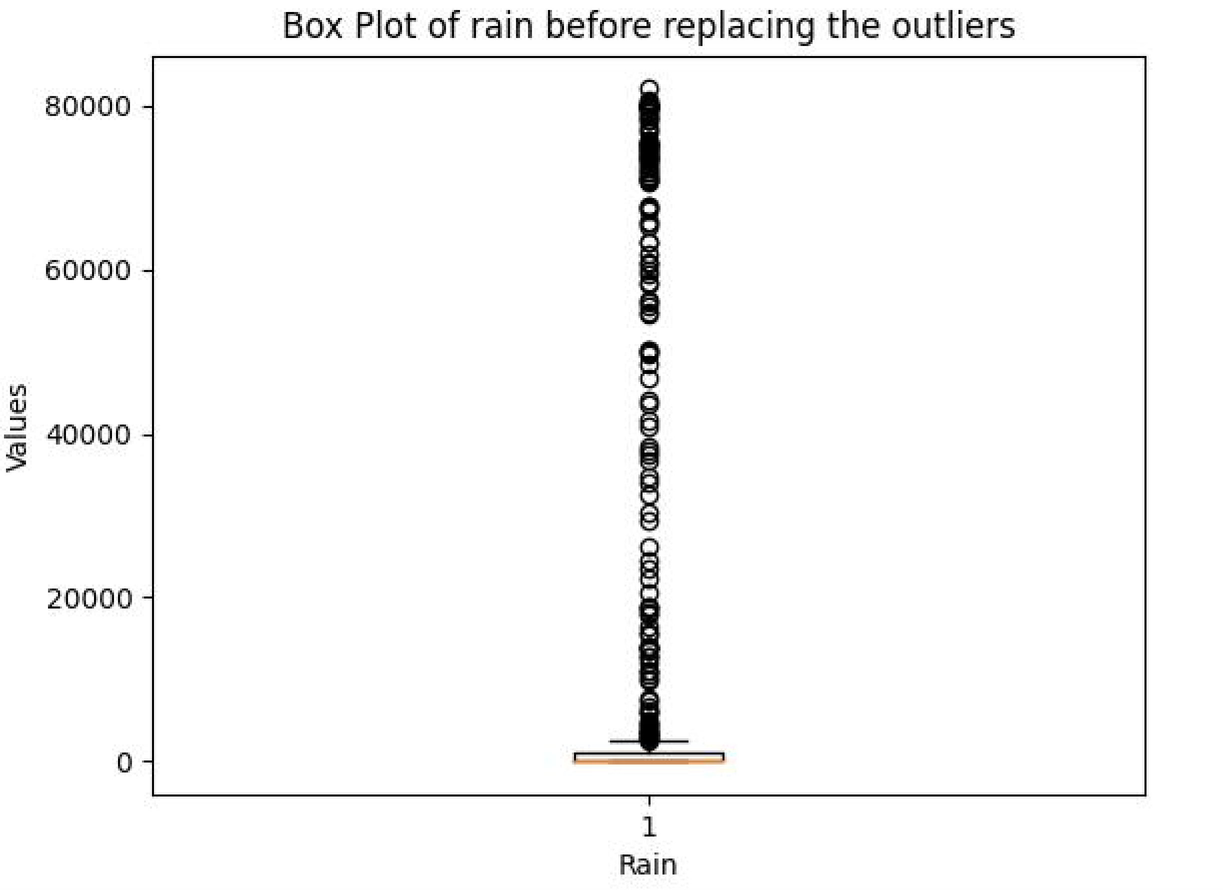


Figure 5 Boxplot for attribute rain (in ml)

Inferences:

1. There are a large number of outliers lying in the range 2500-80000.
2. The Inter quartile range is 1050-0=1050.
3. The data has maximum value 80000 and minimum value 0. The first quartile lies at 0, the second quartile(median) lies at 15.7 and the third quartile lies at 1050. The mode of the data lies between the 1st and 2nd quartile.

4. Since median is greater than the mode, the data is right(positive) skewed.

b.

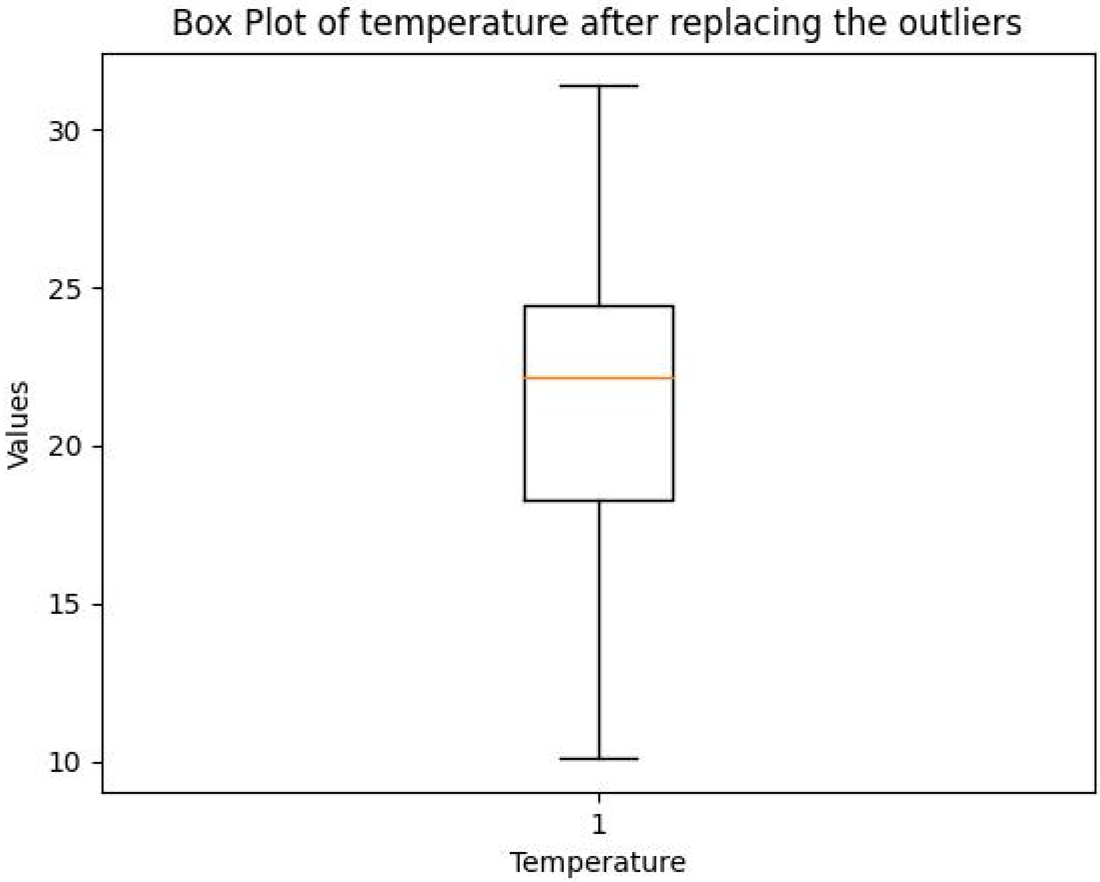


Figure 6 Boxplot for attribute temperature (in °C) after replacing median with outliers

Inferences:

1. There are no outliers, unlike the data before replacing outliers.
2. The inter quartile range is 24.4-18.2 = 6.2, which is almost same as previously obtained value.
3. The data has maximum value 31.33, which is same as the previous data and minimum value 10, which is almost 2.3 greater than the previous data. The first quartile lies at temperature 18.2, the second quartile(median) lies at temperature 22 and the third quartile lies at temperature 24.5, which are all almost same as the previous data. The mode of the data lies between the 2nd and 3rd quartile, same as the previous data.
5. Since median is smaller than the mode, the data is left(negative) skewed, as in the previous case.

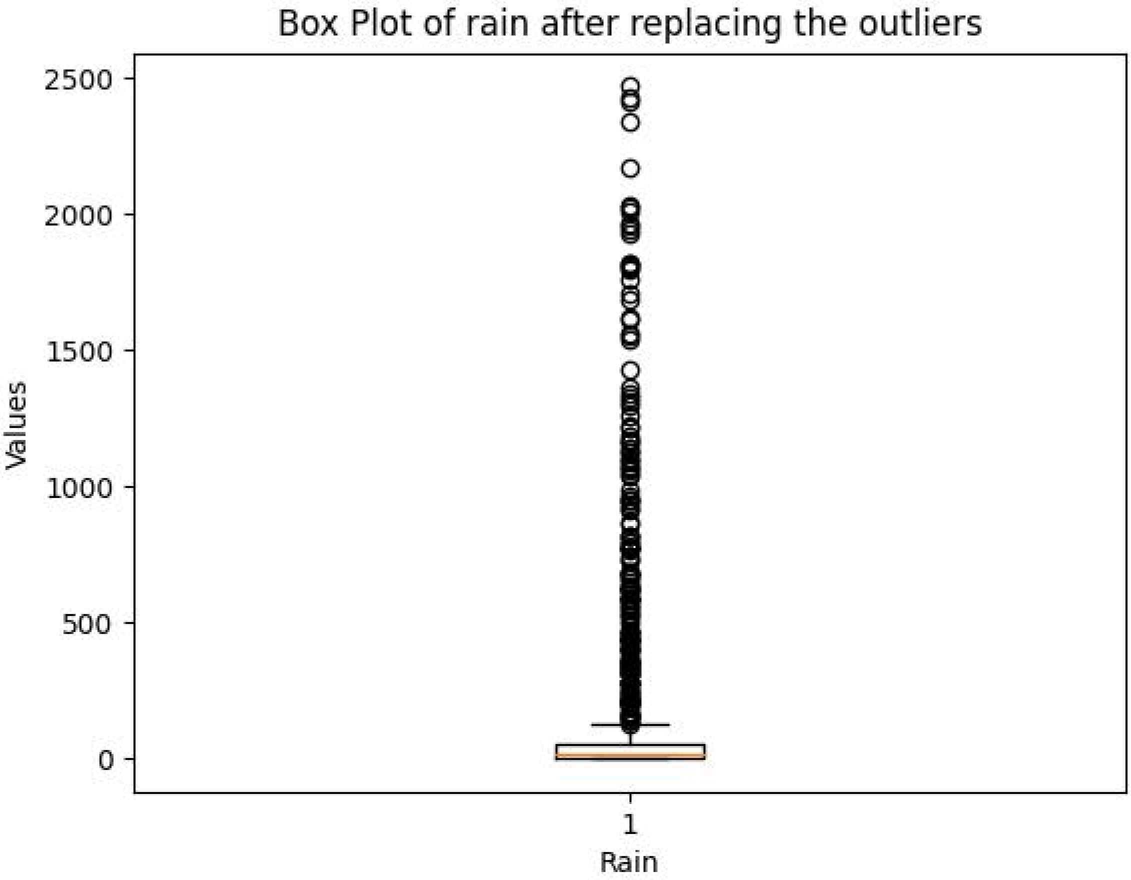


Figure 7 Boxplot for attribute rain (in ml) after replacing median with outliers

Inferences:

1. There are a large number of outliers lying in the range 130-2500, which is way less than the previous case(almost 30 times smaller range)
2. The Inter quartile range is 52-0 = 52, which is way less than the previous case(almost 20 times less).
3. The data has maximum value 2450, which is way less than the previous case(almost 32 times less) and minimum value 0, which is same as the previous case. The first quartile lies at 0(same as previous case), the second quartile(median) lies at 15.7(same as previous case) and the third quartile lies at 52 (at almost 20 times smaller value than the previous case) . The mode of the data lies between the 1st and 2nd quartile, same as in previous case.

4. Since median is greater than the mode, the data is right(positive) skewed, same as the previous case.