Data Cleaning, Preprocessing & Visualization - R Assignment

2023-02-04

Group 9

Nurul Alam - 101443564

Ananth Satish Embrandiri - 101416006

Denny Paul - 101411032

Anuj Yadav - 101419066

Abhishek Singh Bisht - 101420857

Saptarshi Kundu - 101365961

Dataset - Delhi Air Quality Index

About Dataset

This dataset contains air quality data from the national capital of Delhi, India. It includes information on air pollution levels, including particulate matter (PM2.5 and PM10) levels, nitrogen dioxide (NO2), sulfur dioxide (SO2), carbon dioxide (CO2), ozone (O3), and other pollutants. The data was collected from monitoring stations located in various areas of Delhi between November 25, 2020, and January 24, 2023. This dataset is a valuable resource for researchers and policymakers to better understand air quality in Delhi and its impacts on public health.

Import Dataset

```
aqi = read.csv("delhi_aqi.csv")
```

Q1 : Print the structure of the dataset

```
str(aqi)
```

```
## 'data.frame':    18776 obs. of  9 variables:
##  $ date : chr  "2020-11-25 01:00:00" "2020-11-25 02:00:00" "2020-11-25 03:00:00" "2020-11-25 04:00:0
##  $ co   : num  2617 3632 4539 4539 4379 ...
##  $ no   : num  2.18 23.25 52.75 50.96 42.92 ...
```

```
##  $ no2  : num  70.6 89.1 100.1 111 117.9 ...
##  $ o3   : num  13.59 0.33 1.11 6.44 17.17 ...
##  $ so2  : num  38.6 54.4 68.7 78.2 87.7 ...
##  $ pm2_5: num  365 421 464 455 448 ...
##  $ pm10 : num  412 486 542 534 529 ...
##  $ nh3  : num  28.6 41 49.1 48.1 46.6 ...
```

Q2 : List the variables in your dataset

```
colnames(aqi)
```

```
## [1] "date"  "co"    "no"    "no2"   "o3"    "so2"   "pm2_5" "pm10"  "nh3"
```

Q3 : Print the top 15 rows of your dataset

```
head(aqi, n=15)
```

```
##                   date      co    no    no2     o3    so2  pm2_5   pm10   nh3
## 1  2020-11-25 01:00:00 2616.88  2.18  70.60  13.59  38.62 364.61 411.73 28.63
## 2  2020-11-25 02:00:00 3631.59 23.25  89.11   0.33  54.36 420.96 486.21 41.04
## 3  2020-11-25 03:00:00 4539.49 52.75 100.08   1.11  68.67 463.68 541.95 49.14
## 4  2020-11-25 04:00:00 4539.49 50.96 111.04   6.44  78.20 454.81 534.00 48.13
## 5  2020-11-25 05:00:00 4379.27 42.92 117.90  17.17  87.74 448.14 529.19 46.61
## 6  2020-11-25 06:00:00 3898.62 28.39 117.90  40.05 101.09 437.25 511.79 42.05
## 7  2020-11-25 07:00:00 1949.31 14.53 105.56  83.69 185.01 312.76 349.20 12.79
## 8  2020-11-25 08:00:00 1508.71 11.62 112.41  87.98 217.44 275.53 303.47  6.59
## 9  2020-11-25 09:00:00 1361.85  7.04 109.67  95.84 213.62 263.51 289.86  6.02
## 10 2020-11-25 10:00:00 1602.17  3.10  93.22 104.43 152.59 271.25 302.27 12.16
## 11 2020-11-25 11:00:00 2136.23  1.27  94.59  86.55 103.95 284.51 324.34 21.28
## 12 2020-11-25 12:00:00 2590.18  0.19 109.67  50.78  82.02 287.83 336.00 27.87
## 13 2020-11-25 13:00:00 3017.43  0.60 120.64  19.67  69.62 295.37 354.19 35.47
## 14 2020-11-25 14:00:00 3471.37  6.65 117.90   3.00  65.80 325.89 402.37 46.10
## 15 2020-11-25 15:00:00 3898.62 16.09 105.56   0.25  63.90 363.16 456.38 50.66
```

Q4 : Write a user defined function using any of the variables from the data set

```
#get_floor = function(x) {
#  floor(x)
#}

#aqi$pm_2_5_floor = apply(aqi[, "pm2_5"], 1, get_floor)
```

Q5 : Use data manipulation techniques and filter rows based on any logical criteria that exist in your dataset

```
library(dplyr)
```

```
aqi_no_filter = aqi %>% filter(no > 0.0)
dim(aqi_no_filter)
```

```
## [1] 16470     9
```

Q6 : Identify the dependent & independent variables and use reshaping techniques and create a new data frame by joining those variables from your dataset

Q7 : Remove missing values in your dataset

```
dim(aqi)
```

```
## [1] 18776     9
```

```
colSums(is.na(aqi))
```

```
##  date    co    no   no2    o3   so2 pm2_5  pm10   nh3
##     0     0     0     0     0     0     0     0     0
```

```
aqi = na.omit(aqi)
dim(aqi)
```

```
## [1] 18776     9
```

Q8 : Identify and remove duplicated data in your dataset

```
dim(aqi)
```

```
## [1] 18776     9
```

```
sum(duplicated(aqi))
```

```
## [1] 0
```

```
aqi = unique(aqi)
dim(aqi)
```

```
## [1] 18776     9
```

Q9 : Reorder multiple rows in descending order

```
aqi = aqi %>% arrange(desc(date))
```

Q10 : Rename some of the column names in your dataset

```
colnames(aqi)
```

```
## [1] "date"  "co"    "no"    "no2"   "o3"    "so2"   "pm2_5" "pm10"  "nh3"
```

```
names(aqi)[names(aqi) == "date"] = "Date"
names(aqi)[names(aqi) == "co"] = "CO"
names(aqi)[names(aqi) == "no"] = "NO"
colnames(aqi)
```

```
## [1] "Date"  "CO"    "NO"    "no2"   "o3"    "so2"   "pm2_5" "pm10"  "nh3"
```

Q11 : Add new variables in your data frame by using a mathematical function (for e.g. – multiply an existing column by 2 and add it as a new variable to your data frame)

```
aqi$total_pm = aqi$pm2_5 + aqi$pm10
aqi = aqi %>% mutate(pm2_5_10 = pm2_5 * 10)
```

Q12 : Create a training set using random number generator engine.

```
dim(aqi)
```

```
## [1] 18776    11
```

```
set.seed(42)
aqi_train = aqi %>% sample_frac(0.8, replace = FALSE)
dim(aqi_train)
```

```
## [1] 15021    11
```

Q13 : Print the summary statistics of your dataset

```
summary(aqi)
```

```
##      Date                CO                NO              no2
##  Length:18776       Min.   :  260.4   Min.   :  0.00   Min.   :  4.28
##  Class :character   1st Qu.: 1068.1   1st Qu.:  0.68   1st Qu.: 33.93
##  Mode  :character   Median : 1842.5   Median :  5.25   Median : 54.15
##                     Mean   : 2929.2   Mean   : 33.66   Mean   : 66.22
```

```
##                    3rd Qu.: 3685.0   3rd Qu.: 35.76   3rd Qu.: 83.63
##                    Max.   :21148.7   Max.   :500.68   Max.   :460.62
##        o3              so2             pm2_5              pm10
##  Min.   :  0.00   Min.   :  5.25   Min.   :  11.83   Min.   :  15.07
##  1st Qu.:  0.34   1st Qu.: 34.81   1st Qu.:  84.44   1st Qu.: 118.80
##  Median : 27.18   Median : 52.93   Median : 157.44   Median : 209.71
##  Mean   : 60.35   Mean   : 66.69   Mean   : 238.13   Mean   : 300.09
##  3rd Qu.: 92.98   3rd Qu.: 82.02   3rd Qu.: 313.00   3rd Qu.: 387.96
##  Max.   :801.09   Max.   :579.83   Max.   :1708.09   Max.   :1969.93
##       nh3            total_pm          pm2_5_10
##  Min.   :  0.00   Min.   :  27.66   Min.   :  118.3
##  1st Qu.:  9.63   1st Qu.: 207.12   1st Qu.:  844.4
##  Median : 17.48   Median : 365.03   Median : 1574.5
##  Mean   : 25.11   Mean   : 538.22   Mean   : 2381.3
##  3rd Qu.: 30.40   3rd Qu.: 697.48   3rd Qu.: 3130.0
##  Max.   :287.77   Max.   :3678.02   Max.   :17080.9
```

Q14 : Use any of the numerical variables from the dataset and perform the following statistical functions

- **Mean**
- **Median**
- **Mode**
- **Range**

```
mean(aqi$o3)
```

```
## [1] 60.34624
```

```
median(aqi$o3)
```

```
## [1] 27.18
```

```
#Calculating mode
counts = table(aqi$o3)
max_count <- max(counts)
mode_indices <- which(counts == max_count)
mode_values <- names(counts)[mode_indices]
mode_values <- as.numeric(mode_values)
print(mode_values)
```

```
## [1] 0
```

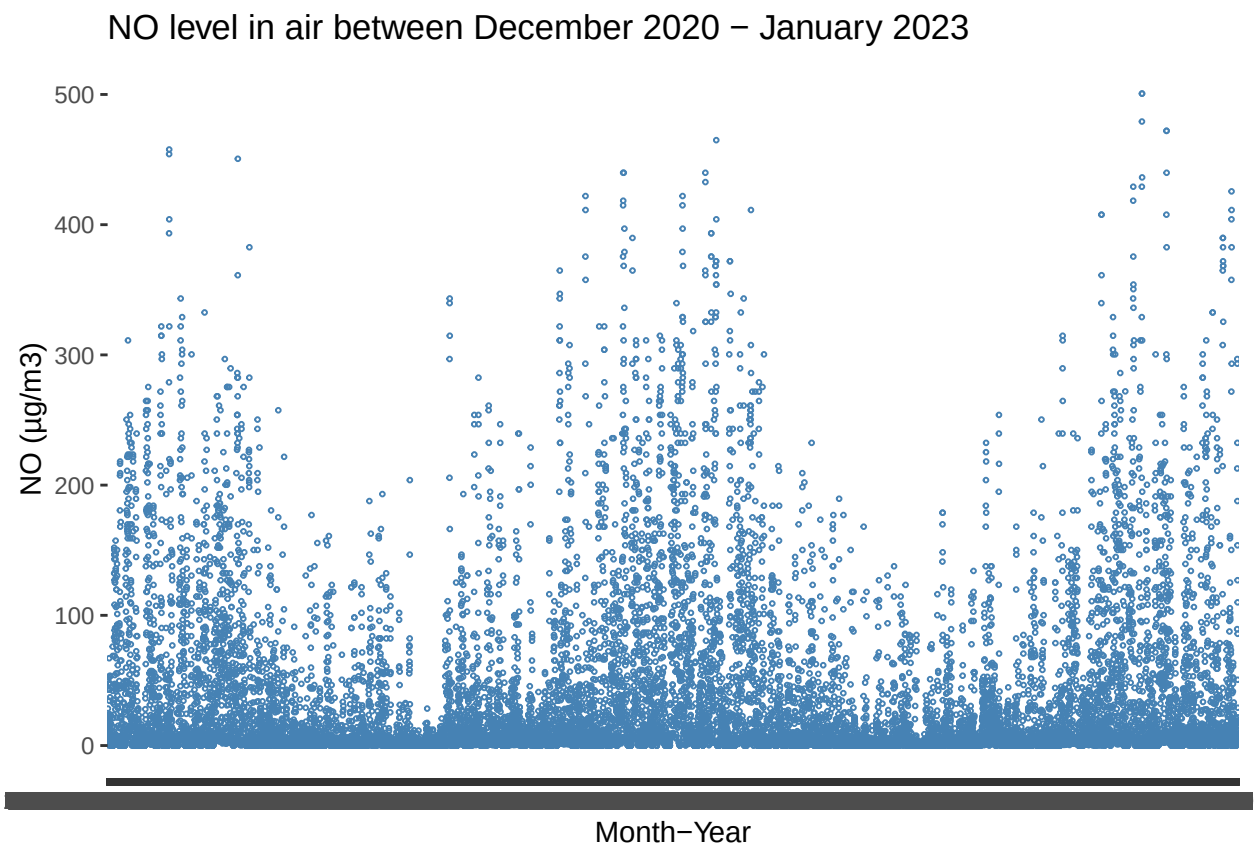
```
range(aqi$o3)
```

```
## [1]   0.00 801.09
```

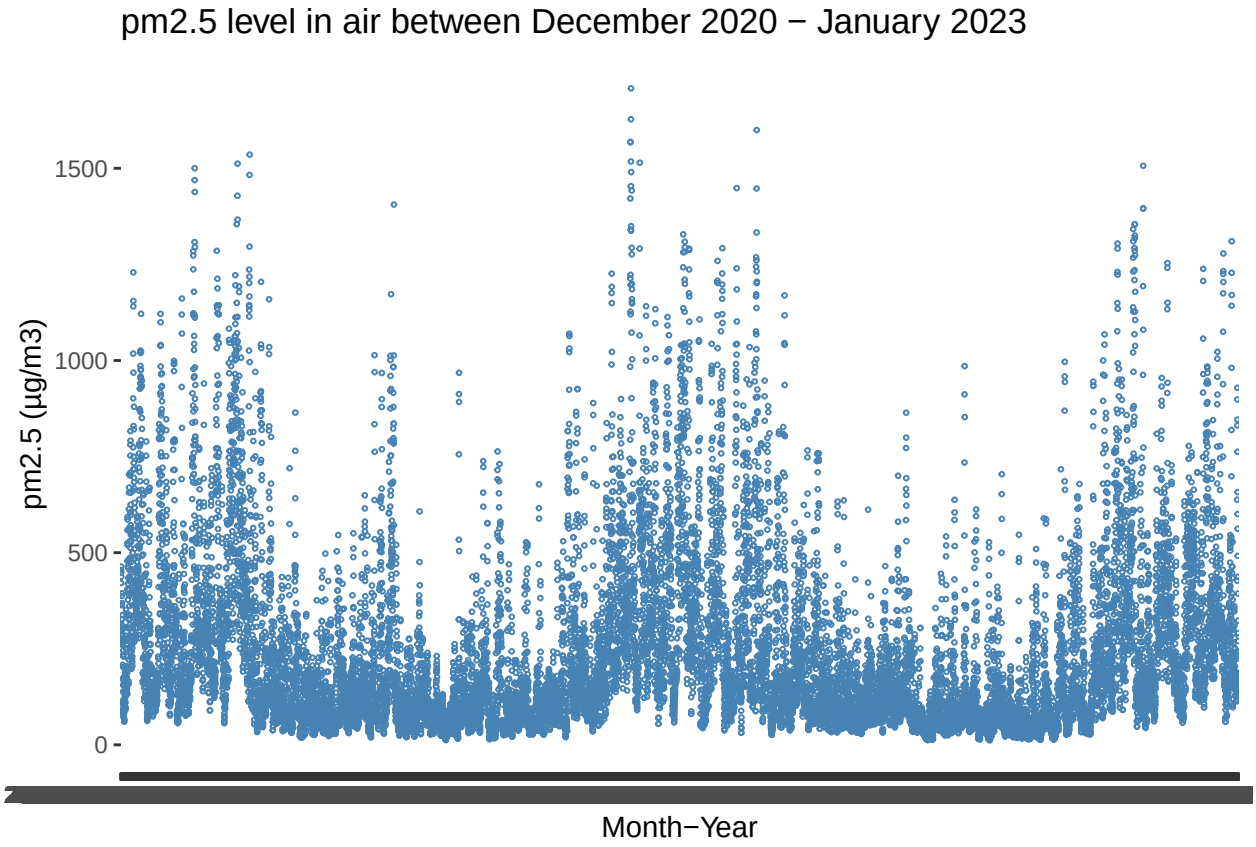
Q15 : Plot a scatter plot for any 2 variables in your dataset

```
library(ggplot2)
```

```
ggplot(data = aqi,aes(y = NO, x = Date))+geom_point(stat='identity', size = 0.5,
        color = "steelblue", shape=21)+labs(x = "Month-Year", y = "NO (µg/m3)",
        title = "NO level in air between December 2020 - January 2023")
```

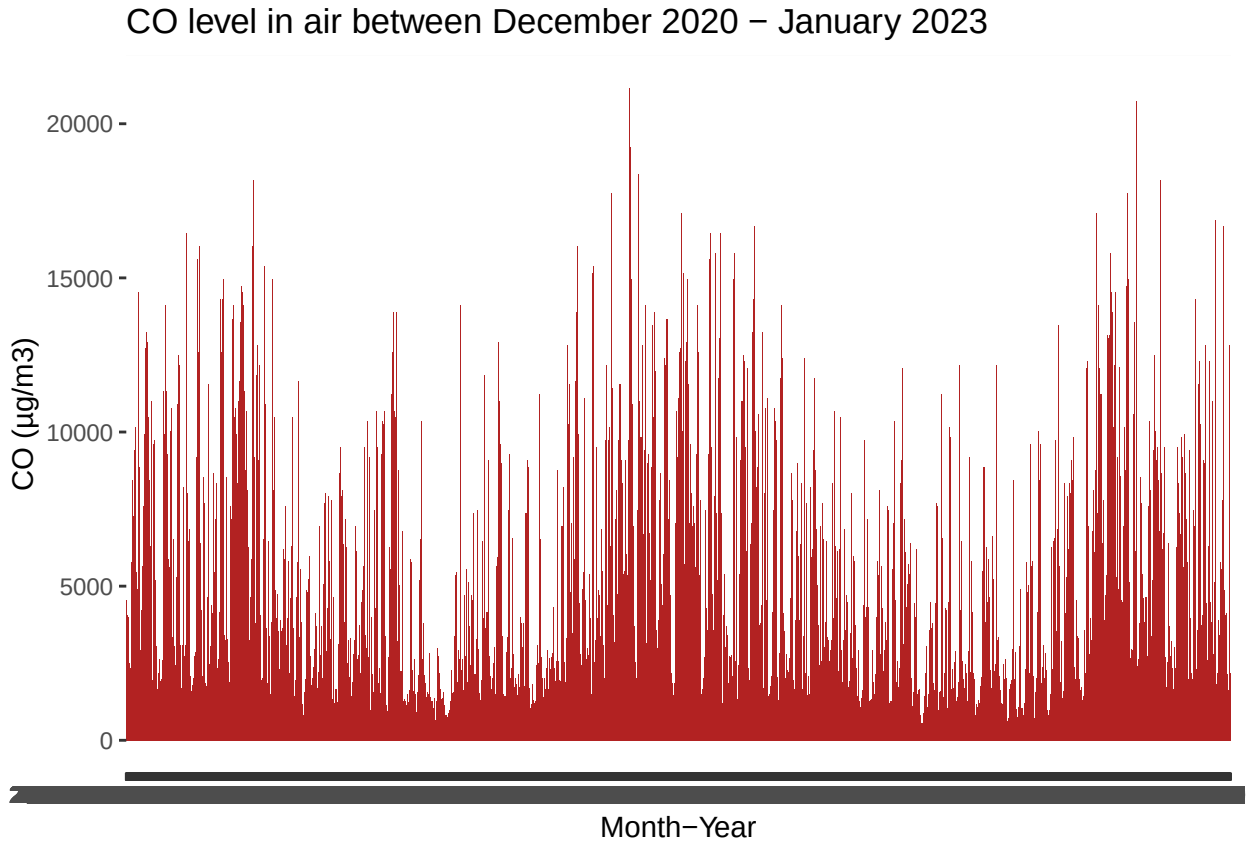



```
ggplot(data = aqi,aes(y = pm2_5, x = Date))+geom_point(stat='identity',
        size = 0.5, color = "steelblue", shape=21)+labs(x = "Month-Year",
        y = "pm2.5 (µg/m3)",
        title = "pm2.5 level in air between December 2020 - January 2023")
```

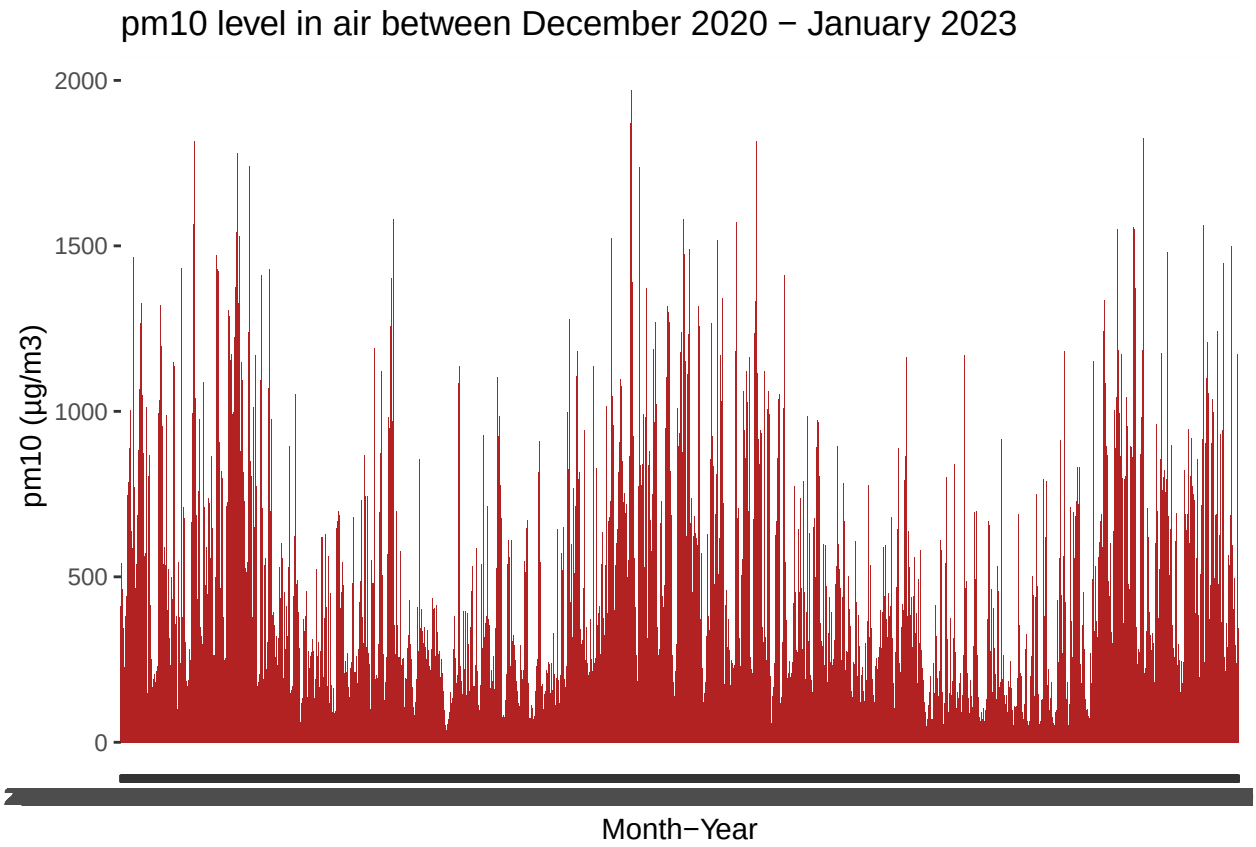


Q16 : Plot a bar plot for any 2 variables in your dataset

```
ggplot(data = aqi,aes(y = CO, x = Date))+geom_bar(stat='identity',
        fill = "firebrick")+labs(x = "Month-Year", y = "CO (µg/m3)",
        title = "CO level in air between December 2020 - January 2023")
```




```
ggplot(data = aqi,aes(y = pm10, x = Date))+geom_bar(stat='identity',
        fill = "firebrick")+labs(x = "Month-Year", y = "pm10 (µg/m3)",
        title = "pm10 level in air between December 2020 - January 2023")
```



Q17 : Find the correlation between any 2 variables by applying least square linear regression model

```
Y = aqi[, "NO"]
X = aqi[, "CO"]
co_no_corr = cor(Y,X, method="pearson")
co_no_corr
```

```
## [1] 0.9141286
```