HW6

Katherine Penney

8/17/2021

Step 1: Load the data

```
airquality
```

```
##     Ozone Solar.R Wind Temp Month Day
## 1      41     190  7.4   67     5   1
## 2      36     118  8.0   72     5   2
## 3      12     149 12.6   74     5   3
## 4      18     313 11.5   62     5   4
## 5      NA      NA 14.3   56     5   5
## 6      28      NA 14.9   66     5   6
## 7      23     299  8.6   65     5   7
## 8      19      99 13.8   59     5   8
## 9       8      19 20.1   61     5   9
## 10     NA     194  8.6   69     5  10
## 11      7      NA  6.9   74     5  11
## 12     16     256  9.7   69     5  12
## 13     11     290  9.2   66     5  13
## 14     14     274 10.9   68     5  14
## 15     18      65 13.2   58     5  15
## 16     14     334 11.5   64     5  16
## 17     34     307 12.0   66     5  17
## 18      6      78 18.4   57     5  18
## 19     30     322 11.5   68     5  19
## 20     11      44  9.7   62     5  20
## 21      1       8  9.7   59     5  21
## 22     11     320 16.6   73     5  22
## 23      4      25  9.7   61     5  23
## 24     32      92 12.0   61     5  24
## 25     NA      66 16.6   57     5  25
## 26     NA     266 14.9   58     5  26
## 27     NA      NA  8.0   57     5  27
## 28     23      13 12.0   67     5  28
## 29     45     252 14.9   81     5  29
## 30    115     223  5.7   79     5  30
## 31     37     279  7.4   76     5  31
## 32     NA     286  8.6   78     6   1
## 33     NA     287  9.7   74     6   2
## 34     NA     242 16.1   67     6   3
## 35     NA     186  9.2   84     6   4
## 36     NA     220  8.6   85     6   5
## 37     NA     264 14.3   79     6   6
```

```
## 38     29     127  9.7   82     6   7
## 39     NA     273  6.9   87     6   8
## 40     71     291 13.8   90     6   9
## 41     39     323 11.5   87     6  10
## 42     NA     259 10.9   93     6  11
## 43     NA     250  9.2   92     6  12
## 44     23     148  8.0   82     6  13
## 45     NA     332 13.8   80     6  14
## 46     NA     322 11.5   79     6  15
## 47     21     191 14.9   77     6  16
## 48     37     284 20.7   72     6  17
## 49     20      37  9.2   65     6  18
## 50     12     120 11.5   73     6  19
## 51     13     137 10.3   76     6  20
## 52     NA     150  6.3   77     6  21
## 53     NA      59  1.7   76     6  22
## 54     NA      91  4.6   76     6  23
## 55     NA     250  6.3   76     6  24
## 56     NA     135  8.0   75     6  25
## 57     NA     127  8.0   78     6  26
## 58     NA      47 10.3   73     6  27
## 59     NA      98 11.5   80     6  28
## 60     NA      31 14.9   77     6  29
## 61     NA     138  8.0   83     6  30
## 62    135     269  4.1   84     7   1
## 63     49     248  9.2   85     7   2
## 64     32     236  9.2   81     7   3
## 65     NA     101 10.9   84     7   4
## 66     64     175  4.6   83     7   5
## 67     40     314 10.9   83     7   6
## 68     77     276  5.1   88     7   7
## 69     97     267  6.3   92     7   8
## 70     97     272  5.7   92     7   9
## 71     85     175  7.4   89     7  10
## 72     NA     139  8.6   82     7  11
## 73     10     264 14.3   73     7  12
## 74     27     175 14.9   81     7  13
## 75     NA     291 14.9   91     7  14
## 76      7      48 14.3   80     7  15
## 77     48     260  6.9   81     7  16
## 78     35     274 10.3   82     7  17
## 79     61     285  6.3   84     7  18
## 80     79     187  5.1   87     7  19
## 81     63     220 11.5   85     7  20
## 82     16       7  6.9   74     7  21
## 83     NA     258  9.7   81     7  22
## 84     NA     295 11.5   82     7  23
## 85     80     294  8.6   86     7  24
## 86    108     223  8.0   85     7  25
## 87     20      81  8.6   82     7  26
## 88     52      82 12.0   86     7  27
## 89     82     213  7.4   88     7  28
## 90     50     275  7.4   86     7  29
## 91     64     253  7.4   83     7  30
```

```
## 92     59     254  9.2   81     7  31
## 93     39      83  6.9   81     8   1
## 94      9      24 13.8   81     8   2
## 95     16      77  7.4   82     8   3
## 96     78      NA  6.9   86     8   4
## 97     35      NA  7.4   85     8   5
## 98     66      NA  4.6   87     8   6
## 99    122     255  4.0   89     8   7
## 100    89     229 10.3   90     8   8
## 101   110     207  8.0   90     8   9
## 102    NA     222  8.6   92     8  10
## 103    NA     137 11.5   86     8  11
## 104    44     192 11.5   86     8  12
## 105    28     273 11.5   82     8  13
## 106    65     157  9.7   80     8  14
## 107    NA      64 11.5   79     8  15
## 108    22      71 10.3   77     8  16
## 109    59      51  6.3   79     8  17
## 110    23     115  7.4   76     8  18
## 111    31     244 10.9   78     8  19
## 112    44     190 10.3   78     8  20
## 113    21     259 15.5   77     8  21
## 114     9      36 14.3   72     8  22
## 115    NA     255 12.6   75     8  23
## 116    45     212  9.7   79     8  24
## 117   168     238  3.4   81     8  25
## 118    73     215  8.0   86     8  26
## 119    NA     153  5.7   88     8  27
## 120    76     203  9.7   97     8  28
## 121   118     225  2.3   94     8  29
## 122    84     237  6.3   96     8  30
## 123    85     188  6.3   94     8  31
## 124    96     167  6.9   91     9   1
## 125    78     197  5.1   92     9   2
## 126    73     183  2.8   93     9   3
## 127    91     189  4.6   93     9   4
## 128    47      95  7.4   87     9   5
## 129    32      92 15.5   84     9   6
## 130    20     252 10.9   80     9   7
## 131    23     220 10.3   78     9   8
## 132    21     230 10.9   75     9   9
## 133    24     259  9.7   73     9  10
## 134    44     236 14.9   81     9  11
## 135    21     259 15.5   76     9  12
## 136    28     238  6.3   77     9  13
## 137     9      24 10.9   71     9  14
## 138    13     112 11.5   71     9  15
## 139    46     237  6.9   78     9  16
## 140    18     224 13.8   67     9  17
## 141    13      27 10.3   76     9  18
## 142    24     238 10.3   68     9  19
## 143    16     201  8.0   82     9  20
## 144    13     238 12.6   64     9  21
## 145    23      14  9.2   71     9  22
```

```
## 146    36     139 10.3   81     9  23
## 147     7      49 10.3   69     9  24
## 148    14      20 16.6   63     9  25
## 149    30     193  6.9   70     9  26
## 150    NA     145 13.2   77     9  27
## 151    14     191 14.3   75     9  28
## 152    18     131  8.0   76     9  29
## 153    20     223 11.5   68     9  30
```

Step 2: Clean the data

Remove NAs

```
airdata <- na.omit(airquality)
airdata
```

```
##     Ozone Solar.R Wind Temp Month Day
## 1      41     190  7.4   67     5   1
## 2      36     118  8.0   72     5   2
## 3      12     149 12.6   74     5   3
## 4      18     313 11.5   62     5   4
## 7      23     299  8.6   65     5   7
## 8      19      99 13.8   59     5   8
## 9       8      19 20.1   61     5   9
## 12     16     256  9.7   69     5  12
## 13     11     290  9.2   66     5  13
## 14     14     274 10.9   68     5  14
## 15     18      65 13.2   58     5  15
## 16     14     334 11.5   64     5  16
## 17     34     307 12.0   66     5  17
## 18      6      78 18.4   57     5  18
## 19     30     322 11.5   68     5  19
## 20     11      44  9.7   62     5  20
## 21      1       8  9.7   59     5  21
## 22     11     320 16.6   73     5  22
## 23      4      25  9.7   61     5  23
## 24     32      92 12.0   61     5  24
## 28     23      13 12.0   67     5  28
## 29     45     252 14.9   81     5  29
## 30    115     223  5.7   79     5  30
## 31     37     279  7.4   76     5  31
## 38     29     127  9.7   82     6   7
## 40     71     291 13.8   90     6   9
## 41     39     323 11.5   87     6  10
## 44     23     148  8.0   82     6  13
## 47     21     191 14.9   77     6  16
## 48     37     284 20.7   72     6  17
## 49     20      37  9.2   65     6  18
## 50     12     120 11.5   73     6  19
## 51     13     137 10.3   76     6  20
## 62    135     269  4.1   84     7   1
## 63     49     248  9.2   85     7   2
## 64     32     236  9.2   81     7   3
## 66     64     175  4.6   83     7   5
```

```
## 67     40     314 10.9   83     7   6
## 68     77     276  5.1   88     7   7
## 69     97     267  6.3   92     7   8
## 70     97     272  5.7   92     7   9
## 71     85     175  7.4   89     7  10
## 73     10     264 14.3   73     7  12
## 74     27     175 14.9   81     7  13
## 76      7      48 14.3   80     7  15
## 77     48     260  6.9   81     7  16
## 78     35     274 10.3   82     7  17
## 79     61     285  6.3   84     7  18
## 80     79     187  5.1   87     7  19
## 81     63     220 11.5   85     7  20
## 82     16       7  6.9   74     7  21
## 85     80     294  8.6   86     7  24
## 86    108     223  8.0   85     7  25
## 87     20      81  8.6   82     7  26
## 88     52      82 12.0   86     7  27
## 89     82     213  7.4   88     7  28
## 90     50     275  7.4   86     7  29
## 91     64     253  7.4   83     7  30
## 92     59     254  9.2   81     7  31
## 93     39      83  6.9   81     8   1
## 94      9      24 13.8   81     8   2
## 95     16      77  7.4   82     8   3
## 99    122     255  4.0   89     8   7
## 100    89     229 10.3   90     8   8
## 101   110     207  8.0   90     8   9
## 104    44     192 11.5   86     8  12
## 105    28     273 11.5   82     8  13
## 106    65     157  9.7   80     8  14
## 108    22      71 10.3   77     8  16
## 109    59      51  6.3   79     8  17
## 110    23     115  7.4   76     8  18
## 111    31     244 10.9   78     8  19
## 112    44     190 10.3   78     8  20
## 113    21     259 15.5   77     8  21
## 114     9      36 14.3   72     8  22
## 116    45     212  9.7   79     8  24
## 117   168     238  3.4   81     8  25
## 118    73     215  8.0   86     8  26
## 120    76     203  9.7   97     8  28
## 121   118     225  2.3   94     8  29
## 122    84     237  6.3   96     8  30
## 123    85     188  6.3   94     8  31
## 124    96     167  6.9   91     9   1
## 125    78     197  5.1   92     9   2
## 126    73     183  2.8   93     9   3
## 127    91     189  4.6   93     9   4
## 128    47      95  7.4   87     9   5
## 129    32      92 15.5   84     9   6
## 130    20     252 10.9   80     9   7
## 131    23     220 10.3   78     9   8
## 132    21     230 10.9   75     9   9
```

```
## 133    24     259  9.7   73     9  10
## 134    44     236 14.9   81     9  11
## 135    21     259 15.5   76     9  12
## 136    28     238  6.3   77     9  13
## 137     9      24 10.9   71     9  14
## 138    13     112 11.5   71     9  15
## 139    46     237  6.9   78     9  16
## 140    18     224 13.8   67     9  17
## 141    13      27 10.3   76     9  18
## 142    24     238 10.3   68     9  19
## 143    16     201  8.0   82     9  20
## 144    13     238 12.6   64     9  21
## 145    23      14  9.2   71     9  22
## 146    36     139 10.3   81     9  23
## 147     7      49 10.3   69     9  24
## 148    14      20 16.6   63     9  25
## 149    30     193  6.9   70     9  26
## 151    14     191 14.3   75     9  28
## 152    18     131  8.0   76     9  29
## 153    20     223 11.5   68     9  30
```

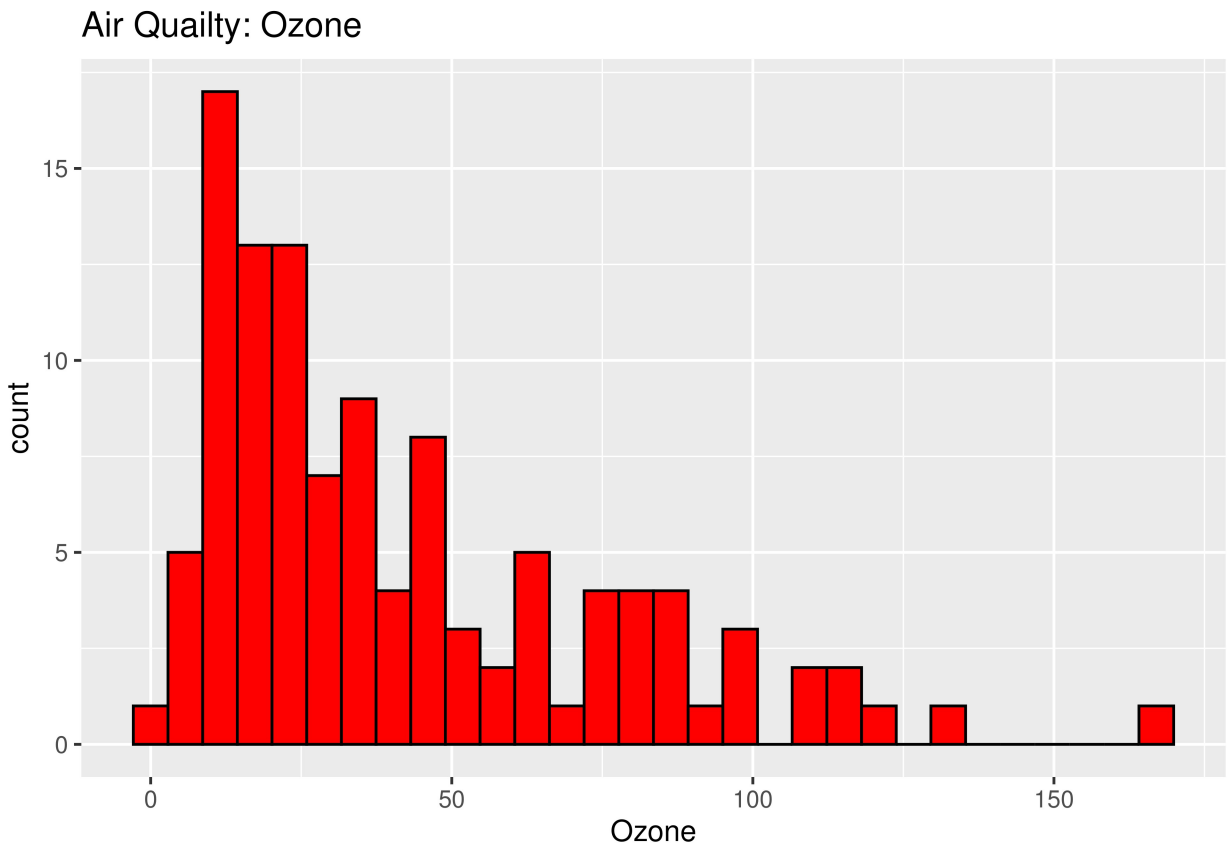
Step 3: Understand the data distribution

Histograms for each variable

```
library(ggplot2)
EnsurePackage <- function(x){
  x <-
  as.character(x)
  if (!require(x,character.only = TRUE)){
    install.packages(pkgs=x, repos="http://cran.r-project.org")
  require(x, character.only = TRUE)
  }
}
EnsurePackage("ggplot2")
```

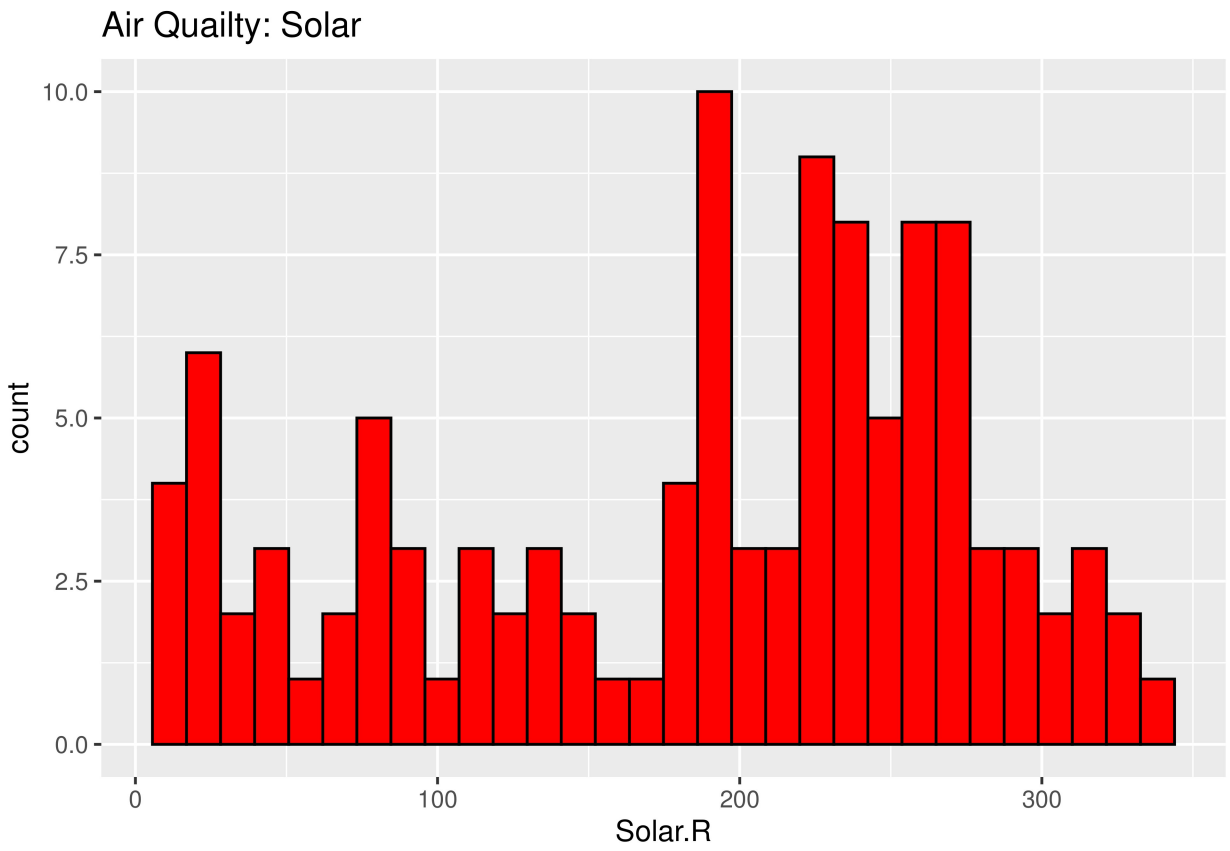
Ozone

```
histozone <- ggplot(airdata, aes(x=Ozone))
histozone <- histozone + geom_histogram(bins=30, color="black", fill="red")
histozone <- histozone + ggtitle("Air Quailty: Ozone")
histozone
```



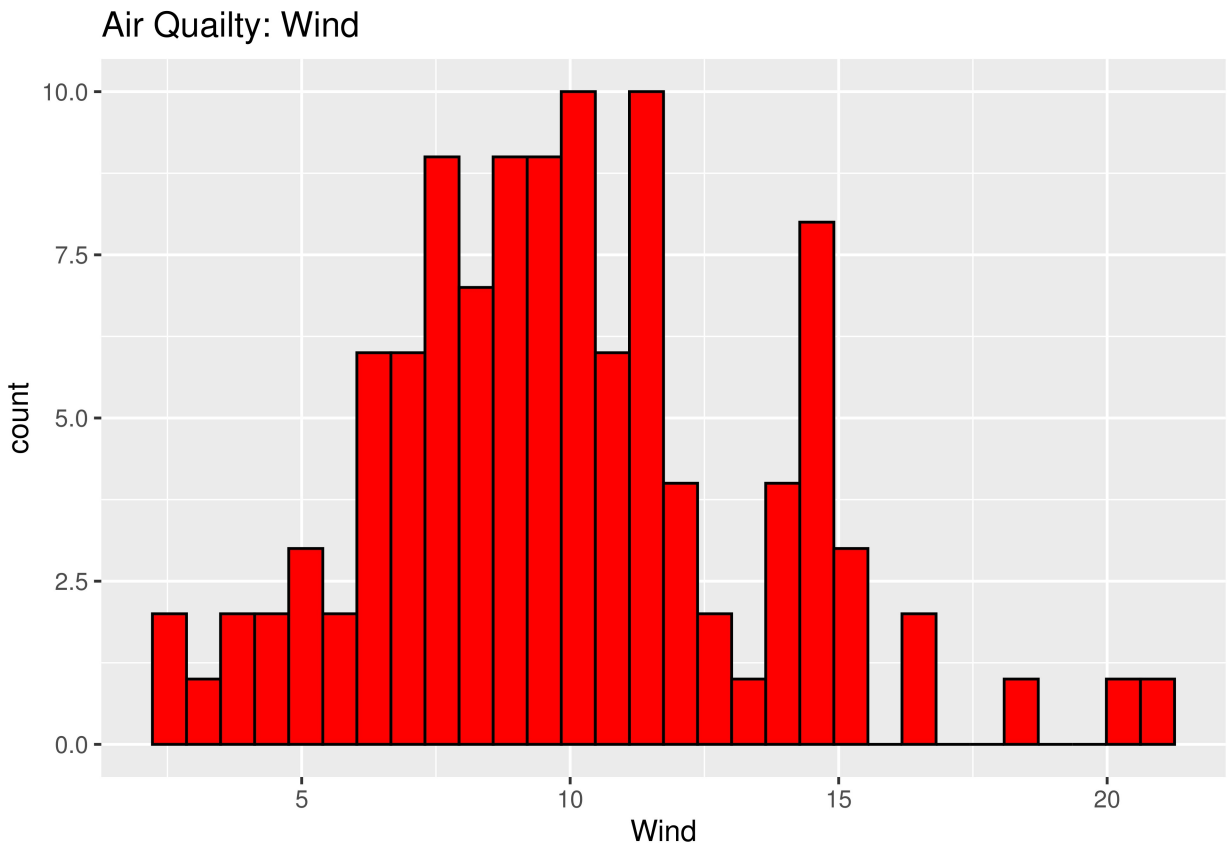
Solar.R

```
histsolar <- ggplot(airdata, aes(x=Solar.R))
histsolar <- histsolar + geom_histogram(bins=30, color="black", fill="red")
histsolar <- histsolar + ggtitle("Air Quailty: Solar")
histsolar
```



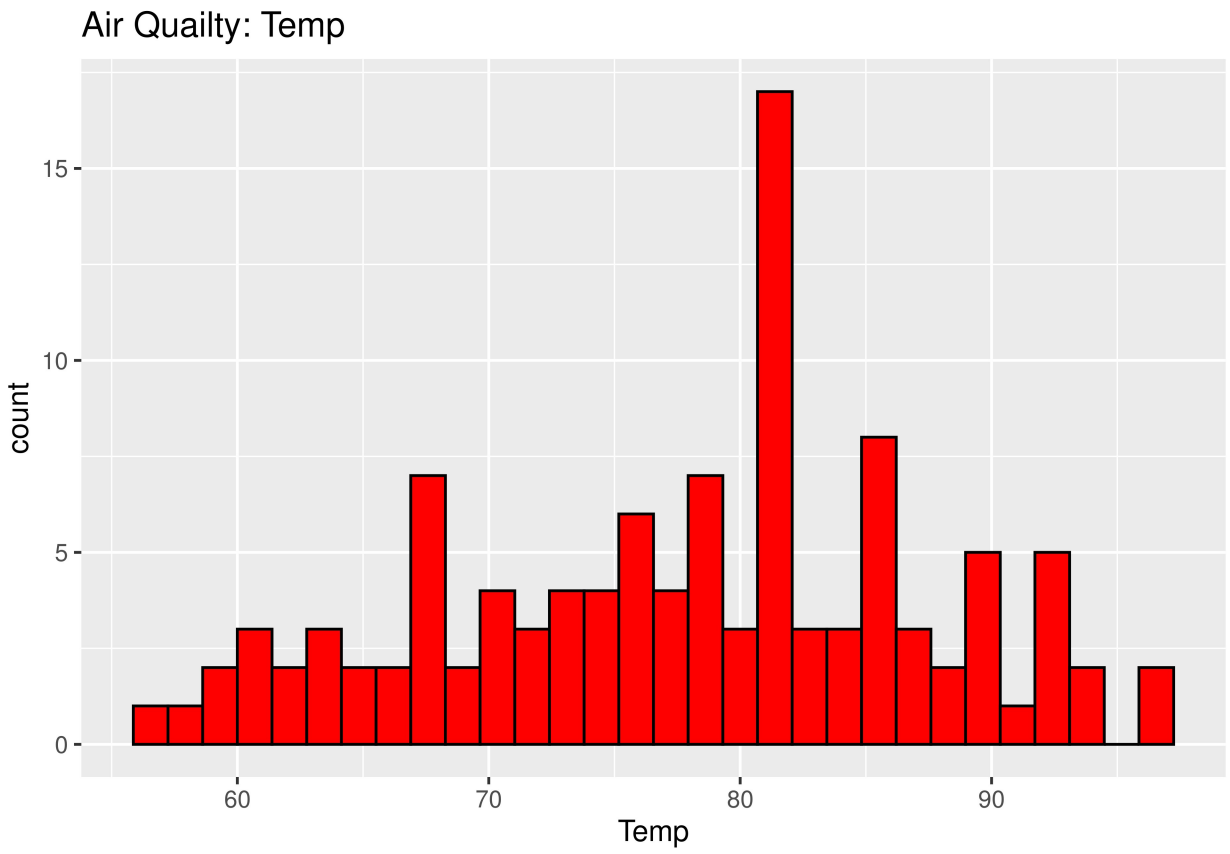
Wind

```
histwind <- ggplot(airdata, aes(x=Wind))
histwind <- histwind + geom_histogram(bins=30, color="black", fill="red")
histwind <- histwind + ggtitle("Air Quailty: Wind")
histwind
```



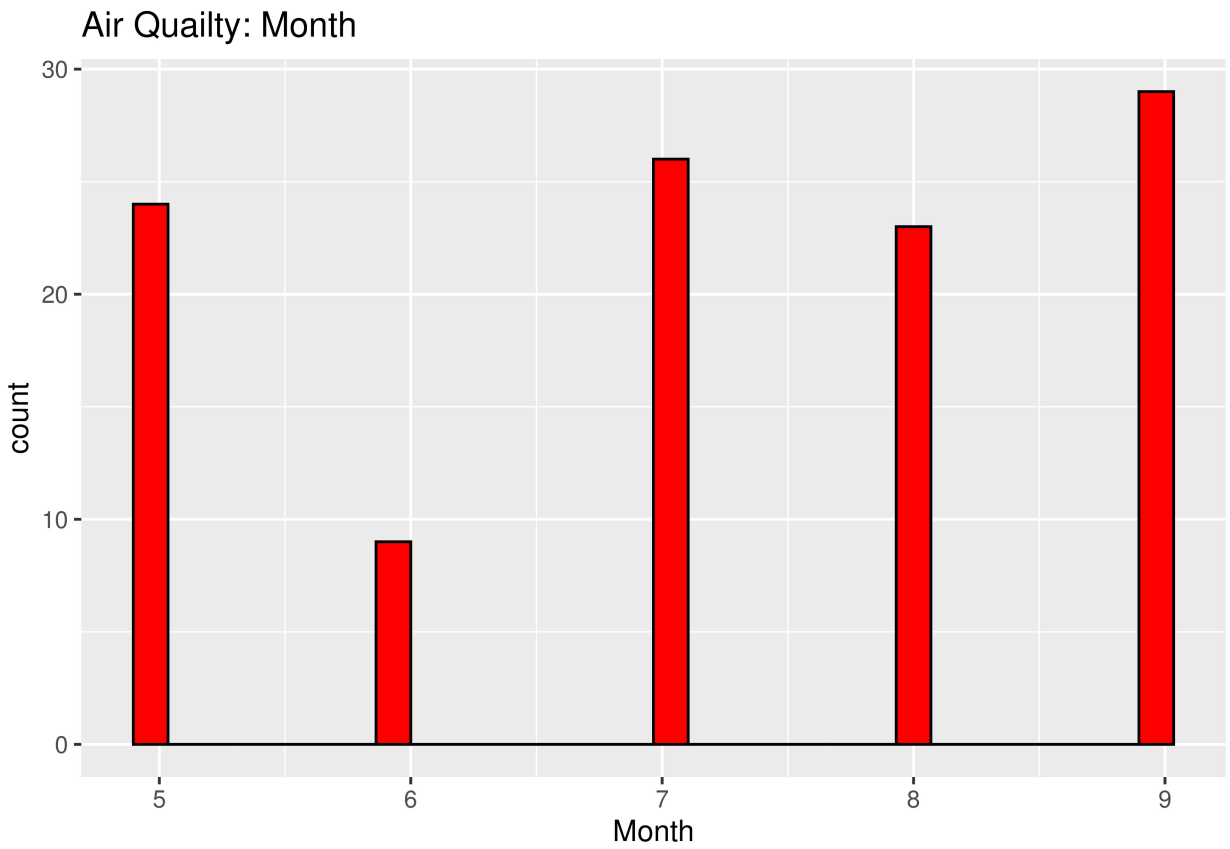
Temp

```
histtemp <- ggplot(airdata, aes(x=Temp))
histtemp <- histtemp + geom_histogram(bins=30, color="black", fill="red")
histtemp <- histtemp + ggtitle("Air Quailty: Temp")
histtemp
```



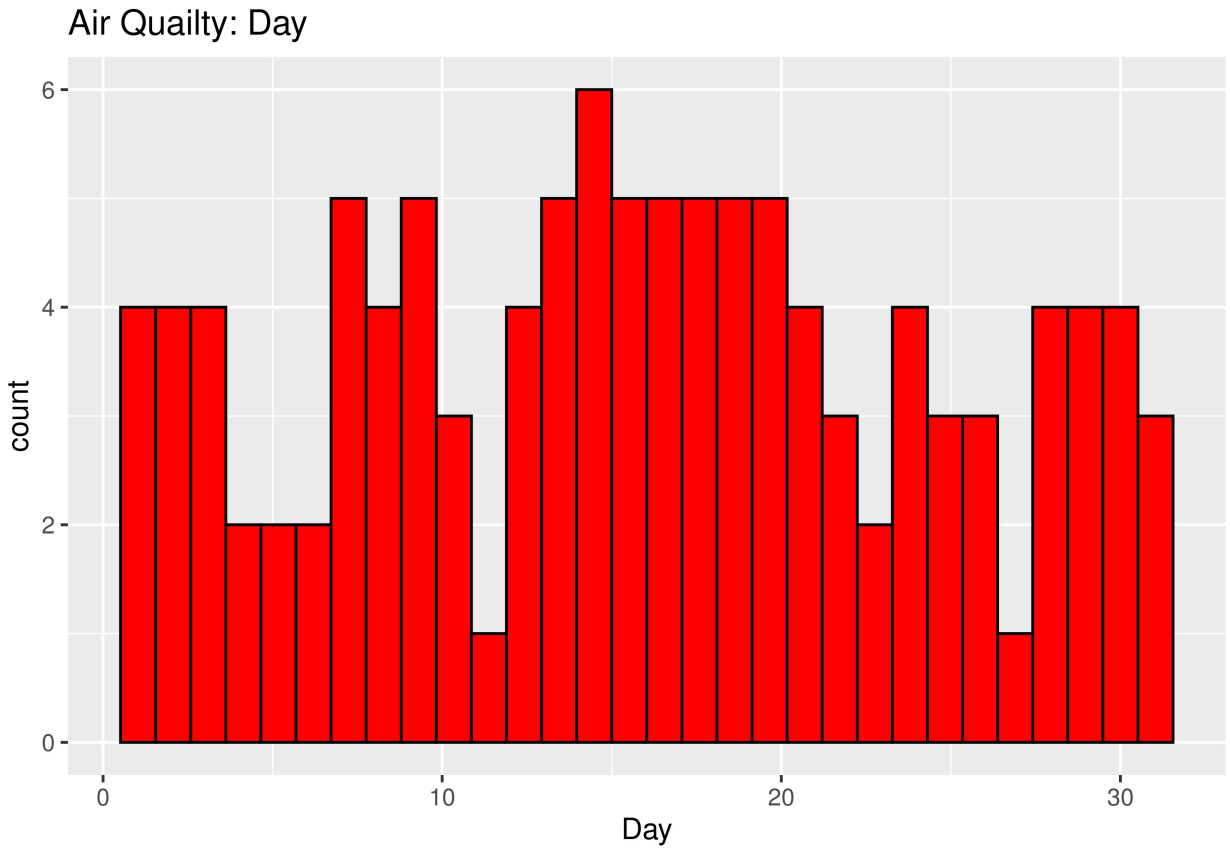
Month

```
histmonth <- ggplot(airdata, aes(x=Month))
histmonth <- histmonth + geom_histogram(bins=30, color="black", fill="red")
histmonth <- histmonth + ggtitle("Air Quailty: Month")
histmonth
```



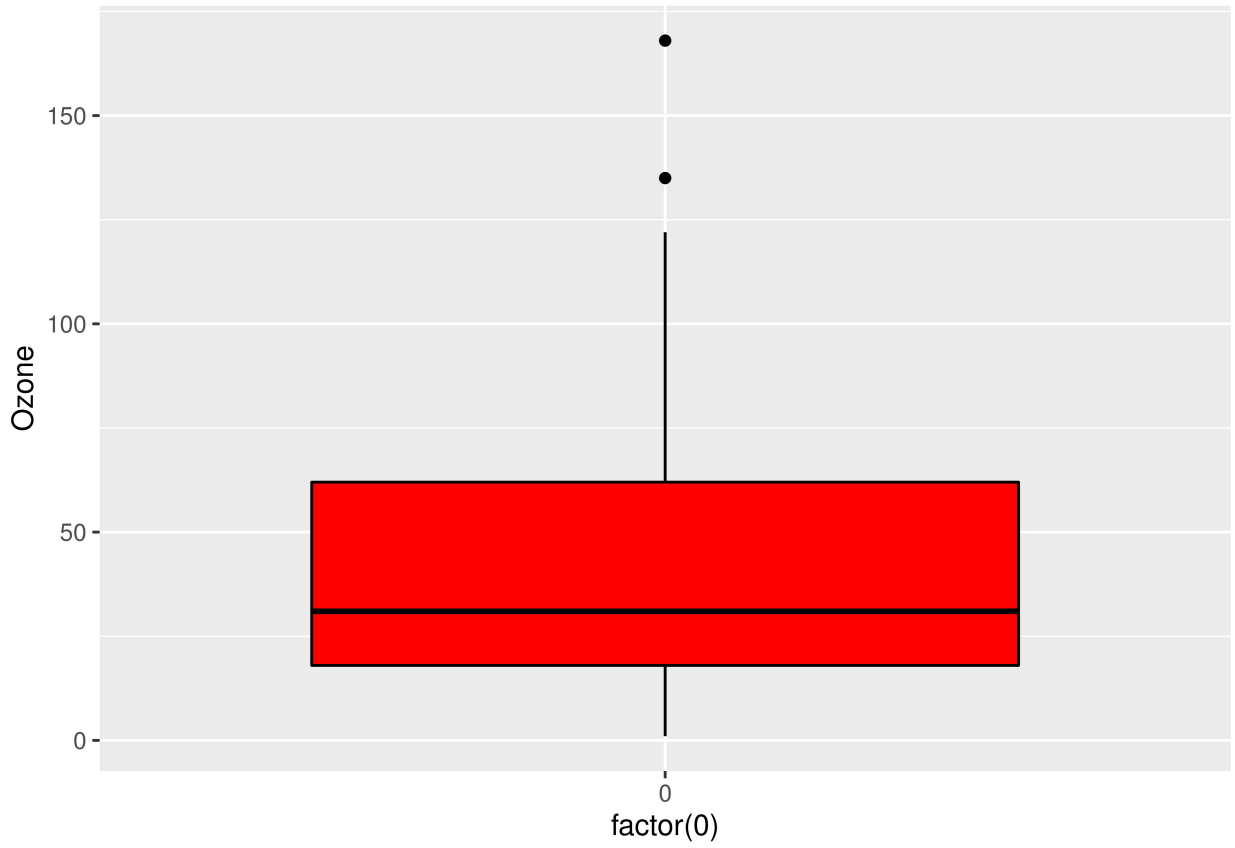
Day

```
histday <- ggplot(airdata, aes(x=Day))
histday <- histday + geom_histogram(bins= 30, color="black", fill="red")
histday <- histday + ggtitle("Air Quailty: Day")
histday
```



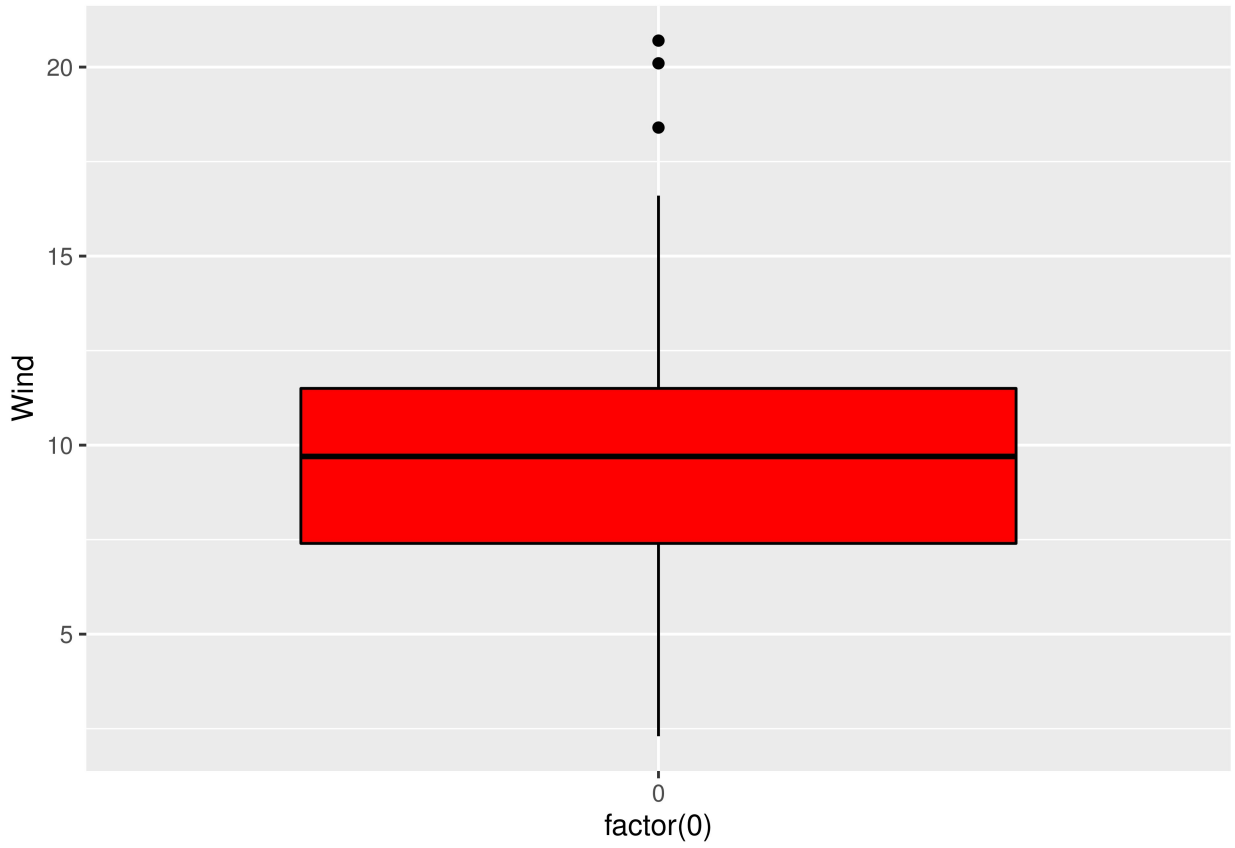
Boxplot for Ozone

```
bpozone <- ggplot(airdata,aes(x=factor(0), Ozone)) + geom_boxplot(color="black", fill="red")
bpozone
```



Boxplot for wind values

```
bpwind <- ggplot(airdata,aes(x=factor(0), Wind))
bpwind <- bpwind + geom_boxplot(color='black', fill="red", na.rm = TRUE )
bpwind
```



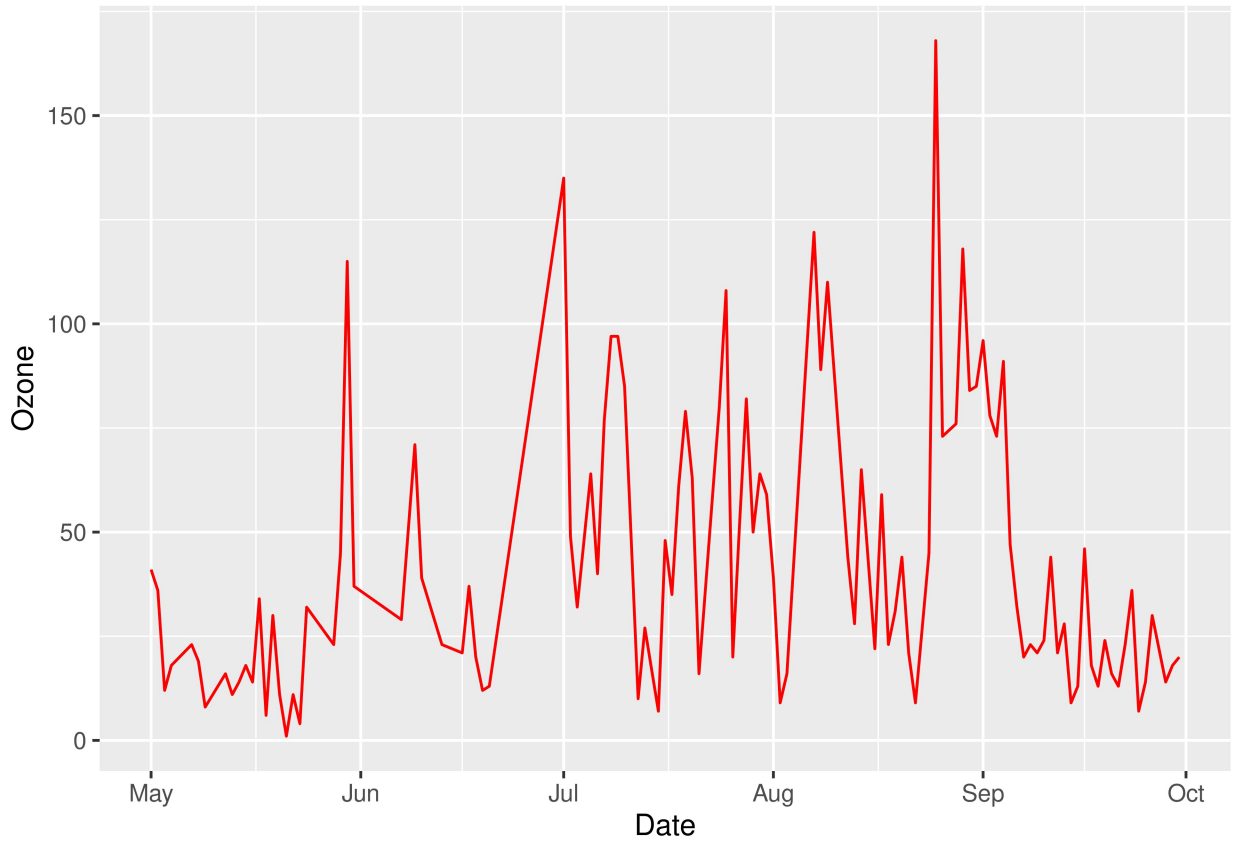
Step 3: Explore How the data changes over time

Make dates correct

```
airdata$Date <- as.Date(paste(airdata$Month, airdata$Day, 1973, sep = "-"), format("%m-%d-%Y"))
```

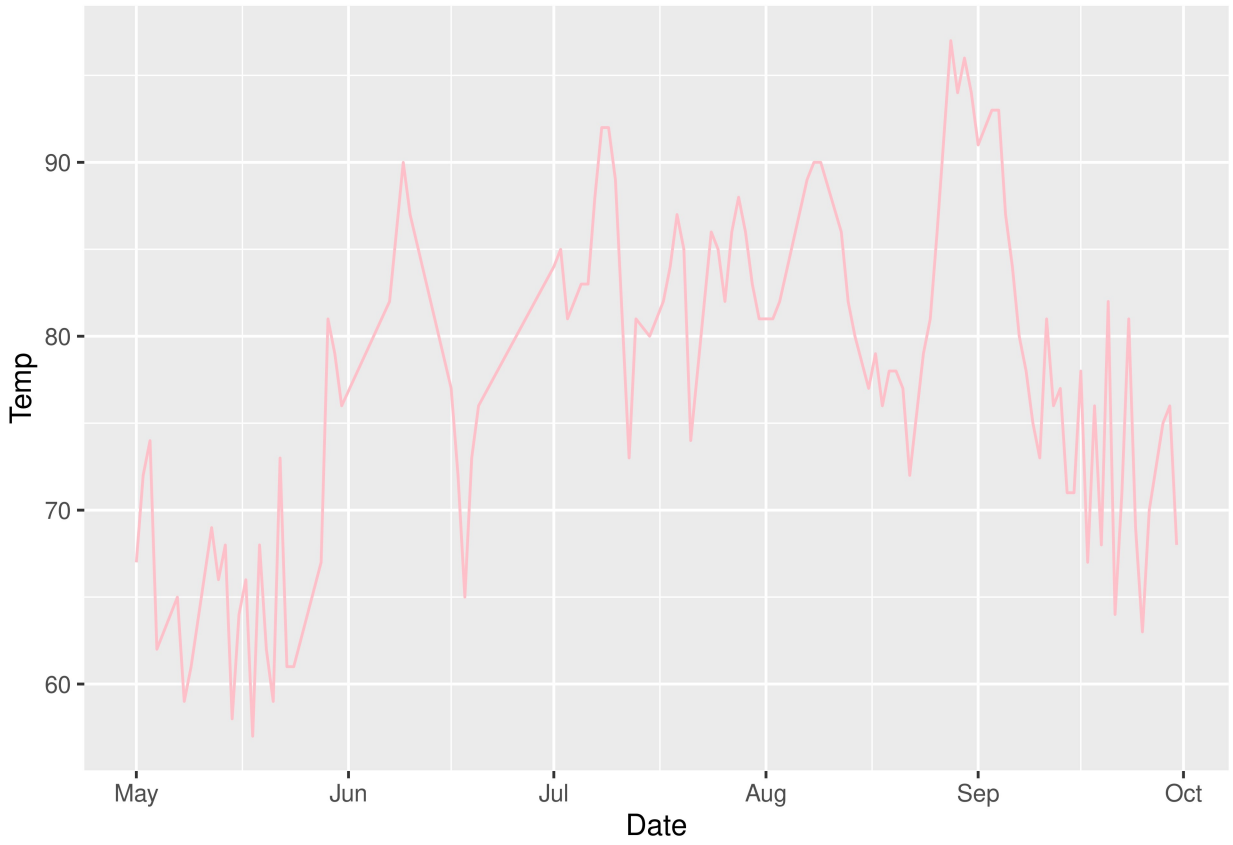
Line chart for Ozone

```
lcozone <- ggplot(airdata, aes(x=Date, y=Ozone)) + geom_line(color="red", size=.5)
lcozone
```



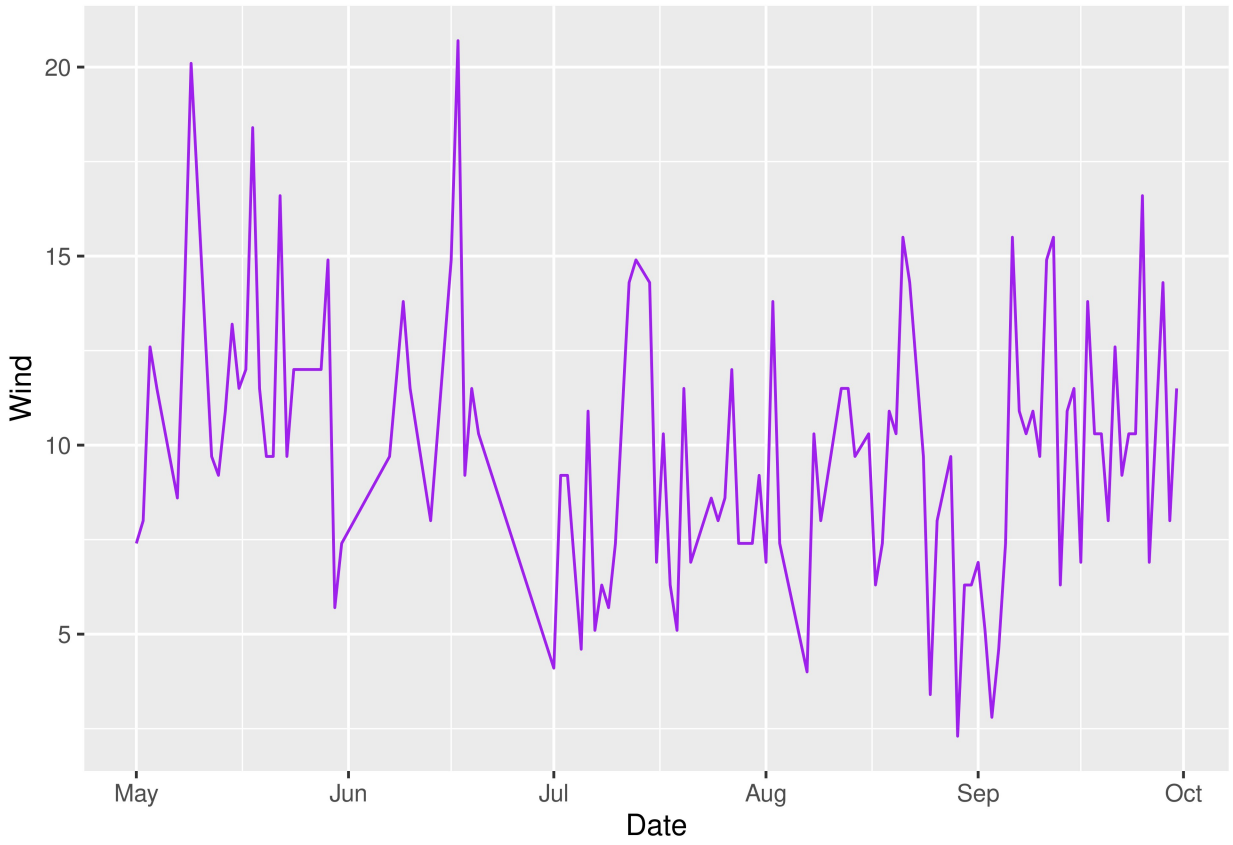
Line chart for Temp

```
lctemp <- ggplot(airdata, aes(x=Date, y=Temp)) + geom_line(color="pink", size=.5)
lctemp
```



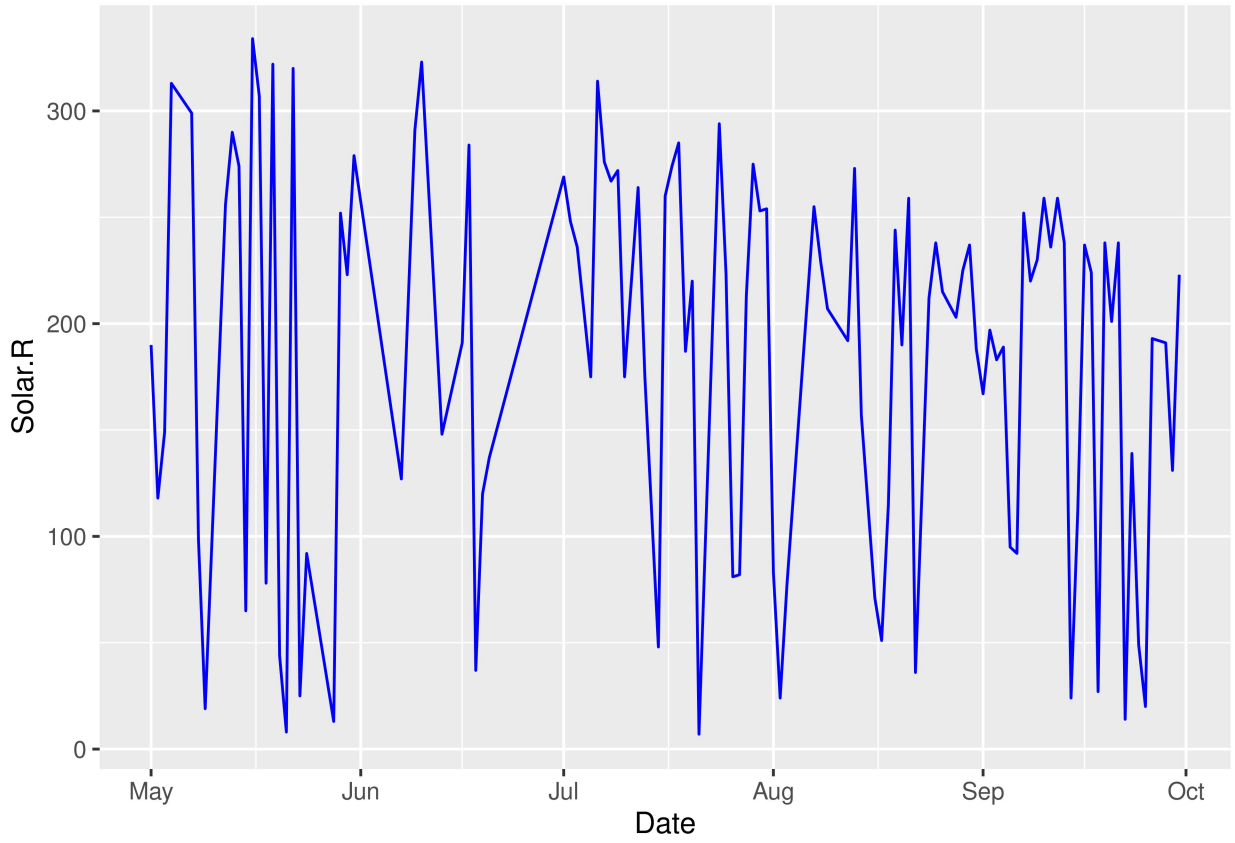
Line chart for Wind

```
lcwind <- ggplot(airdata, aes(x=Date, y=Wind)) + geom_line(color="purple", size=.5)
lcwind
```



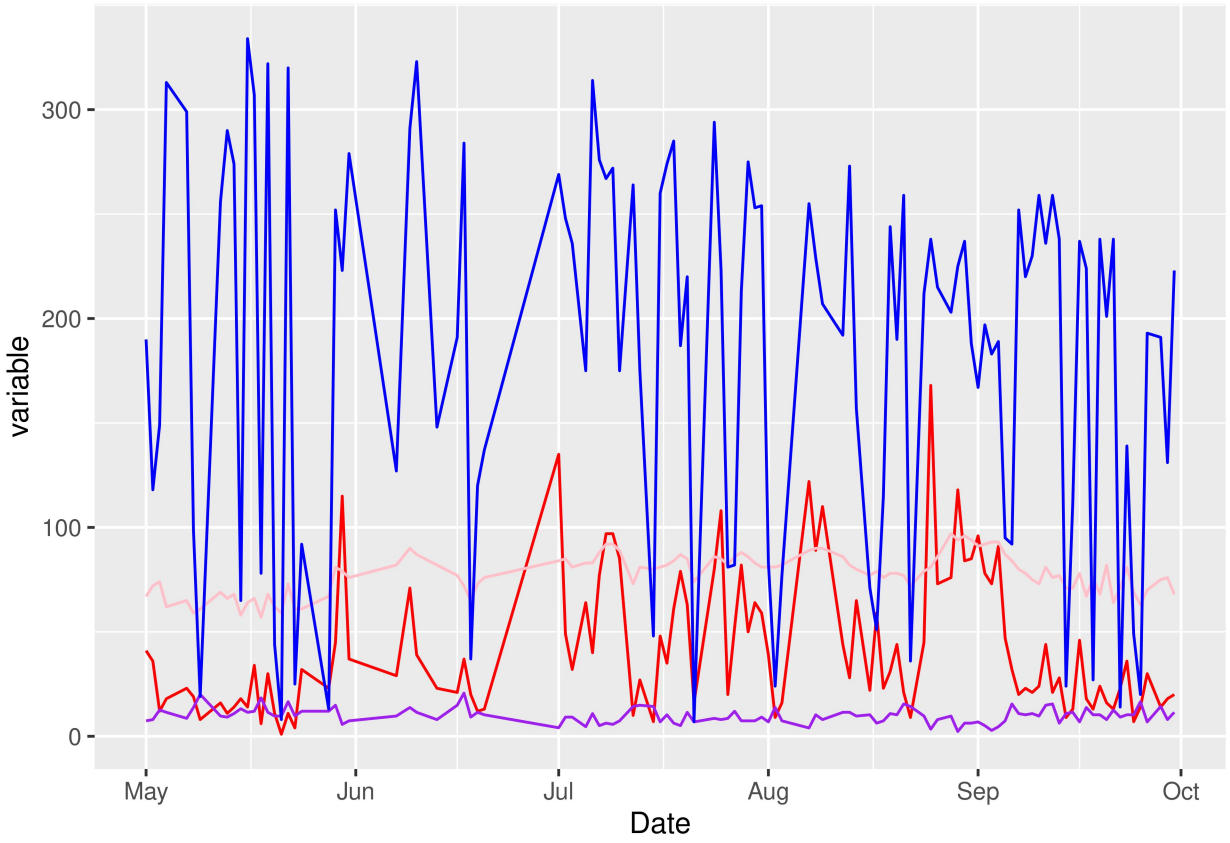
Line chart for Solar

```
lcsolar <- ggplot(airdata, aes(x=Date, y=Solar.R)) + geom_line(color="blue", size=.5)
lcsolar
```



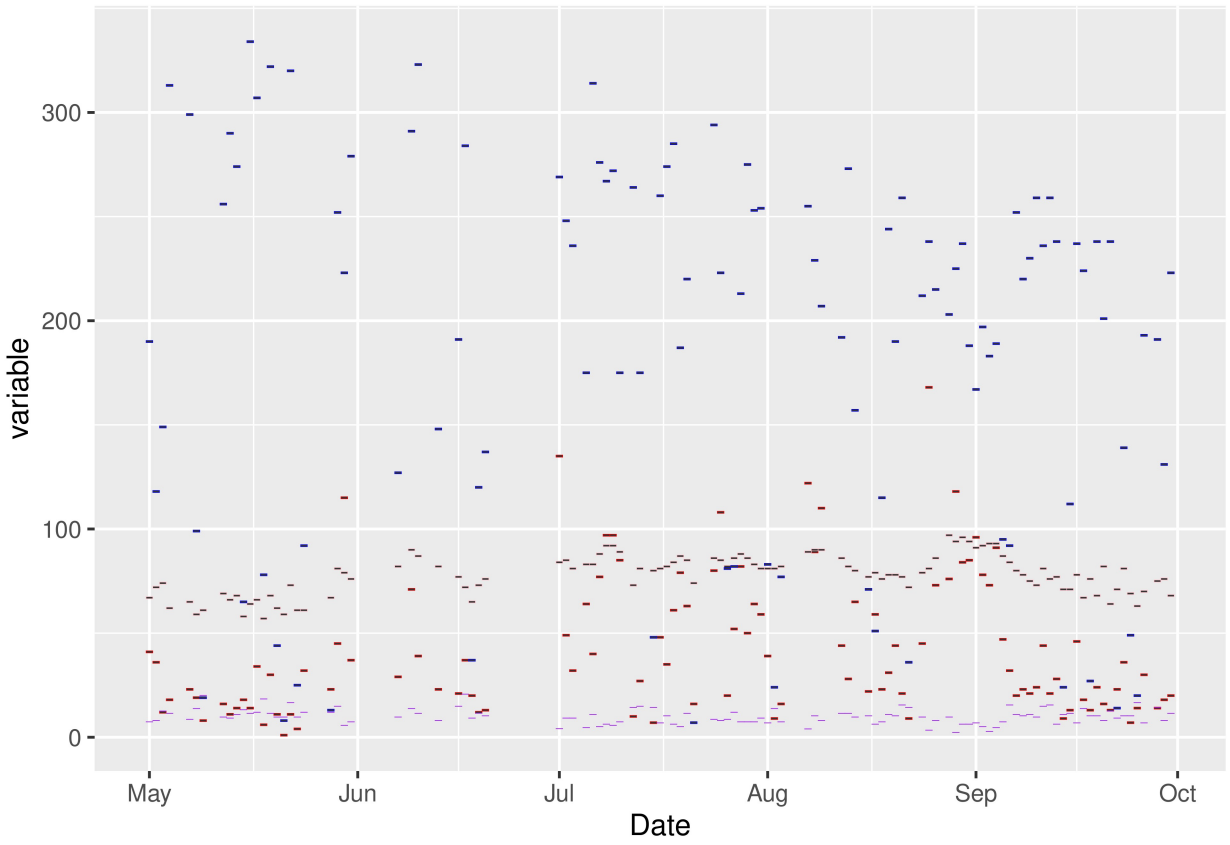
Combine all the data onto one table

```
lineplot <- ggplot(airdata, aes(x=Date, y=variable, group=1))
lineplot <- lineplot + geom_line(aes(y = Ozone), color="red", size=.5)
lineplot <- lineplot + geom_line(aes(y=Temp), color="pink", size=.5)
lineplot <- lineplot + geom_line(aes(y=Wind), color="purple", size=.5)
lineplot <- lineplot + geom_line(aes(y=Solar.R), color="blue", size=.5)
lineplot
```



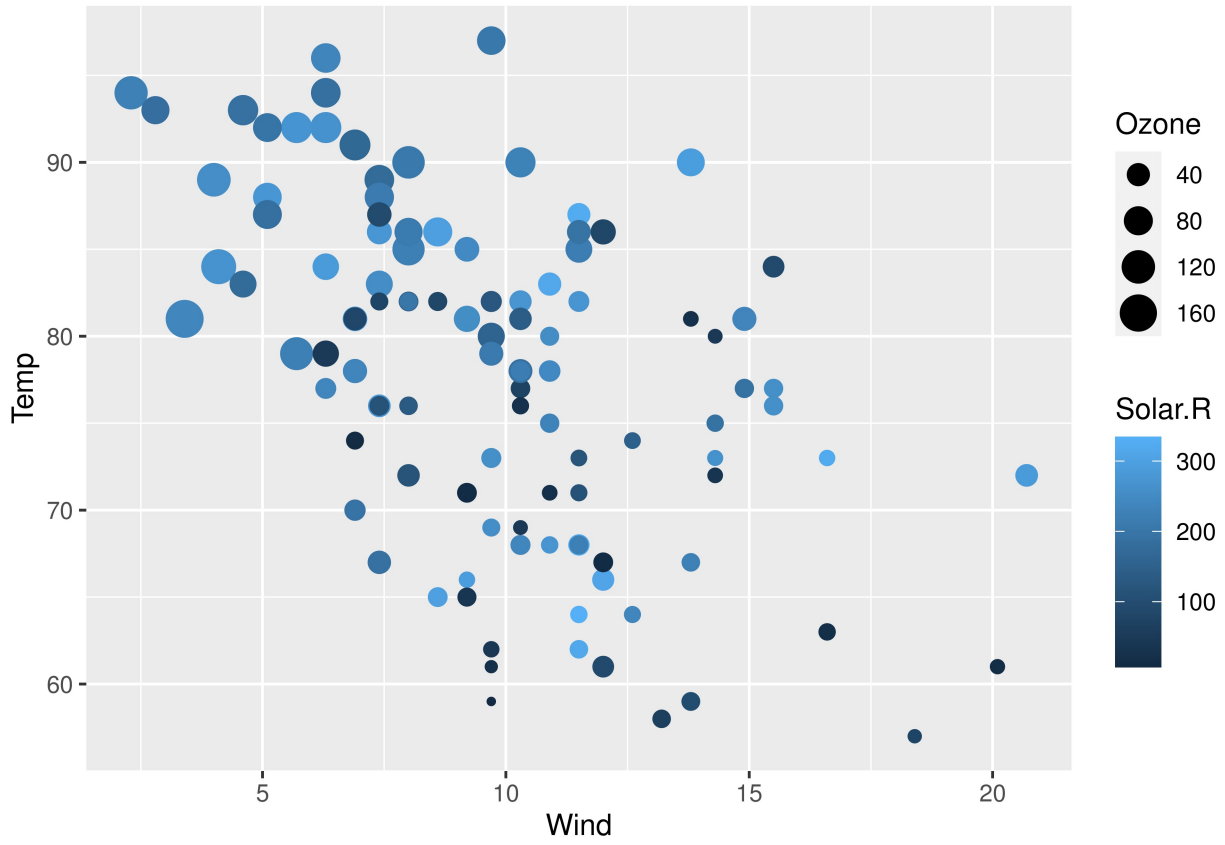
Step 4: Look at all the data via a Heatmap

```
theheatmap <- ggplot(airdata, aes(x=Date, y=variable, group=1))
theheatmap <- theheatmap + geom_tile(aes(y=Ozone), color="red", na.rm = TRUE)
theheatmap <- theheatmap + geom_tile(aes(y=Temp), color="pink", na.rm = TRUE)
theheatmap <- theheatmap + geom_tile(aes(y=Wind), color="purple", na.rm = TRUE)
theheatmap <- theheatmap + geom_tile(aes(y=Solar.R), color="blue", na.rm = TRUE)
theheatmap
```



Step 5: Look at all the data via a scatter

```
satchart <- ggplot(airdata, aes(x=Wind, y=Temp))+geom_point(aes(size=Ozone, color=Solar.R))
satchart
```



Step 6: Final Analysis

There were a few patterns in the data. For example, the wind histogram and the wind box plot seemed to be very similar. You can also see in the geom_lines the change of seasons. The temperature also increases in the summer months which makes sense On the scatter plot, when temperature increased, so did the ozone levels, and when wind increased the temperature went down which aslo makes sense.

The most usefull visual was the line chart. It showed more detail and was easier to analyze and explain the data.