MA213 Basic Statistics and Probability - Lab3 Guide

Lab 3: Plotting and Summaries

Learning Objectives

- Classify and Analyze Variables: Categorize variables based on their types (e.g., numerical/categorical, continuous/discrete, ordinal), assess their association (positive, negative, or independent), and determine which make sense as explanatory vs. response variables.
- Use R for Data Management and Exploration: Utilize R to load, pre-process, and explore data through visualization and summarization techniques.

Graphics with `ggplot2` package

Plotting with `ggplot2` package begins with

```
ggplot(data = df, aes(x=x_xvariable, y=y_variable))
```

where

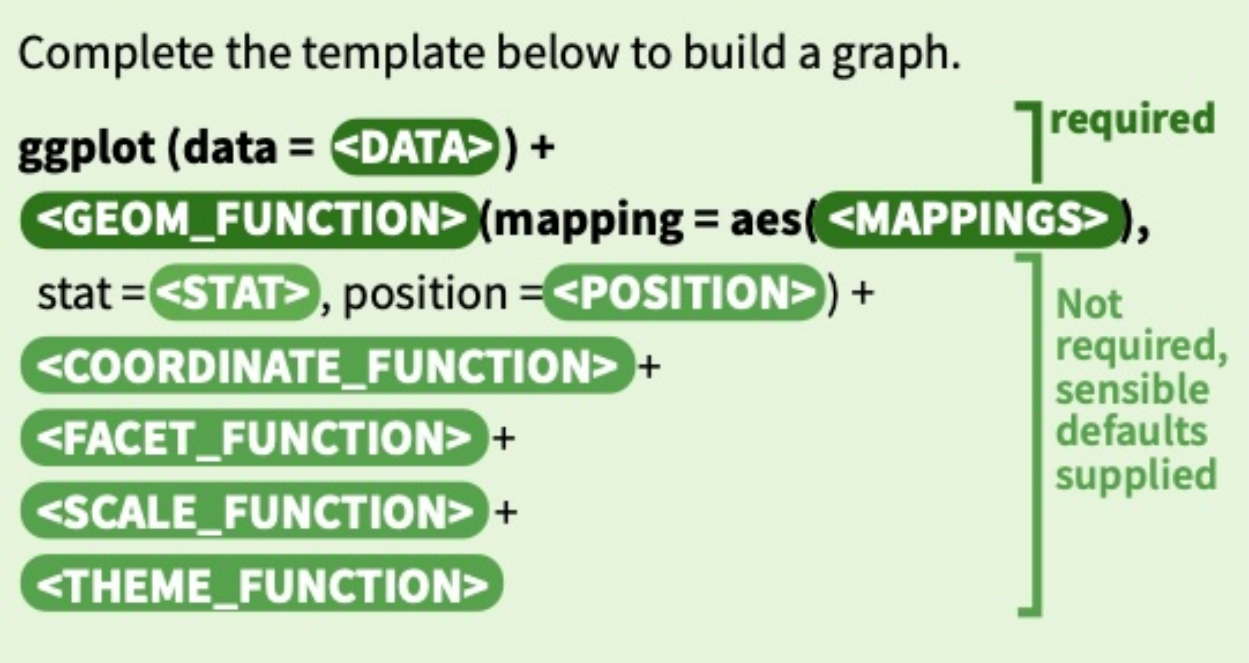
`df` : your dataframe name,

`aes()` : Aesthetics to define -> specifying which variables are mapped to the x and y axes.

and then you add `geoms` functions – geometrical objects as a graphical representation of the data in the plot (points, lines, bars). `ggplot2` offers many different geoms; We will use a few common ones today, including:

- `geom_point()` : scatter plots, dot plots, etc.
- `geom_line()` : trend lines, time-series, etc.
- `geom_histogram()` : histograms

In short,



Plots to show New York Air Quality Data

We want to examine the shape of `Ozone` to see whether the data is symmetric, skewed or how the mean is centered and where. . . ? Let's see how this `Ozone` data is shaped by using several different methods.

Import the Data

```
df = read.csv("Lab3/airquality.csv")
```

1. Summary of `Ozone`.

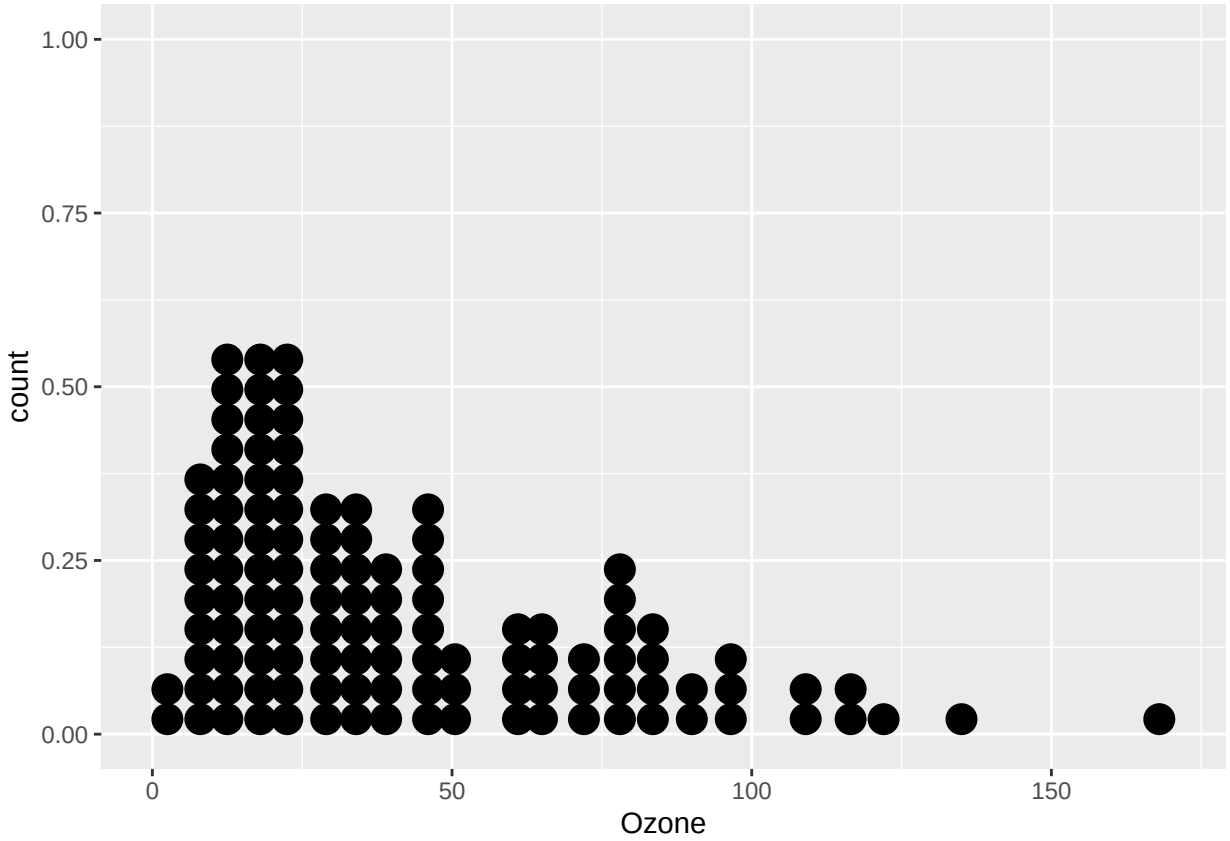
```
summary(df$Ozone)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##    1.00   18.00   31.50   42.13   63.25  168.00      37
```

2. Stacked dot plot of `Ozone` .

```
ggplot(data = df, aes(Ozone)) +
  geom_dotplot(binwidth = 5) # bins of width 5
```

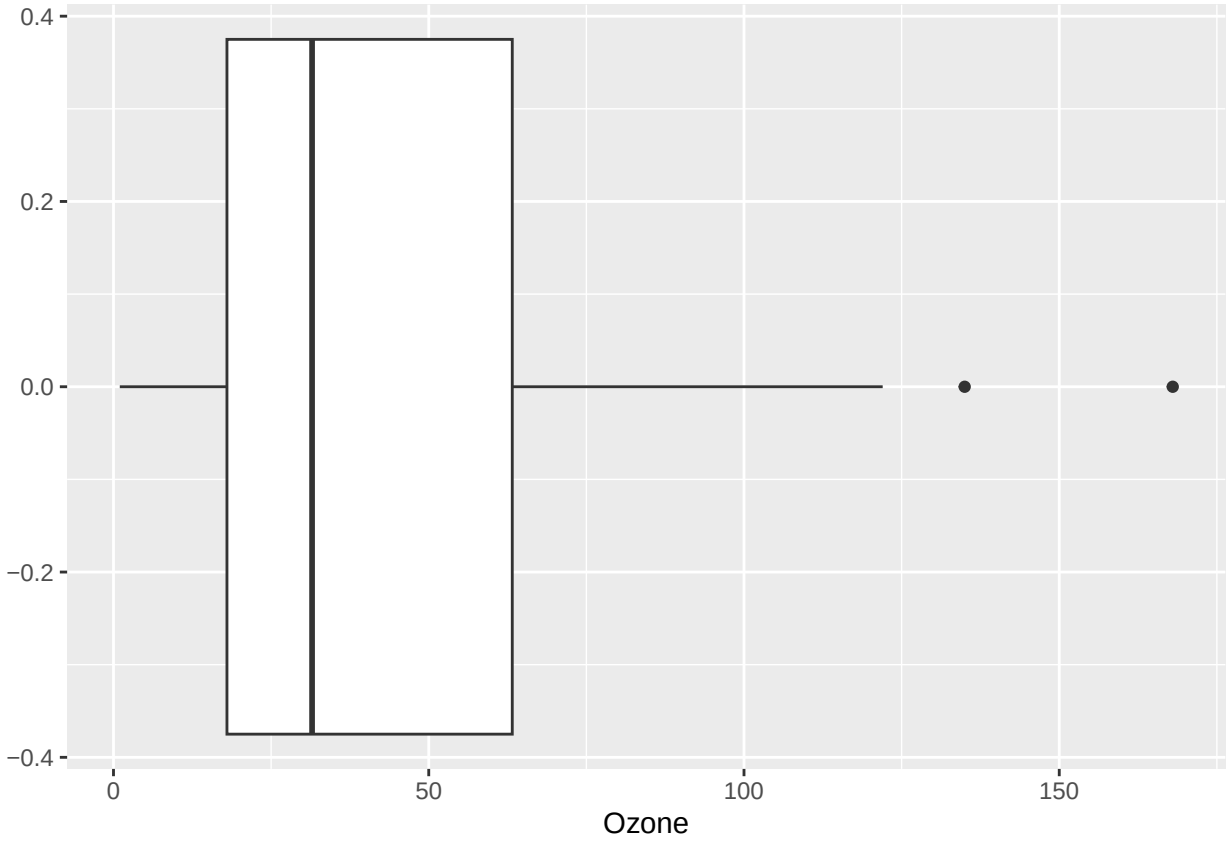
```
## Warning: Removed 37 rows containing missing values or values
## outside the scale range (`stat_bindot()`).
```



3. Box plot of `Ozone`.

```
ggplot(data=df, aes(Ozone)) +
  geom_boxplot()
```

```
## Warning: Removed 37 rows containing non-finite outside the
## scale range (`stat_boxplot()`).
```

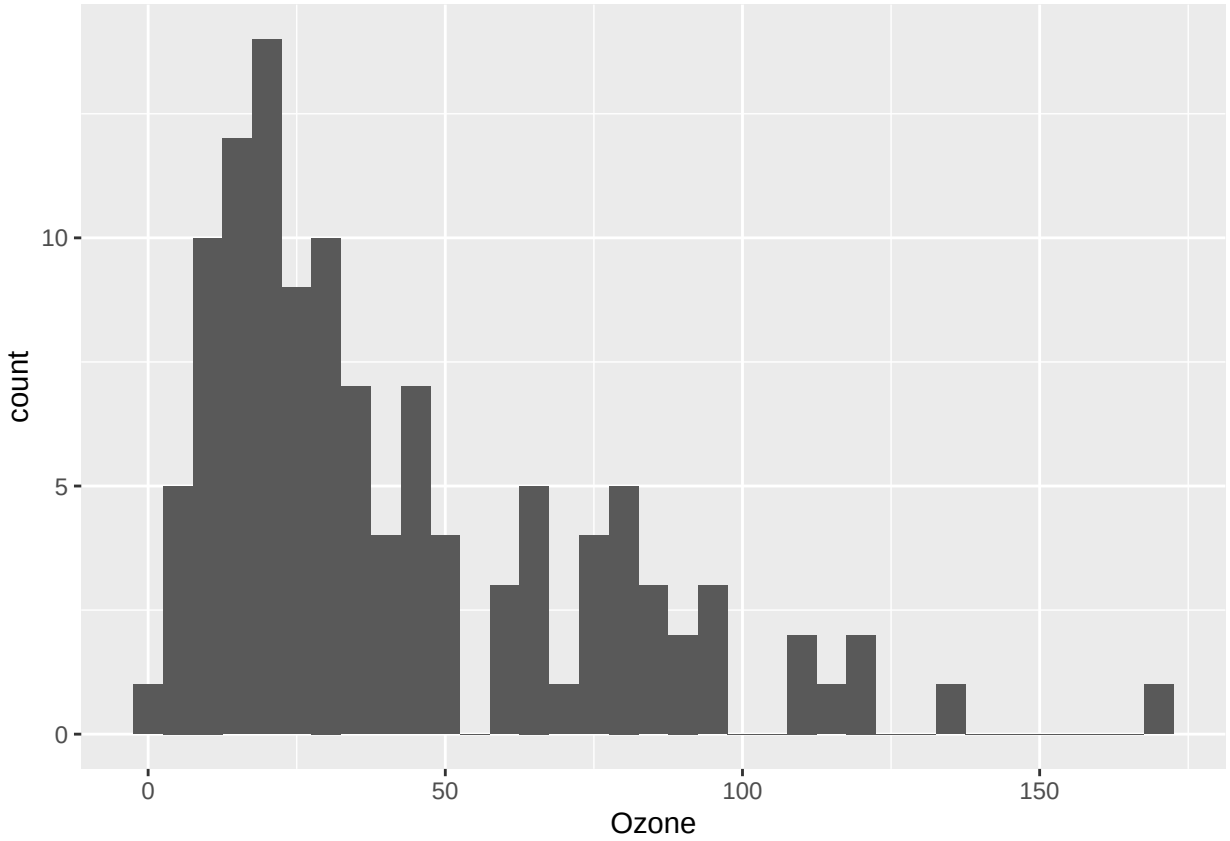


This shows that there are two suspected outliers.

4. Histogram of `Ozone` .

```
# ggplot version

ggplot(data=df ) +
  geom_histogram(mapping=aes(Ozone), binwidth = 5)
```

```
## Warning: Removed 37 rows containing non-finite outside the
## scale range (`stat_bin()`).
```

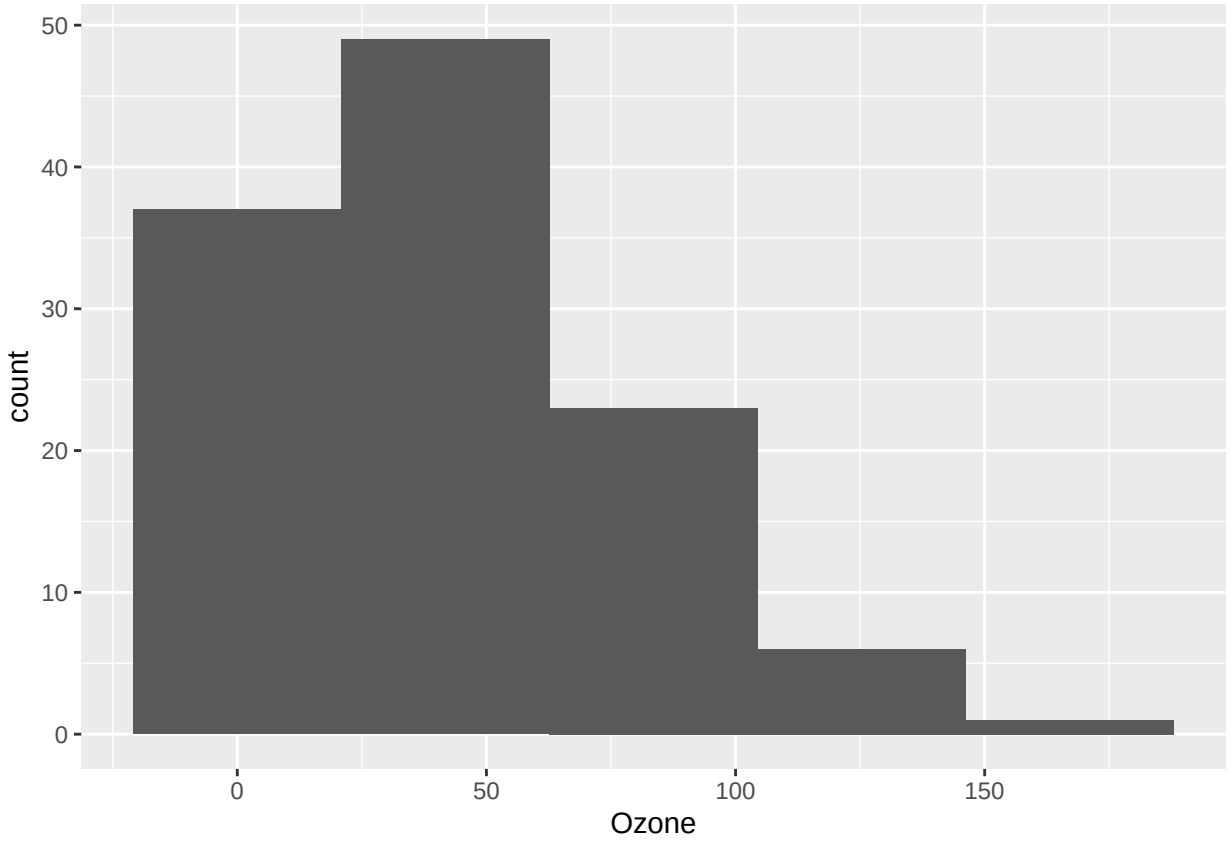


5. Histogram with different bin option

by choosing how many observations in each bin (e.g. `bins=5` means each bin contains 5 observations).

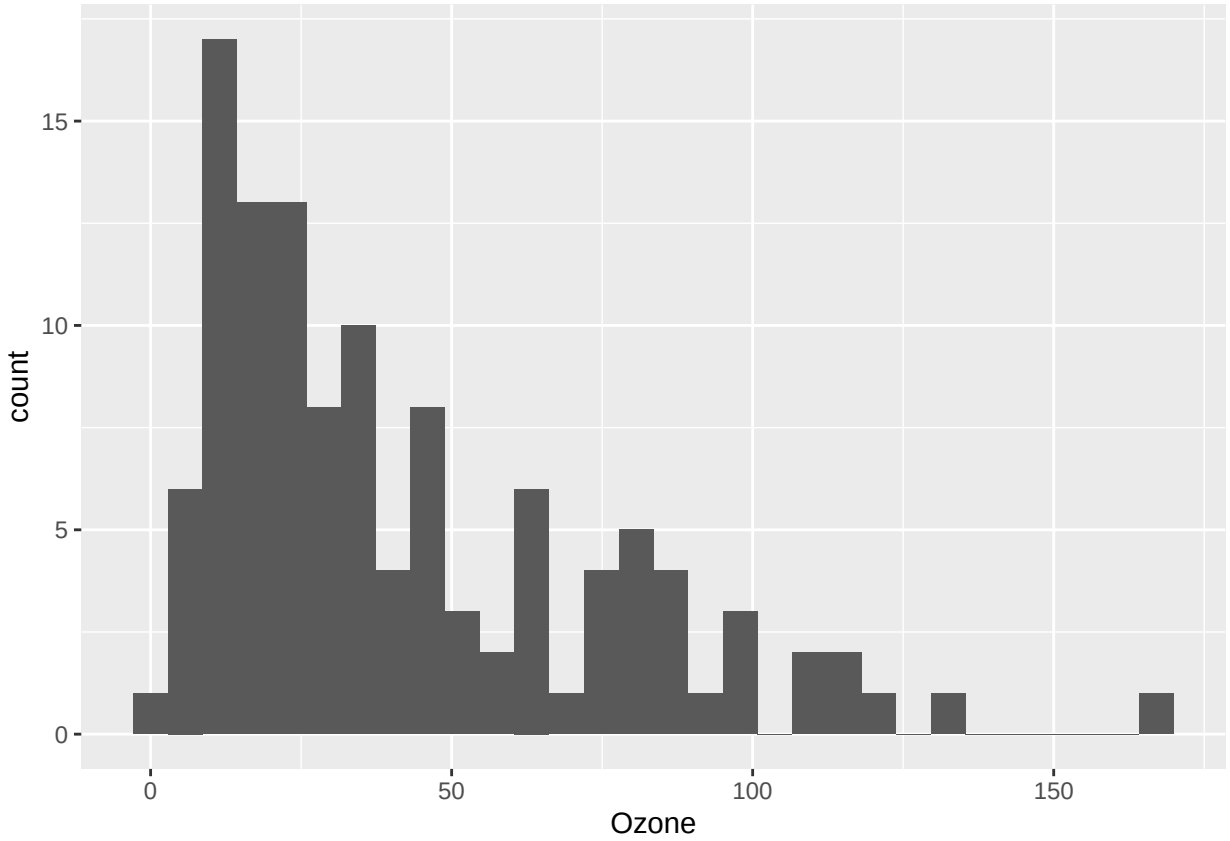
```
# bins = 5
ggplot(data=df ) + geom_histogram(aes(Ozone), bins = 5)
```

```
## Warning: Removed 37 rows containing non-finite outside the
## scale range (`stat_bin()`).
```




```
# bins = 30
ggplot(data=df, aes(Ozone)) +
  geom_histogram(bins = 30)
```

```
## Warning: Removed 37 rows containing non-finite outside the
## scale range (`stat_bin()`).
```

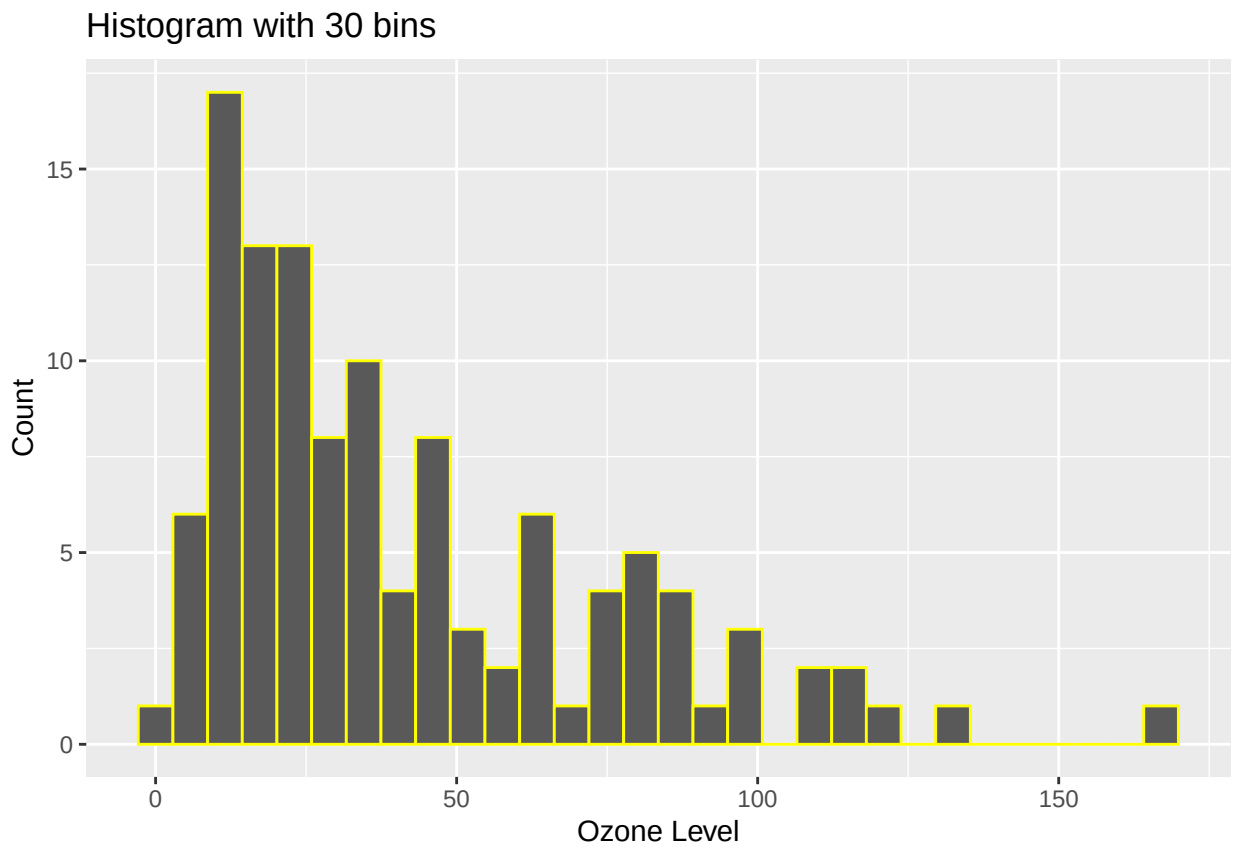


6. Labels in ggplot

With `labs(x='x lable', y='y lable', title = 'name for your plot')` you can name your plot.

```
ggplot(data=df, aes(Ozone)) +
  geom_histogram(bins = 30, color='yellow') +
  labs(x='Ozone Level', y='Count', title = 'Histogram with 30 bins')
```

```
## Warning: Removed 37 rows containing non-finite outside the
## scale range (`stat_bin()`).
```

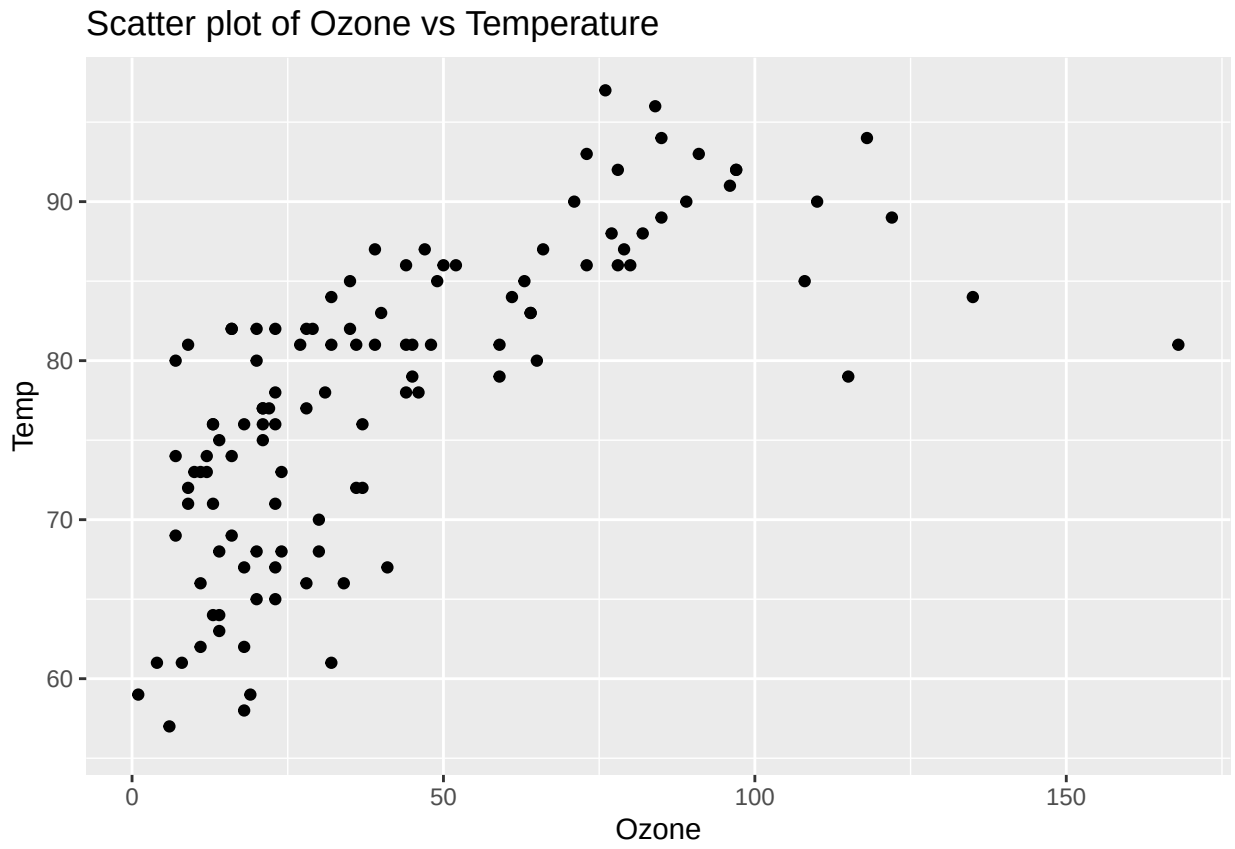


7. Scatter plot of `Ozone` and `Temp` .

We want to examine whether there is a relationship between ozone and temperature (both numerical). How do we want to approach this?

```
ggplot(df) + geom_point(aes(x=Ozone, y=Temp)) +
  labs(title='Scatter plot of Ozone vs Temperature')
```

```
## Warning: Removed 37 rows containing missing values or values
## outside the scale range (`geom_point()`).
```



Titanic Data

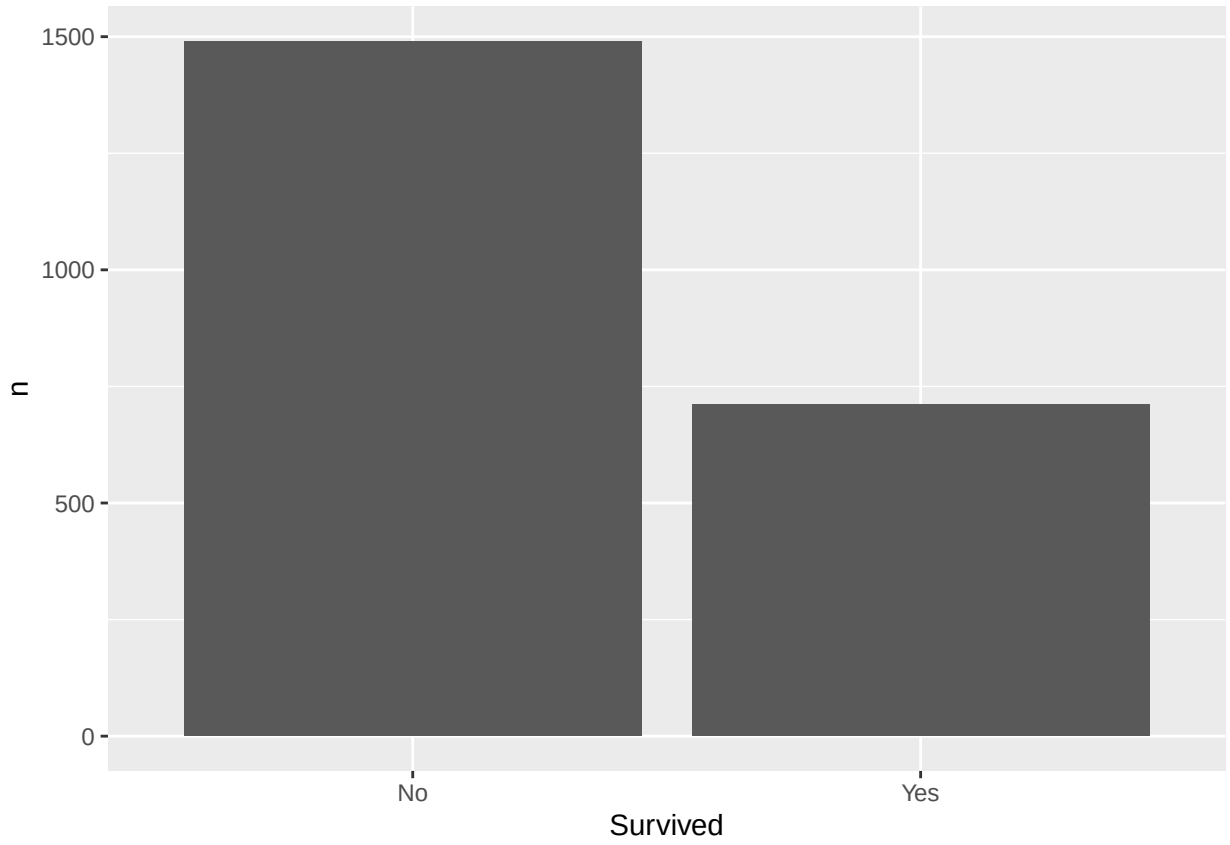
We are going to work with titanic data `titanic.csv`. Let's import the data.

```
# loading from csv file
df <- read.csv("Lab3/titanic.csv")
glimpse(df)
```

```
## Rows: 2,201
## Columns: 5
## $ X        <int> 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18~
## $ Class    <chr> "3rd", "3rd", "3rd", "3rd", "3rd", "3rd", "3rd", "3rd", "3rd"~
## $ Sex      <chr> "Male", "Male", "Male", "Male", "Male", "Male", "Male", "Male~
## $ Age      <chr> "Child", "Child", "Child", "Child", "Child", "Child", "Child"~
## $ Survived <chr> "No", "No", "No", "No", "No", "No", "No", "No", "No", "No", "~
```

8. Barplot for `Survived`

```
new_df <- df %>% count(Survived)
ggplot(new_df, aes(x = Survived, y=n)) +
  geom_col()
```



9. Barplot of `Survived` and `Class`

This shows summary table of `Survived` and `Class`

```
df %>%
  group_by(Survived, Class) %>%
  summarise(count=n())
```

```
## `summarise()` has grouped output by 'Survived'. You
## can override using the `.groups` argument.
```

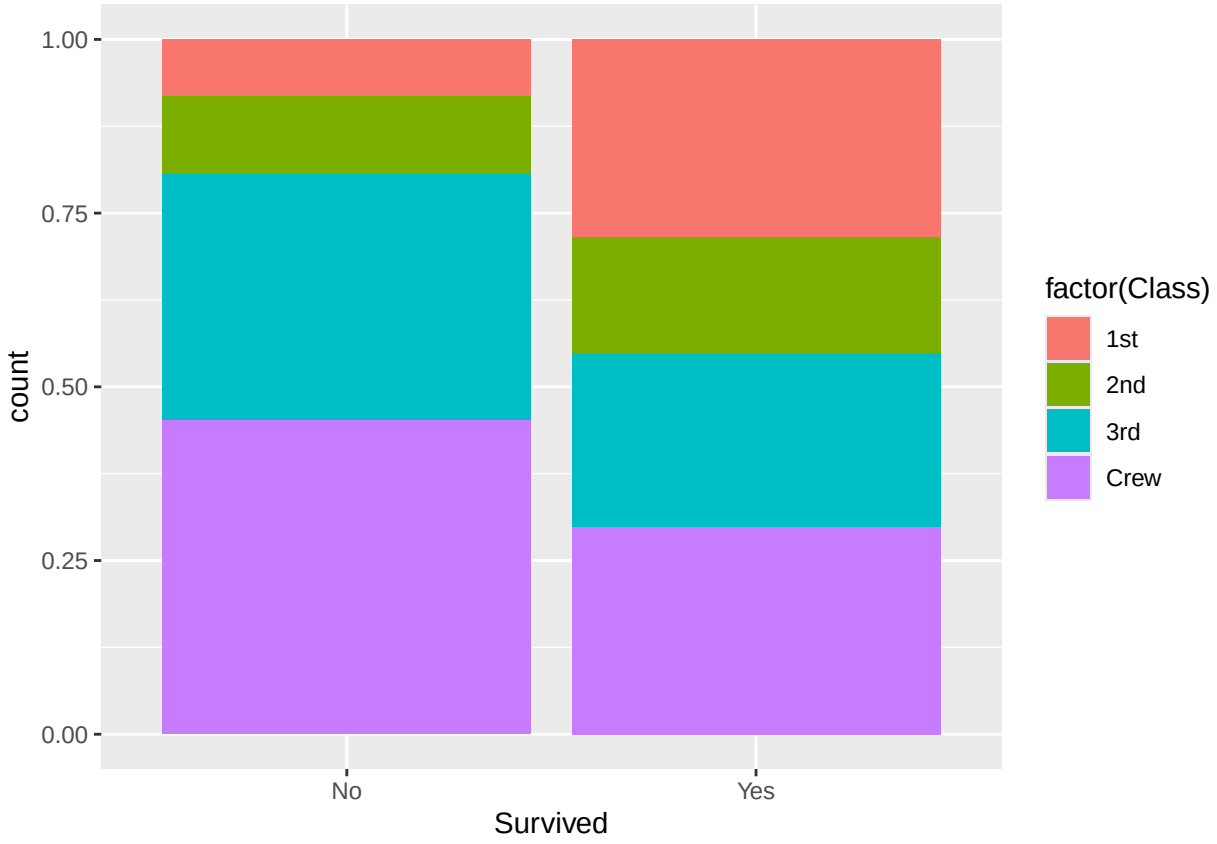
```
## # A tibble: 8 x 3
## # Groups:   Survived [2]
##   Survived Class count
##   <chr>    <chr> <int>
## 1 No       1st     122
## 2 No       2nd     167
## 3 No       3rd     528
## 4 No       Crew    673
## 5 Yes      1st     203
## 6 Yes      2nd     118
## 7 Yes      3rd     178
## 8 Yes      Crew    212
```

Adding `ggplot()` will turn it into barplot using `geom_col()`

```
df %>%
  group_by(Survived, Class) %>%
```

```
  summarise(count=n()) %>%
  ggplot(aes(x = factor(Survived), y=count, fill=factor(Class))) +
  geom_col(position = "fill") +  # position can be changed to "dodge", "stack", "jitter", "fill"
  labs(x="Survived")
```

```
## `summarise()` has grouped output by 'Survived'. You
## can override using the `.groups` argument.
```




```
# for positioning in geom functions
# https://ggplot2.tidyverse.org/reference/layer_positions.html
```

10. Pie chart of `Class`

We need `table` class data first in order to show a pie chart

```
# dplyr + ggplot

table_data <- df %>%
  count(Class) %>%
  mutate(Class = factor(Class))

table_data
```

```
##   Class   n
## 1   1st 325
## 2   2nd 285
## 3   3rd 706
```

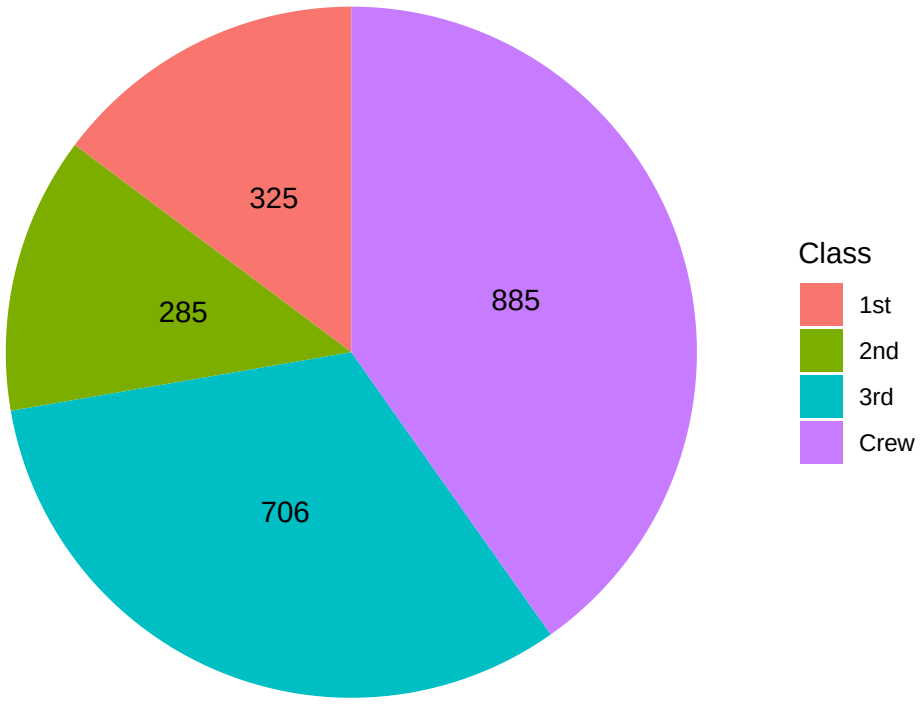
```
## 4  Crew 885
```

```
# alternate way using group_by() + summarise()

table_data2 <- df %>%
  group_by(Class) %>%
  summarise(N = n())

table_data2
```

```
## # A tibble: 4 x 2
##   Class     N
##   <chr> <int>
## 1 1st     325
## 2 2nd     285
## 3 3rd     706
## 4 Crew    885
```

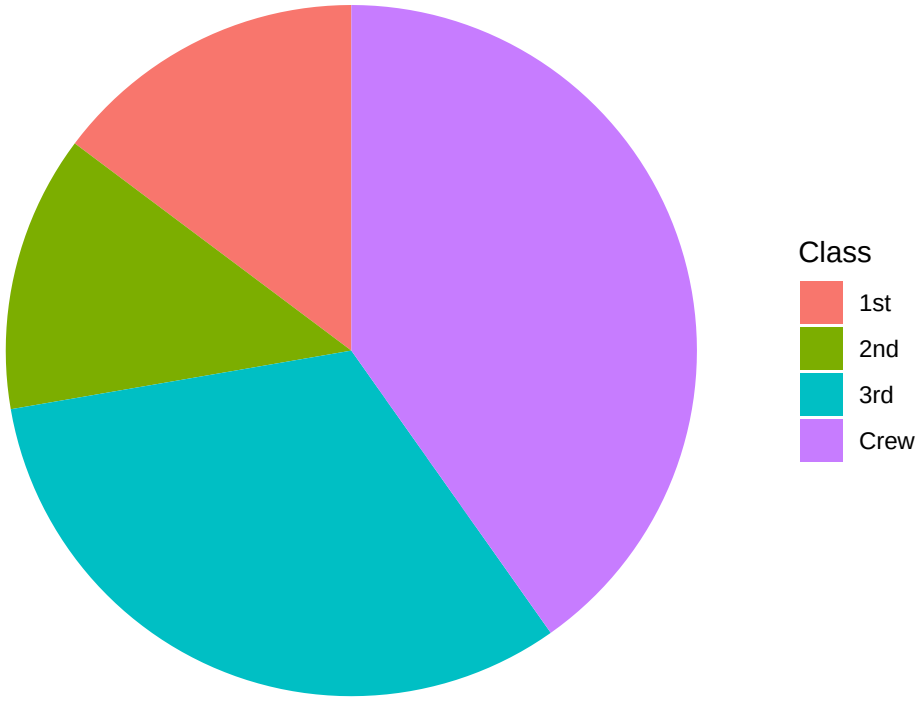
Using this `table` class object `table_data`, we obtain a pie chart.

```
ggplot(data = table_data, aes(x="", y=n, fill=Class)) +
  geom_col() +
  geom_text(aes(label = n), position = position_stack(vjust = 0.5)) +
  coord_polar(theta="y") +
  theme_void()
```

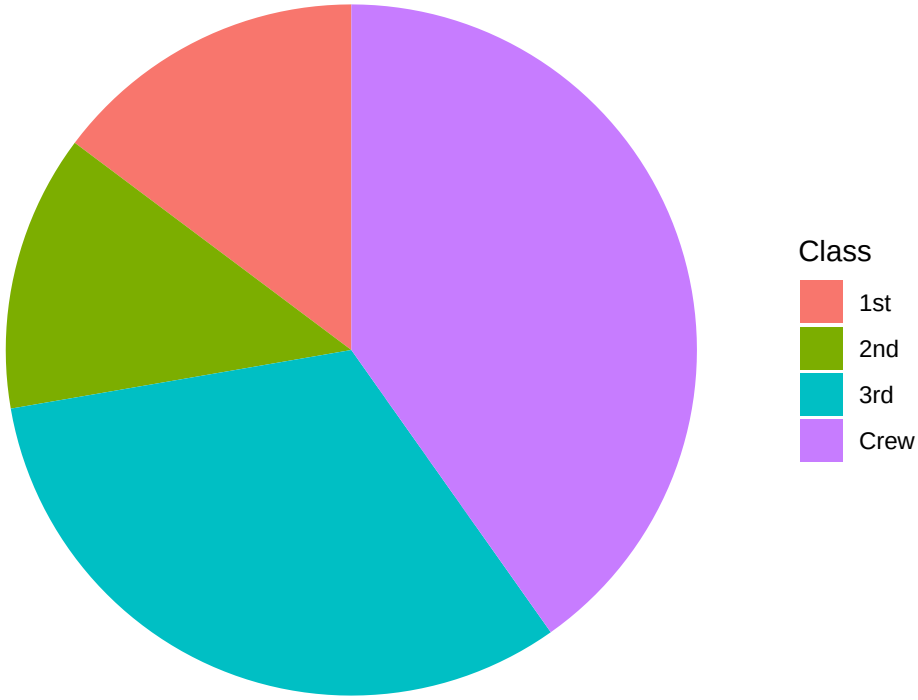



```
# or simply
ggplot(data = table_data, aes(x="", y=n, fill=Class)) +
```

```
  geom_col() +
  coord_polar(theta="y") +
  theme_void()
```




```
# using table_data2
ggplot(data = table_data2, aes(x="", y=N, fill=Class)) +
  geom_col() +
  coord_polar(theta="y") +
  theme_void()
```


Class
1st
2nd
3rd
Crew