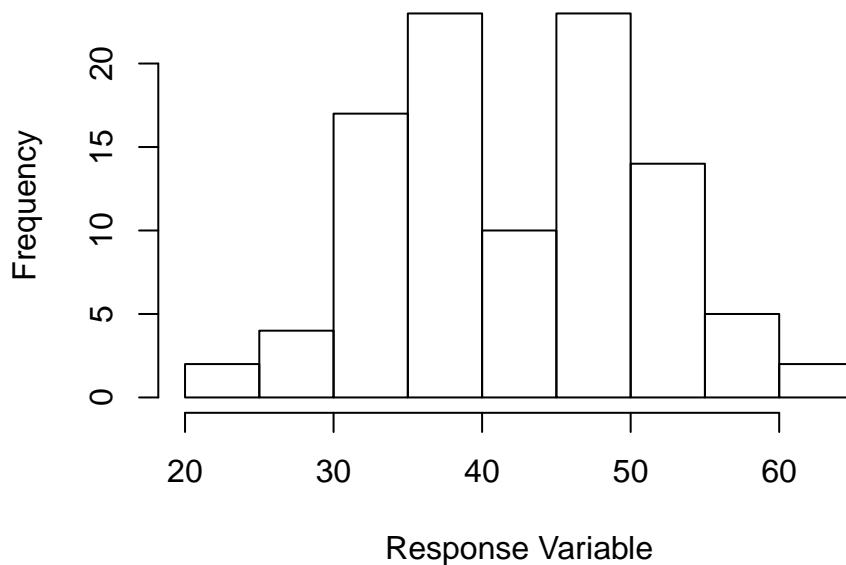


Using Built-in Plotting Functions

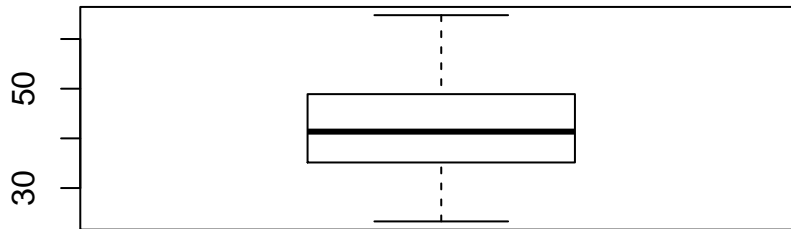
```
#####  
## Plotting One Quantitative Variable  
#####  
## Creating a histogram  
hist(practicedata$respvar, # what the histogram is plotting  
      main='Histogram of Response Variable', # change the main axis title  
      xlab='Response Variable' # change the x-axis label  
      #, freq=TRUE # histogram is of counts  
      # breaks="Sturges", # this can be changed to specify a series of points  
      # for the breaks in the histogram  
      # xlim=c(20,70), # sets the limits of the x-axis  
      # ylim=c(0,25), # sets the limits of the y-axis  
      )
```

Histogram of Response Variable



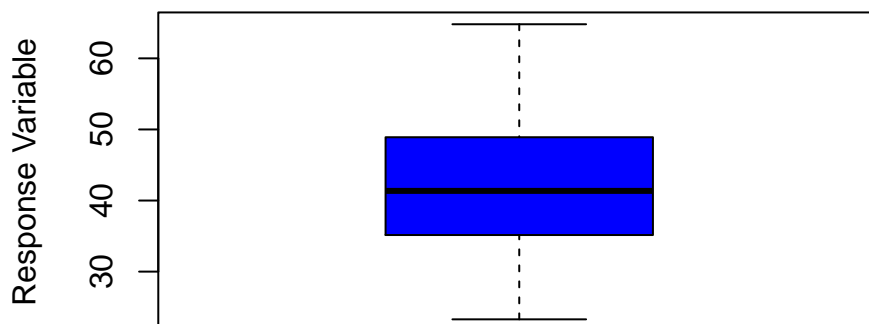
```
## Creating a boxplot:  
boxplot(practicedata$respvar, # what the boxplot is plotting  
        main='Default R Boxplot' # change the main title  
        )
```

Default R Boxplot



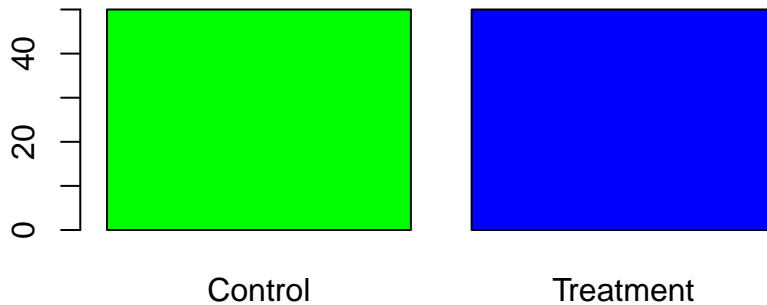
```
## Creating a 'nicer' boxplot  
boxplot(practicedata$respvar, # what the boxplot is plotting  
        main='Nicer R Boxplot', # change the main title  
        ylab='Response Variable', # change the y-axis label  
        names='All Data', # change the name under the boxplot  
        col='blue', # change the color of the boxplot  
        outline=TRUE # Draw outliers if there are any in the data  
        )
```

Nicer R Boxplot

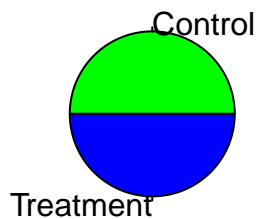


```
#####
## Plotting One Categorical Variable
#####
par(mfrow=c(2,1)) # Put two plots in one figure
## Bar Chart
plot.group<-table(practicedata$groupvar) # Create table of counts
barplot(plot.group, # Bar chart of the variable
        main='Bar Chart of Groups', # change main title
        col=c('green','blue') # change color of each bar
        )
## Pie Chart:
pie(plot.group, # Pie chart of the variable
    main='Pie Chart of Grouping Variable', # change main title
    col=c('green','blue')) # change the color of each slice of the pie
```

Bar Chart of Groups



Pie Chart of Grouping Variable

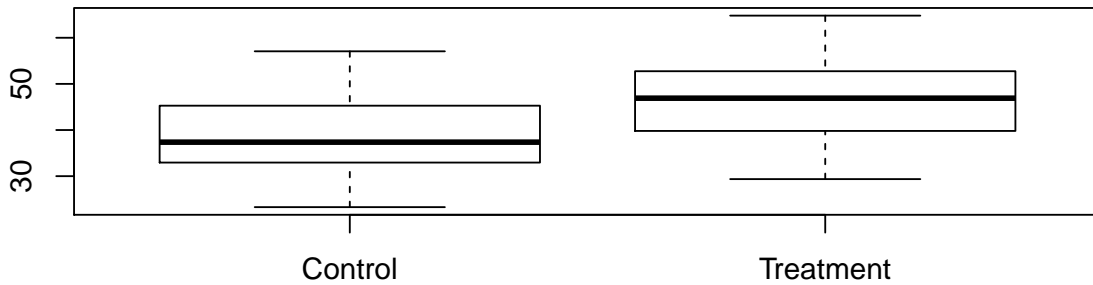


```
#####
## Plotting Two Variables
#####

#### Plotting One Quantitative and One Categorical Variable:

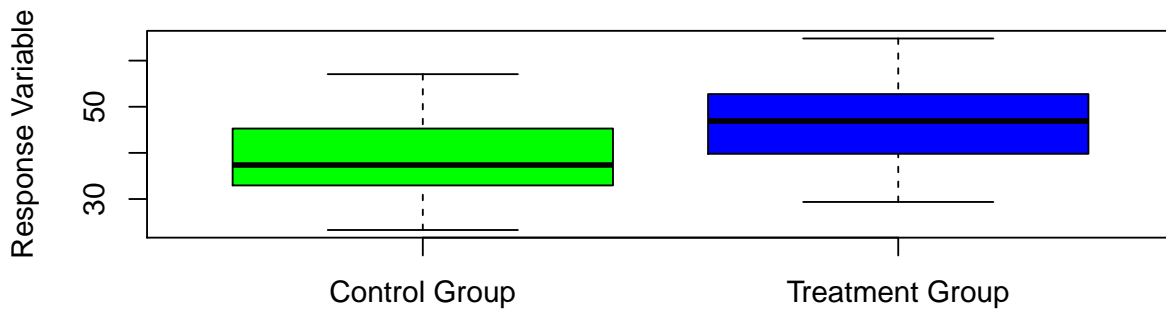
#### Side-by-side boxplots
boxplot(practicedata$respvar~practicedata$groupvar, main='Default R Boxplots')
```

Default R Boxplots



```
boxplot(practicedata$respvar~practicedata$groupvar,
        main='Nicer R Boxplots',
        names=c('Control Group', 'Treatment Group'),
        col=c('green','blue'), # change color of boxes
        ylab='Response Variable' # change y-axis label
        # horizontal=TRUE # change boxplots to horizontal
)
```

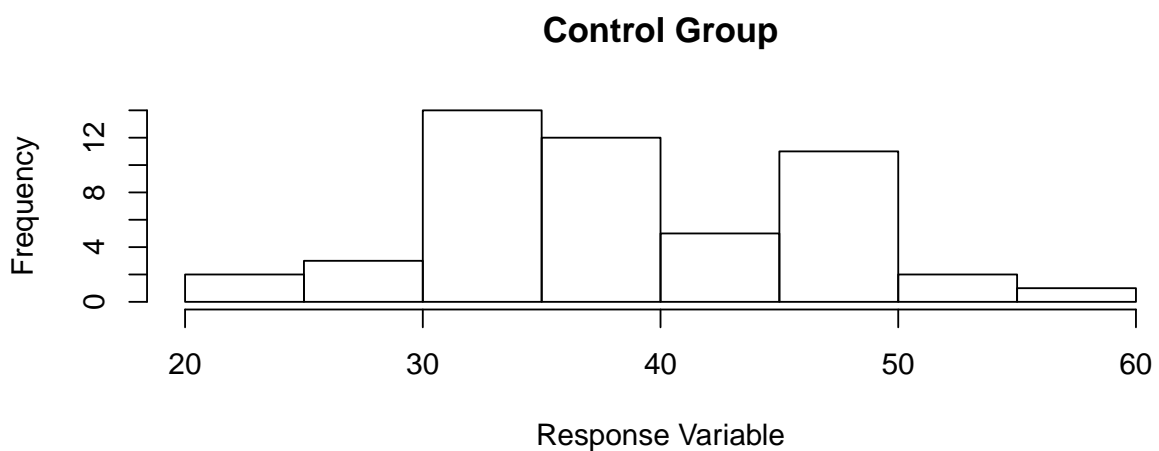
Nicer R Boxplots



```

#### Two Histograms:
# Create a two data subsets for control and treatment individuals
n.controls=50
n.treatments=50
# Extract the first n.controls rows from the data
controldata=practicedata[1:n.controls,]
# Extract everything except the first n.controls rows from the data
treatmentdata=practicedata[-(1:n.controls),]
## Histograms for each group
hist(controldata$respvar,
     main='Control Group', # change the main title
     xlab='Response Variable'
    )

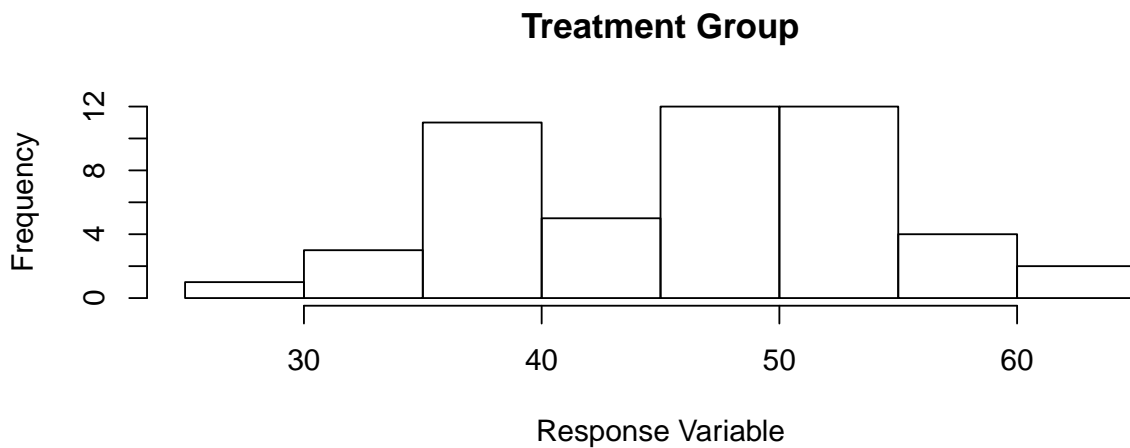
```



```

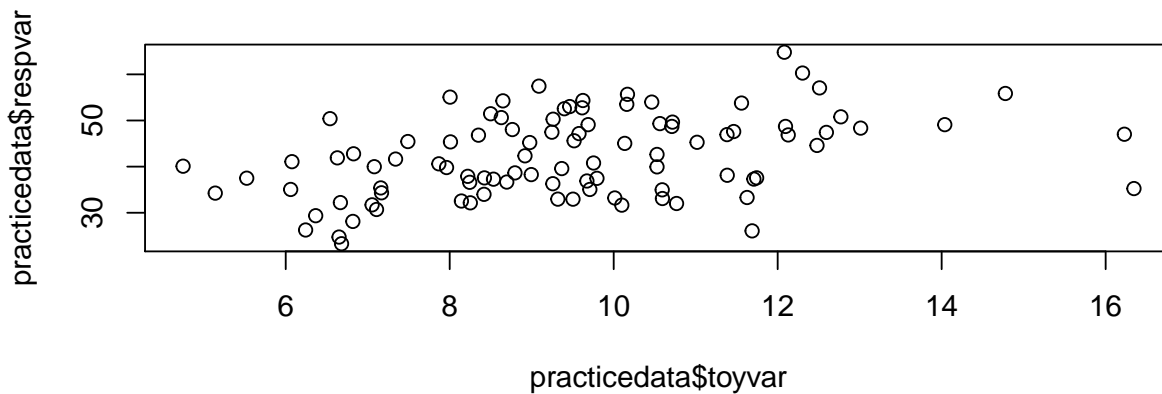
hist(treatmentdata$respvar,
     main='Treatment Group', # change the main title
     xlab='Response Variable'
    )

```



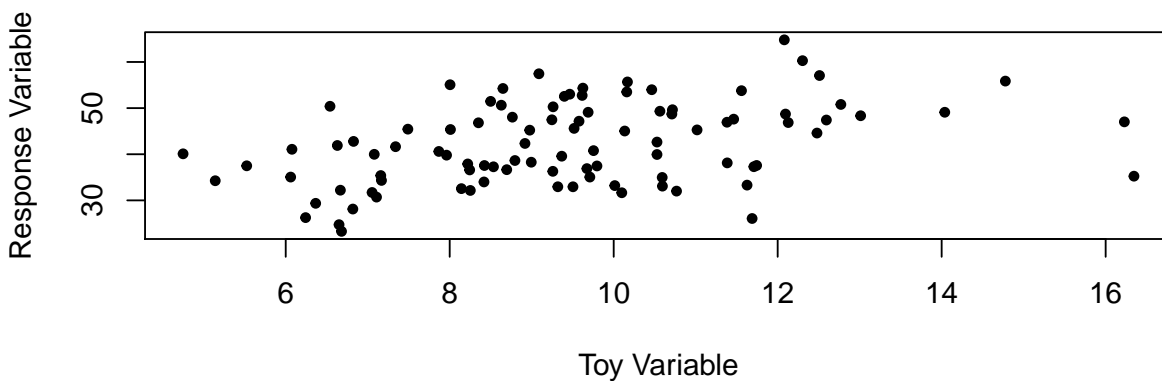
```
#### Plotting two quantitative variables using a scatterplot:
plot(practicedata$toyvar,practicedata$respvar, # x variable, y variable
     main="Default R Scatterplot")
```

Default R Scatterplot



```
plot(practicedata$toyvar,practicedata$respvar, # x variable, y variable
     main="Plot of Response Variable vs. Toy Variable", # change main label
     ylab='Response Variable', # change y-axis label
     xlab='Toy Variable', # change x-axis label
     pch=20 # change the plotting symbol
     #, type='l', # instead of pch, you can create a line plot
     # (make sure your x's are ordered if you do this.)
     # col='black' # change color of plotting symbol
     )
```

Plot of Response Variable vs. Toy Variable



```
#####
## Plots Showing More than Two Variables
#####

## Find the range of the variables we are plotting for BOTH groups
ydatarange=range(practicedata$respvar,na.rm=TRUE)
xdatarange=range(practicedata$toyvar,na.rm=TRUE)

## Create scatterplot with all data
plot(controldata$toyvar,controldata$respvar, # x variable, y variable
      main="Plot of Response Variable vs. Toy Variable", # change main label
      ylab='Response Variable', # change y-axis label
      xlab='Toy Variable', # change x-axis label
      pch=20, # change the plotting symbol
      col='green', # change color of plotting symbol
      xlim=xdatarange, # change the x-axis to cover the range
                    # of both the treatment and control groups
      ylim=ydatarange, # change the y-axis to cover the range
                    # of both the treatment and control groups
      type='n' # create the plotting window, but not the points
    )

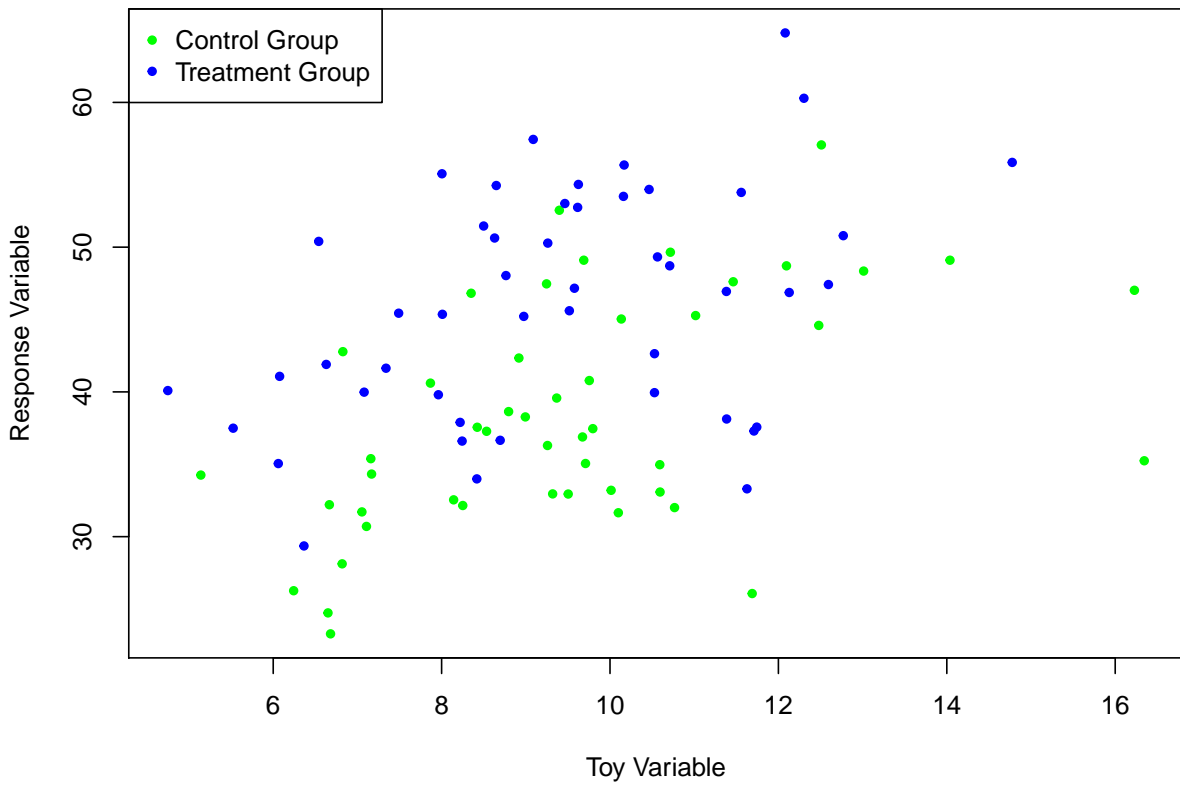
## Add observations for the control data to the plot
points(controldata$toyvar,controldata$respvar, # x variable, y variable
        pch=20, # change the plotting symbol
        col='green' # change color of plotting symbol
    )

## Add observations for the treatment data to the plot
points(treatmentdata$toyvar,treatmentdata$respvar, # x variable, y variable
        pch=20, # change the plotting symbol
        col='blue' # change color of plotting symbol
    )

## Adding a Legend to the Plot
legend('topleft', # location of legend
      legend=c('Control Group','Treatment Group'), # lines of text in the legend
      pch=20, # symbol used in the legend
      col=c('green','blue') # colors of the symbol in the same
                    # order as the lines of text in 'legend'
      # lty=1, lwd=1 # change the line type and width if lines are on the plot
    )

```

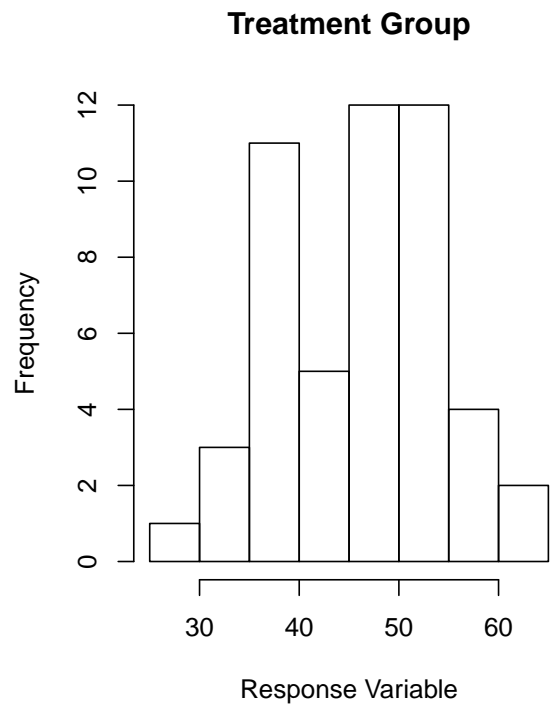
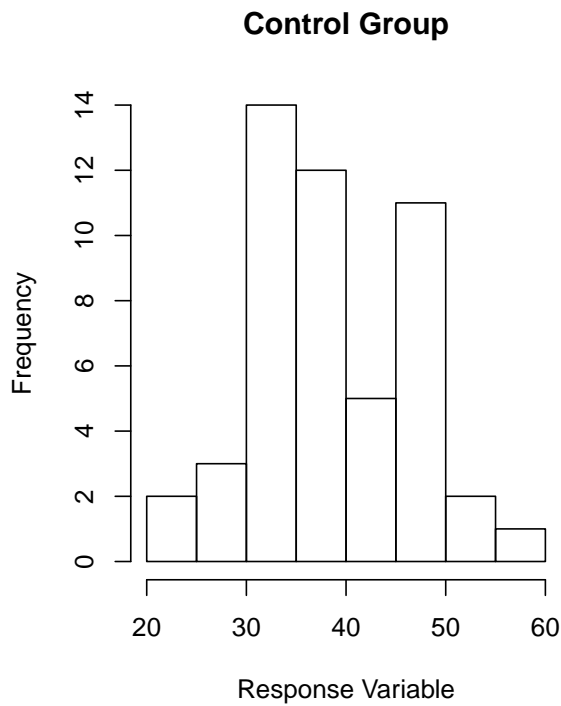
Plot of Response Variable vs. Toy Variable




```
#####
## Using par()
#####

# Example: Using the par function to change the number of plots in the panel
par(mfrow=c(1,2))
#mfrow=c(1,2) creates a plotting window with 2 rows and 1 column of plots
#mfrow=c(2,1) creates a plotting window with 1 row and 2 columns of plots

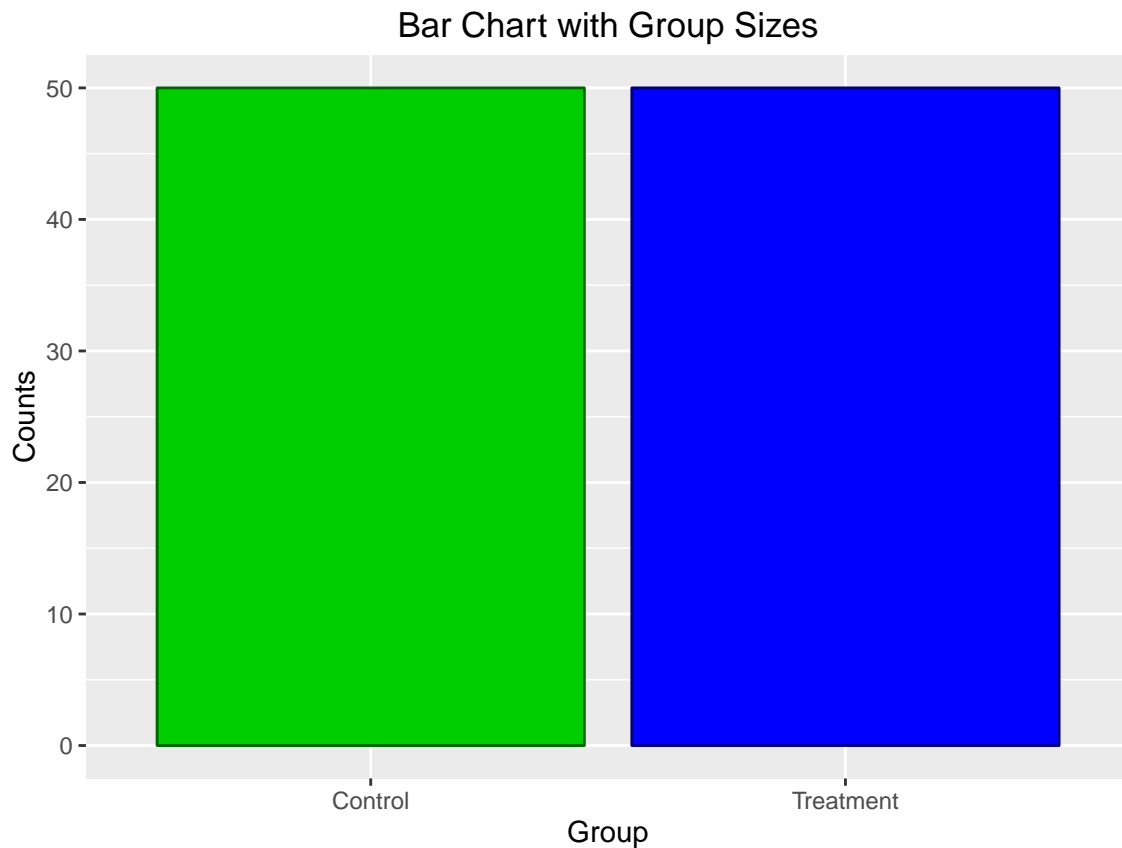
#### Histograms for each group
hist(controldata$respvar,
      main='Control Group', # change the main title
      xlab='Response Variable'
    )
hist(treatmentdata$respvar,
      main='Treatment Group', # change the main title
      xlab='Response Variable'
    )
```



Using ggplot2 Package for Graphics

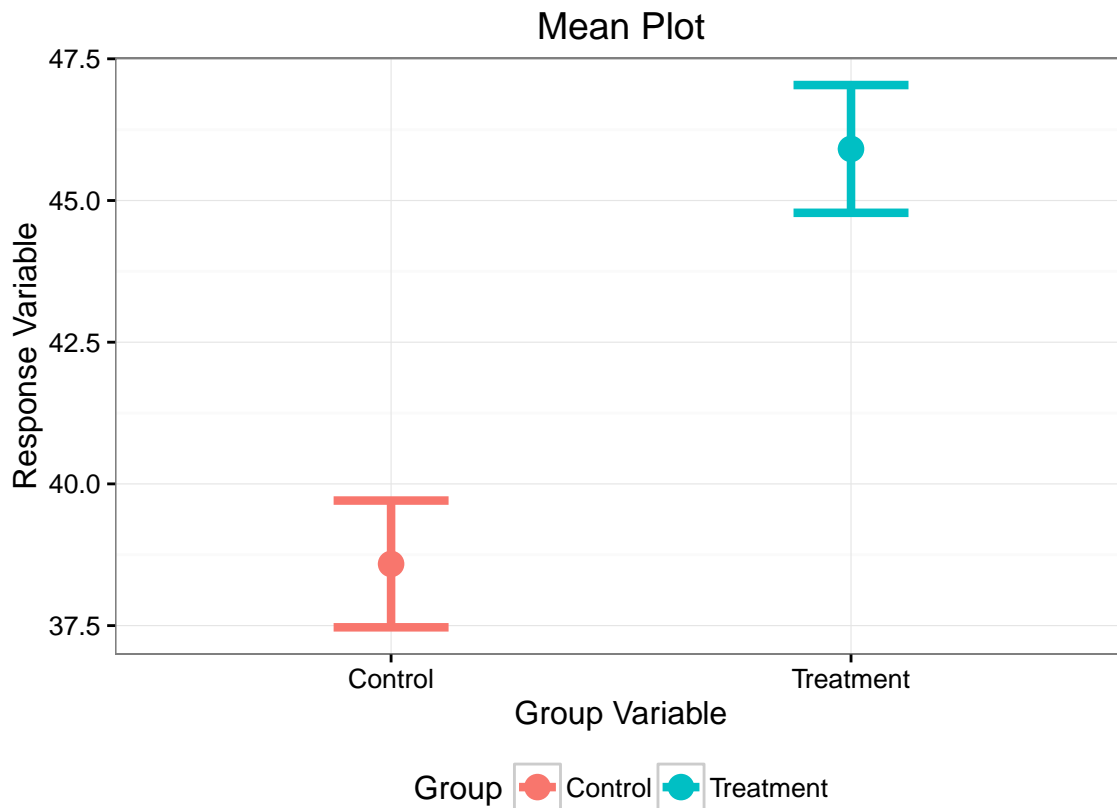
For a helpful guide to ggplot2, go to this website: <https://www.rstudio.com/wp-content/uploads/2015/04/ggplot2-cheatsheet.pdf>

```
#####  
## Plotting One Categorical Variable  
#####  
  
## Make bar graph with ggplot2  
ggplot(data=practicedata,aes(groupvar)) +  
  geom_bar(stat="count",color=c('darkgreen','navy'),fill=3:4) +  
  labs(x='Group',y='Counts',title='Bar Chart with Group Sizes')
```



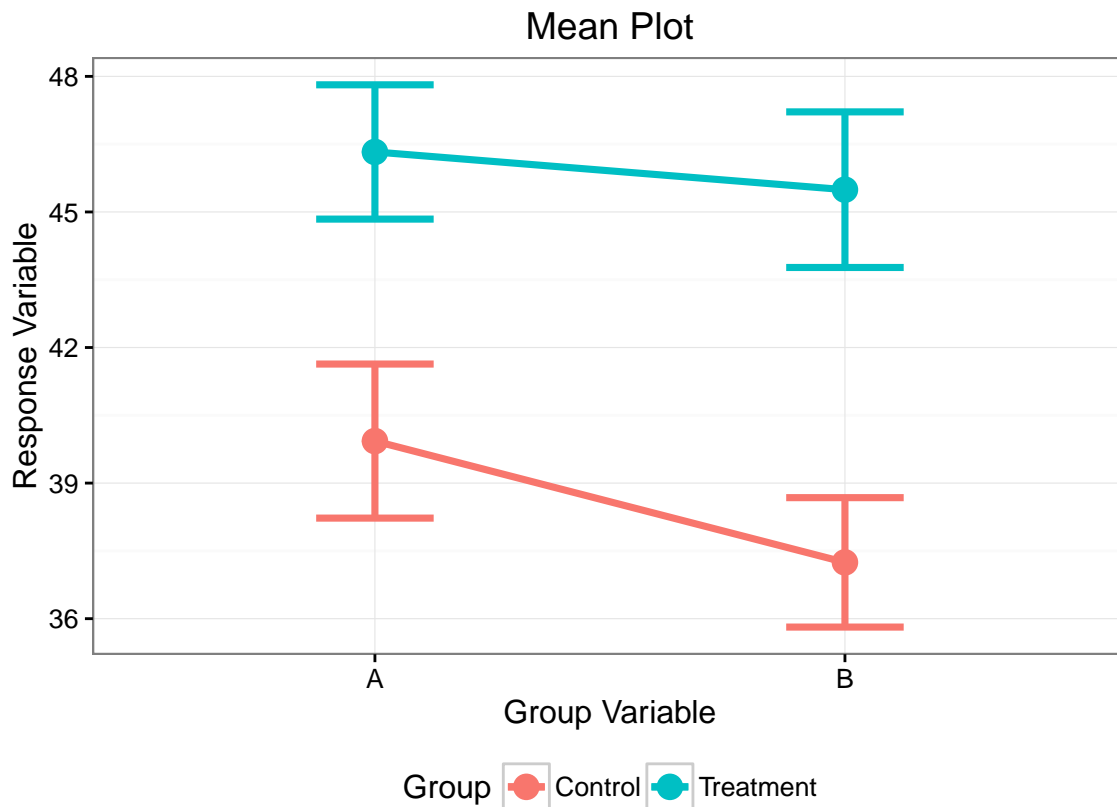
```
#####
## Plotting One Quantitative and One Categorical Variable -- Mean plot
#####
## Calculate summary statistics for ggplot2
summary.stats<-describeBy(x=practicedata$respvar,group=practicedata$groupvar,mat=TRUE)

ggplot(data=summary.stats,aes(x=group1,y=mean,color=group1)) +
  geom_errorbar(aes(ymax=mean+se,ymin=mean-se),size=1.5,width=0.25) + ## Plot errorbars
  geom_point(size=4) + ## Plot points
  scale_color_hue(name="Group") +
  labs(x='Group Variable',y='Response Variable',
       title='Mean Plot') + ## Change plot labels
  theme_bw() +## Changes to white background with grid lines
  theme(legend.position="bottom")
```



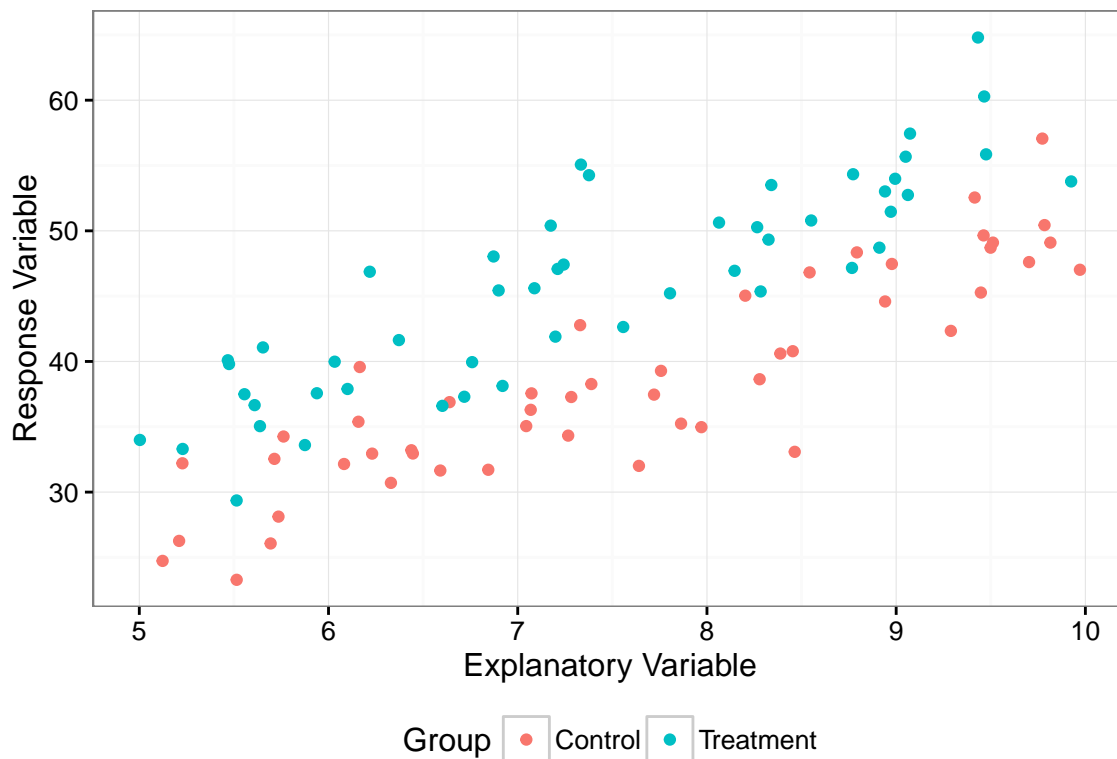
```
#####
## Plotting One Quantitative and Two Categorical Variables -- Mean Plot
#####
## Calculate summary statistics for ggplot2
summary.stats<-describeBy(x=practicedata$respvar,group=practicedata[,c(4,6)],mat=TRUE)

ggplot(data=summary.stats,aes(x=group2,y=mean,color=group1)) +
  geom_line(aes(group=group1),size=1.25 ) + # Plot lines
  geom_errorbar(aes(ymax=mean+se,ymin=mean-se),size=1.25,width=0.25) +
  # Plot standard error bars
  geom_point(size=4) + ## Plot points
  scale_color_hue(name="Group") +
  labs(x='Group Variable',y='Response Variable',
       title='Mean Plot') + ## Change plot labels
  theme_bw() + ## Changes to white background with grid lines
  theme(legend.position="bottom")
```



```
#####
## Plotting Two Quantitative Variables and One Categorical Variable
#####
ggplot(data=practicedata,aes(x=expvar,y=respvar,group=groupvar,color=groupvar)) +
  geom_point() + ## Plot points
  scale_color_hue(name="Group") + ## Change legend title
  labs(x='Explanatory Variable',y='Response Variable',
       title='Scatterplot with Two Variables') + ## Change plot labels
  theme_bw() + ## Changes to white background with grid lines
  theme(legend.position="bottom") ## Place legend at bottom of plot
```

Scatterplot with Two Variables



```
#####
## Plotting Two Quantitative Variables and Two Categorical Variables
#####
ggplot(data=practicedata, aes(x=expvar, y=resvar, group=groupvar, color=groupvar)) +
  geom_point(aes(pch=groupvar2)) + ## Plot points
  scale_color_hue(name="Group") + ## Change legend title
  scale_shape_discrete(name="Group 2") + ## Change legend title
  labs(x='Explanatory Variable', y='Response Variable',
       title='Scatterplot with Two Variables') + ## Change plot labels
  theme_bw() + ## Changes to white background with grid lines
  theme(legend.position="bottom") ## Place legend at bottom of plot
```

Scatterplot with Two Variables

