Additional Graphics with ggplot2

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Introduction:

The ggplot2 package was created by Hadley Wickham and has gained popularity in the R community in recent years. It is a great tool to build both elegant and complex plots.Ggplot2 allows users to build graphs that represent both univariate and multivariate numerical and categorical data in a easy to use manner. Grouping can be represented by color, symbol, size, and transparency. In this tutorial, I am going to show you how to design plots that convey information effectively without affecting the essence of the data. We will create graphs that will be easy to understand and won't require deciphering. I will try to explore functions we have not seen in Stats 133.

Scatterplot With Encircling

An important feature of ggplot would be Encircling. This allows the user to highlight a special group of points in the scatterplot by drawing a circle around them. This can be used through the geom_encircle() in ggalt package.

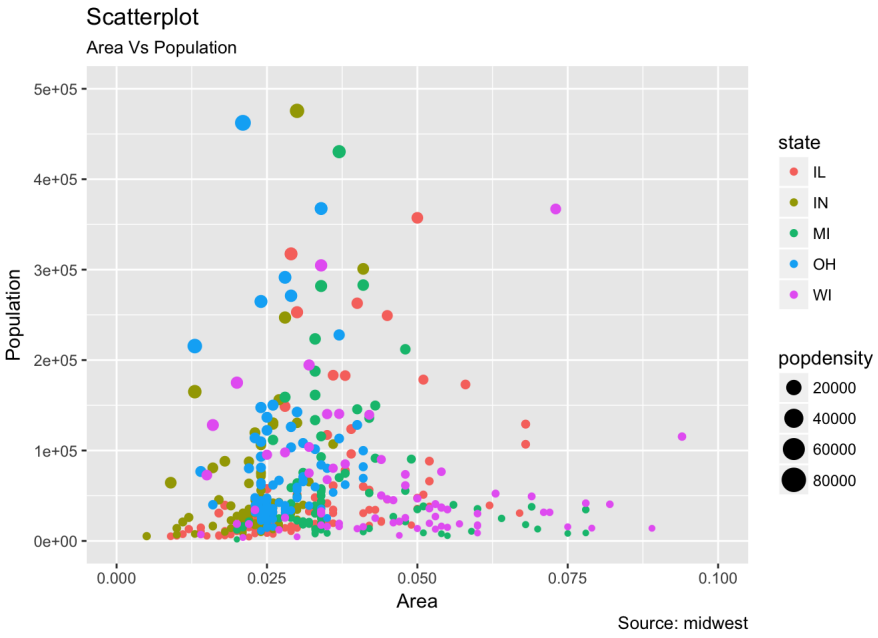
Using the function geom_encircle(), the user first needs to set a new dataframe that contains only the points of interest that will be encircled. It is possible to changed the size of the circle, however, using some feautures of geom encircl. See the below example.

```
#Step 1: load package and data

#install packages
#install.packages("ggplot2")
library(ggplot2)

#load data set
#this data set contains information for population density and population size across midwestern state counties, r
ead it using the function below
populationinfo <- read.csv("https://raw.githubusercontent.com/selva86/datasets/master/midwest.csv")

#have a look at the information contained in the dataset
head(populationinfo)
```

```
##   PID    county state  area poptotal popdensity popwhite popblack
## 1 561     ADAMS    IL 0.052    66090  1270.9615    63917     1702
## 2 562 ALEXANDER    IL 0.014    10626   759.0000     7054     3496
## 3 563       BOND    IL 0.022    14991   681.4091    14477      429
## 4 564     BOONE    IL 0.017    30806  1812.1176    29344      127
## 5 565     BROWN    IL 0.018     5836   324.2222     5264      547
## 6 566    BUREAU    IL 0.050    35688   713.7600    35157       50
##   popamerindian popasian popother percwhite  percblack percamerindan
## 1            98      249      124  96.71206  2.5752761     0.1482826
## 2            19       48        9  66.38434 32.9004329     0.1788067
## 3            35       16       34  96.57128  2.8617170     0.2334734
## 4            46      150     1139  95.25417  0.4122574     0.1493216
## 5            14        5        6  90.19877  9.3728581     0.2398903
## 6            65      195      221  98.51210  0.1401031     0.1821340
##    percasian  percother popadults  perchsd percollege percprof
## 1 0.37675897 0.18762294     43298 75.10740   19.63139 4.355859
## 2 0.45172219 0.08469791      6724 59.72635   11.24331 2.870315
## 3 0.10673071 0.22680275      9669 69.33499   17.03382 4.488572
## 4 0.48691813 3.69733169     19272 75.47219   17.27895 4.197800
## 5 0.08567512 0.10281014      3979 68.86152   14.47600 3.367680
## 6 0.54640215 0.61925577     23444 76.62941   18.90462 3.275891
##   poppovertyknown percpovertyknown percbelowpoverty percchildbelowpovert
## 1           63628          96.27478         13.151443              18.01172
## 2           10529          99.08714         32.244278              45.82651
## 3           14235          94.95697         12.068844              14.03606
## 4           30337          98.47757          7.209019              11.17954
## 5            4815          82.50514         13.520249              13.02289
## 6           35107          98.37200         10.399635              14.15882
##   percadultpoverty percelderlypoverty inmetro category
## 1        11.009776          12.443812       0      AAR
## 2        27.385647          25.228976       0      LHR
## 3        10.852090          12.697410       0      AAR
## 4         5.536013           6.217047       1      ALU
## 5        11.143211          19.200000       0      AAR
## 6         8.179287          11.008586       0      AAR
```

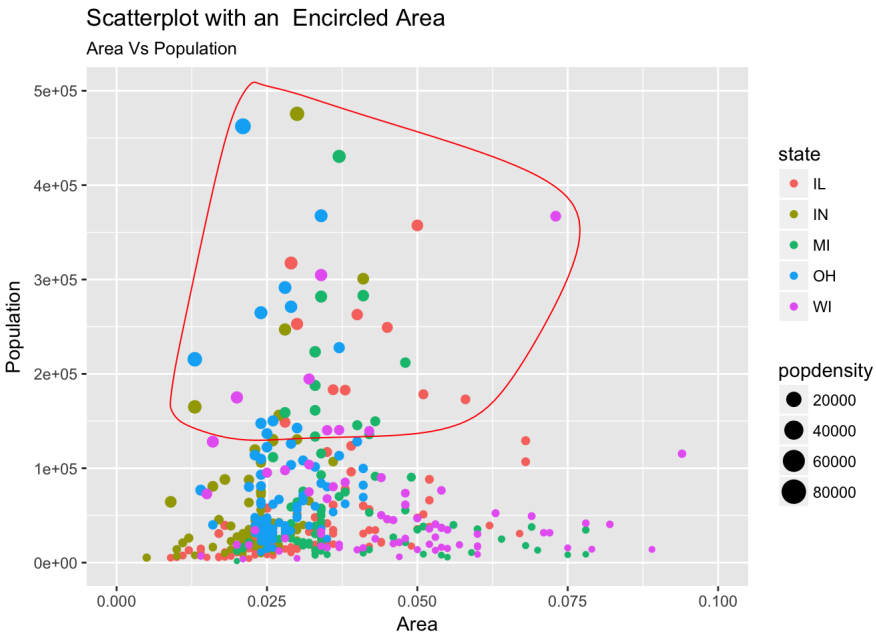
```
# Step 2: do the Scatterplot first
gg <- ggplot(populationinfo, aes(x=area, y=poptotal)) + #the scatterplot features the area of the county vs total population of said county
  geom_point(aes(col=state, size=popdensity)) +
#it is organised by state, each state has its own distinctive colored dot, the size of the dot represents how big the population density is

  xlim(c(0, 0.1)) +
  ylim(c(0, 500000)) +
  labs(subtitle="Area Vs Population",
       y="Population",
       x="Area",
       title="Scatterplot",
       caption = "Source: midwest")

plot(gg)
```

```
## Warning: Removed 15 rows containing missing values (geom_point).
```




```
#Step 3: Encircling
#install the ggalt package to begin the sub sectioning portion
#install.packages('ggalt')
library(ggplot2)
library(ggalt)

#select the area that you want to be circled, set it by selecting a y min and max and an x min and max by subsectioning the row and columns, look at the code below for inspiration:

selected_area <- populationinfo[populationinfo$poptotal > 150000 &
                            populationinfo$poptotal <= 500000 &
                            populationinfo$area > 0.01 &
                            populationinfo$area < 0.1, ]

#Plot
ggplot(populationinfo, aes(x=area, y=poptotal)) +
  geom_point(aes(col=state, size=popdensity)) +   # draw points
  xlim(c(0, 0.1)) +
  ylim(c(0, 500000)) +
  geom_encircle(aes(x=area, y=poptotal),
                data=selected_area,
                color="red",
                size=1,
                expand=0.04) +
  #Within the encircle function, size determines the thickness of the circle line, while expands determines the width of the  circle
  labs(subtitle="Area Vs Population",
       y="Population",
       x="Area",
       title="Scatterplot with an  Encircled Area")
```

```
## Warning: Removed 15 rows containing missing values (geom_point).
```



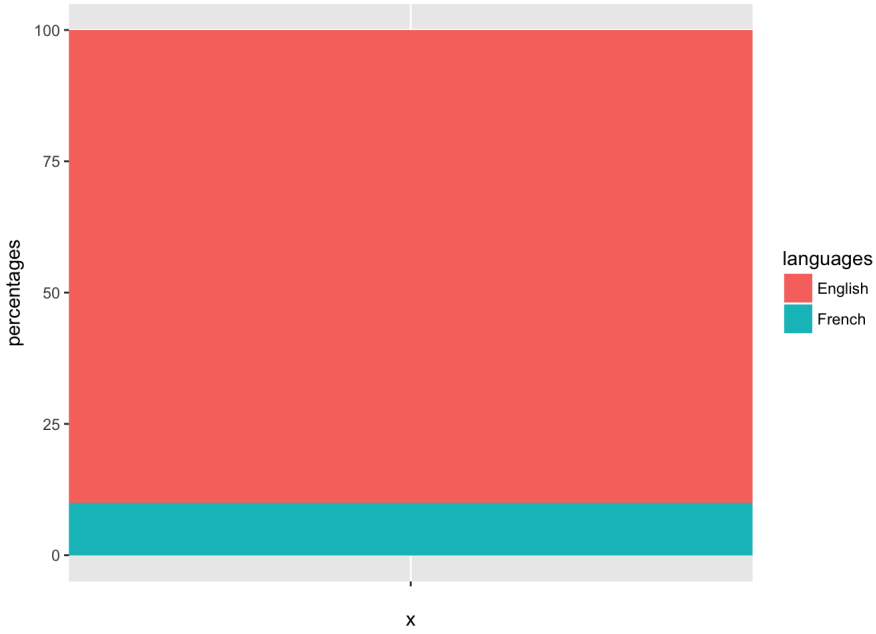
Pie Chart

Another potential use of ggplot2 is to map a pie chart. According to the website tech target a pie chart is a form of data visualisation in which "The independent variable is plotted around a circle in either a clockwise direction or a counterclockwise direction.The dependent variable (usually a percentage) is rendered as an arc whose measure is proportional to the magnitude of the quantity."

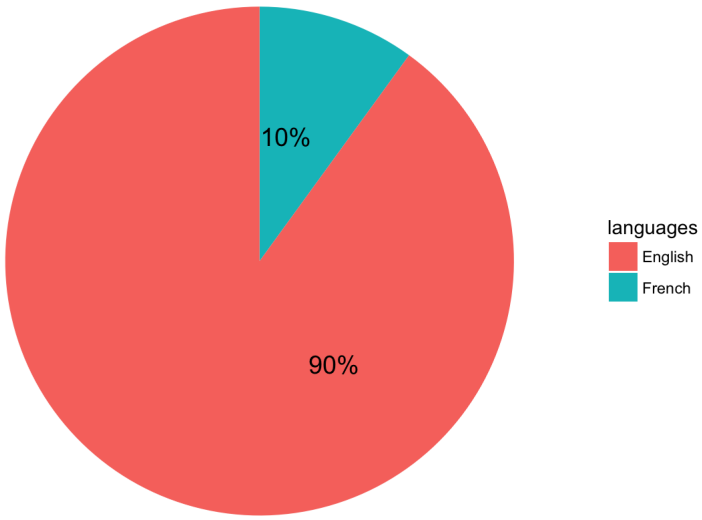
```
#Step 1:Find a data set to work with
#install.packages("scales") to use the percent function
library(scales)
new_data <- data.frame(
  languages = c("French", "English"),
  percentages = c(10, 90)
  )
head(new_data)
```

```
##   languages percentages
## 1    French          10
## 2   English          90
```

```
#step 2:create a Barplot which represents the languages spoken broken down by percentage
graph_newdata<- ggplot(new_data, aes(x="", y=percentages, fill=languages))+
geom_bar(width = 1, stat = "identity")
graph_newdata
```



```
#Step 3: add in the pie chart
#the "y" indicates which values will be used to form the values in the pie chart, in this case it is languages
#theme void removes the axis
pie <- graph_newdata + coord_polar("y") + theme_void() + geom_text(aes(y = percentages/3 + c(0, cumsum(percentages
)[-length(percentages)]),
            label = percent(percentages/100)), size=5)
pie
```




```
#the geom text  function adds the label for percentage
```

Violin Plot

A violin plot is just like a box plot, however, it also puts density and distribution on display.This is achieved through the geom_violin() function.

check out the image for an example of what it can show https://datavizcatalogue.com/methods/images/anatomy/SVG/violin_plot.svg

```
#use read to get the data for the table we want to use; this table contains information about the model of a car,
and the mileage for both highways and cities
gg <- read.csv("https://raw.githubusercontent.com/selva86/datasets/master/mpg_ggplot2.csv")
gg
```

```
##     manufacturer                model displ year cyl      trans drv cty
## 1           audi                   a4   1.8 1999   4   auto(l5)   f  18
## 2           audi                   a4   1.8 1999   4 manual(m5)   f  21
## 3           audi                   a4   2.0 2008   4 manual(m6)   f  20
## 4           audi                   a4   2.0 2008   4   auto(av)   f  21
## 5           audi                   a4   2.8 1999   6   auto(l5)   f  16
## 6           audi                   a4   2.8 1999   6 manual(m5)   f  18
## 7           audi                   a4   3.1 2008   6   auto(av)   f  18
## 8           audi            a4 quattro   1.8 1999   4 manual(m5)   4  18
## 9           audi            a4 quattro   1.8 1999   4   auto(l5)   4  16
## 10          audi            a4 quattro   2.0 2008   4 manual(m6)   4  20
## 11          audi            a4 quattro   2.0 2008   4   auto(s6)   4  19
## 12          audi            a4 quattro   2.8 1999   6   auto(l5)   4  15
## 13          audi            a4 quattro   2.8 1999   6 manual(m5)   4  17
## 14          audi            a4 quattro   3.1 2008   6   auto(s6)   4  17
## 15          audi            a4 quattro   3.1 2008   6 manual(m6)   4  15
## 16          audi            a6 quattro   2.8 1999   6   auto(l5)   4  15
## 17          audi            a6 quattro   3.1 2008   6   auto(s6)   4  17
## 18          audi            a6 quattro   4.2 2008   8   auto(s6)   4  16
## 19     chevrolet     c1500 suburban 2wd   5.3 2008   8   auto(l4)   r  14
## 20     chevrolet     c1500 suburban 2wd   5.3 2008   8   auto(l4)   r  11
## 21     chevrolet     c1500 suburban 2wd   5.3 2008   8   auto(l4)   r  14
## 22     chevrolet     c1500 suburban 2wd   5.7 1999   8   auto(l4)   r  13
## 23     chevrolet     c1500 suburban 2wd   6.0 2008   8   auto(l4)   r  12
## 24     chevrolet               corvette   5.7 1999   8 manual(m6)   r  16
## 25     chevrolet               corvette   5.7 1999   8   auto(l4)   r  15
## 26     chevrolet               corvette   6.2 2008   8 manual(m6)   r  16
## 27     chevrolet               corvette   6.2 2008   8   auto(s6)   r  15
## 28     chevrolet               corvette   7.0 2008   8 manual(m6)   r  15
## 29     chevrolet        k1500 tahoe 4wd   5.3 2008   8   auto(l4)   4  14
## 30     chevrolet        k1500 tahoe 4wd   5.3 2008   8   auto(l4)   4  11
## 31     chevrolet        k1500 tahoe 4wd   5.7 1999   8   auto(l4)   4  11
## 32     chevrolet        k1500 tahoe 4wd   6.5 1999   8   auto(l4)   4  14
## 33     chevrolet                malibu   2.4 1999   4   auto(l4)   f  19
## 34     chevrolet                malibu   2.4 2008   4   auto(l4)   f  22
```

```
## 35     chevrolet               malibu   3.1 1999   6   auto(l4)   f  18
## 36     chevrolet               malibu   3.5 2008   6   auto(l4)   f  18
## 37     chevrolet               malibu   3.6 2008   6   auto(s6)   f  17
## 38         dodge            caravan 2wd   2.4 1999   4   auto(l3)   f  18
## 39         dodge            caravan 2wd   3.0 1999   6   auto(l4)   f  17
## 40         dodge            caravan 2wd   3.3 1999   6   auto(l4)   f  16
## 41         dodge            caravan 2wd   3.3 1999   6   auto(l4)   f  16
## 42         dodge            caravan 2wd   3.3 2008   6   auto(l4)   f  17
## 43         dodge            caravan 2wd   3.3 2008   6   auto(l4)   f  17
## 44         dodge            caravan 2wd   3.3 2008   6   auto(l4)   f  11
## 45         dodge            caravan 2wd   3.8 1999   6   auto(l4)   f  15
## 46         dodge            caravan 2wd   3.8 1999   6   auto(l4)   f  15
## 47         dodge            caravan 2wd   3.8 2008   6   auto(l6)   f  16
## 48         dodge            caravan 2wd   4.0 2008   6   auto(l6)   f  16
## 49         dodge      dakota pickup 4wd   3.7 2008   6 manual(m6)   4  15
## 50         dodge      dakota pickup 4wd   3.7 2008   6   auto(l4)   4  14
## 51         dodge      dakota pickup 4wd   3.9 1999   6   auto(l4)   4  13
## 52         dodge      dakota pickup 4wd   3.9 1999   6 manual(m5)   4  14
## 53         dodge      dakota pickup 4wd   4.7 2008   8   auto(l5)   4  14
## 54         dodge      dakota pickup 4wd   4.7 2008   8   auto(l5)   4  14
## 55         dodge      dakota pickup 4wd   4.7 2008   8   auto(l5)   4   9
## 56         dodge      dakota pickup 4wd   5.2 1999   8 manual(m5)   4  11
## 57         dodge      dakota pickup 4wd   5.2 1999   8   auto(l4)   4  11
## 58         dodge             durango 4wd   3.9 1999   6   auto(l4)   4  13
## 59         dodge             durango 4wd   4.7 2008   8   auto(l5)   4  13
## 60         dodge             durango 4wd   4.7 2008   8   auto(l5)   4   9
## 61         dodge             durango 4wd   4.7 2008   8   auto(l5)   4  13
## 62         dodge             durango 4wd   5.2 1999   8   auto(l4)   4  11
## 63         dodge             durango 4wd   5.7 2008   8   auto(l5)   4  13
## 64         dodge             durango 4wd   5.9 1999   8   auto(l4)   4  11
## 65         dodge    ram 1500 pickup 4wd   4.7 2008   8 manual(m6)   4  12
## 66         dodge    ram 1500 pickup 4wd   4.7 2008   8   auto(l5)   4   9
## 67         dodge    ram 1500 pickup 4wd   4.7 2008   8   auto(l5)   4  13
## 68         dodge    ram 1500 pickup 4wd   4.7 2008   8   auto(l5)   4  13
## 69         dodge    ram 1500 pickup 4wd   4.7 2008   8 manual(m6)   4  12
## 70         dodge    ram 1500 pickup 4wd   4.7 2008   8 manual(m6)   4   9
## 71         dodge    ram 1500 pickup 4wd   5.2 1999   8   auto(l4)   4  11
## 72         dodge    ram 1500 pickup 4wd   5.2 1999   8 manual(m5)   4  11
## 73         dodge    ram 1500 pickup 4wd   5.7 2008   8   auto(l5)   4  13
## 74         dodge    ram 1500 pickup 4wd   5.9 1999   8   auto(l4)   4  11
## 75          ford         expedition 2wd   4.6 1999   8   auto(l4)   r  11
## 76          ford         expedition 2wd   5.4 1999   8   auto(l4)   r  11
## 77          ford         expedition 2wd   5.4 2008   8   auto(l6)   r  12
## 78          ford           explorer 4wd   4.0 1999   6   auto(l5)   4  14
## 79          ford           explorer 4wd   4.0 1999   6 manual(m5)   4  15
## 80          ford           explorer 4wd   4.0 1999   6   auto(l5)   4  14
## 81          ford           explorer 4wd   4.0 2008   6   auto(l5)   4  13
## 82          ford           explorer 4wd   4.6 2008   8   auto(l6)   4  13
## 83          ford           explorer 4wd   5.0 1999   8   auto(l4)   4  13
## 84          ford        f150 pickup 4wd   4.2 1999   6   auto(l4)   4  14
## 85          ford        f150 pickup 4wd   4.2 1999   6 manual(m5)   4  14
## 86          ford        f150 pickup 4wd   4.6 1999   8 manual(m5)   4  13
## 87          ford        f150 pickup 4wd   4.6 1999   8   auto(l4)   4  13
## 88          ford        f150 pickup 4wd   4.6 2008   8   auto(l4)   4  13
## 89          ford        f150 pickup 4wd   5.4 1999   8   auto(l4)   4  11
## 90          ford        f150 pickup 4wd   5.4 2008   8   auto(l4)   4  13
## 91          ford                mustang   3.8 1999   6 manual(m5)   r  18
## 92          ford                mustang   3.8 1999   6   auto(l4)   r  18
## 93          ford                mustang   4.0 2008   6 manual(m5)   r  17
## 94          ford                mustang   4.0 2008   6   auto(l5)   r  16
## 95          ford                mustang   4.6 1999   8   auto(l4)   r  15
## 96          ford                mustang   4.6 1999   8 manual(m5)   r  15
## 97          ford                mustang   4.6 2008   8 manual(m5)   r  15
## 98          ford                mustang   4.6 2008   8   auto(l5)   r  15
## 99          ford                mustang   5.4 2008   8 manual(m6)   r  14
## 100        honda                  civic   1.6 1999   4 manual(m5)   f  28
## 101        honda                  civic   1.6 1999   4   auto(l4)   f  24
## 102        honda                  civic   1.6 1999   4 manual(m5)   f  25
## 103        honda                  civic   1.6 1999   4 manual(m5)   f  23
## 104        honda                  civic   1.6 1999   4   auto(l4)   f  24
## 105        honda                  civic   1.8 2008   4 manual(m5)   f  26
## 106        honda                  civic   1.8 2008   4   auto(l5)   f  25
## 107        honda                  civic   1.8 2008   4   auto(l5)   f  24
## 108        honda                  civic   2.0 2008   4 manual(m6)   f  21
## 109      hyundai                 sonata   2.4 1999   4   auto(l4)   f  18
## 110      hyundai                 sonata   2.4 1999   4 manual(m5)   f  18
## 111      hyundai                 sonata   2.4 2008   4   auto(l4)   f  21
## 112      hyundai                 sonata   2.4 2008   4 manual(m5)   f  21
## 113      hyundai                 sonata   2.5 1999   6   auto(l4)   f  18
## 114      hyundai                 sonata   2.5 1999   6 manual(m5)   f  18
## 115      hyundai                 sonata   3.3 2008   6   auto(l5)   f  19
## 116      hyundai                tiburon   2.0 1999   4   auto(l4)   f  19
## 117      hyundai                tiburon   2.0 1999   4 manual(m5)   f  19
## 118      hyundai                tiburon   2.0 2008   4 manual(m5)   f  20
## 119      hyundai                tiburon   2.0 2008   4   auto(l4)   f  20
```

```
## 120      hyundai                tiburon   2.7 2008   6   auto(l4)   f  17
## 121      hyundai                tiburon   2.7 2008   6 manual(m6)   f  16
## 122      hyundai                tiburon   2.7 2008   6 manual(m5)   f  17
## 123         jeep     grand cherokee 4wd   3.0 2008   6   auto(l5)   4  17
## 124         jeep     grand cherokee 4wd   3.7 2008   6   auto(l5)   4  15
## 125         jeep     grand cherokee 4wd   4.0 1999   6   auto(l4)   4  15
## 126         jeep     grand cherokee 4wd   4.7 1999   8   auto(l4)   4  14
## 127         jeep     grand cherokee 4wd   4.7 2008   8   auto(l5)   4   9
## 128         jeep     grand cherokee 4wd   4.7 2008   8   auto(l5)   4  14
## 129         jeep     grand cherokee 4wd   5.7 2008   8   auto(l5)   4  13
## 130         jeep     grand cherokee 4wd   6.1 2008   8   auto(l5)   4  11
## 131   land rover            range rover   4.0 1999   8   auto(l4)   4  11
## 132   land rover            range rover   4.2 2008   8   auto(s6)   4  12
## 133   land rover            range rover   4.4 2008   8   auto(s6)   4  12
## 134   land rover            range rover   4.6 1999   8   auto(l4)   4  11
## 135      lincoln          navigator 2wd   5.4 1999   8   auto(l4)   r  11
## 136      lincoln          navigator 2wd   5.4 1999   8   auto(l4)   r  11
## 137      lincoln          navigator 2wd   5.4 2008   8   auto(l6)   r  12
## 138      mercury        mountaineer 4wd   4.0 1999   6   auto(l5)   4  14
## 139      mercury        mountaineer 4wd   4.0 2008   6   auto(l5)   4  13
## 140      mercury        mountaineer 4wd   4.6 2008   8   auto(l6)   4  13
## 141      mercury        mountaineer 4wd   5.0 1999   8   auto(l4)   4  13
## 142       nissan                altima   2.4 1999   4 manual(m5)   f  21
## 143       nissan                altima   2.4 1999   4   auto(l4)   f  19
## 144       nissan                altima   2.5 2008   4   auto(av)   f  23
## 145       nissan                altima   2.5 2008   4 manual(m6)   f  23
## 146       nissan                altima   3.5 2008   6 manual(m6)   f  19
## 147       nissan                altima   3.5 2008   6   auto(av)   f  19
## 148       nissan                maxima   3.0 1999   6   auto(l4)   f  18
## 149       nissan                maxima   3.0 1999   6 manual(m5)   f  19
## 150       nissan                maxima   3.5 2008   6   auto(av)   f  19
## 151       nissan         pathfinder 4wd   3.3 1999   6   auto(l4)   4  14
## 152       nissan         pathfinder 4wd   3.3 1999   6 manual(m5)   4  15
## 153       nissan         pathfinder 4wd   4.0 2008   6   auto(l5)   4  14
## 154       nissan         pathfinder 4wd   5.6 2008   8   auto(s5)   4  12
## 155      pontiac             grand prix   3.1 1999   6   auto(l4)   f  18
## 156      pontiac             grand prix   3.8 1999   6   auto(l4)   f  16
## 157      pontiac             grand prix   3.8 1999   6   auto(l4)   f  17
## 158      pontiac             grand prix   3.8 2008   6   auto(l4)   f  18
## 159      pontiac             grand prix   5.3 2008   8   auto(s4)   f  16
## 160       subaru           forester awd   2.5 1999   4 manual(m5)   4  18
## 161       subaru           forester awd   2.5 1999   4   auto(l4)   4  18
## 162       subaru           forester awd   2.5 2008   4 manual(m5)   4  20
## 163       subaru           forester awd   2.5 2008   4 manual(m5)   4  19
## 164       subaru           forester awd   2.5 2008   4   auto(l4)   4  20
## 165       subaru           forester awd   2.5 2008   4   auto(l4)   4  18
## 166       subaru            impreza awd   2.2 1999   4   auto(l4)   4  21
## 167       subaru            impreza awd   2.2 1999   4 manual(m5)   4  19
## 168       subaru            impreza awd   2.5 1999   4 manual(m5)   4  19
## 169       subaru            impreza awd   2.5 1999   4   auto(l4)   4  19
## 170       subaru            impreza awd   2.5 2008   4   auto(s4)   4  20
## 171       subaru            impreza awd   2.5 2008   4   auto(s4)   4  20
## 172       subaru            impreza awd   2.5 2008   4 manual(m5)   4  19
## 173       subaru            impreza awd   2.5 2008   4 manual(m5)   4  20
## 174       toyota            4runner 4wd   2.7 1999   4 manual(m5)   4  15
## 175       toyota            4runner 4wd   2.7 1999   4   auto(l4)   4  16
## 176       toyota            4runner 4wd   3.4 1999   6   auto(l4)   4  15
## 177       toyota            4runner 4wd   3.4 1999   6 manual(m5)   4  15
## 178       toyota            4runner 4wd   4.0 2008   6   auto(l5)   4  16
## 179       toyota            4runner 4wd   4.7 2008   8   auto(l5)   4  14
## 180       toyota                 camry   2.2 1999   4 manual(m5)   f  21
## 181       toyota                 camry   2.2 1999   4   auto(l4)   f  21
## 182       toyota                 camry   2.4 2008   4 manual(m5)   f  21
## 183       toyota                 camry   2.4 2008   4   auto(l5)   f  21
## 184       toyota                 camry   3.0 1999   6   auto(l4)   f  18
## 185       toyota                 camry   3.0 1999   6 manual(m5)   f  18
## 186       toyota                 camry   3.5 2008   6   auto(s6)   f  19
## 187       toyota           camry solara   2.2 1999   4   auto(l4)   f  21
## 188       toyota           camry solara   2.2 1999   4 manual(m5)   f  21
## 189       toyota           camry solara   2.4 2008   4 manual(m5)   f  21
## 190       toyota           camry solara   2.4 2008   4   auto(s5)   f  22
## 191       toyota           camry solara   3.0 1999   6   auto(l4)   f  18
## 192       toyota           camry solara   3.0 1999   6 manual(m5)   f  18
## 193       toyota           camry solara   3.3 2008   6   auto(s5)   f  18
## 194       toyota                corolla   1.8 1999   4   auto(l3)   f  24
## 195       toyota                corolla   1.8 1999   4   auto(l4)   f  24
## 196       toyota                corolla   1.8 1999   4 manual(m5)   f  26
## 197       toyota                corolla   1.8 2008   4 manual(m5)   f  28
## 198       toyota                corolla   1.8 2008   4   auto(l4)   f  26
## 199       toyota land cruiser wagon 4wd   4.7 1999   8   auto(l4)   4  11
## 200       toyota land cruiser wagon 4wd   5.7 2008   8   auto(s6)   4  13
## 201       toyota      toyota tacoma 4wd   2.7 1999   4 manual(m5)   4  15
## 202       toyota      toyota tacoma 4wd   2.7 1999   4   auto(l4)   4  16
## 203       toyota      toyota tacoma 4wd   2.7 2008   4 manual(m5)   4  17
## 204       toyota      toyota tacoma 4wd   3.4 1999   6 manual(m5)   4  15
## 205       toyota      toyota tacoma 4wd   3.4 1999   6   auto(l4)   4  15
```

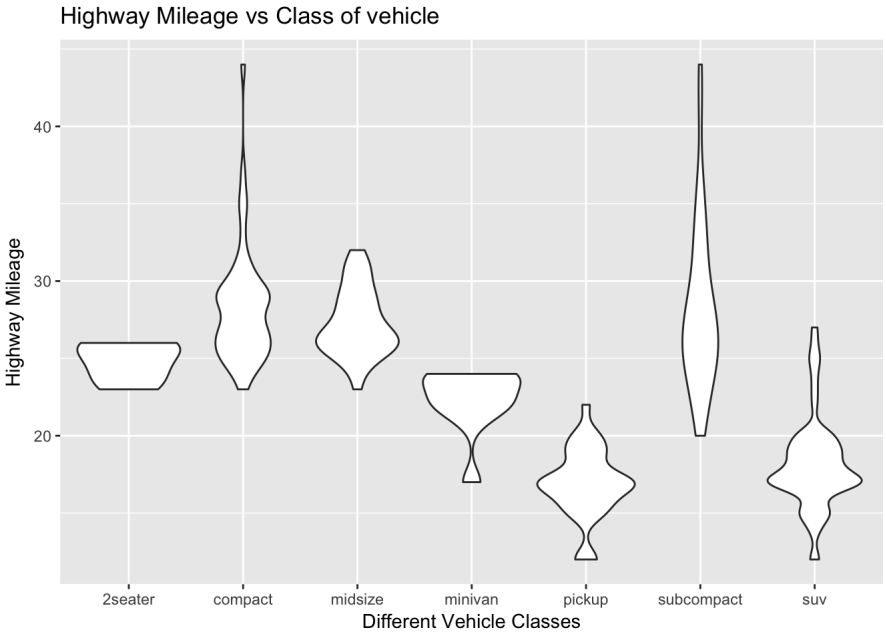
```
## 205       toyota      toyota tacoma 4wd   3.4 1999   6   auto(l4)   4  15
## 206       toyota      toyota tacoma 4wd   4.0 2008   6 manual(m6)   4  15
## 207       toyota      toyota tacoma 4wd   4.0 2008   6   auto(l5)   4  16
## 208   volkswagen                 gti   2.0 1999   4 manual(m5)   f  21
## 209   volkswagen                 gti   2.0 1999   4   auto(l4)   f  19
## 210   volkswagen                 gti   2.0 2008   4 manual(m6)   f  21
## 211   volkswagen                 gti   2.0 2008   4   auto(s6)   f  22
## 212   volkswagen                 gti   2.8 1999   6 manual(m5)   f  17
## 213   volkswagen               jetta   1.9 1999   4 manual(m5)   f  33
## 214   volkswagen               jetta   2.0 1999   4 manual(m5)   f  21
## 215   volkswagen               jetta   2.0 1999   4   auto(l4)   f  19
## 216   volkswagen               jetta   2.0 2008   4   auto(s6)   f  22
## 217   volkswagen               jetta   2.0 2008   4 manual(m6)   f  21
## 218   volkswagen               jetta   2.5 2008   5   auto(s6)   f  21
## 219   volkswagen               jetta   2.5 2008   5 manual(m5)   f  21
## 220   volkswagen               jetta   2.8 1999   6   auto(l4)   f  16
## 221   volkswagen               jetta   2.8 1999   6 manual(m5)   f  17
## 222   volkswagen          new beetle   1.9 1999   4 manual(m5)   f  35
## 223   volkswagen          new beetle   1.9 1999   4   auto(l4)   f  29
## 224   volkswagen          new beetle   2.0 1999   4 manual(m5)   f  21
## 225   volkswagen          new beetle   2.0 1999   4   auto(l4)   f  19
## 226   volkswagen          new beetle   2.5 2008   5 manual(m5)   f  20
## 227   volkswagen          new beetle   2.5 2008   5   auto(s6)   f  20
## 228   volkswagen              passat   1.8 1999   4 manual(m5)   f  21
## 229   volkswagen              passat   1.8 1999   4   auto(l5)   f  18
## 230   volkswagen              passat   2.0 2008   4   auto(s6)   f  19
## 231   volkswagen              passat   2.0 2008   4 manual(m6)   f  21
## 232   volkswagen              passat   2.8 1999   6   auto(l5)   f  16
## 233   volkswagen              passat   2.8 1999   6 manual(m5)   f  18
## 234   volkswagen              passat   3.6 2008   6   auto(s6)   f  17
##     hwy fl      class
## 1    29  p    compact
## 2    29  p    compact
## 3    31  p    compact
## 4    30  p    compact
## 5    26  p    compact
## 6    26  p    compact
## 7    27  p    compact
## 8    26  p    compact
## 9    25  p    compact
## 10   28  p    compact
## 11   27  p    compact
## 12   25  p    compact
## 13   25  p    compact
## 14   25  p    compact
## 15   25  p    compact
## 16   24  p    midsize
## 17   25  p    midsize
## 18   23  p    midsize
## 19   20  r        suv
## 20   15  e        suv
## 21   20  r        suv
## 22   17  r        suv
## 23   17  r        suv
## 24   26  p    2seater
## 25   23  p    2seater
## 26   26  p    2seater
## 27   25  p    2seater
## 28   24  p    2seater
## 29   19  r        suv
## 30   14  e        suv
## 31   15  r        suv
## 32   17  d        suv
## 33   27  r    midsize
## 34   30  r    midsize
## 35   26  r    midsize
## 36   29  r    midsize
## 37   26  r    midsize
## 38   24  r    minivan
## 39   24  r    minivan
## 40   22  r    minivan
## 41   22  r    minivan
## 42   24  r    minivan
## 43   24  r    minivan
## 44   17  e    minivan
## 45   22  r    minivan
## 46   21  r    minivan
## 47   23  r    minivan
## 48   23  r    minivan
## 49   19  r     pickup
## 50   18  r     pickup
## 51   17  r     pickup
## 52   17  r     pickup
## 53   19  r     pickup
## 54   19  r     pickup
## 55   12  e     pickup
```

```
## 55   12  e     pickup
## 56   17  r     pickup
## 57   15  r     pickup
## 58   17  r        suv
## 59   17  r        suv
## 60   12  e        suv
## 61   17  r        suv
## 62   16  r        suv
## 63   18  r        suv
## 64   15  r        suv
## 65   16  r     pickup
## 66   12  e     pickup
## 67   17  r     pickup
## 68   17  r     pickup
## 69   16  r     pickup
## 70   12  e     pickup
## 71   15  r     pickup
## 72   16  r     pickup
## 73   17  r     pickup
## 74   15  r     pickup
## 75   17  r        suv
## 76   17  r        suv
## 77   18  r        suv
## 78   17  r        suv
## 79   19  r        suv
## 80   17  r        suv
## 81   19  r        suv
## 82   19  r        suv
## 83   17  r        suv
## 84   17  r     pickup
## 85   17  r     pickup
## 86   16  r     pickup
## 87   16  r     pickup
## 88   17  r     pickup
## 89   15  r     pickup
## 90   17  r     pickup
## 91   26  r subcompact
## 92   25  r subcompact
## 93   26  r subcompact
## 94   24  r subcompact
## 95   21  r subcompact
## 96   22  r subcompact
## 97   23  r subcompact
## 98   22  r subcompact
## 99   20  p subcompact
## 100  33  r subcompact
## 101  32  r subcompact
## 102  32  r subcompact
## 103  29  p subcompact
## 104  32  r subcompact
## 105  34  r subcompact
## 106  36  r subcompact
## 107  36  c subcompact
## 108  29  p subcompact
## 109  26  r    midsize
## 110  27  r    midsize
## 111  30  r    midsize
## 112  31  r    midsize
## 113  26  r    midsize
## 114  26  r    midsize
## 115  28  r    midsize
## 116  26  r subcompact
## 117  29  r subcompact
## 118  28  r subcompact
## 119  27  r subcompact
## 120  24  r subcompact
## 121  24  r subcompact
## 122  24  r subcompact
## 123  22  d        suv
## 124  19  r        suv
## 125  20  r        suv
## 126  17  r        suv
## 127  12  e        suv
## 128  19  r        suv
## 129  18  r        suv
## 130  14  p        suv
## 131  15  p        suv
## 132  18  r        suv
## 133  18  r        suv
## 134  15  p        suv
## 135  17  r        suv
## 136  16  p        suv
## 137  18  r        suv
## 138  17  r        suv
## 139  19  r        suv
## 140  19  r        suv
```

```
## 141  17  r        suv
## 142  29  r    compact
## 143  27  r    compact
## 144  31  r    midsize
## 145  32  r    midsize
## 146  27  p    midsize
## 147  26  p    midsize
## 148  26  r    midsize
## 149  25  r    midsize
## 150  25  p    midsize
## 151  17  r        suv
## 152  17  r        suv
## 153  20  p        suv
## 154  18  p        suv
## 155  26  r    midsize
## 156  26  p    midsize
## 157  27  r    midsize
## 158  28  r    midsize
## 159  25  p    midsize
## 160  25  r        suv
## 161  24  r        suv
## 162  27  r        suv
## 163  25  p        suv
## 164  26  r        suv
## 165  23  p        suv
## 166  26  r subcompact
## 167  26  r subcompact
## 168  26  r subcompact
## 169  26  r subcompact
## 170  25  p    compact
## 171  27  r    compact
## 172  25  p    compact
## 173  27  r    compact
## 174  20  r        suv
## 175  20  r        suv
## 176  19  r        suv
## 177  17  r        suv
## 178  20  r        suv
## 179  17  r        suv
## 180  29  r    midsize
## 181  27  r    midsize
## 182  31  r    midsize
## 183  31  r    midsize
## 184  26  r    midsize
## 185  26  r    midsize
## 186  28  r    midsize
## 187  27  r    compact
## 188  29  r    compact
## 189  31  r    compact
## 190  31  r    compact
## 191  26  r    compact
## 192  26  r    compact
## 193  27  r    compact
## 194  30  r    compact
## 195  33  r    compact
## 196  35  r    compact
## 197  37  r    compact
## 198  35  r    compact
## 199  15  r        suv
## 200  18  r        suv
## 201  20  r     pickup
## 202  20  r     pickup
## 203  22  r     pickup
## 204  17  r     pickup
## 205  19  r     pickup
## 206  18  r     pickup
## 207  20  r     pickup
## 208  29  r    compact
## 209  26  r    compact
## 210  29  p    compact
## 211  29  p    compact
## 212  24  r    compact
## 213  44  d    compact
## 214  29  r    compact
## 215  26  r    compact
## 216  29  p    compact
## 217  29  p    compact
## 218  29  r    compact
## 219  29  r    compact
## 220  23  r    compact
## 221  24  r    compact
## 222  44  d subcompact
## 223  41  d subcompact
## 224  29  r subcompact
## 225  26  r subcompact
```

```
## 226  28  r subcompact
## 227  29  r subcompact
## 228  29  p    midsize
## 229  29  p    midsize
## 230  28  p    midsize
## 231  29  p    midsize
## 232  26  p    midsize
## 233  26  p    midsize
## 234  26  p    midsize
```

```
# Step 1 create a ggplot with the two variables you want to compare in the x and y axis, in this case
g <- ggplot(gg, aes(class, hwy ))
#Step 2 implement violin plot with the function geom_violin() don't forget to add labels.
g + geom_violin() +
  labs(title = "Highway Mileage vs Class of vehicle",
       x="Different Vehicle Classes",
       y="Highway Mileage")
```



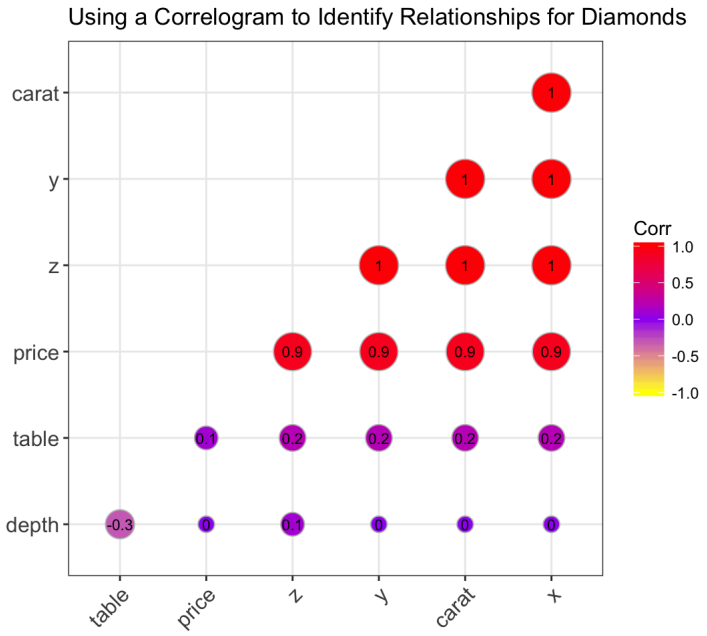
Correlogram

Another extremely interesting graphing function is a correlogram. This function allows the user to look at the correlation of multiple continuous variables present within a dataframe. It presents a graph which allows the user a definitive view to compare how different variables correlate to one another. Let's look at the same data set as above.

```
#install.packages("ggcorrplot")
library(ggplot2)
library(ggcorrplot)

#Load the dataset diamonds built into R
data("diamonds")
head(diamonds)
```

```
## # A tibble: 6 x 10
##   carat       cut color clarity depth table price     x     y     z
##   <dbl>     <ord> <ord>   <ord> <dbl> <dbl> <int> <dbl> <dbl> <dbl>
## 1  0.23     Ideal     E     SI2  61.5    55   326  3.95  3.98  2.43
## 2  0.21   Premium     E     SI1  59.8    61   326  3.89  3.84  2.31
## 3  0.23      Good     E     VS1  56.9    65   327  4.05  4.07  2.31
## 4  0.29   Premium     I     VS2  62.4    58   334  4.20  4.23  2.63
## 5  0.31      Good     J     SI2  63.3    58   335  4.34  4.35  2.75
## 6  0.24 Very Good     J    VVS2  62.8    57   336  3.94  3.96  2.48
```

```r
#Select only the numeric columns for analysis--you can't use qualitative columns
my_num_data <- diamonds[,sapply(diamonds, is.numeric)]

# Correlation matrix
corr <- round(cor(my_num_data ), 1)

# Plot
ggcorrplot(corr, hc.order = TRUE,
           type = "lower",
           lab = TRUE,
           lab_size = 3,
           method="circle",
           colors = c("yellow", "purple", "red"),
           title="Using a Correlogram to Identify Relationships for Diamonds",
           ggtheme=theme_bw)
```



Message

As we can see above, the aspects of ggplot2 I have outlined can be used for different purposes at different times. They can allow the user to gain different visuals of his information, using the pie chart and violin plot function. He can also gain a deeper understanding of relationships through correlogram. Moreover, he can highlight aspects using the enclose feature to bring certain aspects to light. All of these tools can help the user make the most of the data available to him.

Sources

The following sources were used to figure out aspects of using ggplot2, feel free to click the url to visit them yourself

General R Guidelines for ggplot2 “Graphs with ggplot2.” Graphs, Cookbook for R , www.cookbook-r.com/Graphs/.

Pie Chart Definition “What Is Pie Graph (or Pie Chart)? - Definition from Whatls.com.” Whatls.com, whatis.techtarget.com/definition/pie-graph-or-pie-chart.

Pie Chart Tutorial “ggplot2 Pie Chart : Quick Start Guide - R Software and Data Visualization.” ggplot2 Pie Chart : Quick Start Guide - R Software and Data Visualization - Easy Guides - Wiki - STHDA, www.sthda.com/english/wiki/ggplot2-pie-chart-quick-start-guide-r-software-and-data-visualization.

R Visualisation–help with code

Prabhakaran, Selva. “Top 50 ggplot2 Visualizations - The Master List (With Full R Code).” Top 50 ggplot2 Visualizations - The Master List (With Full R Code), r-statistics.co/Top50-Ggplot2-Visualizations-MasterList-R-Code.html#Hierarchical%20Dendrogram.

Help with Encircle

“Package ‘Ggalt.’” CRAN R, 15 Feb. 2017, cran.r-project.org/web/packages/ggalt/ggalt.pdf.

Violin plot explanation help

Holtz, |. “#95 Violin Plot with ggplot2.” The R Graph Gallery, 28 Feb. 2017, www.r-graph-gallery.com/95-violin-plot-with-ggplot2/.

Violin plot Image

datavizcatalogue.com/methods/images/anatomy/SVG/violin_plot.svg.

Correlogram

“Ggcorrplot: Visualization of a Correlation Matrix Using ggplot2.” Ggcorrplot: Visualization of a Correlation Matrix Using ggplot2 - Easy Guides - Wiki - STHDA, www.sthda.com/english/wiki/ggcorrplot-visualization-of-a-correlation-matrix-using-ggplot2.

Adding labels to pie chart

“Adding Percentage Labels on Pie Chart in R.” Stack Overflow, stackoverflow.com/questions/41338757/adding-percentage-labels-on-pie-chart-

in-r.