Sample Visualization

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11/04/2015

R has long been known for its extensive visualization capabilities. The number of packages that handle visualizations are many, yet ggplot shines among them all. Today I will focus on ggplot and discuss plotting histograms and scatter plots. I will purely focus on qplot function, and discuss ggplot structure only briefly.

Introducing the Dataset

In this document we will analyze the Motor Trends data. The dataset was compiled from 1974 issues of Motor Trends magazine and is included with R Base package.

Let us start with loading the dataset.

```
data(mtcars)
```

As we learned in the section on packages, you can querry the documentation for almost anything. Including the datasets included in packages. The document includes descriptions of the variables.

```
?mtcars
```

Let us get a sense of the data.

```
# A summary of variables
summary(mtcars)
```

```
##       mpg             cyl             disp             hp
##  Min.   :10.40   Min.   :4.000   Min.   : 71.1   Min.   : 52.0
##  1st Qu.:15.43   1st Qu.:4.000   1st Qu.:120.8   1st Qu.: 96.5
##  Median :19.20   Median :6.000   Median :196.3   Median :123.0
##  Mean   :20.09   Mean   :6.188   Mean   :230.7   Mean   :146.7
##  3rd Qu.:22.80   3rd Qu.:8.000   3rd Qu.:326.0   3rd Qu.:180.0
##  Max.   :33.90   Max.   :8.000   Max.   :472.0   Max.   :335.0
##       drat             wt             qsec             vs
##  Min.   :2.760   Min.   :1.513   Min.   :14.50   Min.   :0.0000
##  1st Qu.:3.080   1st Qu.:2.581   1st Qu.:16.89   1st Qu.:0.0000
##  Median :3.695   Median :3.325   Median :17.71   Median :0.0000
##  Mean   :3.597   Mean   :3.217   Mean   :17.85   Mean   :0.4375
##  3rd Qu.:3.920   3rd Qu.:3.610   3rd Qu.:18.90   3rd Qu.:1.0000
##  Max.   :4.930   Max.   :5.424   Max.   :22.90   Max.   :1.0000
##        am              gear            carb
##  Min.   :0.0000   Min.   :3.000   Min.   :1.000
##  1st Qu.:0.0000   1st Qu.:3.000   1st Qu.:2.000
##  Median :0.0000   Median :4.000   Median :2.000
##  Mean   :0.4062   Mean   :3.688   Mean   :2.812
##  3rd Qu.:1.0000   3rd Qu.:4.000   3rd Qu.:4.000
##  Max.   :1.0000   Max.   :5.000   Max.   :8.000
```

```r
# Correlation table for first 4 variables (due to space concerns)
cor(mtcars[,1:4])
```

```
##             mpg        cyl       disp         hp
## mpg   1.0000000 -0.8521620 -0.8475514 -0.7761684
## cyl  -0.8521620  1.0000000  0.9020329  0.8324475
## disp -0.8475514  0.9020329  1.0000000  0.7909486
## hp   -0.7761684  0.8324475  0.7909486  1.0000000
```

```r
# bivariate comparisons of categorical variables
table(mtcars[,c("am","cyl")])
```

```
##    cyl
## am   4  6  8
##   0  3  4 12
##   1  8  3  2
```

Plotting with qplot()

Now we can get to the fun part. qplot simplifies the ggplot functionality by automating most common tasks. We will use qplot for most common plots.

```r
# Load the ggplot package
library(ggplot2)
# Review function syntax
?qplot
```

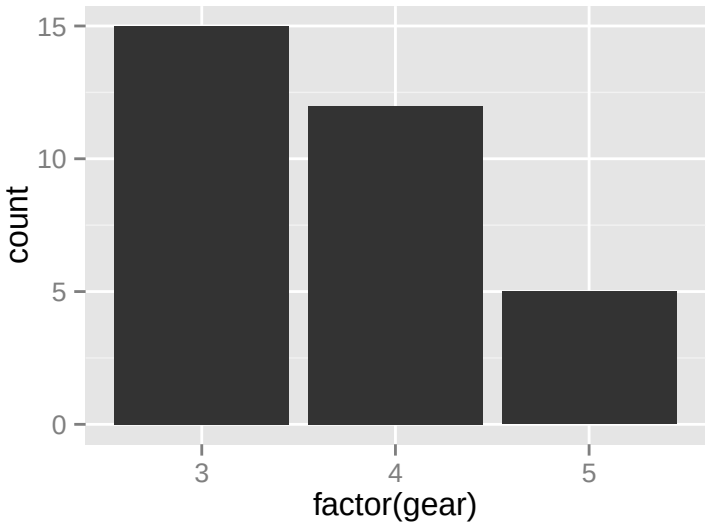
Histogram

You would use a histogram you are interested in frequencies of certain categories, like number of people with certain eye color.

```r
# Numbers we should see for verification.
table(mtcars$gear)
```

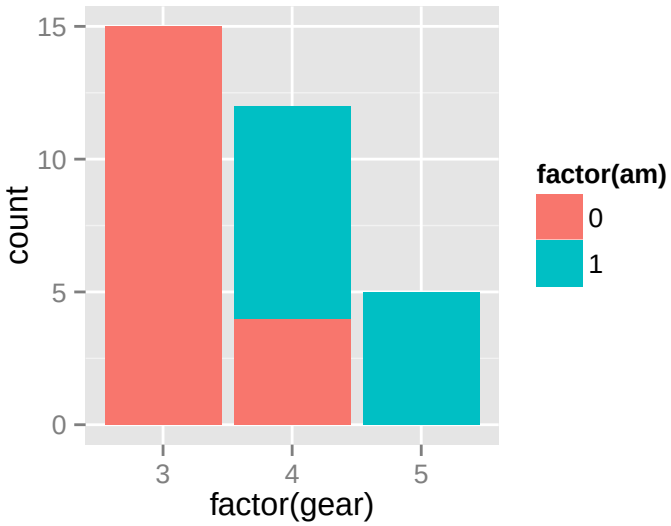
```
##
##  3  4  5
## 15 12  5
```

```r
# Let us report the number of cars with differing number of front gears
qplot(factor(gear), data=mtcars, geom="bar") # used factor to declare categorical
```



If we want to get fancy and want to report across two categorical variables we can color the bars based on another variable.

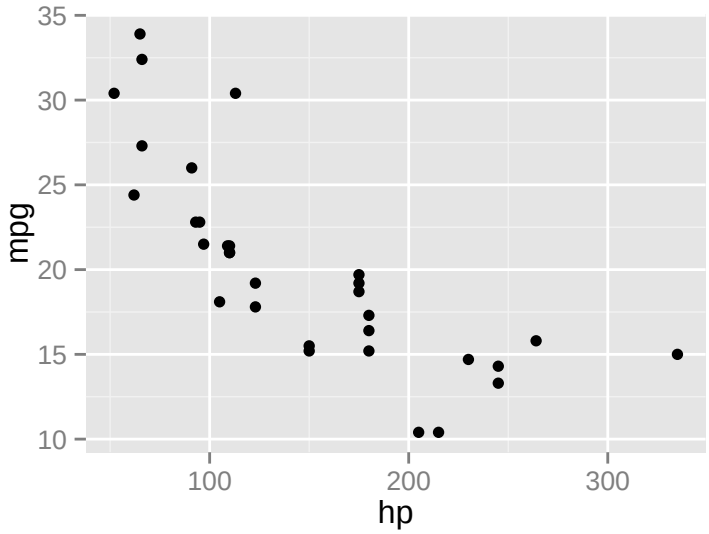
```
qplot(factor(gear), data=mtcars,  fill=factor(am), geom="bar") # used factor to declare categorical
```



Scatter Plots

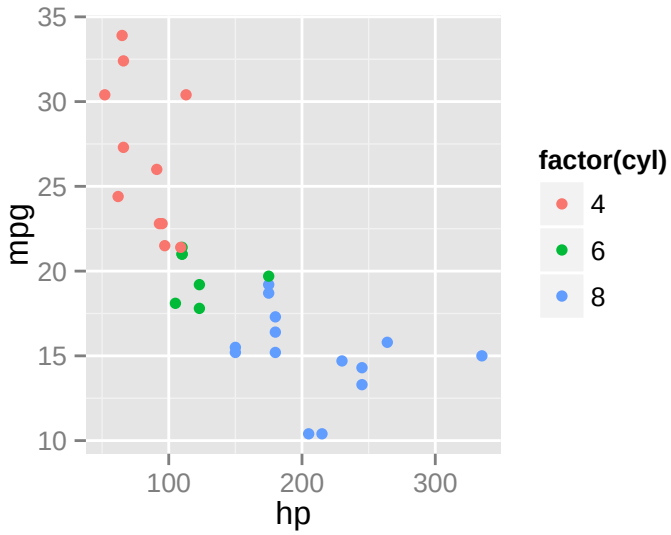
If you are interested in the relationship between two continuous variables, you can use scatter plots.

```
qplot(hp, mpg, data=mtcars)
```



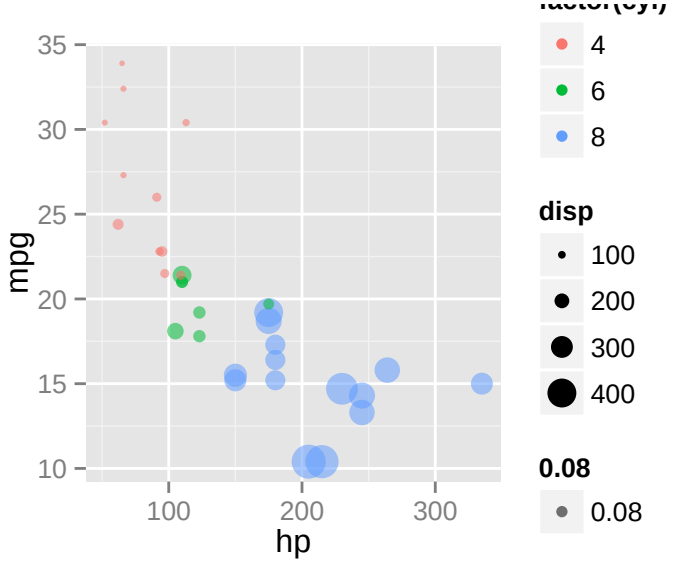
Let us impose an additional factor into the plot. Let us color the dots by the number of cylinders.

```
qplot(hp, mpg, data=mtcars, color=factor(cyl))
```



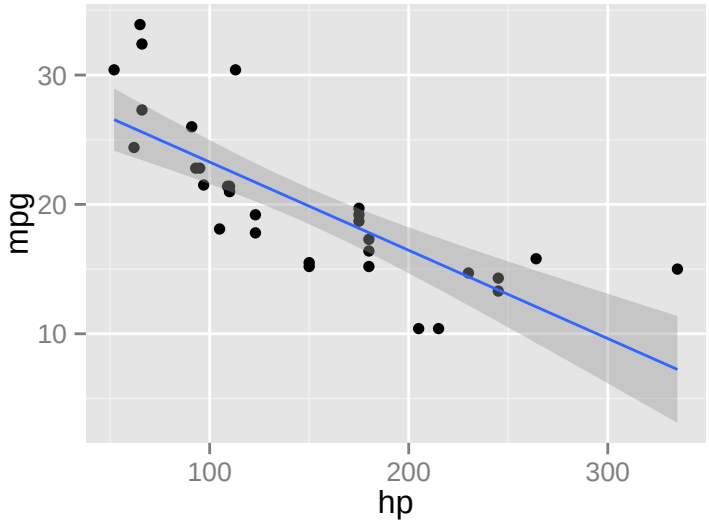
Size of dots dependent on a continuous variable (displacement).

```
qplot(hp, mpg, data=mtcars, color=factor(cyl), size=disp, alpha=.08)
```



Let us fit a regression line. This is where things start to get a bit ggplotty.

```
qplot(hp, mpg, data=mtcars) +
  geom_smooth(method=lm, sd=F)
```



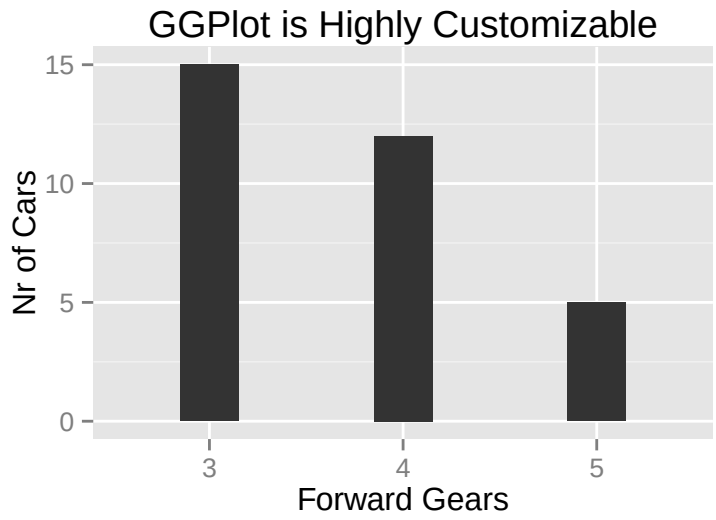
ggplot

qplot provides a convenient command for plotting. While qplot would address 90% of your plotting needs. ggplot is way more than qplot, it is almost a different language just for plotting. The intricacies may be hard to learn and is clearly beyond the scope of this workshop. I am providing ggplot code below to achieve the same results as the qplot, so the attendees can get a sense of what ggplot is really about.

Histogram

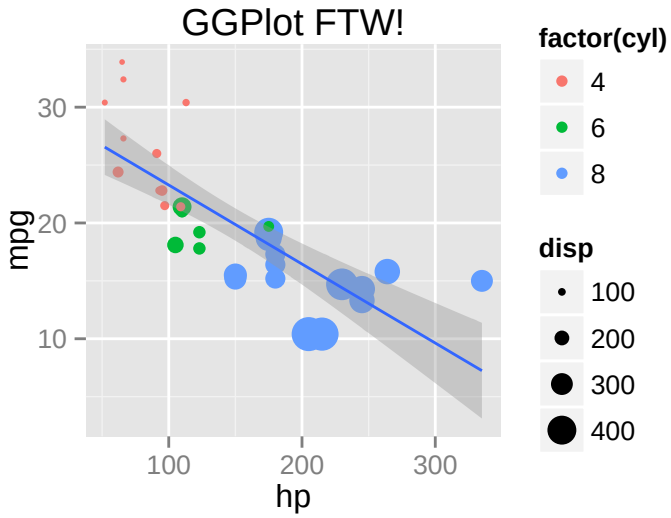
```
# Initialize the plot with variables of interest
ggplot(mtcars, aes(factor(gear))) +
```

```
# Instruct ggplot to plot bars of width .3
  geom_bar(stat = "bin", width=0.3) +
  ggtitle('GGPlot is Highly Customizable') +
  xlab('Forward Gears') +
  ylab('Nr of Cars')
```



Scatter Plot

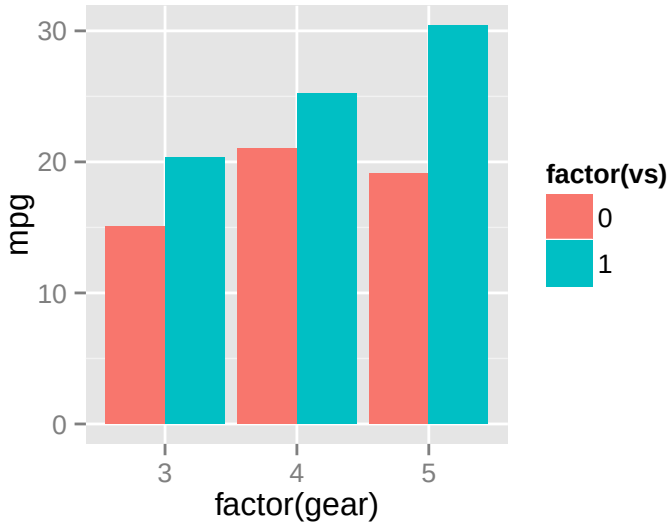
```
ggplot(mtcars, aes(x=hp, y=mpg)) +
  geom_point(aes(color=factor(cyl), size=disp)) + # For scatter plot
    geom_smooth(method=lm) + # Add a regression line
  ggtitle('GGPlot FTW!') # Add a title
```



BONUS: Bar Charts

You use bar charts when you want to visualize the relationship of a continuous variable over a categorical variable (eg. gender-height). Here I plot mean mpg over two categorical variables.

```
ggplot(mtcars,aes(x=factor(gear),y=mpg,fill=factor(vs)), color=factor(vs)) +
  stat_summary(fun.y=mean, position=position_dodge(), geom="bar")
```



caret and Visualizations

We will cover caret a little in machine learning samples. This package provides convenient shortcuts to ggplot functionality. Simplifying most common plotting tasks in machine learning. Please refer to the project page for further reference.