Knitr

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Contents

The three "back ticks" (') must be followed by curly brackets "{", and then "r" to tell the computer that you are using R code. This line is then closed off by another curly bracket "}".

Anything before three more back ticks "''" are then considered R code (a script).

If any code in the document has just a backtick ' then nothing, then another backtick, then that word is just printed as if it were code, such as `hey`.

I'm reading in the bike lanes here.

```
# readin is just a "label" for this code chunk
## code chunk is just a "chunk" of code, where this code usually
## does just one thing, aka a module
### comments are still # here
### you can do all your reading in there
### let's say we loaded some packages
library(stringr)
library(plyr)
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
##
## The following objects are masked from 'package:plyr':
##
##     arrange, count, desc, failwith, id, mutate, rename, summarise,
##     summarize
##
## The following objects are masked from 'package:stats':
##
##     filter, lag
##
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
fname <- "../../data/Bike_Lanes.csv"
bike = read.csv(fname, as.is = TRUE)
```

You can write your introduction here.

Introduction

Bike lanes are in Baltimore. People like them. Why are they so long?

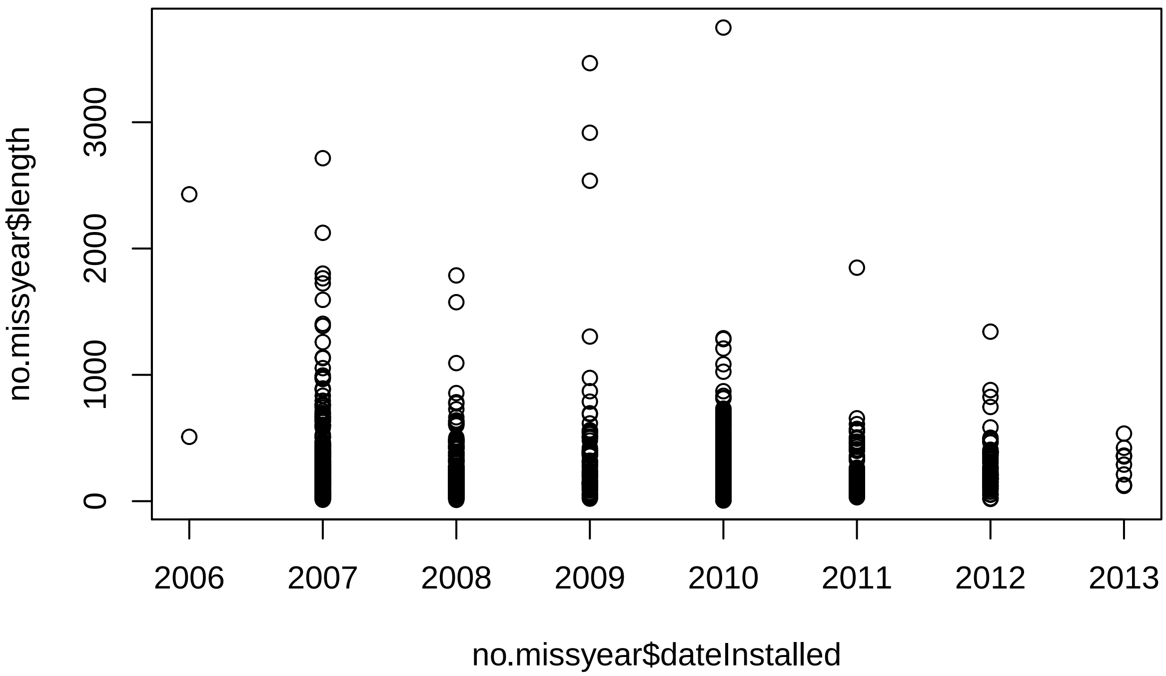
Exploratory Analysis

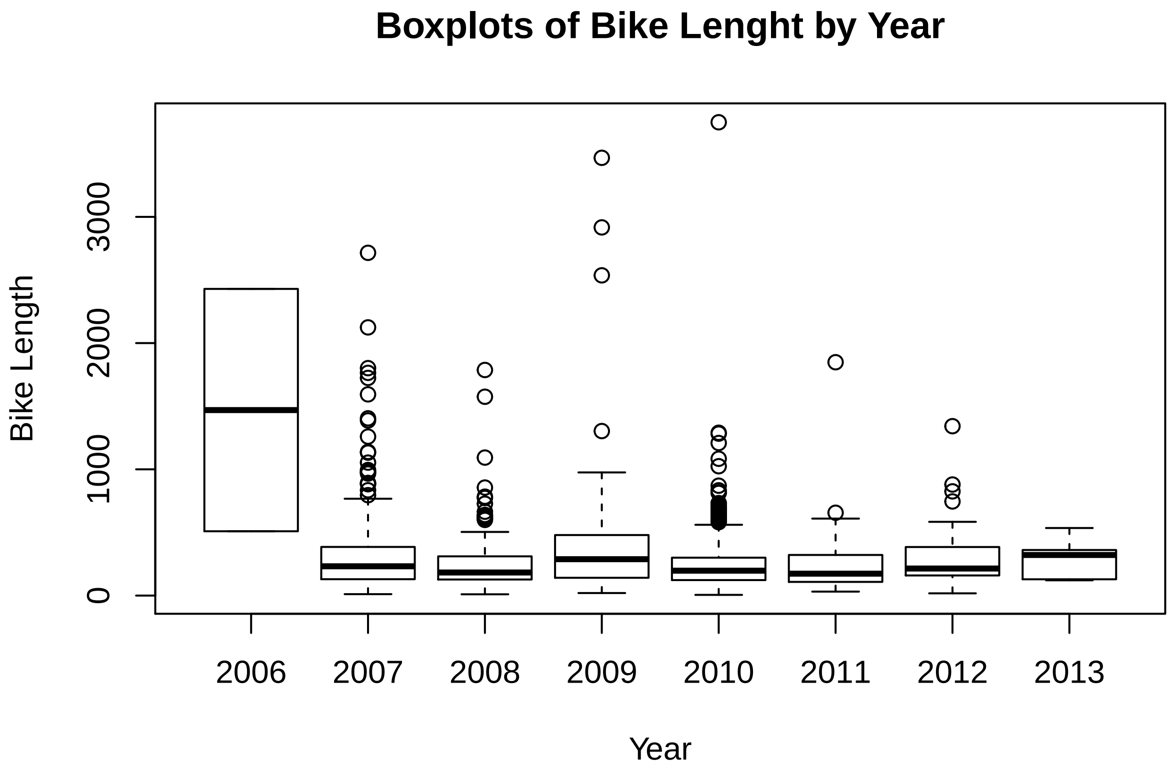
Let's look at some plots of bike length. Let's say we wanted to look at what affects bike length.

Plots of bike length

Note we made the subsection by using three "hashes" (pound signs): ###.

We can turn off R code output by using `echo = FALSE` on the knitr code chunk. s

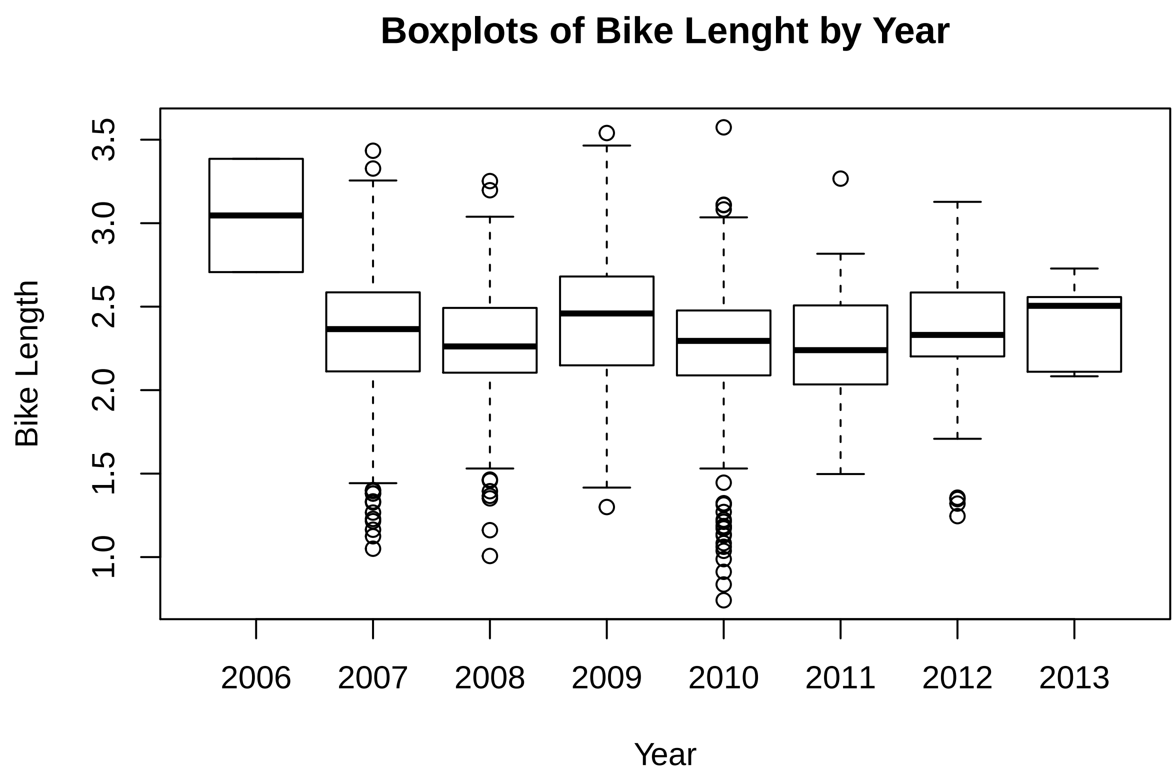




We have a total of 1505 rows.

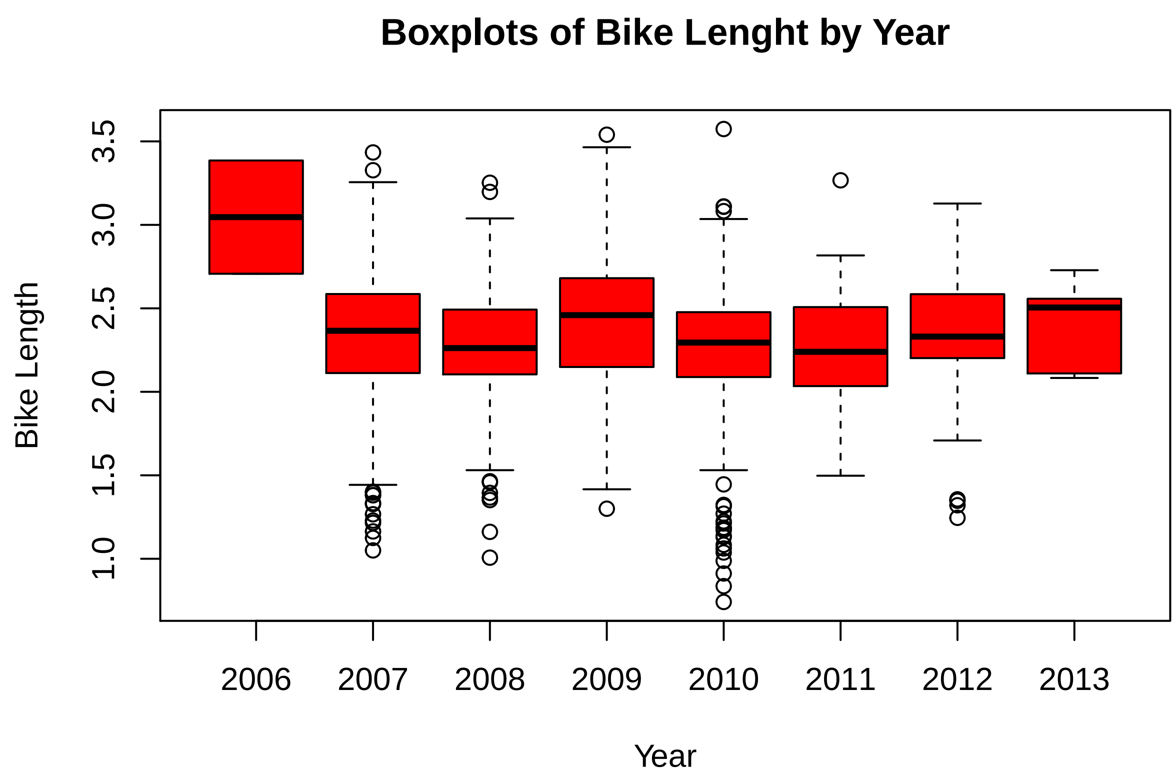
What does it look like if we took the log (base 10) of the bike length:

```
no.missyear$log.length <- log10(no.missyear$length)
### see here that if you specify the data argument, you don't need to do the $
boxplot(log.length ~ dateInstalled, data=no.missyear, main="Boxplots of Bike Lenght by Year", xlab="Yea
```



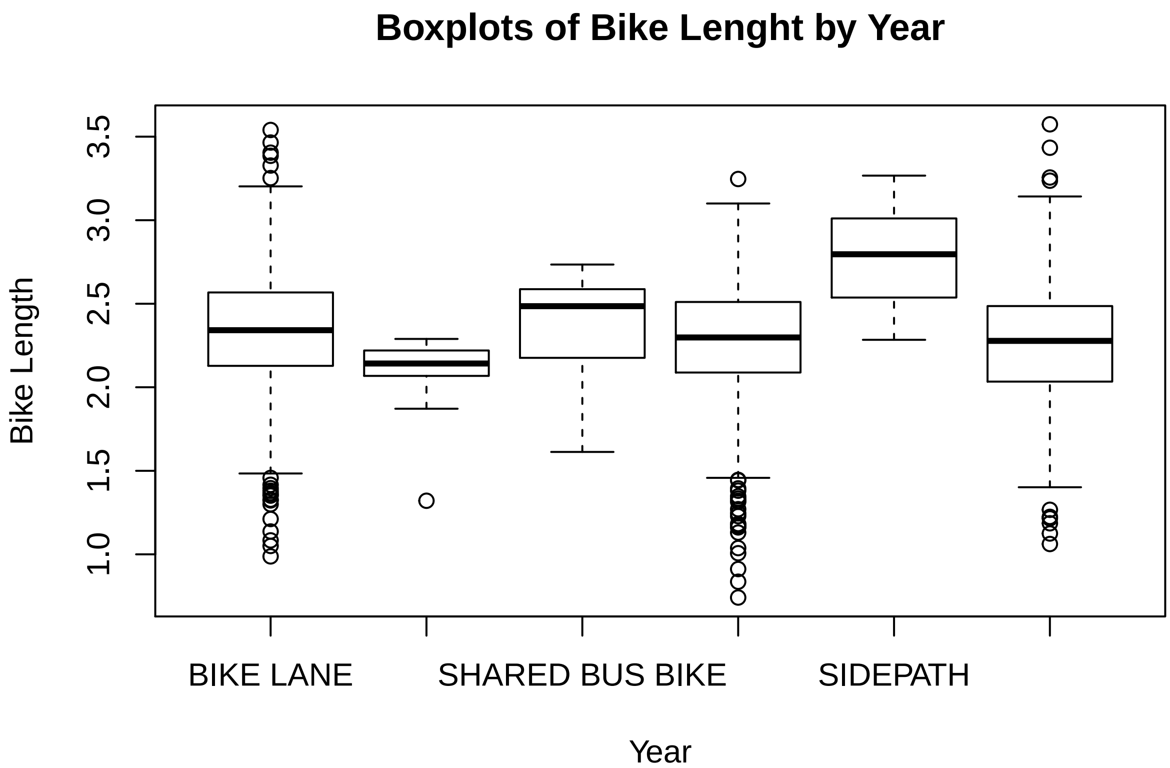
I want my boxplots colored, so I set the `col` argument.

```
boxplot(log.length ~ dateInstalled, data=no.missyear, main="Boxplots of Bike Lenght by Year", xlab="Yea
```



As we can see, 2006 had a much higher bike length. What about for the type of bike path?

```
### type is a character, but when R sees a "character" in a "formula", then it automatically converts i
### a formula is something that has a y ~ x, which says I want to plot y against x
### or if it were a model you would do y ~ x, which meant regress against y
boxplot(log.length ~ type, data=no.missyear, main="Boxplots of Bike Lenght by Year", xlab="Year", ylab=
```



What if we want to extract means by each type?

Let's show a few ways:

```
### tapply takes in vector 1, then does a function by vector 2, and then you tell what
### that function is
tapply(no.missyear$log.length, no.missyear$type, mean)
```

```
##       BIKE LANE      CONTRAFLOW SHARED BUS BIKE         SHARROW
##        2.330611        2.087246        2.363005        2.256425
##        SIDEPATH    SIGNED ROUTE
##        2.781829        2.263746
```

```
## aggregate
aggregate(x=no.missyear$log.length, by=list(no.missyear$type), FUN=mean)
```

```
##           Group.1        x
## 1       BIKE LANE 2.330611
## 2      CONTRAFLOW 2.087246
## 3 SHARED BUS BIKE 2.363005
## 4         SHARROW 2.256425
## 5        SIDEPATH 2.781829
## 6    SIGNED ROUTE 2.263746
```

```
### now let's specify the data argument and use a "formula" - much easier to read and
## more "intuitive"
aggregate(log.length ~ type, data=no.missyear, FUN=mean)
```

```
##              type log.length
## 1       BIKE LANE   2.330611
## 2      CONTRAFLOW   2.087246
## 3 SHARED BUS BIKE   2.363005
## 4         SHARROW   2.256425
## 5        SIDEPATH   2.781829
## 6    SIGNED ROUTE   2.263746
```

```
## ddply is from the plyr package
##takes in a data frame, (the first d refers to data.frame)
## splits it up by some variables (let's say type)
## then we'll use summarise to summarize whatever we want
## then returns a data.frame (the second d) - hence why it's ddply
## if we wanted to do it on a "list" thne return data.frame, it'd be ldply
ddply(no.missyear, .(type), plyr::summarise,
      mean=mean(log.length)
      )
```

```
##              type     mean
## 1       BIKE LANE 2.330611
## 2      CONTRAFLOW 2.087246
## 3 SHARED BUS BIKE 2.363005
## 4         SHARROW 2.256425
## 5        SIDEPATH 2.781829
## 6    SIGNED ROUTE 2.263746
```

```
no.missyear %>% group_by(type) %>%
  dplyr::summarise(mean=mean(log.length))
```

```
## Source: local data frame [6 x 2]
##
##              type     mean
##             (chr)    (dbl)
## 1       BIKE LANE 2.330611
## 2      CONTRAFLOW 2.087246
## 3 SHARED BUS BIKE 2.363005
## 4         SHARROW 2.256425
## 5        SIDEPATH 2.781829
## 6    SIGNED ROUTE 2.263746
```

`ddply` (and other functions in the `plyr` package) is cool because you can do multiple functions really easy.

Let's show a what if we wanted to go over `type` and `dateInstalled`:

```
### For going over 2 variables, we need to do it over a "list" of vectors
tapply(no.missyear$log.length,
       list(no.missyear$type, no.missyear$dateInstalled),
       mean)
```

```
##                    2006     2007     2008     2009     2010     2011
## BIKE LANE      3.046261 2.351256 2.365728 2.381418 2.306994 2.242132
## CONTRAFLOW           NA       NA       NA       NA 2.087246       NA
## SHARED BUS BIKE      NA       NA       NA 2.350759 2.403824       NA
## SHARROW              NA 2.300954 2.220850 2.691814 2.247131       NA
## SIDEPATH             NA       NA 2.625486       NA 2.773850 3.266816
## SIGNED ROUTE         NA 2.287593       NA       NA 2.239475 2.210112
##                   2012     2013
## BIKE LANE      2.36151 2.408306
## CONTRAFLOW          NA       NA
## SHARED BUS BIKE     NA       NA
## SHARROW        2.23636       NA
## SIDEPATH            NA       NA
## SIGNED ROUTE        NA       NA
```

```
tapply(no.missyear$log.length,
       list(no.missyear$type, no.missyear$dateInstalled),
       mean, na.rm=TRUE)
```


```
##                    2006     2007     2008     2009     2010     2011
## BIKE LANE      3.046261 2.351256 2.365728 2.381418 2.306994 2.242132
## CONTRAFLOW           NA       NA       NA       NA 2.087246       NA
## SHARED BUS BIKE      NA       NA       NA 2.350759 2.403824       NA
## SHARROW              NA 2.300954 2.220850 2.691814 2.247131       NA
## SIDEPATH             NA       NA 2.625486       NA 2.773850 3.266816
## SIGNED ROUTE         NA 2.287593       NA       NA 2.239475 2.210112
##                   2012     2013
## BIKE LANE      2.36151 2.408306
## CONTRAFLOW          NA       NA
## SHARED BUS BIKE     NA       NA
## SHARROW        2.23636       NA
## SIDEPATH            NA       NA
## SIGNED ROUTE        NA       NA
```


```
## aggregate - looks better
aggregate(log.length ~ type + dateInstalled, data=no.missyear, FUN=mean)
```

```
##               type dateInstalled log.length
## 1        BIKE LANE          2006   3.046261
## 2        BIKE LANE          2007   2.351256
## 3          SHARROW          2007   2.300954
## 4     SIGNED ROUTE          2007   2.287593
## 5        BIKE LANE          2008   2.365728
## 6          SHARROW          2008   2.220850
## 7         SIDEPATH          2008   2.625486
## 8        BIKE LANE          2009   2.381418
## 9  SHARED BUS BIKE          2009   2.350759
## 10         SHARROW          2009   2.691814
## 11       BIKE LANE          2010   2.306994
## 12      CONTRAFLOW          2010   2.087246
## 13 SHARED BUS BIKE          2010   2.403824
## 14         SHARROW          2010   2.247131
## 15        SIDEPATH          2010   2.773850
```

```
## 16    SIGNED ROUTE          2010   2.239475
## 17       BIKE LANE          2011   2.242132
## 18        SIDEPATH          2011   3.266816
## 19    SIGNED ROUTE          2011   2.210112
## 20       BIKE LANE          2012   2.361510
## 21         SHARROW          2012   2.236360
## 22       BIKE LANE          2013   2.408306
```

```
## ddply is from the plyr package
ddply(no.missyear, .(type, dateInstalled), summarise,
      mean=mean(log.length),
      median=median(log.length),
      Mode=mode(log.length),
      Std.Dev=sd(log.length)
      )
```

```
##                type dateInstalled     mean   median    Mode    Std.Dev
## 1         BIKE LANE          2006 3.046261 3.046261 numeric 0.47973544
## 2         BIKE LANE          2007 2.351256 2.444042 numeric 0.40662247
## 3         BIKE LANE          2008 2.365728 2.354641 numeric 0.38916236
## 4         BIKE LANE          2009 2.381418 2.311393 numeric 0.49447436
## 5         BIKE LANE          2010 2.306994 2.328486 numeric 0.32075915
## 6         BIKE LANE          2011 2.242132 2.235462 numeric 0.33397773
## 7         BIKE LANE          2012 2.361510 2.323863 numeric 0.28528097
## 8         BIKE LANE          2013 2.408306 2.505012 numeric 0.24040604
## 9        CONTRAFLOW          2010 2.087246 2.142250 numeric 0.25655109
## 10 SHARED BUS BIKE          2009 2.350759 2.463997 numeric 0.30609512
## 11 SHARED BUS BIKE          2010 2.403824 2.586681 numeric 0.27379952
## 12          SHARROW          2007 2.300954 2.363596 numeric 0.42192796
## 13          SHARROW          2008 2.220850 2.238021 numeric 0.32664161
## 14          SHARROW          2009 2.691814 2.707891 numeric 0.06945133
## 15          SHARROW          2010 2.247131 2.298322 numeric 0.35904709
## 16          SHARROW          2012 2.236360 2.338508 numeric 0.42924259
## 17         SIDEPATH          2008 2.625486 2.786834 numeric 0.29583110
## 18         SIDEPATH          2010 2.773850 2.773850 numeric 0.33479504
## 19         SIDEPATH          2011 3.266816 3.266816 numeric         NA
## 20     SIGNED ROUTE          2007 2.287593 2.331816 numeric 0.41825297
## 21     SIGNED ROUTE          2010 2.239475 2.255658 numeric 0.39200947
## 22     SIGNED ROUTE          2011 2.210112 2.207824 numeric 0.20880213
```

OK let's do an linear model

```
### type is a character, but when R sees a "character" in a "formula", then it automatically converts i
### a formula is something that has a y ~ x, which says I want to plot y against x
### or if it were a model you would do y ~ x, which meant regress against y
mod.type = lm(log.length ~ type, data=no.missyear)
mod.yr = lm(log.length ~ factor(dateInstalled), data=no.missyear)
mod.yrtype = lm(log.length ~ type + factor(dateInstalled), data=no.missyear)
summary(mod.type)
```

```
##
## Call:
## lm(formula = log.length ~ type, data = no.missyear)
```

```
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.51498 -0.19062  0.02915  0.23220  1.31021
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)          2.33061    0.01487 156.703  < 2e-16 ***
## typeCONTRAFLOW      -0.24337    0.10288  -2.366 0.018127 *
## typeSHARED BUS BIKE  0.03239    0.06062   0.534 0.593194
## typeSHARROW         -0.07419    0.02129  -3.484 0.000509 ***
## typeSIDEPATH         0.45122    0.15058   2.997 0.002775 **
## typeSIGNED ROUTE    -0.06687    0.02726  -2.453 0.014300 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.367 on 1499 degrees of freedom
## Multiple R-squared:  0.01956,    Adjusted R-squared:  0.01629
## F-statistic:  5.98 on 5 and 1499 DF,  p-value: 1.74e-05
```

That's rather UGLY, so let's use a package called `xtable` and then make this model into an `xtable` object and then print it out nicely.

```r
### DON'T DO THIS.  YOU SHOULD ALWAYS DO library() statements in the FIRST code chunk.
### this is just to show you the logic of a report/analysis.
require(xtable)
```

```
## Loading required package: xtable
```

```r
# smod <- summary(mod.yr)
xtab <- xtable(mod.yr)
```

Well `xtable` can make html tables, so let's print this. We must tell R that the results is actually an html output, so we say the results should be embedded in the html "asis" (aka just print out whatever R spits out).

```r
print.xtable(xtab, type="html")
```

Estimate

Std. Error

t value

Pr(>|t|)

(Intercept)

3.0463

0.2600

11.71

0.0000

factor(dateInstalled)2007

-0.7332

0.2608

-2.81

0.0050

factor(dateInstalled)2008

-0.7808

0.2613

-2.99

0.0029

factor(dateInstalled)2009

-0.6394

0.2631

-2.43

0.0152

factor(dateInstalled)2010

-0.7791

0.2605

-2.99

0.0028

factor(dateInstalled)2011

-0.8022

0.2626

-3.05

0.0023

factor(dateInstalled)2012

-0.7152

0.2625

-2.72

0.0065

factor(dateInstalled)2013

-0.6380

0.2849

-2.24

0.0253

OK, that's pretty good, but let's say we have all three models. Another package called `stargazer` can put models together easily and pritn them out. So `xtable` is really good when you are trying to print out a table (in html, otherwise make the table and use `write.csv` to get it in Excel and then format) really quickly and in a report. But it doesn't work so well with *many* models together. So let's use stargazer. Again, you need to use `install.packages("stargazer")` if you don't have function.

```r
require(stargazer)
```

```
## Loading required package: stargazer
##
## Please cite as:
##
##  Hlavac, Marek (2015). stargazer: Well-Formatted Regression and Summary Statistics Tables.
##  R package version 5.2. http://CRAN.R-project.org/package=stargazer
```

OK, so what's the difference here? First off, we said results are "markup", so that it will not try to reformat the output. Also, I didn't want those # for comments, so I just made comment an empty string "".

```r
stargazer(mod.yr, mod.type, mod.yrtype, type="text")
```

```
==================================================================================================
                                              Dependent variable:
                          ------------------------------------------------------------------------
                                                  log.length
                                     (1)                     (2)                     (3)
--------------------------------------------------------------------------------------------------
factor(dateInstalled)2007         -0.733***                                       -0.690***
                                   (0.261)                                         (0.259)

factor(dateInstalled)2008         -0.781***                                       -0.742***
                                   (0.261)                                         (0.260)

factor(dateInstalled)2009         -0.639**                                         -0.619**
                                   (0.263)                                         (0.262)

factor(dateInstalled)2010         -0.779***                                       -0.736***
                                   (0.260)                                         (0.259)

factor(dateInstalled)2011         -0.802***                                       -0.790***
                                   (0.263)                                         (0.261)

factor(dateInstalled)2012         -0.715***                                       -0.700***
                                   (0.262)                                         (0.261)

factor(dateInstalled)2013         -0.638**                                         -0.638**
                                   (0.285)                                         (0.283)

typeCONTRAFLOW                                             -0.243**                -0.224**
                                                           (0.103)                 (0.103)

typeSHARED BUS BIKE                                         0.032                   -0.037
                                                           (0.061)                 (0.069)

typeSHARROW                                                -0.074***               -0.064***
                                                           (0.021)                 (0.023)

typeSIDEPATH                                               0.451***                 0.483***
```

```
                                                   (0.151)                 (0.150)

typeSIGNED ROUTE                                  -0.067**                -0.067**
                                                   (0.027)                 (0.029)

Constant                          3.046***        2.331***                3.046***
                                   (0.260)         (0.015)                 (0.258)

--------------------------------------------------------------------------------------------------
Observations                        1,505           1,505                   1,505
R2                                  0.017           0.020                   0.033
Adjusted R2                         0.012           0.016                   0.026
Residual Std. Error          0.368 (df = 1497)  0.367 (df = 1499)     0.365 (df = 1492)
F Statistic              3.691*** (df = 7; 1497) 5.980*** (df = 5; 1499) 4.285*** (df = 12; 1492)
==================================================================================================
Note:                                                              *p<0.1; **p<0.05; ***p<0.01
```

If we use

```r
stargazer(mod.yr, mod.type, mod.yrtype, type="html")
```

Dependent variable:

log.length

(1)

(2)

(3)

factor(dateInstalled)2007

-0.733***

-0.690***

(0.261)

(0.259)

factor(dateInstalled)2008

-0.781***

-0.742***

(0.261)

(0.260)

factor(dateInstalled)2009

-0.639**

-0.619**

(0.263)

(0.262)

factor(dateInstalled)2010

-0.779***

-0.736***

(0.260)

(0.259)

factor(dateInstalled)2011

-0.802***

-0.790***

(0.263)

(0.261)

factor(dateInstalled)2012

-0.715***

-0.700***

(0.262)

(0.261)

factor(dateInstalled)2013

-0.638**

-0.638**

(0.285)

(0.283)

typeCONTRAFLOW

-0.243**

-0.224**

(0.103)

(0.103)

typeSHARED BUS BIKE

0.032

-0.037

(0.061)

(0.069)

typeSHARROW

-0.074***

-0.064***

(0.021)

(0.023)

typeSIDEPATH

0.451***

0.483***

(0.151)

(0.150)

typeSIGNED ROUTE

-0.067**

-0.067**

(0.027)

(0.029)

Constant

3.046***

2.331***

3.046***

(0.260)

(0.015)

(0.258)

Observations

1,505

1,505

1,505

R2

0.017

0.020

0.033

Adjusted R2

0.012

0.016

0.026

Residual Std. Error

0.368 (df = 1497)

0.367 (df = 1499)

0.365 (df = 1492)

F Statistic

3.691*** (df = 7; 1497)

5.980*** (df = 5; 1499)

4.285*** (df = 12; 1492)

Note:

p<0.1; ***p<0.05;*** p<0.01

Data Extraction

Let's say I want to get data INTO my text. Like there are N number of bike lanes with a date installed that isn't zero. There are 1505 bike lanes with a date installed after 2006. So you use one backtick ' and then you say "r" to tell that it's R code. And then you run R code that gets evaualated and then returns the value. Let's say you want to compute a bunch of things:

```
### let's get number of bike lanes installed by year
n.lanes = ddply(no.missyear, .(dateInstalled), nrow)
names(n.lanes) <- c("date", "nlanes")
n2009 <- n.lanes$nlanes[ n.lanes$date == 2009]
n2010 <- n.lanes$nlanes[ n.lanes$date == 2010]
getwd()
```

```
## [1] "/Users/johnmuschelli/Dropbox/Classes/winterR_2016/Knitr/lecture"
```

Now I can just say there are 86 lanes in 2009 and 625 in 2010.

```
fname <- "../../data/Charm_City_Circulator_Ridership.csv"
# fname <- file.path(data.dir, "Charm_City_Circulator_Ridership.csv")
## file.path takes a directory and makes a full name with a full file path
charm = read.csv(fname, as.is=TRUE)

library(chron)
days = levels(weekdays(1, abbreviate=FALSE))
charm$day <- factor(charm$day, levels=days)
charm$date <- as.Date(charm$date, format="%m/%d/%Y")
cn <- colnames(charm)
daily <- charm[, c("day", "date", "daily")]
```

```
charm$daily <- NULL
require(reshape)
```

```
## Loading required package: reshape
##
## Attaching package: 'reshape'
##
## The following object is masked from 'package:dplyr':
##
##     rename
##
## The following objects are masked from 'package:plyr':
##
##     rename, round_any
```

```
long.charm <- melt(charm, id.vars = c("day", "date"))
long.charm$type <- "Boardings"
long.charm$type[ grepl("Alightings", long.charm$variable)] <- "Alightings"
long.charm$type[ grepl("Average", long.charm$variable)] <- "Average"

long.charm$line <- "orange"
long.charm$line[ grepl("purple", long.charm$variable)] <- "purple"
```

```r
long.charm$line[ grepl("green", long.charm$variable)] <- "green"
long.charm$line[ grepl("banner", long.charm$variable)] <- "banner"
long.charm$variable <- NULL

long.charm$line <-factor(long.charm$line, levels=c("orange", "purple",
                                                   "green", "banner"))

head(long.charm)
```

```
##         day       date value      type   line
## 1    Monday 2010-01-11   877 Boardings orange
## 2   Tuesday 2010-01-12   777 Boardings orange
## 3 Wednesday 2010-01-13  1203 Boardings orange
## 4  Thursday 2010-01-14  1194 Boardings orange
## 5    Friday 2010-01-15  1645 Boardings orange
## 6  Saturday 2010-01-16  1457 Boardings orange
```

```r
### NOW R has a column of day, the date, a "value", the type of value and the
### circulator line that corresponds to it
### value is now either the Alightings, Boardings, or Average from the charm dataset
```

Let's do some plotting now!

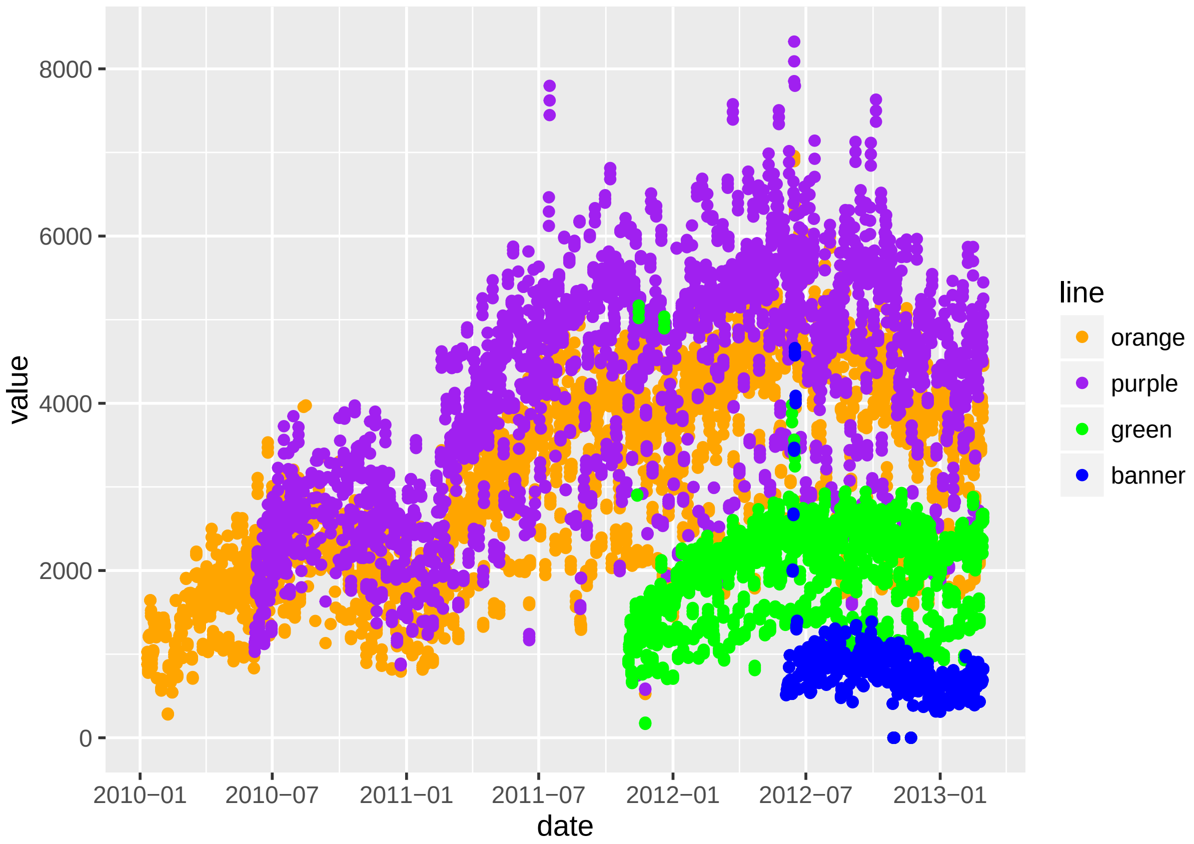
```r
require(ggplot2)
```

```
## Loading required package: ggplot2

## Warning: package 'ggplot2' was built under R version 3.2.3
```

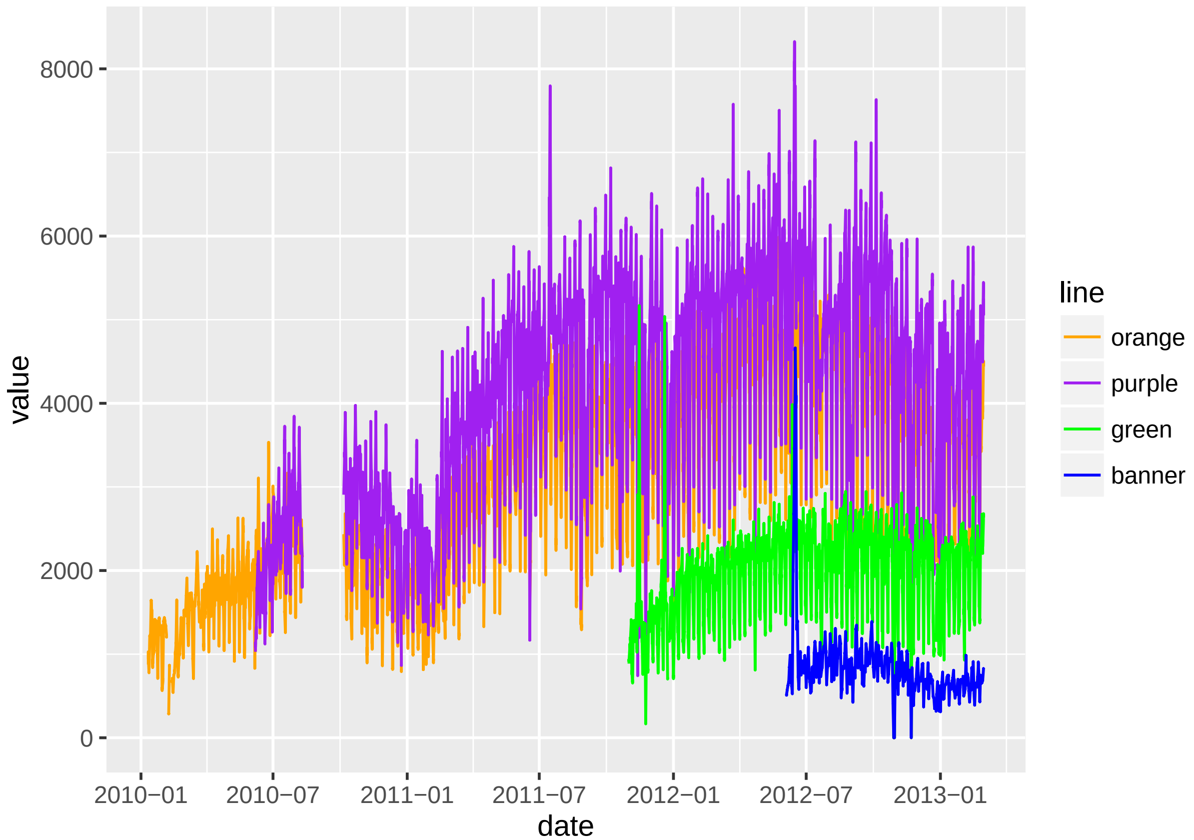
```r
### let's make a "ggplot"
### the format is ggplot(dataframe, aes(x=COLNAME, y=COLNAME))
### where COLNAME are colnames of the dataframe
### you can also set color to a different factor
### other options in AES (fill, alpha level -which is the "transparency" of points)
g <- ggplot(long.charm, aes(x=date, y=value, color=line))
### let's change the colors to what we want- doing this manually, not letting it choose
### for me
g <- g + scale_color_manual(values=c("orange", "purple", "green", "blue"))
### plotting points
g + geom_point()
```

```
## Warning: Removed 5328 rows containing missing values (geom_point).
```



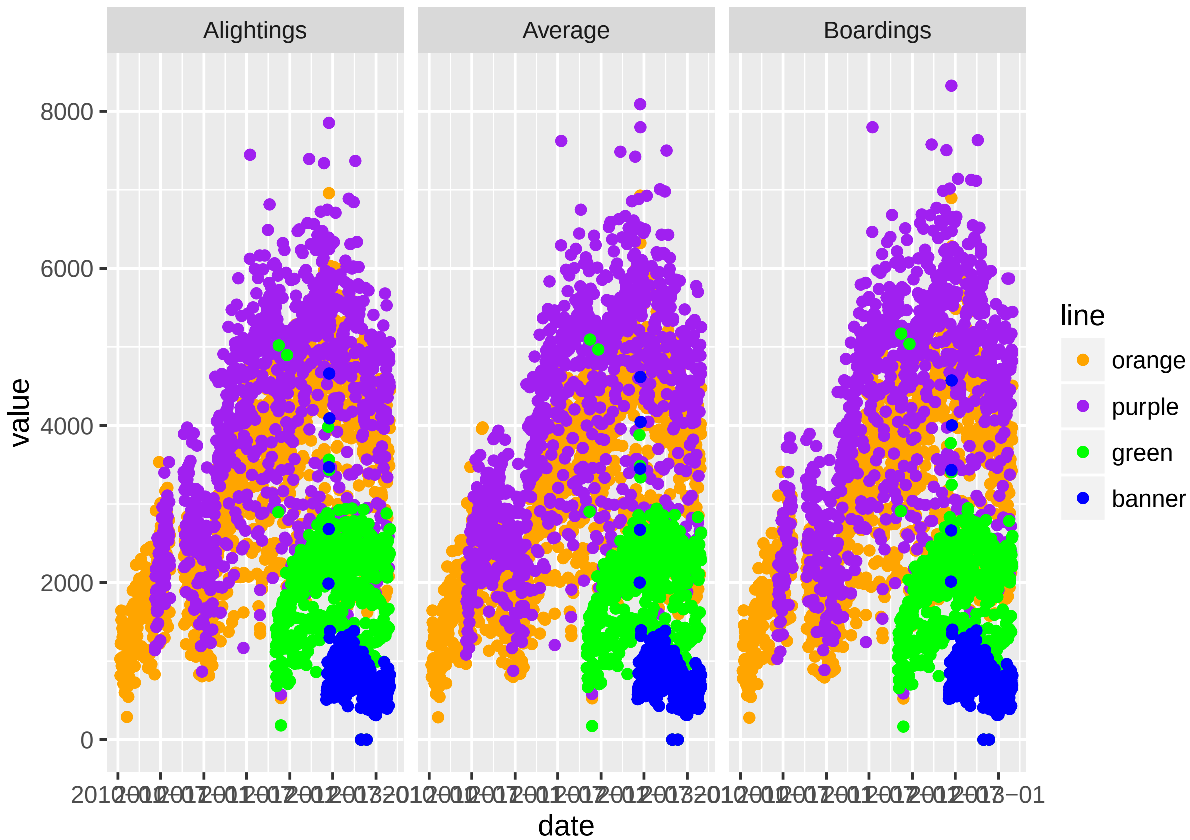

```
### Let's make Lines!
g + geom_line()
```

```
## Warning: Removed 5043 rows containing missing values (geom_path).
```



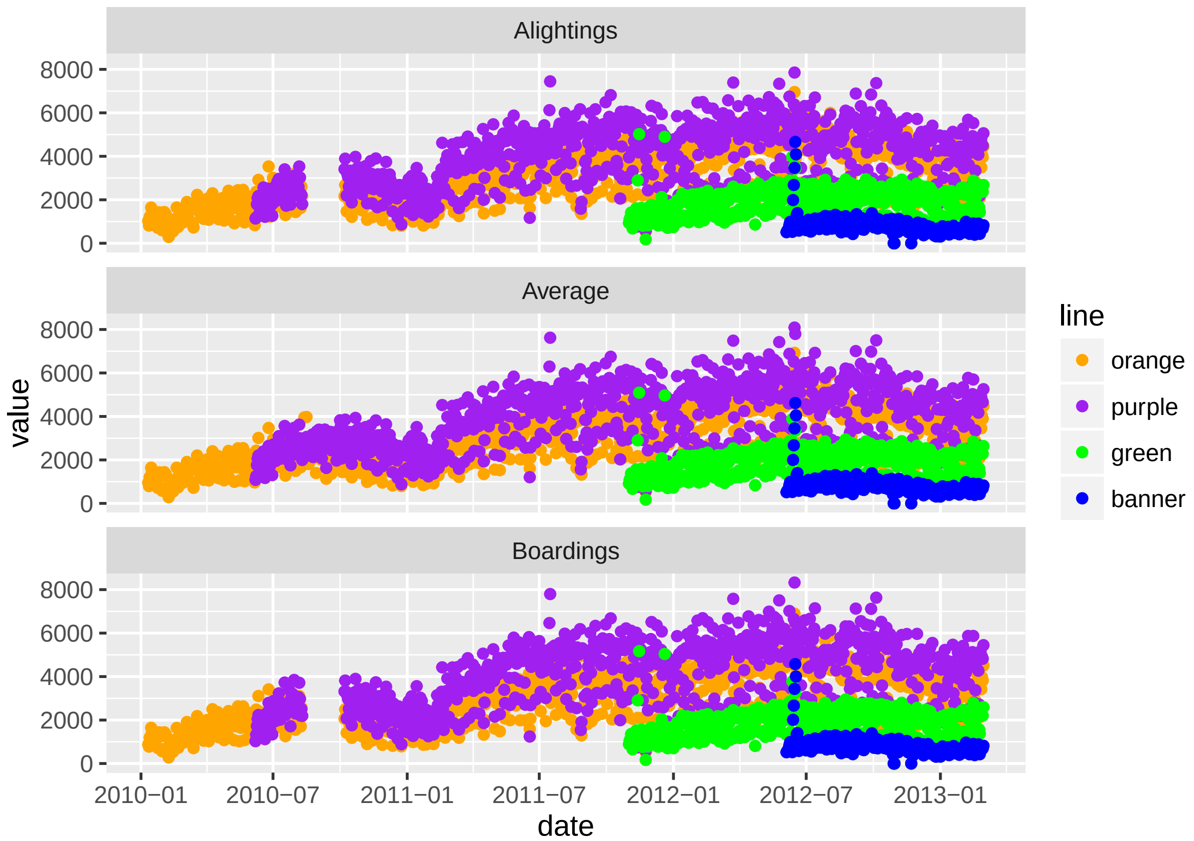

```
### let's make a new plot of poitns
gpoint <- g + geom_point()
### let's plot the value by the type of value - boardings/average, etc
gpoint + facet_wrap(~ type)
```

```
## Warning: Removed 5328 rows containing missing values (geom_point).
```



OK let's turn off some warnings - making `warning=FALSE` (in knitr) as an option.

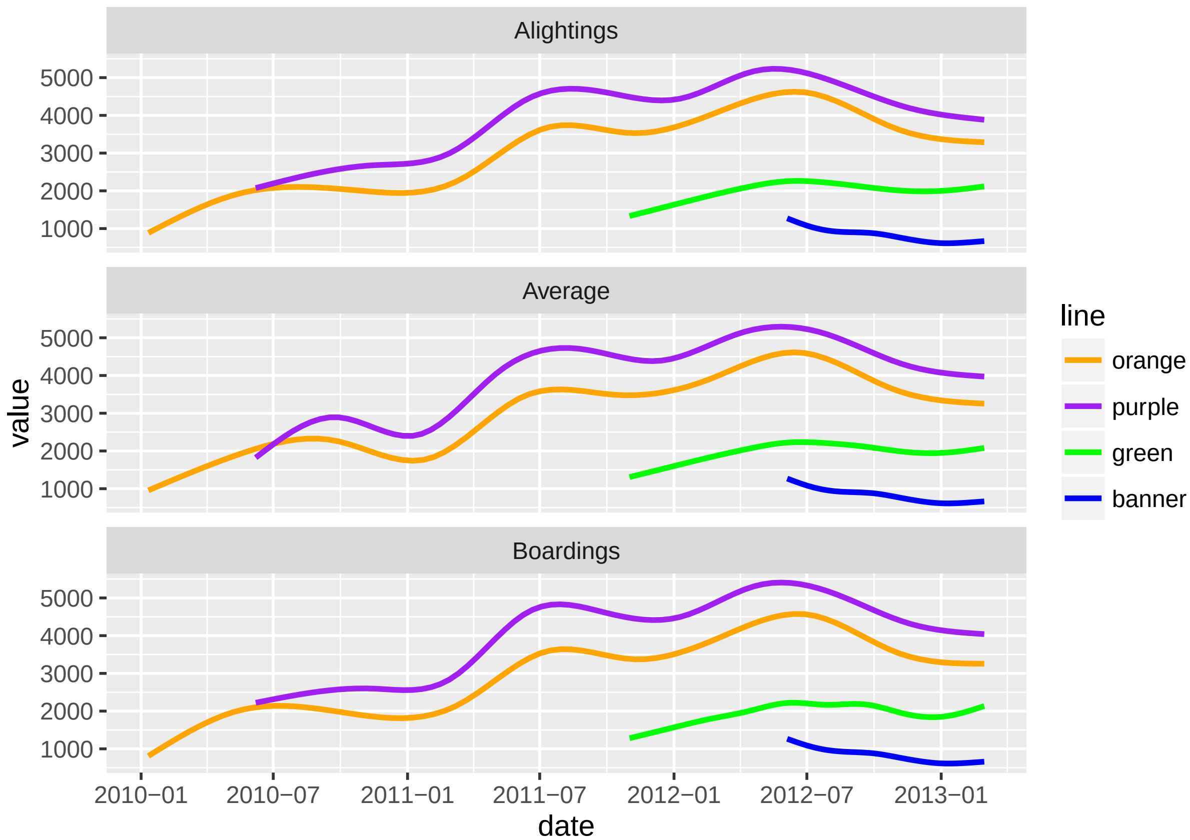
```
## let's compare vertically
gpoint + facet_wrap(~ type, ncol=1)
```

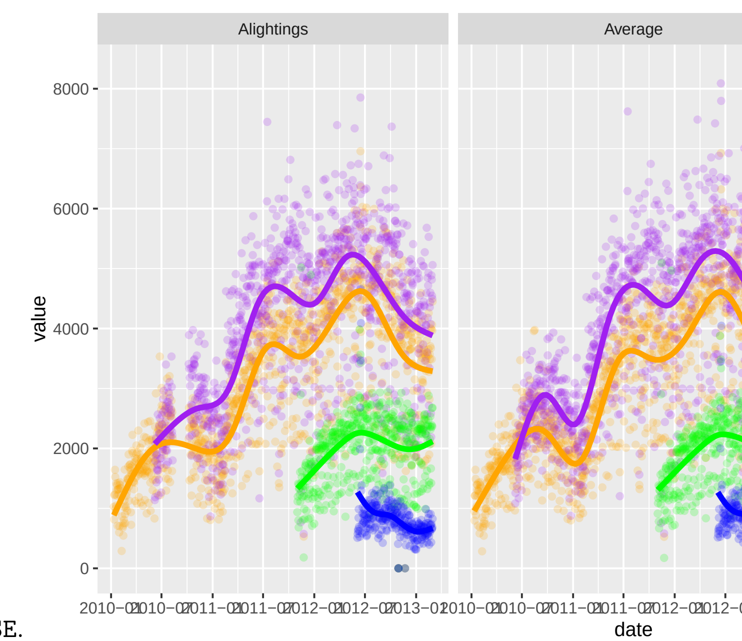



```
gfacet = g + facet_wrap(~ type, ncol=1)
```

We can also smooth the data to give us a overall idea of how the average changes over time. I don't want to do a standard error (se).

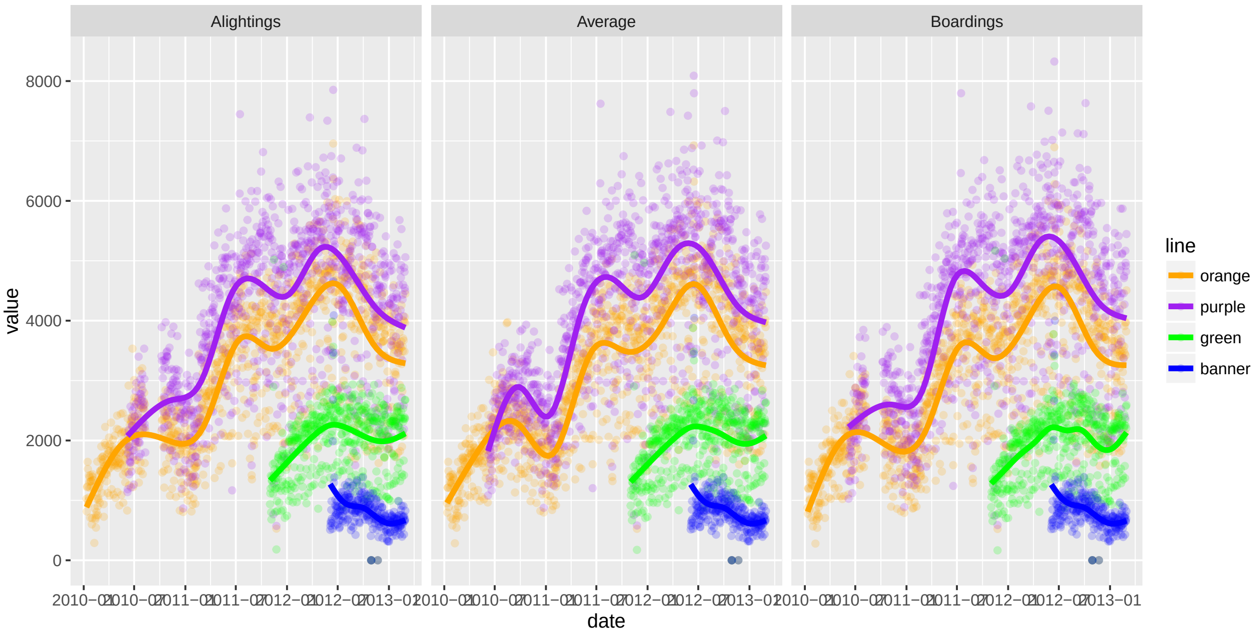
```
## let's smooth this - get a rough estimate of what's going on
gfacet + geom_smooth(se=FALSE)
```





OK, I've seen enough code, let's turn that off, using `echo=FALSE`.

There are still messages, but we can turn these off with `message = FALSE`



Alightings
Average
Boardings
value
8000
6000
4000
2000
0
date
line
orange
purple
green
banner