Module 7

Data Summarization

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Data Summarization

Basic statistical summarization

- `mean(x)`: takes the mean of x
- `sd(x)`: takes the standard deviation of x
- `median(x)`: takes the median of x
- `quantile(x)`: displays sample quantities of x. Default is min, IQR, max
- `range(x)`: displays the range. Same as c(min(x), max(x))

Basic summarization plots

- `plot(x,y)`: scatterplot of x and y
- `boxplot(y~x)`: boxplot of y against levels of x
- `hist(x)`: histogram of x
- `density(X)`: kernel density plot of x

Data Summarization on matrices/data frames

- Basic statistical summarization
  - `rowMeans(x)`: takes the means of each row of x
  - `colMeans(x)`: takes the means of each column of x
  - `rowSums(x)`: takes the sum of each row of x
  - `colSums(x)`: takes the sum of each column of x
  - `summary(x)`: for data frames, displays the quantile information
- Basic summarization plots
  - `matplot(x,y)`: scatterplot of two matrices, x and y
  - `pairs(x,y)`: plots pairwise scatter plots of matrices x and y, column by column

column and row means

```
> dat = read.csv("data/charmcitycirc_reduced.csv", header=T,as.is=T)
> dat2 = dat[,c("day","date", "orangeAverage","purpleAverage","greenAverage",
+                  "bannerAverage","daily")]
> tmp = dat2[,3:6]
> colMeans(tmp,na.rm=TRUE)
```

```
orangeAverage purpleAverage  greenAverage bannerAverage 
       3033.2        4016.9        1957.8         827.3 
```

```
> head(rowMeans(tmp,na.rm=TRUE))
```

```
[1]  952  796 1212 1214 1644 1490
```

Summary

```
> summary(dat2)
```

```
     day                date           orangeAverage   purpleAverage
 Length:1146        Length:1146        Min.   :   0   Min.   :   0
 Class :character   Class :character   1st Qu.:2001   1st Qu.:2795
 Mode  :character   Mode  :character   Median :2968   Median :4222
                                       Mean   :3033   Mean   :4017
                                       3rd Qu.:4020   3rd Qu.:5147
                                       Max.   :6926   Max.   :8090
                                       NA's   :10     NA's   :153
  greenAverage  bannerAverage      daily
 Min.   :   0   Min.   :   0   Min.   :    0
 1st Qu.:1491   1st Qu.: 632   1st Qu.: 4293
 Median :2079   Median : 763   Median : 6702
 Mean   :1958   Mean   : 827   Mean   : 7233
 3rd Qu.:2340   3rd Qu.: 946   3rd Qu.:10501
 Max.   :5094   Max.   :4617   Max.   :22074
 NA's   :661    NA's   :876    NA's   :124
```

Apply statements

You can apply more general functions to the rows or columns of a matrix or data frame, beyond the mean and sum.

```
apply(X, MARGIN, FUN, ...)
```

X : an array, including a matrix.

MARGIN : a vector giving the subscripts which the function will be applied over. E.g., for a matrix 1 indicates rows, 2 indicates columns, c(1, 2) indicates rows and columns. Where X has named dimnames, it can be a character vector selecting dimension names.

FUN : the function to be applied: see 'Details'.

: optional arguments to FUN.

Apply statements

```
> tmp = dat2[,3:6]
> apply(tmp,2,mean,na.rm=TRUE) # column means
```

```
orangeAverage purpleAverage  greenAverage bannerAverage 
       3033.2        4016.9        1957.8         827.3 
```

```
> apply(tmp,2,sd,na.rm=TRUE) # columns sds
```

```
orangeAverage purpleAverage  greenAverage bannerAverage 
       1227.6        1406.7         592.9         436.0 
```

```
> apply(tmp,2,max,na.rm=TRUE) # column maxs
```

```
orangeAverage purpleAverage  greenAverage bannerAverage 
         6926          8090          5094          4617 
```

Other Apply Statements

- `tapply()`: 'table' apply
- `lapply()`: 'list' apply [tomorrow]
- `sapply()`: 'simple' apply [tomorrow]
- Other less used ones...

See more details here: http://nsaunders.wordpress.com/2010/08/20/a-brief-introduction-to-apply-in-r/

`tapply()`

From the help file: "Apply a function to each cell of a ragged array, that is to each (non-empty) group of values given by a unique combination of the levels of certain factors."

```
tapply(X, INDEX, FUN = NULL, ..., simplify = TRUE)
```

Simply put, you can apply function `FUN` to `X` within each categorical level of `INDEX`. It is very useful for assessing properties of continuous data by levels of categorical data.

`tapply()`

For example, we can estimate the highest average daily ridership for each day of the week in 1 line in the Circulator dataset.

```
> tapply(dat$daily, dat$day, max, na.rm=TRUE)
```

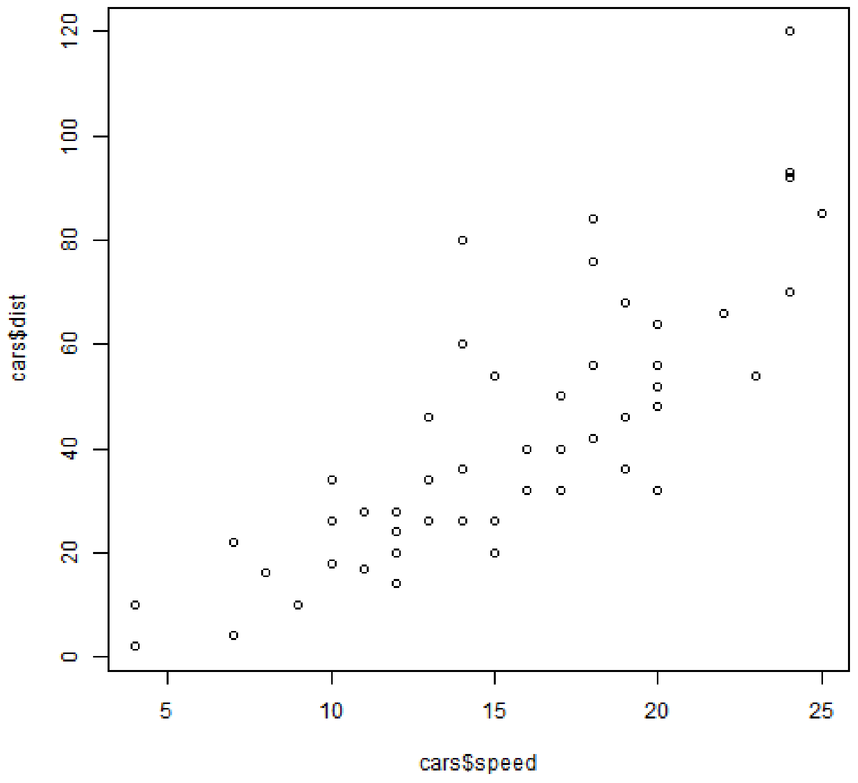
```
   Friday    Monday  Saturday    Sunday  Thursday   Tuesday Wednesday 
    21951     13982     22075     15224     17580     14776     15672 
```

Basic Plots

Plotting is an important component of exploratory data analysis. We will review some of the more useful and informative plots here. We will go over formatting and making plots look nicer in additional lectures.

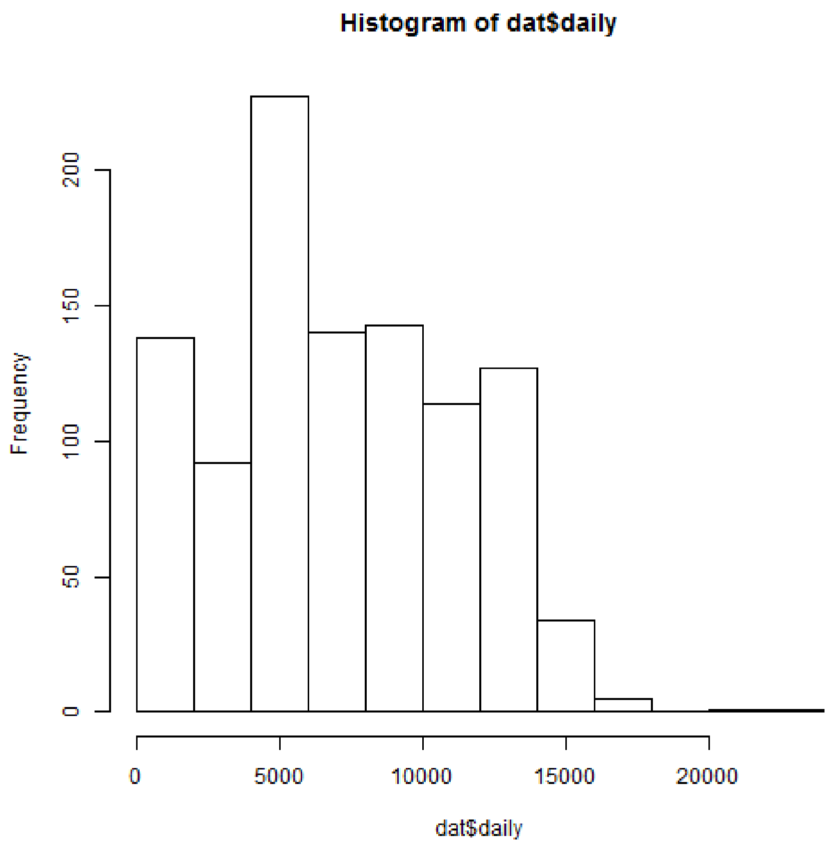
Scatterplot

```
> data(cars)
> plot(cars$speed, cars$dist)
```



Histograms

```
> hist(dat$daily)
```

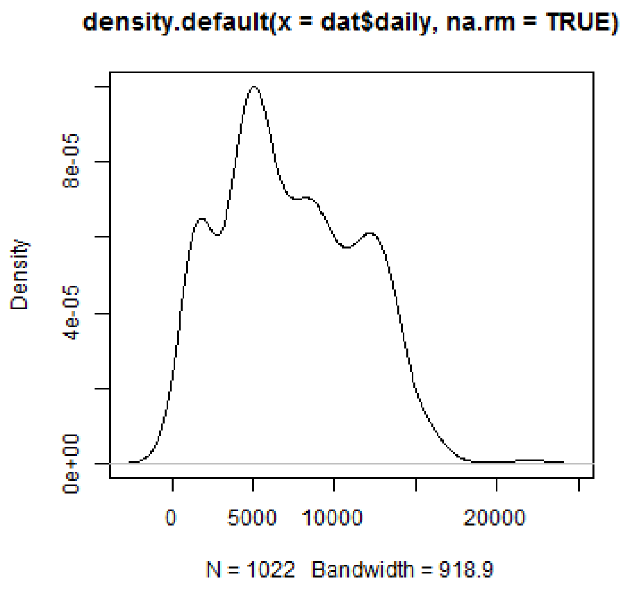


Density

```
> plot(density(dat$daily))
```

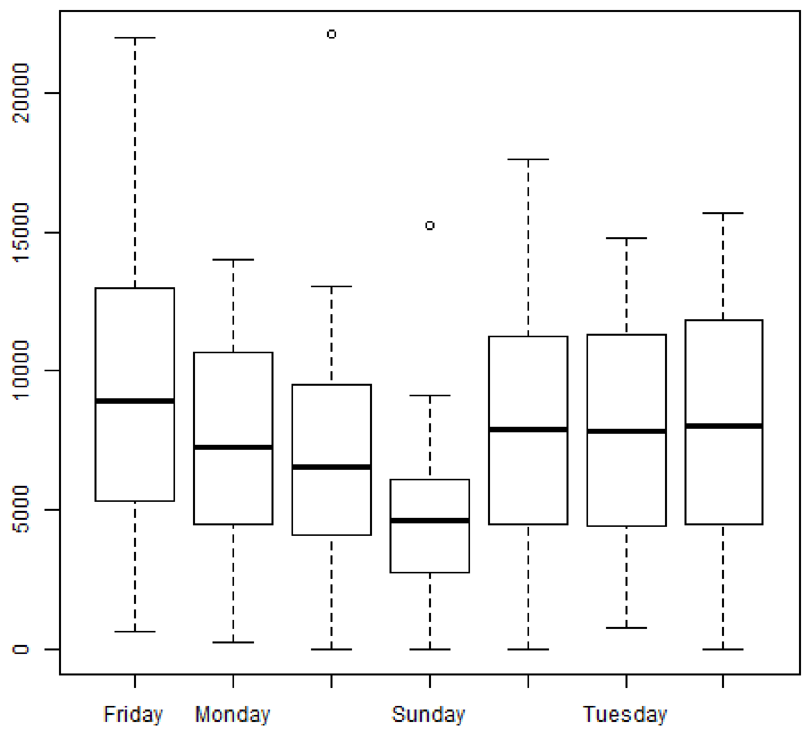
```
Error: 'x' contains missing values
```

```
> plot(density(dat$daily,na.rm=TRUE))
```



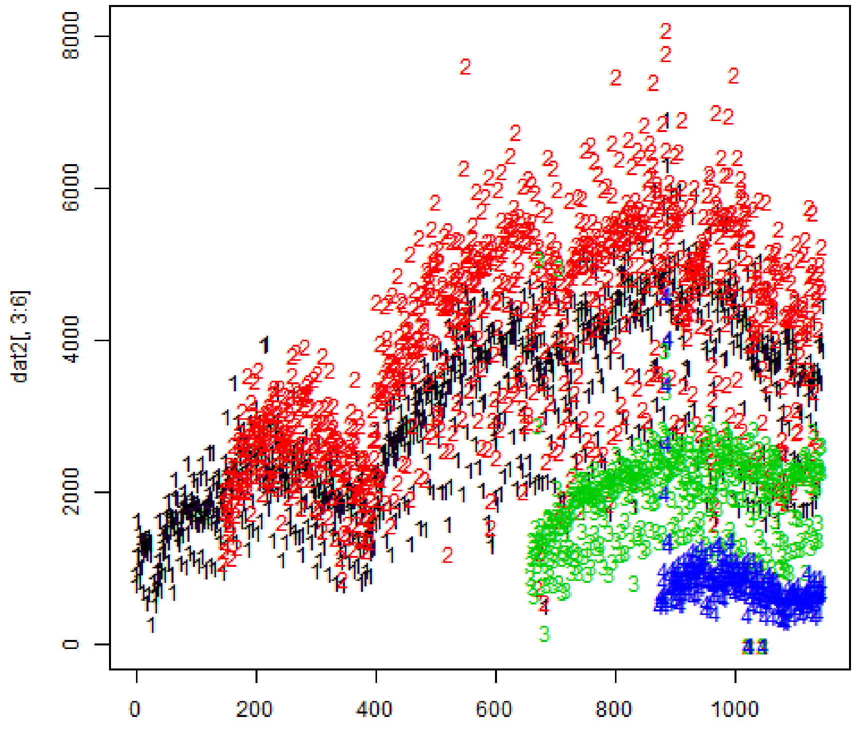
Boxplots

```
> boxplot(dat$daily ~ dat$day)
```



Matrix plot

```
> matplot(dat2[,3:6])
```


dat2[, 3:6]