Exploratory Data Analysis

Part 2: Multivariate graphics + summary statistics

Math 445, Spring 2017

Plotting multiple variables

Basic bivariate graphics

Variable type	Plot suggestions
Quantitative vs. quantitative	Scatterplot
Quantitative vs. categorical	Side-by-side boxplots Facetted histograms/densities

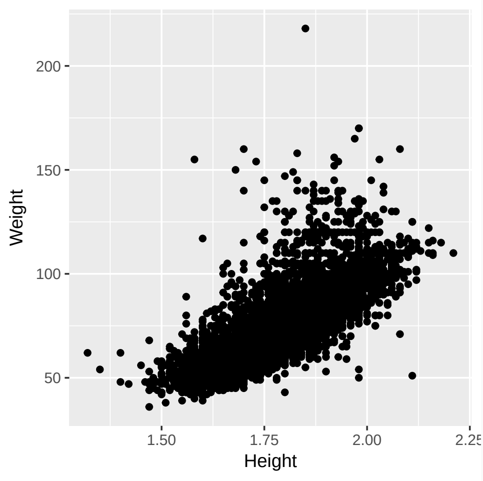
Data: 2012 Olympic Athletes

```
oly12 <- read.table("https://raw.githubusercontent.com/math445-LU/2016/master/data/oly12.cs
    sep = ",", header = TRUE)
oly12$Sport <- abbreviate(oly12$Sport, 12)
str(oly12)
```

```
## 'data.frame': 10384 obs. of  14 variables:
##  $ Name   : Factor w/ 10366 levels "Aaron Brown",..: 5353 121 4117 16 6033 5686 6061 676
##  $ Country: Factor w/ 205 levels "Afghanistan",..: 144 195 68 125 154 68 8 125 94 3 ...
##  $ Age    : int  23 33 30 24 26 27 30 23 27 19 ...
##  $ Height : num  1.7 1.93 1.87 NA 1.78 1.82 1.82 1.87 1.9 1.7 ...
##  $ Weight : int  60 125 76 NA 85 80 73 75 80 NA ...
##  $ Sex    : Factor w/ 2 levels "F","M": 2 2 2 2 1 2 1 2 2 2 ...
##  $ DOB    : Date, format: "1989-02-06" NA ...
##  $ PlaceOB: Factor w/ 4108 levels "","Aachen (GER)",..: 2486 3302 398 48 3436 1 1 1 117
##  $ Gold   : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ Silver : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ Bronze : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ Total  : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ Sport  : chr  "Judo" "Athletics" "Athletics" "Boxing" ...
##  $ Event  : Factor w/ 763 levels "Group All-Around",..: 350 405 251 443 699 406 726 403
```

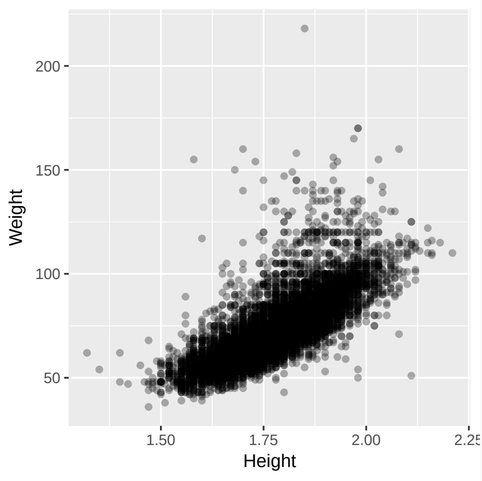
Scatterplots

```
ggplot(data = oly12, mapping = aes(x = Height, y = Weight)) +
  geom_point()
```



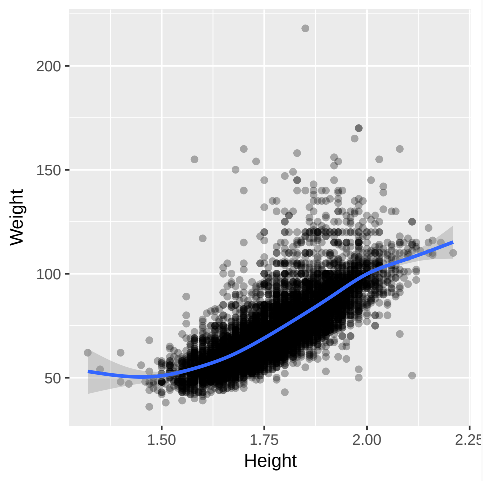
Scatterplots + Alpha Blending

```
ggplot(data = oly12, mapping = aes(x = Height, y = Weight)) +
 geom_point(alpha = 0.3)
```



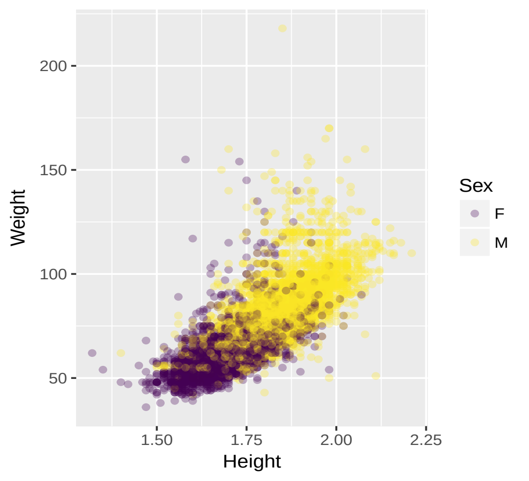
Scatterplots + Smoother

```
ggplot(data = oly12, mapping = aes(x = Height, y = Weight)) +
 geom_point(alpha = 0.3) +
 geom_smooth()
```



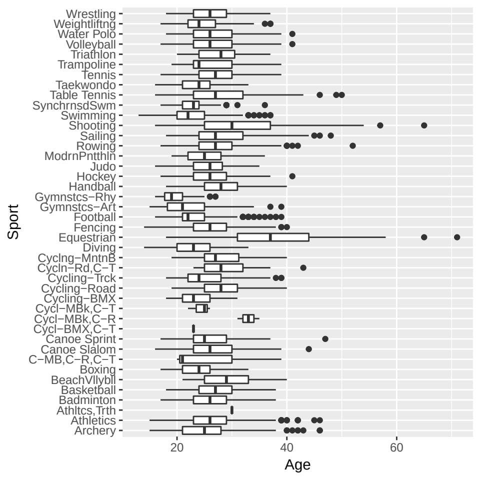
Scatterplots with extra variables

```
library(viridis)
ggplot(data = oly12, mapping = aes(x = Height, y = Weight, color = Sex)) +
  geom_point(alpha = 0.3) +
  scale_color_viridis(discrete = TRUE)
```



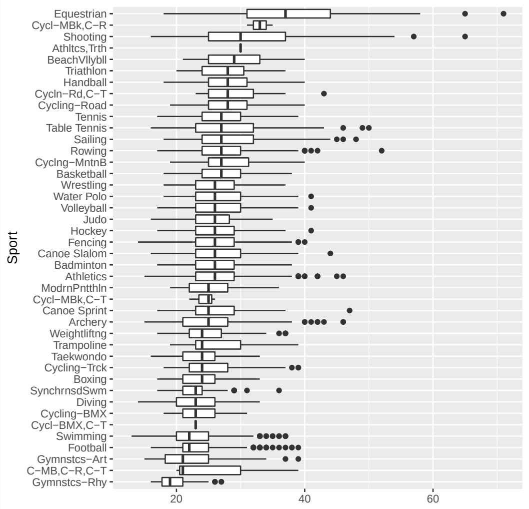
Side-by-side boxplots

```
ggplot(data = oly12, mapping = aes(x = Sport, y = Age)) +
  geom_boxplot() +
  coord_flip()
```



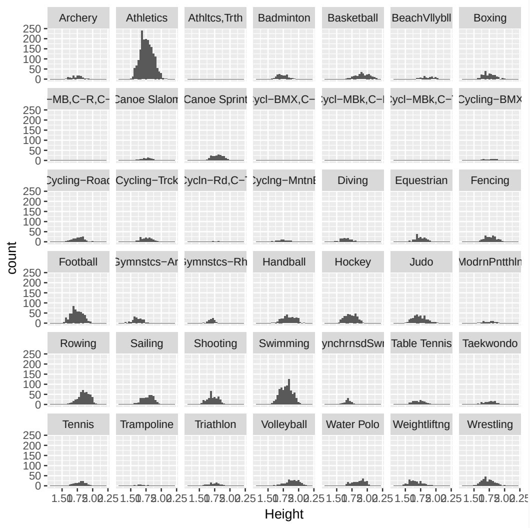
Side-by-side boxplots

```
ggplot(data = oly12, mapping = aes(x = reorder(Sport, Age, median), y = Age)) +
  geom_boxplot() +
  coord_flip() +
  labs(x = "Sport")
```



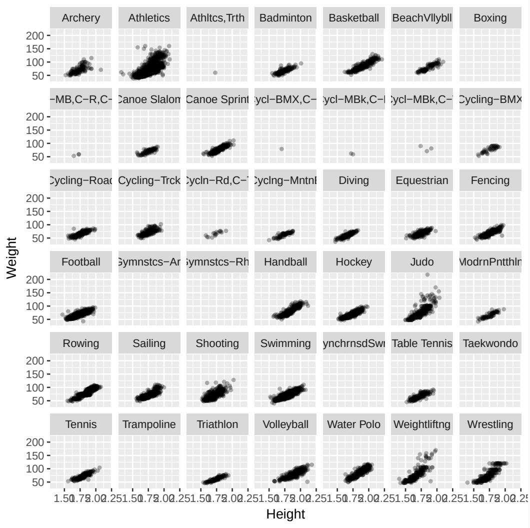
Facetting

```
ggplot(data = oly12, mapping = aes(x = Height)) +
  geom_histogram() +
  facet_wrap(~ Sport)
```



Facetting

```
ggplot(data = oly12, mapping = aes(x = Height, y = Weight)) +
  geom_point(size = 1, alpha = 0.3) +
  facet_wrap(~ Sport)
```



Summarizing data numerically

Univariate summaries

A common way to summarize a variable is to extract the column from the data frame and deal with it separately.

```
mean(oly12$Age)

## [1] 26.06886

median(oly12$Age)

## [1] 25

sd(oly12$Age)

## [1] 5.440561
```

```
var(oly12$Age)

## [1] 29.59971

quantile(oly12$Age, probs = c(0.2, 0.4, 0.6, 0.8))

## 20% 40% 60% 80%
##  22  24  27  30
```

Summaries by group

To obtain summaries by group we can use functionality found in the dplyr package:

```
# install.packages('dplyr') # uncomment if not installed
library(dplyr)
```

In addition to groupwise processing, dplyr provides chaining syntax:

```
# Regular (i.e. function application) syntax
object_name <- function_name(data = data_table, arguments)

# Chaining syntax
object_name <-
  data_table %>%
  function_name(arguments)
```

Summaries by group

Suppose that we are interested in calculating the average age of 2012 Olympic athletes by sport:

```
age_sport <-
  oly12 %>%
  group_by(Sport) %>%
  summarize(avgAge = mean(Age))

head(age_sport)
```

```
## # A tibble: 6  2
##          Sport   avgAge
##          <chr>    <dbl>
## 1      Archery 26.07438
## 2    Athletics 26.17131
## 3 Athltcs,Trth 30.00000
## 4    Badminton 26.15663
## 5   Basketball 27.17844
## 6 BeachVllybll 29.18280
```

Summaries by group

We can also quickly obtain the medal count by country:

```
medal_count <-
  oly12 %>%
  group_by(Country) %>%
  summarize(Gold = sum(Gold), Silver = sum(Silver), Bronze = sum(Bronze)) %>%
  arrange(desc(Gold), desc(Silver), desc(Bronze))

head(medal_count)
```

```
## # A tibble: 6  4
##                      Country  Gold Silver Bronze
##                       <fctr> <int>  <int>  <int>
## 1   United States of America    40     19     20
## 2 People's Republic of China    25     15     13
## 3                    Germany    21     11      8
## 4              Great Britain    11     13     20
## 5                     France    11     11     11
## 6          Republic of Korea    10      2     10
```

Subsetting

What if you only want summaries for one group?

- Create the summaries for all of the groups and then extract the group of interest
- Extract data for the group of interest and then create summaries

The `filter` command in the `dplyr` package allows you to easily subset a data frame:

```
filter(data, criteria)
```

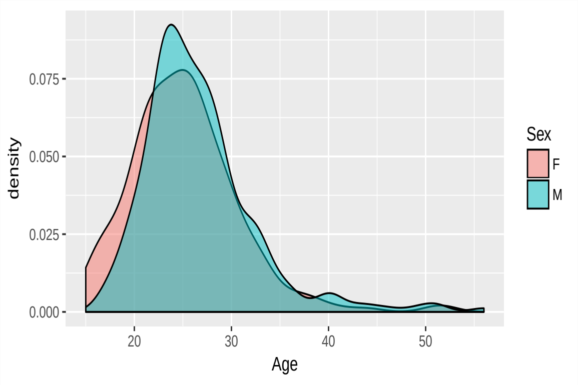
Subsetting

```
oly12 %>%
  filter(Country == "United States of America") %>%
  group_by(Sex) %>%
  summarize(avgAge = mean(Age))
```

```
## # A tibble: 2  2
##      Sex   avgAge
##   <fctr>    <dbl>
## 1      F 26.44528
## 2      M 27.73123
```

Subsetting

```r
oly12 %>%
  filter(Gold > 0 | Silver > 0 | Bronze > 0) %>%
  ggplot(mapping = aes(x = Age, group = Sex, fill = Sex)) +
  geom_density(alpha = 0.5)
```


density
Age
Sex
F
M