Graphics in R: `ggplot2`

a **statsTeachR** resource

Let there be data....

```
library(NHANES)
str(NHANES)

## 'data.frame': 31126 obs. of  32 variables:
##  $ seqn      : num  1 2 3 4 5 6 7 8 9 10 ...
##  $ sex       : Factor w/ 2 levels "male","female": 2 1 2 1 1 2 2 1 2 1 ...
##  $ age       : num  2 77 10 1 49 19 59 13 11 43 ...
##  $ pregnant  : Factor w/ 2 levels "yes","no": 2 2 2 2 2 2 2 2 2 2 ...
##  $ ethnicity : Factor w/ 5 levels "Mexican American",..: 4 3 3 4 3 5 4 3 4 4
##  $ death     : Factor w/ 3 levels "alive","other",..: NA 1 NA NA 1 1 1 NA NA
##  $ followup  : num  NA 90 NA NA 74 86 76 NA NA 79 ...
##  $ smoker    : Factor w/ 2 levels "yes","no": 2 2 2 2 1 2 2 2 2 2 ...
##  $ diabetic  : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ height    : num  0.916 1.74 1.366 NA 1.783 ...
##  $ weight    : num  12.5 75.4 32.9 13.3 92.5 ...
##  $ waist     : num  0.457 0.98 0.647 NA 0.999 0.816 0.907 0.641 0.646 1.08 .
##  $ wci       : num  0.0789 0.0871 0.0817 NA 0.0791 ...
##  $ bmi       : num  14.9 24.9 17.6 NA 29.1 ...
##  $ ptfat     : num  NA 14.3 NA NA 16.5 ...
##  $ tfat      : num  NA 10.8 NA NA 15.2 ...
##  $ lfat      : num  NA 11.4 NA NA 12.7 ...
##  $ llean     : num  NA 22 NA NA 28.6 ...
##  $ lbmi      : num  NA 162935 NA NA 194415 ...
##  $ fbmi      : num  NA 77162 NA NA 91899 ...
##  $ bbmi      : num  NA 9009 NA NA 8134 ...
```

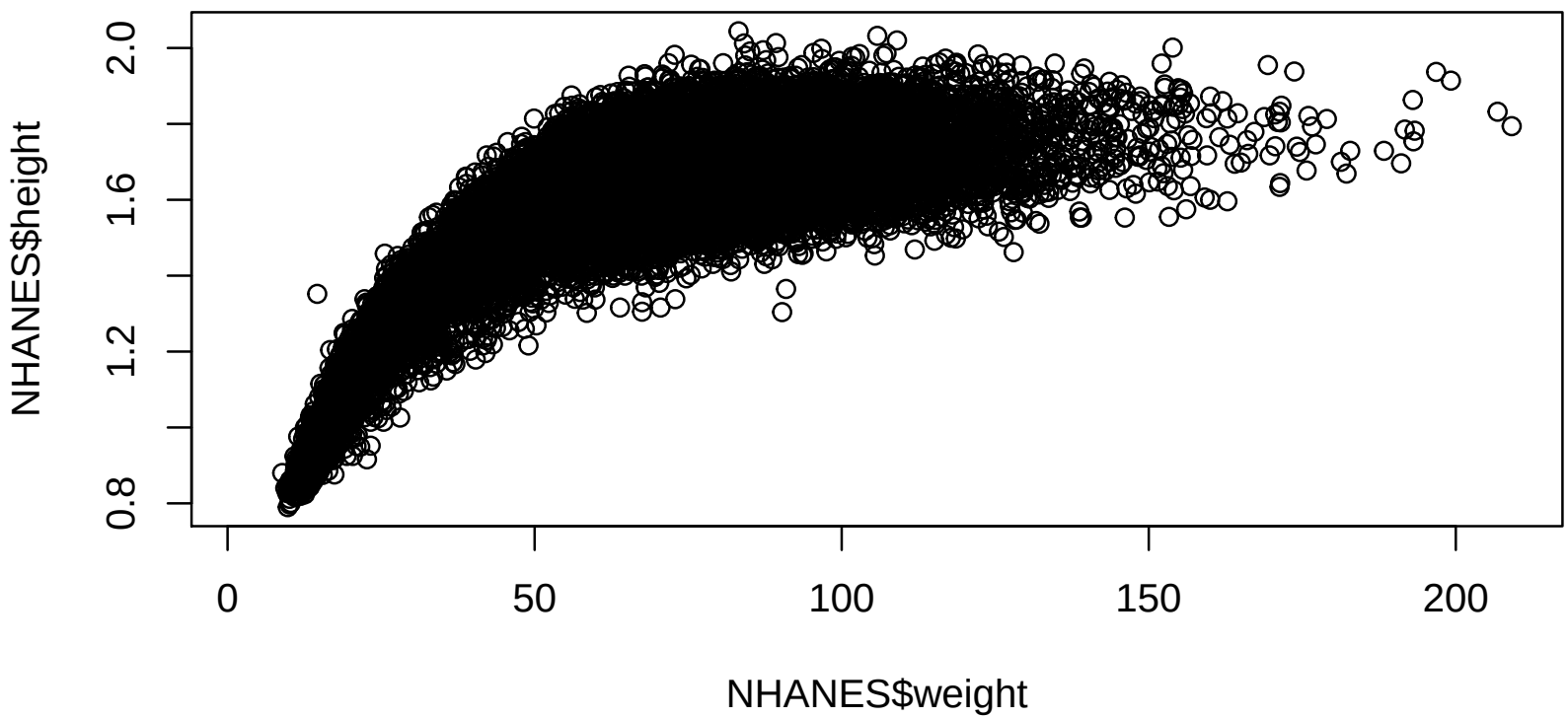
Graphics in R

You have three central choices for making graphics in R

- "Base graphics"
- ggplot2
- lattice

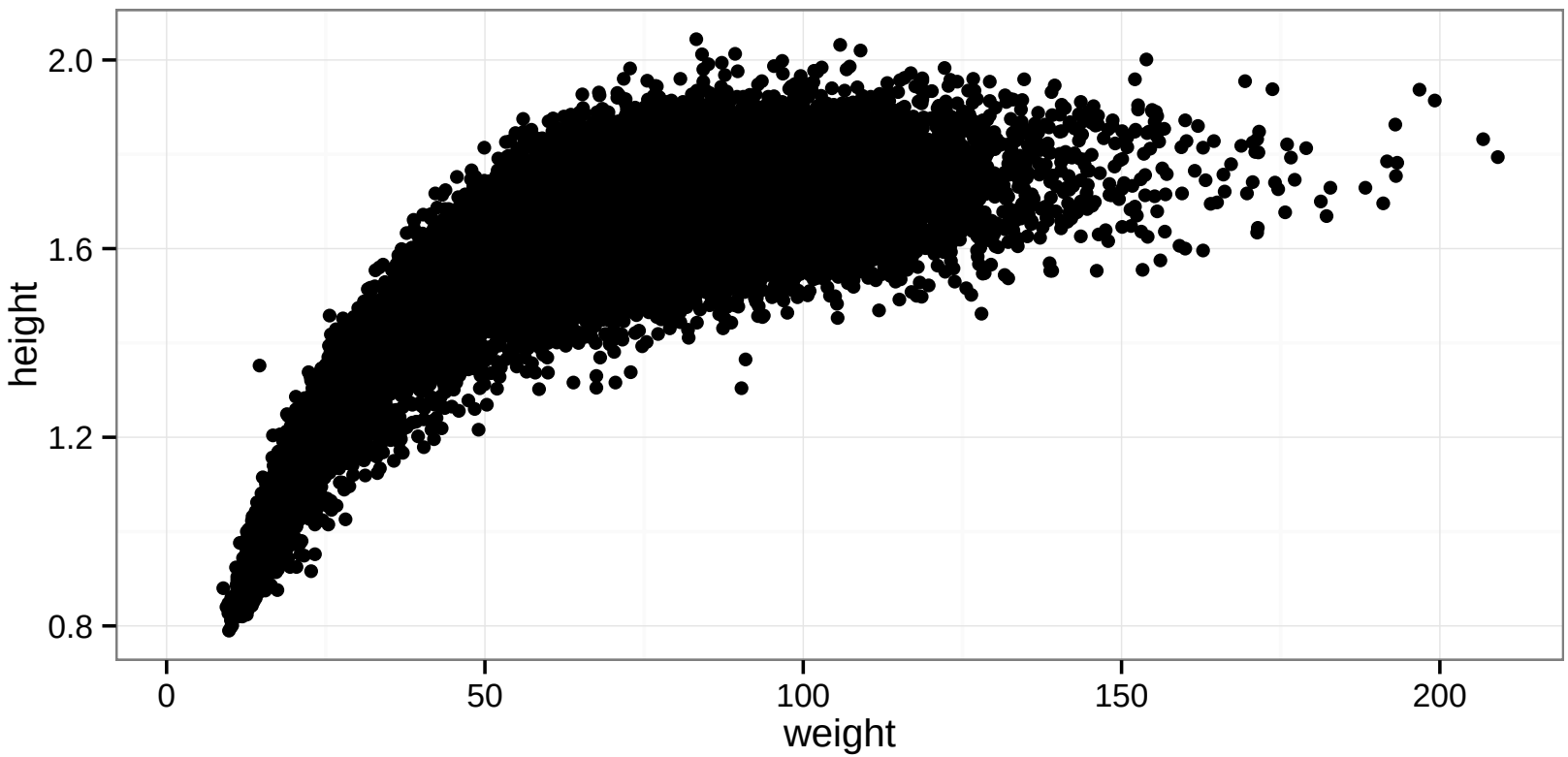
Graphics in R: Base graphics

```
plot(NHANES$weight, NHANES$height)
```



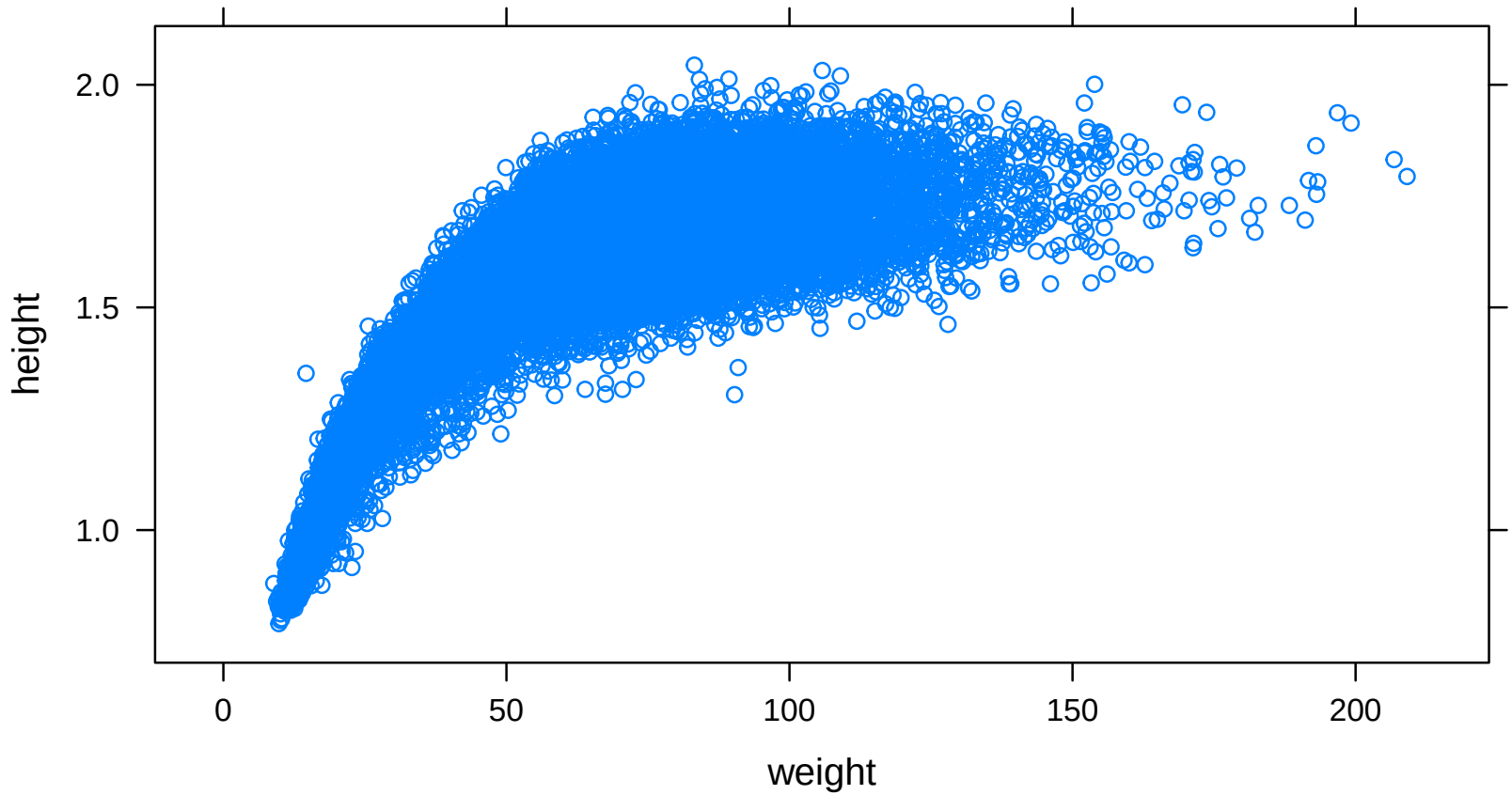
A simple ggplot2 graphic

```
library(ggplot2)
qplot(weight, height, data=NHANES)
```



A simple `lattice` graphic

```
library(lattice)
xyplot(height ~ weight, data=NHANES)
```



The mosaic package can translate between them

```
library(mosaic)
mplot(NHANES)
```

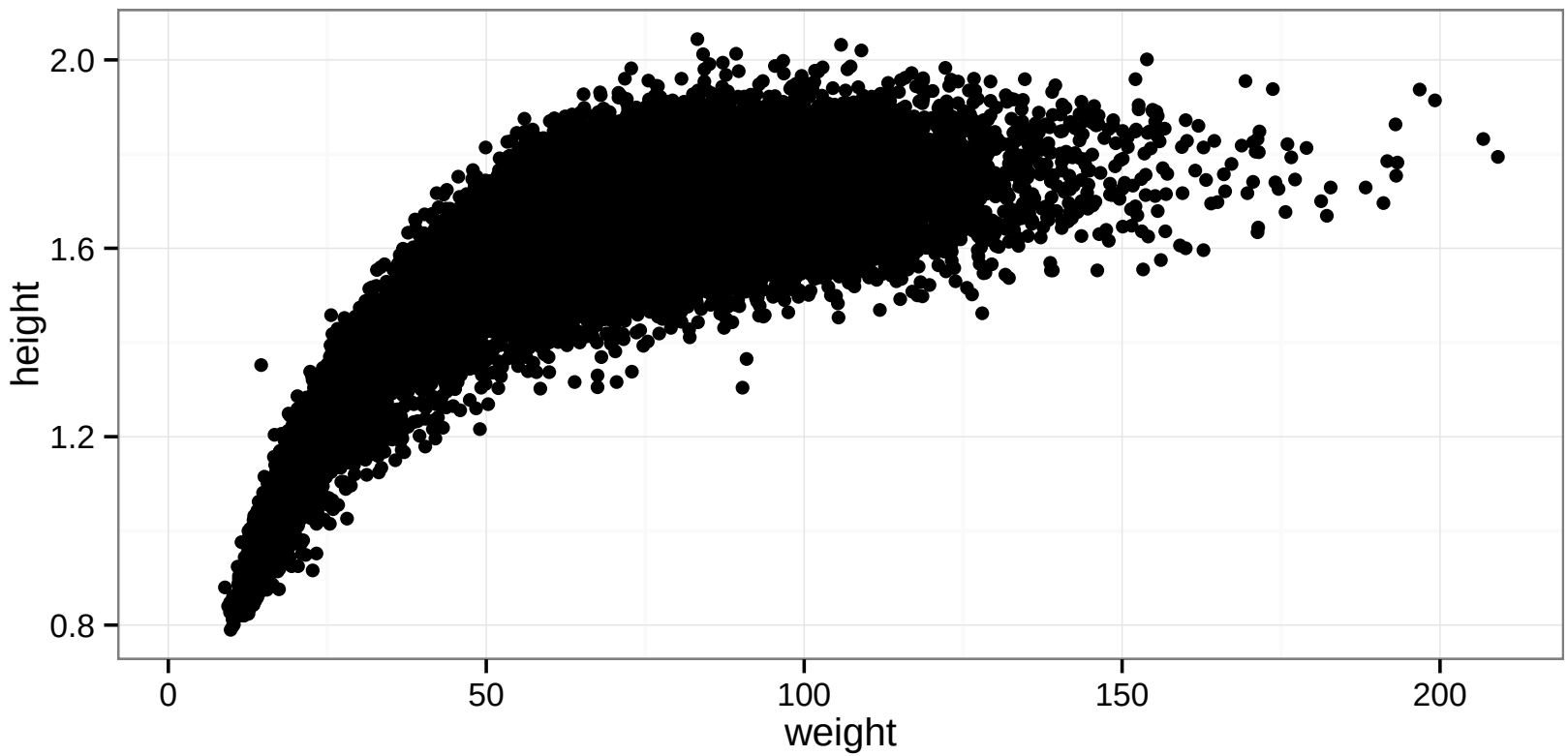
`mplot()` loads a very nice graphical user interface for creating graphics, and spits out the code for ggplot or lattice graphics. Try it out! Practice saving a graphic from RStudio.

Why I use `ggplot2`

- "easy" to create both simple and complex graphics
- unified syntax
- attractive defaults (except for colors)
- actively developed and improved

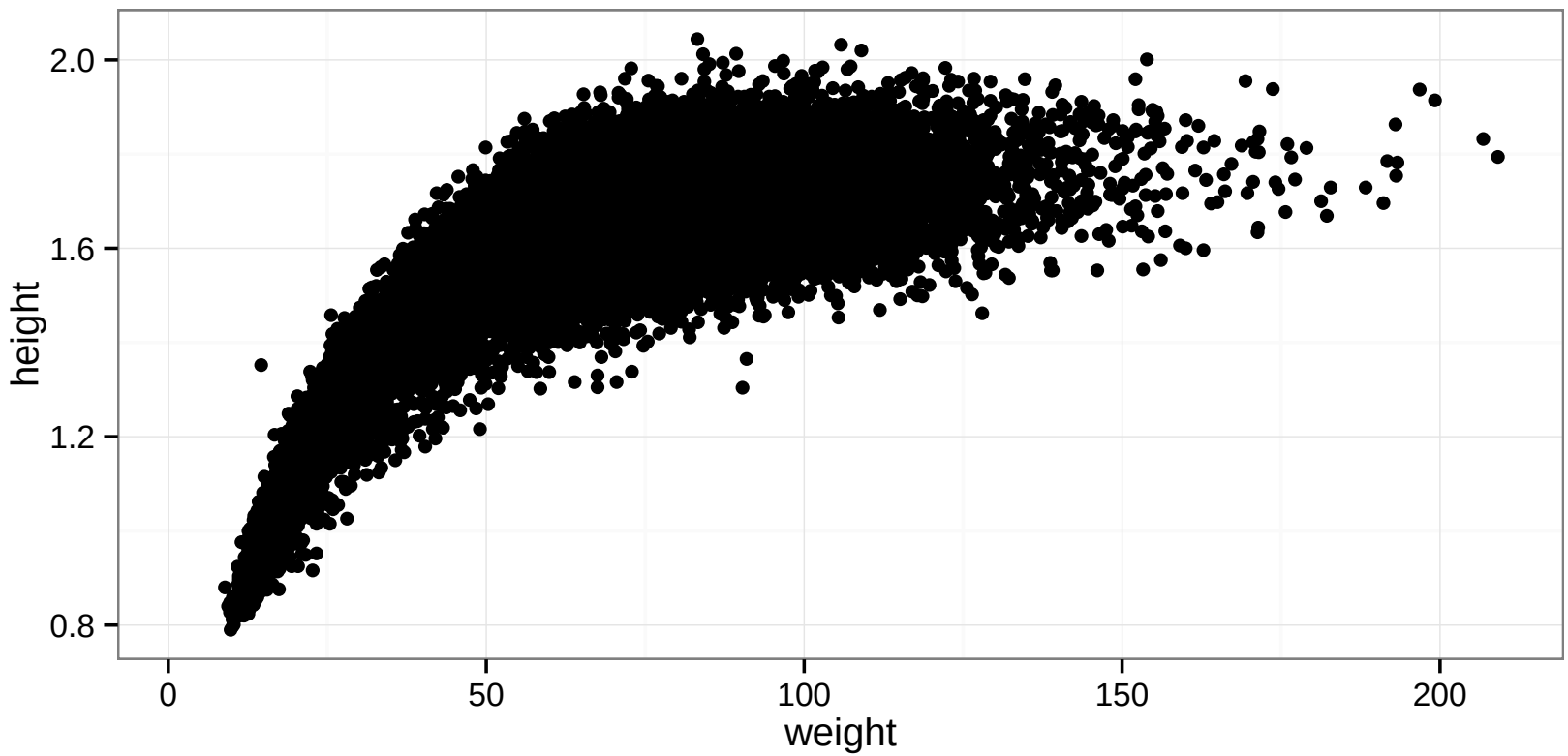
Quick tour of ggplot2 syntax

```
## defaults to scatterplot
qplot(weight, height, data=NHANES)
```



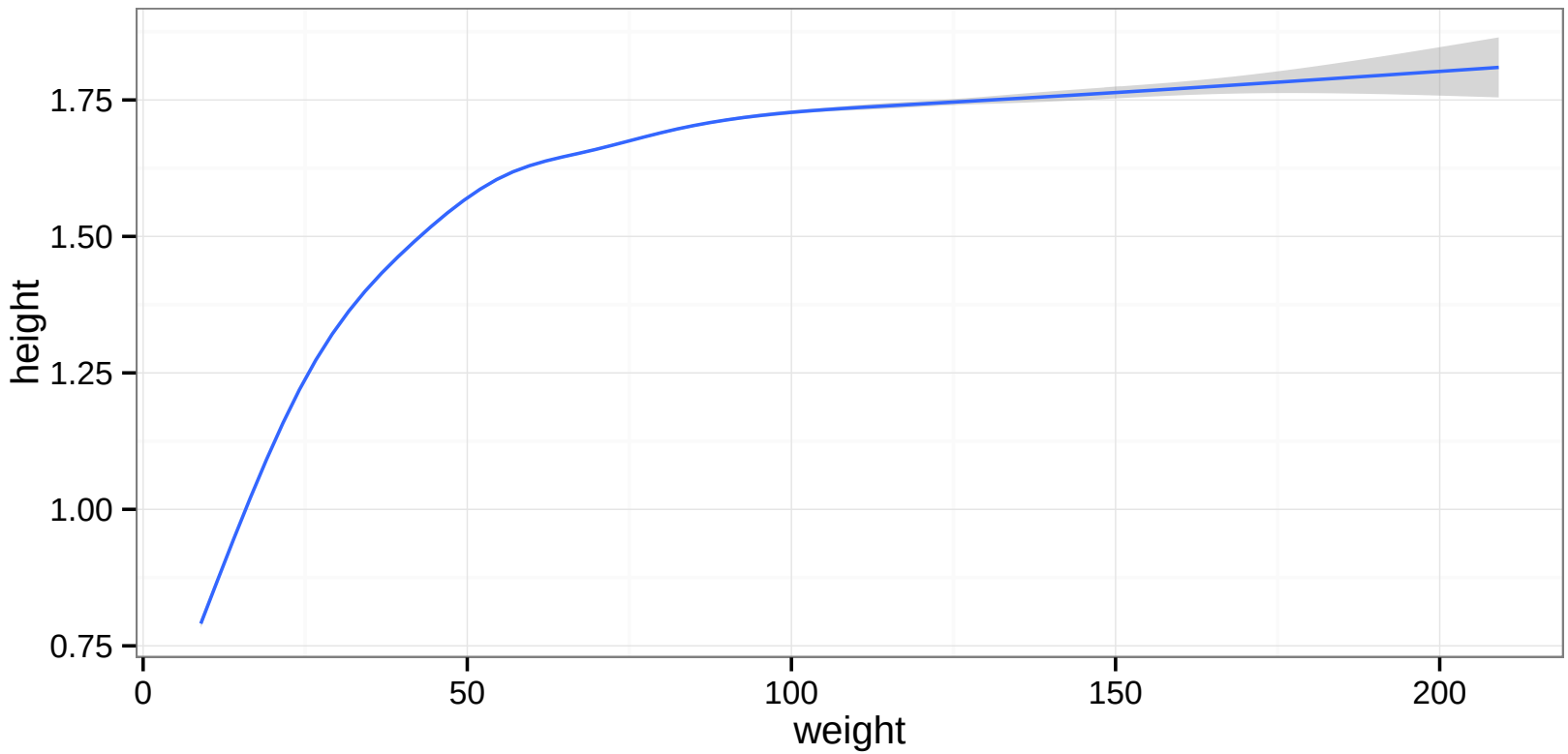
Quick tour of ggplot2 syntax

```
## same as default
qplot(weight, height, data=NHANES, geom="point")
```



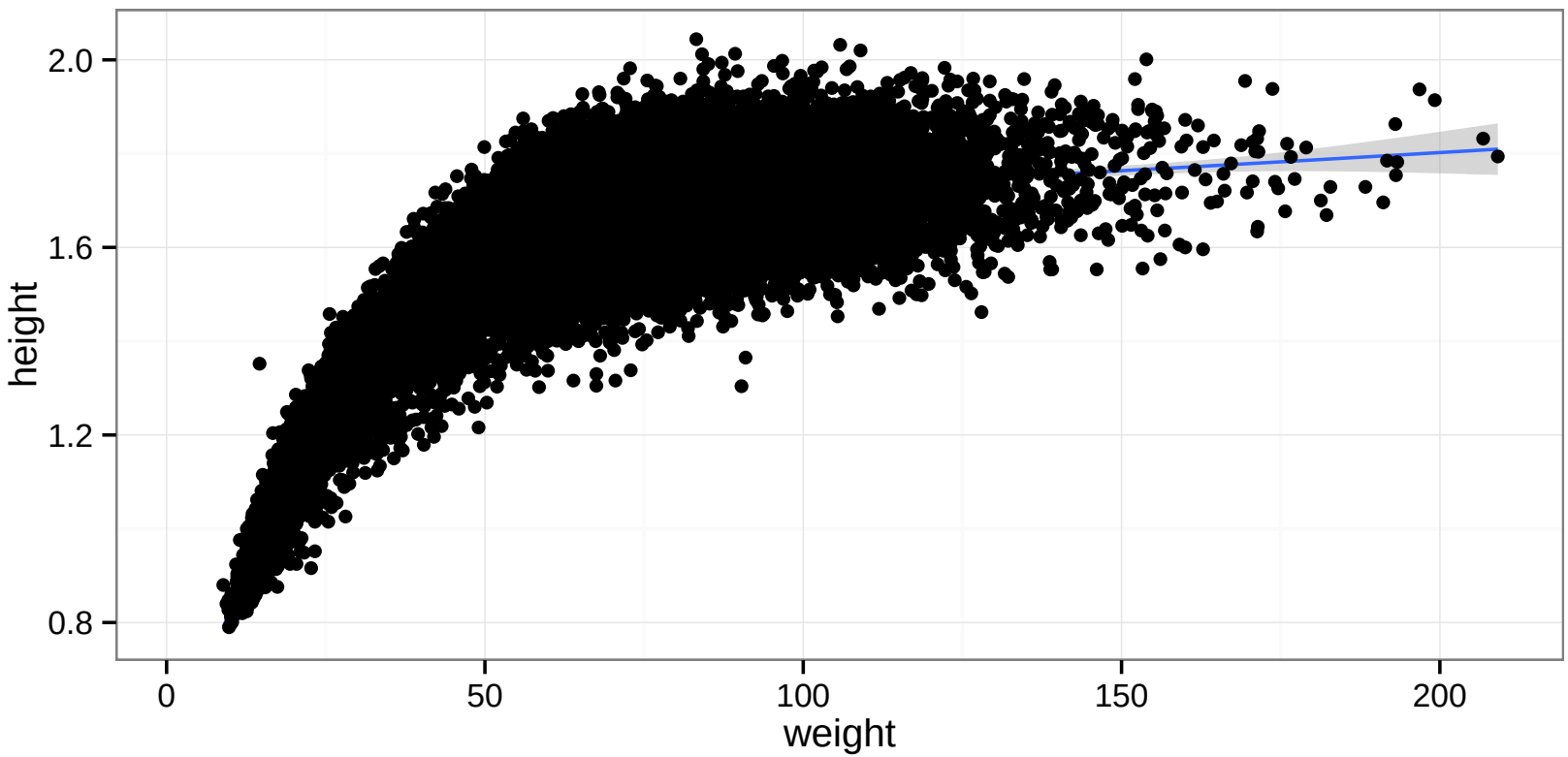
Quick tour of ggplot2 syntax

```
qplot(weight, height, data=NHANES, geom="smooth")
```



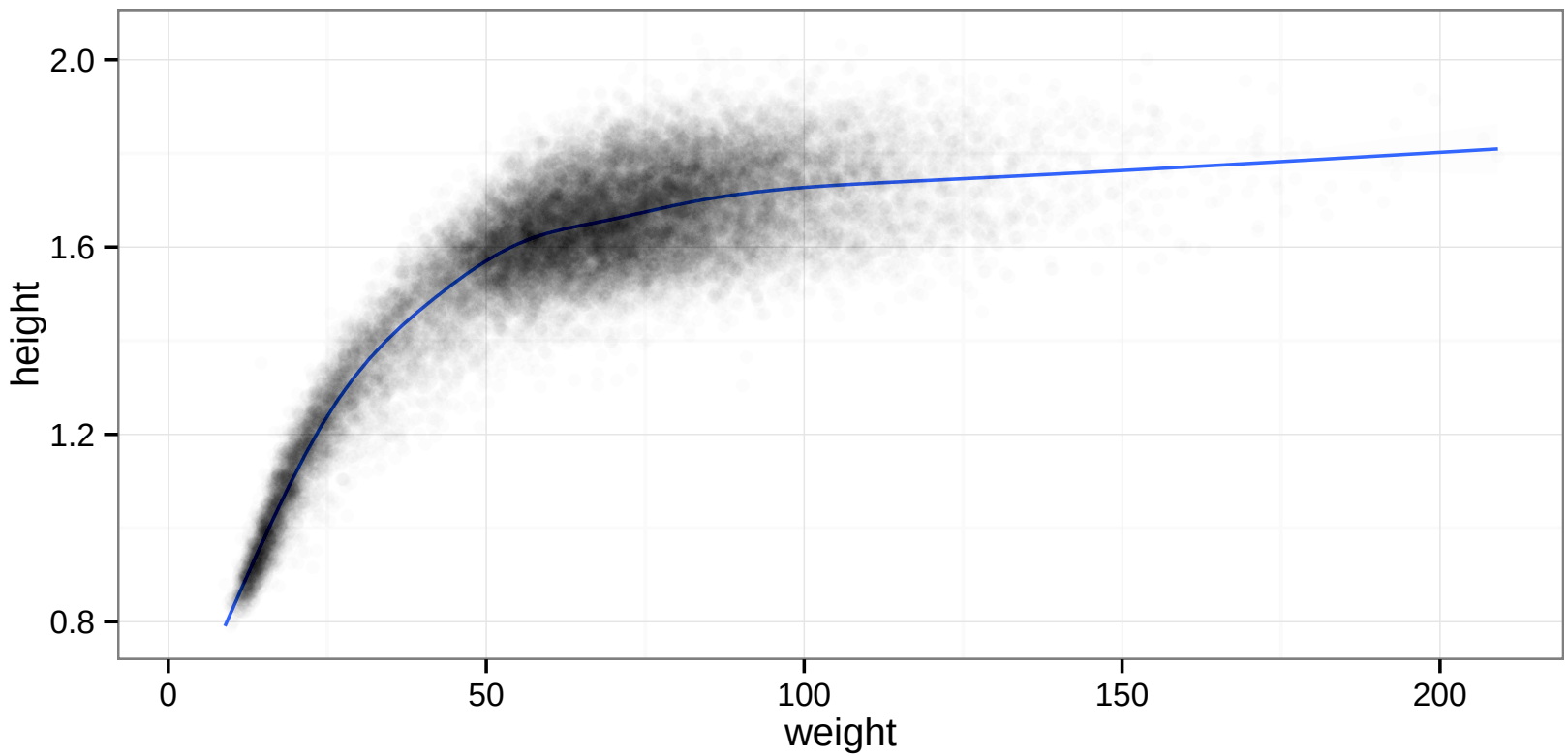
Quick tour of ggplot2 syntax

```
qplot(weight, height, data=NHANES,
      geom=c("smooth", "point"))
```



Quick tour of ggplot2 syntax

```
qplot(weight, height, data=NHANES,
      geom=c("smooth", "point"), alpha=I(.01))
```



ggplot2 building blocks

The grammar ...

- geom
- aesthetics (aes)
- scales
- facets
- data
- ... and more here: http://docs.ggplot2.org/current/

What is a "geom"?

From Hadley:

- Geoms define the basic "shape" of the elements on the plot
- Basics: point, line, bar, text, hline, vline
- Statistics: histogram, smooth, density
- Others: boxplot, pointrange, linerange, ribbon

For more info check out the documentation:
http://docs.ggplot2.org/current/.

What are "aesthetics"?

Aesthetics define a mapping between data and the display.[1]

length	width	depth	trt
2	3	4	a
1	2	1	a
4	5	15	b
9	10	80	b

x	y	colour
2	3	a
1	2	a
4	5	b
9	10	b

[1] Figure credits: Hadley Wickham

Thinking about aesthetics

Each geom has a different set of aesthetics.
What aesthetics might we need for `geom_point`?

Aesthetics for geom_point

`geom_point` understands the following aesthetics

- x (required)
- y (required)
- alpha
- color
- fill
- shape
- size

Aesthetics for `geom_line`

What aesthetics might we need for `geom_line`?

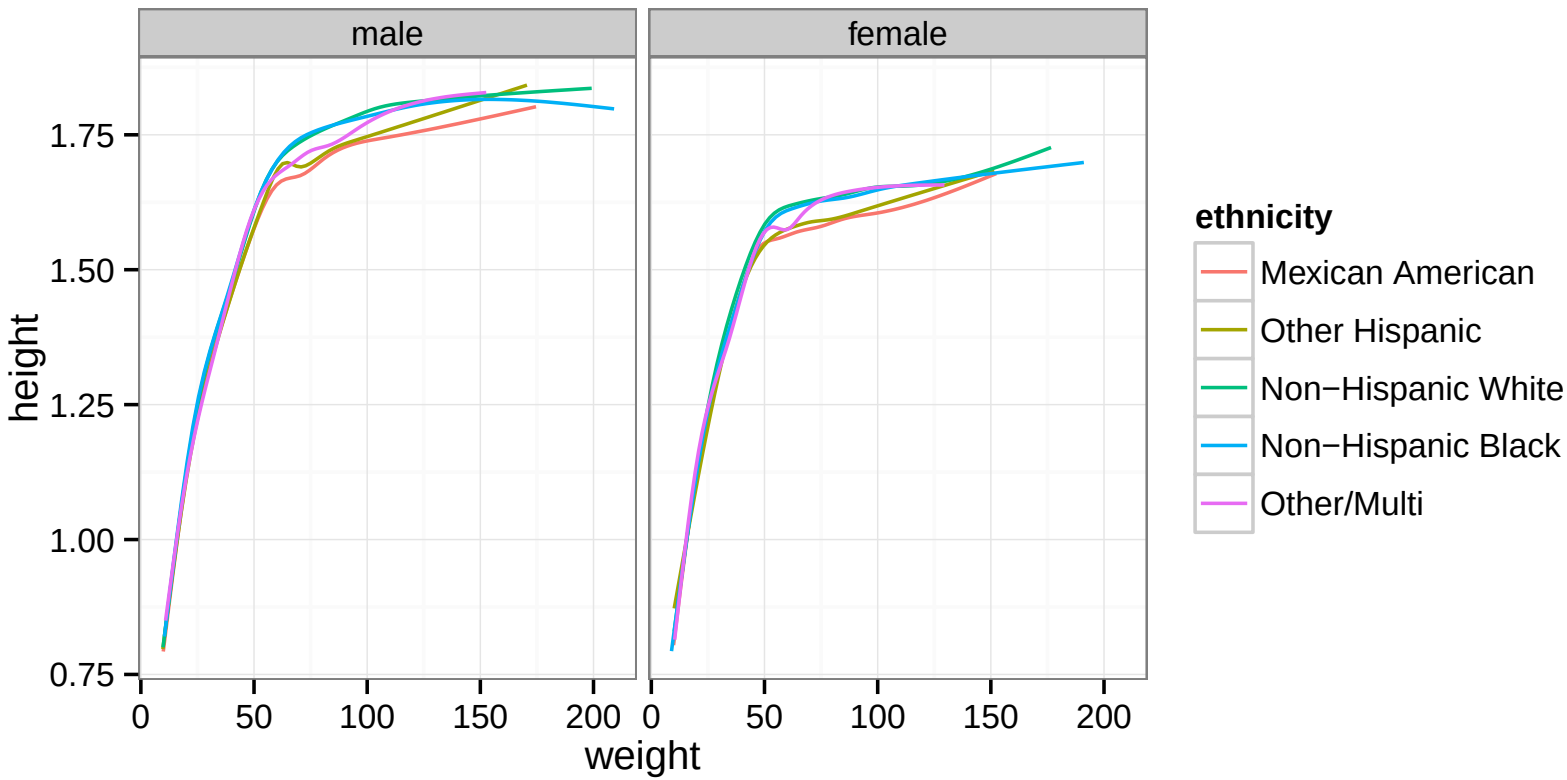
Aesthetics for `geom_line`

What aesthetics might we need for `geom_line`?

- x (required)
- y (required)
- alpha
- color
- linetype
- size

A more involved example

```
qplot(weight, height, data=NHANES,
      geom="smooth", se=FALSE,
      color=ethnicity,
      facets=.~sex)
```



qplot() vs ggplot

```
qplot(weight, height, data=NHANES,
      geom="smooth", se=FALSE,
      color=ethnicity,
      facets=.~sex)
```

```
ggplot(NHANES) +
        geom_smooth(aes(x=weight, y=height, color=ethnicity), se=FALSE) +
        geom_point(aes(x=weight, y=height, color=ethnicity), alpha=I(.01)) +
        facet_grid(.~sex)
```

How to get help with ggplot

- Ask Google: "ggplot [what I'm trying to do]"
- Ask your classmates/instructors on Piazza!
- Post something on stackexchange or the ggplot2 mailing list
- Read more!
  - http://ggplot2.org/
  - Cookbook for R
  - Hadley's book
- Practice, practice, practice.