Make Some Graphs

Modern Plain Text Social Science

Week 04

Kieran Healy

Duke University

September 2025

Make Some Graphs

Load our libraries

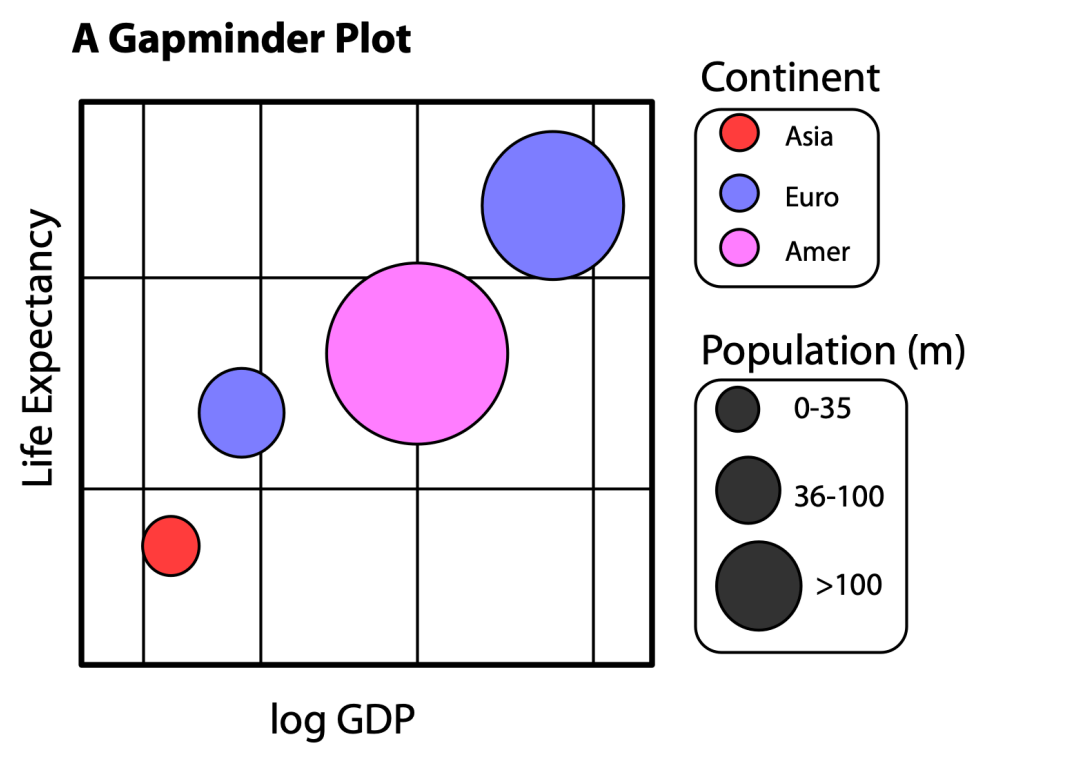
```
library(here)      # manage file paths
library(socviz)    # data and some useful functions
library(tidyverse) # your friend and mine
```

```
── Attaching core tidyverse packages ──────────────────────── tidyverse 2.0.0 ──
✔ dplyr     1.1.4     ✔ readr     2.1.5
✔ forcats   1.0.0     ✔ stringr   1.5.2
✔ ggplot2   4.0.0     ✔ tibble    3.3.0
✔ lubridate 1.9.4     ✔ tidyr     1.3.1
✔ purrr     1.1.0
── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
✖ dplyr::filter() masks stats::filter()
✖ dplyr::lag()    masks stats::lag()
ℹ Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
library(gapminder) # some data
```

A Plot's Components

What we need our code to make



Data **represented** by visual elements;

like *position*, *length*, *color*, and *size*;

Each measured on some **scale**;

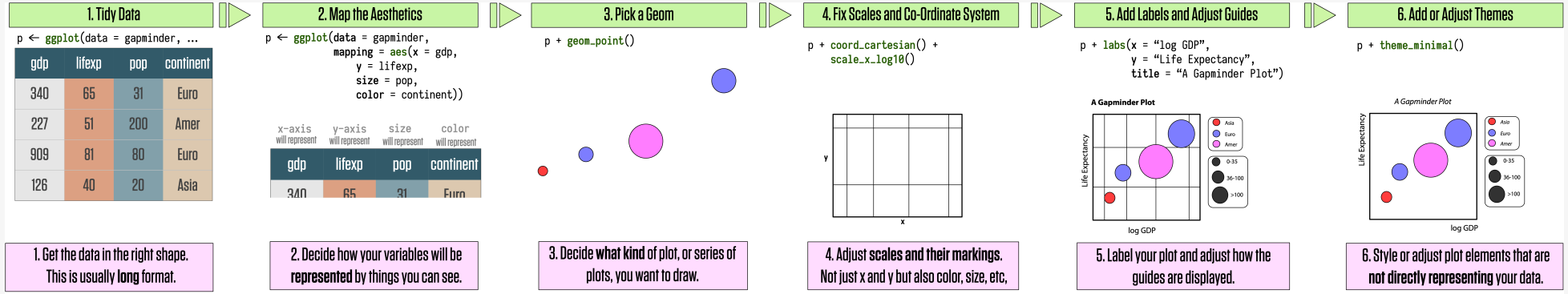
Each scale with a labeled **guide**;

With the plot itself also **titled** and labeled.

How does `ggplot` do this?

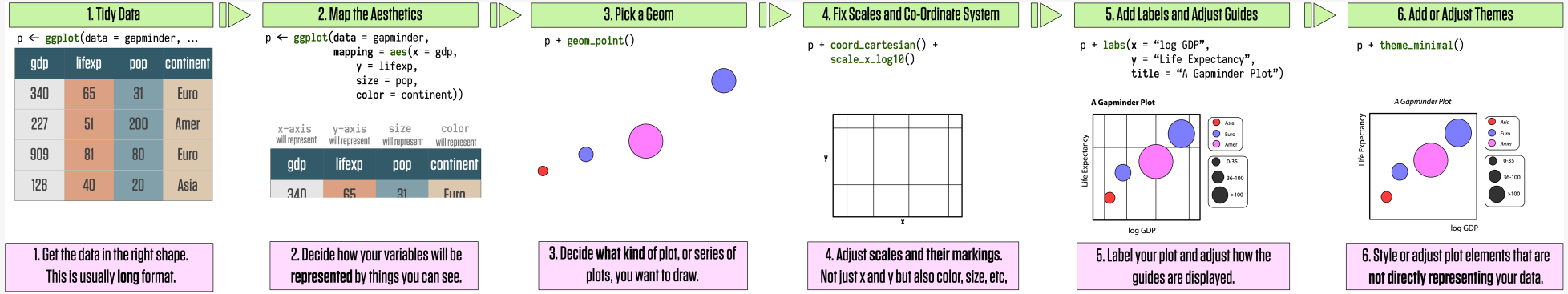
`ggplot`'s flow of action

Here's the whole thing, start to finish



Flow of action

We'll go through it step by step



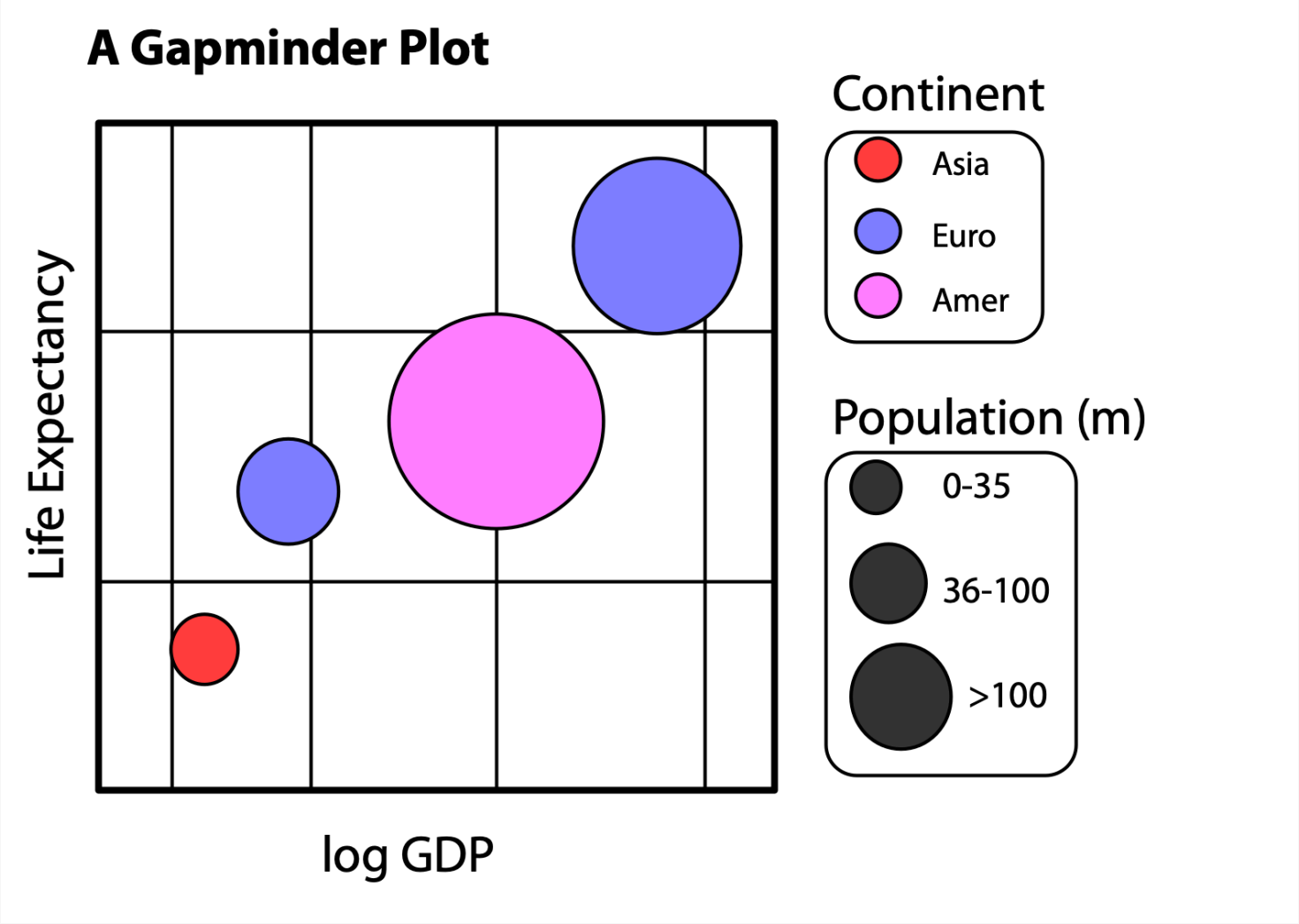
Flow of action

ggplot's flow of action

gdp	lifexp	pop	continent
340	65	31	Euro
227	51	200	Amer
909	81	80	Euro
126	40	20	Asia

What we start with

ggplot's flow of action



Where we're going

ggplot's flow of action

1. Tidy Data

```
p ← ggplot(data = gapminder, ...
```

gdp	lifexp	pop	continent
340	65	31	Euro
227	51	200	Amer
909	81	80	Euro
126	40	20	Asia

1. Get the data in the right shape. This is usually **long** format.

2. Map the Aesthetics

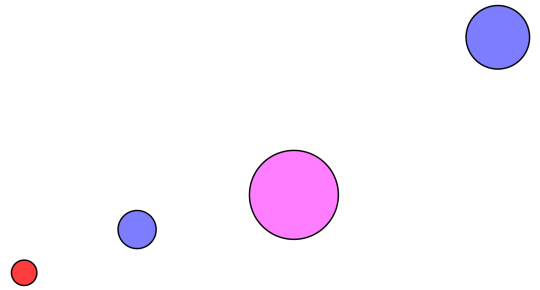
```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdp,
               y = lifexp,
               size = pop,
               color = continent))
```

x-axis will represent	y-axis will represent	size will represent	color will represent
gdp	lifexp	pop	continent
340	65	31	Euro

2. Decide how your variables will be **represented** by things you can see.

3. Pick a Geom

```
p + geom_point()
```



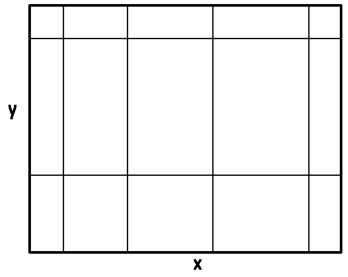
3. Decide **what kind** of plot, or series of plots, you want to draw.

Core steps

ggplot's flow of action

4. Fix Scales and Co-Ordinate System

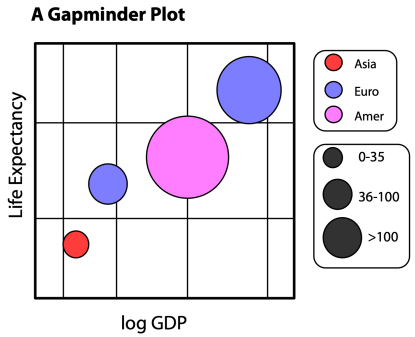
```
p + coord_cartesian() +
    scale_x_log10()
```



4. Adjust **scales and their markings.** Not just x and y but also color, size, etc,

5. Add Labels and Adjust Guides

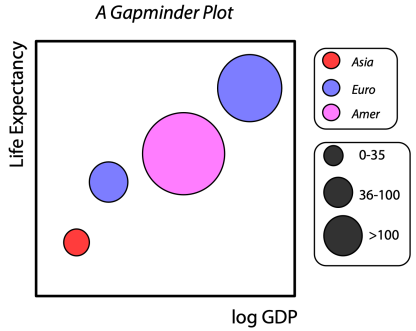
```
p + labs(x = "log GDP",
         y = "Life Expectancy",
         title = "A Gapminder Plot")
```



5. Label your plot and adjust how the guides are displayed.

6. Add or Adjust Themes

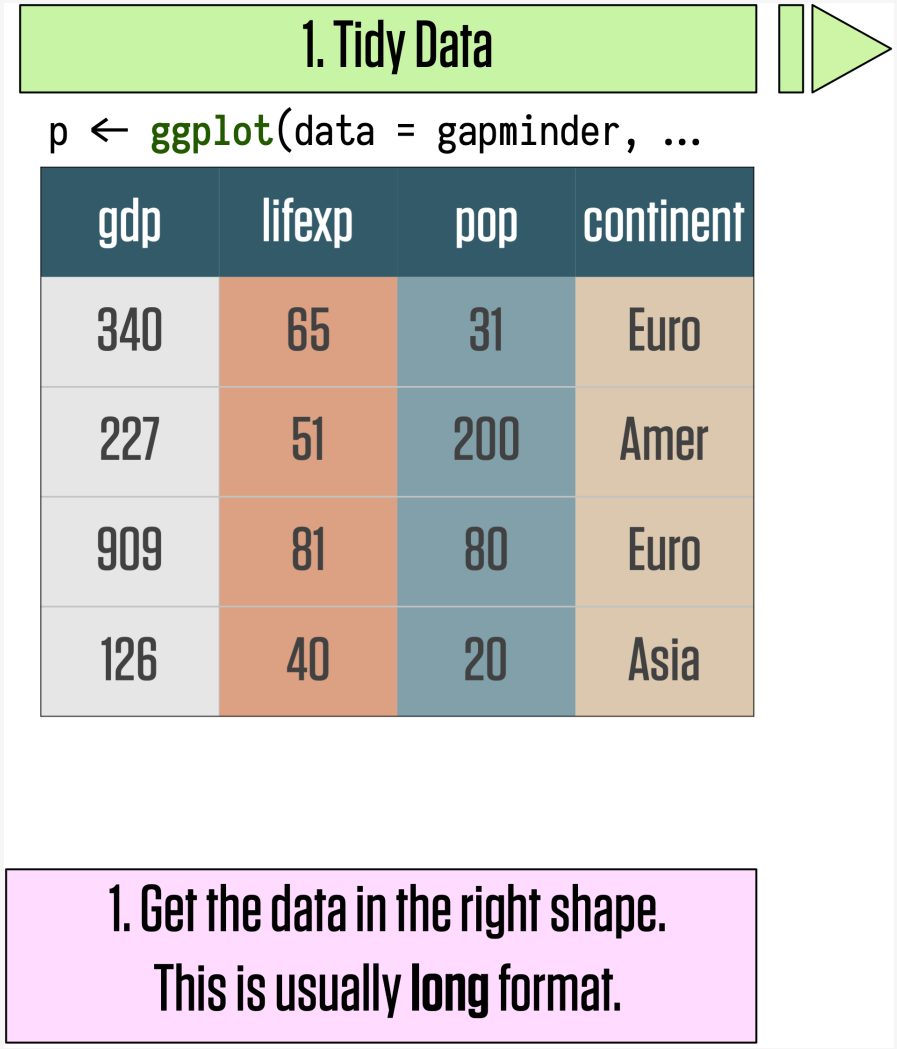
```
p + theme_minimal()
```



6. Style or adjust plot elements that are **not directly representing** your data.

Optional steps

ggplot's flow of action: required



Tidy data

ggplot's flow of action: required

2. Map the Aesthetics

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdp,
                         y = lifexp,
                         size = pop,
                         color = continent))
```

x-axis will represent	y-axis will represent	size will represent	color will represent
gdp	lifexp	pop	continent
340	65	31	Euro

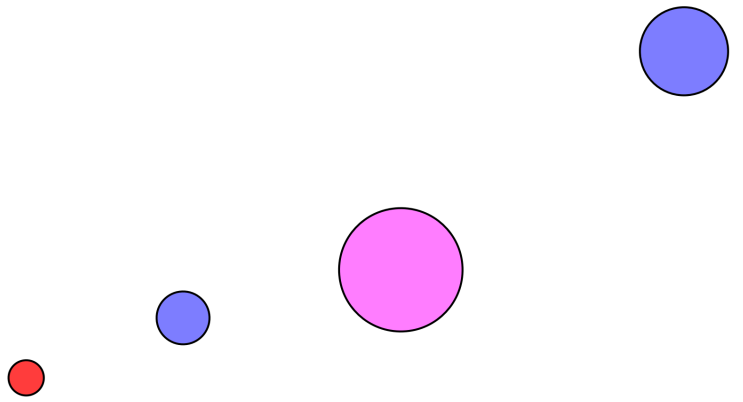
2. Decide how your variables will be represented by things you can see.

Aesthetic mappings

ggplot's flow of action: required

3. Pick a Geom

```
p + geom_point()
```



3. Decide **what kind** of plot, or series of plots, you want to draw.

Let’s go piece by piece

Start with the data

```
gapminder
```

```
# A tibble: 1,704 × 6
   country     continent  year lifeExp      pop gdpPercap
   <fct>       <fct>     <int>   <dbl>    <int>     <dbl>
 1 Afghanistan Asia       1952    28.8  8425333      779.
 2 Afghanistan Asia       1957    30.3  9240934      821.
 3 Afghanistan Asia       1962    32.0 10267083      853.
 4 Afghanistan Asia       1967    34.0 11537966      836.
 5 Afghanistan Asia       1972    36.1 13079460      740.
 6 Afghanistan Asia       1977    38.4 14880372      786.
 7 Afghanistan Asia       1982    39.9 12881816      978.
 8 Afghanistan Asia       1987    40.8 13867957      852.
 9 Afghanistan Asia       1992    41.7 16317921      649.
10 Afghanistan Asia       1997    41.8 22227415      635.
# ℹ 1,694 more rows
```

```
dim(gapminder)
```

```
[1] 1704    6
```

Create a plot object

Data is the `gapminder` tibble.

```
p ← ggplot(data = gapminder)
```

Map variables to aesthetics

Tell `ggplot` the variables you want represented by visual elements on the plot

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y = lifeExp))
```

Map variables to aesthetics

The `mapping = aes( ... )` call links variables to things you will see on the plot.

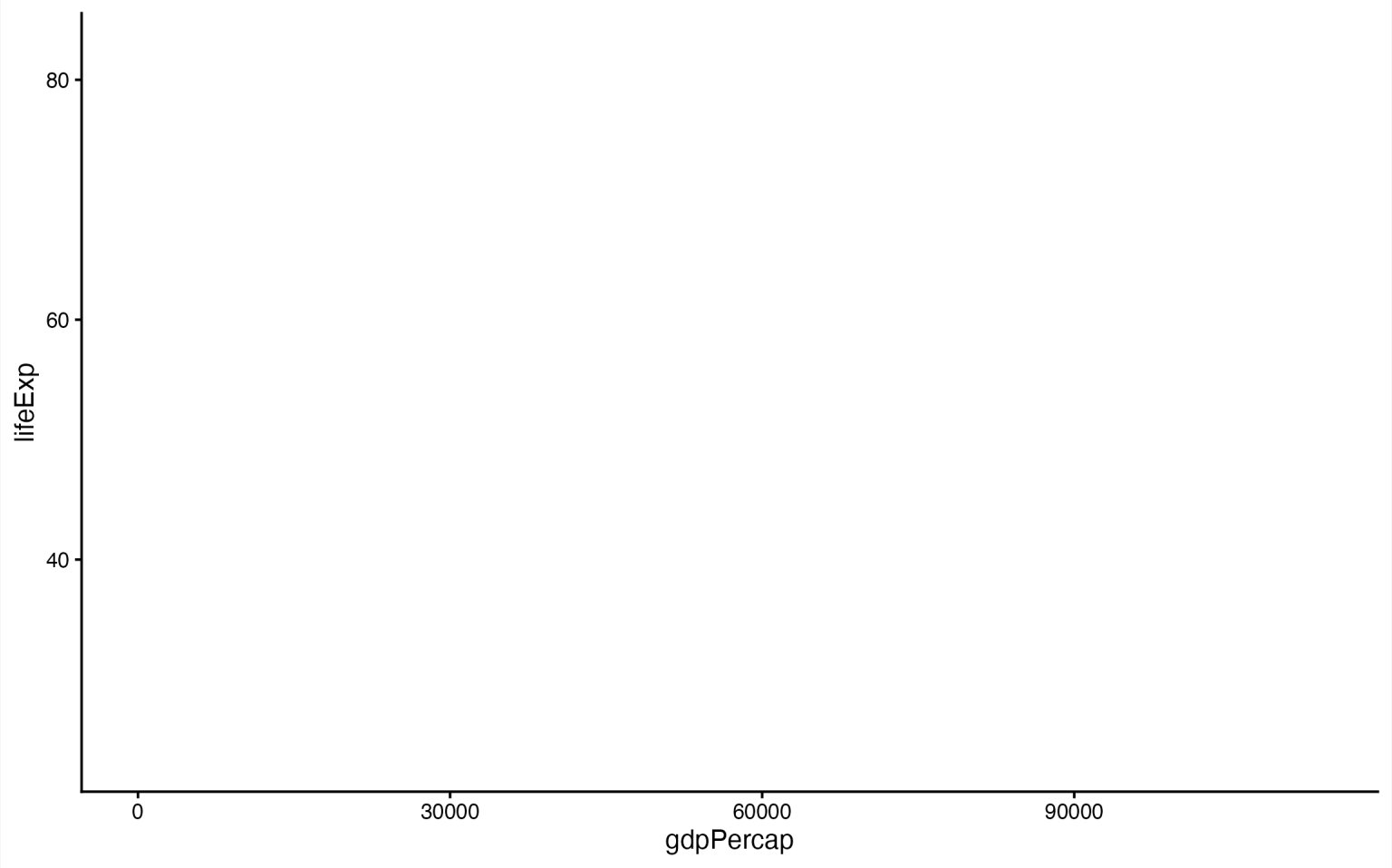
`x` and `y` represent the quantities determining position on the x and y axes.

Other aesthetic mappings can include, e.g., `color`, `shape`, `size`, and `fill`.

Mappings do not *directly* specify the particular, e.g., colors, shapes, or line styles that will appear on the plot. Rather, they establish *which variables* in the data will be represented by *which visible elements* on the plot.

p has data and mappings but no geom

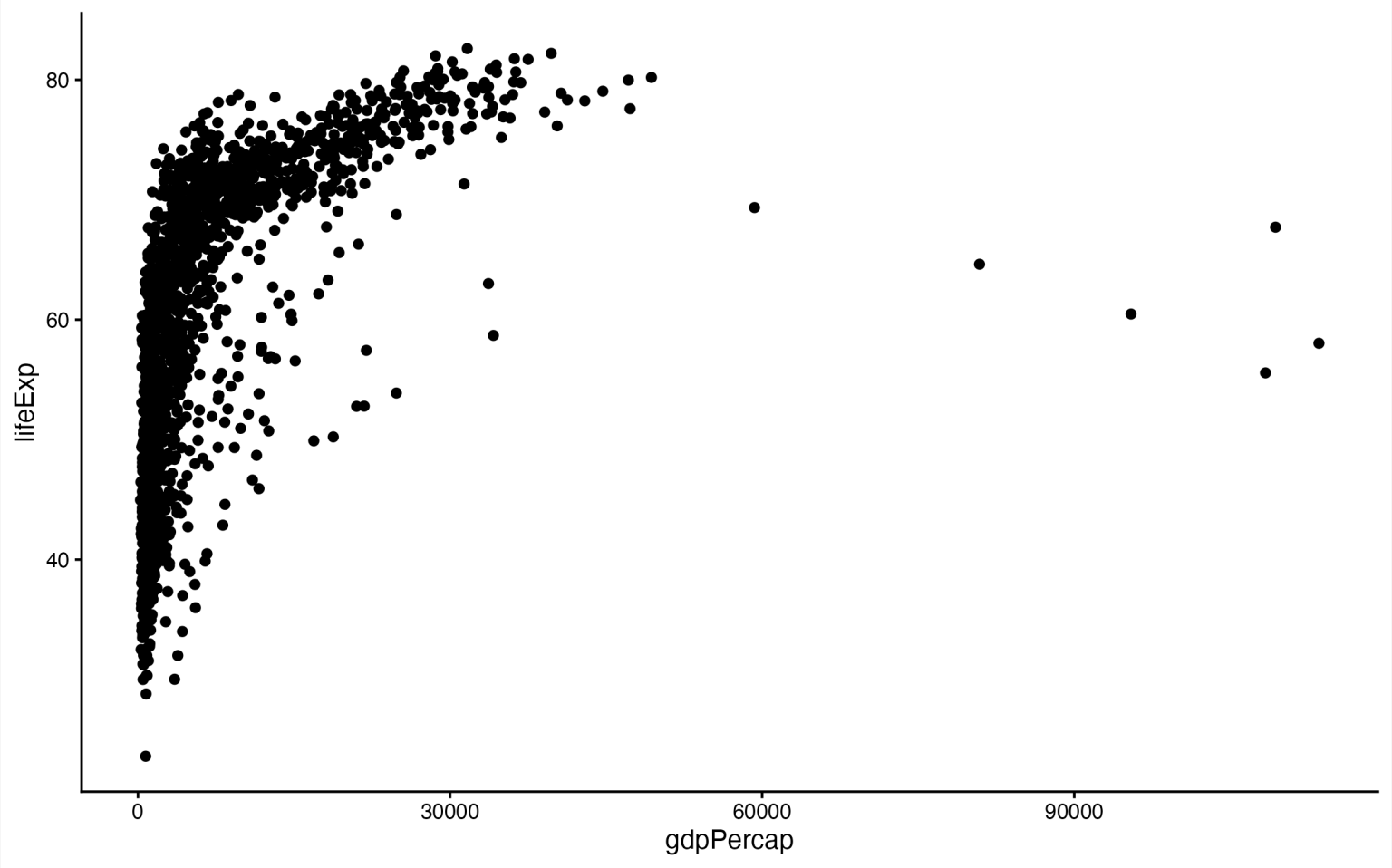
```
p
```



This empty plot has no geoms.

Add a geom

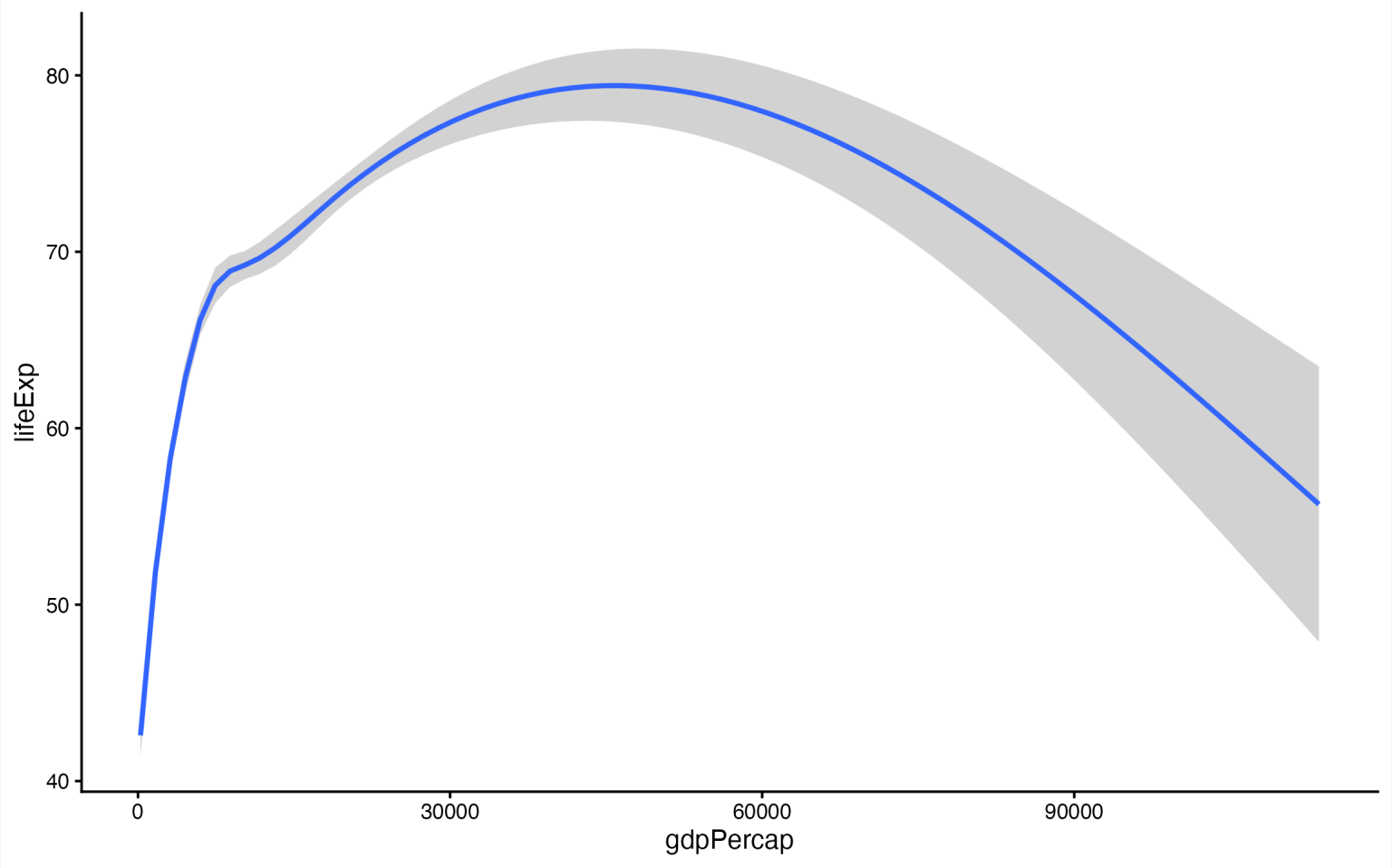
```
p + geom_point()
```



A scatterplot of Life Expectancy vs GDP

Try a different geom

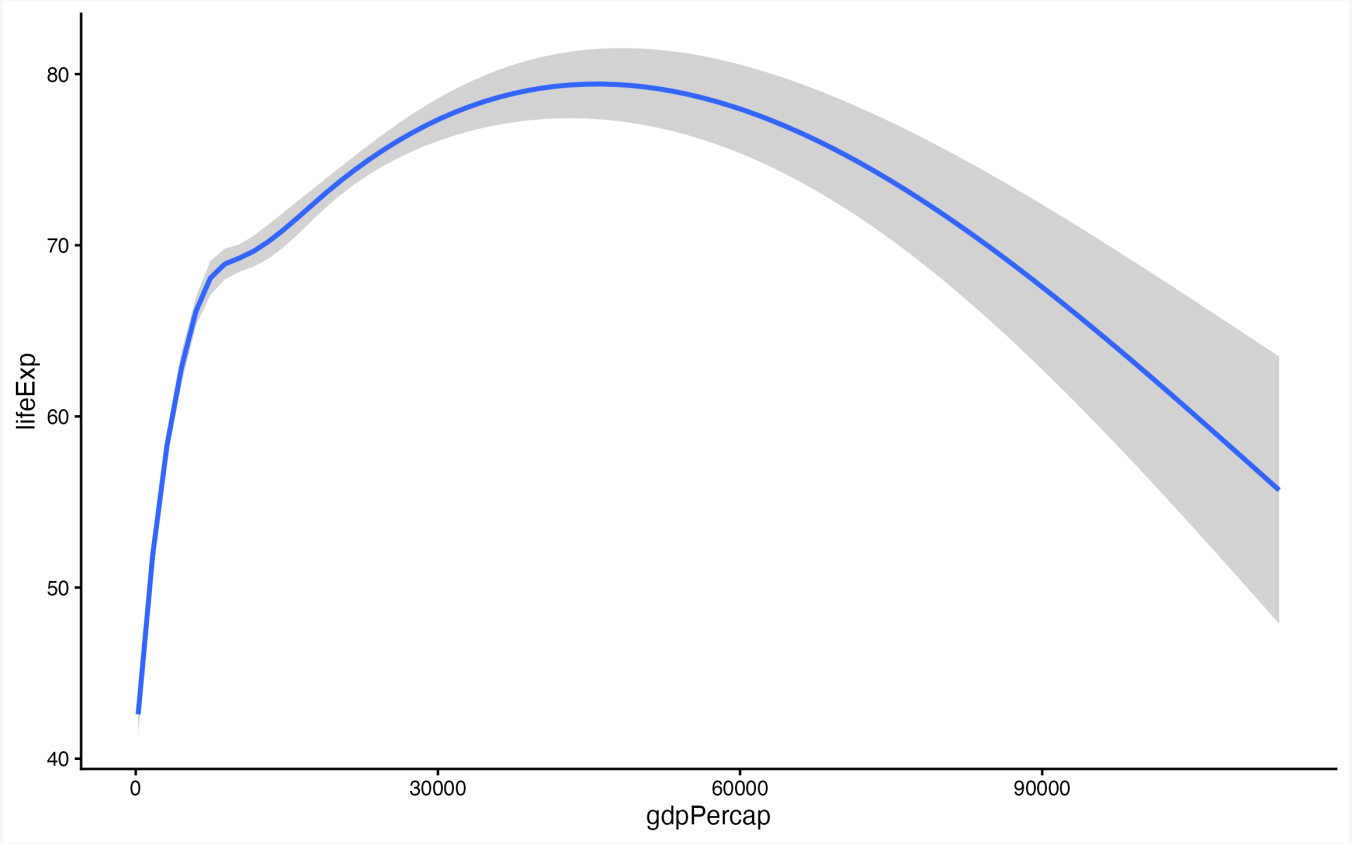
```
p + geom_smooth()
```



A scatterplot of Life Expectancy vs GDP

Build your plots layer by layer

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y=lifeExp))
p + geom_smooth()
```



Life Expectancy vs GDP, using a smoother.

This process is additive

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y=lifeExp))
```

This process is additive

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y=lifeExp))
p + geom_smooth()
```

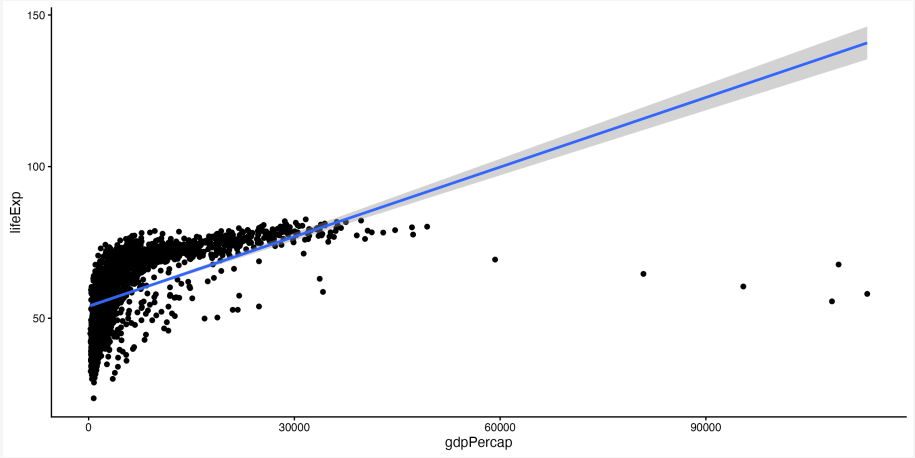
This process is additive

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y=lifeExp))
p + geom_smooth() +
  geom_point()
```

Every geom is a function

Functions take arguments

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y = lifeExp))
p + geom_point() +
  geom_smooth(method = "lm")
```



Keep Layering

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y=lifeExp))
```

Keep Layering

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y=lifeExp))
p + geom_point()
```

Keep Layering

```
p ← ggplot(data = gapminder,
             mapping = aes(x = gdpPercap,
                           y=lifeExp))
p + geom_point() +
    geom_smooth(method = "lm")
```

Keep Layering

```
p ← ggplot(data = gapminder,
             mapping = aes(x = gdpPercap,
                           y=lifeExp))
p + geom_point() +
    geom_smooth(method = "lm") +
    scale_x_log10()
```

Fix the labels

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y=lifeExp))
```

Fix the labels

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y=lifeExp))
p + geom_point()
```

Fix the labels

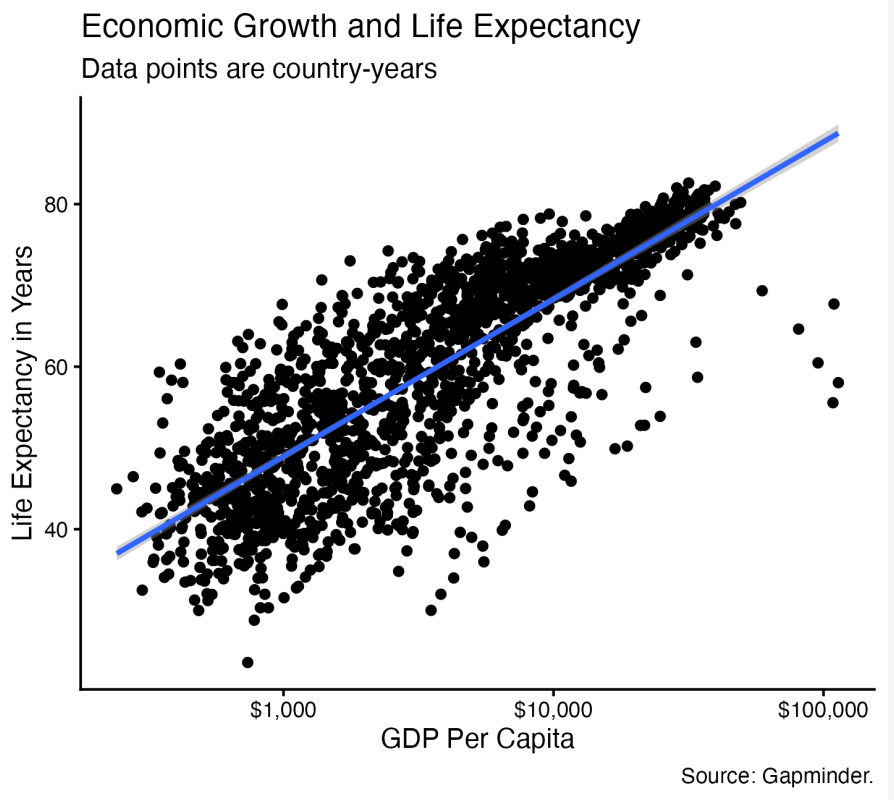
```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y=lifeExp))
p + geom_point() +
    geom_smooth(method = "lm")
```

Fix the labels

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y=lifeExp))
p + geom_point() +
    geom_smooth(method = "lm") +
    scale_x_log10(labels = scales::label_dollar())
```

Add labels, title, and caption

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y = lifeExp))
p + geom_point() +
  geom_smooth(method = "lm") +
    scale_x_log10(labels = scales::label_dollar()) +
    labs(x = "GDP Per Capita",
         y = "Life Expectancy in Years",
         title = "Economic Growth and Life Expectancy",
         subtitle = "Data points are country-years",
         caption = "Source: Gapminder.")
```



Mapping vs Setting your plot's aesthetics

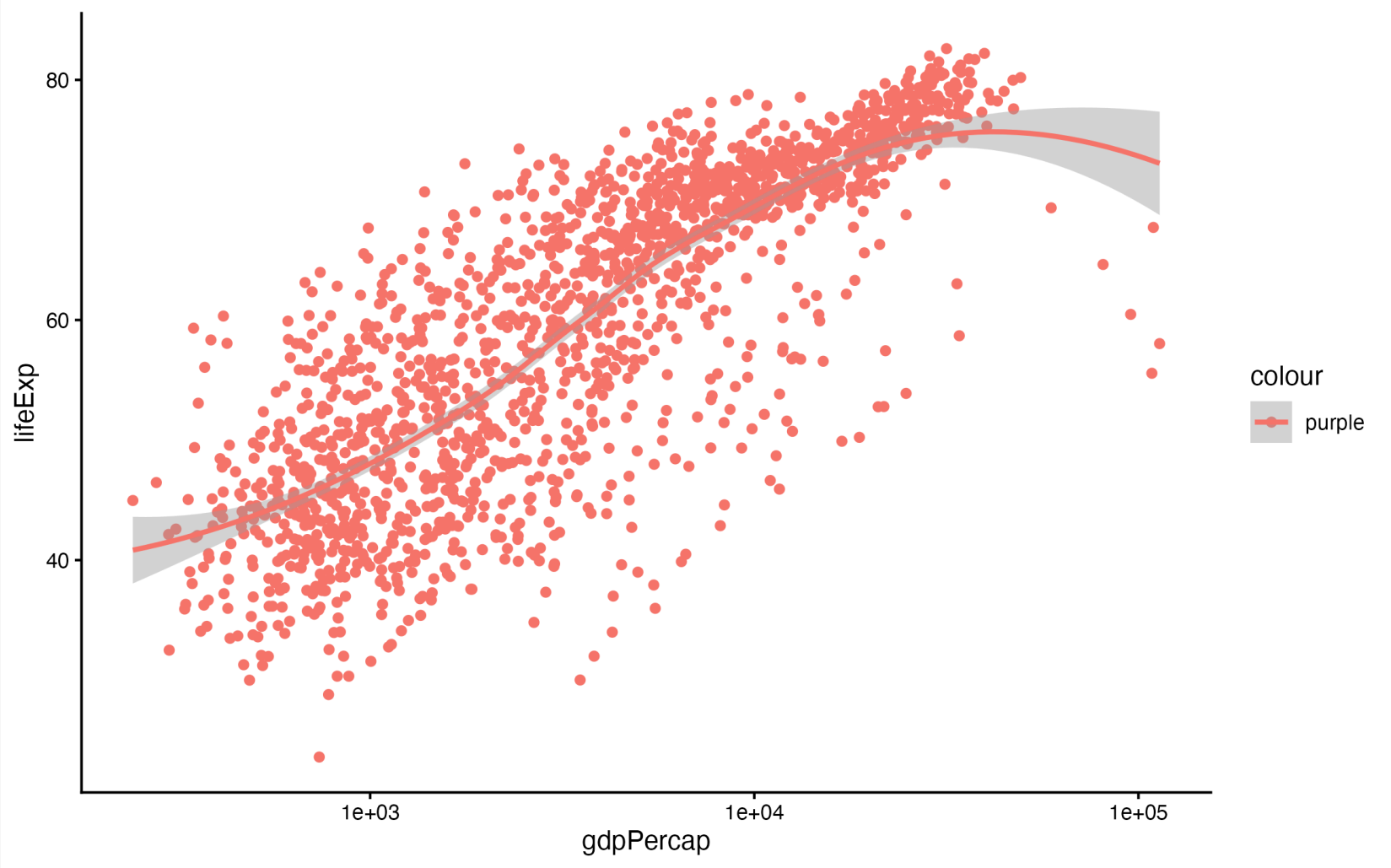
“Can I change the color of the points?”

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y = lifeExp,
                         color = "purple"))

## Put in an object for convenience
p_out ← p + geom_point() +
    geom_smooth(method = "loess") +
    scale_x_log10()
```

What has gone wrong here?

```
p_out
```



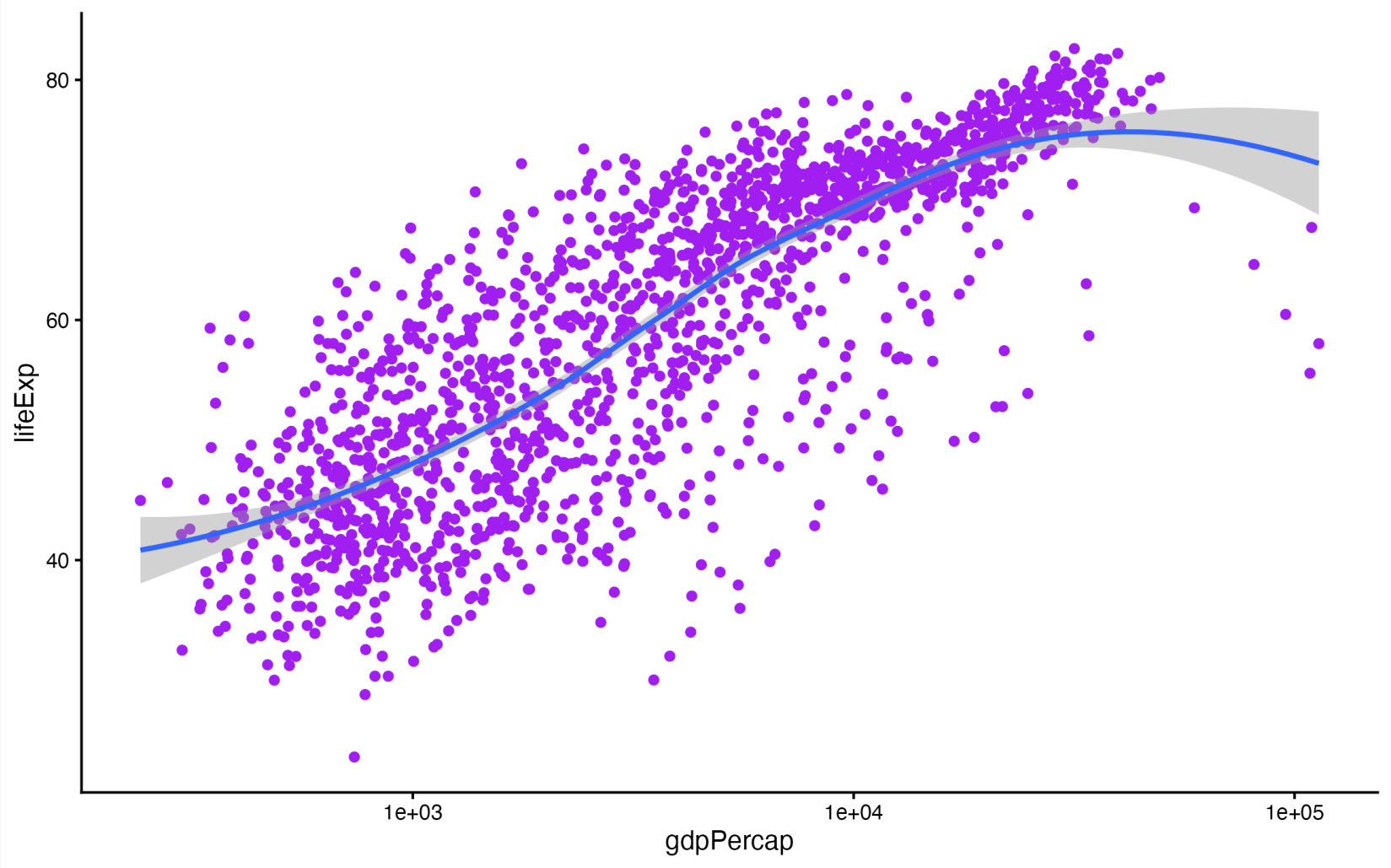
Try again

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y = lifeExp))

## Put in an object for convenience
p_out ← p + geom_point(color = "purple") +
    geom_smooth(method = "loess") +
    scale_x_log10()
```

Try again

```
p_out
```



Geoms can take many arguments

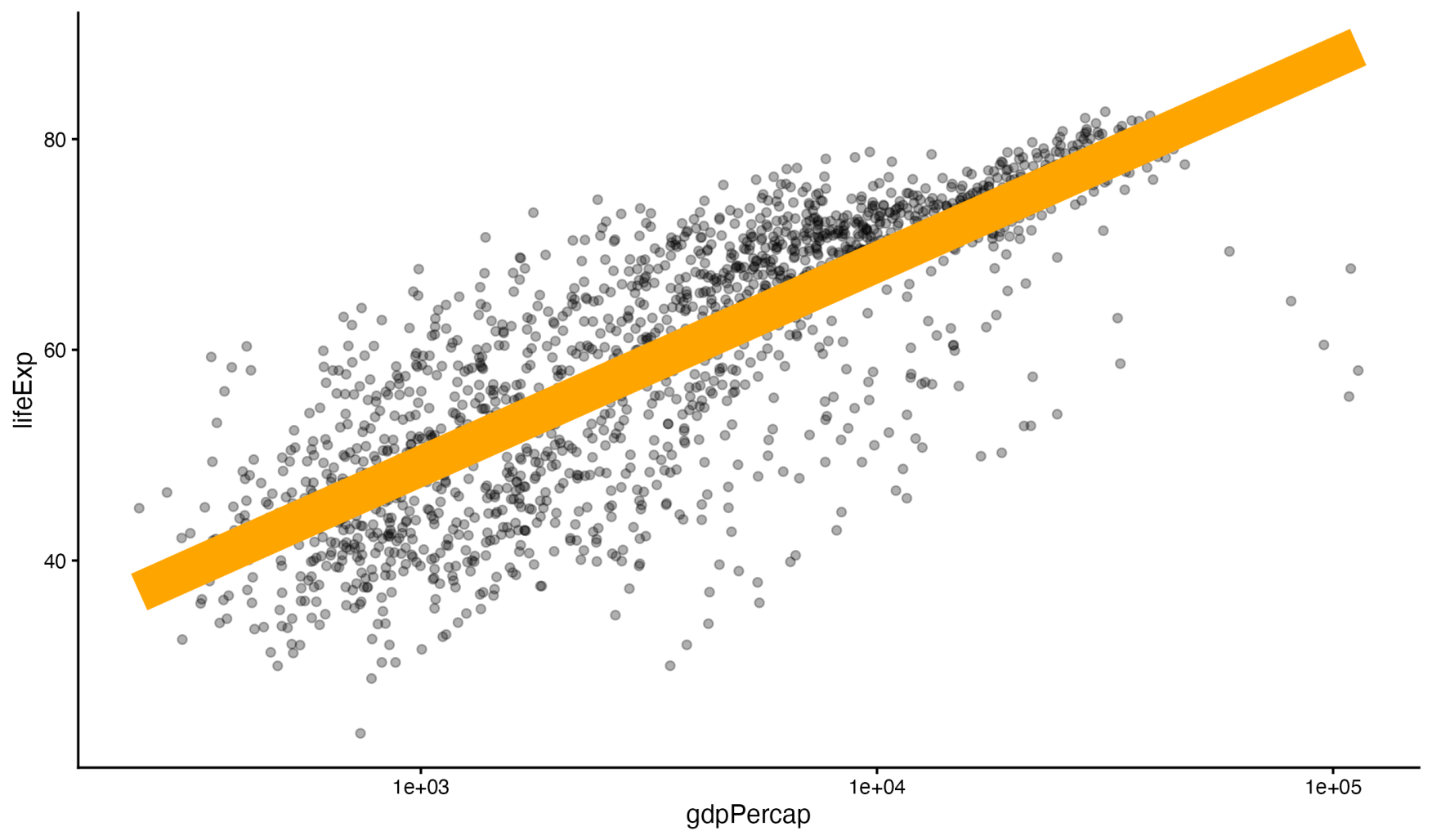
Here we set `color`, `size`, and `alpha`. Meanwhile `x` and `y` are mapped.

We also give non-default values to some other arguments

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y = lifeExp))
p_out ← p + geom_point(alpha = 0.3) +
    geom_smooth(color = "orange",
                se = FALSE,
                linewidth = 8,
                method = "lm") +
    scale_x_log10()
```

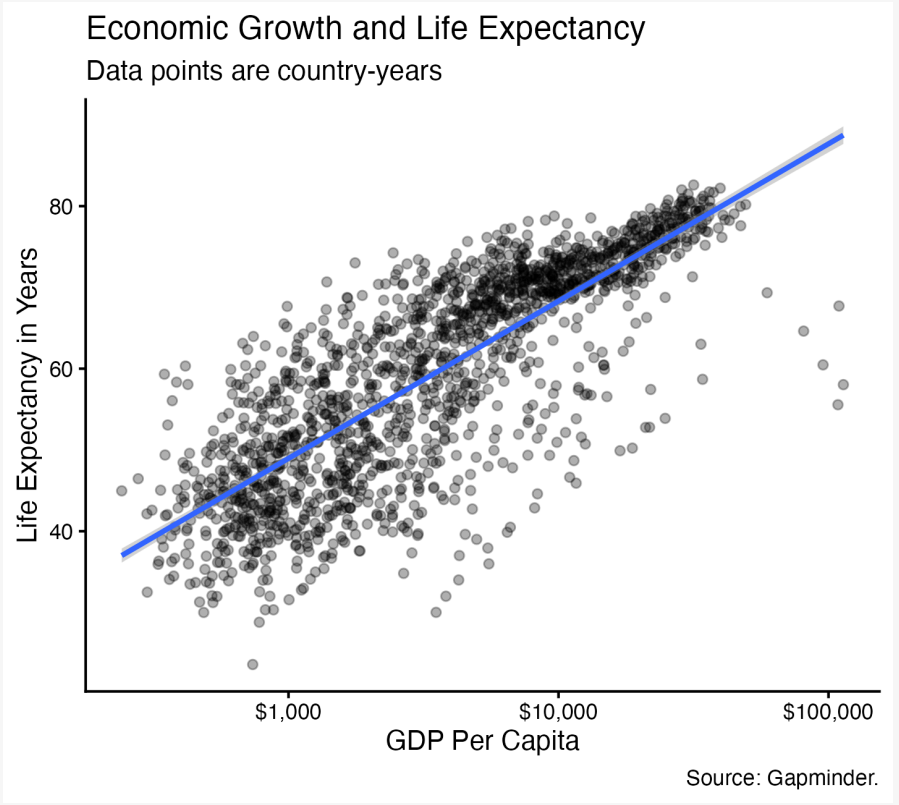
Geoms can take many arguments

```
p_out
```



alpha for overplotting

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y = lifeExp))
p + geom_point(alpha = 0.3) +
  geom_smooth(method = "lm") +
    scale_x_log10(labels = scales::label_dollar()) +
    labs(x = "GDP Per Capita",
         y = "Life Expectancy in Years",
         title = "Economic Growth and Life Expectancy",
         subtitle = "Data points are country-years",
         caption = "Source: Gapminder.")
```



Map or Set values per geom

Geoms can take their own mappings

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y = lifeExp,
                         color = continent,
                         fill = continent))
```

Geoms can take their own mappings

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y = lifeExp,
                         color = continent,
                         fill = continent))
p + geom_point()
```

Geoms can take their own mappings

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y = lifeExp,
                         color = continent,
                         fill = continent))
p + geom_point() +
    geom_smooth(method = "loess")
```

Geoms can take their own mappings

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y = lifeExp,
                         color = continent,
                         fill = continent))
p + geom_point() +
    geom_smooth(method = "loess") +
    scale_x_log10(labels = scales::label_dollar())
```

Geoms can take their own mappings

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y = lifeExp))
```

Geoms can take their own mappings

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y = lifeExp))
p + geom_point(mapping = aes(color = continent))
```

Geoms can take their own mappings

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y = lifeExp))
p + geom_point(mapping = aes(color = continent)) +
    geom_smooth(method = "loess")
```

Geoms can take their own mappings

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y = lifeExp))
p + geom_point(mapping = aes(color = continent)) +
    geom_smooth(method = "loess") +
    scale_x_log10(labels = scales::label_dollar())
```

Geoms can take their own mappings

```
p ← ggplot(data = gapminder,
           mapping = aes(x = gdpPercap,
                         y = lifeExp))
p + geom_point(mapping = aes(color = continent)) +
    geom_smooth(method = "loess") +
    scale_x_log10(labels = scales::label_dollar())
```

Pay attention to which scales and guides are drawn, and why

Guides and scales reflect `aes()` mappings

```
mapping = aes(color =
continent, fill = continent)
```

Guides and scales reflect `aes()` mappings

```
mapping = aes(color =
continent, fill = continent)
```


```
mapping = aes(color =
              continent)
```

Remember: Every mapped variable has a scale

Saving your work

Use ggsave()

```
## Save the most recent plot
ggsave(filename = "figures/my_figure.png")

## Use here() for more robust file paths
ggsave(filename = here("figures", "my_figure.png"))

## A plot object
p_out <- p + geom_point(mapping = aes(color = log(pop))) +
    scale_x_log10()

ggsave(filename = here("figures", "lifexp_vs_gdp_gradient.pdf"),
       plot = p_out)

ggsave(here("figures", "lifexp_vs_gdp_gradient.png"),
       plot = p_out,
       width = 8,
       height = 5)
```

Customize figure output

In single code chunks

Set particular options in any quarto code chunk by including lines like these at the top of the chunk:

```
#| fig-height: 8
#| fig-width: 5
#| fig-cap: "A caption"
```

For the whole document

Use the YAML header:

```yaml
format:
  html:
    fig-width: 8
    fig-height: 6
  pdf:
    fig-width: 7
    fig-height: 5
```