R: Introduction and Review

EC 421, Set 1(r)

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Econometrics

Recall: Applied econometrics, data science, analytics require:

1. Intuition for the **theory** behind statistics/econometrics (assumptions, results, strengths, weaknesses).

2. Practical knowledge of how to **apply theoretical methods** to data.

3. Efficient methods for **working with data** (cleaning, aggregating, joining, visualizing).

This course aims to deepen your knowledge in each of these three areas.

- 1: As before.
- 2–3: **R**

R

What is R?

To quote the R project website:

> R is a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX platforms, Windows and MacOS.

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What does that mean?

- R was created for the statistical and graphical work required by econometrics.
- R has a vibrant, thriving online community. (stack overflow)
- Plus it's **free** and **open source**.

R

Why are we using R?

1. R is **free** and **open source**—saving both you and the university 💰💵💰.

2. *Related:* Outside of a small group of economists, private- and public-sector **employers favor `R`** over `Stata` and most competing softwares.

3. R is very **flexible and powerful**—adaptable to nearly any task, *e.g.*, 'metrics, spatial data analysis, machine learning, web scraping, data cleaning, website building, teaching (these slides).

Why are we using R?

4. *Related:* R imposes **no limitations** on your amount of observations, variables, memory, or processing power. (I'm looking at **you**, `Stata`.)

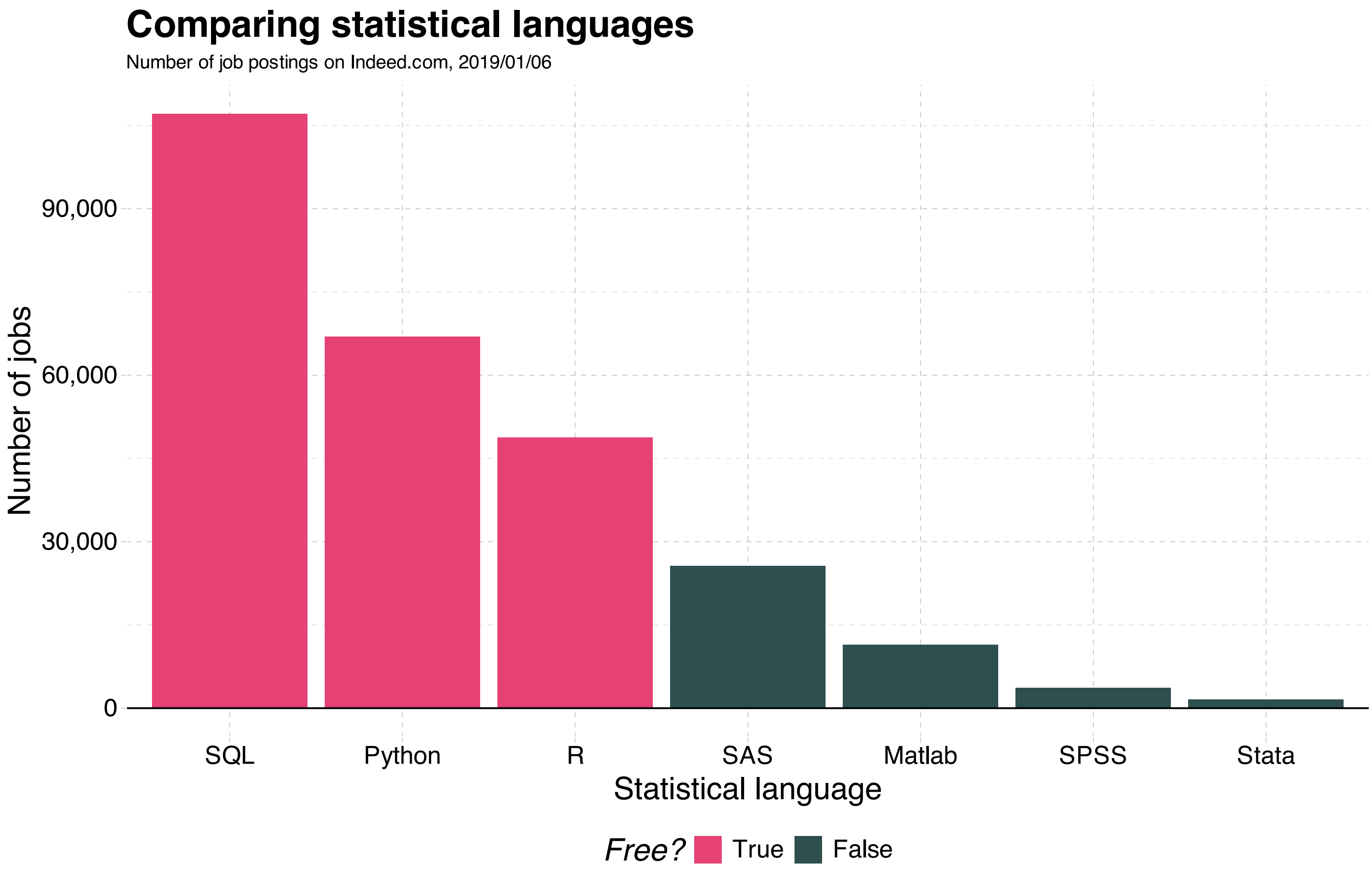
5. If you put in the work,[†] you will come away with a **valuable and marketable** tool.

6. I 💖 **R**

7. R is a nice gateway to (and plays well with) other programming languages (*e.g.*, Python, SQL, C++, JavaScript).

[†]: Learning R definitely requires time and effort.

R


Comparing statistical languages
Number of job postings on Indeed.com, 2019/01/06
Number of jobs
90,000
60,000
30,000
0
SQL
Python
R
SAS
Matlab
SPSS
Stata
Statistical language
Free?
🟥 True
🟩 False

R + Examples

R + Regression

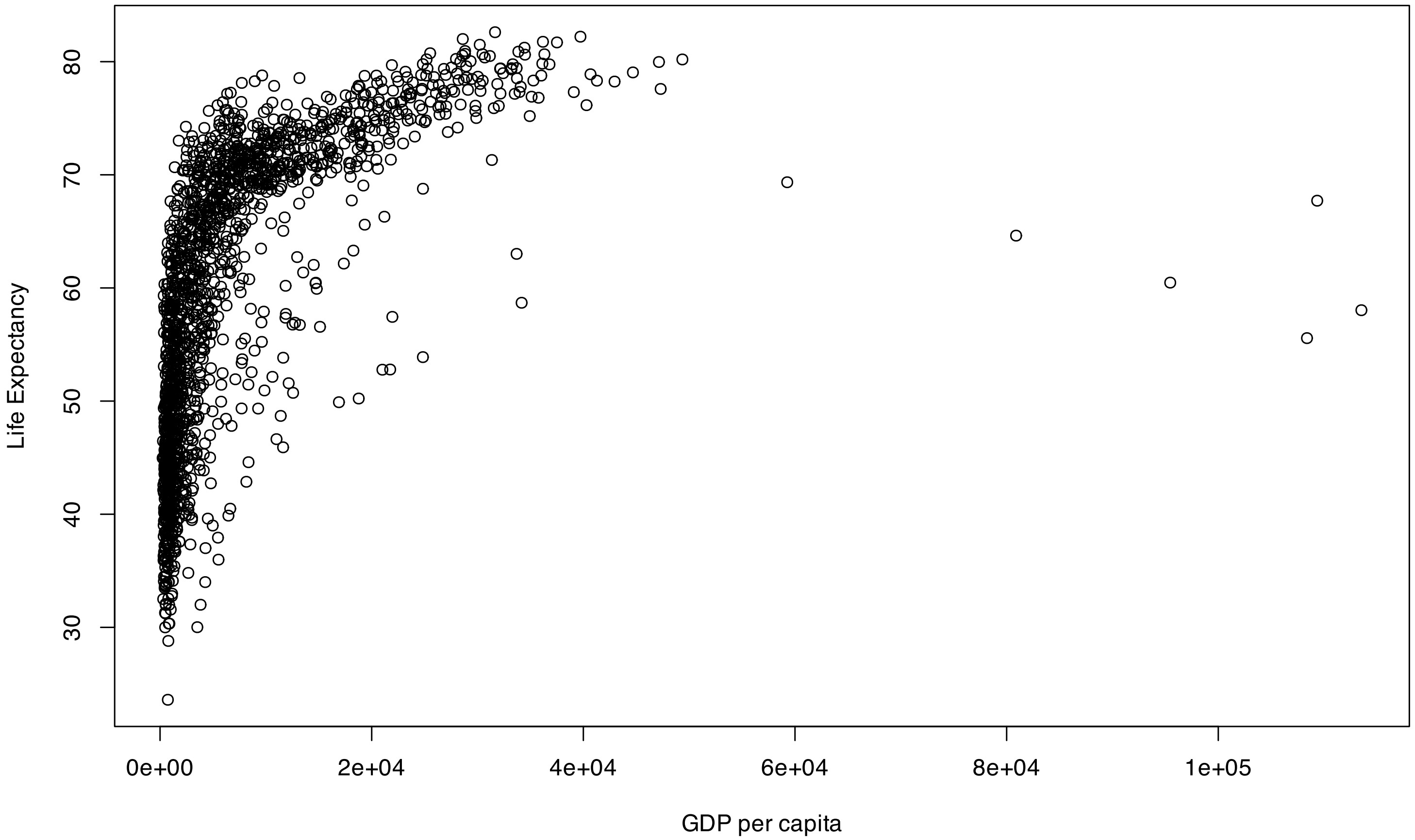
```
# A simple regression
fit = lm(dist ~ 1 + speed, data = cars)
# Show the coefficients
coef(summary(fit))
```

```
#>              Estimate Std. Error   t value     Pr(>|t|)
#> (Intercept) -17.579095  6.7584402 -2.601058 1.231882e-02
#> speed         3.932409  0.4155128  9.463990 1.489836e-12
```

```
# A nice, clear table
library(broom)
tidy(fit)
```

```
#> # A tibble: 2 × 5
#>   term        estimate std.error statistic  p.value
#>   <chr>          <dbl>     <dbl>     <dbl>    <dbl>
#> 1 (Intercept)   -17.6      6.76      -2.60 1.23e- 2
#> 2 speed           3.93     0.416      9.46 1.49e-12
```

R + Plotting (w/ `plot`)

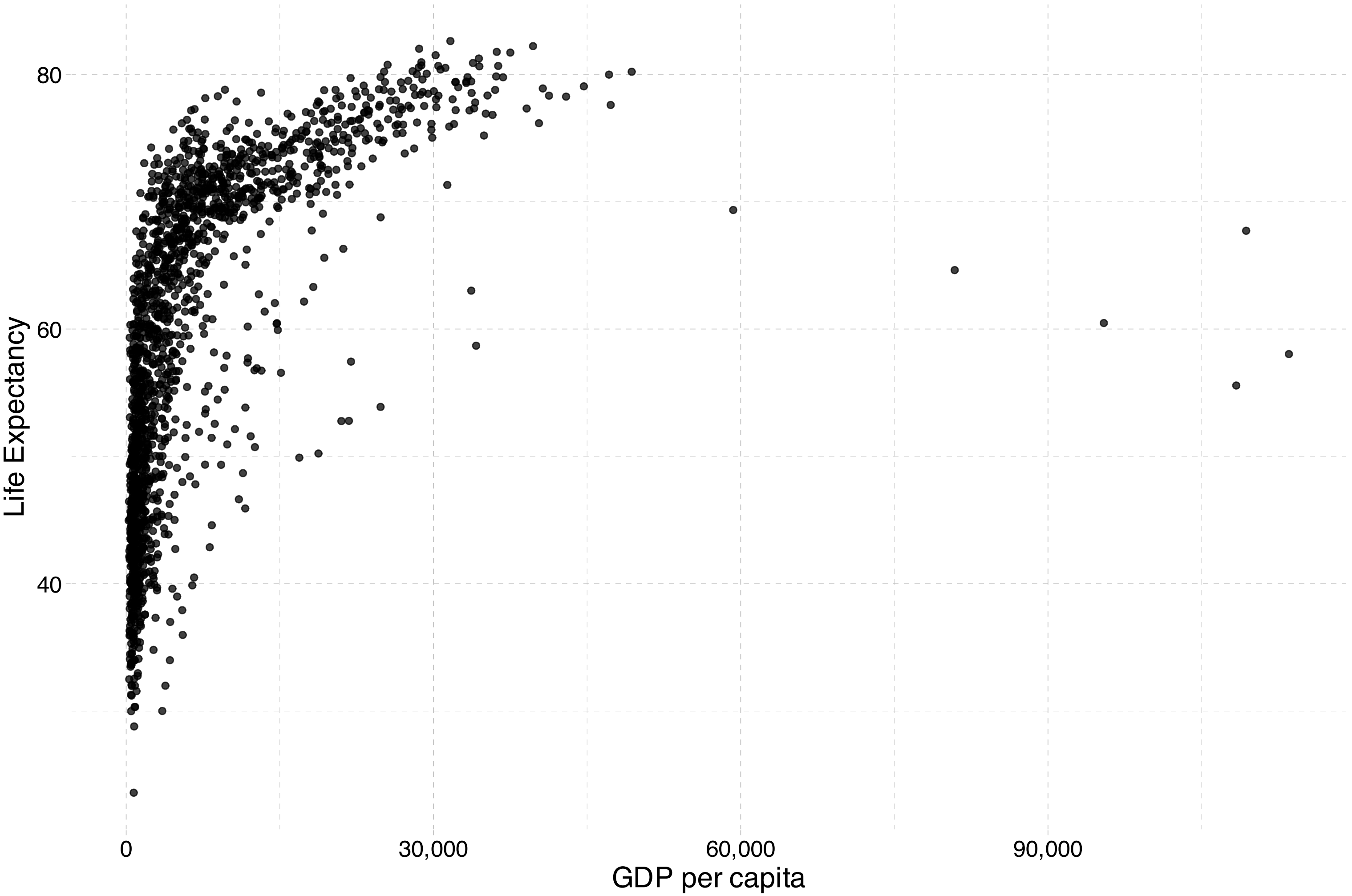


R + Plotting (w/ plot)

```r
# Load packages with dataset
library(gapminder)

# Create dataset
plot(
  x = gapminder$gdpPercap, y = gapminder$lifeExp,
  xlab = "GDP per capita", ylab = "Life Expectancy"
)
```

R + Plotting (w/ `ggplot2`)

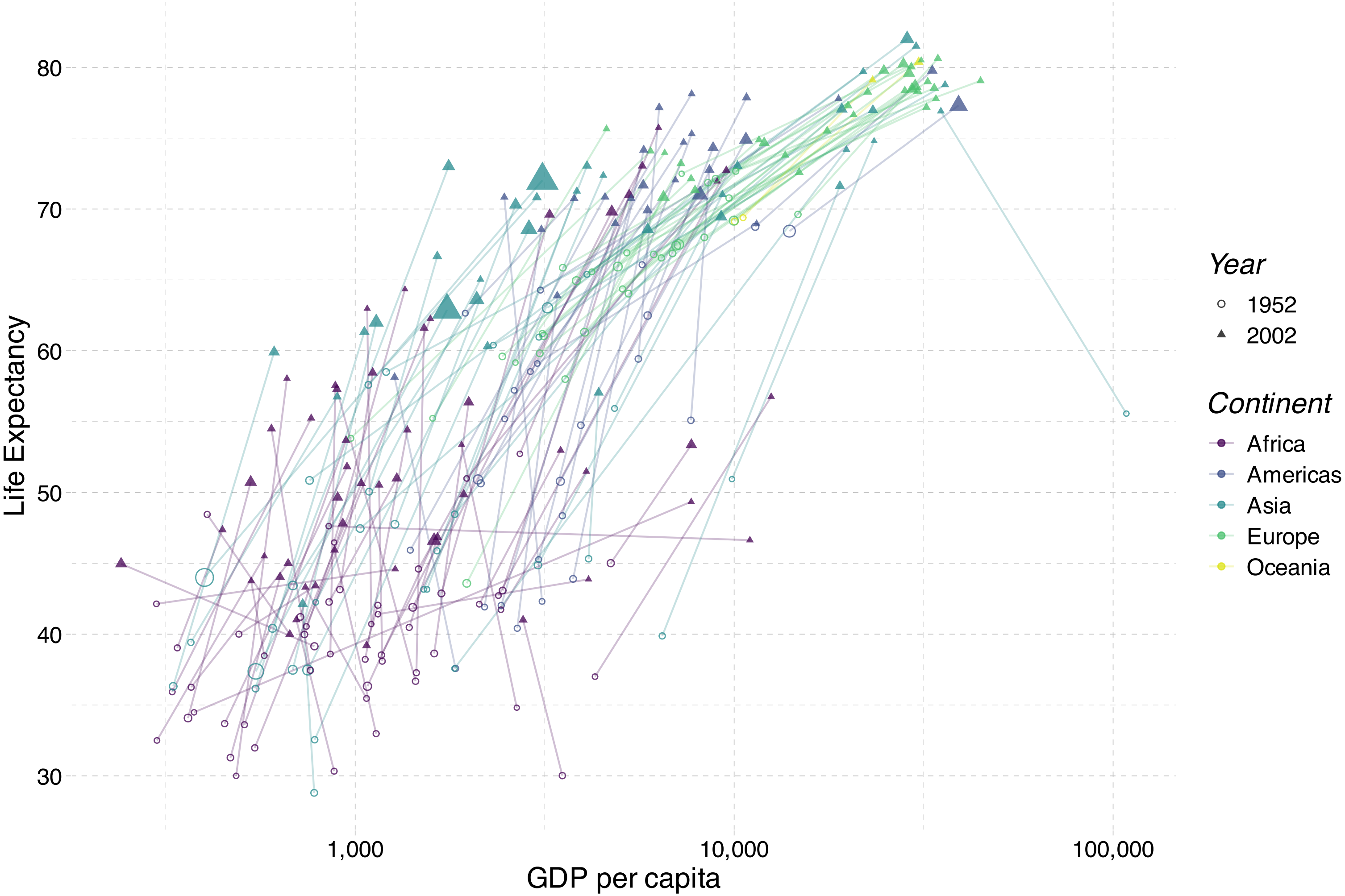


R + Plotting (w/ ggplot2)

```r
# Load packages
library(gapminder); library(dplyr)

# Create dataset
ggplot(data = gapminder, aes(x = gdpPercap, y = lifeExp)) +
geom_point(alpha = 0.75) +
scale_x_continuous("GDP per capita", label = scales::comma) +
ylab("Life Expectancy") +
theme_pander(base_size = 16)
```

R + More plotting (w/ ggplot2)

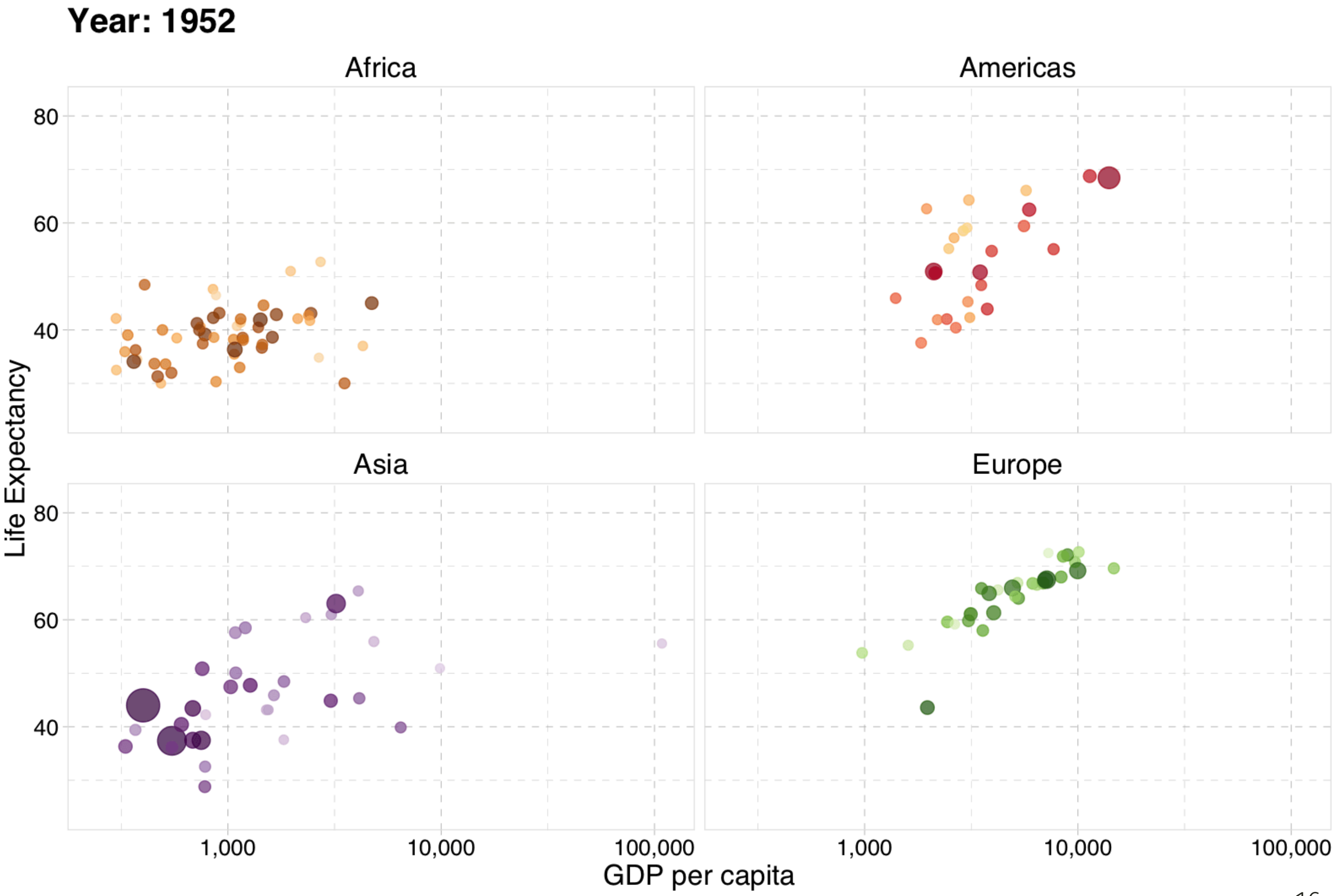


R + More plotting (w/ ggplot2)

```r
# Load packages
library(gapminder); library(dplyr)

# Create dataset
ggplot(
  data = filter(gapminder, year %in% c(1952, 2002)),
  aes(x = gdpPercap, y = lifeExp, color = continent, group = country)
) +
geom_path(alpha = 0.25) +
geom_point(aes(shape = as.character(year), size = pop), alpha = 0.75) +
scale_x_log10("GDP per capita", label = scales::comma) +
ylab("Life Expectancy") +
scale_shape_manual("Year", values = c(1, 17)) +
scale_color_viridis("Continent", discrete = T, end = 0.95) +
guides(size = F) +
theme_pander(base_size = 16)
```

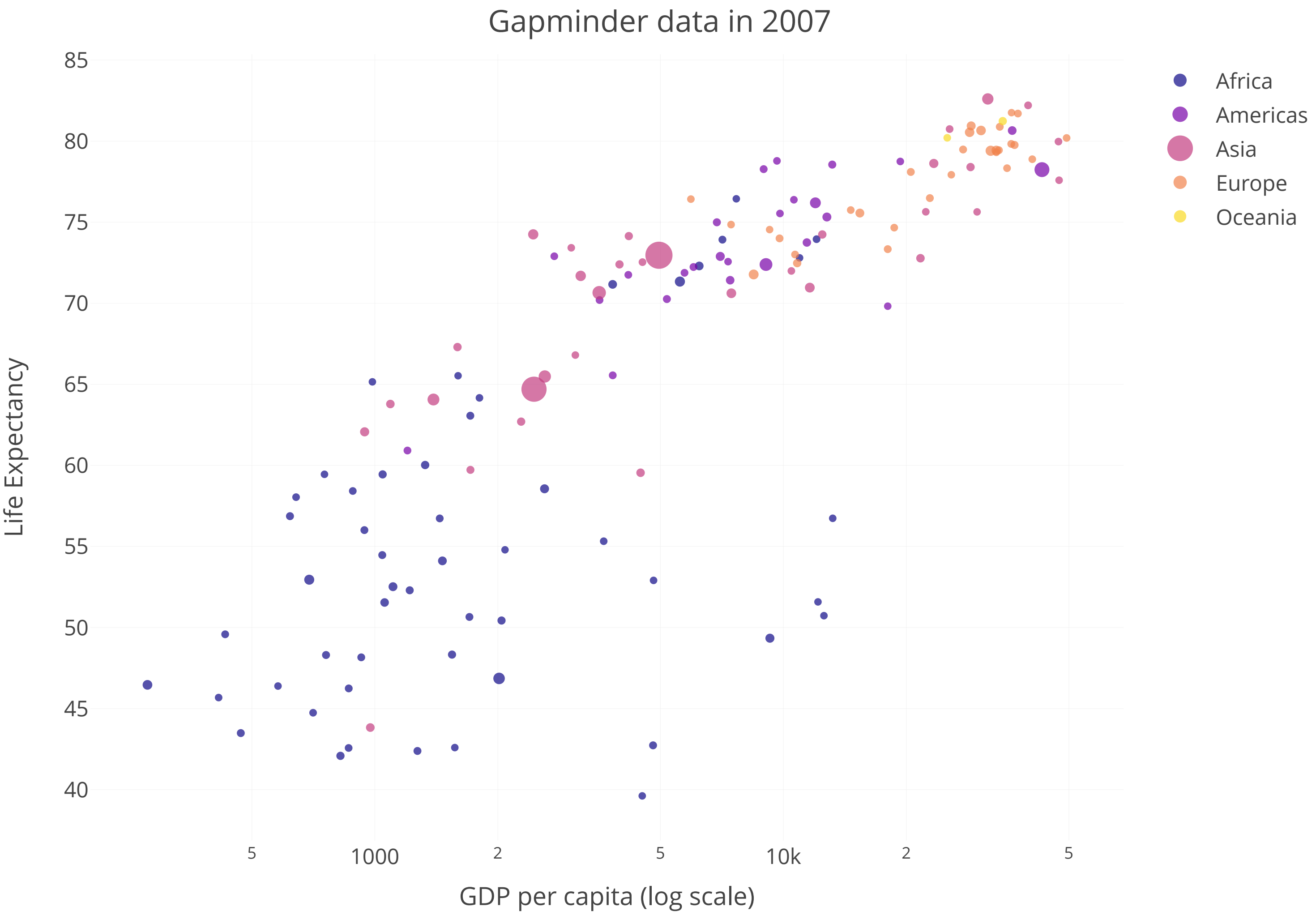
R + Animated plots (w/ gganimate)



R + Animated plots (w/ gganimate)

```r
# The package for animating ggplot2
library(gganimate)
# As before
ggplot(
  data = gapminder %>% filter(continent != "Oceania"),
  aes(gdpPercap, lifeExp, size = pop, color = country)
) +
geom_point(alpha = 0.7, show.legend = FALSE) +
scale_colour_manual(values = country_colors) +
scale_size(range = c(2, 12)) +
scale_x_log10("GDP per capita", label = scales::comma) +
facet_wrap(~continent) +
theme_pander(base_size = 16) +
theme(panel.border = element_rect(color = "grey90", fill = NA)) +
# Here comes the gganimate-specific bits
labs(title = "Year: {frame_time}") +
ylab("Life Expectancy") +
transition_time(year) +
ease_aes("linear")
```

R + Interactive plots (w/ `plotly`)



```r
plot_ly(
  data = gapminder %>% filter(year == 2007),
  x = ~gdpPercap,
  y = ~lifeExp,
  type = "scatter",
  mode = "markers",
  size = ~pop,
  color = ~continent,
  colors = viridis::plasma(n = 5, end = .93),
  text = ~paste(
    "Country: ", country,
    "<br>GDP per capita:", scales::dollar(gdpPercap, 1),
    "<br>Life Expectancy:", scales::comma(lifeExp, 1),
    "<br>Population:", scales::comma(pop)
  ),
  hoverinfo = "text",
  sizes = c(5, 100)
) %>%
  layout(
    title = "Gapminder data in 2007",
    xaxis = list(title = "GDP per capita (log scale)", type = "log"),
    yaxis = list(title = "Life Expectancy")
  )
```

Getting started with R

Starting R

Installation

- Install R.
- Install `RStudio`.
- **Optional/Overkill:** Git
    - Create an account on GitHub
    - Register for a student/educator discount.
    - For installation guidance and troubleshooting, check out Jenny Bryan's website.
- **Note:** Many UO labs have R installed and ready (helpful in an pinch).

Starting R

Resources

Free(-ish)

- Google (which inevitably leads to StackOverflow)
- Time
- ChatGPT, Copilot, and other AI assistants
- Data services at the UO library
- Your classmates
- Your GE and me
- R resources here and here
- swirl and learnr

Money

Short online courses, e.g., DataCamp

Starting R

Some R basics

You will dive deeper into R in lab, but here six big points about R:

1. Everything is an **object**. `foo`
2. Every object has a **name** and **value**. `foo = 2`
3. You use **functions** on these objects. `mean(foo)`
4. Functions come in **libraries** (**packages**) `library(dplyr)`
5. R will try to **help** you. `?dplyr`
6. R has its **quirks**. `NA; error; warning`

Next: Metrics review(s)