Data Visualization Using R & ggplot2

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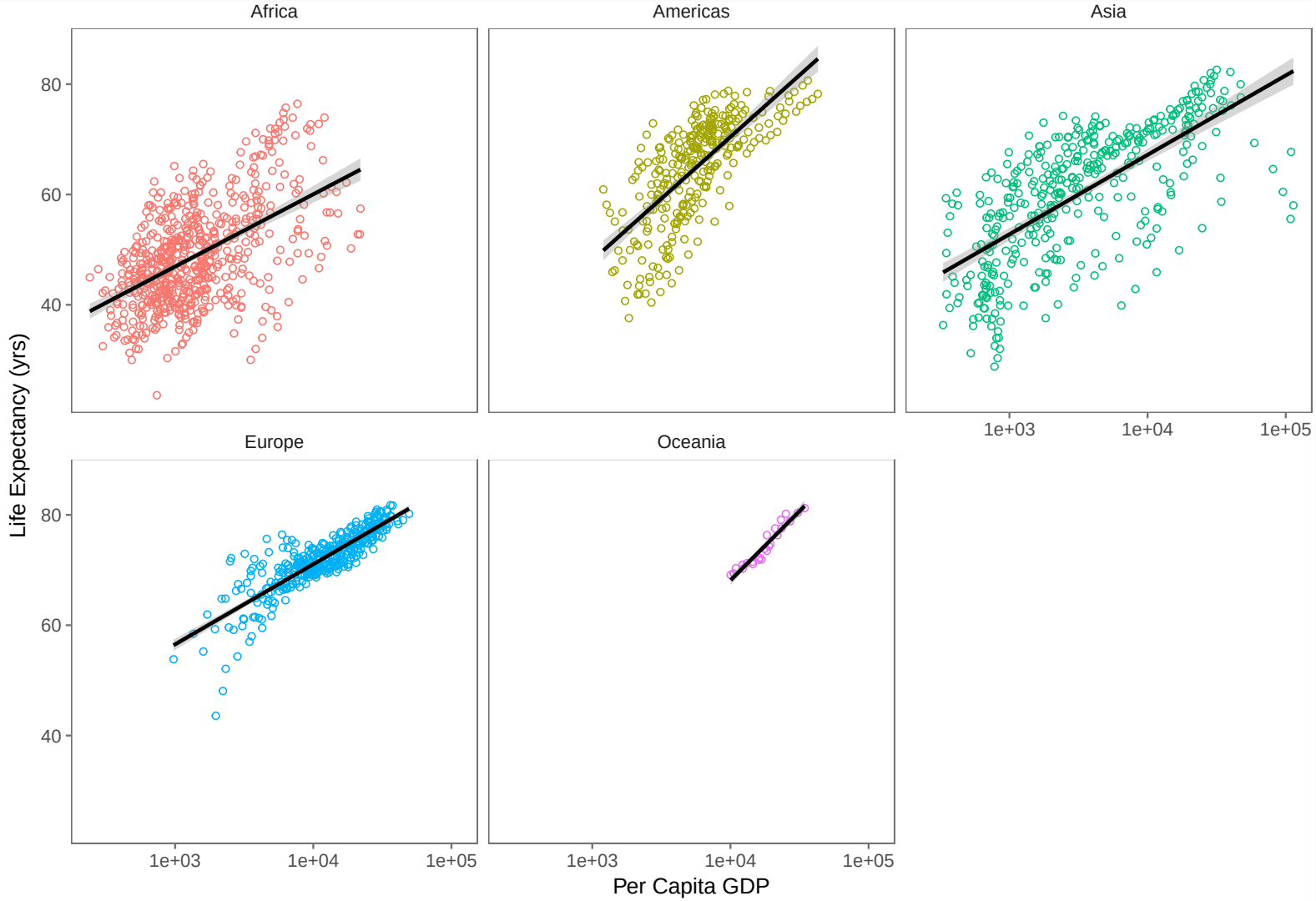
Some housekeeping

Install some packages

```
install.packages("ggplot2", dependencies = TRUE)
install.packages("ggthemes")
install.packages("tidyr")
install.packages("dplyr")
```

Why ggplot?

1 minute

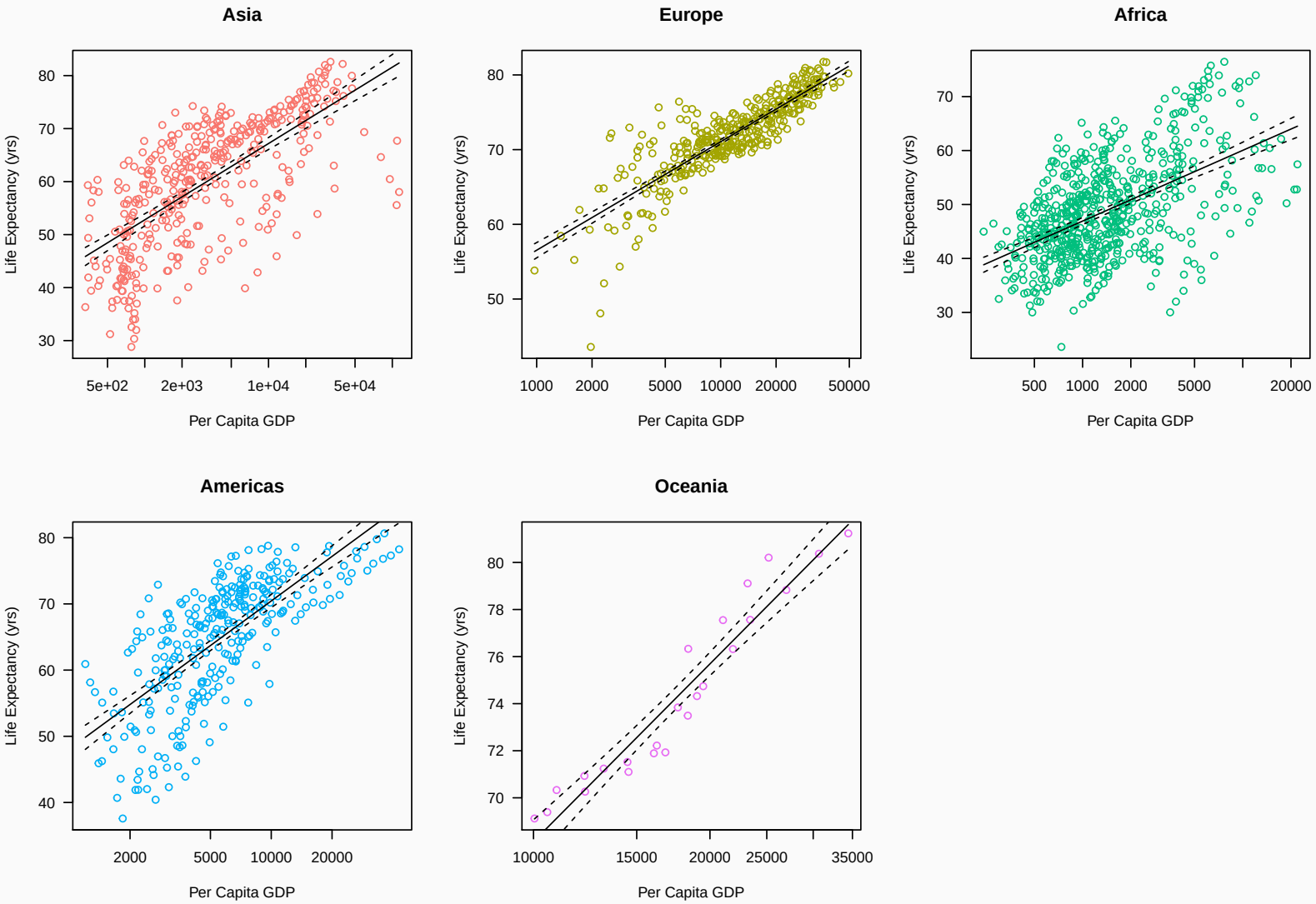

Africa
Americas
Asia
Europe
Oceania
Life Expectancy (yrs)
80
60
40
1e+03
1e+04
1e+05
Per Capita GDP

1 minute

```
library(ggplot2)
library(gapminder)
library(ggthemes)

ggplot(gapminder, aes(x = gdpPercap, y = lifeExp)) +
  geom_point(shape = 1, aes(color = continent)) +
  stat_smooth(method = "lm", size = 1, color = "black") +
  scale_x_log10() +
  xlab("Per Capita GDP") +
  ylab("Life Expectancy (yrs)") +
  facet_wrap(~continent) +
  theme_few() +
  guides(color = FALSE)
```

30 minutes


Asia
Life Expectancy (yrs)
Per Capita GDP
5e+02
2e+03
1e+04
5e+04
Europe
Life Expectancy (yrs)
Per Capita GDP
1000
2000
5000
10000
20000
50000
Africa
Life Expectancy (yrs)
Per Capita GDP
500
1000
2000
5000
20000
Americas
Life Expectancy (yrs)
Per Capita GDP
2000
5000
10000
20000
Oceania
Life Expectancy (yrs)
Per Capita GDP
10000
15000
20000
25000
35000

30 minutes

```
library(scales)
library(gapminder)
gapminder <- as.data.frame(gapminder)
conts <- unique(gapminder[,"continent"])
cols <- scales::hue_pal()(length(conts))
par(mfrow = c(2,3))
counter <- 1
for (i in conts) {
  plot(gapminder[which(gapminder$continent == i), "gdpPercap"],
       gapminder[which(gapminder$continent == i), "lifeExp"], col = col
       xlab = "Per Capita GDP", ylab = "Life Expectancy (yrs)",
       main = i, las = 1, log = "x")
  fit <- lm(gapminder[which(gapminder$continent == i), "lifeExp"] ~
```

But wait, there's more...

```
log(gapminder[which(gapminder$continent == i), "gdpPercap"]))
  pred <- predict(fit, interval = "confidence")
  lines(sort(gapminder[which(gapminder$continent == i), "gdpPercap"]),
  lines(sort(gapminder[which(gapminder$continent == i), "gdpPercap"]),
  lines(sort(gapminder[which(gapminder$continent == i), "gdpPercap"]),
  counter <- counter + 1
}
```

Why ggplot?

Why ggplot?

- More elegant and compact code than with base graphics
- More aesthetically pleasing defaults than lattice
- Very powerful for exploratory data analysis

Why ggplot?

- gg is for grammar of graphics (term by Lee Wilkinson)
- A set of terms that defines the basic components of a plot
- Used to produce figures using coherant, consistant syntax

Why ggplot2?

- Supports a continuum of expertise
- Easy to get started, plenty of power for complex figures

The Grammar

Some terminology

Data

- Must be a data frame (`data.frame()`, `as.data.frame()`)
- Gets pulled into the `ggplot()` object

A quick example

The iris dataset

```
head(iris)
```

```
##   Sepal.Length Sepal.Width Petal.Length Petal.Width Species
## 1          5.1         3.5          1.4         0.2  setosa
## 2          4.9         3.0          1.4         0.2  setosa
## 3          4.7         3.2          1.3         0.2  setosa
## 4          4.6         3.1          1.5         0.2  setosa
## 5          5.0         3.6          1.4         0.2  setosa
## 6          5.4         3.9          1.7         0.4  setosa
```

tidyr

Helps your data play nice with ggplot

tidyr

```
iris[1:2, ]
```

```
##   Sepal.Length Sepal.Width Petal.Length Petal.Width Species
## 1          5.1         3.5          1.4         0.2  setosa
## 2          4.9         3.0          1.4         0.2  setosa
```

```
library(tidyr)
df <- gather(iris, key = flower_attribute,
             value = measurement, -Species)
df[1:2, ]
```

```
##   Species flower_attribute measurement
## 1  setosa     Sepal.Length         5.1
## 2  setosa     Sepal.Length         4.9
```

Aesthetics

Some terminology

aesthetics

- How your data are represented visually
- a.k.a. mapping
- which data on the x
- which data on the y
- but also: color, size, shape, transparency

An example

```
myplot <- ggplot(data = iris, aes(x = Sepal.Length,
                                  y = Sepal.Width))
summary(myplot)
```

```
## data: Sepal.Length, Sepal.Width, Petal.Length, Petal.Width,
##   Species [150x5]
## mapping:  x = Sepal.Length, y = Sepal.Width
## faceting: <ggproto object: Class FacetNull, Facet>
##     compute_layout: function
##     draw_back: function
##     draw_front: function
##     draw_labels: function
##     draw_panels: function
##     finish_data: function
##     init_scales: function
##     map: function
##     map_data: function
##     params: list
```

Geometries

Some terminology

geometry

- The geometric objects in the plot
- points, lines, polygons, etc.
- functions: `geom_point()`, `geom_bar()`, `geom_line()`

Basic structure

```
ggplot(data = iris, aes(x = Sepal.Length, y = Sepal.Width)) +
  geom_point()

# Equivalently...
myplot <- ggplot(data = iris, aes(x = Sepal.Length, y = Sepal.Width))
myplot + geom_point()
```

- Specify the data and variables inside the `ggplot()` function.
- Anything else that goes in here becomes a *global* setting.
- Then add layers: geometric objects, statistical models, and facets.