Data visualization and ggplot2

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Do's and Don'ts for Effective Graphs

Goal: create more effective graphs

According to Naomi Robbins, effective graphs "improve understanding of data". They do not confuse or mislead.

We want to:

- Facilitate comparisons
- Reveal trends

Why we shouldn't use pie charts

The most loathed graph of all and yet surprisingly common.

Give your average person a bunch of numbers that add up to one and they want to make a pie chart.

Why?

Why are they wrong?

http://www.richardhollins.com/blog/why-pie-charts-suck/

"The only worse design than a pie chart is several of them."

This animation created by Darkhorse Analytics illustrates how communication can be greatly enhanced by eliminating clutter and de-emphasizing supporting elements. Every aspect of a figure should be there on a “need to have it” basis.

http://stat545-ubc.github.io/img/less-is-more-darkhorse-analytics.gif

from Wickham's *Tidy Data*

In **tidy data**:

1. Each variable forms a column.
2. Each observation forms a row.
3. Each type of observational unit forms a table.

messy

	treatmenta	treatmentb
John Smith	—	2
Jane Doe	16	11
Mary Johnson	3	1

	John Smith	Jane Doe	Mary Johnson
treatmenta	—	16	3
treatmentb	2	11	1

tidy

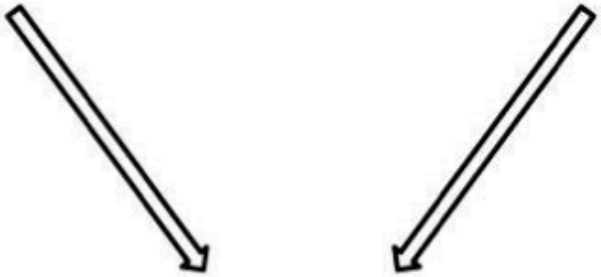
name	trt	result
John Smith	a	—
Jane Doe	a	16
Mary Johnson	a	3
John Smith	b	2
Jane Doe	b	11
Mary Johnson	b	1

https://github.com/jennybc/ggplot2-tutorial/tree/master/ggplot2-tutorial-slides

from White et al's *Nine simple ways* ...

	Habitat		
Species	X	Y	Z
A	0	3	0
B	1	0	2

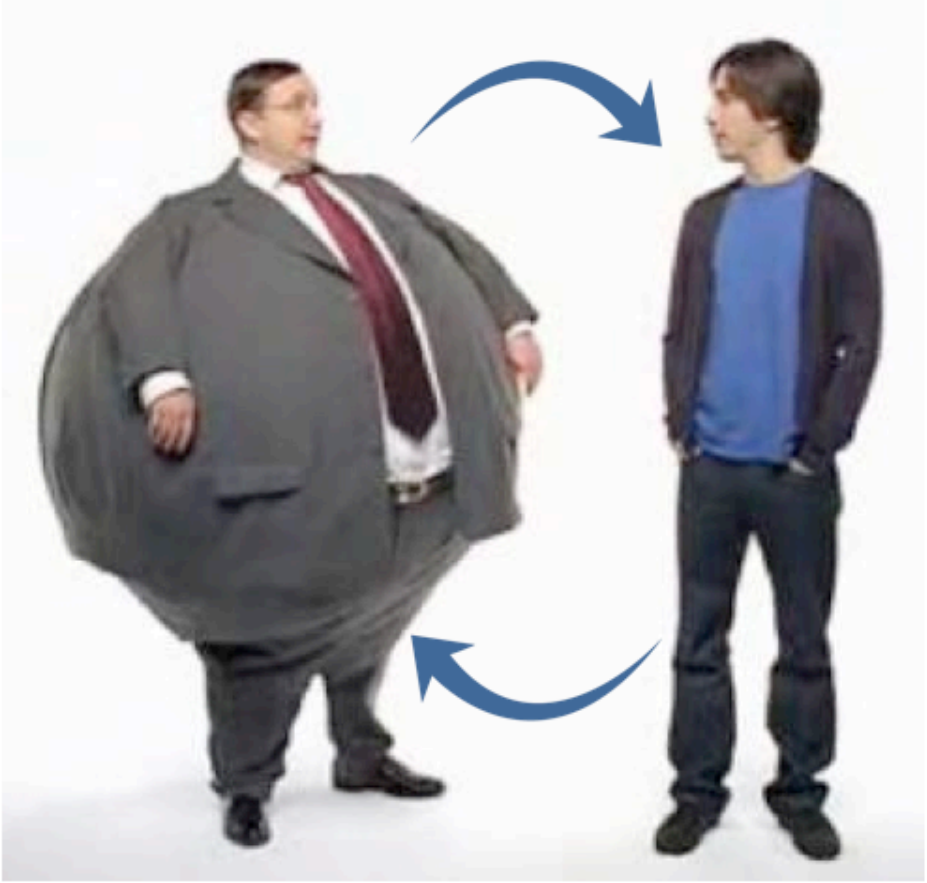
Species	HabitatX	HabitatY	HabitatZ
A	0	3	0
B	1	0	2



Species	Habitat	Abundance
A	Y	3
B	X	1
B	Z	2

https://github.com/jennybc/ggplot2-tutorial/tree/master/ggplot2-tutorial-slides

reshape your data

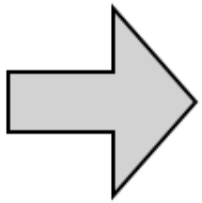


data has a tendency to get shorter and wider, but tall and thin often better for analysis + visualization

from Wickham's *Tidy Data*
see also reshape2

reshape2::melt
tidyr::gather

row	a	b	c
a	1	4	7
b	2	5	8
c	3	6	9



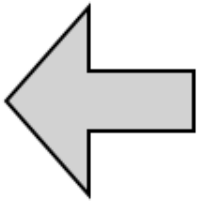
row	column	value
a	a	1
b	a	2
c	a	3
a	b	4
b	b	5
c	b	6
a	c	7
b	c	8
c	c	9

https://github.com/jennybc/ggplot2-tutorial/tree/master/ggplot2-tutorial-slides

from Wickham's *Tidy Data*
see also reshape2

reshape2::cast
tidyr::spread

row	a	b	c
a	1	4	7
b	2	5	8
c	3	6	9

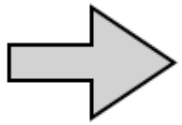


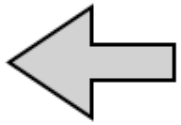
row	column	value
a	a	1
b	a	2
c	a	3
a	b	4
b	b	5
c	b	6
a	c	7
b	c	8
c	c	9

https://github.com/jennybc/ggplot2-tutorial/tree/master/ggplot2-tutorial-slides

gather

row	a	b	c
a	1	4	7
b	2	5	8
c	3	6	9





row	column	value
a	a	1
b	a	2
c	a	3
a	b	4
b	b	5
c	b	6
a	c	7
b	c	8
c	c	9

spread

typical usage pattern:

gather to facilitate analysis and visualization

spread to make compact tables that are nicer for eyeballs

https://github.com/jennybc/ggplot2-tutorial/tree/master/ggplot2-tutorial-slides

Пакет reshape2

```
install.packages("reshape2")
library(“reshape2”)

names(airquality) <- tolower(names(airquality))
head(airquality)

aql <- melt(airquality)
head(aql)
```

Контролируем, какие переменные являются id

```
aql <- melt(airquality, id.vars = c("month", "day"),
  variable.name = "climate_variable",
  value.name = "climate_value")
head(aql)
```

И обратно…

```
aql <- melt(airquality, id.vars = c("month", "day"))
aqw <- dcast(aql, month + day ~ variable)
head(aqw)
```

ggplot2

Author

ggplot2 was developed by Hadley Wickham, assistant professor of statistics at Rice University, Houston. In July 2010 the latest stable release (Version 0.8.8) was published.

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1999 Bachelor of Human Biology, First Class Honours, The University of Auckland, Auckland, New Zealand.

http://www.ceb-institute.org/bbs/wp-content/uploads/2011/09/handout_ggplot2.pdf

```
### устанавливаем и загружаем пакет
install.package("ggplot2")
library("ggplot2")
```

data, in data.frame form

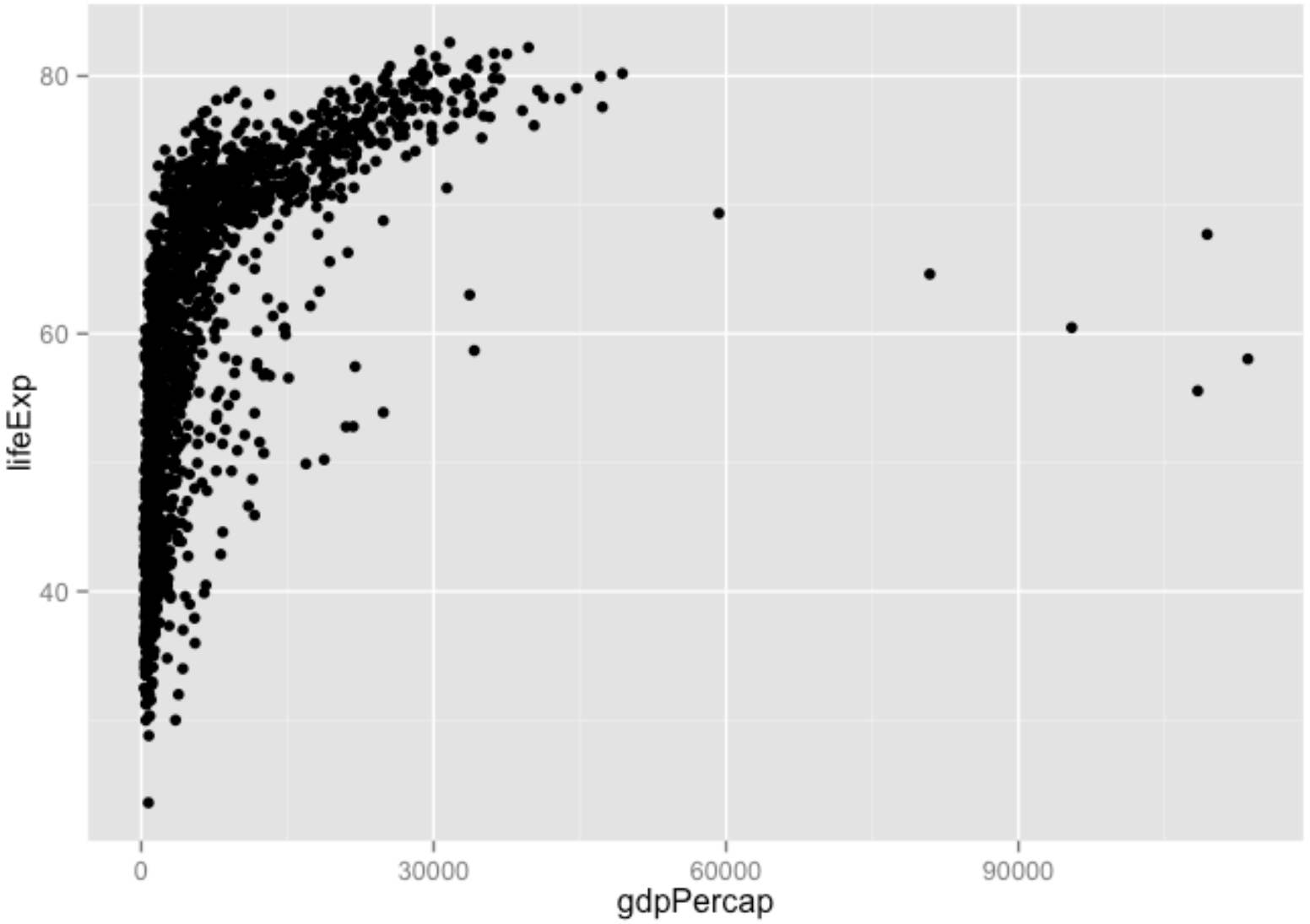
aesthetic: map variables into properties people can perceive visually ... position, color, line type?

geom: specifics of what people see ... points? lines?

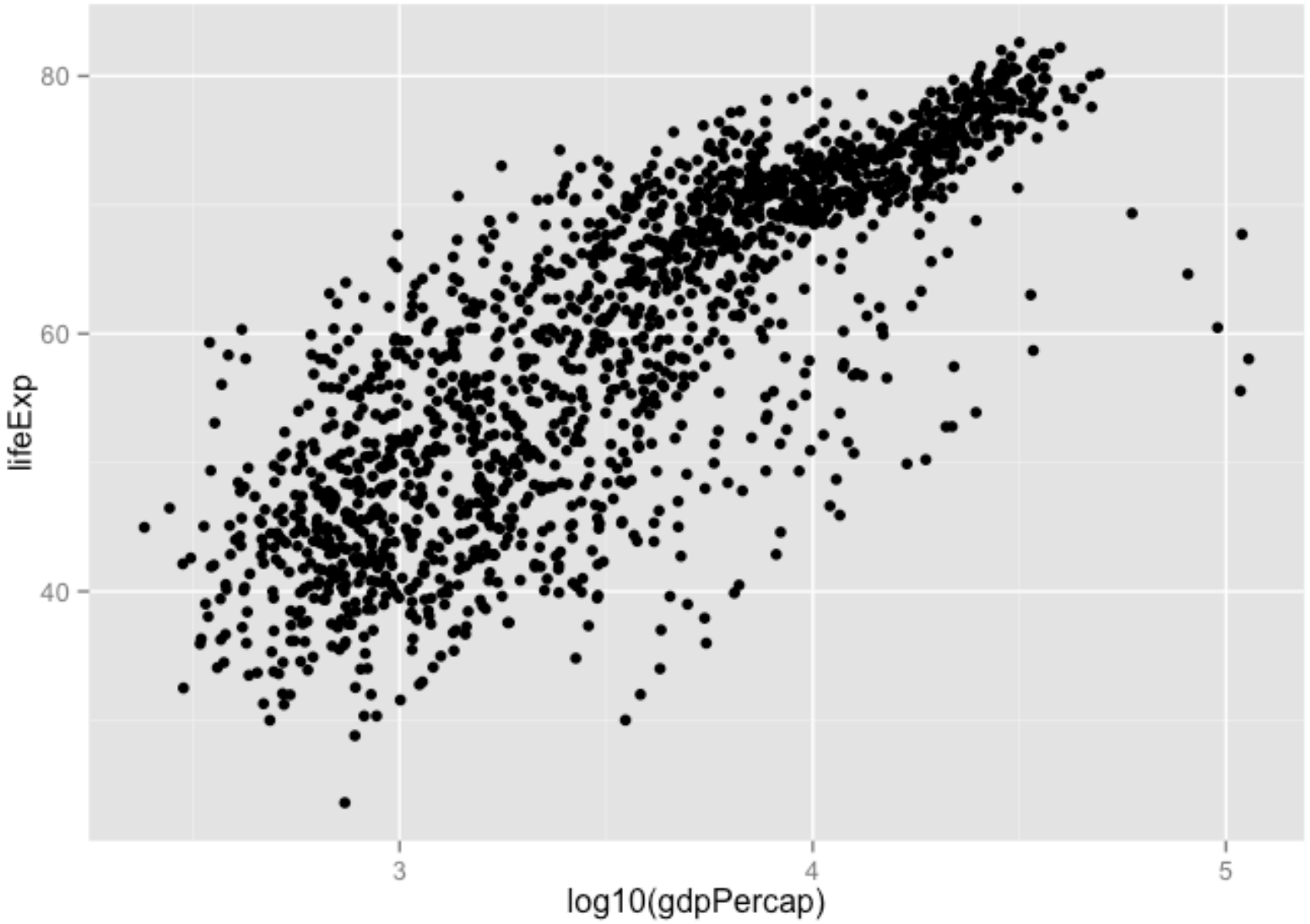
scale: map data values into "computer" values

stat: summarization/transformation of data

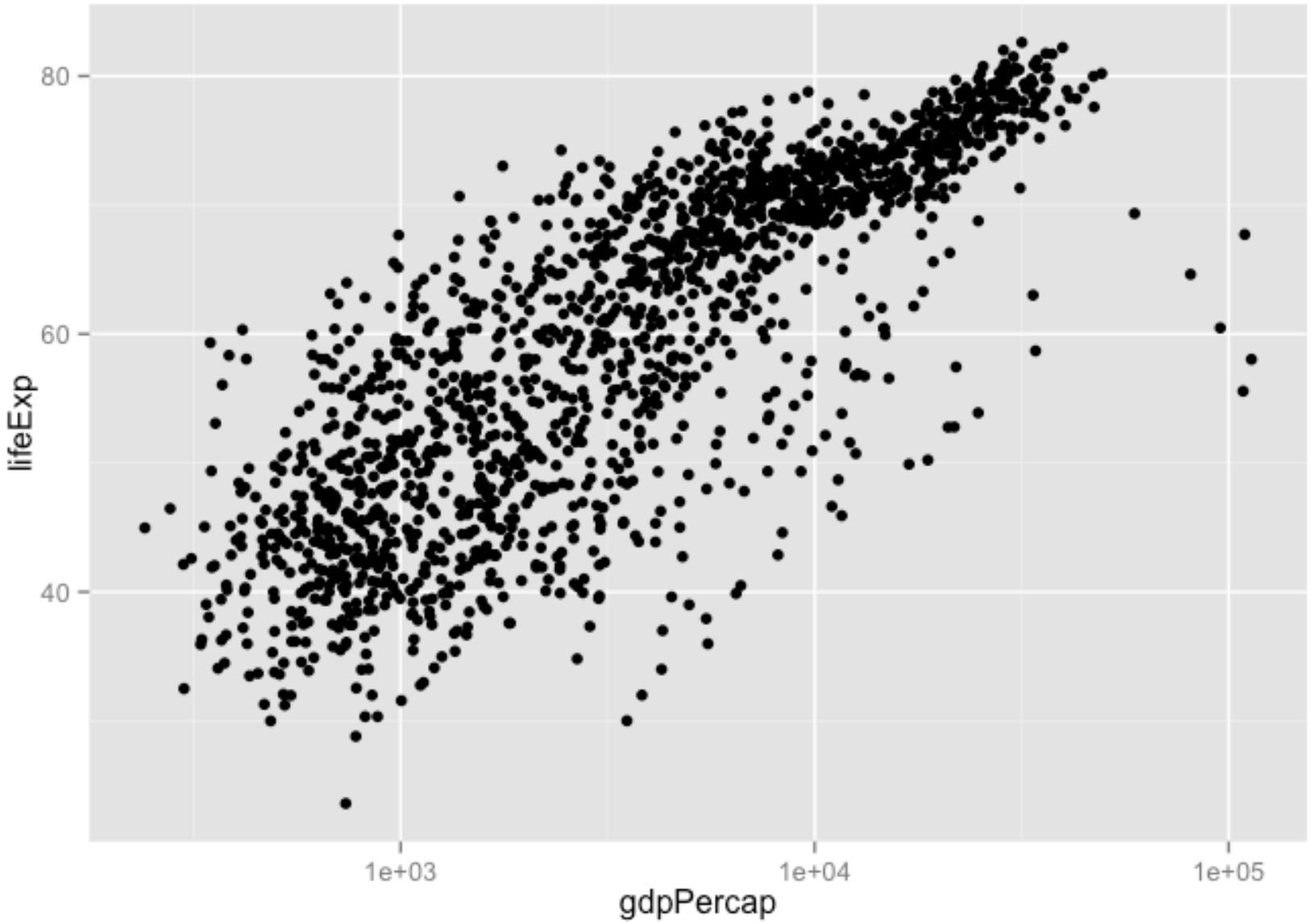
facet: juxtapose related mini-plots of data subsets




```
p <- ggplot(gapminder, aes(x = gdpPercap, y = lifeExp))
p + geom_point()
```

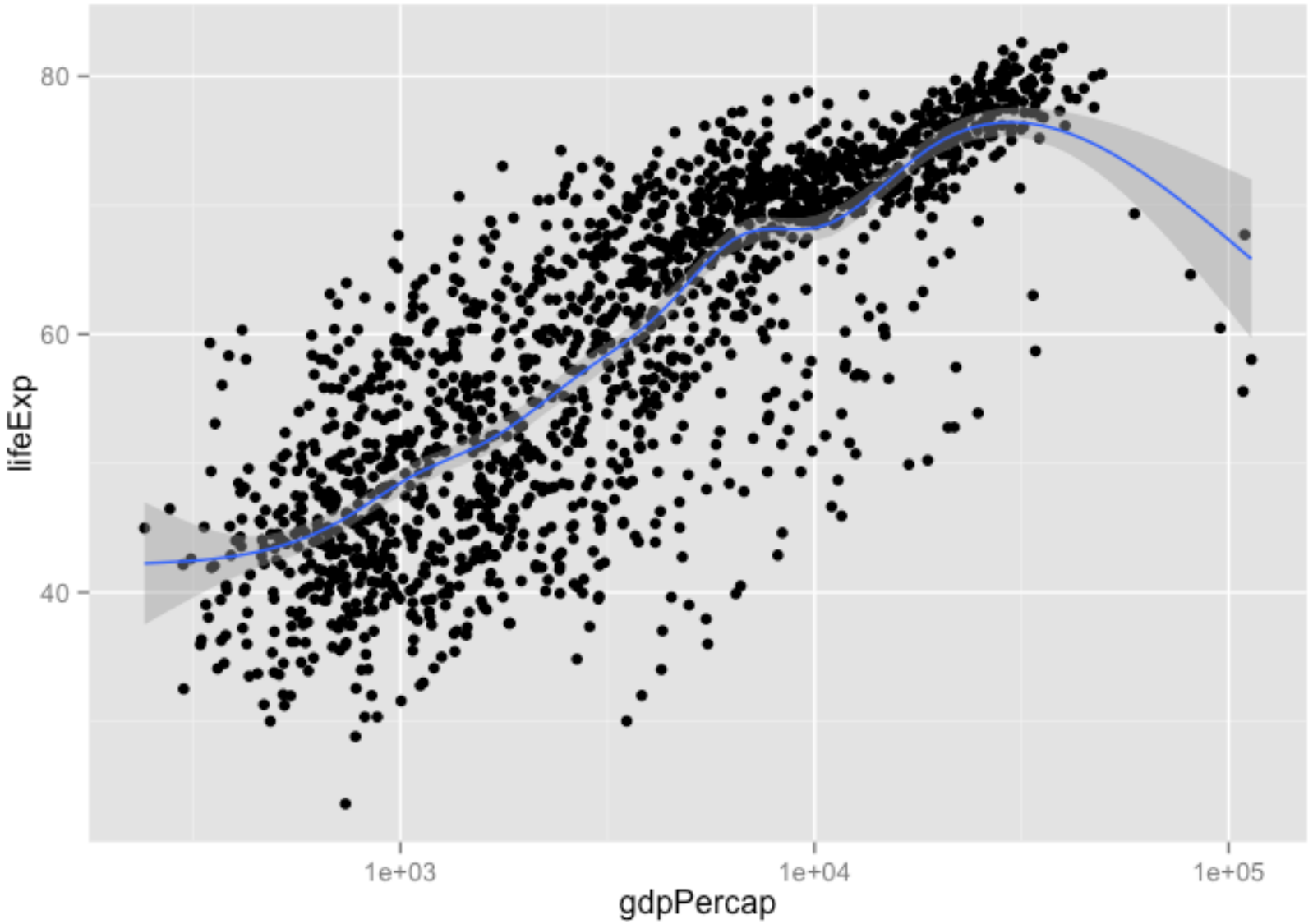



```
ggplot(gapminder, aes(x = log10(gdpPercap), y = lifeExp)) +
geom_point()
```

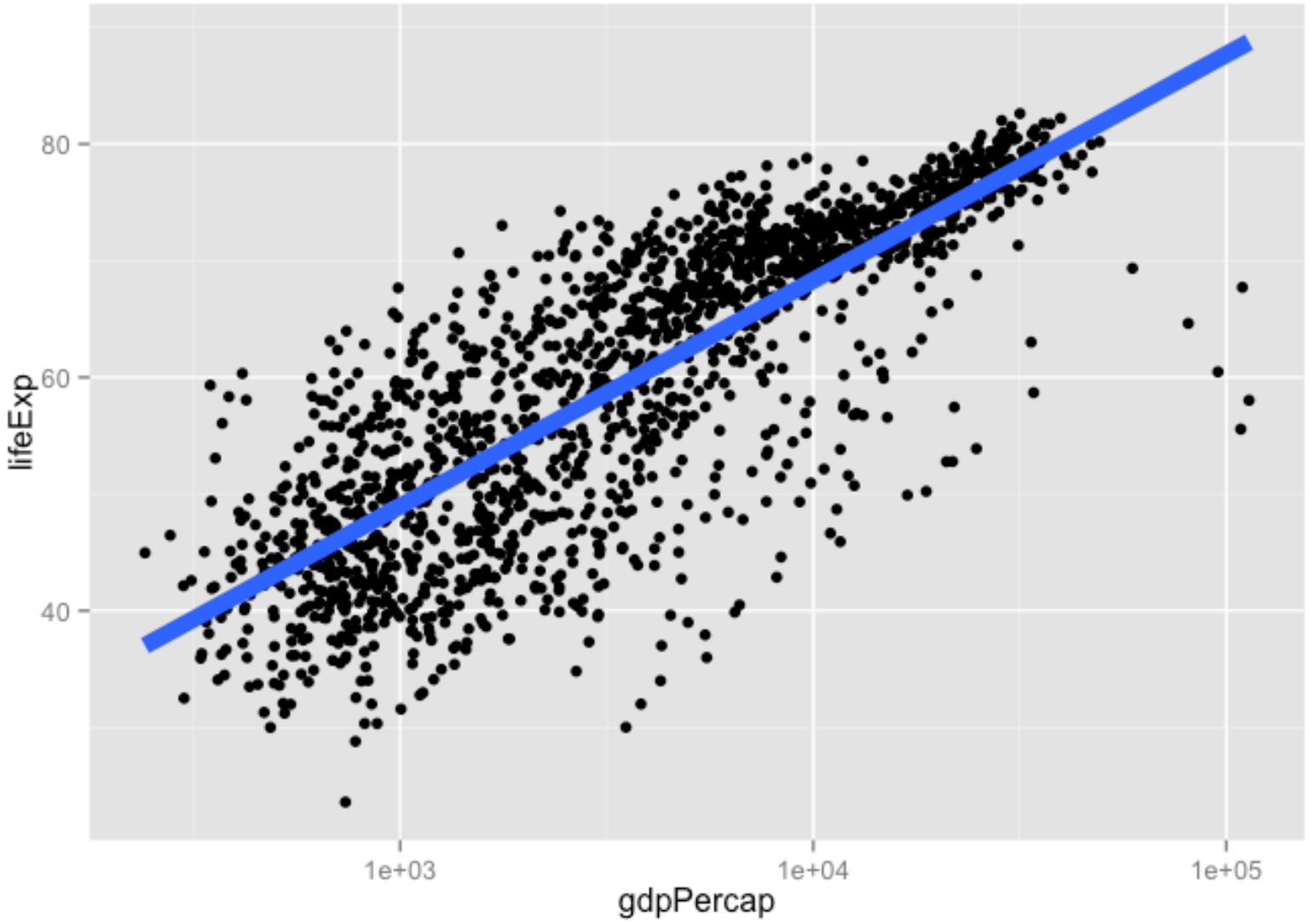



```
p + geom_point() + scale_x_log10()
```


```
ggplot(gapminder, aes(x = gdpPercap, y = lifeExp, color =
continent)) +
  geom_point() + scale_x_log10()
```

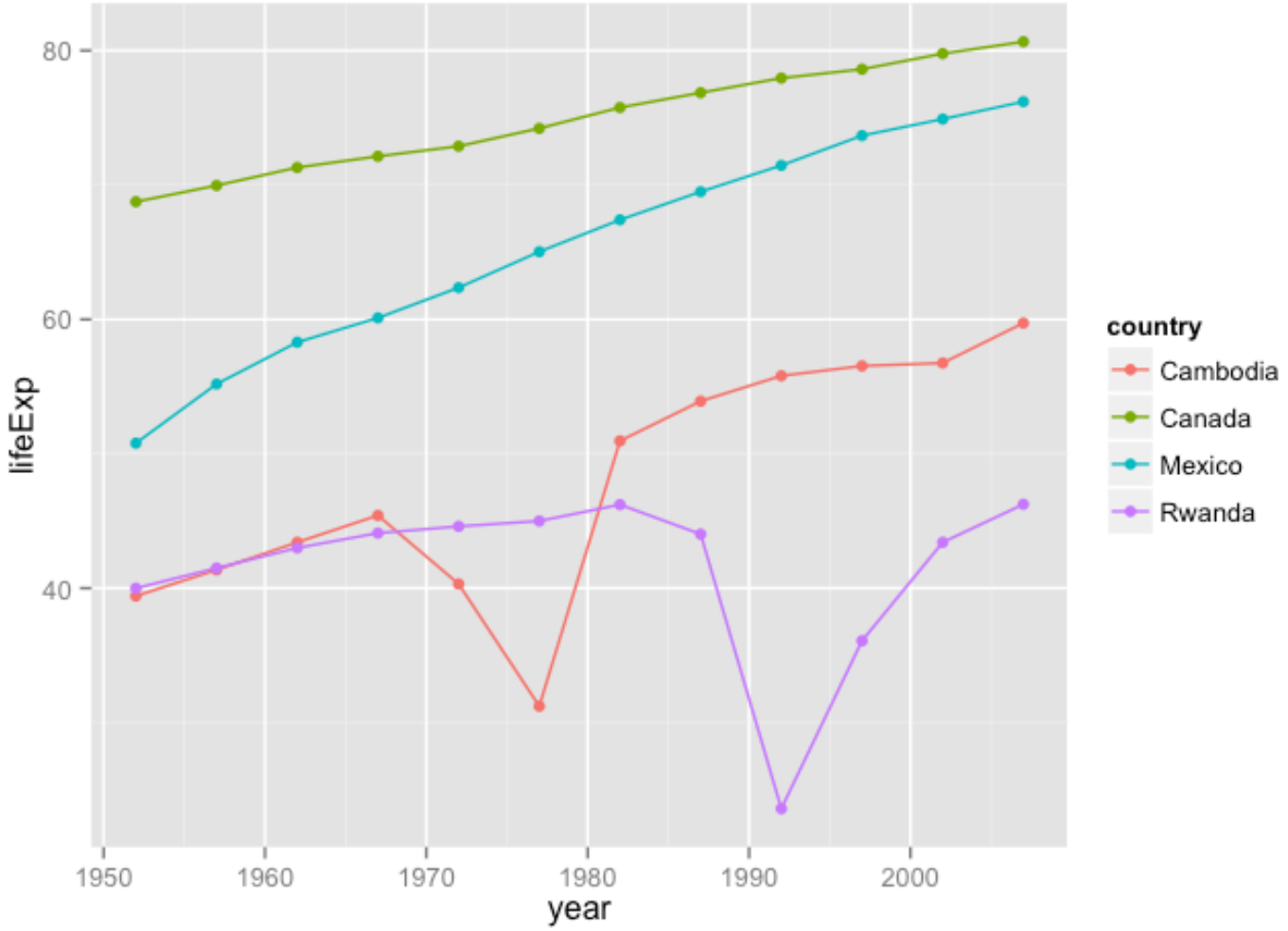



```
p + geom_point() + geom_smooth()
```

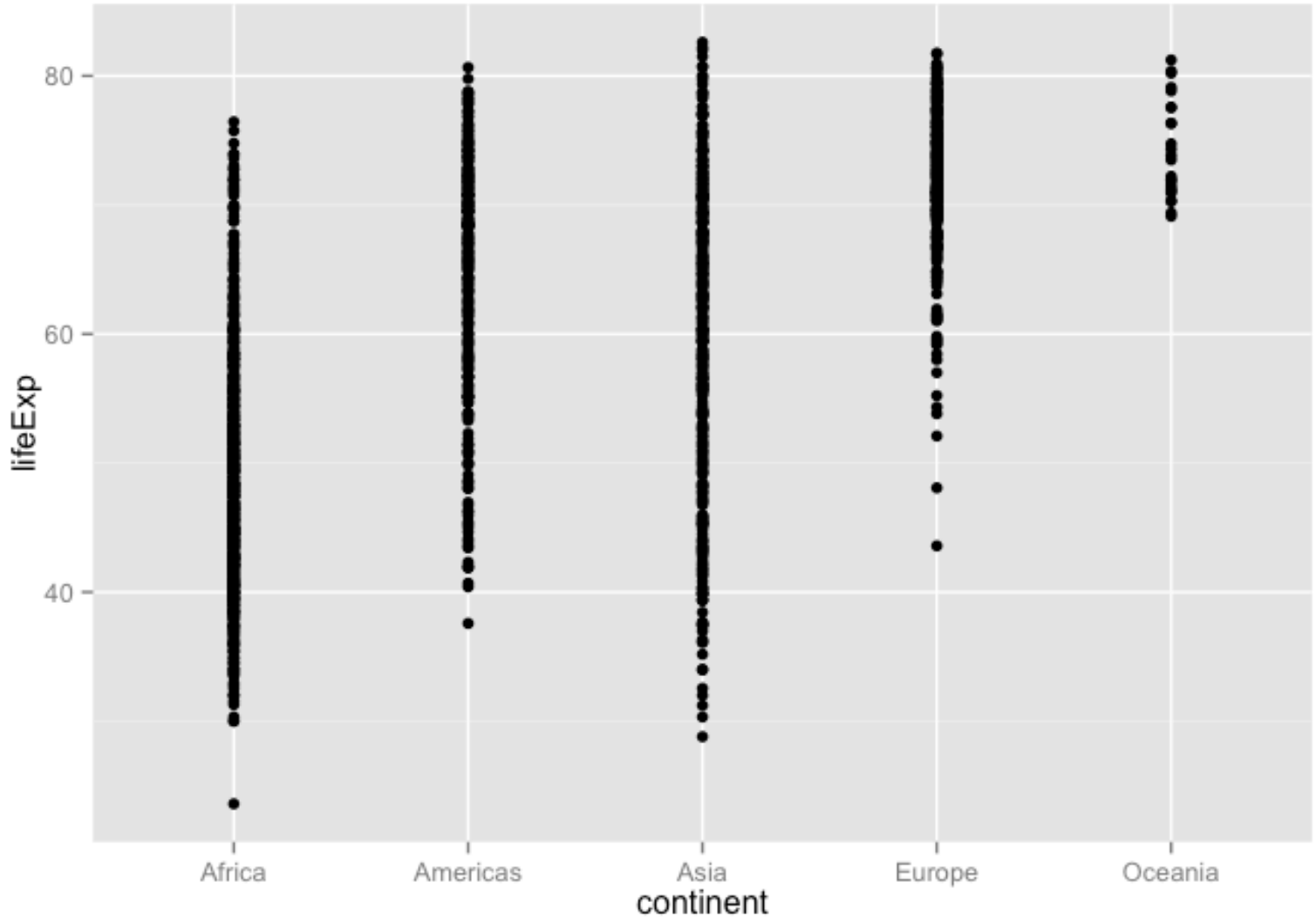



```
p + geom_point() + geom_smooth(lwd = 3, se = FALSE, method
= "lm")
```

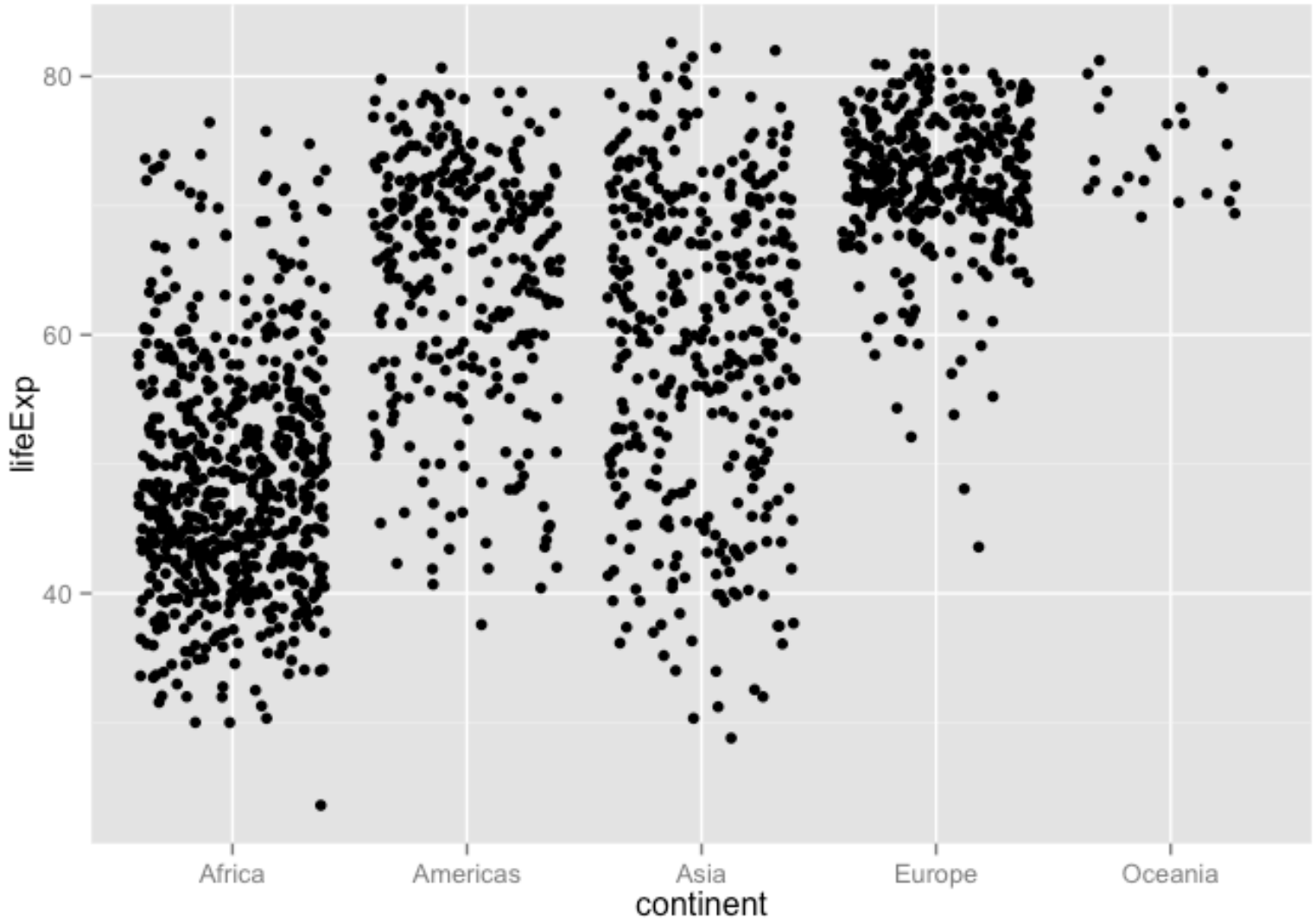

```
ggplot(subset(gapminder, country == "Zimbabwe"),
       aes(x = year, y = lifeExp)) + geom_line() + geom_point()
```



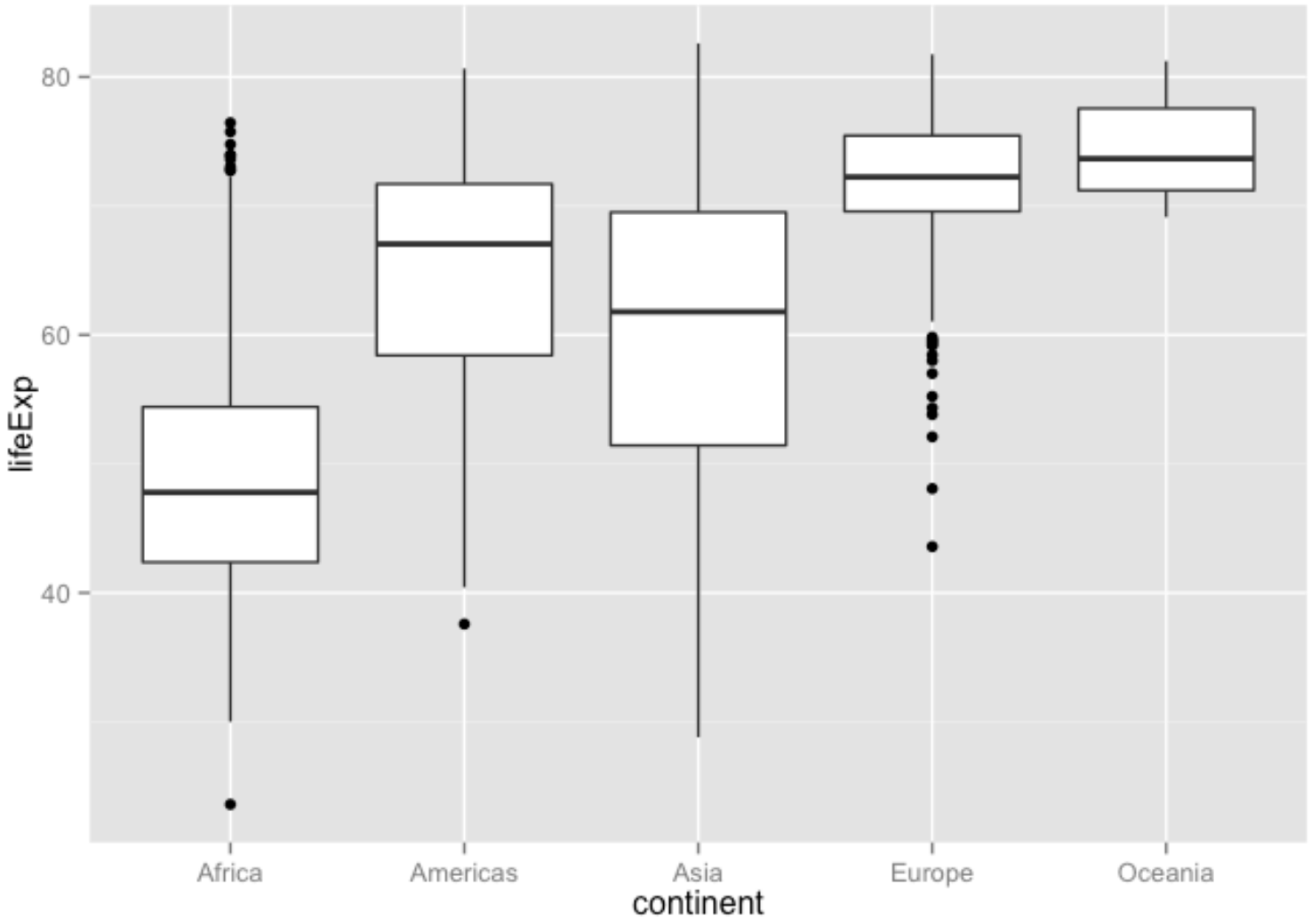

```
jCountries <- c("Canada", "Rwanda", "Cambodia", "Mexico")
ggplot(subset(gapminder, country %in% jCountries),
       aes(x = year, y = lifeExp, color = country)) +
geom_line() + geom_point()
```



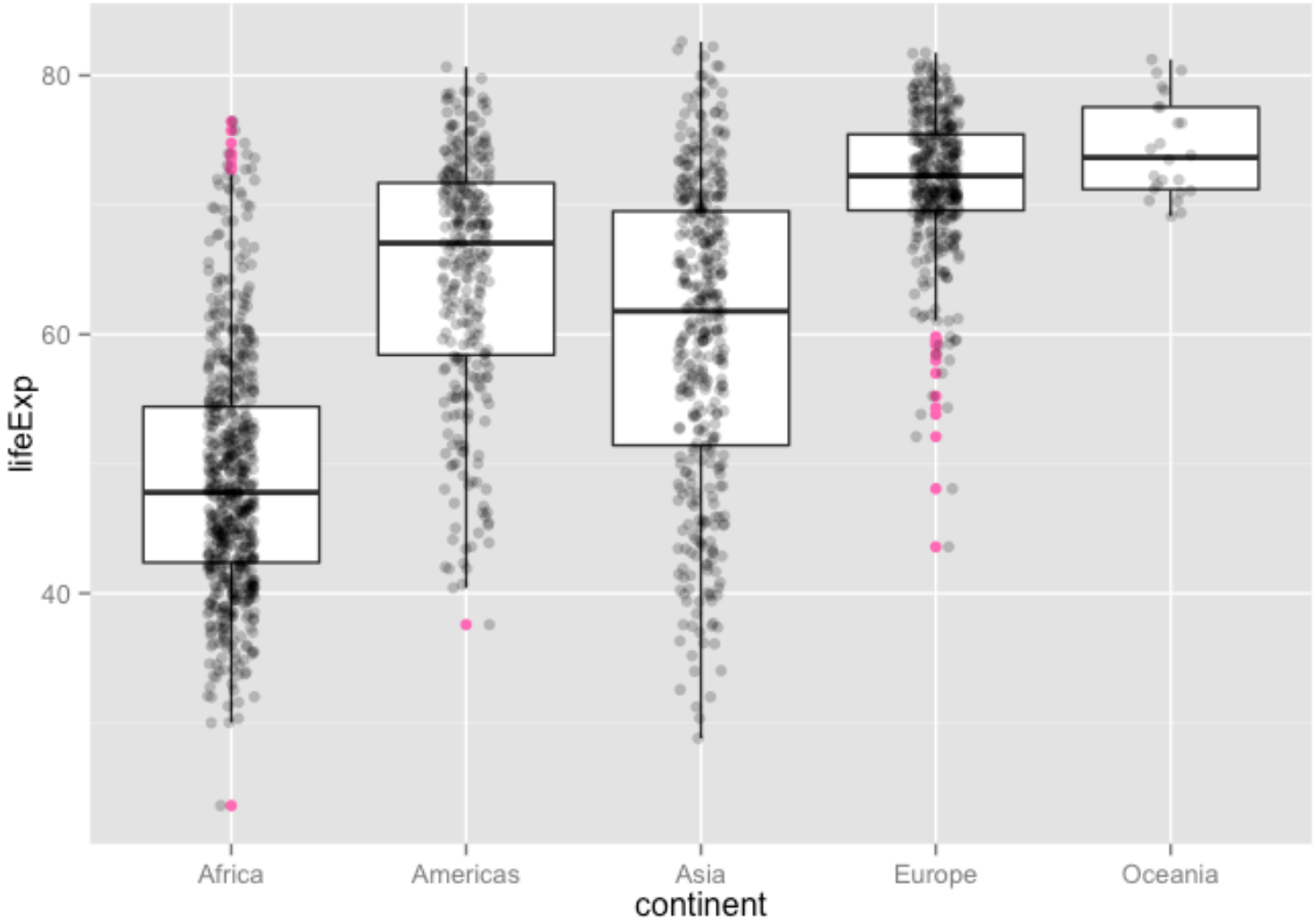

```
ggplot(gapminder, aes(x = continent, y = lifeExp)) +
geom_point()
```



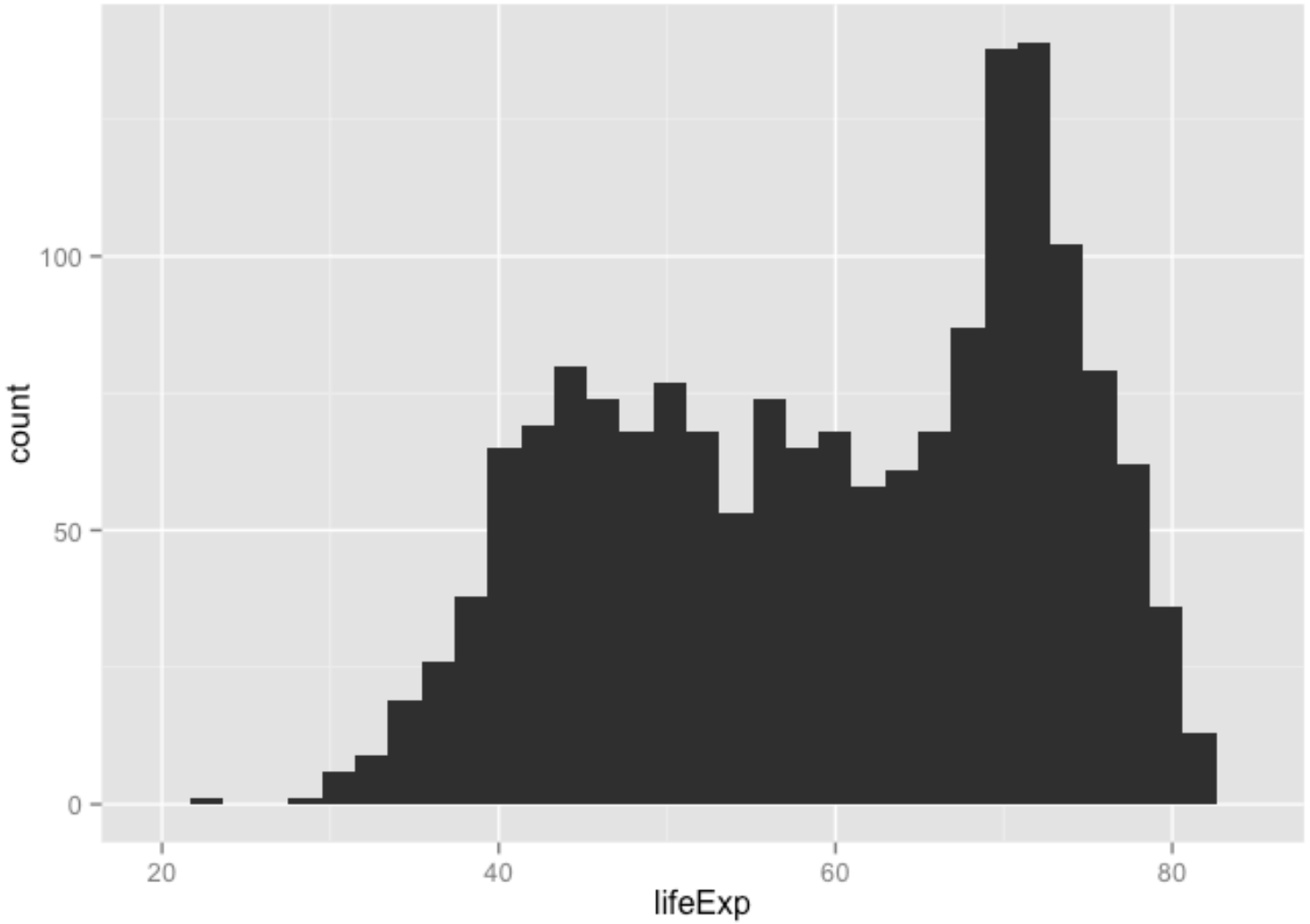

```
ggplot(gapminder, aes(x = continent, y = lifeExp)) +
geom_jitter()
```



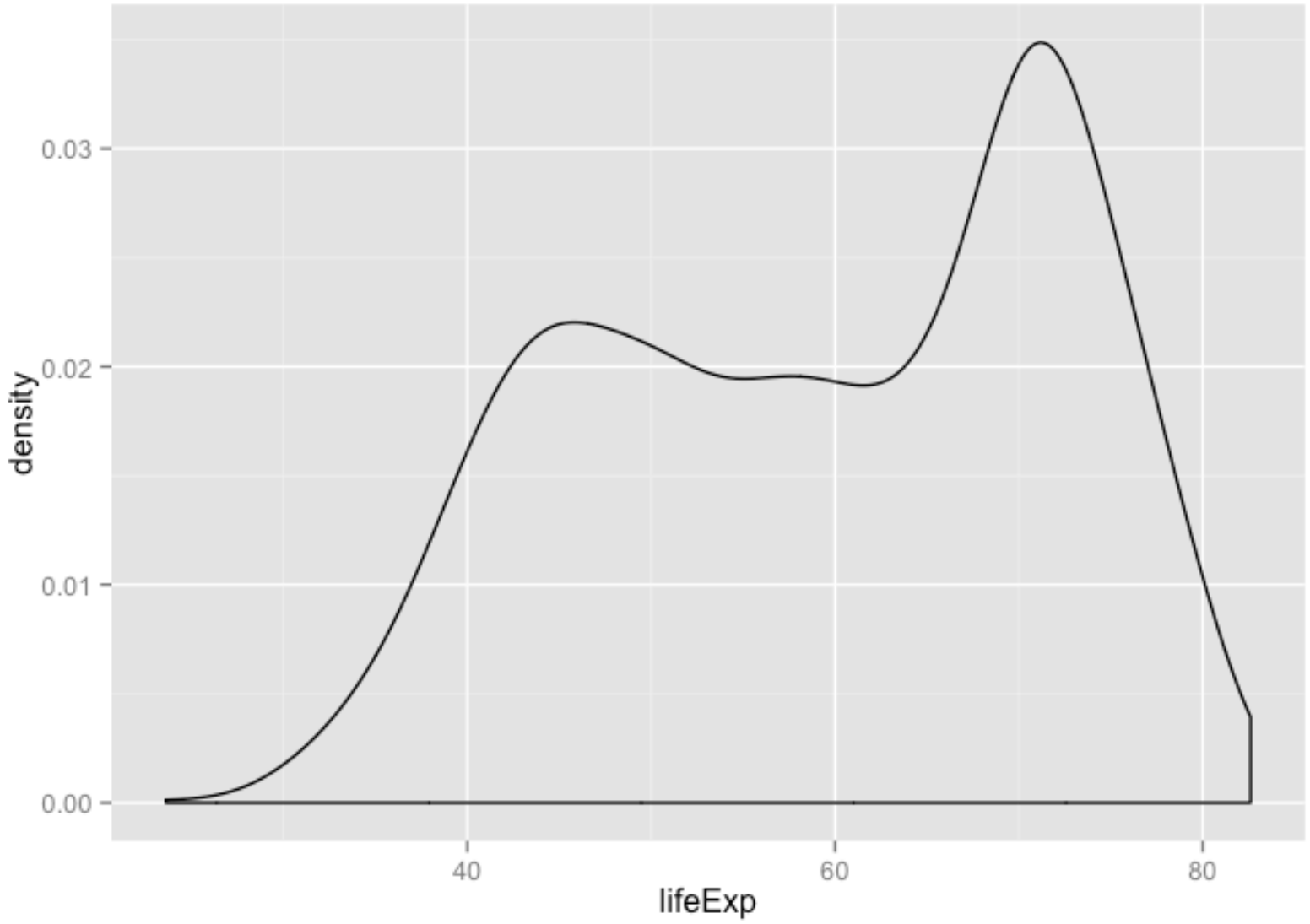

```
ggplot(gapminder, aes(x = continent, y = lifeExp)) +
geom_boxplot()
```



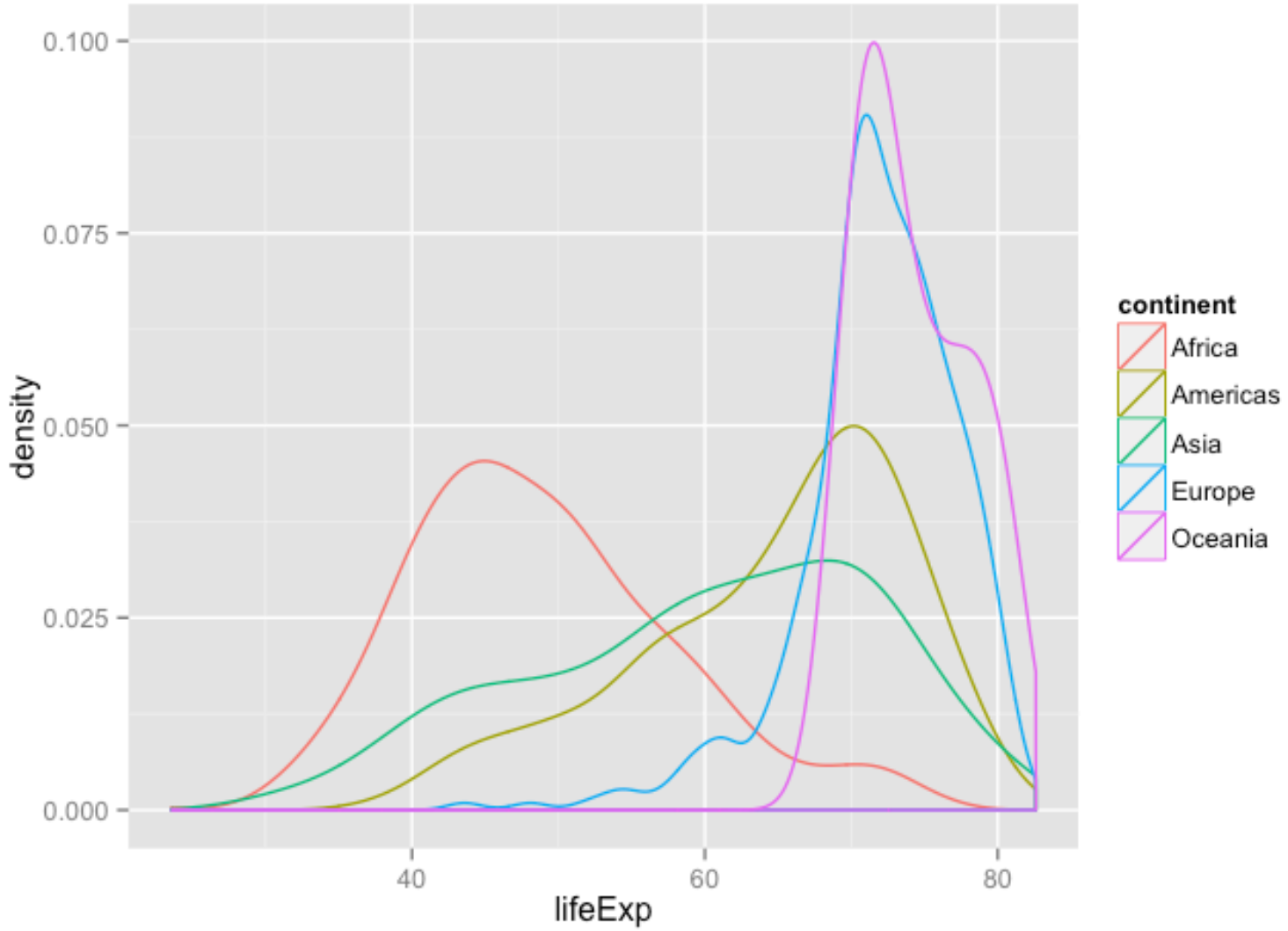

```
ggplot(gapminder, aes(x = continent, y = lifeExp)) +
  geom_boxplot(outlier.colour = "hotpink") +
  geom_jitter(position = position_jitter(width = 0.1, height =
0), alpha = 1/4)
```



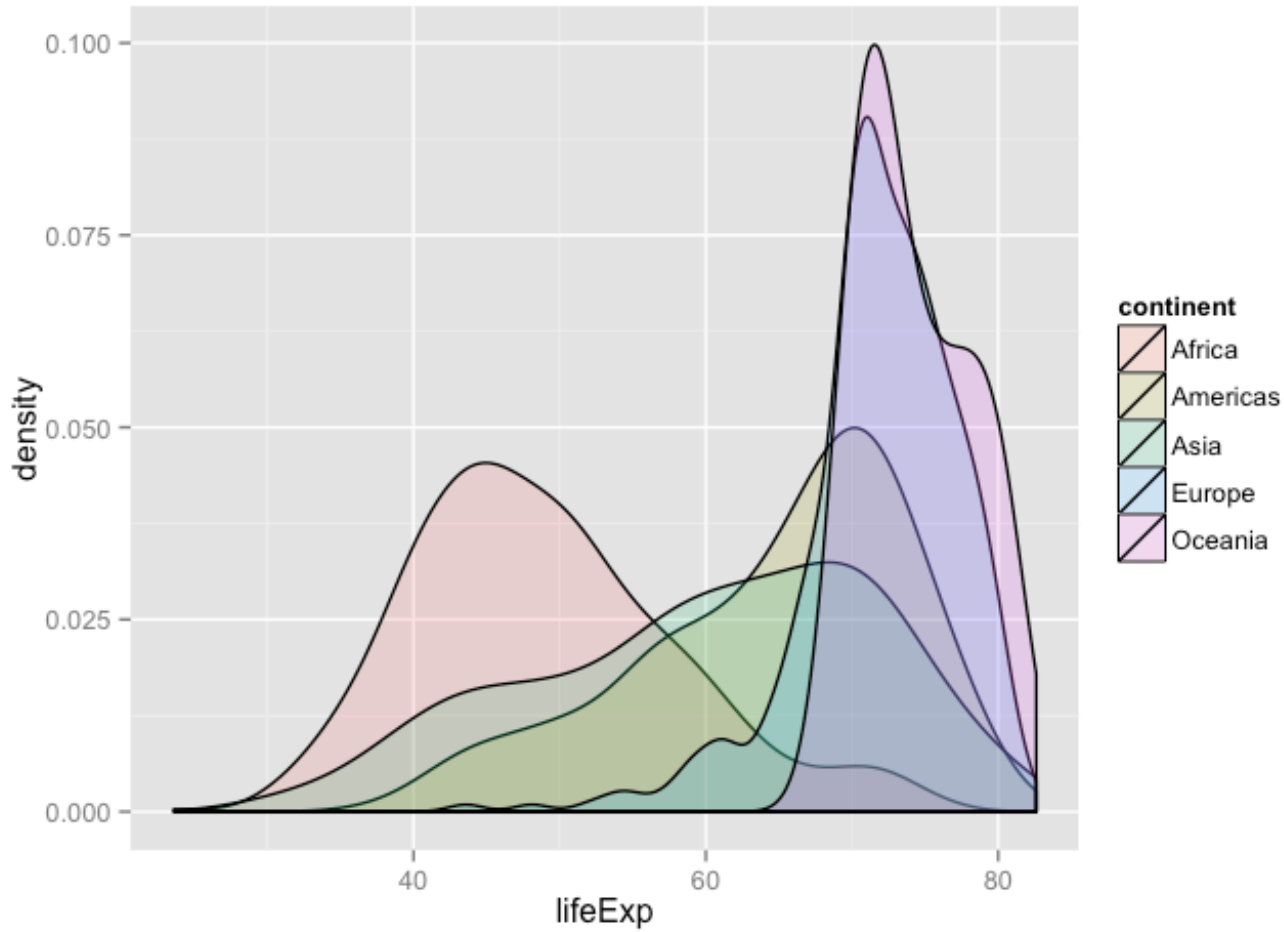

```
ggplot(gapminder, aes(x = lifeExp)) + geom_histogram()
```



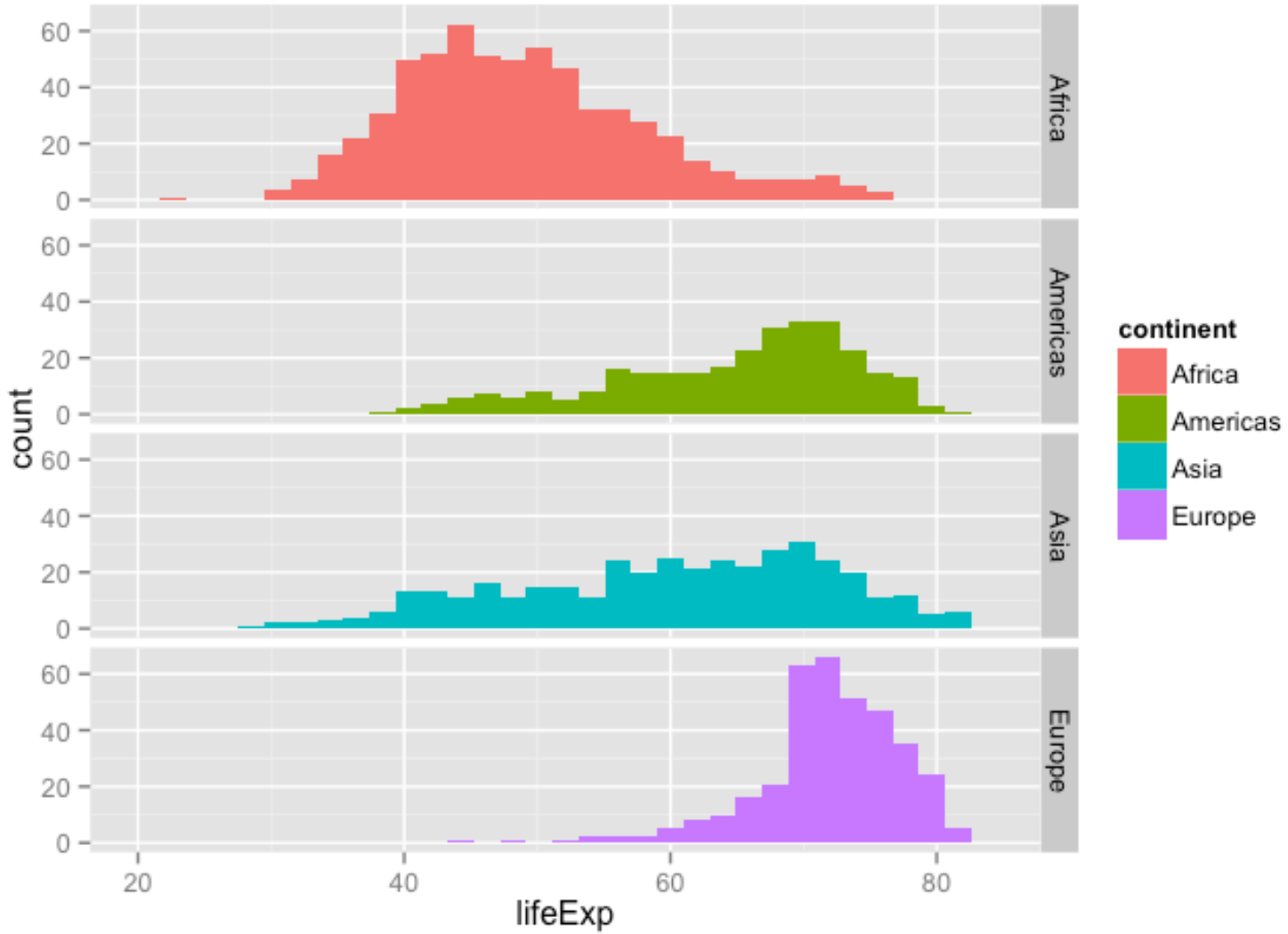

```
ggplot(gapminder, aes(x = lifeExp)) + geom_density()
```



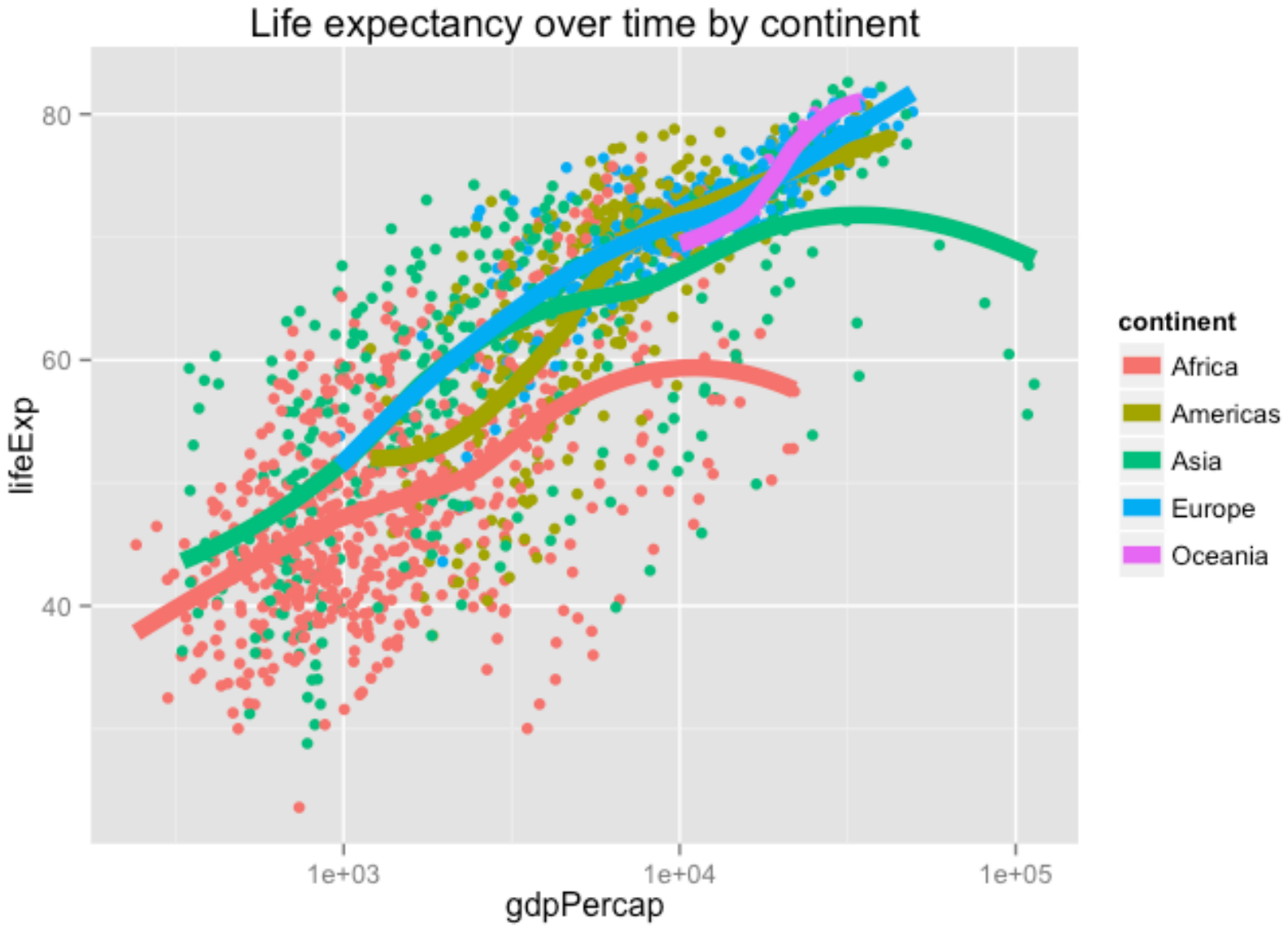

```
ggplot(gapminder, aes(x = lifeExp, color = continent)) +
geom_density()
```



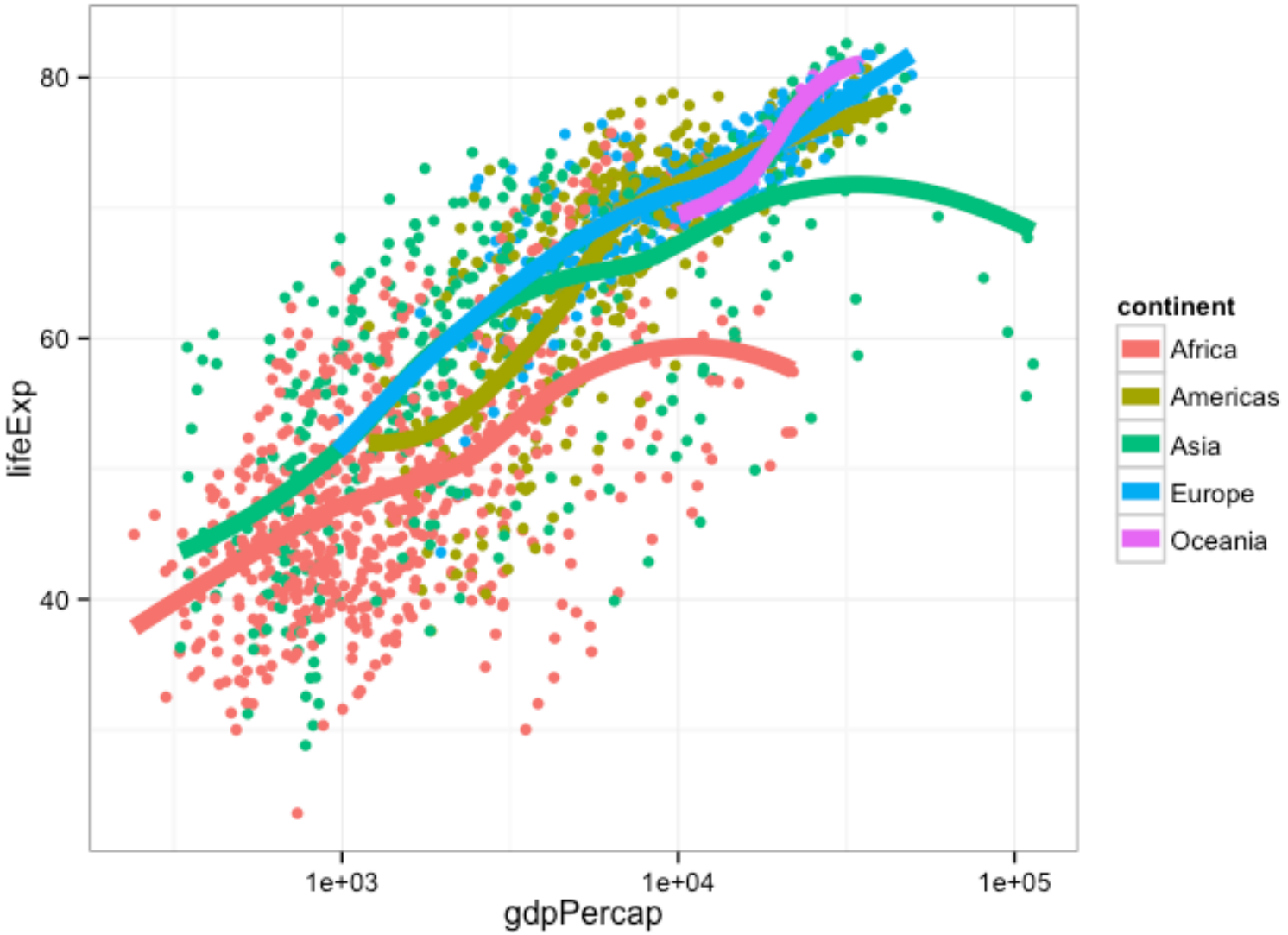

```
ggplot(gapminder, aes(x = lifeExp, fill = continent)) +
  geom_density(alpha = 0.2)
```




```
ggplot(subset(gapminder, continent != "Oceania"),
       aes(x = lifeExp, fill = continent)) +
geom_histogram() +
  facet_grid(continent ~ .)
```




```
p + ggtitle("Life expectancy over time by continent")
```


80
60
40
lifeExp
1e+03
1e+04
1e+05
gdpPercap
continent
Africa
Americas
Asia
Europe
Oceania

```
p + theme_bw()
```