Class 5: Data Visualization (ggplot)

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Using GGPLOT

To use ggplot2 we first need to install it on our computers. To do this we will use the function `install.packages()`.

```
library(ggplot2)
```

```
Warning: package 'ggplot2' was built under R version 4.3.1
```

```
ggplot(cars)
```

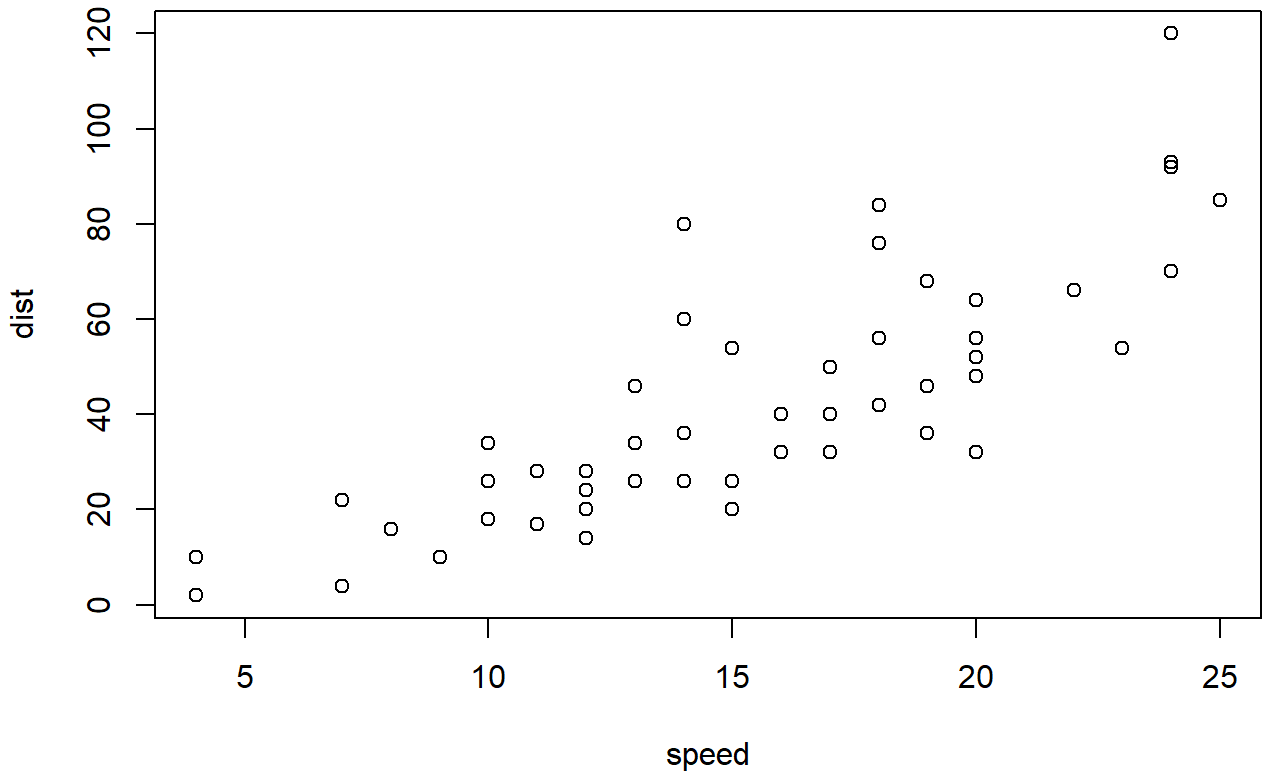


```
head(cars)
```

```
  speed dist
1     4    2
```

```
2     4   10
3     7    4
4     7   22
5     8   16
6     9   10
```

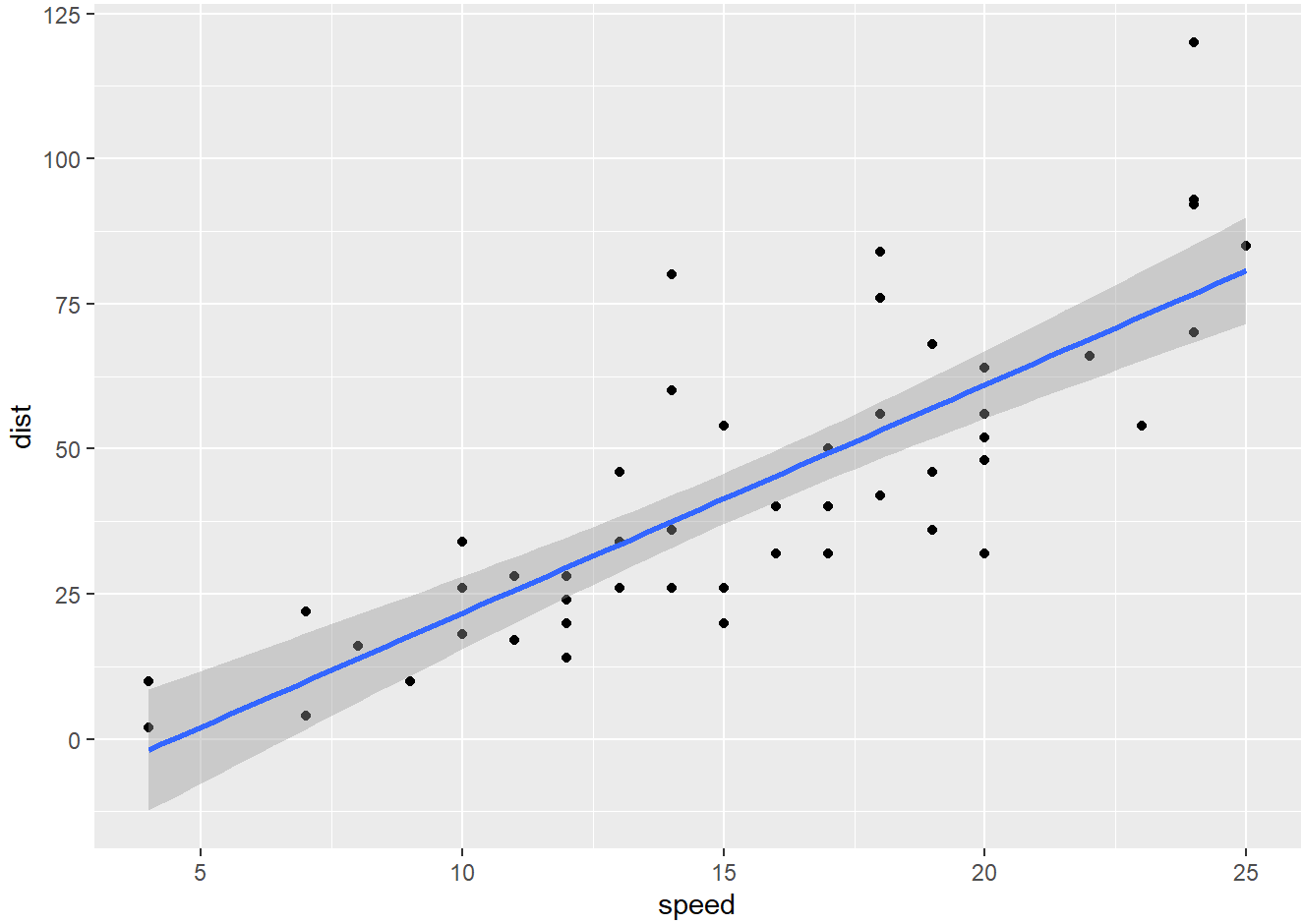
```
plot(cars)
```



ggplot: -data(data.frame for plotting) -aesthetics (aes() values - how to map data) -geom (type of plot)

```
ggplot(cars)+
  aes(x=speed, y=dist)+
  geom_point()+
  geom_smooth(method="lm")
```

```
`geom_smooth()` using formula = 'y ~ x'
```




```
url <- "https://bioboot.github.io/bimm143_S20/class-material/up_down_expression.txt"
genes <- read.delim(url)
head(genes)
```

```
        Gene Condition1 Condition2      State
1      A4GNT -3.6808610 -3.4401355 unchanging
2       AAAS  4.5479580  4.3864126 unchanging
3      AASDH  3.7190695  3.4787276 unchanging
4       AATF  5.0784720  5.0151916 unchanging
5       AATK  0.4711421  0.5598642 unchanging
6 AB015752.4 -3.6808610 -3.5921390 unchanging
```

```
nrow(genes)
```

```
[1] 5196
```

```
ncol(genes)
```

```
[1] 4
```

```
table(genes$State)
```

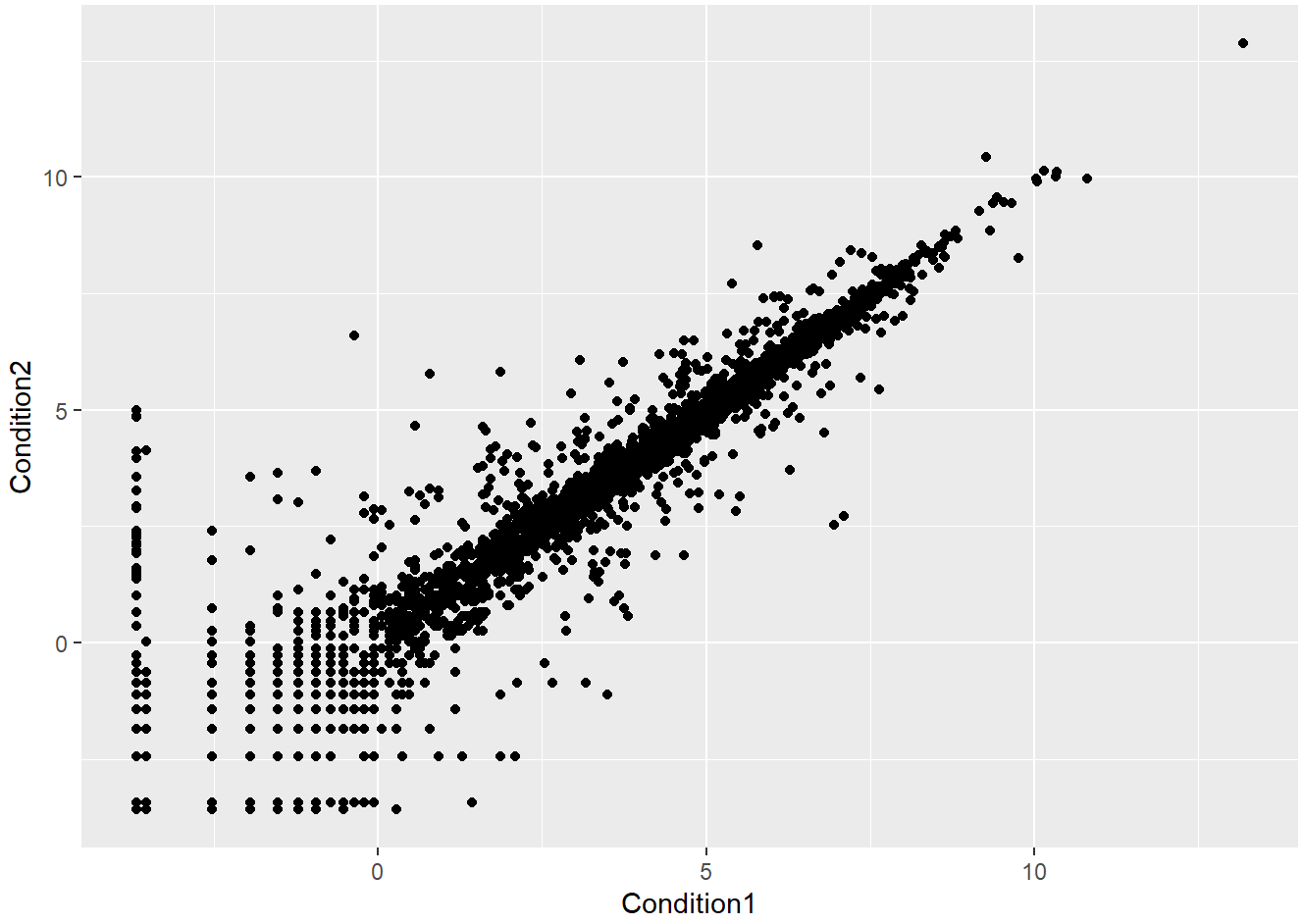
```
      down unchanging         up
        72       4997        127
```

```
round( table(genes$State)/nrow(genes) * 100, 2 )
```

```
      down unchanging         up
      1.39      96.17       2.44
```

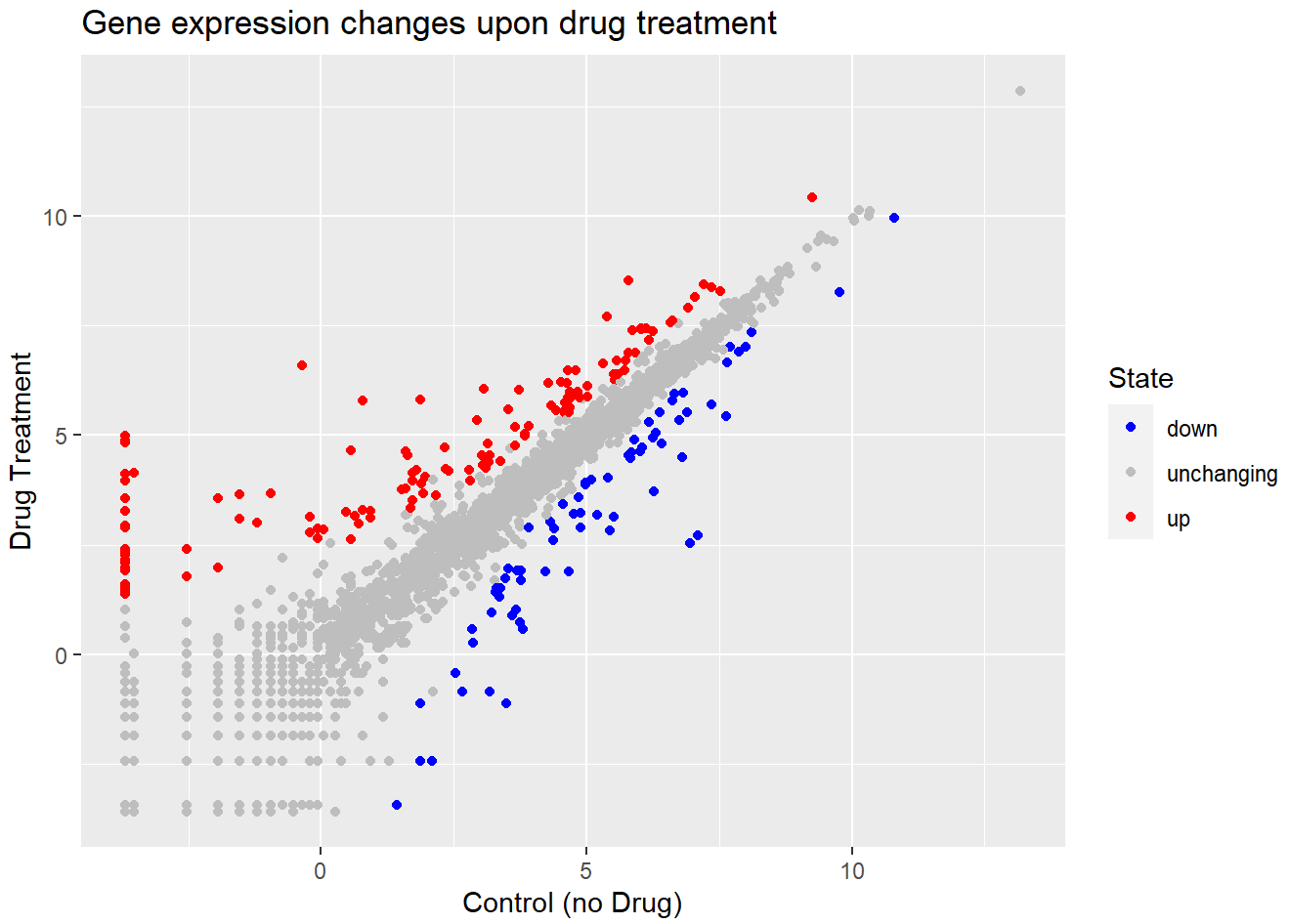
5196 rows, 4 columns, 127 up-regulated genes, 2.44% up-regulated

```
ggplot(genes) +
    aes(x=Condition1, y=Condition2) +
    geom_point()
```




```
p <- ggplot(genes) +
    aes(x=Condition1, y=Condition2, col=State) +
    geom_point()
p
```


```
p +
  scale_colour_manual( values=c("blue","gray","red") )+
  labs(title="Gene expression changes upon drug treatment", x="Control (no Drug)", y="Drug Treatm
```




```
url <- "https://raw.githubusercontent.com/jennybc/gapminder/master/inst/extdata/gapminder.tsv"
gapminder <- read.delim(url)

library(dplyr)
```

```
Warning: package 'dplyr' was built under R version 4.3.1
```

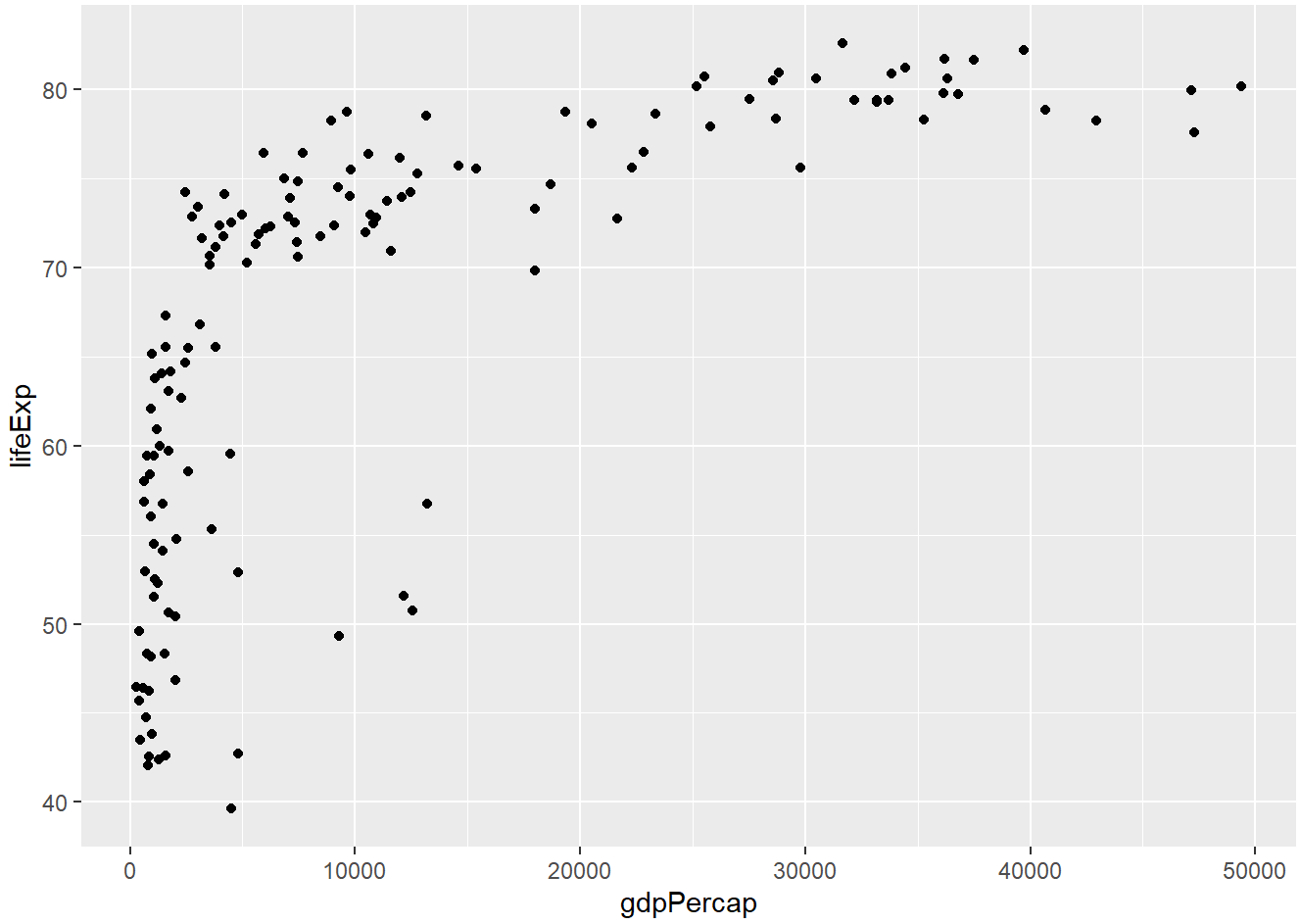
```

Attaching package: 'dplyr'

The following objects are masked from 'package:stats':

    filter, lag

The following objects are masked from 'package:base':

    intersect, setdiff, setequal, union
```

```
gapminder_2007 <- gapminder %>% filter(year==2007)
head(gapminder_2007)
```

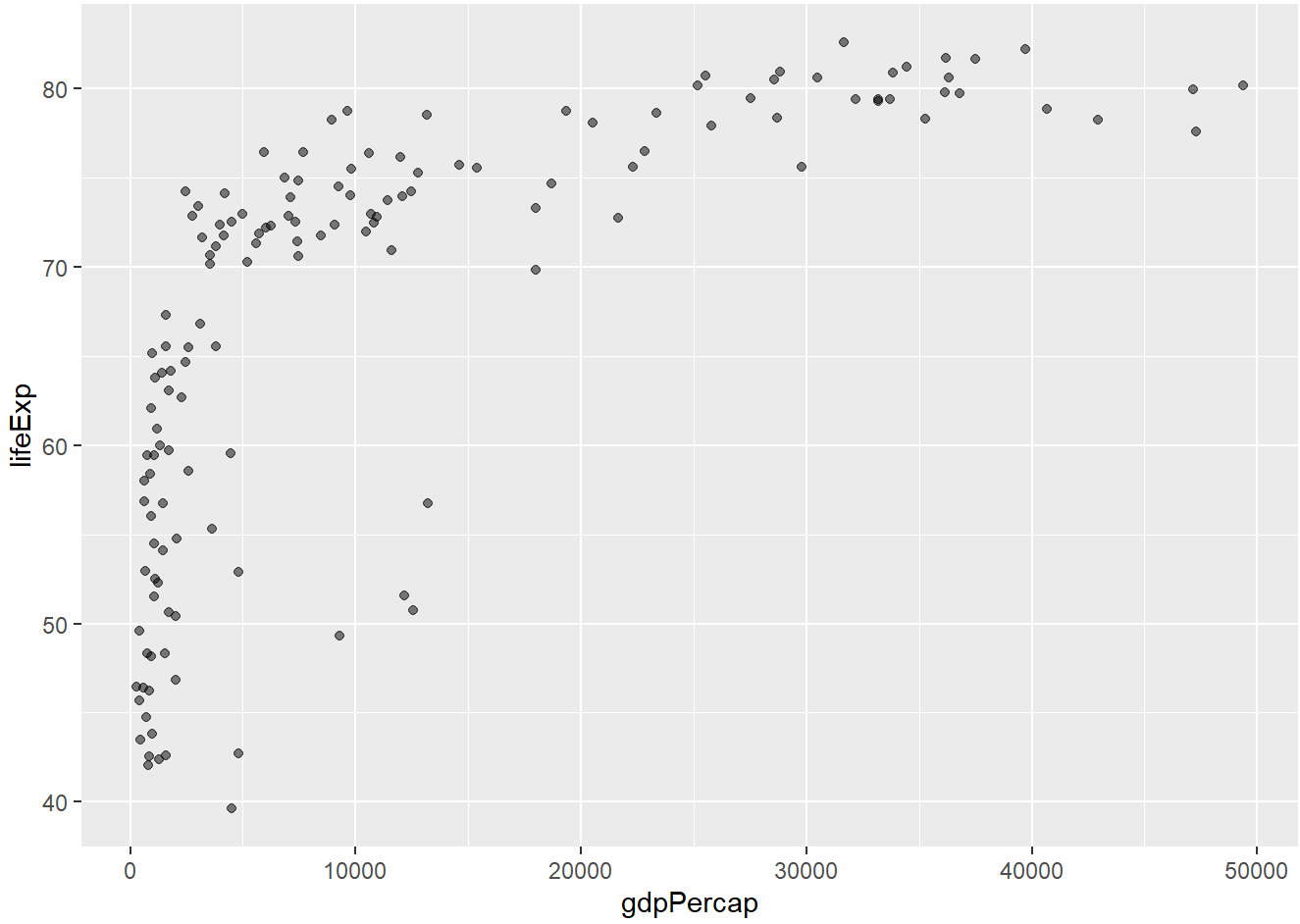
```
      country continent year lifeExp      pop  gdpPercap
1 Afghanistan      Asia 2007  43.828 31889923   974.5803
```

```
2     Albania    Europe 2007  76.423  3600523  5937.0295
3     Algeria    Africa 2007  72.301 33333216  6223.3675
4      Angola    Africa 2007  42.731 12420476  4797.2313
5   Argentina  Americas 2007  75.320 40301927 12779.3796
6   Australia   Oceania 2007  81.235 20434176 34435.3674
```

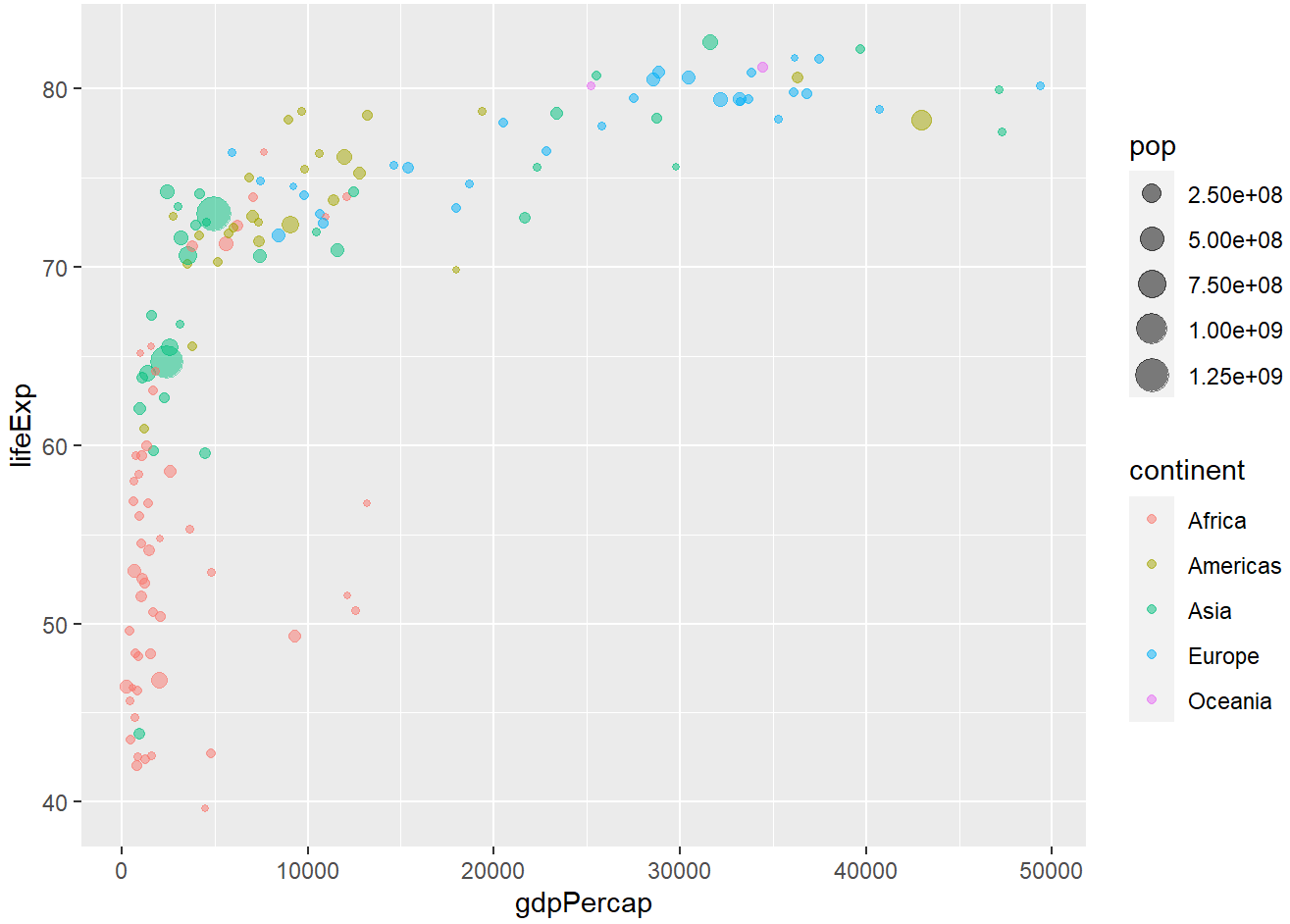
```
ggplot(gapminder_2007) +
  aes(x=gdpPercap, y=lifeExp) +
  geom_point()
```



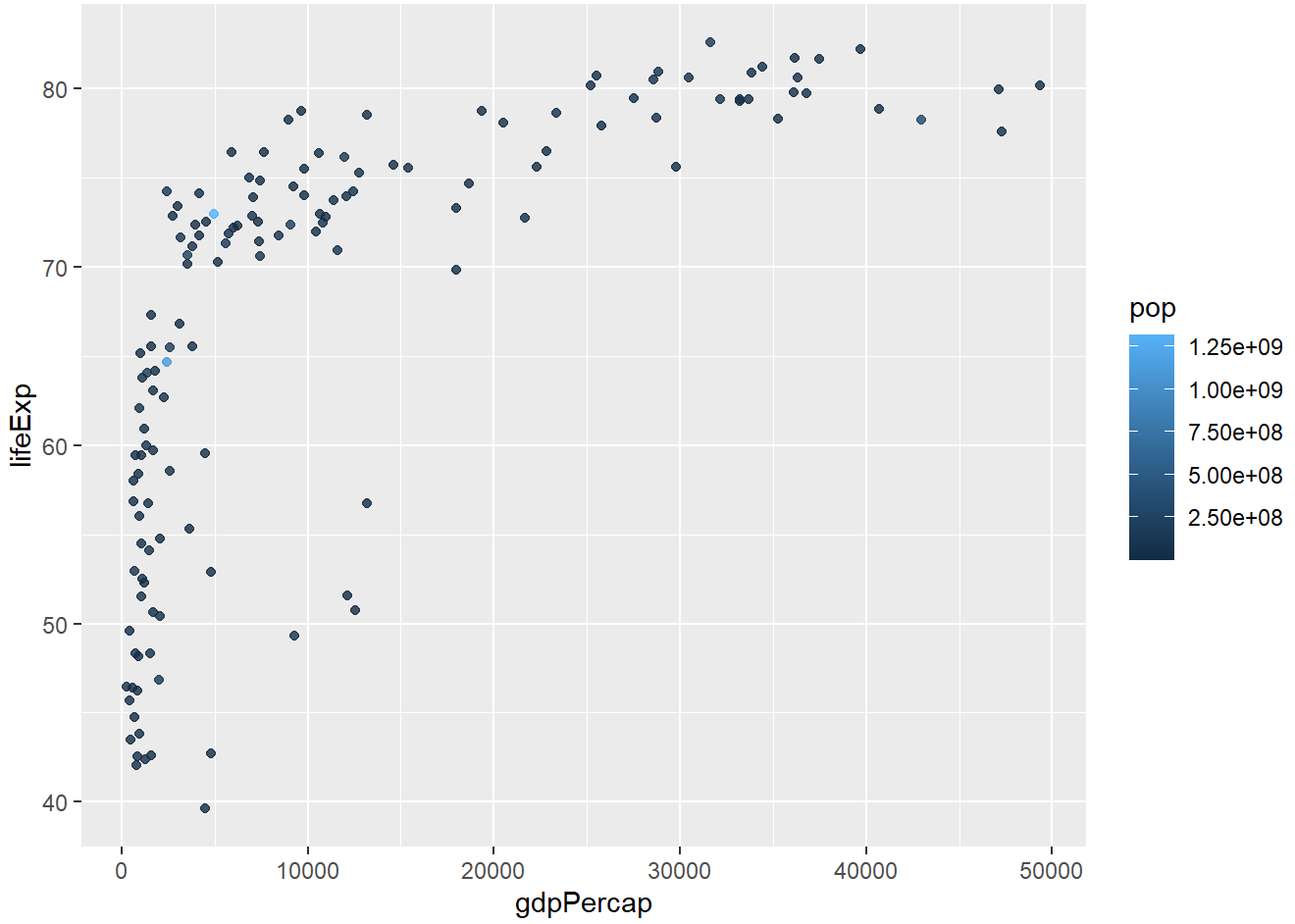

```
ggplot(gapminder_2007) +
  aes(x=gdpPercap, y=lifeExp) +
  geom_point(alpha=0.5)
```



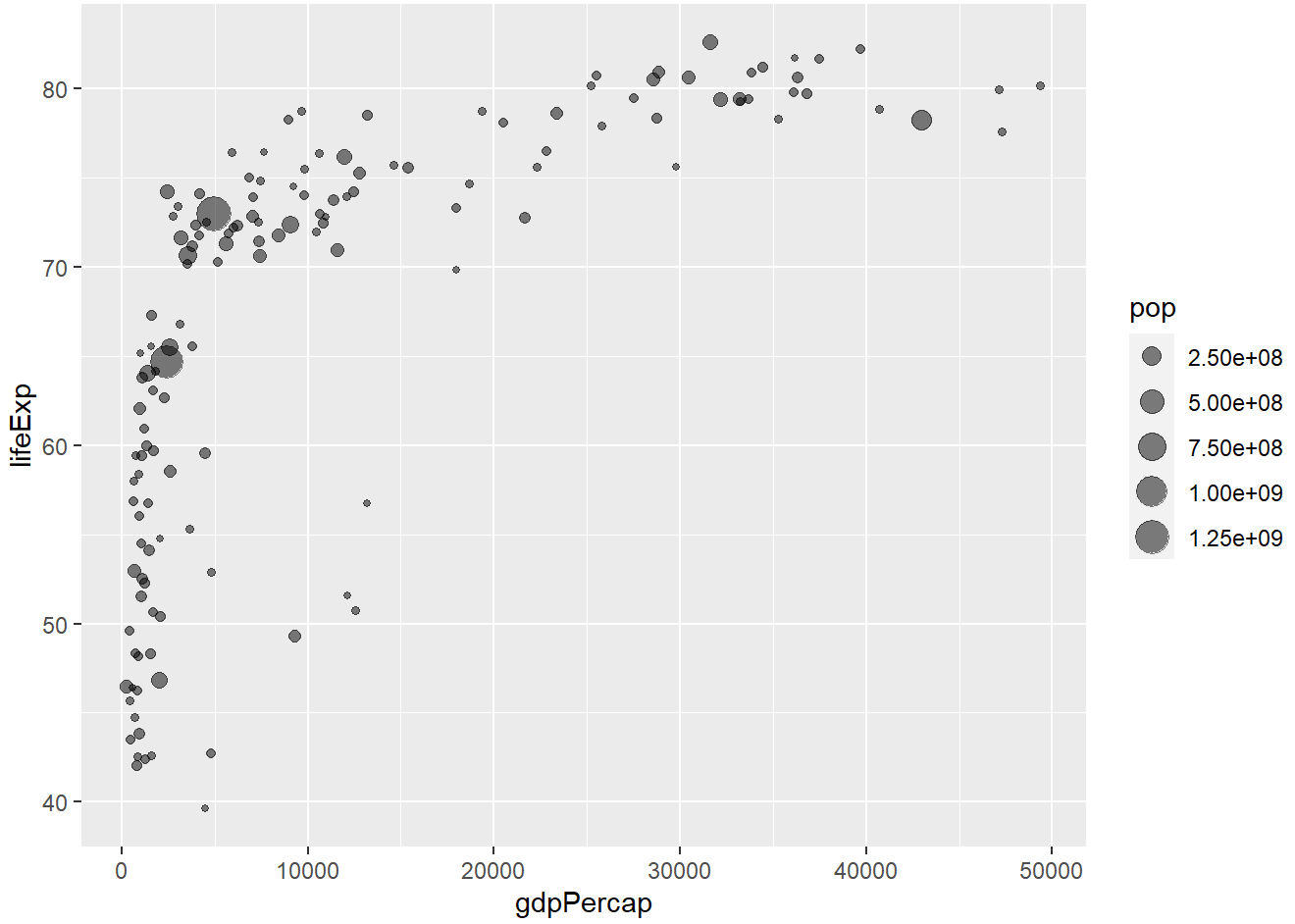

```
ggplot(gapminder_2007) +
  aes(x=gdpPercap, y=lifeExp, color=continent, size=pop) +
  geom_point(alpha=0.5)
```



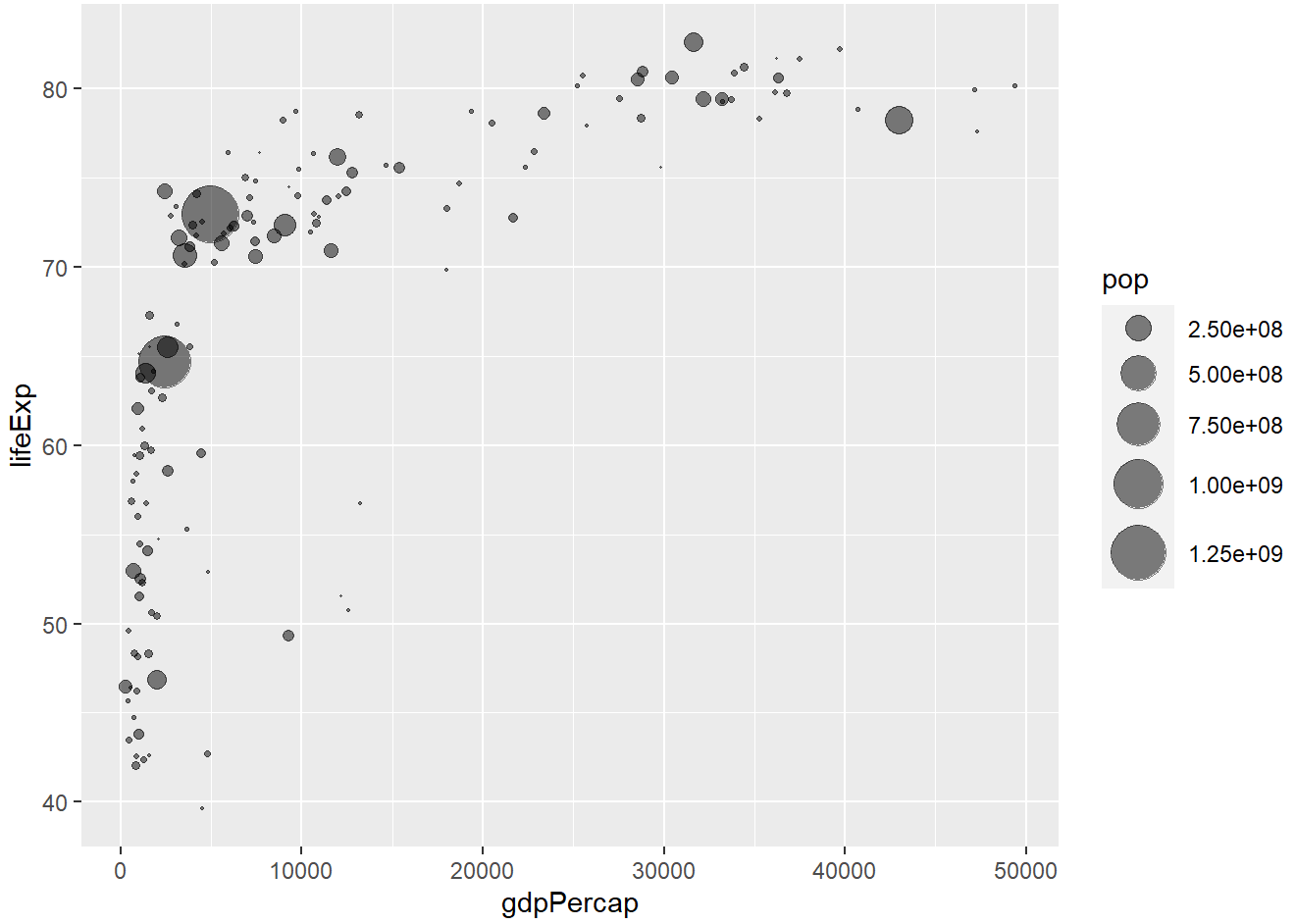

```
ggplot(gapminder_2007) +
  aes(x = gdpPercap, y = lifeExp, color = pop) +
  geom_point(alpha=0.8)
```




```
ggplot(gapminder_2007) +
  aes(x = gdpPercap, y = lifeExp, size = pop) +
  geom_point(alpha=0.5)
```



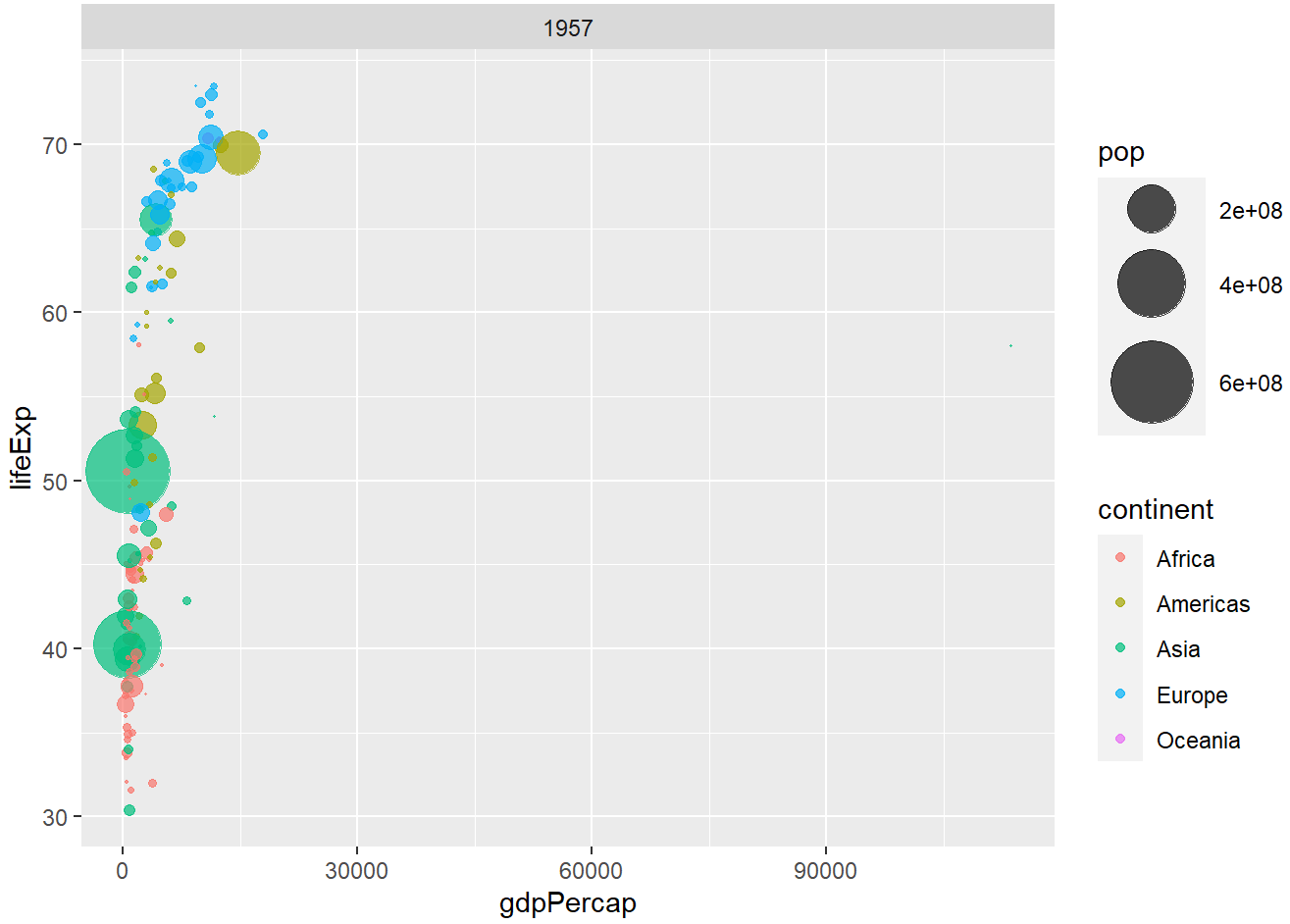

```
ggplot(gapminder_2007) +
  geom_point(aes(x = gdpPercap, y = lifeExp,
                 size = pop), alpha=0.5) +
  scale_size_area(max_size = 10)
```




```
gapminder_1957 <- gapminder %>% filter(year==1957)
head(gapminder_1957)
```

```
      country continent year lifeExp      pop gdpPercap
1 Afghanistan      Asia 1957  30.332  9240934   820.853
2     Albania    Europe 1957  59.280  1476505  1942.284
3     Algeria    Africa 1957  45.685 10270856  3013.976
4      Angola    Africa 1957  31.999  4561361  3827.940
5   Argentina  Americas 1957  64.399 19610538  6856.856
6   Australia   Oceania 1957  70.330  9712569 10949.650
```

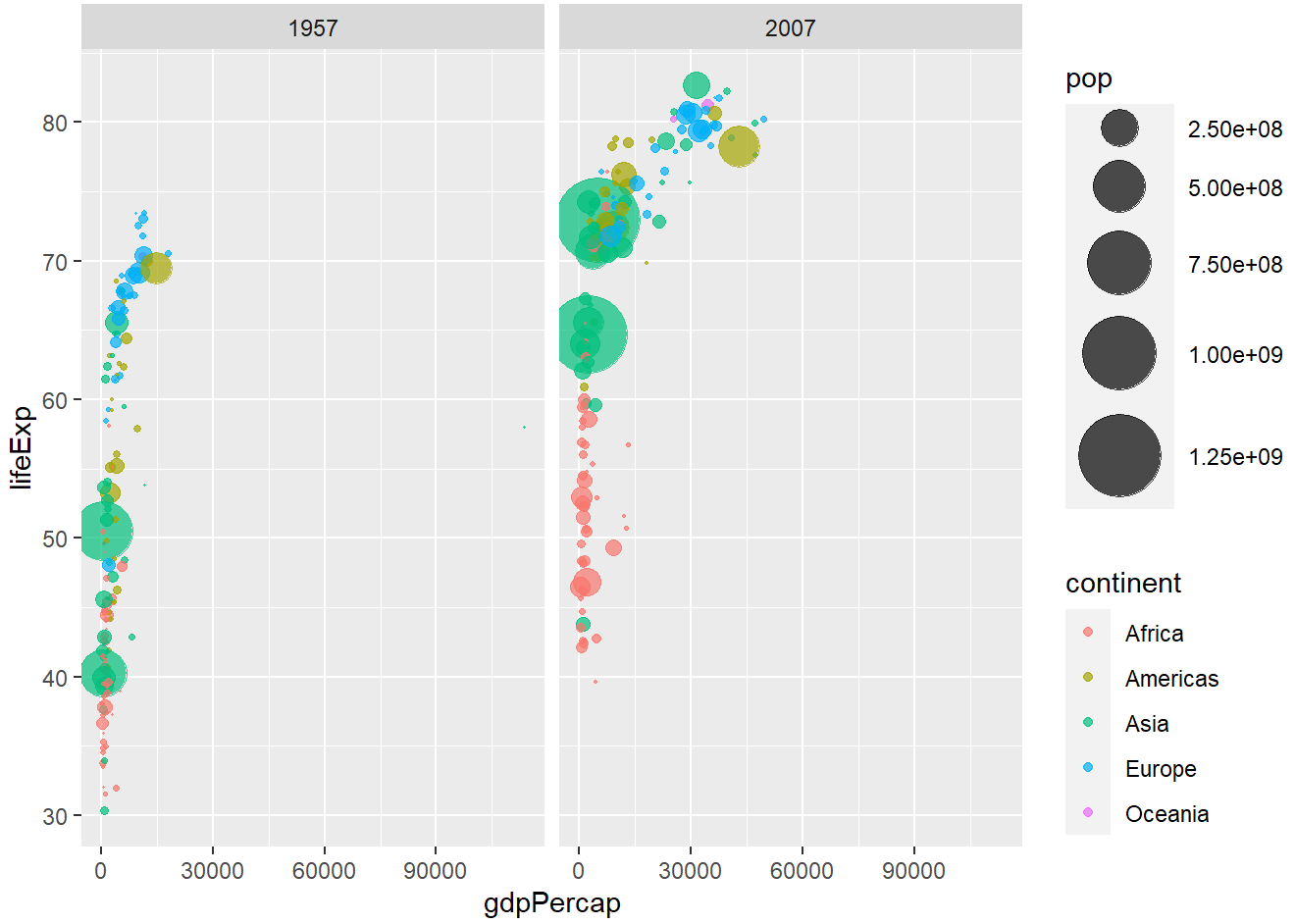
```
ggplot(gapminder_1957) +
  aes(x = gdpPercap, y = lifeExp, color = continent, size = pop) +
  geom_point(alpha=0.7) +
  scale_size_area(max_size = 15) +
  facet_wrap(~year)
```




```
gapminder_1957_2007 <- gapminder %>% filter(year==1957 | year==2007)
head(gapminder_1957_2007)
```

```
      country continent year lifeExp      pop gdpPercap
1 Afghanistan      Asia 1957  30.332  9240934  820.8530
2 Afghanistan      Asia 2007  43.828 31889923  974.5803
3     Albania    Europe 1957  59.280  1476505 1942.2842
4     Albania    Europe 2007  76.423  3600523 5937.0295
5     Algeria    Africa 1957  45.685 10270856 3013.9760
6     Algeria    Africa 2007  72.301 33333216 6223.3675
```

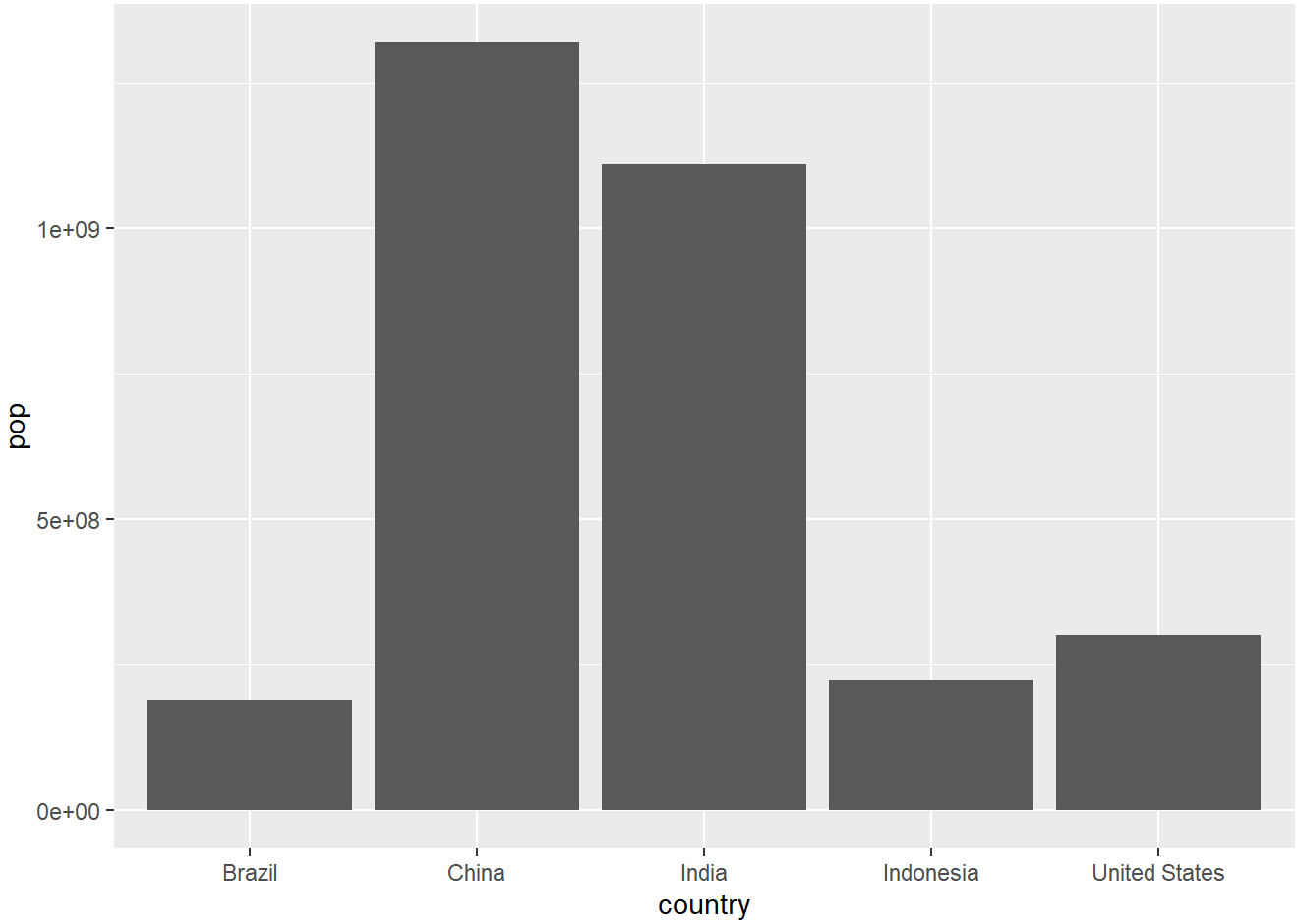
```
ggplot(gapminder_1957_2007) +
  aes(x = gdpPercap, y = lifeExp, color = continent, size = pop) +
  geom_point(alpha=0.7) +
  scale_size_area(max_size = 15) +
  facet_wrap(~year)
```



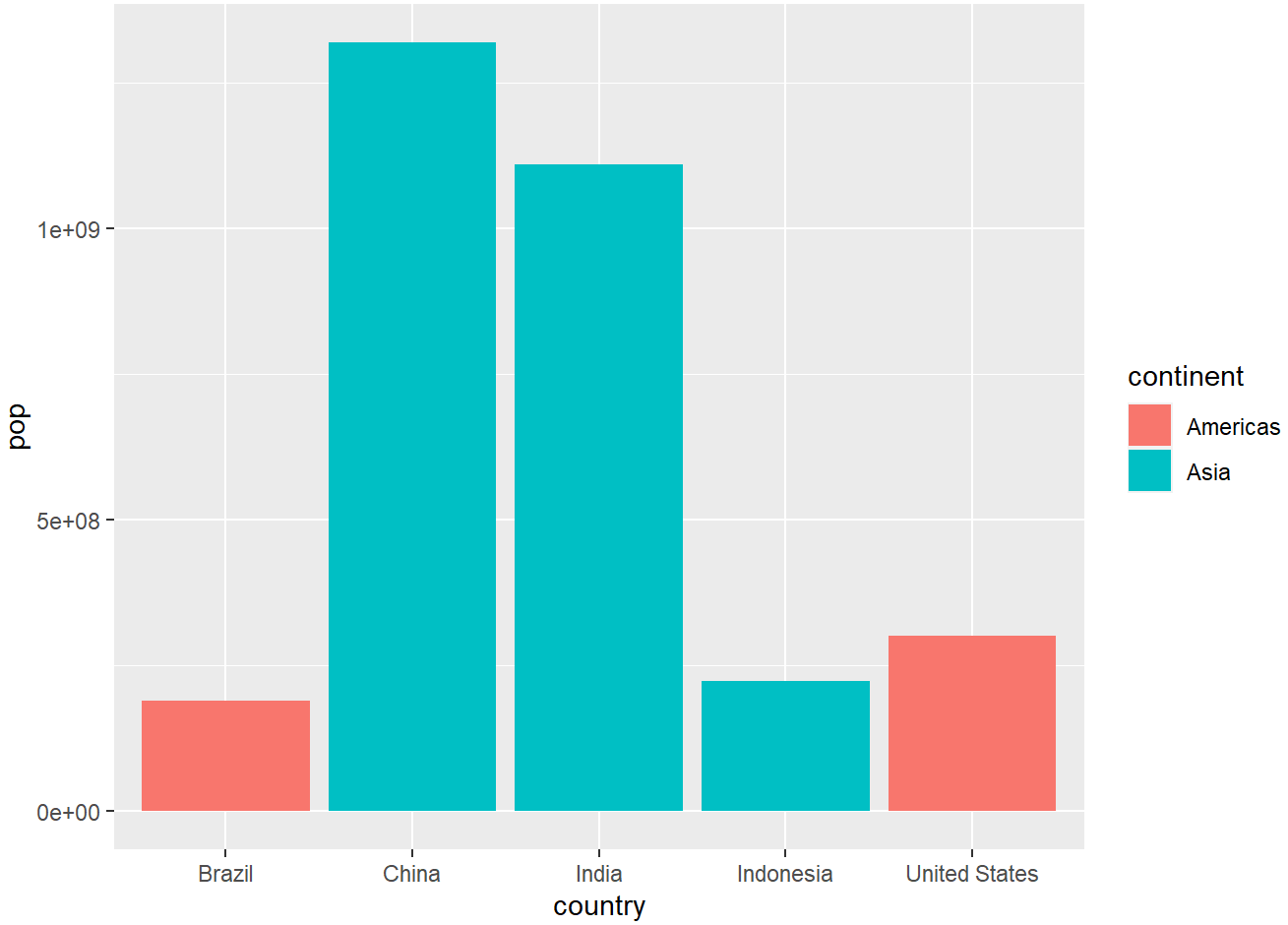

```
gapminder_top5 <- gapminder %>%
  filter(year==2007) %>%
  arrange(desc(pop)) %>%
  top_n(5, pop)

gapminder_top5
```

```
        country continent year lifeExp        pop gdpPercap
1         China      Asia 2007  72.961 1318683096  4959.115
2         India      Asia 2007  64.698 1110396331  2452.210
3 United States  Americas 2007  78.242  301139947 42951.653
4     Indonesia      Asia 2007  70.650  223547000  3540.652
5        Brazil  Americas 2007  72.390  190010647  9065.801
```

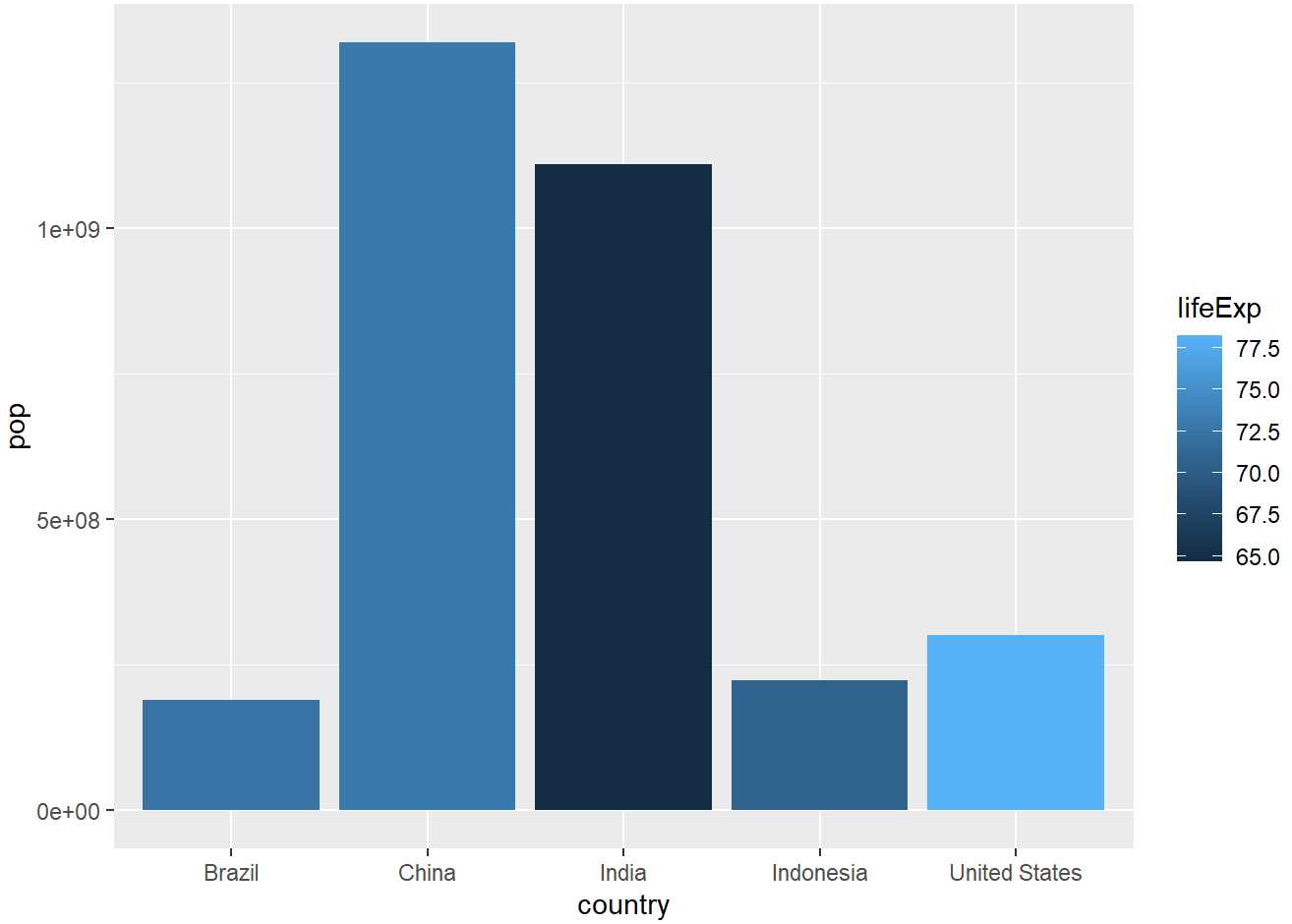
```
ggplot(gapminder_top5) +
  geom_col(aes(x = country, y = pop))
```



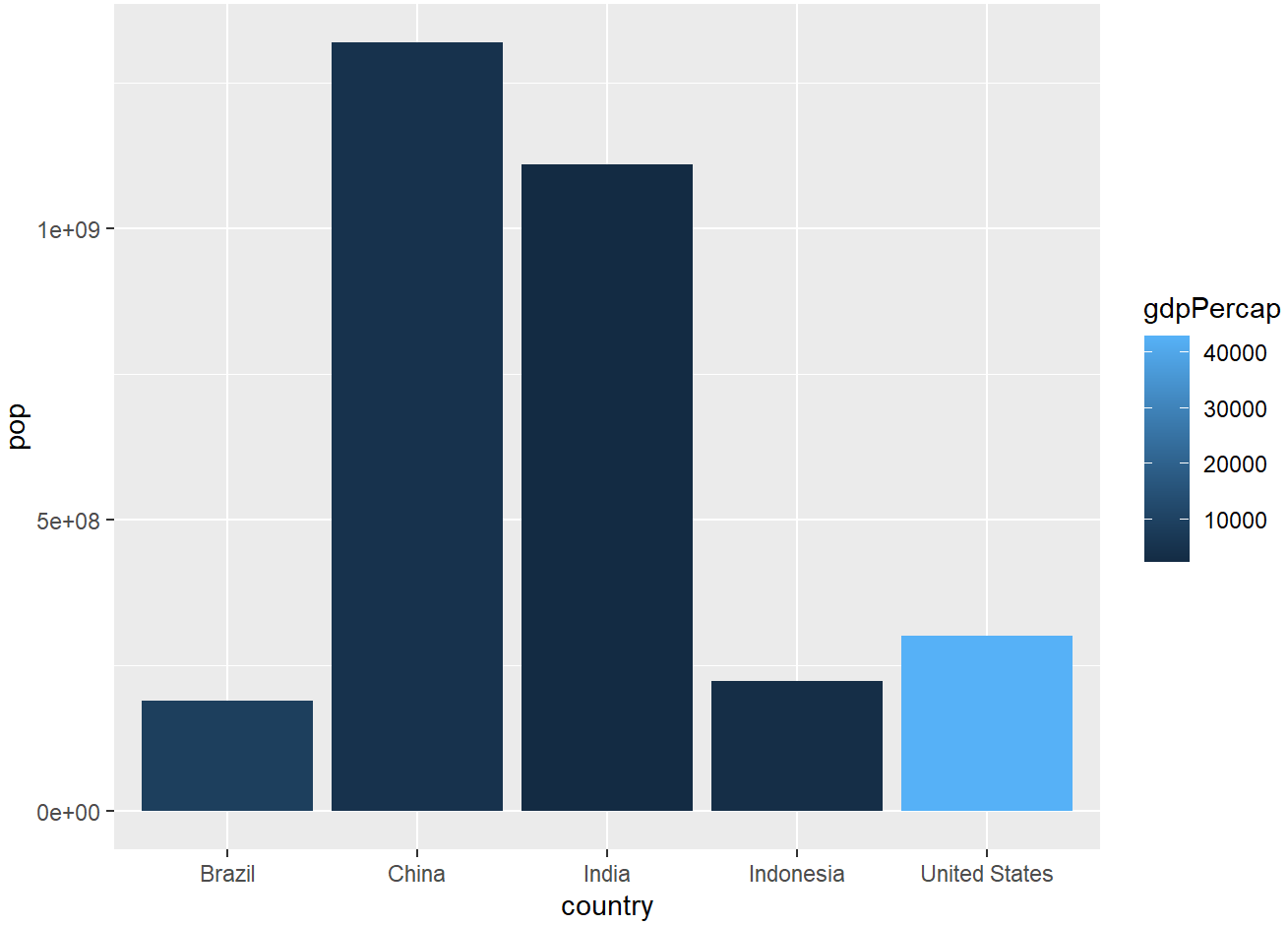

```
ggplot(gapminder_top5) +
  geom_col(aes(x = country, y = pop, fill = continent))
```



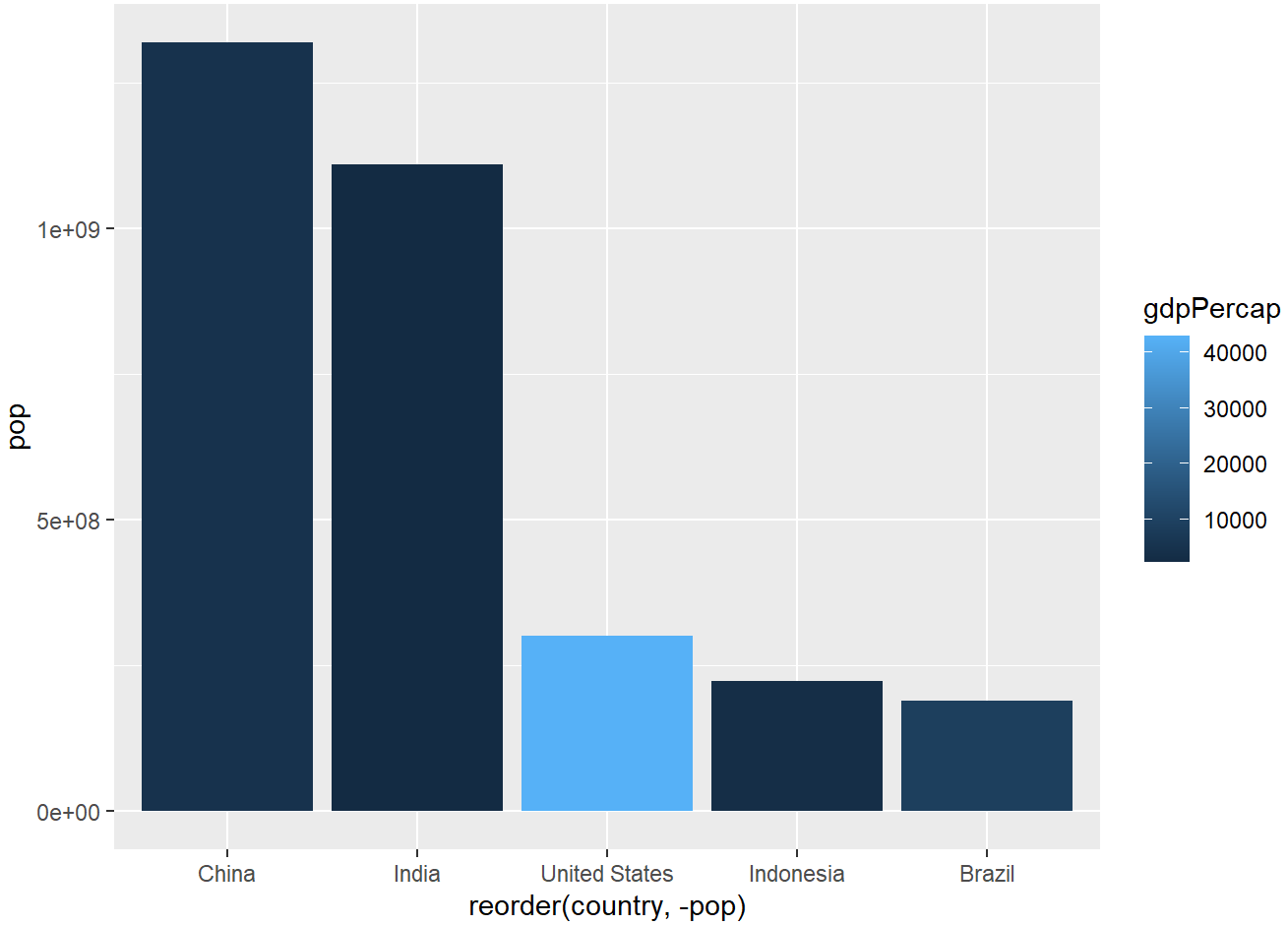

```
ggplot(gapminder_top5) +
  geom_col(aes(x = country, y = pop, fill = lifeExp))
```



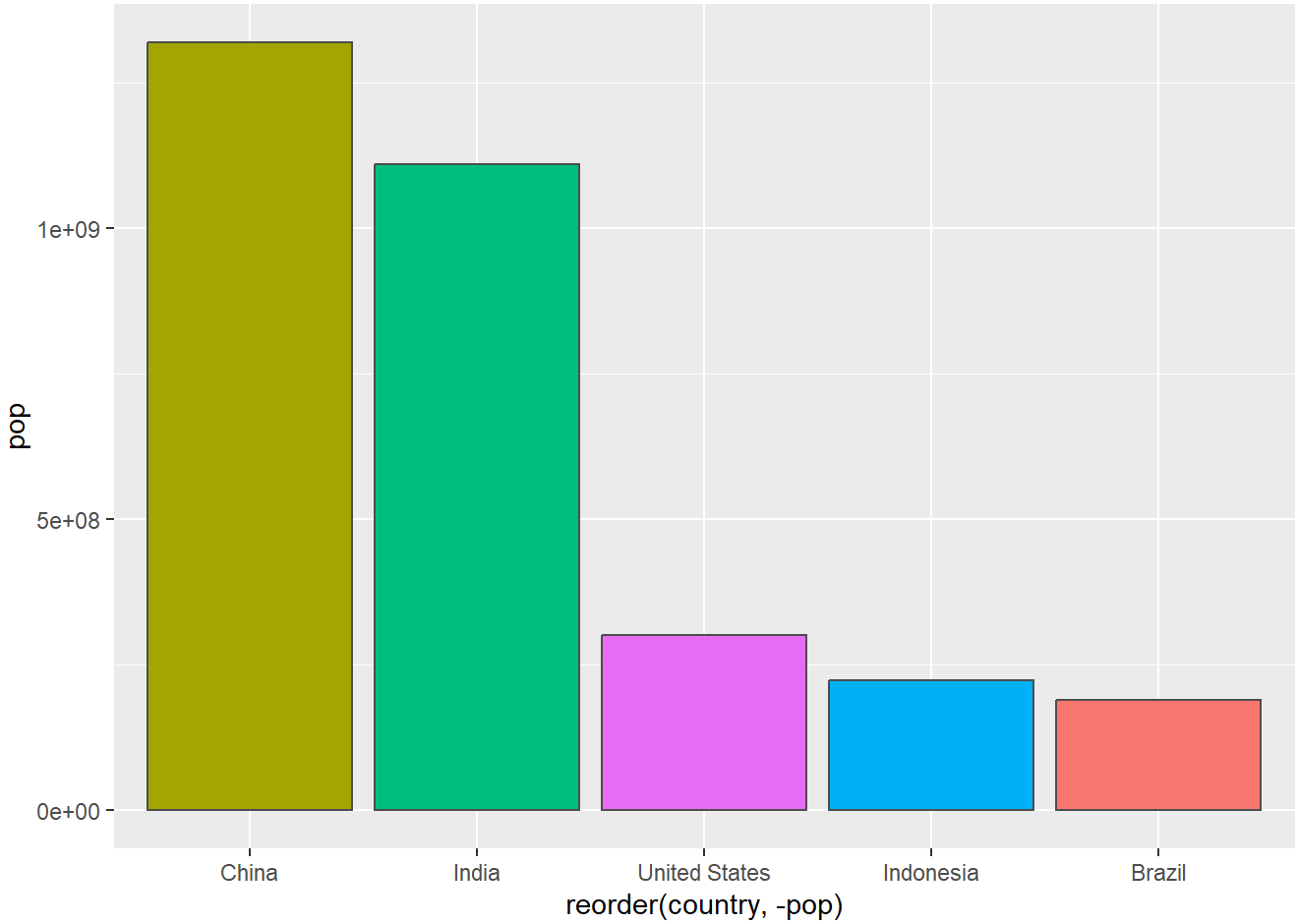

```
ggplot(gapminder_top5) +
  aes(x=country, y=pop, fill=gdpPercap) +
  geom_col()
```




```
ggplot(gapminder_top5) +
  aes(x=reorder(country, -pop), y=pop, fill=gdpPercap) +
  geom_col()
```



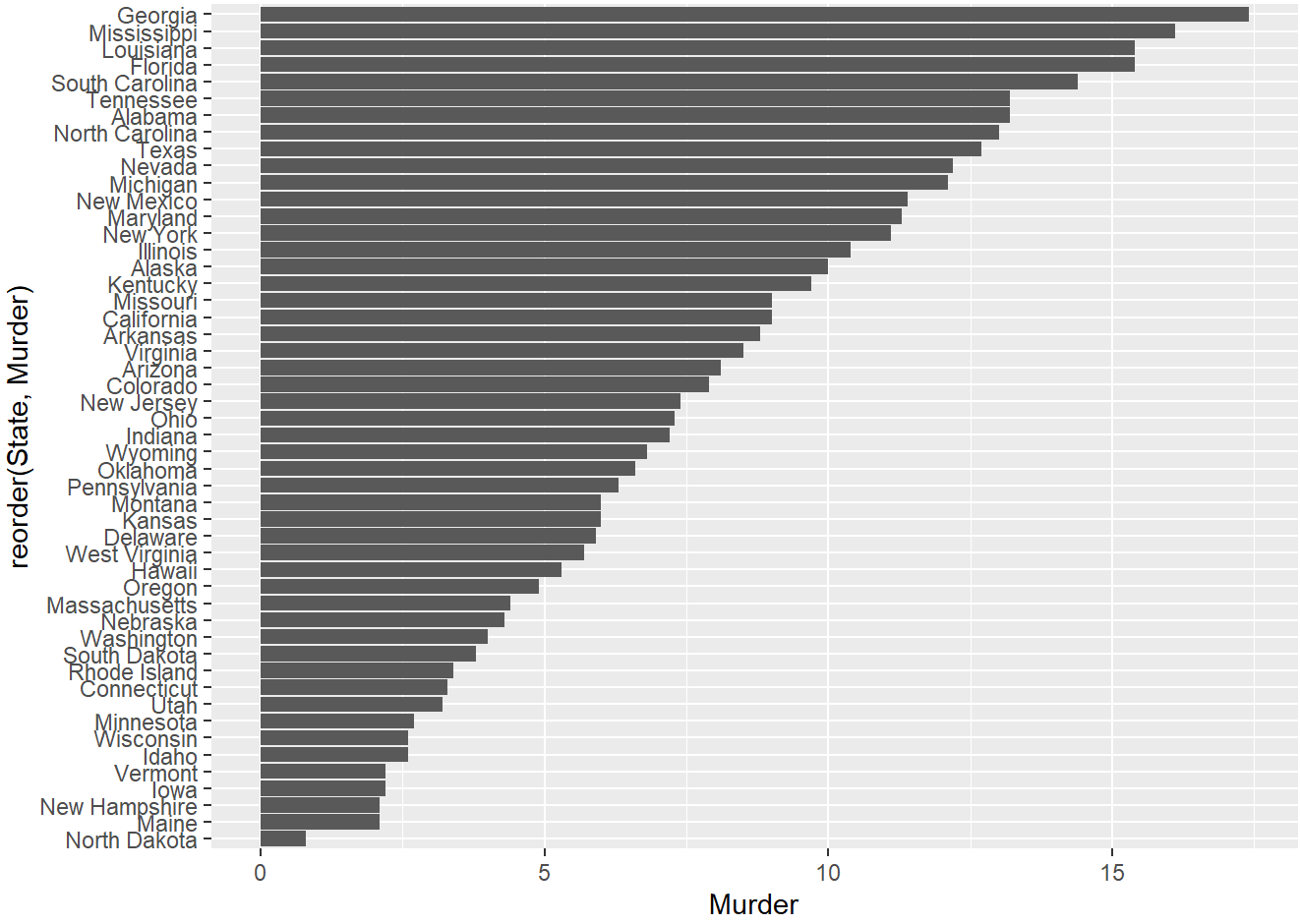

```
ggplot(gapminder_top5) +
  aes(x=reorder(country, -pop), y=pop, fill=country) +
  geom_col(col="gray30") +
  guides(fill="none")
```



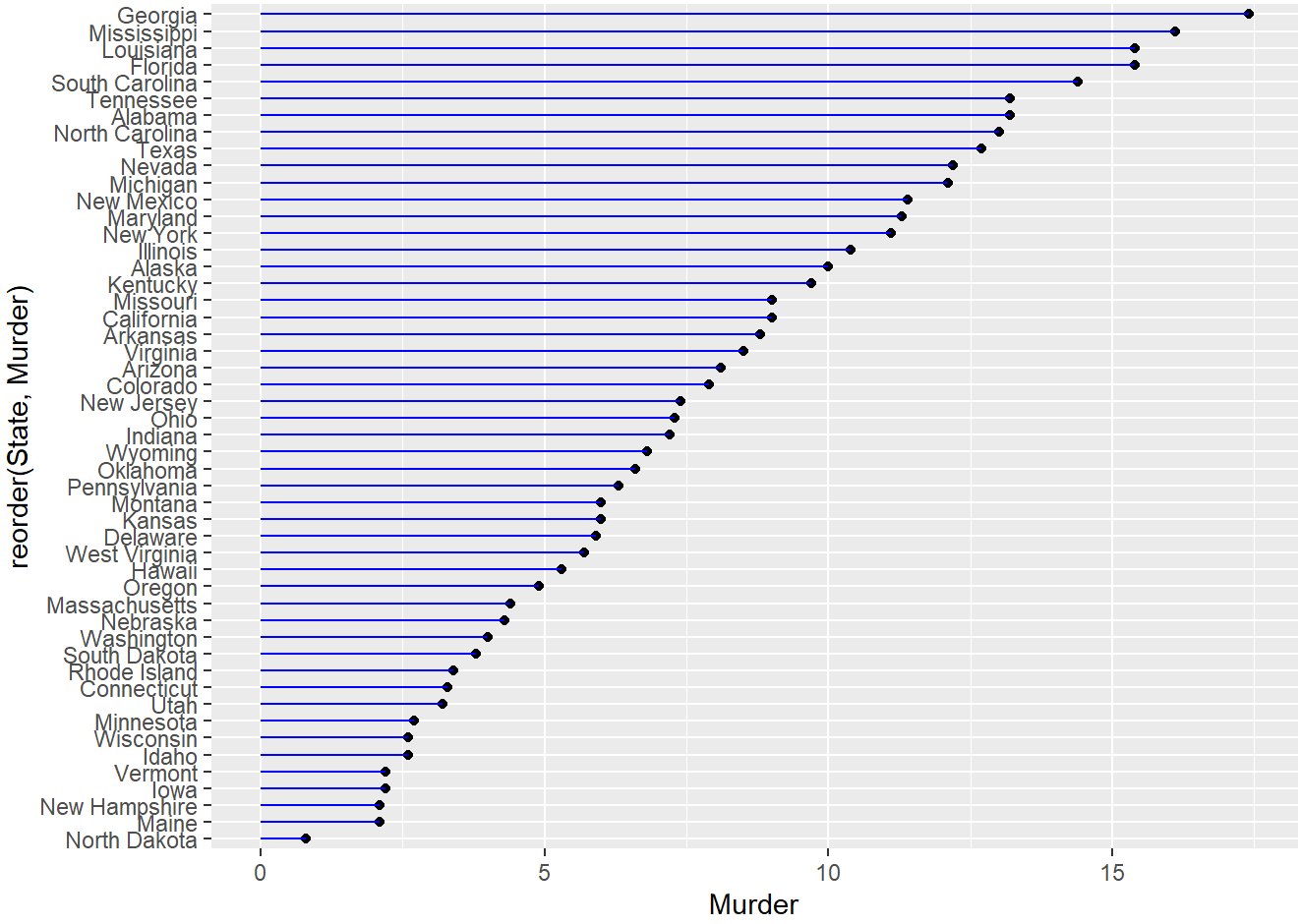

```
head(USArrests)
```

```
           Murder Assault UrbanPop Rape
Alabama      13.2     236       58 21.2
Alaska       10.0     263       48 44.5
Arizona       8.1     294       80 31.0
Arkansas      8.8     190       50 19.5
California    9.0     276       91 40.6
Colorado      7.9     204       78 38.7
```

```
USArrests$State <- rownames(USArrests)

ggplot(USArrests) +
  aes(x=reorder(State,Murder), y=Murder) +
  geom_col() +
  coord_flip()
```




```
ggplot(USArrests) +
  aes(x=reorder(State,Murder), y=Murder) +
  geom_point() +
  geom_segment(aes(x=State,
                   xend=State,
                   y=0,
                   yend=Murder), color="blue") +
  coord_flip()
```




```
library(gapminder)
```

```
Warning: package 'gapminder' was built under R version 4.3.1
```

```
Attaching package: 'gapminder'
```

```
The following object is masked _by_ '.GlobalEnv':
```

```
    gapminder
```

```
library(gganimate)
```

```
Warning: package 'gganimate' was built under R version 4.3.1
```

```
ggplot(gapminder, aes(gdpPercap, lifeExp, size = pop, colour = country)) +
  geom_point(alpha = 0.7, show.legend = FALSE) +
  scale_colour_manual(values = country_colors) +
  scale_size(range = c(2, 12)) +
  scale_x_log10() +
  facet_wrap(~continent) +
  # gganimate
  labs(title = 'Year: {frame_time}', x = 'GDP per capita', y = 'life expectancy') +
```

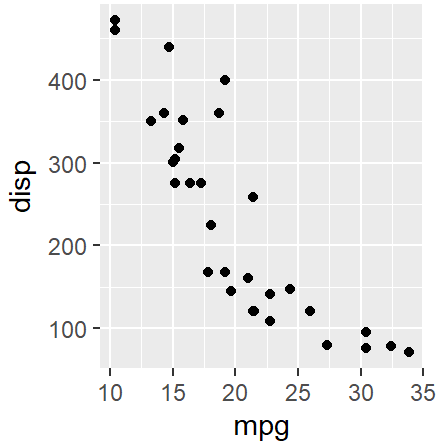
```
  transition_time(year) +
  shadow_wake(wake_length = 0.1, alpha = FALSE)
```

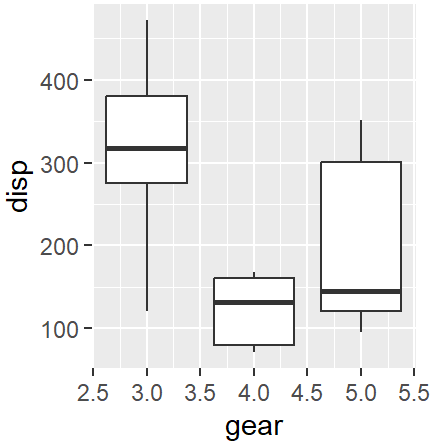

```
library(patchwork)
```

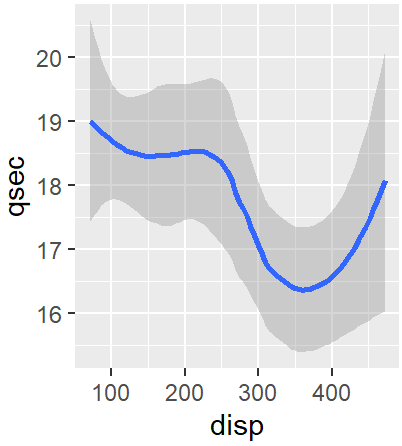
```
Warning: package 'patchwork' was built under R version 4.3.1
```

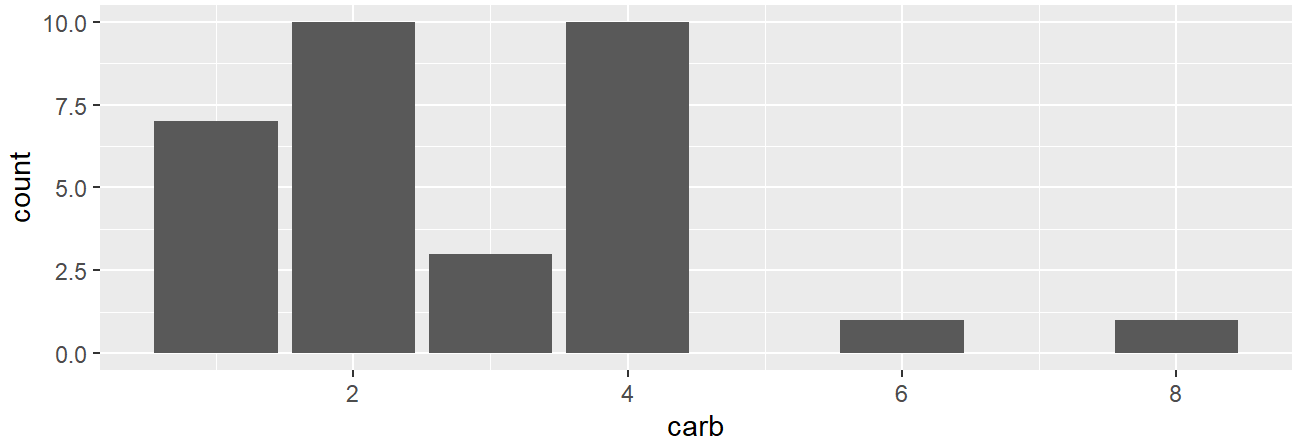
```
p1 <- ggplot(mtcars) + geom_point(aes(mpg, disp))
p2 <- ggplot(mtcars) + geom_boxplot(aes(gear, disp, group = gear))
p3 <- ggplot(mtcars) + geom_smooth(aes(disp, qsec))
p4 <- ggplot(mtcars) + geom_bar(aes(carb))

(p1 | p2 | p3) / p4
```

```
`geom_smooth()` using method = 'loess' and formula = 'y ~ x'
```


disp
400
300
200
100
10
15
20
25
30
35
mpg


disp
400
300
200
100
2.5
3.0
3.5
4.0
4.5
5.0
5.5
gear


qsec
20
19
18
17
16
100
200
300
400
disp


count
10.0
7.5
5.0
2.5
0.0
2
4
6
8
carb