

# Class 5 Data Visualization with ggplot2

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## Using GGPLOT

The ggplot2 package needs to be installed as it does not come in with R “out of the box”.

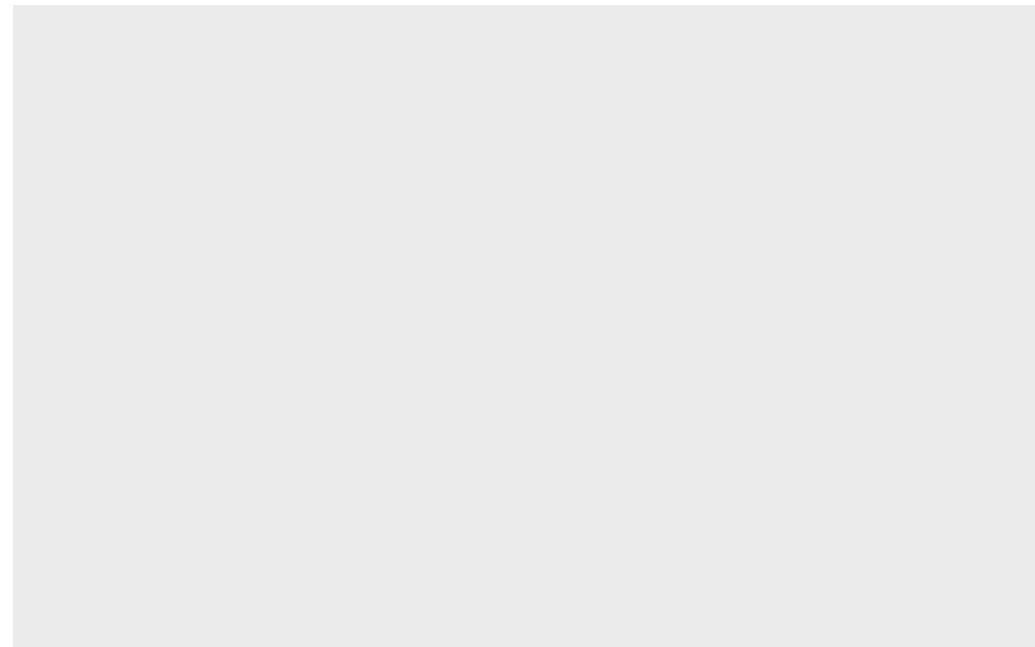
We use the `install.packages()` function to do this. `head()` only show the first 6 rows, can use for large data sets

```
head(cars)
```

```
speed dist
1      4    2
2      4   10
3      7    4
4      7   22
5      8   16
6      9   10
```

To use ggplot I need to load it up before I can call any of the functions in the package. I do this with the `library` function.

```
library(ggplot2)
ggplot()
```



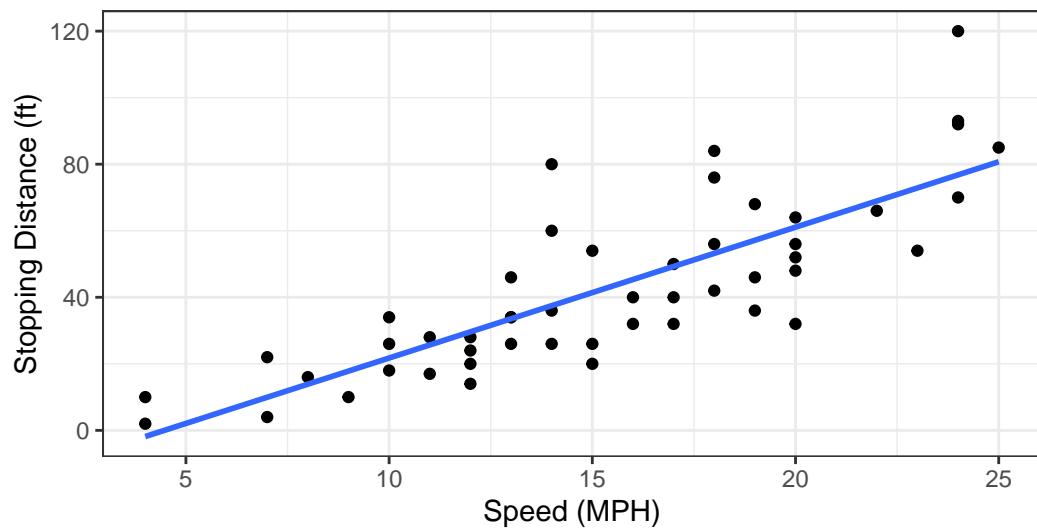
All ggplot figures have at least 3 things:

- data(the stuff we want to plot)
- aesthetic mapping (aes values)
- geoms

```
ggplot(cars) +  
  aes(x=speed, y=dist) +  
  geom_point() +  
  labs(title="Speed and Stopping Distances of Cars",  
       x="Speed (MPH)",  
       y="Stopping Distance (ft)",  
       subtitle = "Your informative subtitle text here",  
       caption="Dataset: 'cars'") +  
  geom_smooth(method="lm", se=FALSE) +  
  theme_bw()  
  
`geom_smooth()` using formula = 'y ~ x'
```

## Speed and Stopping Distances of Cars

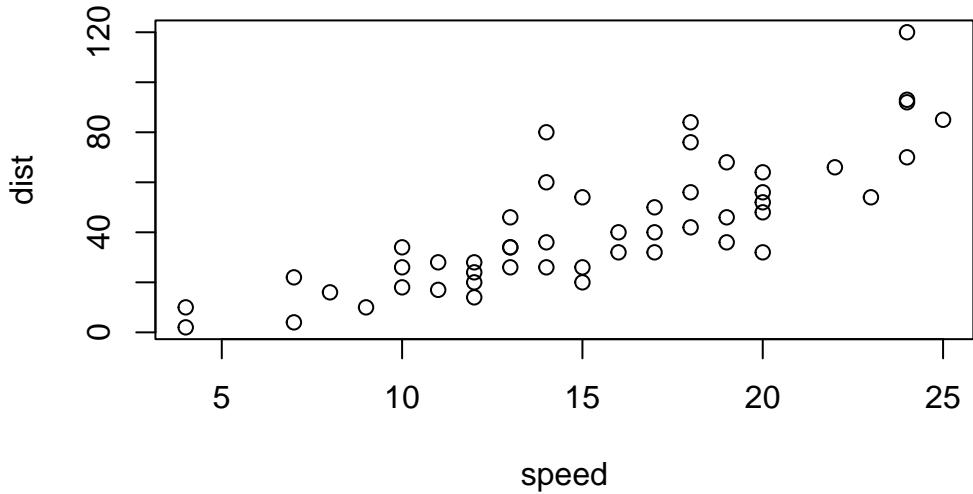
Your informative subtitle text here



Dataset: 'cars'

ggplot is not the only graphing system in R there are lots of others. There is even “base R” graphics.

```
plot(cars)
```



```
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
```

```
colnames(genes)
```

```
[1] "Gene"      "Condition1" "Condition2" "State"
```

```
  ncol(genes)

[1] 4

  table(genes$State)

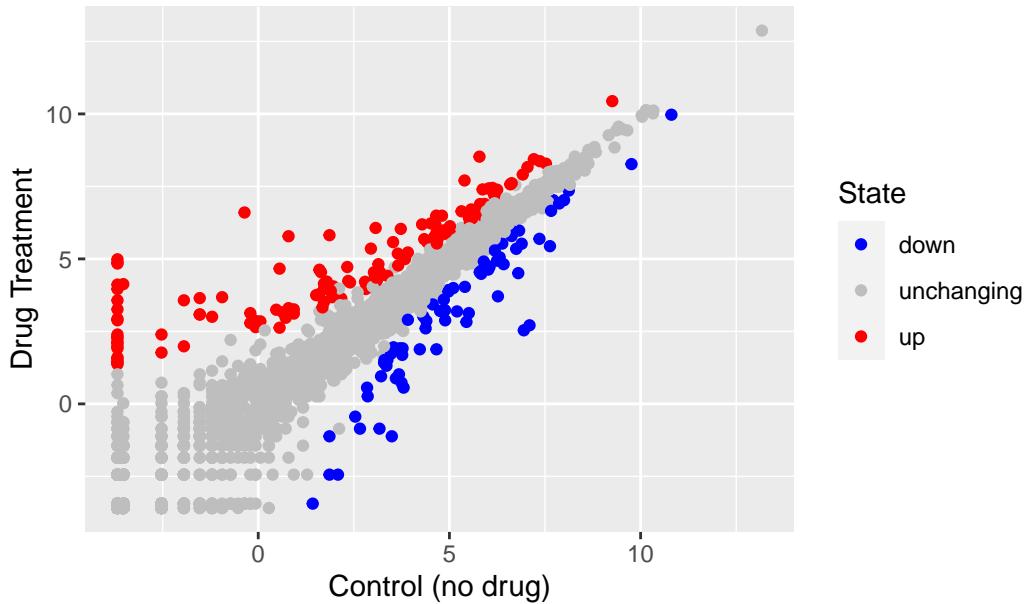
down unchanged      up
  72       4997    127

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

down unchanged      up
 1.39       96.17   2.44

ggplot(genes) +
  aes(x=Condition1, y=Condition2, col=State) +
  geom_point()+
  scale_colour_manual( values=c("blue","gray","red") )+
  labs(title = 'Gene Expression Changes Upon Drug Treatment',
       x="Control (no drug)",
       y = 'Drug Treatment')
```

## Gene Expression Changes Upon Drug Treatment



```
# File location online
url <- "https://raw.githubusercontent.com/jennybc/gapminder/master/inst/extdata/gapminder.csv"

gapminder <- read.delim(url)

# install.packages("dplyr") ## un-comment to install if needed
library(dplyr)
```

Attaching package: 'dplyr'

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

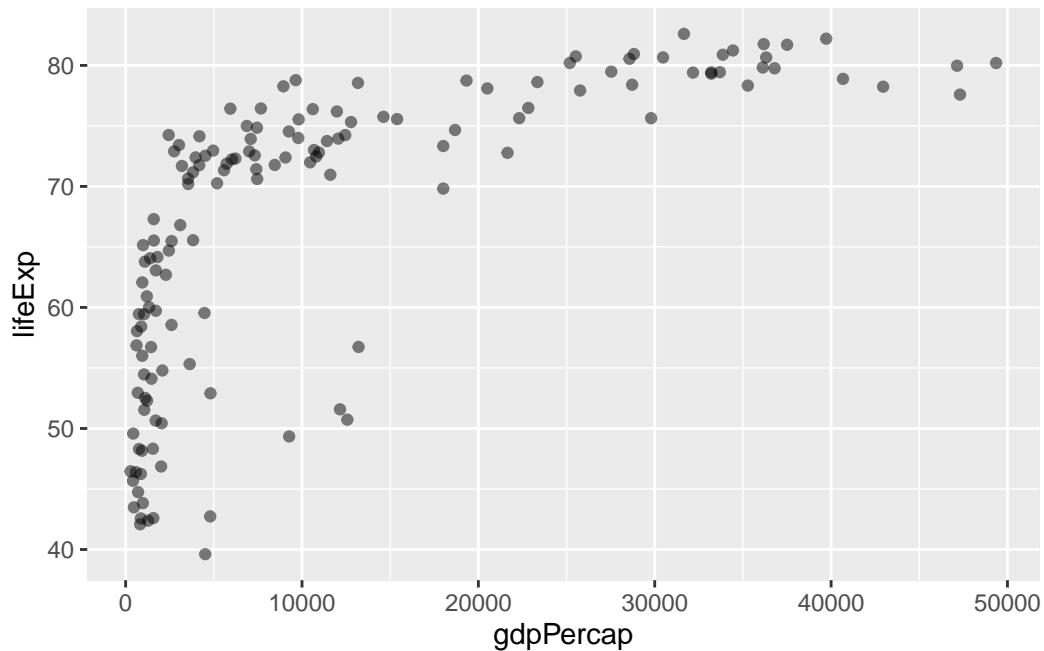
filter, lag

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

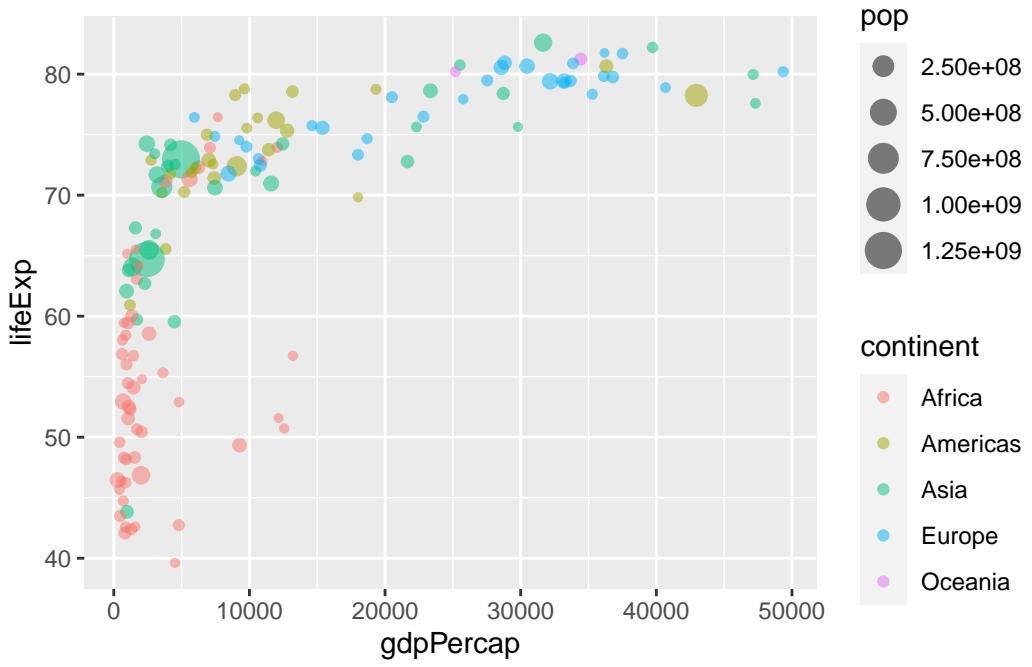
intersect, setdiff, setequal, union

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

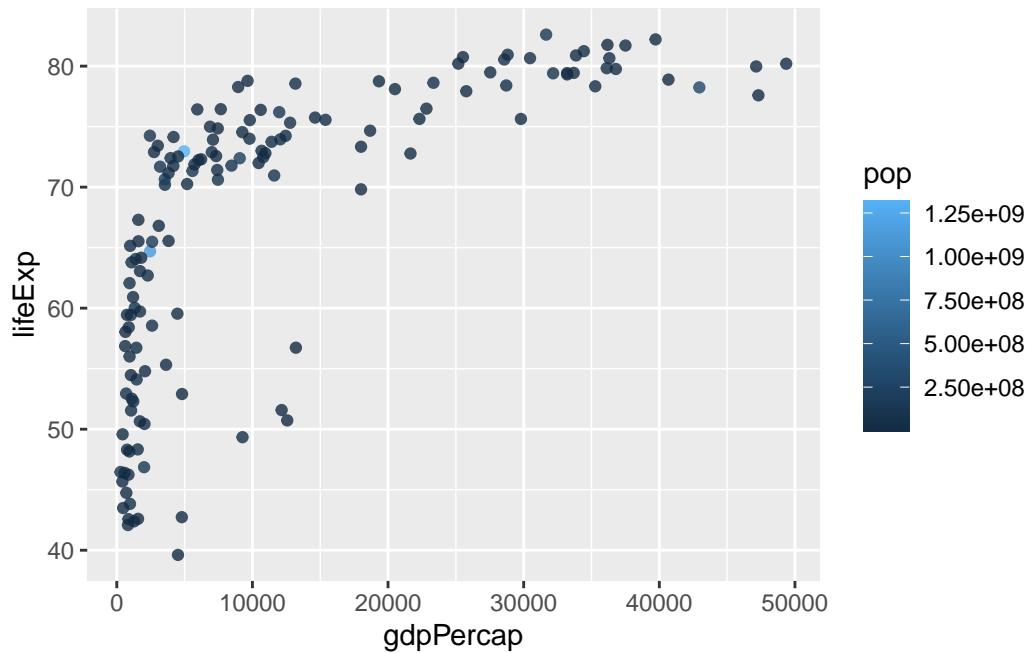
```
ggplot(gapminder_2007) +  
  aes(x=gdpPercap, y=lifeExp) +  
  geom_point(alpha=0.5)
```



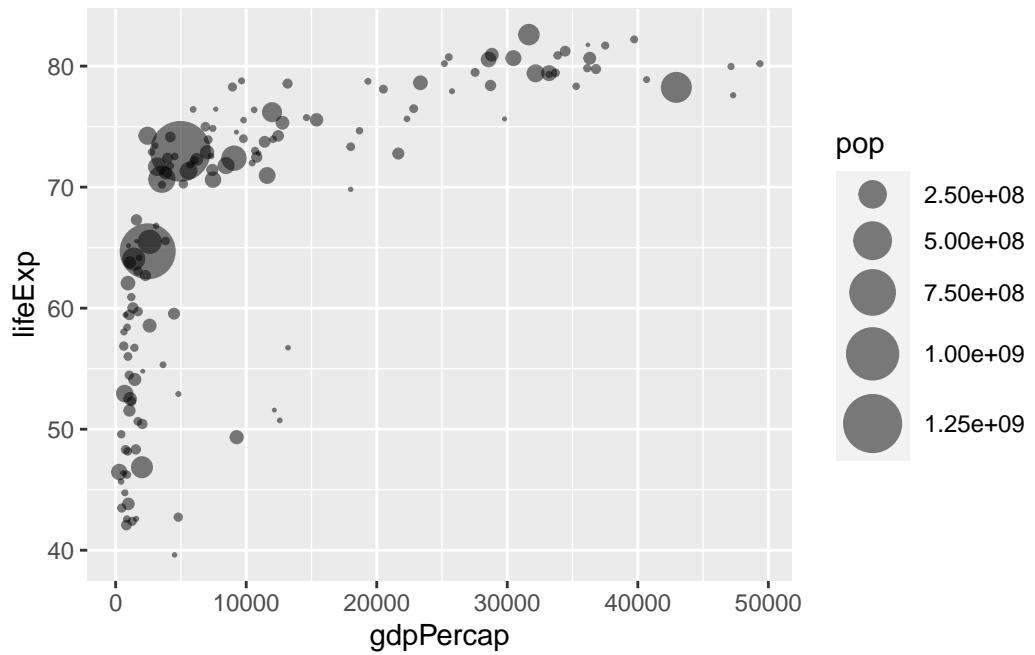
```
ggplot(gapminder_2007) +  
  aes(x=gdpPercap, y=lifeExp, color=continent, size=pop) +  
  geom_point(alpha=0.5)
```



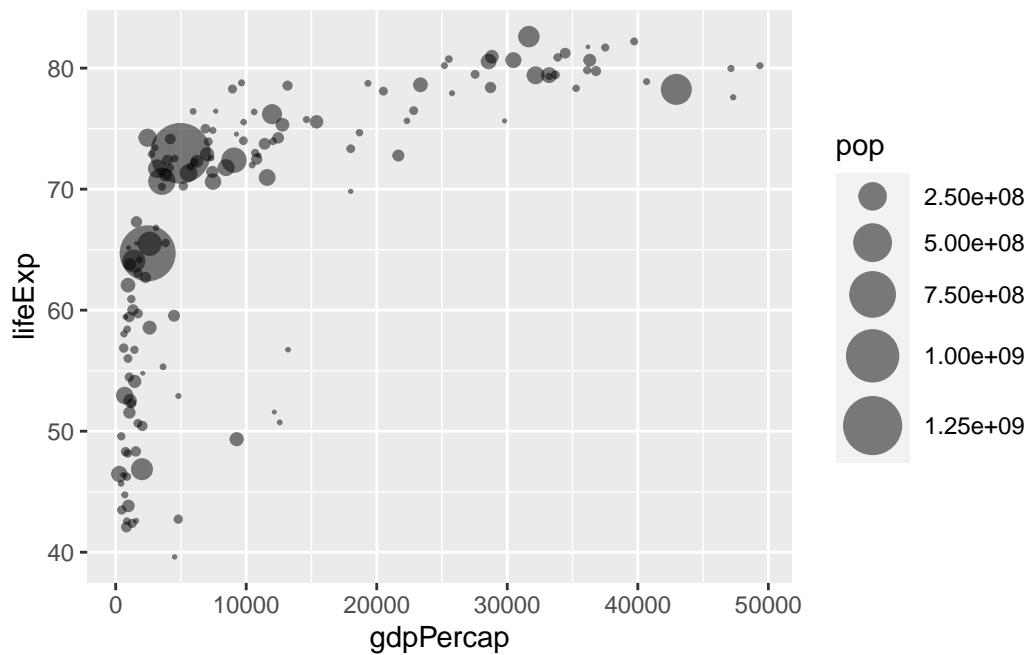
```
ggplot(gapminder_2007) +  
  aes(x = gdpPercap, y = lifeExp, color = pop) +  
  geom_point(alpha=0.8)
```



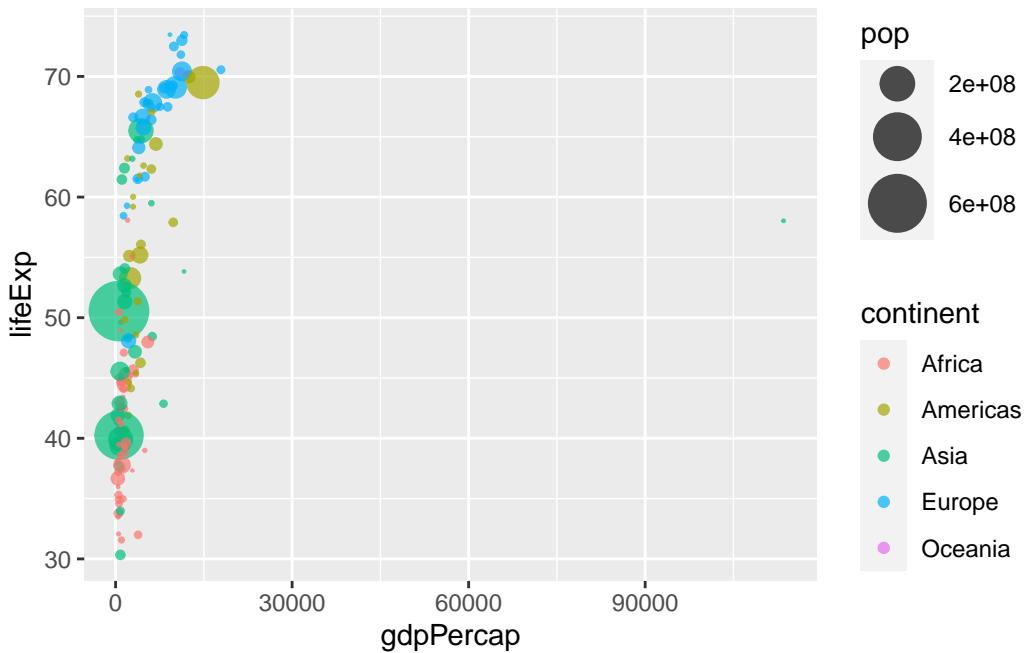
```
ggplot(gapminder_2007) +  
  geom_point(aes(x = gdpPerCap, y = lifeExp,  
                 size = pop), alpha=0.5) +  
  scale_size_area(max_size = 10)
```



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

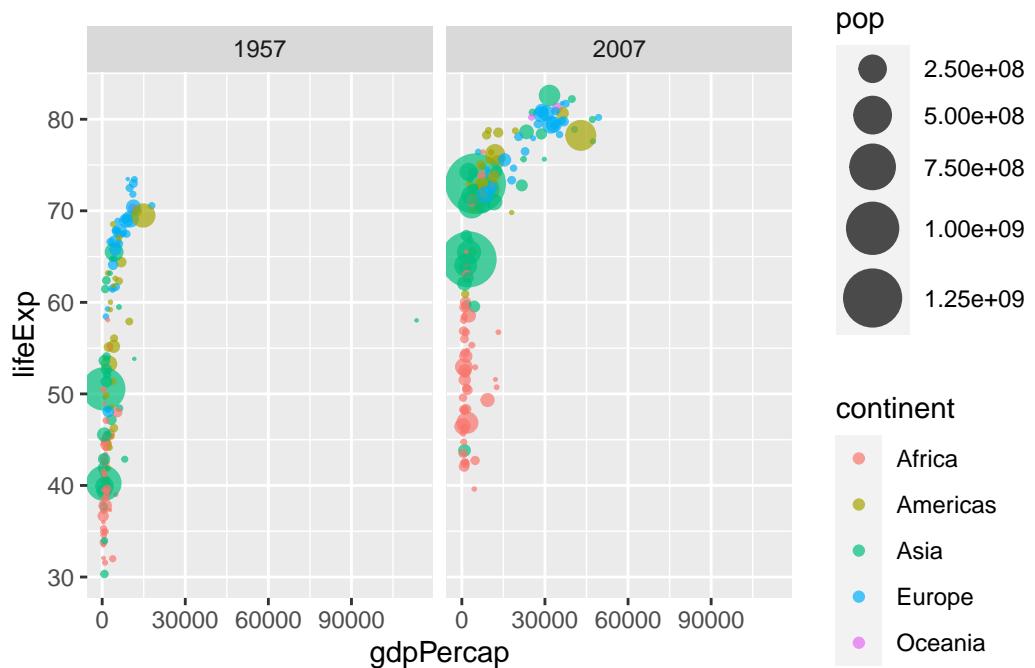


```
gapminder_1957 <- gapminder %>% filter(year==1957)
ggplot(gapminder_1957) +
  aes(x = gdpPercap, y = lifeExp, color=continent,
      size = pop) +
  geom_point(alpha=0.7) +
  scale_size_area(max_size = 10)
```



```
gapminder_1957 <- gapminder %>% filter(year==1957 | year==2007)

ggplot(gapminder_1957) +
  geom_point(aes(x = gdpPercap, y = lifeExp, color=continent,
                 size = pop), alpha=0.7) +
  scale_size_area(max_size = 10) +
  facet_wrap(~year)
```

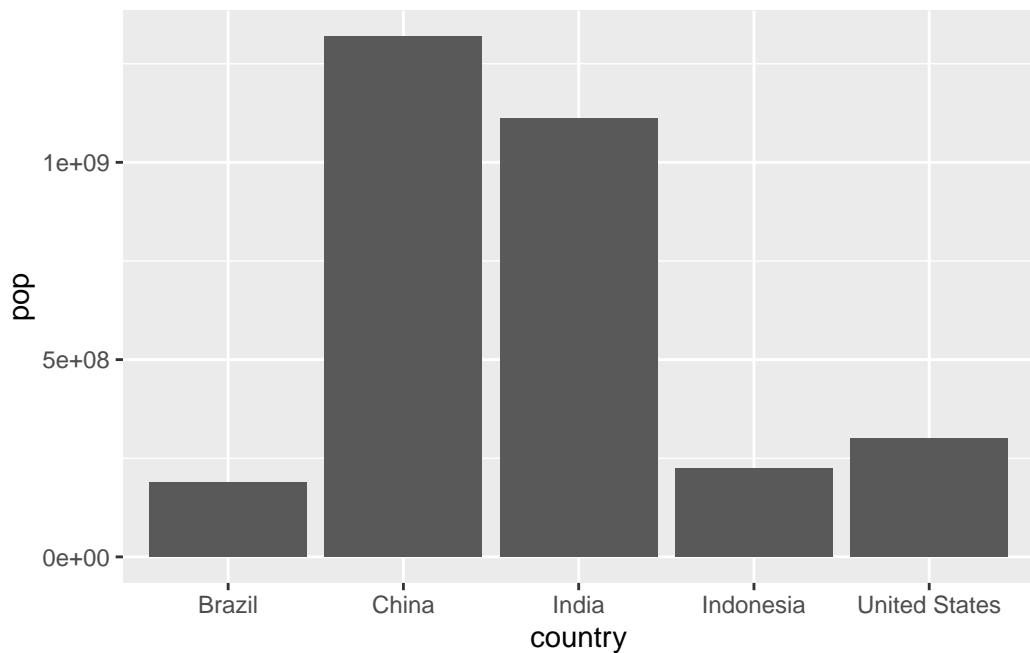


```
gapminder_top5 <- gapminder %>%
  filter(year==2007) %>%
  arrange(desc(pop)) %>%
  top_n(5, pop)
```

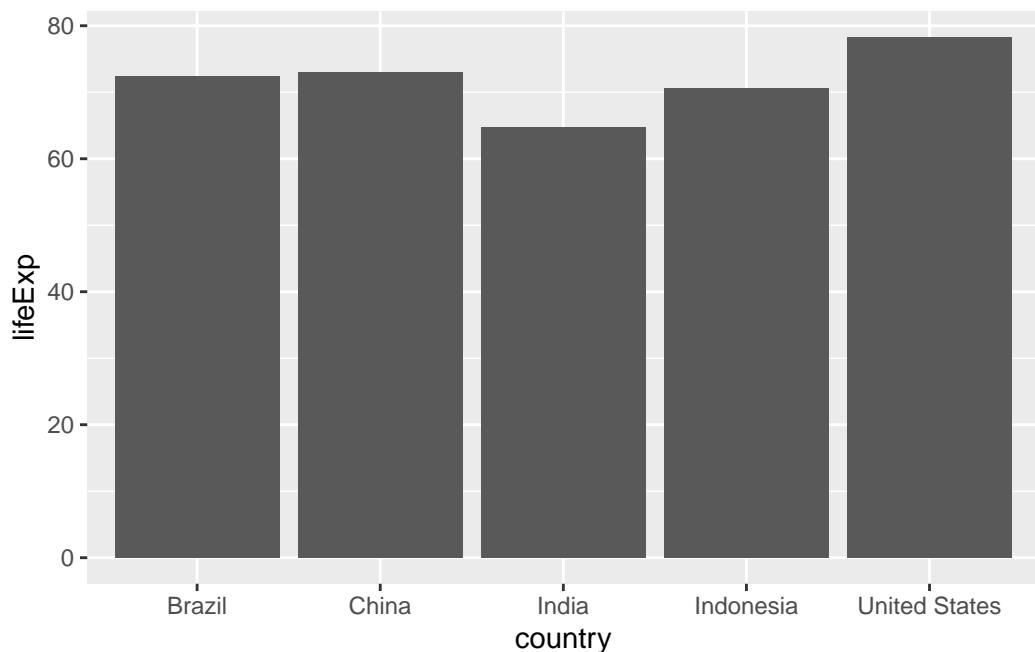
```
gapminder_top5
```

|   | 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  |

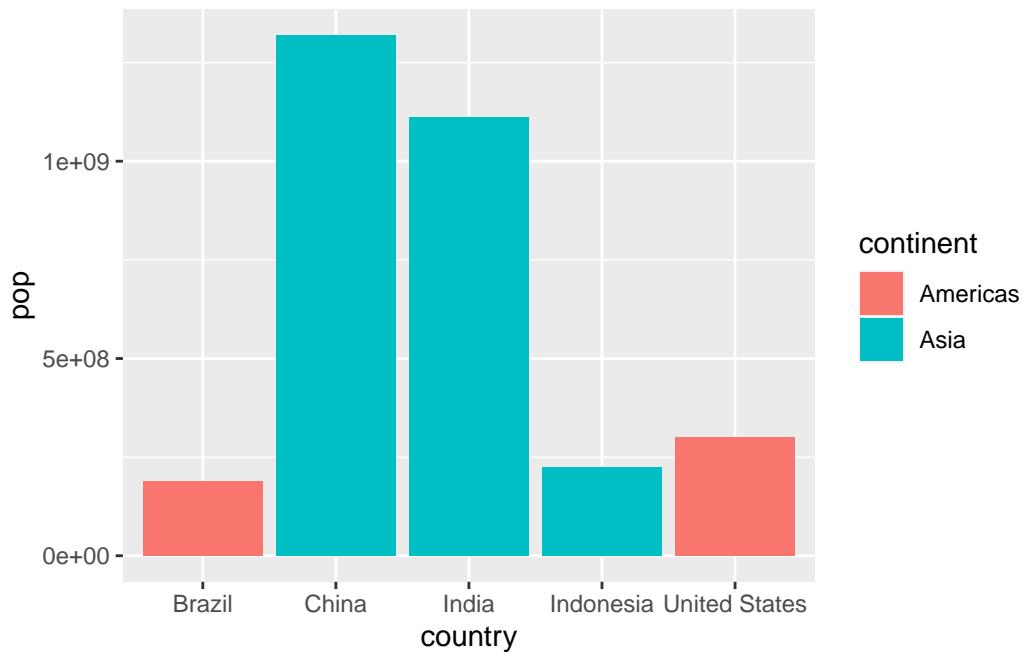
```
ggplot(gapminder_top5) +
  geom_col(aes(x = country, y = pop))
```



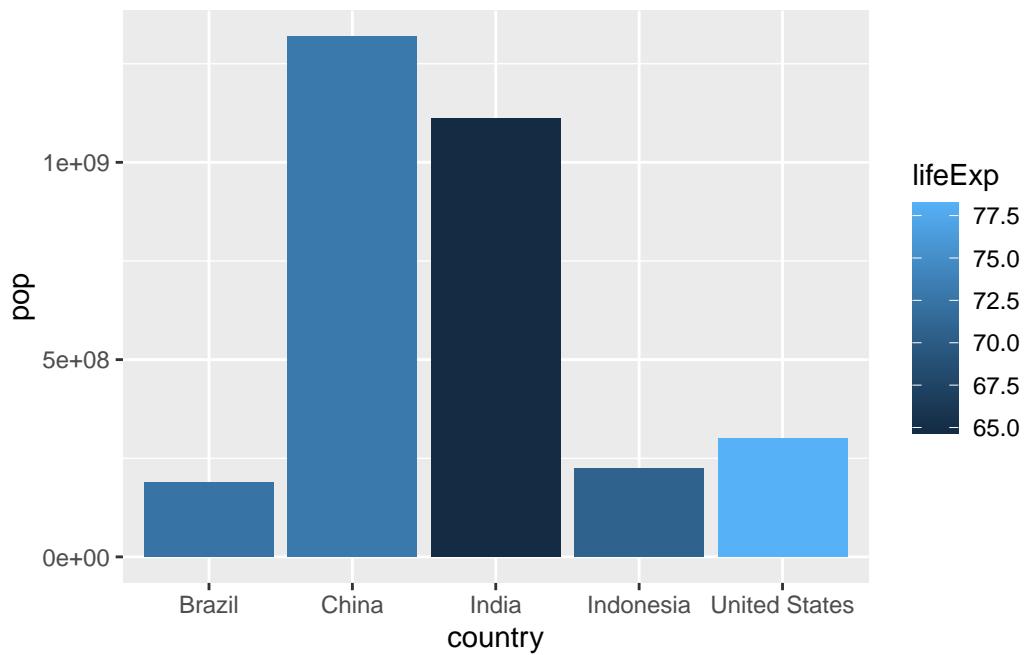
```
ggplot(gapminder_top5) +  
  geom_col(aes(x = country, y = lifeExp))
```



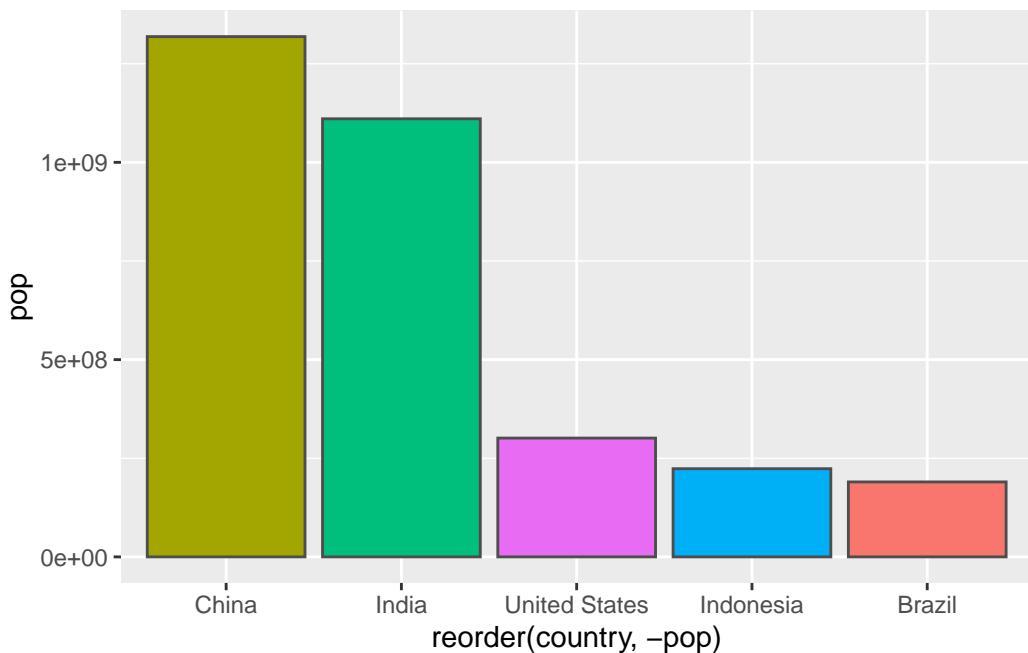
```
ggplot(gapminder_top5) +  
  geom_col(aes(x = country, y = pop, fill = continent))
```



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



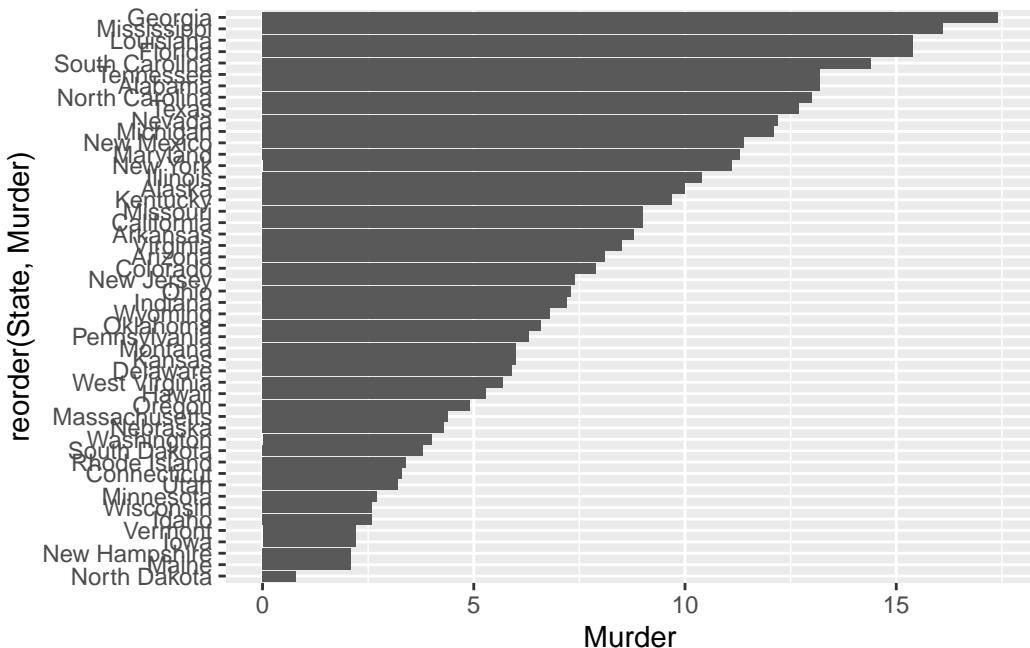
```
ggplot(gapminder_top5) +  
  aes(x=reorder(country, -pop), y=pop, fill=country) +  
  geom_col(col="gray30") +  
  guides(fill="none")
```



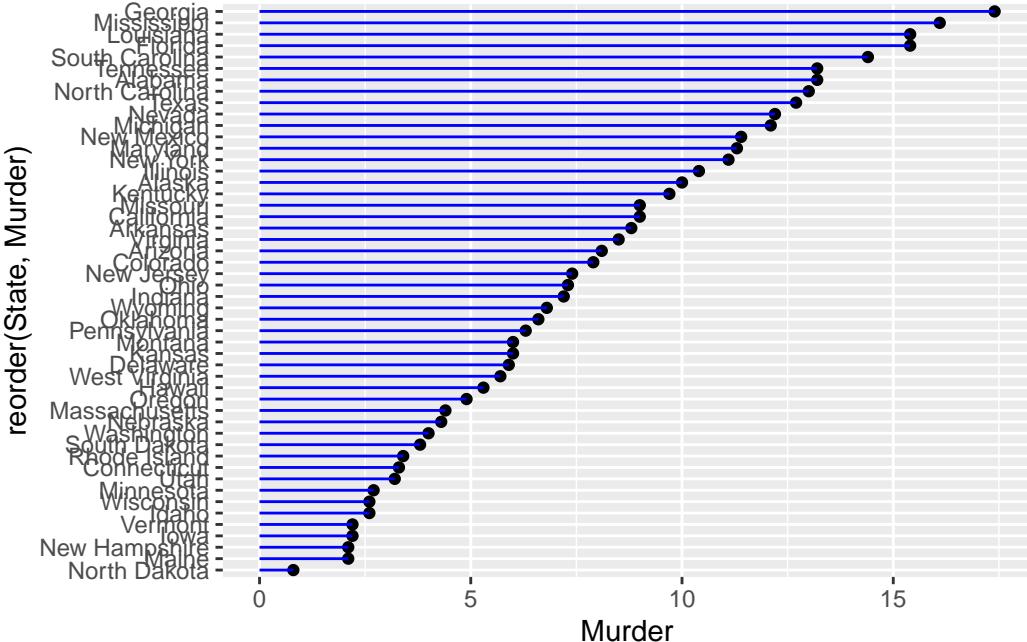
```
head(USArrests)
```

|            | 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)
```

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

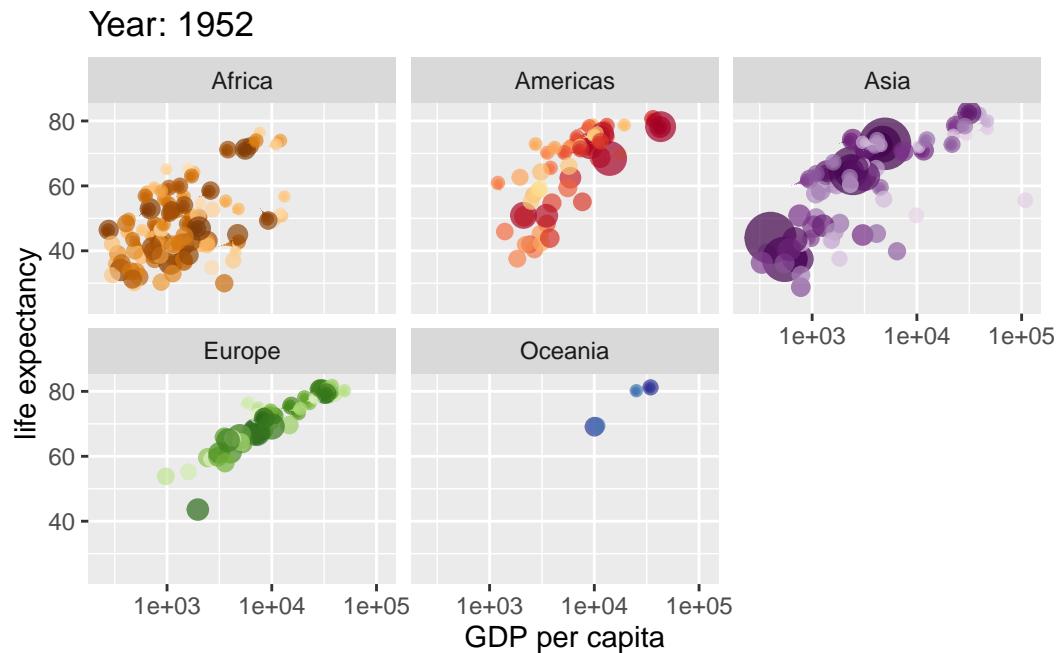
```
The following object is masked _by_ '.GlobalEnv':
```

```
gapminder
```

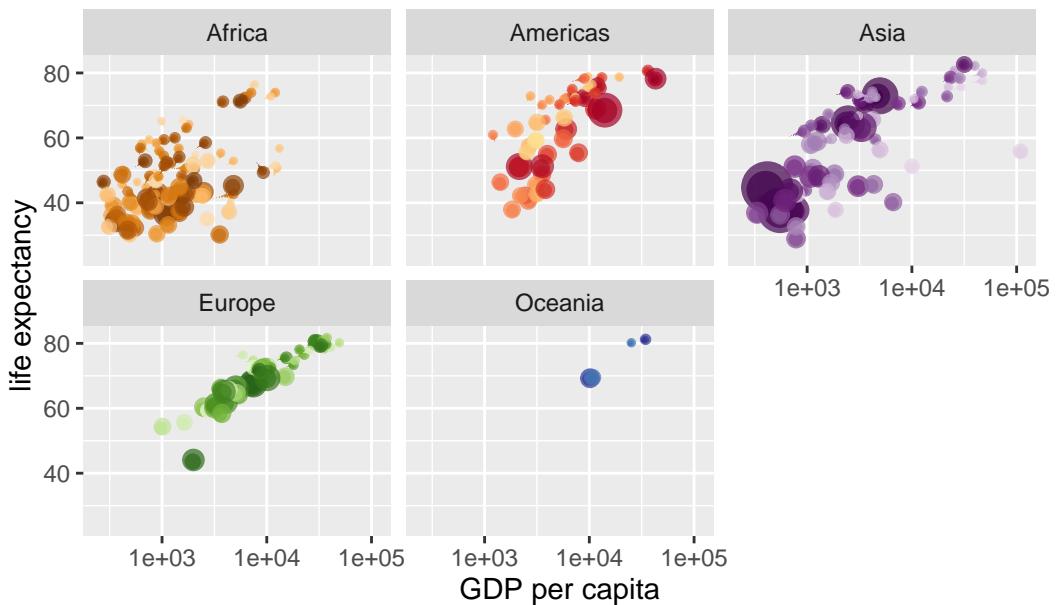
```
library(gganimate)
```

```
# Setup nice regular ggplot of the gapminder data
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 by continent
  facet_wrap(~continent) +
  # Here comes the gganimate specific bits
```

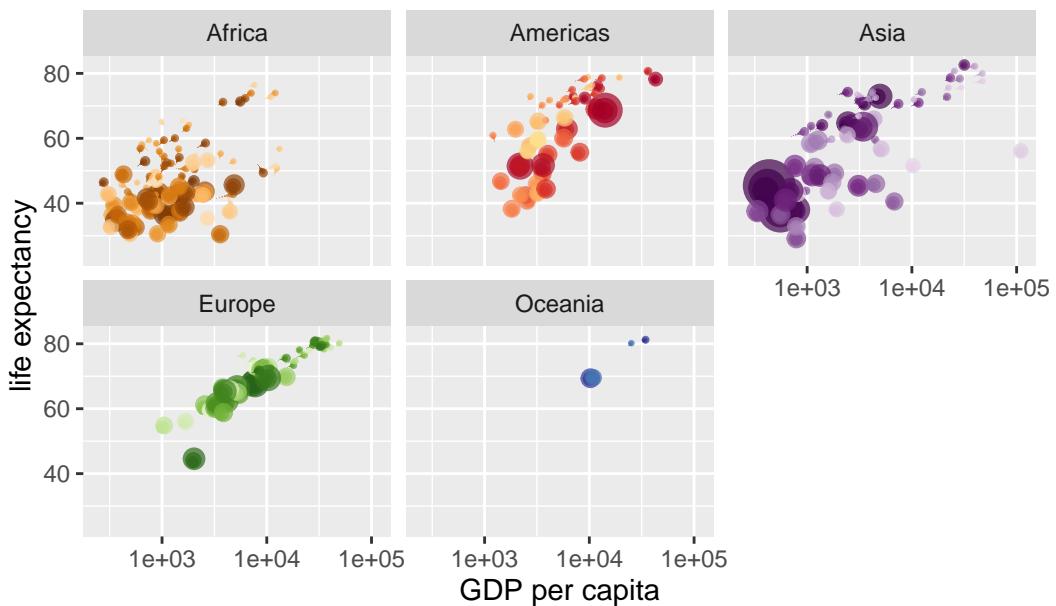
```
labs(title = 'Year: {frame_time}', x = 'GDP per capita', y = 'life expectancy') +  
transition_time(year) +  
shadow_wake(wake_length = 0.1, alpha = FALSE)
```



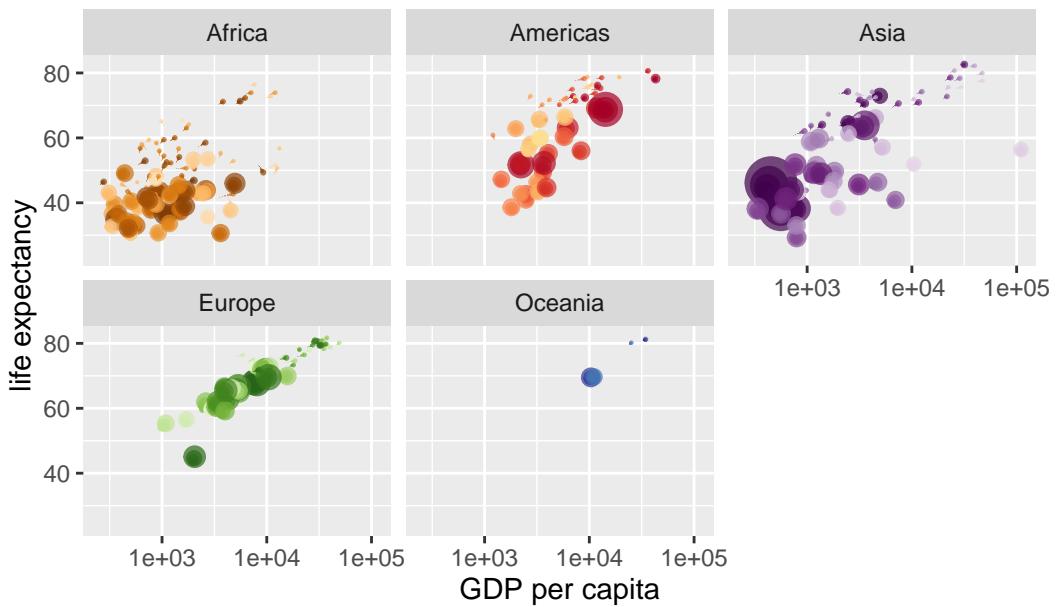
Year: 1953



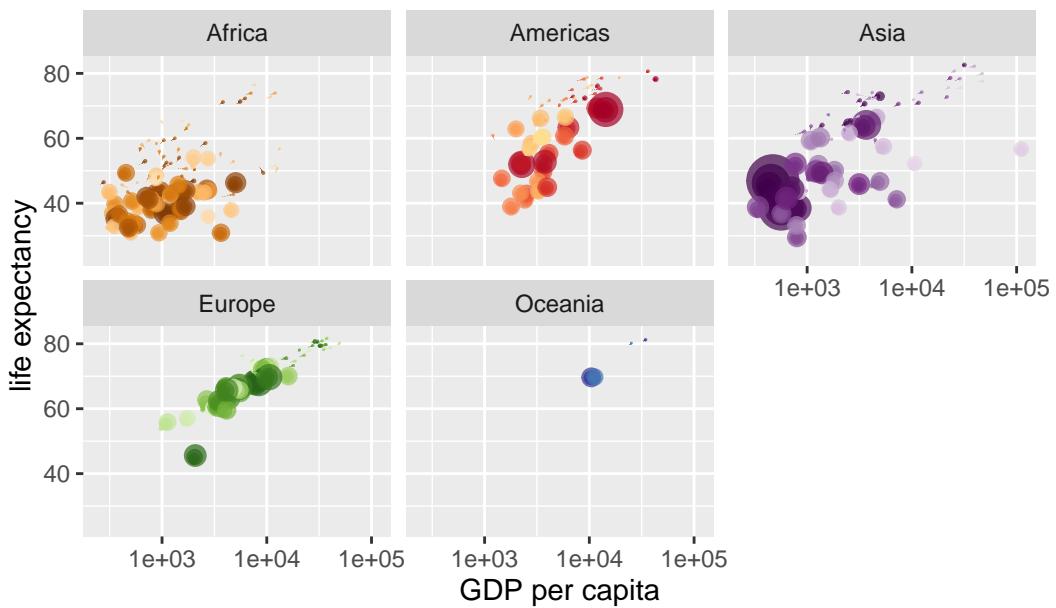
Year: 1953



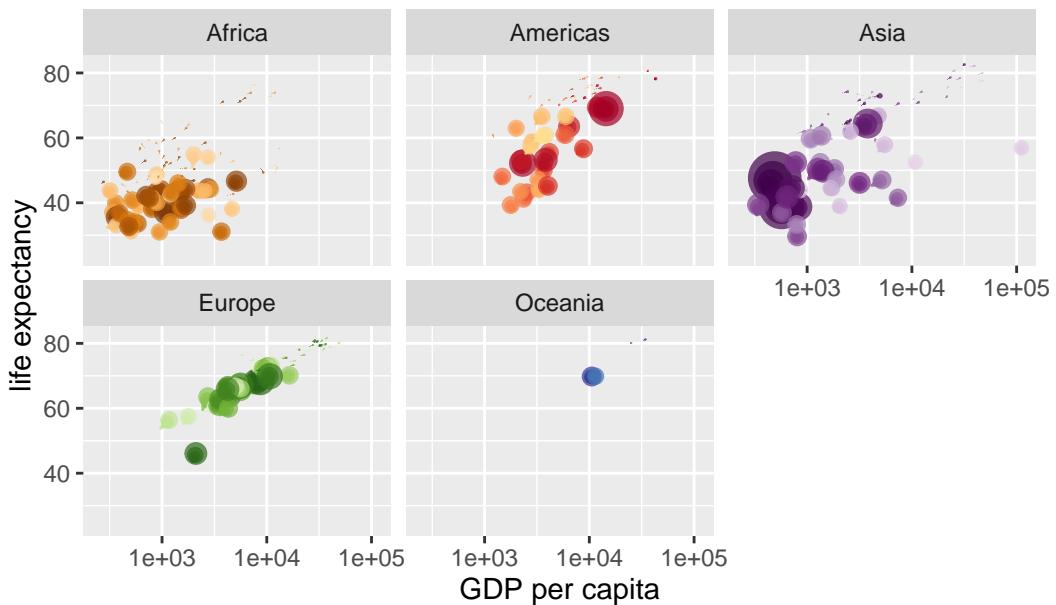
Year: 1954



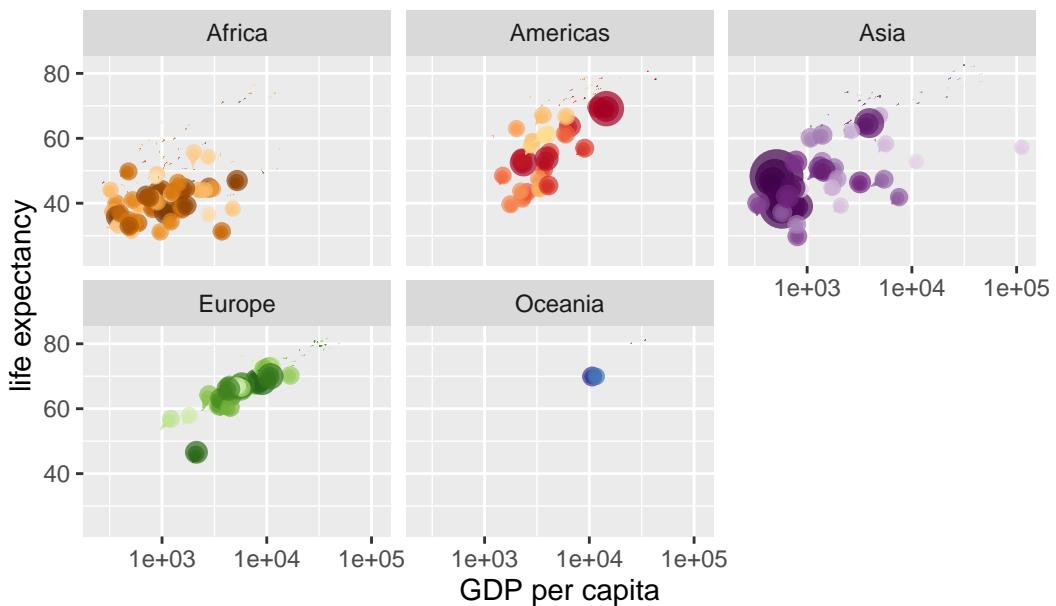
Year: 1954



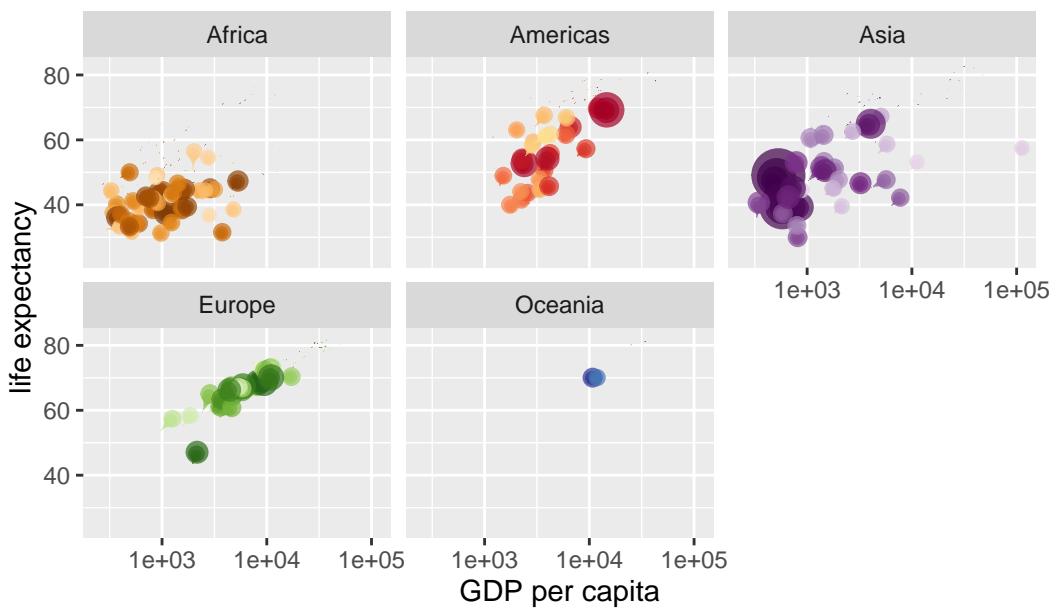
Year: 1955



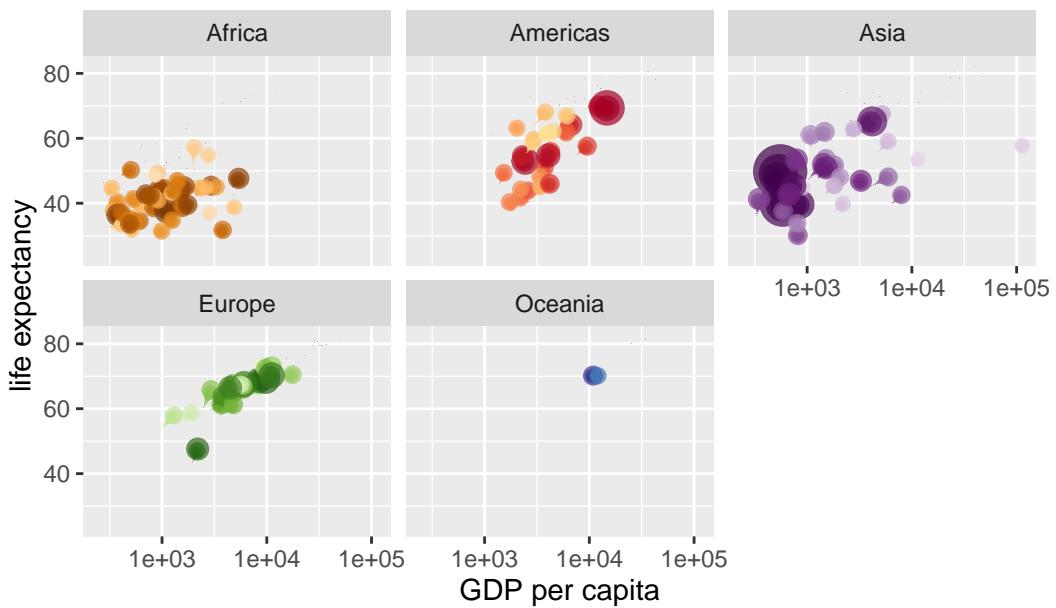
Year: 1955



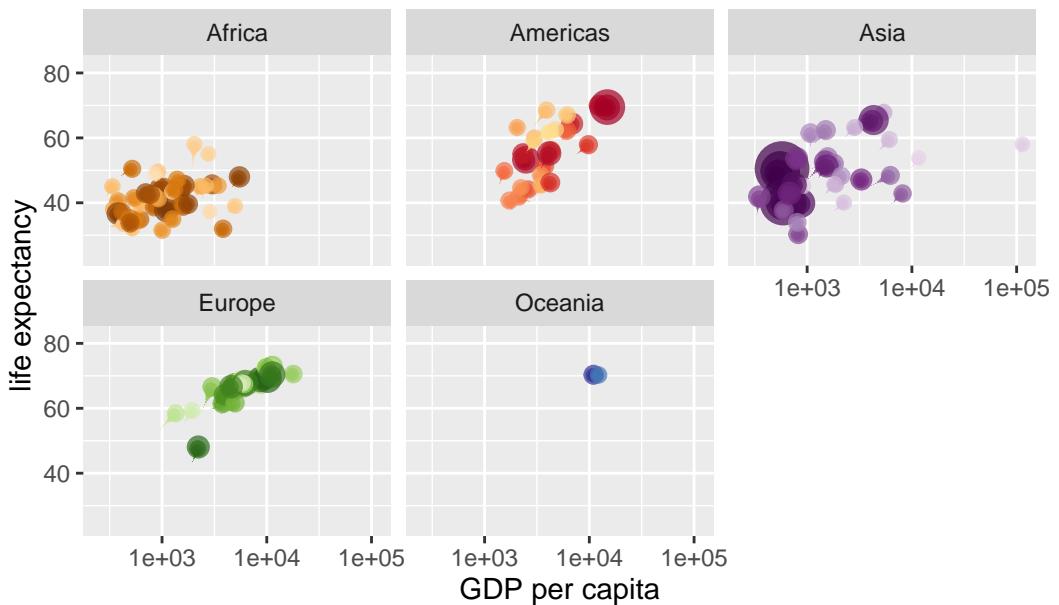
Year: 1956



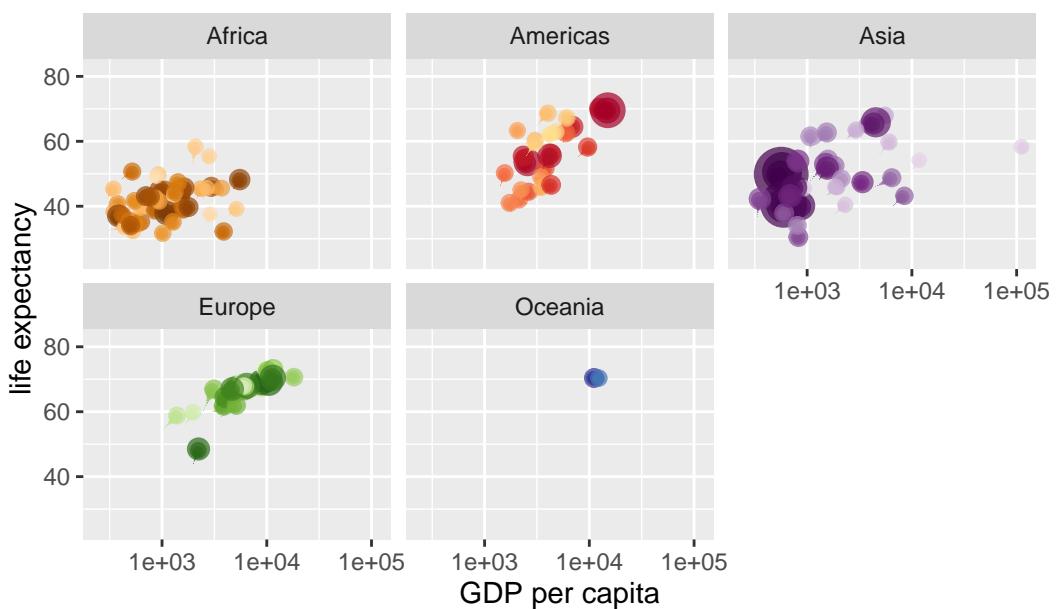
Year: 1956



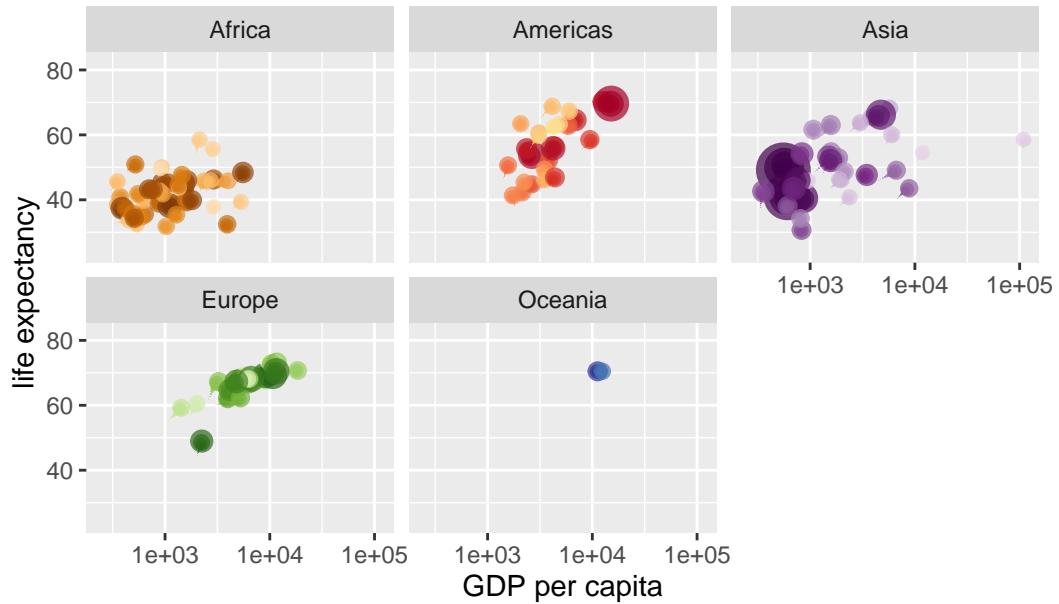
Year: 1957



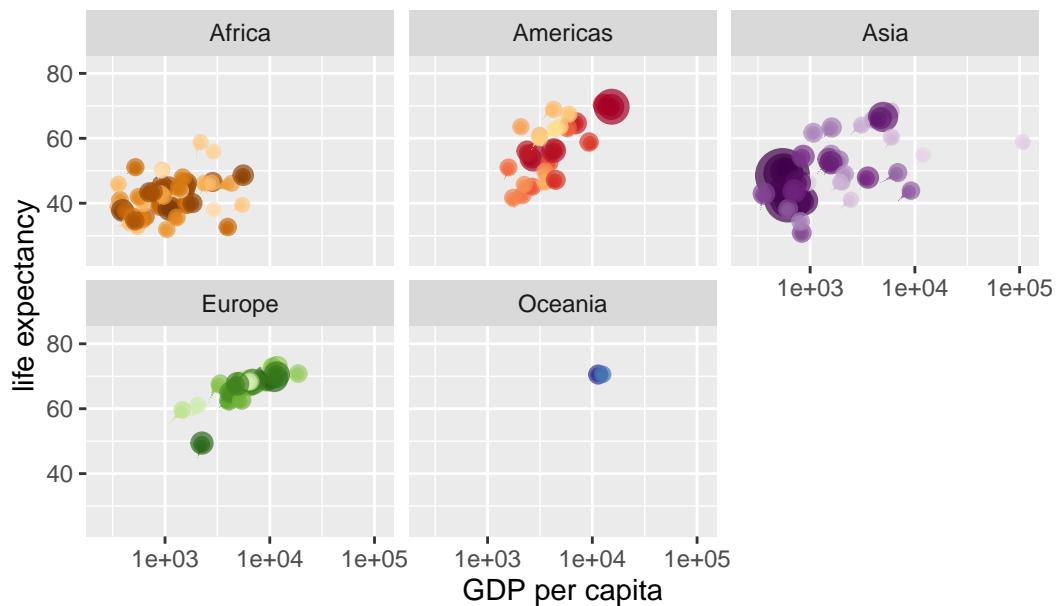
Year: 1958



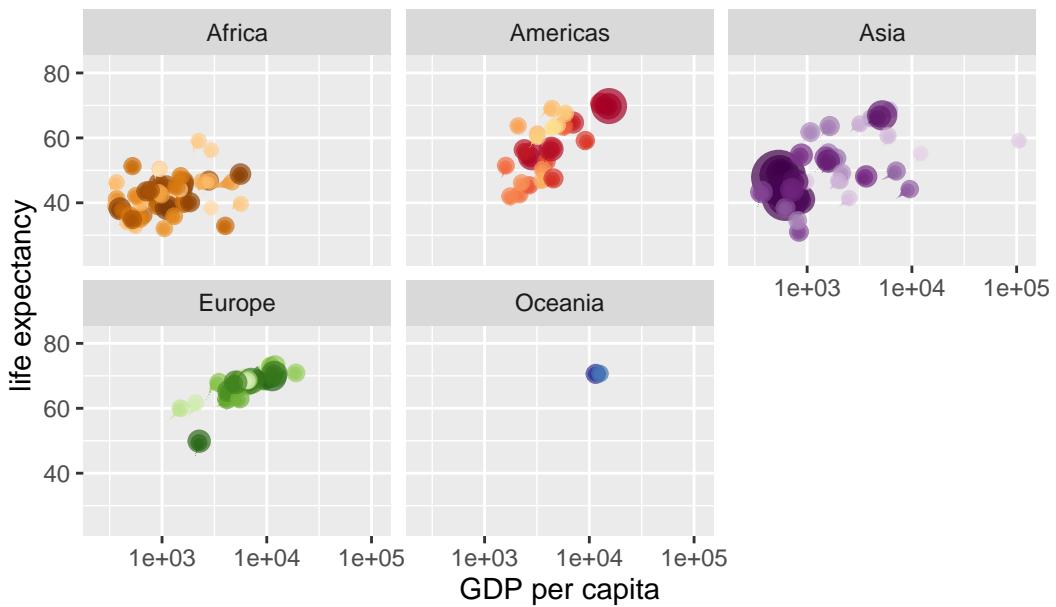
Year: 1958



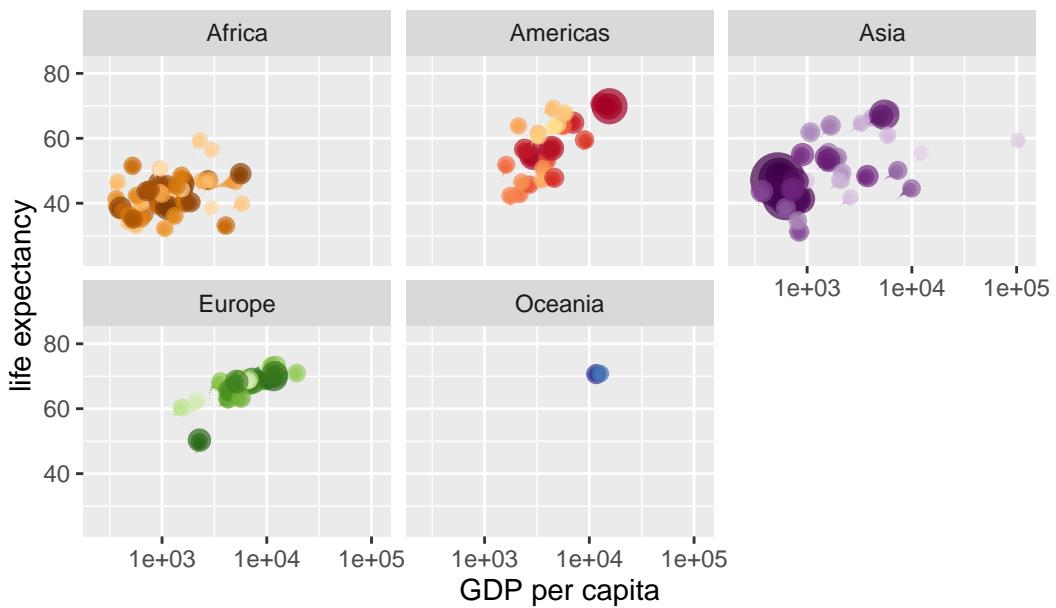
Year: 1959



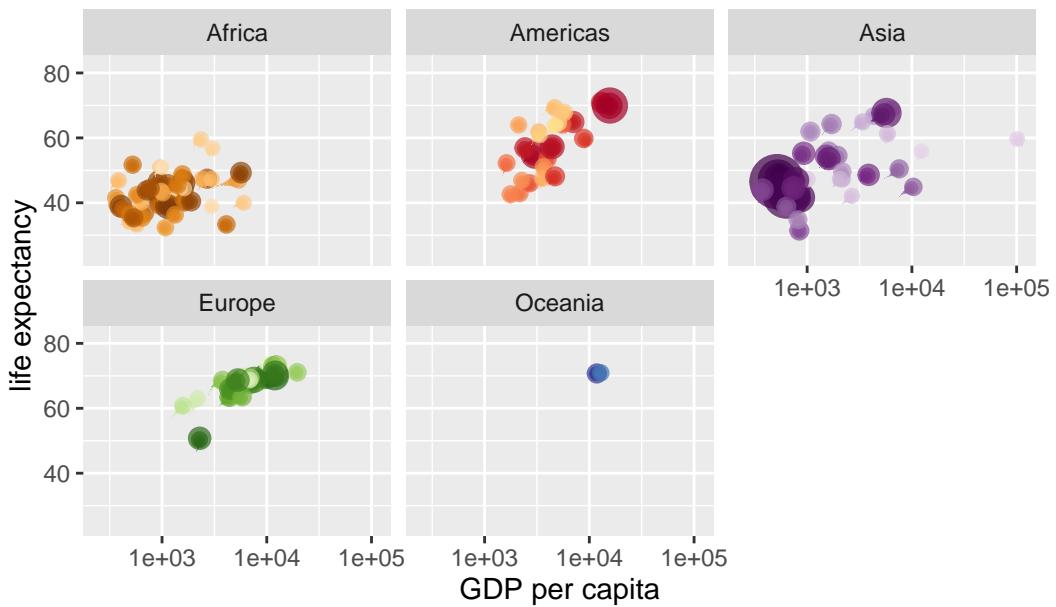
Year: 1959



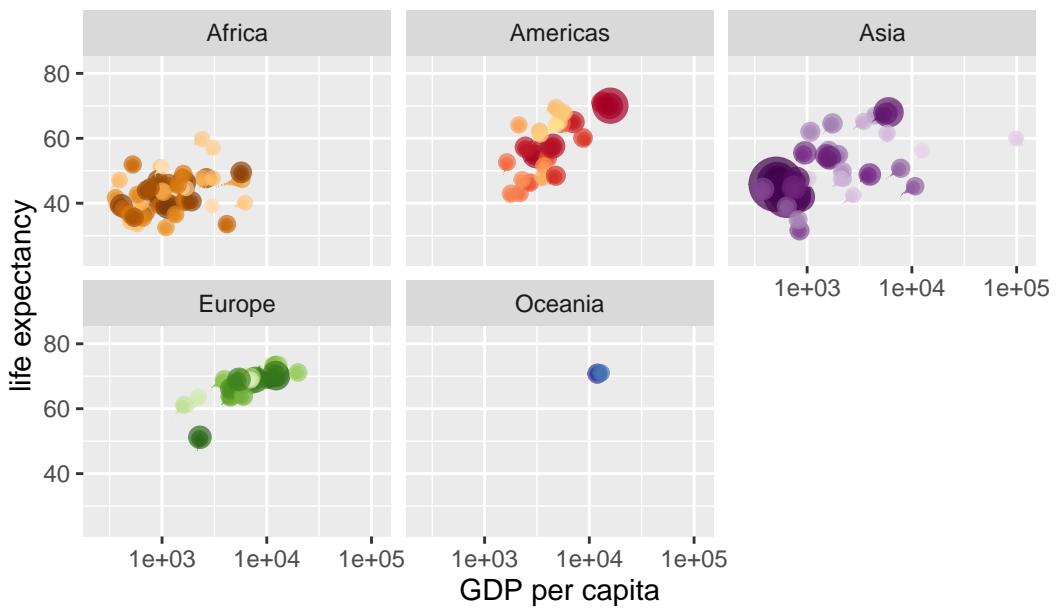
Year: 1960



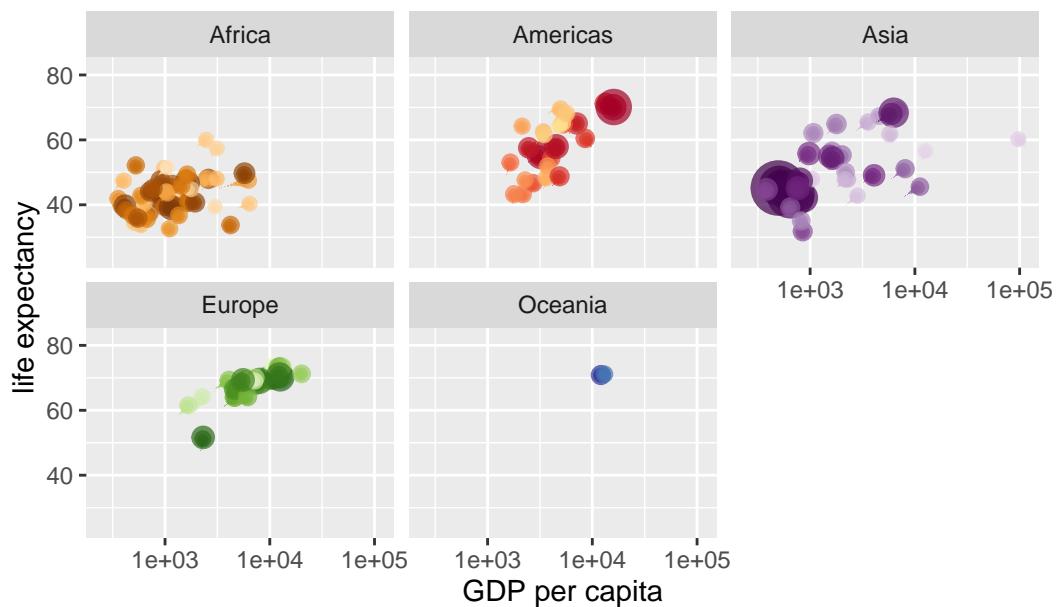
Year: 1960



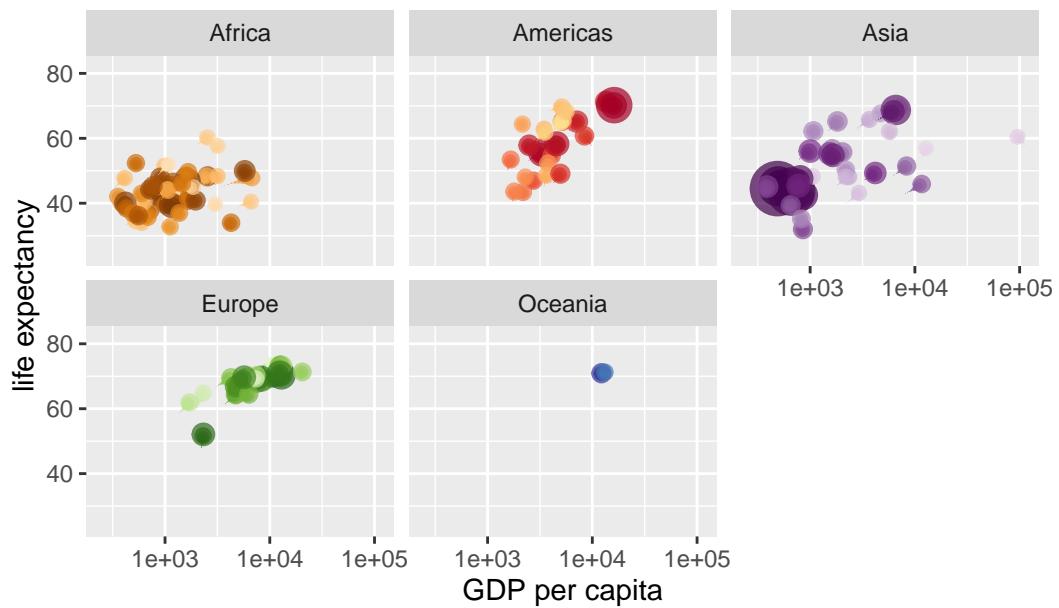
Year: 1961



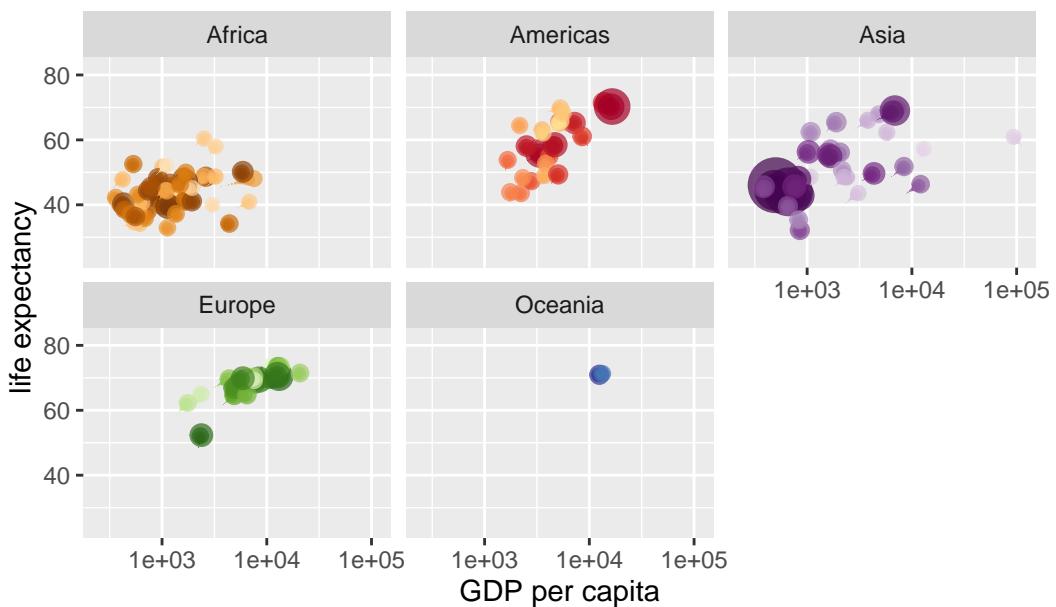
Year: 1961



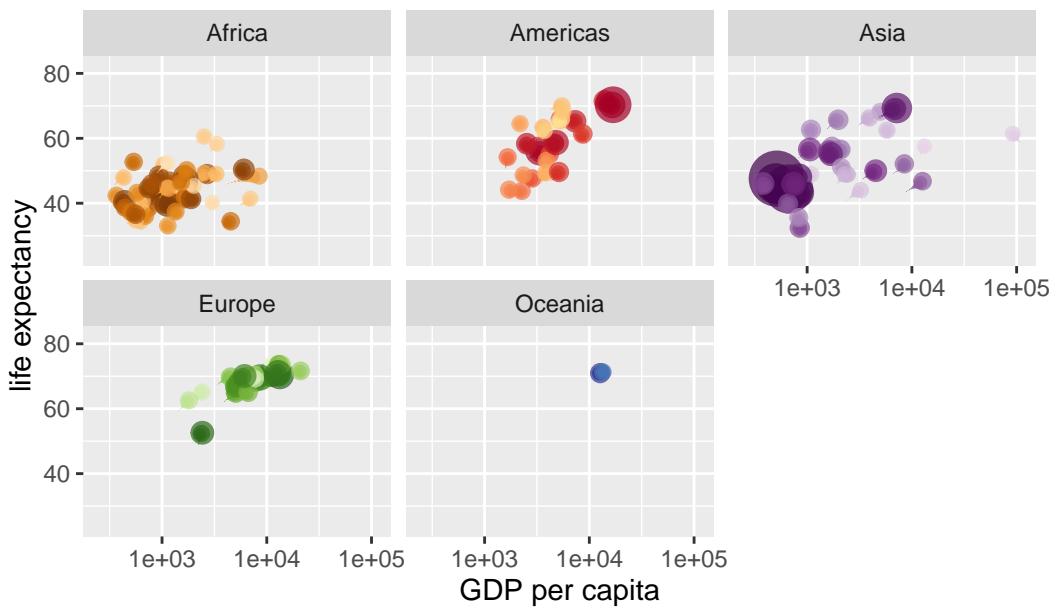
Year: 1962



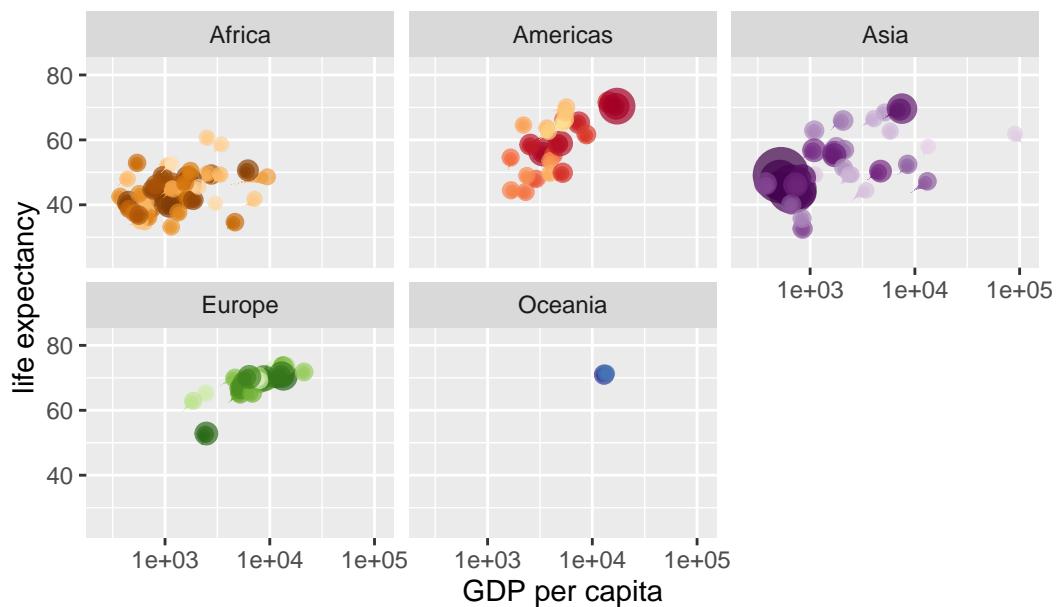
Year: 1963



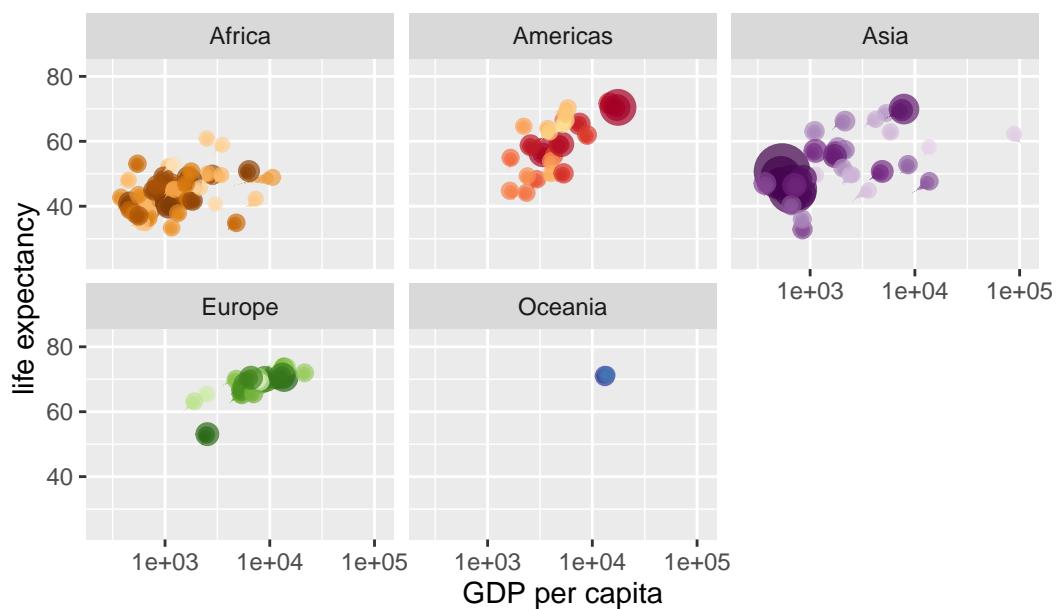
Year: 1963



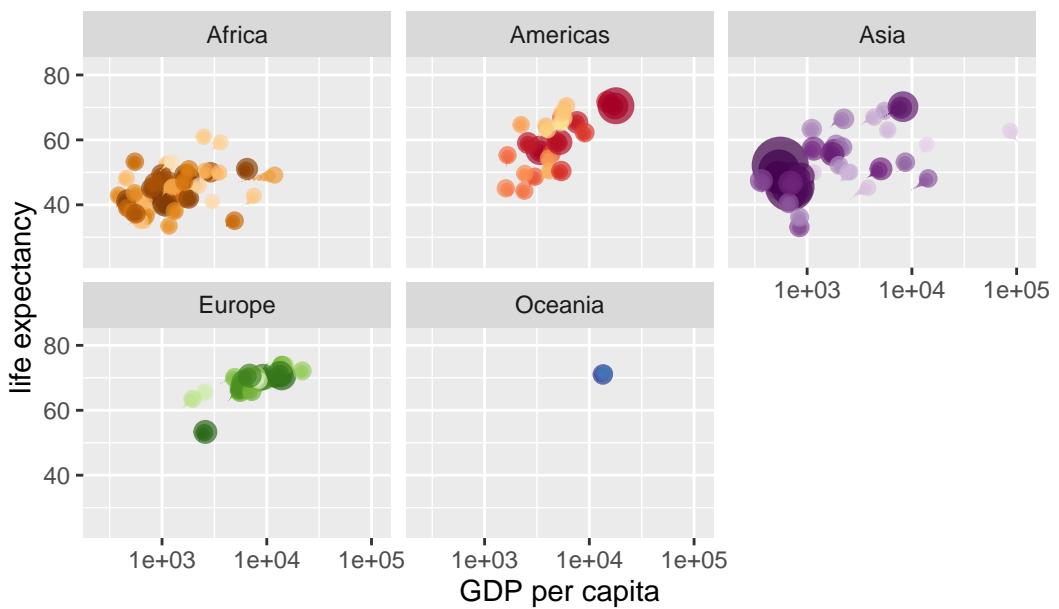
Year: 1964



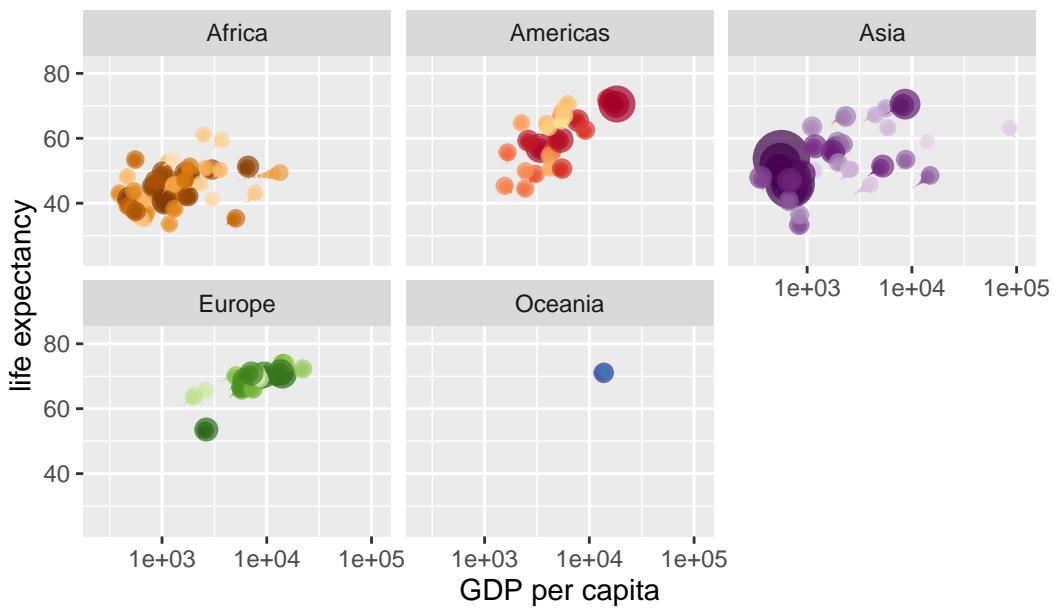
Year: 1964



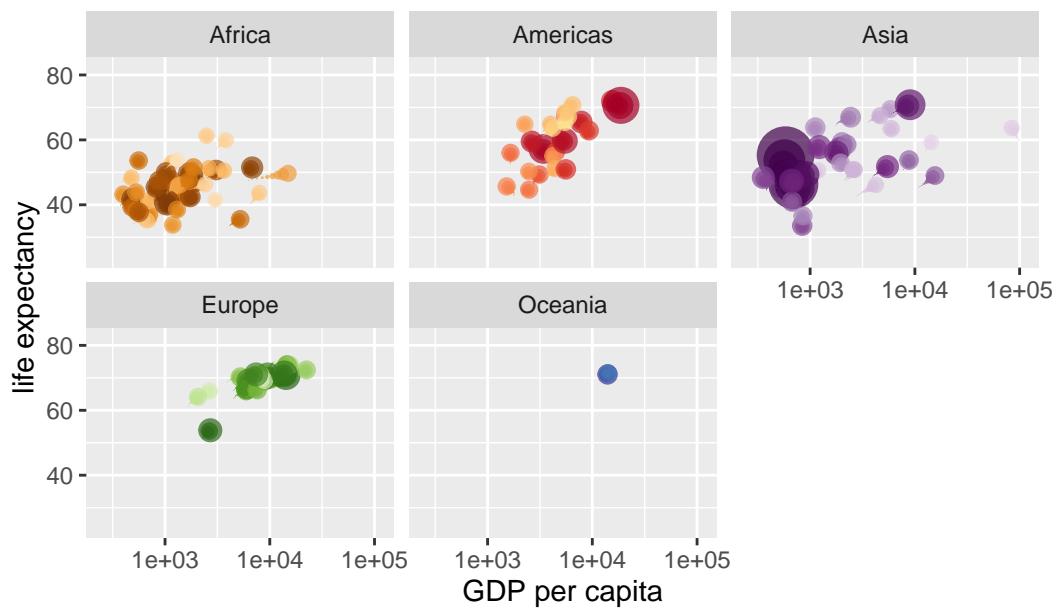
Year: 1965



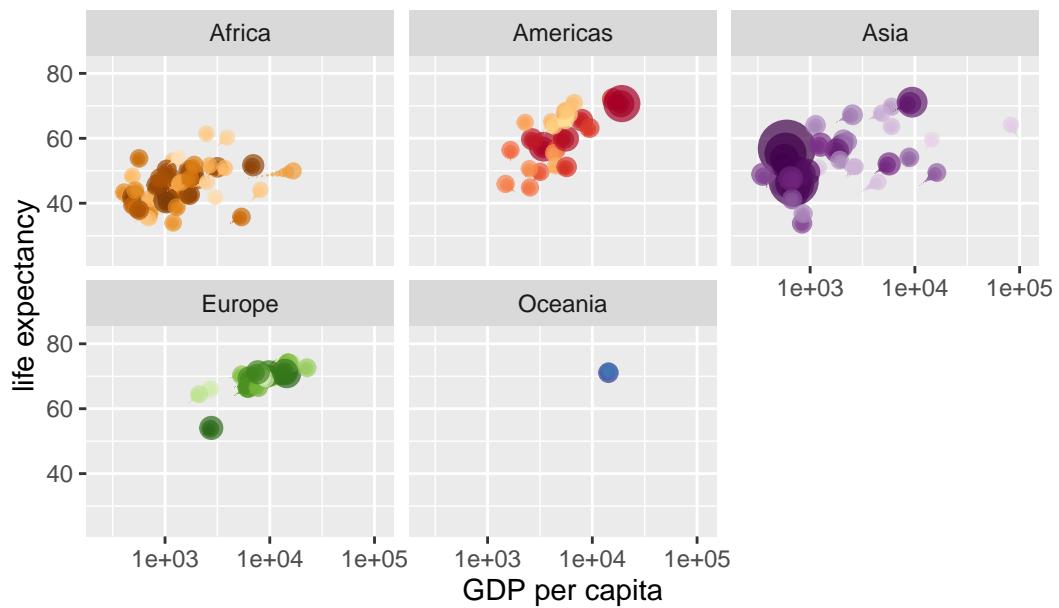
Year: 1965



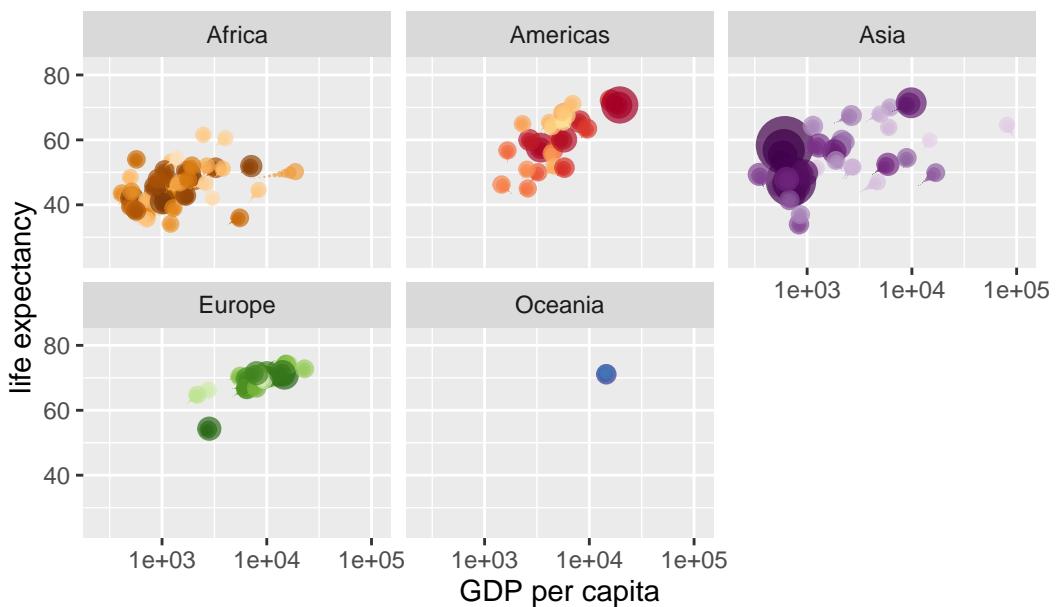
Year: 1966



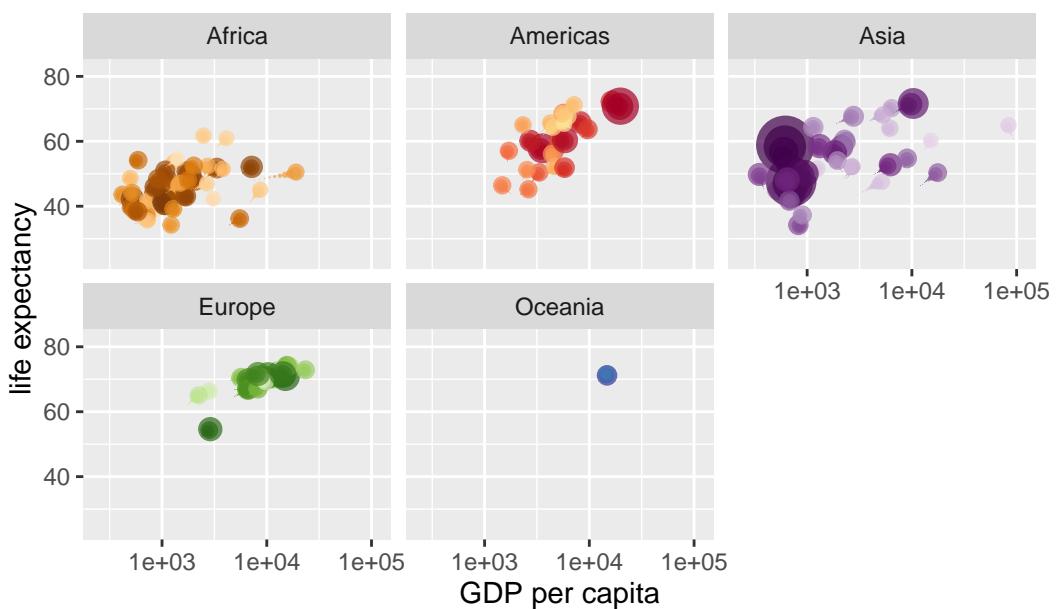
Year: 1966



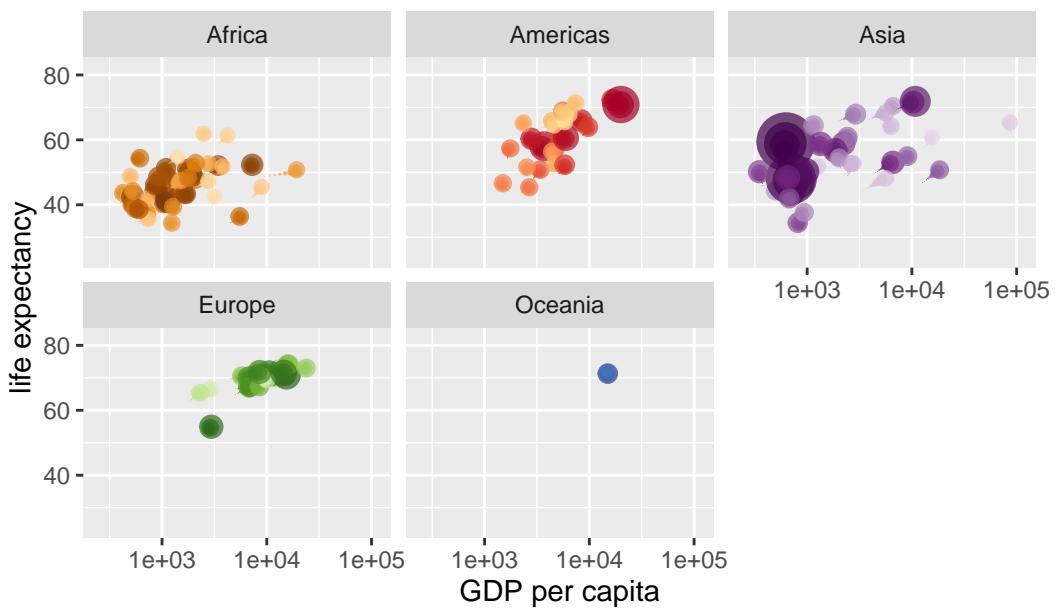
Year: 1967



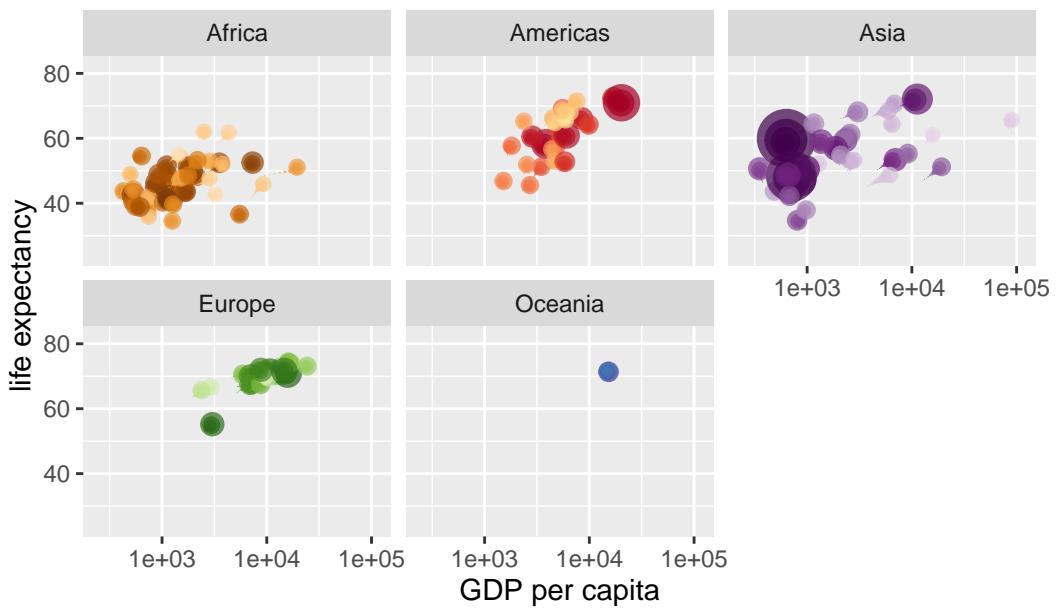
Year: 1968



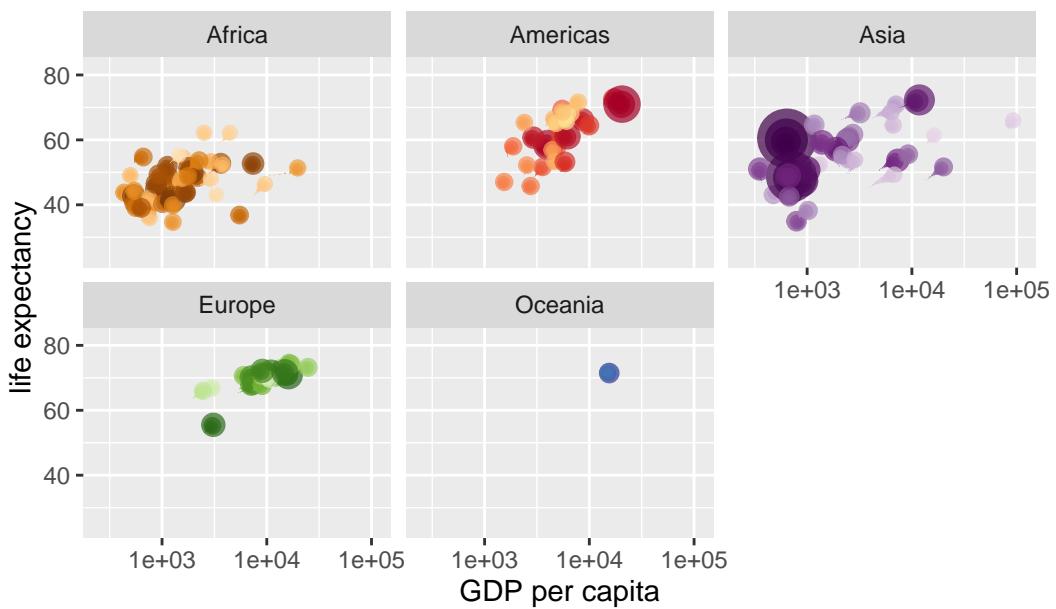
Year: 1968



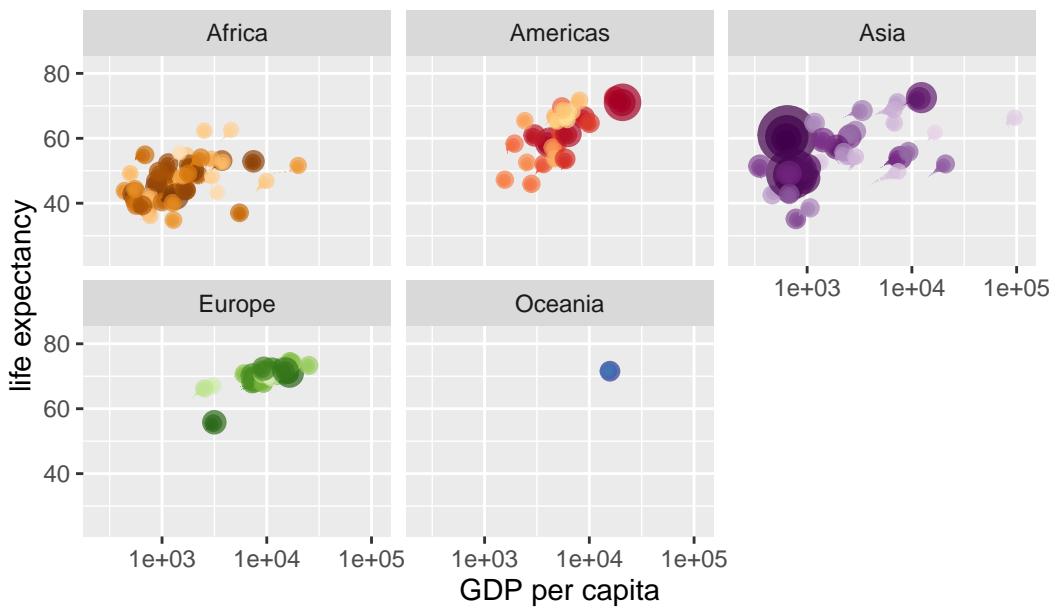
Year: 1969



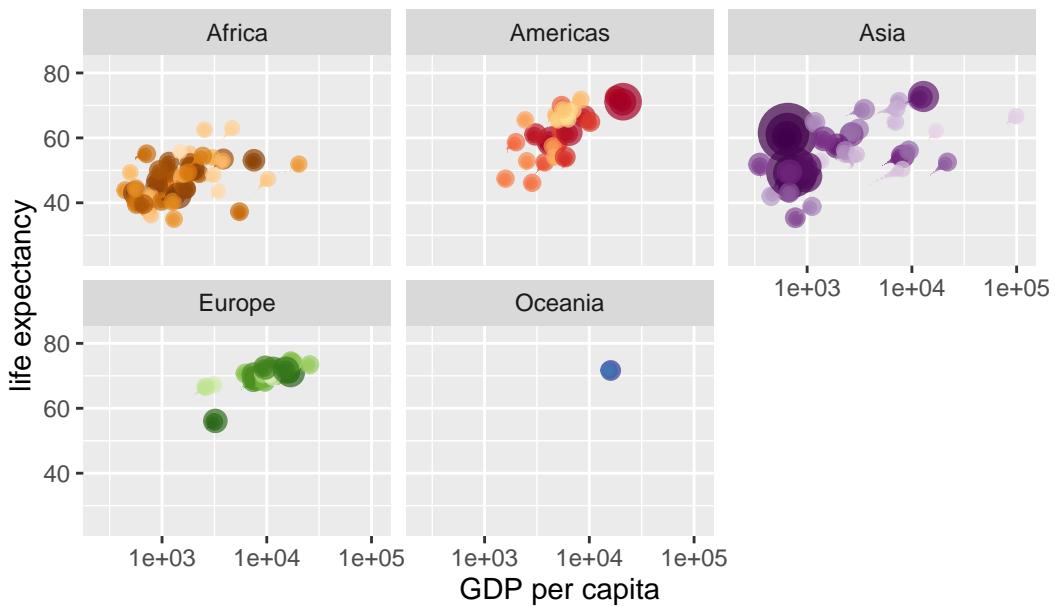
Year: 1969



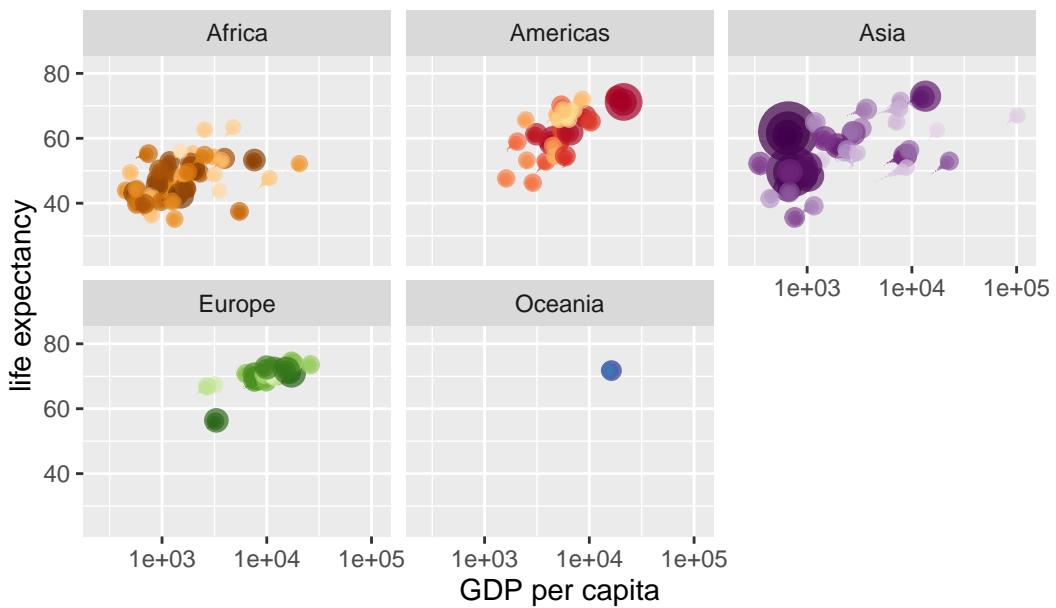
Year: 1970



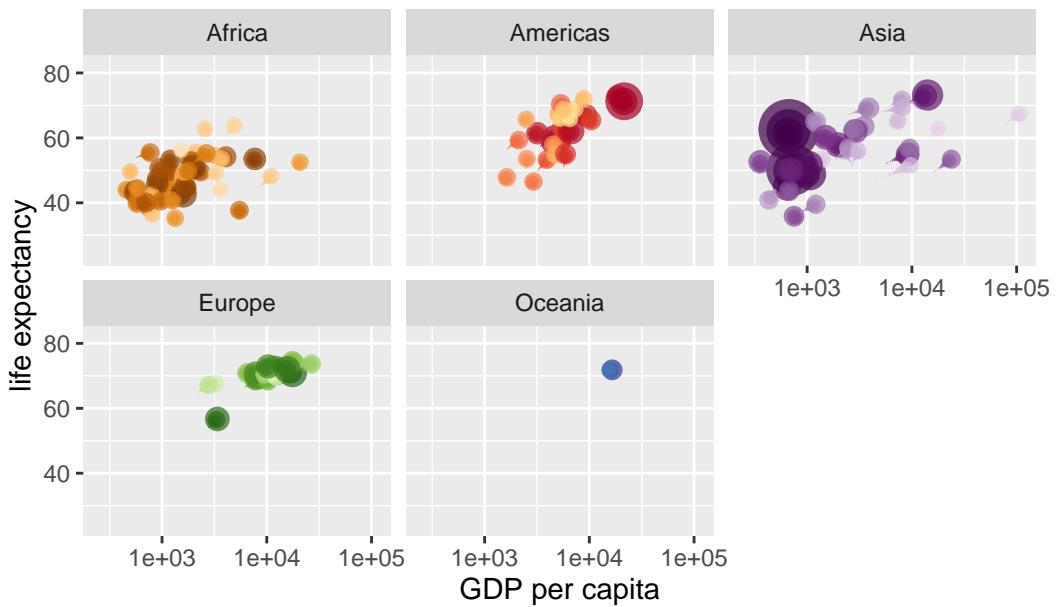
Year: 1970



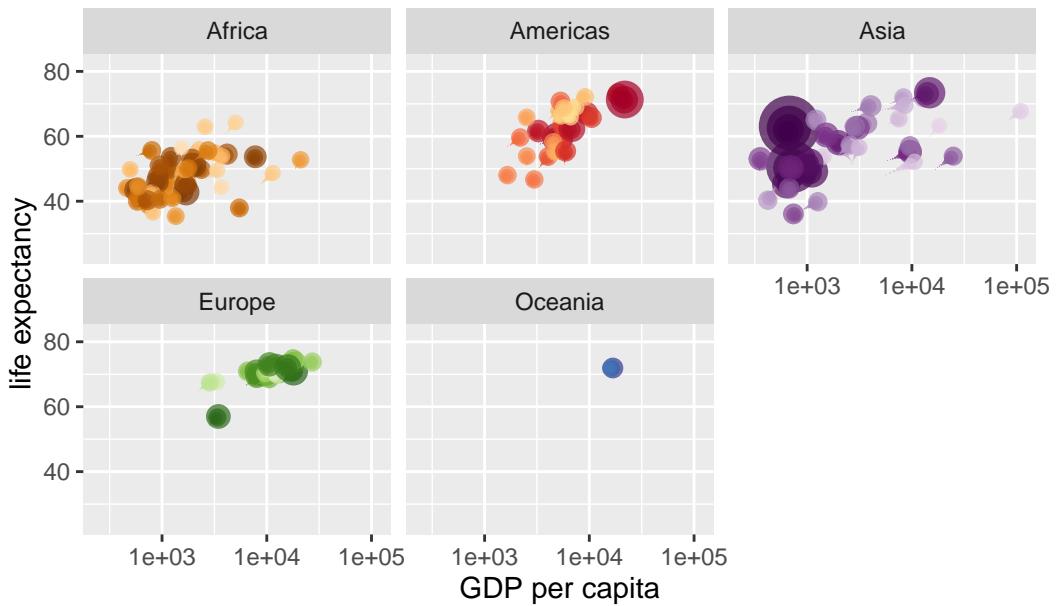
Year: 1971



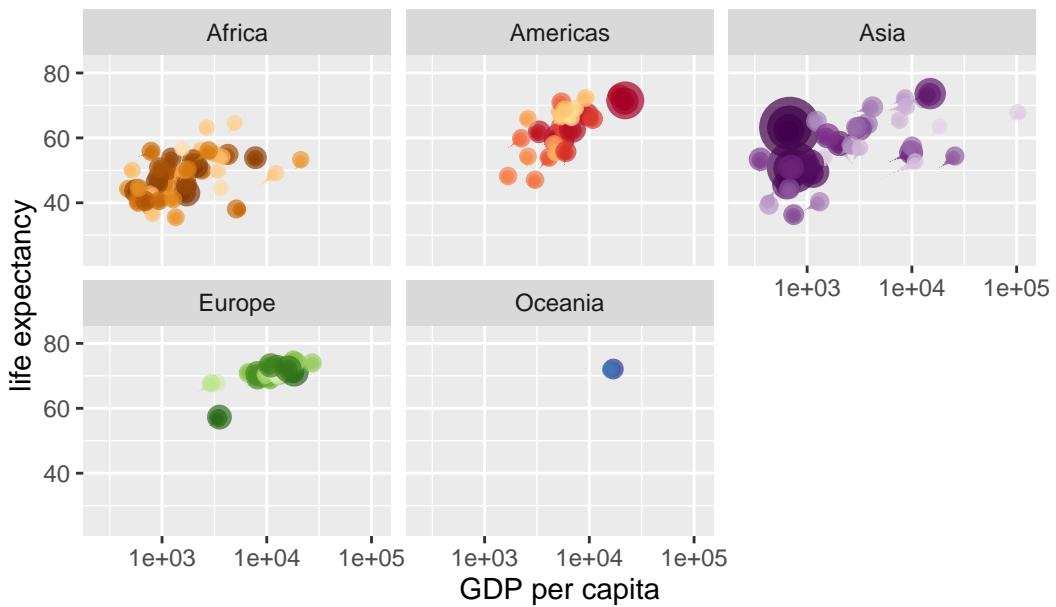
Year: 1971



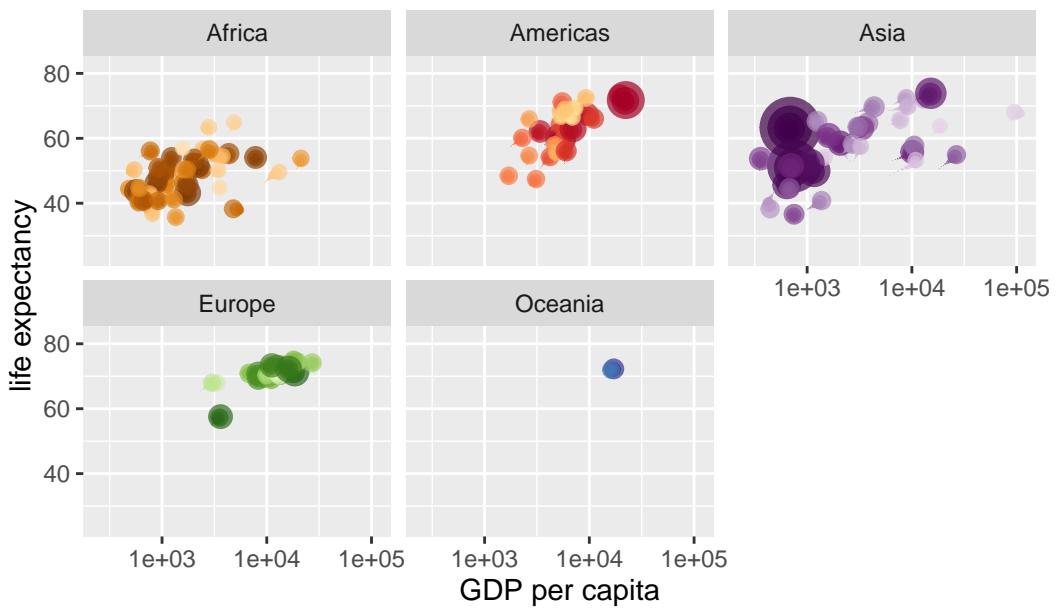
Year: 1972



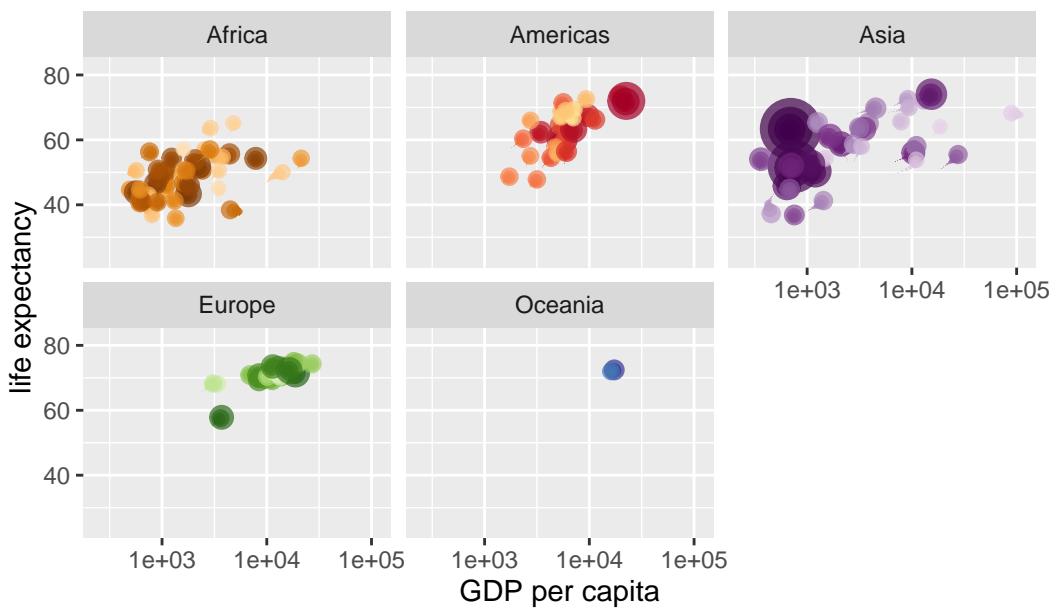
Year: 1973



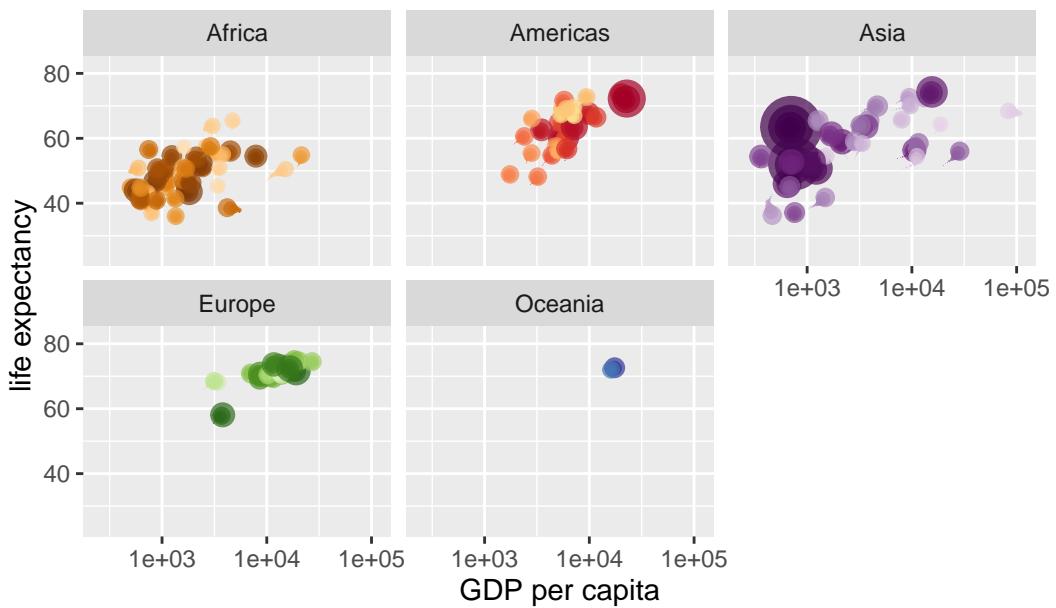
Year: 1973



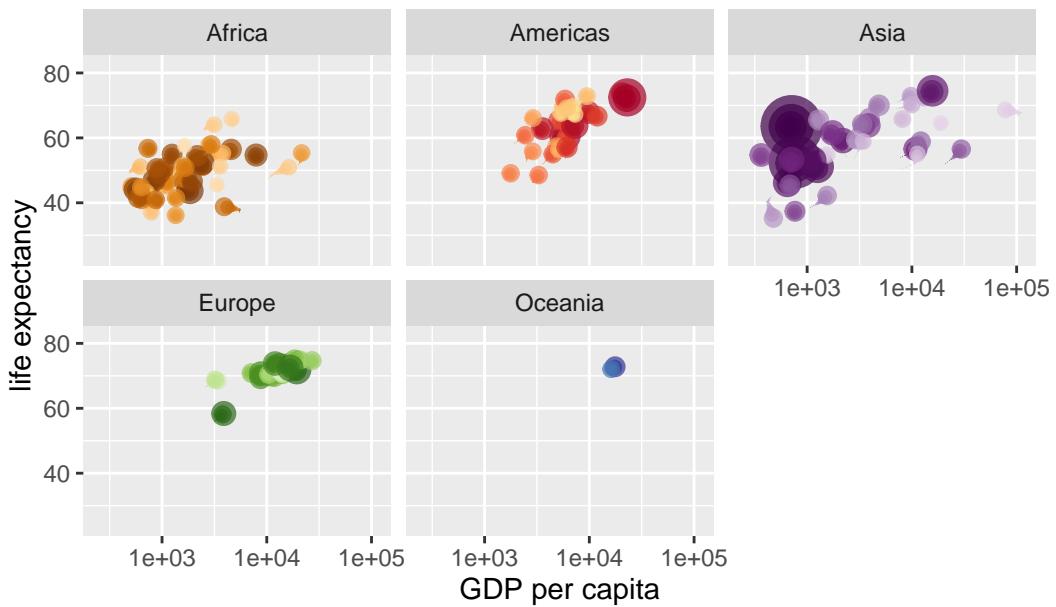
Year: 1974



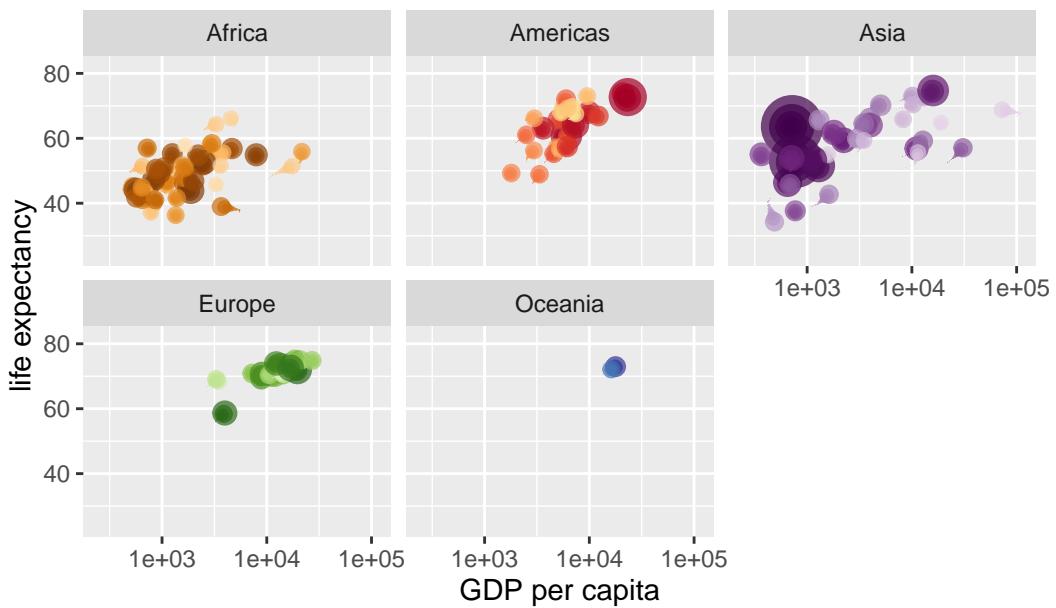
Year: 1974



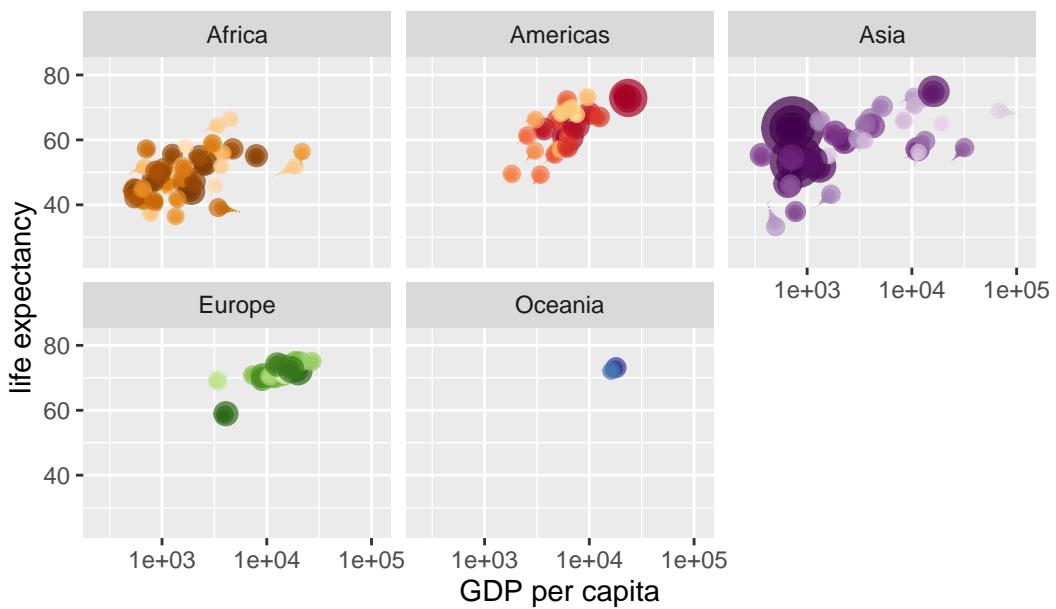
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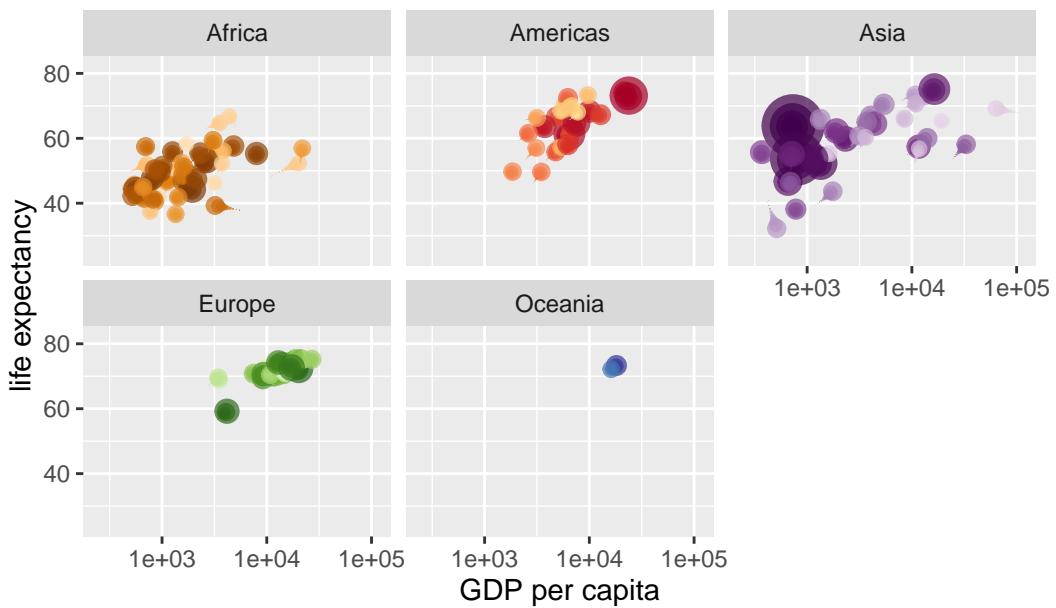
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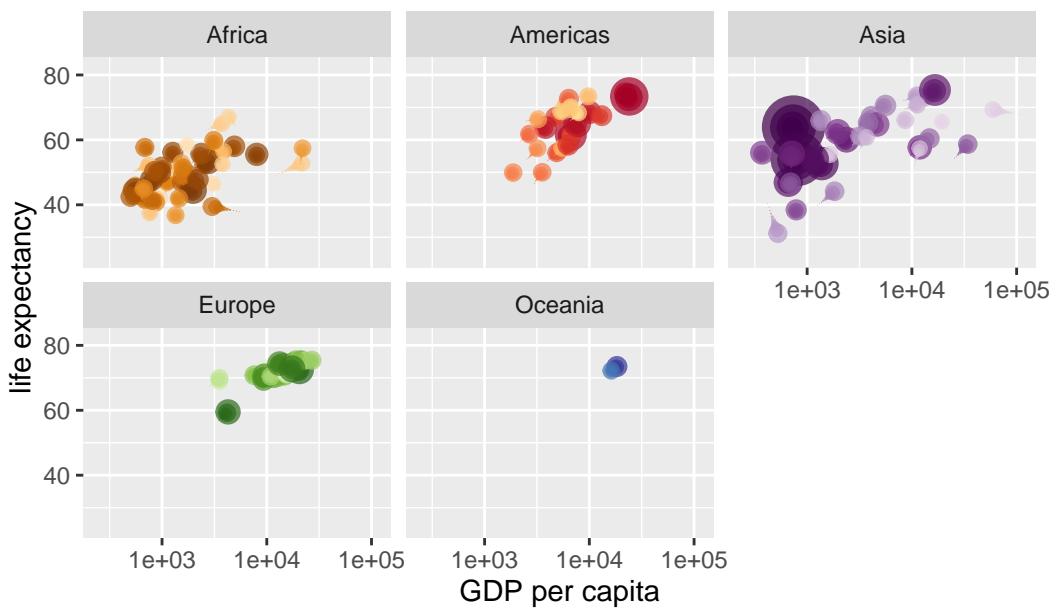
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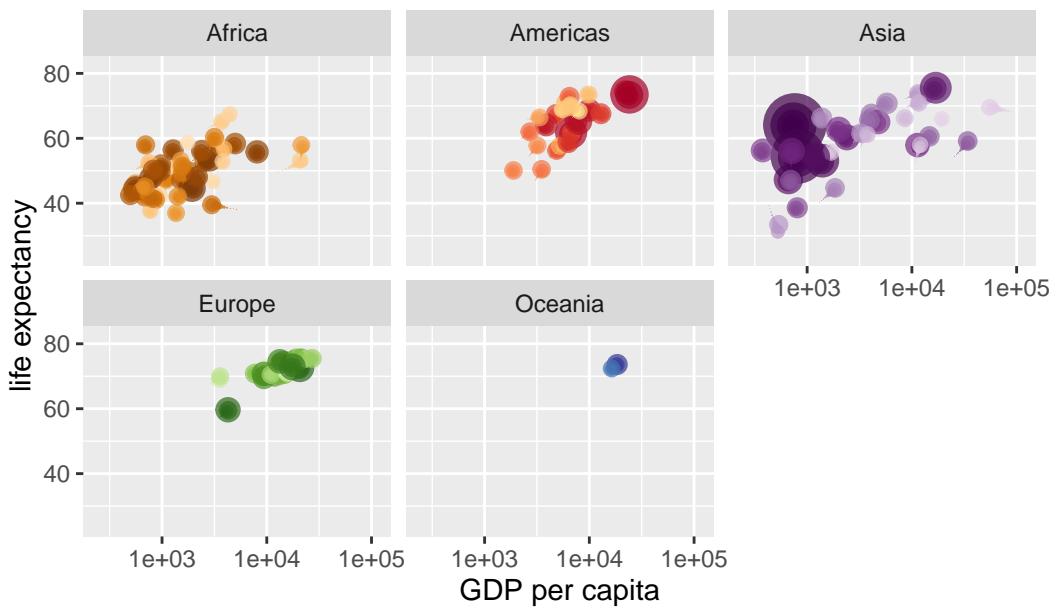
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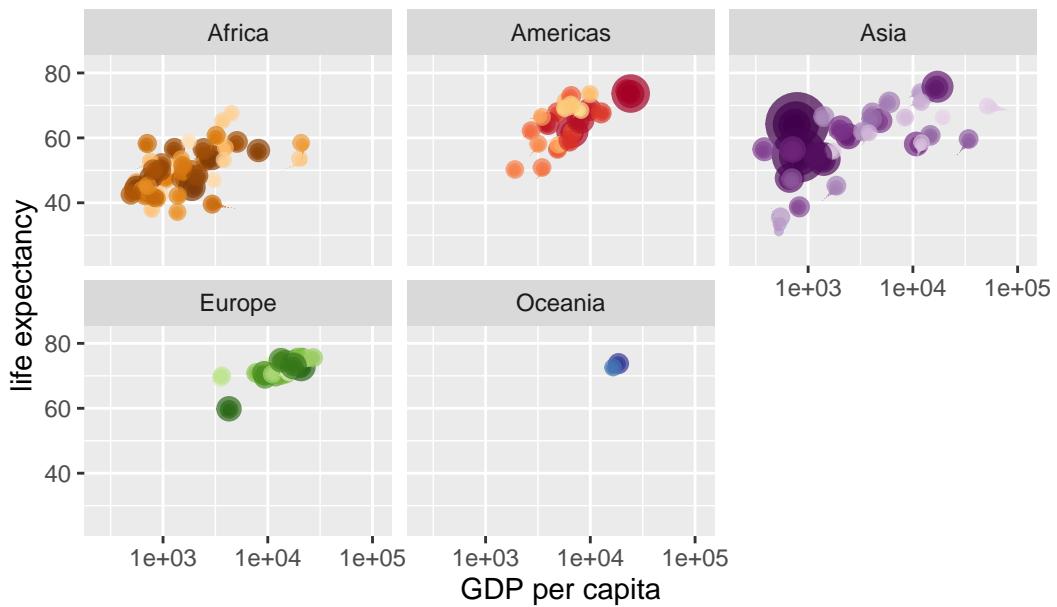
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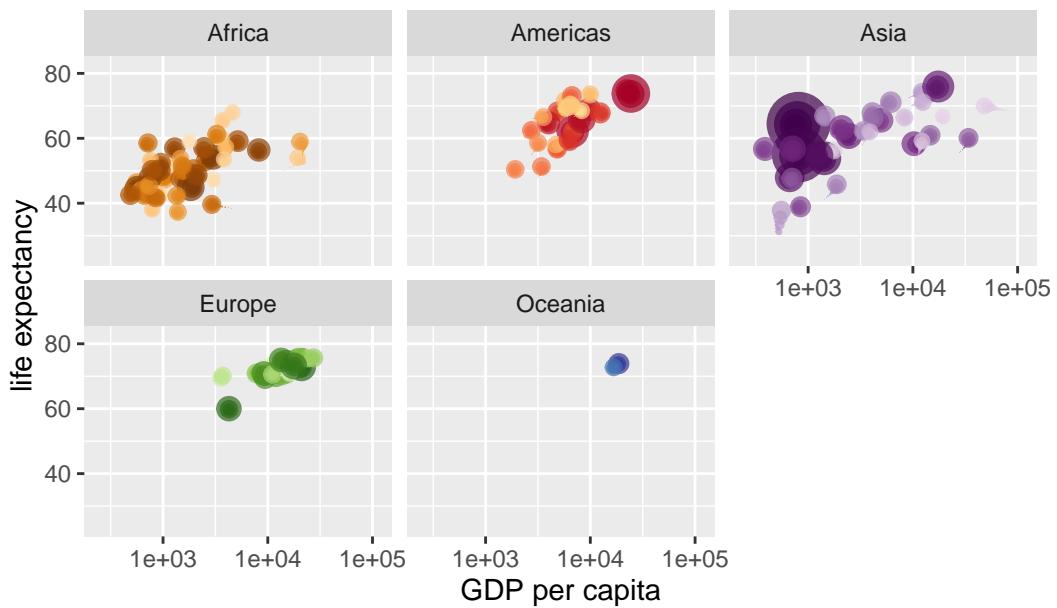
Year: 1978



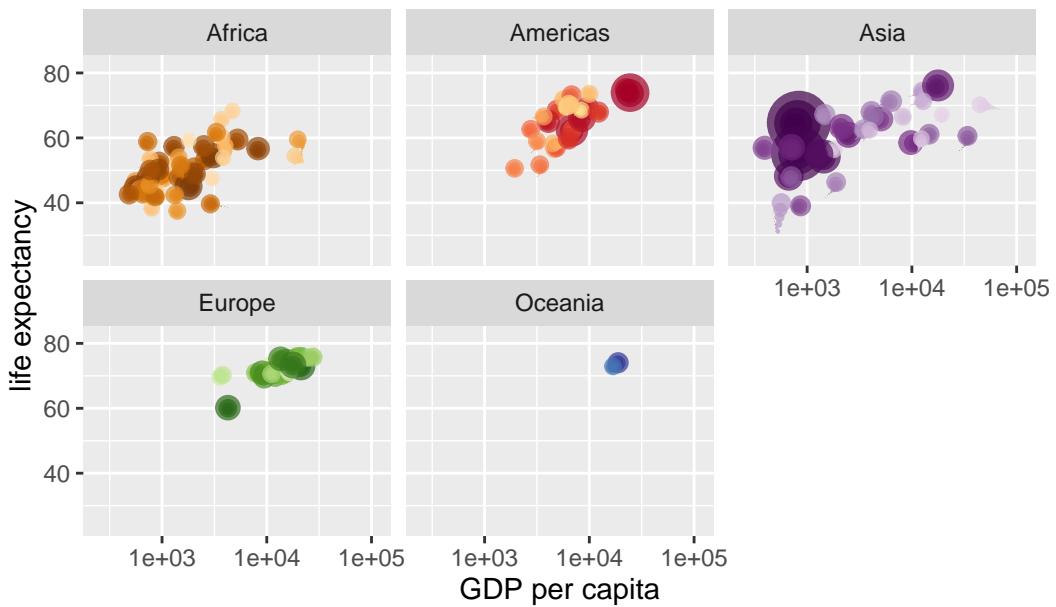
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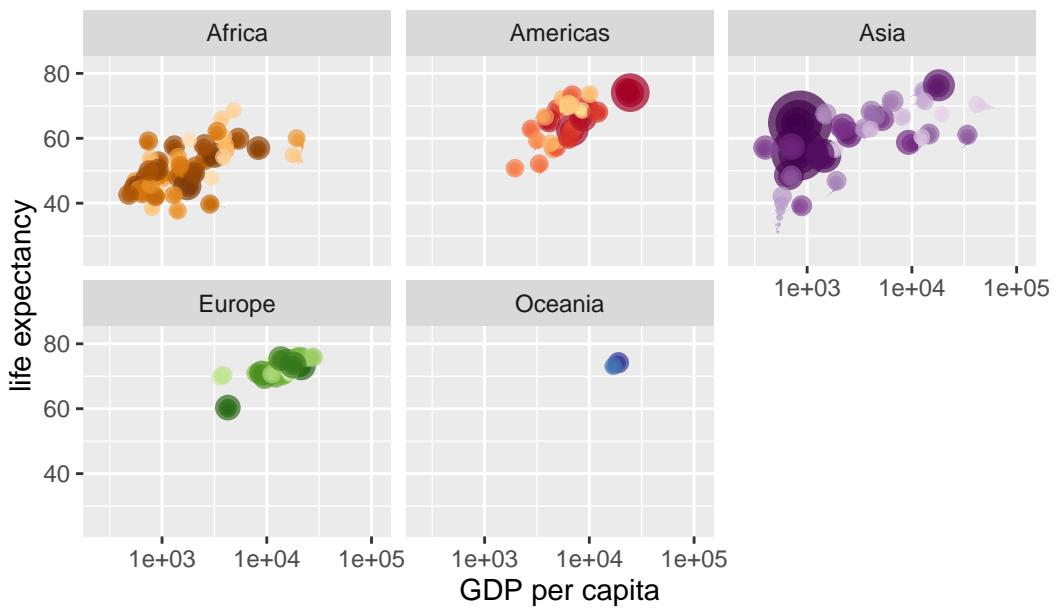
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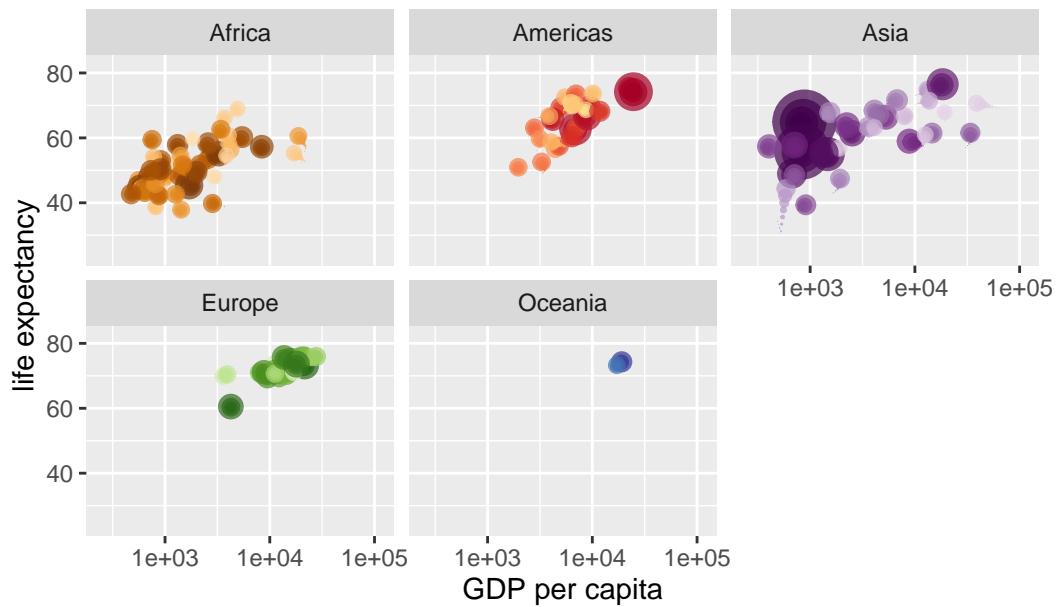
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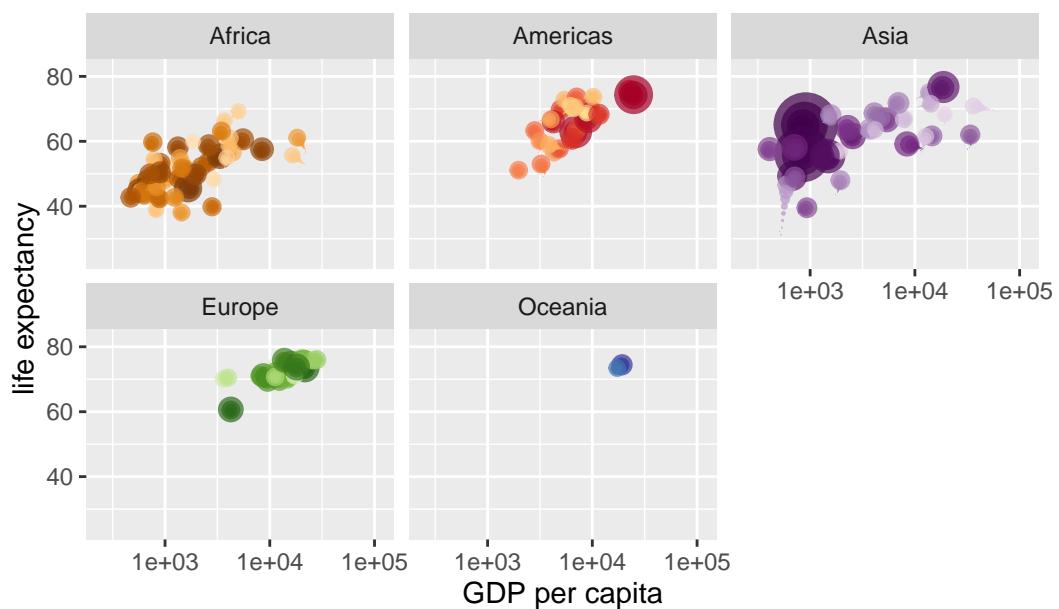
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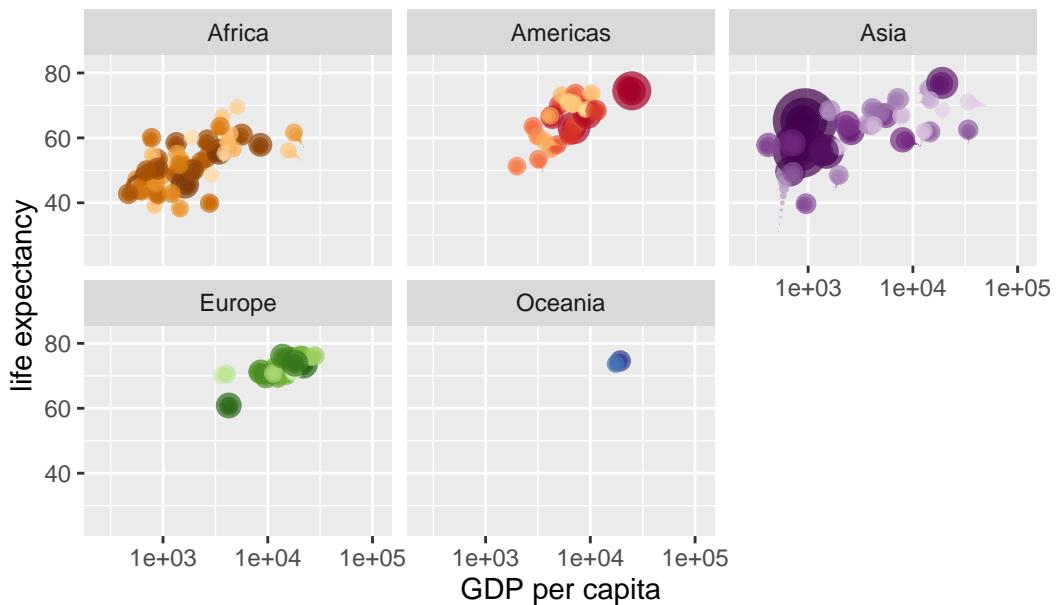
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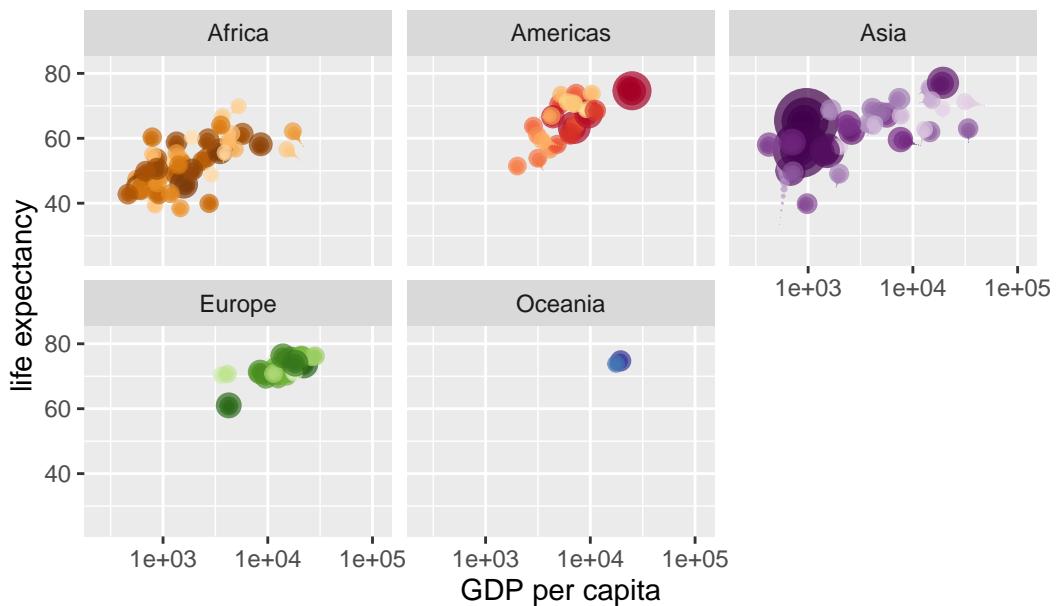
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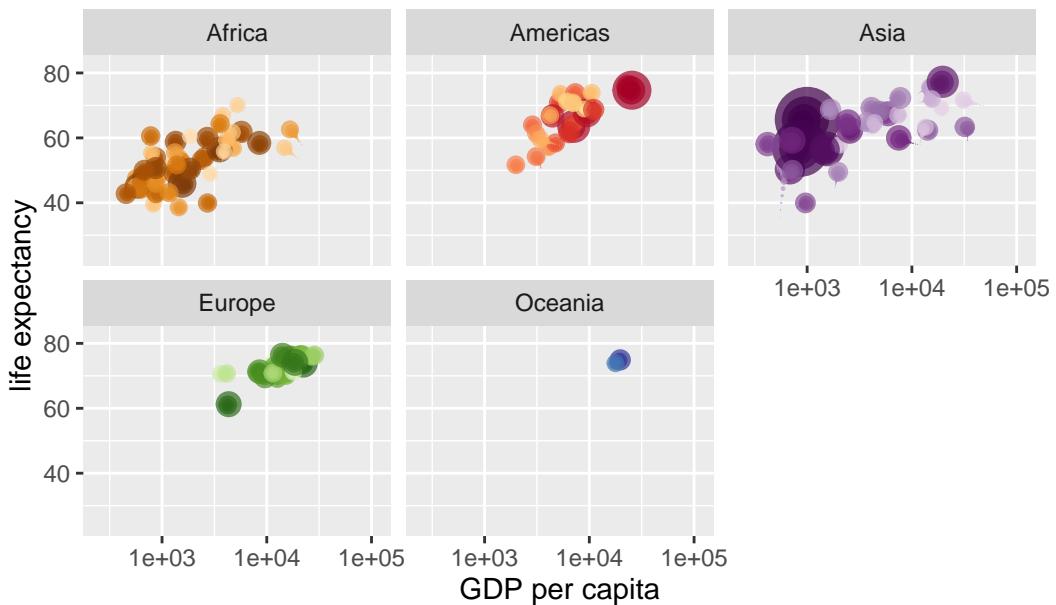
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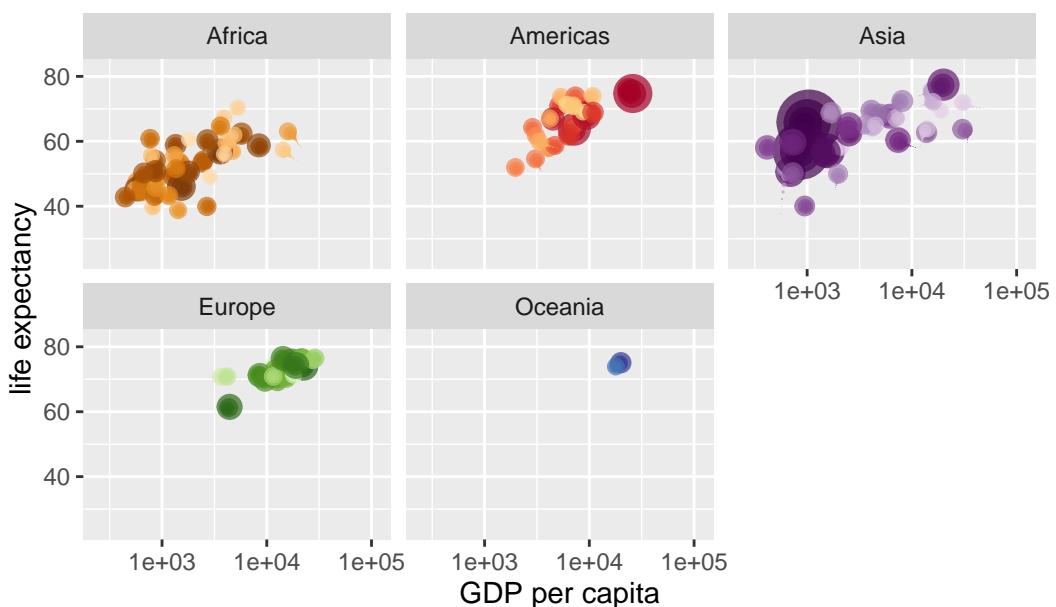
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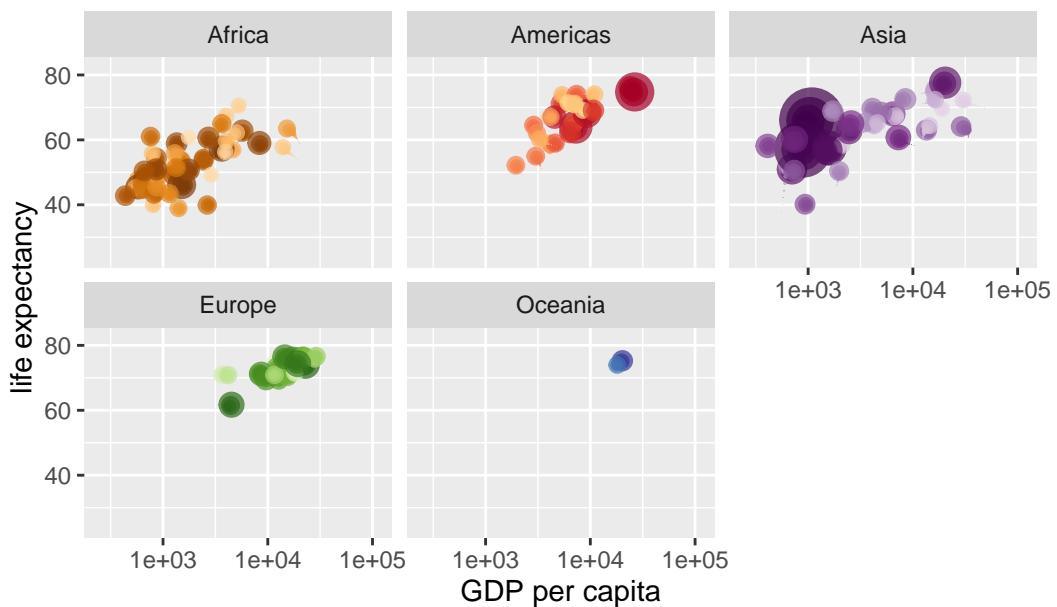
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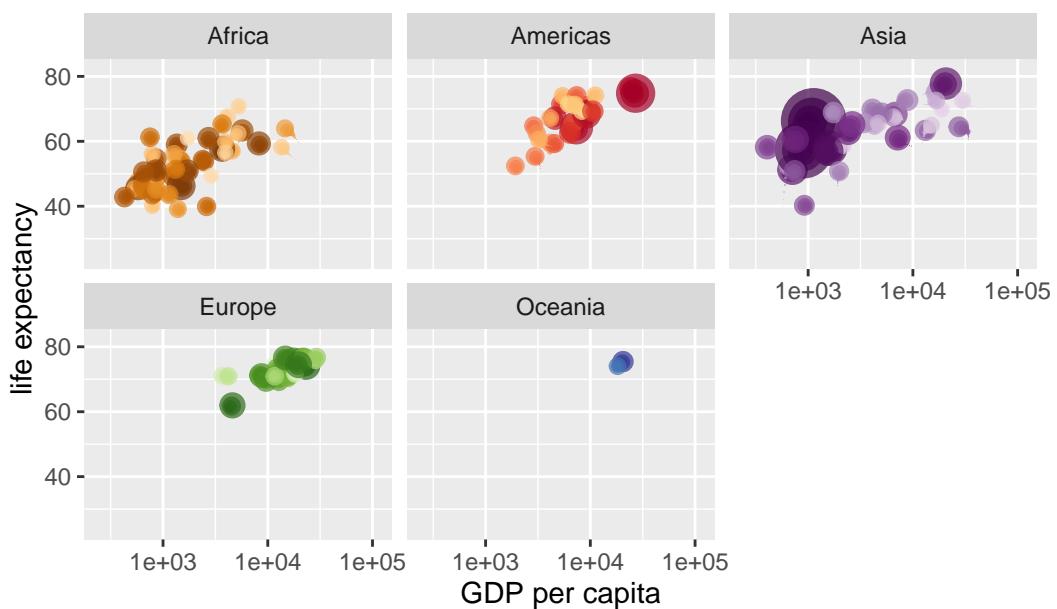
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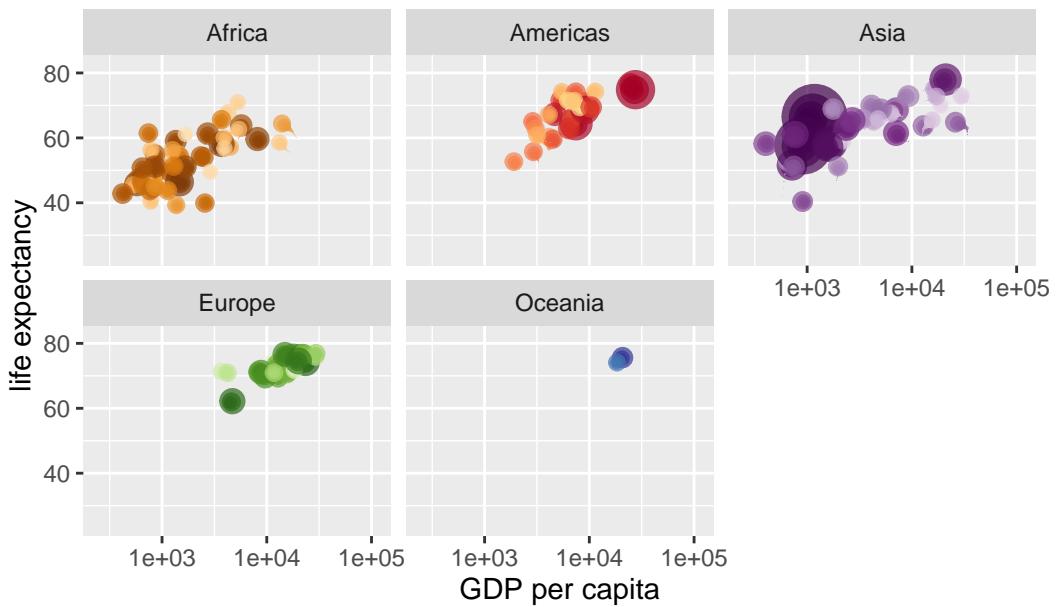
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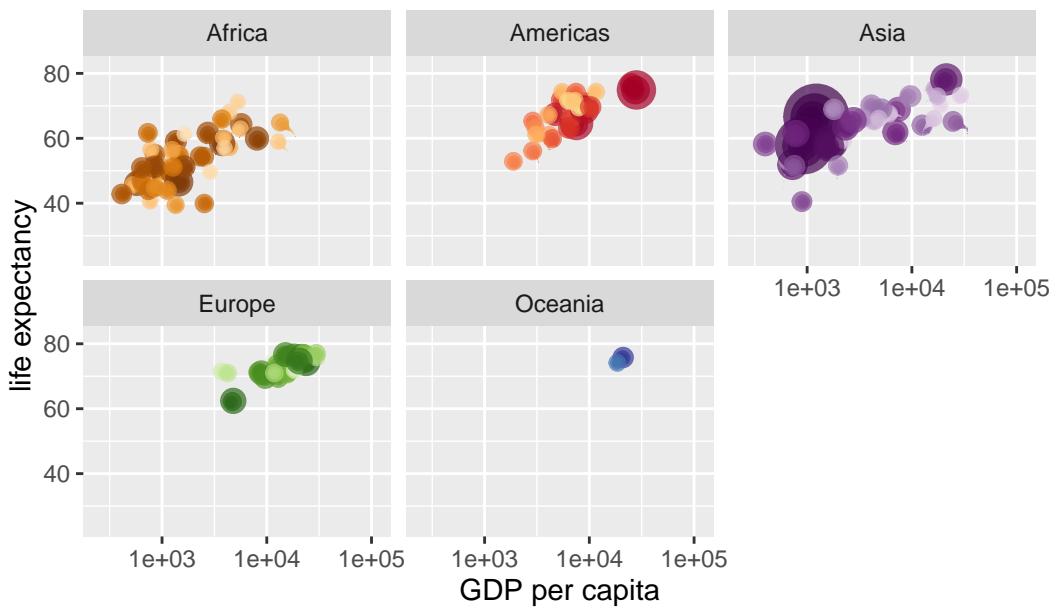
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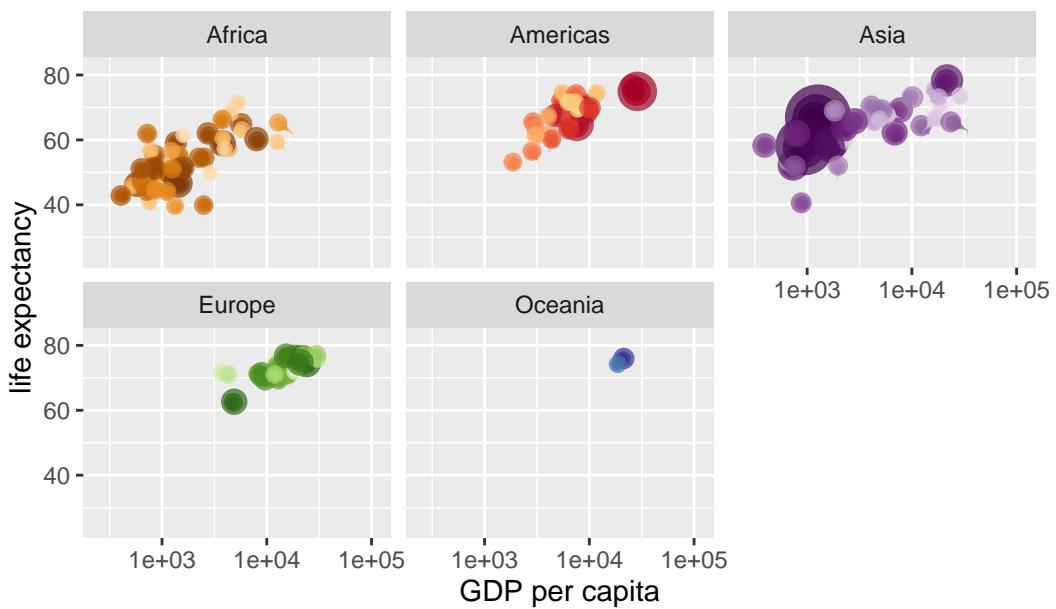
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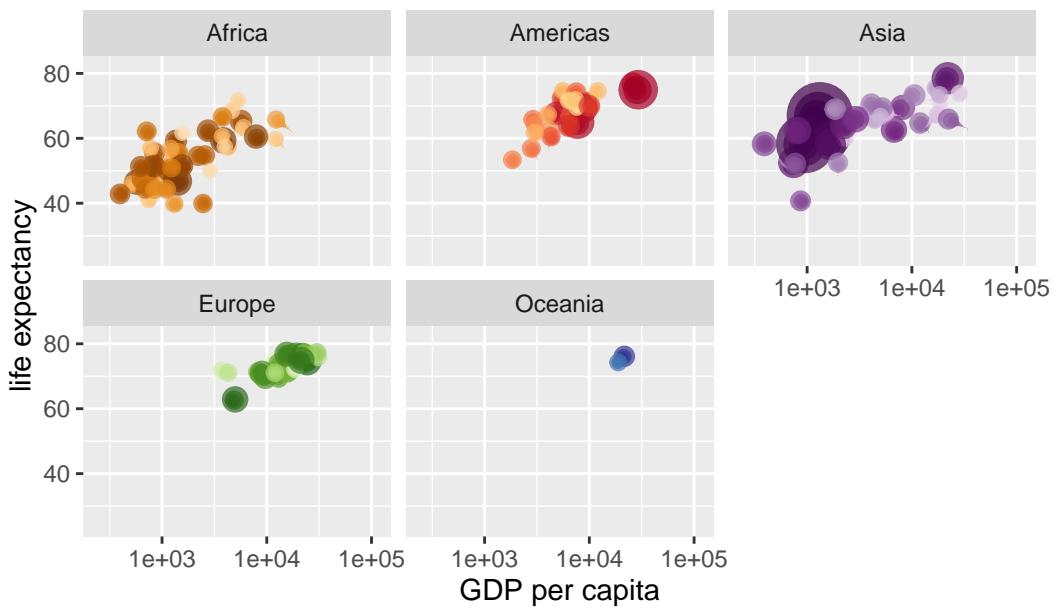
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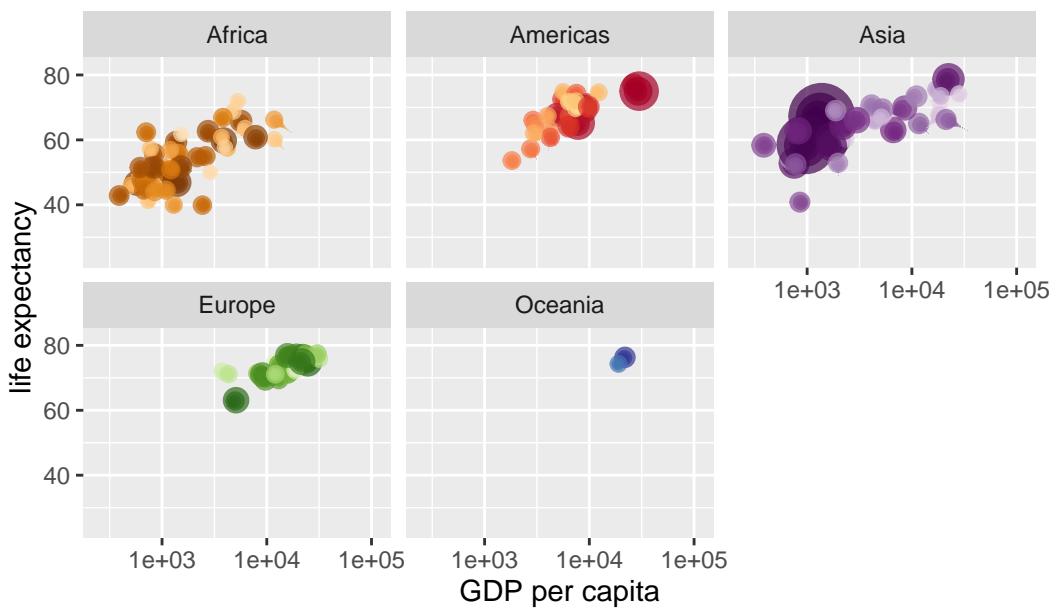
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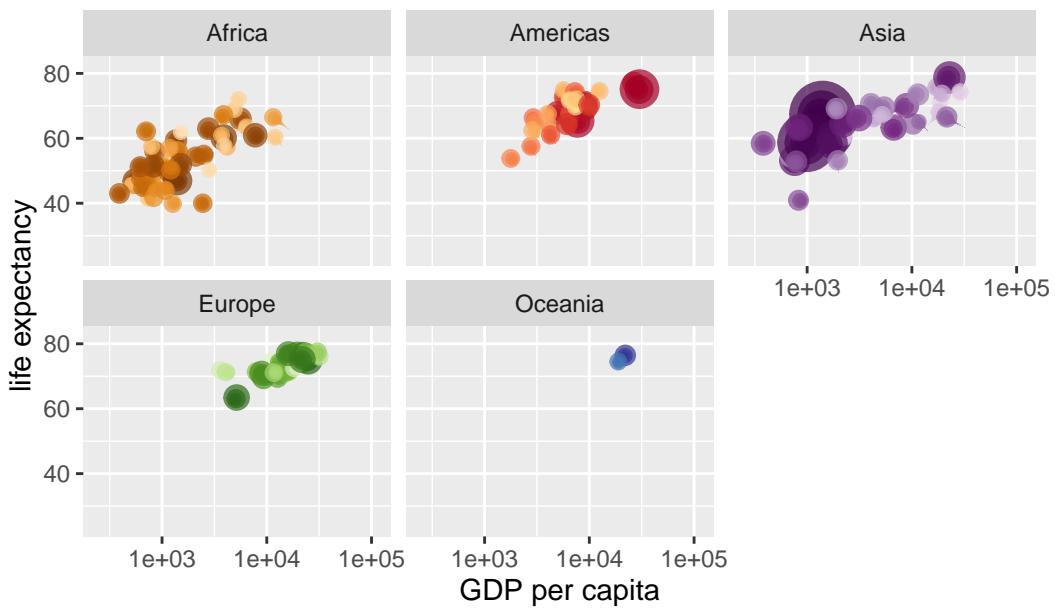
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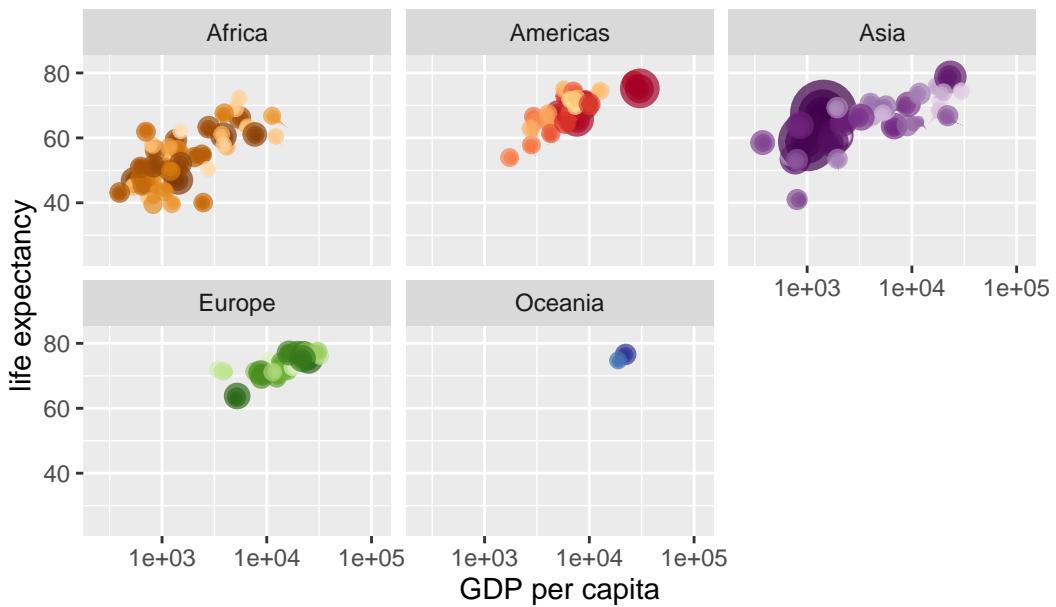
Year: 1987



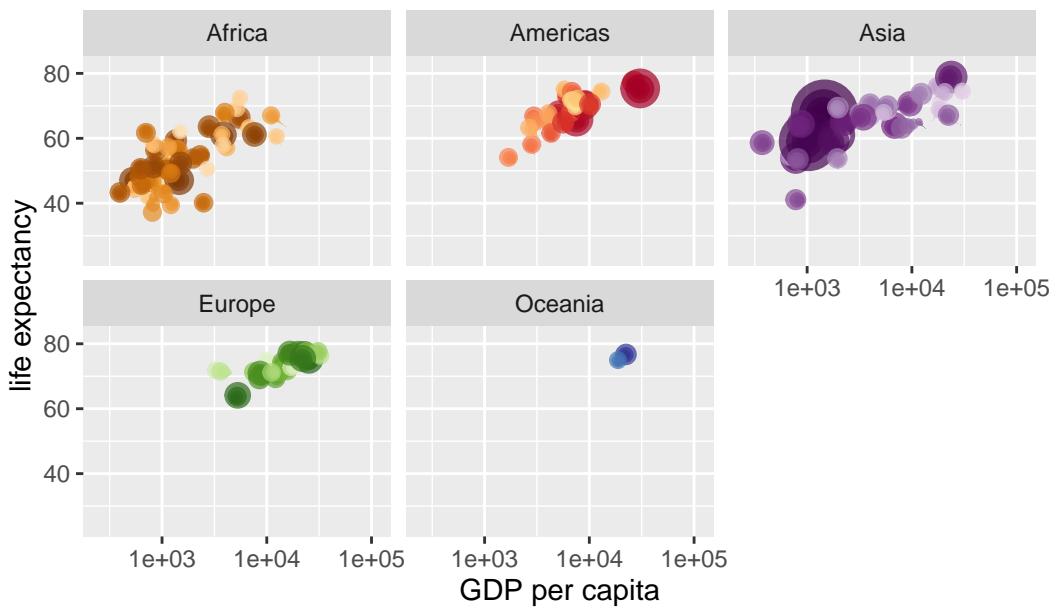
Year: 1988



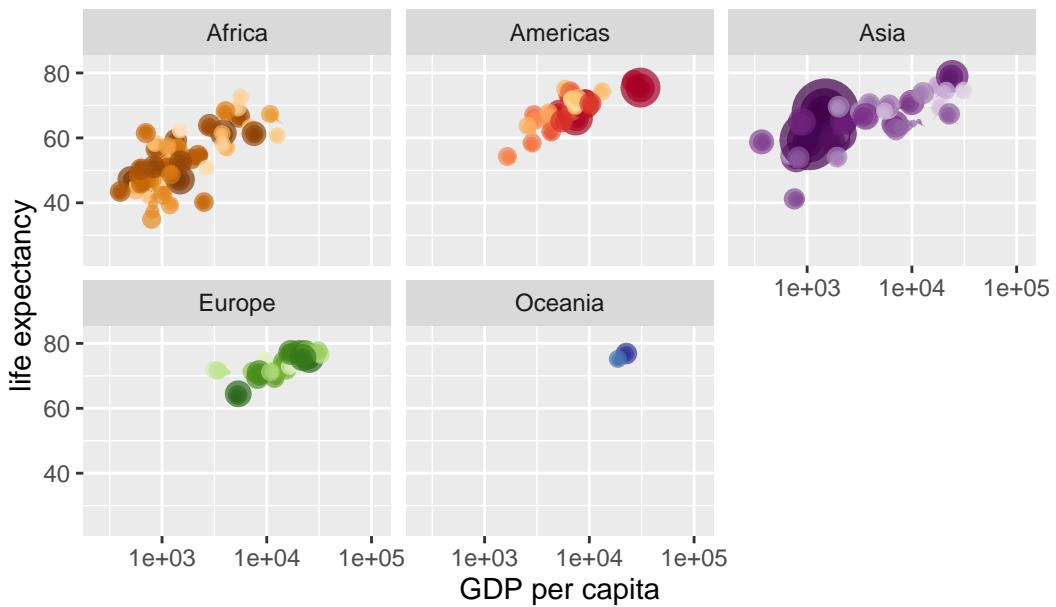
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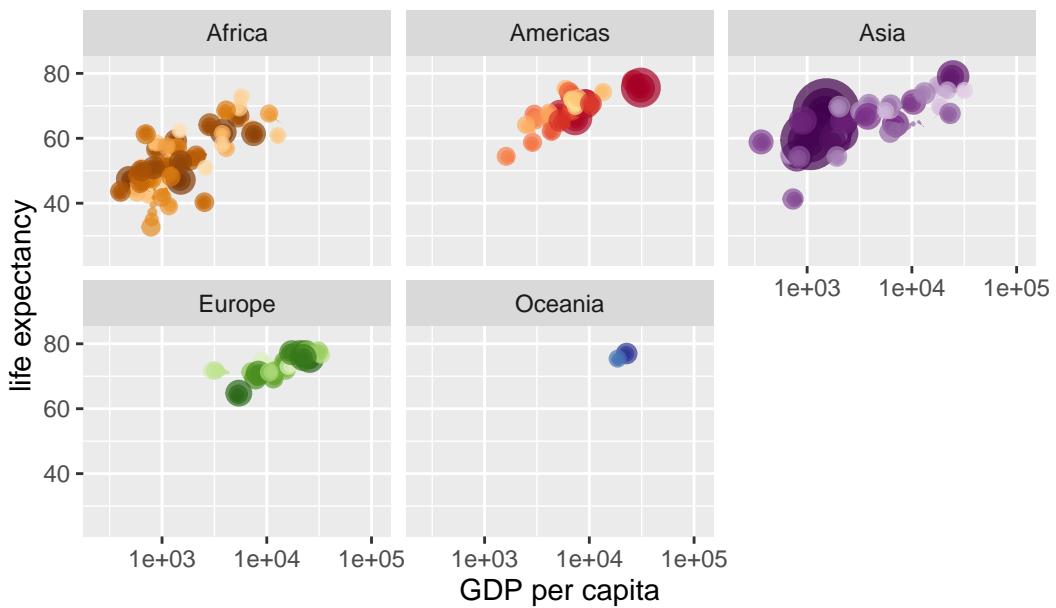
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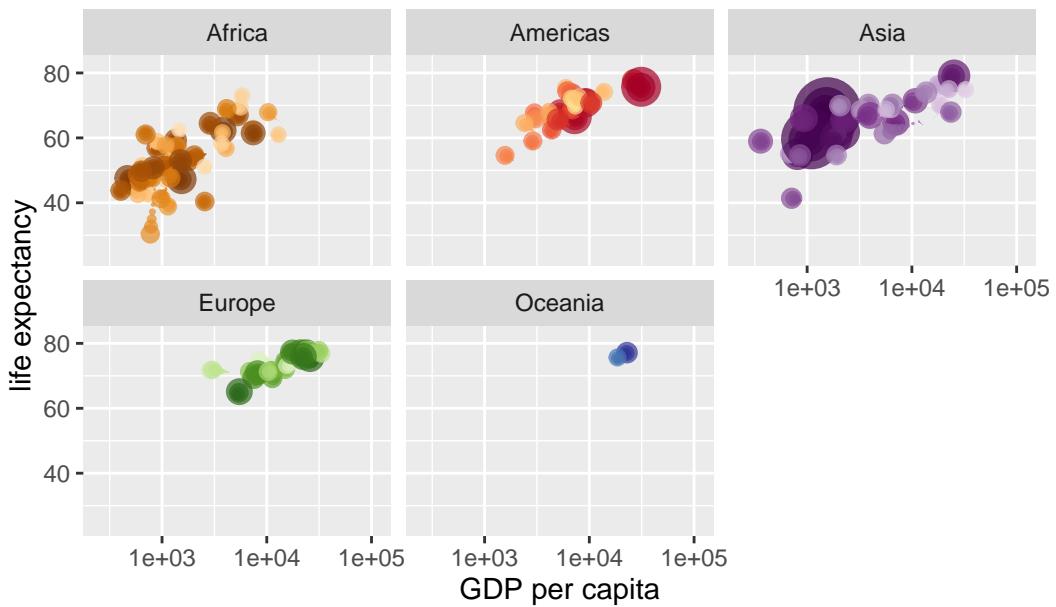
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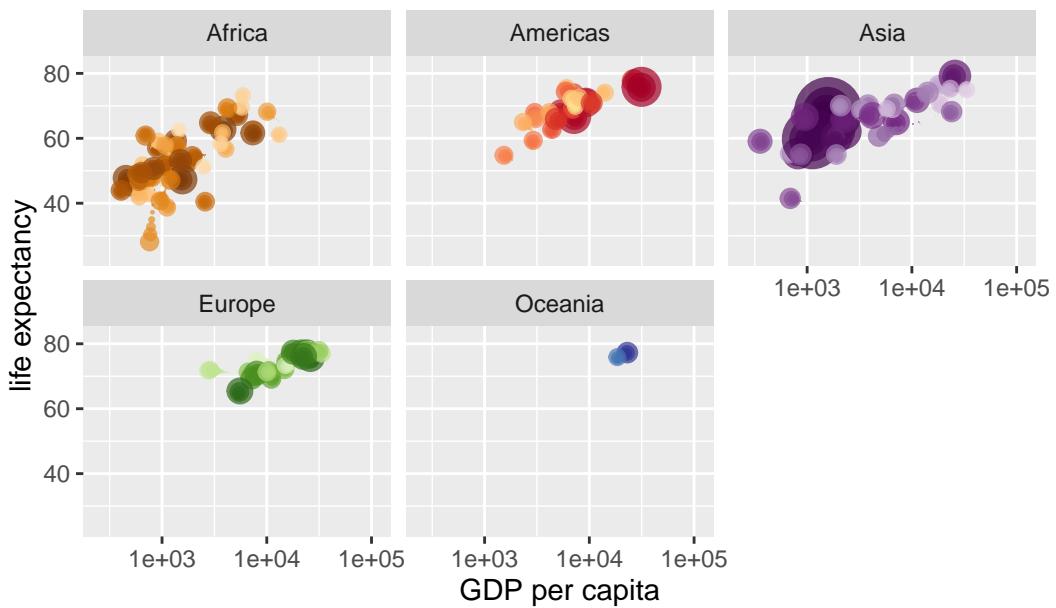
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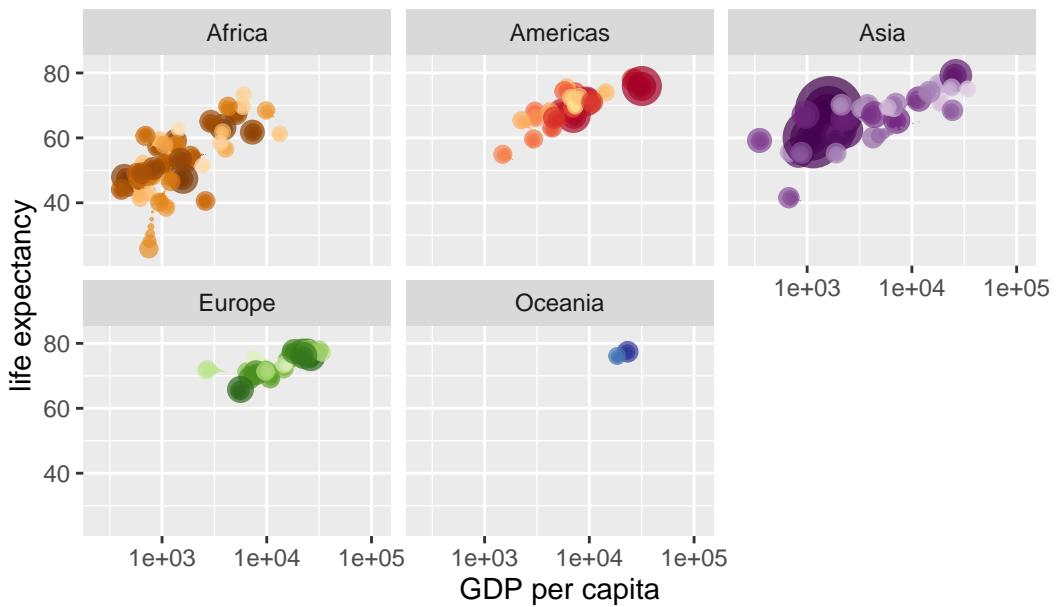
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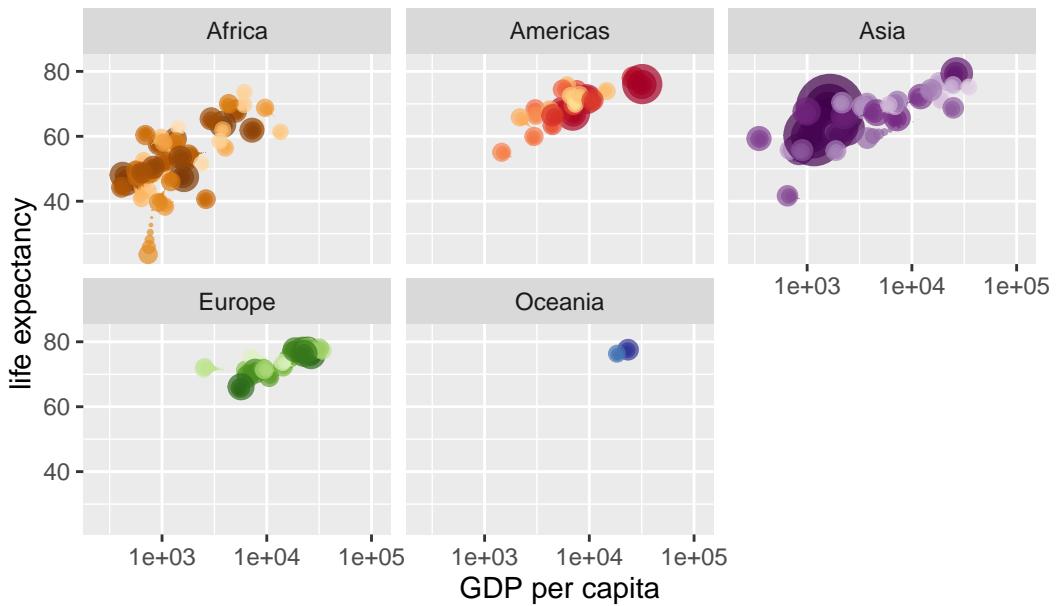
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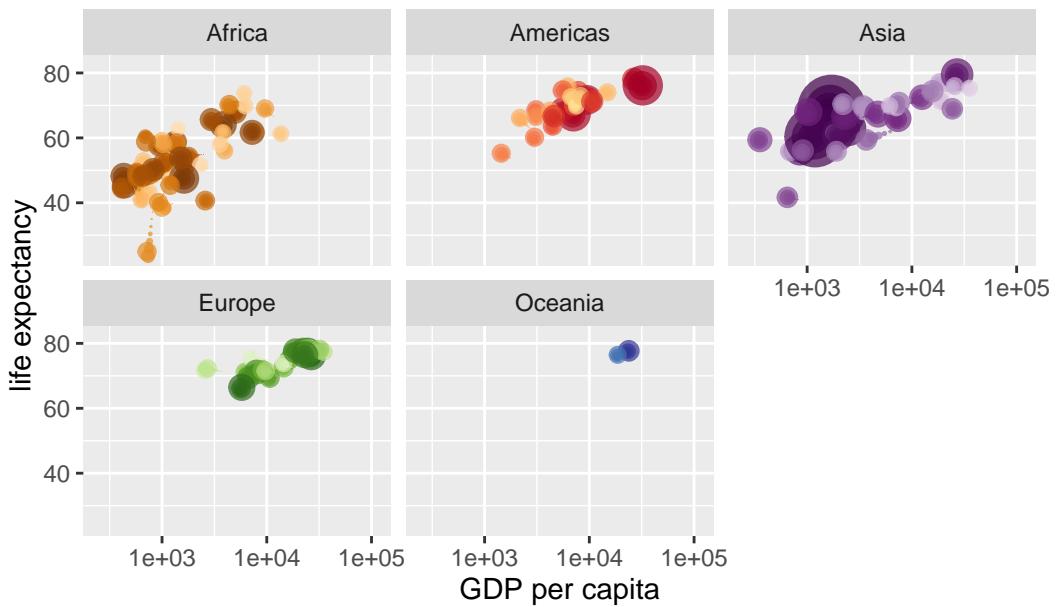
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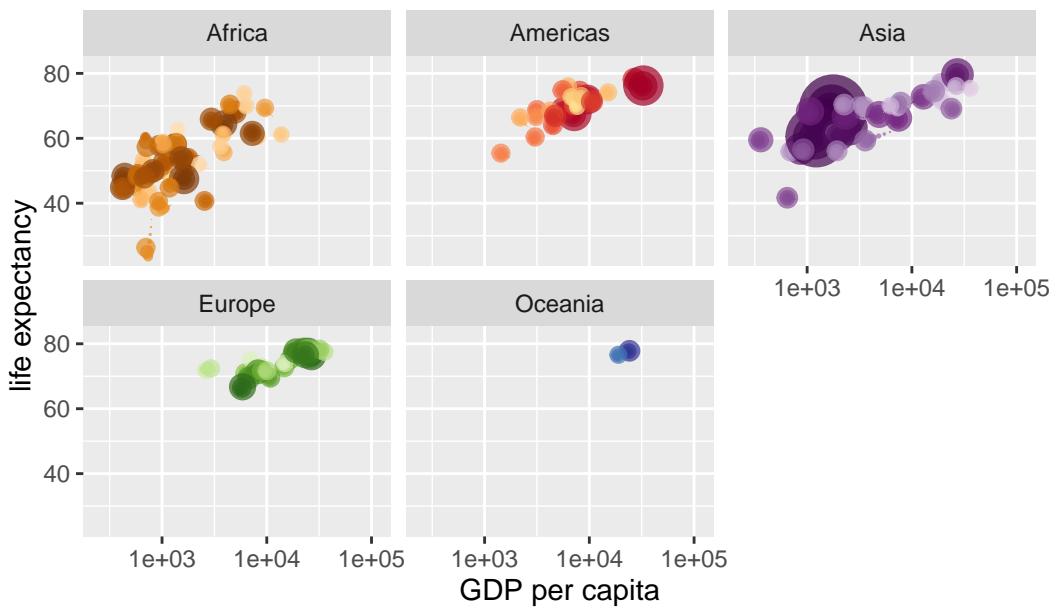
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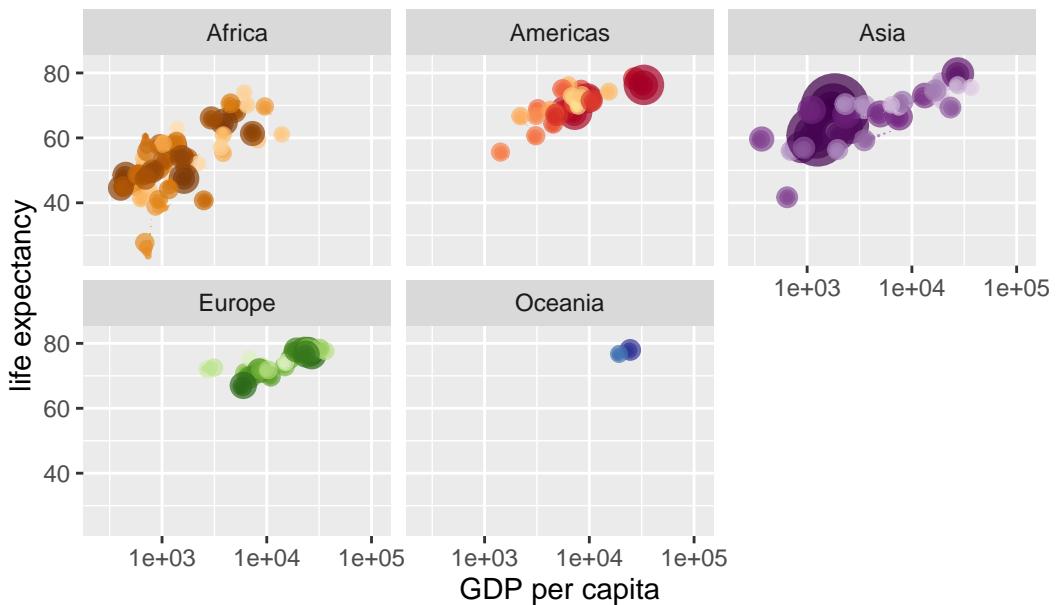
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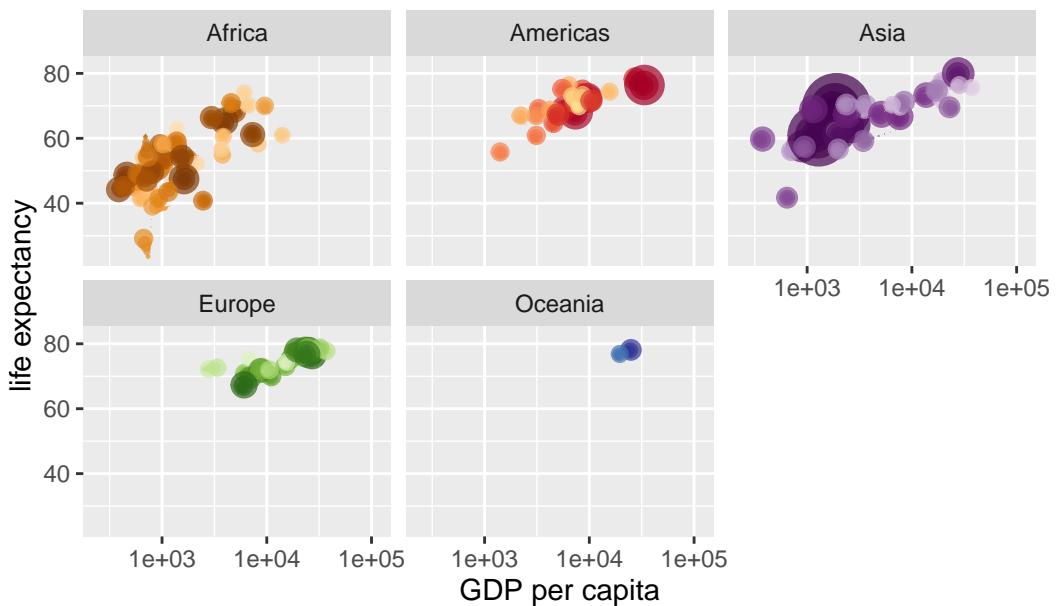
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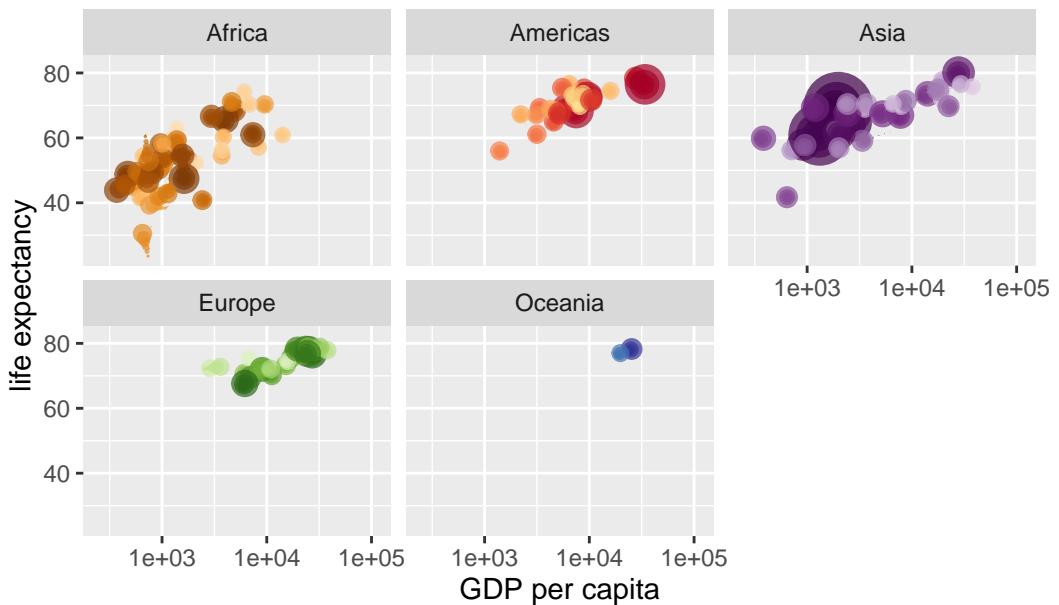
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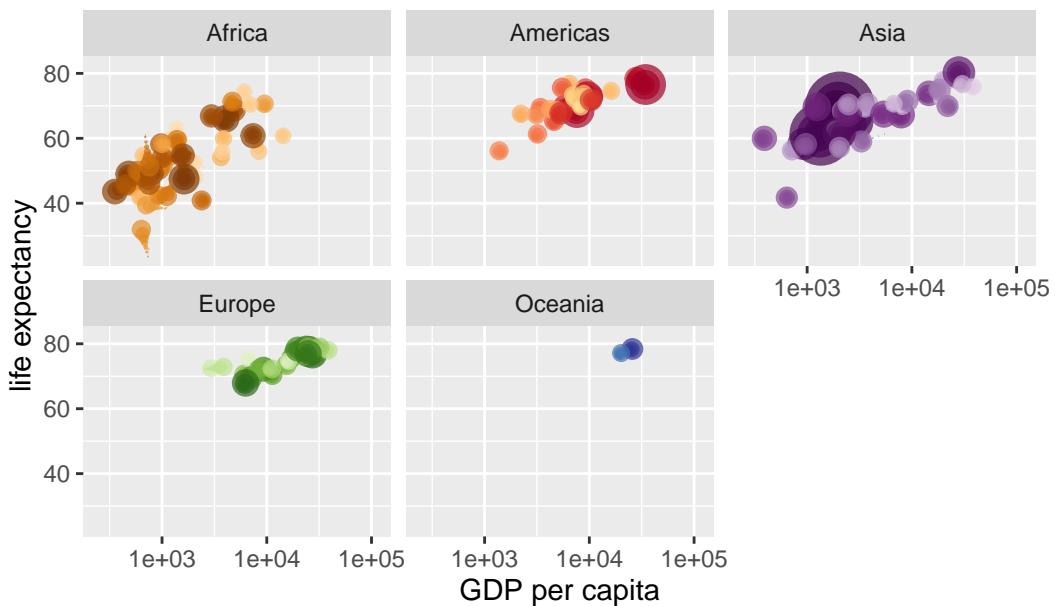
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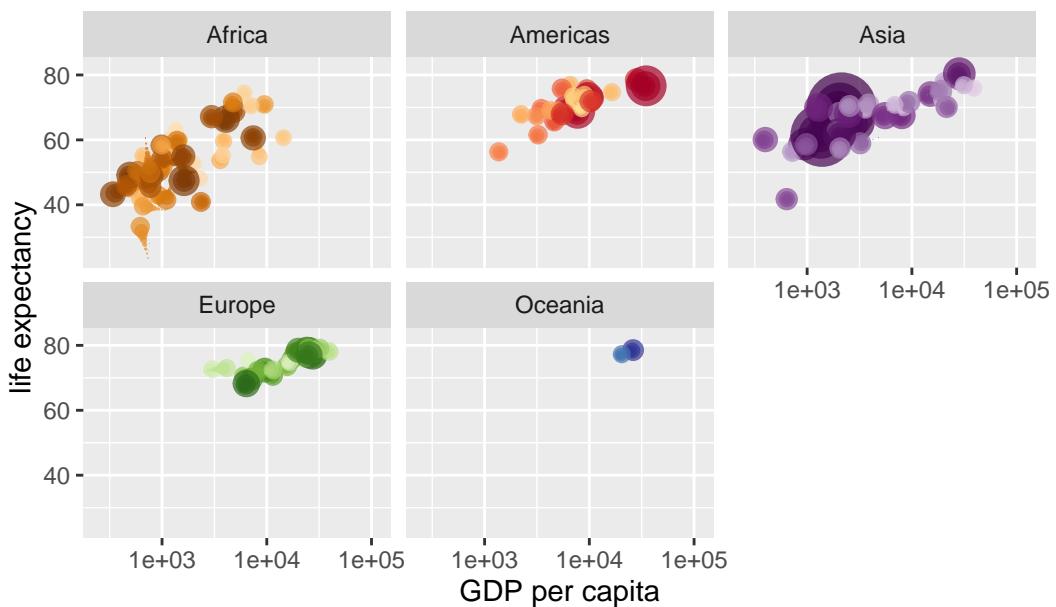
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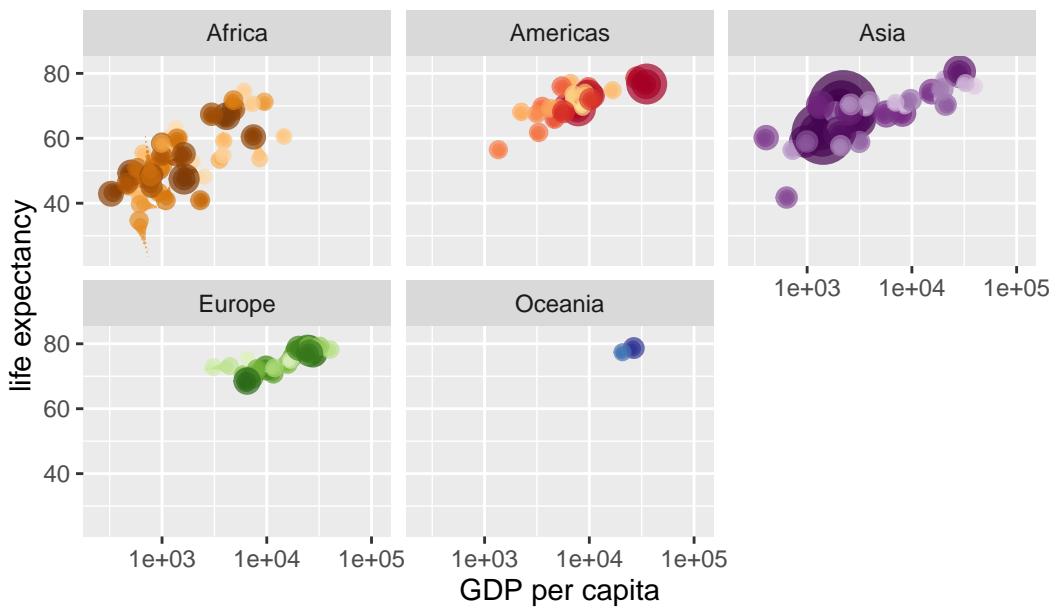
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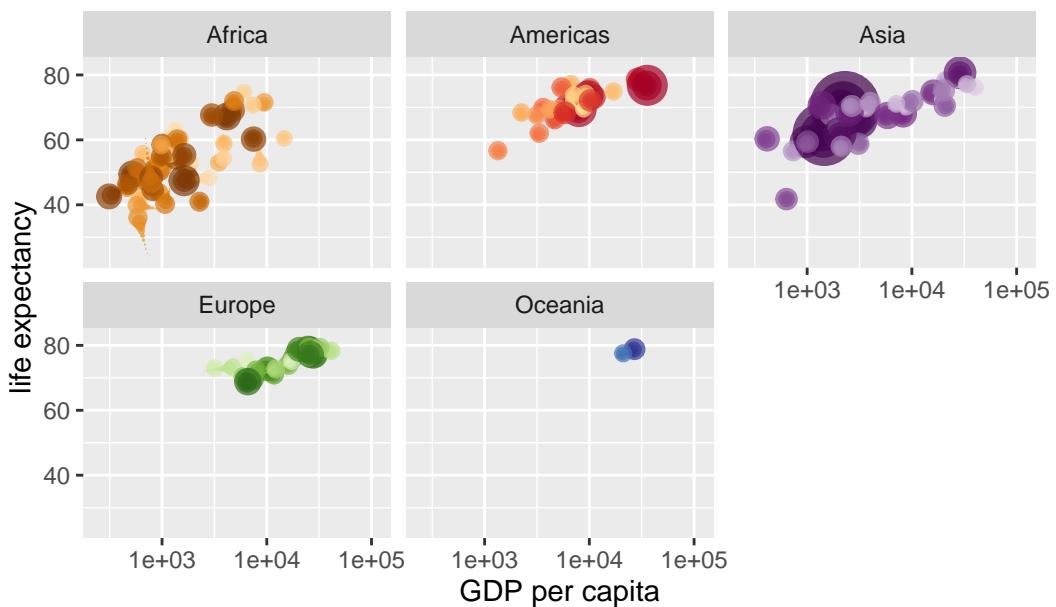
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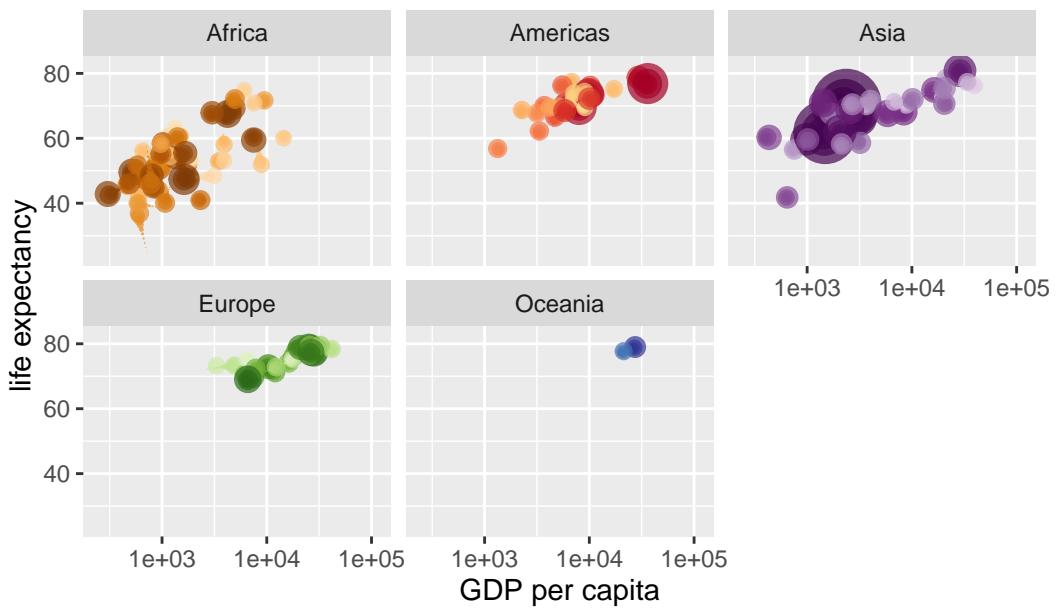
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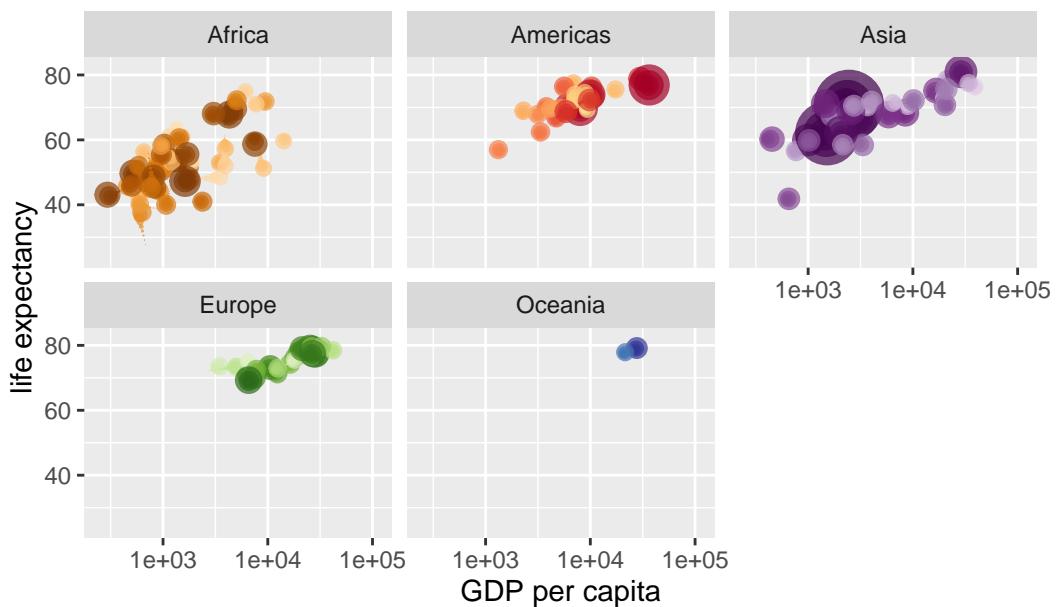
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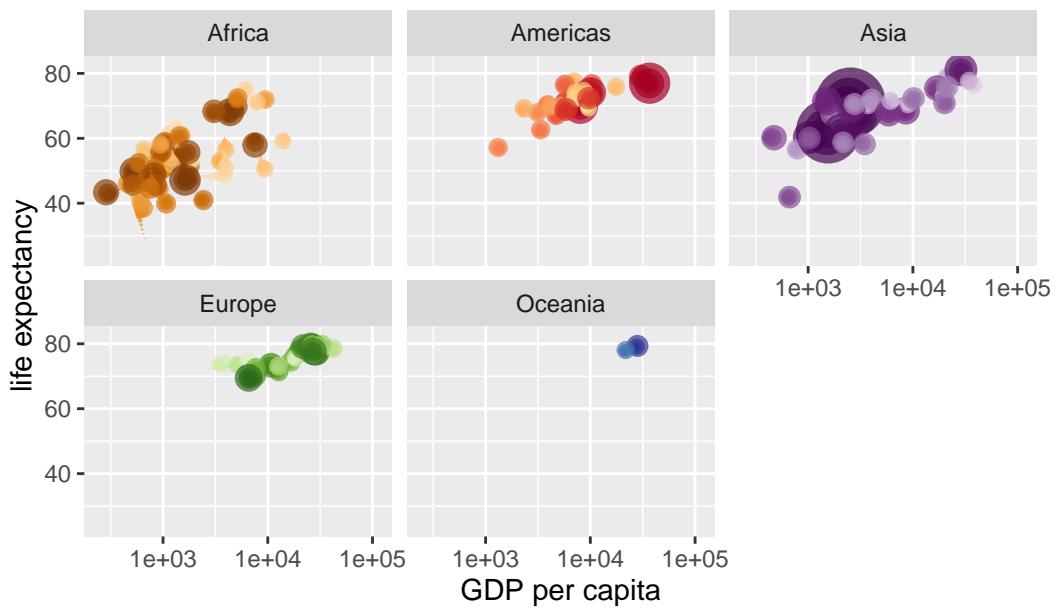
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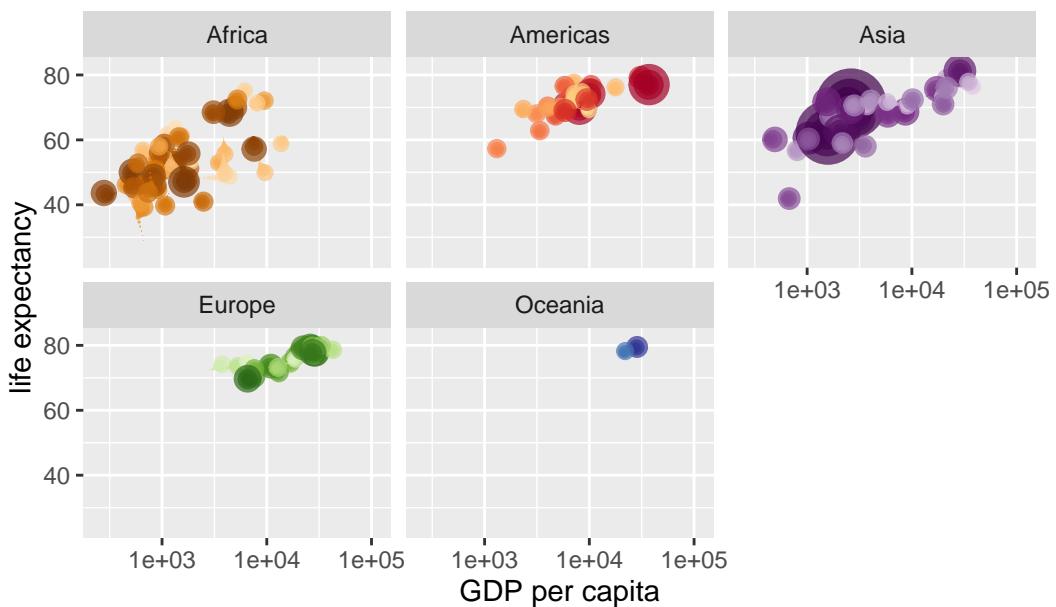
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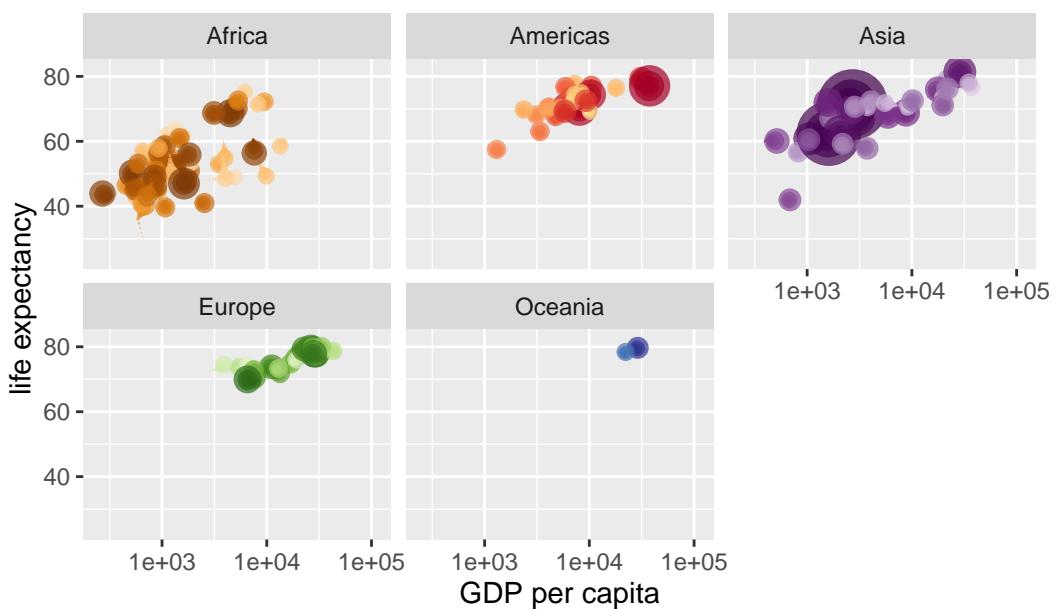
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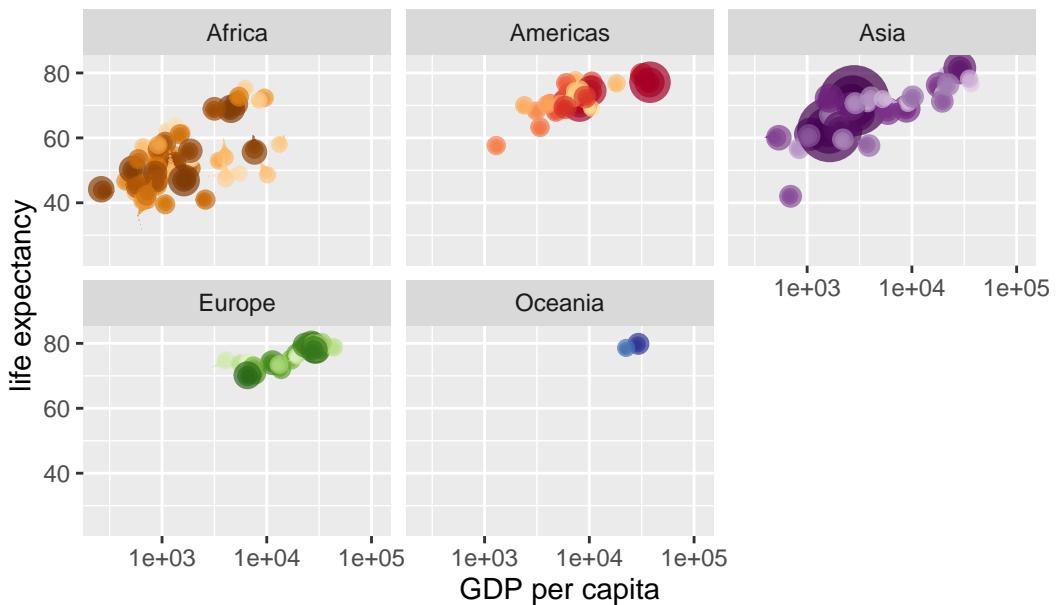
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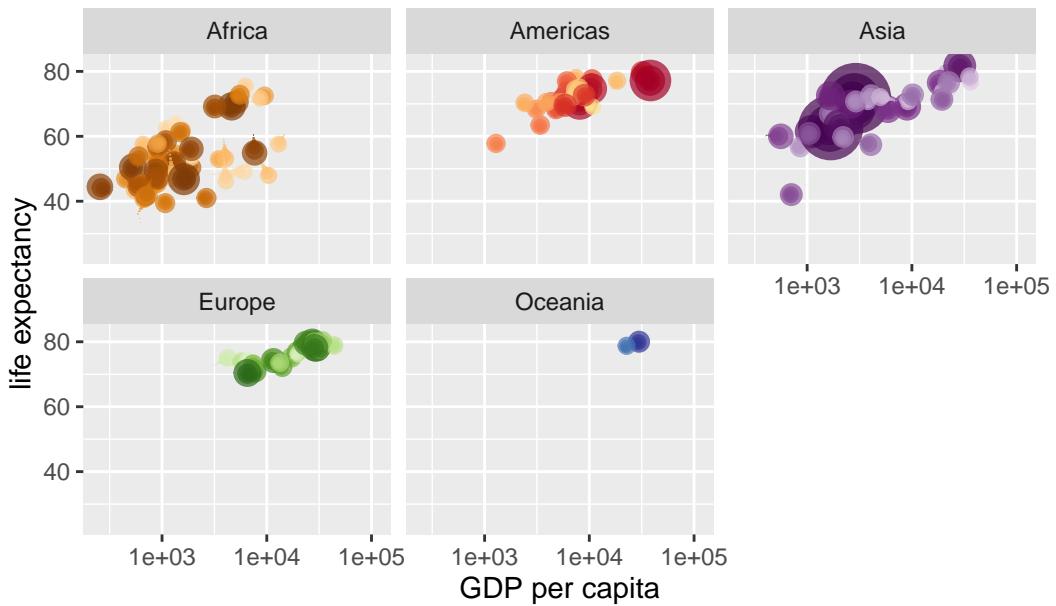
Year: 2000



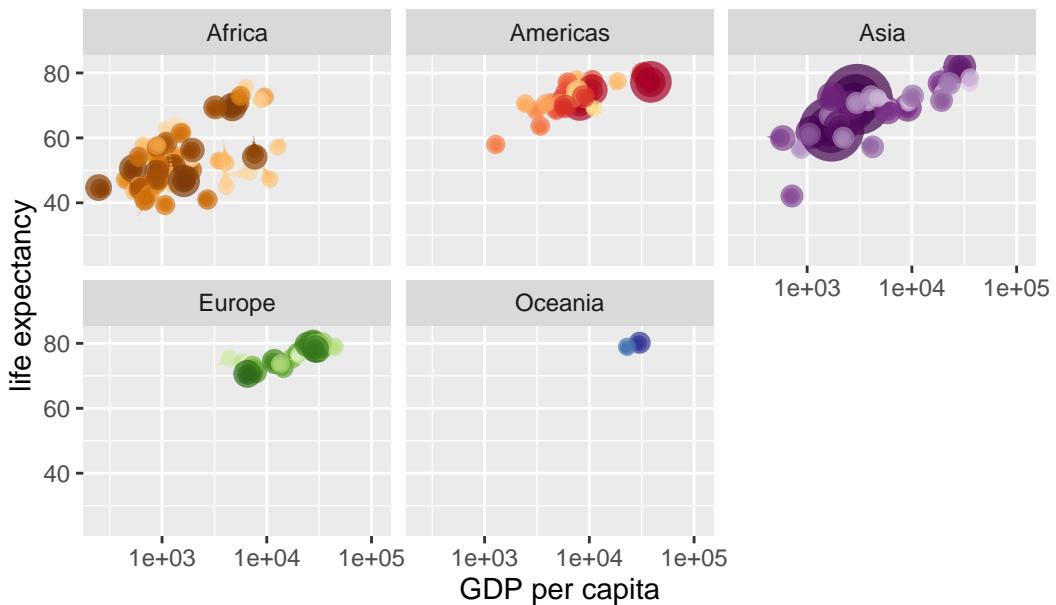
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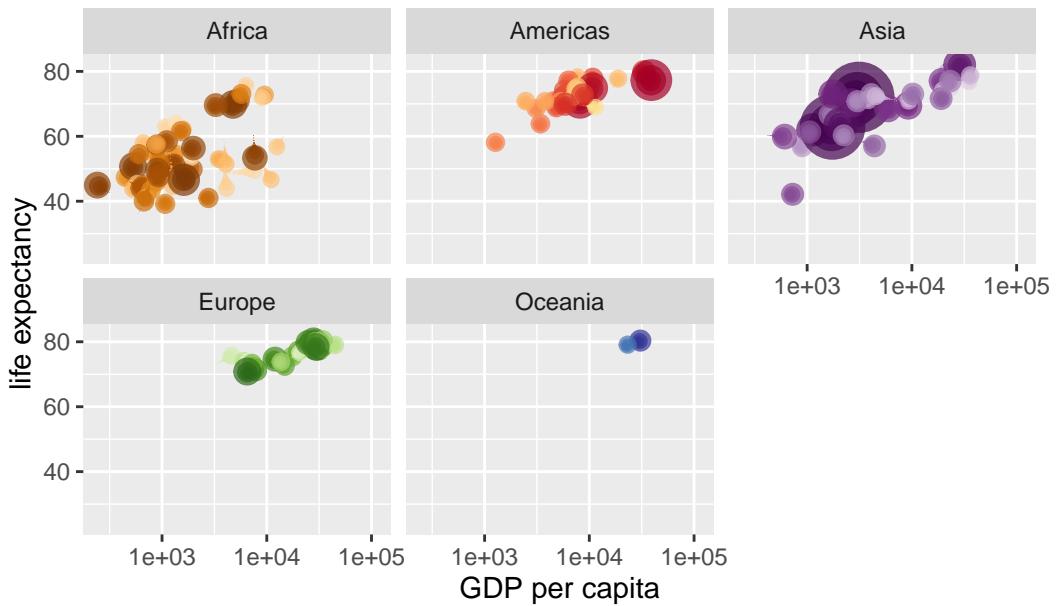
Year: 2001



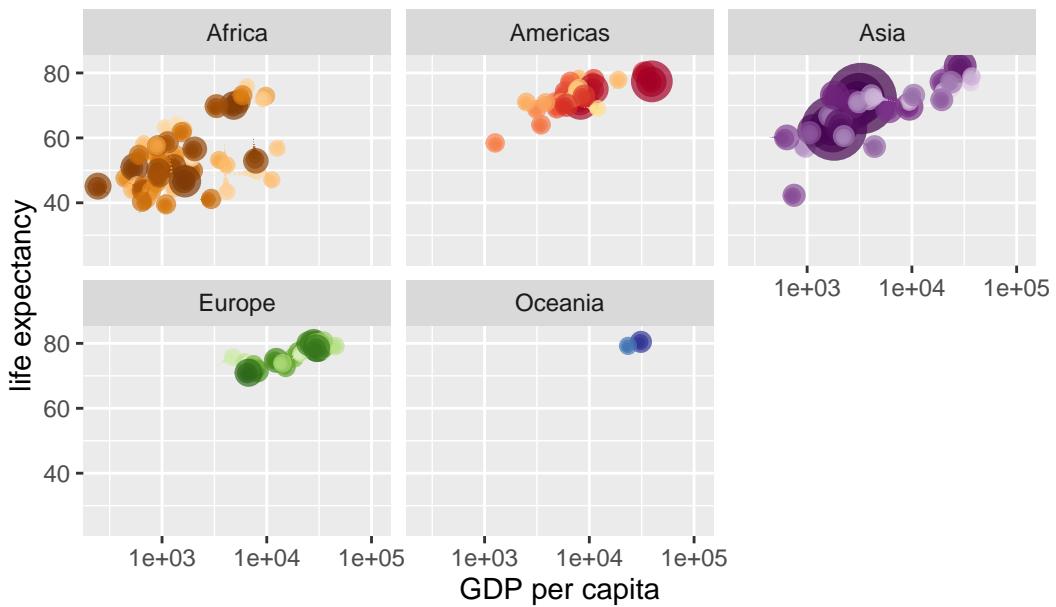
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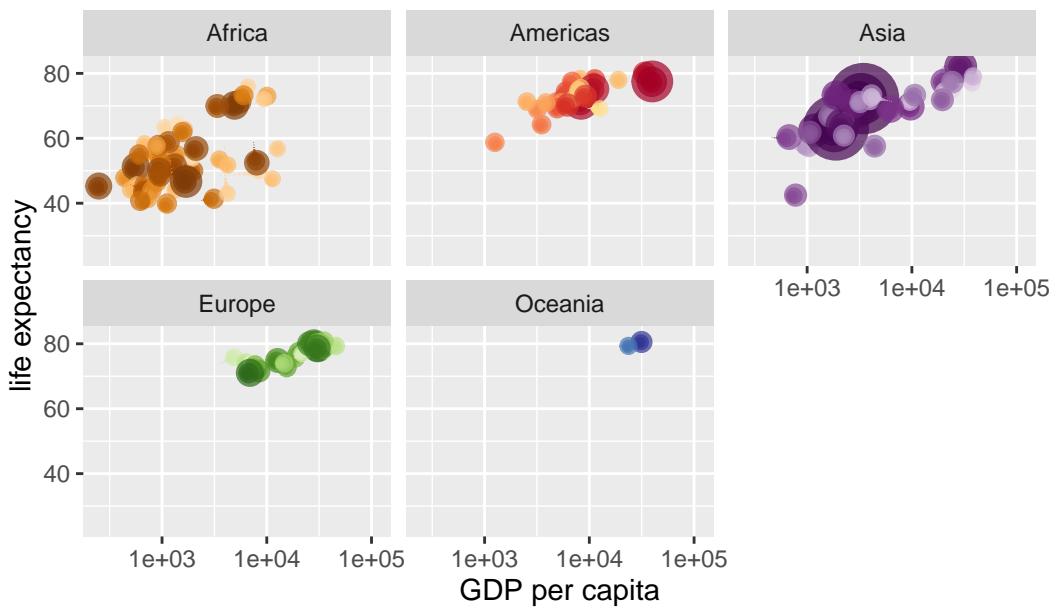
Year: 2002



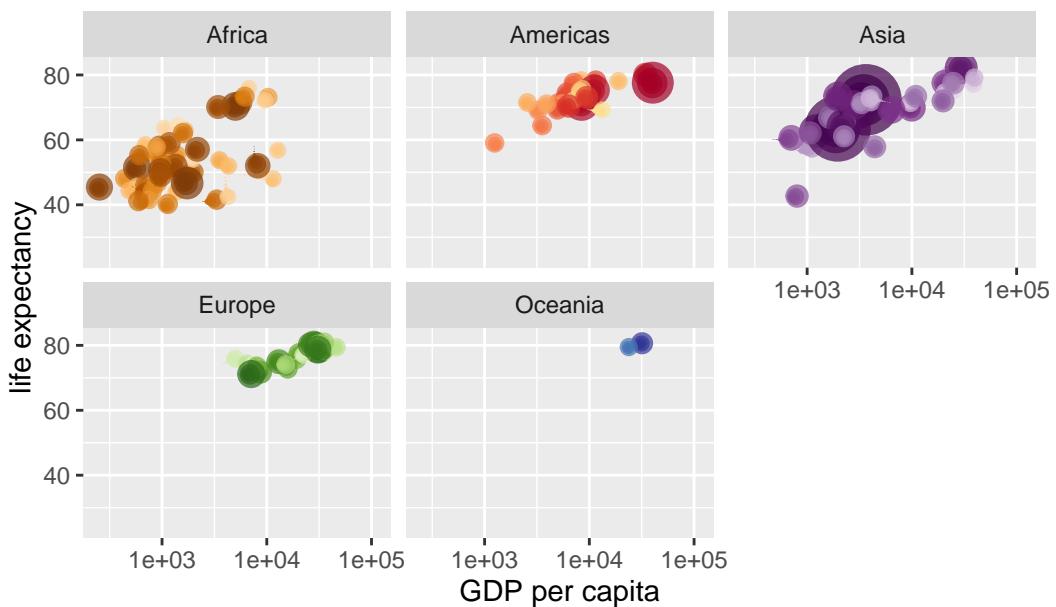
Year: 2003



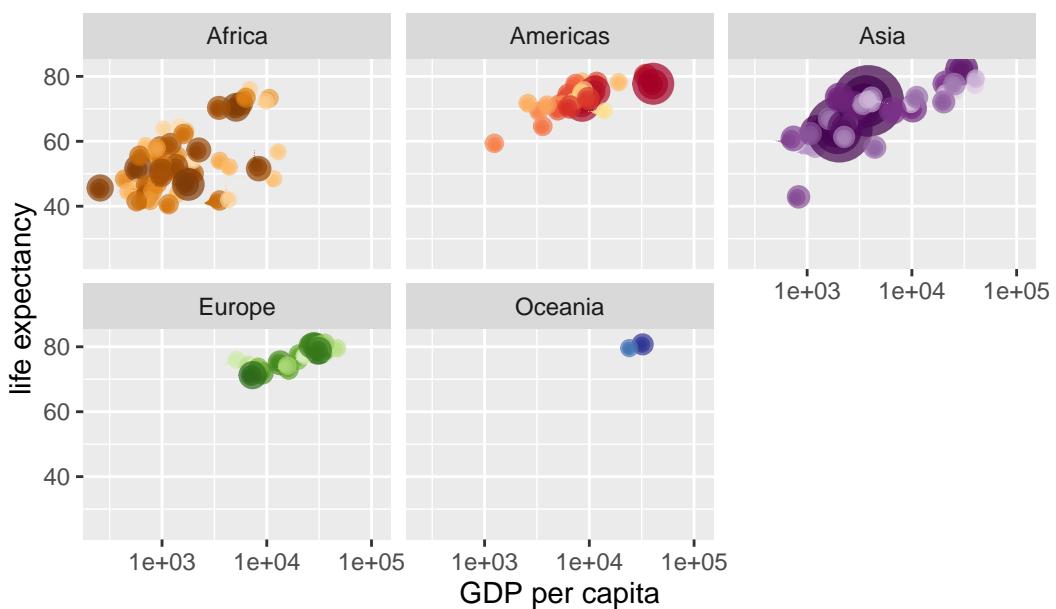
Year: 2003



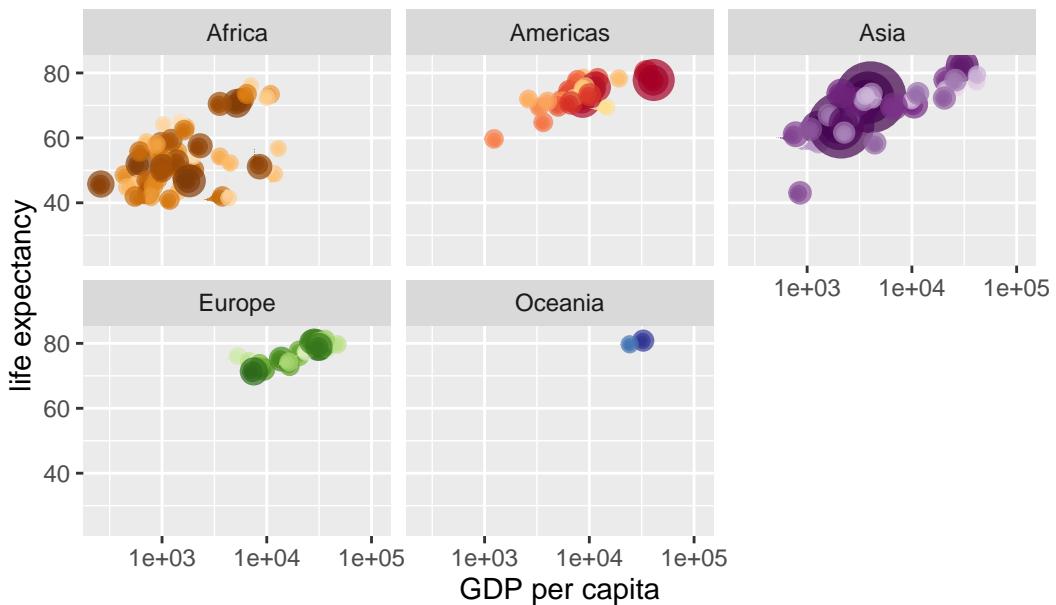
Year: 2004



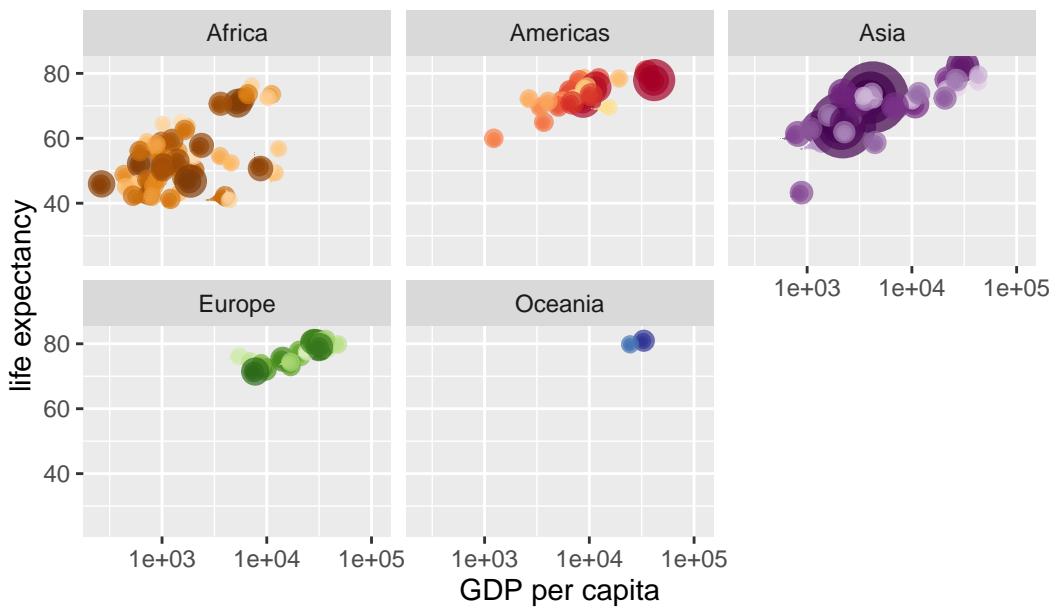
Year: 2004



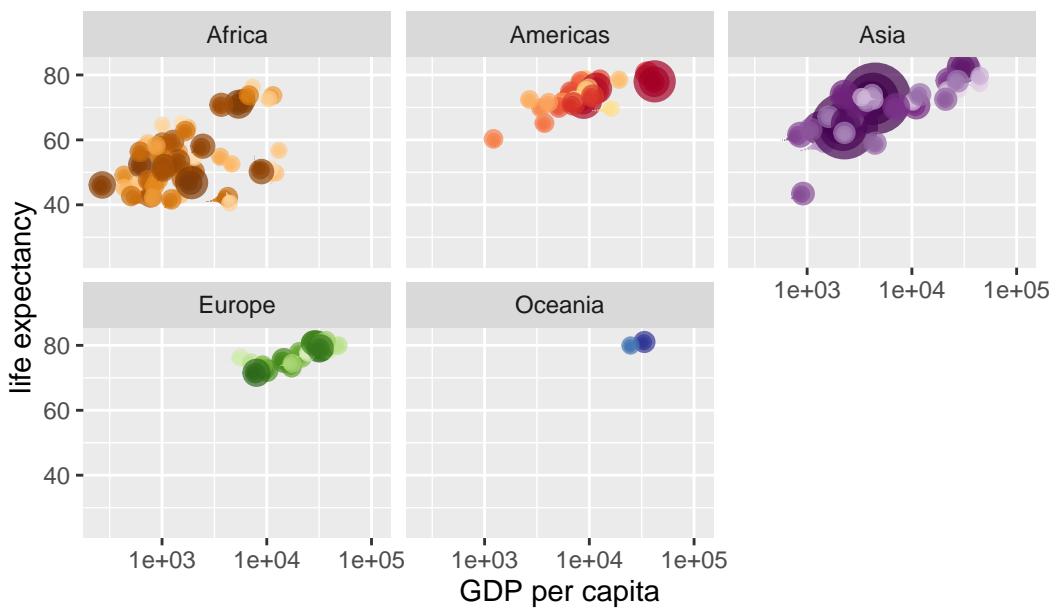
Year: 2005



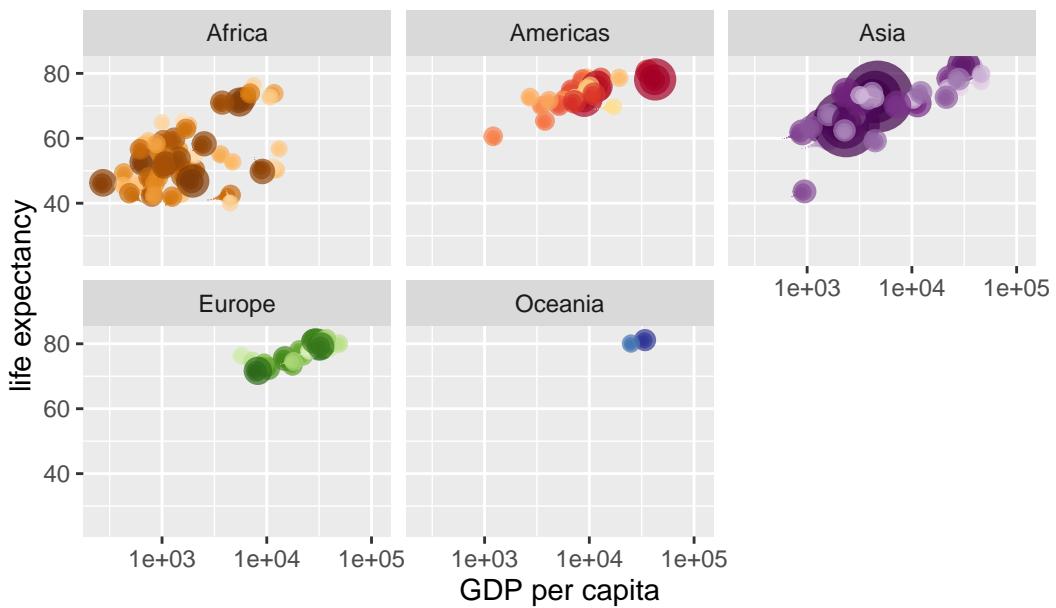
Year: 2005



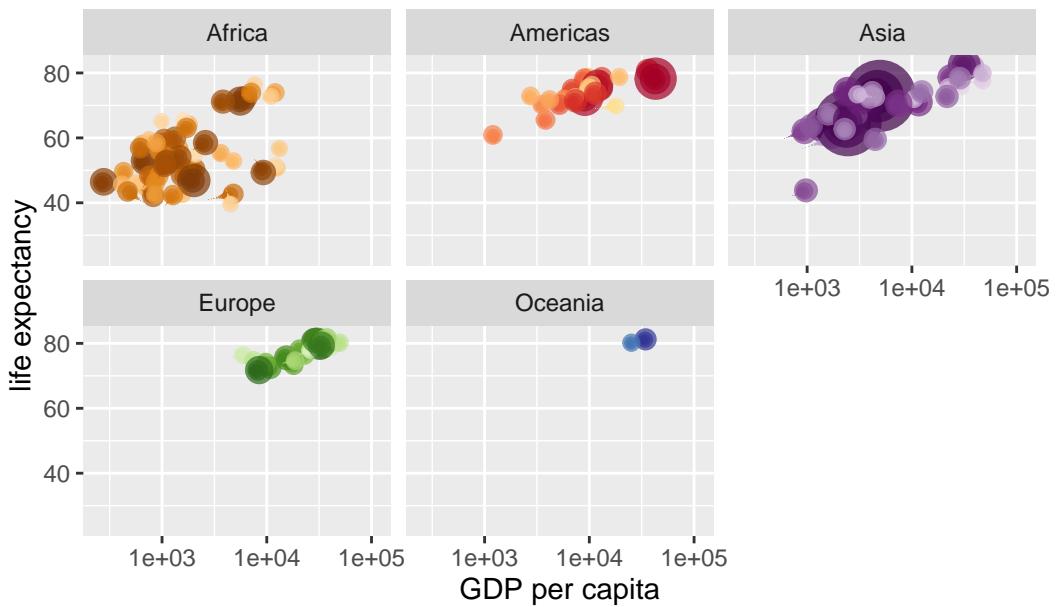
Year: 2006



Year: 2006



Year: 2007



```
library(patchwork)

# Setup some example plots
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))

# Use patchwork to combine them here:
(p1 | p2 | p3) /
  p4

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

