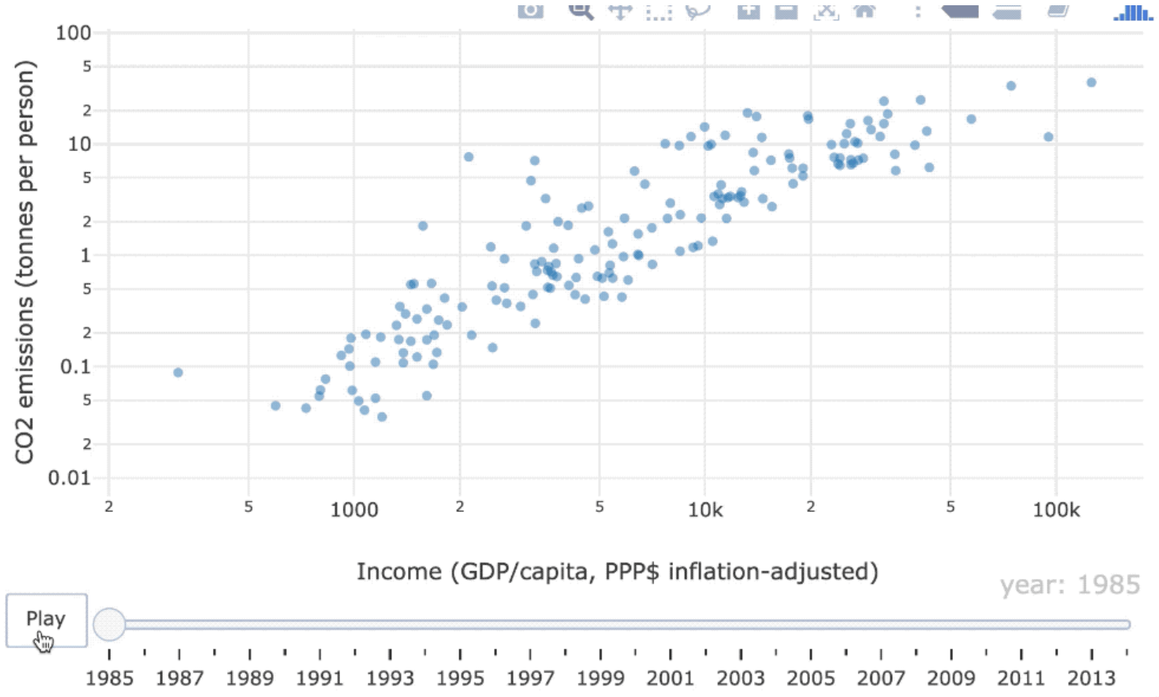
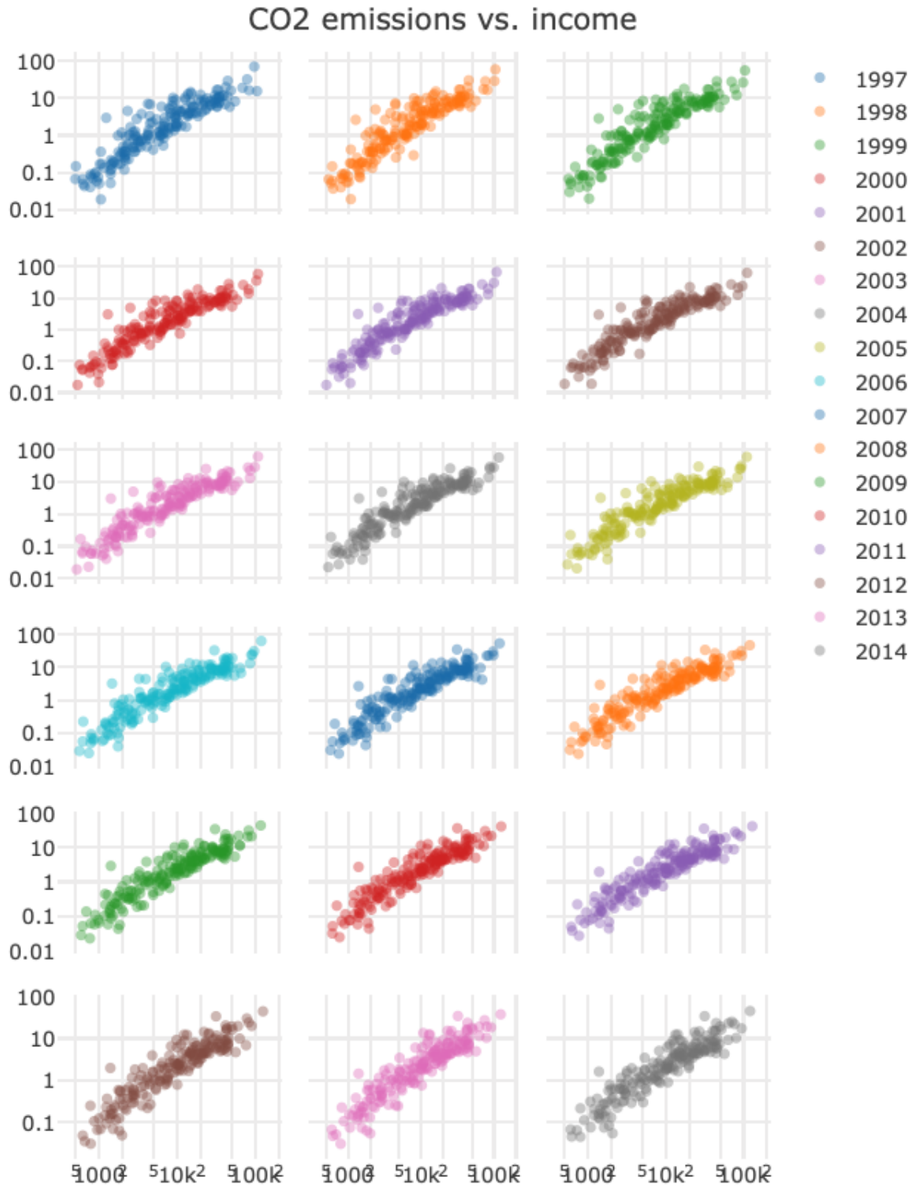
Introduction

INTERMEDIATE INTERACTIVE DATA VISUALIZATION WITH PLOTLY IN R

Adam Loy
Statistician, Carleton College

Motivation





Is it easier to see the changes over time based on the animation? Or the faceted views?

plotly

- Visualization library for interactive and dynamic web-based graphics
- Still under active development

Types of graphics

- Static
- Interactive
- Dynamic

Static graphics

A **static graphic** is permanently fixed after it is created

Interactive graphics

An **interactive graphic** changes based on an action performed by the user

Dynamic graphics

A **dynamic graphic** changes periodically without user input

plotly review

```
msci
```

```
# A tibble: 251 x 7
   Date        Open  High   Low Close Volume Adjusted
   <date>     <dbl> <dbl> <dbl> <dbl>  <int>    <dbl>
 1 2017-01-03  79.8  79.8  78.4  78.7 646000     77.4
 2 2017-01-04  79.1  81.1  79.1  80.7 849200     79.3
 3 2017-01-05  80.4  81.8  80.4  81.6 557500     80.2
 4 2017-01-06  81.8  83.9  81.8  83.4 597800     82.0
 5 2017-01-09  83.1  83.5  82.6  82.7 668100     81.3
 6 2017-01-10  82.3  82.6  81.1  81.5 558900     80.1
 7 2017-01-11  81.2  81.6  80.8  81.5 365500     80.1
# ... with 244 more rows
```

plotly review

```
library(plotly)

msci %>%
  plot_ly(x = ~Date, y = ~Close) %>%
  add_lines()
```


72
70
68
66
64
62
60
Close
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017
Date

Let's practice!

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Utilizing color, symbol and size

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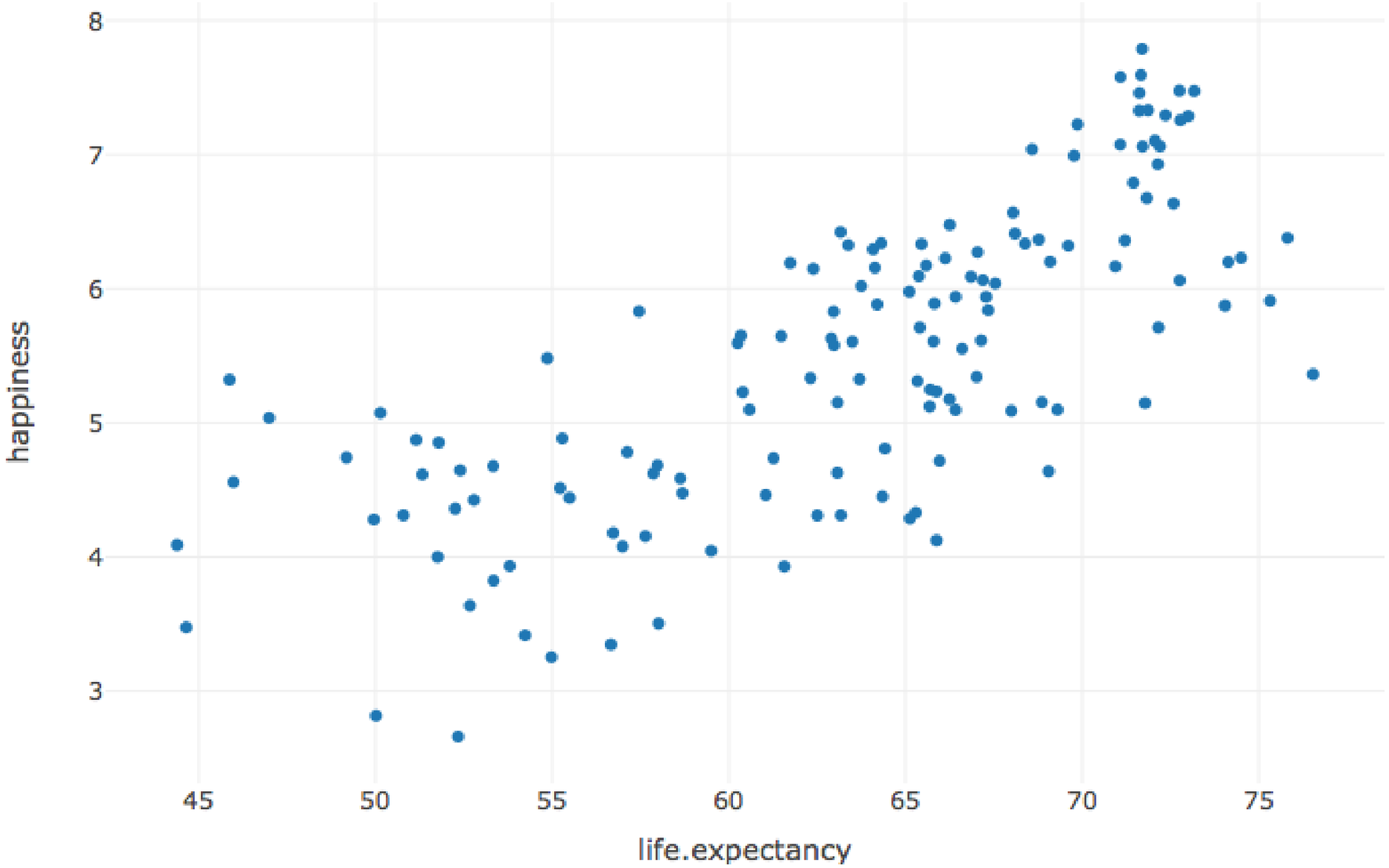

8
7
6
5
4
3
happiness
45
50
55
60
65
70
75
life.expectancy

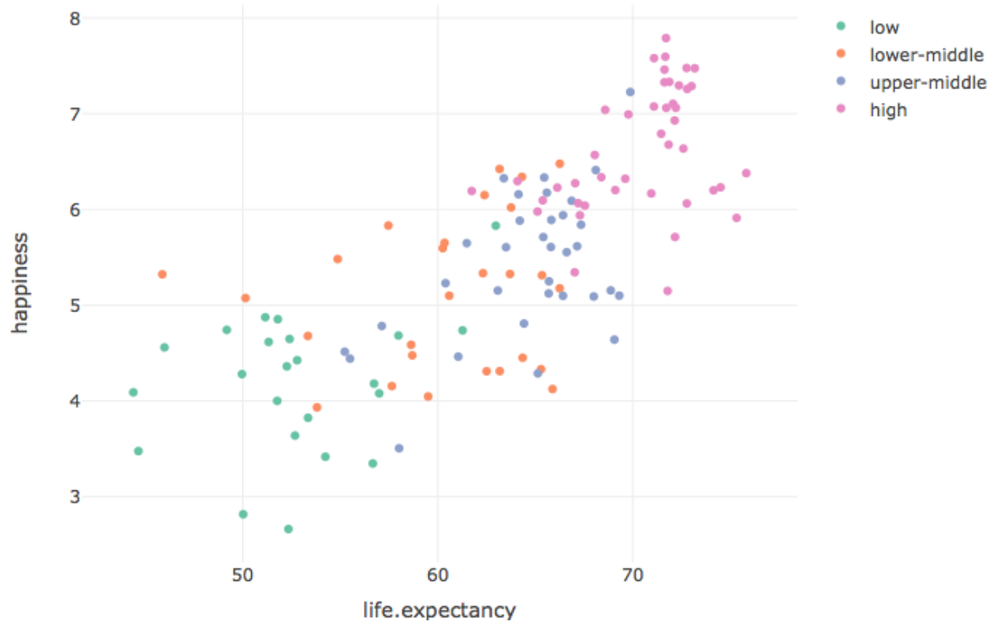
World happiness data

```
dplyr::glimpse(happy)
```

```
Observations: 141
Variables: 11
$ country         <chr> "Afghanistan", "Albania", "Algeria", ...
$ happiness       <dbl> 2.661718, 4.639548, 5.248912, 6.039330, ...
$ region          <chr> "South Asia", "Central and Eastern Europe", ...
$ population      <dbl> 35530081, 2873457, 41318142, 44271041, ...
$ log.gdp         <dbl> 7.460144, 9.373718, 9.540244, 9.843519, ...
$ income          <fct> low, upper-middle, upper-middle, high, ...
$ life.expectancy <dbl> 52.33953, 69.05166, 65.69919, 67.53870, ...
$ social.support  <dbl> 0.4908801, 0.6376983, 0.8067539, 0.9066991, ...
$ freedom         <dbl> 0.4270109, 0.7496110, 0.4366705, 0.8319662, ...
$ generosity      <dbl> -0.106340349, -0.035140377, -0.194670126, -0.18629...
$ corruption      <dbl> 0.9543926, 0.8761346, 0.6997742, 0.8410525, ...
```

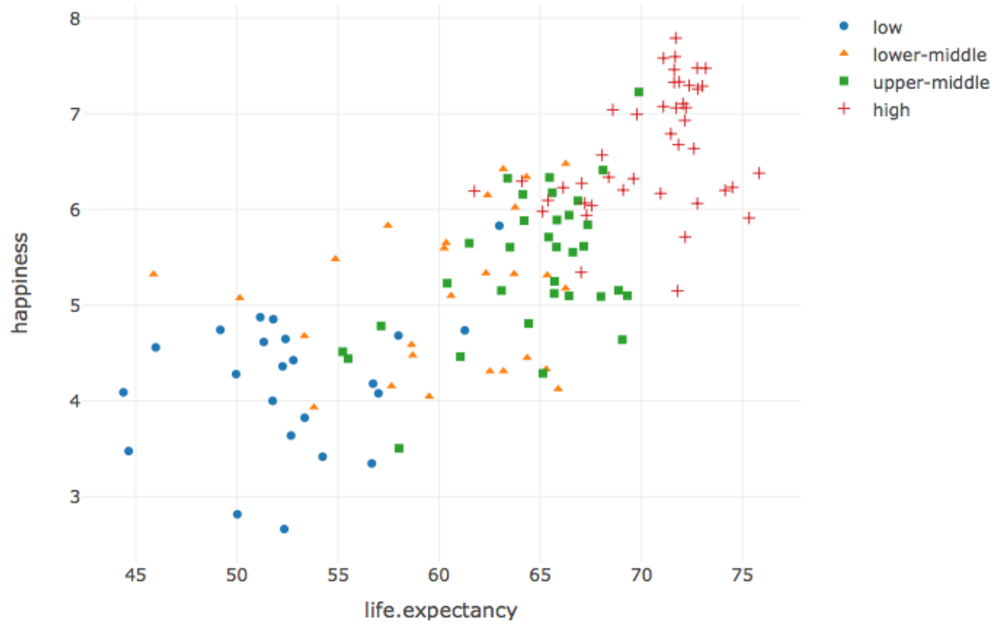
Glyph color

```
happy %>%
  plot_ly(x = ~life.expectancy, y = ~happiness) %>%
  add_markers(color = ~income)
```



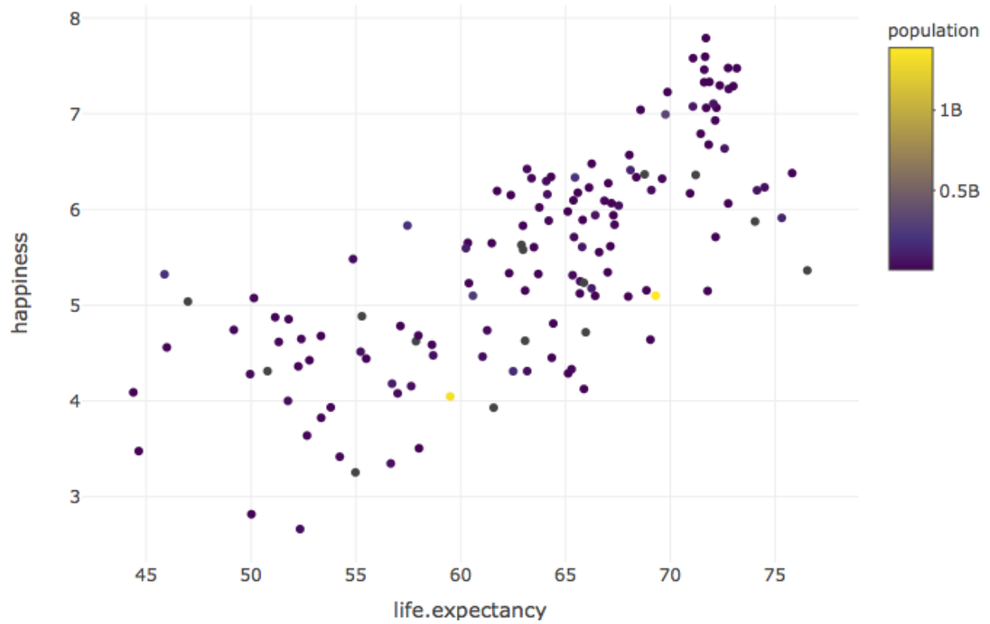
Glyph symbol

```
happy %>%
  plot_ly(x = ~life.expectancy, y = ~happiness) %>%
  add_markers(symbol = ~income)
```



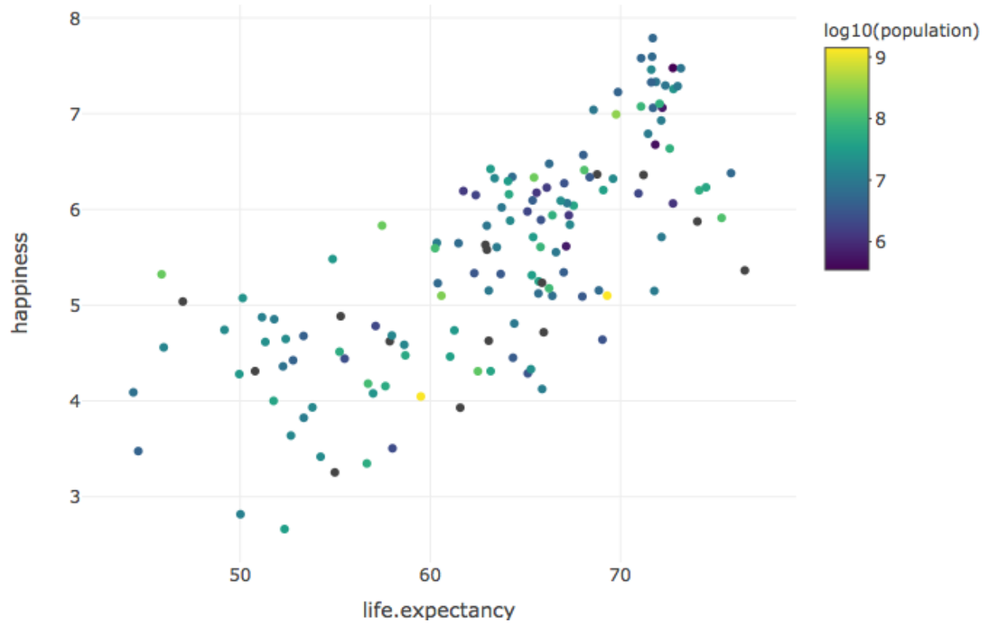
Color based on a quantitative variable

```
happy %>%
  plot_ly(x = ~life.expectancy, y = ~happiness) %>%
  add_markers(color = ~population)
```



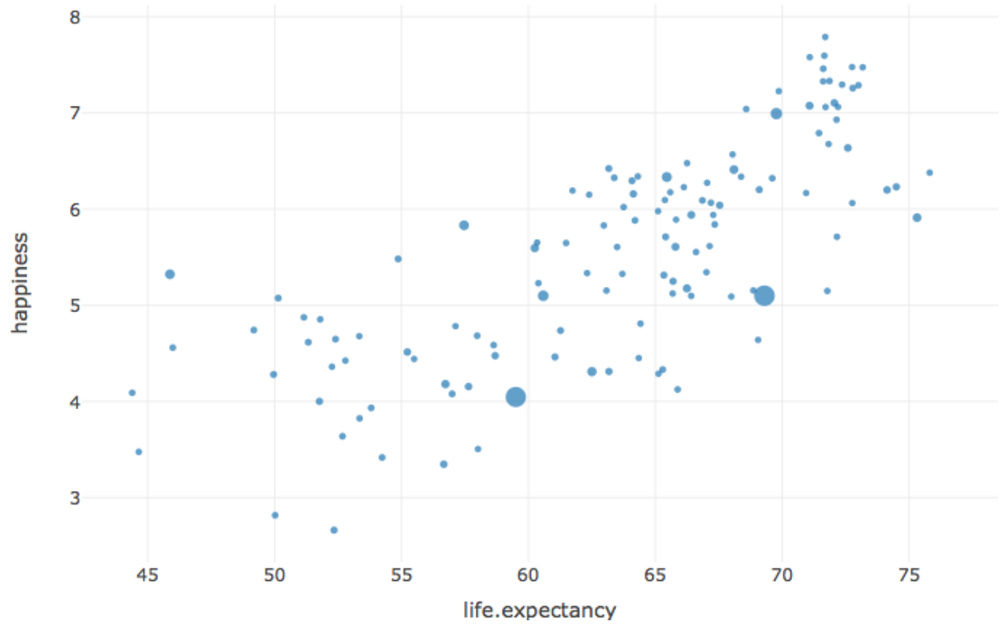
Transformations

```
happy %>%
  plot_ly(x = ~life.expectancy, y = ~happiness) %>%
  add_markers(color = ~log10(population))
```



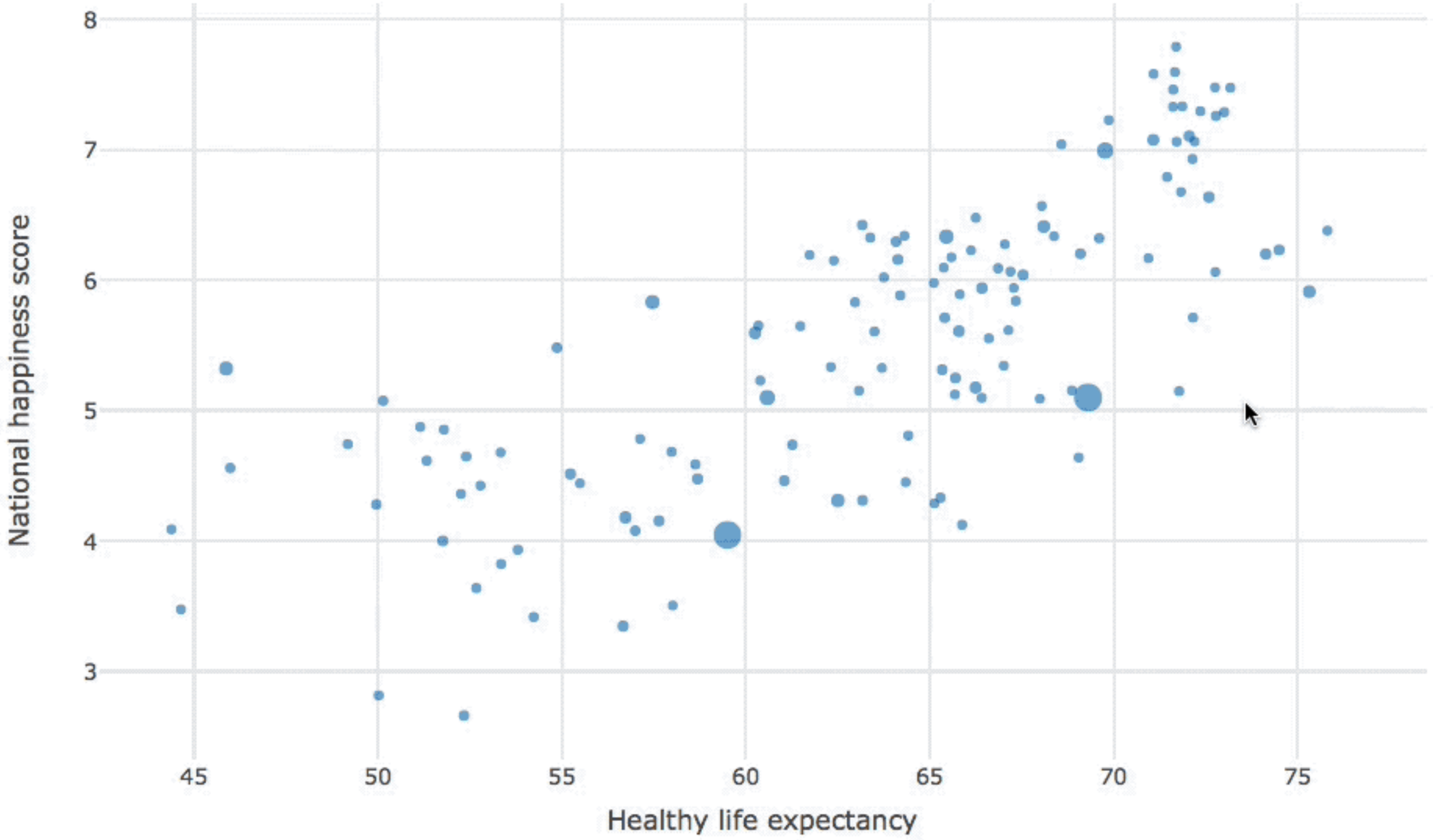
Glyph size

```
happy %>%
  plot_ly(x = ~life.expectancy, y = ~happiness) %>%
  add_markers(size = ~population)
```



Polishing labels

```
happy %>%
  plot_ly(
    x = ~life.expectancy, y = ~happiness,
    hoverinfo = "text",
    text = ~paste("Country: ", country,
                  "</br> Population: ", population)
  ) %>%
  add_markers(size = ~population) %>%
  layout(
    xaxis = list(title = "Healthy life expectancy"),
    yaxis = list(title = "National happiness score")
  )
```


National happiness score
8
7
6
5
4
3
45
50
55
60
65
70
75
Healthy life expectancy

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Moving Beyond Simple Interactivity

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Country-level economic indicators

Source: gapminder.org

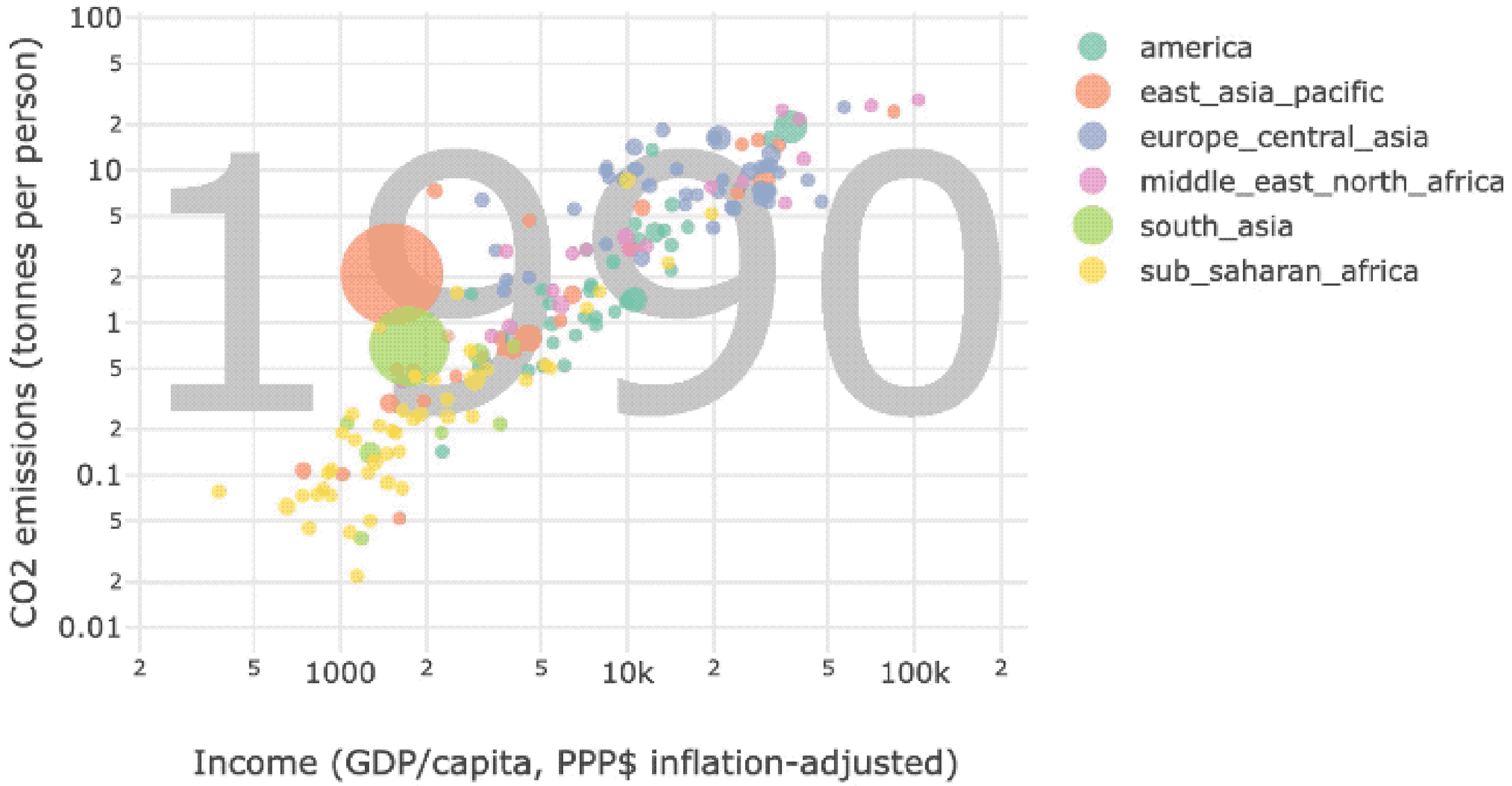
```
world_indicators
```

```
# A tibble: 11,387 x 11
   country  year income     co2 military population  urban life_expectancy four_regions
   <chr>   <dbl>  <dbl>   <dbl>    <dbl>      <dbl>  <dbl>           <dbl> <chr>
 1 Afghan…  1960   1210  0.0461       NA    9000000 7.56e5            38.6 asia
 2 Albania  1960   2790  1.24         NA    1640000 4.94e5            62.7 europe
 3 Algeria  1960   6520  0.554        NA   11100000 3.39e6            52   africa
 4 Andorra  1960  15200 NA            NA      13400 7.84e3            NA   europe
 5 Angola   1960   3860  0.0975       NA    5640000 5.89e5            42.4 africa
 # … with 1.138e+04 more rows, and 2 more variables: eight_regions <chr>, six_regions <ch
```

State-level economic data

```
us_economy
```

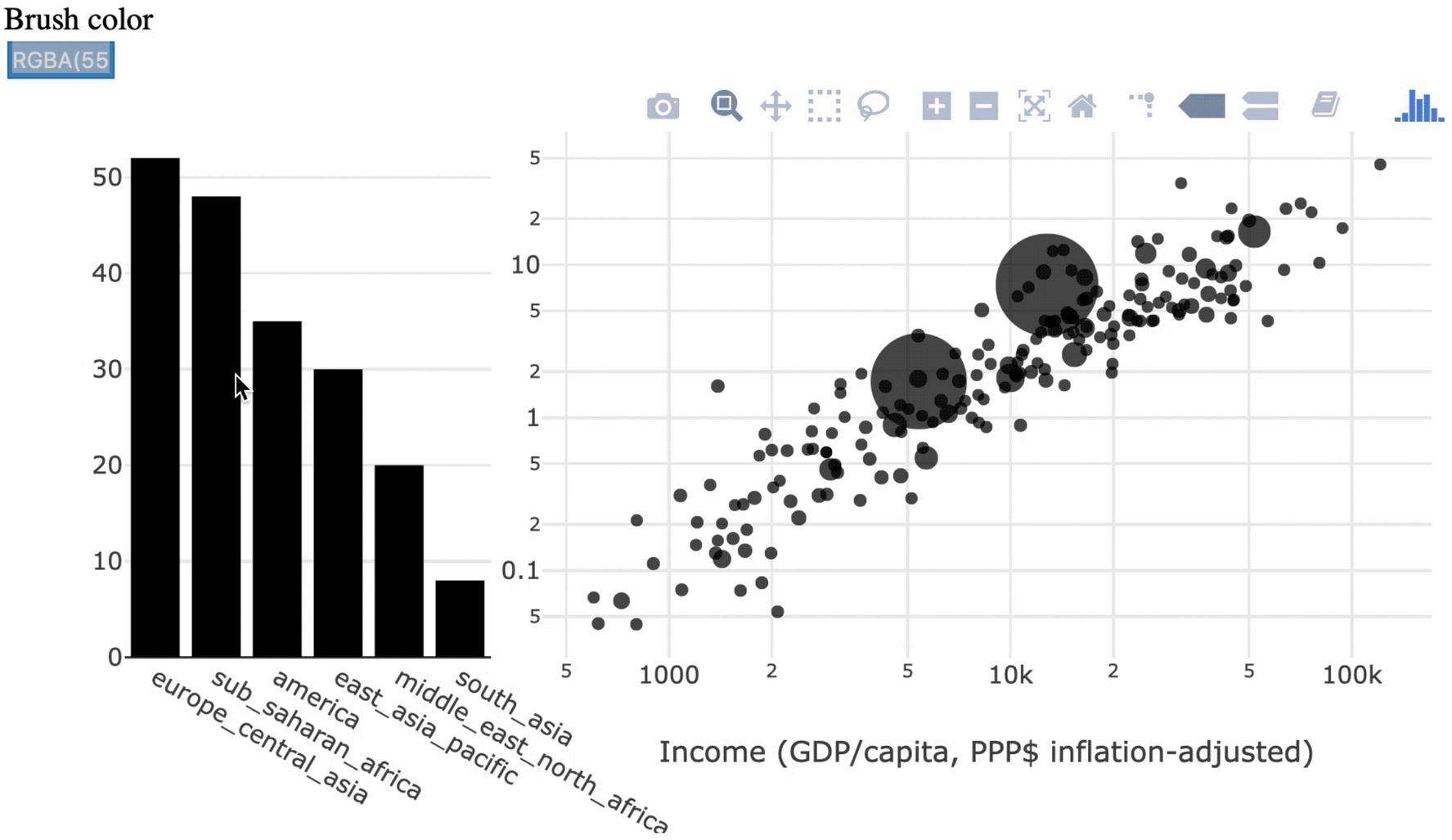
```
# A tibble: 1,071 x 9
  state  year    gdp employment home_owners house_price population region division
  <chr> <dbl>  <dbl>      <dbl>       <dbl>       <dbl>      <dbl> <chr>  <chr>
1 AK     1997 42262.         NA        67.2        159.       609. West   Pacific
2 AK     1998 41157.         NA        66.3        164.       615. West   Pacific
3 AK     1999 40722.         NA        66.4        169.       620. West   Pacific
4 AK     2000 39517.         NA        66.4        172.       628. West   Pacific
5 AK     2001 40974.         NA        65.3        181.       634. West   Pacific
# … with 1,066 more rows
```


1990
CO2 emissions (tonnes per person)
100
5
2
10
5
2
1
5
2
0.1
5
2
0.01
2
5
1000
2
5
10k
2
5
100k
2
Income (GDP/capita, PPP$ inflation-adjusted)
america
east_asia_pacific
europe_central_asia
middle_east_north_africa
south_asia
sub_saharan_africa

Static bubble charts

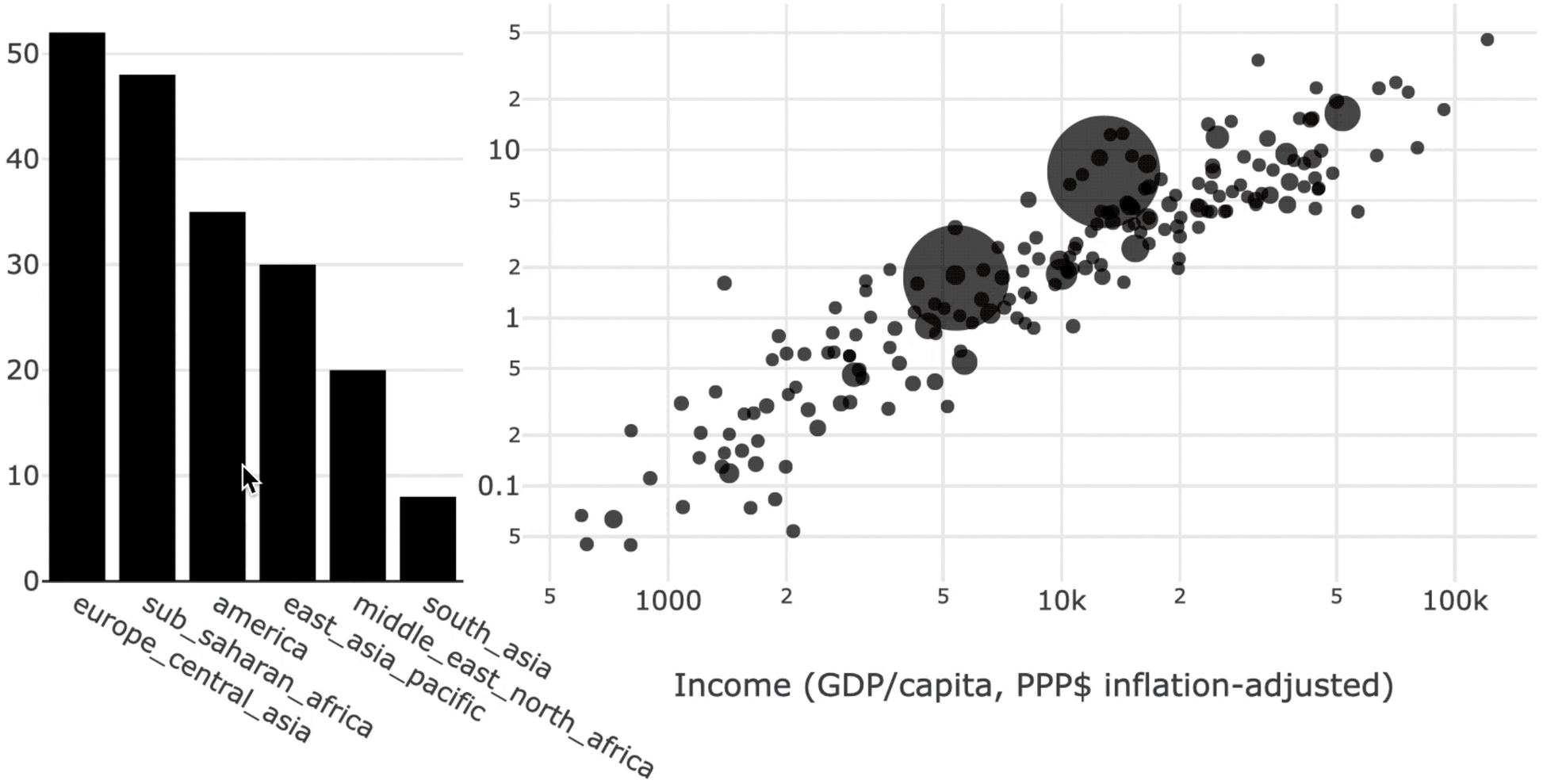
```
world_indicators %>%
   filter(year == 2014) %>%
   plot_ly(
     x = ~income, y = ~co2, hoverinfo = "text",
     text = ~country
   ) %>%
   add_markers(
      size = ~population, color = ~six_regions,
      marker = list(opacity = 0.5,
                    sizemode = "diameter",
                    sizeref = 2)
   )
```

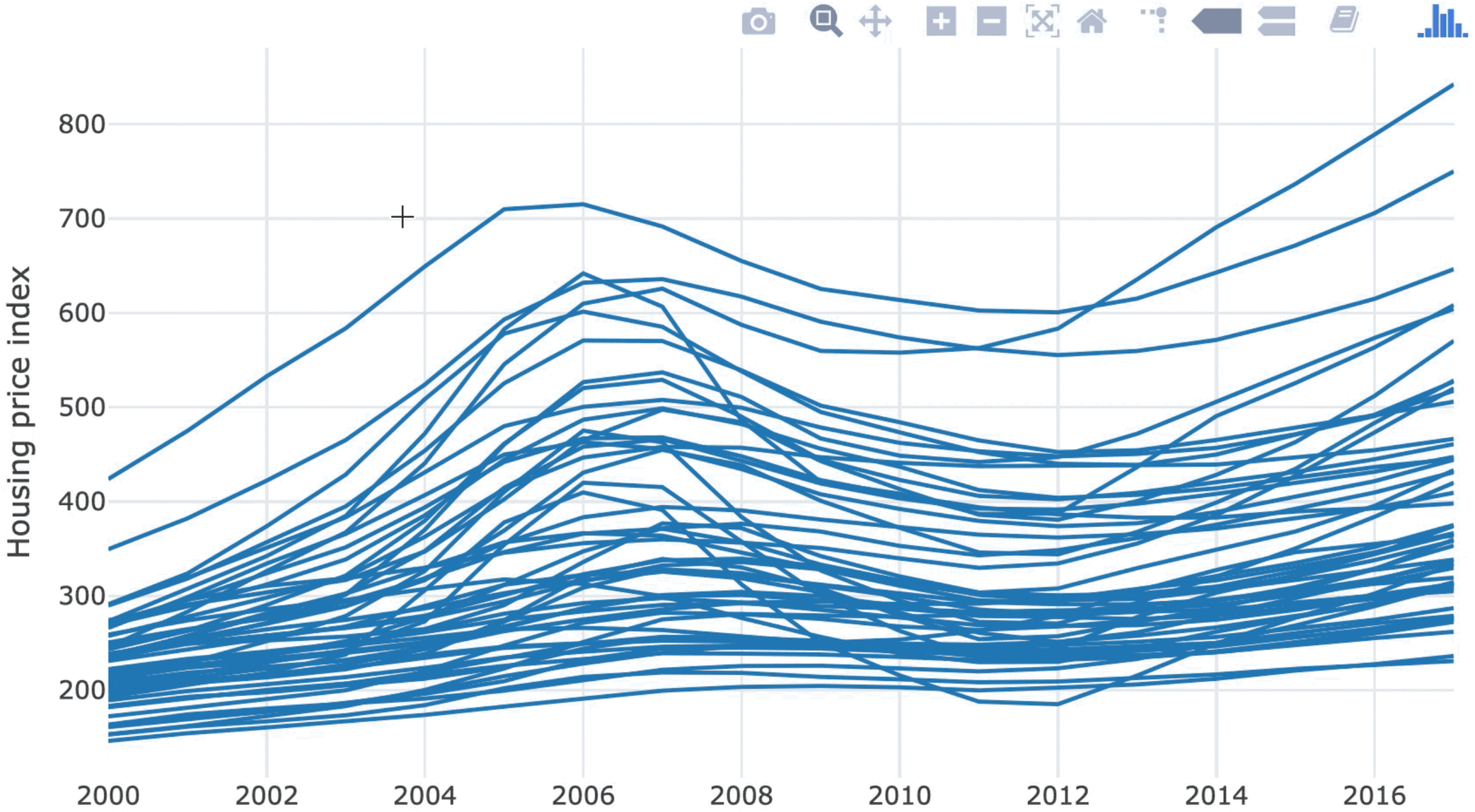
Linked brushing



Brush color

rgba(228




Housing price index
800
700
600
500
400
300
200
2000
2002
2004
2006
2008
2010
2012
2014
2016

Let's explore!

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