Data Visualization
Styling Plots

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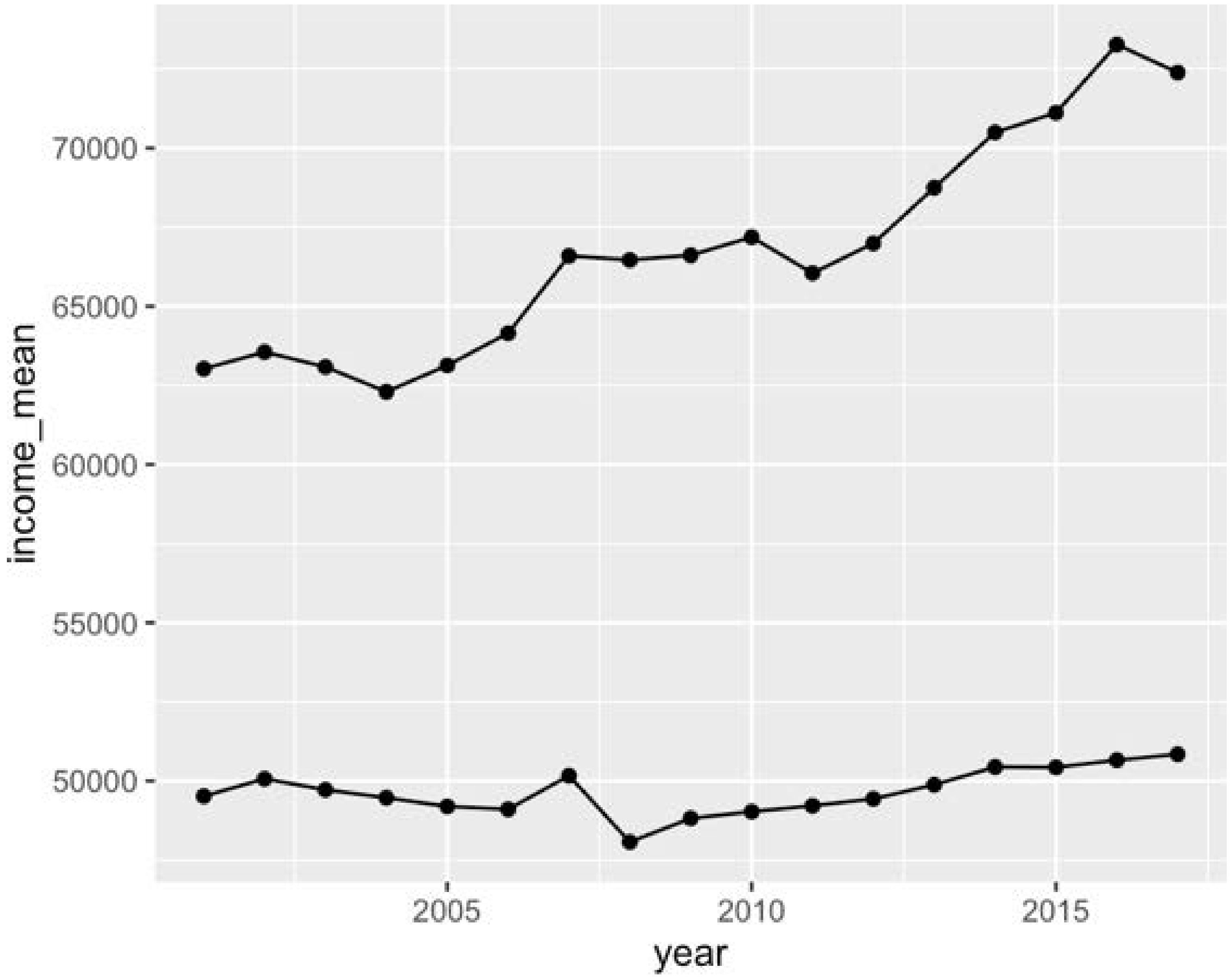
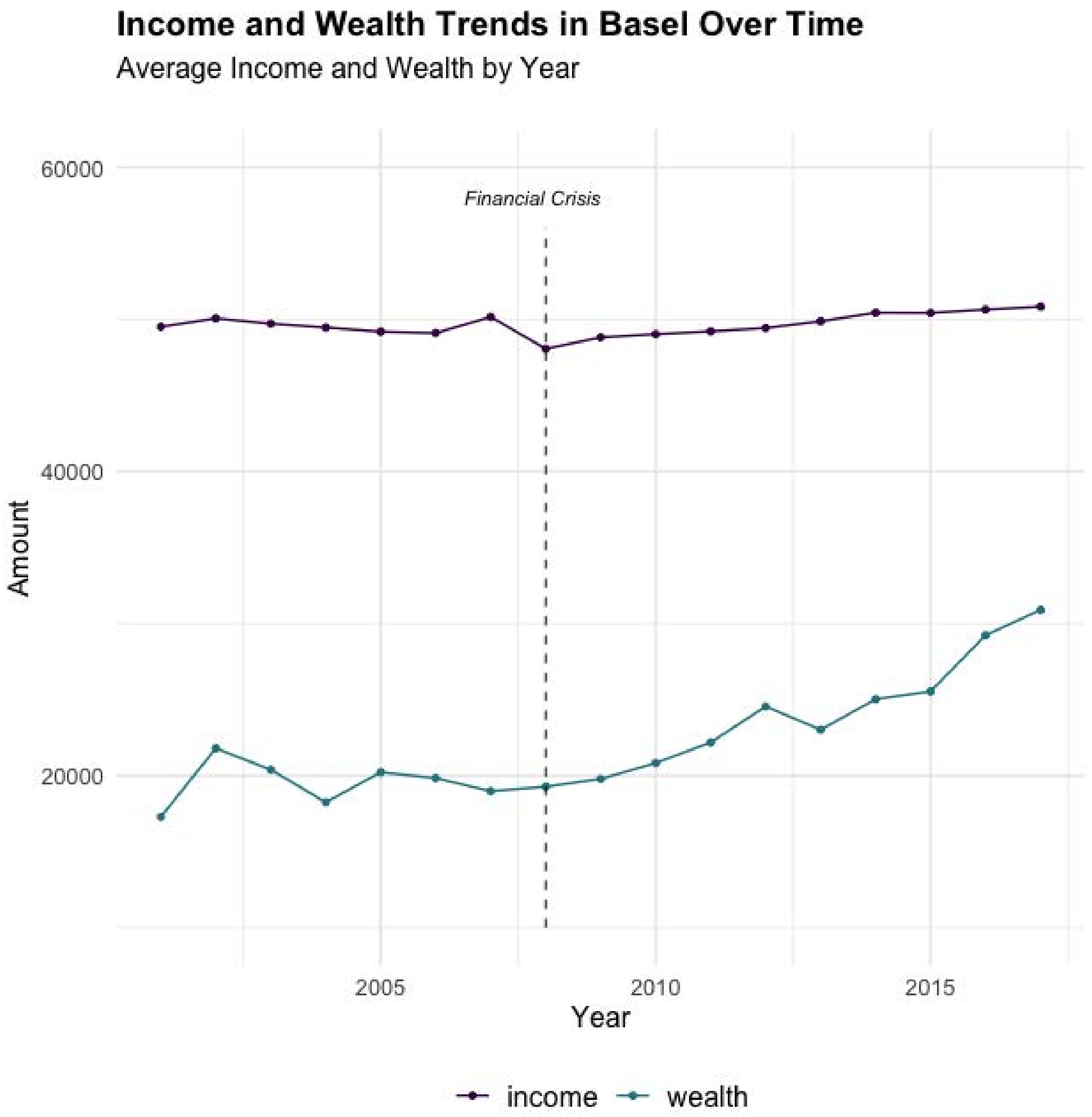
Why is styling important?



vs



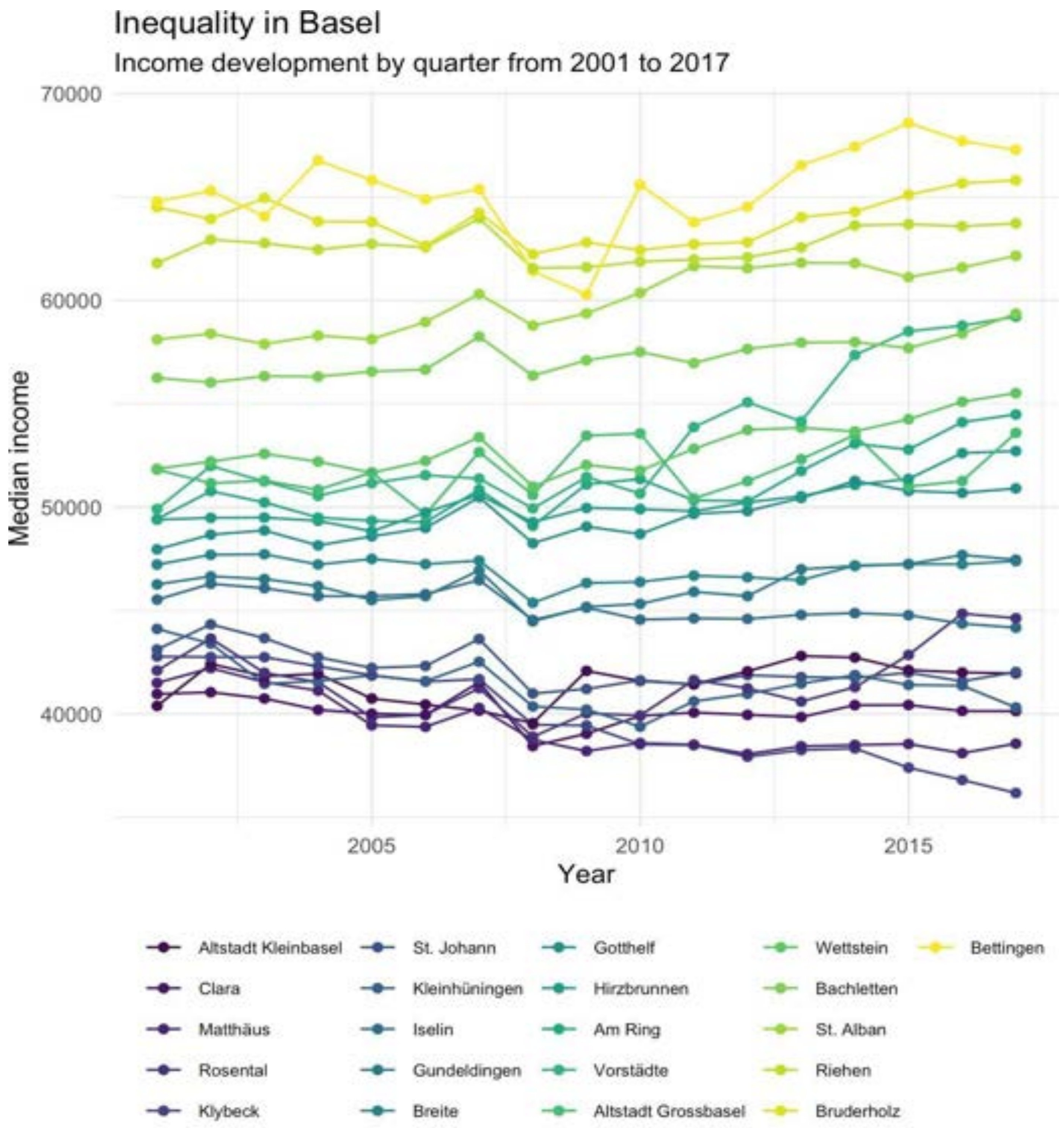
Styling Plots

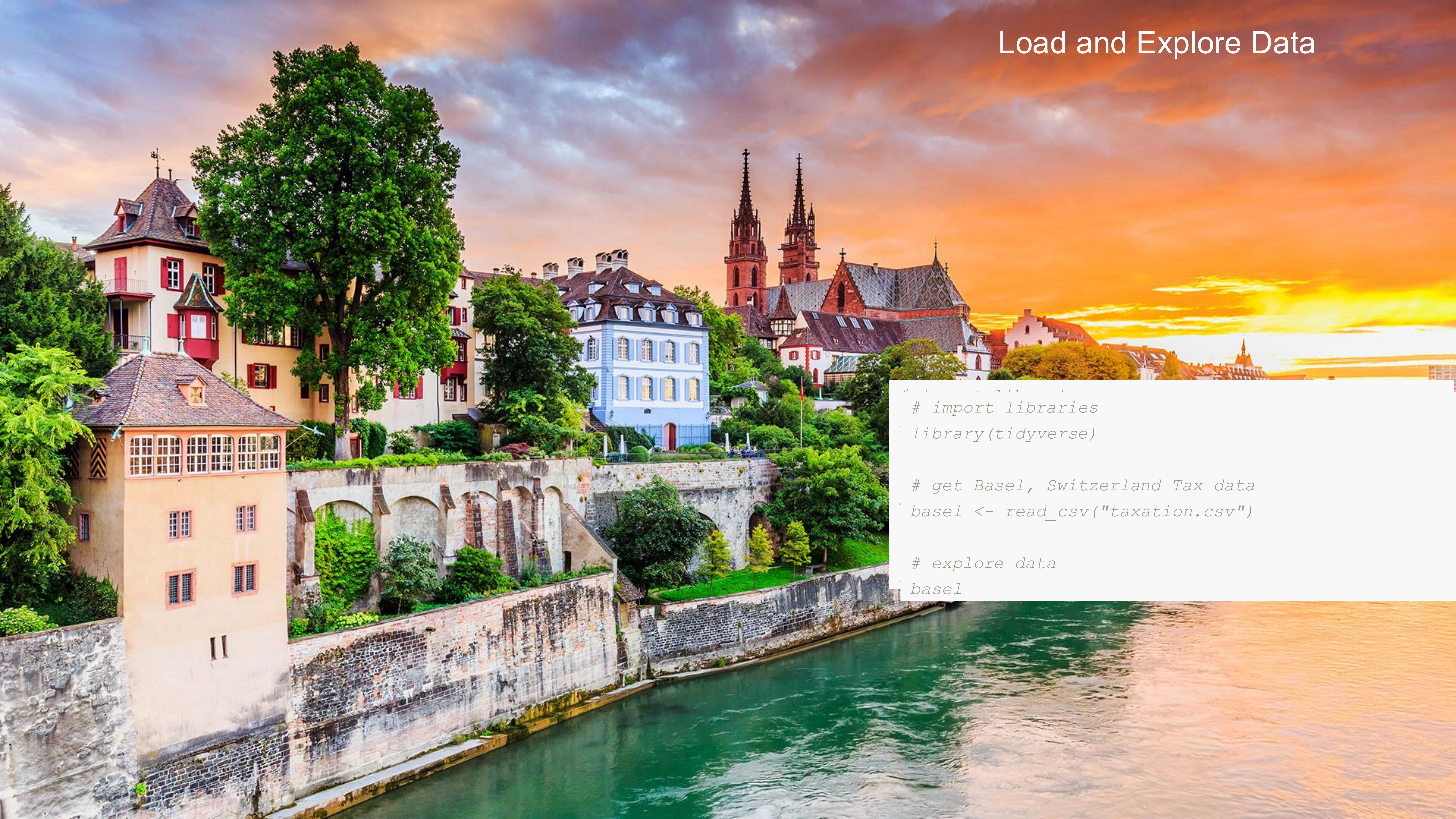
(1) Use existing **theme_*()** presets.

(2) Customize details using **theme ()**

(3) Adjust dimensions using **scale_*()**.

(4) Add an notion using **labs ()**.





Load and Explore Data

```r
# import libraries
library(tidyverse)

# get Basel, Switzerland Tax data
basel <- read_csv("taxation.csv")

# explore data
basel
```

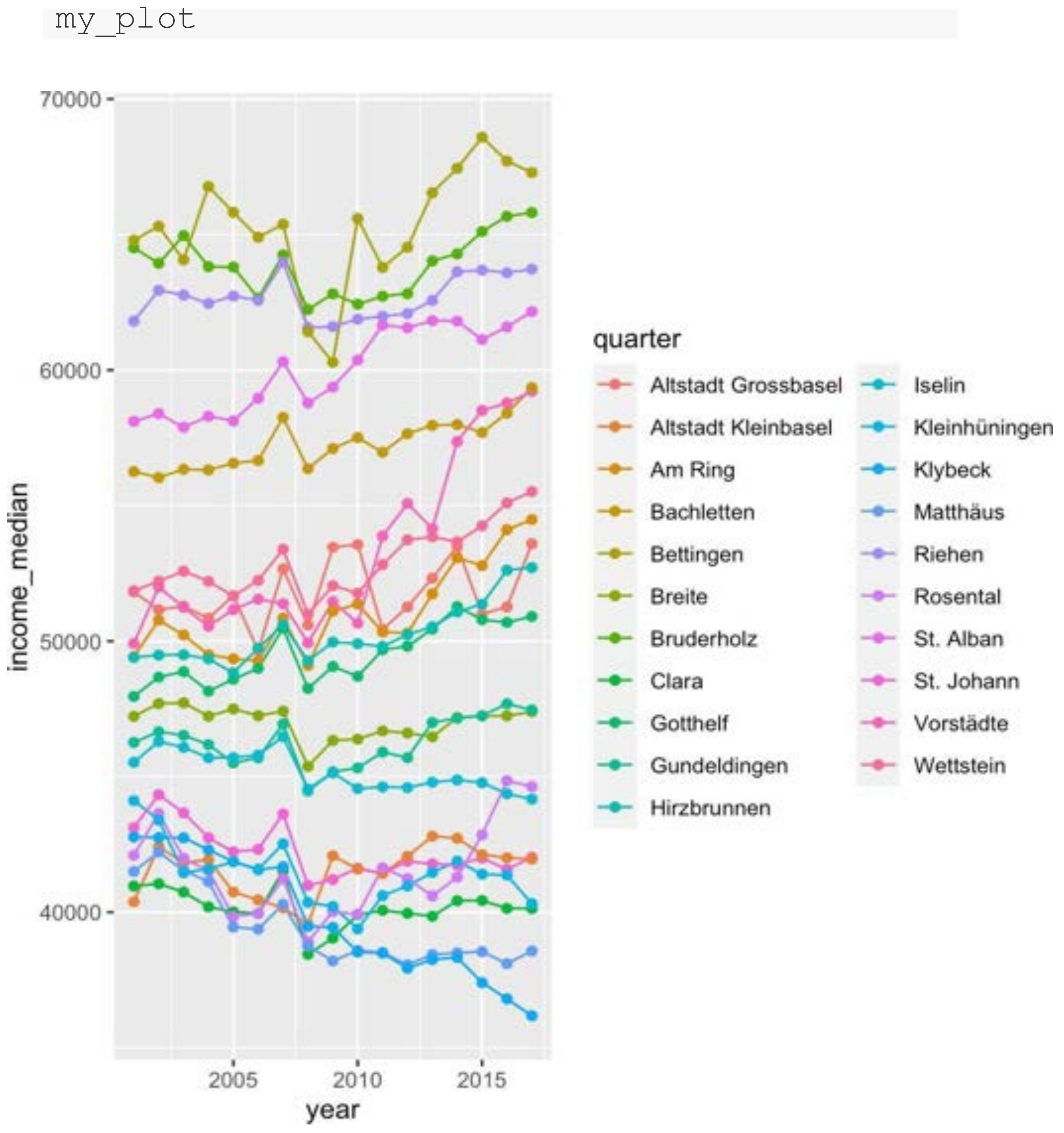
The gg object

The output of `ggplot()` can be stored in an gg object.

The gg object can be expanded using + and the plot can be generated by a simple print.

```
# store plot as object

myplot <- data %>%

     ggplot(aes(x=year,y=income_median, col=quarter))+

     geom_line() +

     geom_point()
```

#



```
my_plot
```

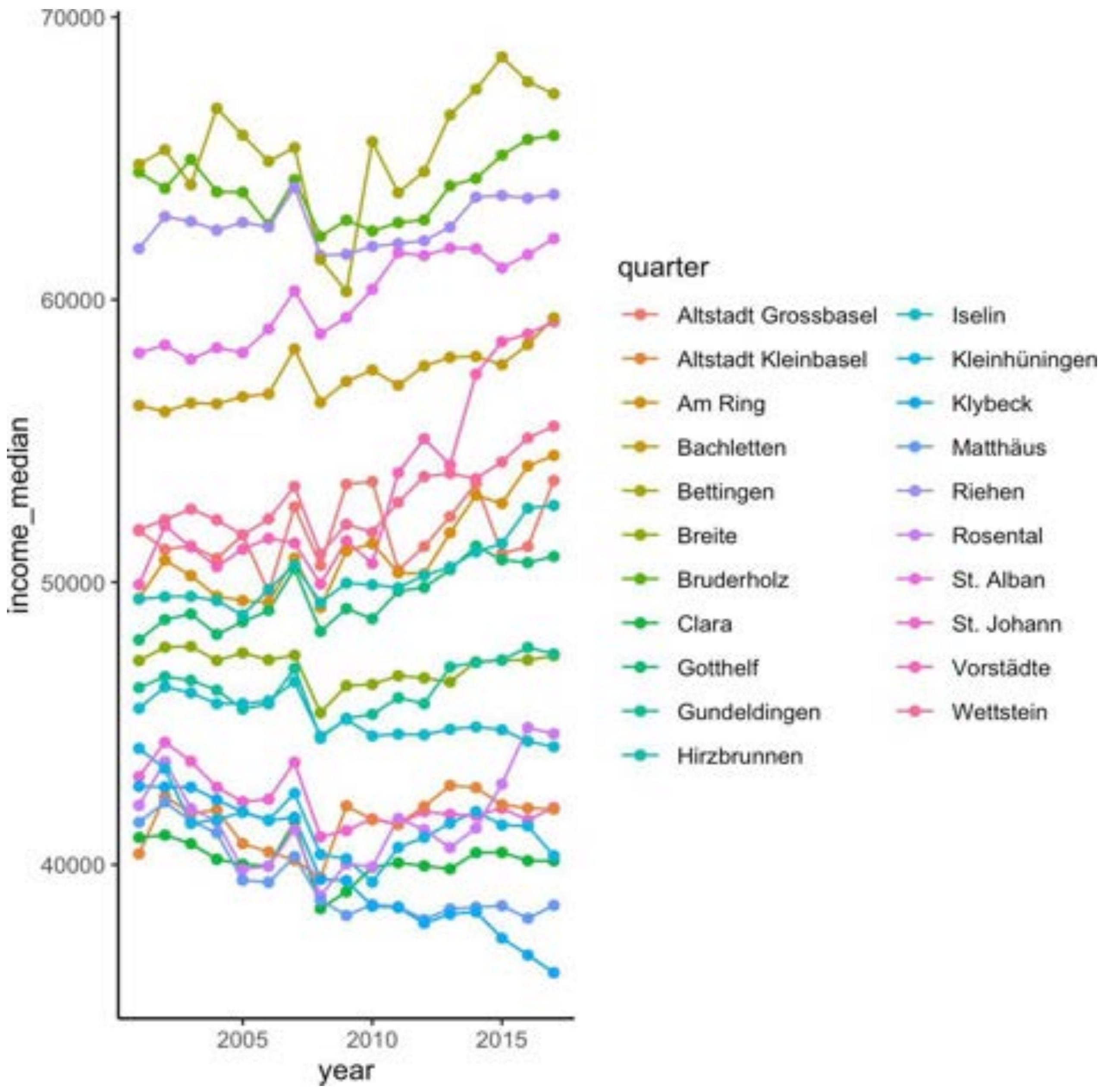
theme_*()

Using `theme_*()` the plot can be styled according to various presets.

A few themes (go through each theme):

```
theme_grey()

theme_gray()

theme_bw()

theme_light()

theme_dark()

theme_minimal()

theme_classic()

theme_void()
```

```
my_plot + theme_classic()
```



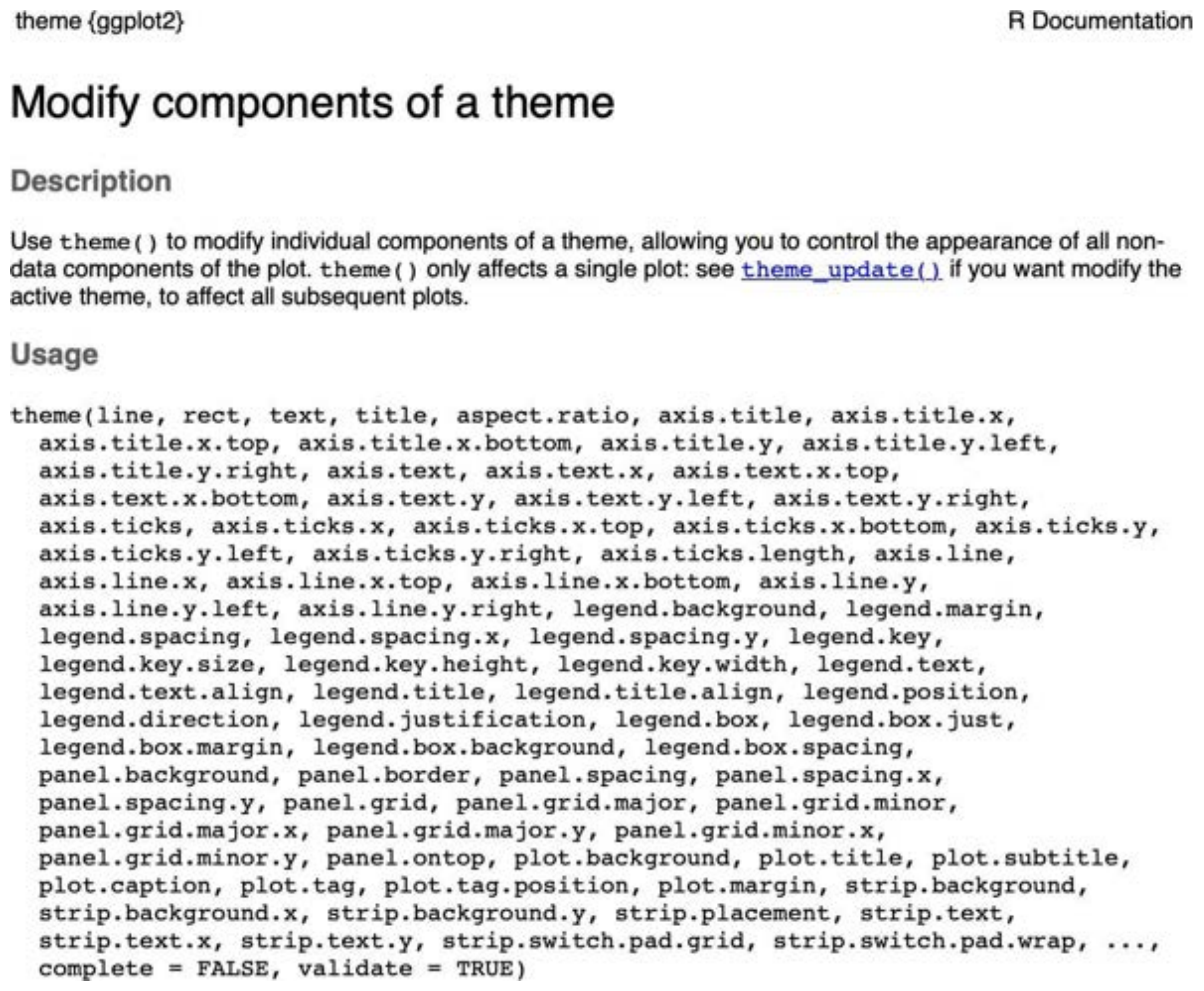
theme_*()

With **96 arguments** `theme()` permits specification of all aesthetic details.

Makes use of helper functions:

- `element_rect()` | for rectangles
- `element_line()` | for lines
- `element_text()` | for text
- `element_blank()` | for removals

```
# Using theme
my_plot +
 theme(argument =
     element_*(),
     argument =
     element_*(),
    ...)
```



theme {ggplot2}   R Documentation

Modify components of a theme

Description

Use `theme()` to modify individual components of a theme, allowing you to control the appearance of all non-data components of the plot. `theme()` only affects a single plot: see `theme_update()` if you want modify the active theme, to affect all subsequent plots.

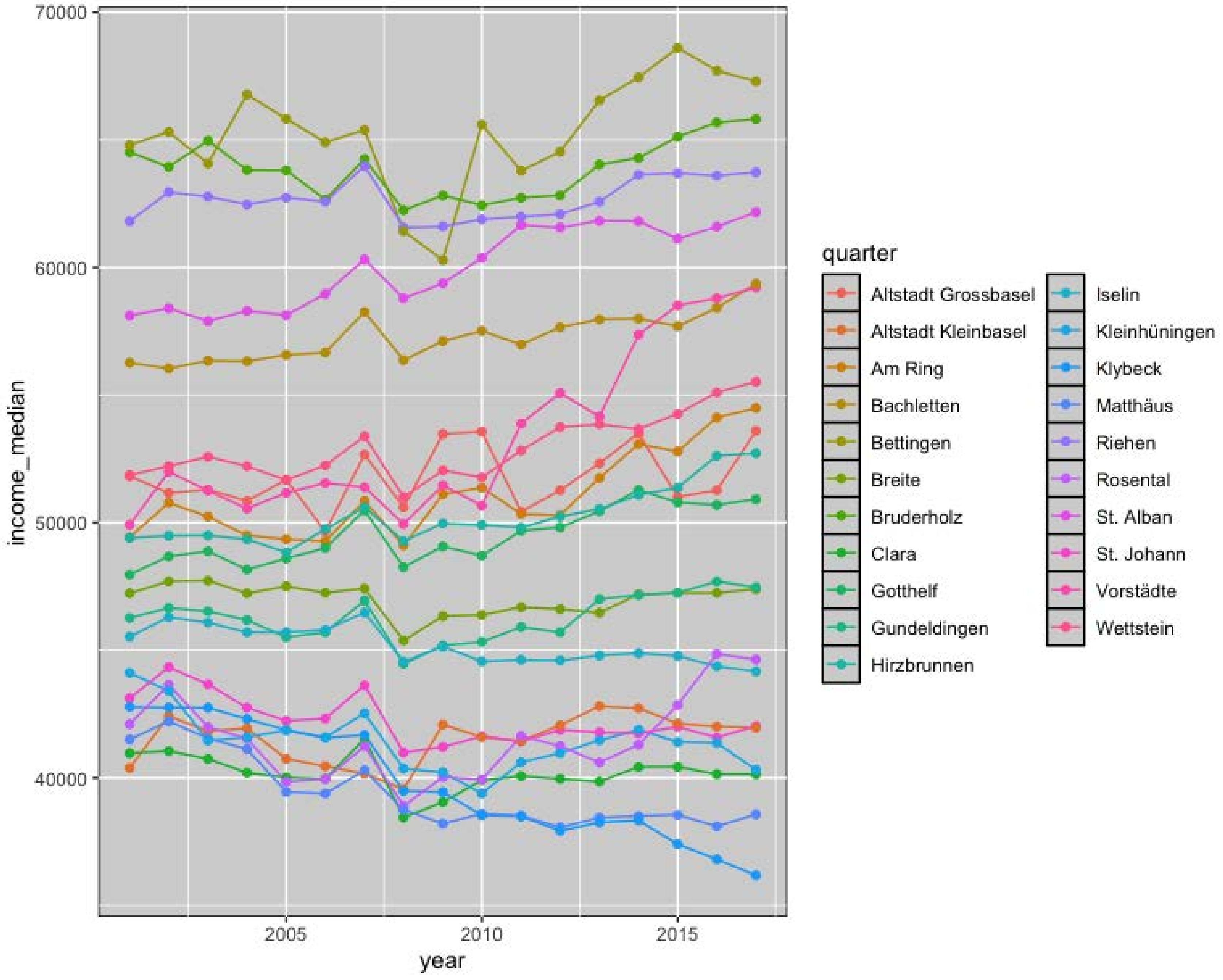
Usage

```
theme(line, rect, text, title, aspect.ratio, axis.title, axis.title.x,
  axis.title.x.top, axis.title.x.bottom, axis.title.y, axis.title.y.left,
  axis.title.y.right, axis.text, axis.text.x, axis.text.x.top,
  axis.text.x.bottom, axis.text.y, axis.text.y.left, axis.text.y.right,
  axis.ticks, axis.ticks.x, axis.ticks.x.top, axis.ticks.x.bottom, axis.ticks.y,
  axis.ticks.y.left, axis.ticks.y.right, axis.ticks.length, axis.line,
  axis.line.x, axis.line.x.top, axis.line.x.bottom, axis.line.y,
  axis.line.y.left, axis.line.y.right, legend.background, legend.margin,
  legend.spacing, legend.spacing.x, legend.spacing.y, legend.key,
  legend.key.size, legend.key.height, legend.key.width, legend.text,
  legend.text.align, legend.title, legend.title.align, legend.position,
  legend.direction, legend.justification, legend.box, legend.box.just,
  legend.box.margin, legend.box.background, legend.box.spacing,
  panel.background, panel.border, panel.spacing, panel.spacing.x,
  panel.spacing.y, panel.grid, panel.grid.major, panel.grid.minor,
  panel.grid.major.x, panel.grid.major.y, panel.grid.minor.x,
  panel.grid.minor.y, panel.ontop, plot.background, plot.title, plot.subtitle,
  plot.caption, plot.tag, plot.tag.position, plot.margin, strip.background,
  strip.background.x, strip.background.y, strip.placement, strip.text,
  strip.text.x, strip.text.y, strip.switch.pad.grid, strip.switch.pad.wrap, ...,
  complete = FALSE, validate = TRUE)
```

theme_*()

The `element_rect()` function is used to define the appearance of rectangular elements in a plot

```
# using element_rect ()
myplot +
  theme (panel.background = element_rect
         (fill = "lightgray", color = "black"))
```

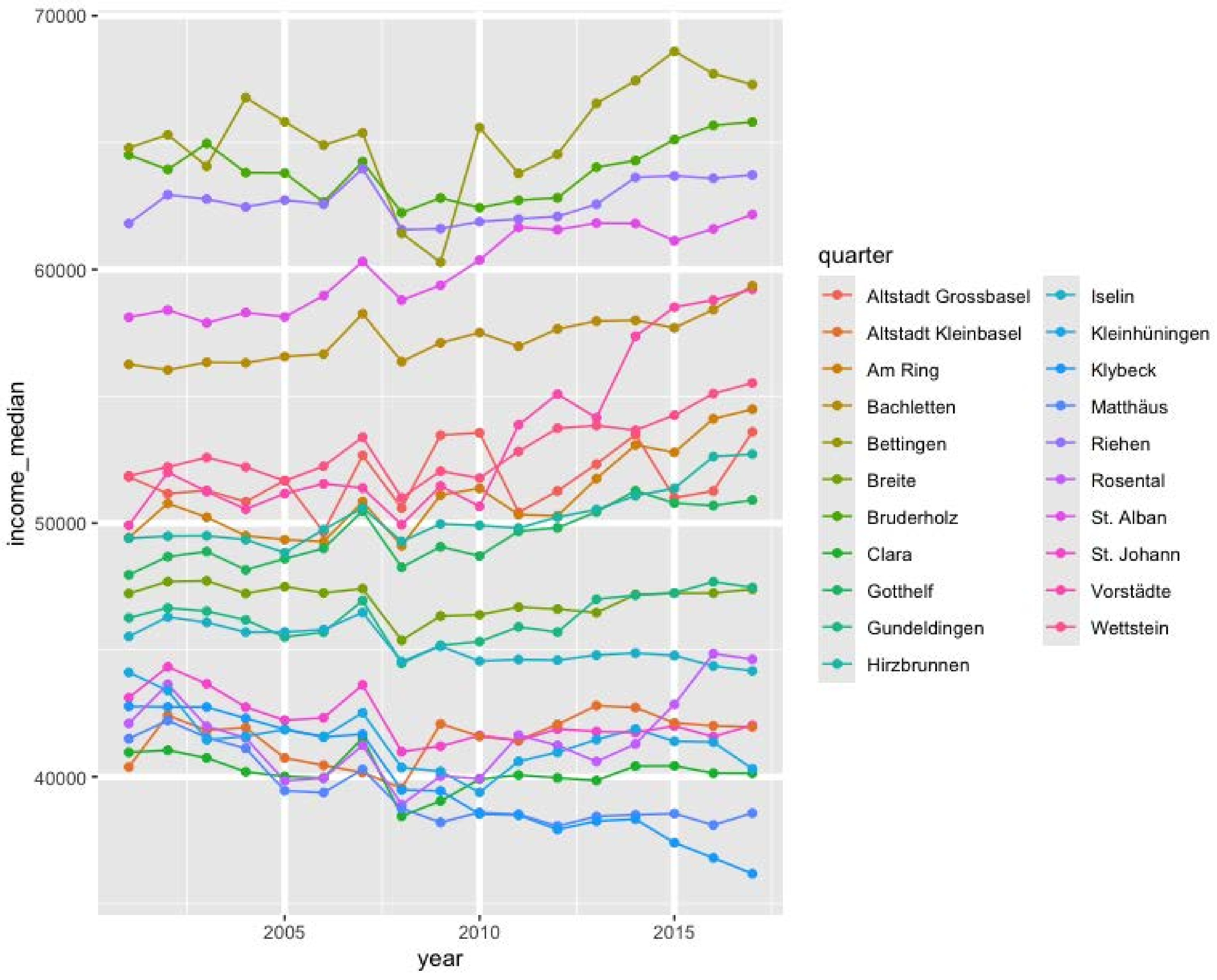


theme_*()

The `element_line()` function is used to define the appearance of **line-based elements** in a plot.

It allows you to customize elements such as grid lines, axis lines, and tick marks.

```
# linewidth
myplot +
  theme (panel.grid.major = element_line
          (color = "white", linewidth= 1.5))
```

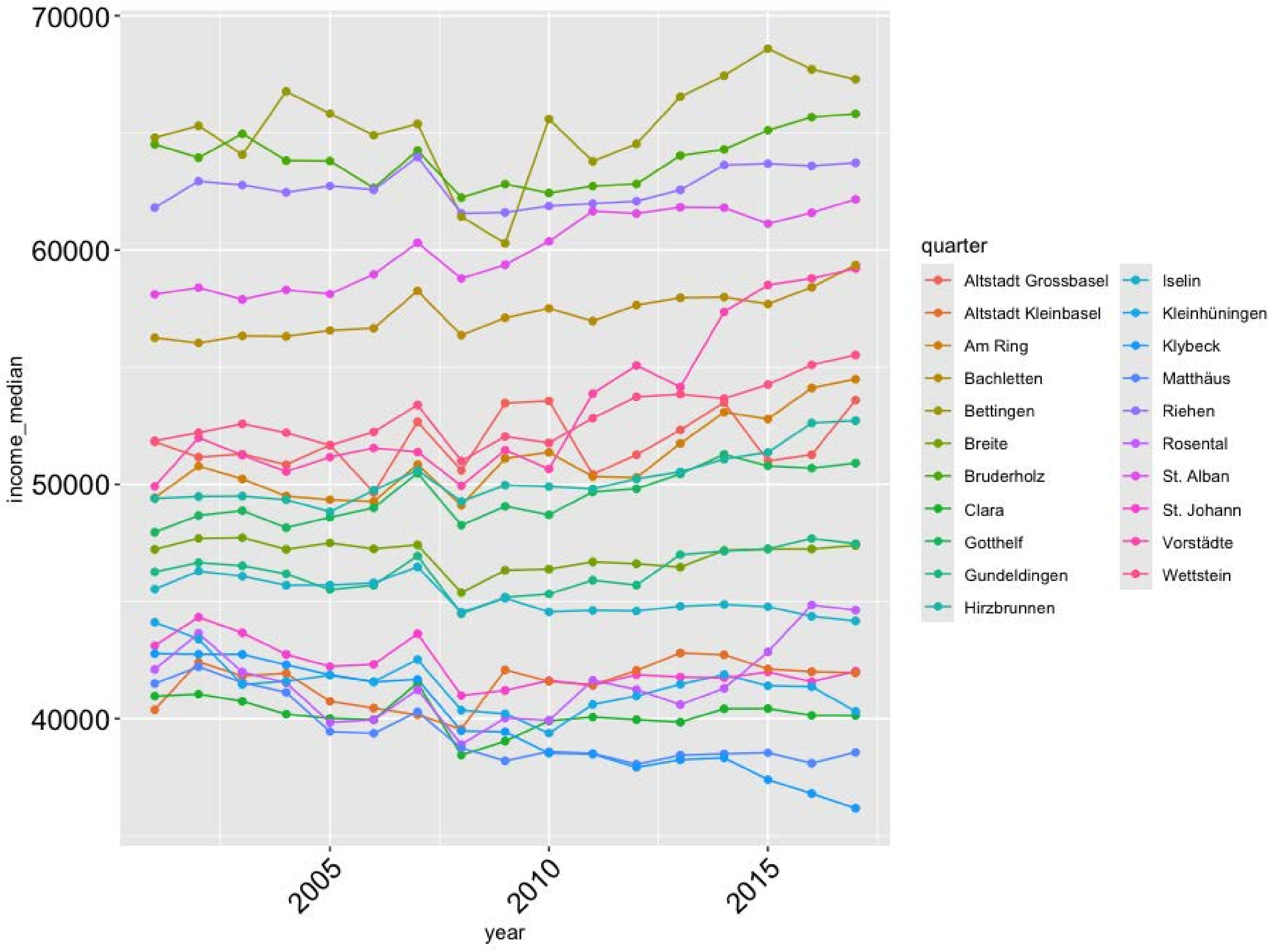


theme_*()

The `element_text()` function is used to customize the appearance of **text-based elements**

It provides control over the size, color, alignment, font style, and more.

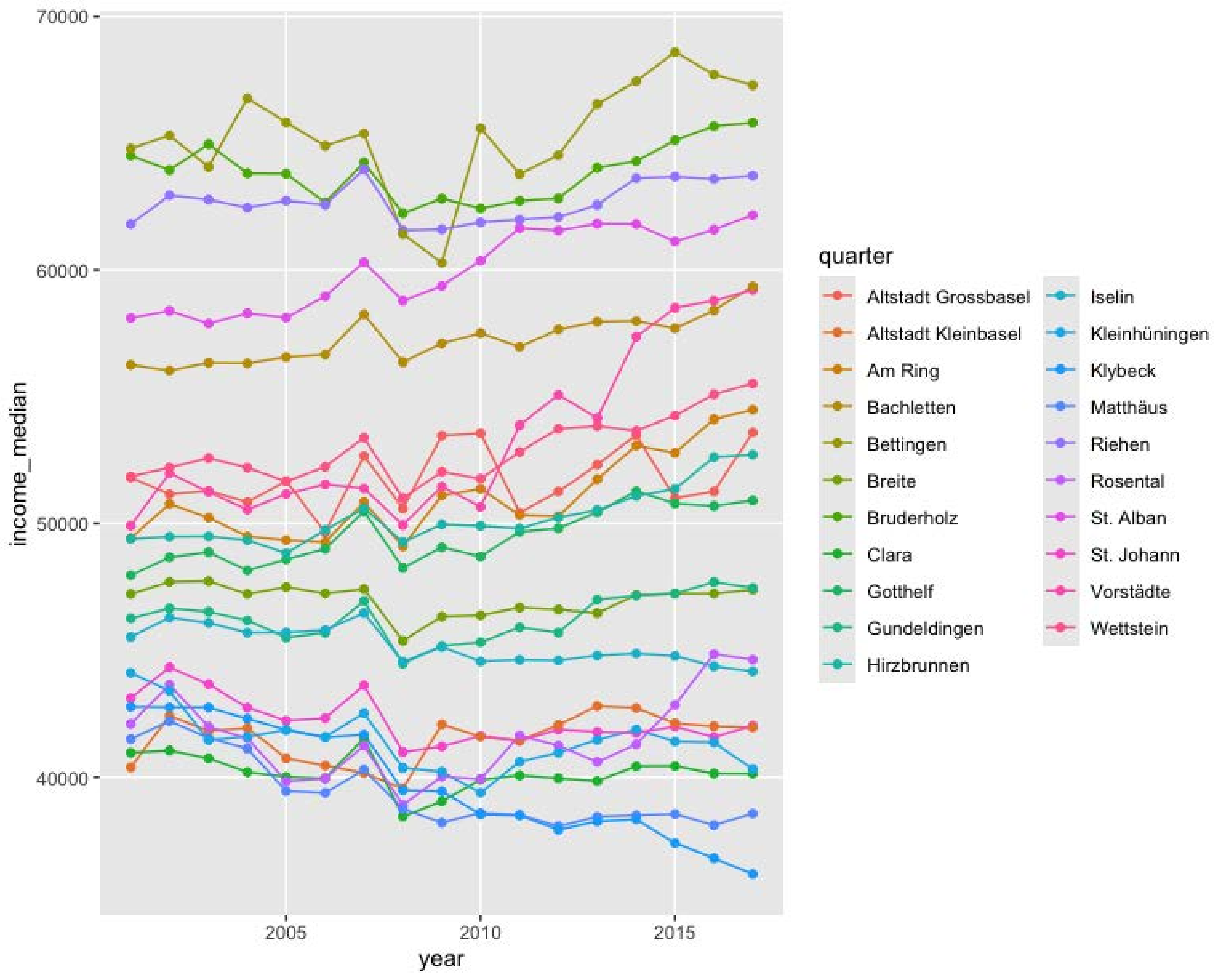
```
# element_text
myplot +
  theme (axis.text.x = element_text
        (size = 15, angle = 45, hjust = 1,
         color = "black"),
  axis.text.y = element_text
        (size = 15, color = "black"))
```



theme_*()

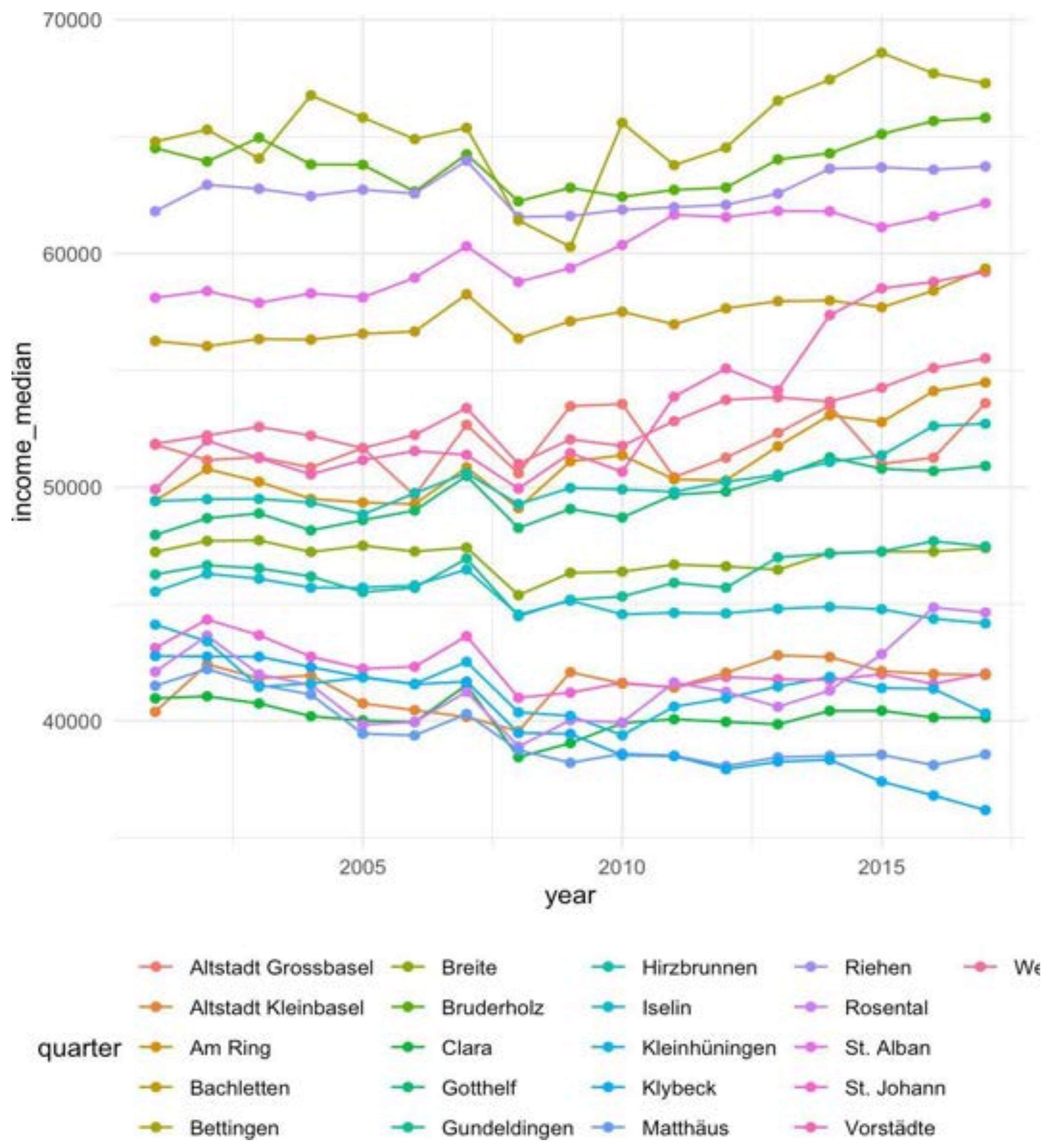
The `element_blank()` function is used to completely **remove or hide graphical elements** from a plot.

```
# element_blank

myplot +

  theme (panel.grid.minor =

element_blank())
```



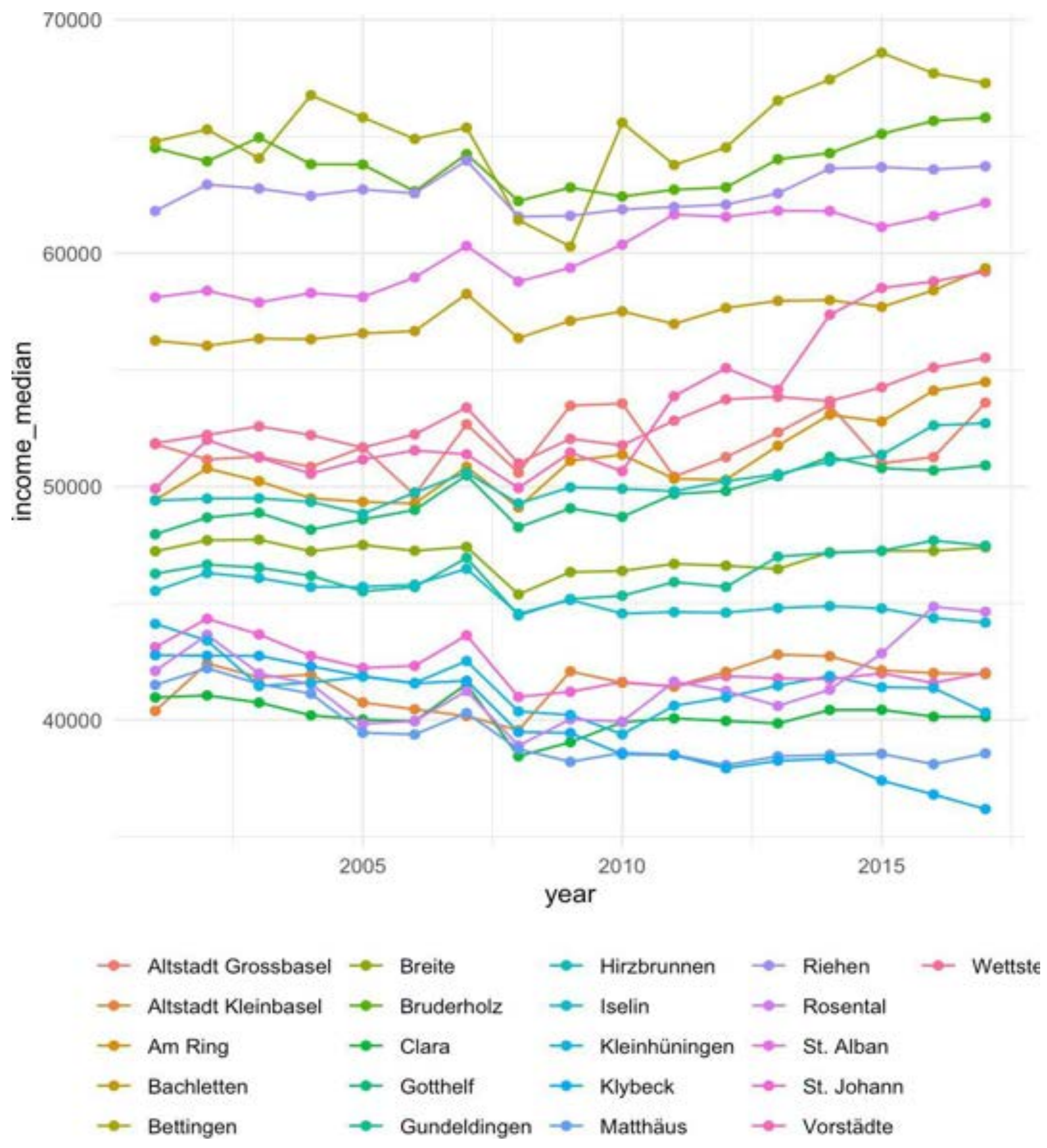
theme_*()

```
# Fixing the legend
myplot +
 theme_minimal() +

 # move legend to bottom
 theme(legend.position = "bottom")
```



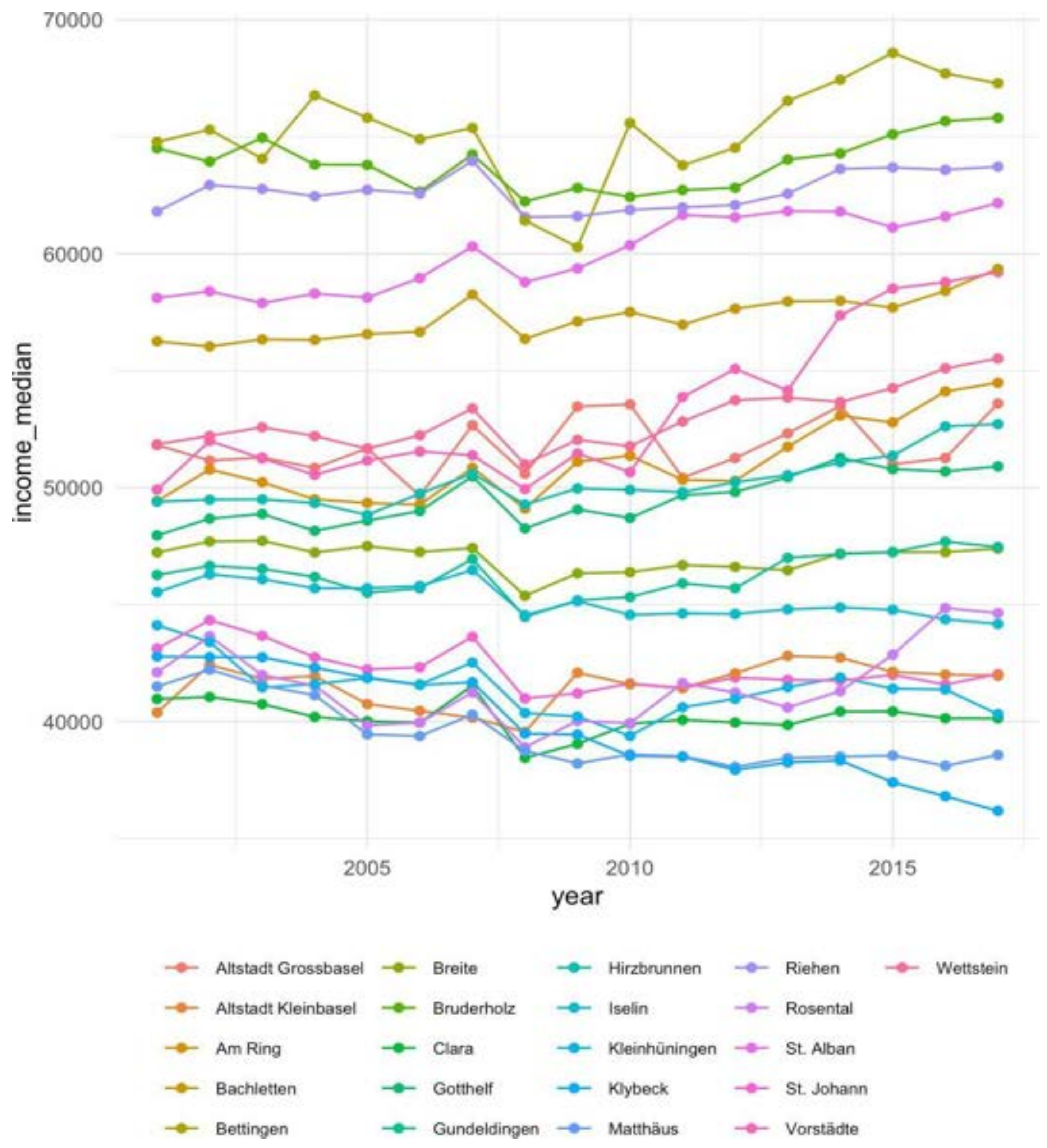
theme_*()

```
# Fixing the legend
myplot +
 theme_minimal() +
 theme(legend.position = "bottom",

   # remove legend title
   legend.title = element_blank())
```



theme_*()

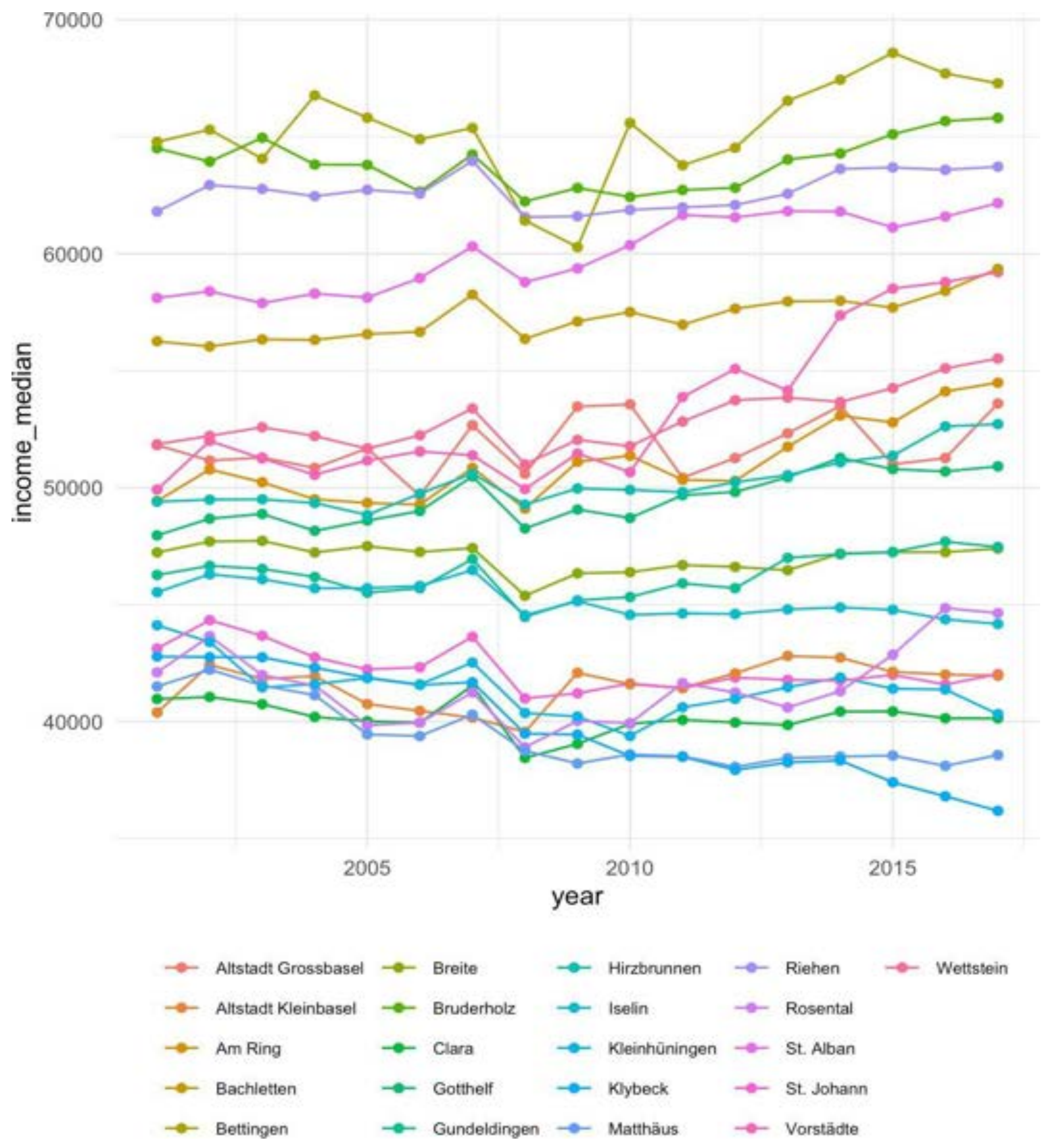
```
# Fixing the legend
my_plot +
 theme_minimal() +
 theme(
  legend.position = "bottom",
  legend.title =
  element_blank(),

  # reduce legend text size
  legend.text = element_text(size = 7))
```



theme_*()

We can also save our adjustments as an object an combine it with a prexisting theme.

```
# save my theme
my_theme <-
 theme(legend.position =
 "bottom",  legend.title =
 element_blank(),
 legend.text = element_text(size = 7))


# Add my theme
my_plot +
 theme_minimal() +
 my_theme
```



scale_*()

Various `scale_*()` functions permit specification of all **dimensions**, including axes, colors, sizes, etc.

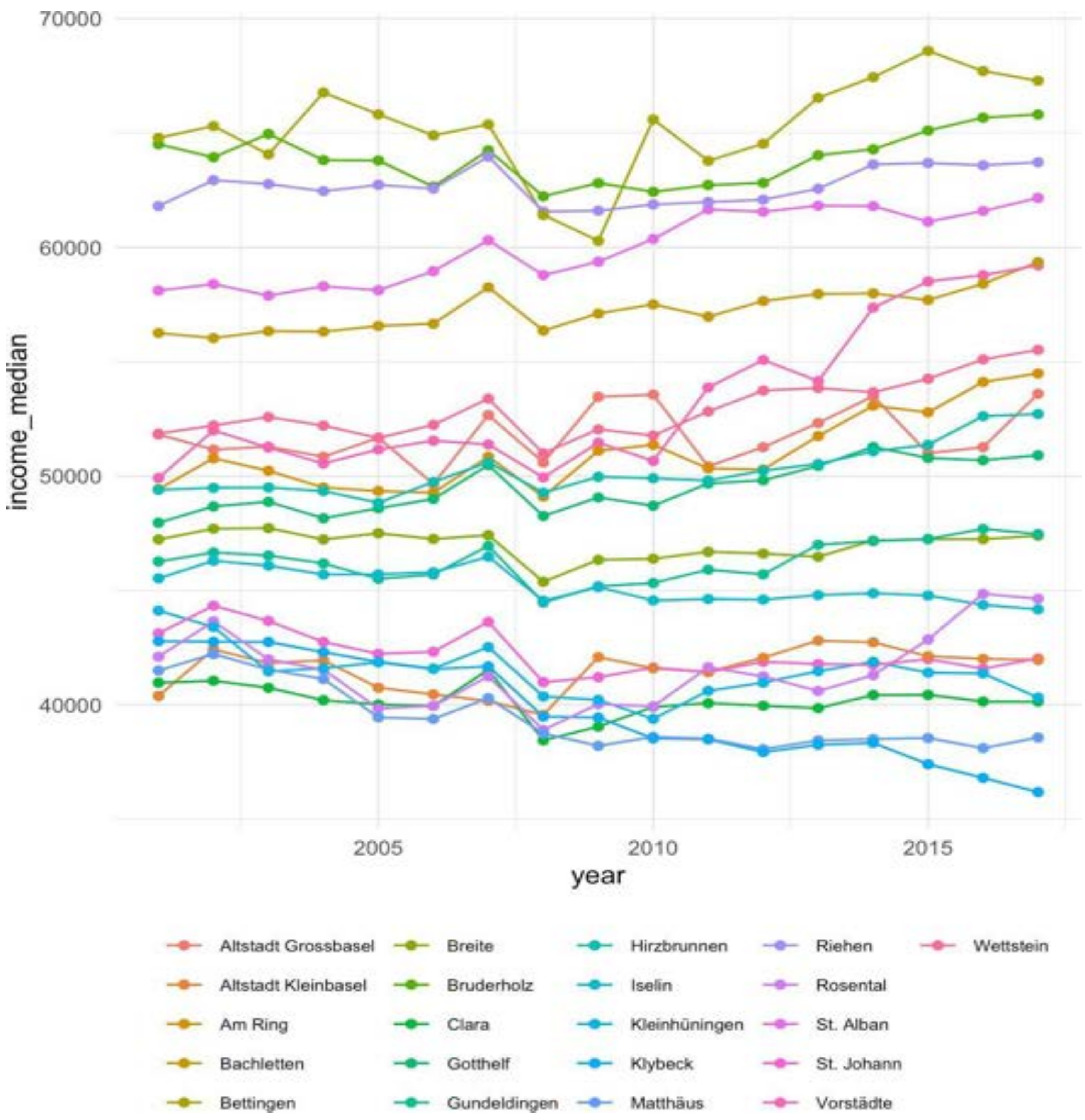
Groups of `scale_*()` functions:

`scale_xy_*` | scales axes

`scale_size_*` | scales sizes

`scale_alpha_*` | scales opacity

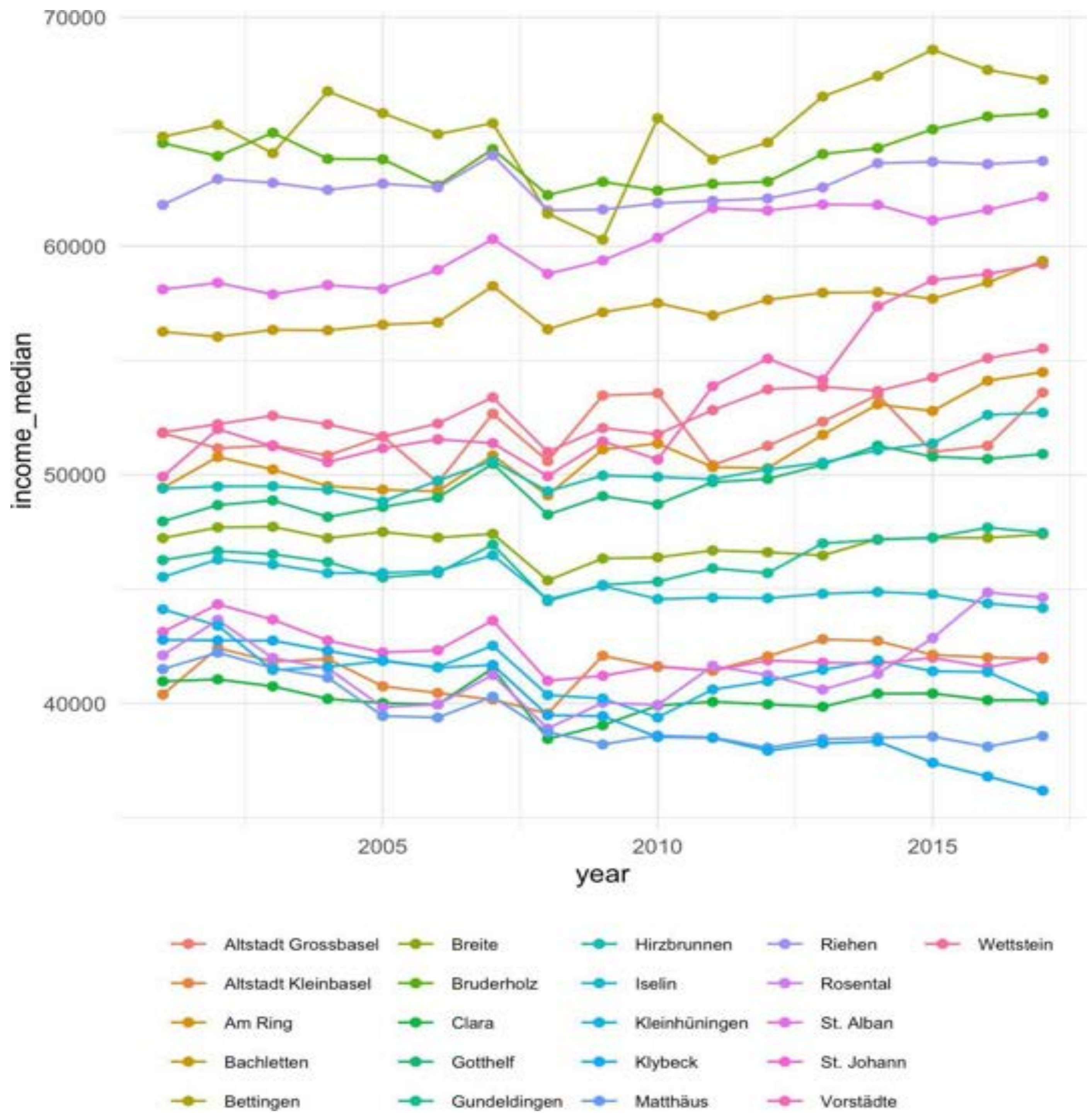
`scale_color_*` | scales colors



scale_*()

`scale_xy_*` can be used to set costum scales

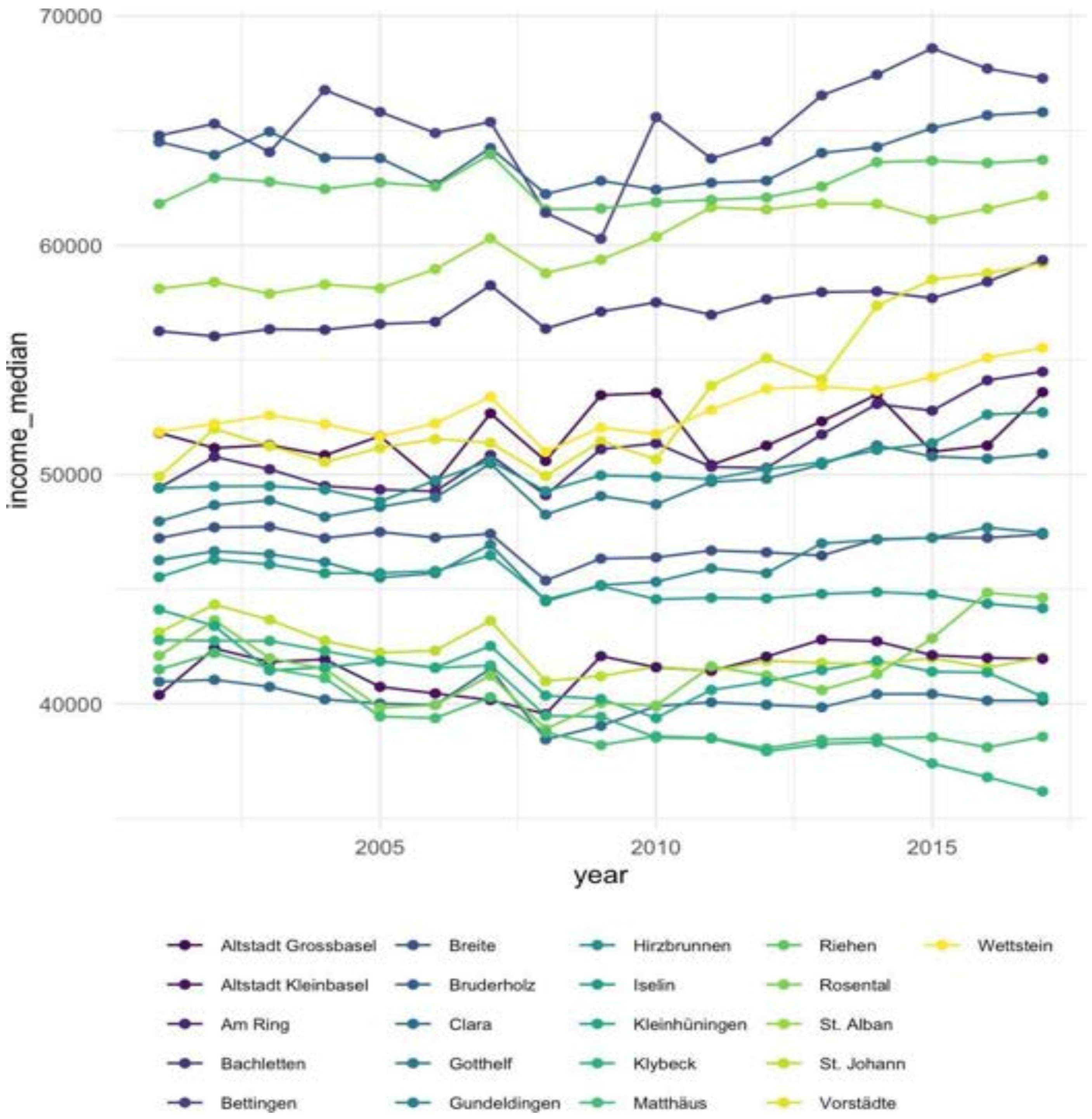
```
# scale_xy

myplot + scale_x_continuous(

  limits = c(2001, 2017),

  breaks = seq (2001, 2017, by = 3))
```



scale_*()

Various `scale_*()` functions permit specification of all **dimensions**, including axes, colors, sizes, etc.

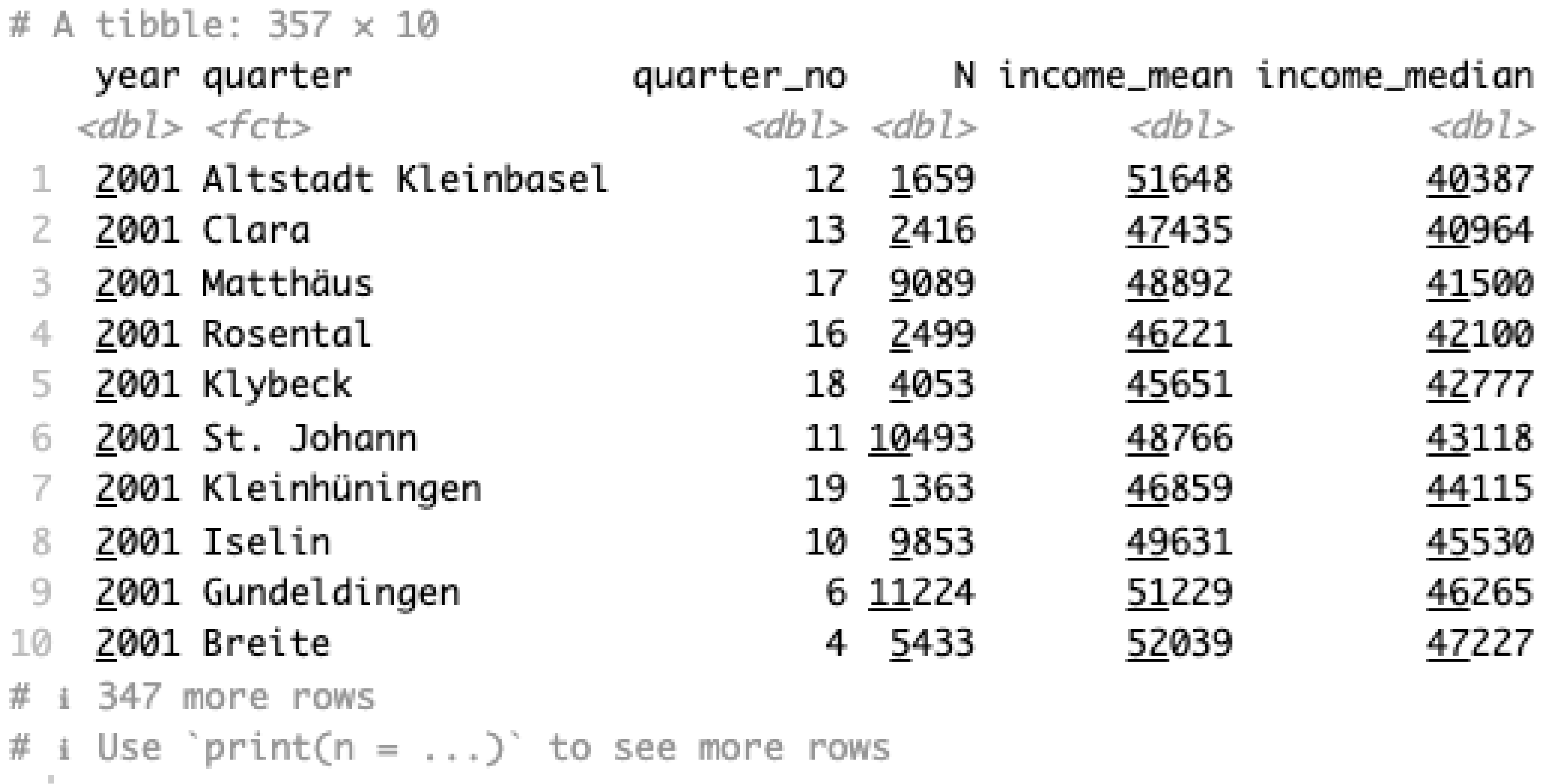
```
# Fixing the legend
my_plot +
 theme_minimal() +
 theme(
  legend.position = "bottom",
  legend.title = element_blank(),
  legend.text = element_text(size=7)+

 # color using viridis
 scale_color_viridis_d()
```



Wrangling

Again, wrangling can help with plotting. The order of discrete variables can be controlled using **factors**.

```
# change data
basel_order <- data %>%

 # factor ordered by income in 2001
 arrange(year, income_median) %>%
 mutate(quarter = as_factor(quarter))

# show data
basel_order
```

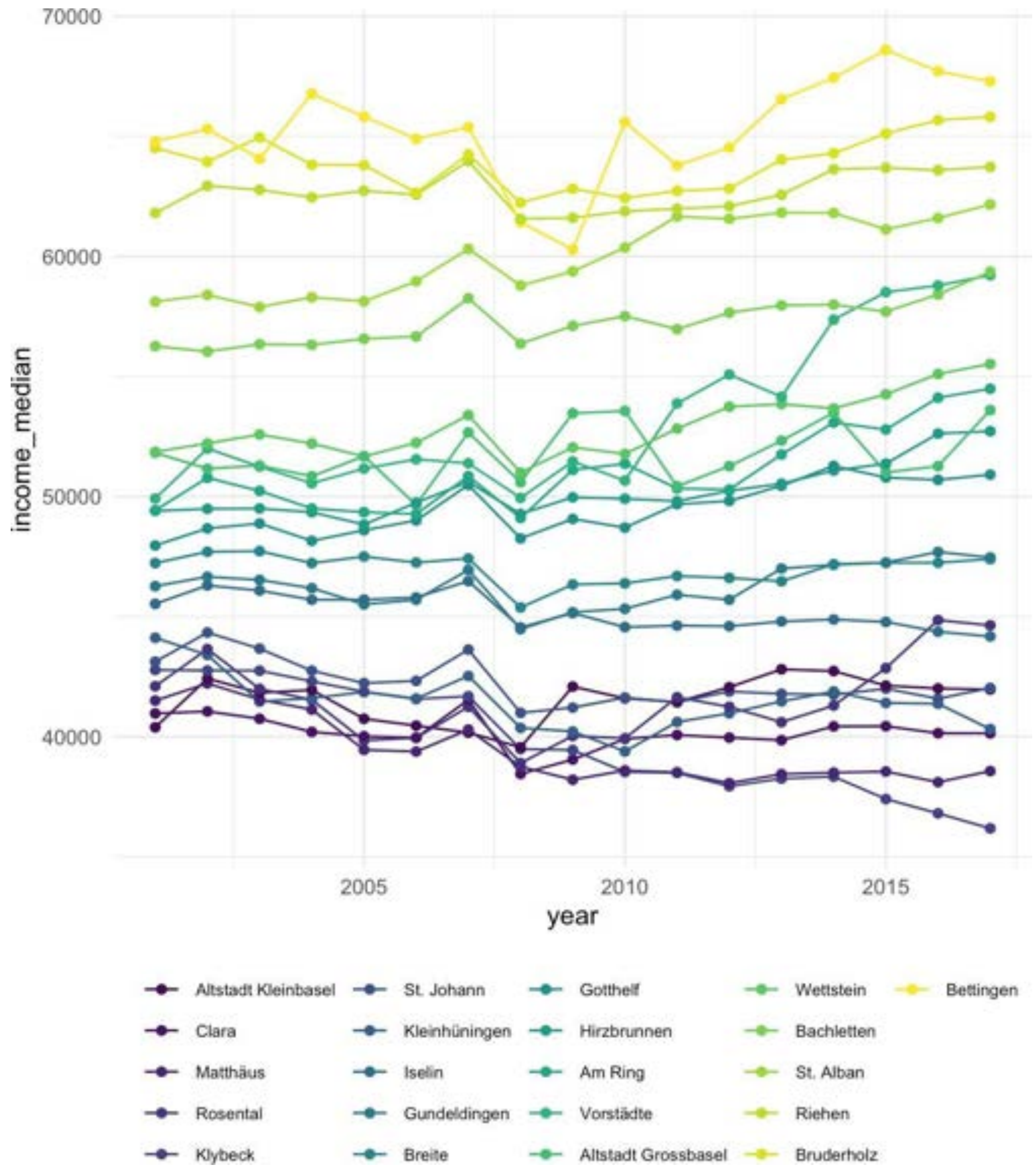


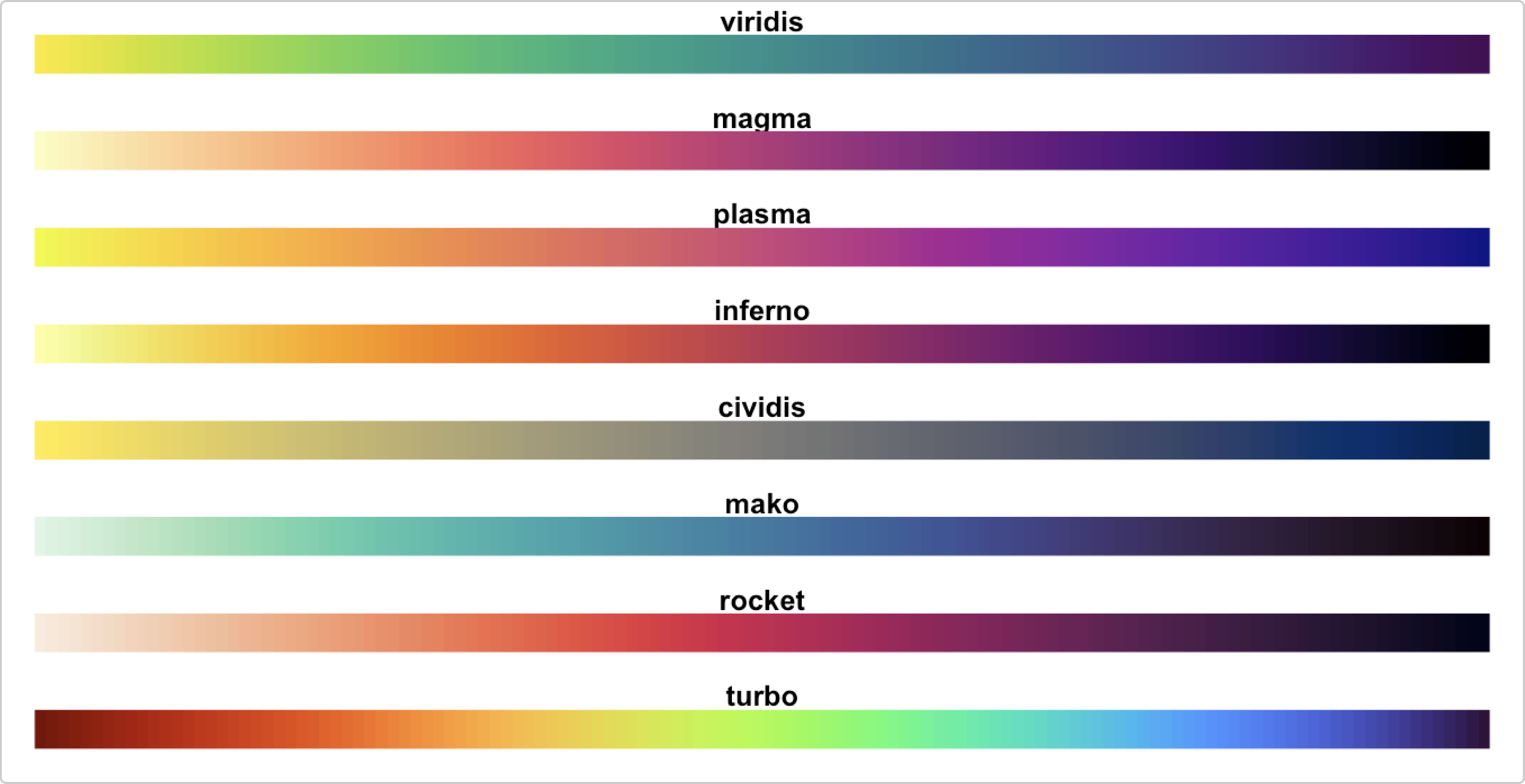
```
# A tibble: 357 × 10
    year quarter              quarter_no     N income_mean income_median
   <dbl> <fct>                     <dbl> <dbl>       <dbl>         <dbl>
 1  2001 Altstadt Kleinbasel          12  1659       51648         40387
 2  2001 Clara                        13  2416       47435         40964
 3  2001 Matthäus                     17  9089       48892         41500
 4  2001 Rosental                     16  2499       46221         42100
 5  2001 Klybeck                      18  4053       45651         42777
 6  2001 St. Johann                   11 10493       48766         43118
 7  2001 Kleinhüningen                19  1363       46859         44115
 8  2001 Iselin                       10  9853       49631         45530
 9  2001 Gundeldingen                  6 11224       51229         46265
10  2001 Breite                        4  5433       52039         47227
# ℹ 347 more rows
# ℹ Use `print(n = ...)` to see more rows
```

Wrangling

Colors are assigned according to the order of factor levels

```
basel_order %>%

  # original code
  ggplot(aes(x = year, y = income_median,
  col = quarter)) +
  geom_line() + geom_point() +
  theme_minimal() +
  theme(legend.position = "bottom",
  legend.title = element_blank(),
  legend.text = element_text(size=7)) +

  # ordered implicitly
  scale_color_viridis_d(option = “viridis")
```

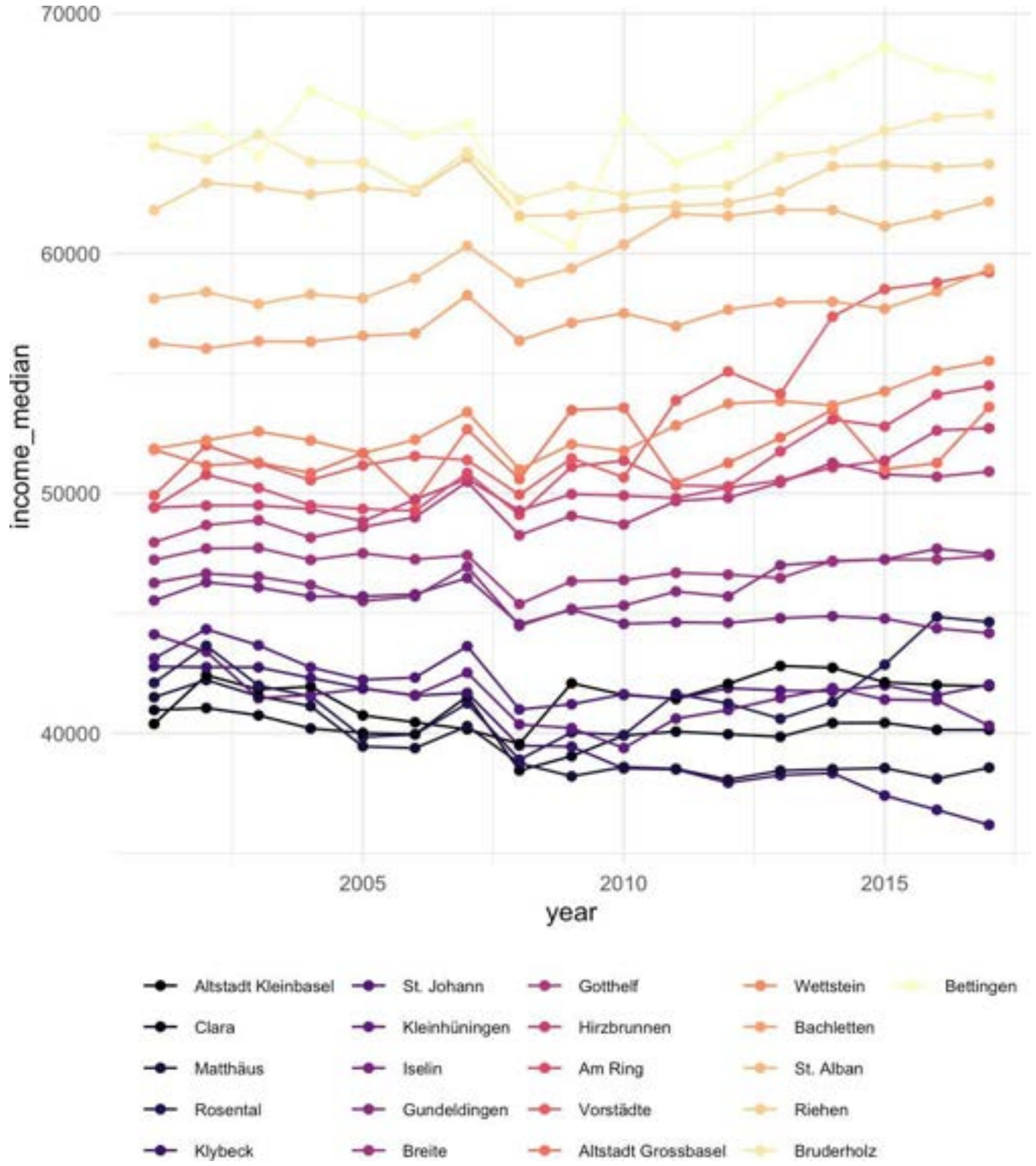



viridis
magma
plasma
inferno
cividis
mako
rocket
turbo

Viridis

`viridis` includes several preset color sets that can **useful for different scenarios**.

```
basel_order %>%

  # original code
  ggplot(aes(x = year, y = income_median,
  col = quarter)) +
  geom_line() + geom_point() +
  theme_minimal() +
  theme(legend.position = "bottom",
  legend.title = element_blank(),
  legend.text = element_text(size=7)) +

  # ordered implicitly
  scale_color_viridis_d (option = “plasma")
```



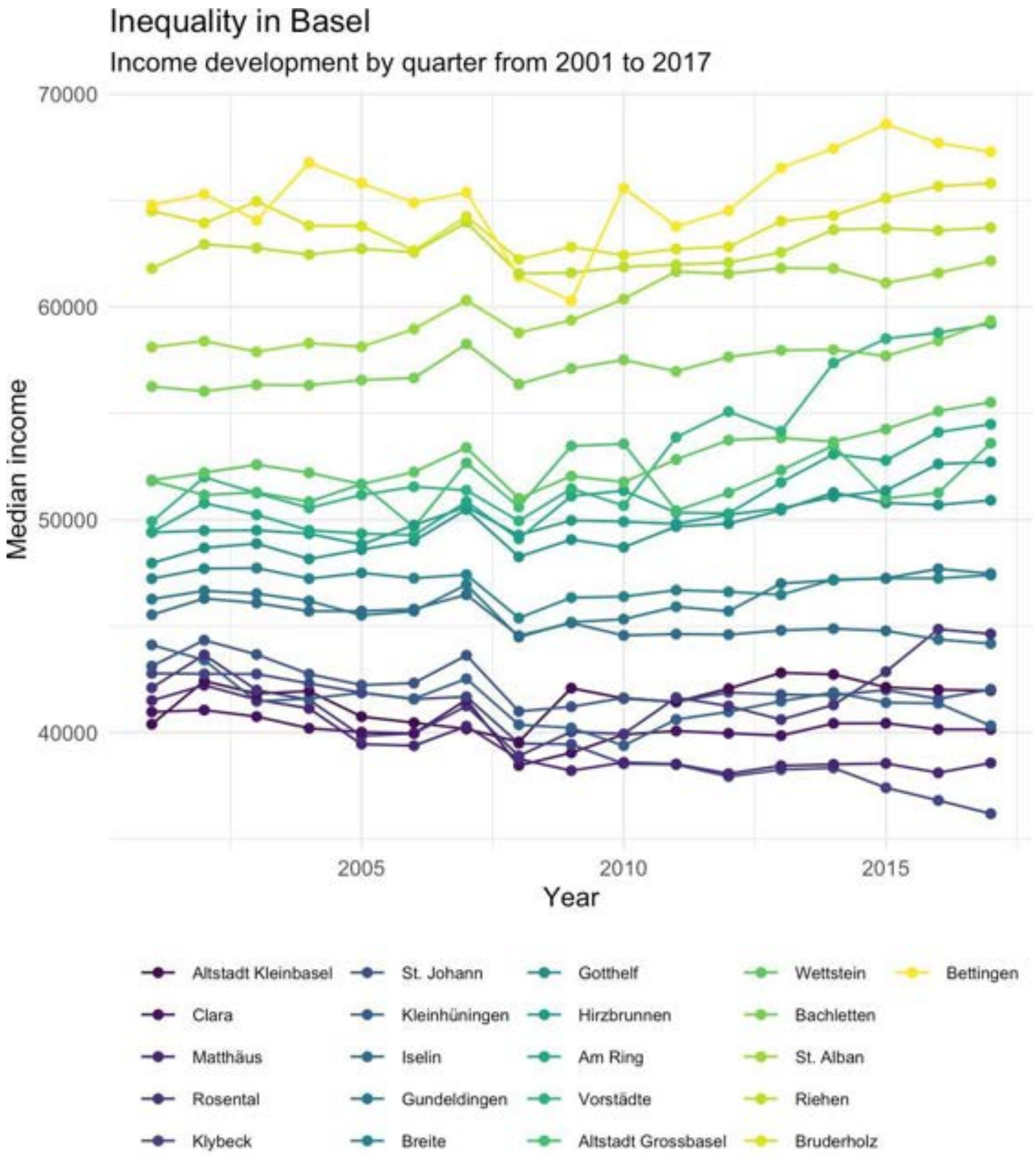
Labs ()

Various annotations can be added using `labs()`.

Key arguments:

- `x,y` | axes
- `title, subtitle` | title and subtitle
- `caption` | caption

```
my_plot +
 labs(x = "Year",
    y = "Median income",
    title = "Inequality in Basel",
    subtitle = "Income development...",
    caption = "Source: Open Data...")
```

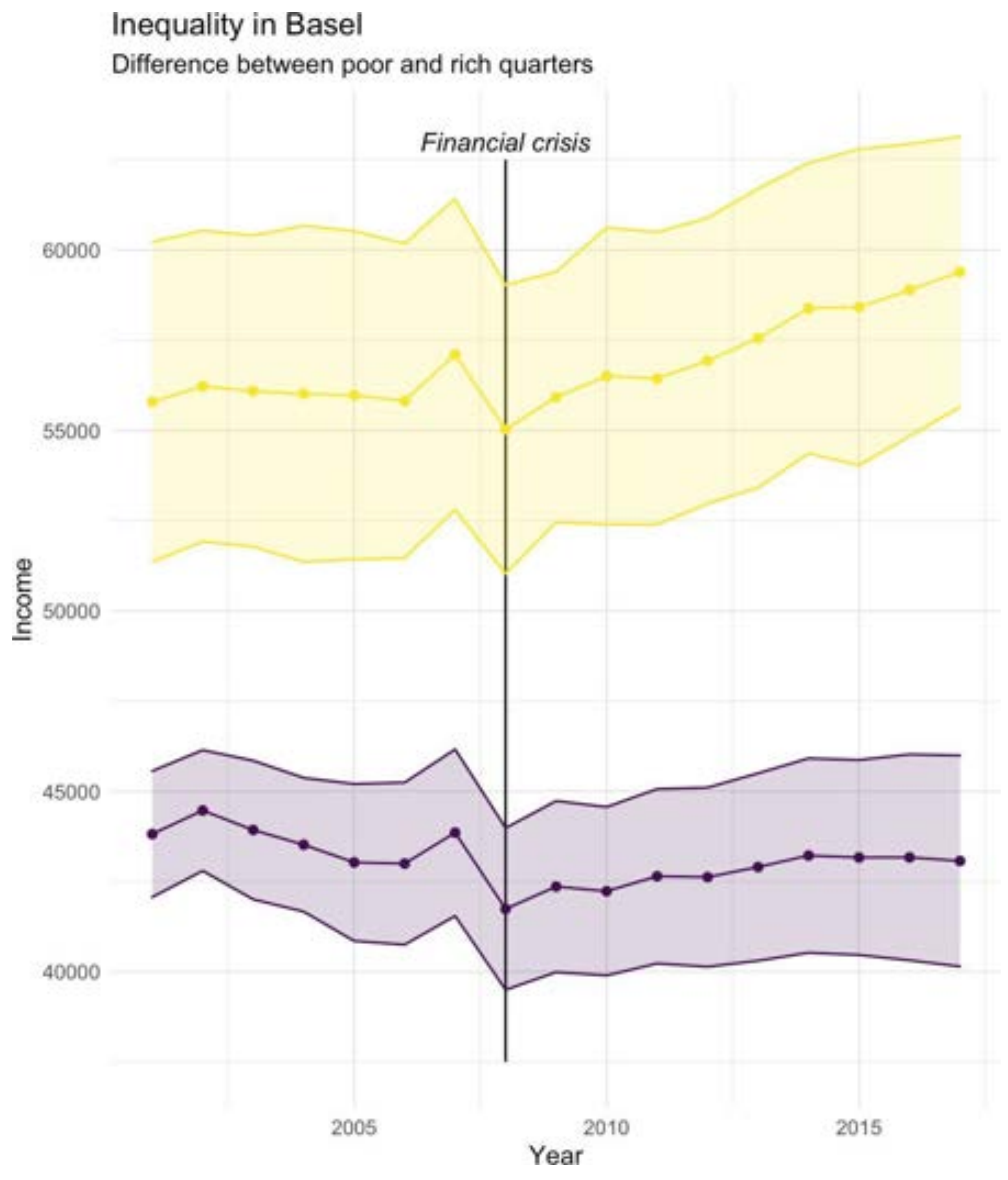


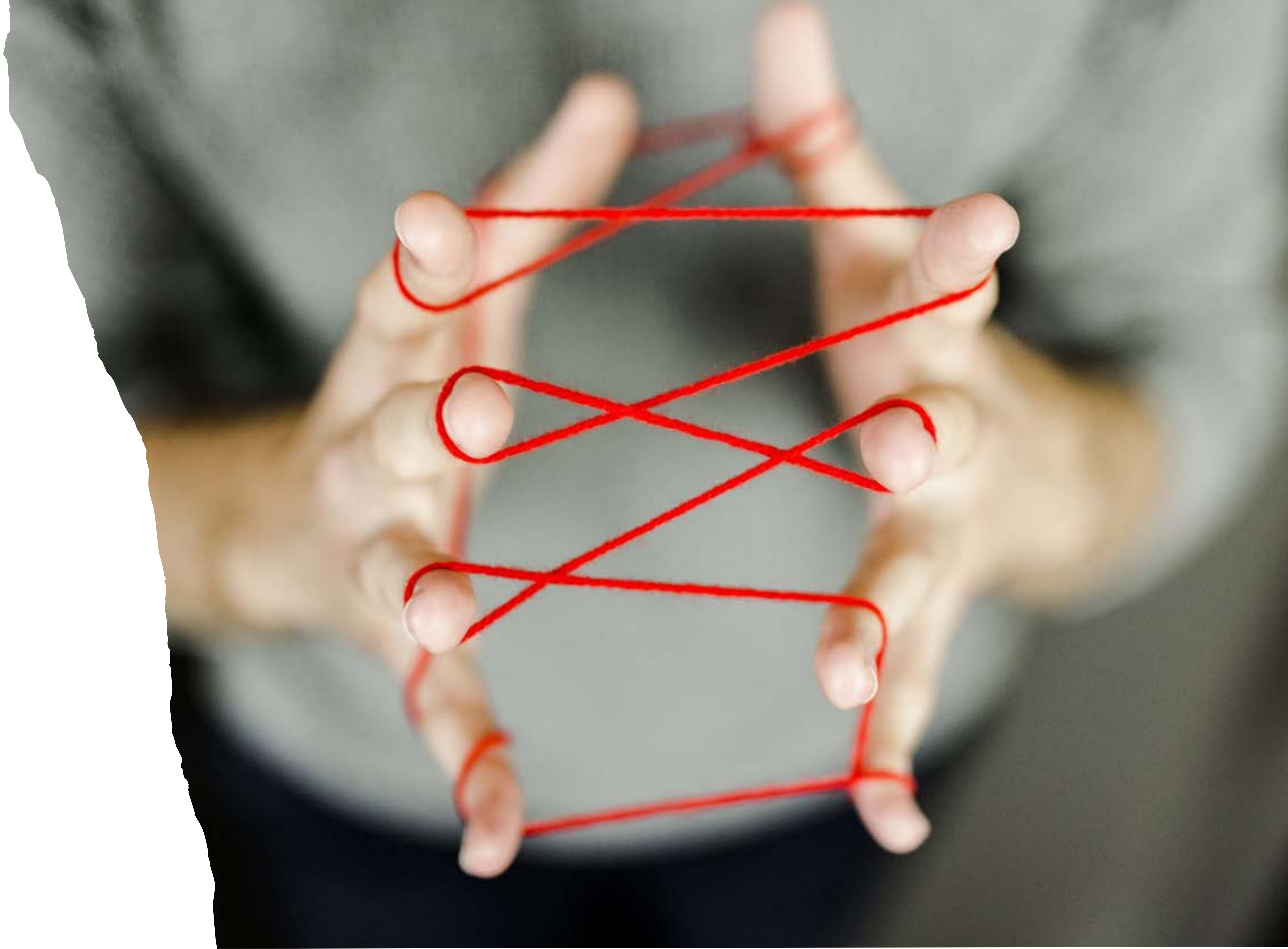
#

annotate ()

`annotate()` can be used to **add any type of plot elements** (layers) using vector specification.

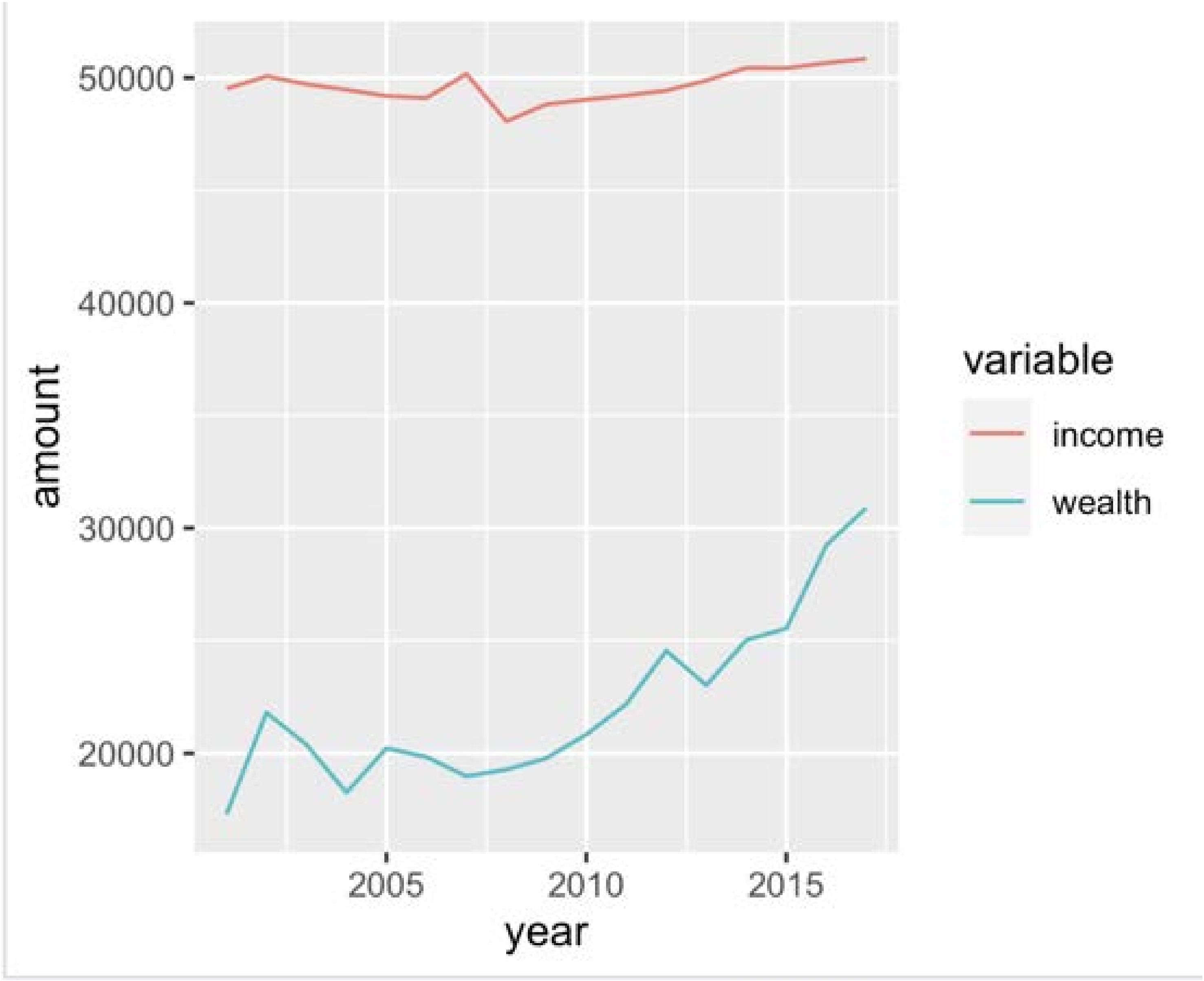
```
... +
 # annotation
   labs(title = "Inequality in Basel",   subtitle =
"Difference between...", x = "Year",
        y = "Income") +
   annotate('line',
            x = 2009, y = c(40000,92000)) +
   annotate('text',
            x = 2005, y = 95000,
            label = "Financial crisis", fontface =
"italic")
```

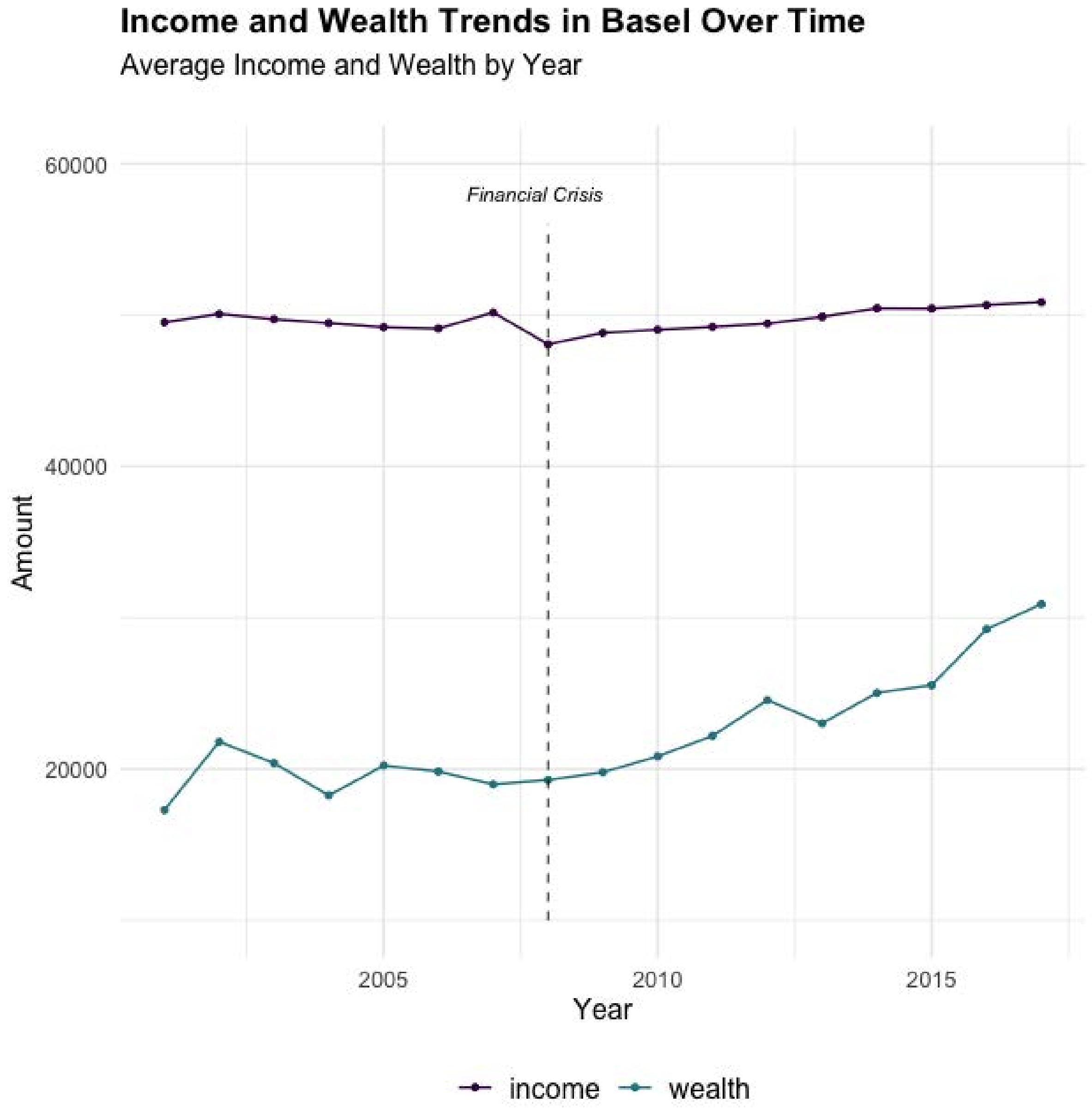




Practice

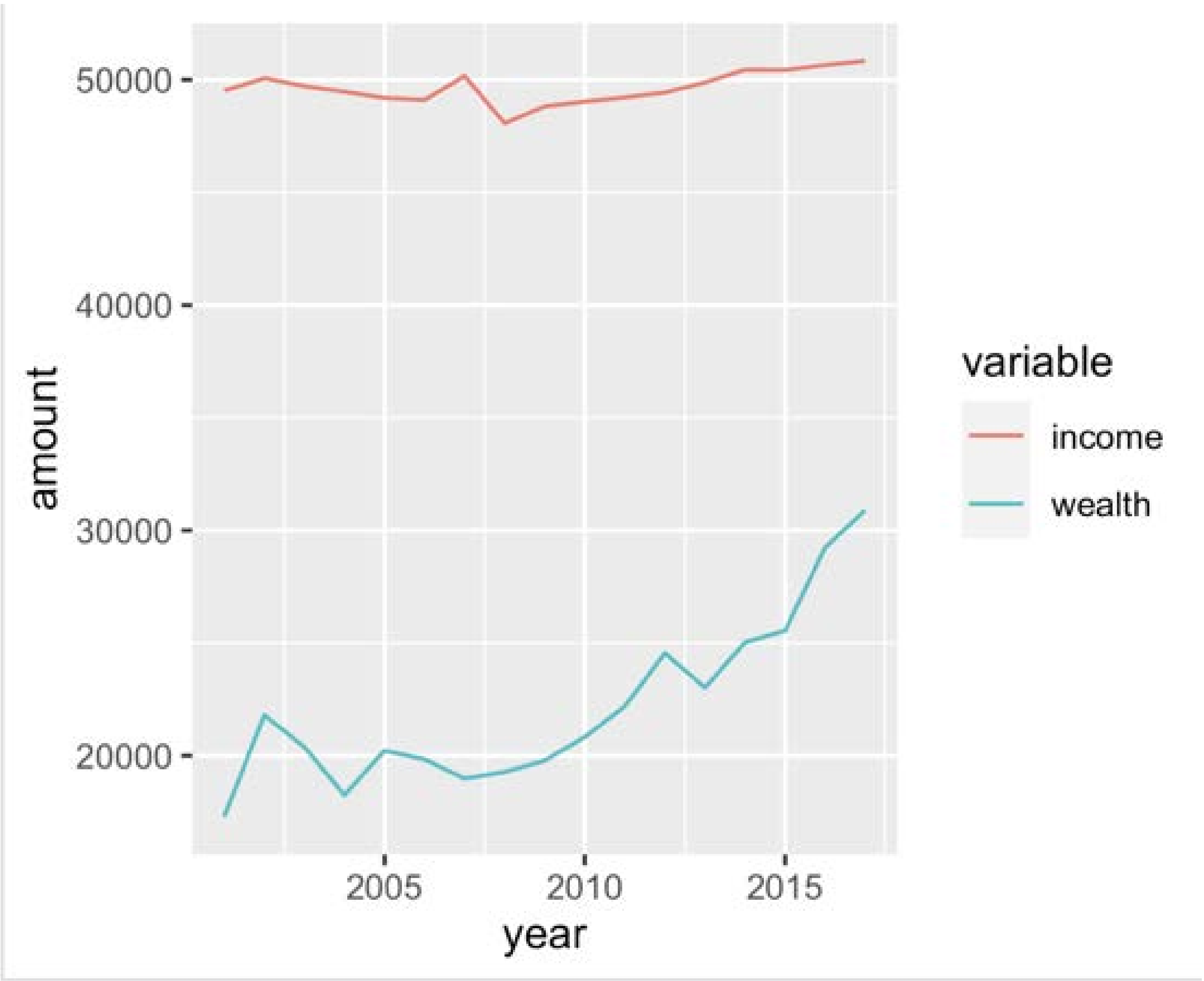
Let´s get from the left plot the rigth one





Practice: https://ggplot2.tidyverse.org/reference/theme.html

```
basel %>%
 group_by(year) %>%
 summarize(income = mean(income_median),
   wealth = mean(wealth_median))  %>%
 pivot_longer(c(income, wealth),
              names_to = "variable",
              values_to = "amount") %>%
 ggplot(aes(x = year, y = amount, color = variable)) +
 geom_line()
```



```
# add points to the lines. Change line size to 0.5 and point size to 1
# assign color #440154" to the data for income and #26828E" to wealth
# Scale the y axes from 10000 to 60000
# add an annotation at x = 2009 to mark the financial crisis
# add a title, a subtitle and insert meaningful axis titles
# attach theme_minimal to the plot
# create margins on each side of the plot
# make the title of the plot bold and create a margin between the subtitle and the plot
# place the legend at the bottom of the plot, remove the legend title
and set the font size to 12
```

```
# Add standard errors to the lines
```

Exam Questions

- If I were to give you a line of code, could you select the correct answer explaining what the code does?