Understanding text size and resolution in ggplot2

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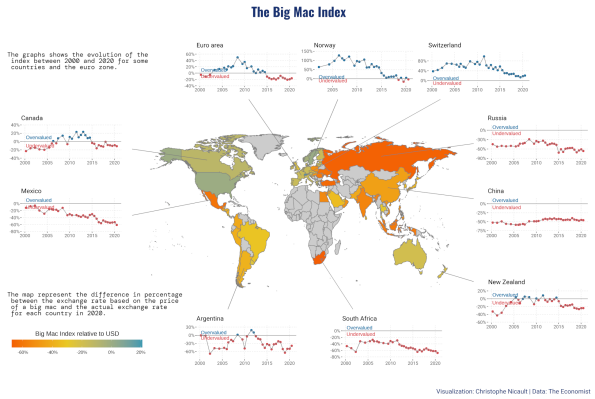
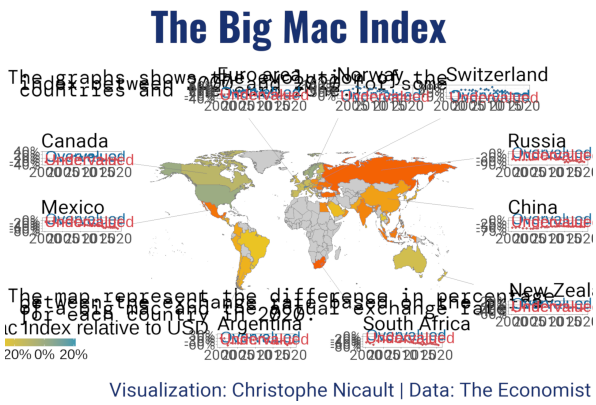
What's complicated about size and resolution ?

Have you ever tried to reproduce a plot like the first one and make minor changes on the size or resolution and end up with something like the second plot ? If yes, stay with me, this is the situation we're going to understand in this article.





There are several things to notice :

- Obviously the font size is not the same and is a lot bigger.
- The map is a bit smaller, but still looks ok.
- The different graphs seem to be crushed, their width are the same, but not their height. In fact they seem to take the same place overall (title and axis text included) but as the font is bigger, there is less room for the graph.
- The legend doesn't fit anymore, and is clipped.

So we're going to see what the problem is, when it occurs, how to solve it, and more importantly how to avoid it.

Screen and image file

First let's review some basic concepts.

Screen dimension and resolution

A screen is basically a matrix of pixels, which is the smallest element that can be displayed.

If we look at the physical dimension, my screen has a diagonal of 24 inches, with a ratio of 16/10, which is 20 x 12.5 inches.

The resolution is 1920 x 1200, my screen is a matrix of 1920 pixels width and 1200 pixels height. The number of pixels per inch is 96 (ppi).

Now we can make some calculation, everything matches :

- width : 1920 (px) / 96 (px/in) = 20 inches
- height: 1200 (px) / 96 (px/in) = 12.5 inches

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- ratio: 1920/1200 = 20/12.5 = 16/10

Image files dimension and resolution

The image saved on a disk is represented also as a matrix of dots. ggplot and ggsave works in physical dimension (in, cm, or mm). To go from the dimension in inches to a number of dots, ggsave uses the number of dots per inches (dpi).

So if we create a plot in ggplot and save it with a dimension of 12 x 10 with the default dpi of 300 for ggsave, the file will be a matrix of (12 * 300) x (10 * 300) = 3600 x 3000 dots.

Now if you open that file on your computer, each dots represent a pixel, which means that the image has a resolution of 3600 x 3000 px.

The relation is : (size in inches) = (screen size in pixel) / PPI or (screen size in pixel) = DPI * (size in inches)

Let's experiment it

We're going to make a small experiment to understand the relation between the screen resolution and the size when saving a plot.

Let say your screen resolution is 1920*1200, the default device is almost taking all screen. The DPI for my screen is 96, so when saving to disk, we can expect the file to be saved with a dimension of 20 x 12.5 inches.

Let's check it out :

First load the libraries and the data

```
library(ggplot2)
library(dplyr)
library(palmerpenguins)
theme_set(theme_bw())
```

Then open a new graphic device with x11() (or quartz(), or windows() depending on your system) with a dimension of 1920 x 1200.

```
x11()
```

Then run the following code, to create a simple plot and save it to disk.

```
plt <- penguins %>%
  ggplot(aes(bill_length_mm, bill_depth_mm, color = species)) +
  geom_point()

ggsave("test.png")),
       plot = plt, dpi = 300)

dev.off()
```

You can see that the plot is saved with a size of 20 x 11.7 inches, which is the dimension of the screen (minus the window's menu bar) divided by the default screen DPI of 96 as expected.

```
Saving 20 x 11.7 in image
```

the size dimension in pixel is different.

Why does it matter for the original problem ?

It matters because some elements of the plot adjusts to the space available, and some are fixed and measured in their real dimension (mm, inches) such as the fonts, creating a distortion when changing the dimension of the plot or its resolution.

The font problem

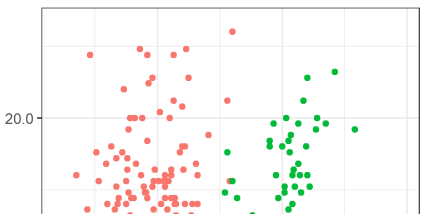
Before continuing, make sure that the window we opened previously is closed.

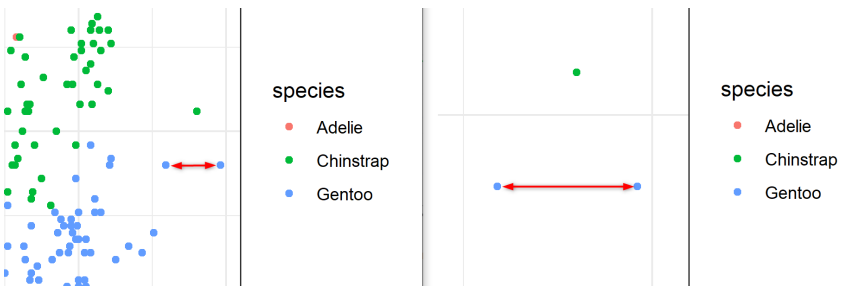
Saving in different dimensions, the plot itself will adapt and use the full size. So for the previous plot, if we save it with 5x5 or 10x10, it works, the two plot will still look very similar

```
ggsave("font_test1_5x5_300.png", plot = plt, width = 5, height = 5, units = "in", dpi = 300)

ggsave("font_test1_10x10_300.png", plot = plt, width = 10, height = 10, units = "in", dpi = 300)
```

But we can notice that the size of the point and the size of the font looks smaller in the second one.




species
Adelie
Chinstrap
Gentoo
species
Adelie
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