



Part V - Base graphics in R (some tips)

the base function to create graphics is `plot()` it simply creates a Cartesian plane where you can plot your data.

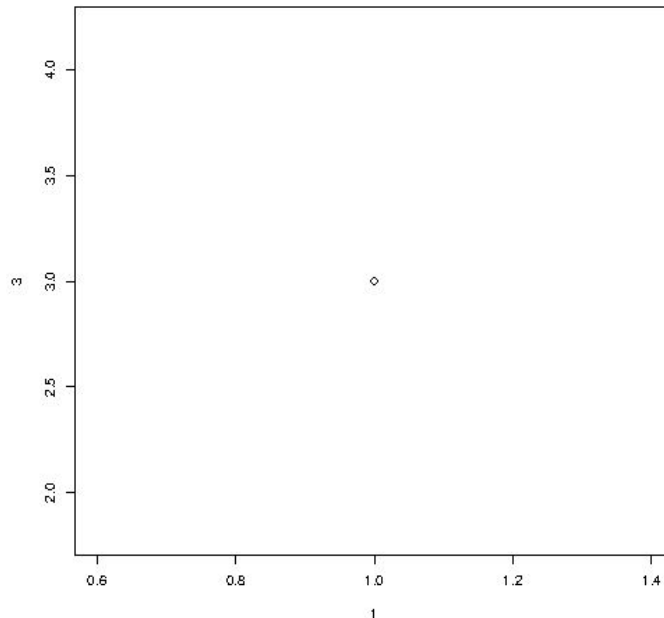
```
>plot(1,3)
```

or

```
>plot(x,y)
```

EXERCISE:

Substitute `x` and `y` with `colname_2` and `colname_3` vectors from the *df* object.

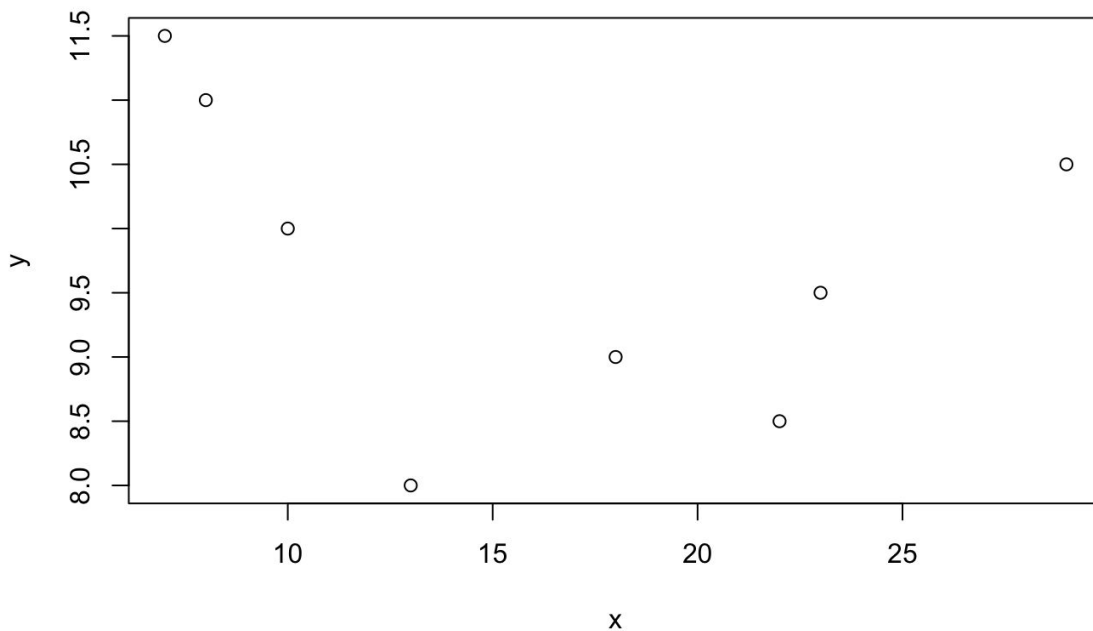




Base graphics in R

Exercise Solution:

```
> x = df$colname_2  
> y = df$colname_3  
> plot(x,y)
```

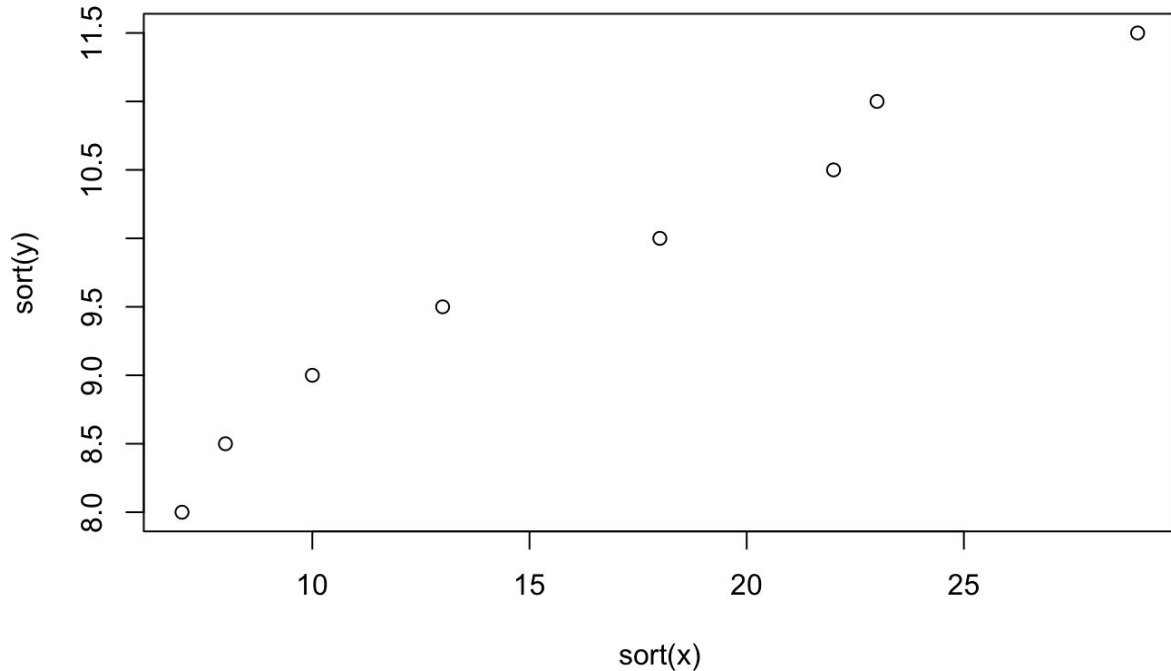




Base graphics in R

you can modify vectors directly before plotting to ameliorate the graphical output

```
> plot(sort(y)~sort(x))
```

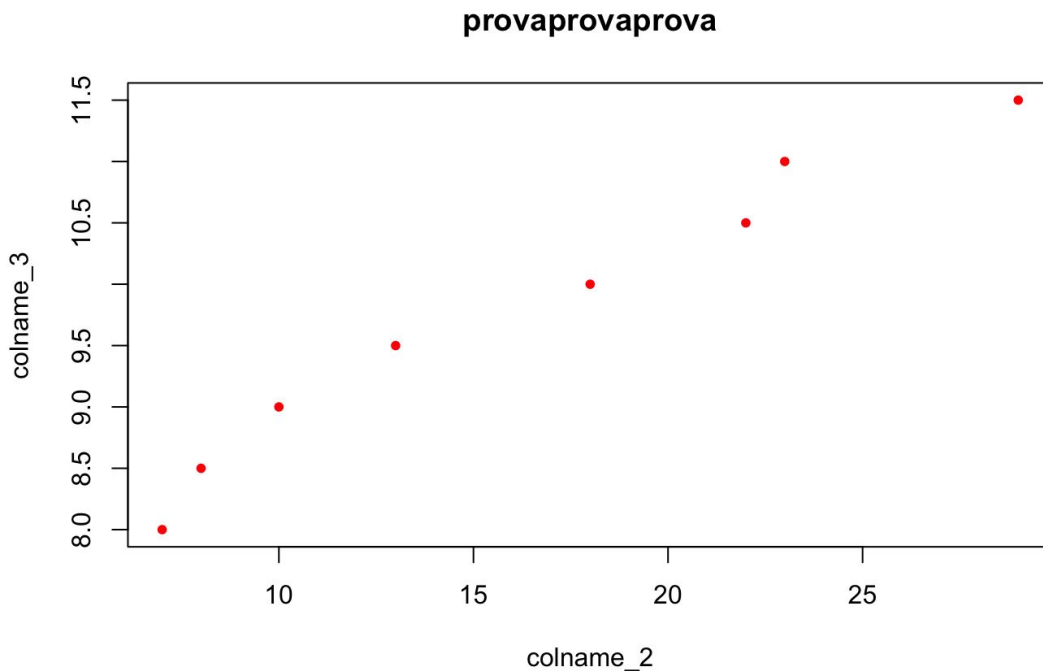




Base graphics in R

Plots can be modified in many different ways (most of Radvance program)

```
> plot(sort(y)~sort(x),  
       col = "red",  
       pch = 20,  
       main = "provaprova",  
       ylab = "colname_3",  
       xlab = "colname_2")
```

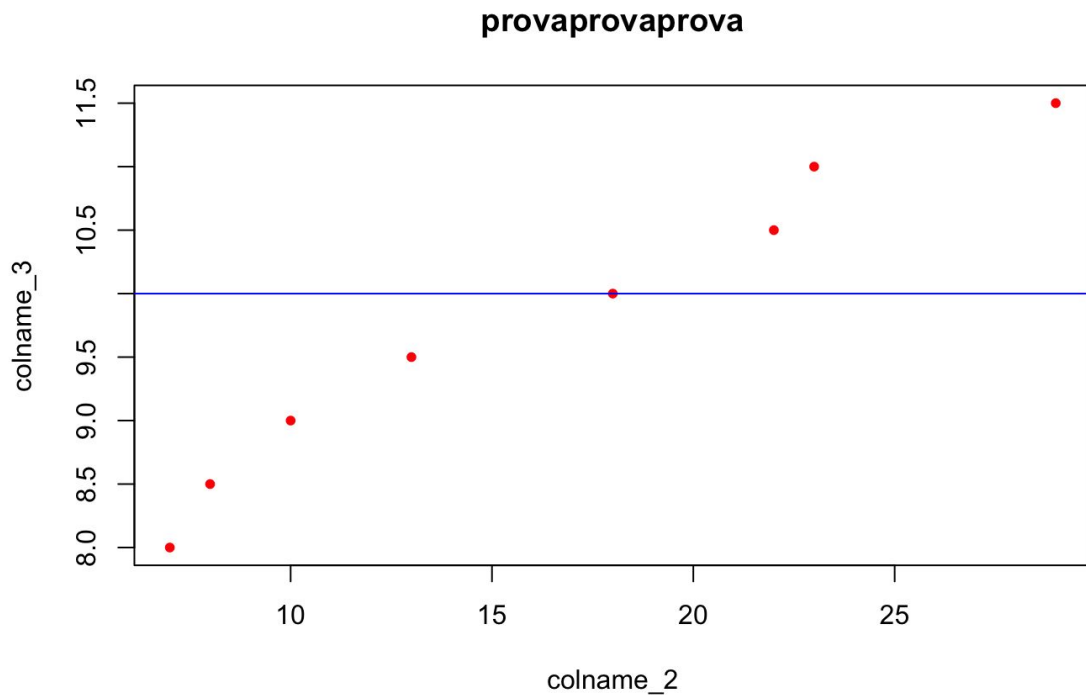




Base graphics in R

`plots()` is a canvas on which you can draw secondary elements, such as lines and legends

```
> plot(sort(y)~sort(x),  
       col = "red",  
       pch = 20,  
       main = "provaprova",  
       ylab = "colname_3",  
       xlab = "colname_2")  
  
> abline(10,0, color = "blue")
```



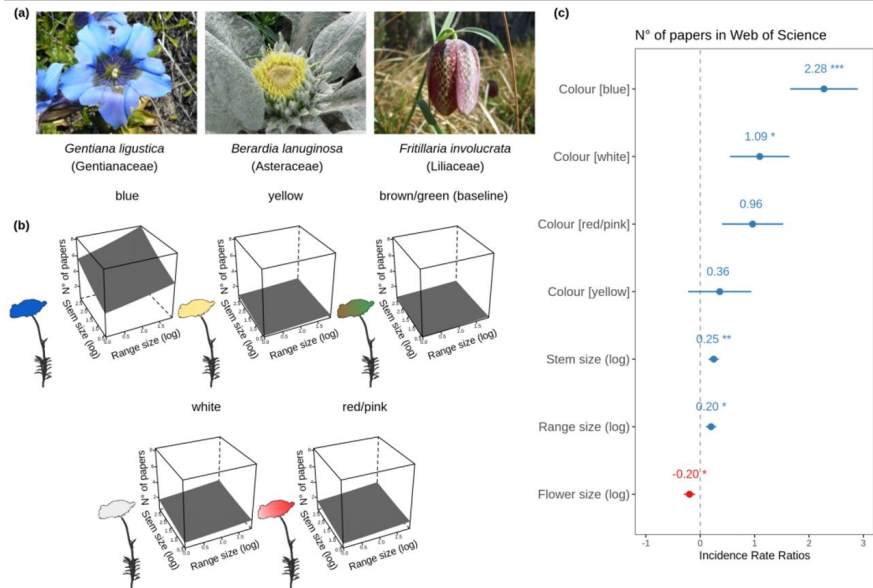
benefits of scientific graphics in R

PROS

1. **Understanding:** steep learning curve
2. **Efficiency:** display different information in small space.
3. **Location:** it integrates mapping directly in graphs
4. **Cost:** R is free country to many other graphic tools

CONS

1. **Time:** especially first times could be time-consuming
2. **Distraction:** you can build complex and fancy graphics-rich reports and charts, focusing more on the form than the function.



graphical notes for scientific data plotting

RULES

INTUITIVENESS

Use intuitive colors. When choosing them, consider what associations do they evoke. If possible, use colors that audience will associate with your data anyway.



MODERATION

Use colors in moderation. For a simple dataset, a single color is preferable. Use color as a strategic tool to highlight the important parts of your visual.



CONSISTENCY

Use colors consistently. Change colors if you want your audience to feel the change for the specific reason, but never simply for the sake of novelty.



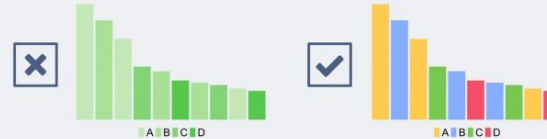
CLARITY

Use colors to make the data easier to read. Make sure your audience will be able to distinguish between the items shown in the visualization.



CLASSIFICATION

Don't use a gradient color palette for categories. And the other way round - different colors for same measurement.



EXPLAINABILITY

Make sure to explain to your audience what exactly used colors mean. Remember to create a color key.



Easy/natural
color
associations

Use as few
colors as you
can

Use the same
color for the
same object
through the
whole report

Each part
should be easy
readable

No gradients
for categories

Legends are
gold as well as
measure units

COLOR PALETTES

QUANTITATIVE DATA - SEQUENTIAL OR DIVERGING COLORS

Color is used to show variations in the data. The palette contains a sequence of colors that clearly indicate which values are larger or smaller than which other ones (sequential scale). It can also visualize the deviation of data values in one of two directions relative to a neutral midpoint (diverging scale). Diverging scale can be viewed as two merged sequential scales.



CATEGORICAL DATA - QUALITATIVE COLORS

Color is used to separate areas into distinct categories. The palette should consist of colors as distinct from one another as possible. The maximum number of categories that can be displayed is about 12 (practically speaking, probably fewer).



All examples are available in Seaborn library. Check also: medialab.github.io/iwanthue/

USAGE GUIDELINES



Colors are useful make your graphs readable, but they must be used in a “correct way”

Journals are increasingly asking for **color-blind** readable figures because ~8% of the global population is affected by colorblindness (mainly males)

there are many packages to create palettes on R:

the most famous = [RColorBrewer](https://rcolorbrewer.github.io/)

the most complete = [paletteer](https://github.com/mbauman/paletteer)

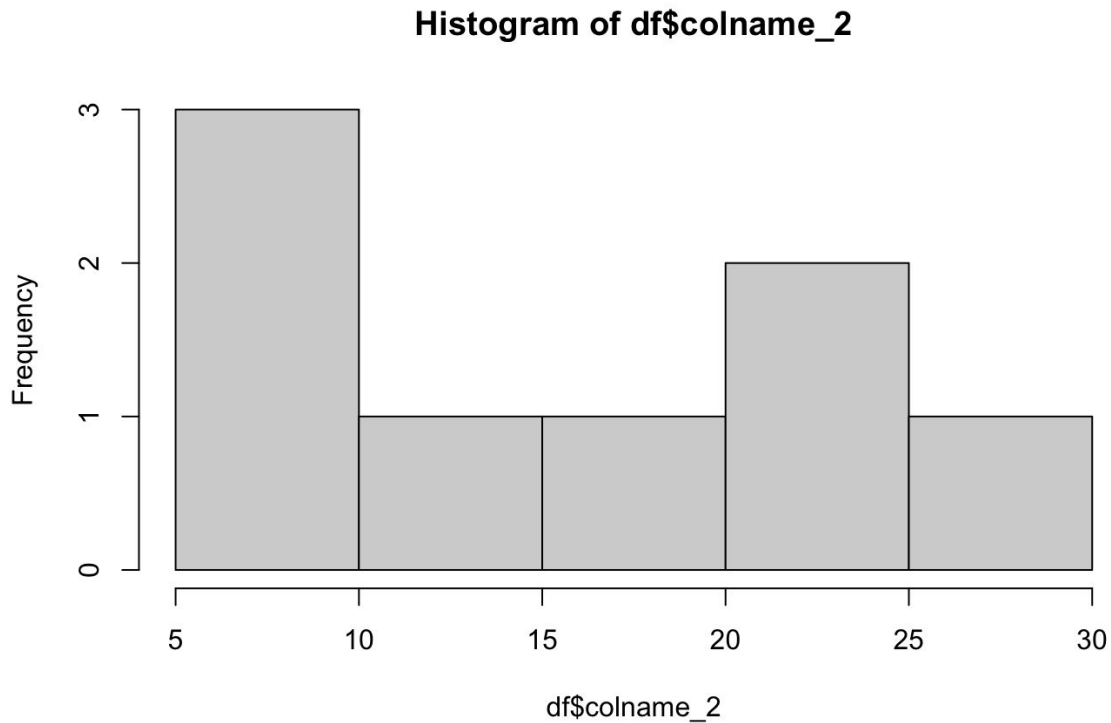
Additionally to colors there are shadings, line styles, point styles



main base graph functions - histograms

hist() is useful for visualize frequencies

```
> hist(df$colname_2)
```





main base graph functions - scatterplots

we already saw these guys before with the `plot()` function!



main base graph functions - boxplots

```
> str(df)

'data.frame': 8 obs. of 3 variables:
 $ colname_1: chr  "A" "A" "B" "B" ...
 $ colname_2: int   13 22 18 23 10 29 8 7
 $ colname_3: num    8 8.5 9 9.5 10 10.5 11 11.5
```

Boxplots are useful to see a variable response to a specific factor ... than you need to verify that you actually have a factor!



main base graph functions - boxplots

```
> boxplot(df$colname_2 ~ as.factor(df$colname_1), main = "box1")
```

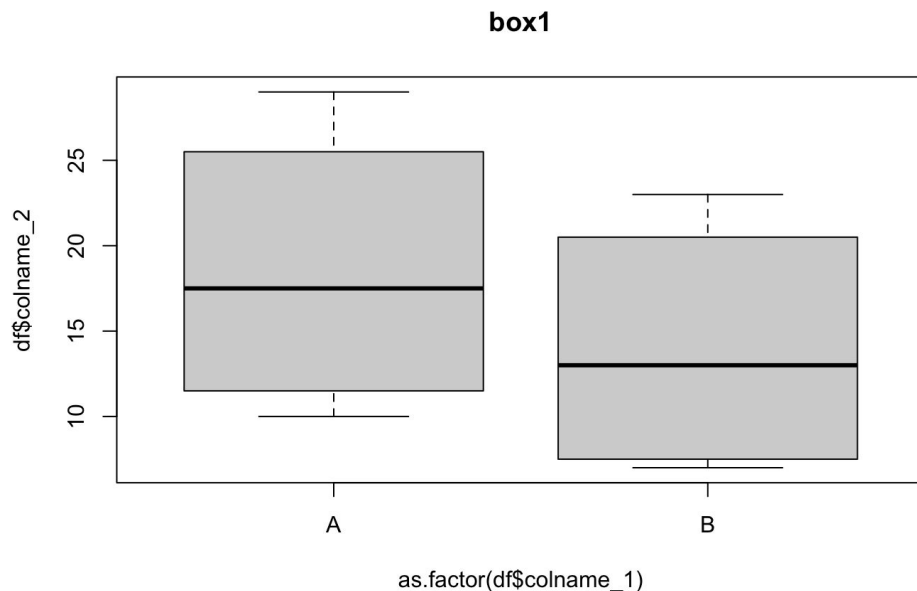
Factors must be in the second argument

you can see multiple plots using the function

```
> par(mfrow=c(plots x row,plots x col))
```

Exercise:

Visualize the two possible boxplot from df
in a single image.

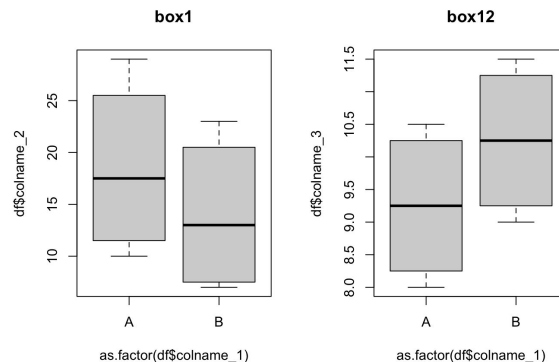




main base graph functions - boxplots

Solution:

```
> par(mfrow=c(1,2))  
  
> boxplot(df$colname_2 ~ as.factor(df$colname_1), main = "box1")  
  
> boxplot(df$colname_3 ~ as.factor(df$colname_1), main = "box2")
```





Saving figures

Find your-own way, but remember that:

- export tool from Rstudio depends on the resolution of your screen.
- figure sizes will depend from the plot window size (by default in Rstudio)
- you can avoid this steps saving images by using the command line (specific functions)
- journals want high resolutions figures (usually 300 dpi), exporting *.pdf figures you save vectorial figures corresponding to infinite dpi!
- post-edit figure as few as you can
- post-edit figures with appropriate softwares (NO POWERPOINT WTF!)



PhD Toolbox - Get ready for Stream 2!

- Working with **lists**
- More advanced stuff on graphics (**ggplot2**)
- composite graphs panels (**gridExtra**, ...)
- Exporting figures
- **Plotting Maps using R**

Aula 1

Tuesday March 7	h 9-13	(sede di Viale Mattioli 25 - Botanical Garden)
Wednesday March 8	h 9-13	(sede di Viale Mattioli 25 - Botanical Garden)
Friday March 19	h 9-13	(sede di Viale Mattioli 25 - Botanical Garden)