Base R
Cheat Sheet

Getting Help

Accessing the help files

?mean
Get help of a particular function.

help.search(‘weighted mean’)
Search the help files for a word or phrase.

help(package = ‘dplyr’)
Find help for a package.

More about an object

str(iris)
Get a summary of an object’s structure.

class(iris)
Find the class an object belongs to.

Using Packages

install.packages(‘dplyr’)
Download and install a package from CRAN.

library(dplyr)
Load the package into the session, making all its functions available to use.

dplyr::select
Use a particular function from a package.

data(iris)
Load a built-in dataset into the environment.

Working Directory

getwd()
Find the current working directory (where inputs are found and outputs are sent).

setwd(‘C://file/path’)
Change the current working directory.

Use projects in RStudio to set the working directory to the folder you are working in.

Vectors

Creating Vectors

`c(2, 4, 6)`	`2 4 6`	Join elements into a vector
`2:6`	`2 3 4 5 6`	An integer sequence
`seq(2, 3, by=0.5)`	`2.0 2.5 3.0`	A complex sequence
`rep(1:2, times=3)`	`1 2 1 2 1 2`	Repeat a vector
`rep(1:2, each=3)`	`1 1 1 2 2 2`	Repeat elements of a vector

Vector Functions

sort(x)
Return x sorted.

table(x)
See counts of values.

rev(x)
Return x reversed.

unique(x)
See unique values.

Selecting Vector Elements

By Position

`x[4]`	The fourth element.
`x[-4]`	All but the fourth.
`x[2:4]`	Elements two to four.
`x[-(2:4)]`	All elements except two to four.
`x[c(1, 5)]`	Elements one and five.

By Value

`x[x == 10]`	Elements which are equal to 10.
`x[x < 0]`	All elements less than zero.
`x[x %in% c(1, 2, 5)]`	Elements in the set 1, 2, 5.

Named Vectors

`x[‘apple’]`	Element with name ‘apple’.

Programming

For Loop

```
for (variable in sequence){
   Do something
}
```

Example

```
for (i in 1:4){
   j <- i + 10
   print(j)
}
```

While Loop

```
while (condition){
   Do something
}
```

Example

```
while (i < 5){
   print(i)
   i <- i + 1
}
```

If Statements

```
if (condition){
   Do something
} else {
   Do something different
}
```

Example

```
if (i > 3){
   print(‘Yes’)
} else {
   print(‘No’)
}
```

Functions

```
function_name <- function(var){
   Do something
   return(new_variable)
}
```

Example

```
square <- function(x){
   squared <- x*x
   return(squared)
}
```

Reading and Writing Data

Also see the **readr** package.

Input	Ouput	Description
`df <- read.table(‘file.txt’)`	`write.table(df, ‘file.txt’)`	Read and write a delimited text file.
`df <- read.csv(‘file.csv’)`	`write.csv(df, ‘file.csv’)`	Read and write a comma separated value file. This is a special case of read.table/ write.table.
`load(‘file.RData’)`	`save(df, file = ’file.Rdata’)`	Read and write an R data file, a file type special for R.

Conditions

`a == b`	Are equal	`a > b`	Greater than	`a >= b`	Greater than or equal to	`is.na(a)`	Is missing
`a != b`	Not equal	`a < b`	Less than	`a <= b`	Less than or equal to	`is.null(a)`	Is null

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Types

Converting between common data types in R. Can always go from a higher value in the table to a lower value.

`as.logical`	`TRUE, FALSE, TRUE`	Boolean values (TRUE or FALSE).
`as.numeric`	`1, 0, 1`	Integers or floating point numbers.
`as.character`	`'1', '0', '1'`	Character strings. Generally preferred to factors.

`as.factor`	`'1', '0', '1',`
	`levels: '1', '0'`
		Character strings with preset levels. Needed for some statistical models.

Maths Functions

`log(x)`	Natural log.	`sum(x)`	Sum.
`exp(x)`	Exponential.	`mean(x)`	Mean.
`max(x)`	Largest element.	`median(x)`	Median.
`min(x)`	Smallest element.	`quantile(x)`	Percentage quantiles.
`round(x, n)`	Round to n decimal places.	`rank(x)`	Rank of elements.
`signif(x, n)`	Round to n significant figures.	`var(x)`	The variance.
`cor(x, y)`	Correlation.	`sd(x)`	The standard deviation.

Variable Assignment

```
> a <- 'apple'
> a
[1] 'apple'
```

The Environment

`ls()`	List all variables in the environment.
`rm(x)`	Remove x from the environment.
`rm(list = ls())`	Remove all variables from the environment.

You can use the environment panel in RStudio to browse variables in your environment.

Matrices

`m <- matrix(x, nrow = 3, ncol = 3)`
Create a matrix from x.

`m[2, ]` - Select a row

`m[ , 1]` - Select a column

`m[2, 3]` - Select an element

`t(m)`
Transpose

`m %*% n`
Matrix Multiplication

`solve(m, n)`
Find x in: m * x = n

Lists

`l <- list(x = 1:5, y = c('a', 'b'))`
A list is a collection of elements which can be of different types.

`l[[2]]`	`l[1]`	`l$x`	`l['y']`
Second element of l.	New list with only the first element.	Element named x.	New list with only element named y.

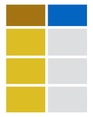
Also see the **dplyr** package.

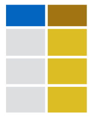
Data Frames

`df <- data.frame(x = 1:3, y = c('a', 'b', 'c'))`
A special case of a list where all elements are the same length.

x	y
1	a
2	b
3	c

List subsetting

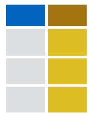
`df$x`


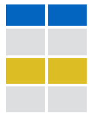
`df[[2]]`


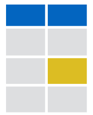
Understanding a data frame

`View(df)`	See the full data frame.
`head(df)`	See the first 6 rows.

Matrix subsetting

`df[ , 2]`


`df[2, ]`


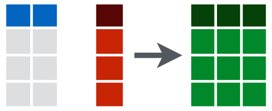
`df[2, 2]`


`nrow(df)`
Number of rows.

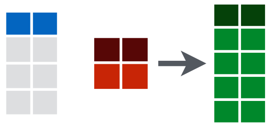
`ncol(df)`
Number of columns.

`dim(df)`
Number of columns and rows.

cbind - Bind columns.



rbind - Bind rows.



Strings

Also see the **stringr** package.

`paste(x, y, sep = ' ')`	Join multiple vectors together.
`paste(x, collapse = ' ')`	Join elements of a vector together.
`grep(pattern, x)`	Find regular expression matches in x.
`gsub(pattern, replace, x)`	Replace matches in x with a string.
`toupper(x)`	Convert to uppercase.
`tolower(x)`	Convert to lowercase.
`nchar(x)`	Number of characters in a string.

Factors

`factor(x)`
Turn a vector into a factor. Can set the levels of the factor and the order.

`cut(x, breaks = 4)`
Turn a numeric vector into a factor by 'cutting' into sections.

Statistics

`lm(y ~ x, data=df)`
Linear model.

`glm(y ~ x, data=df)`
Generalised linear model.

`summary`
Get more detailed information out a model.

`t.test(x, y)`
Perform a t-test for difference between means.

`pairwise.t.test`
Perform a t-test for paired data.

`prop.test`
Test for a difference between proportions.

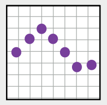
`aov`
Analysis of variance.

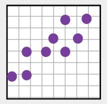
Distributions

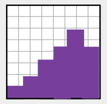
	Random Variates	Density Function	Cumulative Distribution	Quantile
Normal	`rnorm`	`dnorm`	`pnorm`	`qnorm`
Poisson	`rpois`	`dpois`	`ppois`	`qpois`
Binomial	`rbinom`	`dbinom`	`pbinom`	`qbinom`
Uniform	`runif`	`dunif`	`punif`	`qunif`

Plotting

Also see the **ggplot2** package.


`plot(x)`
Values of x in order.


`plot(x, y)`
Values of x against y.

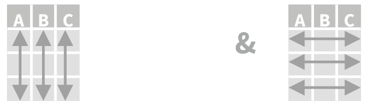

`hist(x)`
Histogram of x.

Dates

See the **lubridate** package.

Data transformation with dplyr : : **CHEATSHEET**

dplyr functions work with pipes and expect **tidy data**. In tidy data:



Each **variable** is in its own **column**

Each **observation**, or **case**, is in its own **row**

pipes

x |> f(y)
becomes **f(x, y)**

Summarize Cases

Apply **summary functions** to columns to create a new table of summary statistics. Summary functions take vectors as input and return one value (see back).

summary function

summarize(.data, …**)**
Compute table of summaries.

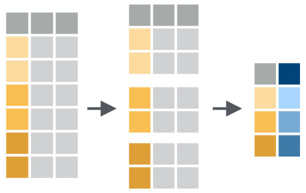
```
mtcars |> summarize(avg = mean(mpg))
```

count(.data, …, wt = NULL, sort = FALSE, name = NULL**)** Count number of rows in each group defined by the variables in … Also **tally()**, **add_count()**, **add_tally()**.

```
mtcars |> count(cyl)
```

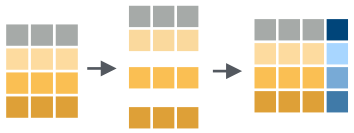
Group Cases

Use **group_by(**.data, …, .add = FALSE, .drop = TRUE**)** to create a "grouped" copy of a table grouped by columns in ... dplyr functions will manipulate each "group" separately and combine the results.



```
mtcars |>
  group_by(cyl) |>
  summarize(avg = mean(mpg))
```

Use **rowwise(**.data, …**)** to group data into individual rows. dplyr functions will compute results for each row. Also apply functions to list-columns. See tidyr cheat sheet for list-column workflow.



```
starwars |>
  rowwise() |>
  mutate(film_count = length(films))
```

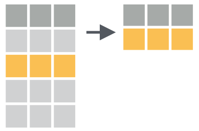
ungroup(x, …**)** Returns ungrouped copy of table.

```
g_mtcars <- mtcars |> group_by(cyl)
ungroup(g_mtcars)
```

Manipulate Cases

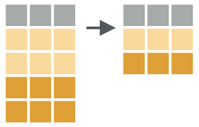
EXTRACT CASES

Row functions return a subset of rows as a new table.



filter(.data, …, .preserve = FALSE**)** Extract rows that meet logical criteria.

```
mtcars |> filter(mpg > 20)
```

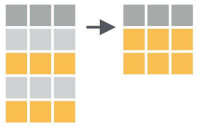


distinct(.data, …, .keep_all = FALSE**)** Remove rows with duplicate values.

```
mtcars |> distinct(gear)
```

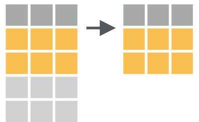
slice(.data, …, .preserve = FALSE**)** Select rows by position.

```
mtcars |> slice(10:15)
```



slice_sample(.data, …, n, prop, weight_by = NULL, replace = FALSE**)** Randomly select rows. Use n to select a number of rows and prop to select a fraction of rows.

```
mtcars |> slice_sample(n = 5, replace = TRUE)
```



slice_min(.data, order_by, …, n, prop, with_ties = TRUE**)** and **slice_max()** Select rows with the lowest and highest values.

```
mtcars |> slice_min(mpg, prop = 0.25)
```

slice_head(.data, …, n, prop**)** and **slice_tail()** Select the first or last rows.

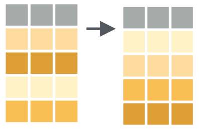
```
mtcars |> slice_head(n = 5)
```

Logical and boolean operators to use with filter()

==	<	<=	is.na()	%in%	|	xor()
!=	>	>=	!is.na()	!	&	

See **?base::Logic** and **?Comparison** for help.

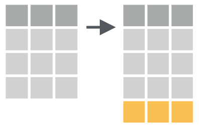
ARRANGE CASES



arrange(.data, …, .by_group = FALSE**)** Order rows by values of a column or columns (low to high), use with **desc()** to order from high to low.

```
mtcars |> arrange(mpg)
mtcars |> arrange(desc(mpg))
```

ADD CASES



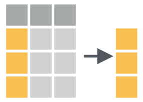
add_row(.data, …, .before = NULL, .after = NULL**)** Add one or more rows to a table.

```
cars |> add_row(speed = 1, dist = 1)
```

Manipulate Variables

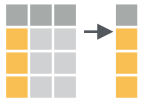
EXTRACT VARIABLES

Column functions return a set of columns as a new vector or table.



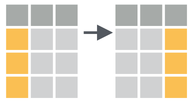
pull(.data, var = -1, name = NULL, …**)** Extract column values as a vector, by name or index.

```
mtcars |> pull(wt)
```



select(.data, …**)** Extract columns as a table.

```
mtcars |> select(mpg, wt)
```



relocate(.data, …, .before = NULL, .after = NULL**)** Move columns to new position.

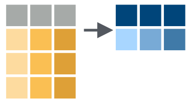
```
mtcars |> relocate(mpg, cyl, .after = last_col())
```

Use these helpers with select() and across()
e.g. mtcars |> select(mpg:cyl)

contains(match**)**	**num_range(**prefix, range**)**	**:**, e.g., mpg:cyl
ends_with(match**)**	**all_of(**x**)/any_of(**x, …, vars**)**	**!**, e.g., !gear
starts_with(match**)**	**matches(**match**)**	**everything()**

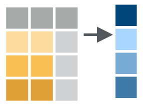
MANIPULATE MULTIPLE VARIABLES AT ONCE

```
df <- tibble(x_1 = c(1, 2), x_2 = c(3, 4), y = c(4, 5))
```



across(.cols, .funs, …, .names = NULL**)** Summarize or mutate multiple columns in the same way.

```
df |> summarize(across(everything(), mean))
```



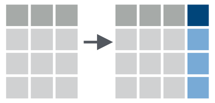
c_across(.cols**)** Compute across columns in row-wise data.

```
df |>
  rowwise() |>
  mutate(x_total = sum(c_across(1:2)))
```

MAKE NEW VARIABLES

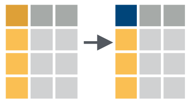
Apply **vectorized functions** to columns. Vectorized functions take vectors as input and return vectors of the same length as output (see back).

vectorized function



mutate(.data, …, .keep = "all", .before = NULL, .after = NULL**)** Compute new column(s). Also **add_column()**.

```
mtcars |> mutate(gpm = 1 / mpg)
mtcars |> mutate(gpm = 1 / mpg, .keep = "none")
```



rename(.data, …**)** Rename columns. Use **rename_with()** to rename with a function.

```
mtcars |> rename(miles_per_gallon = mpg)
```

Vectorized Functions

TO USE WITH MUTATE ()

mutate() applies vectorized functions to columns to create new columns. Vectorized functions take vectors as input and return vectors of the same length as output.

vectorized function

OFFSET

dplyr::**lag()** - offset elements by 1
dplyr::**lead()** - offset elements by -1

CUMULATIVE AGGREGATE

dplyr::**cumall()** - cumulative all()
dplyr::**cumany()** - cumulative any()
cummax() - cumulative max()
dplyr::**cummean()** - cumulative mean()
cummin() - cumulative min()
cumprod() - cumulative prod()
cumsum() - cumulative sum()

RANKING

dplyr::**cume_dist()** - proportion of all values <=
dplyr::**dense_rank()** - rank w ties = min, no gaps
dplyr::**min_rank()** - rank with ties = min
dplyr::**ntile()** - bins into n bins
dplyr::**percent_rank()** - min_rank scaled to [0,1]
dplyr::**row_number()** - rank with ties = "first"

MATH

+, - , *, /, ^, %/%, %% - arithmetic ops
log(), log2(), log10() - logs
<, <=, >, >=, !=, == - logical comparisons
dplyr::**between()** - x >= left & x <= right
dplyr::**near()** - safe == for floating point numbers

MISCELLANEOUS

dplyr::**case_when()** - multi-case if_else()

```
starwars |>
  mutate(type = case_when(
    height > 200 | mass > 200 ~ "large",
      species == "Droid"        ~ "robot",
      TRUE                      ~ "other")
  )
```

dplyr::**coalesce()** - first non-NA values by element across a set of vectors
dplyr::**if_else()** - element-wise if() + else()
dplyr::**na_if()** - replace specific values with NA
pmax() - element-wise max()
pmin() - element-wise min()

Summary Functions

TO USE WITH SUMMARIZE ()

summarize() applies summary functions to columns to create a new table. Summary functions take vectors as input and return single values as output.

summary function

COUNT

dplyr::**n()** - number of values/rows
dplyr::**n_distinct()** - # of uniques
sum(!is.na()) - # of non-NAs

POSITION

mean() - mean, also **mean(!is.na())**
median() - median

LOGICAL

mean() - proportion of TRUEs
sum() - # of TRUEs

ORDER

dplyr::**first()** - first value
dplyr::**last()** - last value
dplyr::**nth()** - value in nth location of vector

RANK

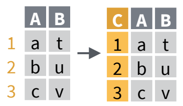
quantile() - nth quantile
min() - minimum value
max() - maximum value

SPREAD

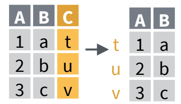
IQR() - Inter-Quartile Range
mad() - median absolute deviation
sd() - standard deviation
var() - variance

Row Names

Tidy data does not use rownames, which store a variable outside of the columns. To work with the rownames, first move them into a column.



tibble::**rownames_to_column()**
Move row names into col.
a <- mtcars |>
rownames_to_column(var = "C")

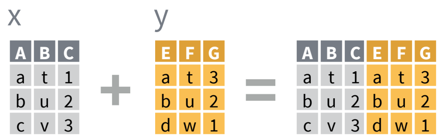


tibble::**column_to_rownames()**
Move col into row names.
a |> column_to_rownames(var = "C")

Also tibble::**has_rownames()** and tibble::**remove_rownames()**.

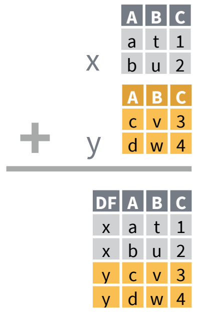
Combine Tables

COMBINE VARIABLES



bind_cols(…, .name_repair**)** Returns tables placed side by side as a single table. Column lengths must be equal. Columns will NOT be matched by id (to do that look at Relational Data below), so be sure to check that both tables are ordered the way you want before binding.

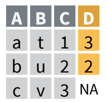
COMBINE CASES



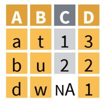
bind_rows(…, .id = NULL**)** Returns tables one on top of the other as a single table. Set .id to a column name to add a column of the original table names (as pictured).

RELATIONAL DATA

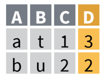
Use a "**Mutating Join**" to join one table to columns from another, matching values with the rows that they correspond to. Each join retains a different combination of values from the tables.



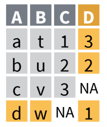
left_join(x, y, by = NULL, copy = FALSE, suffix = c(".x", ".y"), …, keep = FALSE, na_matches = "na"**)** Join matching values from y to x.



right_join(x, y, by = NULL, copy = FALSE, suffix = c(".x", ".y"), …, keep = FALSE, na_matches = "na"**)** Join matching values from x to y.

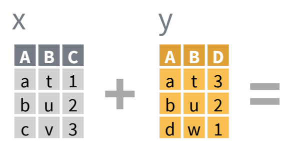


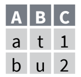
inner_join(x, y, by = NULL, copy = FALSE, suffix = c(".x", ".y"), …, keep = FALSE, na_matches = "na"**)** Join data. Retain only rows with matches.



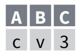
full_join(x, y, by = NULL, copy = FALSE, suffix = c(".x", ".y"), …, keep = FALSE, na_matches = "na"**)** Join data. Retain all values, all rows.

Use a "**Filtering Join**" to filter one table against the rows of another.



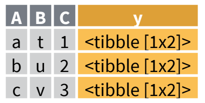


semi_join(x, y, by = NULL, copy = FALSE, …, na_matches = "na"**)** Return rows of x that have a match in y. Use to see what will be included in a join.



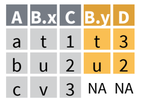
anti_join(x, y, by = NULL, copy = FALSE, …, na_matches = "na"**)** Return rows of x that do not have a match in y. Use to see what will not be included in a join.

Use a "**Nest Join**" to inner join one table to another into a nested data frame.

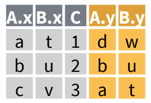


nest_join(x, y, by = NULL, copy = FALSE, keep = FALSE, name = NULL, …**)** Join data, nesting matches from y in a single new data frame column.

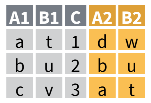
COLUMN MATCHING FOR JOINS



Use **by = c("col1", "col2", …)** to specify one or more common columns to match on.
left_join(x, y, by = "A")

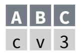


Use a named vector, **by = c("col1" = "col2")**, to match on columns that have different names in each table.
left_join(x, y, by = c("C" = "D"))

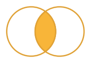


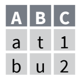
Use **suffix** to specify the suffix to give to unmatched columns that have the same name in both tables.
left_join(x, y, by = c("C" = "D"), suffix = c("1", "2"))

SET OPERATIONS

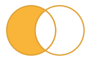


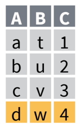
intersect(x, y, …)
Rows that appear in both x and y.





setdiff(x, y, …)
Rows that appear in x but not y.





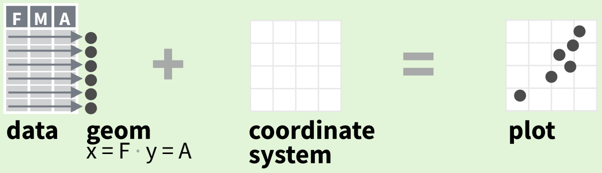
union(x, y, …)
Rows that appear in x or y, duplicates removed). **union_all()** retains duplicates.

Use **setequal()** to test whether two data sets contain the exact same rows (in any order).

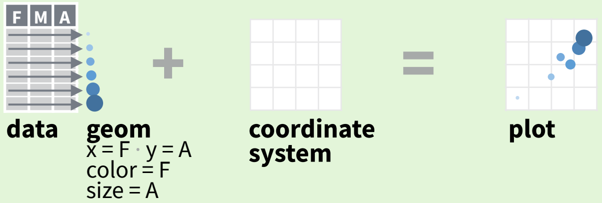
Data visualization with ggplot2 : : CHEATSHEET

Basics

ggplot2 is based on the **grammar of graphics**, the idea that you can build every graph from the same components: a **data** set, a **coordinate system**, and **geoms**—visual marks that represent data points.



To display values, map variables in the data to visual properties of the geom (**aesthetics**) like **size**, **color**, and **x** and **y** locations.



Complete the template below to build a graph.

```
ggplot (data = <DATA>) +                                       ] required
<GEOM_FUNCTION>(mapping = aes(<MAPPINGS>),
 stat = <STAT>, position = <POSITION>) +                       ] Not
<COORDINATE_FUNCTION> +                                          required,
<FACET_FUNCTION> +                                               sensible
<SCALE_FUNCTION> +                                               defaults
<THEME_FUNCTION>                                                 supplied
```

ggplot(data = mpg, **aes**(x = cty, y = hwy)) Begins a plot that you finish by adding layers to. Add one geom function per layer.

last_plot() Returns the last plot.

ggsave("plot.png", width = 5, height = 5) Saves last plot as 5' x 5' file named "plot.png" in working directory. Matches file type to file extension.

Aes Common aesthetic values.

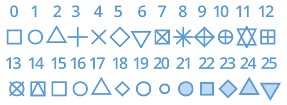
color and **fill** - string ("red", "#RRGGBB")

linetype - integer or string (0 = "blank", 1 = "solid", 2 = "dashed", 3 = "dotted", 4 = "dotdash", 5 = "longdash", 6 = "twodash")

size - integer (in mm for size of points and text)

linewidth - integer (in mm for widths of lines)

shape - integer/shape name or a single character ("a")



Geoms

Use a geom function to represent data points, use the geom's aesthetic properties to represent variables. Each function returns a layer.

GRAPHICAL PRIMITIVES

a <- ggplot(economics, aes(date, unemploy))
b <- ggplot(seals, aes(x = long, y = lat))

a + geom_blank() and **a + expand_limits()**
Ensure limits include values across all plots.

b + geom_curve(aes(yend = lat + 1, xend = long + 1), curvature = 1**)** - x, xend, y, yend, alpha, angle, color, curvature, linetype, size

a + geom_path(lineend = "butt", linejoin = "round", linemitre = 1**)**
x, y, alpha, color, group, linetype, size

a + geom_polygon(aes(alpha = 50)**)** - x, y, alpha, color, fill, group, subgroup, linetype, size

b + geom_rect(aes(xmin = long, ymin = lat, xmax = long + 1, ymax = lat + 1)**)** - xmax, xmin, ymax, ymin, alpha, color, fill, linetype, size

a + geom_ribbon(aes(ymin = unemploy - 900, ymax = unemploy + 900)**)** - x, ymax, ymin, alpha, color, fill, group, linetype, size

LINE SEGMENTS

common aesthetics: x, y, alpha, color, linetype, size

b + geom_abline(aes(intercept = 0, slope = 1)**)**
b + geom_hline(aes(yintercept = lat)**)**
b + geom_vline(aes(xintercept = long)**)**

b + geom_segment(aes(yend = lat + 1, xend = long + 1)**)**
b + geom_spoke(aes(angle = 1:1155, radius = 1)**)**

ONE VARIABLE continuous

c <- ggplot(mpg, aes(hwy)); c2 <- ggplot(mpg)

c + geom_area(stat = "bin"**)**
x, y, alpha, color, fill, linetype, size

c + geom_density(kernel = "gaussian"**)**
x, y, alpha, color, fill, group, linetype, size, weight

c + geom_dotplot()
x, y, alpha, color, fill

c + geom_freqpoly()
x, y, alpha, color, group, linetype, size

c + geom_histogram(binwidth = 5**)**
x, y, alpha, color, fill, linetype, size, weight

c2 + geom_qq(aes(sample = hwy)**)**
x, y, alpha, color, fill, linetype, size, weight

discrete

d <- ggplot(mpg, aes(fl))

d + geom_bar()
x, alpha, color, fill, linetype, size, weight

TWO VARIABLES

both continuous

e <- ggplot(mpg, aes(cty, hwy))

e + geom_label(aes(label = cty), nudge_x = 1, nudge_y = 1**)** - x, y, label, alpha, angle, color, family, fontface, hjust, lineheight, size, vjust

e + geom_point()
x, y, alpha, color, fill, shape, size, stroke

e + geom_quantile()
x, y, alpha, color, group, linetype, size, weight

e + geom_rug(sides = “bl”**)**
x, y, alpha, color, linetype, size

e + geom_smooth(method = lm**)**
x, y, alpha, color, fill, group, linetype, size, weight

e + geom_text(aes(label = cty), nudge_x = 1, nudge_y = 1**)** - x, y, label, alpha, angle, color, family, fontface, hjust, lineheight, size, vjust

one discrete, one continuous

f <- ggplot(mpg, aes(class, hwy))

f + geom_col()
x, y, alpha, color, fill, group, linetype, size

f + geom_boxplot()
x, y, lower, middle, upper, ymax, ymin, alpha, color, fill, group, linetype, shape, size, weight

f + geom_dotplot(binaxis = "y", stackdir = “center"**)**
x, y, alpha, color, fill, group

f + geom_violin(scale = “area"**)**
x, y, alpha, color, fill, group, linetype, size, weight

both discrete

g <- ggplot(diamonds, aes(cut, color))

g + geom_count()
x, y, alpha, color, fill, shape, size, stroke

e + geom_jitter(height = 2, width = 2**)**
x, y, alpha, color, fill, shape, size

continuous bivariate distribution

h <- ggplot(diamonds, aes(carat, price))

h + geom_bin2d(binwidth = c(0.25, 500)**)**
x, y, alpha, color, fill, linetype, size, weight

h + geom_density_2d()
x, y, alpha, color, group, linetype, size

h + geom_hex()
x, y, alpha, color, fill, size

continuous function

i <- ggplot(economics, aes(date, unemploy))

i + geom_area()
x, y, alpha, color, fill, linetype, size

i + geom_line()
x, y, alpha, color, group, linetype, size

i + geom_step(direction = "hv"**)**
x, y, alpha, color, group, linetype, size

visualizing error

df <- data.frame(grp = c("A", "B"), fit = 4:5, se = 1:2)
j <- ggplot(df, aes(grp, fit, ymin = fit - se, ymax = fit + se))

j + geom_crossbar(fatten = 2**)** - x, y, ymax, ymin, alpha, color, fill, group, linetype, size

j + geom_errorbar() - x, ymax, ymin, alpha, color, group, linetype, size, width
Also **geom_errorbarh()**.

j + geom_linerange()
x, ymin, ymax, alpha, color, group, linetype, size

j + geom_pointrange() - x, y, ymin, ymax, alpha, color, fill, group, linetype, shape, size

maps

Draw the appropriate geometric object depending on the simple features present in the data. aes() arguments: map_id, alpha, color, fill, linetype, linewidth.

nc <- **sf::st_read(**system.file("shape/nc.shp", package = "sf")**)**

ggplot(nc) +
 geom_sf(aes(fill = AREA)**)**

THREE VARIABLES

seals$z <- with(seals, sqrt(delta_long^2 + delta_lat^2)); l <- ggplot(seals, aes(long, lat))

l + geom_contour(aes(z = z)**)**
x, y, z, alpha, color, group, linetype, size, weight

l + geom_contour_filled(aes(fill = z)**)**
x, y, alpha, color, fill, group, linetype, size, subgroup

l + geom_raster(aes(fill = z), hjust = 0.5, vjust = 0.5, interpolate = FALSE**)**
x, y, alpha, fill

l + geom_tile(aes(fill = z)**)**
x, y, alpha, color, fill, linetype, size, width

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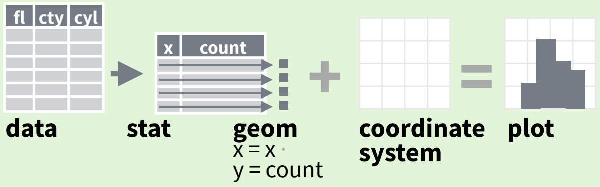
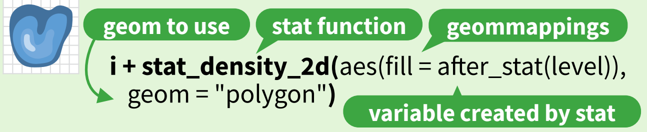
Stats An alternative way to build a layer.

A stat builds new variables to plot (e.g., count, prop).



Visualize a stat by changing the default stat of a geom function, **geom_bar(stat="count")** or by using a stat function, **stat_count(geom="bar")**, which calls a default geom to make a layer (equivalent to a geom function).
Use **after_stat(name)** syntax to map the stat variable **name** to an aesthetic.



geom to use · stat function · geommappings

i + stat_density_2d(aes(fill = after_stat(level)),
geom = "polygon"**)**

variable created by stat

c + stat_bin(binwidth = 1, boundary = 10**)**
x, y | count, ncount, density, ndensity

c + stat_count(width = 1**) x, y** | count, prop

c + stat_density(adjust = 1, kernel = "gaussian"**)**
x, y | count, density, scaled

e + stat_bin_2d(bins = 30, drop = T**)**
x, y, fill | count, density

e + stat_bin_hex(bins = 30**) x, y, fill** | count, density

e + stat_density_2d(contour = TRUE, n = 100**)**
x, y, color, size | level

e + stat_ellipse(level = 0.95, segments = 51, type = "t"**)**

l + stat_contour(aes(z = z)**) x, y, z, order** | level

l + stat_summary_hex(aes(z = z), bins = 30, fun = max**)**
x, y, z, fill | value

l + stat_summary_2d(aes(z = z), bins = 30, fun = mean**)**
x, y, z, fill | value

f + stat_boxplot(coef = 1.5**)**
x, y | lower, middle, upper, width , ymin, ymax

f + stat_ydensity(kernel = "gaussian", scale = "area"**) x, y** |
density, scaled, count, n, violinwidth, width

e + stat_ecdf(n = 40**) x, y** | x, y

e + stat_quantile(quantiles = c(0.1, 0.9),
formula = y ~ log(x), method = "rq"**) x, y** | quantile

e + stat_smooth(method = "lm", formula = y ~ x, se = T,
level = 0.95**) x, y** | se, x, y, ymin, ymax

ggplot() + xlim(-5, 5**) + stat_function(**fun = dnorm,
n = 20, geom = "point"**) x** | x, y

ggplot() + stat_qq(aes(sample = 1:100)**)**
x, y, sample | sample, theoretical

e + stat_sum() x, y, size | n, prop

e + stat_summary(fun.data = "mean_cl_boot"**)**

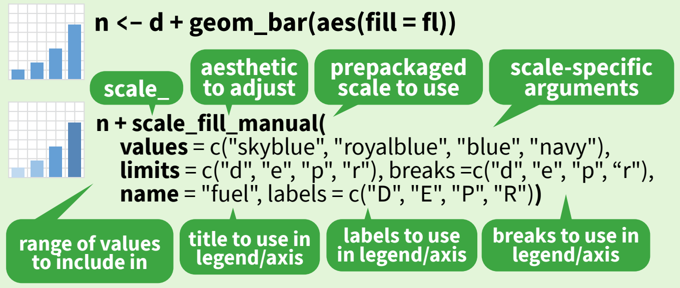
h + stat_summary_bin(fun = "mean", geom = "bar"**)**

e + stat_identity()

e + stat_unique()

Scales Override defaults with **scales** package.

Scales map data values to the visual values of an aesthetic. To change a mapping, add a new scale.



n <- d + geom_bar(aes(fill = fl))

scale_ · aesthetic to adjust · prepackaged scale to use · scale-specific arguments

n + scale_fill_manual(
values = c("skyblue", "royalblue", "blue", "navy"),
limits = c("d", "e", "p", "r"), breaks =c("d", "e", "p", “r"),
name = "fuel", labels = c("D", "E", "P", "R")**)**

range of values to include in · title to use in legend/axis · labels to use in legend/axis · breaks to use in legend/axis

GENERAL PURPOSE SCALES

Use with most aesthetics

scale_*_continuous() - Map cont' values to visual ones.
scale_*_discrete() - Map discrete values to visual ones.
scale_*_binned() - Map continuous values to discrete bins.
scale_*_identity() - Use data values as visual ones.
scale_*_manual(values = c()**)** - Map discrete values to manually chosen visual ones.
scale_*_date(date_labels = "%m/%d"),
date_breaks = "2 weeks"**)** - Treat data values as dates.
scale_*_datetime() - Treat data values as date times.
Same as scale_*_date(). See ?strptime for label formats.

X & Y LOCATION SCALES

Use with x or y aesthetics (x shown here)

scale_x_log10() - Plot x on log10 scale.
scale_x_reverse() - Reverse the direction of the x axis.
scale_x_sqrt() - Plot x on square root scale.

COLOR AND FILL SCALES (DISCRETE)

n + scale_fill_brewer(palette = "Blues"**)**
For palette choices:
RColorBrewer::display.brewer.all()

n + scale_fill_grey(start = 0.2,
end = 0.8, na.value = "red"**)**

COLOR AND FILL SCALES (CONTINUOUS)

o <- c + geom_dotplot(aes(fill = x))

o + scale_fill_distiller(palette = “Blues”**)**

o + scale_fill_gradient(low="red", high=“yellow"**)**

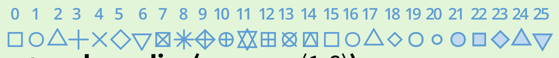
o + scale_fill_gradient2(low = "red", high = “blue”,
mid = "white", midpoint = 25**)**

o + scale_fill_gradientn(colors = topo.colors(6)**)**
Also: rainbow(), heat.colors(), terrain.colors(),
cm.colors(), RColorBrewer::brewer.pal()

SHAPE AND SIZE SCALES

p <- e + geom_point(aes(shape = fl, size = cyl))

p + scale_shape() + scale_size()
p + scale_shape_manual(values = c(3:7)**)**



p + scale_radius(range = c(1,6)**)**
p + scale_size_area(max_size = 6**)**

Coordinate Systems

r <- d + geom_bar()

r + coord_cartesian(xlim = c(0, 5)**)** - xlim, ylim
The default cartesian coordinate system.

r + coord_fixed(ratio = 1/2**)**
ratio, xlim, ylim - Cartesian coordinates with fixed aspect ratio between x and y units.

r + coord_flip()
Flip cartesian coordinates by switching x and y aesthetic mappings.

r + coord_polar(theta = "x", direction=1**)**
theta, start, direction - Polar coordinates.

r + coord_trans(y = “sqrt"**)** - x, y, xlim, ylim
Transformed cartesian coordinates. Set xtrans and ytrans to the name of a window function.

π + coord_sf() - xlim, ylim, crs. Ensures all layers use a common Coordinate Reference System.

Position Adjustments

Position adjustments determine how to arrange geoms that would otherwise occupy the same space.

s <- ggplot(mpg, aes(fl, fill = drv))

s + geom_bar(position = "dodge")
Arrange elements side by side.

s + geom_bar(position = "fill")
Stack elements on top of one another, normalize height.

e + geom_point(position = "jitter")
Add random noise to X and Y position of each element to avoid overplotting.

e + geom_label(position = "nudge")
Nudge labels away from points.

s + geom_bar(position = "stack")
Stack elements on top of one another.

Each position adjustment can be recast as a function with manual **width** and **height** arguments:
s + geom_bar(position = position_dodge(width = 1))

Themes

r + theme_bw()
White background with grid lines.

r + theme_gray()
Grey background (default theme).

r + theme_dark()
Dark for contrast.

r + theme_classic()

r + theme_light()

r + theme_linedraw()

r + theme_minimal()
Minimal theme.

r + theme_void()
Empty theme.

r + theme() Customize aspects of the theme such as axis, legend, panel, and facet properties.
r + labs(title = “Title”) + theme(plot.title.position = “plot”)
r + theme(panel.background = element_rect(fill = “blue”))

Faceting

Facets divide a plot into subplots based on the values of one or more discrete variables.

t <- ggplot(mpg, aes(cty, hwy)) + geom_point()

t + facet_grid(. ~ fl)
Facet into columns based on fl.

t + facet_grid(year ~ .)
Facet into rows based on year.

t + facet_grid(year ~ fl)
Facet into both rows and columns.

t + facet_wrap(~ fl)
Wrap facets into a rectangular layout.

Set **scales** to let axis limits vary across facets.

t + facet_grid(drv ~ fl, scales = "free")
x and y axis limits adjust to individual facets:
"free_x" - x axis limits adjust
"free_y" - y axis limits adjust

Set **labeller** to adjust facet label:

t + facet_grid(. ~ fl, labeller = label_both)

fl: c	fl: d	fl: e	fl: p	fl: r

t + facet_grid(fl ~ ., labeller = label_bquote(alpha ^ .(fl)**))**

α^c	α^d	α^e	α^p	α^r

Labels and Legends

Use **labs()** to label the elements of your plot.

t + labs(x = "New x axis label", **y** = "New y axis label",
title ="Add a title above the plot",
subtitle = "Add a subtitle below title",
caption = "Add a caption below plot",
alt = "Add alt text to the plot",
<AES> = "New <AES> legend title"**)**

t + annotate(geom = "text", x = 8, y = 9, label = “A"**)**
Places a geom with manually selected aesthetics.

p + guides(x = guide_axis(n.dodge = 2)**)** Avoid crowded or overlapping labels with guide_axis(n.dodge or angle).

n + guides(fill = “none"**)** Set legend type for each aesthetic: colorbar, legend, or none (no legend).

n + theme(legend.position = "bottom"**)**
Place legend at "bottom", "top", "left", or “right”.

n + scale_fill_discrete(name = "Title",
labels = c("A", "B", "C", "D", "E")**)**
Set legend title and labels with a scale function.

Zooming

Without clipping (preferred):

t + coord_cartesian(xlim = c(0, 100), ylim = c(10, 20)**)**

With clipping (removes unseen data points):

t + xlim(0, 100**) + ylim(**10, 20**)**

t + scale_x_continuous(limits = c(0, 100)**) +**
scale_y_continuous(limits = c(0, 100)**)**

CC BY SA Posit Software, PBC • info@posit.co • posit.co • Learn more at **ggplot2.tidyverse.org** • HTML cheatsheets at **pos.it/cheatsheets** • ggplot2 3.5.1 • Updated: 2024-05

R GRAPHICAL PARAMETERS CHEATSHEET

Most of the graphical parameters are presented in this cheatsheet. Visit the R graph gallery for more examples !
www.r-graph-gallery.com

Box feature

bty : kind of box

o=complete / ?=top & right / n=no box /
c=top & left & bottom / l=bottom & left

Title

main : name of the title
cex.main : size *cex.main=2*
col.main : color *col.main="red"*
font.main : font *font.main=3*

Margins

See **Graph #135**

mar, oma, omd, omi

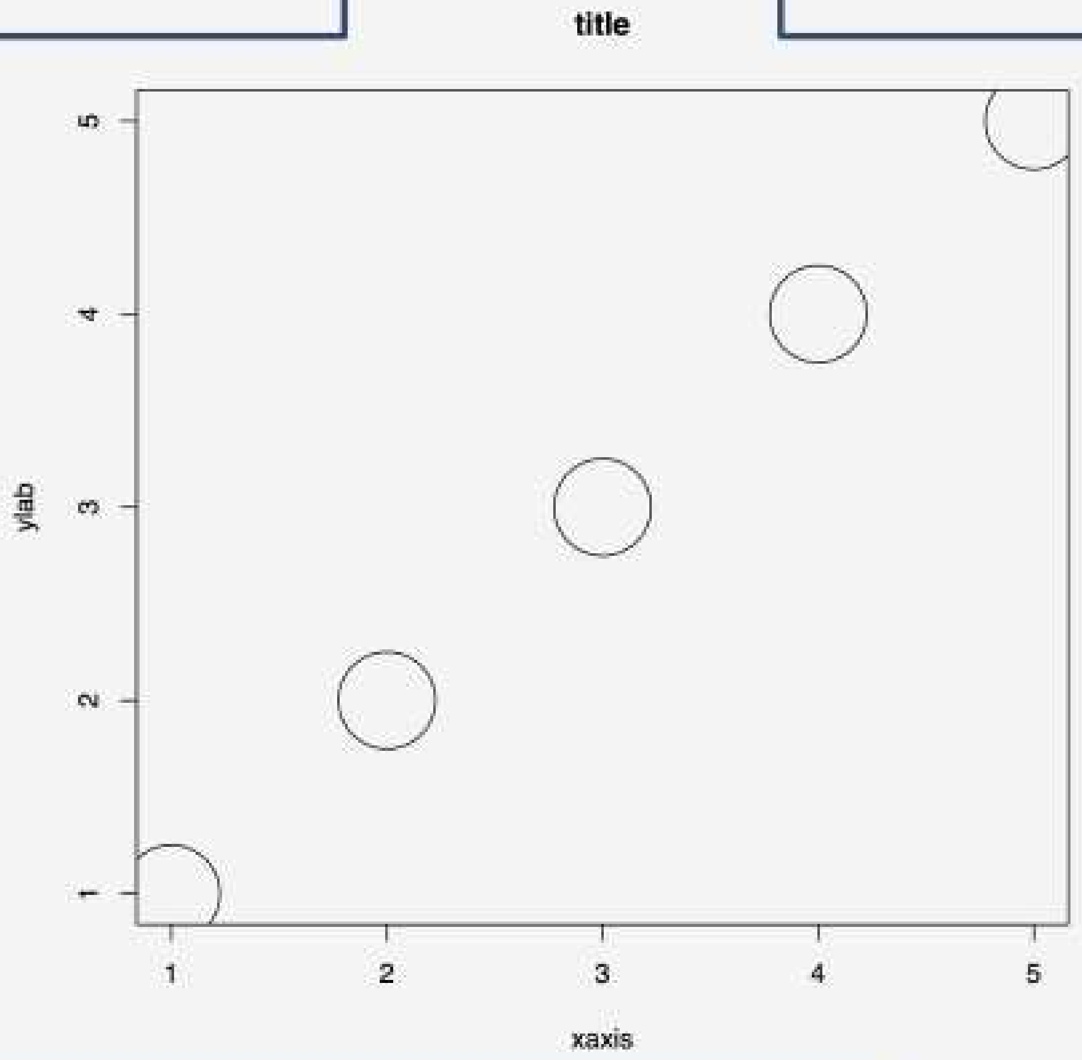
Symbol styles

See **Graph #6**

pch, lwd, pty,
col, cex, type...

General

tck : add a grid on a % of the area *tck=1*
bg : color of the background *par(bg="red")*
font : font of the text *(normal, bold, italic..)*
lheight: size between lines of titles
srt: text rotation in degree



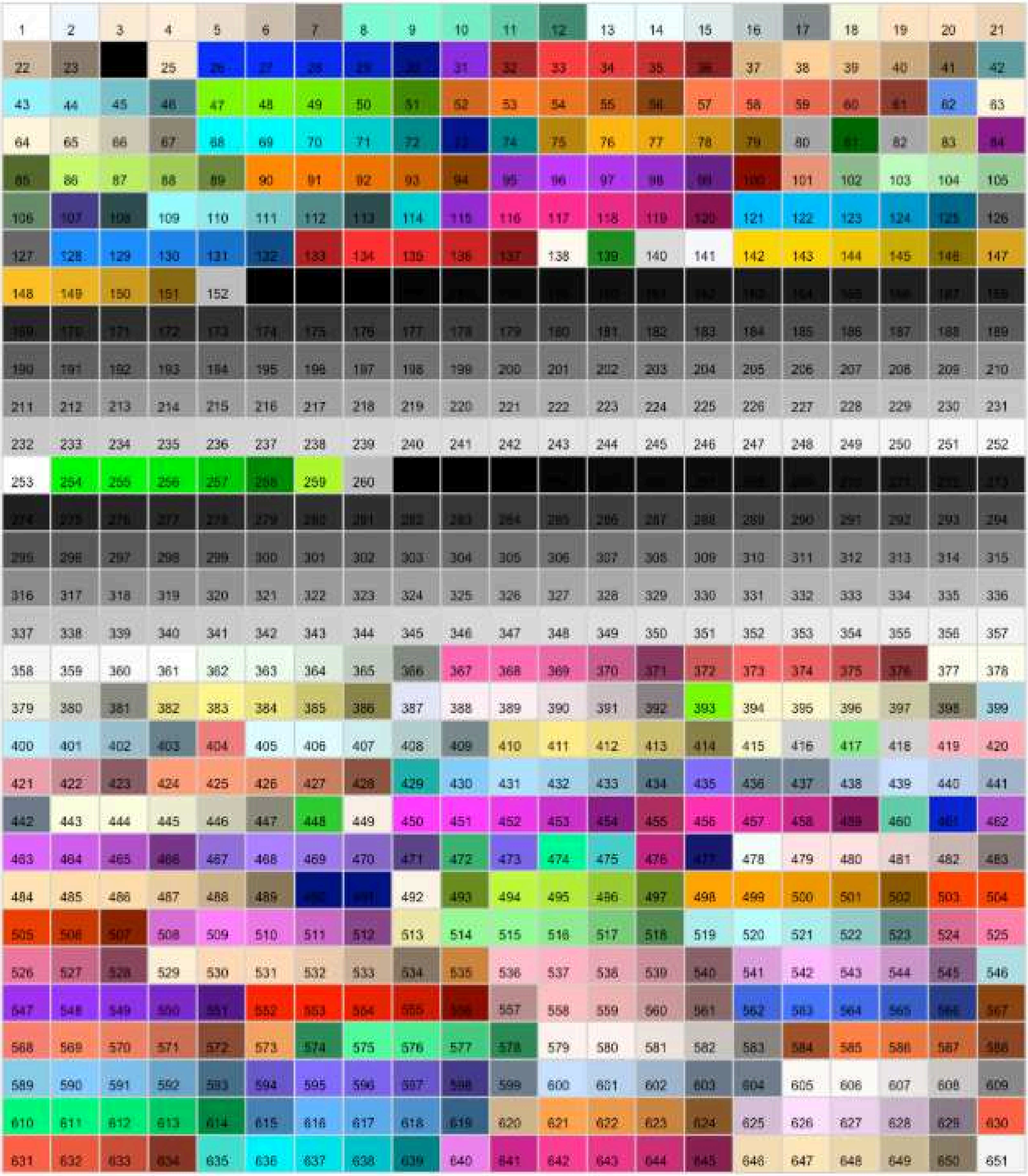
X-axis name

xlab : name of the axis
cex.lab : size *cex.lab=2*
col.lab : color *col.lab="red"*
sub : to add a subtitle

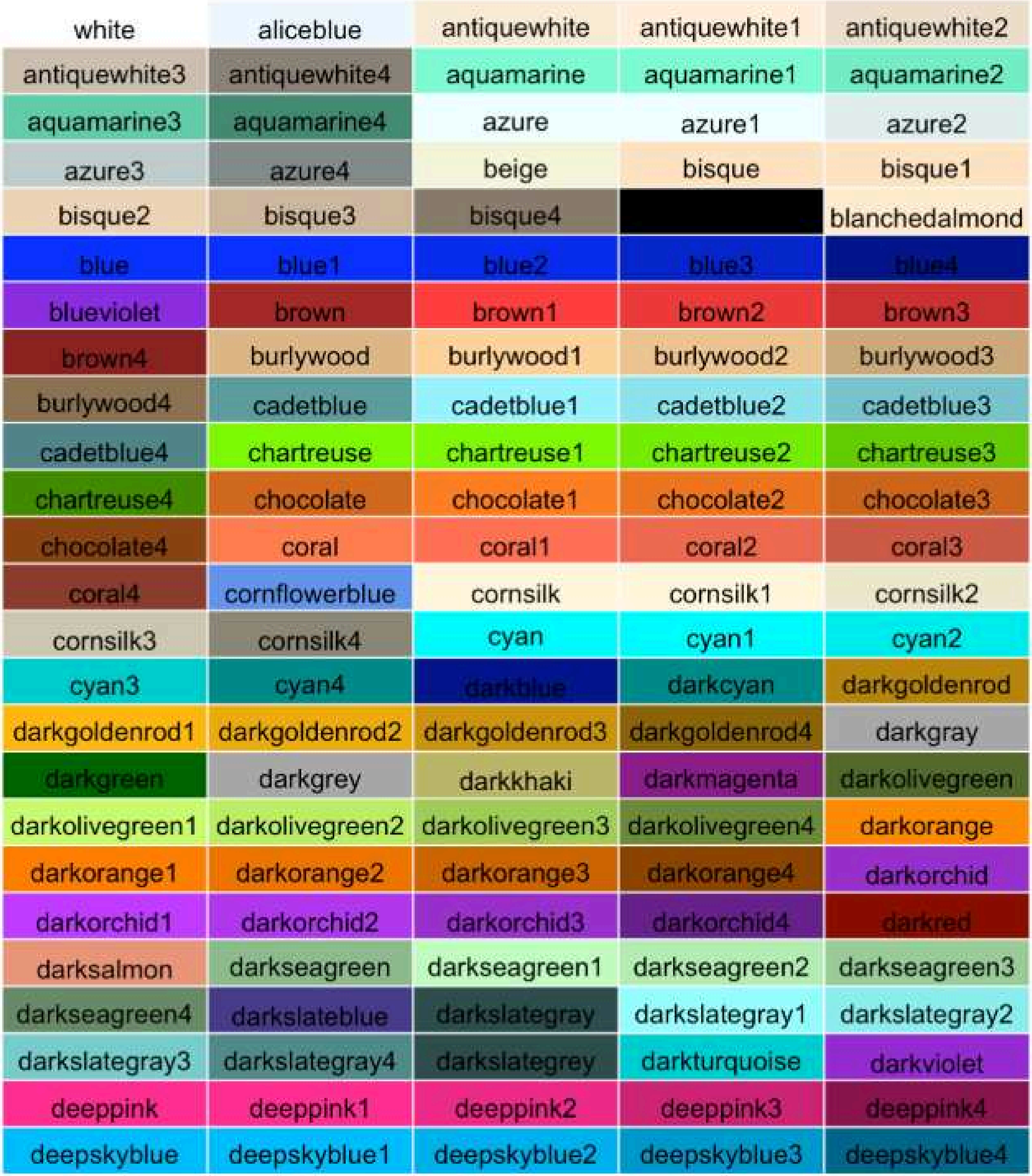
X-axis features

lab : number of graduation *lab=c(12,2,0)*
xaxp : to add c graduation from a to b: *xaxp=c(a,b,c)*
log : for logarithmic scale: *log="x"*
xaxt : to remove x axis: *xaxt="n"*
fg : color of axis, ticks and grid: *fg="red"*
cex.axis : size of tick labels
col.axis : color of tick labels
xlim : limits of the axis *xlim=c(0,10)*
las: orientation of tick labels

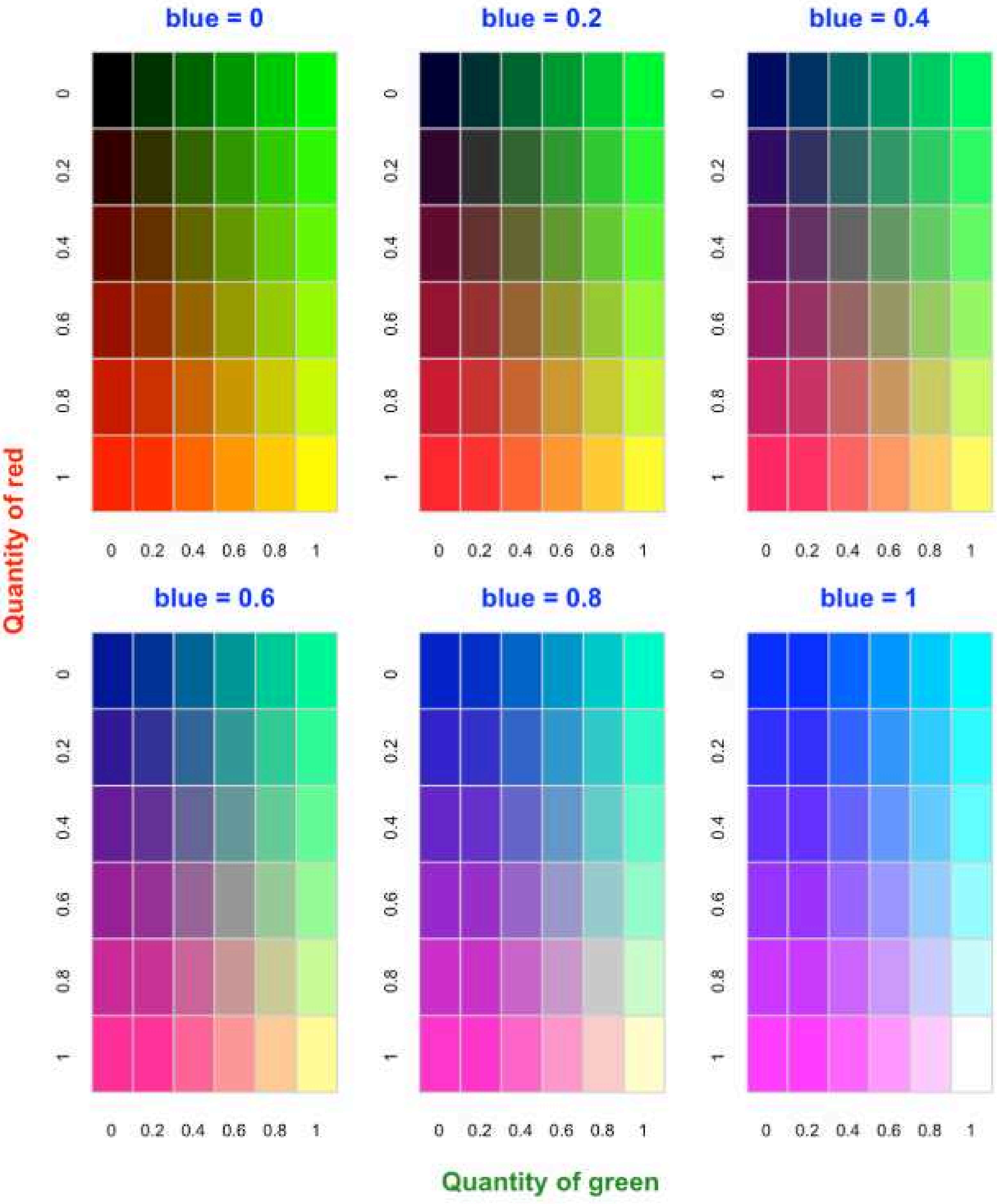
0=parralel to the axis, 1=horizontal...

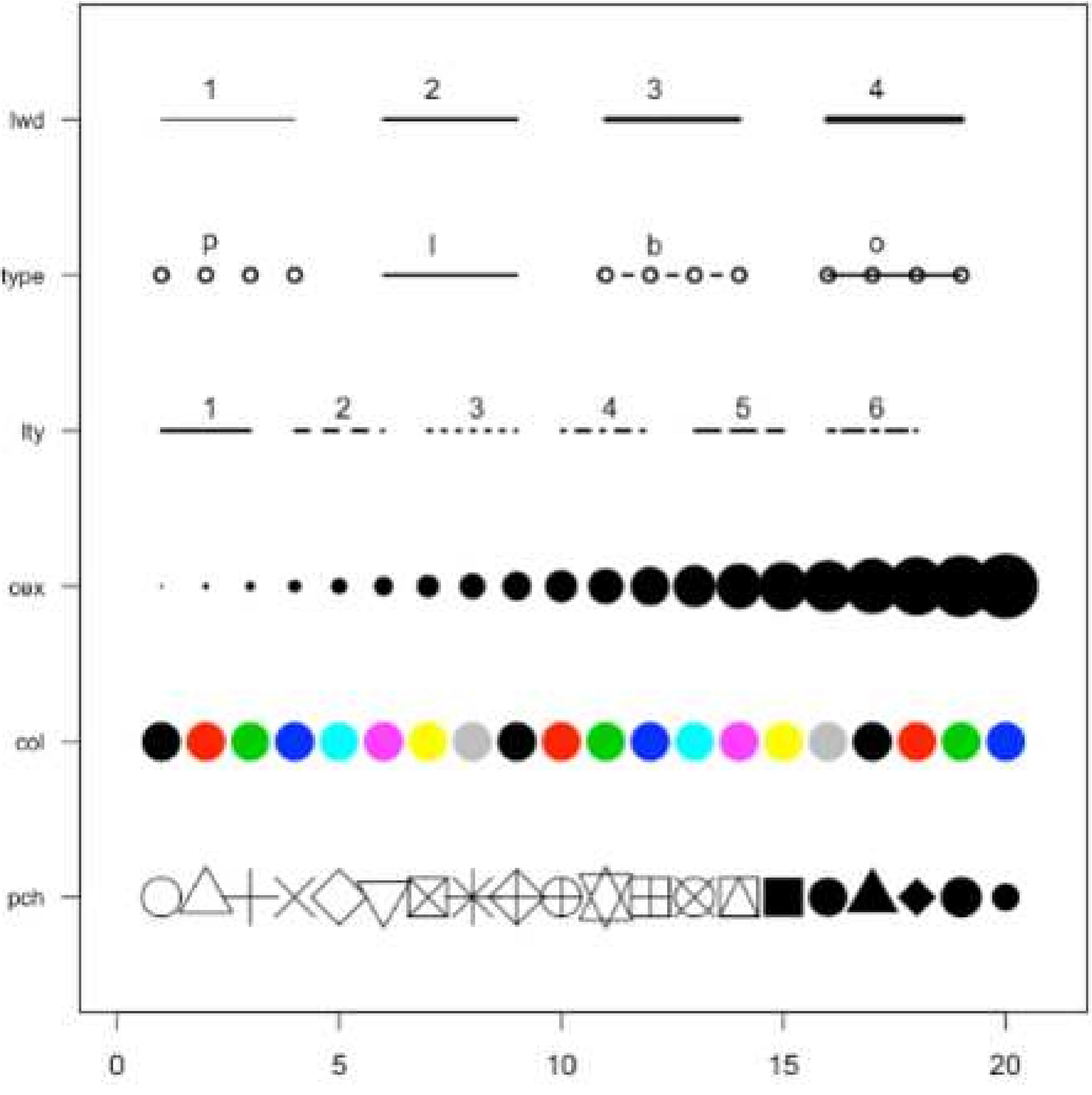


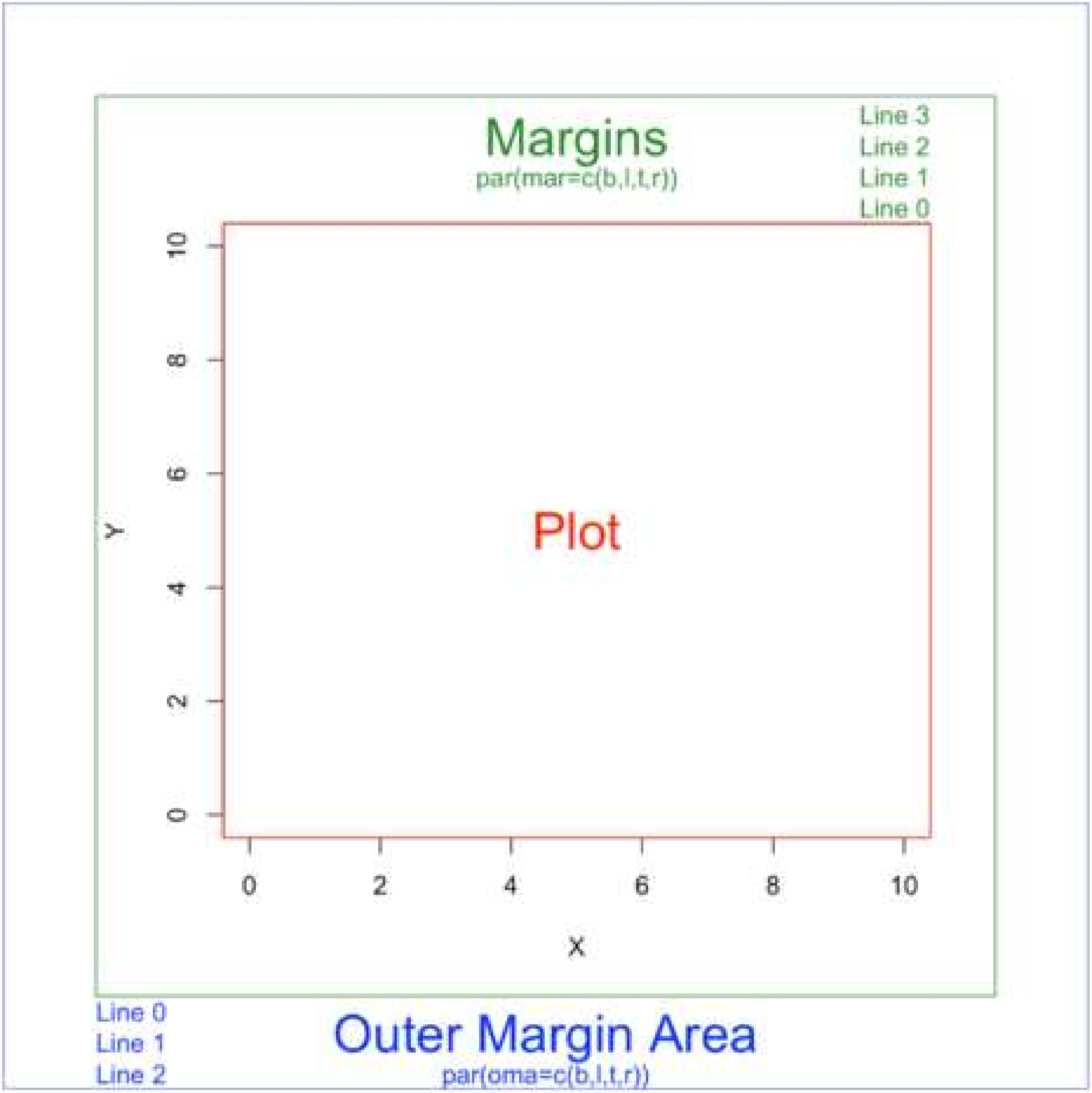
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
22	23		25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126
127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147
148	149	150	151	152				156	157	158	159	160	161	162	163	164	165	166	167	168
169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189
190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231
232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252
253	254	255	256	257	258	259	260				264	265	266	267	268	269	270	271	272	273
274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294
295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315
316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336
337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357
358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378
379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399
400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420
421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441
442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462
463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483
484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504
505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525
526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546
547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567
568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588
589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609
610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630
631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651



white	aliceblue	antiquewhite	antiquewhite1	antiquewhite2
antiquewhite3	antiquewhite4	aquamarine	aquamarine1	aquamarine2
aquamarine3	aquamarine4	azure	azure1	azure2
azure3	azure4	beige	bisque	bisque1
bisque2	bisque3	bisque4		blanchedalmond
blue	blue1	blue2	blue3	blue4
blueviolet	brown	brown1	brown2	brown3
brown4	burlywood	burlywood1	burlywood2	burlywood3
burlywood4	cadetblue	cadetblue1	cadetblue2	cadetblue3
cadetblue4	chartreuse	chartreuse1	chartreuse2	chartreuse3
chartreuse4	chocolate	chocolate1	chocolate2	chocolate3
chocolate4	coral	coral1	coral2	coral3
coral4	cornflowerblue	cornsilk	cornsilk1	cornsilk2
cornsilk3	cornsilk4	cyan	cyan1	cyan2
cyan3	cyan4	darkblue	darkcyan	darkgoldenrod
darkgoldenrod1	darkgoldenrod2	darkgoldenrod3	darkgoldenrod4	darkgray
darkgreen	darkgrey	darkkhaki	darkmagenta	darkolivegreen
darkolivegreen1	darkolivegreen2	darkolivegreen3	darkolivegreen4	darkorange
darkorange1	darkorange2	darkorange3	darkorange4	darkorchid
darkorchid1	darkorchid2	darkorchid3	darkorchid4	darkred
darksalmon	darkseagreen	darkseagreen1	darkseagreen2	darkseagreen3
darkseagreen4	darkslateblue	darkslategray	darkslategray1	darkslategray2
darkslategray3	darkslategray4	darkslategrey	darkturquoise	darkviolet
deeppink	deeppink1	deeppink2	deeppink3	deeppink4
deepskyblue	deepskyblue1	deepskyblue2	deepskyblue3	deepskyblue4


blue = 0
blue = 0.2
blue = 0.4
blue = 0.6
blue = 0.8
blue = 1
0
0.2
0.4
0.6
0.8
1
Quantity of red
Quantity of green


1
2
3
4
lwd
p
l
b
o
type
1
2
3
4
5
6
lty
cex
col
pch
0
5
10
15
20


Margins
par(mar=c(b,l,t,r))
Line 3
Line 2
Line 1
Line 0
10
8
6
4
2
0
Y
Plot
0
2
4
6
8
10
X
Line 0
Line 1
Line 2
Outer Margin Area
par(oma=c(b,l,t,r))

from Data to Viz

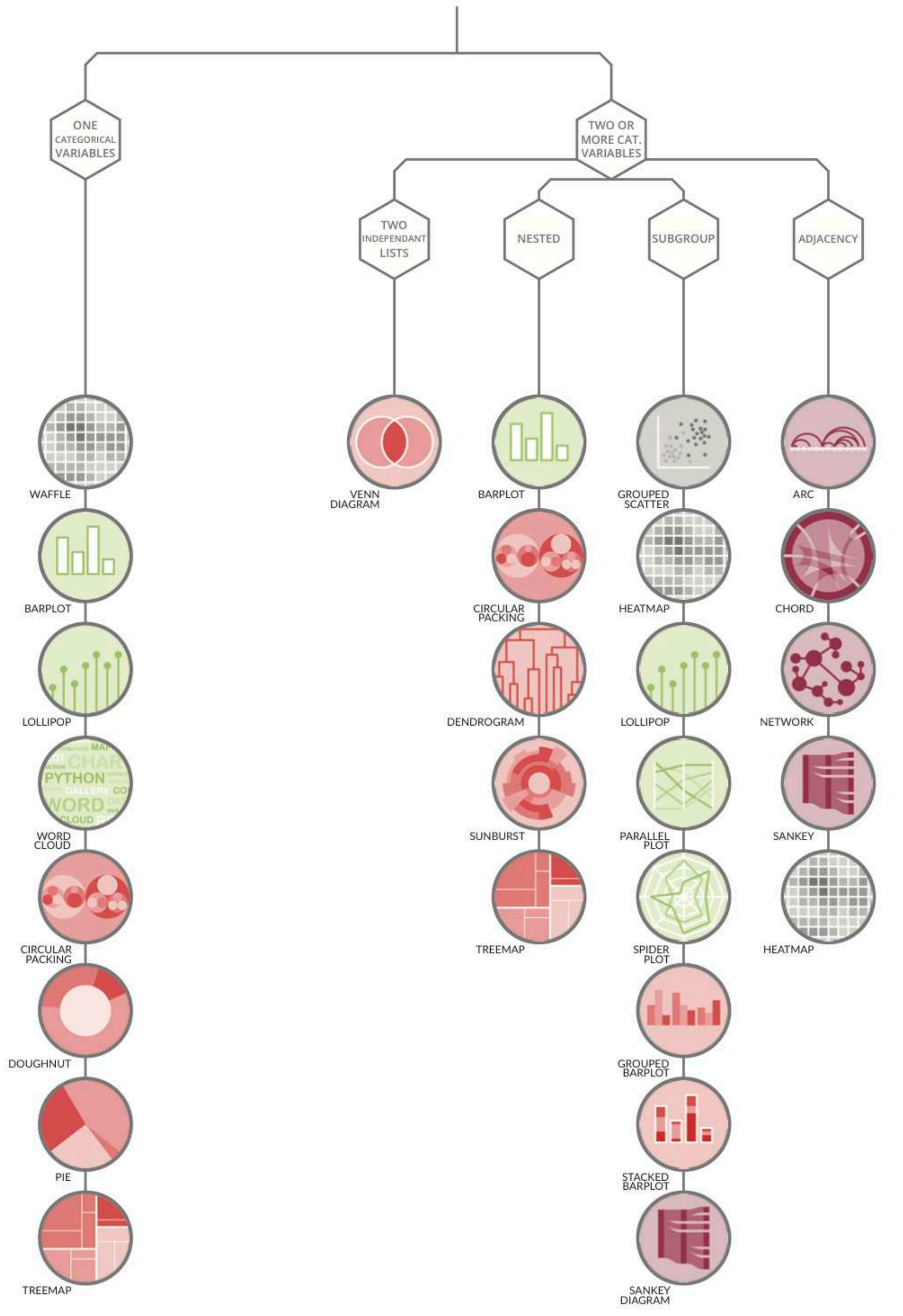
'From Data to Viz' is a classification of chart types based on input data format. It will help you find the perfect chart in three simple steps :

1. Identify what type of data you have.
2. Go to the corresponding decision tree and follow it down to a set of possible charts.
3. Choose the chart from the set that will suit your data and your needs best.

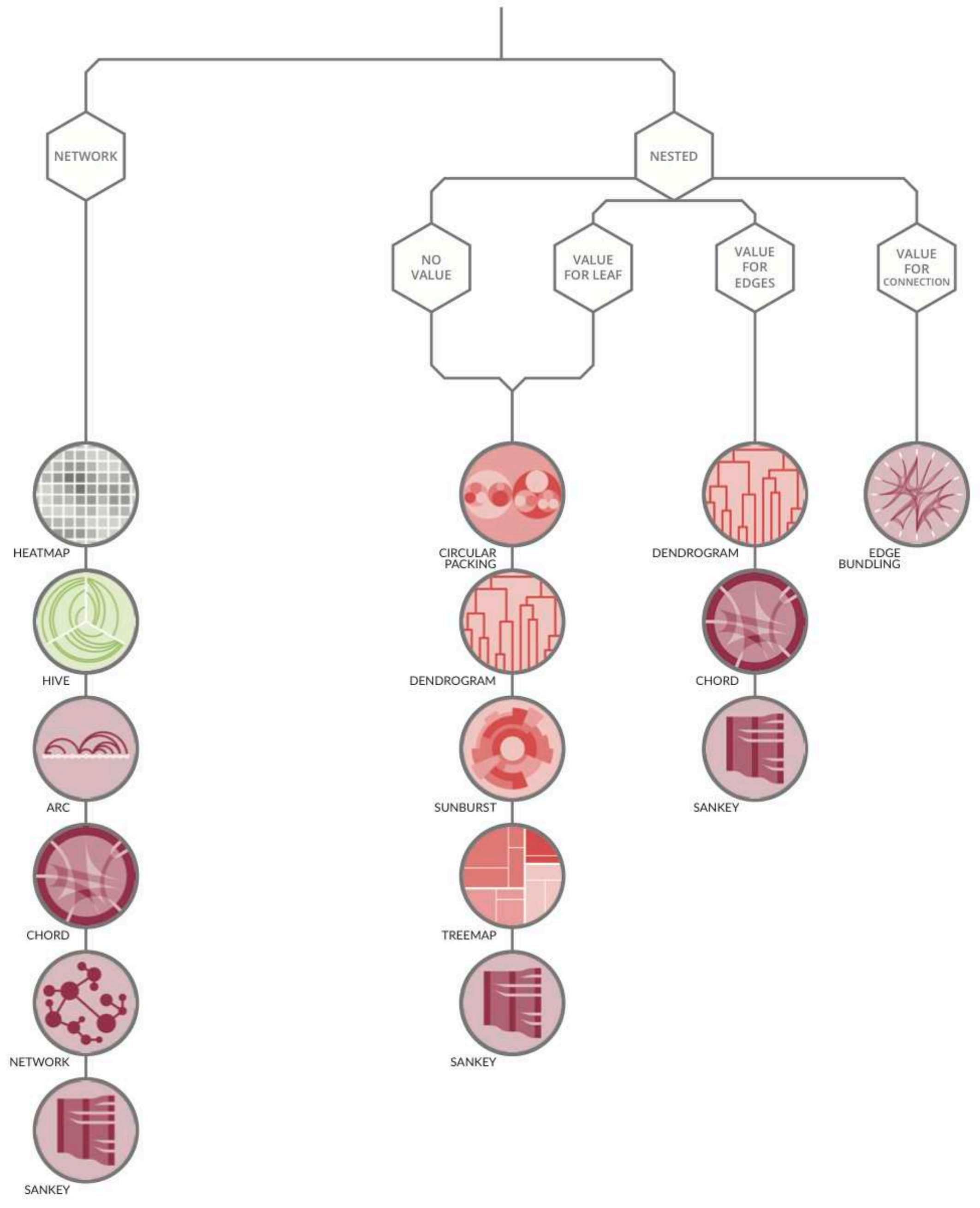
Dataviz is a world with endless possibilities and this project does not claim to be exhaustive. However it should provide you with a good starting point. For an interactive version and much more, visit:

data-to-viz.com

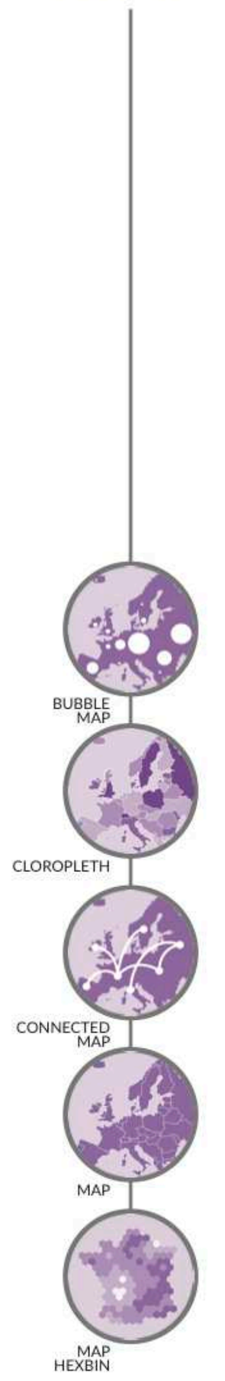
CATEGORIC



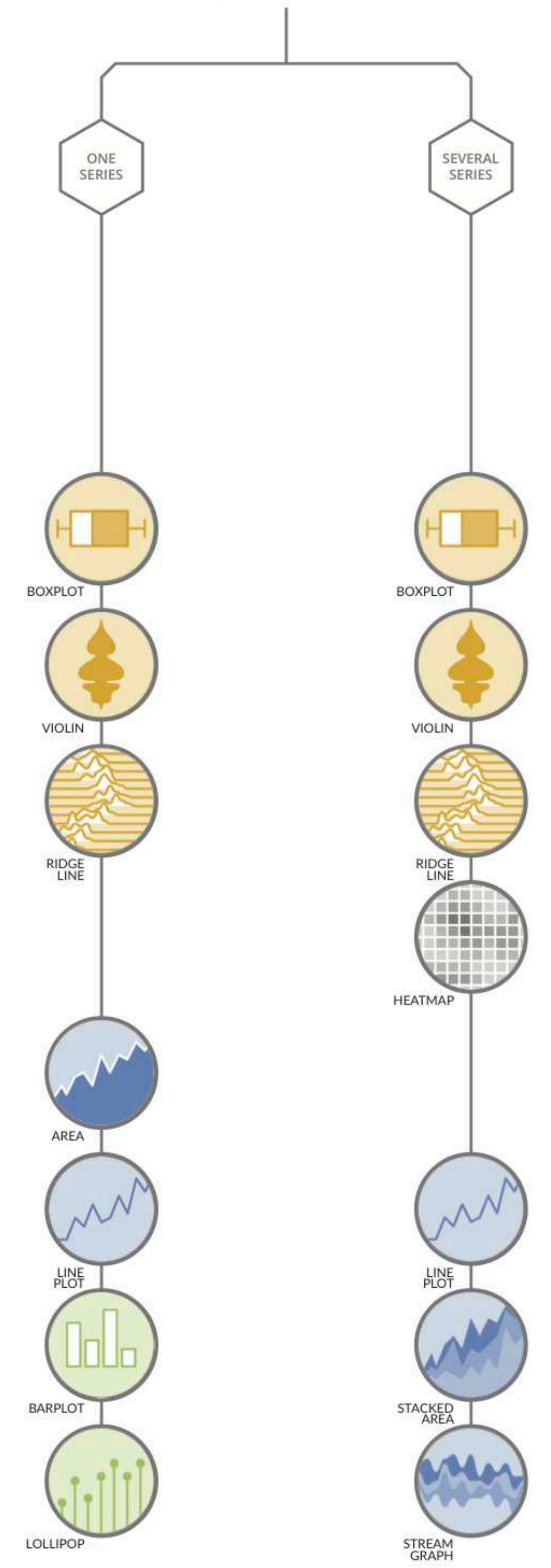
RELATIONAL



MAP



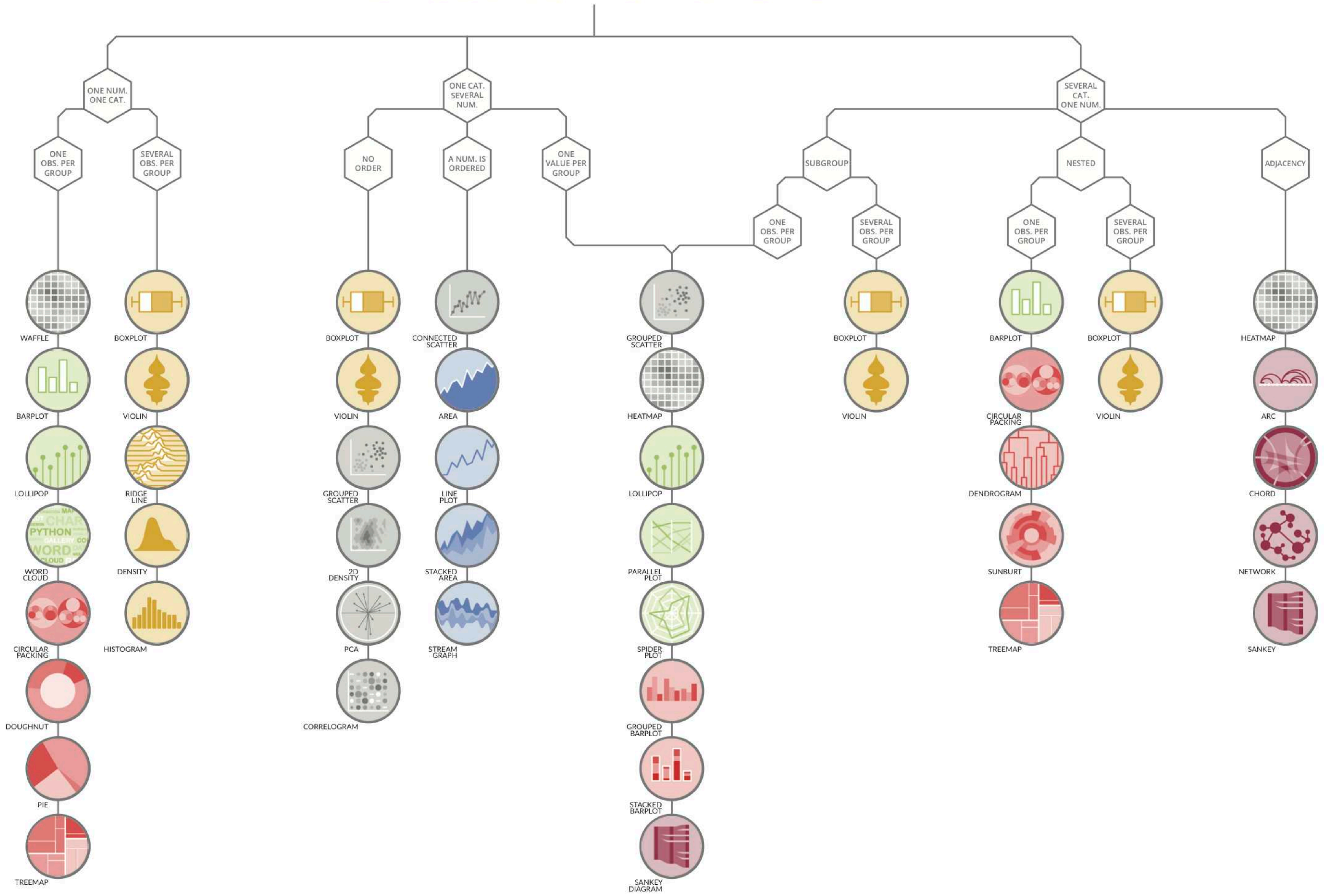
TIME SERIES



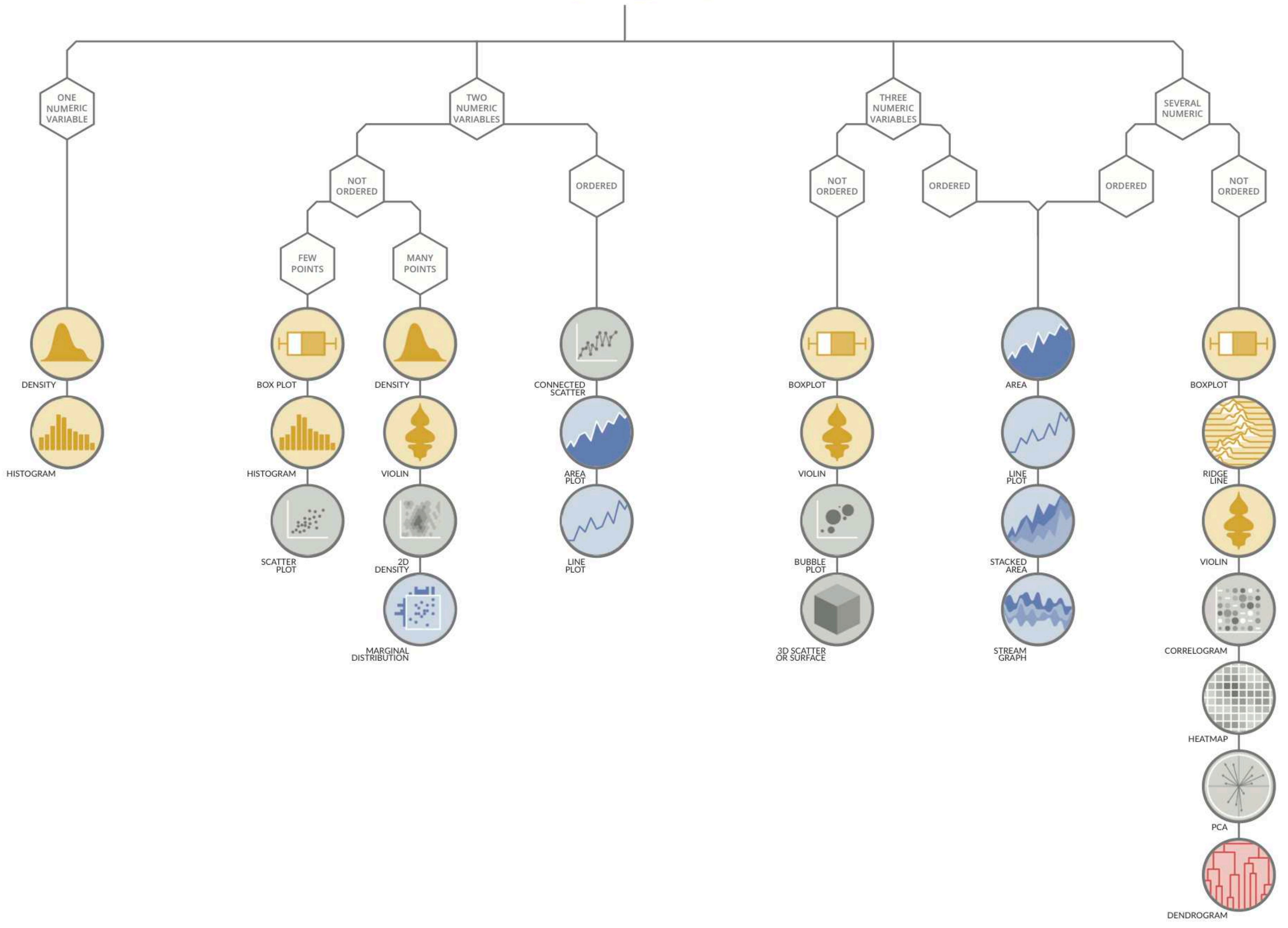
WHAT DO YOU WANT TO SHOW ?

- ● Distribution
- ● Correlation
- ● Ranking
- ● Part of a whole
- ● Evolution
- ● Maps
- ● Flow

CATEGORIC AND NUMERIC



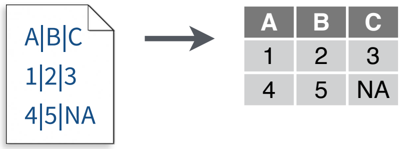
NUMERIC



Data import with the tidyverse : : CHEATSHEET

Read Tabular Data with readr

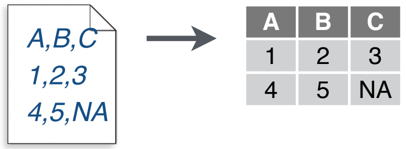
read_*(file, col_names = TRUE, col_types = NULL, col_select = NULL, id = NULL, locale, n_max = Inf, skip = 0, na = c("", "NA"), guess_max = min(1000, n_max), show_col_types = TRUE) See **?read_delim**



```
A|B|C
1|2|3
4|5|NA
```

A	B	C
1	2	3
4	5	NA

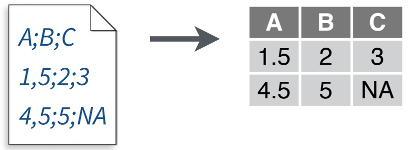
read_delim("file.txt", delim = "|"**)** Read files with any delimiter. If no delimiter is specified, it will automatically guess.
To make file.txt, run: write_file("A|B|C\n1|2|3\n4|5|NA", file = "file.txt")



```
A,B,C
1,2,3
4,5,NA
```

A	B	C
1	2	3
4	5	NA

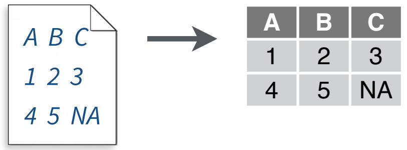
read_csv("file.csv"**)** Read a comma delimited file with period decimal marks.
write_file("A,B,C\n1,2,3\n4,5,NA", file = "file.csv")



```
A;B;C
1,5;2;3
4,5;5;NA
```

A	B	C
1.5	2	3
4.5	5	NA

read_csv2("file2.csv"**)** Read semicolon delimited files with comma decimal marks.
write_file("A;B;C\n1,5;2;3\n4,5;5;NA", file = "file2.csv")



```
A B C
1 2 3
4 5 NA
```

A	B	C
1	2	3
4	5	NA

read_tsv("file.tsv"**)** Read a tab delimited file. Also **read_table()**.
read_fwf("file.tsv", fwf_widths(c(2, 2, NA))**)** Read a fixed width file.
write_file("A\tB\tC\n1\t2\t3\n4\t5\tNA\n", file = "file.tsv")

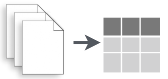
USEFUL READ ARGUMENTS

A	B	C
1	2	3
4	5	NA

No header
read_csv("file.csv", **col_names = FALSE**)

x	y	z
A	B	C
1	2	3
4	5	NA

Provide header
read_csv("file.csv",
  col_names = c("x", "y", "z"))



Read multiple files into a single table
read_csv(**c("f1.csv", "f2.csv", "f3.csv")**,
  id = "origin_file")

1	2	3
4	5	NA

Skip lines
read_csv("file.csv", **skip = 1**)

A	B	C
1	2	3

Read a subset of lines
read_csv("file.csv", **n_max = 1**)

A	B	C
NA	2	3
4	5	NA

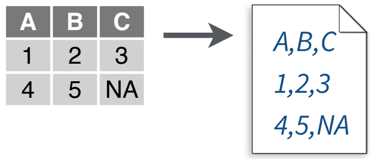
Read values as missing
read_csv("file.csv", **na = c("1")**)

```
A;B;C
1,5;2;3,0
```

Specify decimal marks
read_delim("file2.csv", **locale =
  locale(decimal_mark = ",")**)

Save Data with readr

write_*(x, file, na = "NA", append, col_names, quote, escape, eol, num_threads, progress)



A	B	C
1	2	3
4	5	NA

```
A,B,C
1,2,3
4,5,NA
```

write_delim(x, file, delim = " "**)** Write files with any delimiter.

write_csv(x, file**)** Write a comma delimited file.

write_csv2(x, file**)** Write a semicolon delimited file.

write_tsv(x, file**)** Write a tab delimited file.

One of the first steps of a project is to import outside data into R. Data is often stored in tabular formats, like csv files or spreadsheets.

The front page of this sheet shows how to import and save text files into R using **readr**.

The back page shows how to import spreadsheet data from Excel files using **readxl** or Google Sheets using **googlesheets4**.

OTHER TYPES OF DATA

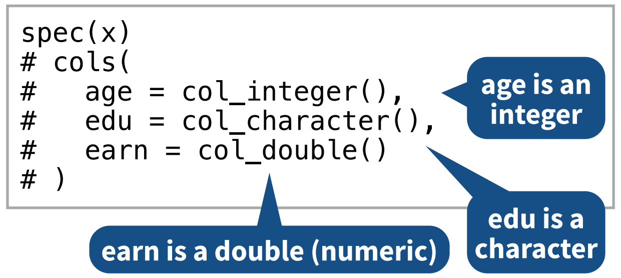
Try one of the following packages to import other types of files:

- **haven** - SPSS, Stata, and SAS files
- **DBI** - databases
- **jsonlite** - json
- **xml2** - XML
- **httr** - Web APIs
- **rvest** - HTML (Web Scraping)
- **readr::read_lines()** - text data

Column Specification with readr

Column specifications define what data type each column of a file will be imported as. By default readr will generate a column spec when a file is read and output a summary.

spec(x**)** Extract the full column specification for the given imported data frame.



```
spec(x)
# cols(
#   age = col_integer(),
#   edu = col_character(),
#   earn = col_double()
# )
```

COLUMN TYPES

Each column type has a function and corresponding string abbreviation.

- **col_logical()** - "l"
- **col_integer()** - "i"
- **col_double()** - "d"
- **col_number()** - "n"
- **col_character()** - "c"
- **col_factor(**levels, ordered = FALSE**)** - "f"
- **col_datetime(**format = ""**)** - "T"
- **col_date(**format = ""**)** - "D"
- **col_time(**format = ""**)** - "t"
- **col_skip()** - "-", "_"
- **col_guess()** - "?"

USEFUL COLUMN ARGUMENTS

Hide col spec message
read_*(file, **show_col_types = FALSE**)

Select columns to import
Use names, position, or selection helpers.
read_*(file, **col_select = c(age, earn)**)

Guess column types
To guess a column type, read_ *() looks at the first 1000 rows of data. Increase with **guess_max**.
read_*(file, **guess_max = Inf**)

DEFINE COLUMN SPECIFICATION

Set a default type

```
read_csv(
  file,
  col_type = list(.default = col_double())
)
```

Use column type or string abbreviation

```
read_csv(
  file,
  col_type = list(x = col_double(), y = "l", z = "_")
)
```

Use a single string of abbreviations

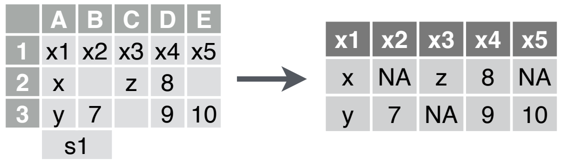
```
# col types: skip, guess, integer, logical, character
read_csv(
  file,
  col_type = "_?ilc"
)
```

posit®

Import Spreadsheets

with readxl

READ EXCEL FILES



	A	B	C	D	E
1	x1	x2	x3	x4	x5
2	x		z	8	
3	y	7		9	10

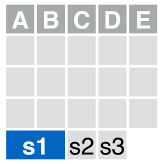
s1

x1	x2	x3	x4	x5
x	NA	z	8	NA
y	7	NA	9	10

read_excel(path, sheet = NULL, range = NULL**)**
Read a .xls or .xlsx file based on the file extension. See front page for more read arguments. Also **read_xls()** and **read_xlsx()**.

```
read_excel("excel_file.xlsx")
```

READ SHEETS

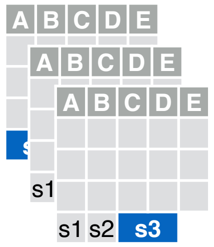


read_excel(path, **sheet = NULL)** Specify which sheet to read by position or name.

```
read_excel(path, sheet = 1)
read_excel(path, sheet = "s1")
```

excel_sheets(path**)** Get a vector of sheet names.

```
excel_sheets("excel_file.xlsx")
```



To **read multiple sheets:**

1. Get a vector of sheet names from the file path.
2. Set the vector names to be the sheet names.
3. Use purrr::map() and purrr::list_rbind() to read multiple files into one data frame.

```
path <- "your_file_path.xlsx"
path |>
  excel_sheets() |>
  set_names() |>
  map(read_excel, path = path) |>
  list_rbind()
```

READXL COLUMN SPECIFICATION

Column specifications define what data type each column of a file will be imported as.

Use the **col_types** argument of **read_excel()** to set the column specification.

Guess column types
To guess a column type, read_ excel() looks at the first 1000 rows of data. Increase with the **guess_max** argument.

```
read_excel(path, guess_max = Inf)
```

Set all columns to same type, e.g. character

```
read_excel(path, col_types = "text")
```

Set each column individually

```
read_excel(
  path,
  col_types = c("text", "guess", "guess","numeric")
)
```

COLUMN TYPES

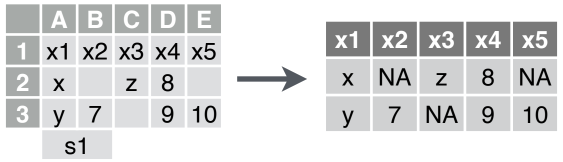
logical	numeric	text	date	list
TRUE	2	hello	1947-01-08	hello
FALSE	3.45	world	1956-10-21	1

- skip
- guess
- logical
- numeric
- text
- date
- list

Use **list** for columns that include multiple data types. See **tidyr** and **purrr** for list-column data.

with googlesheets4

READ SHEETS



	A	B	C	D	E
1	x1	x2	x3	x4	x5
2	x		z	8	
3	y	7		9	10

s1

x1	x2	x3	x4	x5
x	NA	z	8	NA
y	7	NA	9	10

read_sheet(ss, sheet = NULL, range = NULL**)**
Read a sheet from a URL, a Sheet ID, or a dribble from the googledrive package. See front page for more read arguments. Same as **range_read()**.

SHEETS METADATA

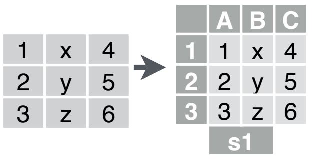
URLs are in the form:
https://docs.google.com/spreadsheets/d/
SPREADSHEET_ID/edit#gid=**SHEET_ID**

gs4_get(ss**)** Get spreadsheet meta data.

gs4_find(...**)** Get data on all spreadsheet files.

sheet_properties(ss**)** Get a tibble of properties for each worksheet. Also **sheet_names()**.

WRITE SHEETS

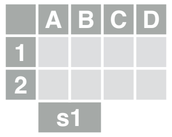


1	x	4
2	y	5
3	z	6

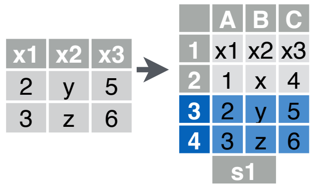
	A	B	C
1	1	x	4
2	2	y	5
3	3	z	6

s1

write_sheet(data, ss = NULL, sheet = NULL**)** Write a data frame into a new or existing Sheet.



gs4_create(name, ..., sheets = NULL**)** Create a new Sheet with a vector of names, a data frame, or a (named) list of data frames.



x1	x2	x3
2	y	5
3	z	6

	A	B	C
1	x1	x2	x3
2	1	x	4
3	2	y	5
4	3	z	6

s1

sheet_append(ss, data, sheet = 1**)** Add rows to the end of a worksheet.

GOOGLESHEETS4 COLUMN SPECIFICATION

Column specifications define what data type each column of a file will be imported as.

Use the **col_types** argument of **read_sheet()/ range_read()** to set the column specification.

Guess column types
To guess a column type read_sheet()/ range_read() looks at the first 1000 rows of data. Increase with **guess_max**.

```
read_sheet(path, guess_max = Inf)
```

Set all columns to same type, e.g. character

```
read_sheet(path, col_types = "c")
```

Set each column individually

```
# col types: skip, guess, integer, logical, character
read_sheets(ss, col_types = "_?ilc")
```

COLUMN TYPES

l	n	c	D	L
TRUE	2	hello	1947-01-08	hello
FALSE	3.45	world	1956-10-21	1

- skip - "_" or "-"
- guess - "?"
- logical - "l"
- integer - "i"
- double - "d"
- numeric - "n"
- date - "D"
- datetime - "T"
- character - "c"
- list-column - "L"
- cell - "C" Returns list of raw cell data.

Use list for columns that include multiple data types. See **tidyr** and **purrr** for list-column data.

OTHER USEFUL EXCEL PACKAGES

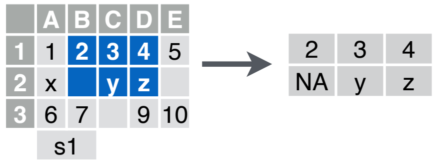
For functions to write data to Excel files, see:

- **openxlsx**
- **writexl**

For working with non-tabular Excel data, see:

- **tidyxl**

CELL SPECIFICATION FOR READXL AND GOOGLESHEETS4



	A	B	C	D	E
1	1	2	3	4	5
2	x		y	z	
3	6	7		9	10

s1

2	3	4
NA	y	z

Use the **range** argument of **readxl::read_excel()** or **googlesheets4::read_sheet()** to read a subset of cells from a sheet.

```
read_excel(path, range = "Sheet1!B1:D2")
read_sheet(ss, range = "B1:D2")
```

Also use the range argument with cell specification functions **cell_limits()**, **cell_rows()**, **cell_cols()**, and **anchored().**

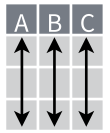
FILE LEVEL OPERATIONS

googlesheets4 also offers ways to modify other aspects of Sheets (e.g. freeze rows, set column width, manage (work)sheets). Go to **googlesheets4.tidyverse.org** to read more.

For whole-file operations (e.g. renaming, sharing, placing within a folder), see the tidyverse package **googledrive** at **googledrive.tidyverse.org**.

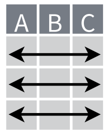
Data tidying with tidyr : : **CHEATSHEET**

Tidy data is a way to organize tabular data in a consistent data structure across packages.
A table is tidy if:

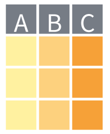


Each **variable** is in its own **column**

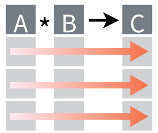
&



Each **observation**, or **case**, is in its own row



Access **variables** as **vectors**



Preserve **cases** in vectorized operations

Tibbles

AN ENHANCED DATA FRAME

Tibbles are a table format provided by the **tibble** package. They inherit the data frame class, but have improved behaviors:

- **Subset** a new tibble with], a vector with [[and $.
- **No partial matching** when subsetting columns.
- **Display** concise views of the data on one screen.

options(tibble.print_max = n, tibble.print_min = m, tibble.width = Inf) Control default display settings.

View() or **glimpse()** View the entire data set.

CONSTRUCT A TIBBLE

tibble(…**)** Construct by columns.

```
tibble(x = 1:3, y = c("a", "b", "c"))
```

tribble(…**)** Construct by rows.

```
tribble(~x,  ~y,
         1, "a",
         2, "b",
         3, "c")
```

Both make this tibble

```
A tibble: 3 × 2
      x     y
  <int> <chr>
1     1     a
2     2     b
3     3     c
```

as_tibble(x, …**)** Convert a data frame to a tibble.

enframe(x, name = "name", value = "value"**)** Convert a named vector to a tibble. Also **deframe()**.

is_tibble(x**)** Test whether x is a tibble.

Reshape Data

- Pivot data to reorganize values into a new layout.

table4a

country	1999	2000
A	0.7K	2K
B	37K	80K
C	212K	213K

country	year	cases
A	1999	0.7K
B	1999	37K
C	1999	212K
A	2000	2K
B	2000	80K
C	2000	213K

pivot_longer(data, cols, names_to = "name", values_to = "value", values_drop_na = FALSE**)**

"Lengthen" data by collapsing several columns into two. Column names move to a new names_to column and values to a new values_to column.

```
pivot_longer(table4a, cols = 2:3, names_to ="year",
  values_to = "cases")
```

table2

country	year	type	count
A	1999	cases	0.7K
A	1999	pop	19M
A	2000	cases	2K
A	2000	pop	20M
B	1999	cases	37K
B	1999	pop	172M
B	2000	cases	80K
B	2000	pop	174M
C	1999	cases	212K
C	1999	pop	1T
C	2000	cases	213K
C	2000	pop	1T

country	year	cases	pop
A	1999	0.7K	19M
A	2000	2K	20M
B	1999	37K	172M
B	2000	80K	174M
C	1999	212K	1T
C	2000	213K	1T

pivot_wider(data, names_from = "name", values_from = "value"**)**

The inverse of pivot_longer(). "Widen" data by expanding two columns into several. One column provides the new column names, the other the values.

```
pivot_wider(table2, names_from = type,
  values_from = count)
```

Split Cells

- Use these functions to split or combine cells into individual, isolated values.

table5

country	century	year
A	19	99
A	20	00
B	19	99
B	20	00

country	year
A	1999
A	2000
B	1999
B	2000

unite(data, col, …, sep = "_", remove = TRUE, na.rm = FALSE**)** Collapse cells across several columns into a single column.

```
unite(table5, century, year, col = "year", sep = "")
```

table3

country	year	rate
A	1999	0.7K/19M
A	2000	2K/20M
B	1999	37K/172M
B	2000	80K/174M

country	year	cases	pop
A	1999	0.7K	19M
A	2000	2K	20M
B	1999	37K	172
B	2000	80K	174

separate_wider_delim(data, cols, delim, ..., names = NULL, names_sep = NULL, names_repair = "check unique", too_few, too_many, cols_remove = TRUE**)** Separate each cell in a column into several columns. Also **separate_wider_regex()** and **separate_wider_position()**.

```
separate(table3, rate, sep = "/",
  into = c("cases", "pop"))
```

table3

country	year	rate
A	1999	0.7K/19M
A	2000	2K/20M
B	1999	37K/172M
B	2000	80K/174M

country	year	rate
A	1999	0.7K
A	1999	19M
A	2000	2K
A	2000	20M
B	1999	37K
B	1999	172M
B	2000	80K
B	2000	174M

separate_longer_delim(data, cols, delim, .., width, keep_eampty**)** Separate each cell in a column into several rows.

```
separate_longer_delim(table3, rate, sep = "/")
```

Expand Tables

Create new combinations of variables or identify implicit missing values (combinations of variables not present in the data).

x

x1	x2	x3
A	1	3
B	1	4
B	2	3

x1	x2
A	1
A	2
B	1
B	2

expand(data, …**)** Create a new tibble with all possible combinations of the values of the variables listed in … Drop other variables.

```
expand(mtcars, cyl, gear,
carb)
```

x

x1	x2	x3
A	1	3
B	1	4
B	2	3

x1	x2	x3
A	1	3
A	2	NA
B	1	4
B	2	3

complete(data, …, fill = list()**)** Add missing possible combinations of values of variables listed in … Fill remaining variables with NA.

```
complete(mtcars, cyl, gear,
carb)
```

Handle Missing Values

Drop or replace explicit missing values (NA).

x

x1	x2
A	1
B	NA
C	NA
D	3
E	NA

x1	x2
A	1
D	3

drop_na(data, …**)** Drop rows containing NA's in … columns.

```
drop_na(x, x2)
```

x

x1	x2
A	1
B	NA
C	NA
D	3
E	NA

x1	x2
A	1
B	1
C	1
D	3
E	3

fill(data, …, .direction = "down"**)** Fill in NA's in … columns using the next or previous value.

```
fill(x, x2)
```

x

x1	x2
A	1
B	NA
C	NA
D	3
E	NA

x1	x2
A	1
B	2
C	2
D	3
E	2

replace_na(data, replace**)** Specify a value to replace NA in selected columns.

```
replace_na(x, list(x2 = 2))
```

Nested Data

A **nested data frame** stores individual tables as a list-column of data frames within a larger organizing data frame. List-columns can also be lists of vectors or lists of varying data types.
Use a nested data frame to:

- Preserve relationships between observations and subsets of data. Preserve the type of the variables being nested (factors and datetimes aren't coerced to character).
- Manipulate many sub-tables at once with **purrr** functions like map(), map2(), or pmap() or with **dplyr** rowwise() grouping.

CREATE NESTED DATA

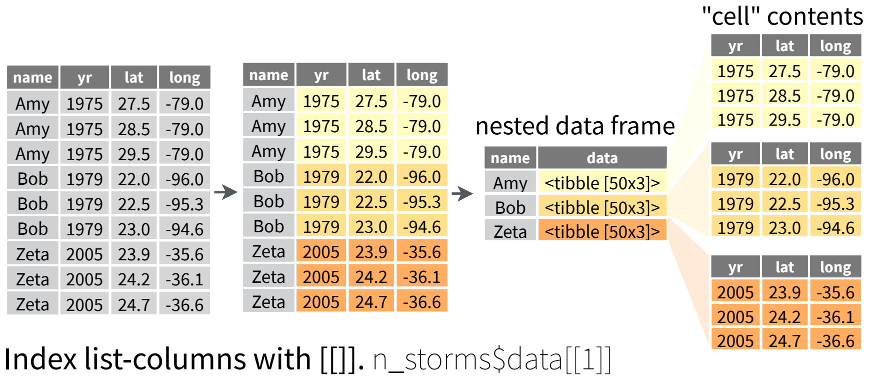
nest(data, …**)** Moves groups of cells into a list-column of a data frame. Use alone or with dplyr::**group_by()**:

1. Group the data frame with **group_by()** and use **nest()** to move the groups into a list-column.

```
n_storms <- storms |>
  group_by(name) |>
  nest()
```

2. Use **nest(new_col = c(x, y))** to specify the columns to group using dplyr::**select()** syntax.

```
n_storms <- storms |>
  nest(data = c(year:long))
```



name	yr	lat	long
Amy	1975	27.5	-79.0
Amy	1975	28.5	-79.0
Amy	1975	29.5	-79.0
Bob	1979	22.0	-96.0
Bob	1979	22.5	-95.3
Bob	1979	23.0	-94.6
Zeta	2005	23.9	-35.6
Zeta	2005	24.2	-36.1
Zeta	2005	24.7	-36.6

name	yr	lat	long
Amy	1975	27.5	-79.0
Amy	1975	28.5	-79.0
Amy	1975	29.5	-79.0
Bob	1979	22.0	-96.0
Bob	1979	22.5	-95.3
Bob	1979	23.0	-94.6
Zeta	2005	23.9	-35.6
Zeta	2005	24.2	-36.1
Zeta	2005	24.7	-36.6

nested data frame

name	data
Amy	<tibble [50x3]>
Bob	<tibble [50x3]>
Zeta	<tibble [50x3]>

"cell" contents

yr	lat	long
1975	27.5	-79.0
1975	28.5	-79.0
1975	29.5	-79.0

yr	lat	long
1979	22.0	-96.0
1979	22.5	-95.3
1979	23.0	-94.6

yr	lat	long
2005	23.9	-35.6
2005	24.2	-36.1
2005	24.7	-36.6

Index list-columns with [[]]. n_storms$data[[1]]

CREATE TIBBLES WITH LIST-COLUMNS

tibble::**tribble(**…**)** Makes list-columns when needed.

```
tribble( ~max, ~seq,
          3,   1:3,
          4,   1:4,
          5,   1:5)
```

max	seq
3	<int [3]>
4	<int [4]>
5	<int [5]>

tibble::**tibble(**…**)** Saves list input as list-columns.

```
tibble(max = c(3, 4, 5), seq = list(1:3, 1:4, 1:5))
```

tibble::**enframe(**x, name="name", value="value"**)** Converts multi-level list to a tibble with list-cols.

```
enframe(list('3'=1:3, '4'=1:4, '5'=1:5), 'max', 'seq')
```

OUTPUT LIST-COLUMNS FROM OTHER FUNCTIONS

dplyr::**mutate()**, **transmute()**, and **summarise()** will output list-columns if they return a list.

```
mtcars |>
  group_by(cyl) |>
  summarise(q = list(quantile(mpg)))
```

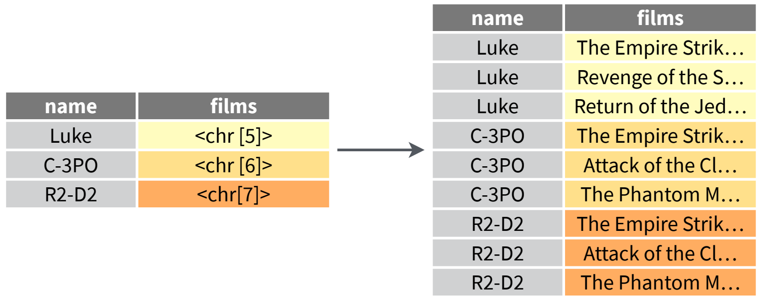
RESHAPE NESTED DATA

unnest(data, cols, ..., keep_empty = FALSE**)** Flatten nested columns back to regular columns. The inverse of nest().

```
n_storms |> unnest(data)
```

unnest_longer(data, col, values_to = NULL, indices_to = NULL**)** Turn each element of a list-column into a row.

```
starwars |>
  select(name, films) |>
  unnest_longer(films)
```

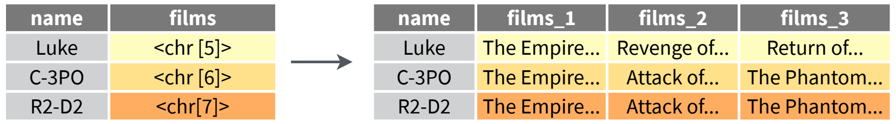


name	films
Luke	<chr [5]>
C-3PO	<chr [6]>
R2-D2	<chr[7]>

name	films
Luke	The Empire Strik…
Luke	Revenge of the S…
Luke	Return of the Jed…
C-3PO	The Empire Strik…
C-3PO	Attack of the Cl…
C-3PO	The Phantom M…
R2-D2	The Empire Strik…
R2-D2	Attack of the Cl…
R2-D2	The Phantom M…

unnest_wider(data, col**)** Turn each element of a list-column into a regular column.

```
starwars |>
  select(name, films) |>
  unnest_wider(films, names_sep = "_")
```

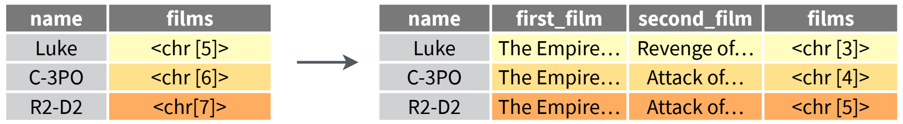


name	films
Luke	<chr [5]>
C-3PO	<chr [6]>
R2-D2	<chr[7]>

name	films_1	films_2	films_3
Luke	The Empire...	Revenge of...	Return of...
C-3PO	The Empire...	Attack of...	The Phantom...
R2-D2	The Empire...	Attack of...	The Phantom...

hoist(.data, .col, ..., .remove = TRUE**)** Selectively pull list components out into their own top-level columns. Uses purrr::pluck() syntax for selecting from lists.

```
starwars |>
  select(name, films) |>
  hoist(films, first_film = 1, second_film = 2)
```



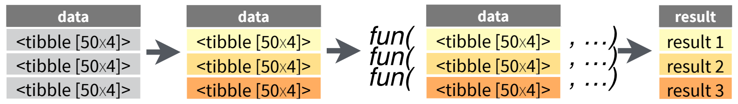
name	films
Luke	<chr [5]>
C-3PO	<chr [6]>
R2-D2	<chr[7]>

name	first_film	second_film	films
Luke	The Empire…	Revenge of…	<chr [3]>
C-3PO	The Empire…	Attack of…	<chr [4]>
R2-D2	The Empire…	Attack of…	<chr [5]>

TRANSFORM NESTED DATA

A vectorized function takes a vector, transforms each element in parallel, and returns a vector of the same length. By themselves vectorized functions cannot work with lists, such as list-columns.

dplyr::**rowwise(**.data, …**)** Group data so that each row is one group, and within the groups, elements of list-columns appear directly (accessed with [[ ), not as lists of length one. **When you use rowwise(), dplyr functions will seem to apply functions to list-columns in a vectorized fashion.**



data
<tibble [50x4]>
<tibble [50x4]>
<tibble [50x4]>

data
<tibble [50x4]>
<tibble [50x4]>
<tibble [50x4]>

	data			result
fun(	<tibble [50x4]>	, …)		result 1
fun(	<tibble [50x4]>	, …)		result 2
fun(	<tibble [50x4]>	, …)		result 3

Apply a function to a list-column and **create a new list-column.**

```
n_storms |>
  rowwise() |>
  mutate(n = list(dim(data)))
```

dim() returns two values per row

wrap with list to tell mutate to create a list-column

Apply a function to a list-column and **create a regular column.**

```
n_storms |>
  rowwise() |>
  mutate(n = nrow(data))
```

nrow() returns one integer per row

Collapse **multiple list-columns** into a single list-column.

```
starwars |>
  rowwise() |>
  mutate(transport = list(append(vehicles, starships)))
```

append() returns a list for each row, so col type must be list

Apply a function to **multiple list-columns.**

```
starwars |>
  rowwise() |>
  mutate(n_transports = length(c(vehicles, starships)))
```

length() returns one integer per row

See **purrr** package for more list functions.

R GRAPHICAL PARAMETERS CHEATSHEET

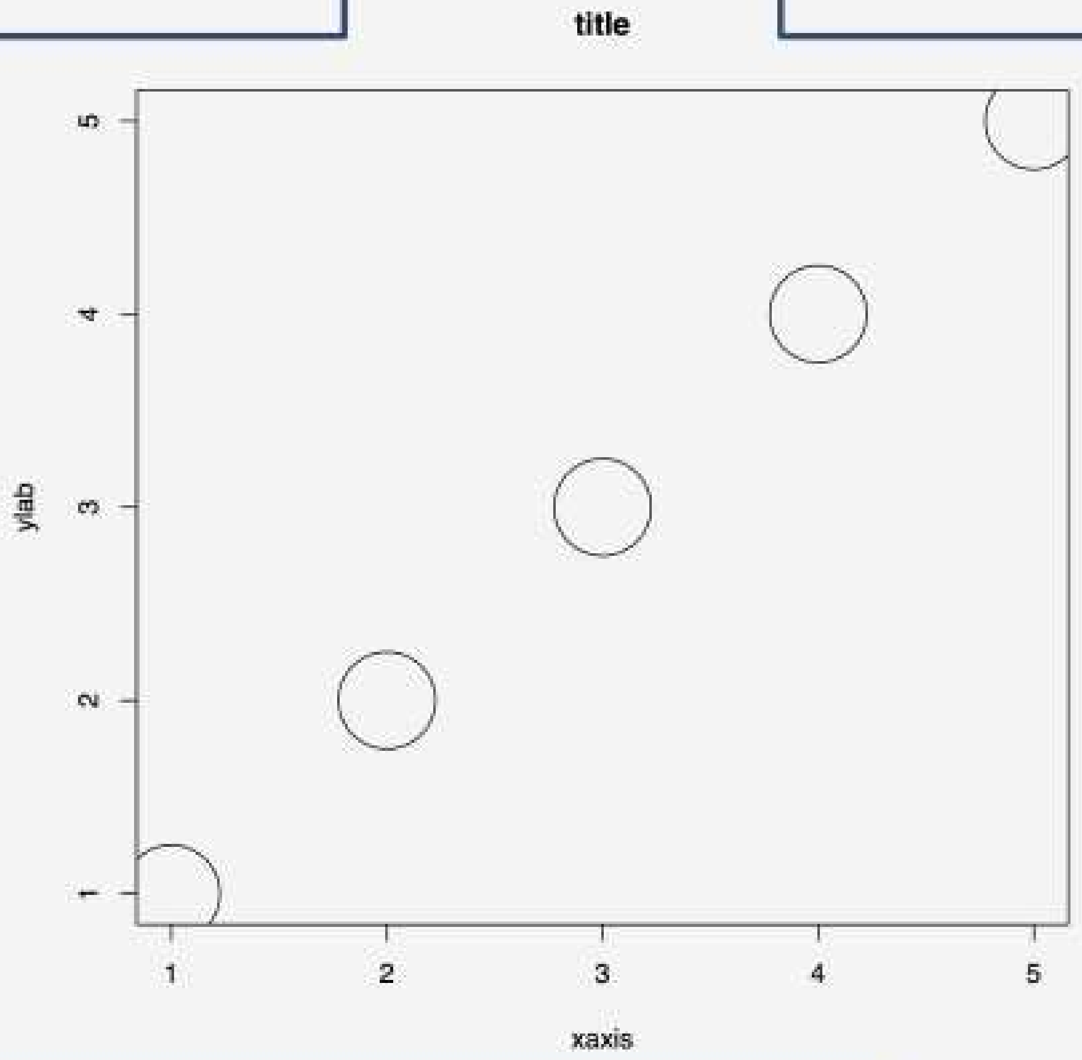
Most of the graphical parameters are presented in this cheatsheet. Visit the R graph gallery for more examples !
www.r-graph-gallery.com

Box feature

bty : kind of box
o=complete / ?=top & right / n=no box / c=top & left & bottom / l=bottom & left

Title

main : name of the title
cex.main : size *cex.main=2*
col.main : color *col.main="red"*
font.main : font *font.main=3*



Margins

See **Graph #135**
mar, oma, omd, omi

General

tck : add a grid on a % of the area *tck=1*
bg : color of the background *par(bg="red")*
font : font of the text *(normal, bold, italic..)*
lheight: size between lines of titles
srt: text rotation in degree

Symbol styles

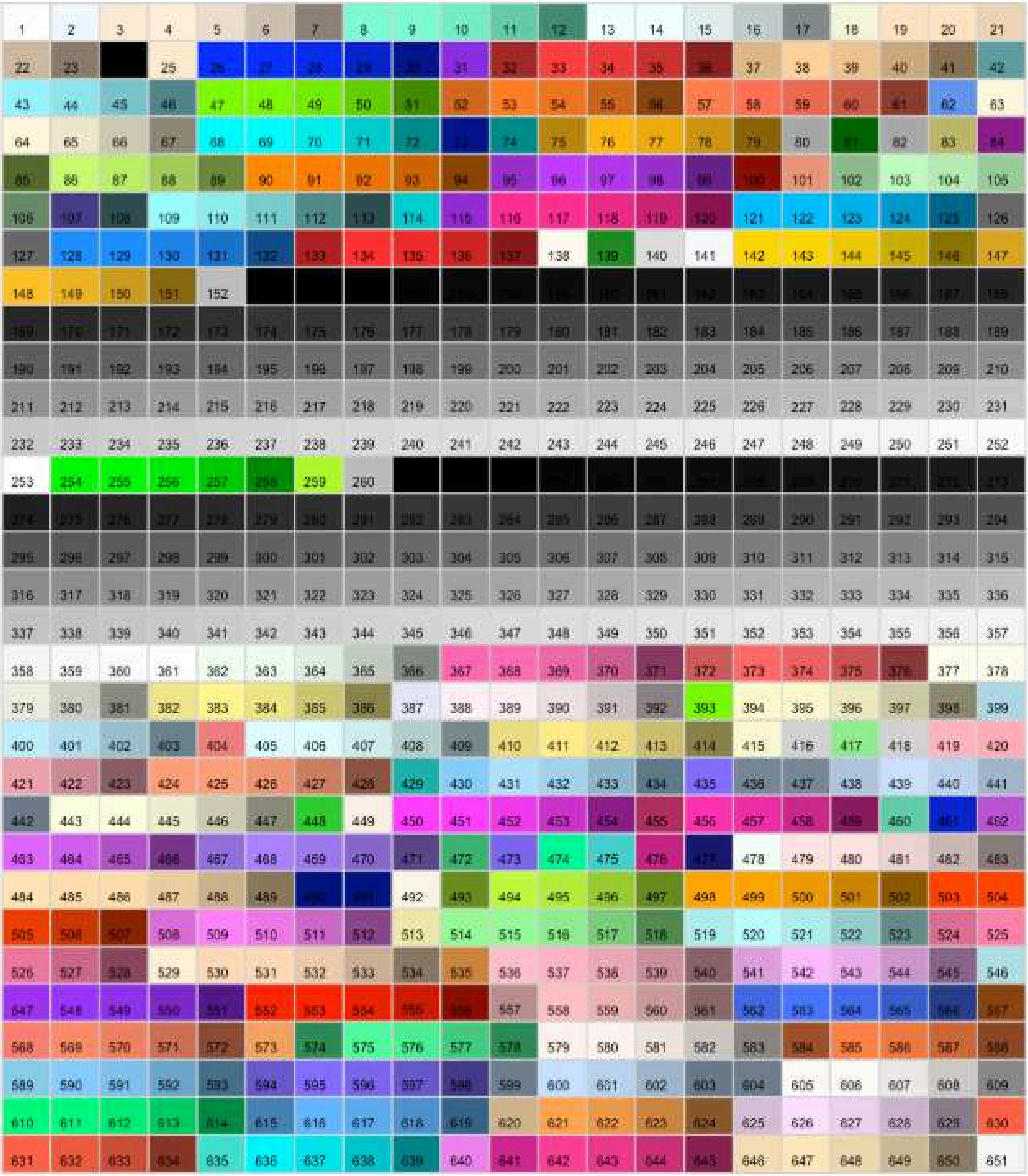
See **Graph #6**
pch, lwd, pty,
col, cex, type...

X-axis features

lab : number of graduation *lab=c(12,2,0)*
xaxp : to add c graduation from a to b: *xaxp=c(a,b,c)*
log : for logarithmic scale: *log="x"*
xaxt : to remove x axis: *xaxt="n"*
fg : color of axis, ticks and grid: *fg="red"*
cex.axis : size of tick labels
col.axis : color of tick labels
xlim : limits of the axis *xlim=c(0,10)*
las: orientation of tick labels
0=parralel to the axis, 1=horizontal...

X-axis name

xlab : name of the axis
cex.lab : size *cex.lab=2*
col.lab : color *col.lab="red"*
sub : to add a subtitle



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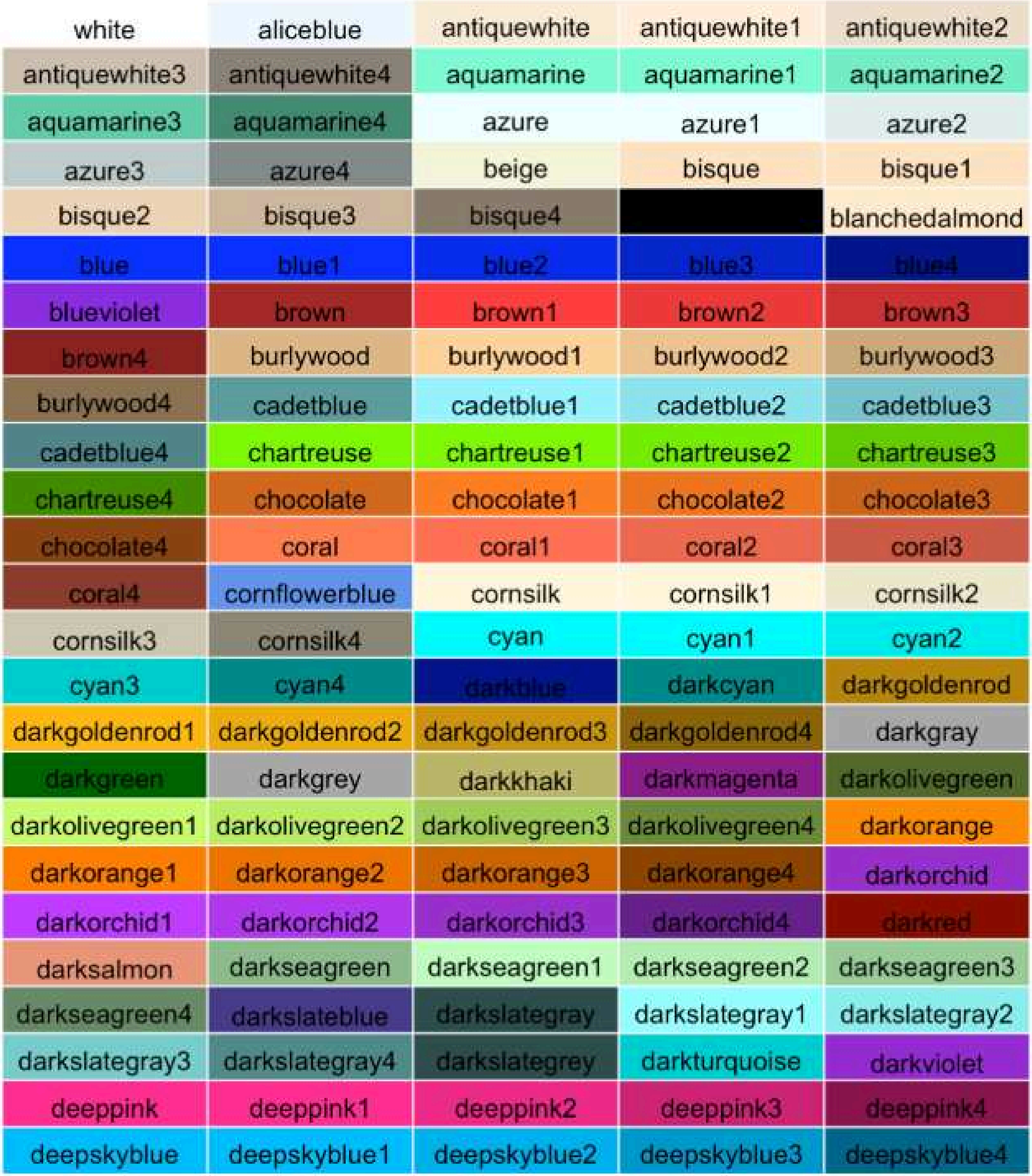

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antiquewhite3	antiquewhite4	aquamarine	aquamarine1	aquamarine2
aquamarine3	aquamarine4	azure	azure1	azure2
azure3	azure4	beige	bisque	bisque1
bisque2	bisque3	bisque4		blanchedalmond
blue	blue1	blue2	blue3	blue4
blueviolet	brown	brown1	brown2	brown3
brown4	burlywood	burlywood1	burlywood2	burlywood3
burlywood4	cadetblue	cadetblue1	cadetblue2	cadetblue3
cadetblue4	chartreuse	chartreuse1	chartreuse2	chartreuse3
chartreuse4	chocolate	chocolate1	chocolate2	chocolate3
chocolate4	coral	coral1	coral2	coral3
coral4	cornflowerblue	cornsilk	cornsilk1	cornsilk2
cornsilk3	cornsilk4	cyan	cyan1	cyan2
cyan3	cyan4	darkblue	darkcyan	darkgoldenrod
darkgoldenrod1	darkgoldenrod2	darkgoldenrod3	darkgoldenrod4	darkgray
darkgreen	darkgrey	darkkhaki	darkmagenta	darkolivegreen
darkolivegreen1	darkolivegreen2	darkolivegreen3	darkolivegreen4	darkorange
darkorange1	darkorange2	darkorange3	darkorange4	darkorchid
darkorchid1	darkorchid2	darkorchid3	darkorchid4	darkred
darksalmon	darkseagreen	darkseagreen1	darkseagreen2	darkseagreen3
darkseagreen4	darkslateblue	darkslategray	darkslategray1	darkslategray2
darkslategray3	darkslategray4	darkslategrey	darkturquoise	darkviolet
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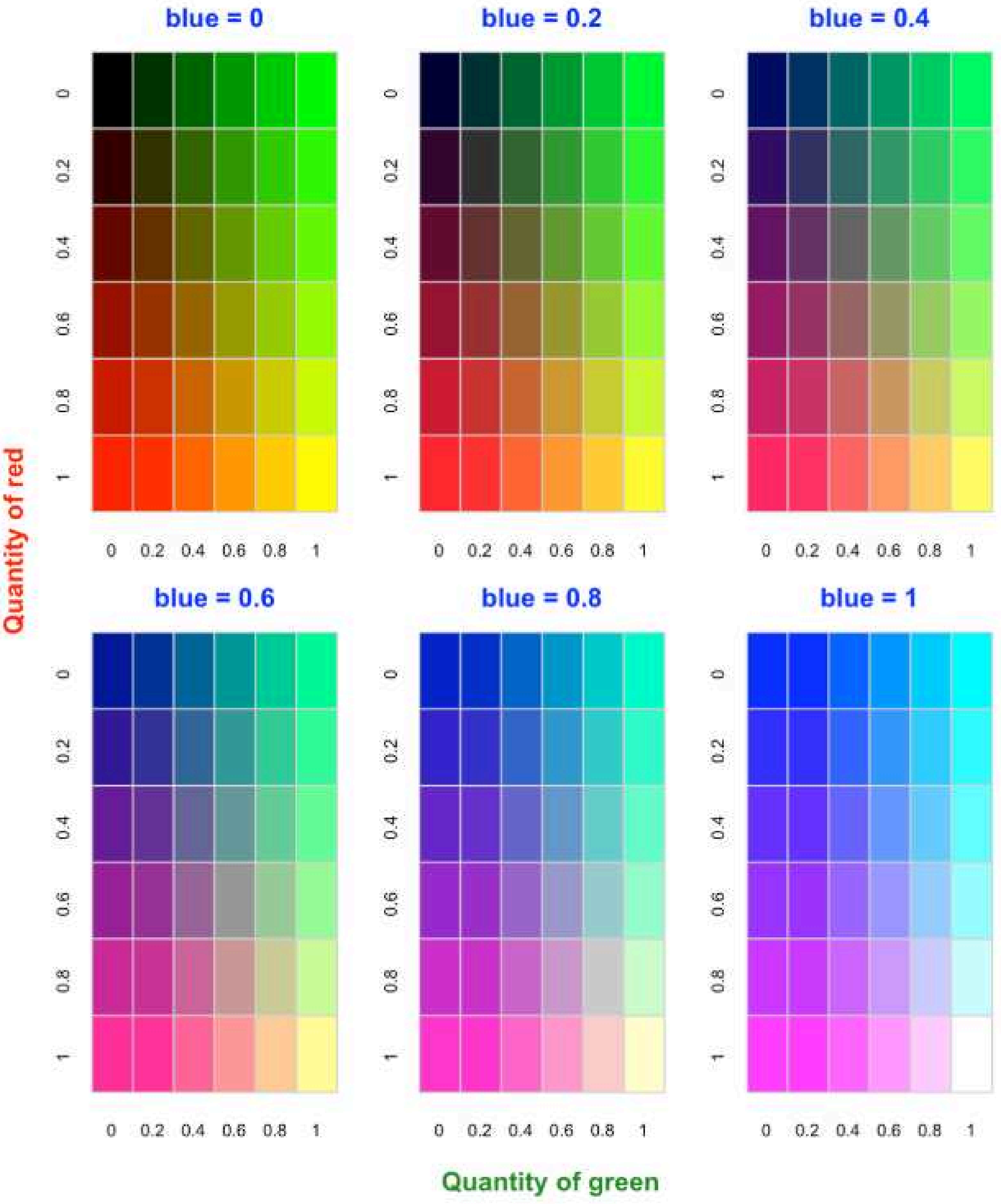
deepskyblue	deepskyblue1	deepskyblue2	deepskyblue3	deepskyblue4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blue = 0.4
blue = 0.6
blue = 0.8
blue = 1
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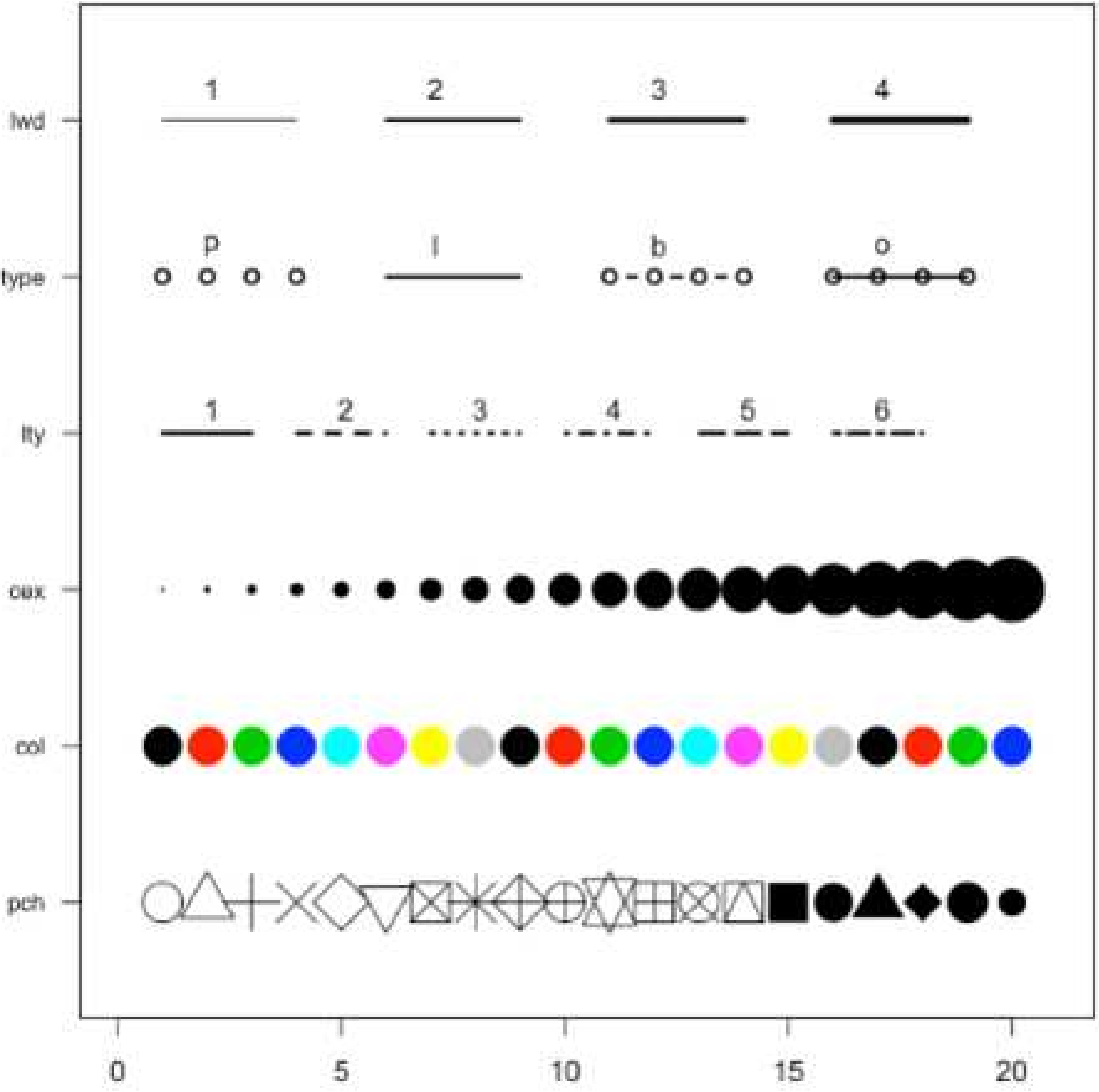
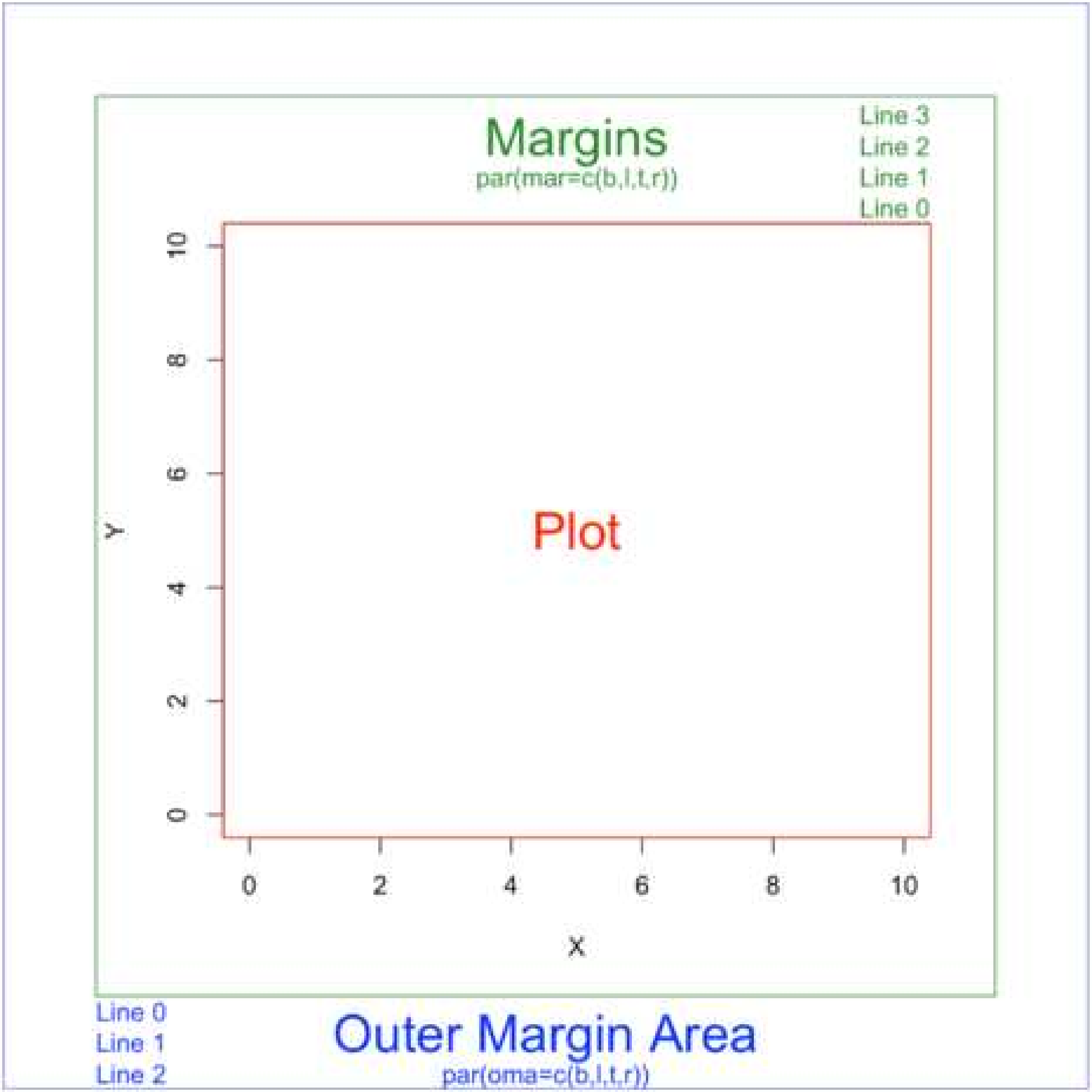
0.2
0.4
0.6
0.8
1
Quantity of red
Quantity of green



1
2
3
4
lwd
p
l
b
o
type
1
2
3
4
5
6
lty
cex
col
pch
0
5
10
15
20


Margins
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Line 3
Line 2
Line 1
Line 0
10
8
6
4
2
0
Y
Plot
0
2
4
6
8
10
X
Line 0
Line 1
Line 2
Outer Margin Area
par(oma=c(b,l,t,r))

from Data to Viz

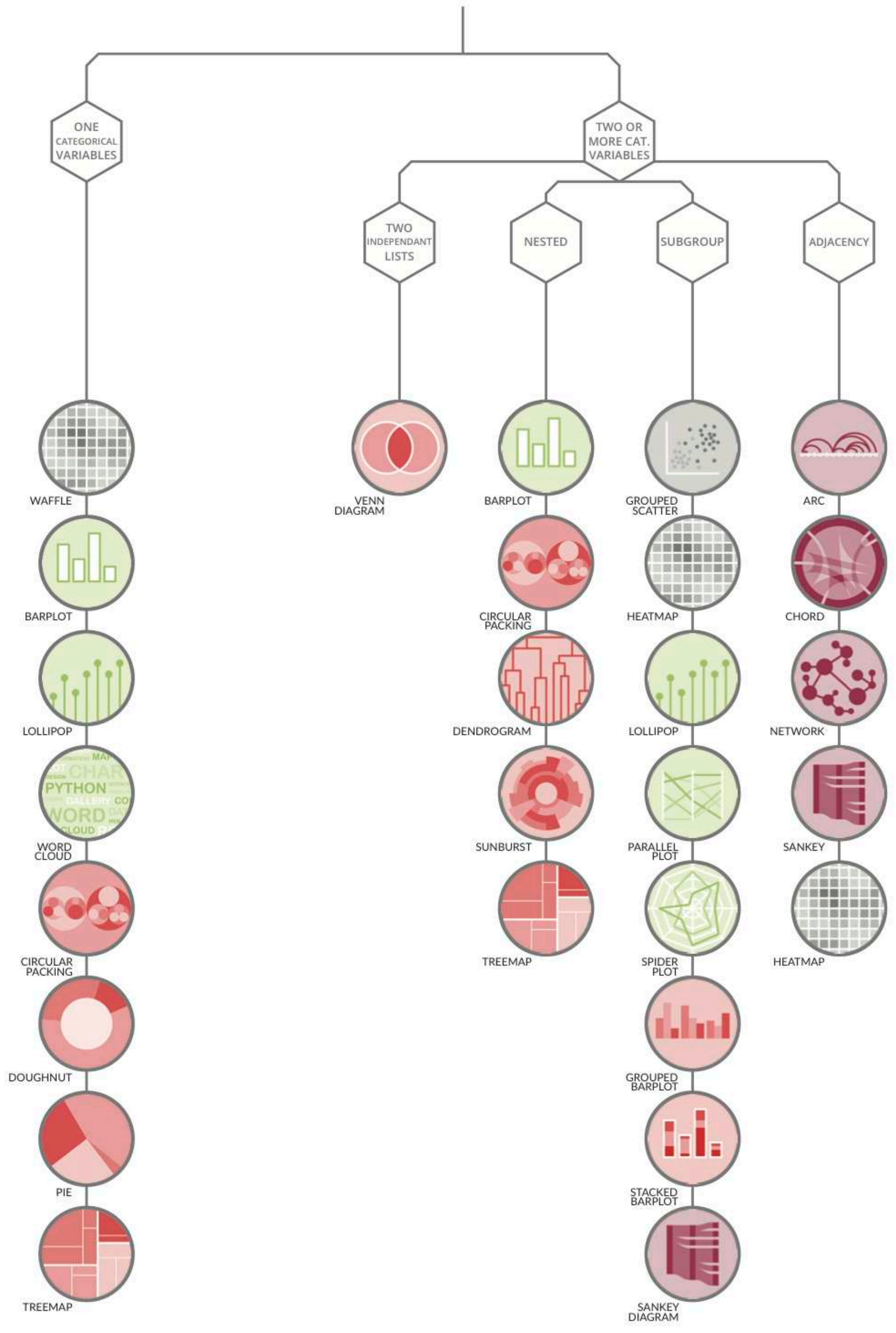
'From Data to Viz' is a classification of chart types based on input data format. It will help you find the perfect chart in three simple steps :

1. Identify what type of data you have.
2. Go to the corresponding decision tree and follow it down to a set of possible charts.
3. Choose the chart from the set that will suit your data and your needs best.

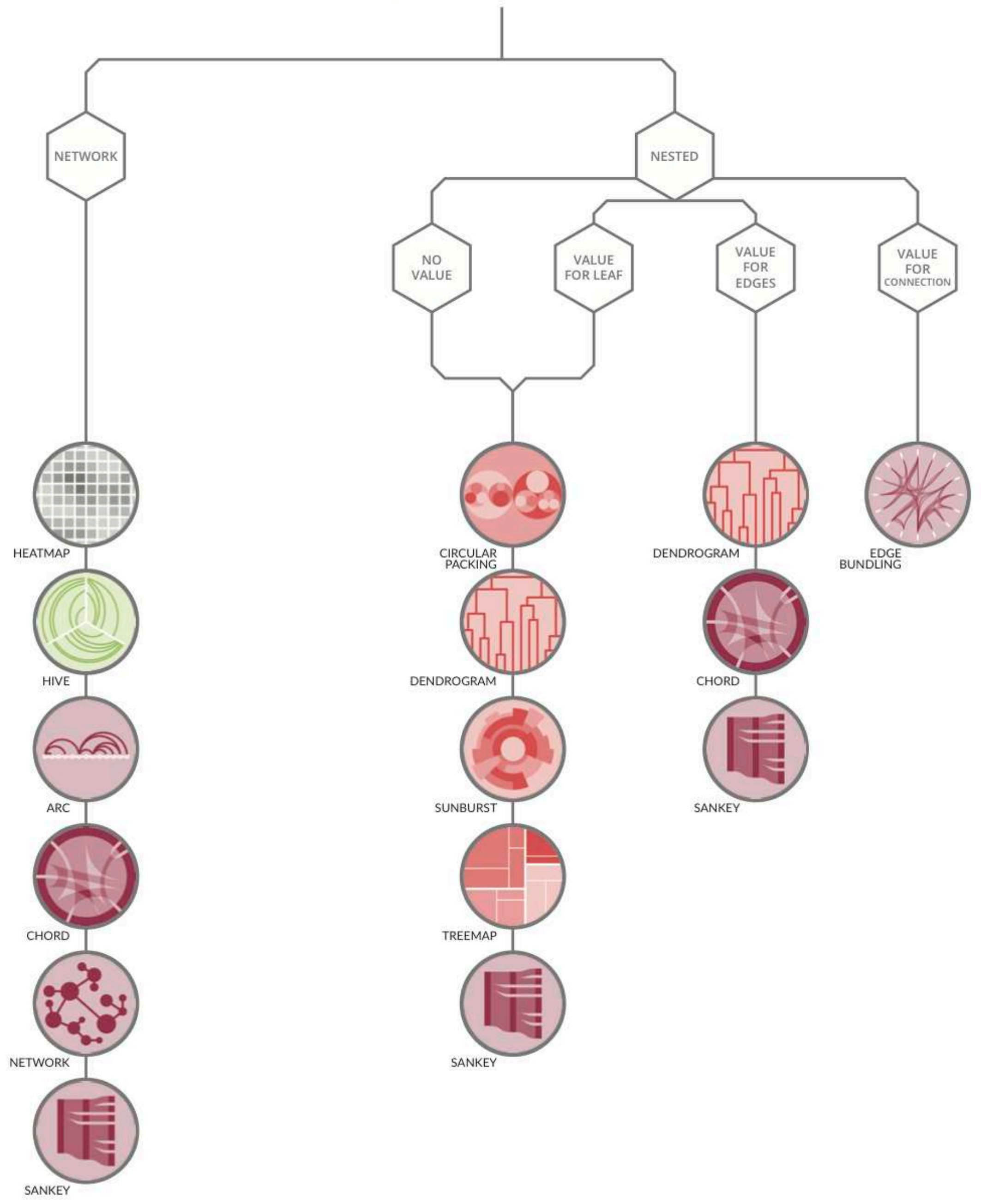
Dataviz is a world with endless possibilities and this project does not claim to be exhaustive. However it should provide you with a good starting point. For an interactive version and much more, visit:

data-to-viz.com

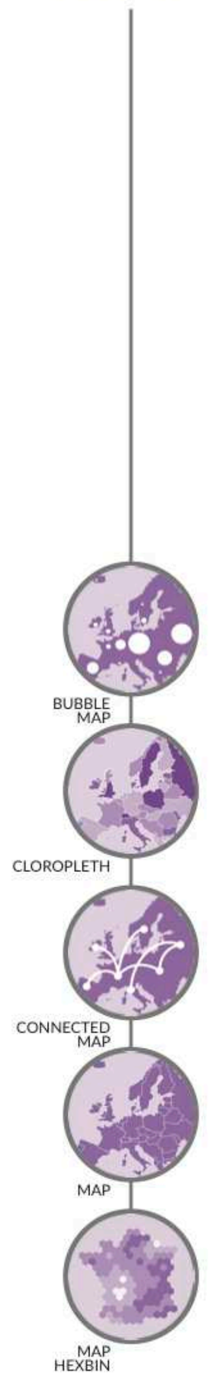
CATEGORIC



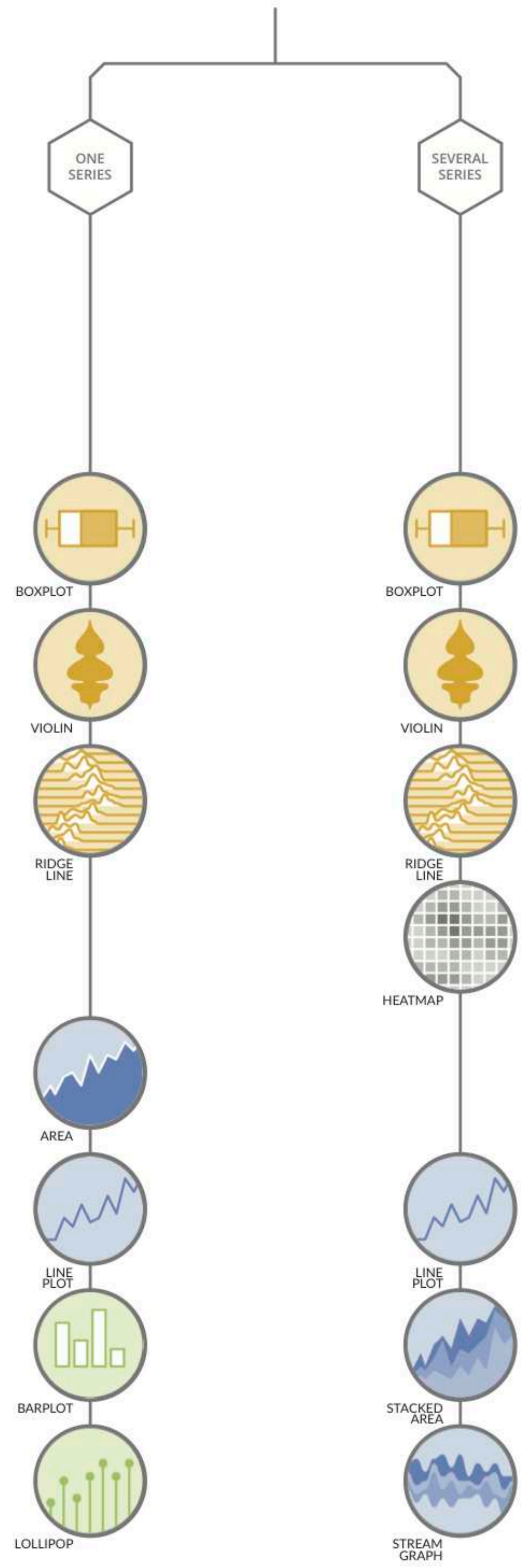
RELATIONAL



MAP



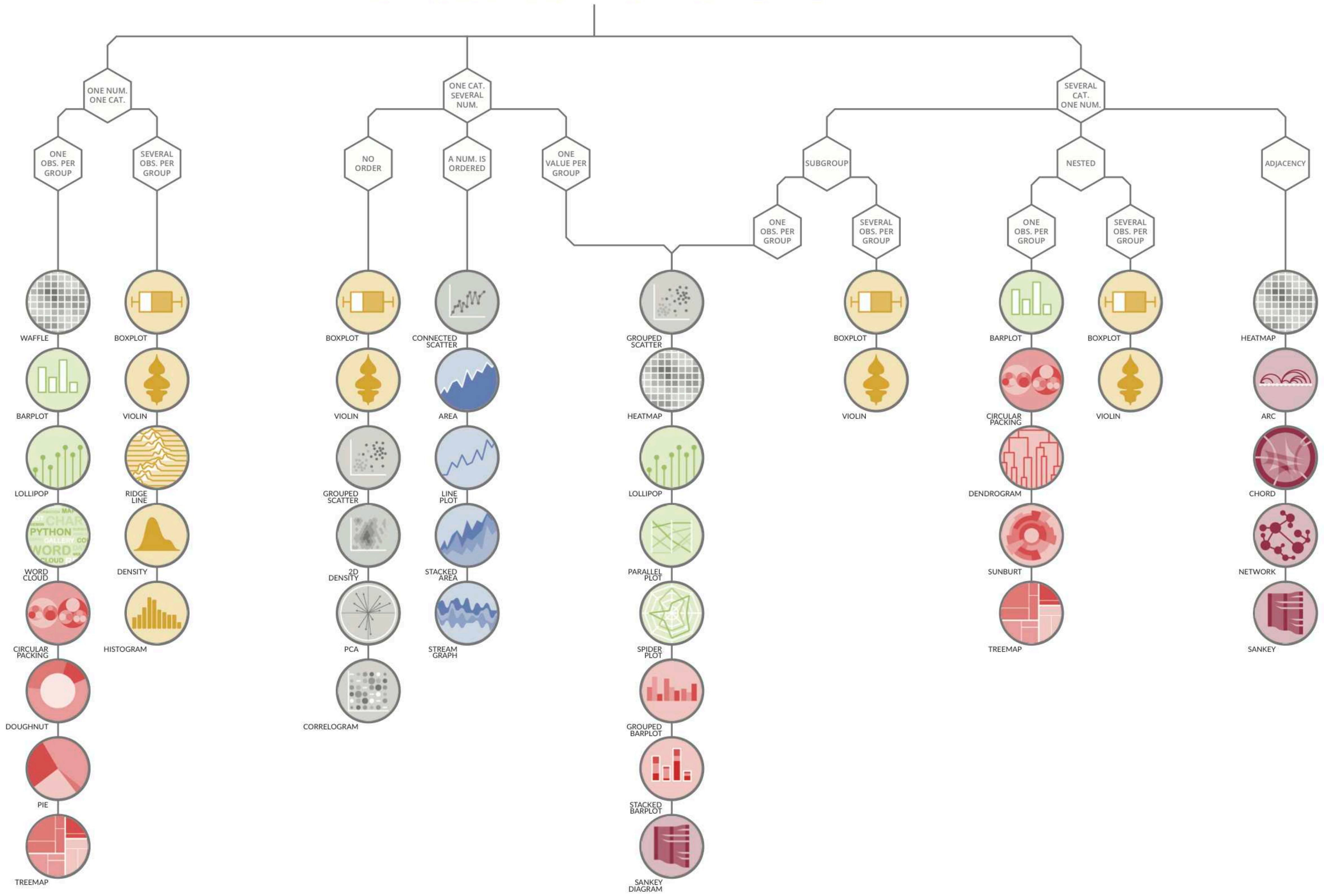
TIME SERIES



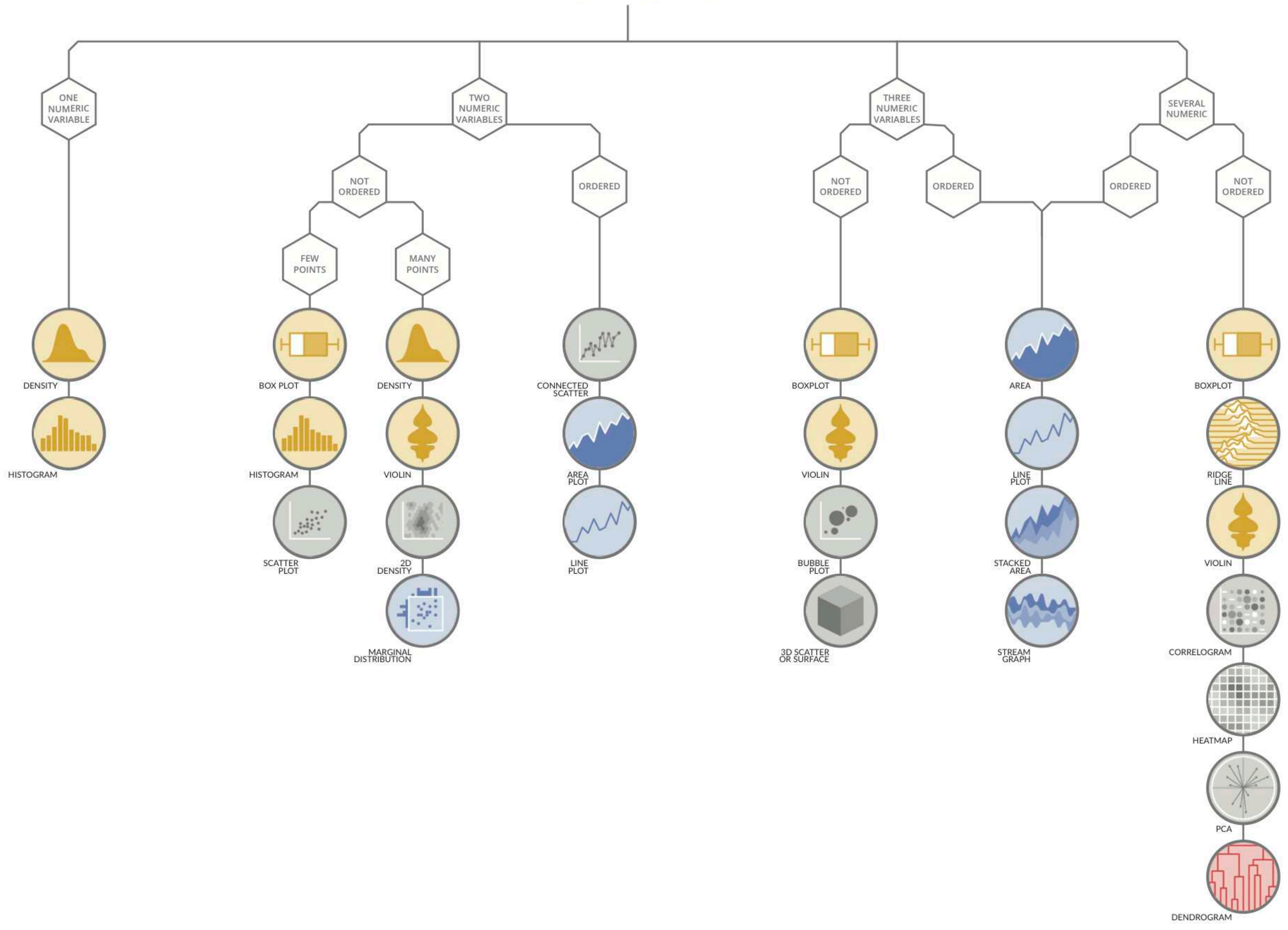
WHAT DO YOU WANT TO SHOW ?

- ● Distribution
- ● Correlation
- ● Ranking
- ● Part of a whole
- ● Evolution
- ● Maps
- ● Flow

CATEGORIC AND NUMERIC



NUMERIC



ONE NUMERIC VARIABLE
TWO NUMERIC VARIABLES
NOT ORDERED
FEW POINTS
MANY POINTS
ORDERED
THREE NUMERIC VARIABLES
NOT ORDERED
ORDERED
SEVERAL NUMERIC
ORDERED
NOT ORDERED
DENSITY
HISTOGRAM
BOX PLOT
HISTOGRAM
SCATTER PLOT
DENSITY
VIOLIN
2D DENSITY
MARGINAL DISTRIBUTION
CONNECTED SCATTER
AREA PLOT
LINE PLOT
BOXPLOT
VIOLIN
BUBBLE PLOT
3D SCATTER OR SURFACE
AREA
LINE PLOT
STACKED AREA
STREAM GRAPH
BOXPLOT
RIDGE LINE
VIOLIN
CORRELOGRAM
HEATMAP
PCA
DENDROGRAM