Introdução ao uso de dados geoespaciais no R

5 Visualização de dados

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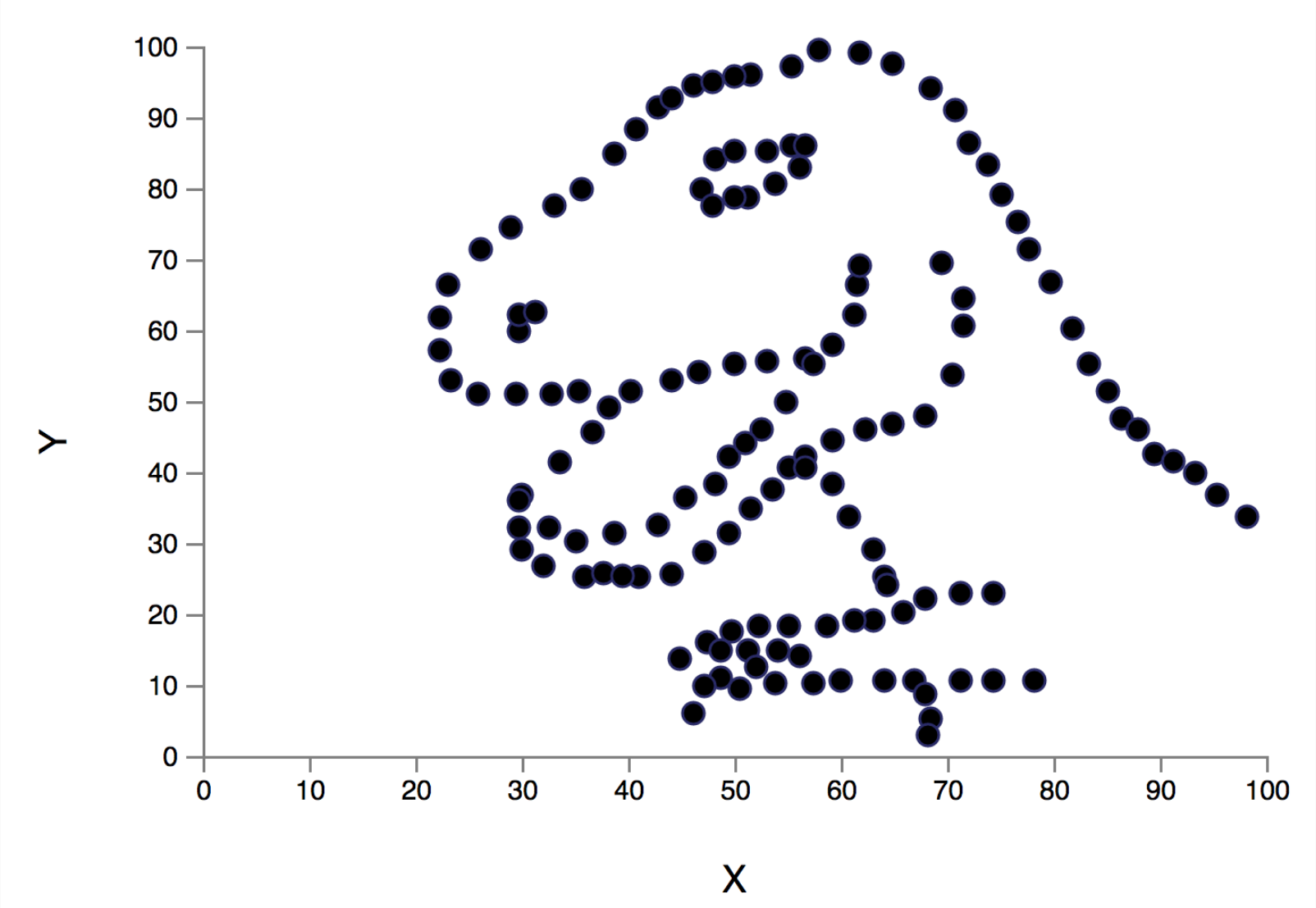
25/10/2021-05/11/2021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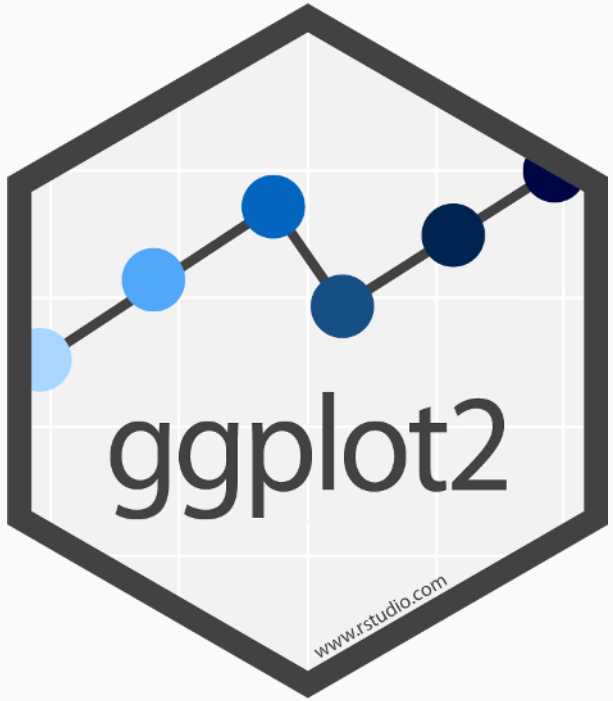
5 Visualização de dados

Conteúdo

1. Contextualização
2. Pacotes para produção de gráficos
3. Gramática dos gráficos
4. Principal material de estudo
5. Principais tipos de gráficos
6. Histograma e Densidade
7. Gráfico de setores
8. Gráfico de barras
9. Gráfico de caixas
10. Gráfico de dispersão
11. Gráfico pareado
12. Combinando gráficos
13. Gráficos animados
14. Gráficos interativos
15. Gráficos usando interface



5 Visualização de dados

Script

`05_script_intro_geoespacial_r.R`

1. Contextualização

Descrição

Melhor forma de **apresentar, sintetizar, discutir e interpretar** seus dados

Necessário em quase todas as **análises estatísticas**

Necessário em quase todas as **publicações**, trabalhos de consultoria, TCC, dissertação, tese, etc.

Existem vários **tipos de gráficos** para representar os padrões em seus dados para **diferentes tipos de finalidades**

De forma simplificada, os gráficos são **representações** dos nossos dados tabulares

2. Pacotes para produção de gráficos

Principais pacotes

graphics: simples, porém útil para visualizações rápidas de quase todos os formatos de arquivos

ggplot2: pacote integrado ao tidyverse, possui uma sintaxe própria baseada na gramática de gráficos por camadas (layers)

ggplot2 extentions: conjunto de pacotes que adicionam diversas expansões ao pacote ggplot2. Exemplos: GGally, gganimate e esquisse

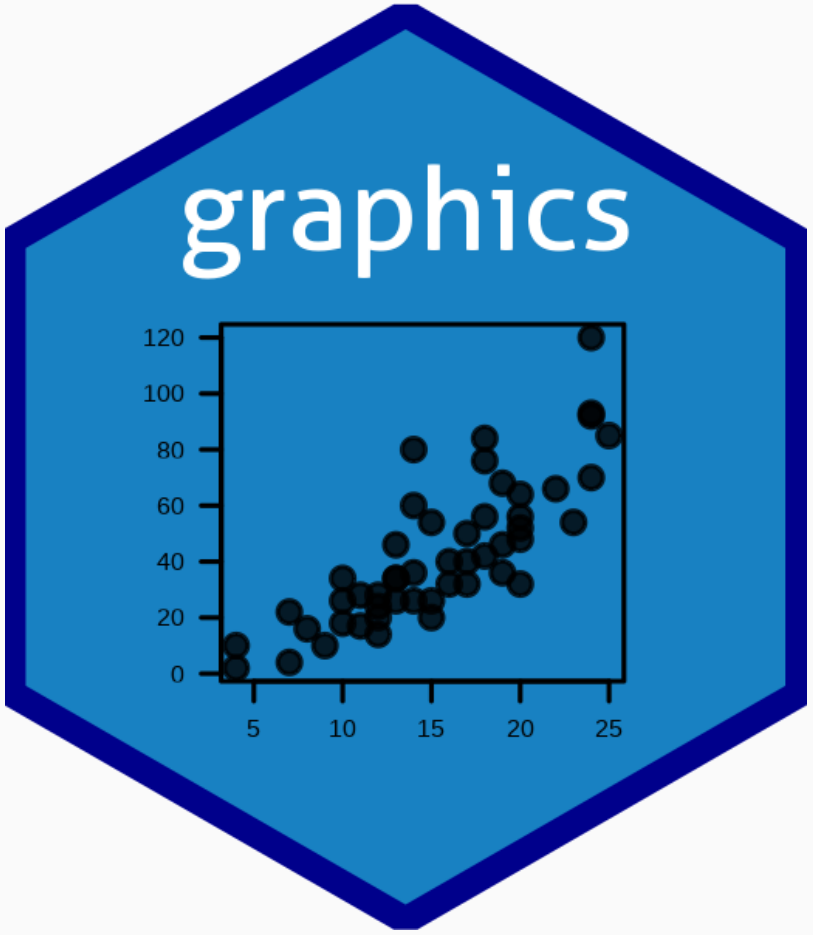
visdat: cria visualizações preliminares de um conjunto de dados inteiro para identificar problemas ou recursos inesperados usando `ggplot2`

ggpubr: fornece algumas funções simplificadas para criar gráficos para publicação, baseados no `ggplot2`

cowplot: pacote que permite combinar vários gráficos de forma elaborada

pacthwork: pacote que permite combinar vários gráficos em um só de forma extremamente simples e com alta qualidade

plotly: pacote para criar gráficos interativos da web por meio da biblioteca gráfica de JavaScript de código aberto plotly.js



graphics

2. Principais pacotes para gráficos

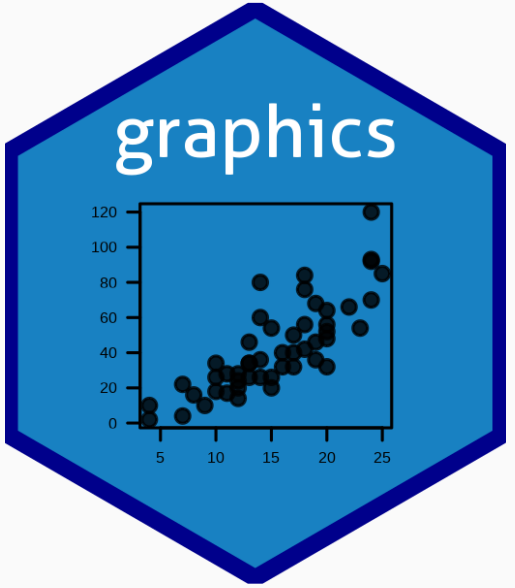
graphics

Default do R e mais simples

Pode ser utilizado para objetos de **diversas classes**

Possui funções como:

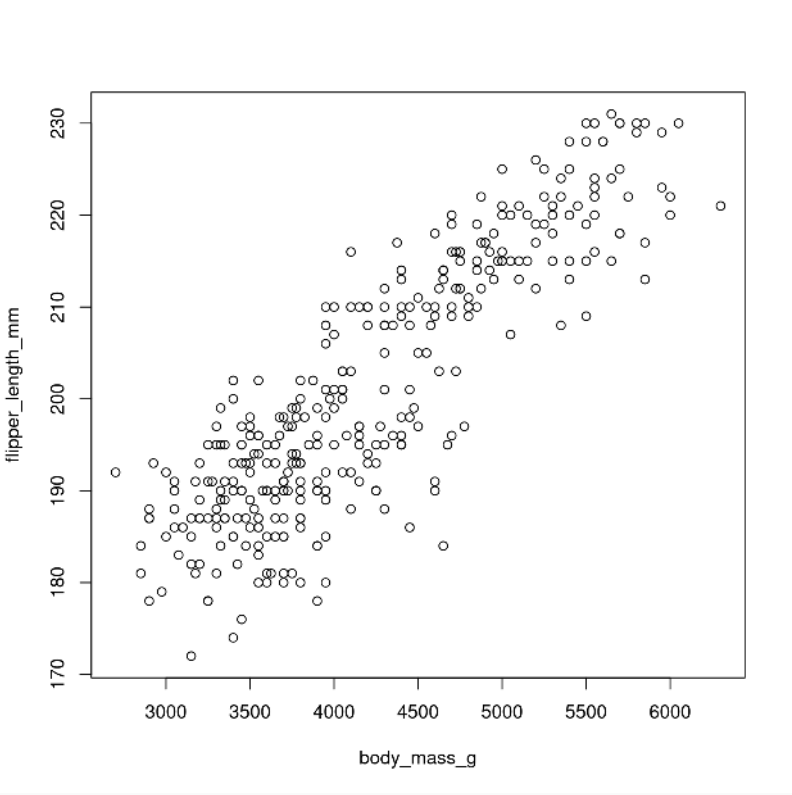
`plot()`
`hist()`
`barplot()`
`boxplot()`
`abline()`
`points()`
`lines()`
`polygon()`

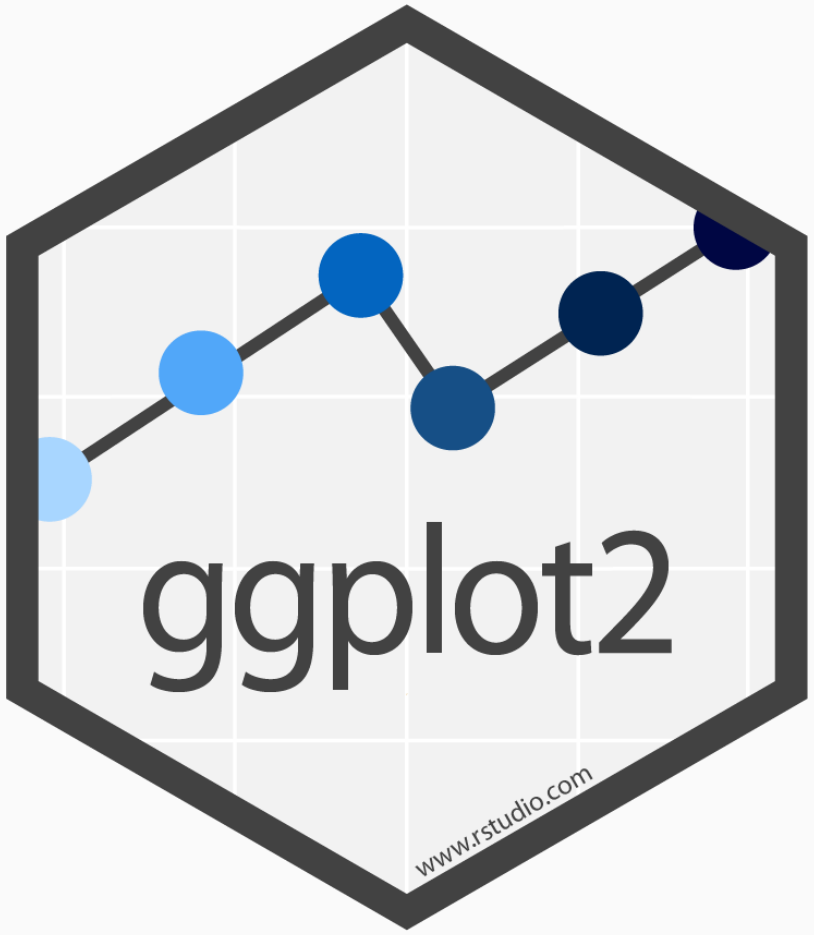


2. Principais pacotes para gráficos

graphics

```
# graphics
plot(flipper_length_mm ~ body_mass_g, data = penguins)
```

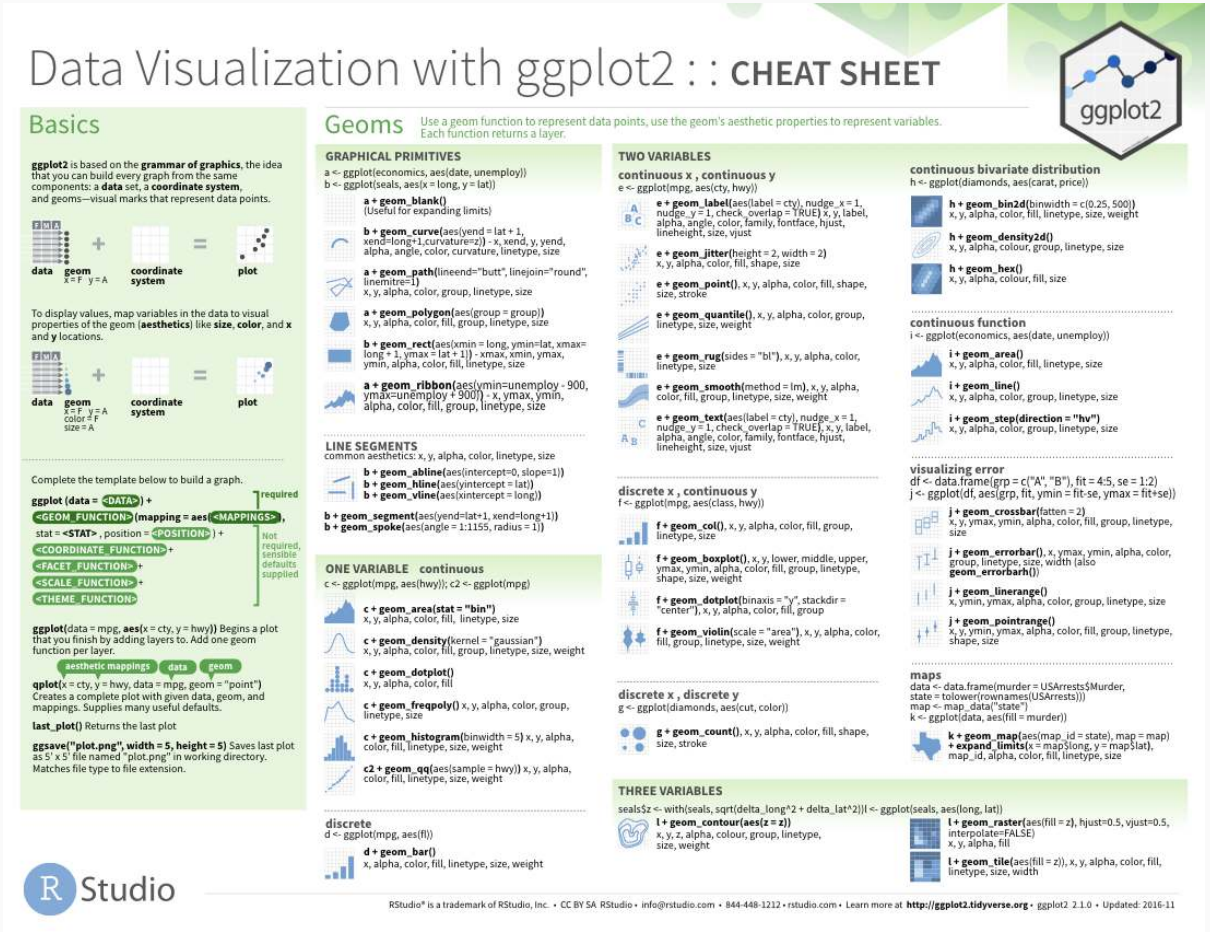




ggplot2

2. Principais pacotes para gráficos

Data Visualization Cheatsheet



[Data Visualization with ggplot2 Cheatsheet]

2. Principais pacotes para gráficos

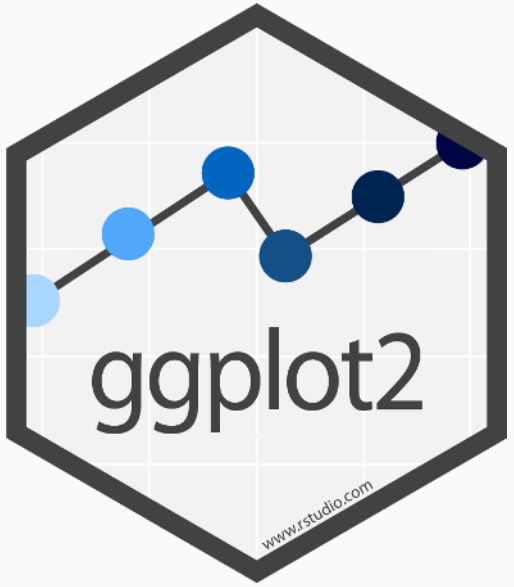
ggplot2

Integrado ao tidyverse, possui uma sintaxe própria

Necessita de funções específicas para objetos de **classes diferentes**

Estruturado dessa forma:

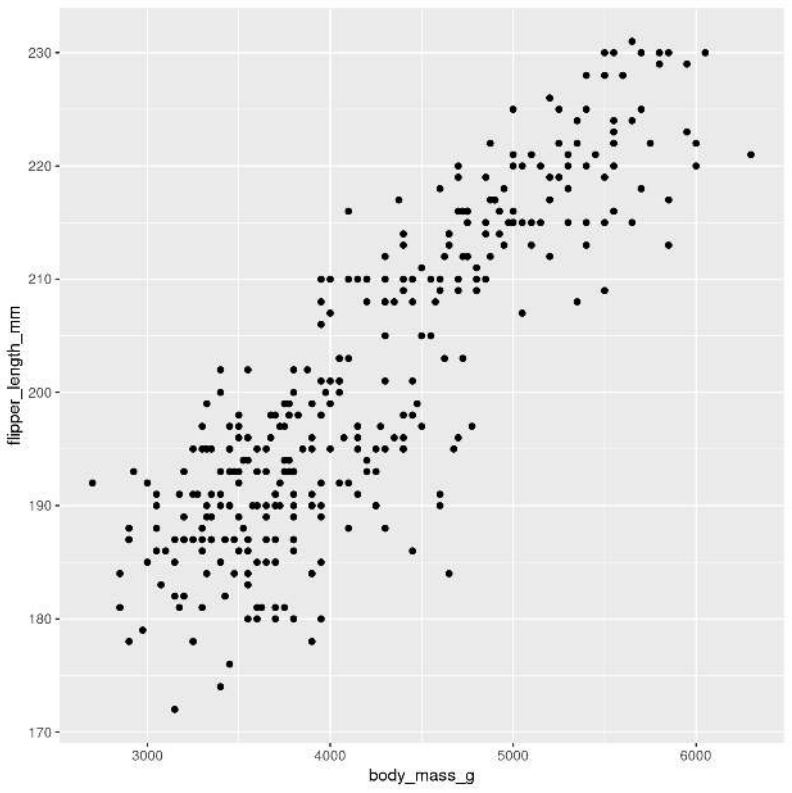
```
ggplot() +
aes() +
geom_() +
facet_() +
stats_() +
coord_() +
theme_()
```



2. Principais pacotes para gráficos

ggplot2

```
# ggplot2
library(ggplot2)
ggplot(data = penguins) + aes(x = body_mass_g, y = flipper_length_mm) + geom_point()
```



ggpubr

2. Principais pacotes para gráficos

ggpubr

Funções fáceis de usar para criar e personalizar plots para publicações baseadas no "ggplot2"

Necessita de funções específicas para gerar **gráficos específicos**

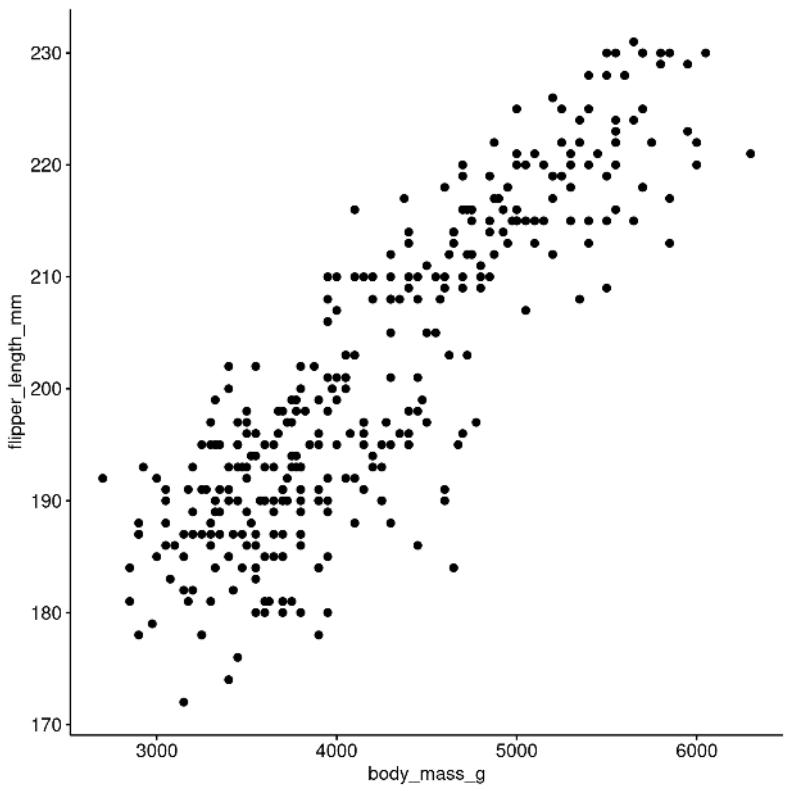
Funções:

`gghistogram()`
`ggdensity()`
`ggboxplot()`
`ggviolin()`
`ggbarplot()`
`ggscatter()`

2. Principais pacotes para gráficos

ggpubr

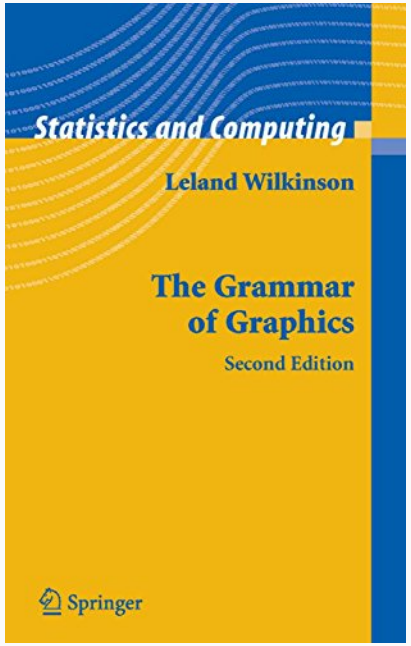
```
# ggpubr
library(ggpubr)
ggscatter(penguins, x = "body_mass_g", y = "flipper_length_mm")
```

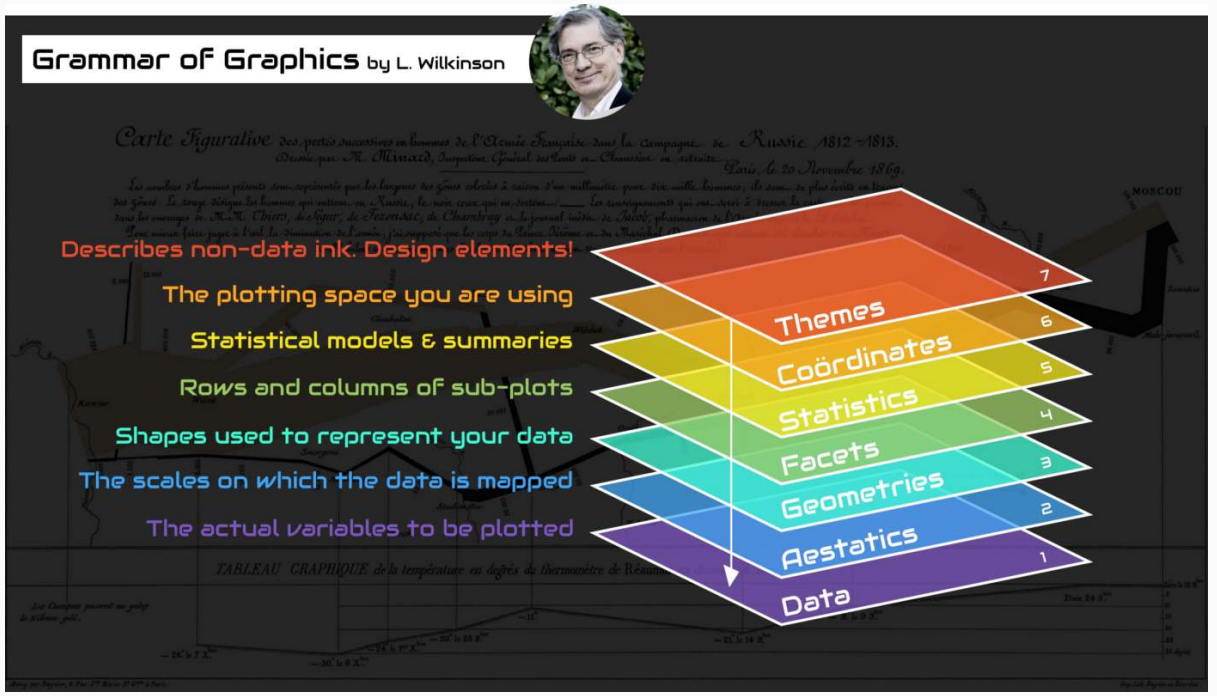


3. Gramática dos gráficos

Descrição

Wilkinson (2005) *Grammar of Graphics*: representação gráfica dos dados a partir de atributos estéticos (do inglês *aesthetic*)

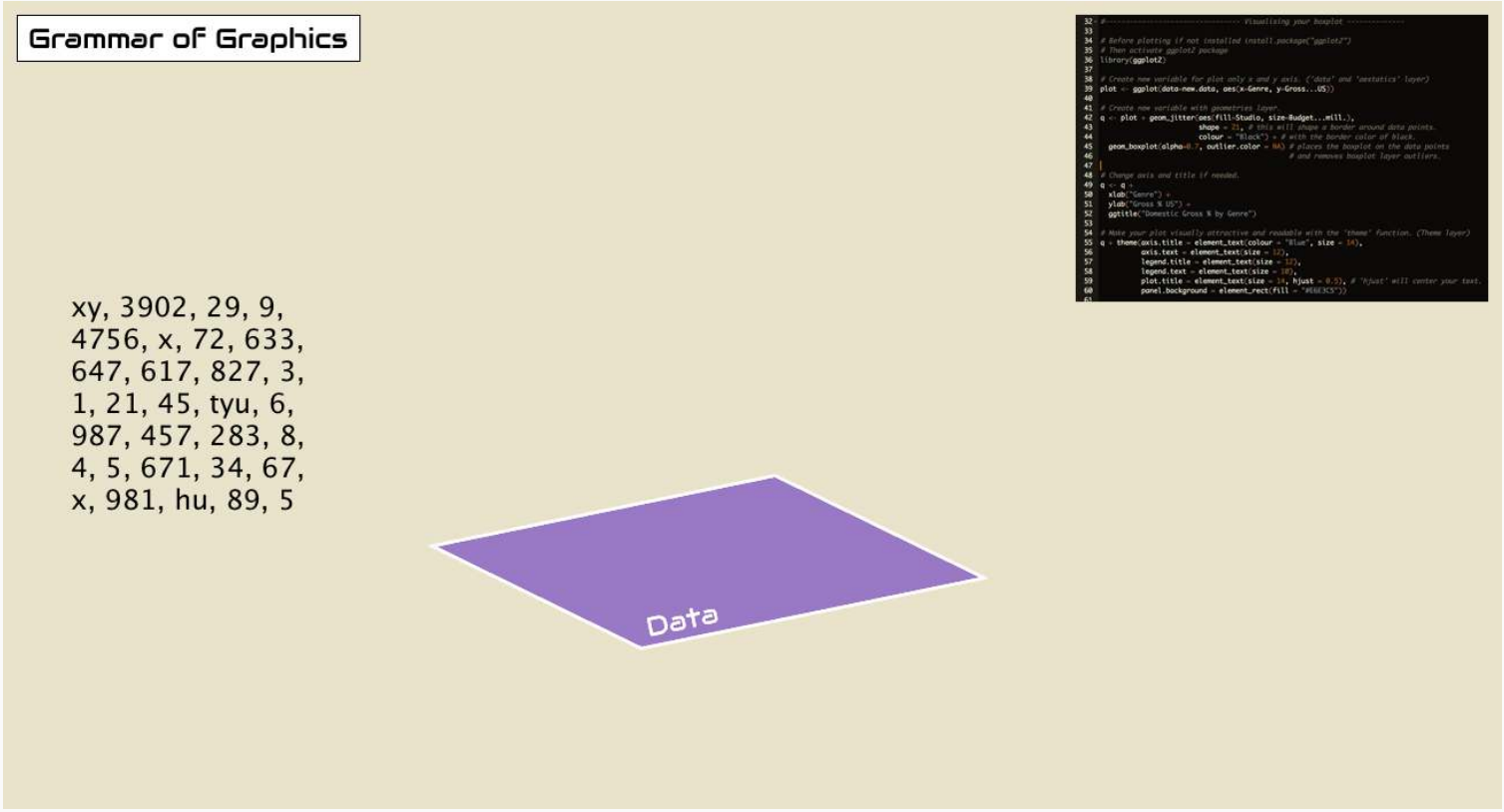




Wilkinson (2005)

3. Gramática dos gráficos

Descrição

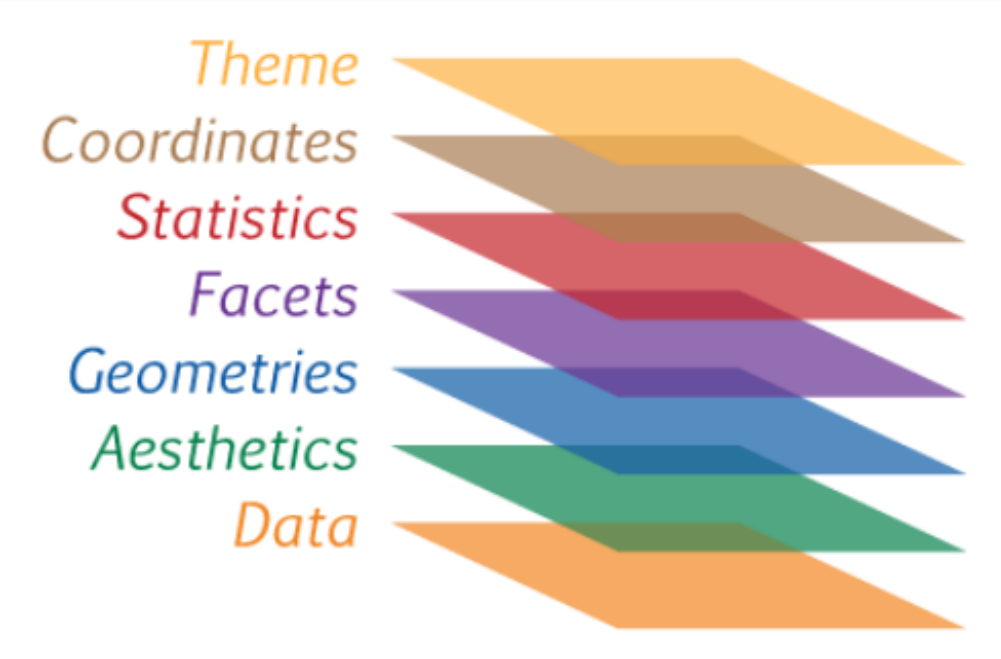


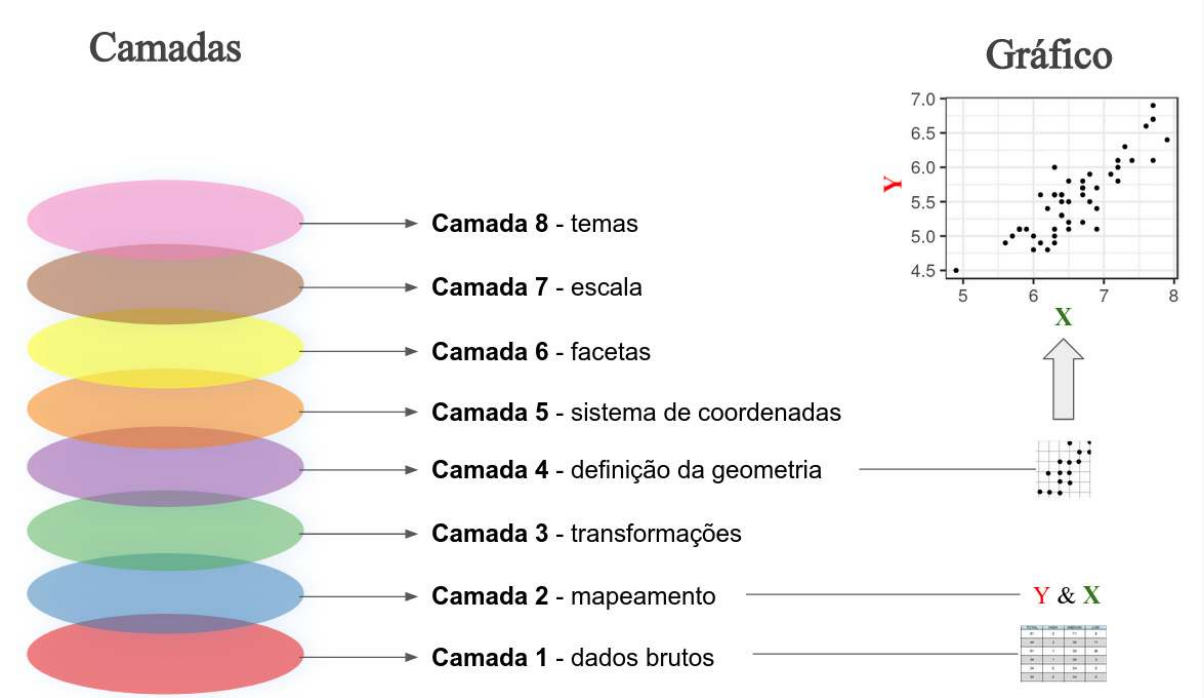
[Think About the Grammar of Graphics When Improving Your Graphs]

3. Gramática dos gráficos

Descrição

Wickham (2008) criou o pacote **ggplot2**, onde “gg” representa a contração de Grammar of Graphics





Wickham (2008)

4. Principal material de estudo

Livros

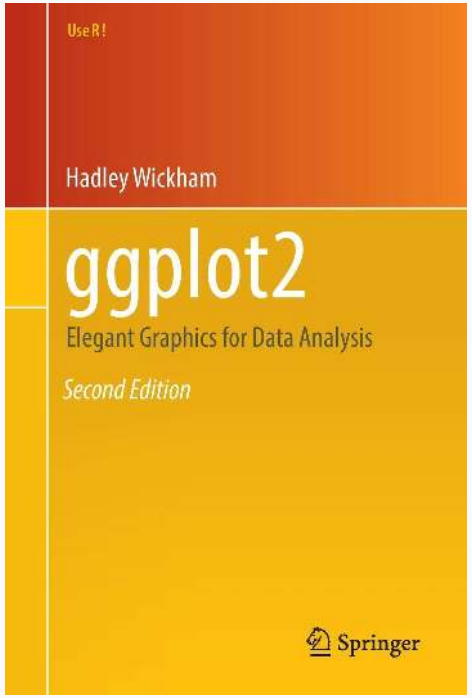
O idealizador e mantenedor do pacote **ggplot2** foi de novo o **Hadley Wickham**

Hadley Wickham

4. Principal material de estudo

Livros

ggplot2 (2009, 2016)

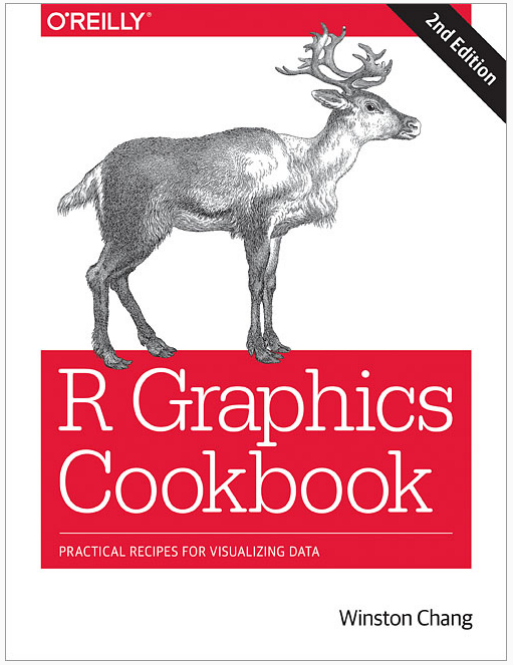


Wickham (2009, 2016)

4. Principal material de estudo

Livros

R Graphics Cookbook (2018)

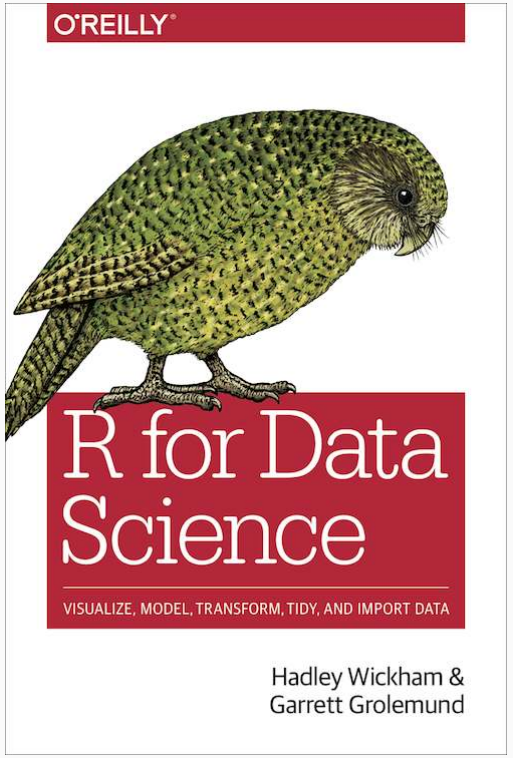


Chang (2018)

4. Principal material de estudo

Livros

R for Data Science (2017)

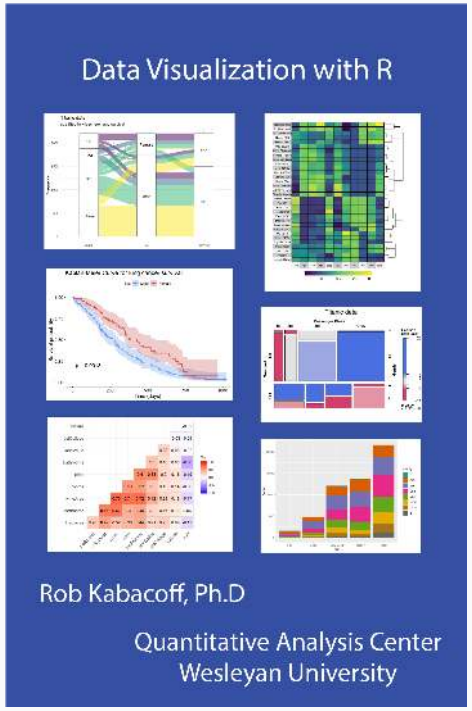


Wickham & Grolemund (2017)

4. Principal material de estudo

Livros

Data Visualization with R (2018)

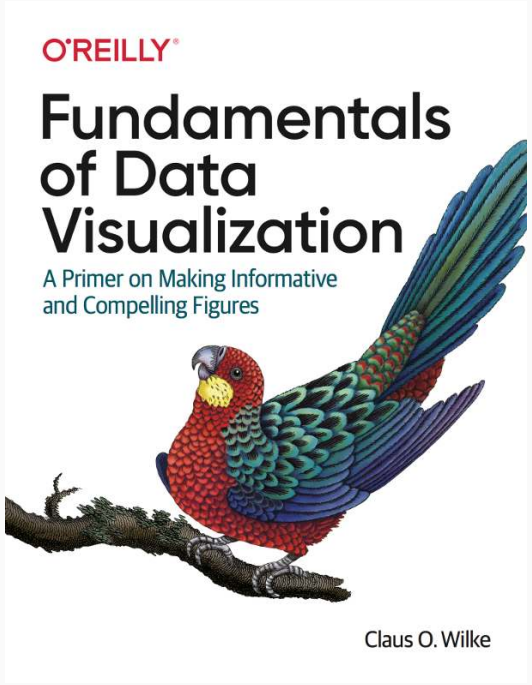


Kabacoff (2018)

4. Principal material de estudo

Livros

Fundamentals of Data Visualization (2019)

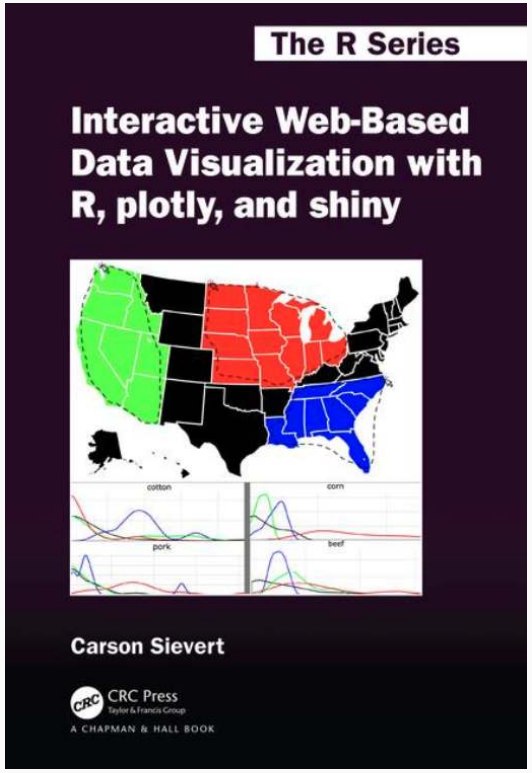


Wilke (2019)

4. Principal material de estudo

Livros

Interactive web-based data visualization with R, plotly, and shiny (2019)

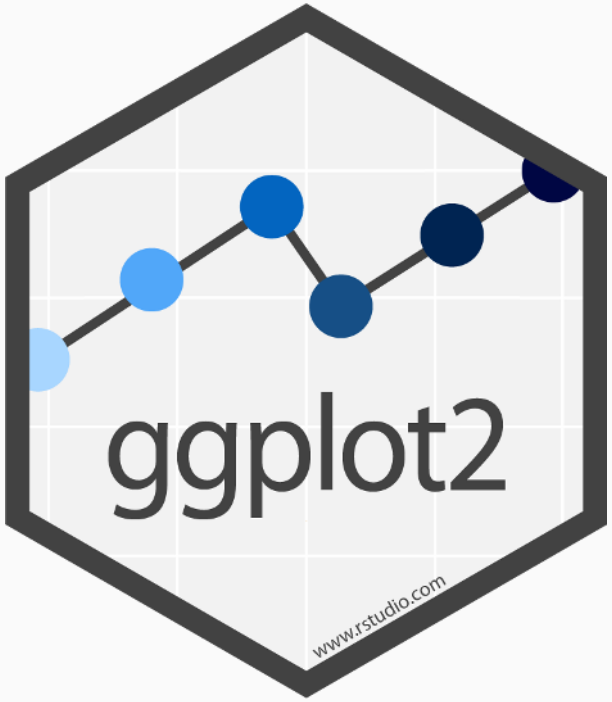


Sievert (2019)

4. Principal material de estudo

Sites

ggplot2: Reference



ggplot2 reference

4. Principal material de estudo

Sites

R Graph Gallery

R Graph Gallery

4. Principal material de estudo

Sites

from Data to Viz

from Data to Viz

4. Principal material de estudo

Sites

Statistical tools for high-throughput data analysis (STHDA)

STHDA

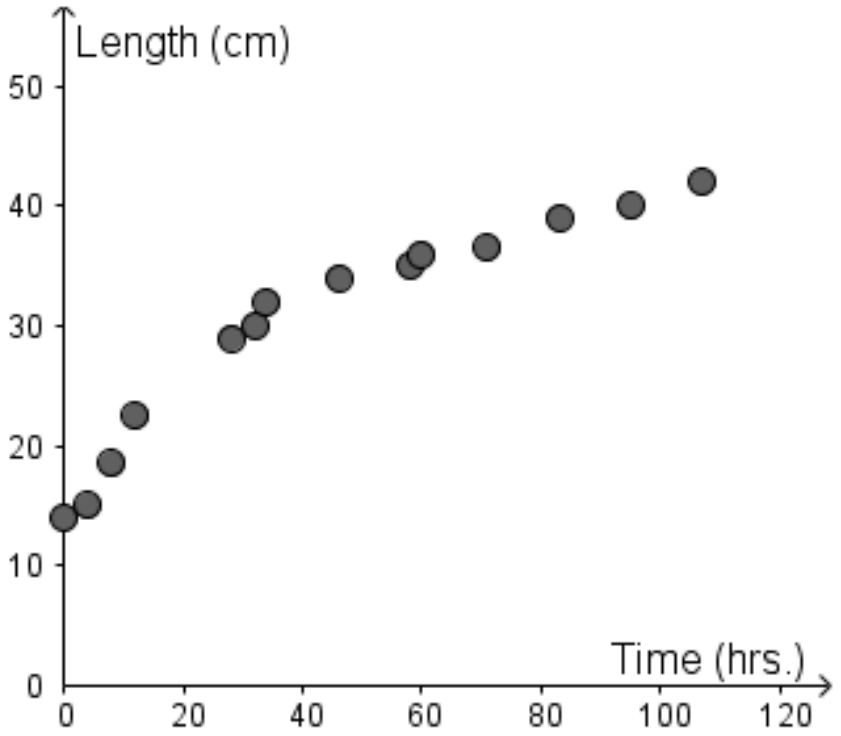
Dúvidas?

Os elementos de um gráfico são representações das colunas (eixos) e linhas (elementos) de nossas matrizes de dados

5. Principais tipos de gráficos

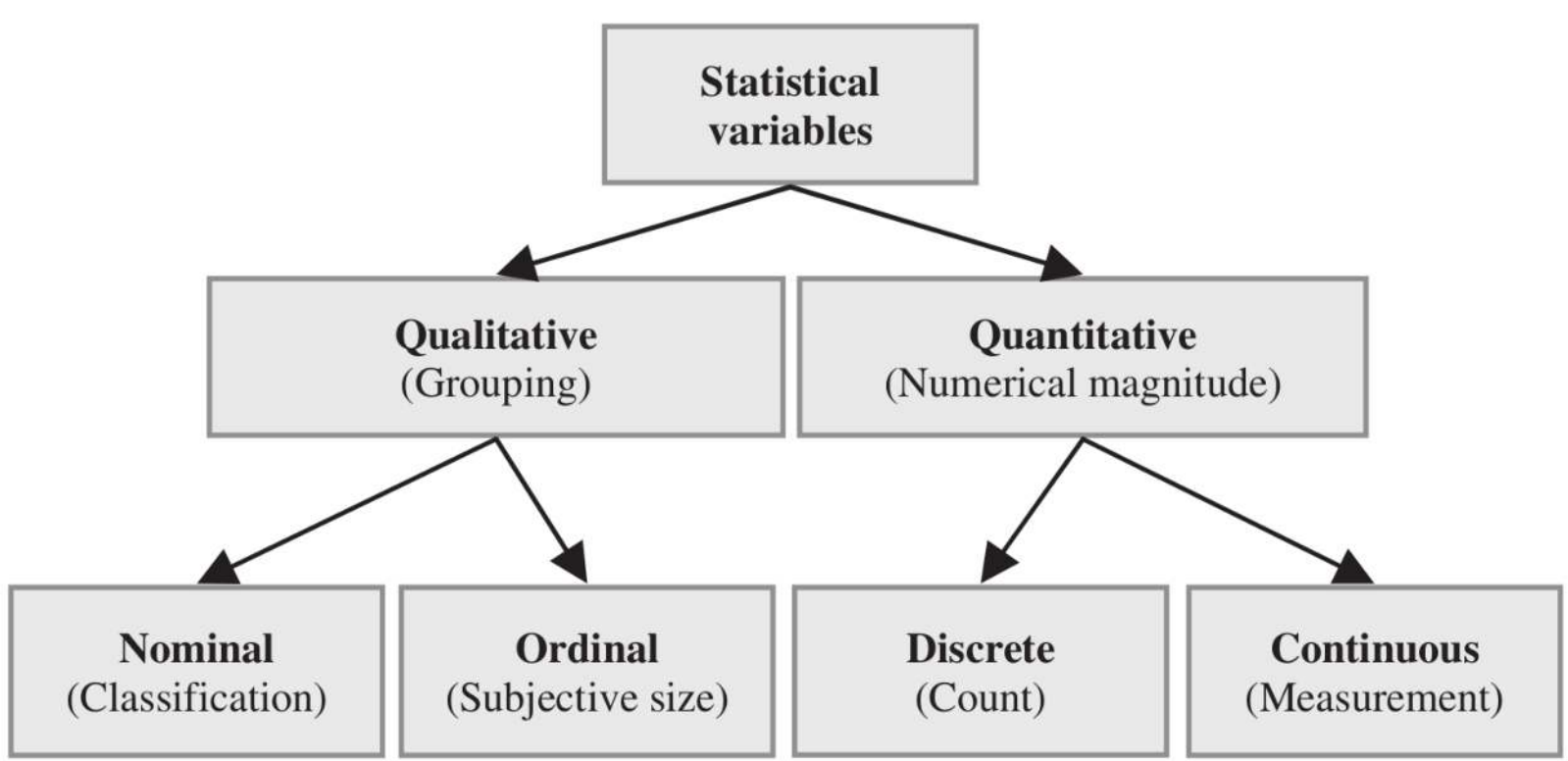
Colunas se tornam eixos e valores a representação

Amount of time from initial measurement (hrs.)	Length
0	14
4	15
8	18.5
12	22.5
28	29
32	30
34	32
46	34
58	35
60	36
71	36.5
83	39
95	40
107	42



5. Principais tipos de gráficos

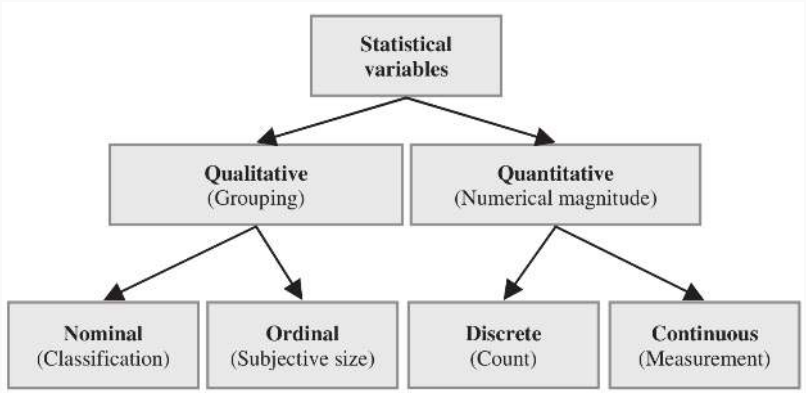
Tipos de variáveis



Matthiopoulos (2011)

5. Principais tipos de gráficos

Tipos de variáveis

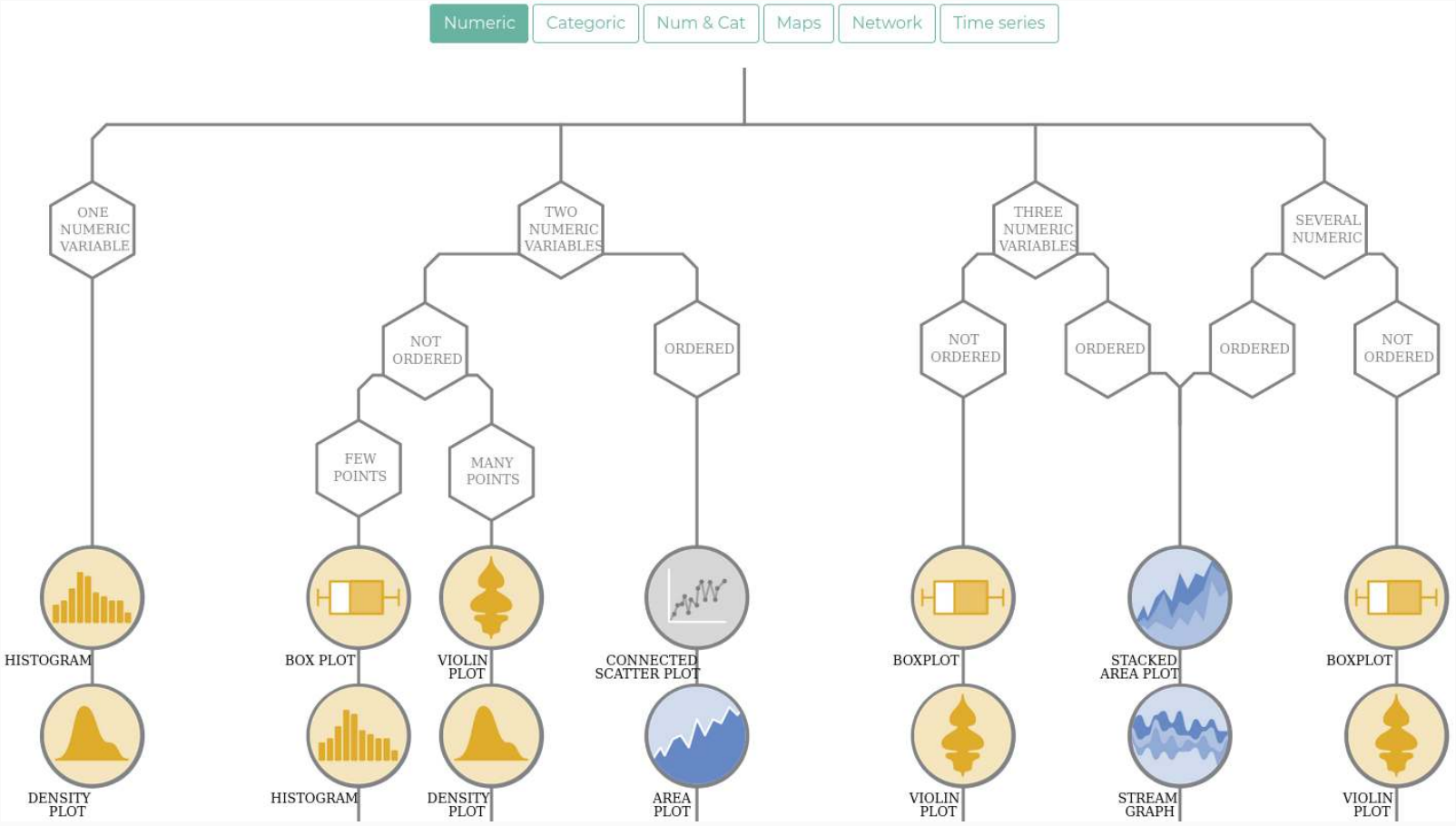


Matthiopoulos (2011), @allison_horst

O **tipo e quantidade das variáveis** indicará o melhor tipo de gráfico para **representar** os dados

5. Principais tipos de gráficos

from Data to Viz



from Data to Viz

Dúvidas?

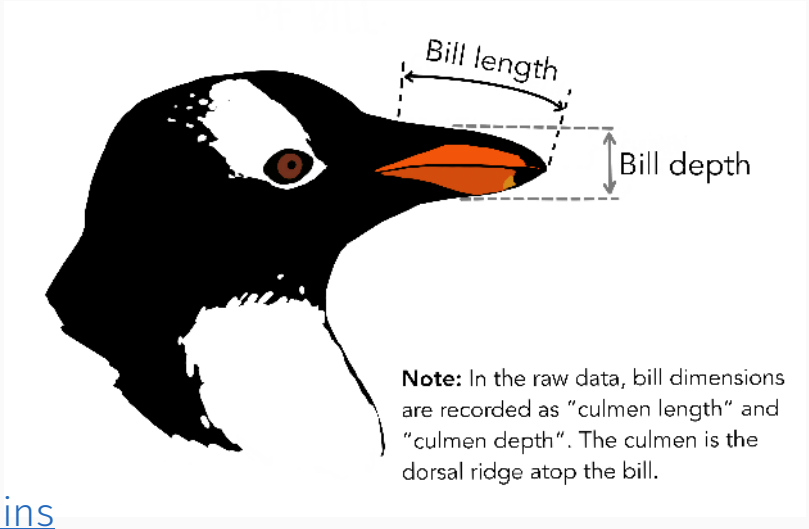
E que dados vamos usar?

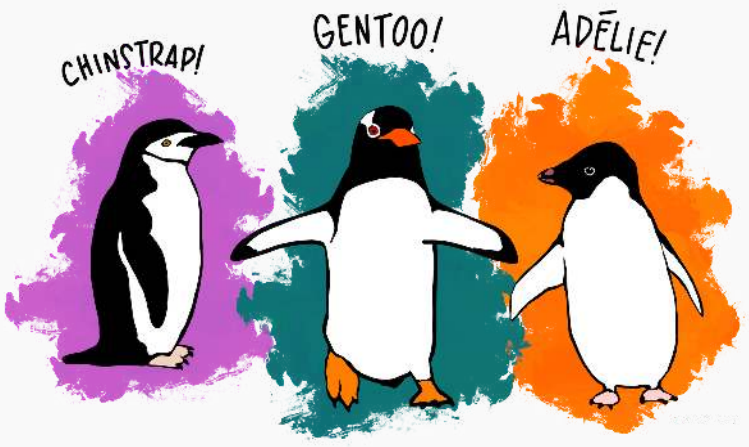
palmerpenguins

palmerpenguins

Dados de medidas de pinguins chamados `palmerpenguins`

```
# carregar
library(palmerpenguins)

# visualizar os dados
penguins

# glimpse
tibble::glimpse(penguins)
```





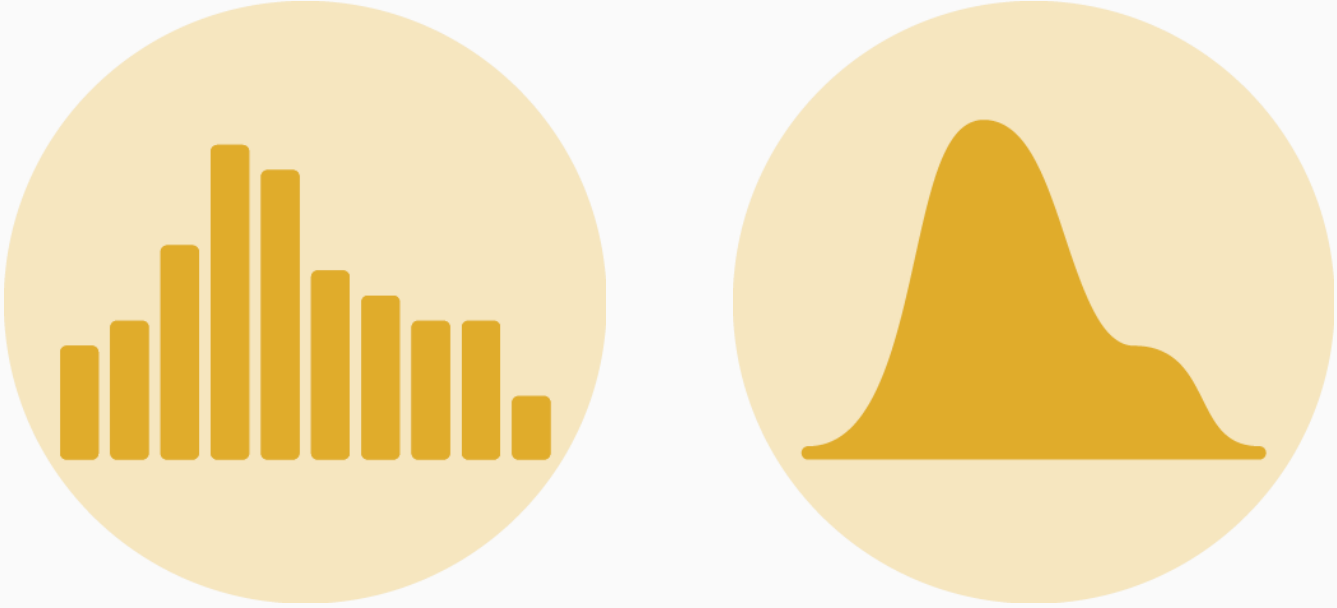
palmerpenguins

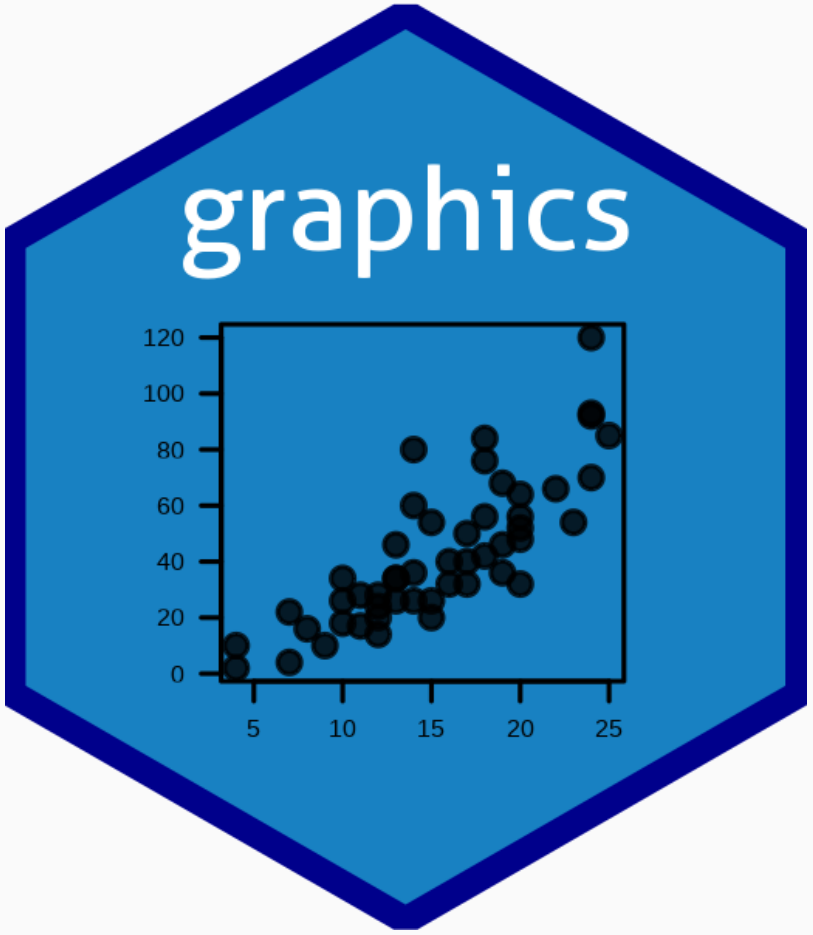
6. Histograma (*Histogram*)

Representa os dados de: uma coluna

Tipo de dado: discreto ou contínuo

Distribuição de frequência e densidade de dados discretos ou contínuos



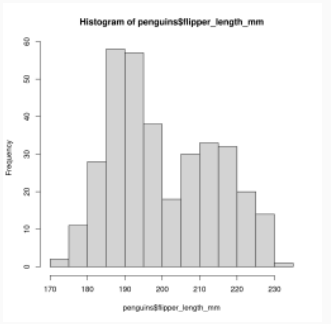


graphics

6. Histograma (*Histogram*)

graphics

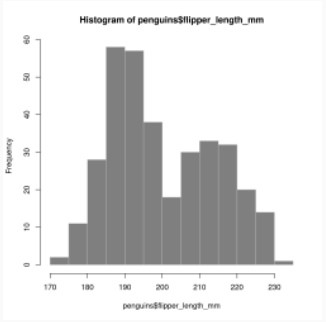
```
hist(penguins$flipper_length_mm)
```



6. Histograma (*Histogram*)

graphics

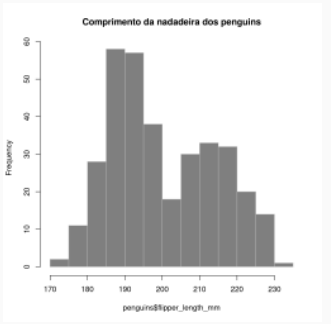
```
hist(penguins$flipper_length_mm,
     col = "gray50",
     border = "gray")
```



6. Histograma (*Histogram*)

graphics

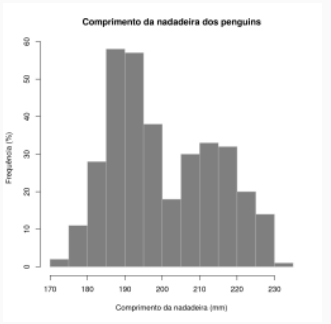
```
hist(penguins$flipper_length_mm,
     col = "gray50",
     border = "gray",
     main = "Comprimento da nadadeira dos penguins")
```



6. Histograma (*Histogram*)

graphics

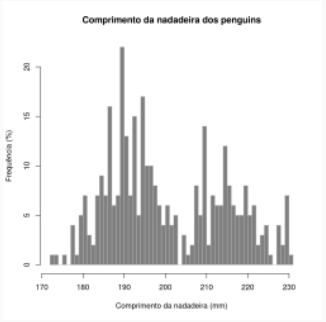
```
hist(penguins$flipper_length_mm,
     col = "gray50",
     border = "gray",
     main = "Comprimento da nadadeira dos penguins",
     xlab = "Comprimento da nadadeira (mm)",
     ylab = "Frequência (%)")
```



6. Histograma (*Histogram*)

graphics

```
hist(penguins$flipper_length_mm,
     col = "gray50",
     border = "gray",
     main = "Comprimento da nadadeira dos penguins",
     xlab = "Comprimento da nadadeira (mm)",
     ylab = "Frequência (%)",
     br = 50)
```



6. Histograma (*Histogram*)

graphics

```
par(mar = c(5, 5, 5, 5))
hist(penguins$flipper_length_mm,
     col = "gray50",
     border = "gray",
     main = "Comprimento da nadadeira dos penguins",
     xlab = "Comprimento da nadadeira (mm)",
     ylab = "Frequência (%)",
     br = 50,
     cex.main = 2,
     cex.lab = 2,
     cex.axis = 1.5)
```

6. Densidade (*Density*)

graphics

```
par(mar = c(5, 5, 5, 5))
hist(penguins$flipper_length_mm,
     col = "gray50",
     border = "gray",
     main = "Comprimento da nadadeira dos penguins",
     xlab = "Comprimento da nadadeira (mm)",
     ylab = "Densidade",
     br = 50,
     cex.main = 2,
     cex.lab = 2,
     cex.axis = 1.5,
     prob = TRUE)
lines(density(na.omit(penguins$flipper_length_mm)))
```

6. Densidade (*Density*)

graphics

```
par(mar = c(5, 5, 5, 5))
plot(density(na.omit(penguins$flipper_length_mm)),
     col = "gray50",
     main = "Comprimento da nadadeira dos penguins",
     xlab = "Comprimento da nadadeira (mm)",
     ylab = "Densidade",
     cex.main = 2,
     cex.lab = 2,
     cex.axis = 1.5)
polygon(density(na.omit(penguins$flipper_length_mm)),
        col = "gray50")
```

6. Densidade (*Density*)

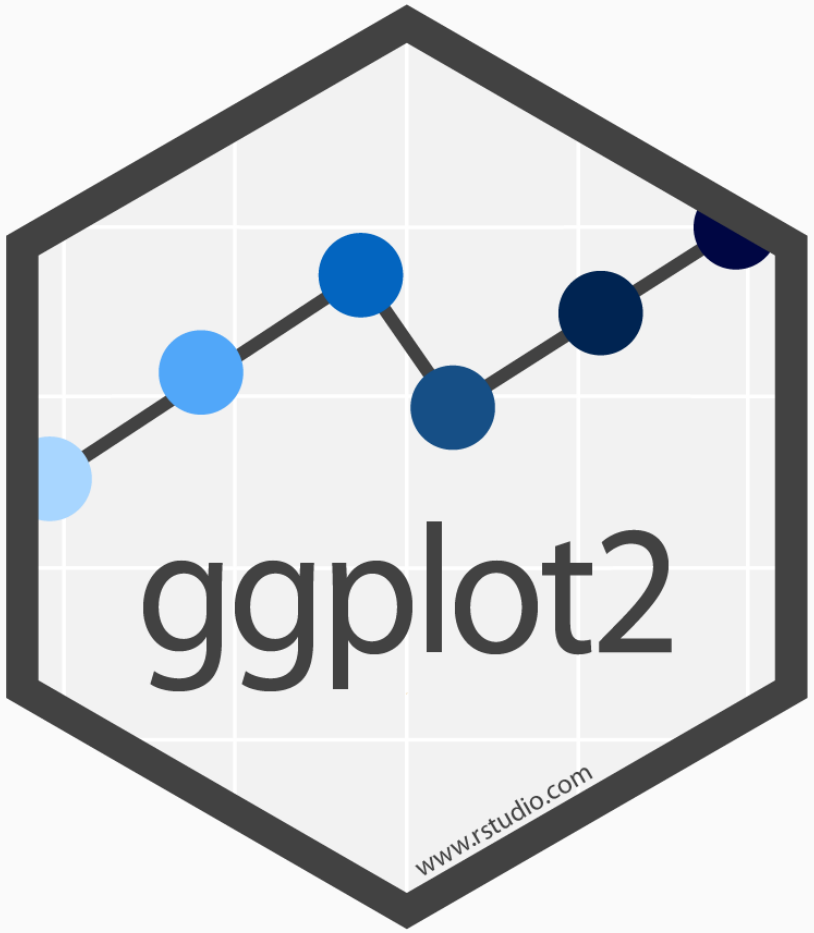
graphics

Exportar

```
png(here::here("03_dados", "graficos", "plot_densidade.png"),
    wi = 15, he = 15, un = "cm", res = 300)
```

```
par(mar = c(5, 5, 5, 5))
plot(density(na.omit(penguins$flipper_length_mm)),
     col = "gray50",
     main = "Comprimento da nadadeira dos penguins",
     xlab = "Comprimento da nadadeira (mm)",
     ylab = "Frequência (%)",
     cex.main = 2,  cex.lab = 2, cex.axis = 1.5)
polygon(density(na.omit(penguins$flipper_length_mm)), col = "gray50")
```

```
dev.off()
```



ggplot2

6. Histograma (*Histogram*)

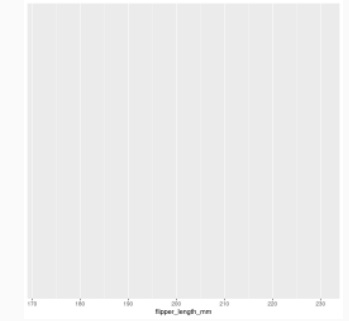
ggplot2

```
ggplot(data = penguins)
```

6. Histograma (*Histogram*)

ggplot2

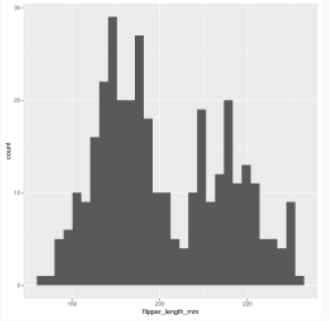
```
ggplot(data = penguins, aes(x = flipper_length_mm))
```



6. Histograma (*Histogram*)

ggplot2

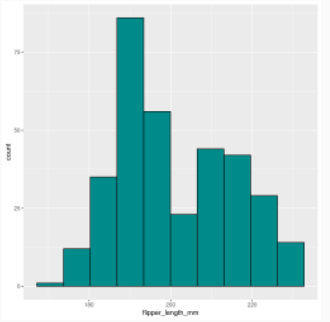
```
ggplot(data = penguins, aes(x = flipper_length_mm)) +
  geom_histogram()
```



6. Histograma (*Histogram*)

ggplot2

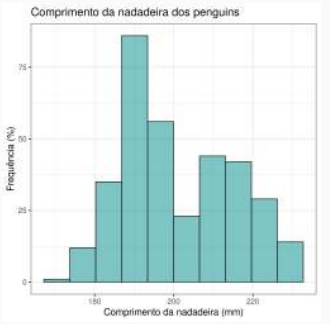
```
ggplot(data = penguins, aes(x = flipper_length_mm)) +
  geom_histogram(color = "black",
                 fill = "cyan4",
                 bins = 10)
```



6. Histograma (*Histogram*)

ggplot2

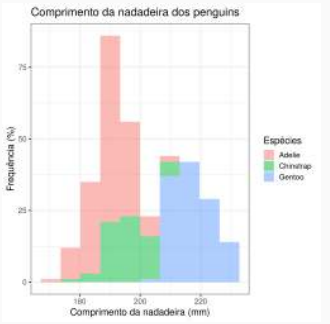
```
ggplot(data = penguins, aes(x = flipper_length_mm)) +
  geom_histogram(color = "black",
                 fill = "cyan4",
                 bins = 10,
                 alpha = .5) +
  labs(title = "Comprimento da nadadeira dos penguins
       x = "Comprimento da nadadeira (mm)",
       y = "Frequência (%)") +
  theme_bw(base_size = 15)
```



6. Histograma (*Histogram*)

ggplot2

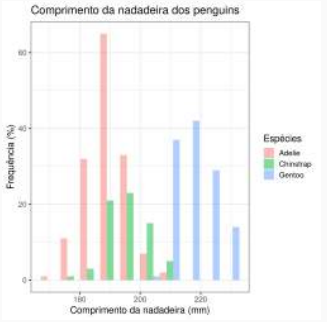
```
ggplot(data = penguins,
       aes(x = flipper_length_mm, fill = species)) +
  geom_histogram(bins = 10, alpha = .5) +
  labs(title = "Comprimento da nadadeira dos penguins
       fill = "Espécies",
       x = "Comprimento da nadadeira (mm)",
       y = "Frequência (%)") +
  theme_bw(base_size = 15)
```



6. Histograma (*Histogram*)

ggplot2

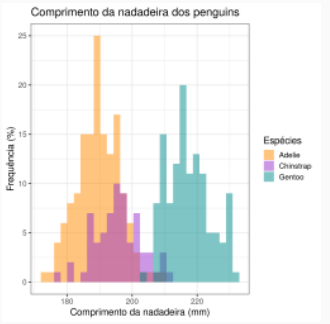
```
ggplot(data = penguins,
       aes(x = flipper_length_mm, fill = species)) +
  geom_histogram(bins = 10, alpha = .5,
                 position = "dodge") +
  labs(title = "Comprimento da nadadeira dos penguins
       fill = "Espécies",
       x = "Comprimento da nadadeira (mm)",
       y = "Frequência (%)") +
  theme_bw(base_size = 15)
```



6. Histograma (*Histogram*)

ggplot2

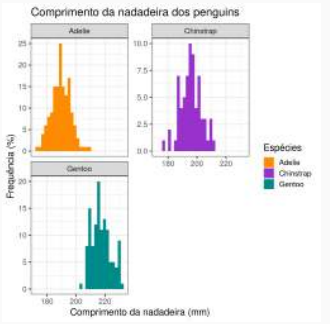
```
ggplot(data = penguins,
       aes(x = flipper_length_mm, fill = species)) +
  geom_histogram(alpha = .5, position = "identity") +
  scale_fill_manual(values = c("darkorange",
                               "darkorchid", "cyan4"
  labs(title = "Comprimento da nadadeira dos penguins
       fill = "Espécies",
       x = "Comprimento da nadadeira (mm)",
       y = "Frequência (%)") +
  theme_bw(base_size = 15)
```



6. Histograma (*Histogram*)

ggplot2

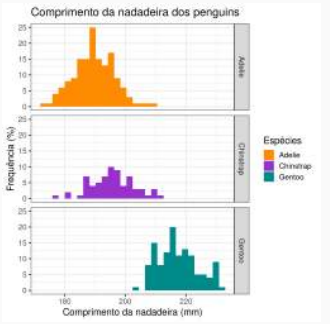
```
ggplot(data = penguins,
       aes(x = flipper_length_mm, fill = species)) +
  geom_histogram() +
  scale_fill_manual(values = c("darkorange",
                               "darkorchid", "cyan4"
  facet_wrap(~ species, ncol = 2, scale = "free_y") +
  labs(title = "Comprimento da nadadeira dos penguins
       fill = "Espécies",
       x = "Comprimento da nadadeira (mm)",
       y = "Frequência (%)") +
  theme_bw(base_size = 15)
```



6. Histograma (*Histogram*)

ggplot2

```
ggplot(data = penguins,
       aes(x = flipper_length_mm, fill = species)) +
  geom_histogram() +
  scale_fill_manual(values = c("darkorange",
                               "darkorchid", "cyan4"
  facet_grid(species ~ .) +
  labs(title = "Comprimento da nadadeira dos penguins
       fill = "Espécies",
       x = "Comprimento da nadadeira (mm)",
       y = "Frequência (%)") +
  theme_bw(base_size = 15)
```



6. Densidade (*Density*)

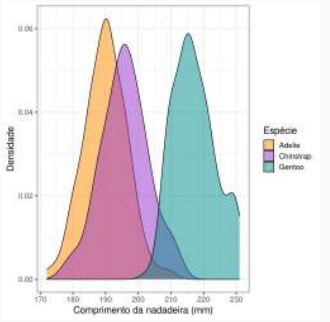
ggplot2

```
ggplot(data = penguins) +
  aes(x = flipper_length_mm) +
  geom_density(color = "black",
               fill = "cyan4", alpha = .5) +
  labs(title = "Comprimento da nadadeira dos penguin
       x = "Comprimento da nadadeira (mm)",
       y = "Densidade") +
  theme_bw(base_size = 15)
```

6. Densidade (*Density*)

ggplot2

```
ggplot(data = penguins,
       aes(x = flipper_length_mm,
           fill = species)) +
  geom_density(alpha = .5) +
  scale_fill_manual(values = c("darkorange",
                               "darkorchid", "cyan4"
  labs(x = "Comprimento da nadadeira (mm)",
       y = "Densidade",
       fill = "Espécie") +
  theme_bw(base_size = 15)
```



6. Histograma (*Histogram*)

ggplot2

Exportar

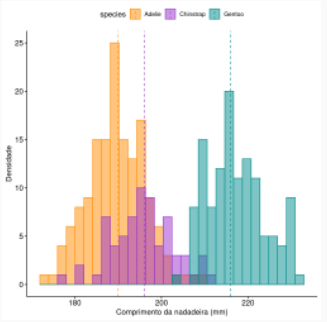
```
ggplot_densidade ← ggplot(data = penguins, aes(x = flipper_length_mm, fill = species)) +
  geom_density(alpha = .5) +
  scale_fill_manual(values = c("darkorange", "darkorchid", "cyan4")) +
  labs(x = "Comprimento da nadadeira (mm)",  y = "Densidade", fill = "Espécie") +
  theme_bw(base_size = 15)

ggsave(filename = here::here("03_dados", "graficos", "histogram_ggplot2.png"),
       plot = ggplot_densidade, wi = 20, he = 15, un = "cm", dpi = 300)
```

ggpubr

6. Histograma (*Histogram*)

ggpubr

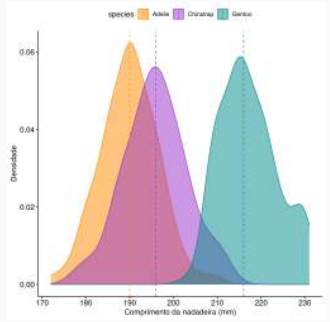
```
gghistogram(data = penguins,
            x = "flipper_length_mm",
            add = "median",
            color = "species",
            fill = "species",
            palette = c("darkorange", "darkorchid",
            xlab = "Comprimento da nadadeira (mm)",
            ylab = "Densidade")
```



6. Densidade (*Density*)

ggpubr

```
ggdensity(data = penguins,
          x = "flipper_length_mm",
          add = "median",
          color = "species",
          fill = "species",
          palette = c("darkorange", "darkorchid", "cy
          xlab = "Comprimento da nadadeira (mm)",
          ylab = "Densidade")
```



6. Densidade (*Density*)

ggpubr

Exportar

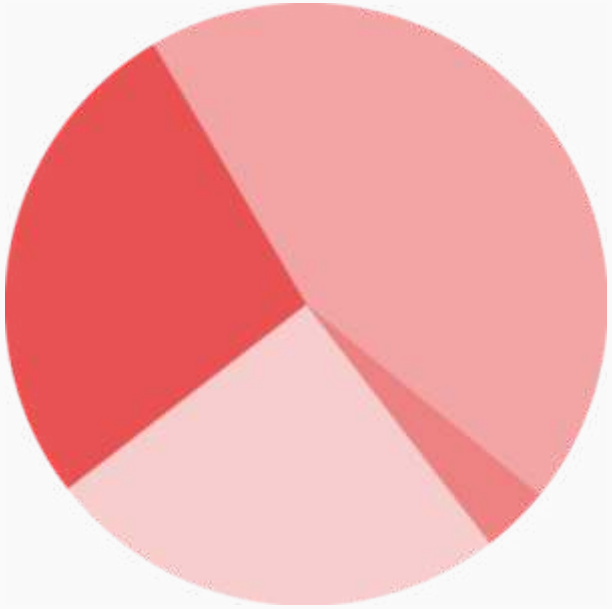
```
ggpubr_densidade ← ggdensity(data = penguins,
                             x = "flipper_length_mm",
                             add = "median",
                             fill = "cyan4",
                             rug = TRUE,
                             add_density = TRUE,
                             xlab = "Comprimento da nadadeira (mm)",
                             ylab = "Densidade")

ggsave(filename = here::here("03_dados", "graficos", "densidade_ggpubr.png"),
       plot = ggpubr_densidade, wi = 20, he = 15, un = "cm", dpi = 300)
```

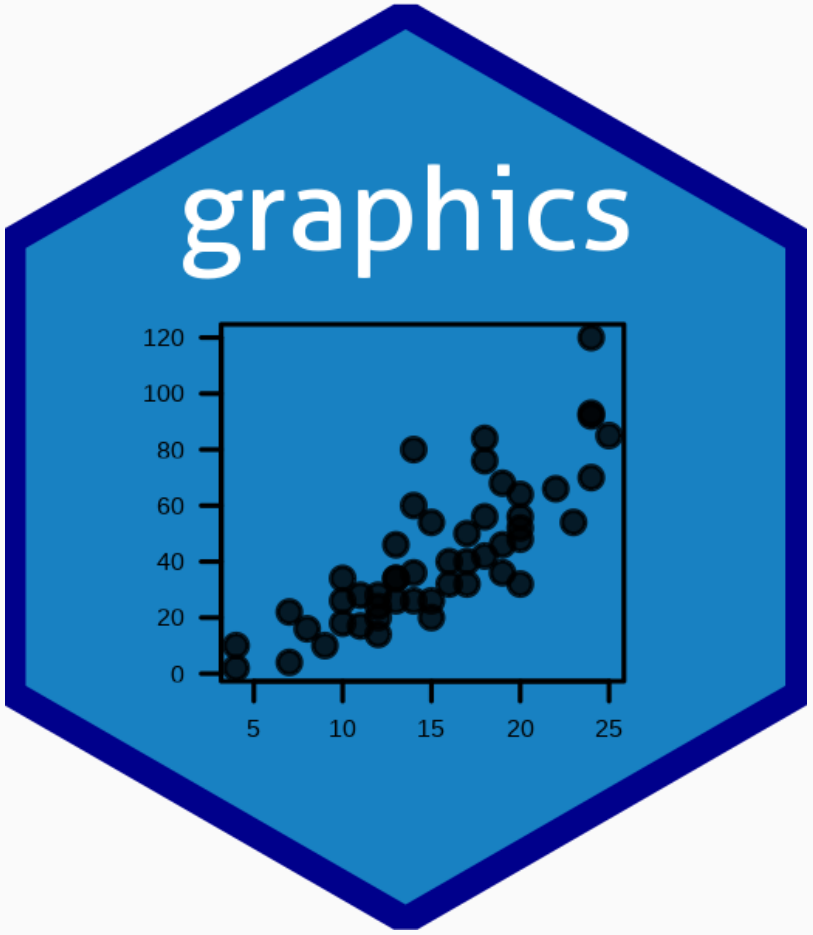
7. Gráfico de setores (*Pie chart*)

Representa os dados de: uma coluna

Tipo de dado: categórico

Proporção ou porcentagem de dados categóricos



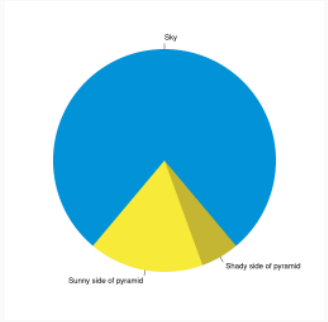


graphics

7. Gráfico de setores (*Pie chart*)

Clássico

```
par(mar = c(0, 1, 0, 1))
pie(c(280, 60, 20),
    c("Sky", "Sunny side of pyramid", "Shady side of
    col = c("#0292D8", "#F7EA39", "#C4B632"),
    init.angle = -50, border = NA)
```



7. Gráfico de setores (*Pie chart*)

Tabela de frequência

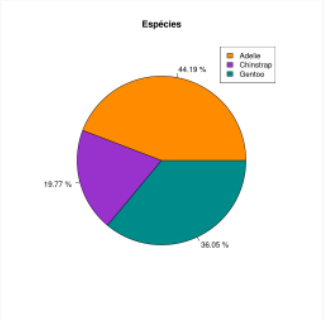
```
# calculo da proporcao
penguins_prop ← penguins %>%
  dplyr::count(species) %>%
  dplyr::mutate(prop = round(n/sum(n), 4)*100)
penguins_prop
```

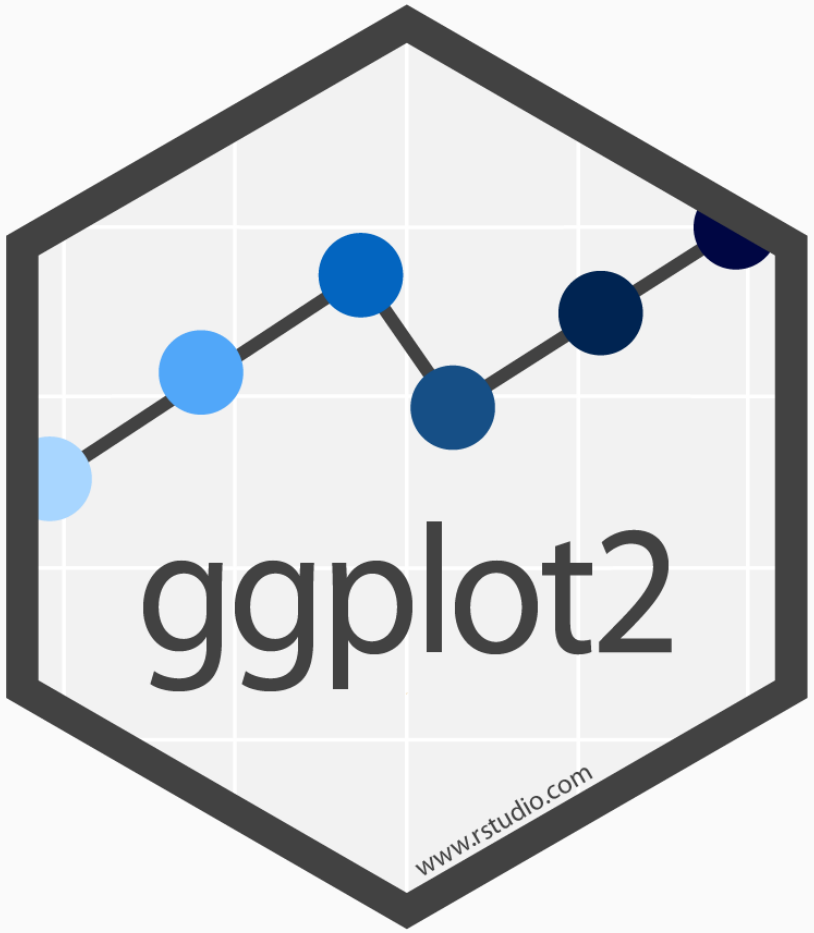
```
## ¤[90m# A tibble: 3 × 3¤[39m
##   species       n  prop
##   ¤[3m¤[90m<fct>¤[39m¤[23m     ¤[3m¤[90m<int>¤[39m¤[23m ¤[3m¤[90m<dbl>¤[39m¤[23m
## ¤[90m1¤[39m Adelie      152  44.2
## ¤[90m2¤[39m Chinstrap    68  19.8
## ¤[90m3¤[39m Gentoo      124  36.0
```

7. Gráfico de setores (*Pie chart*)

graphics

```
par(mar = c(5, 5, 5, 5))
pie(penguins_prop$prop,
    labels = paste(penguins_prop$prop, "%"),
    main = "Espécies",
    col = c("darkorange", "darkorchid", "cyan4"))
legend("topright", legend = penguins_prop$species,
       fill = c("darkorange", "darkorchid", "cyan4"))
```



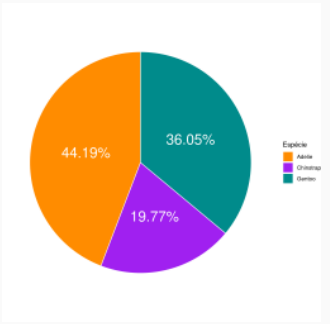


ggplot2

7. Gráfico de setores (*Pie chart*)

ggplot2

```
ggplot(data = penguins_prop,
       aes(x = "", y = prop, fill = species)) +
  geom_bar(stat = "identity", color = "white") +
  coord_polar("y", start = 0) +
  geom_text(aes(label = paste0(prop, "%")),
            color = "white",
            position = position_stack(vjust = .5), si
  scale_fill_manual(values = c("darkorange", "purple'
  theme_void() +
  labs(fill = "Espécie")
```

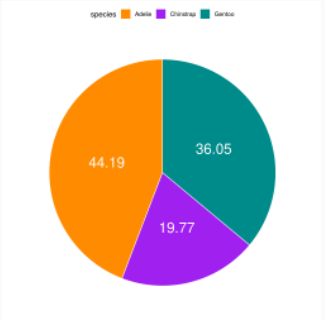


ggpubr

7. Gráfico de setores (*Pie chart*)

ggpubr

```
ggpie(penguins_prop,
      "prop",
      label = "prop",
      lab.pos = "in",
      lab.font = c(8, "white"),
      fill = "species",
      color = "white",
      palette = c("darkorange", "purple", "cyan4"))
```



Mas todos dizem para jogar o gráfico de pizza fora e pedir uma pizza...

… e eu concordo…

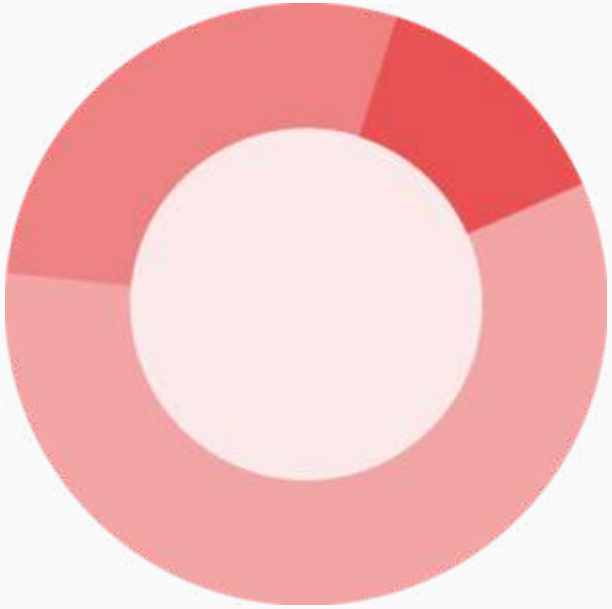
Então vamos usar algo mais saudável: vamos retirar o recheio da pizza...

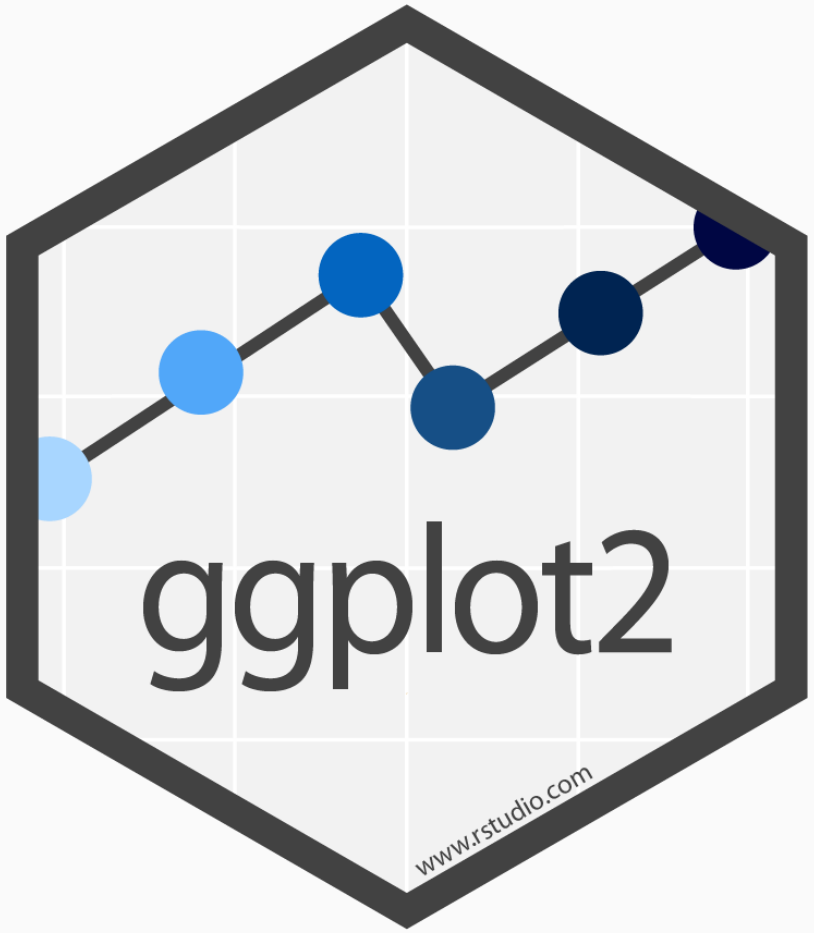
7. Gráfico de setores (*Donut chart*)

Representa os dados de: uma coluna

Tipo de dado: categórico

Proporção ou porcentagem de dados categóricos



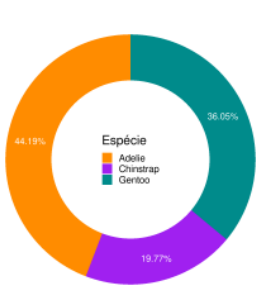


ggplot2

7. Gráfico de setores (*Donut chart*)

ggplot2

```
ggplot(data = penguins_prop,
       aes(x = 2, y = prop, fill = species)) +
  geom_bar(stat = "identity") +
  coord_polar(theta = "y", start = 0) +
  geom_text(aes(label = paste0(prop, "%")),
            color = "white",
            position = position_stack(vjust = .5), si
  scale_fill_manual(values = c("darkorange", "purple"
  xlim(0, 2.5) +
  theme_void() +
  theme(legend.position = c(.5, .5),
        legend.title = element_text(size = 20),
        legend.text = element_text(size = 15)) +
  labs(fill = "Espécie")
```

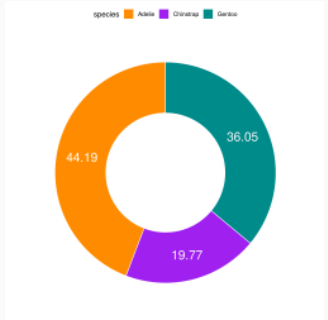


ggpubr

7. Gráfico de setores (*Donut chart*)

ggpubr

```
ggdonutchart(penguins_prop,
             "prop",
             label = "prop",
             lab.pos = "in",
             lab.font = c(7, "white"),
             fill = "species",
             color = "white",
             palette = c("darkorange", "purple", "cya
```

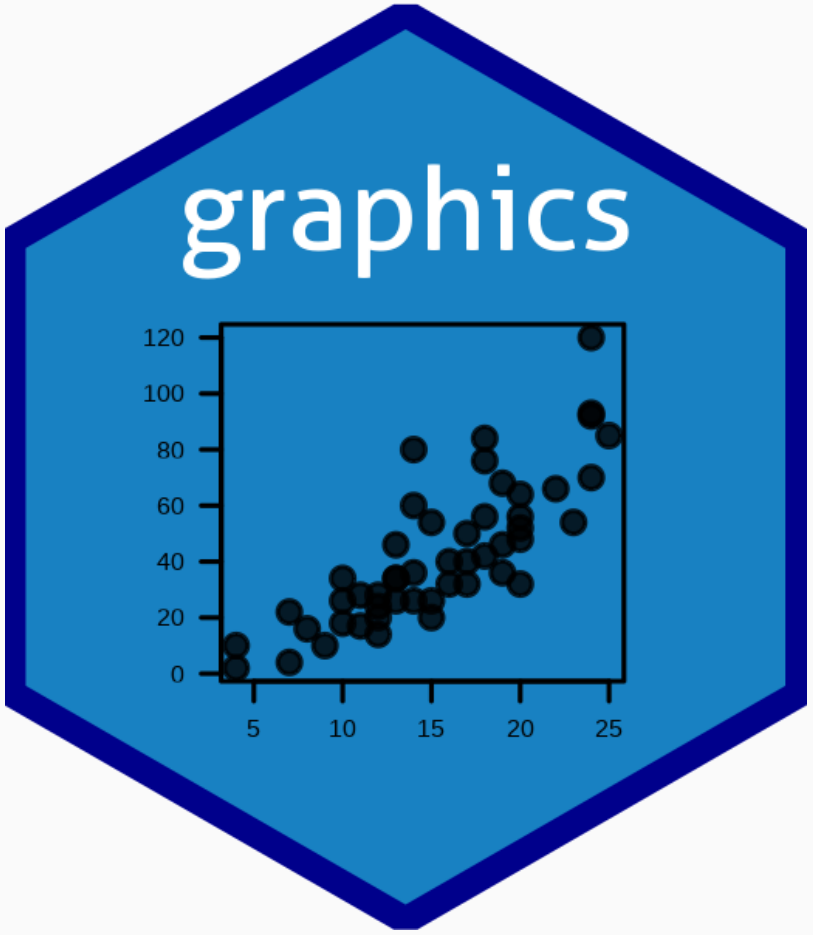


8. Gráfico de barras (*Bar plot*)

Representa os dados de: duas colunas

Modo das colunas: X = categórico e Y = categórico

Resume dados de contagens para uma coluna com diversos tipos de dados



graphics

8. Gráfico de barras (*Bar plot*)

Tabela de frequência

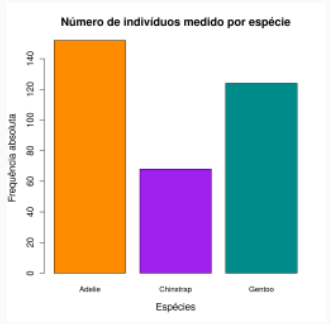
```
# numero de individuos coletados
penguins_count ← penguins %>%
  dplyr::count(species)
penguins_count
```

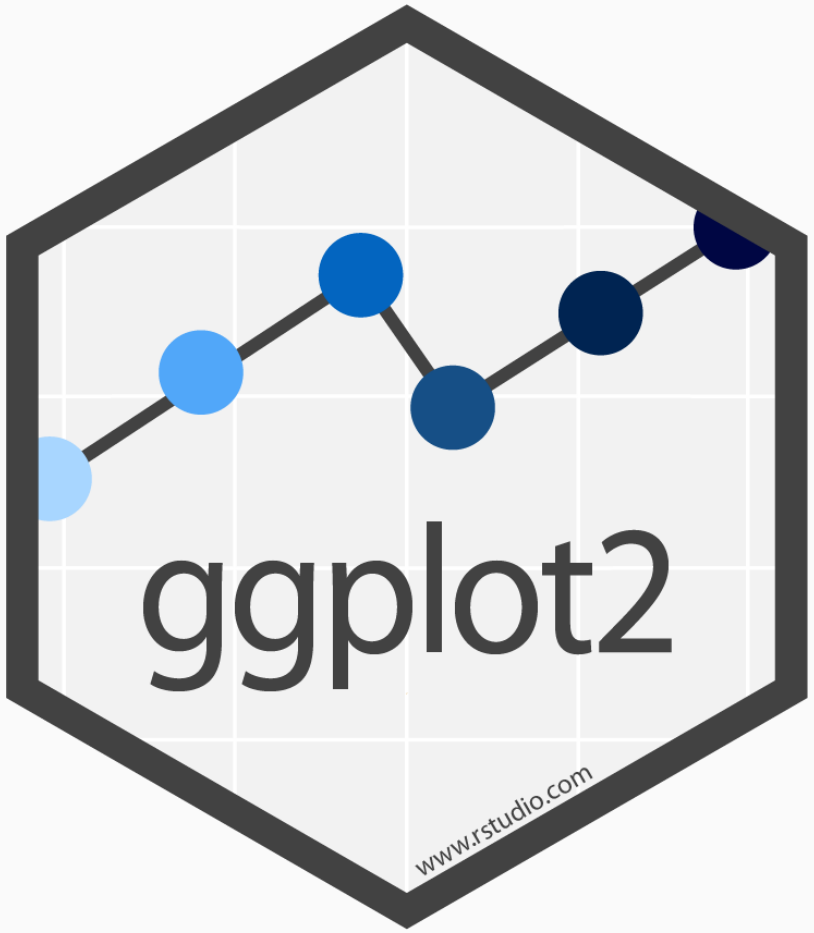
```
## ¤[90m# A tibble: 3 × 2¤[39m
##   species       n
##   ¤[3m¤[90m<fct>¤[39m¤[23m     ¤[3m¤[90m<int>¤[39m¤[23m
## ¤[90m1¤[39m Adelie      152
## ¤[90m2¤[39m Chinstrap    68
## ¤[90m3¤[39m Gentoo      124
```

8. Gráfico de barras (*Bar plot*)

graphics

```
barplot(n ~ species,
        data = penguins_count,
        col = c("darkorange", "purple", "cyan4"),
        main = "Número de indivíduos medido por espé
        xlab = "Espécies",
        ylab = "Frequência absoluta",
        cex.main = 1.5,
        cex.lab = 1.3,
        cex.axis = 1.2)
```



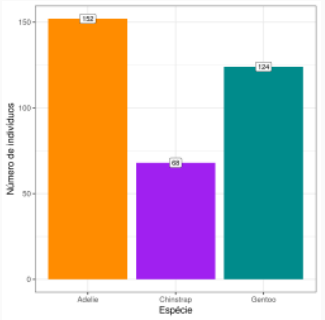


ggplot2

8. Gráfico de barras (*Bar plot*)

ggplot2

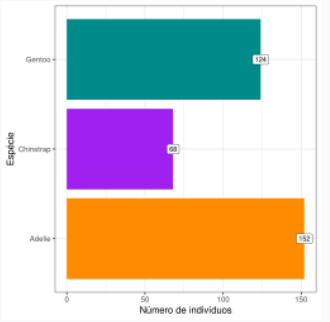
```
ggplot(data = penguins_count,
       aes(x = species, y = n, fill = species)) +
  geom_bar(stat = "identity") +
  geom_label(aes(label = n), fill = "white") +
  scale_fill_manual(values = c("darkorange", "purple
  theme_bw(base_size = 15) +
  theme(legend.position = "none") +
  labs(x = "Espécie",
       y = "Número de indivíduos",
       fill = "Espécie")
```



8. Gráfico de barras (*Bar plot*)

ggplot2

```
ggplot(data = penguins_count,
       aes(x = species, y = n, fill = species)) +
  geom_bar(stat = "identity") +
  geom_label(aes(label = n), fill = "white") +
  scale_fill_manual(values = c("darkorange", "purple
  coord_flip() +
  theme_bw(base_size = 15) +
  theme(legend.position = "none") +
  labs(x = "Espécie",
       y = "Número de indivíduos",
       fill = "Espécie")
```

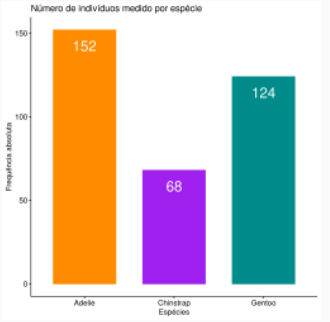


ggpubr

9. Gráfico de barras (*Bar plot*)

ggpubr

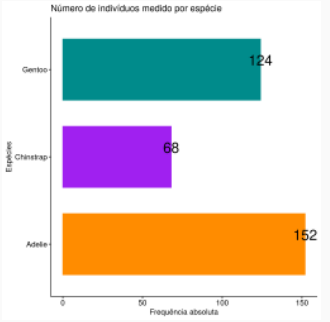
```
ggbarplot(penguins_count,
          x = "species",
          y = "n",
          fill = "species",
          color = "species",
          palette = c("darkorange", "purple", "cyan4
          label = TRUE,
          lab.pos = "in",
          lab.col = "white",
          lab.size = 8,
          main = "Número de indivíduos medido por es
          xlab = "Espécies",
          ylab = "Frequência absoluta",
          legend = "none")
```



9. Gráfico de barras (*Bar plot*)

ggpubr

```
ggbarplot(penguins_count,
          x = "species",
          y = "n",
          fill = "species",
          color = "species",
          palette = c("darkorange", "purple", "cyan4
          label = TRUE,
          lab.pos = "out",
          lab.col = "black",
          lab.size = 8,
          main = "Número de indivíduos medido por es
          xlab = "Espécies",
          ylab = "Frequência absoluta",
          legend = "none",
          orientation = "horiz")
```

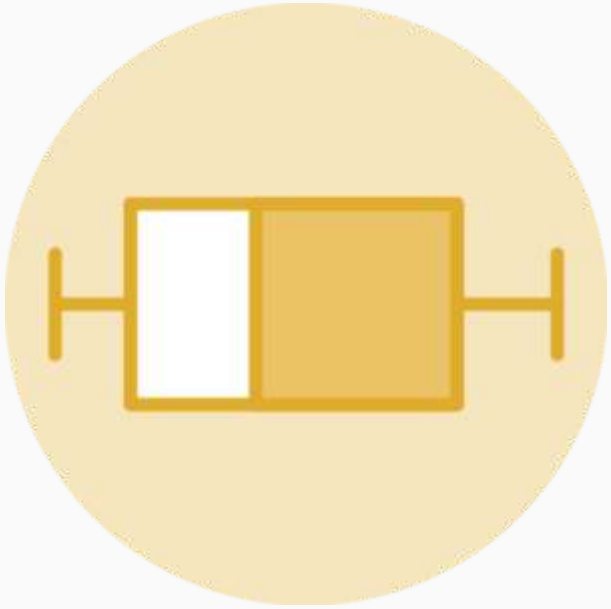


9. Gráfico de caixa (*Box plot*)

Representa os dados de: duas colunas

Modo das colunas: X = categórico e Y = contínuo

Resume informações de medidas contínuas para dois ou mais fatores categóricos

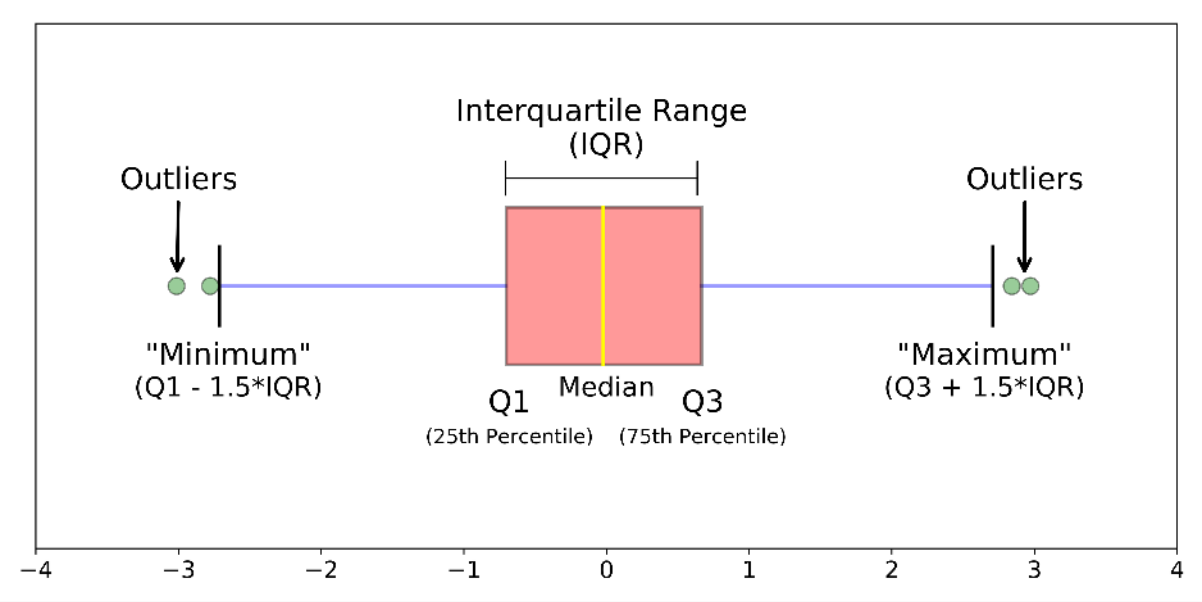


9. Gráfico de caixa (*Box plot*)

Intervalo inter-quartil (*interquartile range* - IQR)

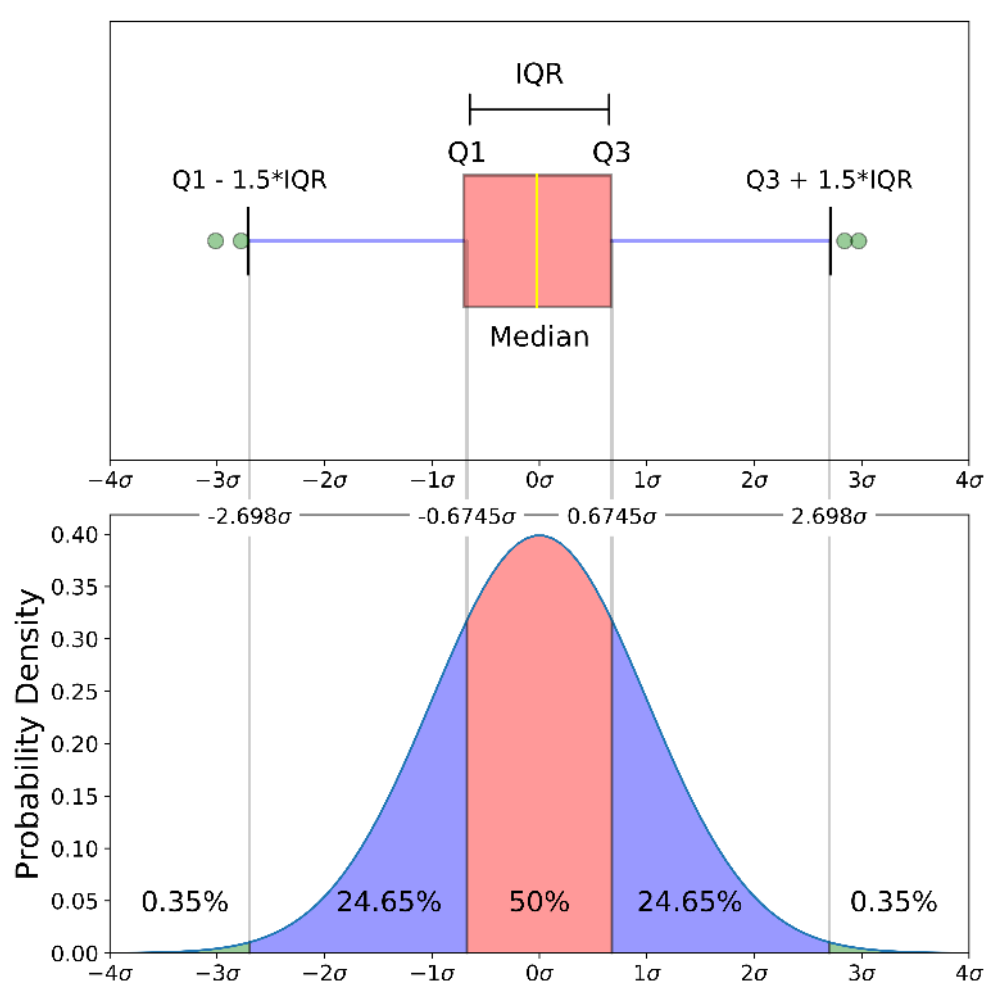
Limite inferior e limite superipor (1.5 x IQR)

Valores exteriores (*outliers*)

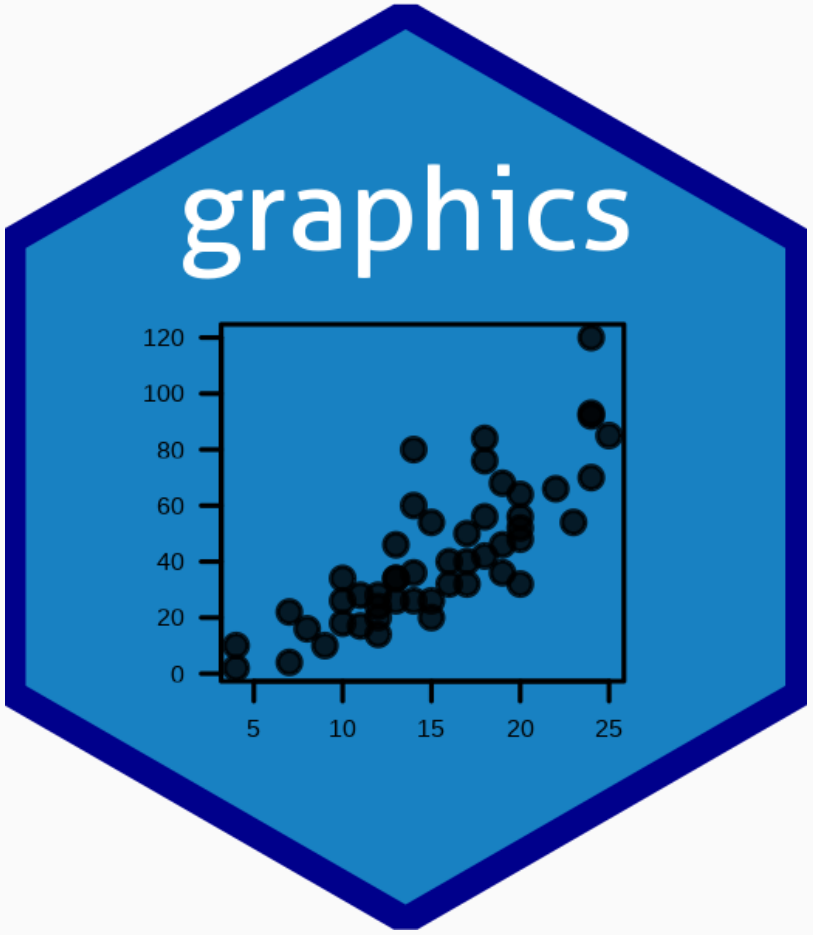


[Understanding Boxplots]

9. Gráfico de caixa (*Box plot*)



[Understanding Boxplots]

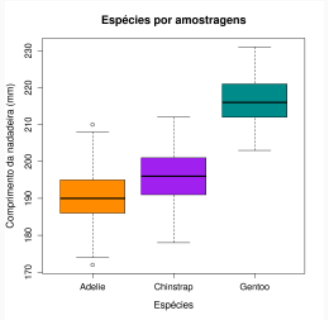


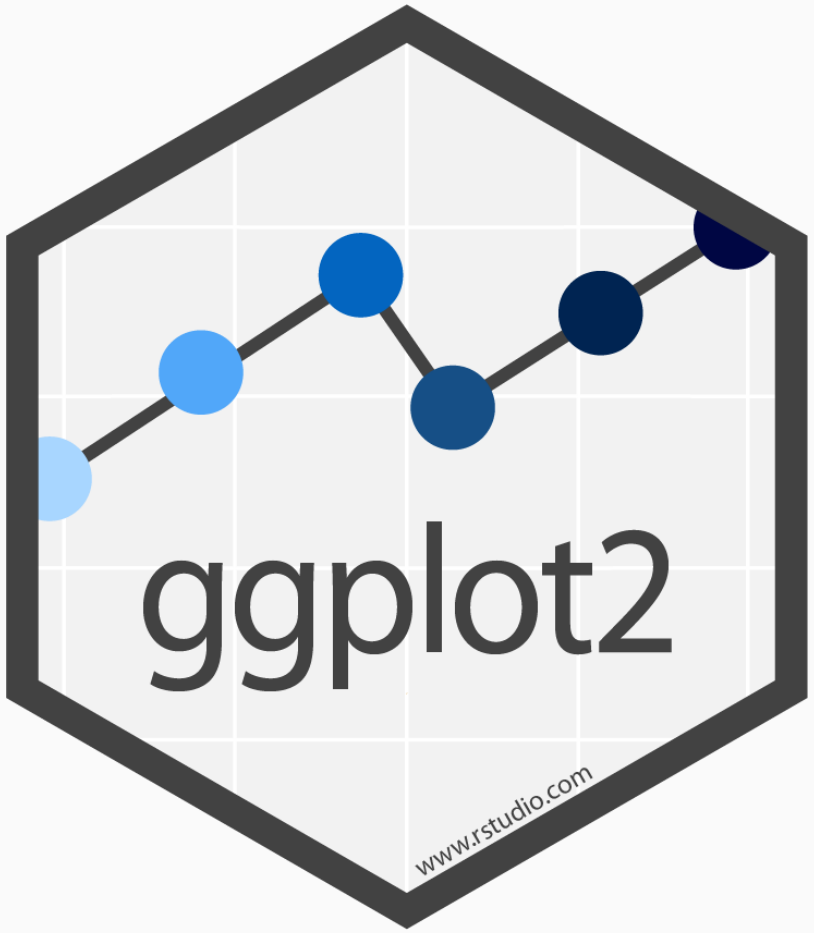
graphics

9. Gráfico de caixa (*Box plot*)

graphics

```
boxplot(flipper_length_mm ~ as.factor(species),
        data = penguins,
        col = c("darkorange", "purple", "cyan4"),
        border = "black",
        main = "Espécies por amostragens",
        xlab = "Espécies",
        ylab = "Comprimento da nadadeira (mm)",
        cex.main = 1.5,
        cex.lab = 1.3,
        cex.axis = 1.2)
```



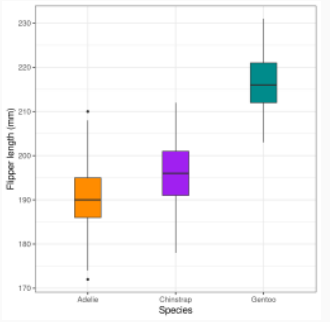


ggplot2

9. Gráfico de caixa (*Box plot*)

ggplott2

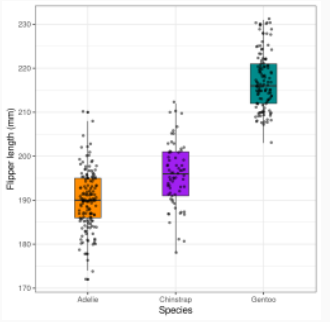
```
ggplot(data = penguins,
       aes(x = species, y = flipper_length_mm, fill =
  geom_boxplot(width = .3,
               show.legend = FALSE) +
  scale_fill_manual(values = c("darkorange", "purple"
  theme_bw(base_size = 15) +
  labs(x = "Species", y = "Flipper length (mm)")
```



9. Gráfico de caixa (*Box plot*)

ggplott2

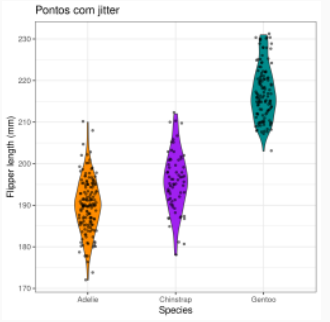
```
ggplot(data = penguins,
       aes(x = species, y = flipper_length_mm, fill =
  geom_boxplot(width = .3,
               show.legend = FALSE) +
  geom_jitter(alpha = .5,
              show.legend = FALSE,
              position = position_jitter(width = .1,
  scale_fill_manual(values = c("darkorange", "purple"
  theme_bw(base_size = 15) +
  labs(x = "Species", y = "Flipper length (mm)")
```



10. Gráfico de caixa (*Violin plot*)

ggplott2

```
ggplot(data = penguins,
       aes(x = species, y = flipper_length_mm, fill =
  geom_violin(width = .3,
              show.legend = FALSE) +
  geom_jitter(alpha = .5,
              show.legend = FALSE,
              position = position_jitter(width = .1,
  scale_fill_manual(values = c("darkorange", "purple"
  theme_bw(base_size = 15) +
  labs(title = "Pontos com jitter", x = "Species", y
```

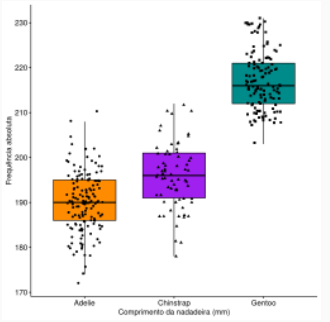


ggpubr

9. Gráfico de caixa (*Box plot*)

ggpubr

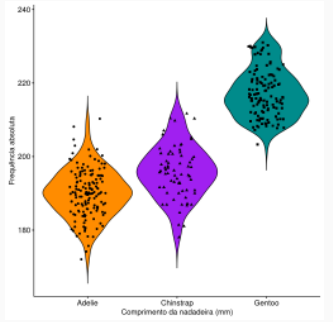
```
ggboxplot(data = penguins,
          x = "species",
          y = "flipper_length_mm",
          add = "jitter",
          shape = "species",
          fill = "species",
          color = "black",
          palette = c("darkorange", "purple", "cyan4"
          xlab = "Comprimento da nadadeira (mm)",
          ylab = "Frequência absoluta",
          legend = "none")
```



10. Gráfico de caixa (*Violin plot*)

ggpubr

```
ggviolin(data = penguins,
         x = "species",
         y = "flipper_length_mm",
         add = "jitter",
         shape = "species",
         fill = "species",
         color = "black",
         palette = c("darkorange", "purple", "cyan4"
         xlab = "Comprimento da nadadeira (mm)",
         ylab = "Frequência absoluta",
         legend = "none")
```

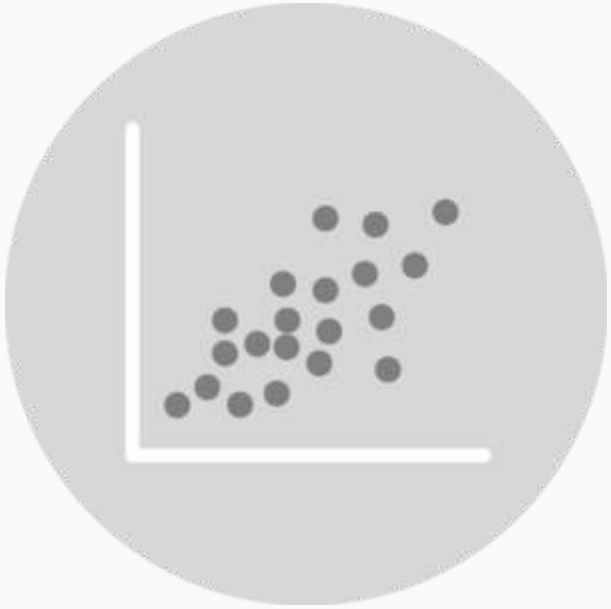


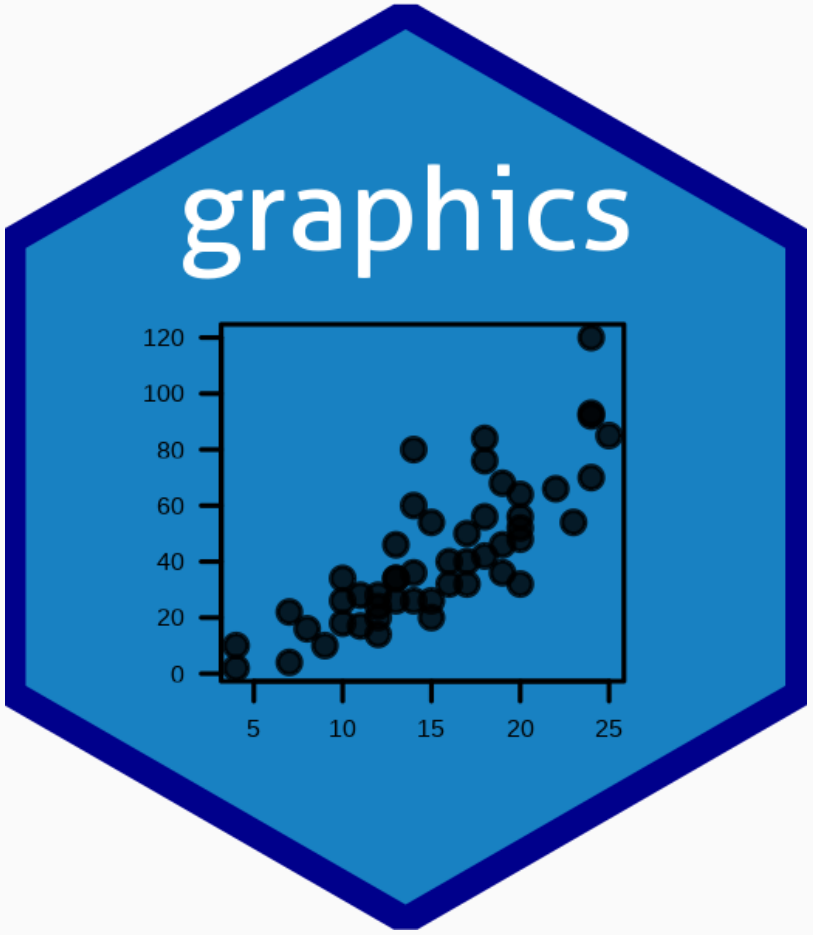
10. Gráfico de dispersão (*Scatter plot*)

Representa os dados de: duas colunas

Modo das colunas: X = numérico e Y = numérico

Plota a relação entre duas variáveis contínuas



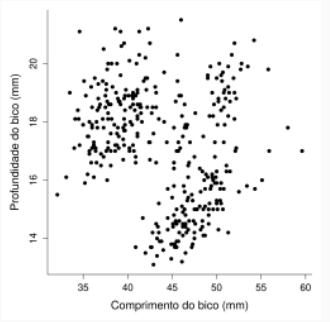


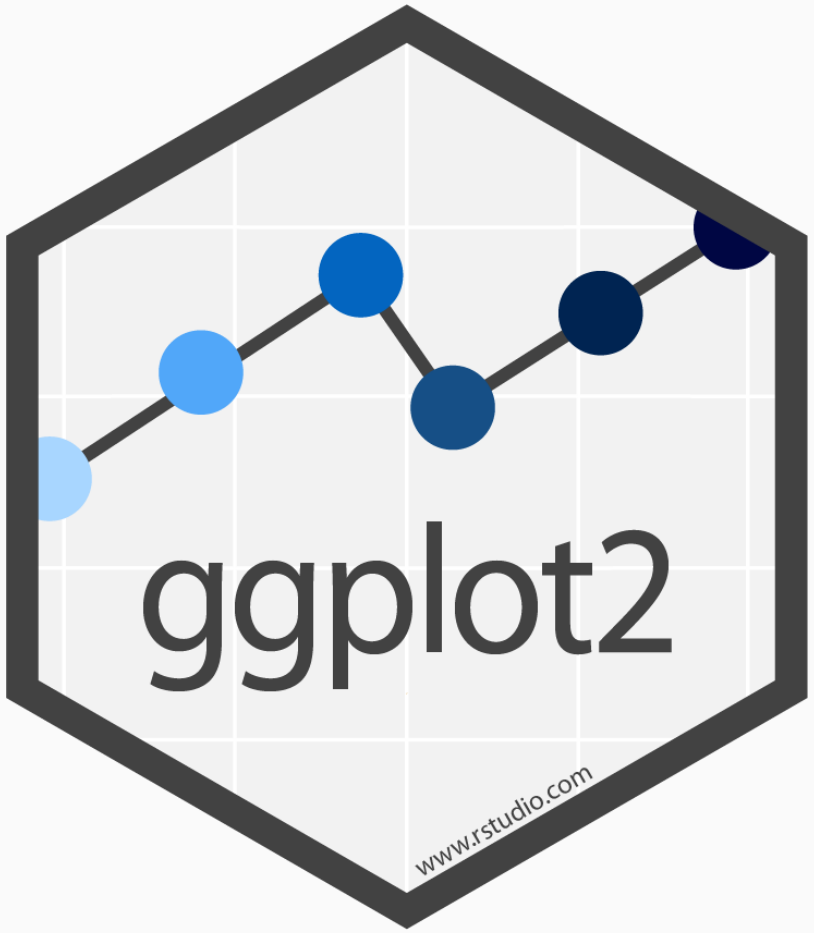
graphics

10. Gráfico de dispersão (*Scatter plot*)

graphics

```
par(mar = c(5, 5, 1, 1))
plot(bill_depth_mm ~ bill_length_mm,
     data = penguins,
     pch = 20,
     cex = 1.5,
     xlab = "Comprimento do bico (mm)",
     ylab = "Profundidade do bico (mm)",
     cex.lab = 1.5,
     cex.axis = 1.3,
     bty = "l")
```



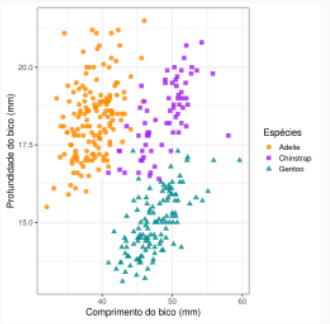


ggplot2

10. Gráfico de dispersão (*Scatter plot*)

ggplot2

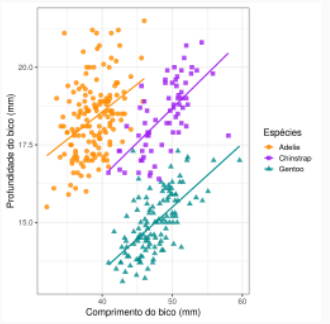
```
ggplot(data = penguins,
       aes(x = bill_length_mm,
           y = bill_depth_mm,
           color = species,
           shape = species)) +
  geom_point(size = 3, alpha = .8) +
  scale_shape_manual(values = c(19, 15, 17)) +
  scale_color_manual(values = c("darkorange", "purple
  theme_bw(base_size = 15) +
  labs(x = "Comprimento do bico (mm)",
       y = "Profundidade do bico (mm)",
       color = "Espécies", shape = "Espécies")
```



10. Gráfico de dispersão (*Scatter plot*)

ggplot2

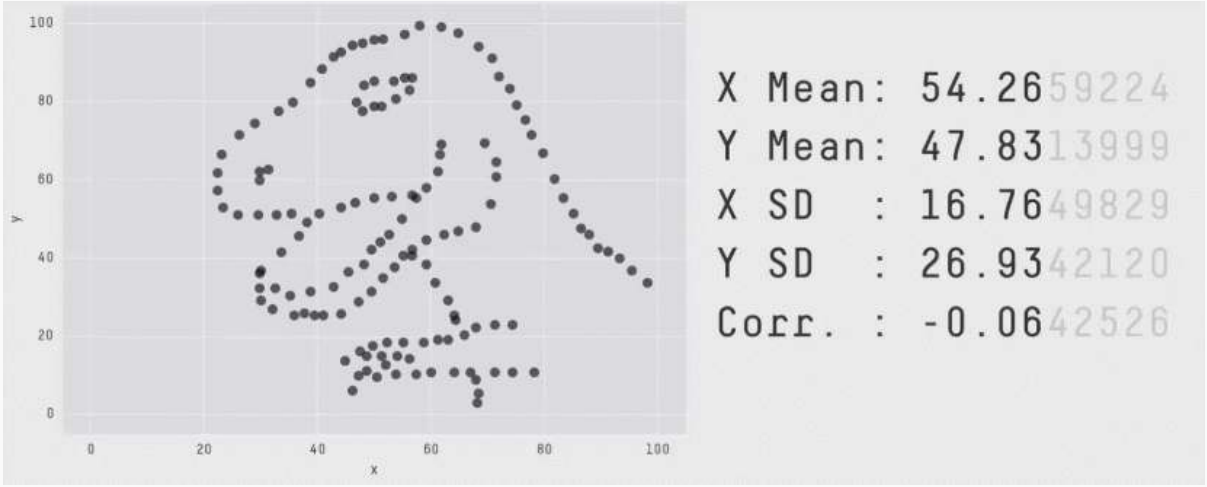
```
ggplot(data = penguins,
       aes(x = bill_length_mm,
           y = bill_depth_mm,
           color = species,
           shape = species)) +
  geom_point(size = 3, alpha = .8) +
  geom_smooth(method = "lm", se = FALSE) +
  scale_shape_manual(values = c(19, 15, 17)) +
  scale_color_manual(values = c("darkorange", "purple
  theme_bw(base_size = 15) +
  labs(x = "Comprimento do bico (mm)",
       y = "Profundidade do bico (mm)",
       color = "Espécies", shape = "Espécies")
```



10. Gráfico de dispersão (*Scatter plot*)

Same Stats, Different Graphs: Generating Datasets with Varied Appearance and Identical Statistics through Simulated Annealing

Justin Matejka, George Fitzmaurice

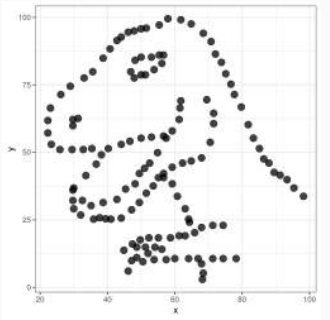


Matejka & Fitzmaurice (2017)

10. Gráfico de dispersão (*Scatter plot*)

dino

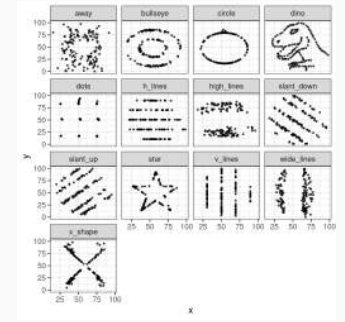
```r
# package
library(datasauRus)

# data + plot
datasaurus_dozen %>%
  dplyr::filter(dataset == "dino") %>%
  ggplot() +
  aes(x = x, y = y) +
  geom_point(colour = "black", fill = "black",
             size = 5, alpha = .75, pch = 21) +
  theme_bw(base_size = 15)
```



10. Gráfico de dispersão (*Scatter plot*)

Todos os plots

```
datasaurus_dozen %>%
  ggplot() +
  aes(x = x, y = y) +
  geom_point(colour = "black", fill = "black",
             size = 1, alpha = .75, pch = 21) +
  facet_wrap(~dataset) +
  theme_bw(base_size = 15)
```

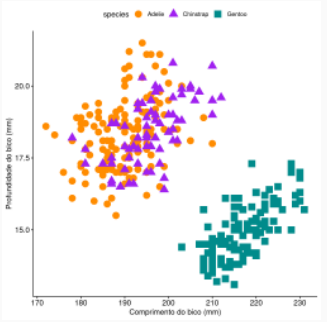


ggpubr

10. Gráfico de dispersão (*Scatter plot*)

ggpubr

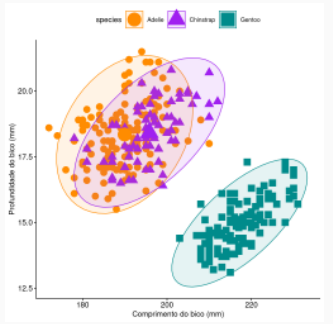
```
ggscatter(data = penguins,
          x = "flipper_length_mm",
          y = "bill_depth_mm",
          color = "species",
          fill = "species",
          palette = c("darkorange", "purple", "cyan4
          shape = "species",
          size = 5,
          xlab = "Comprimento do bico (mm)",
          ylab = "Profundidade do bico (mm)")
```



10. Gráfico de dispersão (*Scatter plot*)

ggpubr

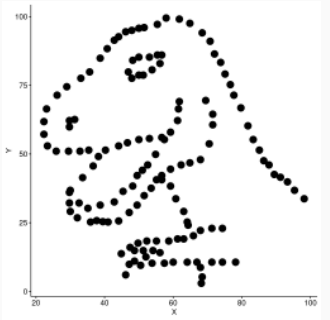
```
ggscatter(data = penguins,
          x = "flipper_length_mm",
          y = "bill_depth_mm",
          color = "species",
          fill = "species",
          palette = c("darkorange", "purple", "cyan4
          shape = "species",
          size = 5,
          xlab = "Comprimento do bico (mm)",
          ylab = "Profundidade do bico (mm)",
          ellipse = TRUE,
          mean.point = TRUE)
```



10. Gráfico de dispersão (*Scatter plot*)

ggpubr

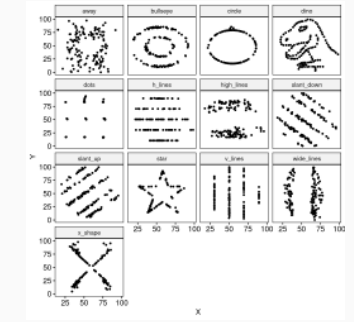
```
ggscatter(data = datasaurus_dozen %>%
            dplyr::filter(dataset == "dino"),
          x = "x",
          y = "y",
          size = 5,
          xlab = "X",
          ylab = "Y")
```



10. Gráfico de dispersão (*Scatter plot*)

ggpubr

```
ggscatter(data = datasaurus_dozen,
          x = "x",
          y = "y",
          size = 1,
          xlab = "X",
          ylab = "Y",
          facet.by = "dataset")
```

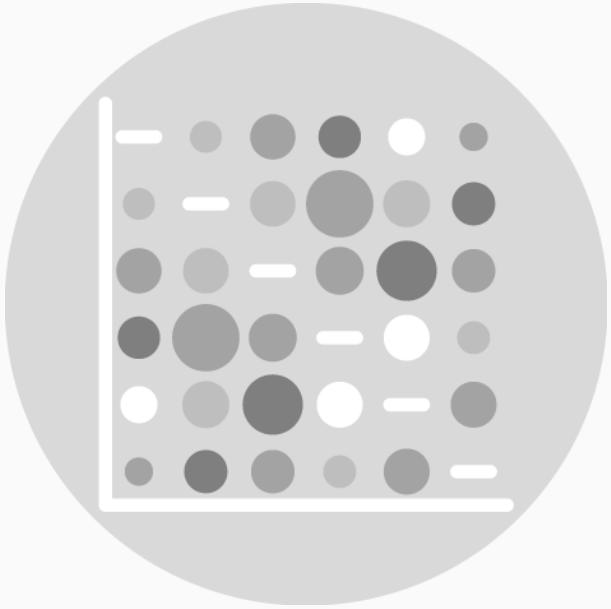


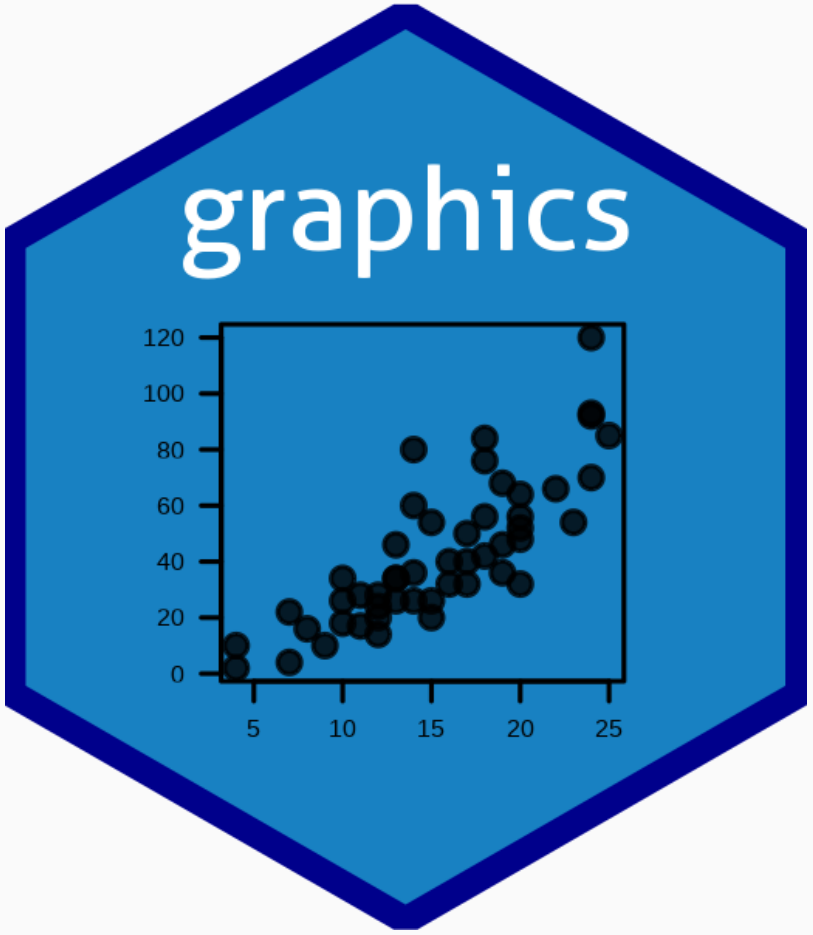
11. Gráfico pareado (*Pairs plot*)

Representa os dados de: muitas colunas

Modo das colunas: X = numérico e Y = numérico

Plota a relação entre duas variáveis contínuas, mas para várias colunas



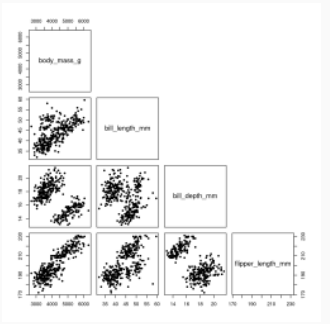


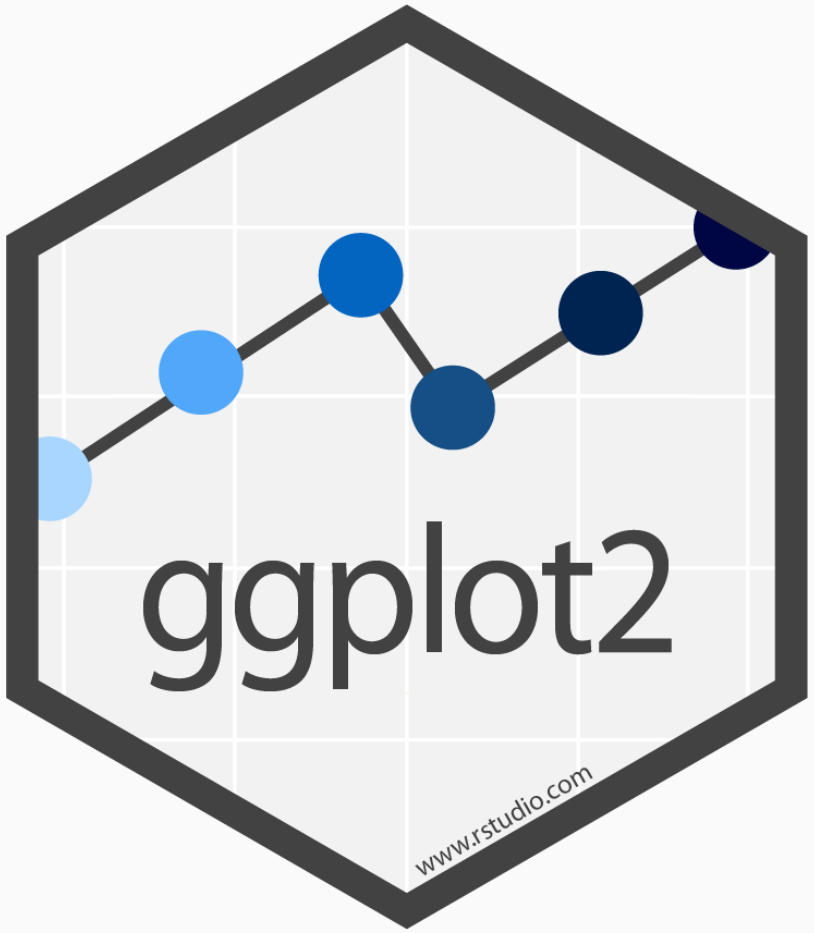
graphics

11. Gráfico pareado (*Pairs plot*)

graphics

```
penguins %>%
  dplyr::select(body_mass_g, ends_with("_mm")) %>%
  pairs(pch = 20,
        upper.panel = NULL)
```



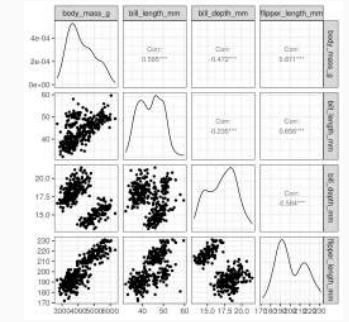


GGally

11. Gráfico pareado (*Pairs plot*)

GGally

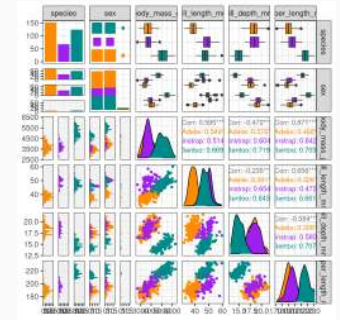
```
# pacote
# install.packages("GGally")
library(GGally)

penguins %>%
  dplyr::select(body_mass_g, ends_with("_mm")) %>%
  ggpairs() +
  theme_bw(base_size = 15)
```



11. Gráfico pareado (*Pairs plot*)

GGally

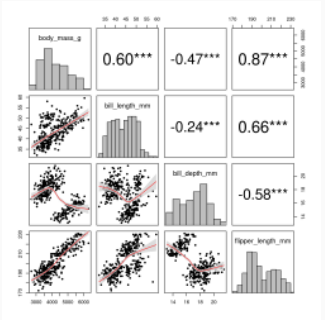
```
penguins %>%
  dplyr::select(species, sex, body_mass_g, ends_with(
  GGally::ggpairs(aes(color = species)) +
  scale_colour_manual(values = c("darkorange", "purp
  scale_fill_manual(values = c("darkorange", "purple
  theme_bw(base_size = 15)
```



11. Gráfico pareado (*Pairs plot*)

psych

```
# pacote
# install.packages("psych")
library(psych)

penguins %>%
  dplyr::select(body_mass_g, ends_with("_mm")) %>%
  pairs.panels(pch = 20,
               ellipses = FALSE,
               density = FALSE,
               stars = TRUE,
               hist.col = "gray",
               digits = 2,
               rug = FALSE,
               breaks = 10,
               ci = TRUE)
```



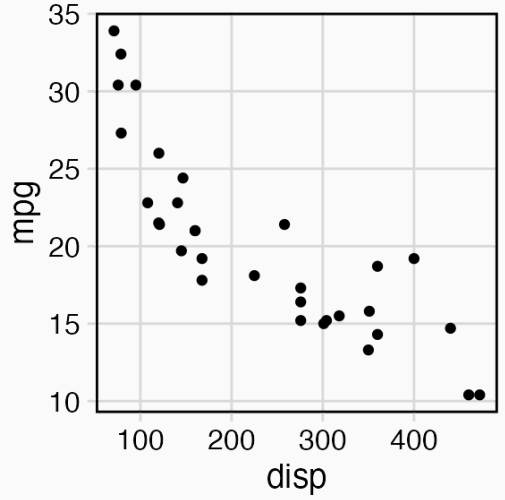
12. Combinando gráficos

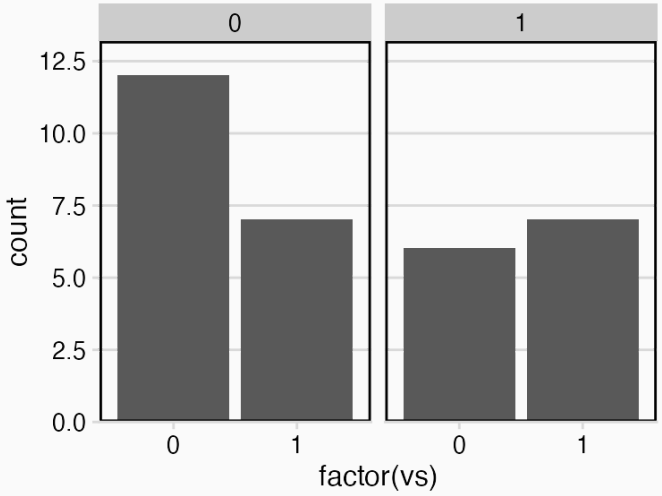
Descrição

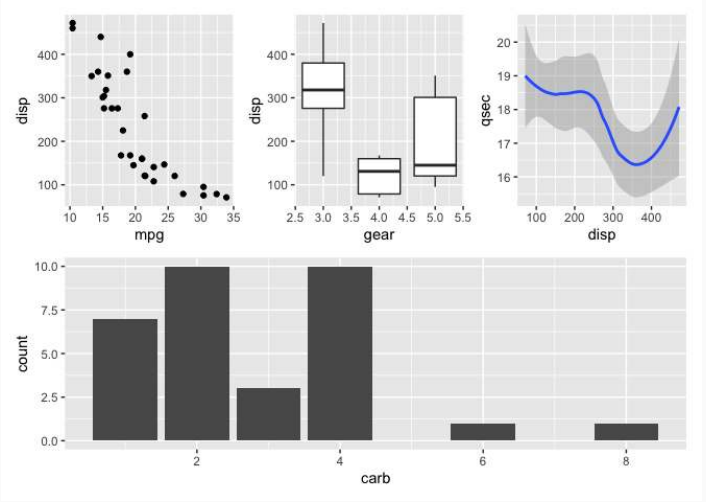
Muitas vezes precisamos **combinar gráficos** para representar nossos dados

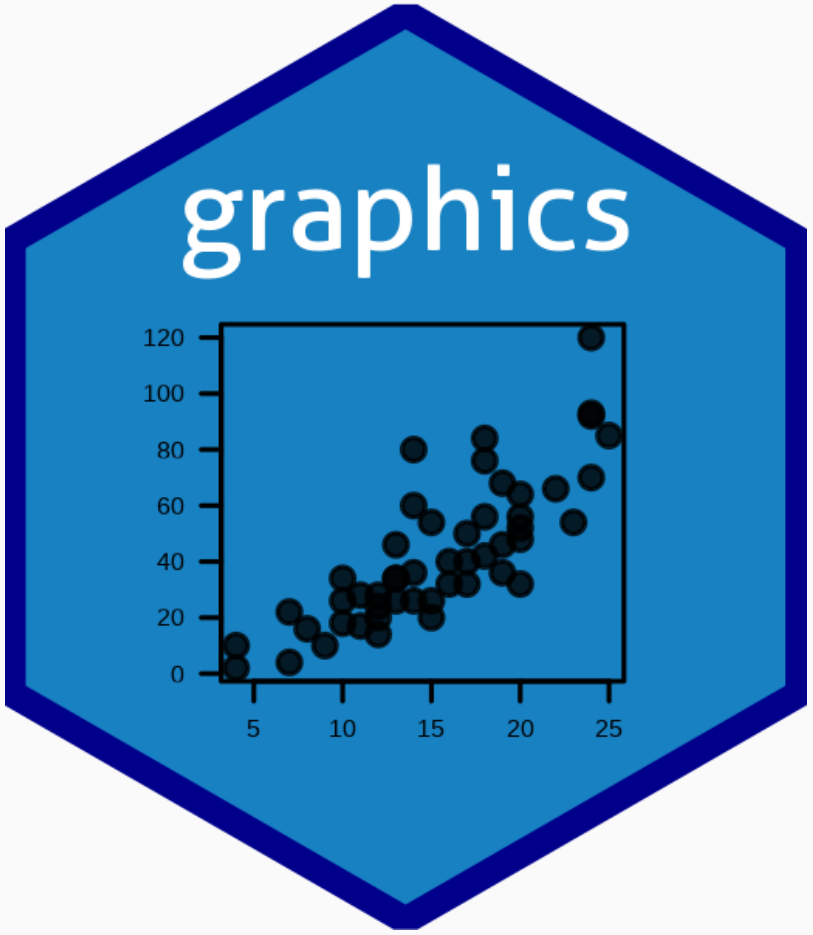
Essa tarefa pode ser realizada depois da criação dos gráficos em aplicativos como Inkscape ou GIMP

Outras vezes, podemos usar códigos e pacotes do R para fazer essa tarefa







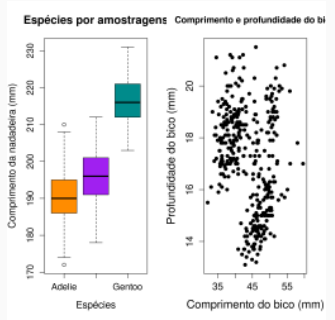


graphics

12. Combinando gráficos

graphics

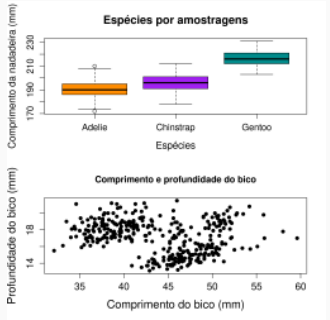
```
par(mfrow = c(1, 2))

boxplot(flipper_length_mm ~ as.factor(species),
        data = penguins,
        col = c("darkorange", "purple", "cyan4"),
        main = "Espécies por amostragens",
        xlab = "Espécies",
        ylab = "Comprimento da nadadeira (mm)",
        cex.main = 1.5, cex.lab = 1.3, cex.axis = 1.

plot(bill_depth_mm ~ bill_length_mm,
     data = penguins,
     pch = 20,
     cex = 1.5,
     main = "Comprimento e profundidade do bico",
     xlab = "Comprimento do bico (mm)",
     ylab = "Profundidade do bico (mm)",
     cex.lab = 1.5, cex.axis = 1.3)
```

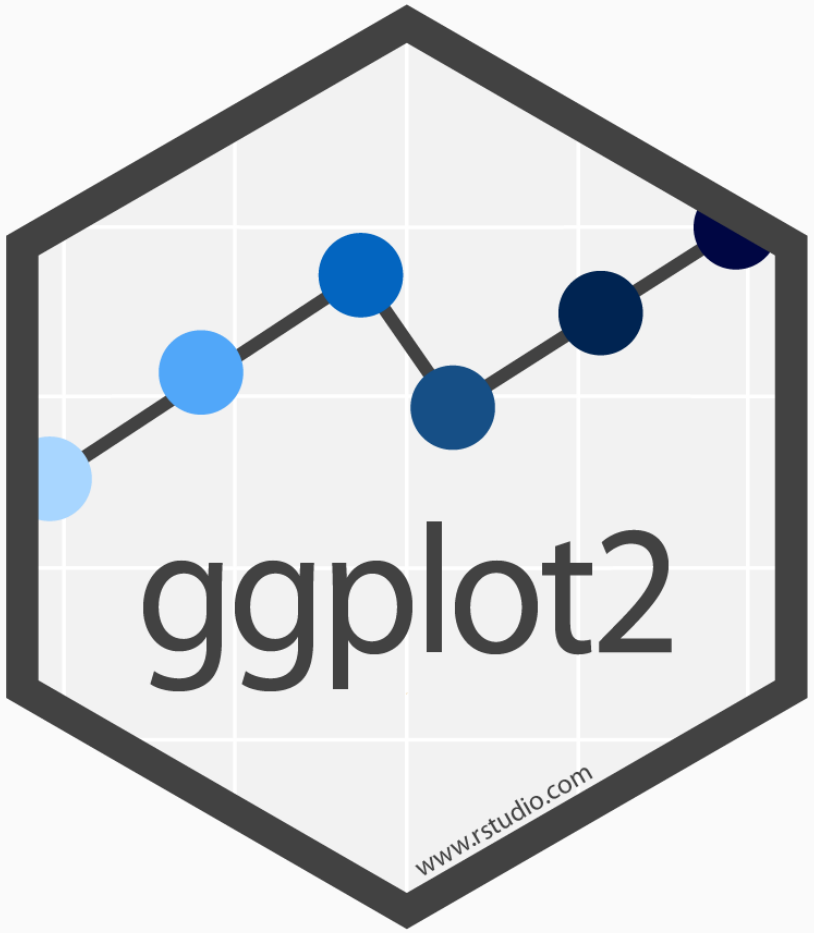


12. Combinando gráficos

graphics

```
par(mfrow = c(2, 1))

boxplot(flipper_length_mm ~ as.factor(species),
        data = penguins,
        col = c("darkorange", "purple", "cyan4"),
        main = "Espécies por amostragens",
        xlab = "Espécies",
        ylab = "Comprimento da nadadeira (mm)",
        cex.main = 1.5, cex.lab = 1.3, cex.axis = 1.1

plot(bill_depth_mm ~ bill_length_mm,
     data = penguins,
     pch = 20,
     cex = 1.5,
     main = "Comprimento e profundidade do bico",
     xlab = "Comprimento do bico (mm)",
     ylab = "Profundidade do bico (mm)",
     cex.lab = 1.5, cex.axis = 1.3)
```



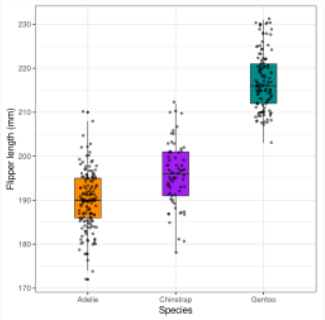


ggplot2

12. Combinando gráficos

ggplot2

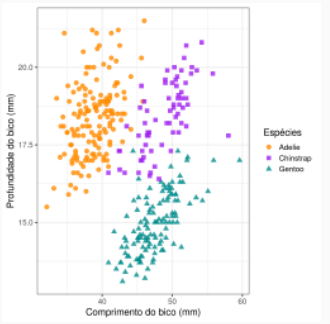
```
ggplot_boxplot ← ggplot(data = penguins,
                        aes(x = species, y = flippe
  geom_boxplot(width = .3,
               show.legend = FALSE) +
  geom_jitter(alpha = .5,
              show.legend = FALSE,
              position = position_jitter(width = .1,
  scale_fill_manual(values = c("darkorange", "purple
  theme_bw(base_size = 15) +
  labs(x = "Species", y = "Flipper length (mm)")
ggplot_boxplot
```

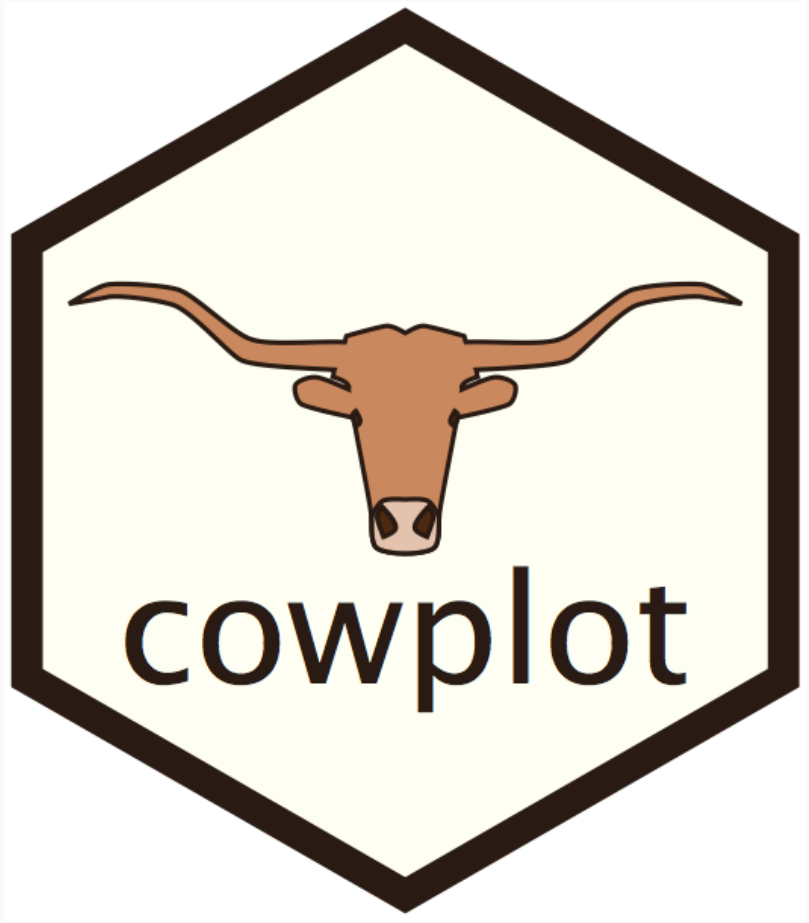


12. Combinando gráficos

ggplot2

```
ggplot_scatterplot ← ggplot(data = penguins,
                            aes(x = bill_length_mm,
                                y = bill_depth_mm,
                                color = species,
                                shape = species)) +
  geom_point(size = 3, alpha = .8) +
  scale_shape_manual(values = c(19, 15, 17)) +
  scale_color_manual(values = c("darkorange", "purple
  theme_bw(base_size = 15) +
  labs(x = "Comprimento do bico (mm)",
       y = "Profundidade do bico (mm)",
       color = "Espécies", shape = "Espécies")
ggplot_scatterplot
```



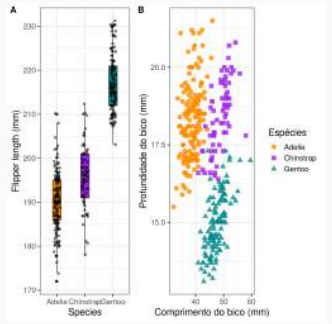


cowplot

12. Combinando gráficos

cowplot

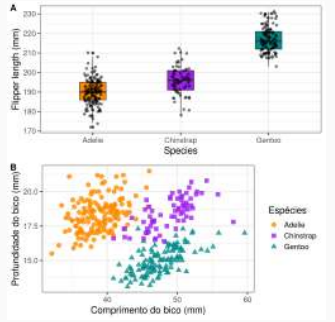
```r
# pacote
# install.packages("cowplot")
library(cowplot)

# combinacao horizontal
plot_grid(ggplot_boxplot, ggplot_scatterplot,
          align = "h", rel_widths = c(1, 1.5),
          labels = "AUTO")
```



12. Combinando gráficos

cowplot

```
# combinacao vertical
plot_grid(ggplot_boxplot, ggplot_scatterplot,
          ncol = 1, align = "v",
          labels = "AUTO")
```

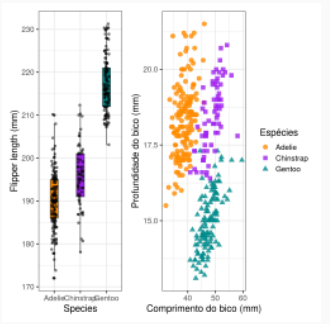


patchwork

12. Combinando gráficos

patchwork

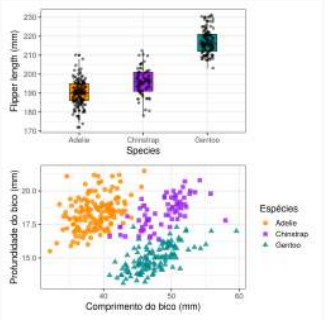
```
# pacote
# install.packages("patchwork")
library(patchwork)

# combinacao horizontal
ggplot_boxplot + ggplot_scatterplot
```

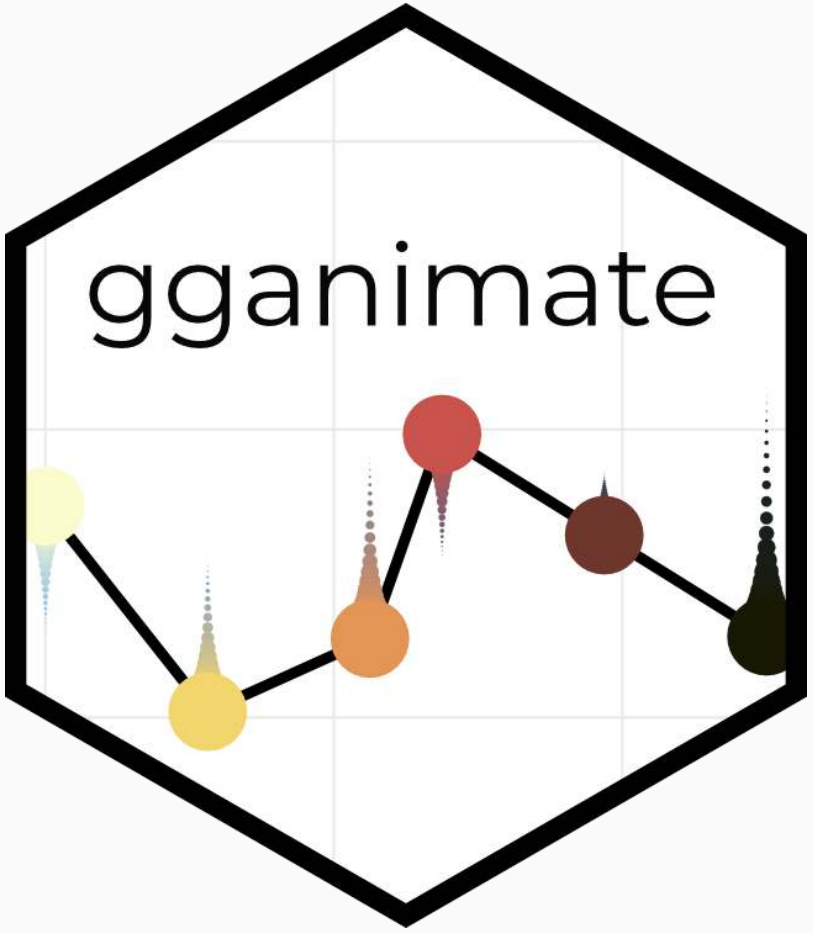


12. Combinando gráficos

patchwork

```
# combinacao vertical
ggplot_boxplot / ggplot_scatterplot
```



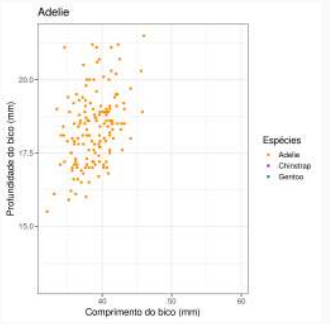


gganimate

13. Gráficos animados

gganimate

```
# pacote
# devtools::install_github('thomasp85/gganimate')
library(gganimate)

plot_animate ← ggplot(data = penguins,
                      aes(x = bill_length_mm,
                          y = bill_depth_mm,
                          color = species)) +
  geom_point() +
  scale_color_manual(values = c("darkorange", "purpl
  theme_bw(base_size = 15) +
  labs(x = "Comprimento do bico (mm)",
       y = "Profundidade do bico (mm)",
       color = "Espécies", shape = "Espécies") +
  labs(title = "{closest_state}") +
  transition_states(species) +
  enter_grow() +
  exit_fade()
plot_animate
```



13. Gráficos animados

gganimate

Exportar

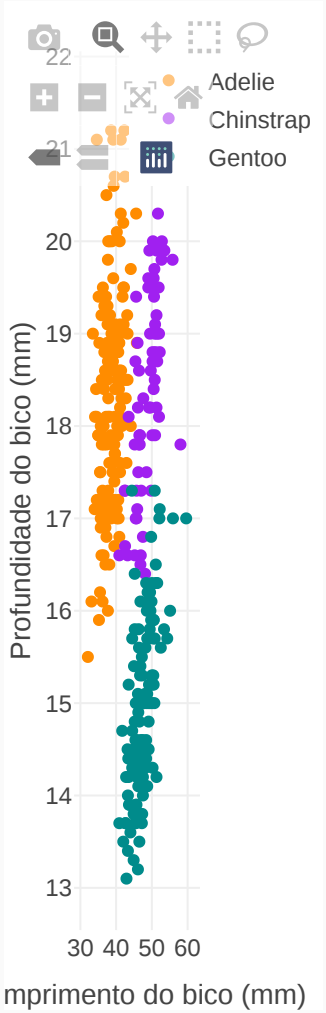
```
gganimate::anim_save(filename = here::here("03_dados",
                                           "graficos" ,
                                           "plot_animate.gif"),
                     animation = plot_animate)
```

plotly

14. Gráficos interativos

plotly

```
# pacote
# install.packages("plotly")
library(plotly)

plot_ly(data = penguins,
        x = ~bill_length_mm,
        y = ~bill_depth_mm,
        type = "scatter",
        color = ~species,
        colors = c("darkorange", "purple", "cyan4"))
  layout(xaxis = list(title = "Comprimento do bico (
         yaxis = list(title = "Profundidade do bico
```



14. Gráficos interativos

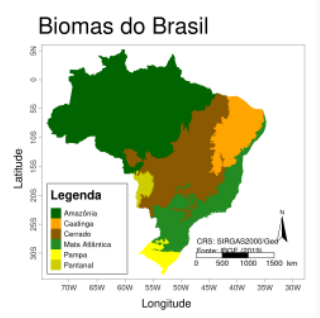
plotly

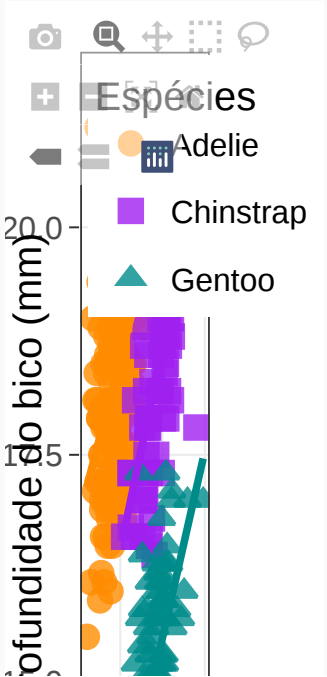
```
plot_ly(data = penguins,
        x = ~bill_length_mm,
        y = ~bill_depth_mm,
        z = ~body_mass_g,
        type = "scatter3d",
        color = ~species,
        colors = c("darkorange", "purple", "cyan4"))
  layout(scene = list(xaxis = list(title = "Comprimen
                      yaxis = list(title = "Profundid
                      zaxis = list(title = "Massa (g
```

14. Gráficos interativos

plotly

```
plot_penguins_scatter_int ← ggplotly(
  ggplot(data = penguins,
         aes(x = bill_length_mm,
             y = bill_depth_mm,
             color = species,
             shape = species)) +
    geom_point(size = 3, alpha = .8) +
    geom_smooth(method = "lm", se = FALSE) +
    scale_shape_manual(values = c(19, 15, 17)) +
    scale_color_manual(values = c("darkorange", "purp
    theme_bw(base_size = 15) +
    labs(x = "Comprimento do bico (mm)",
         y = "Profundidade do bico (mm)",
         color = "Espécies", shape = "Espécies"))
plot_penguins_scatter_int
```



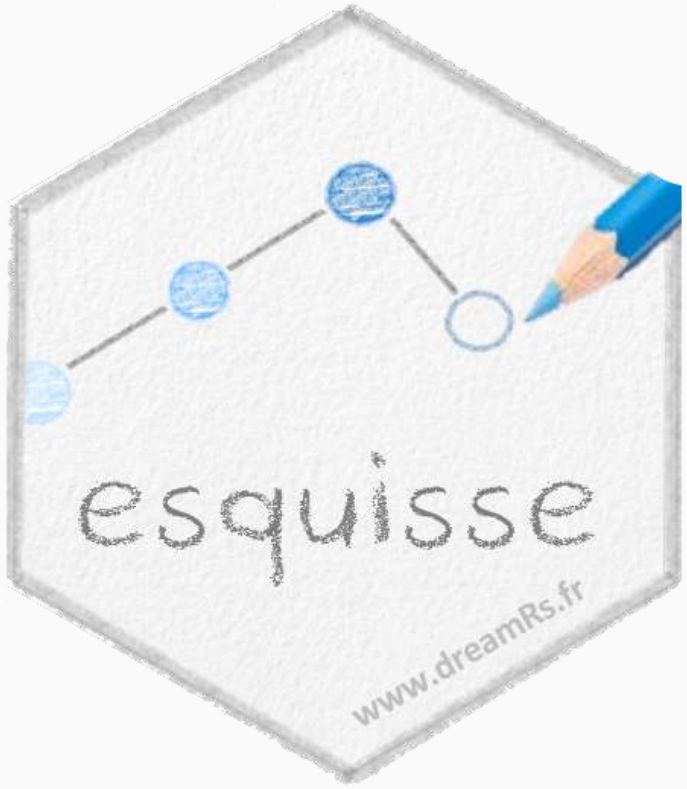


14. Gráficos interativos

plotly

Exportar

```
# pacote
# install.packages("htmlwidgets")
library(htmlwidgets)

# export
htmlwidgets::saveWidget(widget = plot_penguins_scatter_int,
                        file = here::here("03_dados", "graficos" ,"plot_penguins_scatter_int.html"))
```

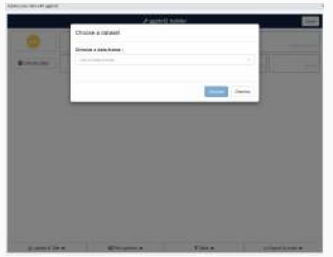


gganimate

15. Gráficos usando interface

esquisse

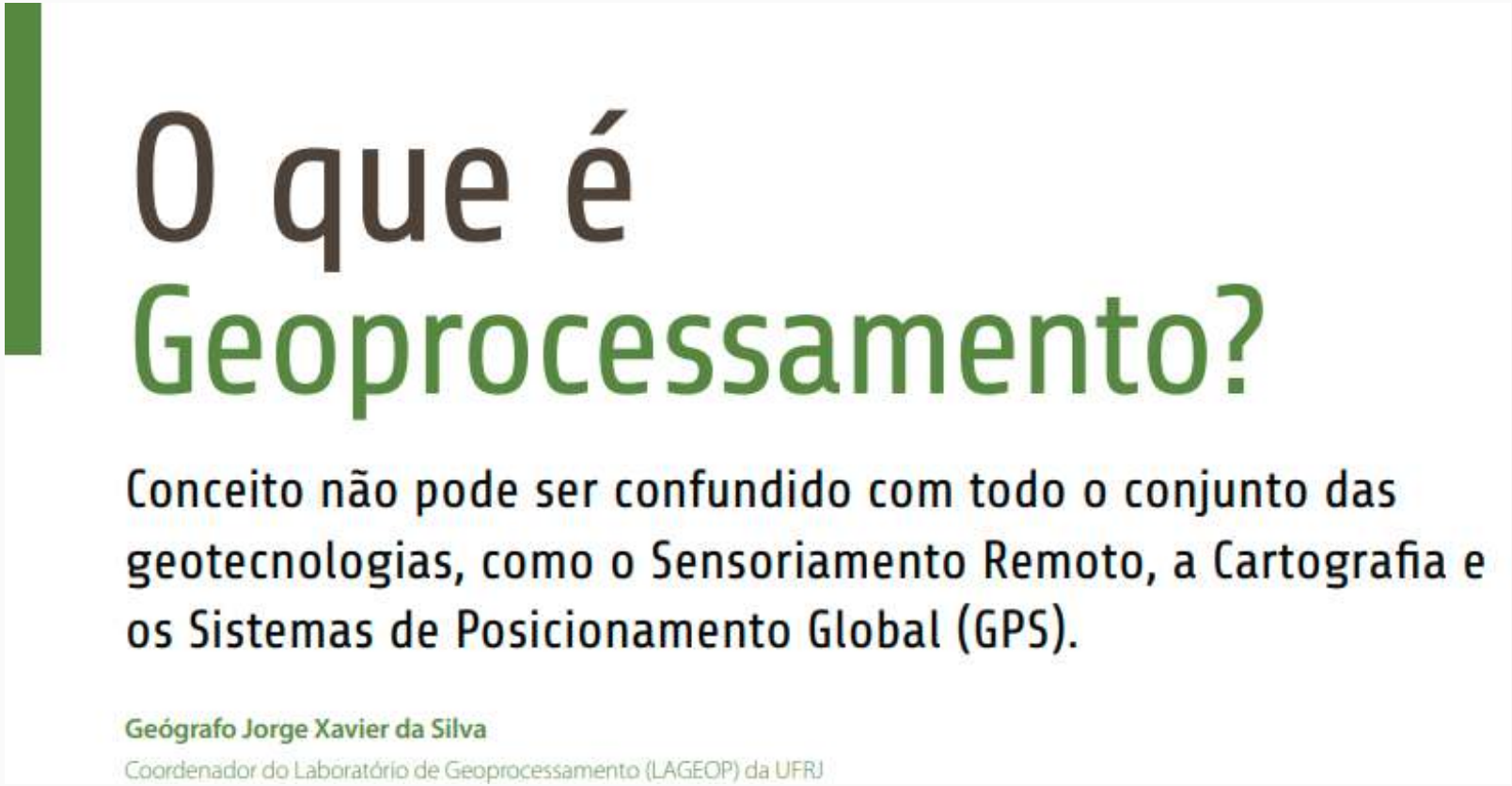
```
# pacote
#install.packages("esquisse")
library(esquisse)

# iniciar
esquisse::esquisser(iris)
esquisse::esquisser(palmerpenguins::penguins)
```



Dúvidas?

Leitura

Leitura



O que é Geoprocessamento?

Conceito não pode ser confundido com todo o conjunto das geotecnologias, como o Sensoriamento Remoto, a Cartografia e os Sistemas de Posicionamento Global (GPS).

Geógrafo Jorge Xavier da Silva
Coordenador do Laboratório de Geoprocessamento (LAGEOP) da UFRJ

Xavier-da-Silva (2009)

Dúvidas?

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Slides criados via pacote xaringan e tema Metropolis. Animação dos sapos por @probzz.