Preparado para: AT autoridade tributária e aduaneira

REFORM/SC2022/126
DELIVERABLE 4

MÓDULO 2
GESTÃO E TRATAMENTO DE DADOS EM R

DESIGNING A NEW VALUATION MODEL
FOR RURAL PROPERTIES IN PORTUGAL

Parte II

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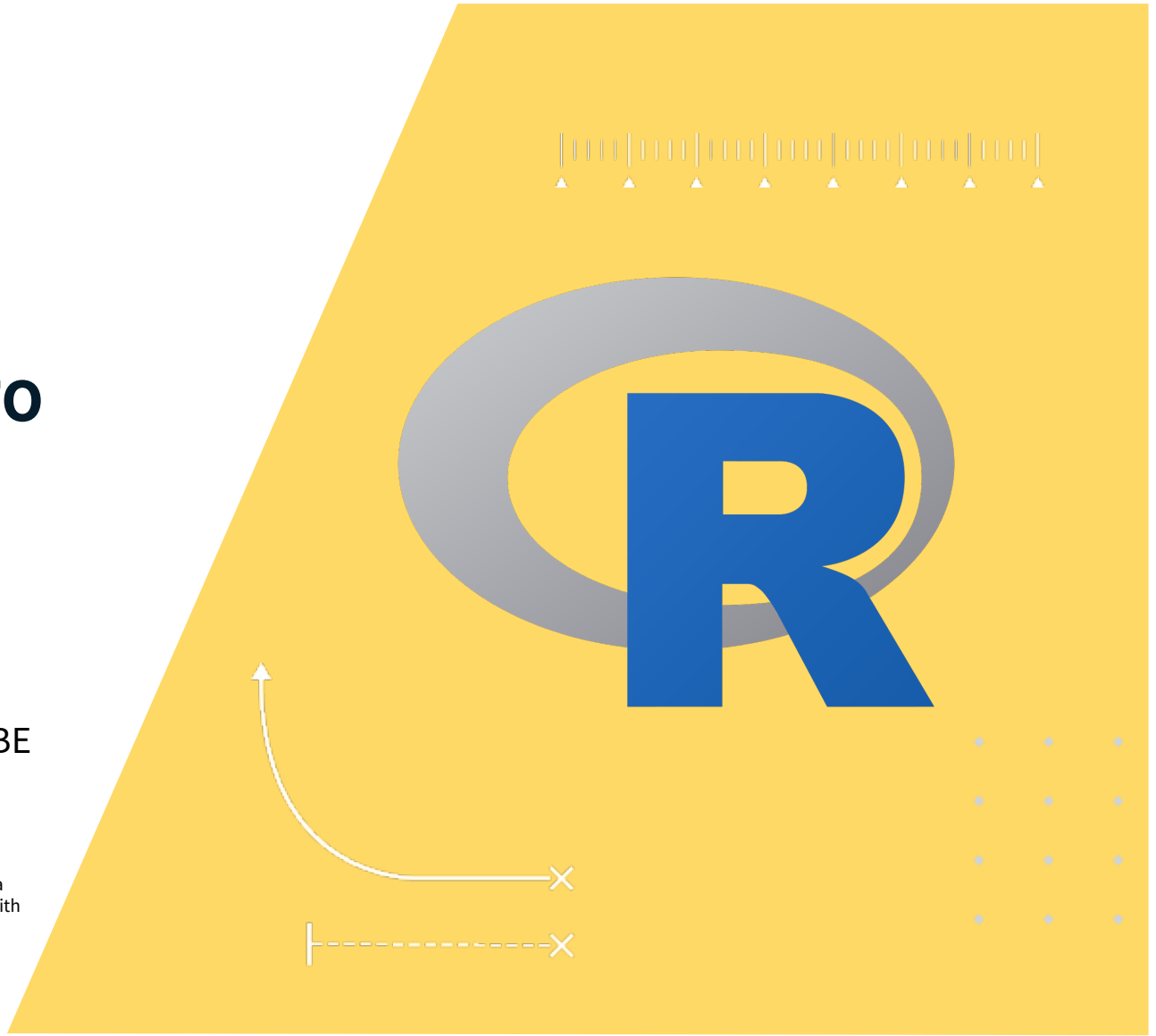
Lisboa, 14 junho 2023



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AARC NOVA SCHOOL OF BUSINESS & ECONOMICS LOBO VASQUES esri INNERLANDS

Programa

Módulos	Duração
Módulo 1 – Introdução ao R: - O que é o R? - Como instalar e configurar o R. - Sintaxe básica e comandos. - Tipos de dados, objetos e classes.	**4 Horas**
Módulo 2 – Gestão e tratamento de dados em R: - Carregar dados no R. - Perceber as estruturas de dados e *subsetting*. - Limpeza de dados: *missing values, outliers* e transformações - Juntar bases de dados	**8 Horas**
Módulo 3 – Estatística básica em R: - Estatísticas descritivas: medidas de dispersão central e variação. - Distribuições probabilísticas: variáveis discretas e contínuas. - Testes de hipóteses.	**8 Horas**

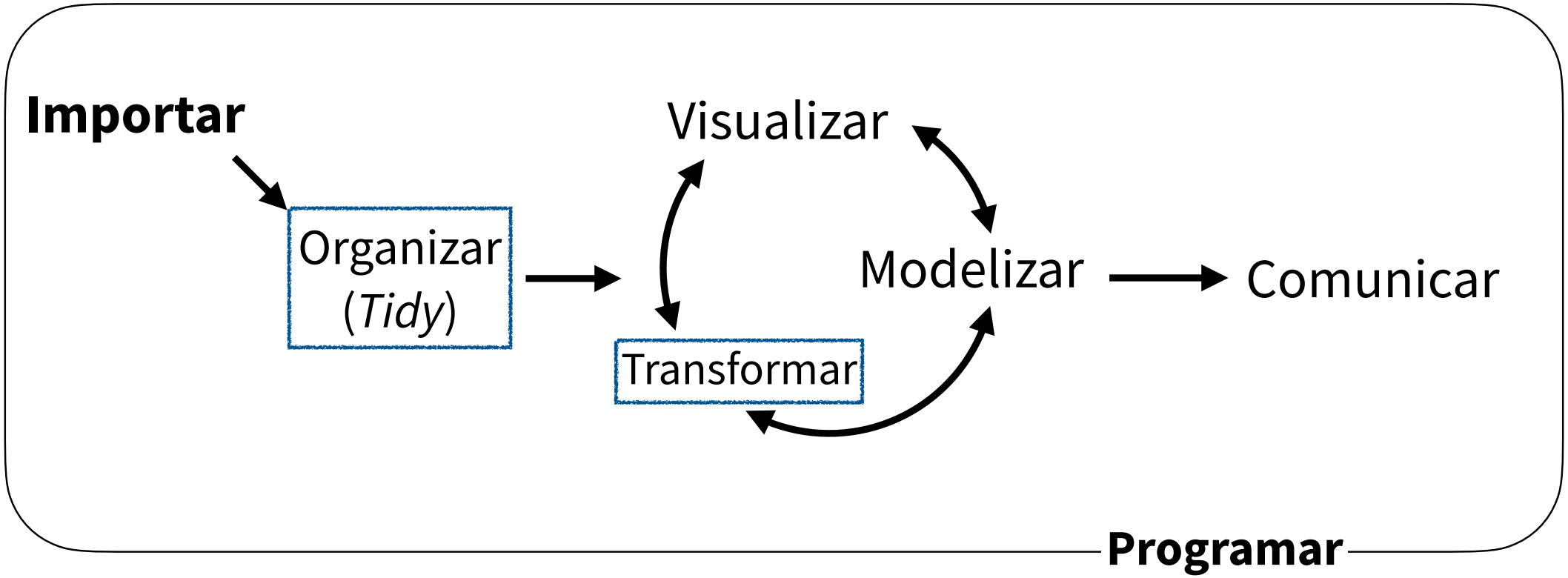
Módulos	Duração
Módulo 4 – Regressão Linear: - O modelo classico linear. - Estimação de parametros segundo o MMQ. - Testes de hipóteses: significância estatística e ajuste do modelo. - Modelo de regressão múltipla. - Testar as premissas: multicolinearidade, heteroscedasticidade e normalidade dos resíduos. - Critérios de seleção dos modelos.	**12 Horas**
Módulo 5 – O modelo: - Estrutura do modelo e premissas – Perceber o modelo (4 Hours). - Uso e tratamento dos dados (4 Hours). - Descrição do modelo (4 Hours). - Aplicação do modelo a cada piloto (12 Hours). - Aplicação autónoma do modelo a uma região (8 Hours).	**32 Horas**

Slides CC BY-SA RStudio

Transformação de dados (I)

Arrumar - *tidy*

Ciência de dados



Vamos a isso

Aceda a este link para começar já

https://posit.cloud/content/5906356

Back to **babynames**

	year	sex	name	n	prop
1	1880	F	Mary	7065	0.0724
2	1880	F	Margar	1578	0.0162
3	1880	F	Martha	1040	0.0107
4	1880	F	Marie	471	0.00483
5	1880	F	Maria	125	0.00128
1	1881	F	Mary	6919	0.0700
2	1881	F	Margar	1658	0.0168
3	1881	F	Martha	1044	0.0106
4	1881	F	Marie	499	0.00505
5	1881	F	Maria	120	0.00121
	1881	M	Gideon	7	0.0001

year	sex	name	n	prop
1880	F	Maria	125	0.00128
1881	F	Maria	120	0.00121
…	…	Maria	…	…

filter()

Extrai observações que cumpram todos os critérios fornecidos

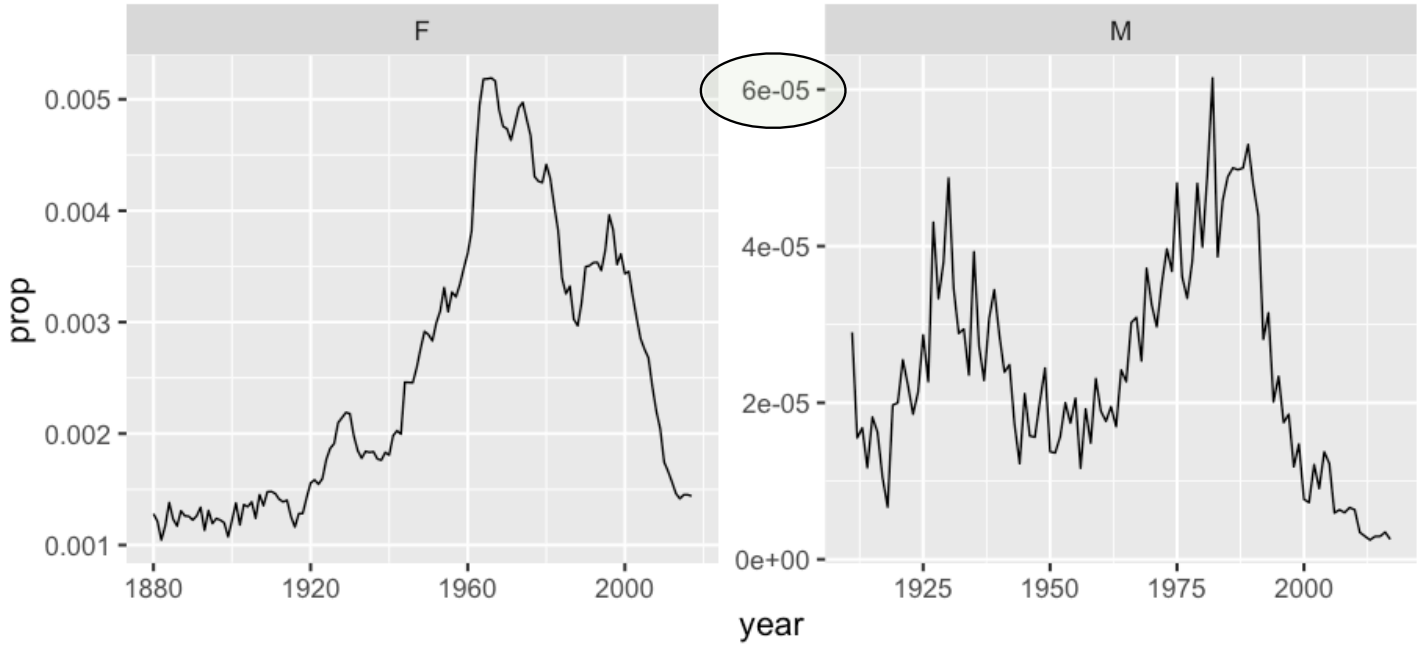
```
filter(babynames, name == "Maria" & year == 1880)
```

babynames

year	sex	name	n	prop
1880	F	Mary	7065	0.0724
1880	F	Margaret	1578	0.0162
1880	F	Martha	1040	0.0107
1880	F	Marie	471	0.00483
1880	F	Maria	125	0.00128
1881	F	Mary	6919	0.0700

year	sex	name	n	prop
1880	F	Maria	125	0.00128

```
babynames %>% filter(name == "Michael") %>%
  ggplot() +
    geom_line(mapping = aes(year, prop)) +
    facet_wrap(~ sex)
```



Quais os nomes mais populares?

Quiz

Será que conseguimos:

1. calcular o número total de bebés de cada nome?

Transformação de dados (II)

Transformar para derivar nova informação

Derivar nova informação

summarise() - resumir **variáveis**
group_by() - agrupar por **casos**
mutate() - criar novas **variáveis**

summarise()

e.g. medidas de tendência central (média, mediana) ou dispersão (desvio padrão)
+ na próxima aula!

Calcular tabela de medidas sumárias:

```
babynames %>% summarise(total = sum(n), max = max(n))
```

babynames

year	sex	name	n	prop
1880	M	John	9655	0.0815
1880	M	William	9532	0.0805
1880	M	James	5927	0.0501
1880	M	Charles	5348	0.0451
1880	M	Garrett	13	0.0001
1881	M	John	8769	0.081

→

total	max
348120517	99686

Medidas sumárias em summarise()

Input: vector

Output: valor

Summary Functions

TO USE WITH SUMMARISE ()

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

summary function

COUNTS

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

LOCATION

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

LOGICALS

mean() - Proportion of TRUE's
sum() - # of TRUE's

POSITION/ORDER

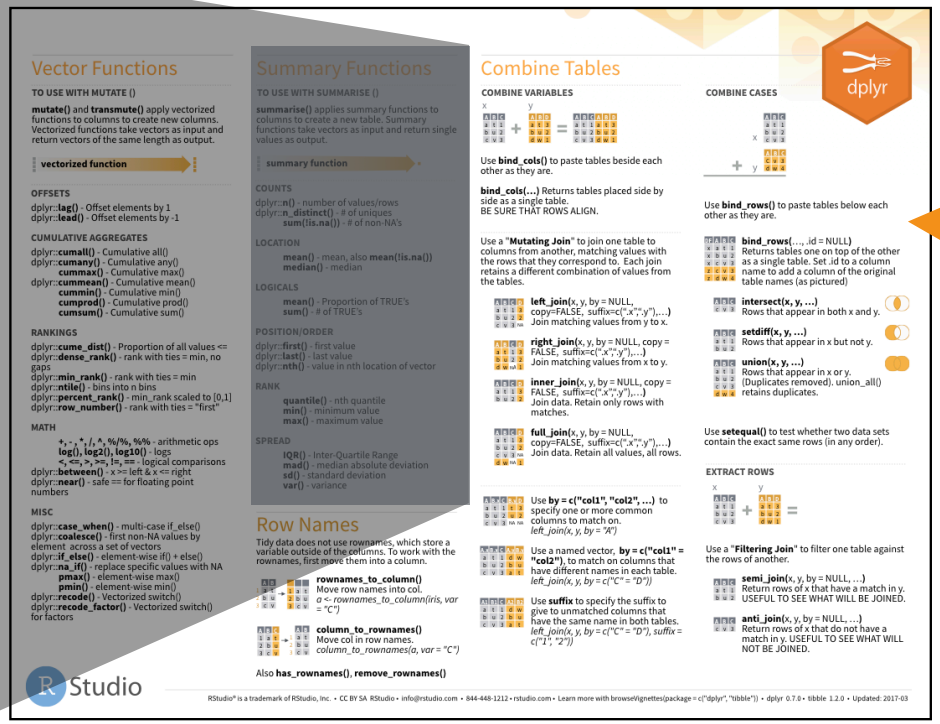
dplyr::**first()** - first value
dplyr::**last()** - last value
dplyr::**nth()** - value in nth location of vector

RANK

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

SPREAD

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



on back

n()

Número de observações num conjunto de dados

```
babynames %>% summarise(n = n())
```

babynames

year	sex	name	n	prop
1880	M	John	9655	0.0815
1880	M	William	9532	0.0805
1880	M	James	5927	0.0501
1880	M	Charles	5348	0.0451
1880	M	Garrett	13	0.0001
1881	M	John	8769	0.081

n
1924665

n_distinct()

Número de casos únicos contidos numa variável (sem repetições)

```
babynames %>% summarise(n = n(), nname = n_distinct(name))
```

babynames

year	sex	name	n	prop
1880	M	John	9655	0.0815
1880	M	William	9532	0.0805
1880	M	James	5927	0.0501
1880	M	Charles	5348	0.0451
1880	M	Garrett	13	0.0001
1881	M	John	8769	0.081

n	nname
1924665	97310

Experimente

Numa única operação, encontre as observações com o nome **“Melo”** e utilize **summarise(), sum()** e **min()** para encontrar:

1. O número total de bebés com o nome Melo
2. O primeiro ano (**year**) em que nasceu um bebé com este nome

```
babynames %>%
  filter(name == "Melo") %>%
  summarise(total = sum(n), first = min(year))
# A tibble: 1 × 2
  total first
  <dbl> <dbl>
1    73  2012
```

Quais são os nomes mais populares?

Nomes mais populares = elevado número de recém-nascidos

1. **Soma** - número de bebés com esse nome, somando as observações de todos os anos disponíveis

```
babynames %>%
  filter(name == “Melo")
# A tibble: 6 × 5
   year sex   name      n       prop
  <dbl> <chr> <chr> <dbl>      <dbl>
1  2012 M     Melo      5 0.00000247
2  2013 M     Melo     11 0.00000545
3  2014 M     Melo      8 0.00000391
4  2015 M     Melo     15 0.00000736
5  2016 M     Melo     16 0.00000793
6  2017 M     Melo     18 0.00000917
```

Não parece muito popular?

```
babynames %>%
  filter(name == “Maria”, sex == 'F')
# A tibble: 138 × 5
    year sex   name      n    prop
   <dbl> <chr> <chr> <dbl>   <dbl>
 1  1880 F     Maria   125 0.00128
 2  1881 F     Maria   120 0.00121
 3  1882 F     Maria   121 0.00105
 4  1883 F     Maria   141 0.00117
 5  1884 F     Maria   190 0.00138
# … with 133 more rows
# ℹ Use `print(n = ...)` to see more rows
```

Como comparar com outros?

```
babynames %>%
  filter(name == "Melo" & sex == "M") %>%
  summarise(total = sum(n))
  total
  <dbl>
1    73
babynames %>%
  filter(name == "Maria" & sex == "F") %>%
  summarise(total = sum(n))
   total
   <dbl>
1 543324
```

group_by()

Agrupa observações em função dos diferentes **casos** de uma ou mais **variável/is**

```
babynames %>%
  group_by(sex) %>%
  summarise(total = sum(n))
```

sex	total
F	172371079
M	175749438

group_by()

```
babynames %>%
  group_by(name) %>%
  summarise(total = sum(n))
```

Também ordena pela variável grupo

sex	total
Aaban	107
Aabha	35
Aabid	10
Aabir	5
Aabriella	22

ungroup()

Remove critérios de group_by

```
babynames %>%
  group_by(sex) %>%
  ungroup() %>%
  summarise(total = sum(n))
```

total
348120517

Experimente

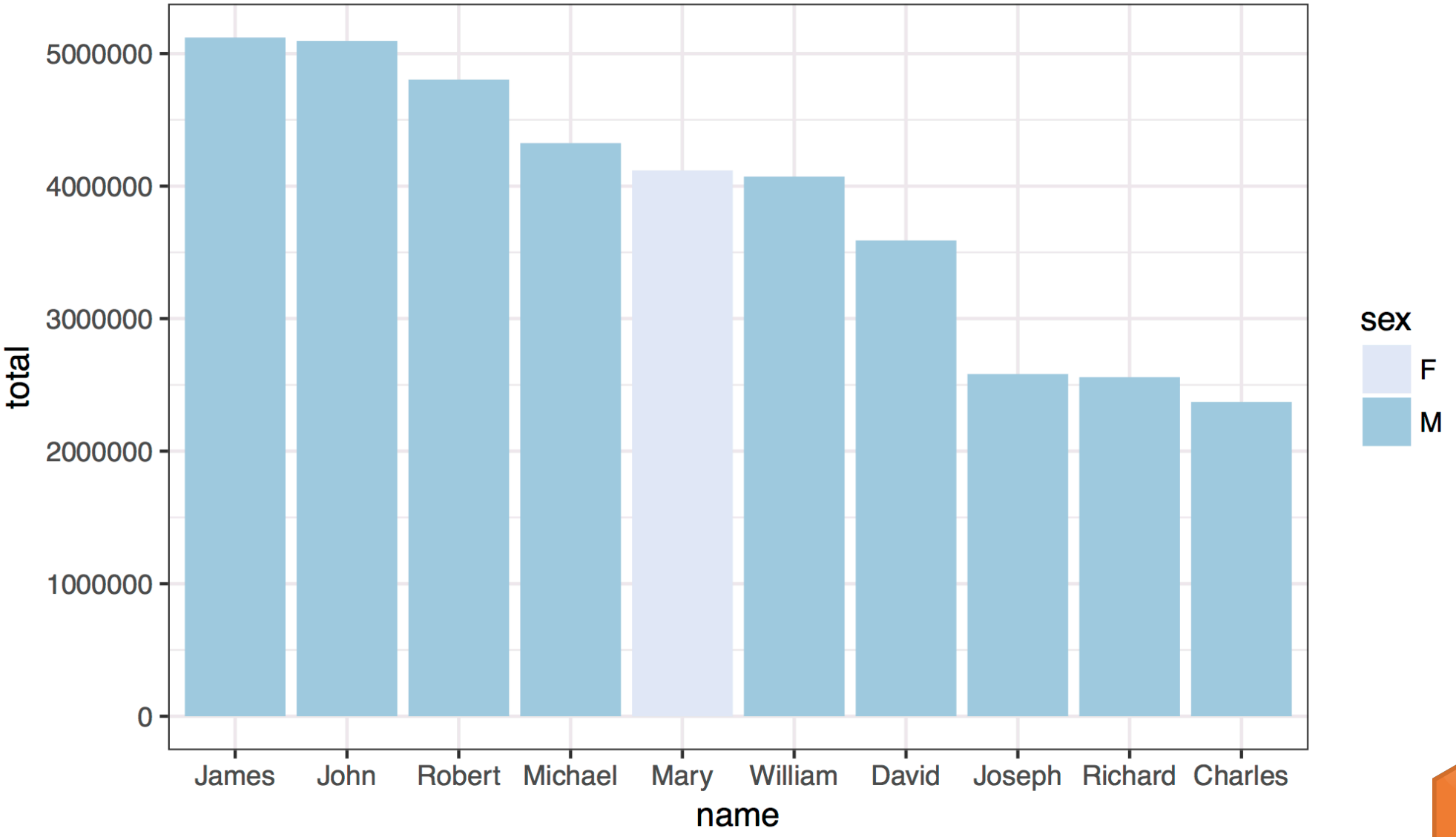
Utilize uma combinação de **group_by()**, **summarise()**, e **arrange()** para ver as 10 combinações mais populares de nome (name) e sexo (**sexo**). Calcule a popularidade como o número *total* de bebés com cada par nome/sexo.

```
babynames %>%
   group_by(name, sex) %>%
   summarise(total = sum(n)) %>%
   arrange(desc(total))
# A tibble: 107,973 × 3
# Groups:   name [97,310]
   name    sex     total
   <chr>   <chr>   <dbl>
 1 James   M     5150472
 2 John    M     5115466
 3 Robert  M     4814815
 4 Michael M     4350824
 5 Mary    F     4123200
# … with 107,968 more rows
```

10+?

```
babynames %>%
  group_by(name, sex) %>%
  summarise(total = sum(n)) %>%
  arrange(desc(total)) %>%
  ungroup %>% slice(1:10)
```

```
# A tibble: 10 × 3
   name    sex     total
   <chr>   <chr>   <dbl>
 1 James   M     5150472
 2 John    M     5115466
 3 Robert  M     4814815
 4 Michael M     4350824
 5 Mary    F     4123200
 6 William M     4102604
...
```


5000000
4000000
3000000
2000000
1000000
0
total
James
John
Robert
Michael
Mary
William
David
Joseph
Richard
Charles
name
sex
F
M

```
babynames %>%
  group_by(name, sex) %>%
  summarise(total = sum(n)) %>%
  arrange(desc(total)) %>%
  ungroup() %>%
  slice(1:10) %>%
  ggplot() +
    geom_col(mapping = aes(x = fct_reorder(name,
      desc(total)), y = total, fill = sex)) +
    theme_bw() +
    scale_fill_brewer() +
    labs(x = "name")
```

Quais são os nomes mais populares?

Nomes mais populares = elevado número de recém-nascidos

1. **Soma** - número de bebés com esse nome, somando as observações de todos os anos disponíveis

Enviesado? Porquê?

```
babynames %>%
  filter(year == 2017) %>%
  summarise(total = sum(n))
##     total
## 1 3546301
```

3,546,301

```
babynames %>%
  filter(year == 1880) %>%
  summarise(total = sum(n))
##     total
## 1  201484
```

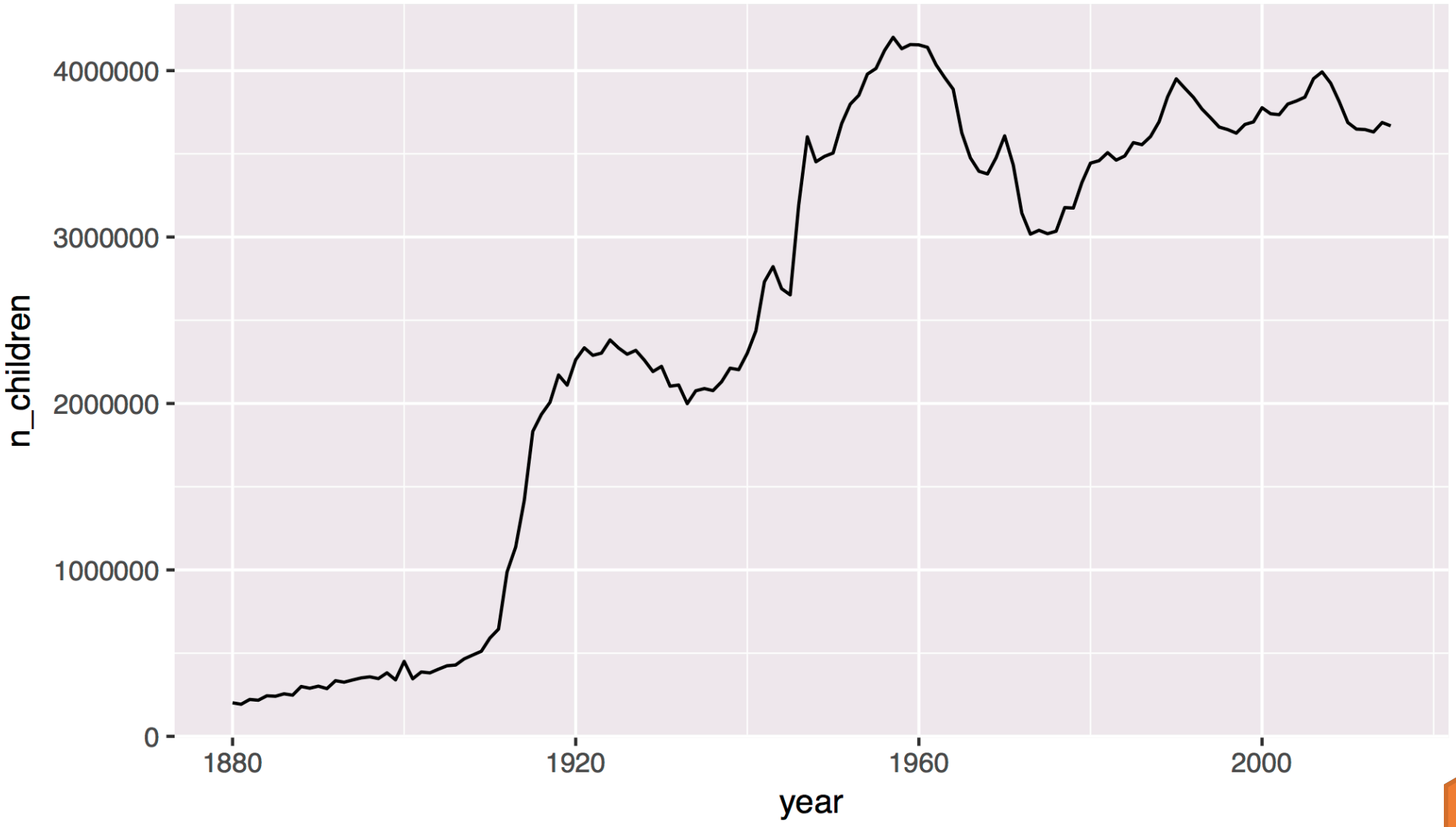
201,484

Experimente

Use group_by() para calcular o número total de bebés registados **em cada ano**.

Mostre os resultados como um gráfico de linhas, uma série temporal

```
babynames %>%
  group_by(year) %>%
  summarise(n_children = sum(n)) %>%
  ggplot() +
    geom_line(mapping = aes(x = year, y = n_children))
```


4000000
3000000
2000000
1000000
0
n_children
1880
1920
1960
2000
year

Qual o nome mais popular em cada ano?

Quais são os nomes mais populares?

Nomes mais populares = elevado número de recém-nascidos

1. **Soma** - número de bebés com esse nome, somando as observações de todos os anos disponíveis
2. **Ordem** - ranking/posição entre os nomes mais populares *em cada ano*

Será que temos informação suficiente para **ordenar os nomes pela sua popularidade em cada ano?**

mutate()

Comando geral - cria novas variáveis/colunas

```
babynames %>%
  mutate(percent = round(prop*100, 2))
```

babynames

year	sex	name	n	prop
1880	M	John	9655	0.0815
1880	M	William	9532	0.0805
1880	M	James	5927	0.0501
1880	M	Charles	5348	0.0451
1880	M	Garrett	13	0.0001
1881	M	John	8769	0.081

year	sex	name	n	prop	percent
1880	M	John	9655	0.0815	8.15
1880	M	William	9532	0.0805	8.05
1880	M	James	5927	0.0501	5.01
1880	M	Charles	5348	0.0451	4.51
1880	M	Garrett	13	0.0001	0.01
1881	M	John	8769	0.081	8.1

mutate()

```
babynames %>%
  mutate(percent = round(prop*100, 2), nper = round(percent))
```

babynames

year	sex	name	n	prop
1880	M	John	9655	0.0815
1880	M	William	9532	0.0805
1880	M	James	5927	0.0501
1880	M	Charles	5348	0.0451
1880	M	Garrett	13	0.0001
1881	M	John	8769	0.081

year	sex	name	n	prop	percent	nper
1880	M	John	9655	0.0815	8.15	8
1880	M	William	9532	0.0805	8.05	8
1880	M	James	5927	0.0501	5.01	5
1880	M	Charles	5348	0.0451	4.51	5
1880	M	Garrett	13	0.0001	0.01	0
1881	M	John	8769	0.081	8.1	8

```
babynames %>%
  mutate(rank =              ?              )
```

min_rank()

Função dá a posição ordinal de cada valor

```
min_rank(c(50, 100, 100, 1000))
# [1] 1 2 2 4
```

(em caso de empate, posição seguinte é partilhada)

```
min_rank(desc(c(50, 100, 100, 1000)))
# [1] 4 2 2 1
```

Experimente

Utilize **mutate()** e **min_rank()** para ordenar as observações pela sua frequência (**n**), da maior para a mais pequena

```
babynames %>%
  mutate(rank = min_rank(desc(prop)))


## A tibble: 1,924,665 x 6
#    year sex   name           n   prop  rank
# 1  1880 F     Mary        7065 0.0724    14
# 2  1880 F     Anna        2604 0.0267   709
# 3  1880 F     Emma        2003 0.0205  1131
# 4  1880 F     Elizabeth   1939 0.0199  1192
# 5  1880 F     Minnie      1746 0.0179  1427
# 6  1880 F     Margaret    1578 0.0162  1683
## … with 1,924,659 more rows
```

Experimente

Agrupe os dados por ano e volte a ordená-los por frequência. Filtre os resultados para manter apenas os nomes mais populares em cada ano

```
babynames %>%
  group_by(year) %>%
  mutate(rank = min_rank(desc(prop))) %>%
  filter(rank == 1)


# A tibble: 138 x 6
# Groups:   year [138]
    year sex   name       n   prop  rank
 1  1880 M     John    9655 0.0815     1
 2  1881 M     John    8769 0.0810     1
 3  1882 M     John    9557 0.0783     1
# … with 135 more rows
```

Funções vetoriais

Input: vector

Output: vector da mesma dimensão (*length*)

Vector Functions

TO USE WITH MUTATE ()

mutate() and **transmute()** apply 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

OFFSETS

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

CUMULATIVE AGGREGATES

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

RANKINGS

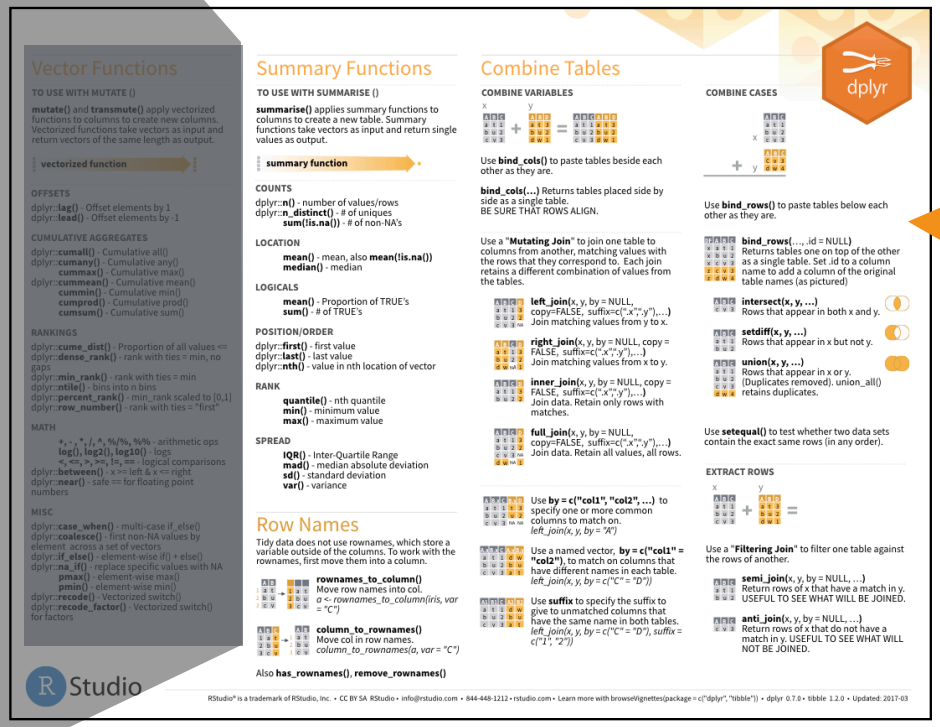
dplyr::**cume_dist()** - Proportion of all values <=
dplyr::**dense_rank()** - rank with ties = min, no gaps
dplyr::**min_rank()** - rank with ties = min
dplyr::**ntile()** - bins into n bins
dplyr::**percent_rank()** - min_rank scaled to [0,1]
dplyr::**row_number()** - rank with ties = "first"

MATH

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

MISC

dplyr::**case_when()** - multi-case if_else()
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()
dplyr::**recode()** - Vectorized switch()
dplyr::**recode_factor()** - Vectorized switch() for factors



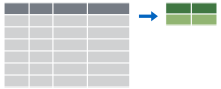
Resumo: verbos dplyr

(Verbos para uma tabela única)

Selecionar variáveis: **select()**

Extrair casos específicos: **filter()**

Reordenar tabela: **arrange()**



Obter medidas sumárias: **summarise()**

Criar novas variáveis: **mutate()**

Transformação de dados (III)

Reorientar dados (*pivot*)

sales.xlsx

```
clientes <- readxl::read_xlsx("sales_data/sales.xlsx", sheet = 'clientes')
clientes
```

```
## # A tibble: 2 × 4
##   id_cliente item_1 item_2          item_3
##        <dbl> <chr>  <chr>           <chr>
## 1          1 pao    leite           banana
## 2          2 leite  papel higienico <NA>
```

```
precos <- readxl::read_xlsx("sales_data/sales.xlsx", sheet = 'precos')
precos
```

```
## # A tibble: 5 × 2
##   item            price
##   <chr>           <dbl>
## 1 abacate           2
## 2 banana            0.5
## 3 pao               1.5
## 4 leite             1
## 5 papel higienico   3
```

clientes

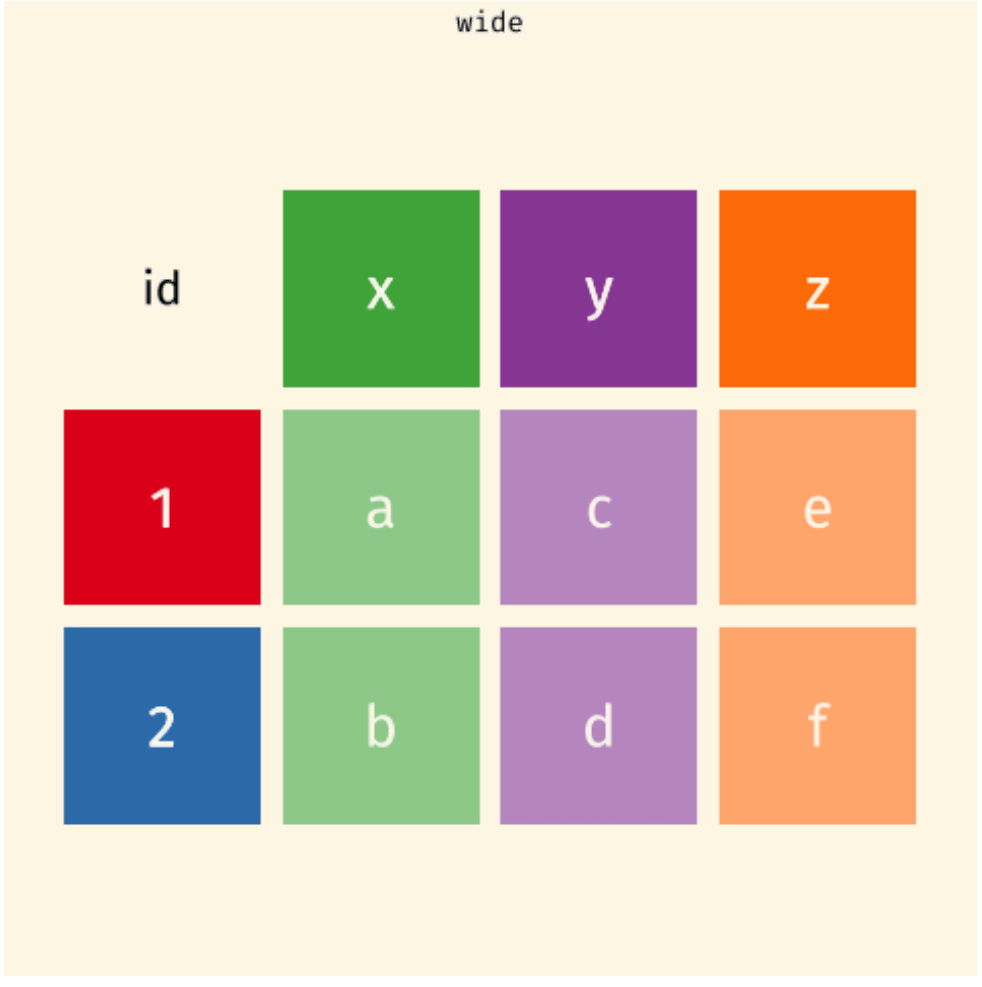
Temos...

```
## # A tibble: 2 × 4
##   id_cliente item_1 item_2          item_3
##        <dbl> <chr>  <chr>          <chr>
## 1          1 pao    leite          banana
## 2          2 leite  papel higienico <NA>
```

Queremos...

```
## # A tibble: 6 × 3
##   id_cliente item_no item
##        <dbl> <chr>   <chr>
## 1          1 item_1  pao
## 2          1 item_2  leite
## 3          1 item_3  banana
## 4          2 item_1  leite
## 5          2 item_2  papel higienico
## 6          2 item_3  <NA>
```

O objetivo



Wide vs. long

wide

mais colunas / variáveis

```
## # A tibble: 2 × 4
##   id_cliente item_1 item_2          item_3
##        <dbl> <chr>  <chr>          <chr>
## 1          1 pao    leite          banana
## 2          2 leite  papel higienico <NA>
```

long

mais linhas / observações

```
## # A tibble: 6 × 3
##   id_cliente item_no item
##        <dbl> <chr>   <chr>
## 1          1 item_1  pao
## 2          1 item_2  leite
## 3          1 item_3  banana
## 4          2 item_1  leite
## 5          2 item_2  papel higienico
## 6          2 item_3  <NA>
```

pivot_longer()

- data

```
pivot_longer(
  data,
  cols,
  names_to = "name",
  values_to = "value"
  )
```

`pivot_longer()`

- `data`
- `cols`: colunas a transpor para formato long

```
pivot_longer(
  data,
  cols,
  names_to = "name",
  values_to = "value"
  )
```

`pivot_longer()`

- `data`
- `cols`: colunas a transpor para formato long
- `names_to`: nome da variável que vai receber os nomes das colunas a transpor para long, como valores

```
pivot_longer(
  data,
  cols,
  names_to = "name",
  values_to = "value"
  )
```

`pivot_longer()`

- `data`
- `cols`: colunas a transpor para formato long
- `names_to`: nome da variável que vai receber os nomes das colunas a transpor para long, como valores
- `values_to`: nome da variável que vai receber os valores atualmente dispersos por várias colunas (string)

```
pivot_longer(
  data,
  cols,
  names_to = "name",
  values_to = "value"
  )
```

clientes → compras

```
compras <- clientes %>%
  pivot_longer(
    cols = item_1:item_3,  # variables item_1 to item_3
    names_to = "item_no",  # column names -> new column called item_no
    values_to = "item"     # values in columns -> new column called item
    )

compras
```

```
## # A tibble: 6 × 3
##   id_cliente item_no item
##        <dbl> <chr>   <chr>
## 1          1 item_1  pao
## 2          1 item_2  leite
## 3          1 item_3  banana
## 4          2 item_1  leite
## 5          2 item_2  papel higienico
## 6          2 item_3  <NA>
```

Exemplo da importância de dados tidy

Várias operações de transformação requerem-no (e.g. *join* - prox. aula)

```
precos
```

```
## # A tibble: 5 × 2
##   item            price
##   <chr>           <dbl>
## 1 abacate           2
## 2 banana            0.5
## 3 pao               1.5
## 4 leite             1
## 5 papel higienico   3
```

```
compras %>%
  left_join(precos)
```

```
## # A tibble: 6 × 4
##   id_cliente item_no item            price
##        <dbl> <chr>   <chr>           <dbl>
## 1          1 item_1  pao               1.5
## 2          1 item_2  leite             1
## 3          1 item_3  banana            0.5
## 4          2 item_1  leite             1
## 5          2 item_2  papel higienico   3
## 6          2 item_3  <NA>             NA
```

compras → clientes

- `data`
- `names_from`: variável em formato long a transpor para nomes de novas colunas
- `values_from`: variável em formato long que contêm valores a dispersar por várias colunas no formato wide

```
compras %>%
  pivot_wider(
    names_from = item_no,
    values_from = item
  )
```

```
## # A tibble: 2 × 4
##   id_cliente item_1 item_2          item_3
##        <dbl> <chr>  <chr>          <chr>
## 1          1 pao    leite          banana
## 2          2 leite  papel higienico <NA>
```

Transformação de dados (IV)

Juntar bases de dados

band & instrument

```
band <- tribble(
   ~name,     ~band,
  "Mick",  "Stones",
  "John", "Beatles",
  "Paul", "Beatles"
)
```

band

name	band
Mick	Stones
John	Beatles
Paul	Beatles

```
instrument <- tribble(
    ~name,   ~plays,
   "John", "guitar",
   "Paul",   "bass",
  "Keith", "guitar"
)
```

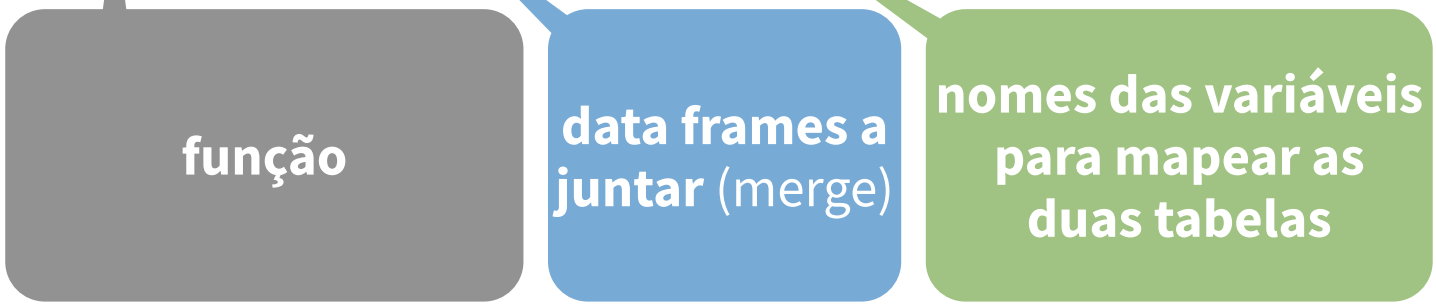
instrument

name	plays
John	guitar
Paul	bass
Keith	guitar

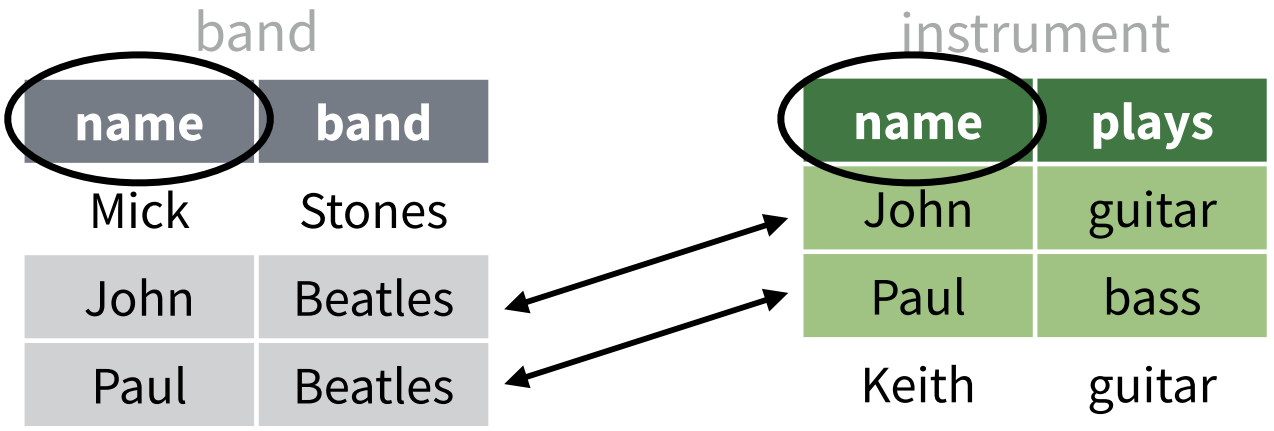
_join - sintaxe

Cada função **join** tem como input duas tabelas, e output uma única

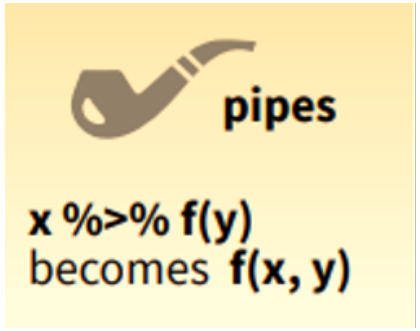
```
left_join(x, y, by = NULL, … )
```

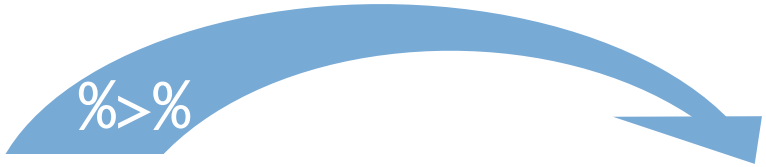


Juntar por nome



Operador pipe %>%






```
instrument   %>%   left_join(_____, by = "name")
```

Passa resultado da esquerda à função da direita, para o seu primeiro argumento. Experimente:

```
left_join(instrument, by = "name")
instrument %>% left_join(by = "name")
```

left

```
band %>% left_join(instrument, by = "name")
```

band

name	band
Mick	Stones
John	Beatles
Paul	Beatles

+

instrument

name	plays
John	guitar
Paul	bass
Keith	guitar

=

name	band	plays
Mick	Stones	<NA>
John	Beatles	guitar
Paul	Beatles	bass

right

```
band %>% right_join(instrument, by = "name")
```

band

name	band
Mick	Stones
John	Beatles
Paul	Beatles

+

instrument

name	plays
John	guitar
Paul	bass
Keith	guitar

=

name	band	plays
John	Beatles	guitar
Paul	Beatles	bass
Keith	<NA>	guitar

full

```
band %>% full_join(instrument, by = "name")
```

band

name	band
Mick	Stones
John	Beatles
Paul	Beatles

+

instrument

name	plays
John	guitar
Paul	bass
Keith	guitar

=

name	band	plays
Mick	Stones	<NA>
John	Beatles	guitar
Paul	Beatles	bass
Keith	<NA>	guitar

inner

```
band %>% inner_join(instrument, by = "name")
```

band

name	band
Mick	Stones
John	Beatles
Paul	Beatles

+

instrument

name	plays
John	guitar
Paul	bass
Keith	guitar

=

name	band	plays
John	Beatles	guitar
Paul	Beatles	bass

Verbos join

left_join() mantém todos os casos da tabela da **esquerda**

right_join() mantém todos os casos da tabela da **direita**

full_join() mantém todos os casos de **qualquer** tabela

inner_join() mantém apenas os casos em comum de **ambas**

semi_join() extrai os cases em que **há correspondência**

anti_join() extrai os cases em que **não há correspondência**

Mini-teste I

Hip.: os bebés de 1969 com o nome de um destes ícones da música tocarão o respetivo instrumento. (Os outros não tocarão nenhum.)

1. Use um **join** para combinar as tabelas **babynames** e **instruments**.
2. Calcule a percentagem de recém-nascidos nesse ano que tocará algum instrumento.

Mini-teste II

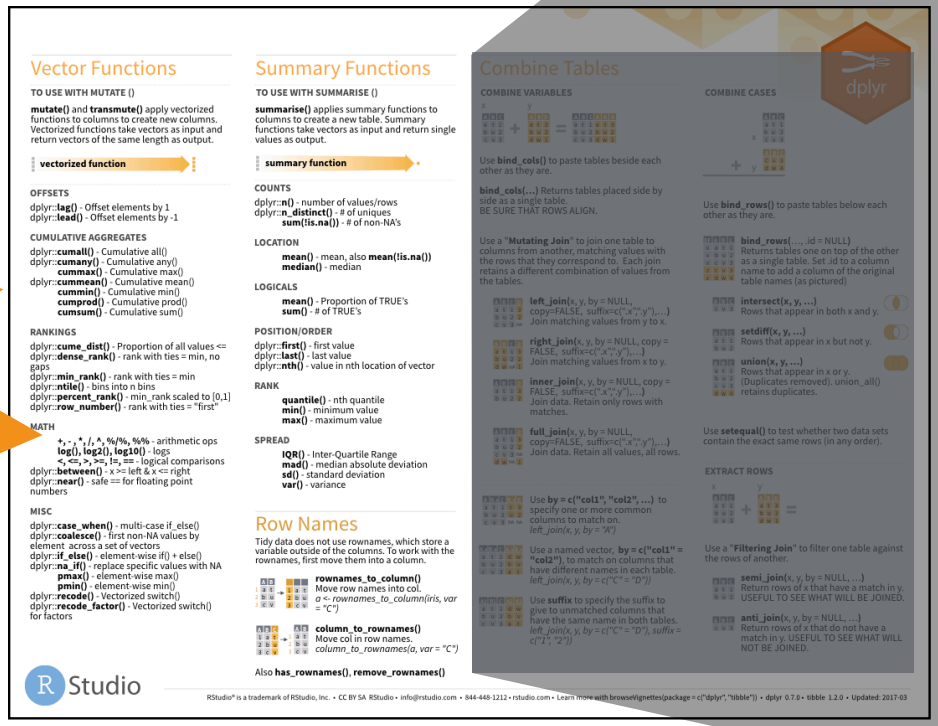
Quanto se gastou em cada categoria de bens?

1. Utilize **read_excel** (do pacote **readxl**) e importe o ficheiro Excel **sales2.xlsx** (ambas as folhas).
2. Reoriente a tabela de **clientes** para formato ***long***, de forma a ficar com 4 variáveis: **id_cliente, item, categoria e num_item**.
   - *Dica: vai precisar da opção **names_sep***
3. Junte as tabelas de **preços** e **clientes** numa única.
4. Calcule o montante gasto por categoria. Cada cliente comprou apenas 1 unidade de cada item.

join

Data Transformation cheatsheet

on back



Vector Functions

TO USE WITH MUTATE ()

mutate() and **transmute()** apply 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

OFFSETS

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

CUMULATIVE AGGREGATES

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

RANKINGS

dplyr::**cume_dist()** - Proportion of all values <=
dplyr::**dense_rank()** - rank with 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

MISC

dplyr::**case_when()** - multi-case if_else()
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()
dplyr::**recode()** - Vectorized switch()
dplyr::**recode_factor()** - Vectorized switch() for factors

Summary Functions

TO USE WITH SUMMARISE ()

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

summary function

COUNTS

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

LOCATION

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

LOGICALS

mean() - Proportion of TRUE's
sum() - # of TRUE's

POSITION/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.

rownames_to_column()
Move row names into col.
a <- rownames_to_column(iris, var = "C")

column_to_rownames()
Move col in row names.
column_to_rownames(a, var = "C")

Also **has_rownames()**, **remove_rownames()**

RStudio

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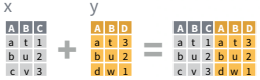
Combine Tables

dplyr

COMBINE VARIABLES



Use **bind_cols()** to paste tables beside each other as they are.

bind_cols(…) Returns tables placed side by side as a single table.
BE SURE THAT ROWS ALIGN.

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"),…)
Join matching values from y to x.

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

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

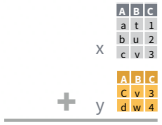
full_join(x, y, by = NULL, copy=FALSE, suffix=c(".x",".y"),…)
Join data. Retain all values, all rows.

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"))

COMBINE CASES



Use **bind_rows()** to paste tables below each other as they are.

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)

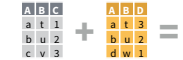
intersect(x, y, …)
Rows that appear in both x and y.

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).

EXTRACT ROWS



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

semi_join(x, y, by = NULL, …)
Return rows of x that have a match in y.
USEFUL TO SEE WHAT WILL BE JOINED.

anti_join(x, y, by = NULL, …)
Return rows of x that do not have a match in y. USEFUL TO SEE WHAT WILL NOT BE JOINED.

dplyr

Quiz 2

Obrigado
e até amanhã!

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