Learning R packages

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Contents

Chapter 1

Intro

1.1 Carrega pacotes a serem usados

```
#install.packages("tidyverse")
#install.packages("dplyr")
#install.packages("tidyr")
#install.packages("ggplot2")

library(tidyverse)
# Manipulação de dados
#library(dplyr)

# Visualização de gráficos
library(ggplot2)
library(gridExtra)
library(patchwork)
library(plotly)
library(esquisse)

# Para dados gráfico de perfis
library(nlme)
```

Ver como citar referências Wickham et al. [2019], Wickham [2023], Wickham et al. [2023c], Wickham et al. [2023a], Wickham and Henry [2023], Wickham et al. [2023b], Xie [2023b], Xie [2023a]

1.2 Alguns atalhos no Rstudio

Para considerar

Operador Pipe (%>%): Ctrl + Shift + M (Windows) ou Cmd + Shift + M (Mac).

Criar novos chunks: Ctrl + Alt + I (Windows) ou Cmd + Option + I (Mac).

1.3 Descrição dos dados `mpg`

Dados de economia de combustível de 1999 a 2008 para *38 modelos populares de carros*. Este conjunto de dados contém um subconjunto dos dados de economia de combustível que a EPA disponibiliza em *https://fueleconomy.gov/*. Ele contém apenas modelos que tiveram um novo lançamento a cada ano entre 1999 e 2008 - isso foi usado como um substituto para a popularidade do carro. Um *data frame* com 234 linhas e 11 variáveis:

- *manufacturer* nome do fabricante
- *model* nome do modelo
- *displ* cilindrada do motor, em litros
- *year* ano de fabricação
- *cyl* número de cilindros
- *trans* tipo de transmissão
- *drv* o tipo de trem de força, onde **f = tração dianteira**, **r = tração traseira** e **4 = 4wd**
- *cty* milhas urbanas por galão
- *hwy* milhas rodoviárias por galão
- *fl* tipo de combustível
- *class* "tipo" de carro

```
#help("mpg")
dados <- mpg
glimpse(dados)
```

```
## Rows: 234
## Columns: 11
## $ manufacturer <chr> "audi", "audi", "audi", "audi", "audi", "audi", "audi", "~
## $ model        <chr> "a4", "a4", "a4", "a4", "a4", "a4", "a4", "a4 quattro", "~
## $ displ        <dbl> 1.8, 1.8, 2.0, 2.0, 2.8, 2.8, 3.1, 1.8, 1.8, 2.0, 2.0, 2.~
## $ year         <int> 1999, 1999, 2008, 2008, 1999, 1999, 2008, 1999, 1999, 200~
## $ cyl          <int> 4, 4, 4, 4, 6, 6, 6, 4, 4, 4, 4, 6, 6, 6, 6, 6, 6, 8, 8, ~
## $ trans        <chr> "auto(l5)", "manual(m5)", "manual(m6)", "auto(av)", "auto~
## $ drv          <chr> "f", "f", "f", "f", "f", "f", "f", "4", "4", "4", "4", "4~
## $ cty          <int> 18, 21, 20, 21, 16, 18, 18, 18, 16, 20, 19, 15, 17, 17, 1~
```

```
## $ hwy          <int> 29, 29, 31, 30, 26, 26, 27, 26, 25, 28, 27, 25, 25, 25, 2~
## $ fl           <chr> "p", "p", "p", "p", "p", "p", "p", "p", "p", "p", "p", "p~
## $ class        <chr> "compact", "compact", "compact", "compact", "compact", "c~
```

```
dados <- mutate(.data = dados,
                across(where(is.character),
                as.factor))
#View(df)
glimpse(dados)
```

```
## Rows: 234
## Columns: 11
## $ manufacturer <fct> audi, audi, audi, audi, audi, audi, audi, audi, audi, aud~
## $ model        <fct> a4, a4, a4, a4, a4, a4, a4, a4 quattro, a4 quattro, a4 qu~
## $ displ        <dbl> 1.8, 1.8, 2.0, 2.0, 2.8, 2.8, 3.1, 1.8, 1.8, 2.0, 2.0, 2.~
## $ year         <int> 1999, 1999, 2008, 2008, 1999, 1999, 2008, 1999, 1999, 200~
## $ cyl          <int> 4, 4, 4, 4, 6, 6, 6, 4, 4, 4, 4, 6, 6, 6, 6, 6, 6, 8, 8, ~
## $ trans        <fct> auto(l5), manual(m5), manual(m6), auto(av), auto(l5), man~
## $ drv          <fct> f, f, f, f, f, f, f, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, r, ~
## $ cty          <int> 18, 21, 20, 21, 16, 18, 18, 18, 16, 20, 19, 15, 17, 17, 1~
## $ hwy          <int> 29, 29, 31, 30, 26, 26, 27, 26, 25, 28, 27, 25, 25, 25, 2~
## $ fl           <fct> p, p, p, p, p, p, p, p, p, p, p, p, p, p, p, p, p, p, r, ~
## $ class        <fct> compact, compact, compact, compact, compact, compact, com~
```

Chapter 2

dplyr (60 minutos)

2.1 Carrega pacotes a serem usados

```
#install.packages("tidyverse")
#install.packages("dplyr")
#install.packages("tidyr")
#install.packages("ggplot2")

library(tidyverse)
# Manipulação de dados
#library(dplyr)

# Visualização de gráficos
library(ggplot2)
library(gridExtra)
library(patchwork)
library(plotly)
library(esquisse)

# Para dados gráfico de perfis
library(nlme)
```

2.2 Descrição dos dados `mpg`

Dados de economia de combustível de 1999 a 2008 para *38 modelos populares de carros*. Este conjunto de dados contém um subconjunto dos dados de economia de combustível que a EPA disponibiliza em *https://fueleconomy.gov/*. Ele contém apenas modelos que tiveram um novo lançamento a cada ano entre 1999 e 2008 - isso foi usado como um substituto para a popularidade do carro. Um

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- *year* ano de fabricação
- *cyl* número de cilindros
- *trans* tipo de transmissão
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- *cty* milhas urbanas por galão
- *hwy* milhas rodoviárias por galão
- *fl* tipo de combustível
- *class* "tipo" de carro

```
#help("mpg")
library(tidyverse)
dados <- mpg
glimpse(dados)
```

```
## Rows: 234
## Columns: 11
## $ manufacturer <chr> "audi", "audi", "audi", "audi", "audi", "audi", "audi", "~
## $ model        <chr> "a4", "a4", "a4", "a4", "a4", "a4", "a4", "a4 quattro", "~
## $ displ        <dbl> 1.8, 1.8, 2.0, 2.0, 2.8, 2.8, 3.1, 1.8, 1.8, 2.0, 2.0, 2.~
## $ year         <int> 1999, 1999, 2008, 2008, 1999, 1999, 2008, 1999, 1999, 200~
## $ cyl          <int> 4, 4, 4, 4, 6, 6, 6, 4, 4, 4, 4, 6, 6, 6, 6, 6, 6, 8, 8, ~
## $ trans        <chr> "auto(l5)", "manual(m5)", "manual(m6)", "auto(av)", "auto~
## $ drv          <chr> "f", "f", "f", "f", "f", "f", "f", "4", "4", "4", "4", "4~
## $ cty          <int> 18, 21, 20, 21, 16, 18, 18, 18, 16, 20, 19, 15, 17, 17, 1~
## $ hwy          <int> 29, 29, 31, 30, 26, 26, 27, 26, 25, 28, 27, 25, 25, 25, 2~
## $ fl           <chr> "p", "p", "p", "p", "p", "p", "p", "p", "p", "p", "p", "p~
## $ class        <chr> "compact", "compact", "compact", "compact", "compact", "c~
```

```
dados <- mutate(.data = dados,
                across(where(is.character),
                as.factor))
#View(df)
glimpse(dados)
```

```
## Rows: 234
## Columns: 11
```

```
## $ manufacturer <fct> audi, audi, audi, audi, audi, audi, audi, audi, audi, aud~
## $ model        <fct> a4, a4, a4, a4, a4, a4, a4, a4 quattro, a4 quattro, a4 qu~
## $ displ        <dbl> 1.8, 1.8, 2.0, 2.0, 2.8, 2.8, 3.1, 1.8, 1.8, 2.0, 2.0, 2.~
## $ year         <int> 1999, 1999, 2008, 2008, 1999, 1999, 2008, 1999, 1999, 200~
## $ cyl          <int> 4, 4, 4, 4, 6, 6, 6, 4, 4, 4, 4, 6, 6, 6, 6, 6, 6, 8, 8, ~
## $ trans        <fct> auto(l5), manual(m5), manual(m6), auto(av), auto(l5), man~
## $ drv          <fct> f, f, f, f, f, f, f, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, r, ~
## $ cty          <int> 18, 21, 20, 21, 16, 18, 18, 18, 16, 20, 19, 15, 17, 17, 1~
## $ hwy          <int> 29, 29, 31, 30, 26, 26, 27, 26, 25, 28, 27, 25, 25, 25, 2~
## $ fl           <fct> p, p, p, p, p, p, p, p, p, p, p, p, p, p, p, p, p, p, r, ~
## $ class        <fct> compact, compact, compact, compact, compact, compact, com~
```

2.3 Lista de funções do pacote dplyr

```
ls("package:dplyr")
```

```
##   [1] "%>%"                  "across"               "add_count"
##   [4] "add_count_"           "add_row"              "add_rownames"
##   [7] "add_tally"            "add_tally_"           "all_equal"
##  [10] "all_of"               "all_vars"             "anti_join"
##  [13] "any_of"               "any_vars"             "arrange"
##  [16] "arrange_"             "arrange_all"          "arrange_at"
##  [19] "arrange_if"           "as.tbl"               "as_data_frame"
##  [22] "as_label"             "as_tibble"            "auto_copy"
##  [25] "band_instruments"     "band_instruments2"    "band_members"
##  [28] "bench_tbls"           "between"              "bind_cols"
##  [31] "bind_rows"            "c_across"             "case_match"
##  [34] "case_when"            "changes"              "check_dbplyr"
##  [37] "coalesce"             "collapse"             "collect"
##  [40] "combine"              "common_by"            "compare_tbls"
##  [43] "compare_tbls2"        "compute"              "consecutive_id"
##  [46] "contains"             "copy_to"              "count"
##  [49] "count_"               "cross_join"           "cumall"
##  [52] "cumany"               "cume_dist"            "cummean"
##  [55] "cur_column"           "cur_data"             "cur_data_all"
##  [58] "cur_group"            "cur_group_id"         "cur_group_rows"
##  [61] "current_vars"         "data_frame"           "db_analyze"
##  [64] "db_begin"             "db_commit"            "db_create_index"
##  [67] "db_create_indexes"    "db_create_table"      "db_data_type"
##  [70] "db_desc"              "db_drop_table"        "db_explain"
##  [73] "db_has_table"         "db_insert_into"       "db_list_tables"
##  [76] "db_query_fields"      "db_query_rows"        "db_rollback"
##  [79] "db_save_query"        "db_write_table"       "dense_rank"
##  [82] "desc"                 "dim_desc"             "distinct"
##  [85] "distinct_"            "distinct_all"         "distinct_at"
```

```
##  [88] "distinct_if"          "distinct_prepare"      "do"
##  [91] "do_"                  "dplyr_col_modify"      "dplyr_reconstruct"
##  [94] "dplyr_row_slice"      "ends_with"             "enexpr"
##  [97] "enexprs"              "enquo"                 "enquos"
## [100] "ensym"                "ensyms"                "eval_tbls"
## [103] "eval_tbls2"           "everything"            "explain"
## [106] "expr"                 "failwith"              "filter"
## [109] "filter_"              "filter_all"            "filter_at"
## [112] "filter_if"            "first"                 "full_join"
## [115] "funs"                 "funs_"                 "glimpse"
## [118] "group_by"             "group_by_"             "group_by_all"
## [121] "group_by_at"          "group_by_drop_default" "group_by_if"
## [124] "group_by_prepare"     "group_cols"            "group_data"
## [127] "group_indices"        "group_indices_"        "group_keys"
## [130] "group_map"            "group_modify"          "group_nest"
## [133] "group_rows"           "group_size"            "group_split"
## [136] "group_trim"           "group_vars"            "group_walk"
## [139] "grouped_df"           "groups"                "id"
## [142] "ident"                "if_all"                "if_any"
## [145] "if_else"              "inner_join"            "intersect"
## [148] "is.grouped_df"        "is.src"                "is.tbl"
## [151] "is_grouped_df"        "join_by"               "lag"
## [154] "last"                 "last_col"              "last_dplyr_warnings"
## [157] "lead"                 "left_join"             "location"
## [160] "lst"                  "make_tbl"              "matches"
## [163] "min_rank"             "mutate"                "mutate_"
## [166] "mutate_all"           "mutate_at"             "mutate_each"
## [169] "mutate_each_"         "mutate_if"             "n"
## [172] "n_distinct"           "n_groups"              "na_if"
## [175] "near"                 "nest_by"               "nest_join"
## [178] "new_grouped_df"       "new_rowwise_df"        "nth"
## [181] "ntile"                "num_range"             "one_of"
## [184] "order_by"             "percent_rank"          "pick"
## [187] "progress_estimated"   "pull"                  "quo"
## [190] "quo_name"             "quos"                  "recode"
## [193] "recode_factor"        "reframe"               "relocate"
## [196] "rename"               "rename_"               "rename_all"
## [199] "rename_at"            "rename_if"             "rename_vars"
## [202] "rename_vars_"         "rename_with"           "right_join"
## [205] "row_number"           "rows_append"           "rows_delete"
## [208] "rows_insert"          "rows_patch"            "rows_update"
## [211] "rows_upsert"          "rowwise"               "same_src"
## [214] "sample_frac"          "sample_n"              "select"
## [217] "select_"              "select_all"            "select_at"
## [220] "select_if"            "select_var"            "select_vars"
## [223] "select_vars_"         "semi_join"             "setdiff"
```

```
## [226] "setequal"              "show_query"            "slice"
## [229] "slice_"                "slice_head"            "slice_max"
## [232] "slice_min"             "slice_sample"          "slice_tail"
## [235] "sql"                   "sql_escape_ident"      "sql_escape_string"
## [238] "sql_join"              "sql_select"            "sql_semi_join"
## [241] "sql_set_op"            "sql_subquery"          "sql_translate_env"
## [244] "src"                   "src_df"                "src_local"
## [247] "src_mysql"             "src_postgres"          "src_sqlite"
## [250] "src_tbls"              "starts_with"           "starwars"
## [253] "storms"                "summarise"             "summarise_"
## [256] "summarise_all"         "summarise_at"          "summarise_each"
## [259] "summarise_each_"       "summarise_if"          "summarize"
## [262] "summarize_"            "summarize_all"         "summarize_at"
## [265] "summarize_each"        "summarize_each_"       "summarize_if"
## [268] "sym"                   "symdiff"               "syms"
## [271] "tally"                 "tally_"                "tbl"
## [274] "tbl_df"                "tbl_nongroup_vars"     "tbl_ptype"
## [277] "tbl_vars"              "tibble"                "top_frac"
## [280] "top_n"                 "transmute"             "transmute_"
## [283] "transmute_all"         "transmute_at"          "transmute_if"
## [286] "tribble"               "type_sum"              "ungroup"
## [289] "union"                 "union_all"             "validate_grouped_df"
## [292] "validate_rowwise_df"   "vars"                  "where"
## [295] "with_groups"           "with_order"            "wrap_dbplyr_obj"
```

2.4 Operador Pipe

```
sqrt(log(44))
```

```
## [1] 1.945299
```

```
44 %>% log %>% sqrt
```

```
## [1] 1.945299
```

2.5 select() para colunas

```
select(dados, manufacturer, model, year)
```

```
## # A tibble: 234 x 3
##    manufacturer model       year
##    <fct>        <fct>      <int>
##  1 audi         a4          1999
##  2 audi         a4          1999
##  3 audi         a4          2008
```

```
##  4 audi         a4          2008
##  5 audi         a4          1999
##  6 audi         a4          1999
##  7 audi         a4          2008
##  8 audi         a4 quattro  1999
##  9 audi         a4 quattro  1999
## 10 audi         a4 quattro  2008
## # ... with 224 more rows
```

```
select(dados, starts_with("m"))
```

```
## # A tibble: 234 x 2
##    manufacturer model
##    <fct>        <fct>
##  1 audi         a4
##  2 audi         a4
##  3 audi         a4
##  4 audi         a4
##  5 audi         a4
##  6 audi         a4
##  7 audi         a4
##  8 audi         a4 quattro
##  9 audi         a4 quattro
## 10 audi         a4 quattro
## # ... with 224 more rows
```

```
select(dados, contains("r"))
```

```
## # A tibble: 234 x 4
##    manufacturer  year trans      drv
##    <fct>        <int> <fct>      <fct>
##  1 audi          1999 auto(l5)   f
##  2 audi          1999 manual(m5) f
##  3 audi          2008 manual(m6) f
##  4 audi          2008 auto(av)   f
##  5 audi          1999 auto(l5)   f
##  6 audi          1999 manual(m5) f
##  7 audi          2008 auto(av)   f
##  8 audi          1999 manual(m5) 4
##  9 audi          1999 auto(l5)   4
## 10 audi          2008 manual(m6) 4
## # ... with 224 more rows
```

```
select(dados, ends_with("y"))
```

```
## # A tibble: 234 x 2
##      cty   hwy
##    <int> <int>
```

```
##  1    18    29
##  2    21    29
##  3    20    31
##  4    21    30
##  5    16    26
##  6    18    26
##  7    18    27
##  8    18    26
##  9    16    25
## 10    20    28
## # ... with 224 more rows
```

```
select(dados, matches("[abc]"))
```

```
## # A tibble: 234 x 6
##    manufacturer  year   cyl trans        cty class
##    <fct>        <int> <int> <fct>      <int> <fct>
##  1 audi          1999     4 auto(l5)      18 compact
##  2 audi          1999     4 manual(m5)    21 compact
##  3 audi          2008     4 manual(m6)    20 compact
##  4 audi          2008     4 auto(av)      21 compact
##  5 audi          1999     6 auto(l5)      16 compact
##  6 audi          1999     6 manual(m5)    18 compact
##  7 audi          2008     6 auto(av)      18 compact
##  8 audi          1999     4 manual(m5)    18 compact
##  9 audi          1999     4 auto(l5)      16 compact
## 10 audi          2008     4 manual(m6)    20 compact
## # ... with 224 more rows
```

```
select(dados, starts_with("m"), starts_with("c"))
```

```
## # A tibble: 234 x 5
##    manufacturer model        cyl   cty class
##    <fct>        <fct>      <int> <int> <fct>
##  1 audi         a4             4    18 compact
##  2 audi         a4             4    21 compact
##  3 audi         a4             4    20 compact
##  4 audi         a4             4    21 compact
##  5 audi         a4             6    16 compact
##  6 audi         a4             6    18 compact
##  7 audi         a4             6    18 compact
##  8 audi         a4 quattro     4    18 compact
##  9 audi         a4 quattro     4    16 compact
## 10 audi         a4 quattro     4    20 compact
## # ... with 224 more rows
```

```
select(dados, ends_with("l"), ends_with("s"))
```

```
## # A tibble: 234 x 6
##    model      displ   cyl fl    trans      class
##    <fct>      <dbl> <int> <fct> <fct>      <fct>
##  1 a4           1.8     4 p     auto(l5)   compact
##  2 a4           1.8     4 p     manual(m5) compact
##  3 a4           2       4 p     manual(m6) compact
##  4 a4           2       4 p     auto(av)   compact
##  5 a4           2.8     6 p     auto(l5)   compact
##  6 a4           2.8     6 p     manual(m5) compact
##  7 a4           3.1     6 p     auto(av)   compact
##  8 a4 quattro   1.8     4 p     manual(m5) compact
##  9 a4 quattro   1.8     4 p     auto(l5)   compact
## 10 a4 quattro   2       4 p     manual(m6) compact
## # ... with 224 more rows
```

```
select(dados, 1:3)
```

```
## # A tibble: 234 x 3
##    manufacturer model      displ
##    <fct>        <fct>      <dbl>
##  1 audi         a4           1.8
##  2 audi         a4           1.8
##  3 audi         a4           2
##  4 audi         a4           2
##  5 audi         a4           2.8
##  6 audi         a4           2.8
##  7 audi         a4           3.1
##  8 audi         a4 quattro   1.8
##  9 audi         a4 quattro   1.8
## 10 audi         a4 quattro   2
## # ... with 224 more rows
```

```
select(dados, c(2,5,7))
```

```
## # A tibble: 234 x 3
##    model        cyl drv
##    <fct>      <int> <fct>
##  1 a4             4 f
##  2 a4             4 f
##  3 a4             4 f
##  4 a4             4 f
##  5 a4             6 f
##  6 a4             6 f
##  7 a4             6 f
##  8 a4 quattro     4 4
##  9 a4 quattro     4 4
## 10 a4 quattro     4 4
```

```
## # ... with 224 more rows
```

```
select(dados, manufacturer:cyl)
```

```
## # A tibble: 234 x 5
##    manufacturer model      displ  year   cyl
##    <fct>        <fct>      <dbl> <int> <int>
##  1 audi         a4           1.8  1999     4
##  2 audi         a4           1.8  1999     4
##  3 audi         a4           2    2008     4
##  4 audi         a4           2    2008     4
##  5 audi         a4           2.8  1999     6
##  6 audi         a4           2.8  1999     6
##  7 audi         a4           3.1  2008     6
##  8 audi         a4 quattro   1.8  1999     4
##  9 audi         a4 quattro   1.8  1999     4
## 10 audi         a4 quattro   2    2008     4
## # ... with 224 more rows
```

```
select(dados,-(manufacturer:cyl))
```

```
## # A tibble: 234 x 6
##    trans      drv     cty   hwy fl    class
##    <fct>      <fct> <int> <int> <fct> <fct>
##  1 auto(l5)   f        18    29 p     compact
##  2 manual(m5) f        21    29 p     compact
##  3 manual(m6) f        20    31 p     compact
##  4 auto(av)   f        21    30 p     compact
##  5 auto(l5)   f        16    26 p     compact
##  6 manual(m5) f        18    26 p     compact
##  7 auto(av)   f        18    27 p     compact
##  8 manual(m5) 4        18    26 p     compact
##  9 auto(l5)   4        16    25 p     compact
## 10 manual(m6) 4        20    28 p     compact
## # ... with 224 more rows
```

2.6 rename()

```
dados1 <- rename(dados,
                 mnfc = manufacturer,
                 mod = model)
dados1
```

```
## # A tibble: 234 x 11
##    mnfc  mod        displ  year   cyl trans      drv     cty   hwy fl    class
##    <fct> <fct>      <dbl> <int> <int> <fct>      <fct> <int> <int> <fct> <fct>
```

```
##  1 audi  a4           1.8  1999     4 auto(l5)   f        18    29 p     compact
##  2 audi  a4           1.8  1999     4 manual(m5) f        21    29 p     compact
##  3 audi  a4           2    2008     4 manual(m6) f        20    31 p     compact
##  4 audi  a4           2    2008     4 auto(av)   f        21    30 p     compact
##  5 audi  a4           2.8  1999     6 auto(l5)   f        16    26 p     compact
##  6 audi  a4           2.8  1999     6 manual(m5) f        18    26 p     compact
##  7 audi  a4           3.1  2008     6 auto(av)   f        18    27 p     compact
##  8 audi  a4 quattro   1.8  1999     4 manual(m5) 4        18    26 p     compact
##  9 audi  a4 quattro   1.8  1999     4 auto(l5)   4        16    25 p     compact
## 10 audi  a4 quattro   2    2008     4 manual(m6) 4        20    28 p     compact
## # ... with 224 more rows
```

```
select(dados,
       mnfc = manufacturer,
       mod = model)
```

```
## # A tibble: 234 x 2
##    mnfc  mod
##    <fct> <fct>
##  1 audi  a4
##  2 audi  a4
##  3 audi  a4
##  4 audi  a4
##  5 audi  a4
##  6 audi  a4
##  7 audi  a4
##  8 audi  a4 quattro
##  9 audi  a4 quattro
## 10 audi  a4 quattro
## # ... with 224 more rows
```

```
select(dados,
       mnfc = manufacturer,
       mod = model,
       everything())
```

```
## # A tibble: 234 x 11
##    mnfc  mod        displ  year   cyl trans      drv     cty   hwy fl    class
##    <fct> <fct>      <dbl> <int> <int> <fct>      <fct> <int> <int> <fct> <fct>
##  1 audi  a4           1.8  1999     4 auto(l5)   f        18    29 p     compact
##  2 audi  a4           1.8  1999     4 manual(m5) f        21    29 p     compact
##  3 audi  a4           2    2008     4 manual(m6) f        20    31 p     compact
##  4 audi  a4           2    2008     4 auto(av)   f        21    30 p     compact
##  5 audi  a4           2.8  1999     6 auto(l5)   f        16    26 p     compact
##  6 audi  a4           2.8  1999     6 manual(m5) f        18    26 p     compact
##  7 audi  a4           3.1  2008     6 auto(av)   f        18    27 p     compact
##  8 audi  a4 quattro   1.8  1999     4 manual(m5) 4        18    26 p     compact
```

```
##  9 audi  a4 quattro   1.8  1999     4 auto(l5)   4        16    25 p     compact
## 10 audi  a4 quattro   2    2008     4 manual(m6) 4        20    28 p     compact
## # ... with 224 more rows
```

2.7 mutate() para colunas

```
mutate(dados, sqrt_cty = sqrt(cty))
```

```
## # A tibble: 234 x 12
##    manufac~1 model displ  year   cyl trans drv     cty   hwy fl    class sqrt_~2
##    <fct>     <fct> <dbl> <int> <int> <fct> <fct> <int> <int> <fct> <fct>   <dbl>
##  1 audi      a4      1.8  1999     4 auto~ f        18    29 p     comp~    4.24
##  2 audi      a4      1.8  1999     4 manu~ f        21    29 p     comp~    4.58
##  3 audi      a4      2    2008     4 manu~ f        20    31 p     comp~    4.47
##  4 audi      a4      2    2008     4 auto~ f        21    30 p     comp~    4.58
##  5 audi      a4      2.8  1999     6 auto~ f        16    26 p     comp~    4
##  6 audi      a4      2.8  1999     6 manu~ f        18    26 p     comp~    4.24
##  7 audi      a4      3.1  2008     6 auto~ f        18    27 p     comp~    4.24
##  8 audi      a4 q~   1.8  1999     4 manu~ 4        18    26 p     comp~    4.24
##  9 audi      a4 q~   1.8  1999     4 auto~ 4        16    25 p     comp~    4
## 10 audi      a4 q~   2    2008     4 manu~ 4        20    28 p     comp~    4.47
## # ... with 224 more rows, and abbreviated variable names 1: manufacturer,
## #   2: sqrt_cty
```

```
names(dados)
```

```
##  [1] "manufacturer" "model"        "displ"        "year"         "cyl"
##  [6] "trans"        "drv"          "cty"          "hwy"          "fl"
## [11] "class"
```

```
dados<- mutate(dados, sqrt_cty = sqrt(cty))
names(dados)
```

```
##  [1] "manufacturer" "model"        "displ"        "year"         "cyl"
##  [6] "trans"        "drv"          "cty"          "hwy"          "fl"
## [11] "class"        "sqrt_cty"
```

```
dados <- mutate(dados,
`soma de variáveis` = (cty + hwy) / 2)
names(dados)
```

```
##  [1] "manufacturer"      "model"             "displ"
##  [4] "year"              "cyl"               "trans"
##  [7] "drv"               "cty"               "hwy"
## [10] "fl"                "class"             "sqrt_cty"
## [13] "soma de variáveis"
```

```
dados <- mutate(dados,
            car = paste(manufacturer, model, sep = " "),
            `cyl / trans` = paste(cyl, " cylinders", " / ", trans, " transmission", se
dados
```

```
## # A tibble: 234 x 15
##    manufac~1 model displ  year   cyl trans drv     cty   hwy fl    class sqrt_~2
##    <fct>     <fct> <dbl> <int> <int> <fct> <fct> <int> <int> <fct> <fct>   <dbl>
##  1 audi      a4      1.8  1999     4 auto~ f        18    29 p     comp~    4.24
##  2 audi      a4      1.8  1999     4 manu~ f        21    29 p     comp~    4.58
##  3 audi      a4      2    2008     4 manu~ f        20    31 p     comp~    4.47
##  4 audi      a4      2    2008     4 auto~ f        21    30 p     comp~    4.58
##  5 audi      a4      2.8  1999     6 auto~ f        16    26 p     comp~    4
##  6 audi      a4      2.8  1999     6 manu~ f        18    26 p     comp~    4.24
##  7 audi      a4      3.1  2008     6 auto~ f        18    27 p     comp~    4.24
##  8 audi      a4 q~   1.8  1999     4 manu~ 4        18    26 p     comp~    4.24
##  9 audi      a4 q~   1.8  1999     4 auto~ 4        16    25 p     comp~    4
## 10 audi      a4 q~   2    2008     4 manu~ 4        20    28 p     comp~    4.47
## # ... with 224 more rows, 3 more variables: `soma de variáveis` <dbl>,
## #   car <chr>, `cyl / trans` <chr>, and abbreviated variable names
## #   1: manufacturer, 2: sqrt_cty
```

2.8 transmute()

```
transmute(dados,
          `avg miles per gallon` = (cty + hwy) / 2)
```

```
## # A tibble: 234 x 1
##    `avg miles per gallon`
##                     <dbl>
##  1                   23.5
##  2                   25
##  3                   25.5
##  4                   25.5
##  5                   21
##  6                   22
##  7                   22.5
##  8                   22
##  9                   20.5
## 10                   24
## # ... with 224 more rows
```

```
transmute(dados,
          car = paste(manufacturer, model, sep = " "),
          `cyl / trans` = paste(cyl, " cylinders", " / ", trans, " transmission", sep =
```

```
## # A tibble: 234 x 2
##    car             `cyl / trans`
##    <chr>           <chr>
##  1 audi a4         4 cylinders / auto(l5) transmission
##  2 audi a4         4 cylinders / manual(m5) transmission
##  3 audi a4         4 cylinders / manual(m6) transmission
##  4 audi a4         4 cylinders / auto(av) transmission
##  5 audi a4         6 cylinders / auto(l5) transmission
##  6 audi a4         6 cylinders / manual(m5) transmission
##  7 audi a4         6 cylinders / auto(av) transmission
##  8 audi a4 quattro 4 cylinders / manual(m5) transmission
##  9 audi a4 quattro 4 cylinders / auto(l5) transmission
## 10 audi a4 quattro 4 cylinders / manual(m6) transmission
## # ... with 224 more rows
```

2.9 filter() para linhas

```
filter(dados, manufacturer == "audi")
```

```
## # A tibble: 18 x 15
##    manufac~1 model displ  year   cyl trans drv     cty   hwy fl    class sqrt_~2
##    <fct>     <fct> <dbl> <int> <int> <fct> <fct> <int> <int> <fct> <fct>   <dbl>
##  1 audi      a4      1.8  1999     4 auto~ f        18    29 p     comp~    4.24
##  2 audi      a4      1.8  1999     4 manu~ f        21    29 p     comp~    4.58
##  3 audi      a4      2    2008     4 manu~ f        20    31 p     comp~    4.47
##  4 audi      a4      2    2008     4 auto~ f        21    30 p     comp~    4.58
##  5 audi      a4      2.8  1999     6 auto~ f        16    26 p     comp~    4
##  6 audi      a4      2.8  1999     6 manu~ f        18    26 p     comp~    4.24
##  7 audi      a4      3.1  2008     6 auto~ f        18    27 p     comp~    4.24
##  8 audi      a4 q~   1.8  1999     4 manu~ 4        18    26 p     comp~    4.24
##  9 audi      a4 q~   1.8  1999     4 auto~ 4        16    25 p     comp~    4
## 10 audi      a4 q~   2    2008     4 manu~ 4        20    28 p     comp~    4.47
## 11 audi      a4 q~   2    2008     4 auto~ 4        19    27 p     comp~    4.36
## 12 audi      a4 q~   2.8  1999     6 auto~ 4        15    25 p     comp~    3.87
## 13 audi      a4 q~   2.8  1999     6 manu~ 4        17    25 p     comp~    4.12
## 14 audi      a4 q~   3.1  2008     6 auto~ 4        17    25 p     comp~    4.12
## 15 audi      a4 q~   3.1  2008     6 manu~ 4        15    25 p     comp~    3.87
## 16 audi      a6 q~   2.8  1999     6 auto~ 4        15    24 p     mids~    3.87
## 17 audi      a6 q~   3.1  2008     6 auto~ 4        17    25 p     mids~    4.12
## 18 audi      a6 q~   4.2  2008     8 auto~ 4        16    23 p     mids~    4
## # ... with 3 more variables: `soma de variáveis` <dbl>, car <chr>,
## #   `cyl / trans` <chr>, and abbreviated variable names 1: manufacturer,
## #   2: sqrt_cty
```

```
filter(dados, manufacturer == "audi" & year == "1999")
```

```
## # A tibble: 9 x 15
##   manufact~1 model displ  year   cyl trans drv     cty   hwy fl    class sqrt_~2
##   <fct>      <fct> <dbl> <int> <int> <fct> <fct> <int> <int> <fct> <fct>   <dbl>
## 1 audi       a4      1.8  1999     4 auto~ f        18    29 p     comp~    4.24
## 2 audi       a4      1.8  1999     4 manu~ f        21    29 p     comp~    4.58
## 3 audi       a4      2.8  1999     6 auto~ f        16    26 p     comp~    4
## 4 audi       a4      2.8  1999     6 manu~ f        18    26 p     comp~    4.24
## 5 audi       a4 q~   1.8  1999     4 manu~ 4        18    26 p     comp~    4.24
## 6 audi       a4 q~   1.8  1999     4 auto~ 4        16    25 p     comp~    4
## 7 audi       a4 q~   2.8  1999     6 auto~ 4        15    25 p     comp~    3.87
## 8 audi       a4 q~   2.8  1999     6 manu~ 4        17    25 p     comp~    4.12
## 9 audi       a6 q~   2.8  1999     6 auto~ 4        15    24 p     mids~    3.87
## # ... with 3 more variables: `soma de variáveis` <dbl>, car <chr>,
## #   `cyl / trans` <chr>, and abbreviated variable names 1: manufacturer,
## #   2: sqrt_cty
```

```
filter(dados, manufacturer == "audi", year == 1999)
```

```
## # A tibble: 9 x 15
##   manufact~1 model displ  year   cyl trans drv     cty   hwy fl    class sqrt_~2
##   <fct>      <fct> <dbl> <int> <int> <fct> <fct> <int> <int> <fct> <fct>   <dbl>
## 1 audi       a4      1.8  1999     4 auto~ f        18    29 p     comp~    4.24
## 2 audi       a4      1.8  1999     4 manu~ f        21    29 p     comp~    4.58
## 3 audi       a4      2.8  1999     6 auto~ f        16    26 p     comp~    4
## 4 audi       a4      2.8  1999     6 manu~ f        18    26 p     comp~    4.24
## 5 audi       a4 q~   1.8  1999     4 manu~ 4        18    26 p     comp~    4.24
## 6 audi       a4 q~   1.8  1999     4 auto~ 4        16    25 p     comp~    4
## 7 audi       a4 q~   2.8  1999     6 auto~ 4        15    25 p     comp~    3.87
## 8 audi       a4 q~   2.8  1999     6 manu~ 4        17    25 p     comp~    4.12
## 9 audi       a6 q~   2.8  1999     6 auto~ 4        15    24 p     mids~    3.87
## # ... with 3 more variables: `soma de variáveis` <dbl>, car <chr>,
## #   `cyl / trans` <chr>, and abbreviated variable names 1: manufacturer,
## #   2: sqrt_cty
```

```
filter(dados, manufacturer == "audi" | manufacturer == "dodge") %>%
  print(n = 20)
```

```
## # A tibble: 55 x 15
##    manufac~1 model displ  year   cyl trans drv     cty   hwy fl    class sqrt_~2
##    <fct>     <fct> <dbl> <int> <int> <fct> <fct> <int> <int> <fct> <fct>   <dbl>
##  1 audi      a4      1.8  1999     4 auto~ f        18    29 p     comp~    4.24
##  2 audi      a4      1.8  1999     4 manu~ f        21    29 p     comp~    4.58
##  3 audi      a4      2    2008     4 manu~ f        20    31 p     comp~    4.47
##  4 audi      a4      2    2008     4 auto~ f        21    30 p     comp~    4.58
##  5 audi      a4      2.8  1999     6 auto~ f        16    26 p     comp~    4
```

```
##  6 audi      a4      2.8  1999     6 manu~ f        18    26 p     comp~    4.24
##  7 audi      a4      3.1  2008     6 auto~ f        18    27 p     comp~    4.24
##  8 audi      a4 q~   1.8  1999     4 manu~ 4        18    26 p     comp~    4.24
##  9 audi      a4 q~   1.8  1999     4 auto~ 4        16    25 p     comp~    4
## 10 audi      a4 q~   2    2008     4 manu~ 4        20    28 p     comp~    4.47
## 11 audi      a4 q~   2    2008     4 auto~ 4        19    27 p     comp~    4.36
## 12 audi      a4 q~   2.8  1999     6 auto~ 4        15    25 p     comp~    3.87
## 13 audi      a4 q~   2.8  1999     6 manu~ 4        17    25 p     comp~    4.12
## 14 audi      a4 q~   3.1  2008     6 auto~ 4        17    25 p     comp~    4.12
## 15 audi      a4 q~   3.1  2008     6 manu~ 4        15    25 p     comp~    3.87
## 16 audi      a6 q~   2.8  1999     6 auto~ 4        15    24 p     mids~    3.87
## 17 audi      a6 q~   3.1  2008     6 auto~ 4        17    25 p     mids~    4.12
## 18 audi      a6 q~   4.2  2008     8 auto~ 4        16    23 p     mids~    4
## 19 dodge     cara~   2.4  1999     4 auto~ f        18    24 r     mini~    4.24
## 20 dodge     cara~   3    1999     6 auto~ f        17    24 r     mini~    4.12
## # ... with 35 more rows, 3 more variables: `soma de variáveis` <dbl>,
## #   car <chr>, `cyl / trans` <chr>, and abbreviated variable names
## #   1: manufacturer, 2: sqrt_cty
```

```
filter(dados, manufacturer %in% c("audi", "dodge")) %>%
  print(n = 20)
```

```
## # A tibble: 55 x 15
##    manufac~1 model displ  year   cyl trans drv     cty   hwy fl    class sqrt_~2
##    <fct>     <fct> <dbl> <int> <int> <fct> <fct> <int> <int> <fct> <fct>   <dbl>
##  1 audi      a4      1.8  1999     4 auto~ f        18    29 p     comp~    4.24
##  2 audi      a4      1.8  1999     4 manu~ f        21    29 p     comp~    4.58
##  3 audi      a4      2    2008     4 manu~ f        20    31 p     comp~    4.47
##  4 audi      a4      2    2008     4 auto~ f        21    30 p     comp~    4.58
##  5 audi      a4      2.8  1999     6 auto~ f        16    26 p     comp~    4
##  6 audi      a4      2.8  1999     6 manu~ f        18    26 p     comp~    4.24
##  7 audi      a4      3.1  2008     6 auto~ f        18    27 p     comp~    4.24
##  8 audi      a4 q~   1.8  1999     4 manu~ 4        18    26 p     comp~    4.24
##  9 audi      a4 q~   1.8  1999     4 auto~ 4        16    25 p     comp~    4
## 10 audi      a4 q~   2    2008     4 manu~ 4        20    28 p     comp~    4.47
## 11 audi      a4 q~   2    2008     4 auto~ 4        19    27 p     comp~    4.36
## 12 audi      a4 q~   2.8  1999     6 auto~ 4        15    25 p     comp~    3.87
## 13 audi      a4 q~   2.8  1999     6 manu~ 4        17    25 p     comp~    4.12
## 14 audi      a4 q~   3.1  2008     6 auto~ 4        17    25 p     comp~    4.12
## 15 audi      a4 q~   3.1  2008     6 manu~ 4        15    25 p     comp~    3.87
## 16 audi      a6 q~   2.8  1999     6 auto~ 4        15    24 p     mids~    3.87
## 17 audi      a6 q~   3.1  2008     6 auto~ 4        17    25 p     mids~    4.12
## 18 audi      a6 q~   4.2  2008     8 auto~ 4        16    23 p     mids~    4
## 19 dodge     cara~   2.4  1999     4 auto~ f        18    24 r     mini~    4.24
## 20 dodge     cara~   3    1999     6 auto~ f        17    24 r     mini~    4.12
## # ... with 35 more rows, 3 more variables: `soma de variáveis` <dbl>,
```

```
## #   car <chr>, `cyl / trans` <chr>, and abbreviated variable names
## #   1: manufacturer, 2: sqrt_cty
```

```
filter(dados, hwy >= 30) %>%
  select(hwy) %>%
  print(n = 26)
```

```
## # A tibble: 26 x 1
##      hwy
##    <int>
##  1    31
##  2    30
##  3    30
##  4    33
##  5    32
##  6    32
##  7    32
##  8    34
##  9    36
## 10    36
## 11    30
## 12    31
## 13    31
## 14    32
## 15    31
## 16    31
## 17    31
## 18    31
## 19    30
## 20    33
## 21    35
## 22    37
## 23    35
## 24    44
## 25    44
## 26    41
```

```
filter(dados, year != 1999) %>%
  select(year) %>%
  print(n = 30)
```

```
## # A tibble: 117 x 1
##     year
##    <int>
##  1  2008
##  2  2008
##  3  2008
```

```
##  4  2008
##  5  2008
##  6  2008
##  7  2008
##  8  2008
##  9  2008
## 10  2008
## 11  2008
## 12  2008
## 13  2008
## 14  2008
## 15  2008
## 16  2008
## 17  2008
## 18  2008
## 19  2008
## 20  2008
## 21  2008
## 22  2008
## 23  2008
## 24  2008
## 25  2008
## 26  2008
## 27  2008
## 28  2008
## 29  2008
## 30  2008
## # ... with 87 more rows
```

```
filter(dados, between(cty,15, 22))
```

```
## # A tibble: 143 x 15
##    manufac~1 model displ  year   cyl trans drv     cty   hwy fl    class sqrt_~2
##    <fct>     <fct> <dbl> <int> <int> <fct> <fct> <int> <int> <fct> <fct>   <dbl>
##  1 audi      a4      1.8  1999     4 auto~ f        18    29 p     comp~    4.24
##  2 audi      a4      1.8  1999     4 manu~ f        21    29 p     comp~    4.58
##  3 audi      a4      2    2008     4 manu~ f        20    31 p     comp~    4.47
##  4 audi      a4      2    2008     4 auto~ f        21    30 p     comp~    4.58
##  5 audi      a4      2.8  1999     6 auto~ f        16    26 p     comp~    4
##  6 audi      a4      2.8  1999     6 manu~ f        18    26 p     comp~    4.24
##  7 audi      a4      3.1  2008     6 auto~ f        18    27 p     comp~    4.24
##  8 audi      a4 q~   1.8  1999     4 manu~ 4        18    26 p     comp~    4.24
##  9 audi      a4 q~   1.8  1999     4 auto~ 4        16    25 p     comp~    4
## 10 audi      a4 q~   2    2008     4 manu~ 4        20    28 p     comp~    4.47
## # ... with 133 more rows, 3 more variables: `soma de variáveis` <dbl>,
## #   car <chr>, `cyl / trans` <chr>, and abbreviated variable names
```

```
## #   1: manufacturer, 2: sqrt_cty
```

2.10 slice() para linhas

```
slice(dados, 1:5)
```

```
## # A tibble: 5 x 15
##   manufact~1 model displ  year   cyl trans drv     cty   hwy fl    class sqrt_~2
##   <fct>      <fct> <dbl> <int> <int> <fct> <fct> <int> <int> <fct> <fct>   <dbl>
## 1 audi       a4      1.8  1999     4 auto~ f        18    29 p     comp~    4.24
## 2 audi       a4      1.8  1999     4 manu~ f        21    29 p     comp~    4.58
## 3 audi       a4      2    2008     4 manu~ f        20    31 p     comp~    4.47
## 4 audi       a4      2    2008     4 auto~ f        21    30 p     comp~    4.58
## 5 audi       a4      2.8  1999     6 auto~ f        16    26 p     comp~    4
## # ... with 3 more variables: `soma de variáveis` <dbl>, car <chr>,
## #   `cyl / trans` <chr>, and abbreviated variable names 1: manufacturer,
## #   2: sqrt_cty
```

```
# dados[1:5,]

slice(dados, 20:30)
```

```
## # A tibble: 11 x 15
##    manufac~1 model displ  year   cyl trans drv     cty   hwy fl    class sqrt_~2
##    <fct>     <fct> <dbl> <int> <int> <fct> <fct> <int> <int> <fct> <fct>   <dbl>
##  1 chevrolet c150~   5.3  2008     8 auto~ r        11    15 e     suv      3.32
##  2 chevrolet c150~   5.3  2008     8 auto~ r        14    20 r     suv      3.74
##  3 chevrolet c150~   5.7  1999     8 auto~ r        13    17 r     suv      3.61
##  4 chevrolet c150~   6    2008     8 auto~ r        12    17 r     suv      3.46
##  5 chevrolet corv~   5.7  1999     8 manu~ r        16    26 p     2sea~    4
##  6 chevrolet corv~   5.7  1999     8 auto~ r        15    23 p     2sea~    3.87
##  7 chevrolet corv~   6.2  2008     8 manu~ r        16    26 p     2sea~    4
##  8 chevrolet corv~   6.2  2008     8 auto~ r        15    25 p     2sea~    3.87
##  9 chevrolet corv~   7    2008     8 manu~ r        15    24 p     2sea~    3.87
## 10 chevrolet k150~   5.3  2008     8 auto~ 4        14    19 r     suv      3.74
## 11 chevrolet k150~   5.3  2008     8 auto~ 4        11    14 e     suv      3.32
## # ... with 3 more variables: `soma de variáveis` <dbl>, car <chr>,
## #   `cyl / trans` <chr>, and abbreviated variable names 1: manufacturer,
## #   2: sqrt_cty
```

```
# dados[20:30,]
```

2.11 arrange() para linhas

```
# ordenar "displ" de menor a maior
arrange(dados, displ)
```

```
## # A tibble: 234 x 15
##    manufac~1 model displ  year   cyl trans drv     cty   hwy fl    class sqrt_~2
##    <fct>     <fct> <dbl> <int> <int> <fct> <fct> <int> <int> <fct> <fct>   <dbl>
##  1 honda     civic   1.6  1999     4 manu~ f        28    33 r     subc~    5.29
##  2 honda     civic   1.6  1999     4 auto~ f        24    32 r     subc~    4.90
##  3 honda     civic   1.6  1999     4 manu~ f        25    32 r     subc~    5
##  4 honda     civic   1.6  1999     4 manu~ f        23    29 p     subc~    4.80
##  5 honda     civic   1.6  1999     4 auto~ f        24    32 r     subc~    4.90
##  6 audi      a4      1.8  1999     4 auto~ f        18    29 p     comp~    4.24
##  7 audi      a4      1.8  1999     4 manu~ f        21    29 p     comp~    4.58
##  8 audi      a4 q~   1.8  1999     4 manu~ 4        18    26 p     comp~    4.24
##  9 audi      a4 q~   1.8  1999     4 auto~ 4        16    25 p     comp~    4
## 10 honda     civic   1.8  2008     4 manu~ f        26    34 r     subc~    5.10
## # ... with 224 more rows, 3 more variables: `soma de variáveis` <dbl>,
## #   car <chr>, `cyl / trans` <chr>, and abbreviated variable names
## #   1: manufacturer, 2: sqrt_cty
```

```
arrange(dados, displ) %>%
  print(n=20)
```

```
## # A tibble: 234 x 15
##    manufac~1 model displ  year   cyl trans drv     cty   hwy fl    class sqrt_~2
##    <fct>     <fct> <dbl> <int> <int> <fct> <fct> <int> <int> <fct> <fct>   <dbl>
##  1 honda     civic   1.6  1999     4 manu~ f        28    33 r     subc~    5.29
##  2 honda     civic   1.6  1999     4 auto~ f        24    32 r     subc~    4.90
##  3 honda     civic   1.6  1999     4 manu~ f        25    32 r     subc~    5
##  4 honda     civic   1.6  1999     4 manu~ f        23    29 p     subc~    4.80
##  5 honda     civic   1.6  1999     4 auto~ f        24    32 r     subc~    4.90
##  6 audi      a4      1.8  1999     4 auto~ f        18    29 p     comp~    4.24
##  7 audi      a4      1.8  1999     4 manu~ f        21    29 p     comp~    4.58
##  8 audi      a4 q~   1.8  1999     4 manu~ 4        18    26 p     comp~    4.24
##  9 audi      a4 q~   1.8  1999     4 auto~ 4        16    25 p     comp~    4
## 10 honda     civic   1.8  2008     4 manu~ f        26    34 r     subc~    5.10
## 11 honda     civic   1.8  2008     4 auto~ f        25    36 r     subc~    5
## 12 honda     civic   1.8  2008     4 auto~ f        24    36 c     subc~    4.90
## 13 toyota    coro~   1.8  1999     4 auto~ f        24    30 r     comp~    4.90
## 14 toyota    coro~   1.8  1999     4 auto~ f        24    33 r     comp~    4.90
## 15 toyota    coro~   1.8  1999     4 manu~ f        26    35 r     comp~    5.10
## 16 toyota    coro~   1.8  2008     4 manu~ f        28    37 r     comp~    5.29
## 17 toyota    coro~   1.8  2008     4 auto~ f        26    35 r     comp~    5.10
## 18 volkswag~ pass~   1.8  1999     4 manu~ f        21    29 p     mids~    4.58
```

```
## 19 volkswag~ pass~   1.8  1999     4 auto~ f        18    29 p     mids~    4.24
## 20 volkswag~ jetta   1.9  1999     4 manu~ f        33    44 d     comp~    5.74
## # ... with 214 more rows, 3 more variables: `soma de variáveis` <dbl>,
## #   car <chr>, `cyl / trans` <chr>, and abbreviated variable names
## #   1: manufacturer, 2: sqrt_cty
```

```
# ordenar "displ" de maior a  menor
arrange(dados, desc(displ))
```

```
## # A tibble: 234 x 15
##    manufac~1 model displ  year   cyl trans drv     cty   hwy fl    class sqrt_~2
##    <fct>     <fct> <dbl> <int> <int> <fct> <fct> <int> <int> <fct> <fct>   <dbl>
##  1 chevrolet corv~   7    2008     8 manu~ r        15    24 p     2sea~    3.87
##  2 chevrolet k150~   6.5  1999     8 auto~ 4        14    17 d     suv      3.74
##  3 chevrolet corv~   6.2  2008     8 manu~ r        16    26 p     2sea~    4
##  4 chevrolet corv~   6.2  2008     8 auto~ r        15    25 p     2sea~    3.87
##  5 jeep      gran~   6.1  2008     8 auto~ 4        11    14 p     suv      3.32
##  6 chevrolet c150~   6    2008     8 auto~ r        12    17 r     suv      3.46
##  7 dodge     dura~   5.9  1999     8 auto~ 4        11    15 r     suv      3.32
##  8 dodge     ram ~   5.9  1999     8 auto~ 4        11    15 r     pick~    3.32
##  9 chevrolet c150~   5.7  1999     8 auto~ r        13    17 r     suv      3.61
## 10 chevrolet corv~   5.7  1999     8 manu~ r        16    26 p     2sea~    4
## # ... with 224 more rows, 3 more variables: `soma de variáveis` <dbl>,
## #   car <chr>, `cyl / trans` <chr>, and abbreviated variable names
## #   1: manufacturer, 2: sqrt_cty
```

```
arrange(dados, desc(displ)) %>%
  print(n=20)
```

```
## # A tibble: 234 x 15
##    manufac~1 model displ  year   cyl trans drv     cty   hwy fl    class sqrt_~2
##    <fct>     <fct> <dbl> <int> <int> <fct> <fct> <int> <int> <fct> <fct>   <dbl>
##  1 chevrolet corv~   7    2008     8 manu~ r        15    24 p     2sea~    3.87
##  2 chevrolet k150~   6.5  1999     8 auto~ 4        14    17 d     suv      3.74
##  3 chevrolet corv~   6.2  2008     8 manu~ r        16    26 p     2sea~    4
##  4 chevrolet corv~   6.2  2008     8 auto~ r        15    25 p     2sea~    3.87
##  5 jeep      gran~   6.1  2008     8 auto~ 4        11    14 p     suv      3.32
##  6 chevrolet c150~   6    2008     8 auto~ r        12    17 r     suv      3.46
##  7 dodge     dura~   5.9  1999     8 auto~ 4        11    15 r     suv      3.32
##  8 dodge     ram ~   5.9  1999     8 auto~ 4        11    15 r     pick~    3.32
##  9 chevrolet c150~   5.7  1999     8 auto~ r        13    17 r     suv      3.61
## 10 chevrolet corv~   5.7  1999     8 manu~ r        16    26 p     2sea~    4
## 11 chevrolet corv~   5.7  1999     8 auto~ r        15    23 p     2sea~    3.87
## 12 chevrolet k150~   5.7  1999     8 auto~ 4        11    15 r     suv      3.32
## 13 dodge     dura~   5.7  2008     8 auto~ 4        13    18 r     suv      3.61
## 14 dodge     ram ~   5.7  2008     8 auto~ 4        13    17 r     pick~    3.61
## 15 jeep      gran~   5.7  2008     8 auto~ 4        13    18 r     suv      3.61
```

```
## 16 toyota    land~   5.7  2008     8 auto~ 4        13    18 r     suv      3.61
## 17 nissan    path~   5.6  2008     8 auto~ 4        12    18 p     suv      3.46
## 18 ford      expe~   5.4  1999     8 auto~ r        11    17 r     suv      3.32
## 19 ford      expe~   5.4  2008     8 auto~ r        12    18 r     suv      3.46
## 20 ford      f150~   5.4  1999     8 auto~ 4        11    15 r     pick~    3.32
## # ... with 214 more rows, 3 more variables: `soma de variáveis` <dbl>,
## #   car <chr>, `cyl / trans` <chr>, and abbreviated variable names
## #   1: manufacturer, 2: sqrt_cty
```

```
select(dados, displ, cty) %>%
  arrange(displ, cty) %>%
  print(n = 20)
```

```
## # A tibble: 234 x 2
##    displ   cty
##    <dbl> <int>
##  1   1.6    23
##  2   1.6    24
##  3   1.6    24
##  4   1.6    25
##  5   1.6    28
##  6   1.8    16
##  7   1.8    18
##  8   1.8    18
##  9   1.8    18
## 10   1.8    21
## 11   1.8    21
## 12   1.8    24
## 13   1.8    24
## 14   1.8    24
## 15   1.8    25
## 16   1.8    26
## 17   1.8    26
## 18   1.8    26
## 19   1.8    28
## 20   1.9    29
## # ... with 214 more rows
```

```
select(dados, displ, cty) %>%
  arrange(displ, desc(cty)) %>%
  print(n = 20)
```

```
## # A tibble: 234 x 2
##    displ   cty
##    <dbl> <int>
##  1   1.6    28
##  2   1.6    25
```

```
##  3   1.6    24
##  4   1.6    24
##  5   1.6    23
##  6   1.8    28
##  7   1.8    26
##  8   1.8    26
##  9   1.8    26
## 10   1.8    25
## 11   1.8    24
## 12   1.8    24
## 13   1.8    24
## 14   1.8    21
## 15   1.8    21
## 16   1.8    18
## 17   1.8    18
## 18   1.8    18
## 19   1.8    16
## 20   1.9    35
## # ... with 214 more rows
```

2.12 distinct() para linhas

```
dados_exemplo <- data.frame(id = 1:3,
                            name = c("John", "Max", "Julia"))
dados_exemplo
```

```
##   id  name
## 1  1  John
## 2  2   Max
## 3  3 Julia
```

```
# bind_rows == rbind()
dados_exemplo<- bind_rows(dados_exemplo, slice(dados_exemplo, 2))
dados_exemplo
```

```
##   id  name
## 1  1  John
## 2  2   Max
## 3  3 Julia
## 4  2   Max
```

```
distinct(dados_exemplo)
```

```
##   id  name
## 1  1  John
## 2  2   Max
```

```
## 3  3 Julia
```

```
dados_exemplo2 <- data.frame(id = c(1,1,2),
                             name = c("John", "Max", "Julia"))
dados_exemplo2
```

```
##   id  name
## 1  1  John
## 2  1   Max
## 3  2 Julia
```

```
distinct(dados_exemplo2)
```

```
##   id  name
## 1  1  John
## 2  1   Max
## 3  2 Julia
```

```
dados_duplicados <- select(dados, manufacturer, model)
dados_duplicados
```

```
## # A tibble: 234 x 2
##    manufacturer model
##    <fct>        <fct>
##  1 audi         a4
##  2 audi         a4
##  3 audi         a4
##  4 audi         a4
##  5 audi         a4
##  6 audi         a4
##  7 audi         a4
##  8 audi         a4 quattro
##  9 audi         a4 quattro
## 10 audi         a4 quattro
## # ... with 224 more rows
```

```
dados_nao_duplicados <- distinct(dados_duplicados)
dados_nao_duplicados
```

```
## # A tibble: 38 x 2
##    manufacturer model
##    <fct>        <fct>
##  1 audi         a4
##  2 audi         a4 quattro
##  3 audi         a6 quattro
##  4 chevrolet    c1500 suburban 2wd
##  5 chevrolet    corvette
##  6 chevrolet    k1500 tahoe 4wd
```

```
##  7 chevrolet    malibu
##  8 dodge        caravan 2wd
##  9 dodge        dakota pickup 4wd
## 10 dodge        durango 4wd
## # ... with 28 more rows
```

2.13 summarise()

```
summarise(dados, `média hwy` = mean(hwy))
```

```
## # A tibble: 1 x 1
##   `média hwy`
##         <dbl>
## 1        23.4
```

```
summarise(dados,
          `num. de dados` = n(),
          `num. modelos` = n_distinct(model))
```

```
## # A tibble: 1 x 2
##   `num. de dados` `num. modelos`
##             <int>          <int>
## 1             234             38
```

```
# levels(dados$model)
summarise(dados,
          `mín. hwy` = min(hwy, na.rm = TRUE),
          `mín. cty` = min(cty, na.rm = TRUE),
          `máx. hwy` = max(hwy, na.rm = TRUE),
          `máx. cty` = max(cty, na.rm = TRUE))
```

```
## # A tibble: 1 x 4
##   `mín. hwy` `mín. cty` `máx. hwy` `máx. cty`
##        <int>      <int>      <int>      <int>
## 1         12          9         44         35
```

```
dados %>%
  summarise_at(c("hwy", "cty"), list(min, max), na.rm = TRUE)
```

```
## # A tibble: 1 x 4
##   hwy_fn1 cty_fn1 hwy_fn2 cty_fn2
##     <int>   <int>   <int>   <int>
## 1      12       9      44      35
```

```
dados %>%
  summarise_if(is.numeric, list(min, max), na.rm = TRUE)
```

```
## # A tibble: 1 x 14
```

```
##   displ_fn1 year_fn1 cyl_fn1 cty_fn1 hwy_fn1 sqrt_cty_~1 soma ~2 displ~3 year_~4
##       <dbl>    <int>   <int>   <int>   <int>       <dbl>   <dbl>   <dbl>   <int>
## 1       1.6     1999       4       9      12           3    10.5       7    2008
## # ... with 5 more variables: cyl_fn2 <int>, cty_fn2 <int>, hwy_fn2 <int>,
## #   sqrt_cty_fn2 <dbl>, `soma de variáveis_fn2` <dbl>, and abbreviated variable
## #   names 1: sqrt_cty_fn1, 2: `soma de variáveis_fn1`, 3: displ_fn2,
## #   4: year_fn2
```

```
dados %>%
  summarise_if(is.numeric, min, na.rm = TRUE)
```

```
## # A tibble: 1 x 7
##   displ  year   cyl   cty   hwy sqrt_cty `soma de variáveis`
##   <dbl> <int> <int> <int> <int>    <dbl>               <dbl>
## 1   1.6  1999     4     9    12        3                10.5
```

```
dados %>%
  summarise_if(is.numeric, max, na.rm = TRUE)
```

```
## # A tibble: 1 x 7
##   displ  year   cyl   cty   hwy sqrt_cty `soma de variáveis`
##   <dbl> <int> <int> <int> <int>    <dbl>               <dbl>
## 1     7  2008     8    35    44     5.92                39.5
```

```
Tiago<- function(dados){
  sd(dados)/mean(dados)
}

dados %>%
  summarise_if(is.numeric, Tiago)
```

```
## # A tibble: 1 x 7
##   displ    year   cyl   cty   hwy sqrt_cty `soma de variáveis`
##   <dbl>   <dbl> <dbl> <dbl> <dbl>    <dbl>               <dbl>
## 1 0.372 0.00225 0.274 0.252 0.254    0.125               0.251
```

2.14 group_by()

```
group_by(dados, manufacturer)
```

```
## # A tibble: 234 x 15
## # Groups:   manufacturer [15]
##    manufac~1 model displ  year   cyl trans drv     cty   hwy fl    class sqrt_~2
##    <fct>     <fct> <dbl> <int> <int> <fct> <fct> <int> <int> <fct> <fct>   <dbl>
##  1 audi      a4      1.8  1999     4 auto~ f        18    29 p     comp~    4.24
##  2 audi      a4      1.8  1999     4 manu~ f        21    29 p     comp~    4.58
##  3 audi      a4      2    2008     4 manu~ f        20    31 p     comp~    4.47
```

```
##  4 audi      a4      2    2008     4 auto~ f        21    30 p     comp~    4.58
##  5 audi      a4      2.8  1999     6 auto~ f        16    26 p     comp~    4
##  6 audi      a4      2.8  1999     6 manu~ f        18    26 p     comp~    4.24
##  7 audi      a4      3.1  2008     6 auto~ f        18    27 p     comp~    4.24
##  8 audi      a4 q~   1.8  1999     4 manu~ 4        18    26 p     comp~    4.24
##  9 audi      a4 q~   1.8  1999     4 auto~ 4        16    25 p     comp~    4
## 10 audi      a4 q~   2    2008     4 manu~ 4        20    28 p     comp~    4.47
## # ... with 224 more rows, 3 more variables: `soma de variáveis` <dbl>,
## #   car <chr>, `cyl / trans` <chr>, and abbreviated variable names
## #   1: manufacturer, 2: sqrt_cty
```

```
dados %>%
  group_by(manufacturer) %>%
  summarise(`num. carros` = n())
```

```
## # A tibble: 15 x 2
##    manufacturer `num. carros`
##    <fct>                <int>
##  1 audi                    18
##  2 chevrolet               19
##  3 dodge                   37
##  4 ford                    25
##  5 honda                    9
##  6 hyundai                 14
##  7 jeep                     8
##  8 land rover               4
##  9 lincoln                  3
## 10 mercury                  4
## 11 nissan                  13
## 12 pontiac                  5
## 13 subaru                  14
## 14 toyota                  34
## 15 volkswagen              27
```

```
dados %>%
  group_by(model) %>%
  summarise(`média hwy` = mean(hwy),
            `min. hwy` = min(hwy),
            `max. hwy` = max(hwy))
```

```
## # A tibble: 38 x 4
##    model              `média hwy` `min. hwy` `max. hwy`
##    <fct>                    <dbl>      <int>      <int>
##  1 4runner 4wd               18.8         17         20
##  2 a4                        28.3         26         31
##  3 a4 quattro                25.8         25         28
##  4 a6 quattro                24           23         25
```

```
##  5 altima                   28.7         26         32
##  6 c1500 suburban 2wd       17.8         15         20
##  7 camry                    28.3         26         31
##  8 camry solara             28.1         26         31
##  9 caravan 2wd              22.4         17         24
## 10 civic                    32.6         29         36
## # ... with 28 more rows
```

2.15 count()

```
count(dados)
```

```
## # A tibble: 1 x 1
##       n
##   <int>
## 1   234
```

```
dados %>%
  group_by(manufacturer) %>%
  count()
```

```
## # A tibble: 15 x 2
## # Groups:   manufacturer [15]
##    manufacturer     n
##    <fct>        <int>
##  1 audi            18
##  2 chevrolet       19
##  3 dodge           37
##  4 ford            25
##  5 honda            9
##  6 hyundai         14
##  7 jeep             8
##  8 land rover       4
##  9 lincoln          3
## 10 mercury          4
## 11 nissan          13
## 12 pontiac          5
## 13 subaru          14
## 14 toyota          34
## 15 volkswagen      27
```

```
# Equivalente com o código anterior
dados %>%
  group_by(manufacturer) %>%
  summarise(cars = n())
```

```
## # A tibble: 15 x 2
```

```
##    manufacturer  cars
##    <fct>        <int>
##  1 audi            18
##  2 chevrolet       19
##  3 dodge           37
##  4 ford            25
##  5 honda            9
##  6 hyundai         14
##  7 jeep             8
##  8 land rover       4
##  9 lincoln          3
## 10 mercury          4
## 11 nissan          13
## 12 pontiac          5
## 13 subaru          14
## 14 toyota          34
## 15 volkswagen      27
```

2.16 sample_n()

```
set.seed(567)
sample_n(dados, size = 10, replace = F)
```

```
## # A tibble: 10 x 15
##    manufac~1 model displ  year   cyl trans drv     cty   hwy fl    class sqrt_~2
##    <fct>     <fct> <dbl> <int> <int> <fct> <fct> <int> <int> <fct> <fct>   <dbl>
##  1 mercury   moun~   5    1999     8 auto~ 4        13    17 r     suv      3.61
##  2 chevrolet corv~   7    2008     8 manu~ r        15    24 p     2sea~    3.87
##  3 dodge     ram ~   4.7  2008     8 manu~ 4        12    16 r     pick~    3.46
##  4 toyota    land~   4.7  1999     8 auto~ 4        11    15 r     suv      3.32
##  5 volkswag~ jetta   2    1999     4 auto~ f        19    26 r     comp~    4.36
##  6 dodge     cara~   3.8  1999     6 auto~ f        15    21 r     mini~    3.87
##  7 honda     civic   1.8  2008     4 auto~ f        25    36 r     subc~    5
##  8 ford      must~   4.6  1999     8 auto~ r        15    21 r     subc~    3.87
##  9 chevrolet c150~   5.3  2008     8 auto~ r        14    20 r     suv      3.74
## 10 ford      expe~   5.4  1999     8 auto~ r        11    17 r     suv      3.32
## # ... with 3 more variables: `soma de variáveis` <dbl>, car <chr>,
## #   `cyl / trans` <chr>, and abbreviated variable names 1: manufacturer,
## #   2: sqrt_cty
```

```
sample_n(dados, size = 10, replace = T)
```

```
## # A tibble: 10 x 15
##    manufac~1 model displ  year   cyl trans drv     cty   hwy fl    class sqrt_~2
##    <fct>     <fct> <dbl> <int> <int> <fct> <fct> <int> <int> <fct> <fct>   <dbl>
```

```
##  1 chevrolet c150~   5.3  2008     8 auto~ r        11    15 e     suv      3.32
##  2 volkswag~ gti     2    2008     4 auto~ f        22    29 p     comp~    4.69
##  3 dodge     dako~   4.7  2008     8 auto~ 4        14    19 r     pick~    3.74
##  4 ford      expl~   4.6  2008     8 auto~ 4        13    19 r     suv      3.61
##  5 dodge     cara~   3.8  2008     6 auto~ f        16    23 r     mini~    4
##  6 chevrolet k150~   5.3  2008     8 auto~ 4        14    19 r     suv      3.74
##  7 dodge     dura~   5.2  1999     8 auto~ 4        11    16 r     suv      3.32
##  8 toyota    camry   2.4  2008     4 manu~ f        21    31 r     mids~    4.58
##  9 toyota    camry   3    1999     6 manu~ f        18    26 r     mids~    4.24
## 10 subaru    impr~   2.2  1999     4 auto~ 4        21    26 r     subc~    4.58
## # ... with 3 more variables: `soma de variáveis` <dbl>, car <chr>,
## #   `cyl / trans` <chr>, and abbreviated variable names 1: manufacturer,
## #   2: sqrt_cty
```

2.17 sample_frac()

```
sample_frac(dados, size = 0.1, replace = F)
```

```
## # A tibble: 23 x 15
##    manufac~1 model displ  year   cyl trans drv     cty   hwy fl    class sqrt_~2
##    <fct>     <fct> <dbl> <int> <int> <fct> <fct> <int> <int> <fct> <fct>   <dbl>
##  1 toyota    coro~   1.8  2008     4 manu~ f        28    37 r     comp~    5.29
##  2 lincoln   navi~   5.4  1999     8 auto~ r        11    17 r     suv      3.32
##  3 honda     civic   1.6  1999     4 auto~ f        24    32 r     subc~    4.90
##  4 audi      a6 q~   2.8  1999     6 auto~ 4        15    24 p     mids~    3.87
##  5 nissan    path~   4    2008     6 auto~ 4        14    20 p     suv      3.74
##  6 toyota    camry   3.5  2008     6 auto~ f        19    28 r     mids~    4.36
##  7 subaru    impr~   2.5  2008     4 auto~ 4        20    25 p     comp~    4.47
##  8 toyota    toyo~   3.4  1999     6 auto~ 4        15    19 r     pick~    3.87
##  9 audi      a4 q~   3.1  2008     6 manu~ 4        15    25 p     comp~    3.87
## 10 toyota    coro~   1.8  1999     4 manu~ f        26    35 r     comp~    5.10
## # ... with 13 more rows, 3 more variables: `soma de variáveis` <dbl>,
## #   car <chr>, `cyl / trans` <chr>, and abbreviated variable names
## #   1: manufacturer, 2: sqrt_cty
```

Chapter 3

ggplot2 (60 minutos)

3.1 Carrega pacotes a serem usados

```
#install.packages("tidyverse")
#install.packages("dplyr")
#install.packages("tidyr")
#install.packages("ggplot2")

library(tidyverse)
# Manipulação de dados
#library(dplyr)

# Visualização de gráficos
library(ggplot2)
library(gridExtra)
library(patchwork)
library(plotly)
library(esquisse)

# Para dados gráfico de perfis
library(nlme)
```

Alguns links

The R Graph Gallery

120 registered extensions available to explore

link 1: patchwork

link 2: patchwork

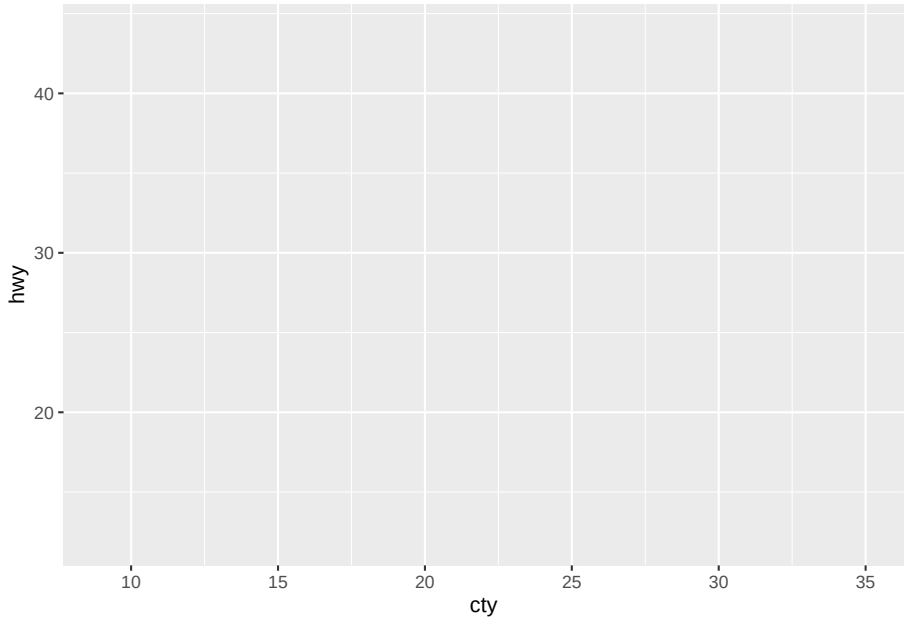
```
ls("package:ggplot2")
```

3.2 Lista de funções do pacote ggplot2

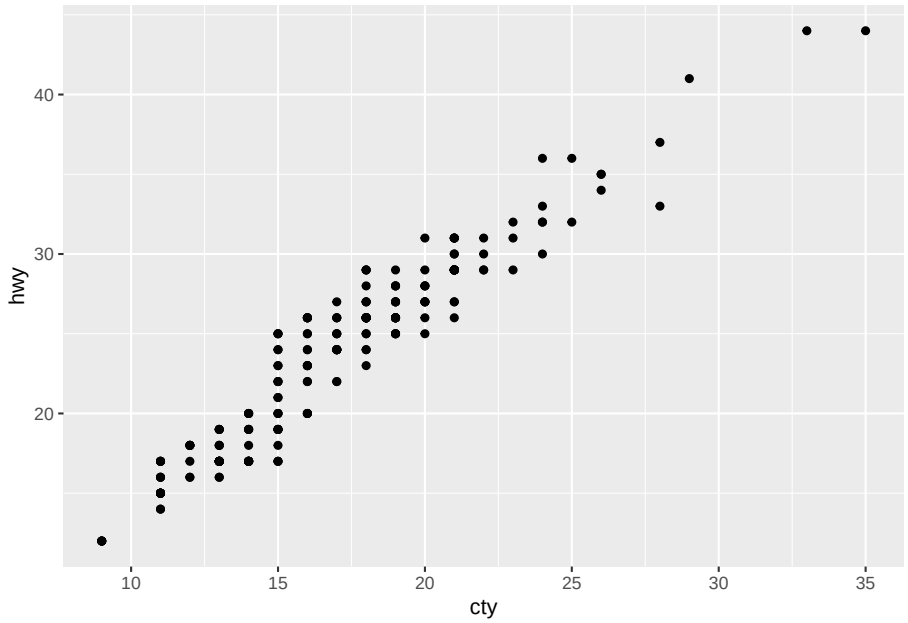
```
dados <- mpg
ggplot(dados)
```

3.3 Primeiros passos usando geom_point

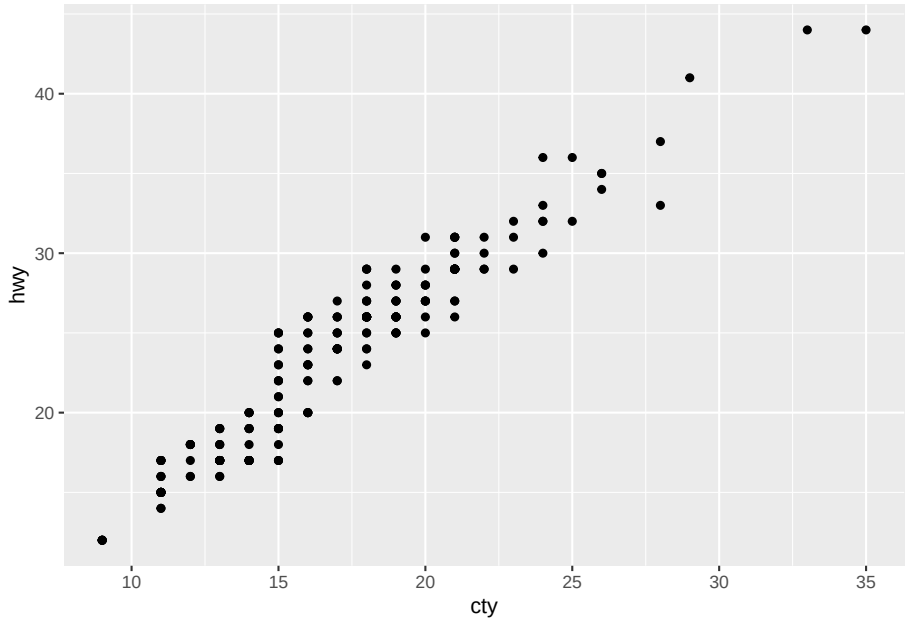

```
ggplot(dados, aes(x = cty, y = hwy))
```



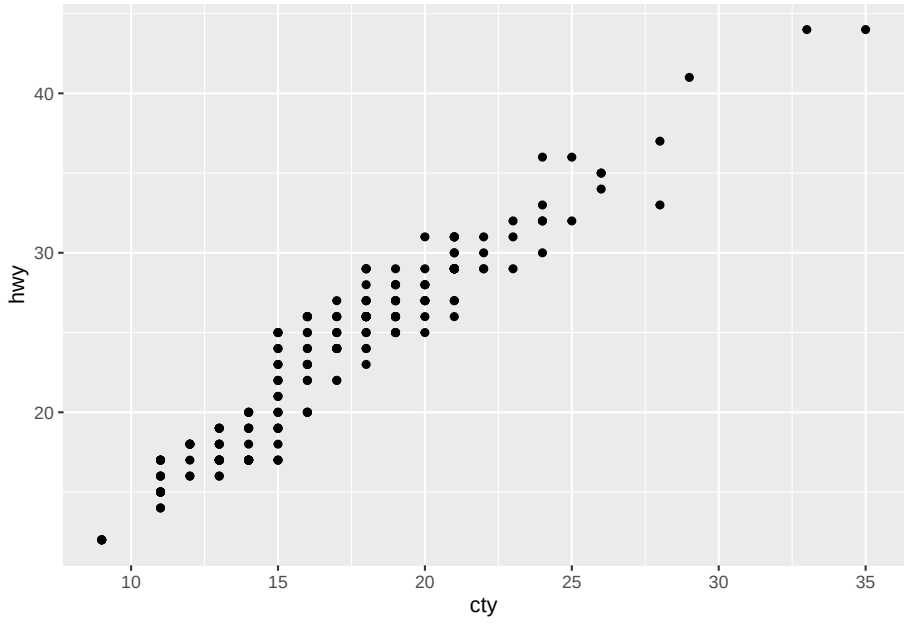

```
# Alternativas
ggplot(dados, aes(x = cty, y = hwy)) +
  geom_point()
```



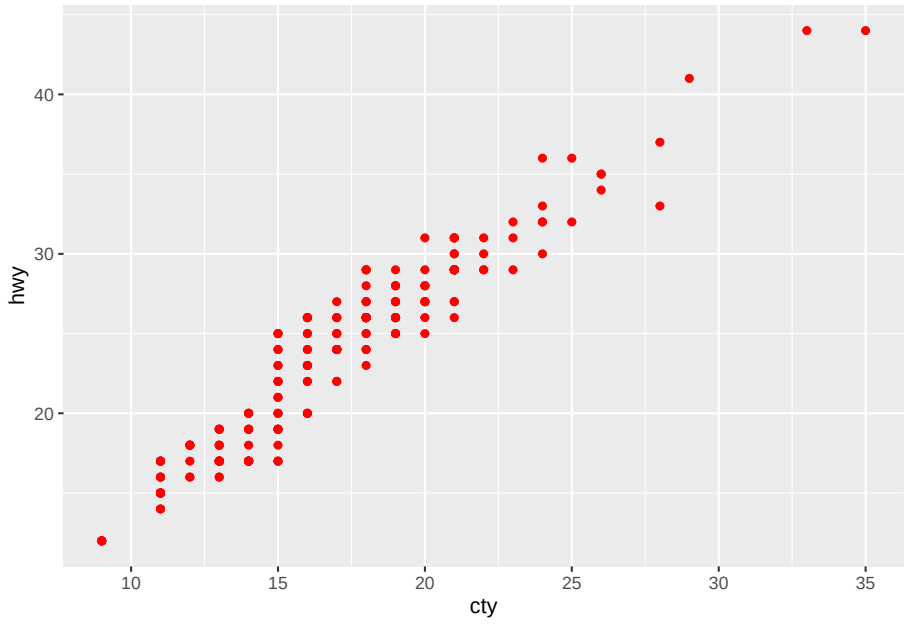
```
ggplot(dados) +
  geom_point(aes(x = cty, y = hwy))
```



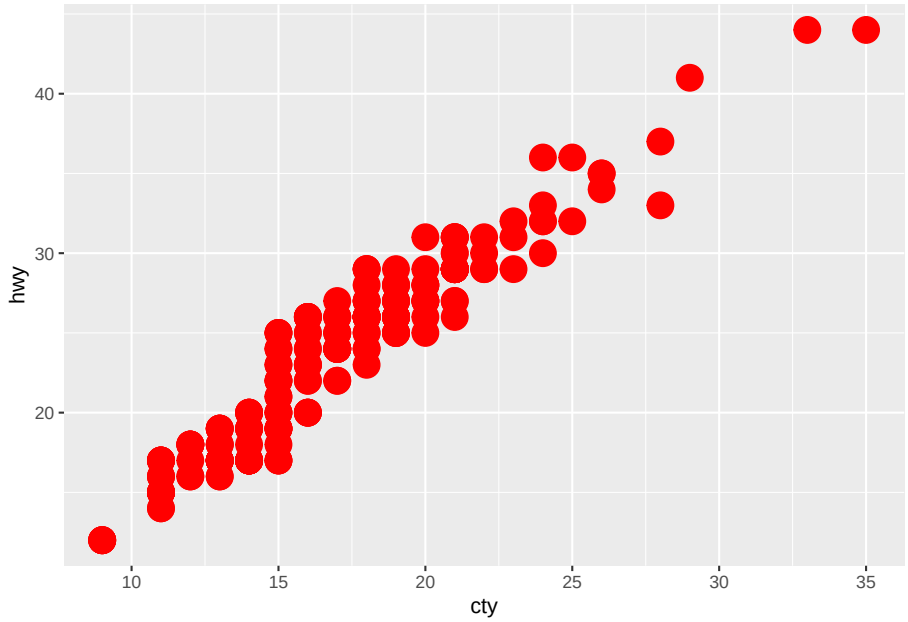

```
ggplot() +
  geom_point(data = dados, aes(x = cty, y = hwy))
```



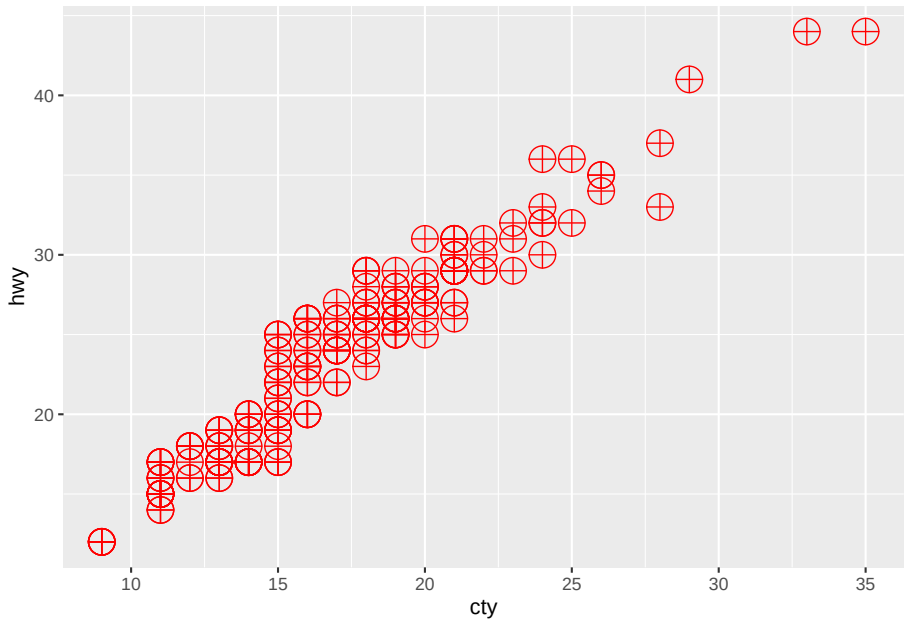

```
# Fim

ggplot(dados, aes(x = cty, y = hwy)) +
  geom_point(colour = "red")
```



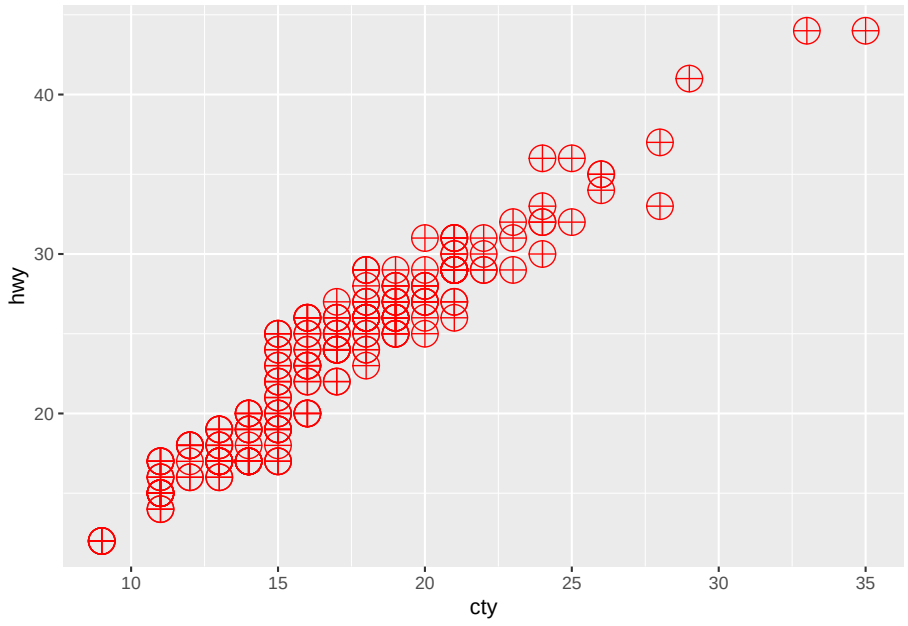
```
ggplot(dados, aes(x = cty, y = hwy)) +
  geom_point(colour = "red", size = 6)
```



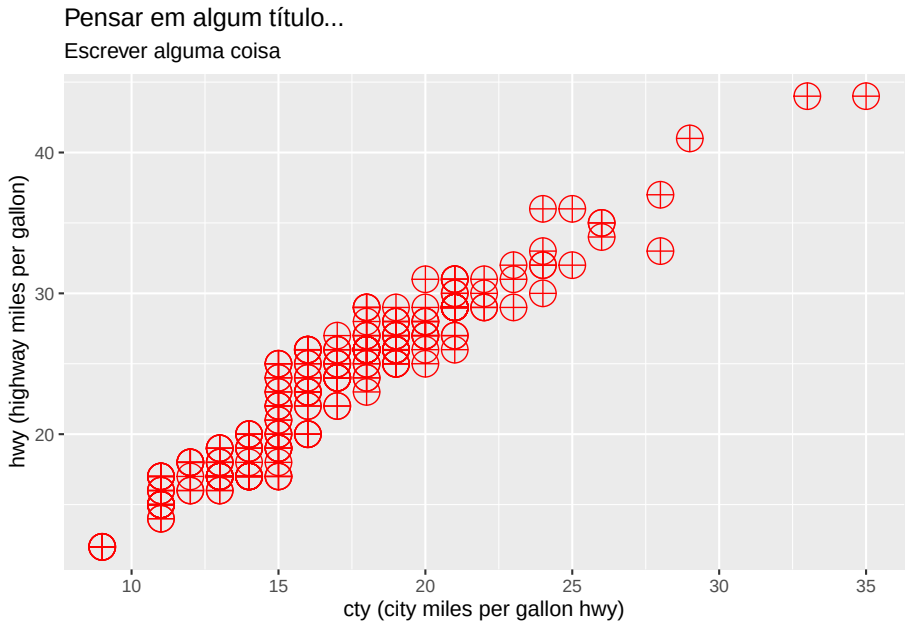

```
ggplot(dados, aes(x = cty, y = hwy)) +
  geom_point(colour = "red", size = 6, shape = 10)
```




```
# Alternativa
ggplot(dados, aes(x = cty, y = hwy)) +
  geom_point(colour = "red", size = 6, shape = "circle plus")
```



```
ggplot(dados, aes(x = cty, y = hwy)) +
  geom_point(colour = "red", size = 6, shape = 10)+
  labs(x = "cty (city miles per gallon hwy)",
       y = "hwy (highway miles per gallon)",
       title = "Pensar em algum título...",
       subtitle = "Escrever alguma coisa")
```

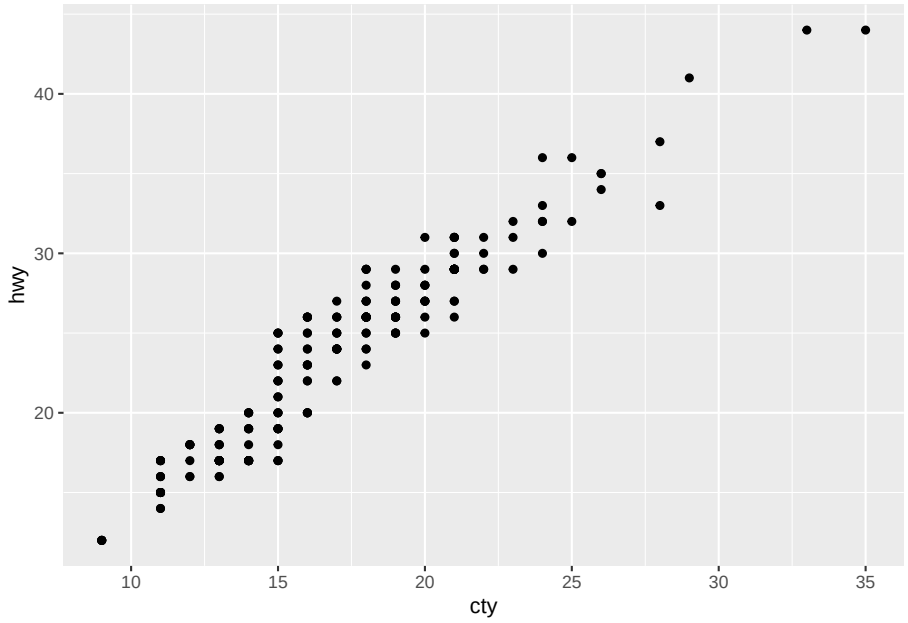


3.3.1 Mais detalhes sobre geom_point

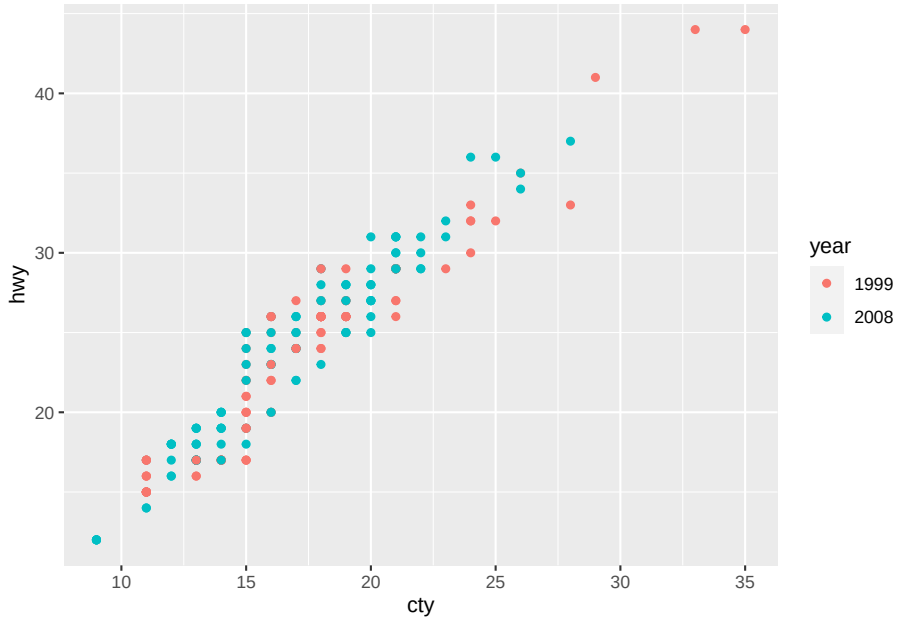
geom_point() understands the following aesthetics (required aesthetics are in bold):

- x
- y
- alpha
- colour
- fill
- group
- shape
- size
- stroke

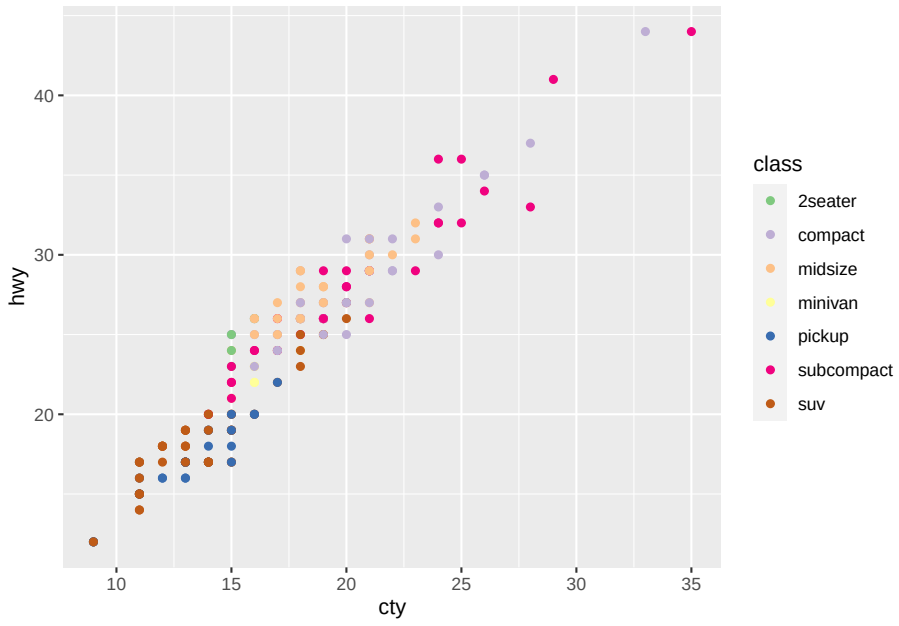
```
ggplot(dados, aes(x = cty, y = hwy)) +
  geom_point()
```



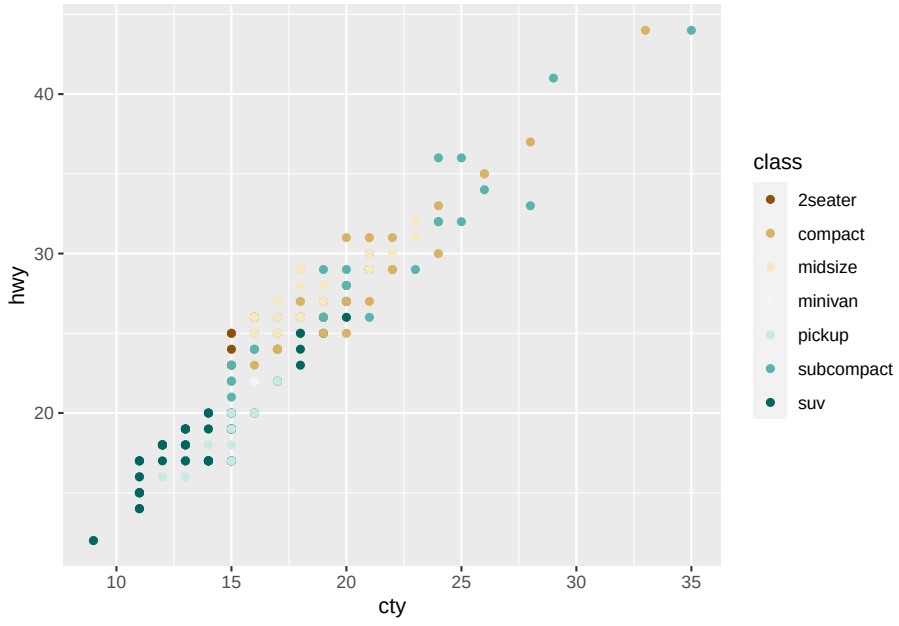

```
ggplot(dados, aes(x = cty, y = hwy, col = factor(year))) +
  geom_point() +
  labs(col = "year")
```



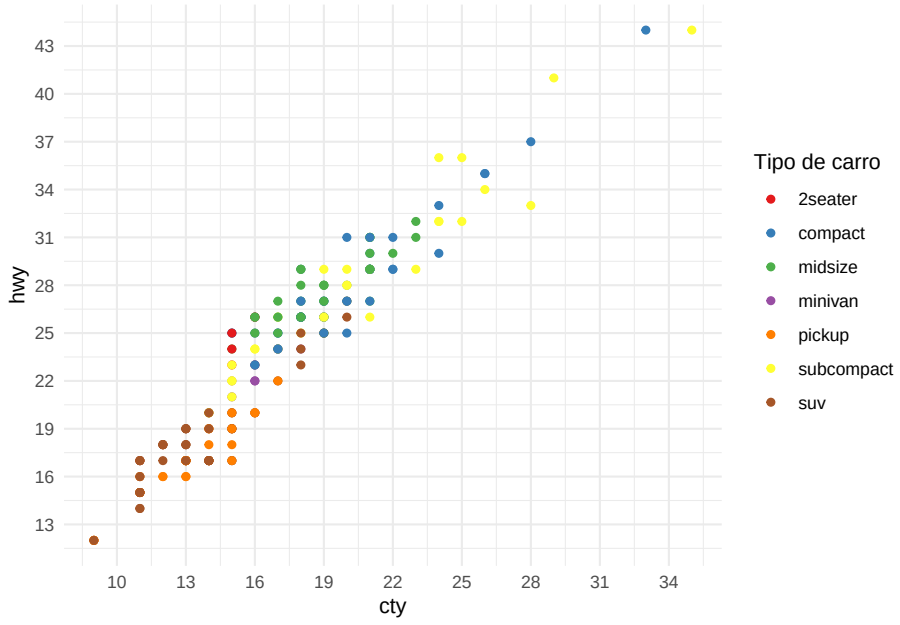

```
# Alternativa
ggplot(dados, aes(x = cty, y = hwy, col = factor(class))) +
  geom_point() +
  labs(col = "class")+
  scale_color_brewer(type = "qual")
```



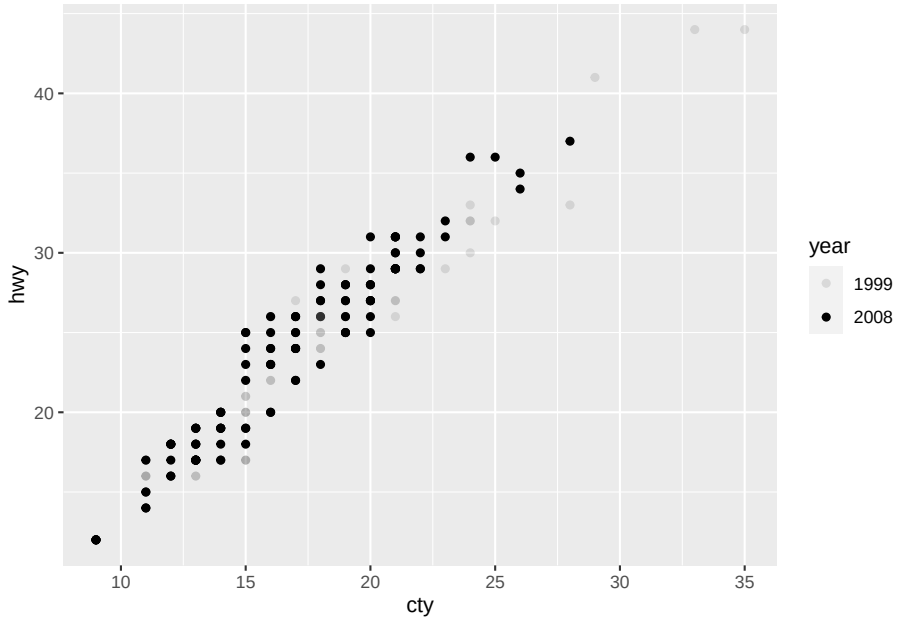

```
ggplot(dados, aes(x = cty, y = hwy, col = factor(class))) +
  geom_point() +
  labs(col = "class")+
  scale_color_brewer(type = "div")
```



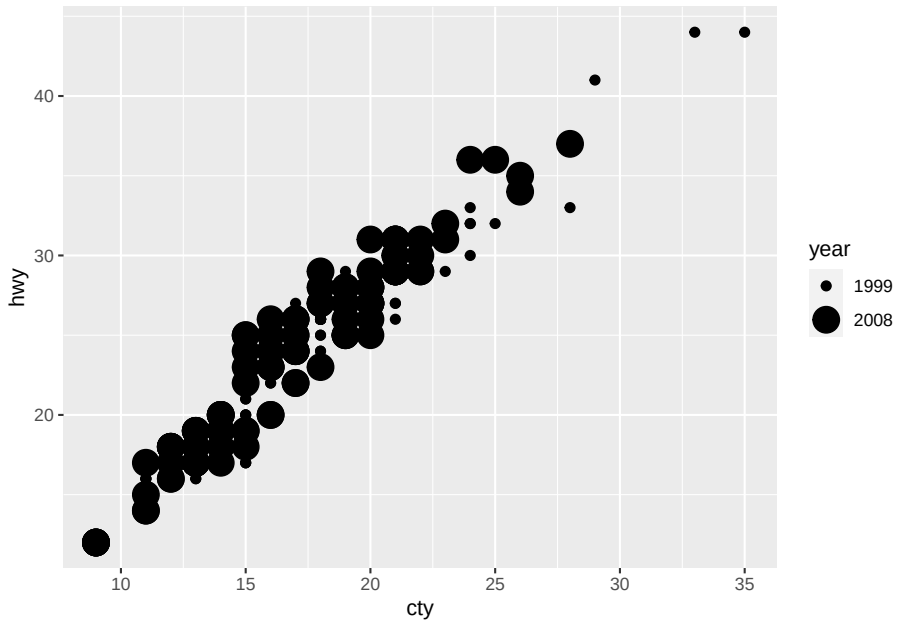
```
ggplot(dados, aes(x = cty, y = hwy, col = factor(class))) +
  geom_point() +
  labs(col = "class")+
  scale_color_brewer(palette = "Set1", name = "Tipo de carro")+
  scale_y_continuous(breaks = seq(10,60,3))+
  scale_x_continuous(breaks = seq(10,40,3))+
  theme_minimal()
```



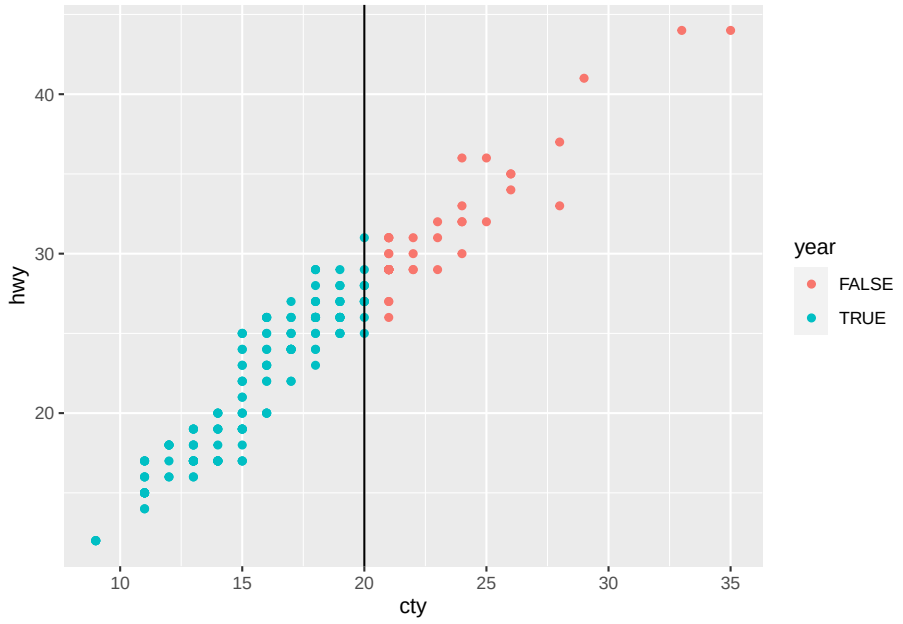

```
ggplot(dados, aes(x = cty, y = hwy, alpha = factor(year))) +
  geom_point() +
  labs(alpha = "year")
```



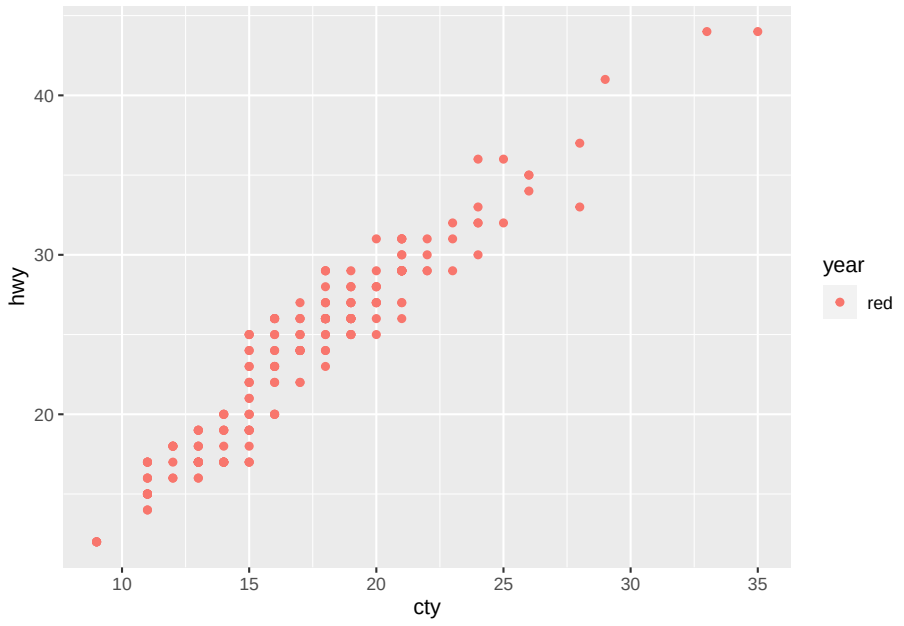

```
ggplot(dados, aes(x = cty, y = hwy, size = factor(year))) +
  geom_point() +
  labs(size = "year")
```



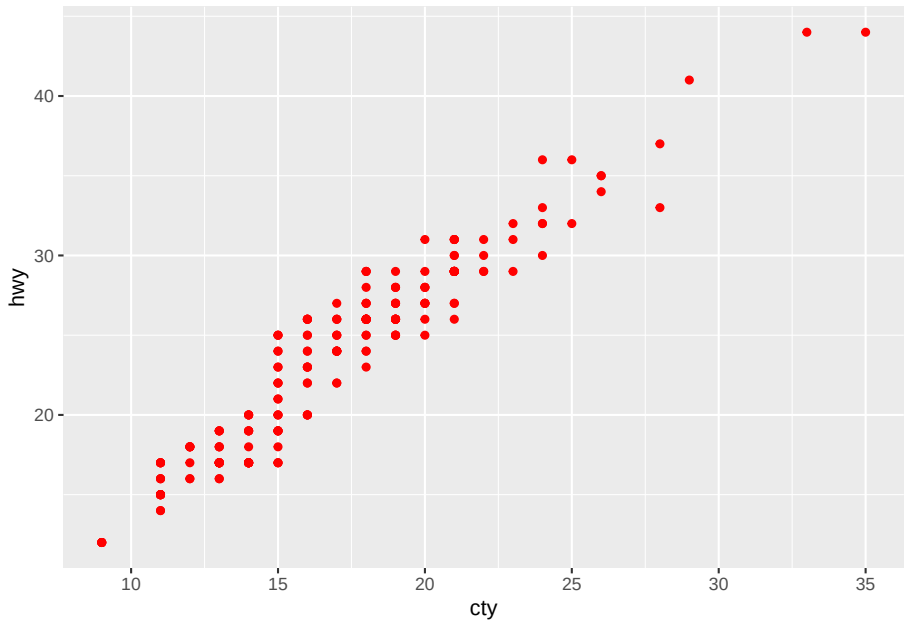
```
# Alternativa
ggplot(dados, aes(x = cty, y = hwy, col = cty <= 20)) +
  geom_point() +
  geom_vline(xintercept = 20)+
  labs(col = "year")
```



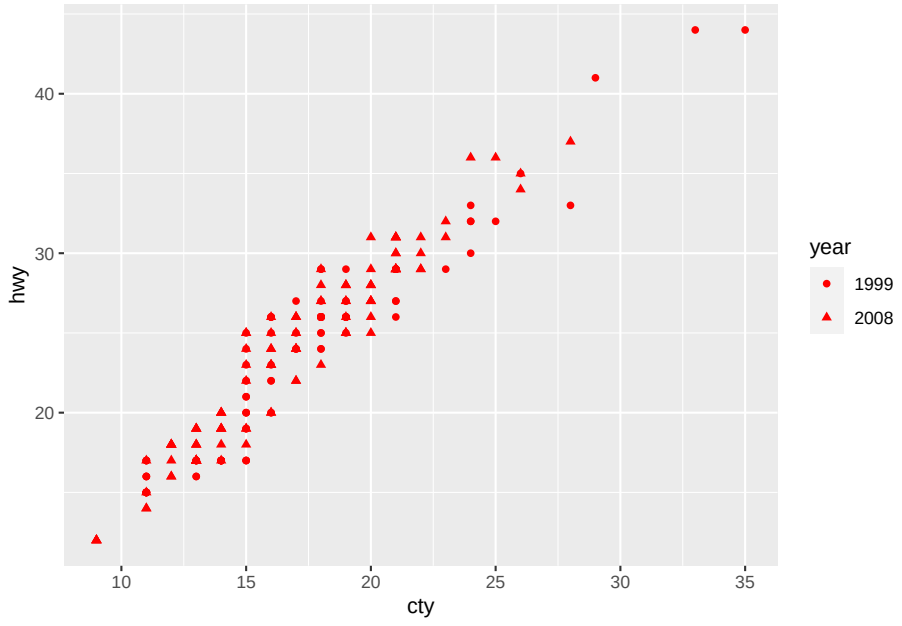

```
# Erro comum
ggplot(dados, aes(x = cty, y = hwy, col = "red")) +
  geom_point()+
  labs(col = "year")
```



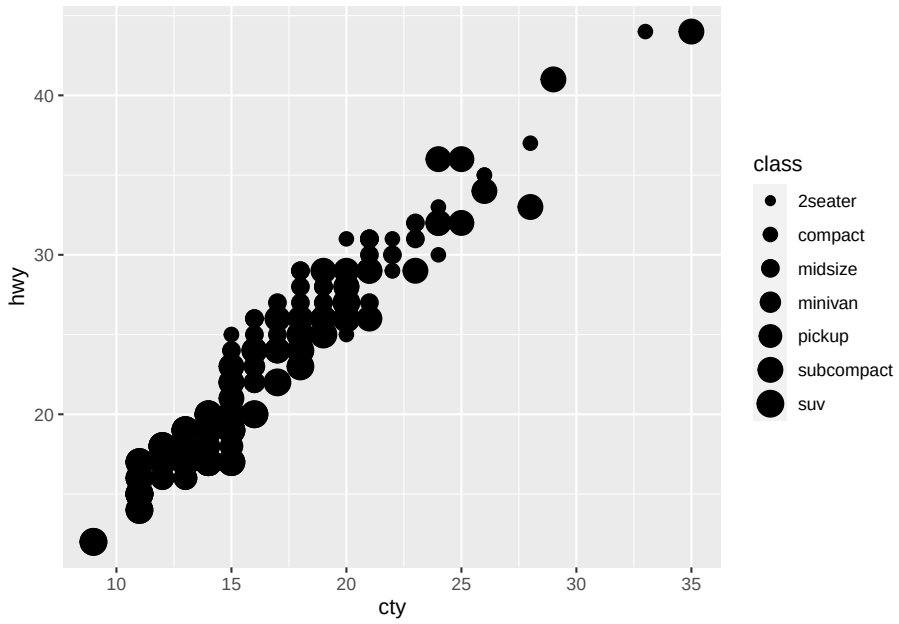

```
ggplot(dados, aes(x = cty, y = hwy)) +
  geom_point(col = "red")+
  labs(col = "year")
```



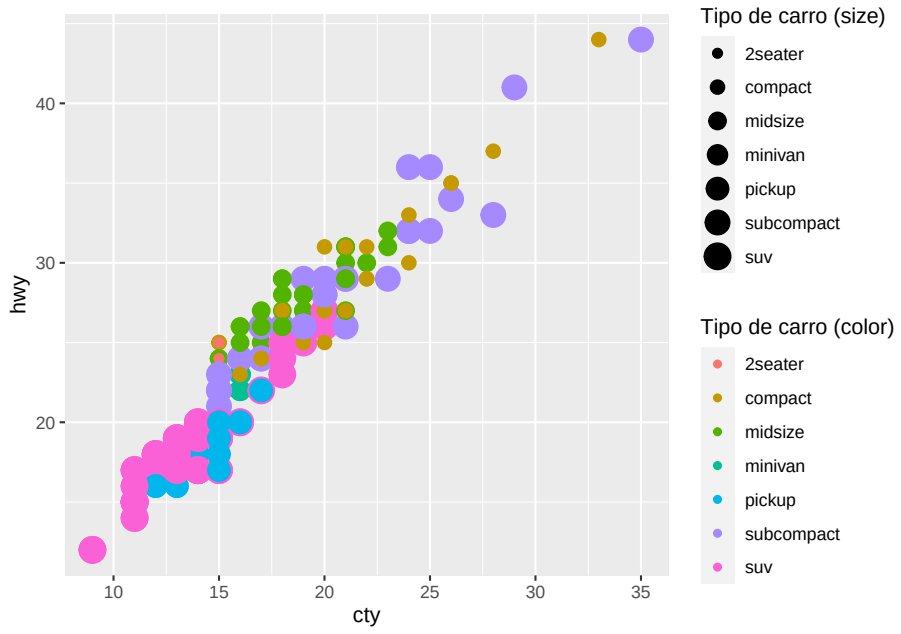
```
# Fim  Erro comum

ggplot(dados, aes(x = cty, y = hwy, shape = factor(year))) +
  geom_point(col = "red") +
  labs(shape = "year")
```



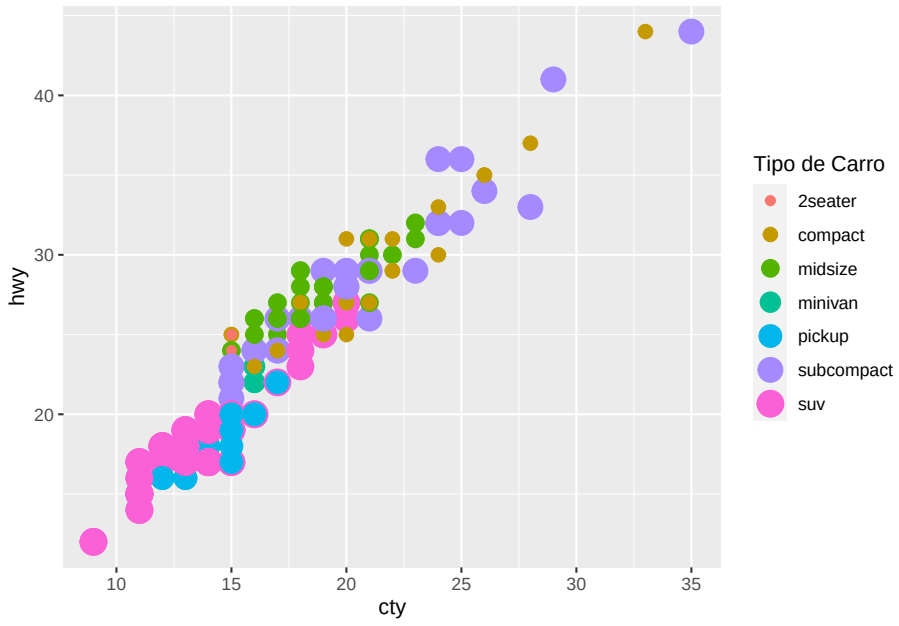

```
ggplot(dados, aes(x = cty, y = hwy, size = class)) +
  geom_point() +
  labs(size = "class")
```



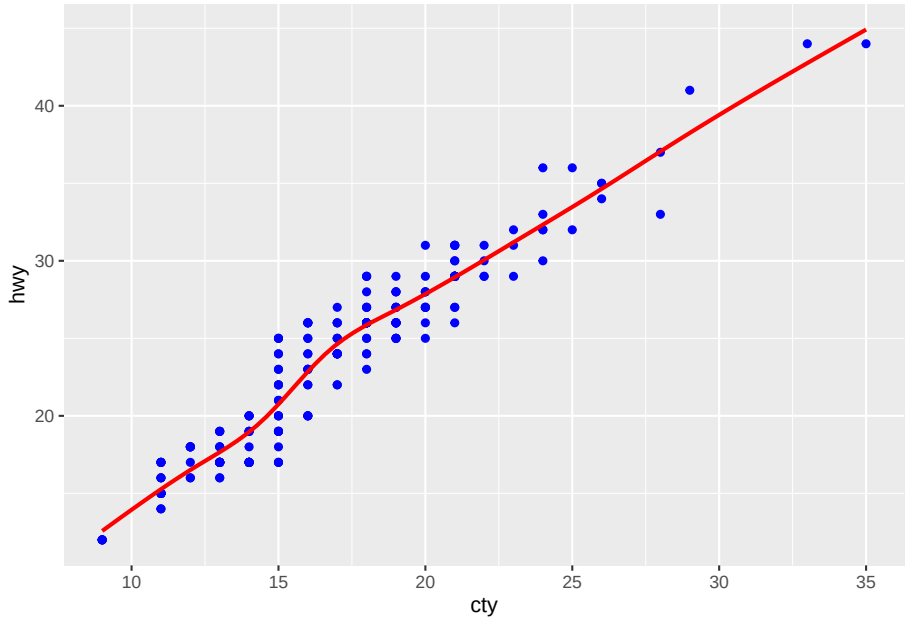

```
ggplot(dados, aes(x = cty, y = hwy,
                  size = class,
                  col = class)) +
  geom_point() +
  guides(colour = guide_legend("Tipo de carro (color)"),
         size = guide_legend("Tipo de carro (size)"))
```



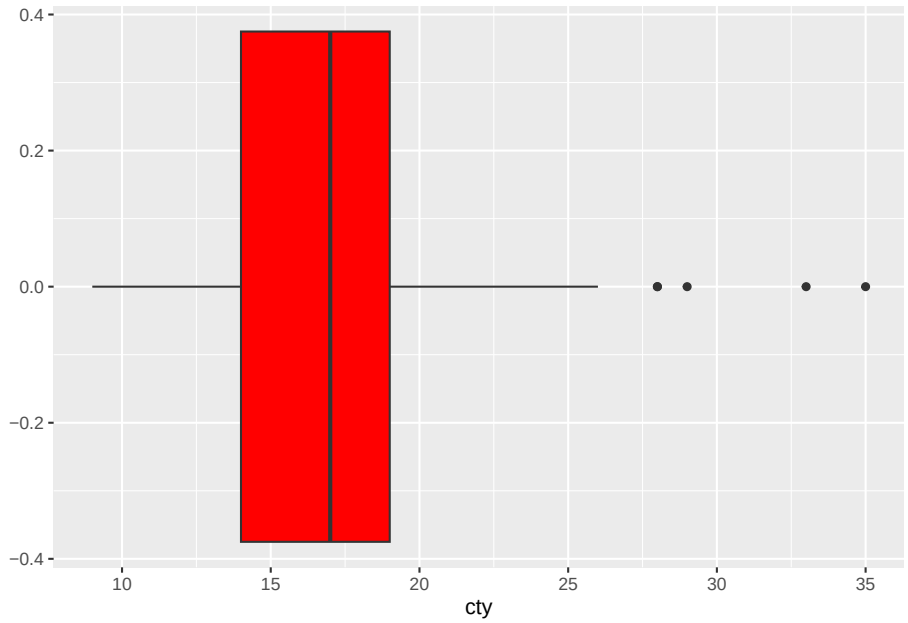

```
ggplot(dados, aes(x = cty, y = hwy,
                  size = class,
                  col = class)) +
  geom_point() +
  labs(col = "Tipo de Carro", size = "Tipo de Carro")+
  guides(col = "legend")
```



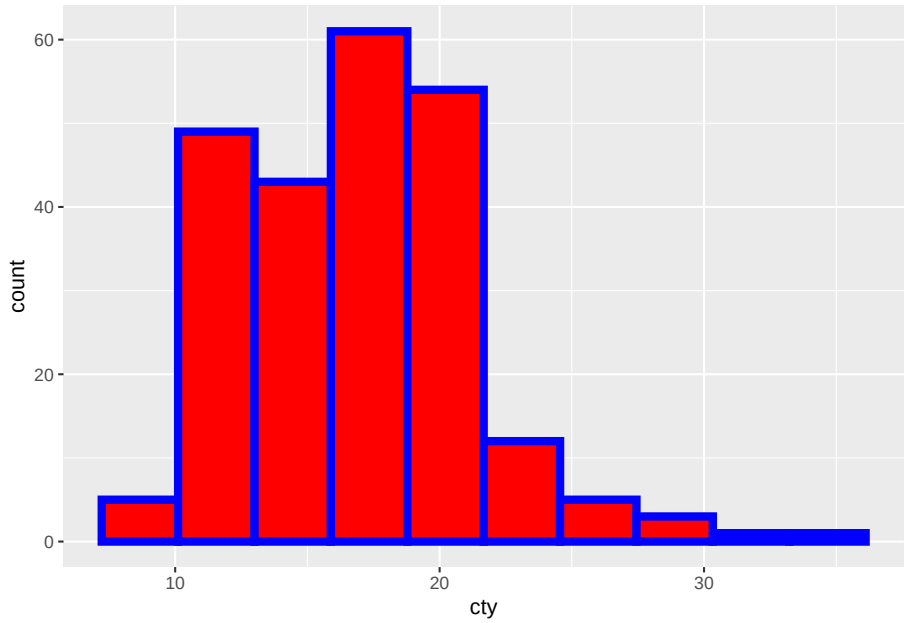

```
v1<- ggplot(dados, aes(x = cty, y = hwy)) +
  geom_point(col = "blue")+
  geom_smooth(method = mgcv::gam,
              formula = y ~ s(x, bs = "cs") ,
              col = "red",
              se = FALSE)
v1
```



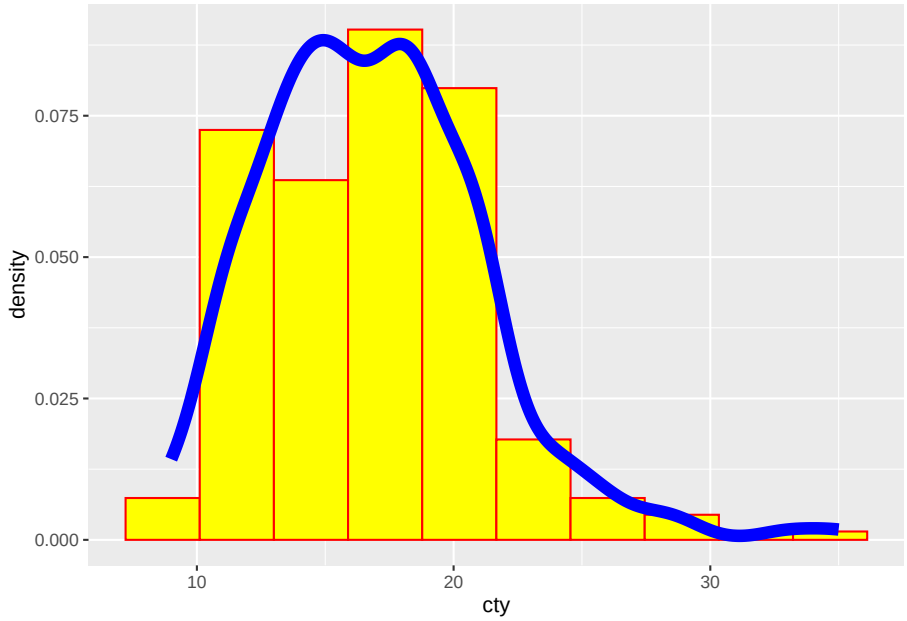

```
v2 <- ggplot(dados, aes(x = cty)) +
  geom_boxplot(fill = "red")
v2
```



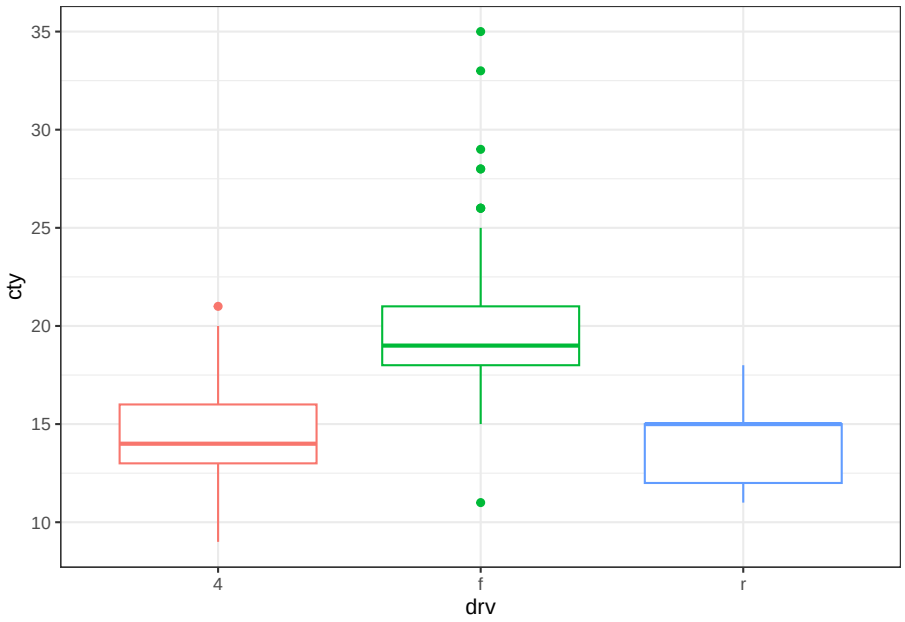
```
v3 <- ggplot(dados, aes(x = cty)) +
  geom_histogram(bins = 10, fill = "red", col = "blue", lwd=2)
v3
```




```
v4<- ggplot(dados, aes(x = cty)) +
  geom_histogram(aes(y = after_stat(density)),
                 bins = 10, fill = "yellow", col = "red") +
  geom_density(col = "blue", lwd =3)
v4
```




```
# Adicional (estatístic experimental)
ggplot(dados, aes(x = drv, y = cty, col = drv)) +
  geom_boxplot()+
  theme_bw()+
  theme(legend.position = "none")
```



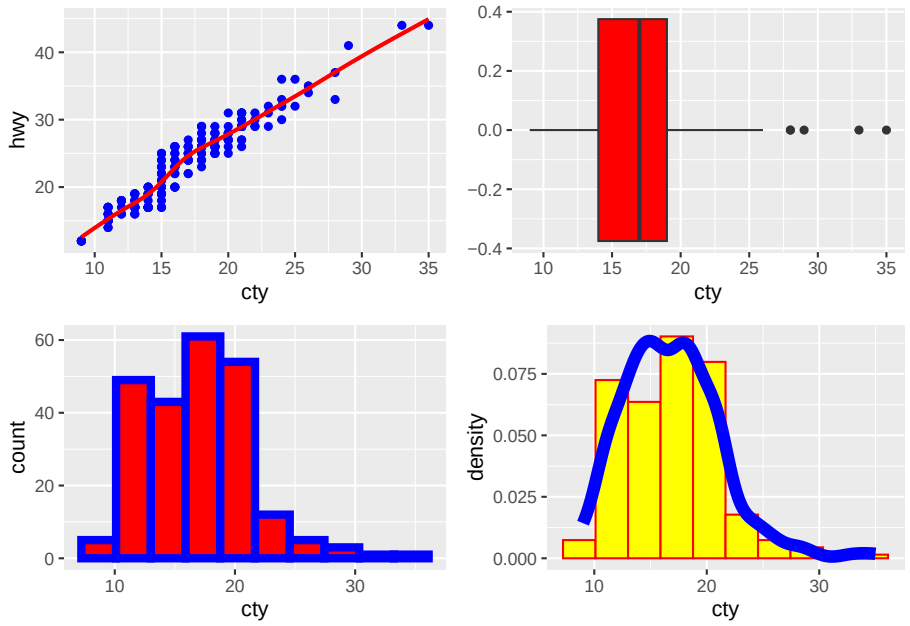
3.5 gridExtra e patchwork

Alguns links

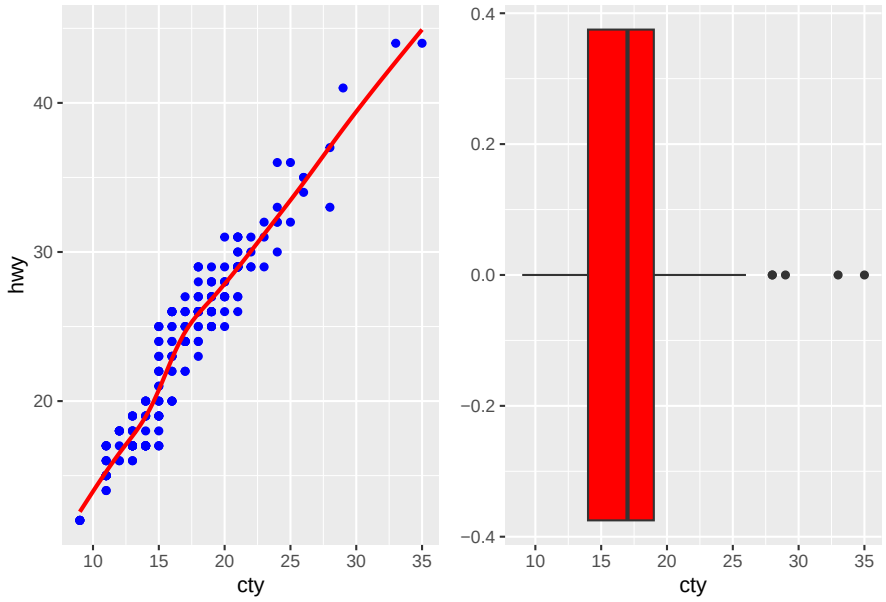
link 1: patchwork

link 2: patchwork

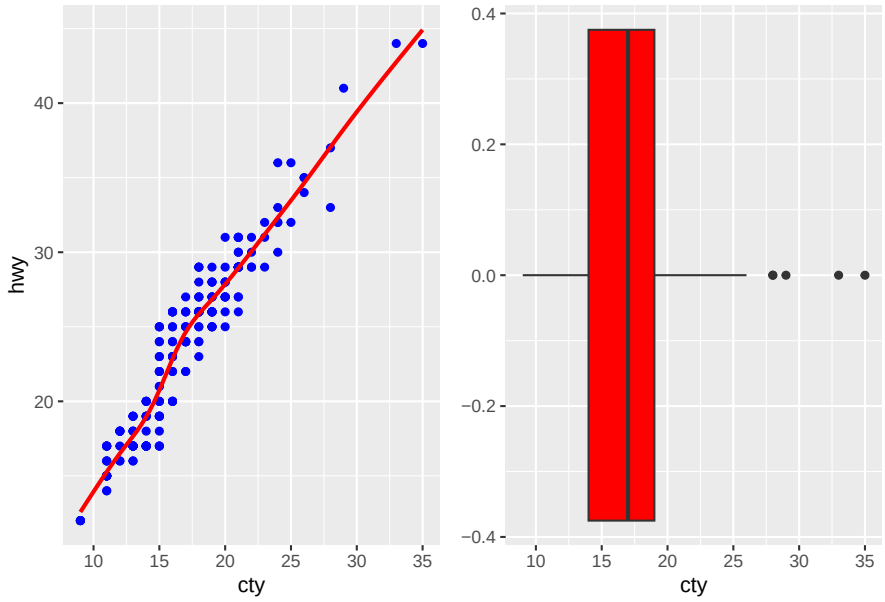
```
# gridExtra
grid.arrange(v1, v2, v3, v4)
```



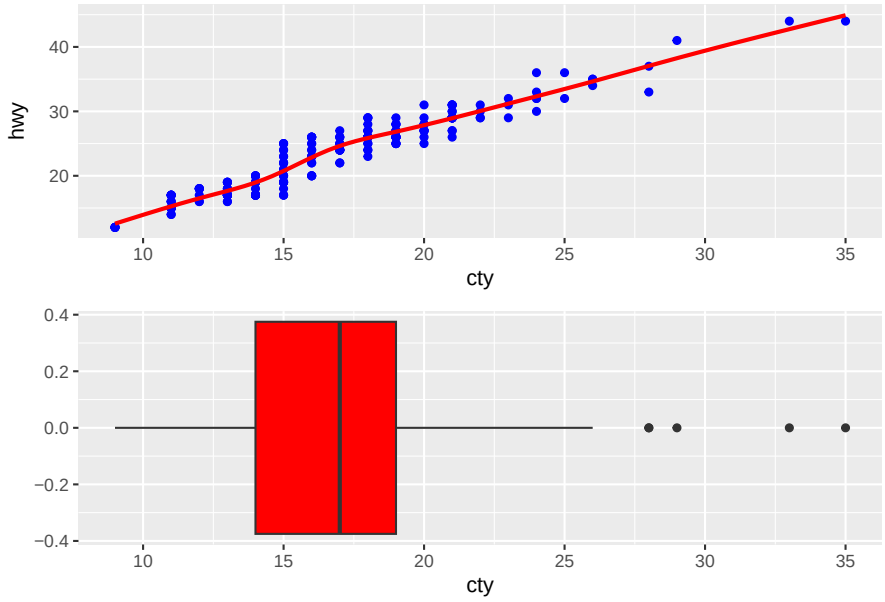

```
# patchwork
v1 + v2
```



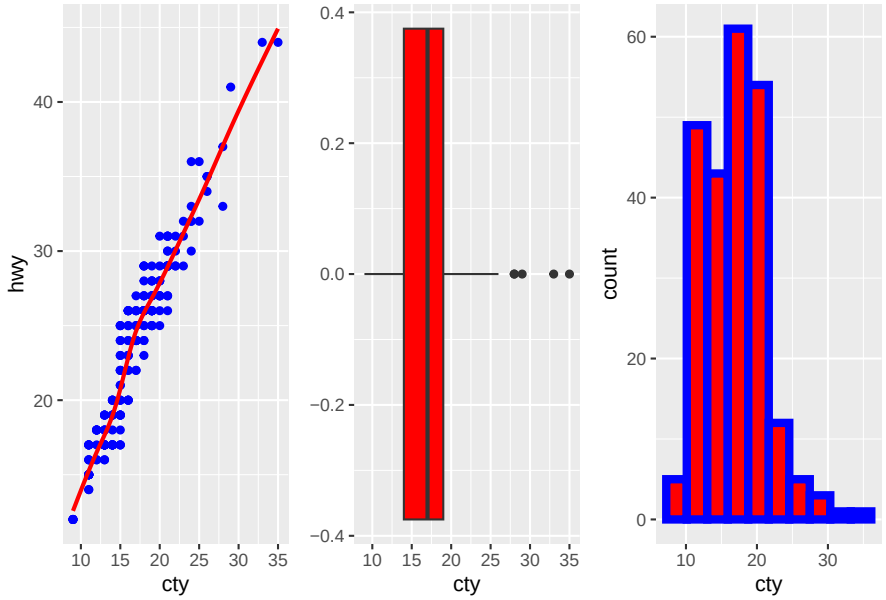
```
v1 | v2
```



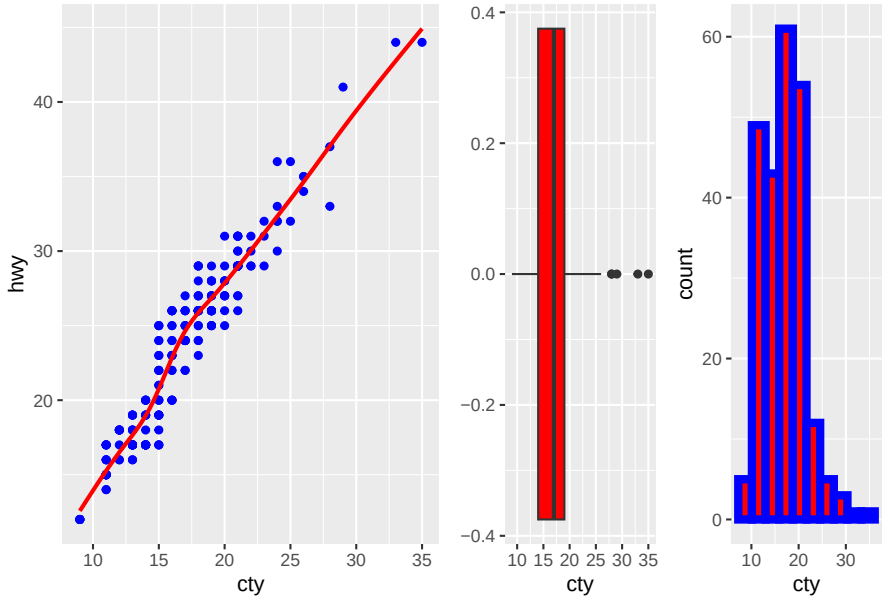

```
v1 / v2
```



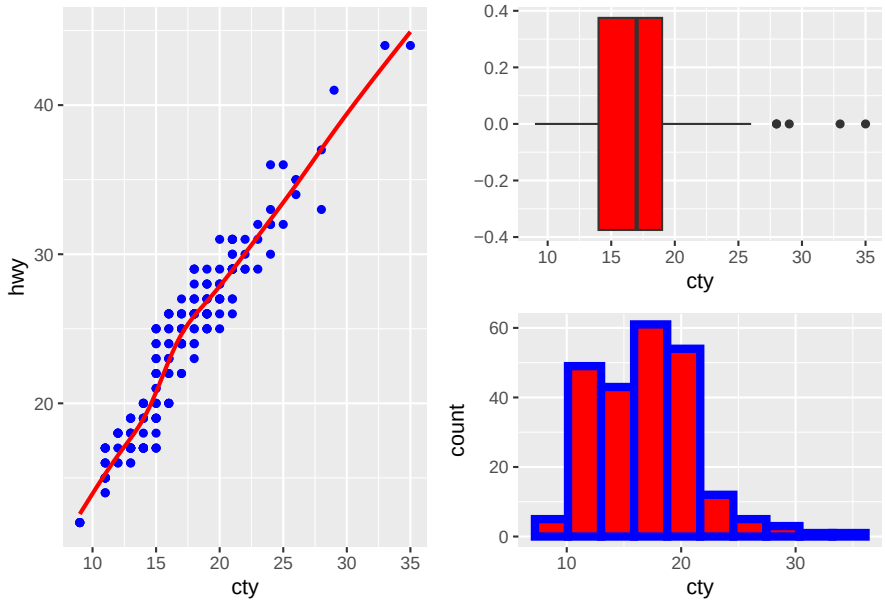
```
v1 + v2 + v3
```



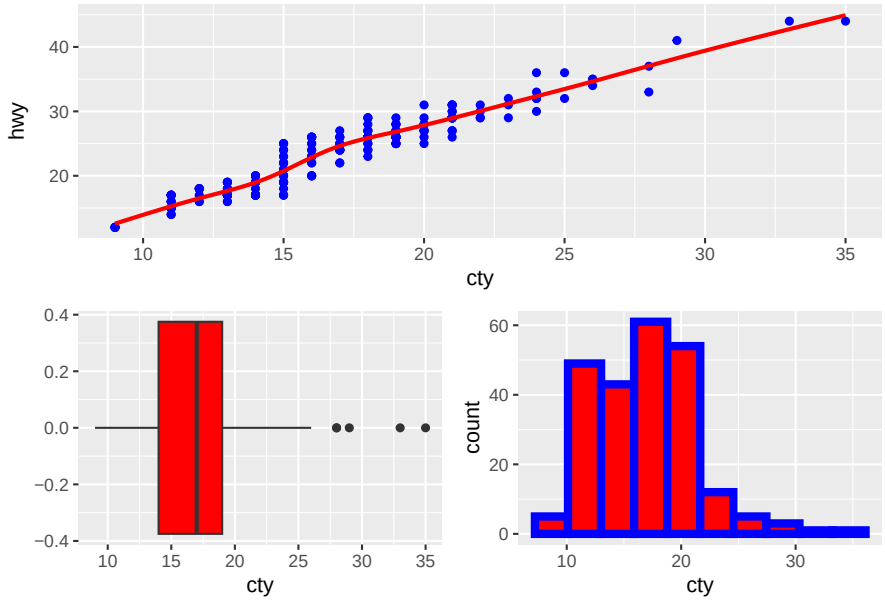

```
v1 + (v2 + v3)
```



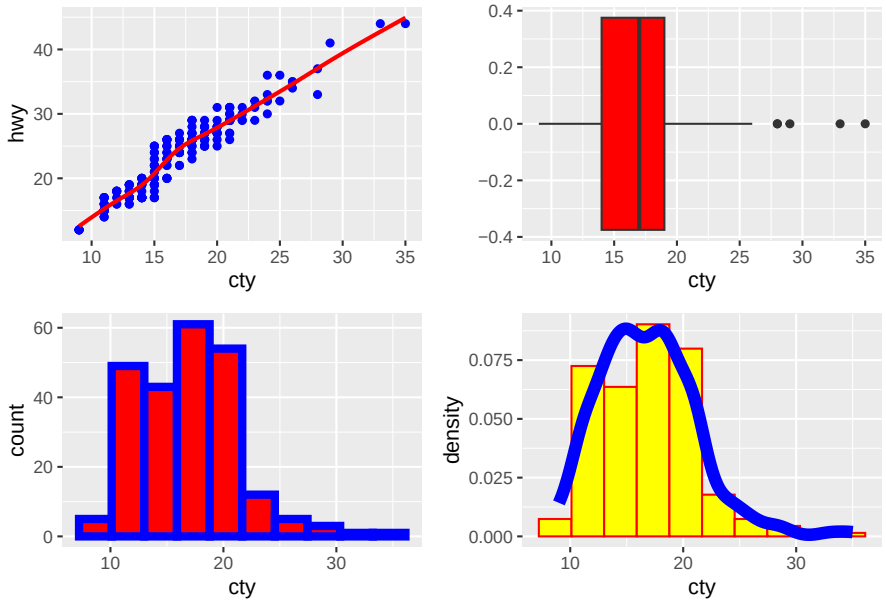
```
v1 | (v2 / v3)
```



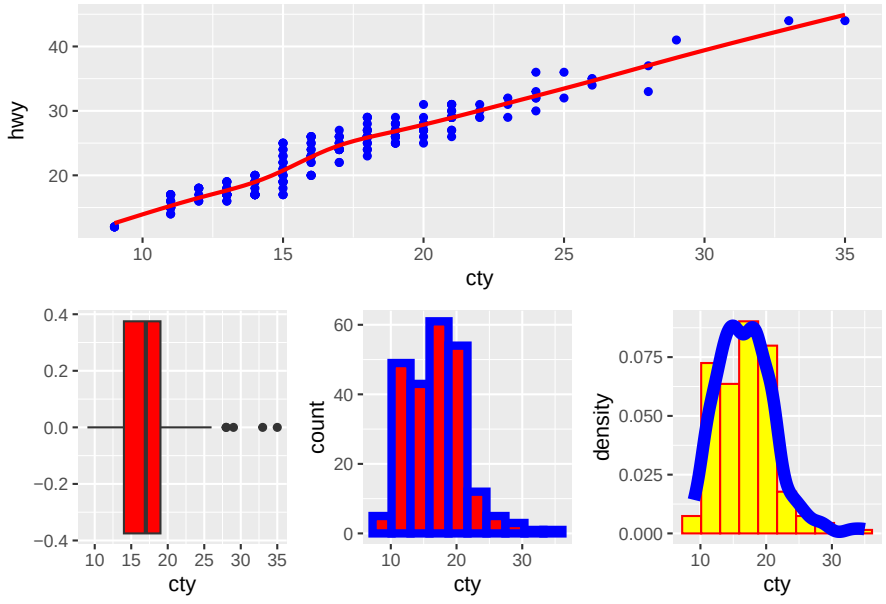

```
v1 / (v2 + v3)
```



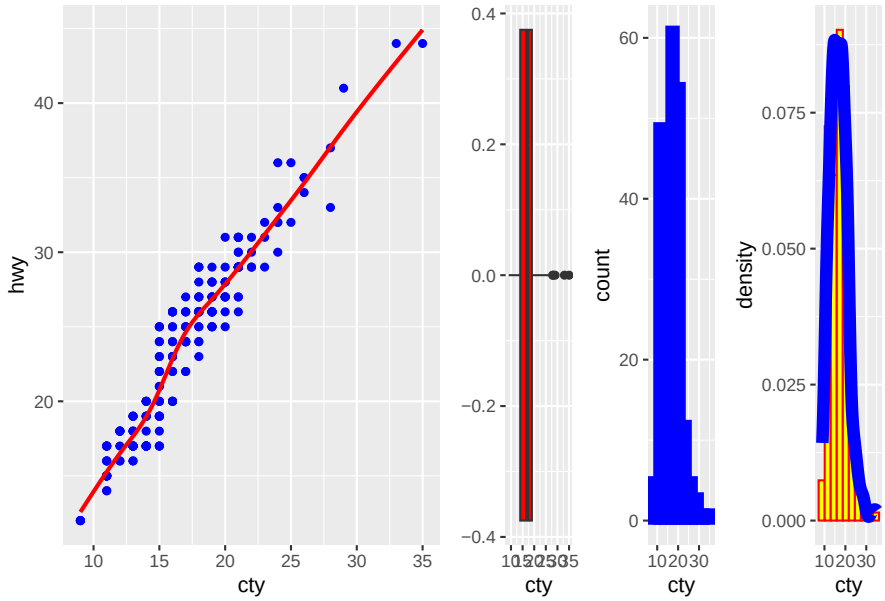
```
v1 + v2 + v3 + v4
```



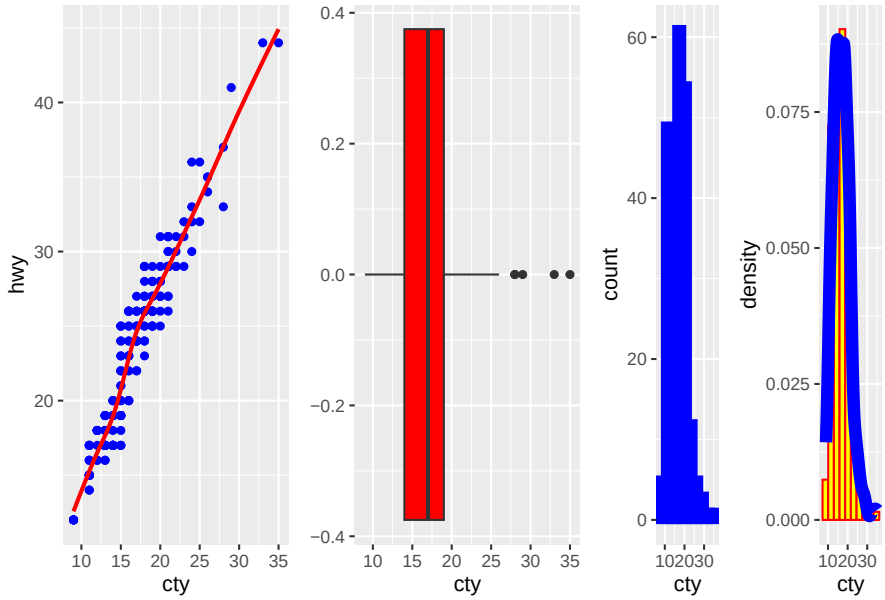

```
v1/(v2+v3+v4)
```



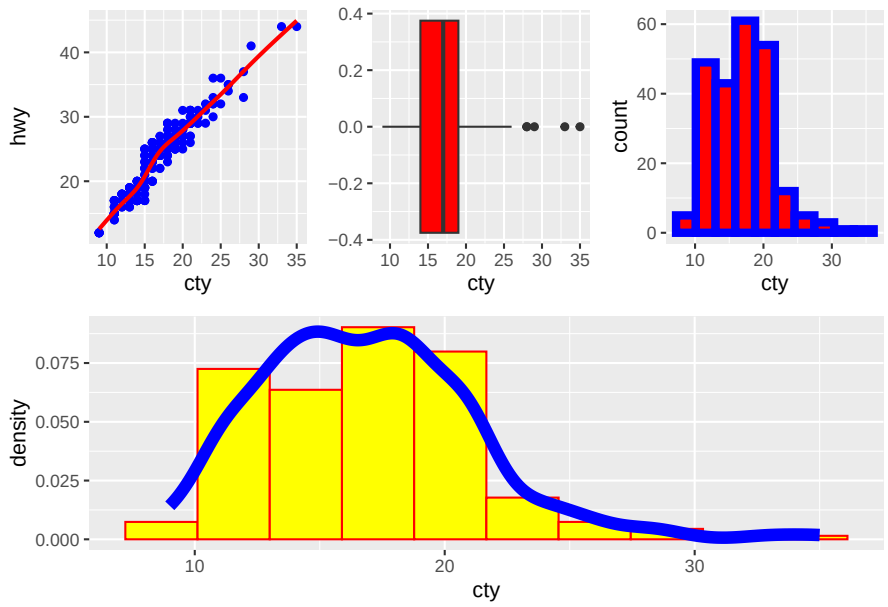
```
v1  + (v2 + v3 + v4)
```



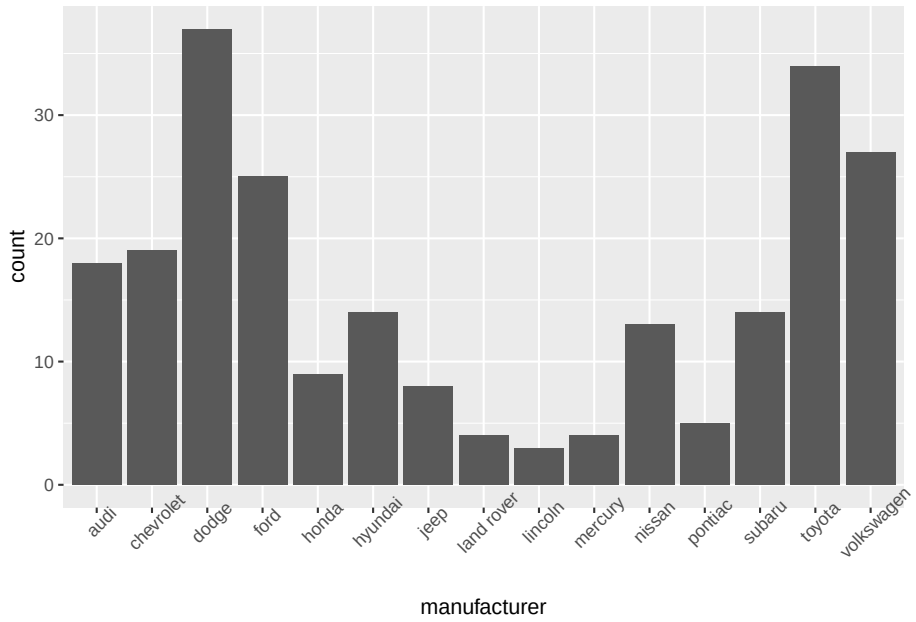

```
v1  + v2 + (v3 + v4)
```



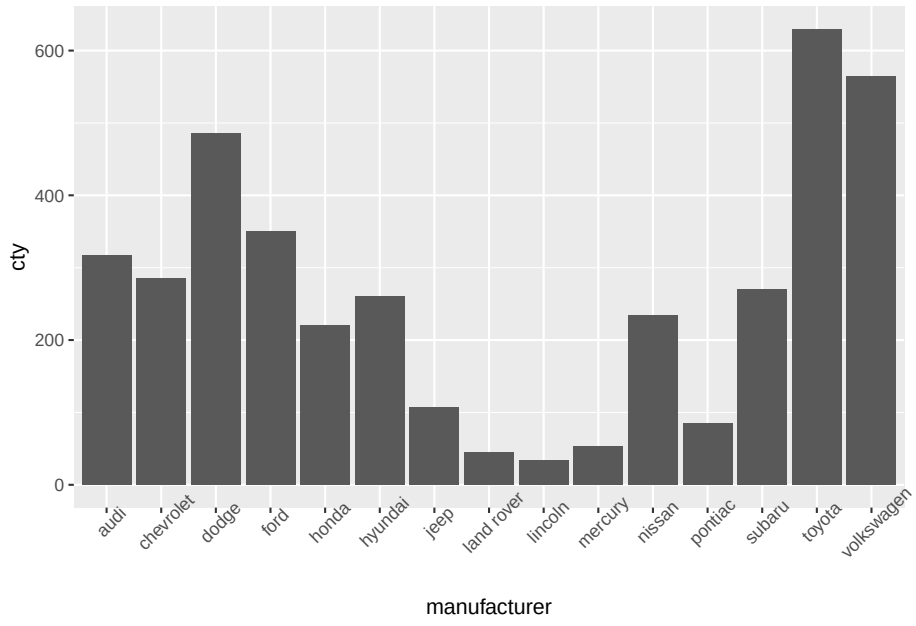
```
(v1 | v2 | v3) / v4
```




```
v5 <- ggplot(dados , aes(x = manufacturer)) +
  geom_bar()+
  theme(axis.text.x = element_text(angle = 45))
v5
```



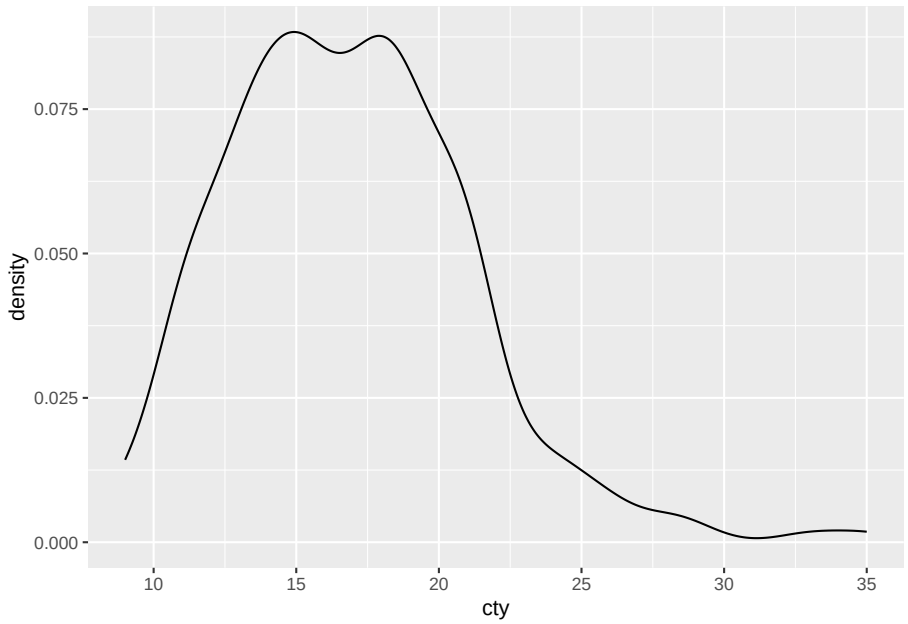

```
# Dúvidas no geom_col
v6 <- ggplot(dados , aes(x = manufacturer, y = cty)) +
  geom_col()+
  theme(axis.text.x = element_text(angle = 45))
v6
```



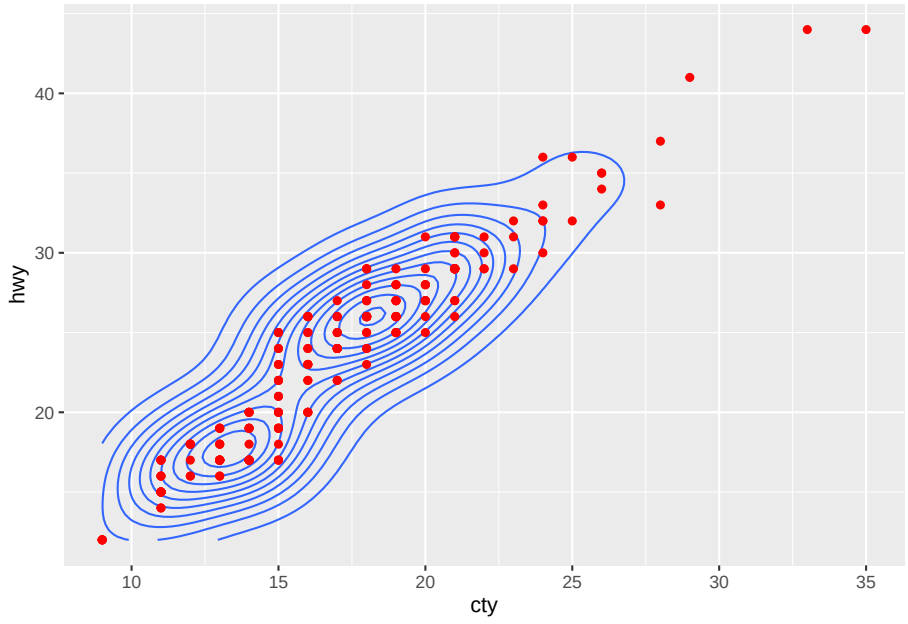

```
dados %>%
  select(manufacturer, cty) %>%
  group_by(manufacturer) %>%
  summarise(soma_total_cty = sum(cty),
            n = n())
```

```
## # A tibble: 15 x 3
##    manufacturer soma_total_cty     n
##    <chr>                 <int> <int>
##  1 audi                    317    18
##  2 chevrolet               285    19
##  3 dodge                   486    37
##  4 ford                    350    25
##  5 honda                   220     9
##  6 hyundai                 261    14
##  7 jeep                    108     8
##  8 land rover               46     4
##  9 lincoln                  34     3
## 10 mercury                  53     4
## 11 nissan                  235    13
## 12 pontiac                  85     5
## 13 subaru                  270    14
## 14 toyota                  630    34
## 15 volkswagen              565    27
```

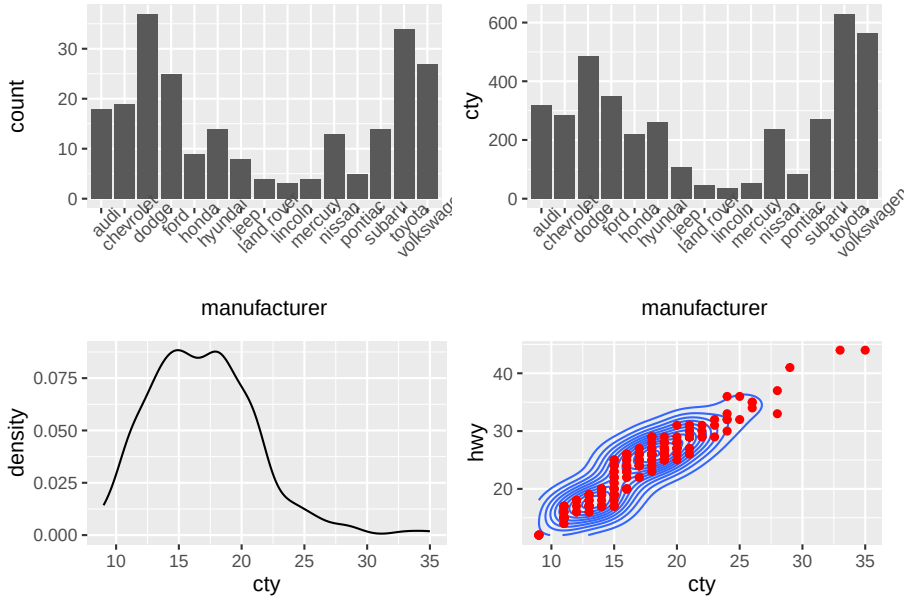
```
# dados %>%
#   filter(manufacturer == "audi") %>%
#   select(cty) %>%
#   sum()
v7 <- ggplot(dados , aes(x = cty)) +
  geom_density()
v7
```




```
v8 <- ggplot(dados, aes(x = cty, y = hwy)) +
  geom_density2d()+
  geom_point(colour = "red")
v8
```




```
(v5+v6)/ (v7 + v8)
```




```
# Deixar pra depois...
 dados %>%
    select(manufacturer, hwy, year) %>%
```

```
    filter(manufacturer == "audi", year == "1999") %>%
    summarise(media = max(hwy))
```

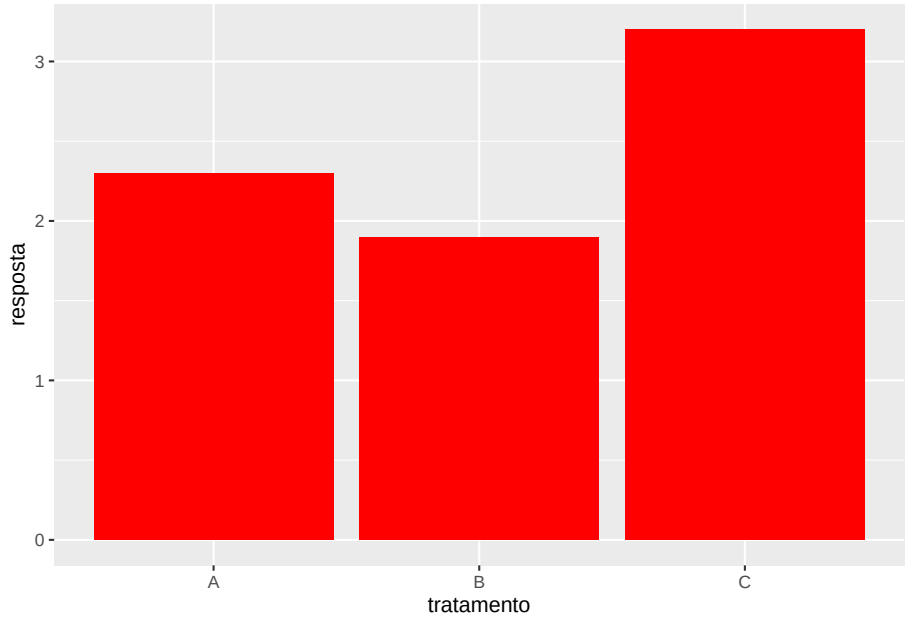
```
## # A tibble: 1 x 1
##   media
##   <int>
## 1    29
```

```
# plotly
ggplotly(
ggplot(dados, aes(x = manufacturer, y = hwy, fill = factor(year))) +
  geom_col(position = "dodge") +
  labs(fill = "year") +
  theme(axis.text.x = element_text(angle = 45)))

dados %>% select(manufacturer, hwy, year) %>%
  group_by(manufacturer, year) %>%
  summarise(media = mean(hwy))
```

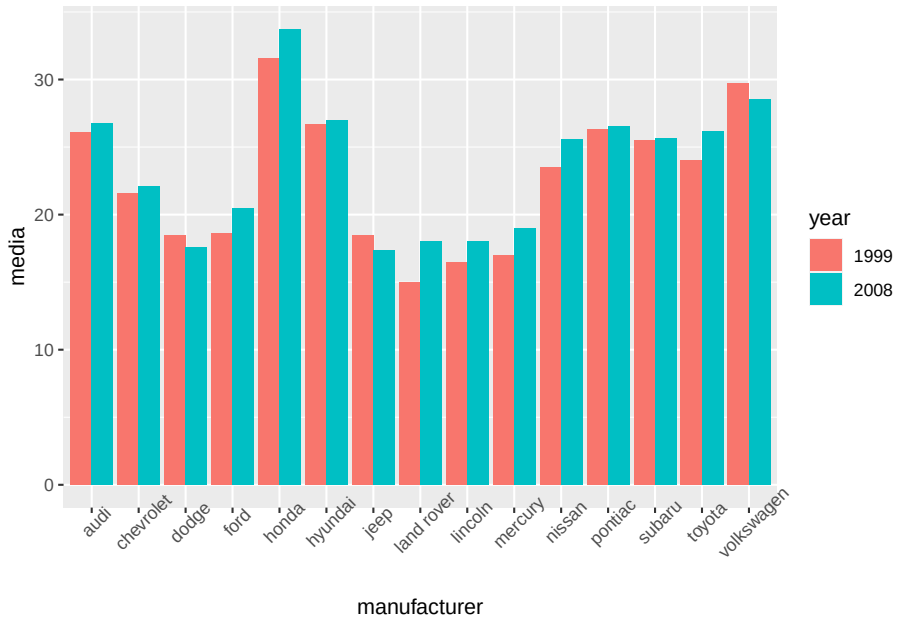
```
# Para pensar

(dados_trat <- data.frame(tratamento = LETTERS[1:3],
                          resposta = c(2.3, 1.9, 3.2)))
```

```
##   tratamento resposta
## 1          A      2.3
## 2          B      1.9
## 3          C      3.2
```

```
ggplot(dados_trat, aes(tratamento, resposta)) +
  geom_col(fill = "red")
```

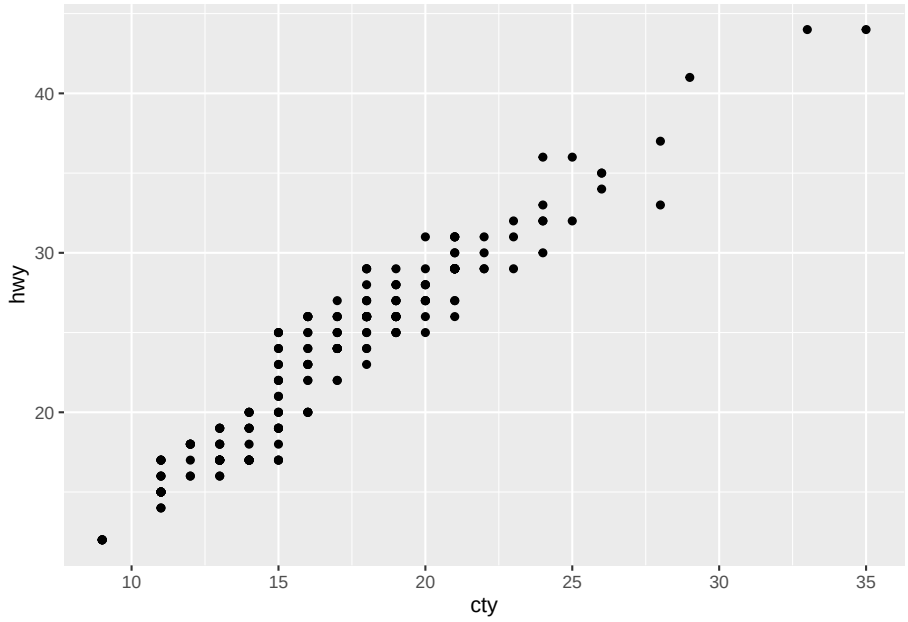



```
# Mais detalhes...
dados %>% select(manufacturer, hwy, year) %>%
  group_by(manufacturer, year) %>%
  summarise(media = mean(hwy), .groups = "drop") %>%
  ggplot(aes(x = manufacturer, y = media, fill = factor(year)))+
  geom_col(position = "dodge")+
  labs(fill = "year") +
  theme(axis.text.x = element_text(angle = 45))
```

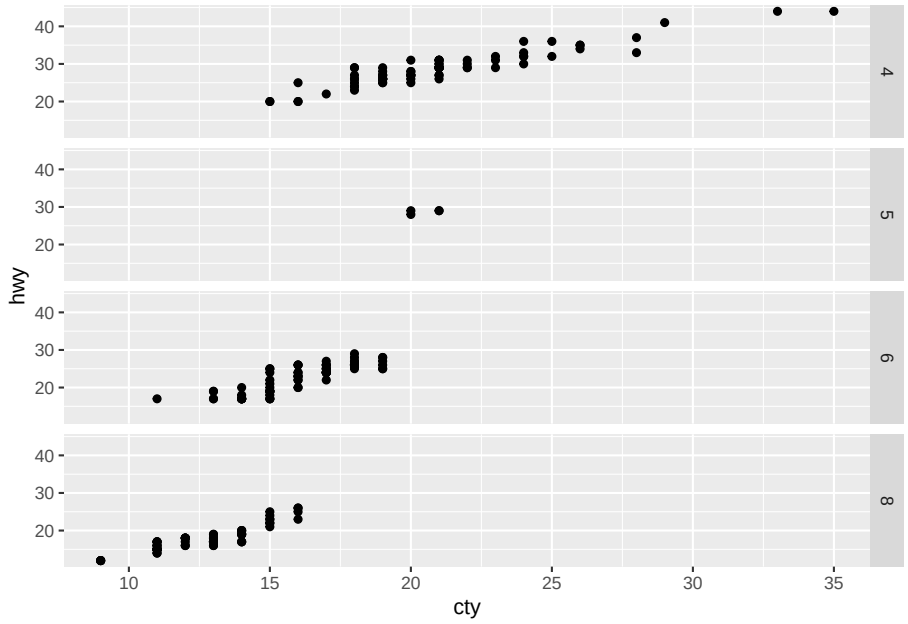



```
p1<- ggplot(dados, aes(x = cty, y = hwy)) +
  geom_point()
p1
```

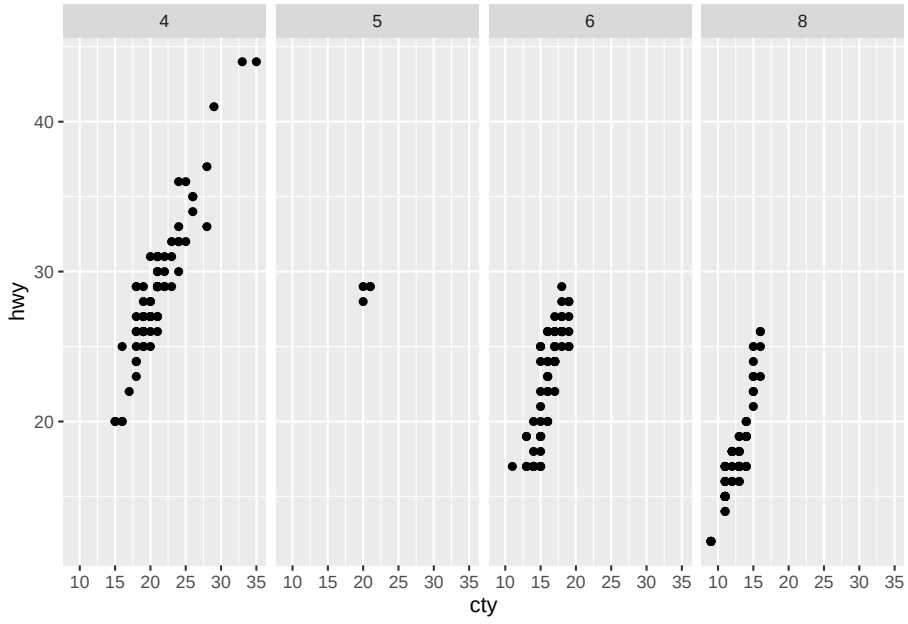
3.7 facet_grid, facet_wrap



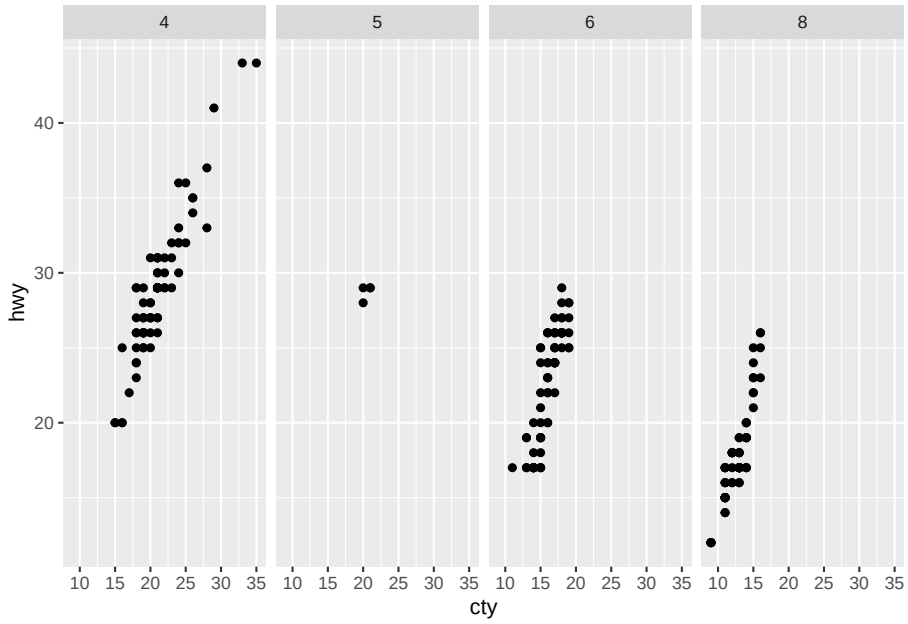

```
p1 + facet_grid(rows = vars(cyl))
```



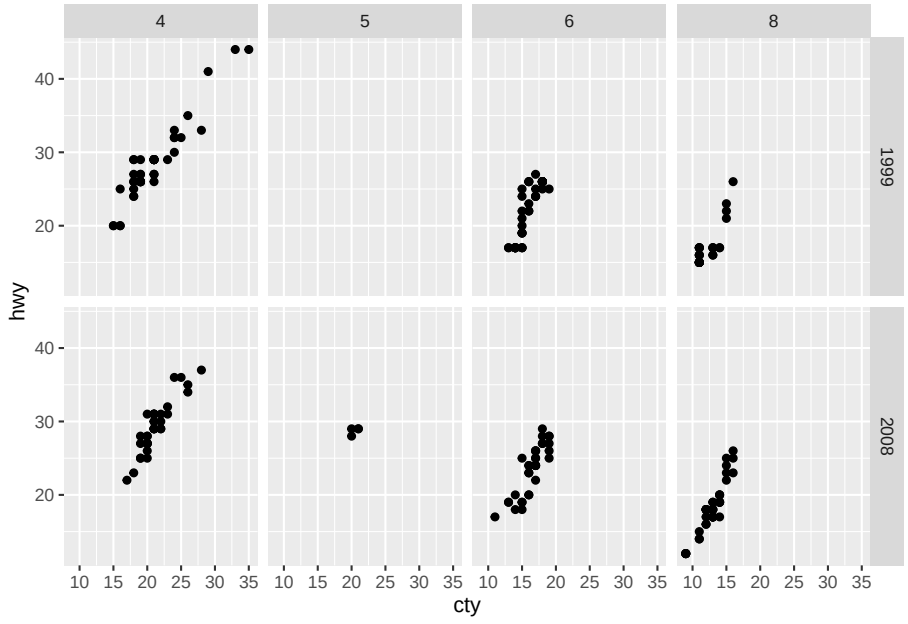

```
p1 + facet_grid(cols = vars(cyl))
```



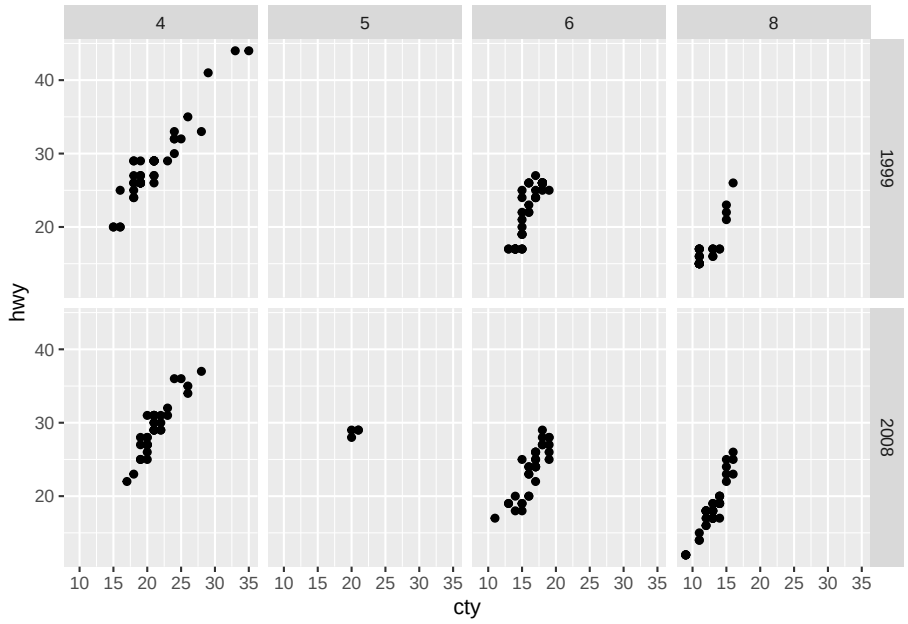

```
p1 + facet_grid(~cyl)
```



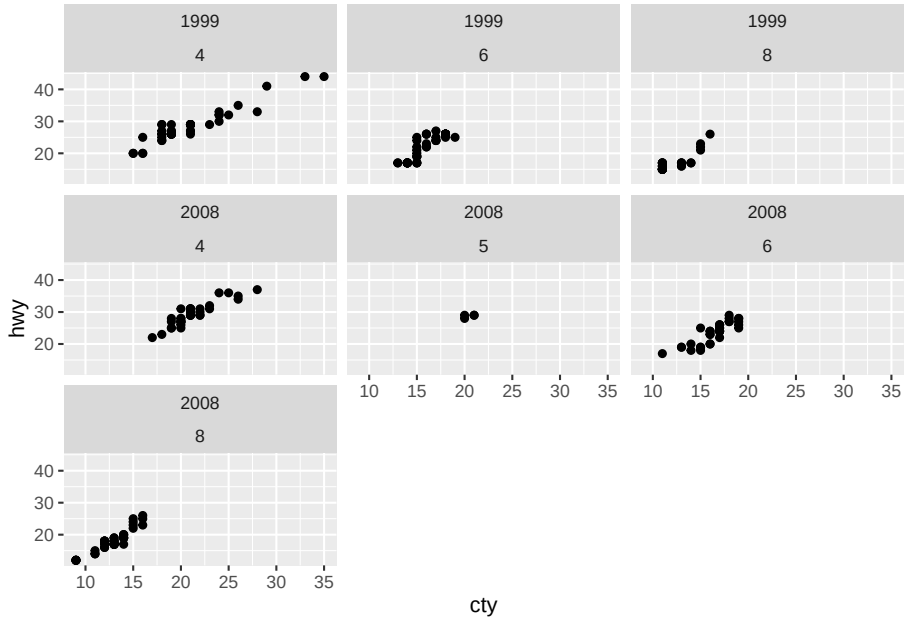

```
p1 + facet_grid(rows = vars(year), cols =vars(cyl))
```



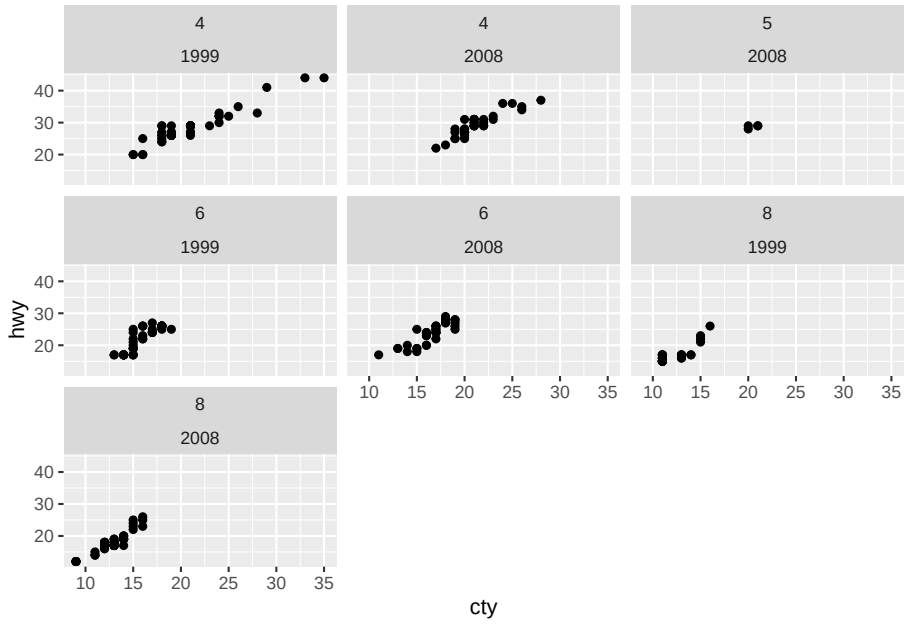

```
p1 + facet_grid(year~cyl)
```



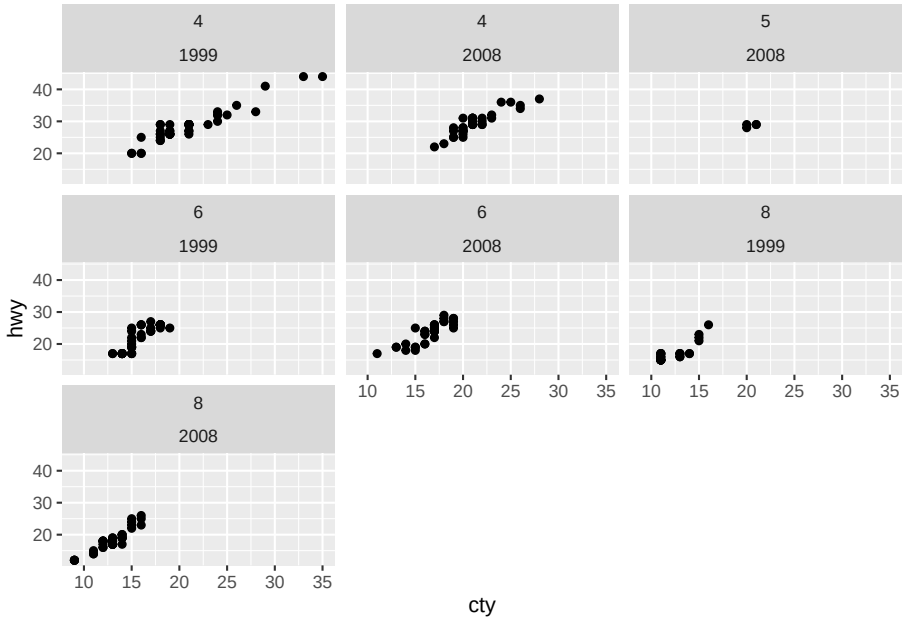

```
p1 + facet_wrap(year ~ cyl)
```



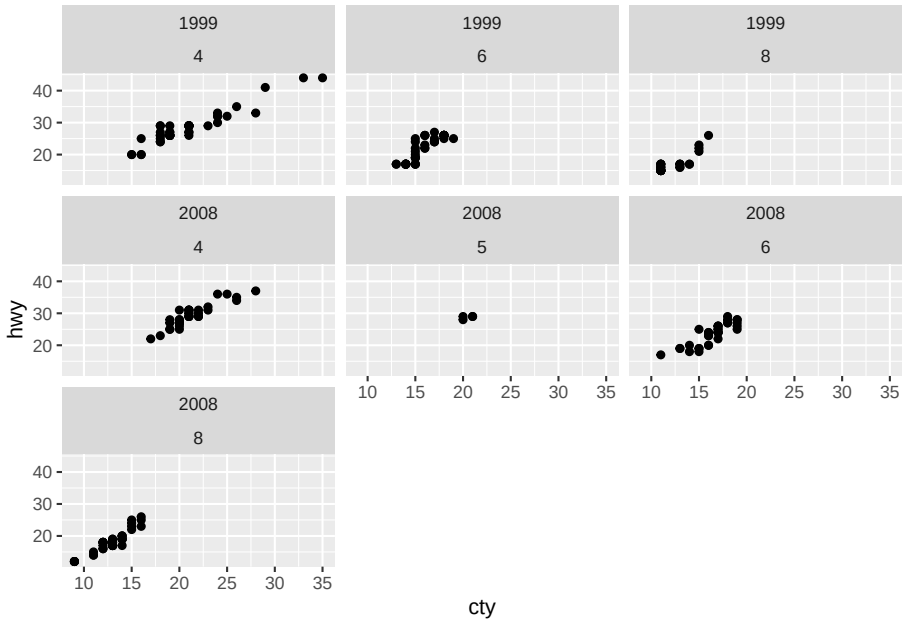

```
p1 + facet_wrap(cyl ~ year)
```



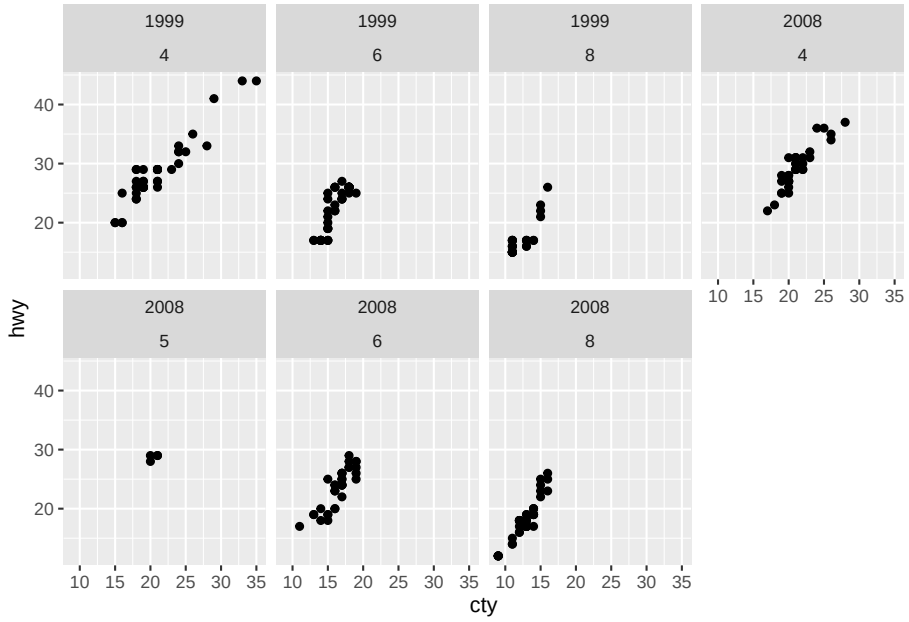

```
p1 + facet_wrap(~cyl + year)
```



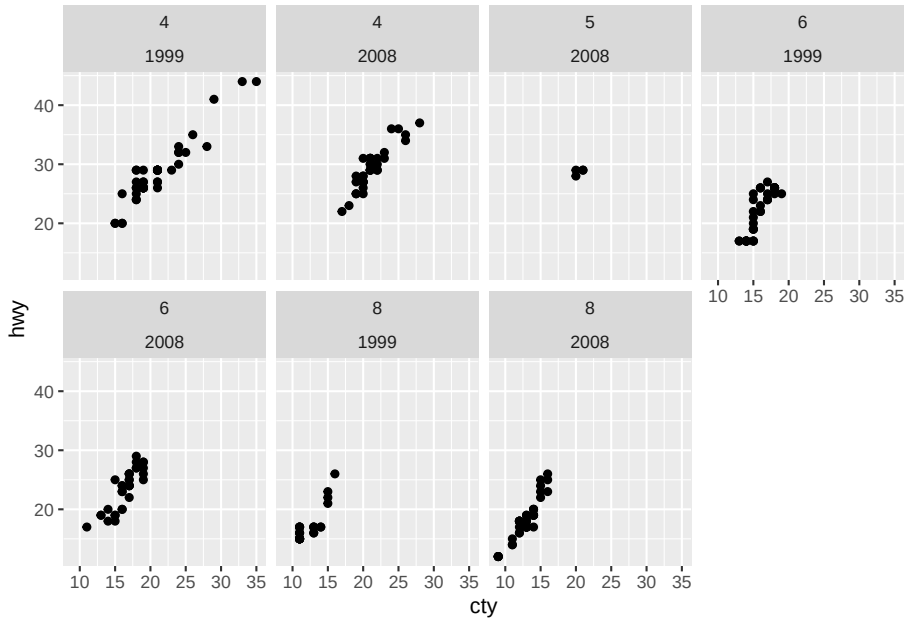

```
p1 + facet_wrap(~year + cyl)
```



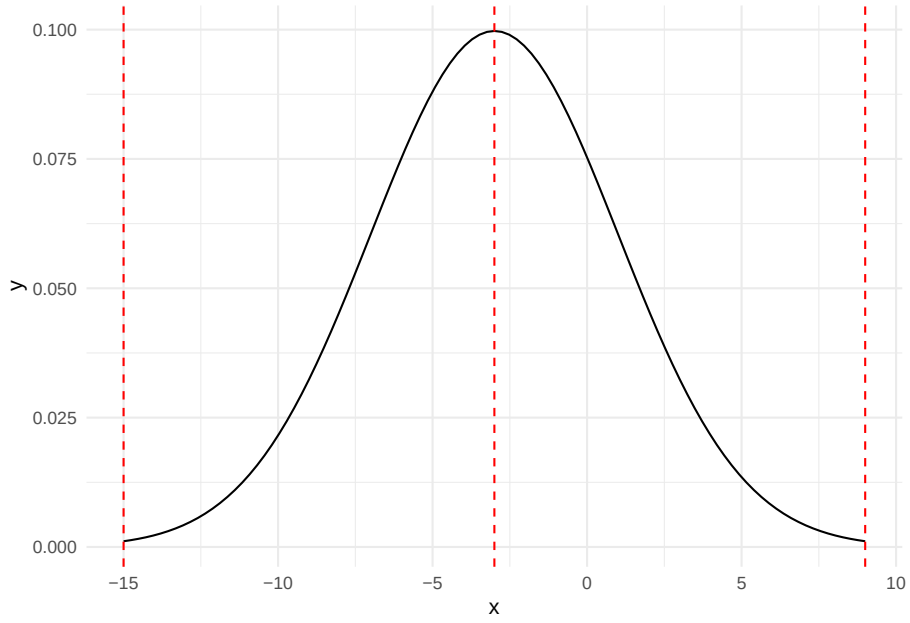

```
p1 + facet_wrap(year ~ cyl, ncol = 4)
```



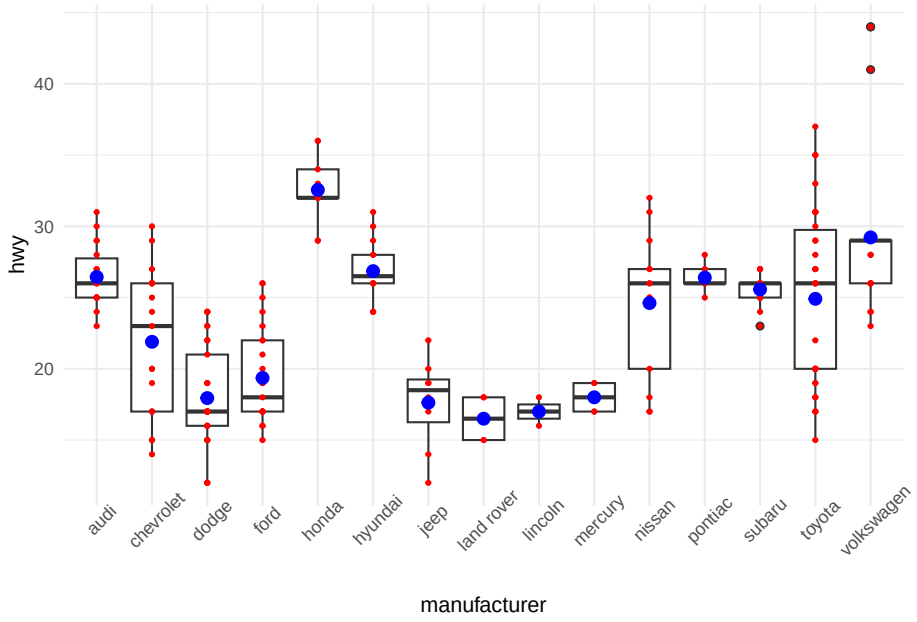

```
p1 + facet_wrap(cyl ~ year, ncol = 4)
```



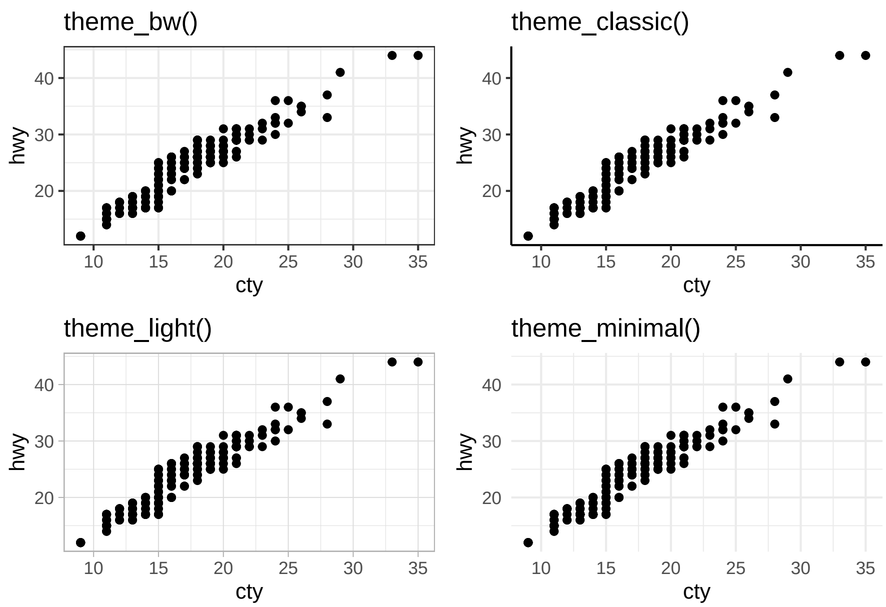
```
a<- -3 # média
b<- 4  # desv. padrão
ggplot(data.frame(x = c(a - 3*b, a + 3*b)), aes(x)) +
  stat_function(fun = dnorm, args = list(mean = a, sd = b))+
  geom_vline(xintercept = c(a - 3*b, a, a + 3*b), col = "red", lty = 2)+
  theme_minimal()
```




```
ggplot(dados, aes(x = manufacturer, y = hwy)) +
  geom_boxplot()+
  geom_point(col = "red", size=0.8)+
  stat_summary(fun = mean, col = "blue")+
  theme_minimal()+
  theme(axis.text.x = element_text(angle = 45))
```




```
a1<- p1 + theme_bw() + labs(title = "theme_bw()")
a2<- p1 + theme_classic() + labs(title = "theme_classic()")
a3<- p1 + theme_light() + labs(title = "theme_light()")
a4<- p1 + theme_minimal() + labs(title = "theme_minimal()")

a1 + a2 + a3 + a4
```

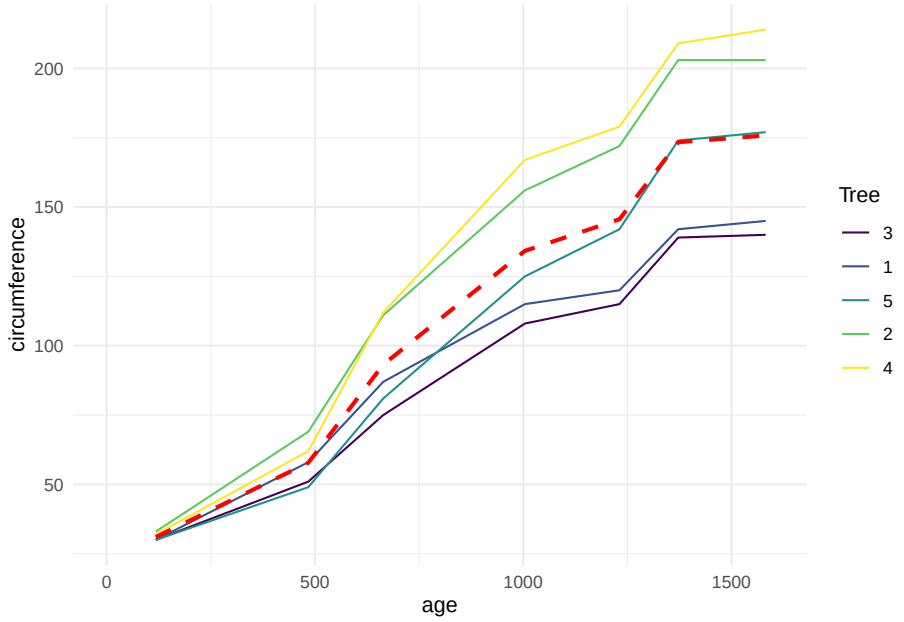


3.11 Gráfico [illegible] (Spaghetti plot)

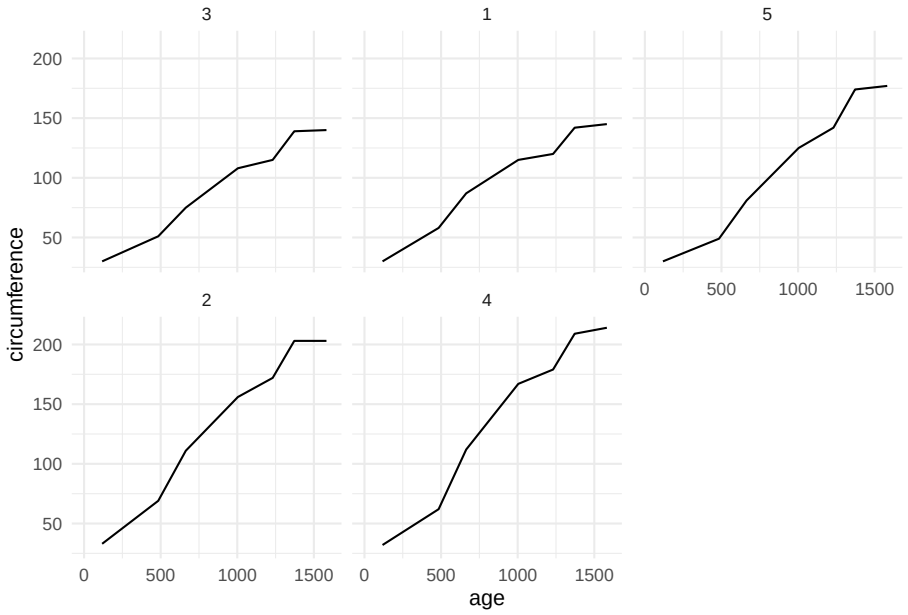
```
glimpse(Orange)
```

```
## Rows: 35
## Columns: 3
## $ Tree          <ord> 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 3, 3, 3, 3, 3,~
## $ age           <dbl> 118, 484, 664, 1004, 1231, 1372, 1582, 118, 484, 664, 10~
## $ circumference <dbl> 30, 58, 87, 115, 120, 142, 145, 33, 69, 111, 156, 172, 2~
```

```
ggplot(Orange, aes(x = age, y = circumference, group = Tree,
                   col = Tree)) +
  geom_line()+
  stat_summary(aes(group = 1), fun = mean, col = "red",
               geom = "line", size = 1, show.legend = FALSE,
               linetype = 2)+
  xlim(0, 1600)+
  theme_minimal()
```




```
ggplot(Orange, aes(x = age, y = circumference, group = Tree)) +
  geom_line()+
  xlim(0, 1600)+
  facet_wrap(~Tree)+
  theme_minimal()+
  theme(legend.position = "none")
```



3.12 plotly

plotly cran

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

Plotly R Open Source Graphing Library

```
ggplotly(v1)
ggplotly(v2)
ggplotly(v4)
ggplotly(v5)
```

3.13 esquisse

Alguns links de interesse

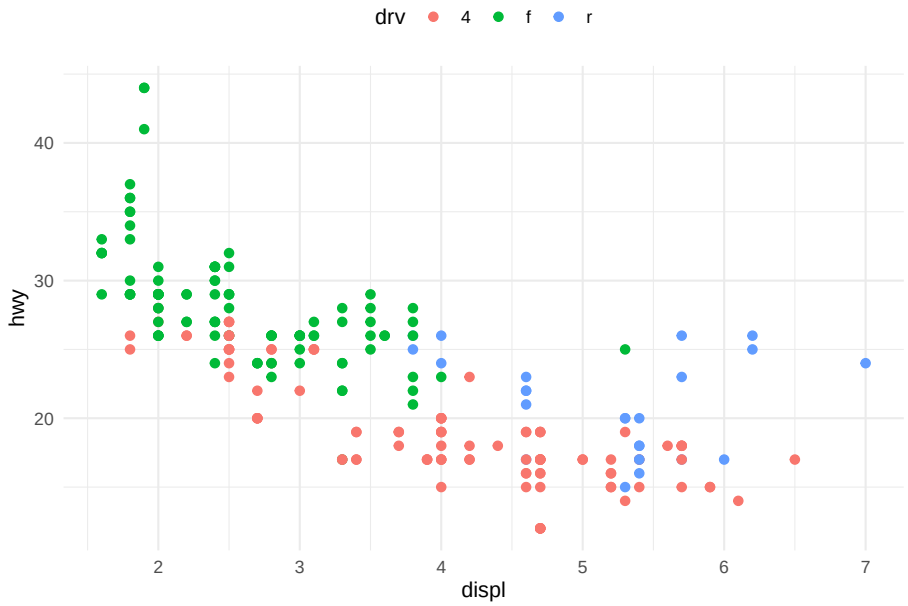
esquisse

esquisse + shiny

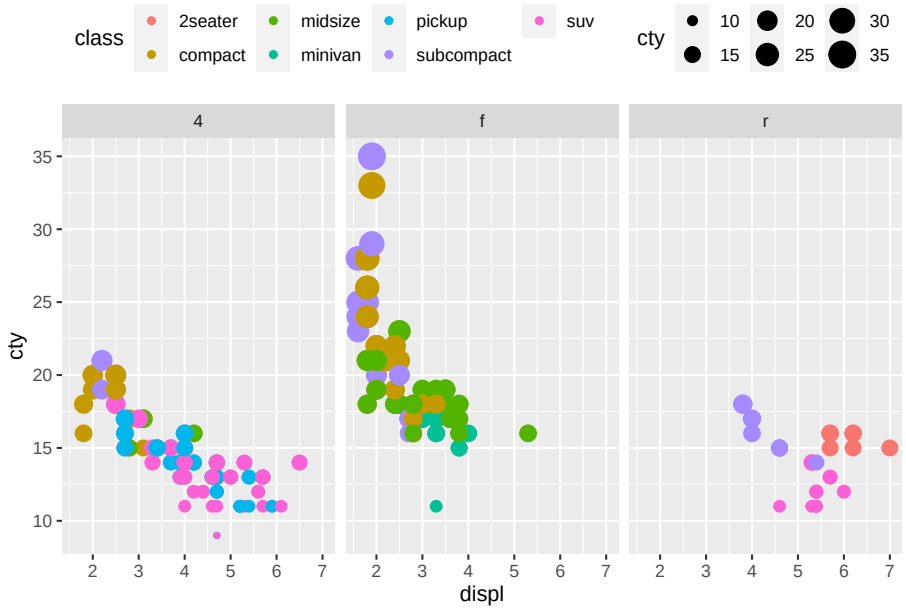
```
esquisser(dados)
```

```
  aes(x = displ, y = hwy, colour = drv) +
  geom_point(shape = "circle", size = 1.85) +
  scale_color_hue(direction = 1) +
  theme_minimal() +
  theme(legend.position = "top")
```


3.14 Exemplo esquisse




```
ggplot(dados) +
  aes(x = displ, y = cty, colour = class, size = cty) +
  geom_point(shape = "circle") +
  scale_color_hue(direction = 1) +
  theme(legend.position = "top") +
  facet_wrap(vars(drv))
```


class
2seater
compact
midsize
minivan
pickup
subcompact
suv
cty
10
15
20
25
30
35
4
f
r
cty
displ

Chapter 4

purrr

```
library(tidyverse)
ls("package:purrr")
```

```
##   [1] "%@%"                "%||%"               "%>%"
##   [4] "accumulate"         "accumulate_right"   "accumulate2"
##   [7] "array_branch"       "array_tree"         "as_mapper"
##  [10] "as_vector"          "assign_in"          "at_depth"
##  [13] "attr_getter"        "auto_browse"        "chuck"
##  [16] "compact"            "compose"            "cross"
##  [19] "cross_d"            "cross_df"           "cross_n"
##  [22] "cross2"             "cross3"             "detect"
##  [25] "detect_index"       "discard"            "discard_at"
##  [28] "done"               "every"              "exec"
##  [31] "flatten"            "flatten_chr"        "flatten_dbl"
##  [34] "flatten_df"         "flatten_dfc"        "flatten_dfr"
##  [37] "flatten_int"        "flatten_lgl"        "flatten_raw"
##  [40] "has_element"        "head_while"         "imap"
##  [43] "imap_chr"           "imap_dbl"           "imap_dfc"
##  [46] "imap_dfr"           "imap_int"           "imap_lgl"
##  [49] "imap_raw"           "imodify"            "insistently"
##  [52] "invoke"             "invoke_map"         "invoke_map_chr"
##  [55] "invoke_map_dbl"     "invoke_map_df"      "invoke_map_dfc"
##  [58] "invoke_map_dfr"     "invoke_map_int"     "invoke_map_lgl"
##  [61] "invoke_map_raw"     "is_atomic"          "is_bare_atomic"
##  [64] "is_bare_character"  "is_bare_double"     "is_bare_integer"
##  [67] "is_bare_list"       "is_bare_logical"    "is_bare_numeric"
##  [70] "is_bare_vector"     "is_character"       "is_double"
##  [73] "is_empty"           "is_formula"         "is_function"
##  [76] "is_integer"         "is_list"            "is_logical"
```

```
##  [79] "is_null"             "is_rate"             "is_scalar_atomic"
##  [82] "is_scalar_character" "is_scalar_double"    "is_scalar_integer"
##  [85] "is_scalar_list"      "is_scalar_logical"   "is_scalar_vector"
##  [88] "is_vector"           "iwalk"               "keep"
##  [91] "keep_at"             "lift"                "lift_dl"
##  [94] "lift_dv"             "lift_ld"             "lift_lv"
##  [97] "lift_vd"             "lift_vl"             "list_along"
## [100] "list_assign"         "list_c"              "list_cbind"
## [103] "list_flatten"        "list_merge"          "list_modify"
## [106] "list_rbind"          "list_simplify"       "list_transpose"
## [109] "lmap"                "lmap_at"             "lmap_if"
## [112] "map"                 "map_at"              "map_chr"
## [115] "map_dbl"             "map_depth"           "map_df"
## [118] "map_dfc"             "map_dfr"             "map_if"
## [121] "map_int"             "map_lgl"             "map_raw"
## [124] "map_vec"             "map2"                "map2_chr"
## [127] "map2_dbl"            "map2_df"             "map2_dfc"
## [130] "map2_dfr"            "map2_int"            "map2_lgl"
## [133] "map2_raw"            "map2_vec"            "modify"
## [136] "modify_at"           "modify_depth"        "modify_if"
## [139] "modify_in"           "modify_tree"         "modify2"
## [142] "negate"              "none"                "partial"
## [145] "pluck"               "pluck_depth"         "pluck_exists"
## [148] "pluck<-"             "pmap"                "pmap_chr"
## [151] "pmap_dbl"            "pmap_df"             "pmap_dfc"
## [154] "pmap_dfr"            "pmap_int"            "pmap_lgl"
## [157] "pmap_raw"            "pmap_vec"            "possibly"
## [160] "prepend"             "pwalk"               "quietly"
## [163] "rate_backoff"        "rate_delay"          "rate_reset"
## [166] "rate_sleep"          "rbernoulli"          "rdunif"
## [169] "reduce"              "reduce_right"        "reduce2"
## [172] "reduce2_right"       "rep_along"           "rerun"
## [175] "safely"              "set_names"           "simplify"
## [178] "simplify_all"        "slowly"              "some"
## [181] "splice"              "tail_while"          "transpose"
## [184] "update_list"         "vec_depth"           "walk"
## [187] "walk2"               "when"                "zap"
```

4.1 map functions

```
example("map")
```

```
##
## map> # Compute normal distributions from an atomic vector
## map> 1:10 |>
```

```
## map+   map(rnorm, n = 10)
## [[1]]
##  [1] -0.21922348  0.61996465  1.29024877  0.11019642  0.59216413  0.87487471
##  [7]  0.39567527 -1.02818925 -0.81626024 -0.02669643
##
## [[2]]
##  [1] 5.7748559 1.4410355 2.8421403 0.6115358 1.2729774 1.6114799 0.7816303
##  [8] 2.7443002 0.5157748 1.7379449
##
## [[3]]
##  [1] 1.7785115 2.5023306 3.2356692 5.5216912 2.5630065 2.4648148 3.4178825
##  [8] 3.1202642 3.9779527 0.9282494
##
## [[4]]
##  [1] 4.857196 3.571092 2.367683 3.389621 4.905757 4.102200 4.032000 3.443664
##  [9] 5.395998 4.641652
##
## [[5]]
##  [1] 4.398464 6.080639 4.873609 4.843892 4.047706 4.245536 4.657401 3.671805
##  [9] 6.436675 3.743995
##
## [[6]]
##  [1] 5.642601 5.902677 3.763949 6.788100 5.421124 8.629236 5.842409 5.309218
##  [9] 5.328469 5.649454
##
## [[7]]
##  [1] 7.036166 6.369926 7.137499 6.989909 6.494763 8.151830 7.674627 7.274734
##  [9] 6.740540 6.973178
##
## [[8]]
##  [1]  8.566392 10.646892  6.802248  8.860256  8.211045  6.536649  8.282630
##  [8]  8.011455  8.468509  7.119174
##
## [[9]]
##  [1]  9.513433  9.958892 10.836989  9.675665  6.940989  9.308194 10.965672
##  [8]  9.068537  9.914014  8.871290
##
## [[10]]
##  [1]  9.651390 10.108473  9.055043 10.582112  9.444427  9.998619  9.896081
##  [8] 10.241184  8.666145  9.672320
##
##
## map> # You can also use an anonymous function
## map> 1:10 |>
## map+   map(\(x) rnorm(10, x))
## [[1]]
```

```
##  [1]  0.8673994  1.7287065 -0.2481662 -1.1399910  1.6306988 -1.6557005
##  [7]  1.6206918  0.2477373  1.8680921  0.2386029
##
## [[2]]
##  [1] 1.7421001 2.3557942 1.1523195 0.2790364 2.7476298 0.8111794 0.1694989
##  [8] 2.5691697 0.7063602 3.2158305
##
## [[3]]
##  [1] 2.8730810 4.6178702 2.7328835 2.1959393 3.2452071 1.7167346 2.5633084
##  [8] 1.7339964 0.6740952 2.2906973
##
## [[4]]
##  [1] 3.671998 3.479038 3.893398 4.631399 4.361525 2.408883 1.889459 3.219626
##  [9] 4.511175 2.397565
##
## [[5]]
##  [1] 3.625986 4.499937 3.858146 4.846787 5.267548 4.840228 5.786236 5.374074
##  [9] 6.073319 4.707545
##
## [[6]]
##  [1] 6.533980 5.869597 5.690176 7.462380 6.440103 5.476440 5.807940 6.114901
##  [9] 6.097795 3.320757
##
## [[7]]
##  [1] 7.144552 7.067992 6.622119 6.781972 7.280636 6.584233 8.116805 6.181617
##  [9] 5.285551 7.641457
##
## [[8]]
##  [1] 6.399352 8.797040 8.801813 8.100830 7.385564 9.125073 6.817197 6.861263
##  [9] 9.193877 8.321368
##
## [[9]]
##  [1]  7.737925  9.973844  9.658762 10.958670  8.529904  8.341193  8.958649
##  [8] 10.289513  8.606465  9.539204
##
## [[10]]
##  [1]  9.303470 10.861467 11.197694 10.075318 10.963940  9.069624 10.693454
##  [8]  9.944944 12.486999  9.065917
##
##
## map> # Simplify output to a vector instead of a list by computing the mean of the di
## map> 1:10 |>
## map+   map(rnorm, n = 10) |>  # output a list
## map+   map_dbl(mean)           # output an atomic vector
##  [1]  0.9192822  2.3160661  2.5959577  3.6388191  4.7337620  6.2108932
##  [7]  6.9112006  7.6226543  8.9107109 10.1328084
```

```
##
## map> # Using set_names() with character vectors is handy to keep track
## map> # of the original inputs:
## map> set_names(c("foo", "bar")) |> map_chr(paste0, ":suffix")
##         foo          bar
## "foo:suffix" "bar:suffix"
##
## map> # Working with lists
## map> favorite_desserts <- list(Sophia = "banana bread", Eliott = "pancakes", Karina = "chocola
##
## map> favorite_desserts |> map_chr(\(food) paste(food, "rocks!"))
##                  Sophia                  Eliott                  Karina
##   "banana bread rocks!"       "pancakes rocks!" "chocolate cake rocks!"
##
## map> # Extract by name or position
## map> # .default specifies value for elements that are missing or NULL
## map> l1 <- list(list(a = 1L), list(a = NULL, b = 2L), list(b = 3L))
##
## map> l1 |> map("a", .default = "???")
## [[1]]
## [1] 1
##
## [[2]]
## [1] "???"
##
## [[3]]
## [1] "???"
##
##
## map> l1 |> map_int("b", .default = NA)
## [1] NA  2  3
##
## map> l1 |> map_int(2, .default = NA)
## [1] NA  2 NA
##
## map> # Supply multiple values to index deeply into a list
## map> l2 <- list(
## map+   list(num = 1:3,     letters[1:3]),
## map+   list(num = 101:103, letters[4:6]),
## map+   list()
## map+ )
##
## map> l2 |> map(c(2, 2))
## [[1]]
## [1] "b"
##
```

```
## [[2]]
## [1] "e"
##
## [[3]]
## NULL
##
##
## map> # Use a list to build an extractor that mixes numeric indices and names,
## map> # and .default to provide a default value if the element does not exist
## map> l2 |> map(list("num", 3))
## [[1]]
## [1] 3
##
## [[2]]
## [1] 103
##
## [[3]]
## NULL
##
##
## map> l2 |> map_int(list("num", 3), .default = NA)
## [1]   3 103  NA
##
## map> # Working with data frames
## map> # Use map_lgl(), map_dbl(), etc to return a vector instead of a list:
## map> mtcars |> map_dbl(sum)
##      mpg      cyl     disp       hp     drat       wt     qsec       vs
##  642.900  198.000 7383.100 4694.000  115.090  102.952  571.160   14.000
##       am     gear     carb
##   13.000  118.000   90.000
##
## map> # A more realistic example: split a data frame into pieces, fit a
## map> # model to each piece, summarise and extract R^2
## map> mtcars |>
## map+   split(mtcars$cyl) |>
## map+   map(\(df) lm(mpg ~ wt, data = df)) |>
## map+   map(summary) |>
## map+   map_dbl("r.squared")
##         4         6         8
## 0.5086326 0.4645102 0.4229655
```

```
example("map_at")
```

```
##
## map_at> # Use a predicate function to decide whether to map a function:
## map_at> iris |> map_if(is.factor, as.character) |> str()
```

```
## List of 5
##  $ Sepal.Length: num [1:150] 5.1 4.9 4.7 4.6 5 5.4 4.6 5 4.4 4.9 ...
##  $ Sepal.Width : num [1:150] 3.5 3 3.2 3.1 3.6 3.9 3.4 3.4 2.9 3.1 ...
##  $ Petal.Length: num [1:150] 1.4 1.4 1.3 1.5 1.4 1.7 1.4 1.5 1.4 1.5 ...
##  $ Petal.Width : num [1:150] 0.2 0.2 0.2 0.2 0.2 0.4 0.3 0.2 0.2 0.1 ...
##  $ Species     : chr [1:150] "setosa" "setosa" "setosa" "setosa" ...
##
## map_at> # Specify an alternative with the `.else` argument:
## map_at> iris |> map_if(is.factor, as.character, .else = as.integer) |> str()
## List of 5
##  $ Sepal.Length: int [1:150] 5 4 4 4 5 5 4 5 4 4 ...
##  $ Sepal.Width : int [1:150] 3 3 3 3 3 3 3 3 2 3 ...
##  $ Petal.Length: int [1:150] 1 1 1 1 1 1 1 1 1 1 ...
##  $ Petal.Width : int [1:150] 0 0 0 0 0 0 0 0 0 0 ...
##  $ Species     : chr [1:150] "setosa" "setosa" "setosa" "setosa" ...
##
## map_at> # Use numeric vector of positions select elements to change:
## map_at> iris |> map_at(c(4, 5), is.numeric) |> str()
## List of 5
##  $ Sepal.Length: num [1:150] 5.1 4.9 4.7 4.6 5 5.4 4.6 5 4.4 4.9 ...
##  $ Sepal.Width : num [1:150] 3.5 3 3.2 3.1 3.6 3.9 3.4 3.4 2.9 3.1 ...
##  $ Petal.Length: num [1:150] 1.4 1.4 1.3 1.5 1.4 1.7 1.4 1.5 1.4 1.5 ...
##  $ Petal.Width : logi TRUE
##  $ Species     : logi FALSE
##
## map_at> # Use vector of names to specify which elements to change:
## map_at> iris |> map_at("Species", toupper) |> str()
## List of 5
##  $ Sepal.Length: num [1:150] 5.1 4.9 4.7 4.6 5 5.4 4.6 5 4.4 4.9 ...
##  $ Sepal.Width : num [1:150] 3.5 3 3.2 3.1 3.6 3.9 3.4 3.4 2.9 3.1 ...
##  $ Petal.Length: num [1:150] 1.4 1.4 1.3 1.5 1.4 1.7 1.4 1.5 1.4 1.5 ...
##  $ Petal.Width : num [1:150] 0.2 0.2 0.2 0.2 0.2 0.4 0.3 0.2 0.2 0.1 ...
##  $ Species     : chr [1:150] "SETOSA" "SETOSA" "SETOSA" "SETOSA" ...
```

```
example("map_chr")
```

```
##
## mp_chr> # Compute normal distributions from an atomic vector
## mp_chr> 1:10 |>
## mp_chr+   map(rnorm, n = 10)
## [[1]]
##  [1] -0.85168108  0.76824209 -0.56511354 -0.06777455  0.57043127  1.30155578
##  [7]  1.16753920  1.52753789  1.12292030  0.01333625
##
## [[2]]
##  [1] 1.91871196 1.00887403 2.29752782 1.90109619 1.78721545 0.22585994
```

```
##  [7] 0.03538443 2.40662183 0.38638058 1.11132602
##
## [[3]]
##  [1] 2.651643 2.071479 2.853637 3.195515 1.299768 2.829301 1.917916 3.690585
##  [9] 3.149101 3.508463
##
## [[4]]
##  [1] 3.100968 3.704232 4.181968 4.487123 3.756079 2.614169 4.169220 5.556129
##  [9] 1.040538 3.834227
##
## [[5]]
##  [1] 4.455109 5.843573 5.836780 5.789861 3.819823 4.864703 5.272119 3.971494
##  [9] 3.877954 3.920218
##
## [[6]]
##  [1] 6.128488 5.269266 4.746380 5.998051 5.211171 5.692527 5.115889 5.407193
##  [9] 5.354067 4.977758
##
## [[7]]
##  [1] 7.778251 6.425110 6.480761 7.882017 7.638080 8.376106 6.137801 9.204223
##  [9] 7.159064 5.365655
##
## [[8]]
##  [1] 9.367648 7.962897 8.384708 7.099967 7.473288 7.960293 8.781524 7.414348
##  [9] 8.373046 7.320071
##
## [[9]]
##  [1]  8.799551 10.157066  9.938182  9.109629  9.443643  8.339518  7.433778
##  [8]  8.538323  8.887992  9.175111
##
## [[10]]
##  [1] 10.560306 10.001851  9.918324 10.092168 10.499342  9.861110  8.877598
##  [8] 11.320864 10.037930 11.582468
##
##
## mp_chr> # You can also use an anonymous function
## mp_chr> 1:10 |>
## mp_chr+   map(\(x) rnorm(10, x))
## [[1]]
##  [1] -0.256235468  0.403628264  0.814251705  1.693920654  0.004675947
##  [6]  0.514057678  1.594697099  0.294070964  1.233135815  1.667718565
##
## [[2]]
##  [1] 2.769956 1.604054 3.225234 2.074651 1.663276 3.769481 2.058021 2.335913
##  [9] 2.098923 1.458392
##
```

```
## [[3]]
##  [1] 5.243628 3.743062 1.683377 2.979773 2.411894 3.419146 3.063397 3.396117
##  [9] 1.507323 4.208722
##
## [[4]]
##  [1] 4.178070 4.783422 5.051980 6.232170 5.427191 5.553087 4.284079 3.521486
##  [9] 4.857818 4.967079
##
## [[5]]
##  [1] 3.651478 5.139131 3.429966 3.533333 4.843882 4.412174 4.876708 4.076763
##  [9] 3.805323 4.639675
##
## [[6]]
##  [1] 5.436713 4.585468 7.685593 6.017759 5.886818 5.314155 5.180880 4.251106
##  [9] 4.471331 5.299659
##
## [[7]]
##  [1] 6.870764 8.394335 9.143564 7.090066 6.812236 5.003781 5.490337 6.238033
##  [9] 7.421588 8.322179
##
## [[8]]
##  [1] 8.043987 8.465914 7.839869 7.659624 8.423641 8.662921 9.002733 7.984377
##  [9] 5.762954 7.484663
##
## [[9]]
##  [1]  8.951246 10.445702 11.314291  9.482388  7.449872  9.187757 10.039788
##  [8] 10.037846 10.021328  9.896112
##
## [[10]]
##  [1]  9.455509 10.951248 10.297551 10.295419 11.252473 10.906418  9.040358
##  [8]  9.274158  9.443515 10.693993
##
##
## mp_chr> # Simplify output to a vector instead of a list by computing the mean of the distribut
## mp_chr> 1:10 |>
## mp_chr+   map(rnorm, n = 10) |>  # output a list
## mp_chr+   map_dbl(mean)           # output an atomic vector
##  [1] 1.042545 2.138783 3.272661 4.154313 5.400198 6.471239 7.267552 8.366422
##  [9] 8.559555 9.877008
##
## mp_chr> # Using set_names() with character vectors is handy to keep track
## mp_chr> # of the original inputs:
## mp_chr> set_names(c("foo", "bar")) |> map_chr(paste0, ":suffix")
##          foo          bar
## "foo:suffix" "bar:suffix"
##
```

```
## mp_chr> # Working with lists
## mp_chr> favorite_desserts <- list(Sophia = "banana bread", Eliott = "pancakes", Kari
##
## mp_chr> favorite_desserts |> map_chr(\(food) paste(food, "rocks!"))
##                  Sophia                  Eliott                  Karina
##   "banana bread rocks!"       "pancakes rocks!" "chocolate cake rocks!"
##
## mp_chr> # Extract by name or position
## mp_chr> # .default specifies value for elements that are missing or NULL
## mp_chr> l1 <- list(list(a = 1L), list(a = NULL, b = 2L), list(b = 3L))
##
## mp_chr> l1 |> map("a", .default = "???")
## [[1]]
## [1] 1
##
## [[2]]
## [1] "???"
##
## [[3]]
## [1] "???"
##
##
## mp_chr> l1 |> map_int("b", .default = NA)
## [1] NA  2  3
##
## mp_chr> l1 |> map_int(2, .default = NA)
## [1] NA  2 NA
##
## mp_chr> # Supply multiple values to index deeply into a list
## mp_chr> l2 <- list(
## mp_chr+   list(num = 1:3,     letters[1:3]),
## mp_chr+   list(num = 101:103, letters[4:6]),
## mp_chr+   list()
## mp_chr+ )
##
## mp_chr> l2 |> map(c(2, 2))
## [[1]]
## [1] "b"
##
## [[2]]
## [1] "e"
##
## [[3]]
## NULL
##
##
```

```
## mp_chr> # Use a list to build an extractor that mixes numeric indices and names,
## mp_chr> # and .default to provide a default value if the element does not exist
## mp_chr> l2 |> map(list("num", 3))
## [[1]]
## [1] 3
##
## [[2]]
## [1] 103
##
## [[3]]
## NULL
##
##
## mp_chr> l2 |> map_int(list("num", 3), .default = NA)
## [1]   3 103  NA
##
## mp_chr> # Working with data frames
## mp_chr> # Use map_lgl(), map_dbl(), etc to return a vector instead of a list:
## mp_chr> mtcars |> map_dbl(sum)
##      mpg      cyl     disp       hp     drat       wt     qsec       vs
##  642.900  198.000 7383.100 4694.000  115.090  102.952  571.160   14.000
##       am     gear     carb
##   13.000  118.000   90.000
##
## mp_chr> # A more realistic example: split a data frame into pieces, fit a
## mp_chr> # model to each piece, summarise and extract R^2
## mp_chr> mtcars |>
## mp_chr+   split(mtcars$cyl) |>
## mp_chr+   map(\(df) lm(mpg ~ wt, data = df)) |>
## mp_chr+   map(summary) |>
## mp_chr+   map_dbl("r.squared")
##         4         6         8
## 0.5086326 0.4645102 0.4229655
example("map_dbl")
```

```
##
## mp_dbl> # Compute normal distributions from an atomic vector
## mp_dbl> 1:10 |>
## mp_dbl+   map(rnorm, n = 10)
## [[1]]
##  [1]  0.3476306  1.7316611 -0.1753930  2.8673698  1.4791364  1.2004899
##  [7]  1.9613883  2.3933887  1.7338007  0.7538462
##
## [[2]]
##  [1] 2.6156601 2.6617185 1.4562090 3.3027790 2.6707032 3.7408707 2.2518540
```

```
##  [8] 0.4147404 3.3655861 3.1782048
##
## [[3]]
##  [1] 2.545065 3.464680 4.209379 2.475425 3.866565 2.950048 4.177523 4.123372
##  [9] 2.443118 3.716092
##
## [[4]]
##  [1] 2.746408 3.678958 1.901714 2.697845 4.229762 6.287872 4.721969 2.716255
##  [9] 2.655370 3.913068
##
## [[5]]
##  [1] 4.848411 6.217218 5.860600 4.290726 5.359172 4.338016 5.378972 4.621194
##  [9] 4.661215 5.448782
##
## [[6]]
##  [1] 4.964610 4.330497 5.755487 4.783411 6.102427 5.936313 5.051508 5.456728
##  [9] 6.182962 7.573270
##
## [[7]]
##  [1] 7.568044 6.827848 6.154640 8.104314 8.326734 7.594313 9.521609 7.760222
##  [9] 5.737743 4.945799
##
## [[8]]
##  [1] 7.855690 8.753814 7.865452 8.089714 6.296199 8.685428 8.982580 7.493034
##  [9] 8.196391 8.443106
##
## [[9]]
##  [1]  9.649724  9.946690  8.723827  8.065357 10.732050  9.164829  7.871796
##  [8] 10.997025  8.535412  9.398967
##
## [[10]]
##  [1] 10.836244  9.265765  9.607562 10.695390 10.287032 11.368406  8.617340
##  [8]  9.177379 10.943942 10.289098
##
##
## mp_dbl> # You can also use an anonymous function
## mp_dbl> 1:10 |>
## mp_dbl+   map(\(x) rnorm(10, x))
## [[1]]
##  [1]  3.9760990  1.2546184  3.6945091  3.0545441  1.8364784 -0.8665479
##  [7]  0.9590658  1.2907192  0.7090193  0.7583964
##
## [[2]]
##  [1] 0.5883726 2.1143714 2.1673827 1.9771929 1.5946221 2.7158357 2.9110070
##  [8] 1.2992958 1.7654225 3.0695912
##
```

```
## [[3]]
##  [1] 3.319163 1.908390 2.654627 3.530621 3.023206 3.674209 2.770407 2.354166
##  [9] 1.716390 2.015556
##
## [[4]]
##  [1] 5.502928 2.768500 3.336934 4.262855 2.857247 5.323900 4.701552 5.892758
##  [9] 3.427574 4.249538
##
## [[5]]
##  [1] 3.791824 4.935267 5.484745 5.191809 4.772089 5.018183 6.415839 4.950196
##  [9] 3.985086 6.258460
##
## [[6]]
##  [1] 6.571083 7.383522 5.616048 5.072386 6.692594 6.469453 8.101564 7.398066
##  [9] 7.562004 8.310780
##
## [[7]]
##  [1] 7.918544 8.213427 7.906841 6.727089 7.150600 4.864023 7.258692 6.127592
##  [9] 5.140484 5.229383
##
## [[8]]
##  [1]  8.275425  8.039419  7.339205  7.921887  9.382642  7.534802 10.096296
##  [8]  7.877838  7.267259  6.409670
##
## [[9]]
##  [1]  9.597695  9.426004  7.143627  8.904132 11.399949  9.733212  7.424642
##  [8]  9.835707  9.934420 10.512917
##
## [[10]]
##  [1] 10.830231 10.386768 10.281093 10.262580  9.346308 10.208831 10.716805
##  [8]  9.567074  9.253650  9.732950
##
##
## mp_dbl> # Simplify output to a vector instead of a list by computing the mean of the distribut
## mp_dbl> 1:10 |>
## mp_dbl+   map(rnorm, n = 10) |>  # output a list
## mp_dbl+   map_dbl(mean)           # output an atomic vector
##  [1] 0.7081292 1.7889272 2.6529856 4.3318019 4.8410694 5.6520300 7.0866786
##  [8] 7.8052077 9.1405763 9.7279751
##
## mp_dbl> # Using set_names() with character vectors is handy to keep track
## mp_dbl> # of the original inputs:
## mp_dbl> set_names(c("foo", "bar")) |> map_chr(paste0, ":suffix")
##          foo          bar
## "foo:suffix" "bar:suffix"
##
```

```
## mp_dbl> # Working with lists
## mp_dbl> favorite_desserts <- list(Sophia = "banana bread", Eliott = "pancakes", Kari
##
## mp_dbl> favorite_desserts |> map_chr(\(food) paste(food, "rocks!"))
##                  Sophia                  Eliott                  Karina
##   "banana bread rocks!"       "pancakes rocks!" "chocolate cake rocks!"
##
## mp_dbl> # Extract by name or position
## mp_dbl> # .default specifies value for elements that are missing or NULL
## mp_dbl> l1 <- list(list(a = 1L), list(a = NULL, b = 2L), list(b = 3L))
##
## mp_dbl> l1 |> map("a", .default = "???")
## [[1]]
## [1] 1
##
## [[2]]
## [1] "???"
##
## [[3]]
## [1] "???"
##
##
## mp_dbl> l1 |> map_int("b", .default = NA)
## [1] NA  2  3
##
## mp_dbl> l1 |> map_int(2, .default = NA)
## [1] NA  2 NA
##
## mp_dbl> # Supply multiple values to index deeply into a list
## mp_dbl> l2 <- list(
## mp_dbl+   list(num = 1:3,     letters[1:3]),
## mp_dbl+   list(num = 101:103, letters[4:6]),
## mp_dbl+   list()
## mp_dbl+ )
##
## mp_dbl> l2 |> map(c(2, 2))
## [[1]]
## [1] "b"
##
## [[2]]
## [1] "e"
##
## [[3]]
## NULL
##
##
```

```
## mp_dbl> # Use a list to build an extractor that mixes numeric indices and names,
## mp_dbl> # and .default to provide a default value if the element does not exist
## mp_dbl> l2 |> map(list("num", 3))
## [[1]]
## [1] 3
##
## [[2]]
## [1] 103
##
## [[3]]
## NULL
##
##
## mp_dbl> l2 |> map_int(list("num", 3), .default = NA)
## [1]   3 103  NA
##
## mp_dbl> # Working with data frames
## mp_dbl> # Use map_lgl(), map_dbl(), etc to return a vector instead of a list:
## mp_dbl> mtcars |> map_dbl(sum)
##      mpg      cyl     disp       hp     drat       wt     qsec       vs
##  642.900  198.000 7383.100 4694.000  115.090  102.952  571.160   14.000
##       am     gear     carb
##   13.000  118.000   90.000
##
## mp_dbl> # A more realistic example: split a data frame into pieces, fit a
## mp_dbl> # model to each piece, summarise and extract R^2
## mp_dbl> mtcars |>
## mp_dbl+   split(mtcars$cyl) |>
## mp_dbl+   map(\(df) lm(mpg ~ wt, data = df)) |>
## mp_dbl+   map(summary) |>
## mp_dbl+   map_dbl("r.squared")
##         4         6         8
## 0.5086326 0.4645102 0.4229655
example("map_df")
```

```
##
## map_df> # map -----------------------------------------
## map_df> # Was:
## map_df> mtcars |>
## map_df+   split(mtcars$cyl) |>
## map_df+   map(\(df) lm(mpg ~ wt, data = df)) |>
## map_df+   map_dfr(\(mod) as.data.frame(t(as.matrix(coef(mod)))))
##   (Intercept)        wt
## 1    39.57120 -5.647025
## 2    28.40884 -2.780106
```

```
## 3    23.86803 -2.192438
##
## map_df> # Now:
## map_df> mtcars |>
## map_df+   split(mtcars$cyl) |>
## map_df+   map(\(df) lm(mpg ~ wt, data = df)) |>
## map_df+   map(\(mod) as.data.frame(t(as.matrix(coef(mod))))) |>
## map_df+   list_rbind()
##   (Intercept)        wt
## 1    39.57120 -5.647025
## 2    28.40884 -2.780106
## 3    23.86803 -2.192438
##
## map_df> # map2 ---------------------------------------------
## map_df>
## map_df> ex_fun <- function(arg1, arg2){
## map_df+   col <- arg1 + arg2
## map_df+   x <- as.data.frame(col)
## map_df+ }
##
## map_df> arg1 <- 1:4
##
## map_df> arg2 <- 10:13
##
## map_df> # was
## map_df> map2_dfr(arg1, arg2, ex_fun)
##   col
## 1  11
## 2  13
## 3  15
## 4  17
##
## map_df> # now
## map_df> map2(arg1, arg2, ex_fun) |> list_rbind()
##   col
## 1  11
## 2  13
## 3  15
## 4  17
##
## map_df> # was
## map_df> map2_dfc(arg1, arg2, ex_fun)
##   col...1 col...2 col...3 col...4
## 1      11      13      15      17
##
## map_df> # now
```

```
## map_df> map2(arg1, arg2, ex_fun) |> list_cbind()
##   col...1 col...2 col...3 col...4
## 1      11      13      15      17
```

```
example("map_dfc")
```

```
##
## mp_dfc> # map ------------------------------------------
## mp_dfc> # Was:
## mp_dfc> mtcars |>
## mp_dfc+   split(mtcars$cyl) |>
## mp_dfc+   map(\(df) lm(mpg ~ wt, data = df)) |>
## mp_dfc+   map_dfr(\(mod) as.data.frame(t(as.matrix(coef(mod)))))
##   (Intercept)        wt
## 1    39.57120 -5.647025
## 2    28.40884 -2.780106
## 3    23.86803 -2.192438
##
## mp_dfc> # Now:
## mp_dfc> mtcars |>
## mp_dfc+   split(mtcars$cyl) |>
## mp_dfc+   map(\(df) lm(mpg ~ wt, data = df)) |>
## mp_dfc+   map(\(mod) as.data.frame(t(as.matrix(coef(mod))))) |>
## mp_dfc+   list_rbind()
##   (Intercept)        wt
## 1    39.57120 -5.647025
## 2    28.40884 -2.780106
## 3    23.86803 -2.192438
##
## mp_dfc> # map2 -----------------------------------------
## mp_dfc>
## mp_dfc> ex_fun <- function(arg1, arg2){
## mp_dfc+   col <- arg1 + arg2
## mp_dfc+   x <- as.data.frame(col)
## mp_dfc+ }
##
## mp_dfc> arg1 <- 1:4
##
## mp_dfc> arg2 <- 10:13
##
## mp_dfc> # was
## mp_dfc> map2_dfr(arg1, arg2, ex_fun)
##   col
## 1  11
## 2  13
## 3  15
```

```
## 4  17
##
## mp_dfc> # now
## mp_dfc> map2(arg1, arg2, ex_fun) |> list_rbind()
##   col
## 1  11
## 2  13
## 3  15
## 4  17
##
## mp_dfc> # was
## mp_dfc> map2_dfc(arg1, arg2, ex_fun)
##   col...1 col...2 col...3 col...4
## 1      11      13      15      17
##
## mp_dfc> # now
## mp_dfc> map2(arg1, arg2, ex_fun) |> list_cbind()
##   col...1 col...2 col...3 col...4
## 1      11      13      15      17
```

```
example("map_dfr")
```

```
##
## mp_dfr> # map ------------------------------------------
## mp_dfr> # Was:
## mp_dfr> mtcars |>
## mp_dfr+   split(mtcars$cyl) |>
## mp_dfr+   map(\(df) lm(mpg ~ wt, data = df)) |>
## mp_dfr+   map_dfr(\(mod) as.data.frame(t(as.matrix(coef(mod)))))
##   (Intercept)        wt
## 1    39.57120 -5.647025
## 2    28.40884 -2.780106
## 3    23.86803 -2.192438
##
## mp_dfr> # Now:
## mp_dfr> mtcars |>
## mp_dfr+   split(mtcars$cyl) |>
## mp_dfr+   map(\(df) lm(mpg ~ wt, data = df)) |>
## mp_dfr+   map(\(mod) as.data.frame(t(as.matrix(coef(mod))))) |>
## mp_dfr+   list_rbind()
##   (Intercept)        wt
## 1    39.57120 -5.647025
## 2    28.40884 -2.780106
## 3    23.86803 -2.192438
##
## mp_dfr> # map2 -----------------------------------------
```

```
## mp_dfr>
## mp_dfr> ex_fun <- function(arg1, arg2){
## mp_dfr+   col <- arg1 + arg2
## mp_dfr+   x <- as.data.frame(col)
## mp_dfr+ }
##
## mp_dfr> arg1 <- 1:4
##
## mp_dfr> arg2 <- 10:13
##
## mp_dfr> # was
## mp_dfr> map2_dfr(arg1, arg2, ex_fun)
##   col
## 1  11
## 2  13
## 3  15
## 4  17
##
## mp_dfr> # now
## mp_dfr> map2(arg1, arg2, ex_fun) |> list_rbind()
##   col
## 1  11
## 2  13
## 3  15
## 4  17
##
## mp_dfr> # was
## mp_dfr> map2_dfc(arg1, arg2, ex_fun)
##   col...1 col...2 col...3 col...4
## 1      11      13      15      17
##
## mp_dfr> # now
## mp_dfr> map2(arg1, arg2, ex_fun) |> list_cbind()
##   col...1 col...2 col...3 col...4
## 1      11      13      15      17
```

```
example("map_int")
```

```
##
## map_nt> # Compute normal distributions from an atomic vector
## map_nt> 1:10 |>
## map_nt+   map(rnorm, n = 10)
## [[1]]
##  [1] 2.5422111 0.4021407 1.7141481 2.7224324 0.9183636 1.9756588 1.2910241
##  [8] 1.9339577 3.6850796 2.1987220
##
```

```
## [[2]]
##  [1] 1.2452496 2.7253760 2.5737687 0.2338606 2.6551470 1.5293998 1.1392398
##  [8] 1.3034853 0.3254777 2.6342778
##
## [[3]]
##  [1] 2.929580 2.988331 5.080413 3.129451 1.342445 2.784670 3.289659 4.321456
##  [9] 3.861922 3.085172
##
## [[4]]
##  [1] 3.897529 1.773898 4.087206 3.201323 1.669706 5.621821 4.660167 5.633675
##  [9] 4.232073 5.473411
##
## [[5]]
##  [1] 5.411422 4.588226 3.967858 5.918767 6.343955 4.872591 6.178822 4.562077
##  [9] 4.994500 4.134530
##
## [[6]]
##  [1] 5.234314 5.141253 5.951185 5.992574 8.411677 6.967372 7.840896 4.571293
##  [9] 7.141144 4.905555
##
## [[7]]
##  [1] 7.347490 7.048284 7.804674 7.947599 7.799814 6.991067 6.519861 6.168931
##  [9] 7.677628 7.387143
##
## [[8]]
##  [1] 8.526634 6.163702 7.717388 8.740053 9.122004 6.299988 8.331645 9.552575
##  [9] 8.039764 7.578471
##
## [[9]]
##  [1] 9.724332 7.950483 9.336435 6.722180 7.611632 8.502948 9.624389 8.525958
##  [9] 8.559207 7.183400
##
## [[10]]
##  [1]  7.766780 10.015169  9.044650 10.255979  8.167602  9.910853  8.236558
##  [8]  8.392112  9.498035  9.901574
##
##
## map_nt> # You can also use an anonymous function
## map_nt> 1:10 |>
## map_nt+   map(\(x) rnorm(10, x))
## [[1]]
##  [1] 0.9014311 1.6870138 2.9377070 0.5282615 0.8509901 0.7816072 1.2315584
##  [8] 1.4241753 2.1827224 1.3141799
##
## [[2]]
##  [1]  1.00221094  2.88656973  1.88722030  1.91012022 -0.44551995 -0.07006742
```

```
##  [7]  1.71234760  1.17464140  0.47764710  2.30489031
##
## [[3]]
##  [1] 2.209367 4.025049 3.952060 4.189782 3.674476 2.610965 4.502394 3.854455
##  [9] 2.461879 3.958585
##
## [[4]]
##  [1] 2.939385 3.620529 3.460630 4.186249 2.648621 4.732140 3.148058 4.360798
##  [9] 3.279369 2.229546
##
## [[5]]
##  [1] 3.903176 7.040207 4.125612 6.585749 6.627877 6.136277 4.101456 5.274264
##  [9] 4.627127 5.038865
##
## [[6]]
##  [1] 4.693792 6.869907 5.560754 5.011828 6.953520 7.671481 4.278122 5.737529
##  [9] 5.268749 7.553824
##
## [[7]]
##  [1] 7.107738 6.395664 6.598625 6.790873 6.522937 7.842332 6.706031 6.625714
##  [9] 8.062757 7.082121
##
## [[8]]
##  [1] 7.741817 7.943173 8.699790 6.820926 9.047361 7.669509 7.913519 8.590472
##  [9] 7.663706 8.928659
##
## [[9]]
##  [1]  9.821693  9.361577  8.585243  8.353028  7.961186  9.789546 10.141514
##  [8]  8.136637  9.678746  9.075393
##
## [[10]]
##  [1]  7.806962  8.695467 10.255478  9.624756  8.629521 10.118393  9.172750
##  [8] 10.593297  9.355767  8.721120
##
##
## map_nt> # Simplify output to a vector instead of a list by computing the mean of the distribut
## map_nt> 1:10 |>
## map_nt+   map(rnorm, n = 10) |>  # output a list
## map_nt+   map_dbl(mean)           # output an atomic vector
##  [1] 0.5751133 1.9352741 2.5438236 4.1117336 5.3934533 6.0711326 7.0581415
##  [8] 8.1600126 9.0996499 9.8527587
##
## map_nt> # Using set_names() with character vectors is handy to keep track
## map_nt> # of the original inputs:
## map_nt> set_names(c("foo", "bar")) |> map_chr(paste0, ":suffix")
##          foo          bar
```

```
## "foo:suffix" "bar:suffix"
##
## map_nt> # Working with lists
## map_nt> favorite_desserts <- list(Sophia = "banana bread", Eliott = "pancakes", Kari
##
## map_nt> favorite_desserts |> map_chr(\(food) paste(food, "rocks!"))
##                  Sophia                  Eliott                  Karina
##   "banana bread rocks!"       "pancakes rocks!" "chocolate cake rocks!"
##
## map_nt> # Extract by name or position
## map_nt> # .default specifies value for elements that are missing or NULL
## map_nt> l1 <- list(list(a = 1L), list(a = NULL, b = 2L), list(b = 3L))
##
## map_nt> l1 |> map("a", .default = "???")
## [[1]]
## [1] 1
##
## [[2]]
## [1] "???"
##
## [[3]]
## [1] "???"
##
##
## map_nt> l1 |> map_int("b", .default = NA)
## [1] NA  2  3
##
## map_nt> l1 |> map_int(2, .default = NA)
## [1] NA  2 NA
##
## map_nt> # Supply multiple values to index deeply into a list
## map_nt> l2 <- list(
## map_nt+   list(num = 1:3,     letters[1:3]),
## map_nt+   list(num = 101:103, letters[4:6]),
## map_nt+   list()
## map_nt+ )
##
## map_nt> l2 |> map(c(2, 2))
## [[1]]
## [1] "b"
##
## [[2]]
## [1] "e"
##
## [[3]]
## NULL
```

```
##
##
## map_nt> # Use a list to build an extractor that mixes numeric indices and names,
## map_nt> # and .default to provide a default value if the element does not exist
## map_nt> l2 |> map(list("num", 3))
## [[1]]
## [1] 3
##
## [[2]]
## [1] 103
##
## [[3]]
## NULL
##
##
## map_nt> l2 |> map_int(list("num", 3), .default = NA)
## [1]   3 103  NA
##
## map_nt> # Working with data frames
## map_nt> # Use map_lgl(), map_dbl(), etc to return a vector instead of a list:
## map_nt> mtcars |> map_dbl(sum)
##      mpg      cyl     disp       hp     drat       wt     qsec       vs
##  642.900  198.000 7383.100 4694.000  115.090  102.952  571.160   14.000
##       am     gear     carb
##   13.000  118.000   90.000
##
## map_nt> # A more realistic example: split a data frame into pieces, fit a
## map_nt> # model to each piece, summarise and extract R^2
## map_nt> mtcars |>
## map_nt+   split(mtcars$cyl) |>
## map_nt+   map(\(df) lm(mpg ~ wt, data = df)) |>
## map_nt+   map(summary) |>
## map_nt+   map_dbl("r.squared")
##         4         6         8
## 0.5086326 0.4645102 0.4229655
```

```
example("map_lgl")
```

```
##
## mp_lgl> # Compute normal distributions from an atomic vector
## mp_lgl> 1:10 |>
## mp_lgl+   map(rnorm, n = 10)
## [[1]]
##  [1]  3.2596259  1.1308918  2.8777759 -0.8100157  0.9469446 -0.5830875
##  [7]  1.8059201 -0.5292960  0.6767301  2.1339415
##
```

```
## [[2]]
##  [1] 2.518656 3.579340 1.253173 2.877509 1.817905 4.174185 2.387985 2.516081
##  [9] 2.508694 3.029748
##
## [[3]]
##  [1] 2.613659 2.115088 2.155567 2.430888 2.831859 2.391442 2.735278 3.700055
##  [9] 3.254243 1.190567
##
## [[4]]
##  [1] 5.738088 5.258269 2.682881 3.342720 2.812177 4.755213 3.705133 3.944537
##  [9] 4.359484 4.144489
##
## [[5]]
##  [1] 5.550374 3.740629 4.638784 6.304297 5.602153 2.749538 5.810548 5.460709
##  [9] 5.289067 2.589647
##
## [[6]]
##  [1] 5.279711 4.805143 4.111902 6.909805 5.666989 5.606887 7.142211 7.947518
##  [9] 5.833854 7.043028
##
## [[7]]
##  [1] 6.828755 6.862319 6.251082 6.582391 6.593893 7.680063 7.239242 5.638960
##  [9] 8.374596 6.688960
##
## [[8]]
##  [1] 10.394254  9.109028  6.748479  6.387435  9.299408  8.197549  7.307681
##  [8]  9.495579  7.877587  8.015704
##
## [[9]]
##  [1]  6.988197  8.859449  9.635704 11.090629  9.339850  9.387460  8.709038
##  [8]  9.074269  8.911087  8.417523
##
## [[10]]
##  [1] 11.245625  9.790738  9.772852  8.828806  9.768221  9.556613  9.516199
##  [8] 11.197519  8.892167 11.115274
##
##
## mp_lgl> # You can also use an anonymous function
## mp_lgl> 1:10 |>
## mp_lgl+   map(\(x) rnorm(10, x))
## [[1]]
##  [1] -0.3400305  1.8758790  0.7571540  1.5774422  0.3581211  0.2266559
##  [7]  0.4826123  0.9561373  0.8676008  1.2213767
##
## [[2]]
##  [1] -0.4531517  1.7916098  1.8831952  3.9097523  2.1478987  2.1906216
```

```
##  [7]  1.0598576  3.4049266  3.8275817  0.8980735
##
## [[3]]
##  [1] 3.413596 1.350841 3.854446 2.971624 3.877913 4.372073 2.909050 2.295326
##  [9] 3.030605 1.815552
##
## [[4]]
##  [1] 4.968972 3.063306 3.321670 5.021347 3.055649 2.082722 4.857545 3.422961
##  [9] 3.865416 4.065119
##
## [[5]]
##  [1] 4.222720 3.830492 4.287737 5.583767 4.764375 4.988556 5.041906 5.655340
##  [9] 5.685690 6.013751
##
## [[6]]
##  [1] 6.551380 6.111882 5.015243 7.476668 7.344987 6.801517 6.444911 4.801799
##  [9] 6.813110 5.986108
##
## [[7]]
##  [1] 5.158183 6.103998 5.527856 9.363381 7.585124 5.331641 6.549442 5.274425
##  [9] 5.689743 7.436685
##
## [[8]]
##  [1] 5.361061 8.717293 8.796389 8.559136 7.198982 7.234764 7.789078 6.785173
##  [9] 8.882919 7.572246
##
## [[9]]
##  [1] 6.660130 8.160774 9.000252 7.813552 7.660528 6.748073 8.655040 9.712961
##  [9] 8.119107 9.390383
##
## [[10]]
##  [1] 10.05775 10.63391 12.67074 10.27345 10.49757 10.01225  7.95253 11.13273
##  [9] 10.64671 11.34946
##
##
## mp_lgl> # Simplify output to a vector instead of a list by computing the mean of the distribut
## mp_lgl> 1:10 |>
## mp_lgl+   map(rnorm, n = 10) |>  # output a list
## mp_lgl+   map_dbl(mean)           # output an atomic vector
##  [1] 1.087478 1.726914 2.585272 4.393208 4.819396 6.258533 6.984639 8.327838
##  [9] 8.658229 9.873142
##
## mp_lgl> # Using set_names() with character vectors is handy to keep track
## mp_lgl> # of the original inputs:
## mp_lgl> set_names(c("foo", "bar")) |> map_chr(paste0, ":suffix")
##          foo          bar
```

```
## "foo:suffix" "bar:suffix"
##
## mp_lgl> # Working with lists
## mp_lgl> favorite_desserts <- list(Sophia = "banana bread", Eliott = "pancakes", Kari
##
## mp_lgl> favorite_desserts |> map_chr(\(food) paste(food, "rocks!"))
##                  Sophia                  Eliott                  Karina
##   "banana bread rocks!"       "pancakes rocks!" "chocolate cake rocks!"
##
## mp_lgl> # Extract by name or position
## mp_lgl> # .default specifies value for elements that are missing or NULL
## mp_lgl> l1 <- list(list(a = 1L), list(a = NULL, b = 2L), list(b = 3L))
##
## mp_lgl> l1 |> map("a", .default = "???")
## [[1]]
## [1] 1
##
## [[2]]
## [1] "???"
##
## [[3]]
## [1] "???"
##
##
## mp_lgl> l1 |> map_int("b", .default = NA)
## [1] NA  2  3
##
## mp_lgl> l1 |> map_int(2, .default = NA)
## [1] NA  2 NA
##
## mp_lgl> # Supply multiple values to index deeply into a list
## mp_lgl> l2 <- list(
## mp_lgl+   list(num = 1:3,     letters[1:3]),
## mp_lgl+   list(num = 101:103, letters[4:6]),
## mp_lgl+   list()
## mp_lgl+ )
##
## mp_lgl> l2 |> map(c(2, 2))
## [[1]]
## [1] "b"
##
## [[2]]
## [1] "e"
##
## [[3]]
## NULL
```

```
##
##
## mp_lgl> # Use a list to build an extractor that mixes numeric indices and names,
## mp_lgl> # and .default to provide a default value if the element does not exist
## mp_lgl> l2 |> map(list("num", 3))
## [[1]]
## [1] 3
##
## [[2]]
## [1] 103
##
## [[3]]
## NULL
##
##
## mp_lgl> l2 |> map_int(list("num", 3), .default = NA)
## [1]   3 103  NA
##
## mp_lgl> # Working with data frames
## mp_lgl> # Use map_lgl(), map_dbl(), etc to return a vector instead of a list:
## mp_lgl> mtcars |> map_dbl(sum)
##      mpg      cyl     disp       hp     drat       wt     qsec       vs
##  642.900  198.000 7383.100 4694.000  115.090  102.952  571.160   14.000
##       am     gear     carb
##   13.000  118.000   90.000
##
## mp_lgl> # A more realistic example: split a data frame into pieces, fit a
## mp_lgl> # model to each piece, summarise and extract R^2
## mp_lgl> mtcars |>
## mp_lgl+   split(mtcars$cyl) |>
## mp_lgl+   map(\(df) lm(mpg ~ wt, data = df)) |>
## mp_lgl+   map(summary) |>
## mp_lgl+   map_dbl("r.squared")
##         4         6         8
## 0.5086326 0.4645102 0.4229655
example("map_vec")
```

```
##
## map_vc> # Compute normal distributions from an atomic vector
## map_vc> 1:10 |>
## map_vc+   map(rnorm, n = 10)
## [[1]]
##  [1]  2.17626138  1.67804928  0.92008228  0.78759298  1.61457855  0.16079783
##  [7] -0.06332941  1.92674341  3.01708606 -2.48891510
##
```

```
## [[2]]
##  [1]  3.673801542  3.744711466  2.375820275  2.245955988  0.203559117
##  [6]  2.254103836  2.949852028 -0.002146877  2.801867340  0.609013011
##
## [[3]]
##  [1] 3.977877 3.351175 1.743524 2.103031 3.412541 3.081624 2.528418 4.326099
##  [9] 4.787997 1.786226
##
## [[4]]
##  [1] 3.475558 5.900686 4.531925 4.764991 5.097481 5.020726 4.584727 4.055680
##  [9] 3.519812 3.236487
##
## [[5]]
##  [1] 3.398525 5.040242 4.005221 5.143551 4.812688 5.004925 5.944297 3.097594
##  [9] 5.860018 6.119821
##
## [[6]]
##  [1] 4.816311 5.571360 4.844557 6.450414 4.792054 6.874158 5.374873 4.483418
##  [9] 6.532257 5.905215
##
## [[7]]
##  [1] 7.169294 7.882082 6.154702 7.393026 9.598388 6.861219 5.807888 7.132601
##  [9] 6.284560 6.850790
##
## [[8]]
##  [1] 8.959371 9.911555 8.767932 7.779349 6.089274 7.179417 8.224626 6.441294
##  [9] 7.754638 8.274268
##
## [[9]]
##  [1]  8.045379  8.879460  7.726395  8.373508  8.172428  8.413684 10.585410
##  [8]  8.529829  8.192435  7.995716
##
## [[10]]
##  [1] 10.606845 10.289215  8.758001 11.642749  8.847500 11.376809  8.474199
##  [8]  9.359728 10.864990 10.765945
##
##
## map_vc> # You can also use an anonymous function
## map_vc> 1:10 |>
## map_vc+   map(\(x) rnorm(10, x))
## [[1]]
##  [1]  3.4662913  1.1723220  1.4859593  0.6499027  0.2562959 -0.3725985
##  [7]  0.6677580  0.7043232  0.5045961  1.1031765
##
## [[2]]
##  [1] 1.502955 2.934855 3.679970 3.469558 2.303236 3.924677 1.257266 2.533597
```

```
##  [9] 3.576809 1.962461
##
## [[3]]
##  [1] 2.483381 1.630704 2.499152 5.332570 2.364430 2.609793 3.443532 2.112707
##  [9] 2.492230 2.940492
##
## [[4]]
##  [1] 5.033334 4.493912 3.377618 2.887420 4.553999 2.790638 4.724331 5.938032
##  [9] 4.782328 4.809190
##
## [[5]]
##  [1] 3.566891 7.110768 1.669611 5.150061 6.508896 4.173412 3.537395 6.773813
##  [9] 5.472850 5.920432
##
## [[6]]
##  [1] 5.692475 6.099684 5.818728 6.125640 7.045099 6.359195 6.078522 5.901653
##  [9] 5.486840 6.620587
##
## [[7]]
##  [1] 8.300186 7.377238 7.303532 7.444543 6.810121 6.459232 5.197436 7.171643
##  [9] 5.948223 7.668153
##
## [[8]]
##  [1] 9.129422 7.096704 7.209470 5.945316 6.977012 7.734776 7.334505 8.089630
##  [9] 9.083683 6.311505
##
## [[9]]
##  [1] 10.789999  8.729235  8.947319  7.514307  8.758411  6.698666  7.415218
##  [8]  8.819029  8.620932  8.958309
##
## [[10]]
##  [1] 11.751580 12.782818  9.512278 10.527264  6.844998  9.808908  9.774774
##  [8]  9.776148  8.531300 10.411145
##
##
## map_vc> # Simplify output to a vector instead of a list by computing the mean of the distribut
## map_vc> 1:10 |>
## map_vc+   map(rnorm, n = 10) |>  # output a list
## map_vc+   map_dbl(mean)           # output an atomic vector
##  [1]  0.6617901  2.1134256  2.9571496  3.9290110  4.8397800  6.2243426
##  [7]  6.5905257  7.9533669  8.9295762 10.3075540
##
## map_vc> # Using set_names() with character vectors is handy to keep track
## map_vc> # of the original inputs:
## map_vc> set_names(c("foo", "bar")) |> map_chr(paste0, ":suffix")
##          foo          bar
```

```
## "foo:suffix" "bar:suffix"
##
## map_vc> # Working with lists
## map_vc> favorite_desserts <- list(Sophia = "banana bread", Eliott = "pancakes", Kari
##
## map_vc> favorite_desserts |> map_chr(\(food) paste(food, "rocks!"))
##                  Sophia                  Eliott                  Karina
##   "banana bread rocks!"       "pancakes rocks!" "chocolate cake rocks!"
##
## map_vc> # Extract by name or position
## map_vc> # .default specifies value for elements that are missing or NULL
## map_vc> l1 <- list(list(a = 1L), list(a = NULL, b = 2L), list(b = 3L))
##
## map_vc> l1 |> map("a", .default = "???")
## [[1]]
## [1] 1
##
## [[2]]
## [1] "???"
##
## [[3]]
## [1] "???"
##
##
## map_vc> l1 |> map_int("b", .default = NA)
## [1] NA  2  3
##
## map_vc> l1 |> map_int(2, .default = NA)
## [1] NA  2 NA
##
## map_vc> # Supply multiple values to index deeply into a list
## map_vc> l2 <- list(
## map_vc+   list(num = 1:3,     letters[1:3]),
## map_vc+   list(num = 101:103, letters[4:6]),
## map_vc+   list()
## map_vc+ )
##
## map_vc> l2 |> map(c(2, 2))
## [[1]]
## [1] "b"
##
## [[2]]
## [1] "e"
##
## [[3]]
## NULL
```

```
##
##
## map_vc> # Use a list to build an extractor that mixes numeric indices and names,
## map_vc> # and .default to provide a default value if the element does not exist
## map_vc> l2 |> map(list("num", 3))
## [[1]]
## [1] 3
##
## [[2]]
## [1] 103
##
## [[3]]
## NULL
##
##
## map_vc> l2 |> map_int(list("num", 3), .default = NA)
## [1]   3 103  NA
##
## map_vc> # Working with data frames
## map_vc> # Use map_lgl(), map_dbl(), etc to return a vector instead of a list:
## map_vc> mtcars |> map_dbl(sum)
##      mpg      cyl     disp       hp     drat       wt     qsec       vs
##  642.900  198.000 7383.100 4694.000  115.090  102.952  571.160   14.000
##       am     gear     carb
##   13.000  118.000   90.000
##
## map_vc> # A more realistic example: split a data frame into pieces, fit a
## map_vc> # model to each piece, summarise and extract R^2
## map_vc> mtcars |>
## map_vc+   split(mtcars$cyl) |>
## map_vc+   map(\(df) lm(mpg ~ wt, data = df)) |>
## map_vc+   map(summary) |>
## map_vc+   map_dbl("r.squared")
##         4         6         8
## 0.5086326 0.4645102 0.4229655
```

4.2 map2 functions

```
example("map2")
```

```
##
## map2> x <- list(1, 1, 1)
##
## map2> y <- list(10, 20, 30)
##
```

```
## map2> map2(x, y, \(x, y) x + y)
## [[1]]
## [1] 11
##
## [[2]]
## [1] 21
##
## [[3]]
## [1] 31
##
##
## map2> # Or just
## map2> map2(x, y, `+`)
## [[1]]
## [1] 11
##
## [[2]]
## [1] 21
##
## [[3]]
## [1] 31
##
##
## map2> # Split into pieces, fit model to each piece, then predict
## map2> by_cyl <- mtcars |> split(mtcars$cyl)
##
## map2> mods <- by_cyl |> map(\(df) lm(mpg ~ wt, data = df))
##
## map2> map2(mods, by_cyl, predict)
## $`4`
##     Datsun 710      Merc 240D       Merc 230       Fiat 128    Honda Civic
##       26.47010       21.55719       21.78307       27.14774       30.45125
## Toyota Corolla  Toyota Corona      Fiat X1-9  Porsche 914-2   Lotus Europa
##       29.20890       25.65128       28.64420       27.48656       31.02725
##     Volvo 142E
##       23.87247
##
## $`6`
##      Mazda RX4  Mazda RX4 Wag Hornet 4 Drive        Valiant       Merc 280
##       21.12497       20.41604       19.47080       18.78968       18.84528
##      Merc 280C   Ferrari Dino
##       18.84528       20.70795
##
## $`8`
##   Hornet Sportabout          Duster 360          Merc 450SE          Merc 450SL
##            16.32604            16.04103            14.94481            15.69024
```

```
##         Merc 450SLC  Cadillac Fleetwood Lincoln Continental   Chrysler Imperial
##            15.58061            12.35773            11.97625            12.14945
##    Dodge Challenger         AMC Javelin          Camaro Z28    Pontiac Firebird
##            16.15065            16.33700            15.44907            15.43811
##      Ford Pantera L       Maserati Bora
##            16.91800            16.04103
```

```
example("map2_chr")
```

```
##
## mp2_ch> x <- list(1, 1, 1)
##
## mp2_ch> y <- list(10, 20, 30)
##
## mp2_ch> map2(x, y, \(x, y) x + y)
## [[1]]
## [1] 11
##
## [[2]]
## [1] 21
##
## [[3]]
## [1] 31
##
##
## mp2_ch> # Or just
## mp2_ch> map2(x, y, `+`)
## [[1]]
## [1] 11
##
## [[2]]
## [1] 21
##
## [[3]]
## [1] 31
##
##
## mp2_ch> # Split into pieces, fit model to each piece, then predict
## mp2_ch> by_cyl <- mtcars |> split(mtcars$cyl)
##
## mp2_ch> mods <- by_cyl |> map(\(df) lm(mpg ~ wt, data = df))
##
## mp2_ch> map2(mods, by_cyl, predict)
## $`4`
##     Datsun 710      Merc 240D       Merc 230       Fiat 128    Honda Civic
##       26.47010       21.55719       21.78307       27.14774       30.45125
```

```
## Toyota Corolla  Toyota Corona      Fiat X1-9  Porsche 914-2   Lotus Europa
##       29.20890       25.65128       28.64420       27.48656       31.02725
##     Volvo 142E
##       23.87247
##
## $`6`
##      Mazda RX4  Mazda RX4 Wag Hornet 4 Drive        Valiant       Merc 280
##       21.12497       20.41604       19.47080       18.78968       18.84528
##      Merc 280C   Ferrari Dino
##       18.84528       20.70795
##
## $`8`
##   Hornet Sportabout          Duster 360          Merc 450SE          Merc 450SL
##            16.32604            16.04103            14.94481            15.69024
##         Merc 450SLC  Cadillac Fleetwood Lincoln Continental   Chrysler Imperial
##            15.58061            12.35773            11.97625            12.14945
##    Dodge Challenger         AMC Javelin          Camaro Z28    Pontiac Firebird
##            16.15065            16.33700            15.44907            15.43811
##      Ford Pantera L       Maserati Bora
##            16.91800            16.04103
```

```
example("map2_dbl")
```

```
##
## mp2_db> x <- list(1, 1, 1)
##
## mp2_db> y <- list(10, 20, 30)
##
## mp2_db> map2(x, y, \(x, y) x + y)
## [[1]]
## [1] 11
##
## [[2]]
## [1] 21
##
## [[3]]
## [1] 31
##
##
## mp2_db> # Or just
## mp2_db> map2(x, y, `+`)
## [[1]]
## [1] 11
##
## [[2]]
## [1] 21
```

```
##
## [[3]]
## [1] 31
##
##
## mp2_db> # Split into pieces, fit model to each piece, then predict
## mp2_db> by_cyl <- mtcars |> split(mtcars$cyl)
##
## mp2_db> mods <- by_cyl |> map(\(df) lm(mpg ~ wt, data = df))
##
## mp2_db> map2(mods, by_cyl, predict)
## $`4`
##     Datsun 710      Merc 240D       Merc 230       Fiat 128    Honda Civic
##       26.47010       21.55719       21.78307       27.14774       30.45125
## Toyota Corolla  Toyota Corona      Fiat X1-9  Porsche 914-2   Lotus Europa
##       29.20890       25.65128       28.64420       27.48656       31.02725
##     Volvo 142E
##       23.87247
##
## $`6`
##      Mazda RX4  Mazda RX4 Wag Hornet 4 Drive        Valiant       Merc 280
##       21.12497       20.41604       19.47080       18.78968       18.84528
##      Merc 280C   Ferrari Dino
##       18.84528       20.70795
##
## $`8`
##   Hornet Sportabout          Duster 360          Merc 450SE          Merc 450SL
##             16.32604            16.04103            14.94481            15.69024
##         Merc 450SLC  Cadillac Fleetwood Lincoln Continental   Chrysler Imperial
##             15.58061            12.35773            11.97625            12.14945
##    Dodge Challenger         AMC Javelin          Camaro Z28    Pontiac Firebird
##             16.15065            16.33700            15.44907            15.43811
##      Ford Pantera L       Maserati Bora
##             16.91800            16.04103
```

```
example("map2_df")
```

```
##
## mp2_df> # map -----------------------------------------------
## mp2_df> # Was:
## mp2_df> mtcars |>
## mp2_df+   split(mtcars$cyl) |>
## mp2_df+   map(\(df) lm(mpg ~ wt, data = df)) |>
## mp2_df+   map_dfr(\(mod) as.data.frame(t(as.matrix(coef(mod)))))
##   (Intercept)        wt
## 1    39.57120 -5.647025
```

```
## 2    28.40884 -2.780106
## 3    23.86803 -2.192438
##
## mp2_df> # Now:
## mp2_df> mtcars |>
## mp2_df+   split(mtcars$cyl) |>
## mp2_df+   map(\(df) lm(mpg ~ wt, data = df)) |>
## mp2_df+   map(\(mod) as.data.frame(t(as.matrix(coef(mod))))) |>
## mp2_df+   list_rbind()
##   (Intercept)        wt
## 1    39.57120 -5.647025
## 2    28.40884 -2.780106
## 3    23.86803 -2.192438
##
## mp2_df> # map2 ---------------------------------------------
## mp2_df>
## mp2_df> ex_fun <- function(arg1, arg2){
## mp2_df+   col <- arg1 + arg2
## mp2_df+   x <- as.data.frame(col)
## mp2_df+ }
##
## mp2_df> arg1 <- 1:4
##
## mp2_df> arg2 <- 10:13
##
## mp2_df> # was
## mp2_df> map2_dfr(arg1, arg2, ex_fun)
##   col
## 1  11
## 2  13
## 3  15
## 4  17
##
## mp2_df> # now
## mp2_df> map2(arg1, arg2, ex_fun) |> list_rbind()
##   col
## 1  11
## 2  13
## 3  15
## 4  17
##
## mp2_df> # was
## mp2_df> map2_dfc(arg1, arg2, ex_fun)
##   col...1 col...2 col...3 col...4
## 1      11      13      15      17
##
```

```
## mp2_df> # now
## mp2_df> map2(arg1, arg2, ex_fun) |> list_cbind()
##   col...1 col...2 col...3 col...4
## 1      11      13      15      17
```

```
example("map2_dfc")
```

```
##
## mp2_df> # map -----------------------------------------
## mp2_df> # Was:
## mp2_df> mtcars |>
## mp2_df+   split(mtcars$cyl) |>
## mp2_df+   map(\(df) lm(mpg ~ wt, data = df)) |>
## mp2_df+   map_dfr(\(mod) as.data.frame(t(as.matrix(coef(mod)))))
##   (Intercept)        wt
## 1    39.57120 -5.647025
## 2    28.40884 -2.780106
## 3    23.86803 -2.192438
##
## mp2_df> # Now:
## mp2_df> mtcars |>
## mp2_df+   split(mtcars$cyl) |>
## mp2_df+   map(\(df) lm(mpg ~ wt, data = df)) |>
## mp2_df+   map(\(mod) as.data.frame(t(as.matrix(coef(mod))))) |>
## mp2_df+   list_rbind()
##   (Intercept)        wt
## 1    39.57120 -5.647025
## 2    28.40884 -2.780106
## 3    23.86803 -2.192438
##
## mp2_df> # map2 ----------------------------------------
## mp2_df>
## mp2_df> ex_fun <- function(arg1, arg2){
## mp2_df+   col <- arg1 + arg2
## mp2_df+   x <- as.data.frame(col)
## mp2_df+ }
##
## mp2_df> arg1 <- 1:4
##
## mp2_df> arg2 <- 10:13
##
## mp2_df> # was
## mp2_df> map2_dfr(arg1, arg2, ex_fun)
##   col
## 1  11
## 2  13
```

```
## 3  15
## 4  17
##
## mp2_df> # now
## mp2_df> map2(arg1, arg2, ex_fun) |> list_rbind()
##   col
## 1  11
## 2  13
## 3  15
## 4  17
##
## mp2_df> # was
## mp2_df> map2_dfc(arg1, arg2, ex_fun)
##   col...1 col...2 col...3 col...4
## 1      11      13      15      17
##
## mp2_df> # now
## mp2_df> map2(arg1, arg2, ex_fun) |> list_cbind()
##   col...1 col...2 col...3 col...4
## 1      11      13      15      17
```

```
example("map2_dfr")
```

```
##
## mp2_df> # map -----------------------------------------------
## mp2_df> # Was:
## mp2_df> mtcars |>
## mp2_df+   split(mtcars$cyl) |>
## mp2_df+   map(\(df) lm(mpg ~ wt, data = df)) |>
## mp2_df+   map_dfr(\(mod) as.data.frame(t(as.matrix(coef(mod)))))
##   (Intercept)        wt
## 1    39.57120 -5.647025
## 2    28.40884 -2.780106
## 3    23.86803 -2.192438
##
## mp2_df> # Now:
## mp2_df> mtcars |>
## mp2_df+   split(mtcars$cyl) |>
## mp2_df+   map(\(df) lm(mpg ~ wt, data = df)) |>
## mp2_df+   map(\(mod) as.data.frame(t(as.matrix(coef(mod))))) |>
## mp2_df+   list_rbind()
##   (Intercept)        wt
## 1    39.57120 -5.647025
## 2    28.40884 -2.780106
## 3    23.86803 -2.192438
##
```

```
## mp2_df> # map2 -------------------------------------------
## mp2_df>
## mp2_df> ex_fun <- function(arg1, arg2){
## mp2_df+   col <- arg1 + arg2
## mp2_df+   x <- as.data.frame(col)
## mp2_df+ }
##
## mp2_df> arg1 <- 1:4
##
## mp2_df> arg2 <- 10:13
##
## mp2_df> # was
## mp2_df> map2_dfr(arg1, arg2, ex_fun)
##   col
## 1  11
## 2  13
## 3  15
## 4  17
##
## mp2_df> # now
## mp2_df> map2(arg1, arg2, ex_fun) |> list_rbind()
##   col
## 1  11
## 2  13
## 3  15
## 4  17
##
## mp2_df> # was
## mp2_df> map2_dfc(arg1, arg2, ex_fun)
##   col...1 col...2 col...3 col...4
## 1      11      13      15      17
##
## mp2_df> # now
## mp2_df> map2(arg1, arg2, ex_fun) |> list_cbind()
##   col...1 col...2 col...3 col...4
## 1      11      13      15      17
```

```
example("map2_int")
```

```
##
## mp2_nt> x <- list(1, 1, 1)
##
## mp2_nt> y <- list(10, 20, 30)
##
## mp2_nt> map2(x, y, \(x, y) x + y)
## [[1]]
```

```
## [1] 11
##
## [[2]]
## [1] 21
##
## [[3]]
## [1] 31
##
##
## mp2_nt> # Or just
## mp2_nt> map2(x, y, `+`)
## [[1]]
## [1] 11
##
## [[2]]
## [1] 21
##
## [[3]]
## [1] 31
##
##
## mp2_nt> # Split into pieces, fit model to each piece, then predict
## mp2_nt> by_cyl <- mtcars |> split(mtcars$cyl)
##
## mp2_nt> mods <- by_cyl |> map(\(df) lm(mpg ~ wt, data = df))
##
## mp2_nt> map2(mods, by_cyl, predict)
## $`4`
##     Datsun 710      Merc 240D       Merc 230       Fiat 128    Honda Civic
##       26.47010       21.55719       21.78307       27.14774       30.45125
## Toyota Corolla  Toyota Corona      Fiat X1-9  Porsche 914-2   Lotus Europa
##       29.20890       25.65128       28.64420       27.48656       31.02725
##     Volvo 142E
##       23.87247
##
## $`6`
##      Mazda RX4  Mazda RX4 Wag Hornet 4 Drive        Valiant       Merc 280
##       21.12497       20.41604       19.47080       18.78968       18.84528
##      Merc 280C   Ferrari Dino
##       18.84528       20.70795
##
## $`8`
##   Hornet Sportabout          Duster 360          Merc 450SE          Merc 450SL
##             16.32604            16.04103            14.94481            15.69024
##         Merc 450SLC  Cadillac Fleetwood Lincoln Continental   Chrysler Imperial
##             15.58061            12.35773            11.97625            12.14945
```

```
##    Dodge Challenger         AMC Javelin          Camaro Z28    Pontiac Firebird
##            16.15065            16.33700            15.44907            15.43811
##      Ford Pantera L       Maserati Bora
##            16.91800            16.04103
```

```
example("map2_lgl")
```

```
##
## mp2_lg> x <- list(1, 1, 1)
##
## mp2_lg> y <- list(10, 20, 30)
##
## mp2_lg> map2(x, y, \(x, y) x + y)
## [[1]]
## [1] 11
##
## [[2]]
## [1] 21
##
## [[3]]
## [1] 31
##
##
## mp2_lg> # Or just
## mp2_lg> map2(x, y, `+`)
## [[1]]
## [1] 11
##
## [[2]]
## [1] 21
##
## [[3]]
## [1] 31
##
##
## mp2_lg> # Split into pieces, fit model to each piece, then predict
## mp2_lg> by_cyl <- mtcars |> split(mtcars$cyl)
##
## mp2_lg> mods <- by_cyl |> map(\(df) lm(mpg ~ wt, data = df))
##
## mp2_lg> map2(mods, by_cyl, predict)
## $`4`
##     Datsun 710      Merc 240D       Merc 230       Fiat 128    Honda Civic
##       26.47010       21.55719       21.78307       27.14774       30.45125
## Toyota Corolla  Toyota Corona      Fiat X1-9  Porsche 914-2   Lotus Europa
##       29.20890       25.65128       28.64420       27.48656       31.02725
```

```
##     Volvo 142E
##       23.87247
##
## $`6`
##      Mazda RX4  Mazda RX4 Wag Hornet 4 Drive        Valiant       Merc 280
##       21.12497       20.41604       19.47080       18.78968       18.84528
##      Merc 280C   Ferrari Dino
##       18.84528       20.70795
##
## $`8`
##   Hornet Sportabout          Duster 360          Merc 450SE          Merc 450SL
##             16.32604            16.04103            14.94481            15.69024
##         Merc 450SLC  Cadillac Fleetwood Lincoln Continental   Chrysler Imperial
##             15.58061            12.35773            11.97625            12.14945
##    Dodge Challenger         AMC Javelin          Camaro Z28    Pontiac Firebird
##             16.15065            16.33700            15.44907            15.43811
##      Ford Pantera L       Maserati Bora
##             16.91800            16.04103
```

```
example("map2_raw")
example("map2_vec")
```

```
##
## mp2_vc> x <- list(1, 1, 1)
##
## mp2_vc> y <- list(10, 20, 30)
##
## mp2_vc> map2(x, y, \(x, y) x + y)
## [[1]]
## [1] 11
##
## [[2]]
## [1] 21
##
## [[3]]
## [1] 31
##
##
## mp2_vc> # Or just
## mp2_vc> map2(x, y, `+`)
## [[1]]
## [1] 11
##
## [[2]]
## [1] 21
##
```

```
## [[3]]
## [1] 31
##
##
## mp2_vc> # Split into pieces, fit model to each piece, then predict
## mp2_vc> by_cyl <- mtcars |> split(mtcars$cyl)
##
## mp2_vc> mods <- by_cyl |> map(\(df) lm(mpg ~ wt, data = df))
##
## mp2_vc> map2(mods, by_cyl, predict)
## $`4`
##     Datsun 710      Merc 240D       Merc 230       Fiat 128    Honda Civic
##       26.47010       21.55719       21.78307       27.14774       30.45125
## Toyota Corolla  Toyota Corona      Fiat X1-9  Porsche 914-2   Lotus Europa
##       29.20890       25.65128       28.64420       27.48656       31.02725
##     Volvo 142E
##       23.87247
##
## $`6`
##      Mazda RX4  Mazda RX4 Wag Hornet 4 Drive        Valiant       Merc 280
##       21.12497       20.41604       19.47080       18.78968       18.84528
##      Merc 280C   Ferrari Dino
##       18.84528       20.70795
##
## $`8`
##   Hornet Sportabout          Duster 360          Merc 450SE          Merc 450SL
##             16.32604            16.04103            14.94481            15.69024
##         Merc 450SLC  Cadillac Fleetwood Lincoln Continental   Chrysler Imperial
##             15.58061            12.35773            11.97625            12.14945
##    Dodge Challenger         AMC Javelin          Camaro Z28    Pontiac Firebird
##             16.15065            16.33700            15.44907            15.43811
##      Ford Pantera L       Maserati Bora
##             16.91800            16.04103
```

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