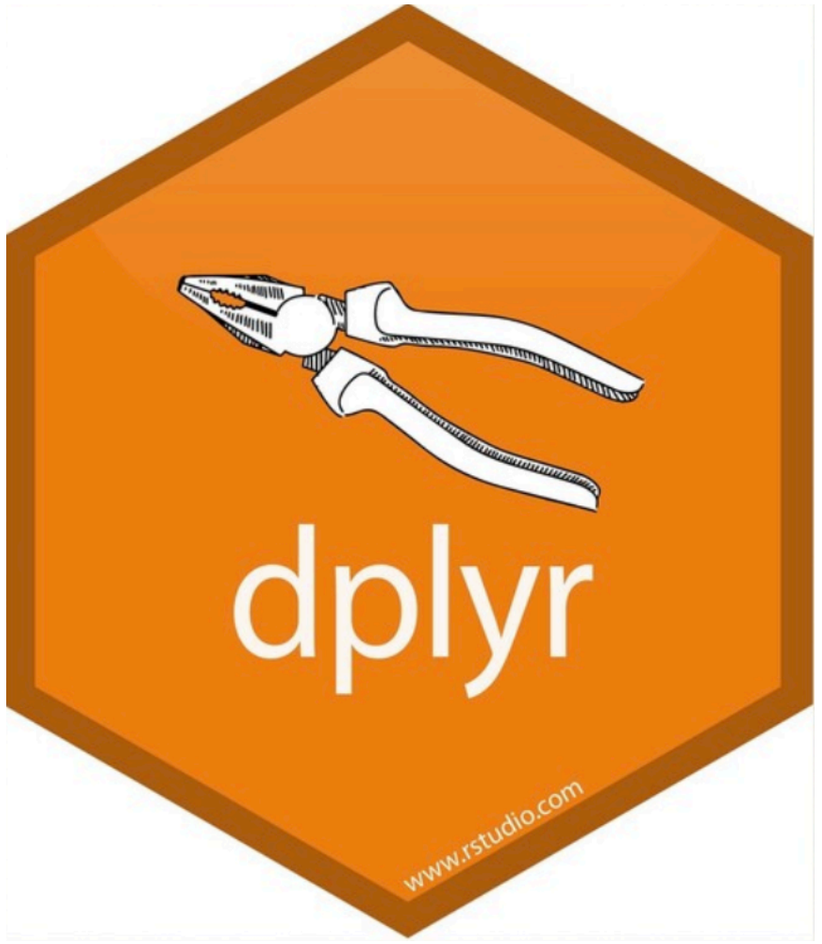
Data Manipulation with dplyr (basics)



Outline

The dplyr package

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Tidy data

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The basic functions

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- Manipulating rows: filter(), arrange(), slice()

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- Manipulating rows: filter(), arrange(), slice()
- Manipulating columns: mutate(), select(), summarize()

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Tidy data

The basic functions

- Manipulating rows: filter(), arrange(), slice()
- Manipulating columns: mutate(), select(), summarize()
- Others: group_by()

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First argument is the data (data frame/tibble)

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Subsequent arguments describe your proposed actions

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dplyr functions all have similar form:

First argument is the data (data frame/tibble)

Subsequent arguments describe your proposed actions

Result is a data frame / tibble

Tidy Data

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Basic principles of tidy data:

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We will spend a large amount of time on tidying data (*tidyr*)!

Data Transformation with dplyr : : **CHEAT SHEET**

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

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

&

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

pipes

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

Summarise Cases

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

summarise(.data, …)
Compute table of summaries.
summarise(mtcars, avg = mean(mpg))

count(x, ..., wt = NULL, sort = FALSE)
Count number of rows in each group defined by the variables in … Also **tally**().
count(iris, Species)

VARIATIONS

summarise_all() - Apply funs to every column.
summarise_at() - Apply funs to specific columns.
summarise_if() - Apply funs to all cols of one type.

Group Cases

Use **group_by()** to create a "grouped" copy of a table. dplyr functions will manipulate each "group" separately and then combine the results.

```
mtcars %>%
group_by(cyl) %>%
summarise(avg = mean(mpg))
```

group_by(.data, ..., add = FALSE**)**
Returns copy of table grouped by …
g_iris <- group_by(iris, Species)

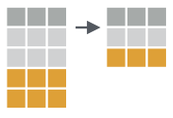
ungroup(x, …**)**
Returns ungrouped copy of table.
ungroup(g_iris)

Manipulate Cases

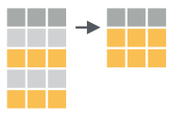
EXTRACT CASES

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

filter(.data, …**)** Extract rows that meet logical criteria. *filter(iris, Sepal.Length > 7)*

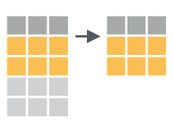


distinct(.data, ..., .keep_all = FALSE**)** Remove rows with duplicate values.
distinct(iris, Species)



sample_frac(tbl, size = 1, replace = FALSE, weight = NULL, .env = parent.frame()**)** Randomly select fraction of rows.
sample_frac(iris, 0.5, replace = TRUE)

sample_n(tbl, size, replace = FALSE, weight = NULL, .env = parent.frame()**)** Randomly select size rows. *sample_n(iris, 10, replace = TRUE)*



slice(.data, …**)** Select rows by position.
slice(iris, 10:15)

top_n(x, n, wt**)** Select and order top n entries (by group if grouped data). *top_n(iris, 5, Sepal.Width)*

Logical and boolean operators to use with filter()

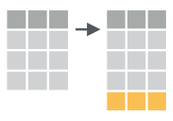
<	<=	is.na()	%in%	|	xor()
>	>=	!is.na()	!	&	

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

ARRANGE CASES

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

ADD CASES



add_row(.data, ..., .before = NULL, .after = NULL**)**
Add one or more rows to a table.
add_row(faithful, eruptions = 1, waiting = 1)

Manipulate Variables

EXTRACT VARIABLES

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

pull(.data, var = -1**)** Extract column values as a vector. Choose by name or index.
pull(iris, Sepal.Length)

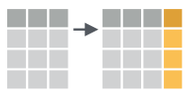
select(.data, …**)**
Extract columns as a table. Also **select_if()**.
select(iris, Sepal.Length, Species)

Use these helpers with select (),
e.g. select(iris, starts_with("Sepal"))

contains(match**)**	**num_range(**prefix, range**)**	**:**, e.g. mpg:cyl
ends_with(match**)**	**one_of(**…**)**	**-**, e.g, -Species
matches(match**)**	**starts_with(**match**)**	

MAKE NEW VARIABLES

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

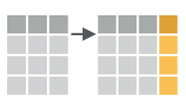


mutate(.data, …**)**
Compute new column(s).
mutate(mtcars, gpm = 1/mpg)

transmute(.data, …**)**
Compute new column(s), drop others.
transmute(mtcars, gpm = 1/mpg)

mutate_all(.tbl, .funs, …**)** Apply funs to every column. Use with **funs()**. Also **mutate_if()**.
mutate_all(faithful, funs(log(.), log2(.)))
mutate_if(iris, is.numeric, funs(log(.)))

mutate_at(.tbl, .cols, .funs, …**)** Apply funs to specific columns. Use with **funs()**, **vars()** and the helper functions for select().
mutate_at(iris, vars(-Species), funs(log(.)))



add_column(.data, ..., .before = NULL, .after = NULL**)** Add new column(s). Also **add_count()**, **add_tally()**. *add_column(mtcars, new = 1:32)*

rename(.data, …**)** Rename columns.
rename(iris, Length = Sepal.Length)

filter()

filter() manipulates rows by keeping qualifying rows

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```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
    1     1     a
    2     2     b
    3     2     a
    4     3     b
    5     1     a
```

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filter(data, ...)
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```

```
tb %>% filter(x == 1)
```

filter()

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filter(data, ...)
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`data:` The data to be manipulated

`...` : One or more logical tests to match

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# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
    1     1     a
    2     2     b
    3     2     a
    4     3     b
    5     1     a
```

```
tb %>% filter(x == 1)

# A tibble: 1 x 3
      x     y     c
  <int> <int> <chr>
    1     1     a
```

filter()

What logical test can we use inside of filter?

Logical and boolean operators to use with filter()

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

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

x < y	Less than
x > y	Greater than
x == y	Equal to
x <= y	Less than or equal to
x >= y	Greater than or equal to
x != y	Not equal to
x %in% y	Group membership
is.na(x)	Is NA
!is.na(x)	Is not NA

filter()

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      x     y     c
  <int> <int> <chr>
      1     1     a
      2     2     b
      3     2     a
      4     3     b
      5     1     a
```

filter()

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      3     2     a
      4     3     b
      5     1     a
```

```
tb %>% filter(x = 1)
```

filter()

```
# A tibble: 5 x 3
      x     y     c
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1     1     1     a
2     2     2     b
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tb %>% filter(x = 1)
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# A tibble: 5 x 3
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5     1     1     a
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tb %>% filter(x = 1)
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tb %>% filter(c == a)
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What's wrong with these function calls?

filter()

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# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
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5     1     1     a
```

```
tb %>% filter(x = 1)
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```
tb %>% filter(c == a)
```

What's wrong with these function calls?

```
tb %>% filter(x == 1)
```

```
tb %>% filter(c == "a")
```

filter()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
      1     1     a
      2     2     b
      3     2     a
      4     3     b
      5     1     a
```

Filter can take in multiple logical tests!

filter()

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# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

Filter can take in multiple logical tests!

If you supply them with the comma, they will be combined with “and”

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# A tibble: 5 x 3
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The same operation can be done with boolean operators!

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```

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```
tb %>% filter(y == 2, c == "a")    =    tb %>% filter(y == 2 & c == "a")
```

filter()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
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3     3     2     a
4     4     3     b
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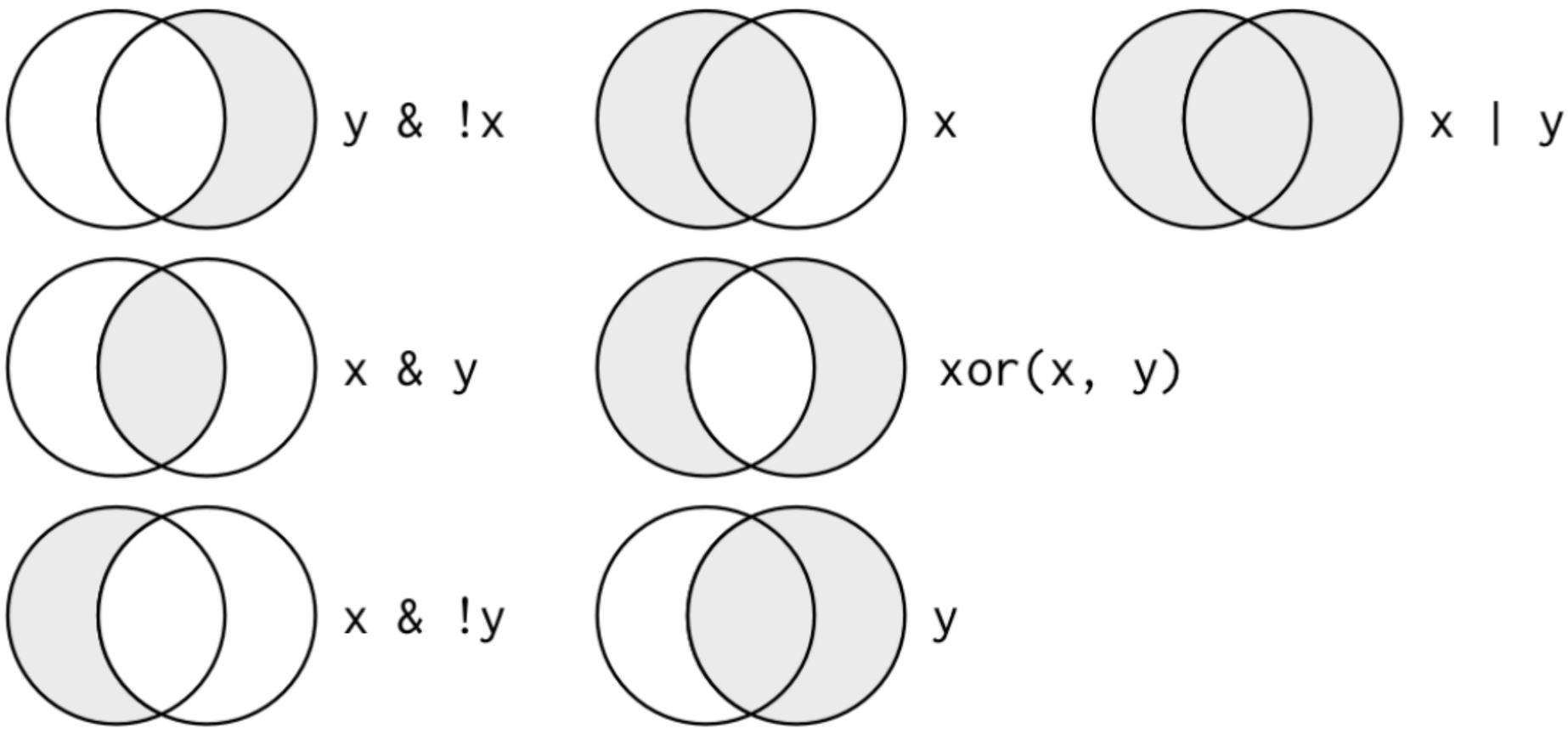
The same operation can be done with boolean operators!

```
tb %>% filter(y == 2, c == "a")    =    tb %>% filter(y == 2 & c == "a")
```

?base::Logic

a & b	and
a | b	or
xor(a, b)	exactly or
!a	not

filter()



Credit: R4DS

arrange()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
      1     1     a
      2     2     b
      3     2     a
      4     3     b
      5     1     a
```

arrange() arranges rows! By default, in ascending order

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# A tibble: 5 x 3
      x     y     c
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1     1     1     a
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```
tb %>% arrange(y)
```

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# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
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```
 # A tibble: 5 x 3
       x     y c
   <int> <int> <chr>
 1     1     1 a
 5     1     1 a
 2     2     2 b
 3     2     2 a
 4     3     3 b
```

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# A tibble: 5 x 3
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# A tibble: 5 x 3
      x     y c
  <int> <int> <chr>
1     1     1 a
5     1     1 a
2     2     2 b
3     2     2 a
4     3     3 b
```

```
tb %>% arrange(desc(y))
```

arrange()

```
# A tibble: 5 x 3
      x     y c
  <int> <int> <chr>
1     1     1 a
2     2     2 b
3     3     2 a
4     4     3 b
5     5     1 a
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# A tibble: 5 x 3
      x     y c
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5     5     1 a
2     2     2 b
3     3     2 a
4     4     3 b
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tb %>% arrange(desc(y))
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```
# A tibble: 5 x 3
      x     y c
  <int> <int> <chr>
4     4     3 b
2     2     2 b
3     3     2 a
1     1     1 a
5     5     1 a
```

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# A tibble: 5 x 3
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```
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1     4     3 b
2     2     2 b
3     3     2 a
4     1     1 a
5     5     1 a
```

desc() will sort by descending order

arrange()

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# A tibble: 5 x 3
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      x     y c
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1     4     3 b
2     2     2 b
3     3     2 a
4     1     1 a
5     5     1 a
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You can also arrange based on multiple variables

arrange()

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tb %>% arrange(y,c)
```

arrange()

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# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

You can also arrange based on multiple variables!

```
tb %>% arrange(y,c)
```

```
# A tibble: 5 x 3
      x     y c
  <int> <int> <chr>
1     1     1 a
2     5     1 a
3     3     2 a
4     2     2 b
5     4     3 b
```

```
tb %>% arrange(y,desc(c))
```

```
# A tibble: 5 x 3
      x     y c
  <int> <int> <chr>
1     1     1 a
2     5     1 a
3     2     2 b
4     3     2 a
5     4     3 b
```

Ties are broken from left to right with multiple variables

slice()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

slice() allows you to select certain rows from the data

slice()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

slice() allows you to select certain rows from the data

```
tb %>% slice(1)
```

slice()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

slice() allows you to select certain rows from the data

```
tb %>% slice(1)
```

```
# A tibble: 1 x 3
      x     y c
  <int> <int> <chr>
1     1     1 a
```

slice()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

slice() allows you to select certain rows from the data

```
tb %>% slice(1)
```

```
# A tibble: 1 x 3
      x     y c
  <int> <int> <chr>
1     1     1 a
```

```
tb %>% slice(1:3)
```

slice()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

slice() allows you to select certain rows from the data

```
tb %>% slice(1)
```

```
# A tibble: 1 x 3
      x     y c
  <int> <int> <chr>
1     1     1 a
```

```
tb %>% slice(1:3)
```

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

slice()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

slice() allows you to select certain rows from the data

```
tb %>% slice(1)
```

```
# A tibble: 1 x 3
      x     y c
  <int> <int> <chr>
1     1     1 a
```

```
tb %>% slice(1:3)
```

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

```
tb %>% slice(-c(2,4))
```

slice()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

slice() allows you to select certain rows from the data

```
tb %>% slice(1)
```

```
# A tibble: 1 x 3
      x     y c
  <int> <int> <chr>
1     1     1 a
```

```
tb %>% slice(1:3)
```

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

```
tb %>% slice(-c(2,4))
```

```
# A tibble: 3 x 3
      x     y c
  <int> <int> <chr>
1     1     1 a
2     3     2 a
3     5     1 a
```

mutate()

mutate() allows you to create and/or modify columns

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

mutate()

mutate() allows you to create and/or modify columns

```
tb %>% mutate(z = x+y)
```

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

mutate()

mutate() allows you to create and/or modify columns

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

```
tb %>% mutate(z = x+y)
```

```
# A tibble: 5 x 4
      x     y c         z
  <int> <int> <chr> <int>
1     1     1 a         2
2     2     2 b         4
3     3     2 a         5
4     4     3 b         7
5     5     1 a         6
```

mutate()

mutate() allows you to create and/or modify columns

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

```
tb %>% mutate(z = x+y)
```

```
# A tibble: 5 x 4
      x     y c         z
  <int> <int> <chr> <int>
1     1     1 a         2
2     2     2 b         4
3     3     2 a         5
4     4     3 b         7
5     5     1 a         6
```

```
tb %>% mutate(z = x+y, w = x*y)
```

mutate()

mutate() allows you to create and/or modify columns

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

```
tb %>% mutate(z = x+y)
```

```
# A tibble: 5 x 4
      x     y c         z
  <int> <int> <chr> <int>
1     1     1 a         2
2     2     2 b         4
3     3     2 a         5
4     4     3 b         7
5     5     1 a         6
```

```
tb %>% mutate(z = x+y, w = x*y)
```

```
# A tibble: 5 x 5
      x     y c         z     w
  <int> <int> <chr> <int> <int>
1     1     1 a         2     1
2     2     2 b         4     4
3     3     2 a         5     6
4     4     3 b         7    12
5     5     1 a         6     5
```

mutate()

mutate() allows you to create and/or modify columns

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

mutate()

mutate() allows you to create and/or modify columns

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

```
tb %>% mutate(z = x+y, z2 = z^2)
```

mutate()

mutate() allows you to create and/or modify columns

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

```
tb %>% mutate(z = x+y, z2 = z^2)
```

```
# A tibble: 5 x 5
      x     y c         z    z2
  <int> <int> <chr> <int> <dbl>
1     1     1 a         2     4
2     2     2 b         4    16
3     3     2 a         5    25
4     4     3 b         7    49
5     5     1 a         6    36
```

mutate()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

mutate() allows you to create and/or modify columns

```
tb %>% mutate(z = x+y, z2 = z^2)
```

```
# A tibble: 5 x 5
      x     y c         z    z2
  <int> <int> <chr> <int> <dbl>
1     1     1 a         2     4
2     2     2 b         4    16
3     3     2 a         5    25
4     4     3 b         7    49
5     5     1 a         6    36
```

Rolls the computations over

mutate()

mutate() allows you to create and/or modify columns

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

```
tb %>% mutate(z = x+y, z2 = z^2)
```

```
# A tibble: 5 x 5
      x     y c         z    z2
  <int> <int> <chr> <int> <dbl>
1     1     1 a         2     4
2     2     2 b         4    16
3     3     2 a         5    25
4     4     3 b         7    49
5     5     1 a         6    36
```

```
tb %>% mutate(y = x+y)
```

Rolls the computations over

mutate()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

mutate() allows you to create and/or modify columns

```
tb %>% mutate(z = x+y, z2 = z^2)
```

```
# A tibble: 5 x 5
      x     y c         z    z2
  <int> <int> <chr> <int> <dbl>
1     1     1 a         2     4
2     2     2 b         4    16
3     3     2 a         5    25
4     4     3 b         7    49
5     5     1 a         6    36
```

Rolls the computations over

```
tb %>% mutate(y = x+y)
```

```
# A tibble: 5 x 3
      x     y c
  <int> <int> <chr>
1     1     2 a
2     2     4 b
3     3     5 a
4     4     7 b
5     5     6 a
```

mutate()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

mutate() allows you to create and/or modify columns

```
tb %>% mutate(z = x+y, z2 = z^2)
```

```
# A tibble: 5 x 5
      x     y c         z    z2
  <int> <int> <chr> <int> <dbl>
1     1     1 a         2     4
2     2     2 b         4    16
3     3     2 a         5    25
4     4     3 b         7    49
5     5     1 a         6    36
```

Rolls the computations over

```
tb %>% mutate(y = x+y)
```

```
# A tibble: 5 x 3
      x     y c
  <int> <int> <chr>
1     1     2 a
2     2     4 b
3     3     5 a
4     4     7 b
5     5     6 a
```

Replaces variables as well

mutate()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
      1     1     a
      2     2     b
      3     2     a
      4     3     b
      5     1     a
```

mutate() allows you to create and/or modify columns

```
tb %>% mutate(z = x+y, z2 = z^2)
```

```
# A tibble: 5 x 5
      x     y c         z    z2
  <int> <int> <chr> <int> <dbl>
      1     1 a         2     4
      2     2 b         4    16
      3     2 a         5    25
      4     3 b         7    49
      5     1 a         6    36
```

Rolls the computations over

```
tb %>% mutate(y = x+y)
```

```
# A tibble: 5 x 3
      x     y c
  <int> <int> <chr>
      1     2 a
      2     4 b
      3     5 a
      4     7 b
      5     6 a
```

Replaces variables as well

There are many mutate() variants!

select()

select() allows you select/deselect certain columns

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

select()

select() allows you select/deselect certain columns

```
tb %>% select(x,y)
```

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

select()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

select() allows you select/deselect certain columns

```
tb %>% select(x,y)
```

```
# A tibble: 5 x 2
      x     y
  <int> <int>
1     1     1
2     2     2
3     3     2
4     4     3
5     5     1
```

select()

select() allows you select/deselect certain columns

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

```
tb %>% select(x,y)
```

```
# A tibble: 5 x 2
      x     y
  <int> <int>
1     1     1
2     2     2
3     3     2
4     4     3
5     5     1
```

```
tb %>% select(1,2)
```

select()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

select() allows you select/deselect certain columns

```
tb %>% select(x,y)
```

```
# A tibble: 5 x 2
      x     y
  <int> <int>
1     1     1
2     2     2
3     3     2
4     4     3
5     5     1
```

```
tb %>% select(1,2)
```

```
# A tibble: 5 x 2
      x     y
  <int> <int>
1     1     1
2     2     2
3     3     2
4     4     3
5     5     1
```

select()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

select() allows you select/deselect certain columns

```
tb %>% select(x,y)
```

```
# A tibble: 5 x 2
      x     y
  <int> <int>
1     1     1
2     2     2
3     3     2
4     4     3
5     5     1
```

```
tb %>% select(1,2)
```

```
# A tibble: 5 x 2
      x     y
  <int> <int>
1     1     1
2     2     2
3     3     2
4     4     3
5     5     1
```

```
tb %>% select(1:2)
```

select()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

select() allows you select/deselect certain columns

```
tb %>% select(x,y)
```

```
# A tibble: 5 x 2
      x     y
  <int> <int>
1     1     1
2     2     2
3     3     2
4     4     3
5     5     1
```

```
tb %>% select(1,2)
```

```
# A tibble: 5 x 2
      x     y
  <int> <int>
1     1     1
2     2     2
3     3     2
4     4     3
5     5     1
```

```
tb %>% select(1:2)
```

```
# A tibble: 5 x 2
      x     y
  <int> <int>
1     1     1
2     2     2
3     3     2
4     4     3
5     5     1
```

select()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

select() allows you select/deselect certain columns

```
tb %>% select(x,y)
```

```
# A tibble: 5 x 2
      x     y
  <int> <int>
1     1     1
2     2     2
3     3     2
4     4     3
5     5     1
```

```
tb %>% select(1,2)
```

```
# A tibble: 5 x 2
      x     y
  <int> <int>
1     1     1
2     2     2
3     3     2
4     4     3
5     5     1
```

```
tb %>% select(1:2)
```

```
# A tibble: 5 x 2
      x     y
  <int> <int>
1     1     1
2     2     2
3     3     2
4     4     3
5     5     1
```

Names are preferred if possible for more readable code

select()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

select() allows you select/deselect certain columns

```
tb %>% select(-3)
```

```
# A tibble: 5 x 2
      x     y
  <int> <int>
1     1     1
2     2     2
3     3     2
4     4     3
5     5     1
```

```
tb %>% select(-c)
```

```
# A tibble: 5 x 2
      x     y
  <int> <int>
1     1     1
2     2     2
3     3     2
4     4     3
5     5     1
```

select()

There are different helper functions that can make selecting variables easier!

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

select()

There are different helper functions that can make selecting variables easier!

```
tb %>% select(one_of(c("x", "y")))
```

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

select()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

There are different helper functions that can make selecting variables easier!

```
tb %>% select(one_of(c("x", "y")))
```

```
# A tibble: 5 x 2
      x     y
  <int> <int>
1     1     1
2     2     2
3     3     2
4     4     3
5     5     1
```

select()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

There are different helper functions that can make selecting variables easier!

```
tb %>% select(one_of(c("x", "y")))
```

```
# A tibble: 5 x 2
      x     y
  <int> <int>
1     1     1
2     2     2
3     3     2
4     4     3
5     5     1
```

Helper functions
starts_with("x")
ends_with("x")
contains("x")
one_of(c("x", "y", "z"))

select()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

There are different helper functions that can make selecting variables easier!

Helper functions
starts_with("x")
ends_with("x")
contains("x")
one_of(c("x", "y", "z"))

```
tb %>% select(one_of(c("x", "y")))
```

```
# A tibble: 5 x 2
      x     y
  <int> <int>
1     1     1
2     2     2
3     2     2
4     3     3
5     1     1
```

These functions have to do with regular expressions.
We will talk about these later!

summarize()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
      1     1     a
      2     2     b
      3     2     a
      4     3     b
      5     1     a
```

summarize()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

summarize() applies a summary function that creates a real-valued statistic

summarize()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

summarize() applies a summary function that creates a real-valued statistic

There are lots of variants of summarize as well!

summarize()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

summarize() applies a summary function that creates a real-valued statistic

There are lots of variants of summarize as well!

We will usually see summarize() used in conjunction with group_by()

summarize()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

summarize() applies a summary function that creates a real-valued statistic

```
tb %>% summarize(xbar = mean(x))
```

There are lots of variants of summarize as well!

We will usually see summarize() used in conjunction with group_by()

summarize()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

summarize() applies a summary function that creates a real-valued statistic

```
tb %>% summarize(xbar = mean(x))
```

```
# A tibble: 1 x 1
   xbar
  <dbl>
1     3
```

There are lots of variants of summarize as well!

We will usually see summarize() used in conjunction with group_by()

group_by()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
5     5     1     a
```

group_by() groups certain variables together to enable conditional computation. We will usually use group_by() in conjunction with summarize() to create statistics for each group

group_by()

```
# A tibble: 5 x 3
      x     y     c
  <int> <int> <chr>
1     1     1     a
2     2     2     b
3     3     2     a
4     4     3     b
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```
diamonds %>%
 group_by(cut) %>%
 summarize(mean = mean(price))
```

group_by()

```
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      x     y     c
  <int> <int> <chr>
1     1     1     a
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3     3     2     a
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There are lots of variants of summarize as well!

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```
diamonds %>%
 group_by(cut) %>%
 summarize(mean = mean(price))
```

```
# A tibble: 5 x 2
  cut         mean
  <ord>      <dbl>
1 Fair       4359.
2 Good       3929.
3 Very Good  3982.
4 Premium    4584.
5 Ideal      3458.
```