Intro to dplyr

24 January 2020

Modern Research Methods

Course Website: https://cumulativescience.netlify.com/

babynames

Names of male and female babies born in the US from 1880 to 2015. 1.8M rows.

```
# install.packages("babynames")
library(babynames)
```

babynames

year <dbl>	sex <chr>	name <chr>	n <int>	prop <dbl>
1880	F	Mary	7065	7.238433e-02
1880	F	Anna	2604	2.667923e-02
1880	F	Emma	2003	2.052170e-02
1880	F	Elizabeth	1939	1.986599e-02
1880	F	Minnie	1746	1.788861e-02
1880	F	Margaret	1578	1.616737e-02
1880	F	Ida	1472	1.508135e-02
1880	F	Alice	1414	1.448711e-02
1880	F	Bertha	1320	1.352404e-02
1880	F	Sarah	1288	1.319618e-02

1–10 of 1,858,689 rows Previous 1 2 3 4 5 6 ... 100 Next

How to isolate?

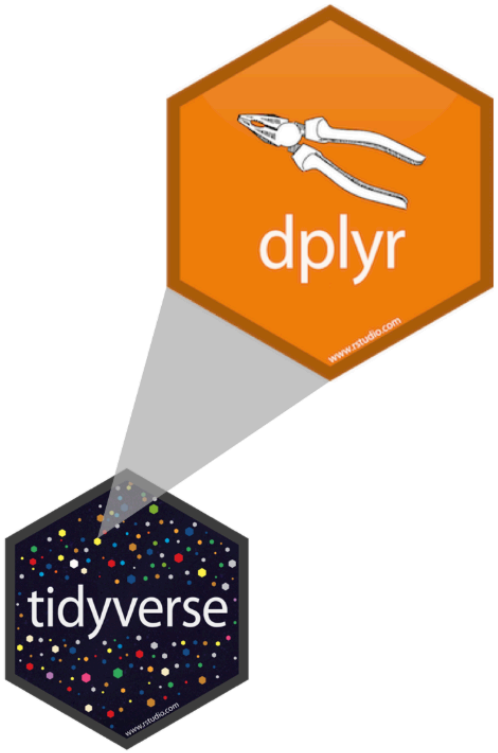
year	sex	name	n	prop
1880	M	John	9655	0.0815
1880	M	William	9532	0.0805
1880	M	James	5927	0.0501
1880	M	Charles	5348	0.0451
1880	M	Garrett	13	0.0001
1881	M	John	8769	0.081
1881	M	William	8524	0.0787
1881	M	James	5442	0.0503
1881	M	Charles	4664	0.0431
1881	M	Garrett	7	0.0001
1881	M	Gideon	7	0.0001

→

year	sex	name	n	prop
1880	M	Garrett	13	0.0001
1881	M	Garrett	7	0.0001
…	…	Garrett	…	…

Transform Data with

dplyr is based on the concepts of functions as verbs that manipulate data frames.



- `filter`: pick rows matching criteria
- `slice`: pick rows using index(es)
- `select`: pick columns by name
- `pull`: grab a column as a vector
- `arrange`: reorder rows
- `mutate`: add new variables
- `distinct`: filter for unique rows
- `sample_n` / `sample_frac`: randomly sample rows
- `summarise`: reduce variables to values
- ... (many more)

Adapted from [datasciencebox.](#) by CC

Isolating data

select() - extract **variables**
filter() - extract **cases**
arrange() - reorder **cases**

Things to know about dplyr functions

- First argument is *always* a data frame
- Subsequent arguments say what to do with that data frame
- Always return a data frame
- Don't modify in place

Adapted from datasciencebox. by CC

select()

select()

Extract columns by name.

```
select(.data, …)
```

data frame to transform

name(s) of columns to extract
(or a select helper function)

select()

Extract columns by name.

```
select(babynames, name, prop)
```

babynames

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

→

name	prop
John	0.0815
William	0.0805
James	0.0501
Charles	0.0451
Garrett	0.0001
John	0.081

1. Go to the course website and open Assignment A1: https://cumulativescience.netlify.com

2. Go to R Cloud and open up Assignment A1: https://rstudio.cloud/

Exercise 1

Alter the code to select just the **n** column:

```
select(babynames, name, prop)
```

01:00

```
select(babynames, n)
#      n
#   <int>
# 1  7065
# 2  2604
# 3  2003
# 4  1939
# 5  1746
# …    …
```

select() helpers

: - Select range of columns

```
select(storms, storm:pressure)
```

- - Select every column but

```
select(storms, -c(storm, pressure))
```

starts_with() - Select columns that start with…

```
select(storms, starts_with("w"))
```

ends_with() - Select columns that end with…

```
select(storms, ends_with("e"))
```

Quiz

Which of these is NOT a way to select the **name** and **n** columns together?

```
select(babynames, -c(year, sex, prop))

select(babynames, name:n)

select(babynames, starts_with("n"))

select(babynames, ends_with("n"))
```

Quiz

Which of these is NOT a way to select the **name** and **n** columns together?

```
select(babynames, -c(year, sex, prop))

select(babynames, name:n)

select(babynames, starts_with("n"))

select(babynames, ends_with("n"))
```

filter()

filter()

Extract rows that meet logical criteria.

```
filter(.data, … )
```

data frame to transform

one or more logical tests (filter returns each row for which the test is TRUE)

common syntax

Each function takes a data frame / tibble as its first argument and returns a data frame / tibble.

```
filter(.data, … )
```

dplyr function

data frame to transform

function specific arguments

filter()

Extract rows that meet logical criteria.

```
filter(babynames, name == "Garrett")
```

babynames

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

→

year	sex	name	n	prop
1880	M	Garrett	13	0.0001
1881	M	Garrett	7	0.0001
…	…	Garrett	…	…

filter()

Extract rows that meet logical criteria.

```
filter(babynames, name == "Garrett")
```

babynames

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

= sets
(returns nothing)

== tests if equal
(returns TRUE or FALSE)

Logical tests

?Comparison

`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

Exercise 2

See if you can use the logical operators to manipulate our code below to show:

- All of the names where **prop** is greater than or equal to 0.08
- All of the children named “Sea”
- All of the names that have a missing value for **n**
  (Hint: this should return an empty data set).

04:00

```r
filter(babynames, prop >= 0.08)
#    year   sex    name     n       prop
# 1  1880     M    John  9655 0.08154630
# 2  1880     M William  9531 0.08049899
# 3  1881     M    John  8769 0.08098299
```

```r
filter(babynames, name == "Sea")
#    year   sex  name     n         prop
# 1  1982     F   Sea     5 2.756771e-06
# 2  1985     M   Sea     6 3.119547e-06
# 3  1986     M   Sea     5 2.603512e-06
# 4  1998     F   Sea     5 2.580377e-06
```

```r
filter(babynames, is.na(n))
#  0 rows
```

Two common mistakes

1. Using `=` instead of `==`

```
filter(babynames, name = "Sea")
filter(babynames, name == "Sea")
```

2. Forgetting quotes

```
filter(babynames, name == Sea)
filter(babynames, name == "Sea")
```

filter()

Extract rows that meet *every* logical criteria.

```
filter(babynames, name == "Garrett", year == 1880)
```

babynames

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

→

year	sex	name	n	prop
1880	M	Garrett	13	0.0001

Boolean operators

?base::Logic

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

filter()

Extract rows that meet *every* logical criteria.

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

babynames

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

→

year	sex	name	n	prop
1880	M	Garrett	13	0.0001

Two more common mistakes

3. Collapsing multiple tests into one

```
filter(babynames, 10 < n < 20)
filter(babynames, 10 < n, n < 20)
```

4. Stringing together many tests (when you could use %in%)

```
filter(babynames, n == 5 | n == 6 | n == 7 | n == 8)
filter(babynames, n %in% c(5, 6, 7, 8))
```

arrange()

arrange()

Order rows from smallest to largest values.

```
arrange(.data, …)
```

data frame to transform

one or more columns to order by (additional columns will be used as tie breakers)

arrange()

Order rows from smallest to largest values.

```
arrange(babynames, n)
```

babynames

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

→

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

Exercise 3

Arrange babynames by **n**. Add **prop** as a second (tie breaking) variable to arrange on.

Can you tell what the smallest value of **n** is?

02:00

```r
arrange(babynames, n, prop)
#    year   sex        name     n         prop
#  1  2007     M       Aaban     5 2.259872e-06
#  2  2007     M      Aareon     5 2.259872e-06
#  3  2007     M       Aaris     5 2.259872e-06
#  4  2007     M         Abd     5 2.259872e-06
#  5  2007     M  Abdulazeez     5 2.259872e-06
#  6  2007     M   Abdulhadi     5 2.259872e-06
#  7  2007     M  Abdulhamid     5 2.259872e-06
#  8  2007     M  Abdulkadir     5 2.259872e-06
#  9  2007     M Abdulraheem     5 2.259872e-06
# 10  2007     M  Abdulrahim     5 2.259872e-06
# ... with 1,858,679 more rows
```

%>%

Steps

```
boys_2015 <- filter(babynames, year == 2015, sex == "M")
boys_2015 <- select(boys_2015, name, n)
boys_2015 <- arrange(boys_2015, desc(n))
boys_2015
```

1. Filter babynames to just boys born in 2015
2. Select the name and n columns from the result
3. Arrange those columns so that the most popular names appear near the top.

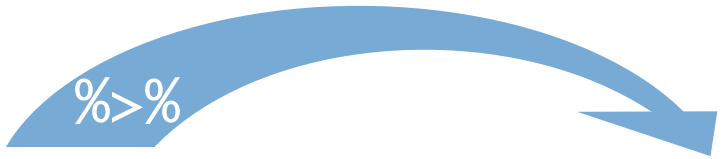
Steps

```
boys_2015 <- filter(babynames, year == 2015, sex == "M")
boys_2015 <- select(boys_2015, name, n)
boys_2015 <- arrange(boys_2015, desc(n))
boys_2015
```

Steps

```
arrange(select(filter(babynames, year == 2015,
  sex == "M"), name, n), desc(n))
```

The pipe operator %>%




```
babynames          filter(______, n == 99680)
```

Passes result on left into first argument of function on right.
So, for example, these do the same thing. Try it.

```
filter(babynames, n == 99680)
babynames %>% filter(n == 99680)
```

Pipes

```
boys_2015 <- filter(babynames, year == 2015, sex == "M")
boys_2015 <- select(boys_2015, name, n)
boys_2015 <- arrange(boys_2015, desc(n))
boys_2015
```

```
babynames %>%
  filter(year == 2015, sex == "M") %>%
  select(name, n) %>%
  arrange(desc(n))
```

```
foo_foo <- little_bunny()
```

```
foo_foo %>%
  hop_through(forest) %>%
  scoop_up(field_mouse) %>%
  bop_on(head)
```

vs.

```
foo_foo2 <- hop_through(foo_foo, forest)
foo_foo3 <- scoop_up(foo_foo2, field_mouse)
bop_on(foo_foo3,  head)
```

Shortcut to type %>%

Cmd + Shift + M (Mac)

Ctrl + Shift + M (Windows)

Exercise 4

Use **%>%** to write a sequence of functions that:

1. Filter babynames to just the girls that were born in 2015
2. Select the **name** and **n** columns
3. Arrange the results so that the most popular names are near the top.

05:00

```r
babynames %>%
  filter(year == 2015, sex == "F") %>%
  select(name, n) %>%
  arrange(desc(n))
#        name     n
#  1      Emma 20355
#  2    Olivia 19553
#  3    Sophia 17327
#  4       Ava 16286
#  5  Isabella 15504
#  6       Mia 14820
#  7   Abigail 12311
#  8     Emily 11727
#  9 Charlotte 11332
# 10    Harper 10241
# ... with 18,983 more rows
```

Assignment A1

- Due next Thursday (Jan. 30th at noon)
- Turn in both .Rmd and .html file to Canvas
- You are welcomed, and encouraged, to work with each other on the problems. But, you must turn in your own work.

How to get help

- Check out the readings
- Look at the cheatsheets – linked on course website under "resources"
- Look at the help files
- Often it's a lot more pleasant an experience to get your questions answered in person. Make use of the instructors' office hours, we're here to help!
- Or, email us (please email both of us):
  - mollylewis@cmu.edu
  - jaeahk@andrew.cmu.edu

How to get help

- Give your question context from course concepts not course assignments.
  - Good context: "I have a question on filtering"
  - Bad context: "I have a question on Assignment 1 Exercise 9”
- Where appropriate, provide links to specific files on Rstudio Cloud and the specific line number in the body of your email. This will help your helper understand your question.
- Be precise in your description:
  - Good description: "I am getting the following error and I'm not sure how to resolve it - Error: could not find function ”read_csv" "
  - Bad description: "R giving errors, help me! Aaaarrrrrgh!”

Adapted from datasciencebox. by CC

Acknowledgements

Slides adapted from datasciencebox and Rstudio by CC