Transform Data with

babynames

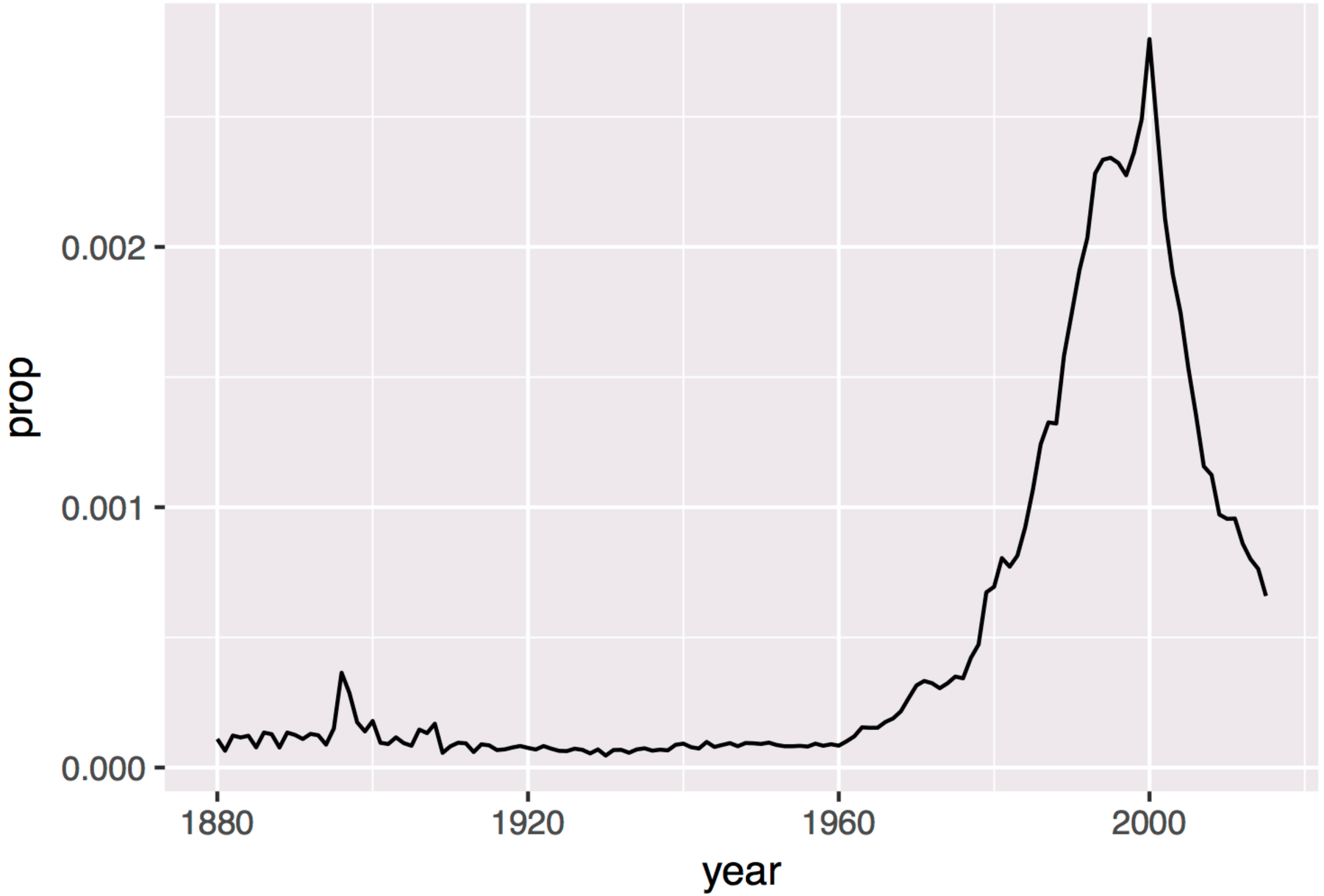
Names of male and female babies born in the US from 1880 to 2015. 1.8M rows.

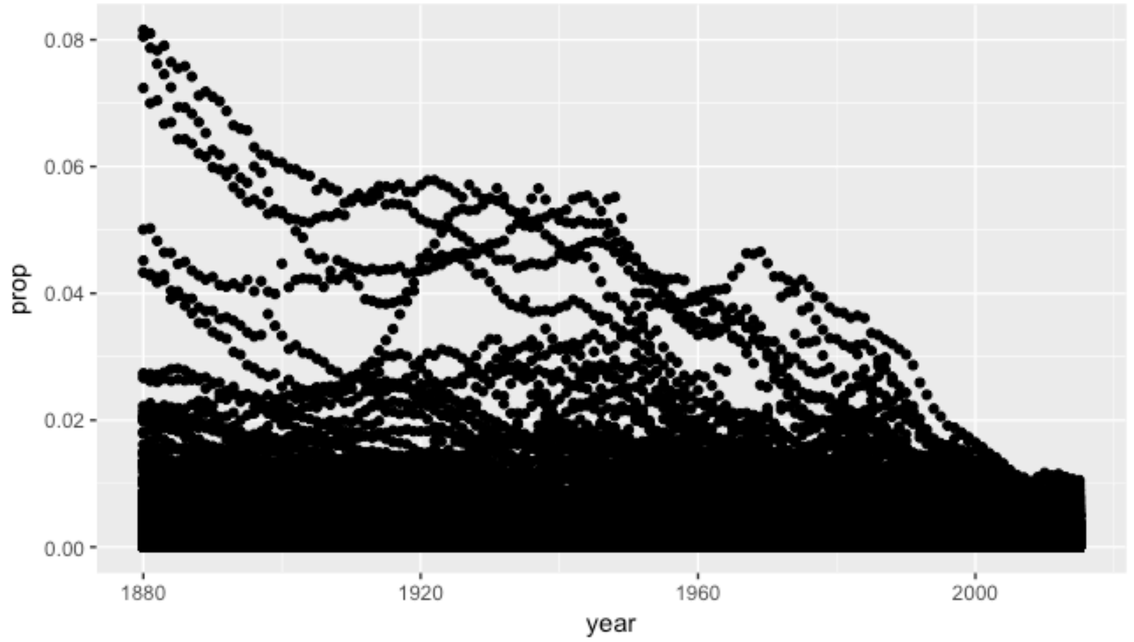
```
# install.packages("babynames")
library(babynames)
```

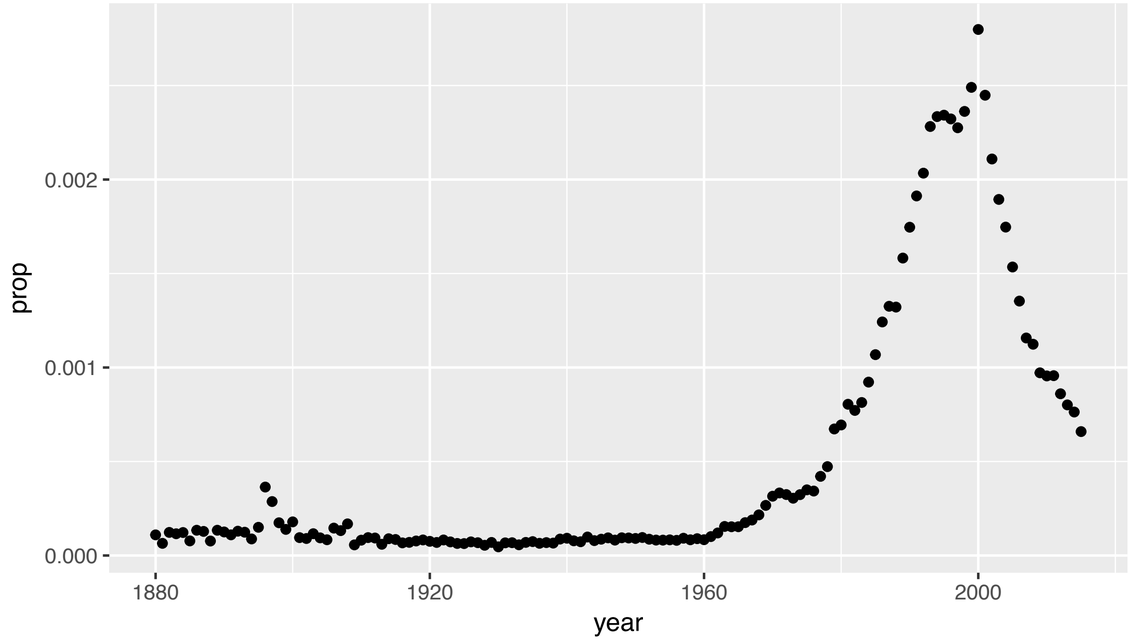
babynames

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

Proportion of boys with the name Garrett




0.08
0.06
0.04
0.02
0.00
prop
1880
1920
1960
2000
year


0.002
0.001
0.000
prop
1880
1920
1960
2000
year

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	…	…

dplyr

dplyr

A package that transforms data.

dplyr implements a *grammar* for transforming tabular data.

Isolating data

select() - extract **variables**

filter() - extract **cases**

arrange() - reorder **cases**

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

Your Turn 1

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

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

```
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"))
```

select() helpers

contains() - Select columns whose names contain...

```
select(storms, contains("d"))
```

matches() - Select columns whose names match regular expression

```
select(storms, matches("^.{4}$"))
```

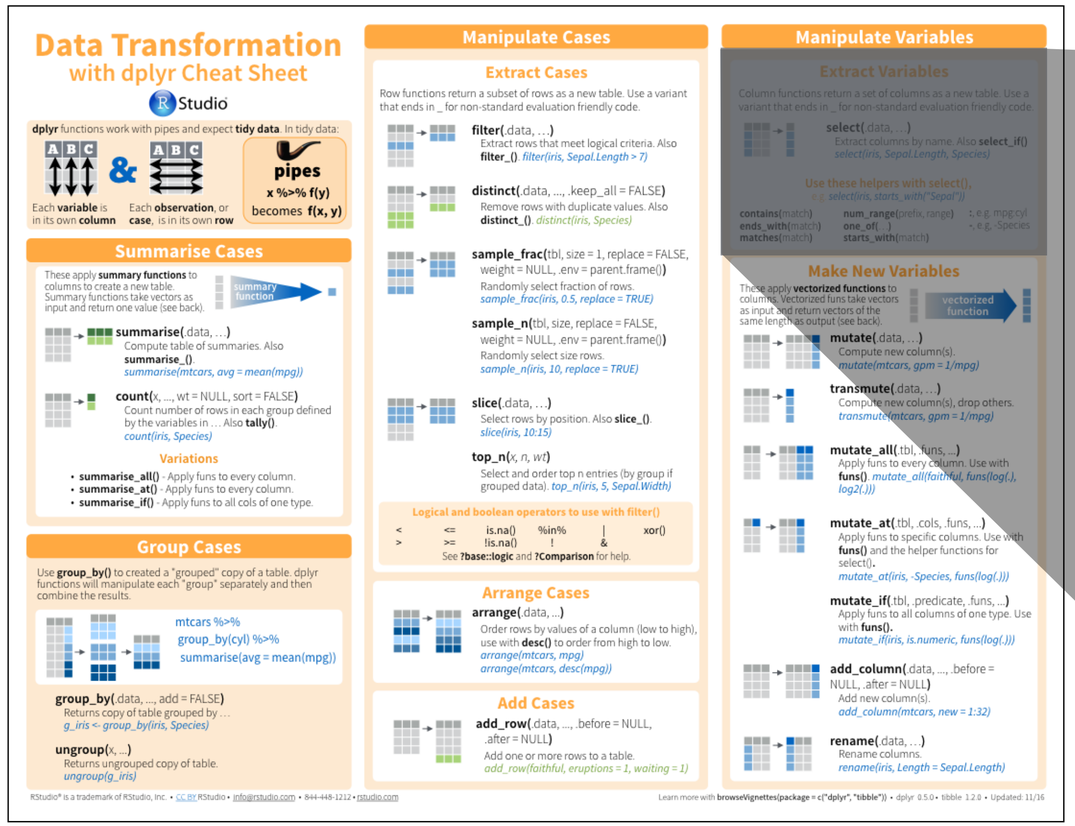
one_of() - Select columns whose names are one of a set

```
select(storms, one_of(c("storm", "storms", "Storm"))
```

num_range() - Select columns named in prefix, number style

```
select(storms, num_range("x", 1:5))
```

select() helpers



Data Transformation with dplyr Cheat Sheet

RStudio

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. Summary functions take vectors as input and return one value (see back).

summary function

summarise(.data, …) Compute table of summaries. Also **summarise_()**. *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 every column.
- **summarise_if()** - Apply funs to all cols of one type.

Group Cases

Use **group_by()** to created 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. Use a variant that ends in _ for non-standard evaluation friendly code.

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

distinct(.data, ..., .keep_all = FALSE) Remove rows with duplicate values. Also **distinct_()**. *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. Also **slice_()**. *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 (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 table. Use a variant that ends in _ for non-standard evaluation friendly code.

select(.data, …) Extract columns by name. Also **select_if()** *select(iris, Sepal.Length, Species)*

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

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

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).

vectorized function

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()**. *mutate_all(faithful, funs(log(.), log2(.)))*

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

mutate_if(.tbl, .predicate, .funs, ...) Apply funs to all columns of one type. Use with **funs()**. *mutate_if(iris, is.numeric, funs(log(.)))*

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

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

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Learn more with **browseVignettes(package = c("dplyr", "tibble"))** • dplyr 0.5.0 • tibble 1.2.0 • Updated: 11/16

Extract Variables

Column functions return a set of columns as a new table. Use a variant that ends in _ for non-standard evaluation friendly code.

select(.data, …**)**
Extract columns by name. Also **select_if()**
select(iris, Sepal.Length, Species)

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

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

dplyr

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, … )
```

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

Your Turn 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).

```
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
```

```
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
```

```
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
`a %in% c(a, b)`	one of (in)

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

Your Turn 3

Use Boolean operators to alter the code below to return only the rows that contain:

- Girls named Sea
- Names that were used by exactly 5 or 6 children in 1880
- Names that are one of Acura, Lexus, or Yugo

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

```
filter(babynames, name == "Sea", sex == "F")
#    year   sex  name      n          prop
# 1  1982     F   Sea      5 2.756771e-06
# 2  1998     F   Sea      5 2.580377e-06
```

```
filter(babynames, n == 5 | n == 6, year == 1880)
#    year   sex    name      n          prop
# 1  1880     F    Abby      6 6.147289e-05
# 2  1880     F  Aileen      6 6.147289e-05
# …     …      …       …      …             …
```

```
filter(babynames, name == "Acura" | name =="Lexus" |name =="Yugo"))
#    year   sex  name     n          prop
# 1  1990     F Lexus    36 1.752932e-05
# 2  1990     M Lexus    12 5.579156e-06
# …     …      …     …     …             …
```

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))
```

```
filter(babynames, name == "Sea", sex == "F")
#    year   sex  name      n          prop
# 1  1982     F   Sea      5 2.756771e-06
# 2  1998     F   Sea      5 2.580377e-06
```

```
filter(babynames, n == 5 | n == 6, year == 1880)
#    year   sex    name      n          prop
# 1  1880     F    Abby      6 6.147289e-05
# 2  1880     F  Aileen      6 6.147289e-05
# …     …     …       …      …             …
```

```
filter(babynames, name %in% c("Acura", "Lexus", "Yugo"))
#    year   sex  name      n          prop
# 1  1990     F Lexus    36 1.752932e-05
# 2  1990     M Lexus    12 5.579156e-06
# …     …     …      …      …             …
```

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

Your Turn 4

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

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

```
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
```

desc()

Changes ordering to largest to smallest.

```
arrange(babynames, desc(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	John	9655	0.0815
1880	M	William	9532	0.0805
1881	M	John	8769	0.081
1880	M	James	5927	0.0501
1880	M	Charles	5348	0.0451
1880	M	Garrett	13	0.0001

Your Turn 5

Use **desc()** to find the names with the highest **prop**.

Then, use **desc()** to find the names with the highest **n**.

```
arrange(babynames, desc(prop))
#      year   sex     name      n       prop
#  1   1880     M     John   9655 0.08154630
#  2   1881     M     John   8769 0.08098299
#  3   1880     M  William   9531 0.08049899
#  4   1883     M     John   8894 0.07907324
#  5   1881     M  William   8524 0.07872038
#  6   1882     M     John   9557 0.07831617
#  7   1884     M     John   9388 0.07648751
#  8   1882     M  William   9298 0.07619375
#  9   1886     M     John   9026 0.07582198
# 10   1885     M     John   8756 0.07551791
# ... with 1,858,679 more rows
```

```
arrange(babynames, desc(n))
#      year   sex     name     n       prop
#  1   1947     F    Linda 99680 0.05483609
#  2   1948     F    Linda 96211 0.05521159
#  3   1947     M    James 94763 0.05102057
#  4   1957     M  Michael 92726 0.04238659
#  5   1947     M   Robert 91646 0.04934237
#  6   1949     F    Linda 91010 0.05184281
#  7   1956     M  Michael 90623 0.04225479
#  8   1958     M  Michael 90517 0.04203881
#  9   1948     M    James 88588 0.04969679
# 10   1954     M  Michael 88493 0.04279403
# ... 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.

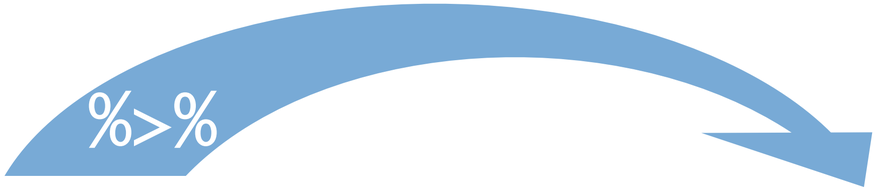
Steps

```
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

```
babynames
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))
```

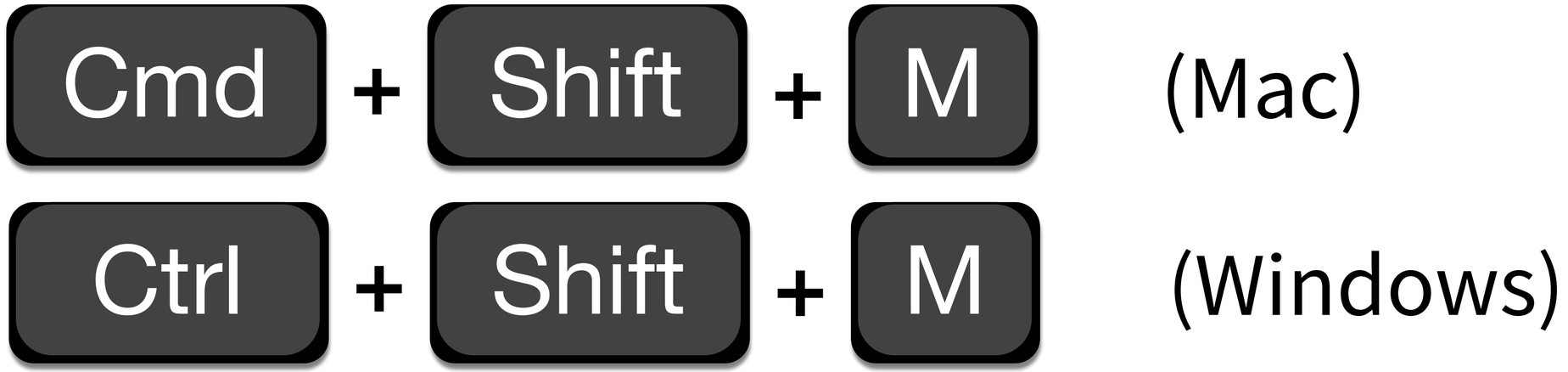
```
foo_foo <- little_bunny()
```

```
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 %>%



Your Turn 6

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

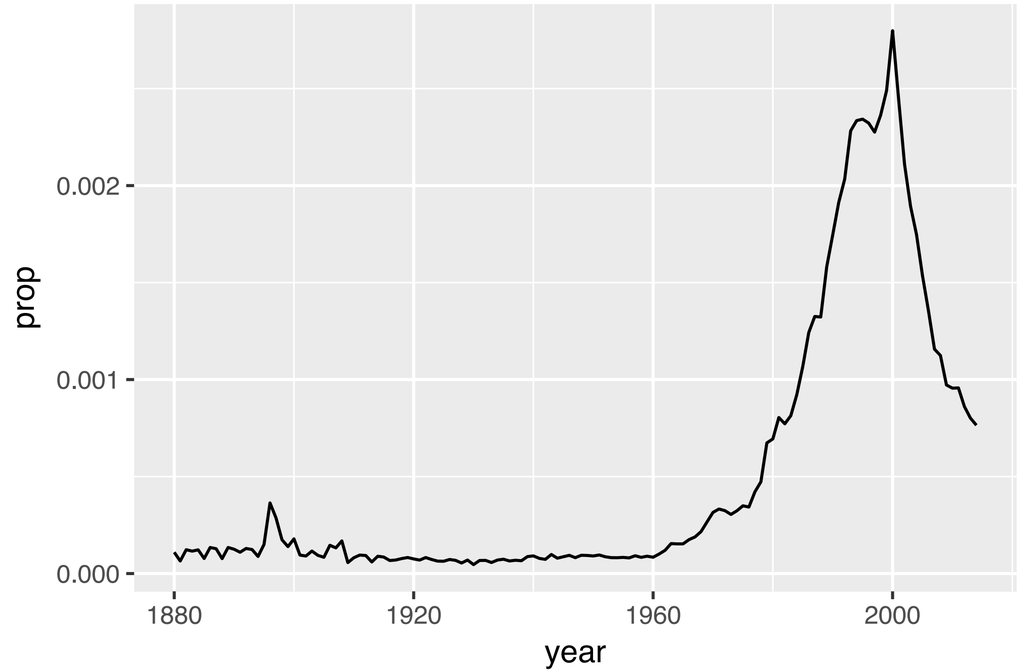
1. Filter babynames to just the girls that were born in 2015
2. Select the **name** and **n** columns
3. Arrange the results so that the most popular names are near the top.

```
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
```

Exam

1. Trim babynames to just the rows that contain your **name** and your **sex**
2. Trim the result to just the columns that will appear in your graph (not strictly necessary, but useful practice)
3. Plot the results as a line graph with **year** on the x axis and **prop** on the y axis

```
babynames %>%
  filter(name == "Garrett", sex == "M") %>%
  select(year, prop) %>%
  ggplot() +
    geom_line(mapping = aes(year, prop))
```



What are the most popular names?

How should we define popularity?

A name is popular if:

How should we define popularity?

A name is popular if:

1. **Sums** - a large number of children have the name when you sum across years

How should we define popularity?

A name is popular if:

1. **Sums** - a large number of children have the name when you sum across years
2. **Ranks** - it consistently ranks among the top names from year to year.

Quiz

Do we have enough information to:

1. Calculate the total number of children with each name?
2. Rank names within each year?

Deriving information

summarise() - summarise **variables**

group_by() - group **cases**

mutate() - create new **variables**

summarise()

summarise()

Compute table of summaries.

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

babynames

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

total	max
127538	99680

Your Turn 7

Use summarise() to compute three statistics *about the data*:

1. The first (minimum) year in the dataset
2. The last (maximum) year in the dataset
3. The total number of children represented in the data

```
babynames %>%
   summarise(first = min(year),
             last = max(year),
             total = sum(n))
#   first  last     total
# 1  1880  2015 340851912
```

@cdhowe

Your Turn 8

Extract the rows where **name == "Khaleesi"**. Then use summarise() and a summary functions to find:

1. The total number of children named Khaleesi
2. The first **year** Khaleesi appeared in the data

```
babynames %>%
  filter(name == "Khaleesi") %>%
  summarise(total = sum(n), first = min(year))
#   total first
# 1  1127  2011
```

Summary functions

Take a vector as input.

Return a single value as output.

Summary Functions

to use with summarise()

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

Counts

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

Location

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

Logicals

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

Position/Order

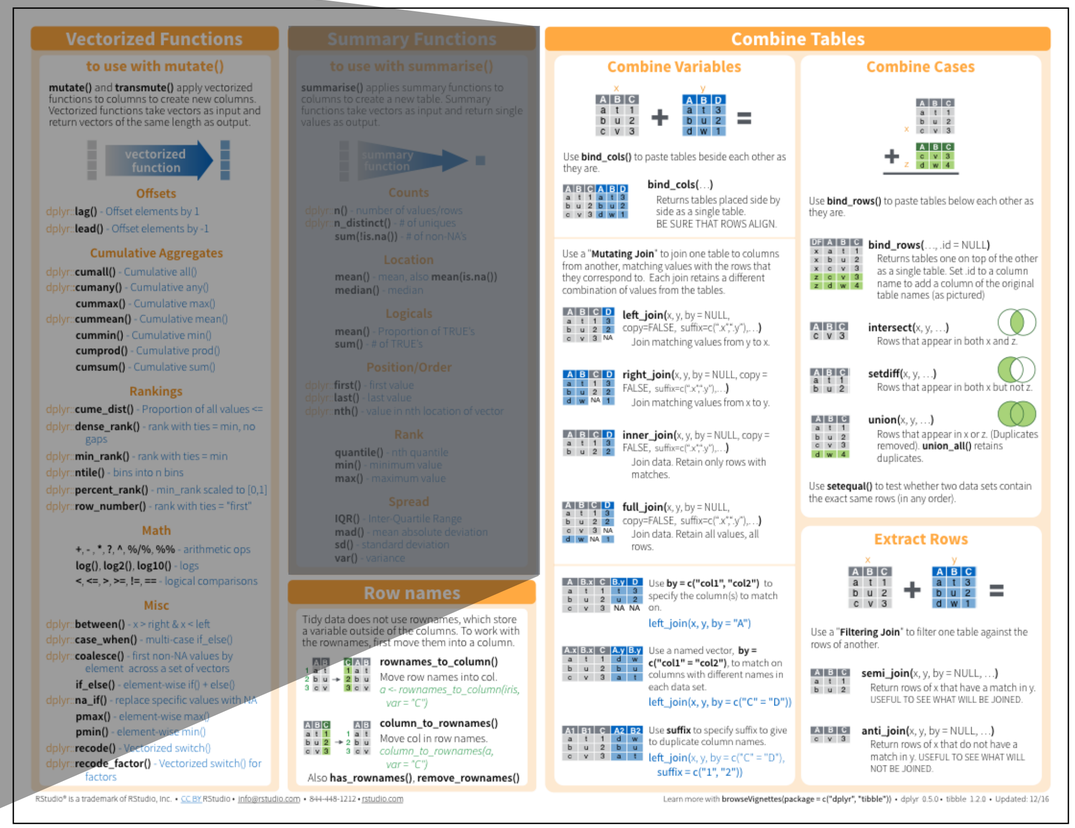
dplyr::**first()** - first value
dplyr::**last()** - last value
dplyr::**nth()** - value in nth location of vector

Rank

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

Spread

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



dplyr

n()

The number of rows in a dataset/group

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

babynames

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

n
1858689

n_distinct()

The number of distinct values in a variable

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

babynames

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

n	nname
1858689	95025

Grouping cases

group_by()

Groups cases by common values of one or more columns.

```
babynames %>%
  group_by(sex)
```

```
Source: local data frame [1,825,433 x 5]
Groups: sex [2]

    year   sex       name     n       prop
   <dbl> <chr>      <chr> <int>      <dbl>
1   1880     F       Mary  7065 0.07238359
```

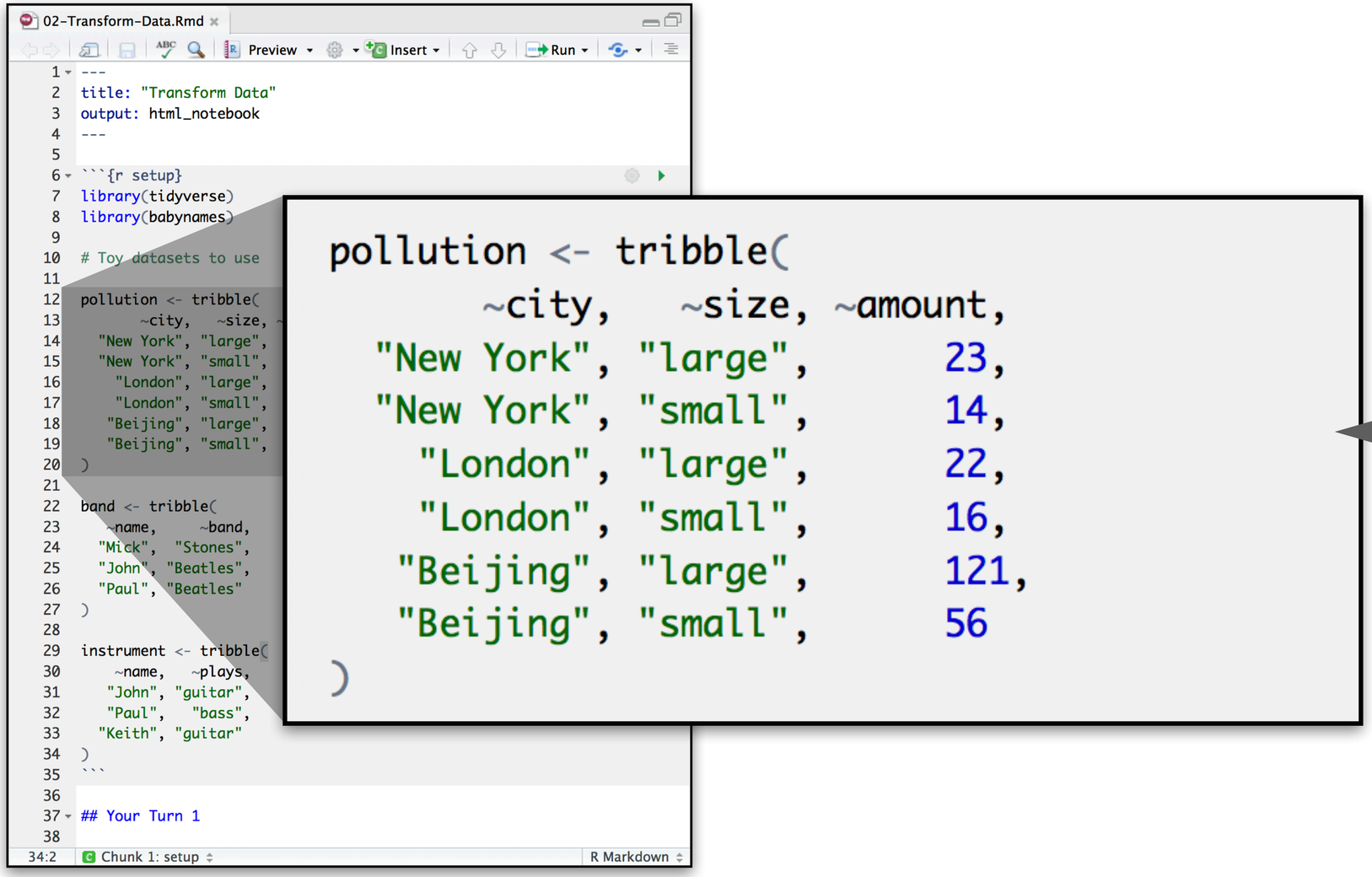
group_by()

Groups cases by common values.

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

sex	total
F	167070477
M	170064949

Transform Data Notebook



Toy data sets to practice with

dplyr

```
pollution <- tribble(
       ~city,   ~size, ~amount,
  "New York", "large",      23,
  "New York", "small",      14,
    "London", "large",      22,
    "London", "small",      16,
   "Beijing", "large",      121,
   "Beijing", "small",      56
)
```

pollution

city	particle size	amount ($\mu g/m^3$)
New York	large	23
New York	small	14
London	large	22
London	small	16
Beijing	large	121
Beijing	small	56

city	particle size	amount (μg/m^3)
New York	large	23
New York	small	14
London	large	22
London	small	16
Beijing	large	121
Beijing	small	56

mean	sum	n
42	252	6

```
pollution %>%
  summarise(mean = mean(amount), sum = sum(amount), n = n())
```

city	particle size	amount ($\mu g/m^3$)
New York	large	23
New York	small	14
London	large	22
London	small	16
Beijing	large	121
Beijing	small	56

mean	sum	n
42	252	6

city	particle size	amount ($\mu g/m^3$)
New York	large	23
New York	small	14
London	large	22
London	small	16
Beijing	large	121
Beijing	small	56

mean	sum	n
42	252	6

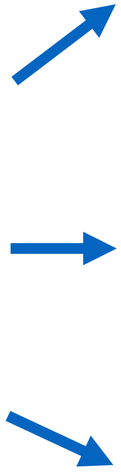
city	particle size	amount ($\mu g/m^3$)
New York	large	23
New York	small	14
London	large	22
London	small	16
Beijing	large	121
Beijing	small	56

mean	sum	n
18.5	37	2
19.0	38	2
88.5	177	2

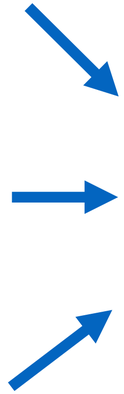
group_by() + summarise()

group_by()

city	particle size	amount ($\mu g/m^3$)
New York	large	23
New York	small	14
London	large	22
London	small	16
Beijing	large	121
Beijing	small	56



city	particle size	amount ($\mu g/m^3$)
New York	large	23
New York	small	14
London	large	22
London	small	16
Beijing	large	121
Beijing	small	56

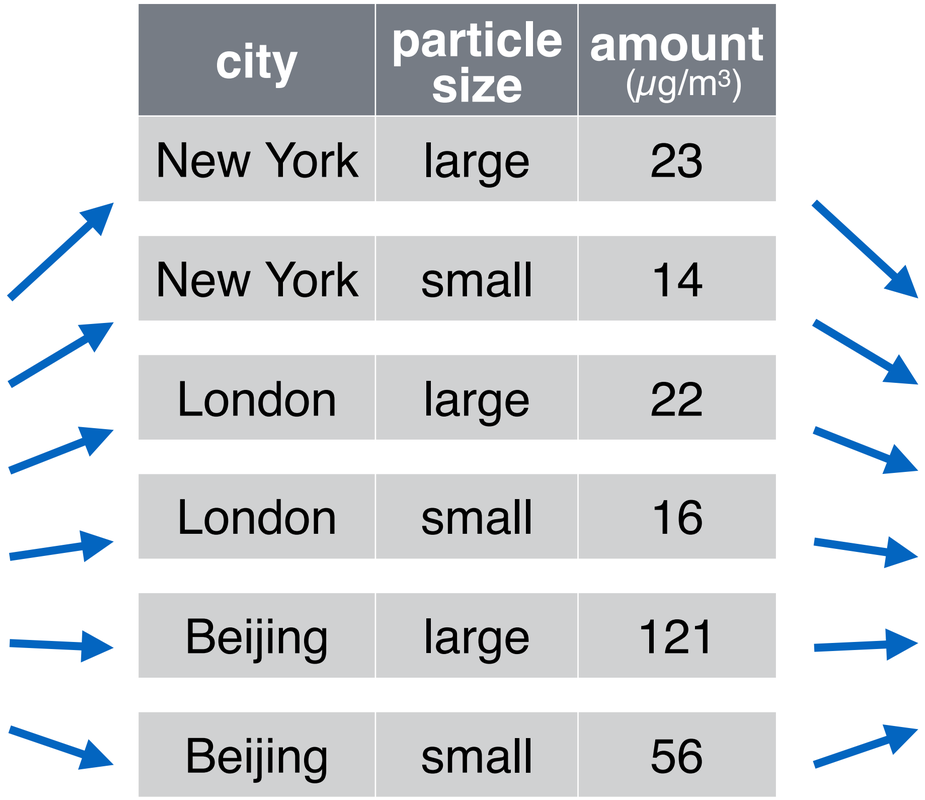


city	mean	sum	n
New York	18.5	37	2
London	19.0	38	2
Beijing	88.5	177	2

```
pollution %>%
  group_by(city) %>%
  summarise(mean = mean(amount), sum = sum(amount), n = n())
```

group_by()

city	particle size	amount ($\mu g/m^3$)
New York	large	23
New York	small	14
London	large	22
London	small	16
Beijing	large	121
Beijing	small	56



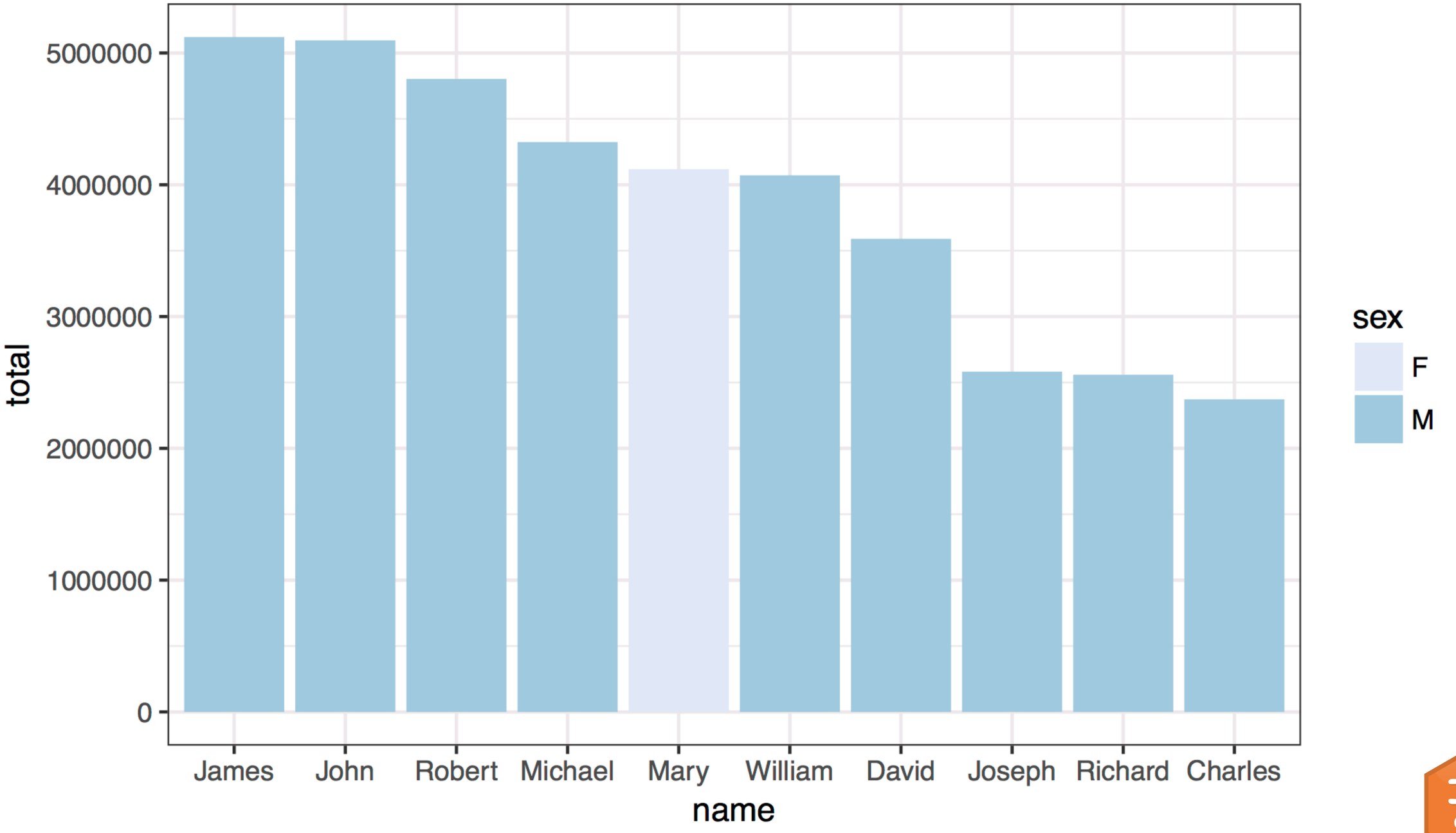
city	particle size	mean	sum	n
New York	large	23	23	1
New York	small	14	14	1
London	large	22	22	1
London	small	16	16	1
Beijing	large	121	121	1
Beijing	small	56	56	1

```
pollution %>%
  group_by(city, size) %>%
  summarise(mean = mean(amount), sum = sum(amount), n = n())
```

Your Turn 9

Use **group_by()**, **summarise()**, and **arrange()** to display the ten most popular names. Compute popularity as the total number of children of a single gender given a name.

```
babynames %>%
  group_by(name, sex) %>%
  summarise(total = sum(n)) %>%
  arrange(desc(total))
#       name   sex   total
#  1   James     M 5120990
#  2    John     M 5095674
#  3  Robert     M 4803068
#  4 Michael     M 4323928
#  5    Mary     F 4118058
#  6 William     M 4071645
#  7   David     M 3589754
#  8  Joseph     M 2581785
#  9 Richard     M 2558165
# 10 Charles     M 2371621
# ... with 105,376 more rows
```


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

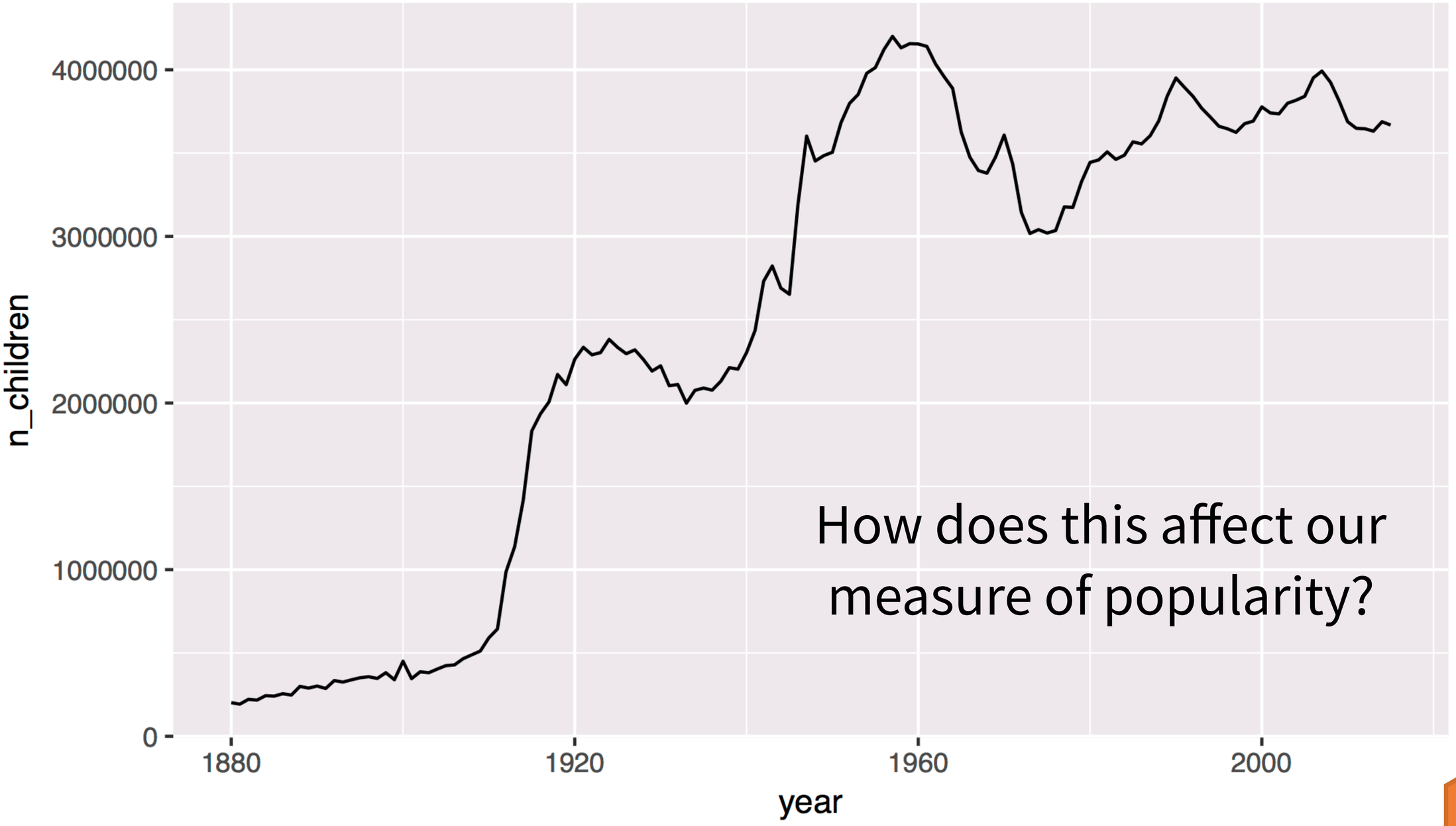
```
babynames %>%
  group_by(name, sex) %>%
  summarise(total = sum(n)) %>%
  arrange(desc(total)) %>%
  ungroup() %>%
  slice(1:10) %>%
  ggplot() +
    geom_col(mapping = aes(x = fct_reorder(name,
      desc(total)), y = total, fill = sex)) +
    theme_bw() +
    scale_fill_brewer() +
    labs(x =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

Your Turn 10

Use grouping to calculate **number of children born each year**.

Plot the results as a line graph.

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



How does this affect our measure of popularity?

mutate()

mutate()

Create new columns.

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

babynames

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

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

mutate()

Create new columns.

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

babynames

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

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

Vectorized functions

Take a vector as input.

Return a vector of the same length as output.

Vectorized Functions

to use with mutate()

mutate() and **transmute()** apply vectorized functions to columns to create new columns. Vectorized functions take vectors as input and return vectors of the same length as output.

Offsets

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

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

Cumulative Aggregates

dplyr::**cumall()** - Cumulative all()

dplyr::**cumany()** - Cumulative any()

cummax() - Cumulative max()

dplyr::**cummean()** - Cumulative mean()

cummin() - Cumulative min()

cumprod() - Cumulative prod()

cumsum() - Cumulative sum()

Rankings

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

dplyr::**dense_rank()** - rank with ties = min, no gaps

dplyr::**min_rank()** - rank with ties = min

dplyr::**ntile()** - bins into n bins

dplyr::**percent_rank()** - min_rank scaled to [0,1]

dplyr::**row_number()** - rank with ties = "first"

Math

+, **-** , *****, **?**, **^**, **%/%**, **%%** - arithmetic ops

log(), **log2()**, **log10()** - logs

<, **<=**, **>**, **>=**, **!=**, **==** - logical comparisons

Misc

dplyr::**between()** - x > right & x < left

dplyr::**case_when()** - multi-case if_else()

dplyr::**coalesce()** - first non-NA values by element across a set of vectors

if_else() - element-wise if() + else()

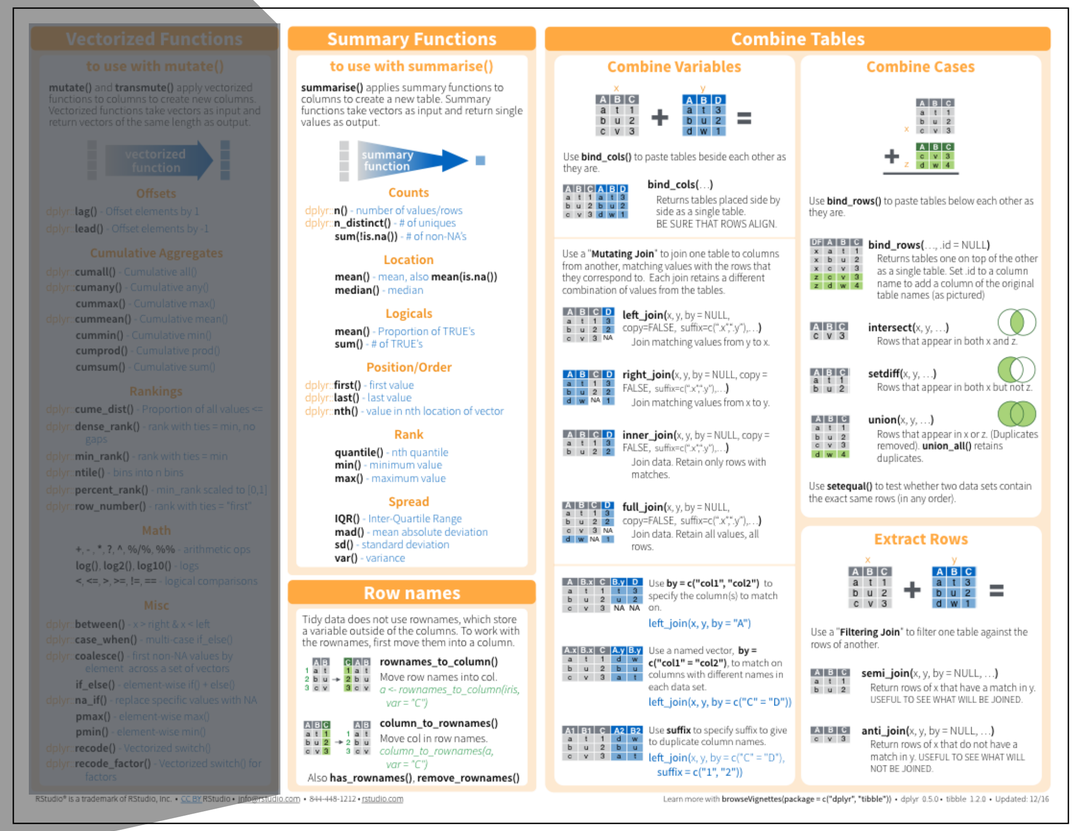
dplyr::**na_if()** - replace specific values with NA

pmax() - element-wise max()

pmin() - element-wise min()

dplyr::**recode()** - Vectorized switch()

dplyr::**recode_factor()** - Vectorized switch() for factors



Recap: Single table verbs

Extract variables with **select()**

Extract cases with **filter()**

Arrange cases, with **arrange()**.

Make tables of summaries with **summarise()**.

Make new variables, with **mutate()**.

Transform Data with