NYC DATA SCIENCE
ACADEMY

Data Science with R (Data Analytics)

Manipulating Data with ‘dplyr’

Data Science Bootcamp

Outline

1. Baby names & baby births datasets
2. Background of dplyr
3. Basic functions in dplyr
    - Subset, transform, and reorder datasets
    - Join datasets
    - Groupwise operations on datasets

Baby names data

Baby Names & Baby Births Datasets

Load the data

- Make sure the data sets are in your working directory.
- stringsAsFactors = FALSE.
  - Prevent R from reading in strings as factors (the default).

```
#Remember to set your working directory.
bnames = read.csv("data/bnames.csv.bz2", stringsAsFactors = FALSE)
births = read.csv("data/births.csv", stringsAsFactors = FALSE)
```

Baby Names Data

```
head(bnames,5)
```

```
   year  name     prop    sex  soundex
1  1880  John     0.0815  boy  J500
2  1880  William  0.0805  boy  W450
3  1880  James    0.0501  boy  J520
4  1880  Charles  0.0452  boy  C642
5  1880  George   0.0433  boy  G620
```

```
tail(bnames,5)
```

```
        year  name      prop      sex   soundex
257996  2008  Carleigh  0.000128  girl  C642
257997  2008  Iyana     0.000128  girl  I500
257998  2008  Kenley    0.000127  girl  K540
257999  2008  Sloane    0.000127  girl  S450
258000  2008  Elianna   0.000127  girl  E450
```

Baby names data

Example

- Use logical subsetting to extract your name from the dataset. Plot the trend over time.
- What geom should you use?
- Do you need any extra aesthetics?

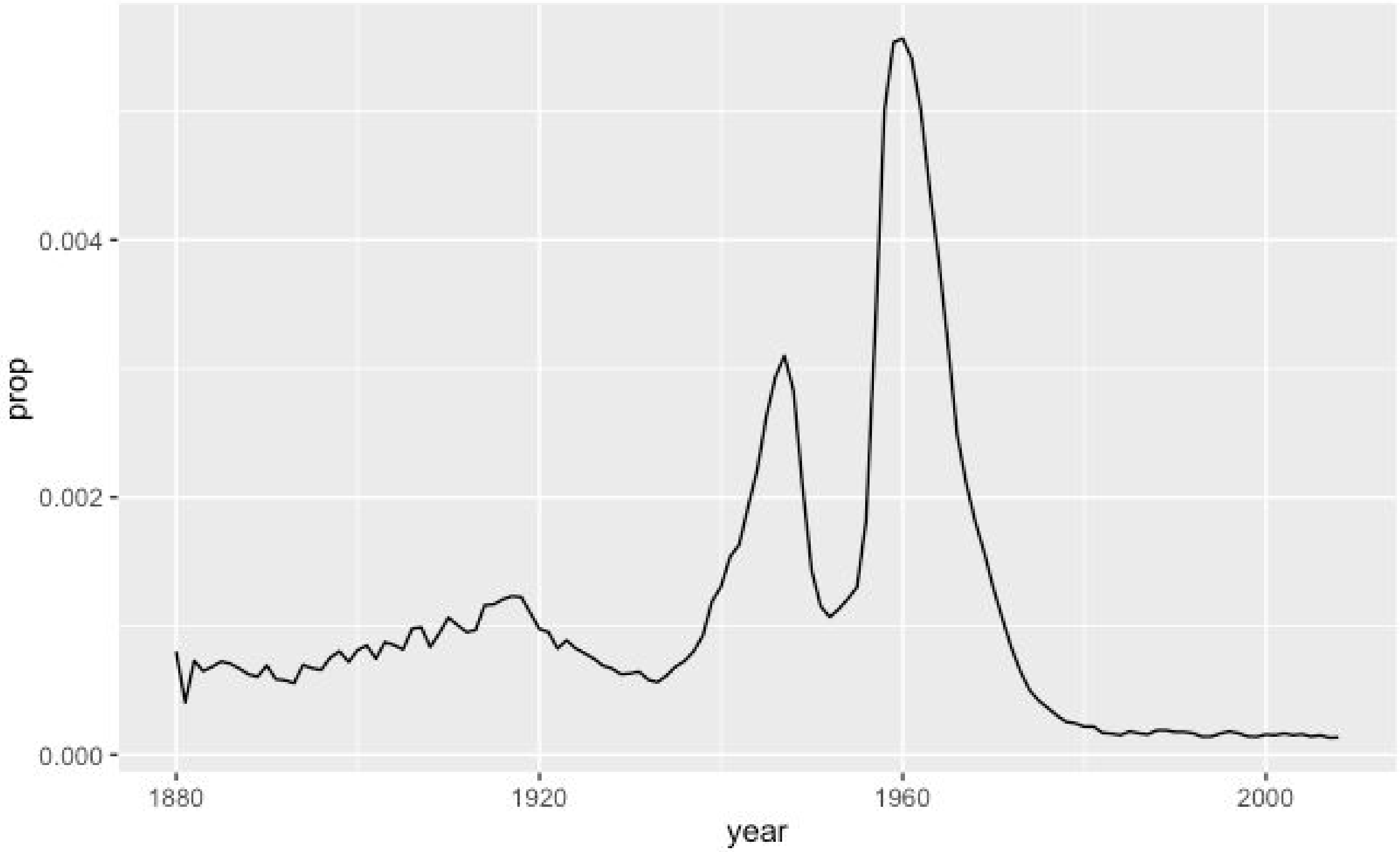
Baby names data

Answer

```
mike <- bnames[bnames$name == "Mike", ]
qplot(year, prop, data = mike, geom = "line")
```

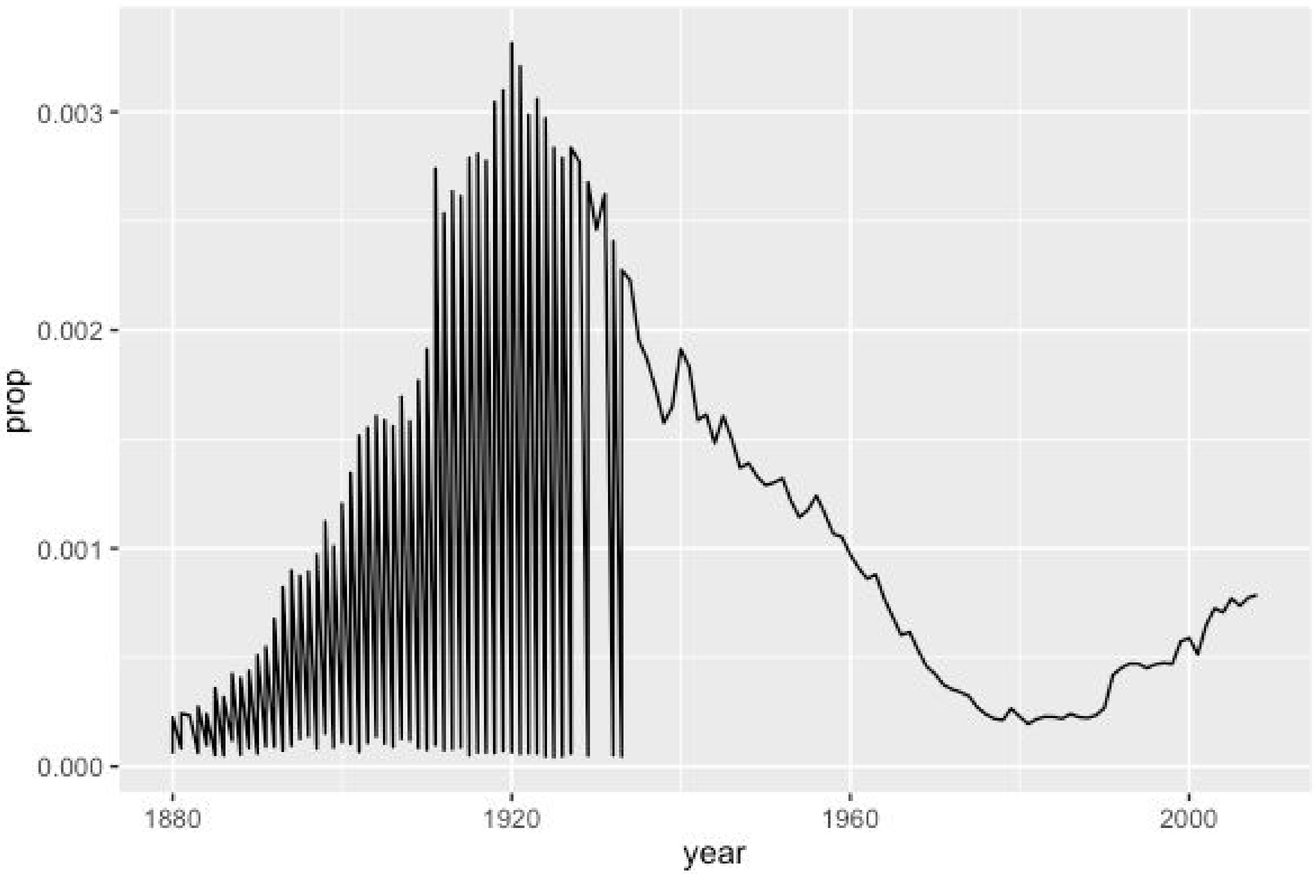
Baby names data

```
mike <- bnames[bnames$name == "Mike", ]
qplot(year, prop, data = mike, geom = "line")
```



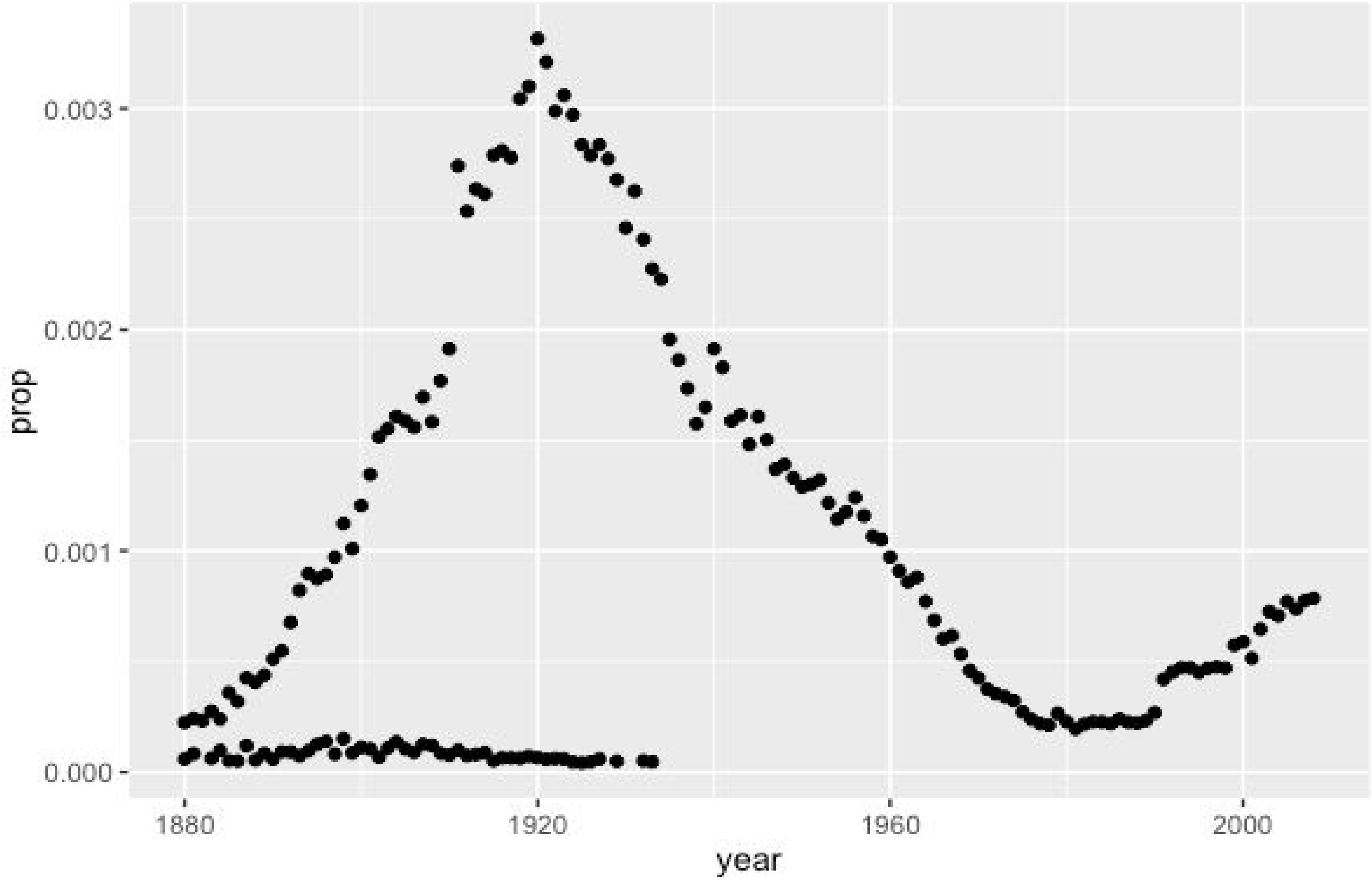
What's happening?

```
vivian <- bnames[bnames$name == "Vivian", ]
qplot(year, prop, data = vivian, geom = "line")
```



What's happening?

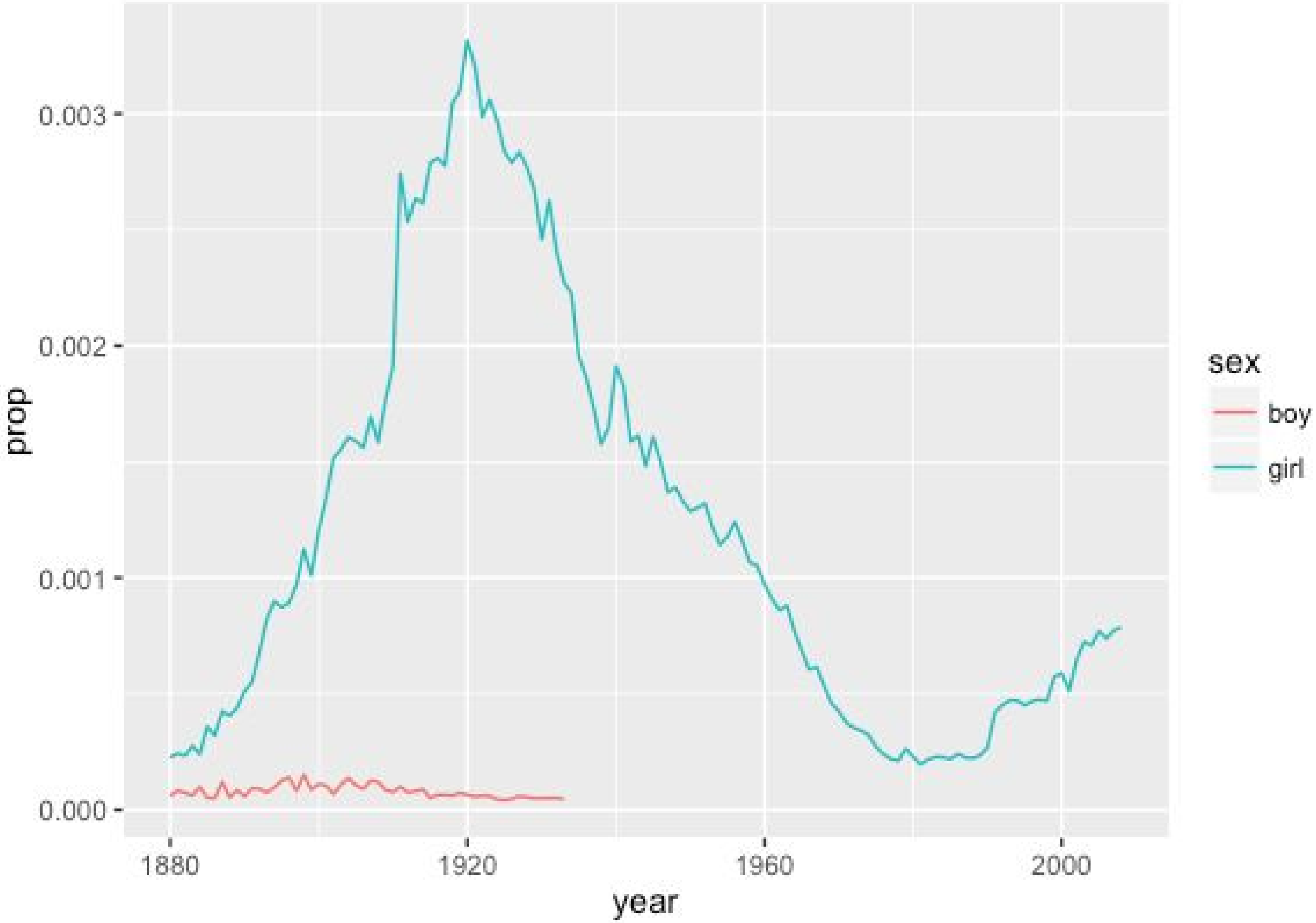
```
qplot(year, prop, data = vivian, geom = "point")
```



color = sex

- creates a different colored line for each sex

```
qplot(year, prop, data = vivian, geom = "line", color = sex)
```



Two names

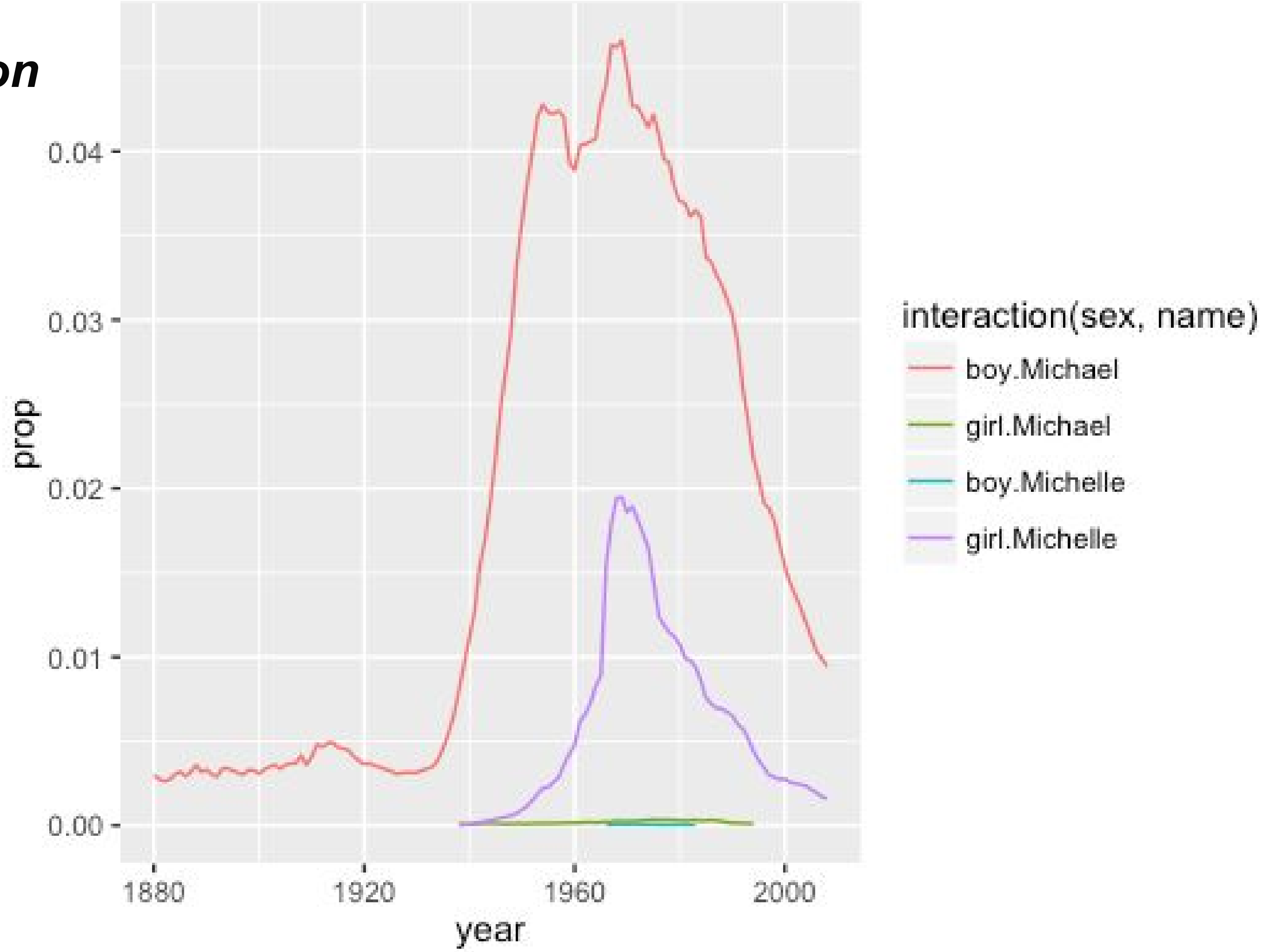
Use *interaction*

- interaction(sex, name)
    - use interaction to group on the combination of two variables.

```
michaels <- bnames[bnames$name == "Michael" |
                   bnames$name == "Michelle", ]
qplot(year, prop, data = michaels, geom = "line",
        color = interaction(sex, name))
```

Two names

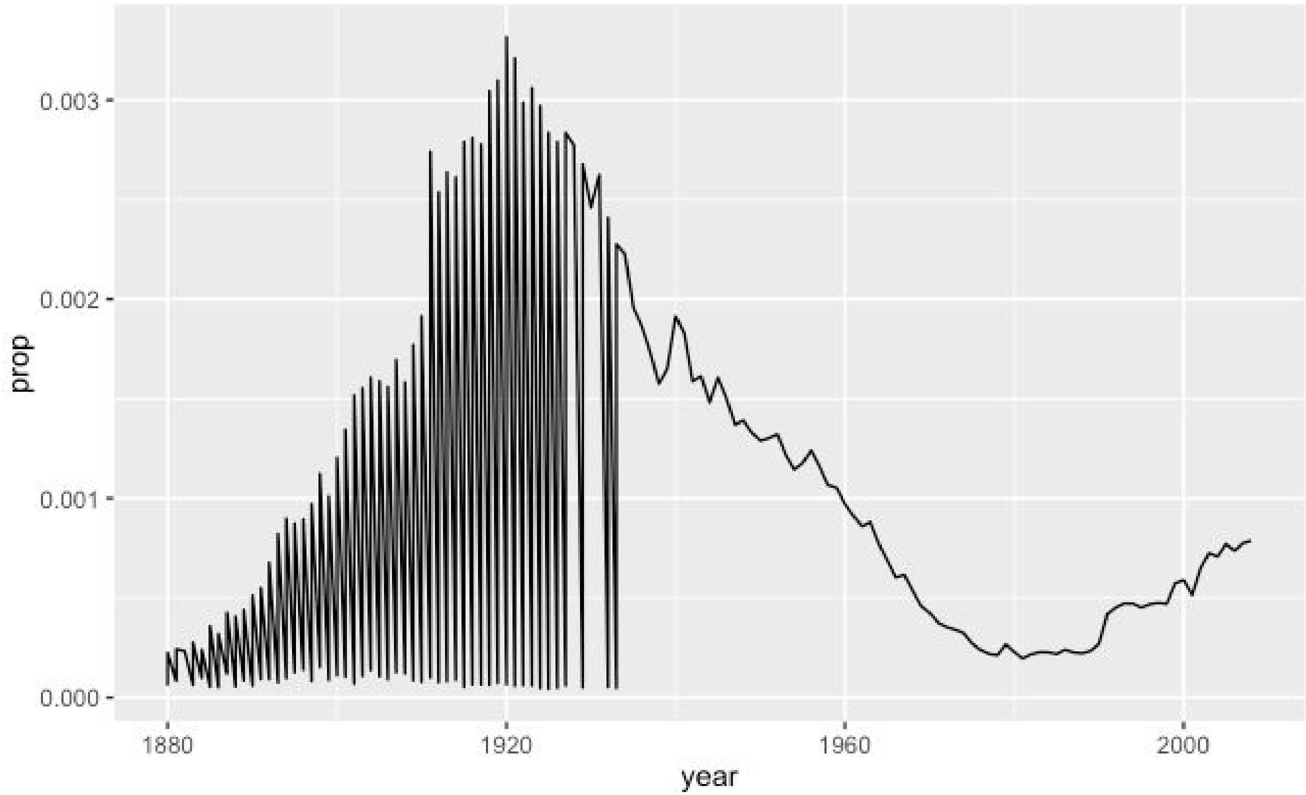
Use *interaction*



Back to the plot

Saw tooth appearance implies grouping is incorrect.

```
vivian <- bnames[bnames$name == "Vivian", ]
qplot(year, prop, data = vivian, geom = "line")
```



dplyr

dplyr

A Grammar of Data Manipulation.

A fast, consistent tool for working with dataframe-like objects, both in memory and out of memory.

dplyr

An R package to manipulate data!

- Easier!
- Faster!!

```r
#install.packages("dplyr")
library(dplyr)
```

dplyr

When working with data you must:

- Figure out what you want to do.
- Precisely describe what you want in the form of a computer program.
- Execute the code.

dplyr

The dplyr package makes each of these steps faster and easier by:

- Elucidating the most common data manipulation operations.
  - Options are helpfully constrained when thinking about how to tackle a problem.
- Providing simple functions that correspond to the most common data manipulation verbs.
  - Easily translate your thoughts into code.
- Using efficient data storage
  - Spend as little time as possible waiting for the computer.

dplyr

tbl_df

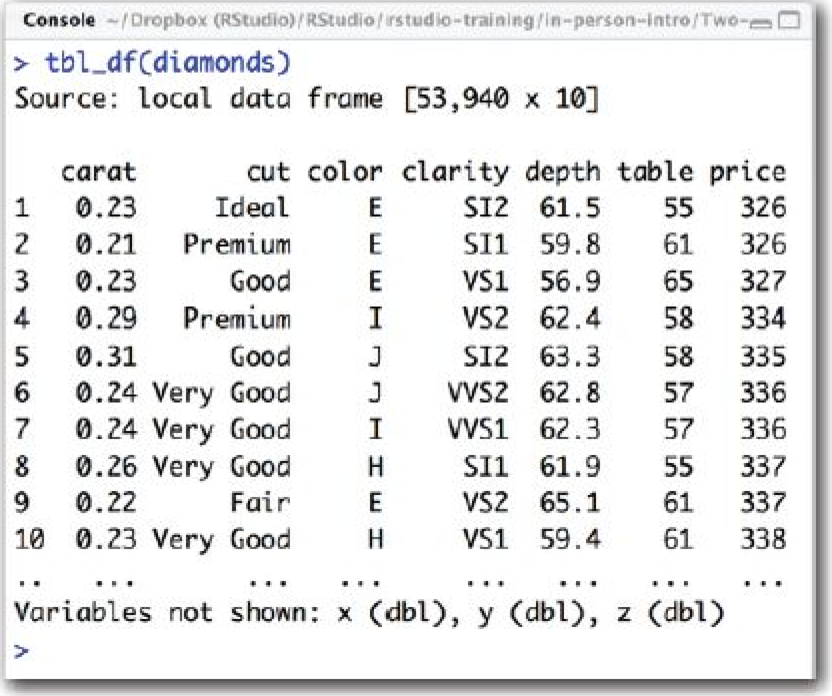
- tbl is a special case of dataframe that can be manipulated more easily.
- use tbl_df function

```
bnames = tbl_df(bnames)
births = tbl_df(births)
class(bnames)
```

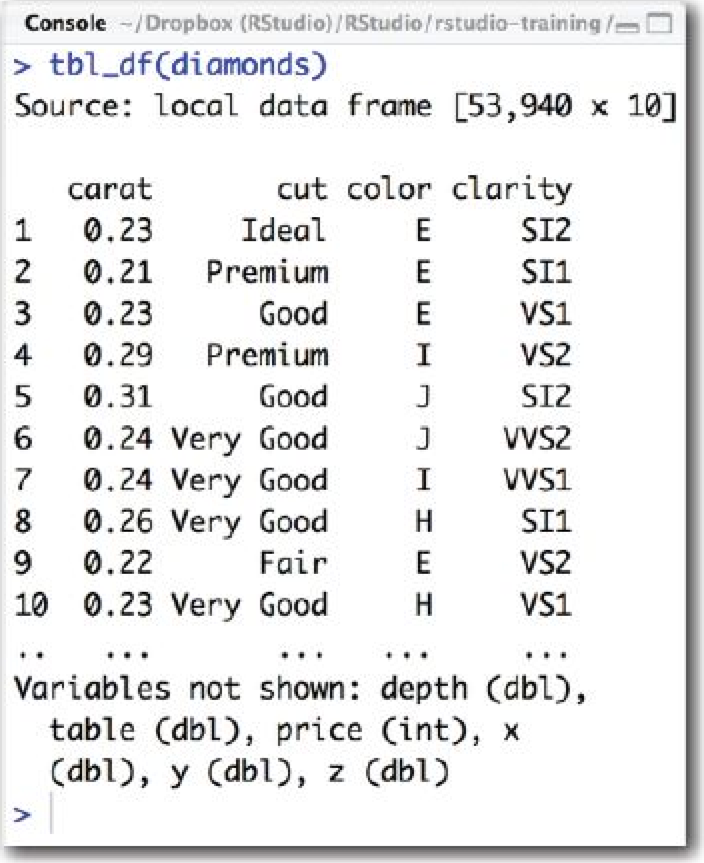
```
[1] "tbl_df"     "tbl"        "data.frame"
```

dplyr

R will show only the part of the tbl that fits the console.


Console ~/Dropbox (RStudio)/RStudio/rstudio-training/in-person-intro/Two-

```
> tbl_df(diamonds)
Source: local data frame [53,940 x 10]

   carat       cut color clarity depth table price
1   0.23     Ideal     E     SI2  61.5    55   326
2   0.21   Premium     E     SI1  59.8    61   326
3   0.23      Good     E     VS1  56.9    65   327
4   0.29   Premium     I     VS2  62.4    58   334
5   0.31      Good     J     SI2  63.3    58   335
6   0.24 Very Good     J    VVS2  62.8    57   336
7   0.24 Very Good     I    VVS1  62.3    57   336
8   0.26 Very Good     H     SI1  61.9    55   337
9   0.22      Fair     E     VS2  65.1    61   337
10  0.23 Very Good     H     VS1  59.4    61   338
..   ...       ...   ...     ...   ...   ...   ...
Variables not shown: x (dbl), y (dbl), z (dbl)
>
```



```
> tbl_df(diamonds)
Source: local data frame [53,940 x 10]

   carat       cut color clarity
1   0.23     Ideal     E     SI2
2   0.21   Premium     E     SI1
3   0.23      Good     E     VS1
4   0.29   Premium     I     VS2
5   0.31      Good     J     SI2
6   0.24 Very Good     J    VVS2
7   0.24 Very Good     I    VVS1
8   0.26 Very Good     H     SI1
9   0.22      Fair     E     VS2
10  0.23 Very Good     H     VS1
..   ...       ...   ...     ...
Variables not shown: depth (dbl),
  table (dbl), price (int), x
  (dbl), y (dbl), z (dbl)
>
```

Use View() to see more

Subset, Transform and Reorder

Subset, Transform and Reorder

1. filter
2. select
3. arrange
4. mutate
5. summarise

Data Manipulation

Structure

- The first argument for these functions is a data frame.
- Subsequent arguments say what to do with that data frame.
- The functions always return a data frame.

Data Manipulation

Structure

- Initialize the data:

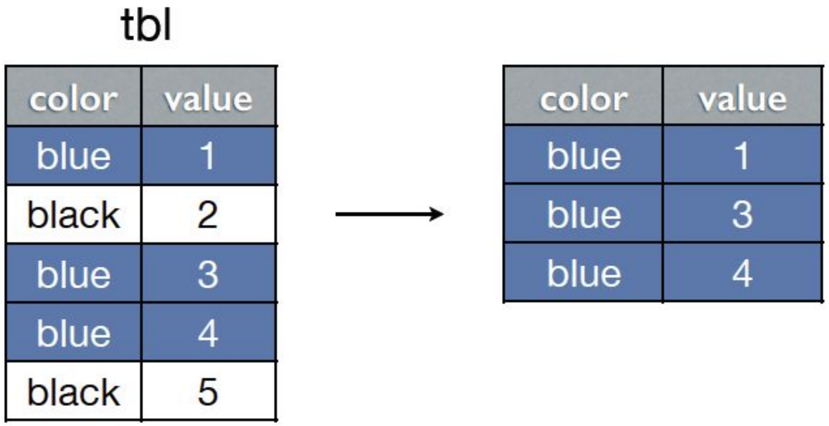
```
df = data.frame(
  color = c("blue", "black", "blue", "blue", "black"),
  value = 1:5)
tbl = tbl_df(df)
```

Filter

filter

```
filter(tbl, color == "blue")
```

```
Source: local data frame [3 x 2]

    color     value
1   blue      1
2   blue      3
3   blue      4
```



tbl

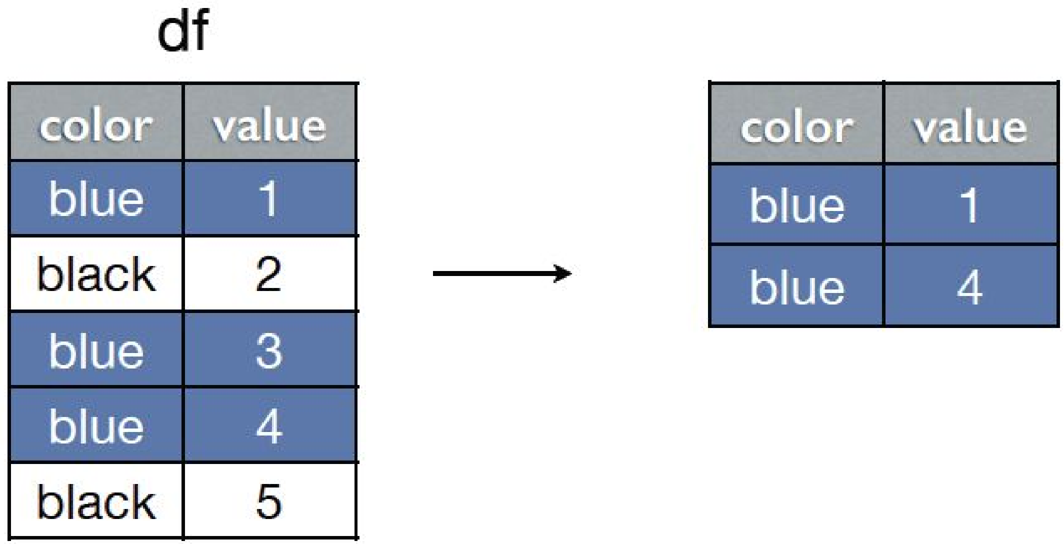
color	value
blue	1
black	2
blue	3
blue	4
black	5

color	value
blue	1
blue	3
blue	4

filter

```
filter(df, value %in% c(1, 4))
```

```
     color     value
1    blue      1
2    blue      4
```



df

color	value
blue	1
black	2
blue	3
blue	4
black	5

→

color	value
blue	1
blue	4

filter

Example

- In the bnames dataset:

  a. Find all of the names that are in the same soundex as the name “Vivian”.

  b. Find all of the girls born in 1900 or 2000.

  c. How many times did a name reach a prop greater than 0.01 after the year 2000?

filter

Example

- Find all of the names that are in the same soundex as the name “Vivian”.

```
vivian = filter(bnames, name == "Vivian")
vivian$soundex[1]
```

```
[1] "V150"
```

```
filter(bnames, soundex == "V150")
```

```
Source: local data frame [251 x 5]

     year    name    prop       sex     soundex
1    1880    Vivian  0.000059   boy     V150
2    1881    Vivian  0.000083   boy     V150
3    1883    Vivian  0.000062   boy     V150
...
```

filter

Example

- Find all of the girls born in 1900 or 2000.

```
filter(bnames, sex == "girl" & (year == 1900 | year == 2000))
```

```
Source: local data frame [2,000 x 5]

    year   name       prop    sex   soundex
1   1900   Mary       0.0526  girl  M600
2   1900   Helen      0.0200  girl  H450
3   1900   Anna       0.0192  girl  A500
4   1900   Margaret   0.0167  girl  M626
5   1900   Ruth       0.0150  girl  R300
6   1900   Elizabeth  0.0129  girl  E421
7   1900   Florence   0.0123  girl  F465
8   1900   Ethel      0.0123  girl  E340
9   1900   Marie      0.0121  girl  M600
10  1900   Lillian    0.0107  girl  L450
...
```

filter

Example

- How many times did a name reach a prop greater than 0.01 after the year 2000?

```
filter(bnames, year > 2000 & prop > 0.01)
```

```
Source: local data frame [57 x 5]

     year     name          prop     sex      soundex
1    2001     Jacob         0.0157   boy      J210
2    2001     Michael       0.0144   boy      M240
3    2001     Matthew       0.0130   boy      M300
4    2001     Joshua        0.0126   boy      J200
5    2001     Christopher   0.0112   boy      C623
6    2001     Nicholas      0.0111   boy      N242
```

select

select

Use the select statement to select a subset of the overall data.

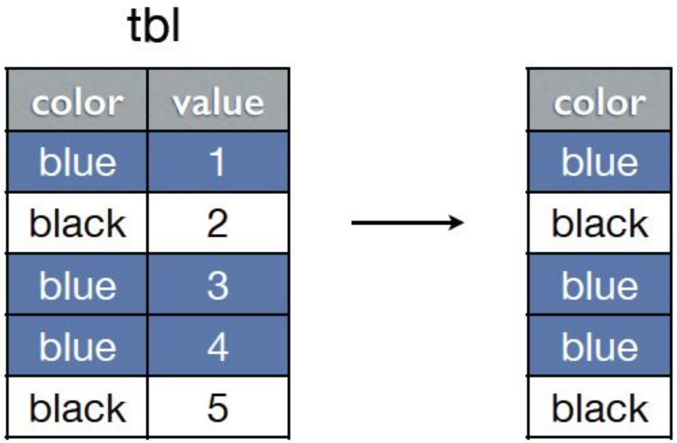
What do you think this statement will do?

```
select(tbl, color)
```

select

```
select(tbl, color)
```

```
Source: local data frame [5 x 1]
        color
1       blue
2       black
3       blue
4       blue
5       black
```



tbl

color	value
blue	1
black	2
blue	3
blue	4
black	5

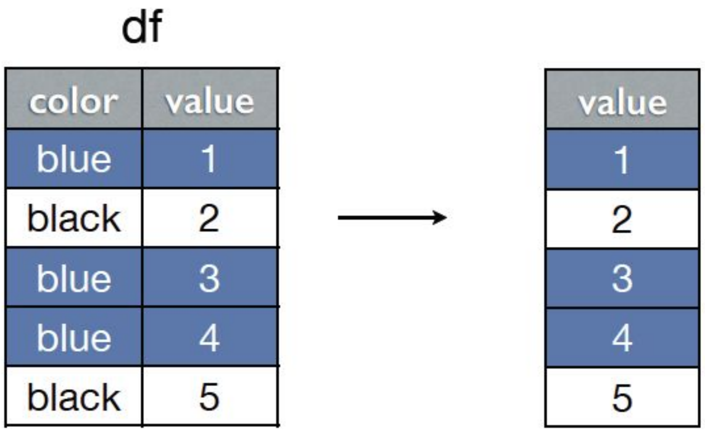
→

color
blue
black
blue
blue
black

select

```
select(tbl, -color)
```

```
Source: local data frame [5 x 1]
         value
1        1
2        2
3        3
4        4
5        5
```



df

color	value
blue	1
black	2
blue	3
blue	4
black	5

value
1
2
3
4
5

select

Example

- Let’s try bringing up the help documentation for select.

```
help(select)
```

- Scroll down to the “Special Functions” section:
    a. What are some other ways you can select variables?

select

- starts_with(x, ignore.case = TRUE): names starting with x.
- ends_with(x, ignore.case = TRUE): names ending in x.
- contains(x, ignore.case = TRUE): selects all variables whose name contains x.
- matches(x, ignore.case = TRUE): selects all variables whose name matches the regular expression x.
- num_range("x", 1:5, width = 2): selects all variables (numerically) from x01 to x05.
- one_of("x", "y", "z"): selects variables provided in a character vector.
- everything(): selects all variables.

select

Example

The following statements all select the soundex variable from the baby names dataset; one of them selects more than just the soundex variable.

```
select(bnames, soundex)
select(bnames, starts_with("sound"))
select(bnames, ends_with("ex"))
```

Difference Between *filter* and *select*

- filter:
  - Keep rows by criteria.
- select:
  - Pick columns by name.

rename

- select can also rename the variables in the resulting dataset:
- select(iris, petal_length = Petal.Length)
- select() keeps only the variables you specify.

```
head(
  select(iris, petal_length = Petal.Length)
  )
```

```
       petal_length
1      1.4
2      1.4
3      1.3
4      1.5
5      1.4
6      1.7
```

rename

- rename function is similar to the select function.
- rename(iris, petal_length = Petal.Length).
- rename() keeps all variables.

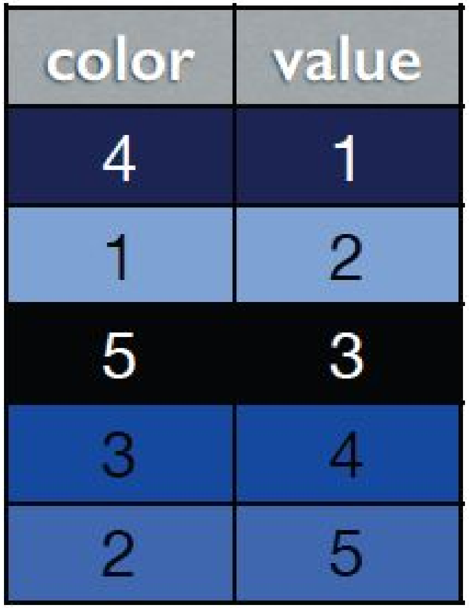
```
head(
  rename(iris, petal_length = Petal.Length)
  )
```

```
    Sepal.Length  Sepal.Width  petal_length  Petal.Width  Species
1   5.1           3.5          1.4           0.2          setosa
2   4.9           3.0          1.4           0.2          setosa
3   4.7           3.2          1.3           0.2          setosa
4   4.6           3.1          1.5           0.2          setosa
5   5.0           3.6          1.4           0.2          setosa
6   5.4           3.9          1.7           0.4          setosa
```

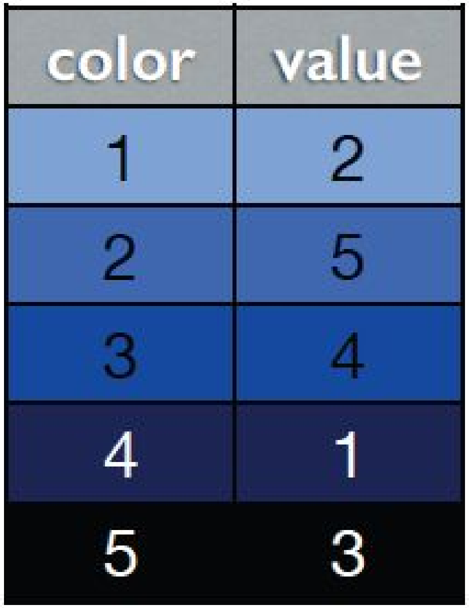
arrange

arrange

```
df1 = data.frame(color = c(4,1,5,3,2),
                 value = 1:5)
arrange(df1, color)
```



color	value
4	1
1	2
5	3
3	4
2	5



color	value
1	2
2	5
3	4
4	1
5	3

Original Method

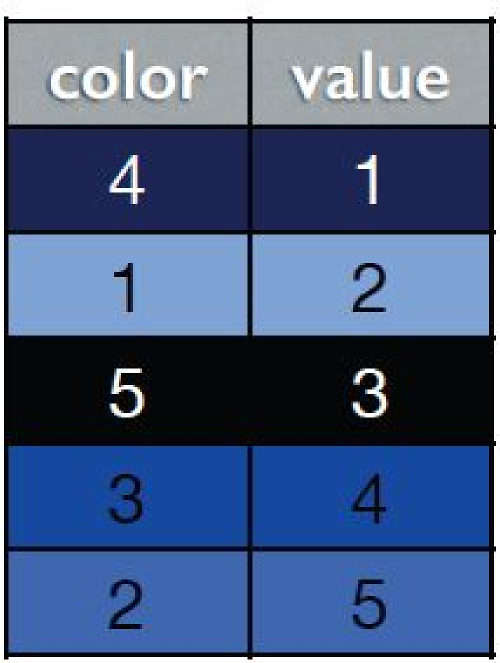
order function:

```
df_order = order(df1$color) #Returns the indices for ascending order.
df1[df_order,]
```

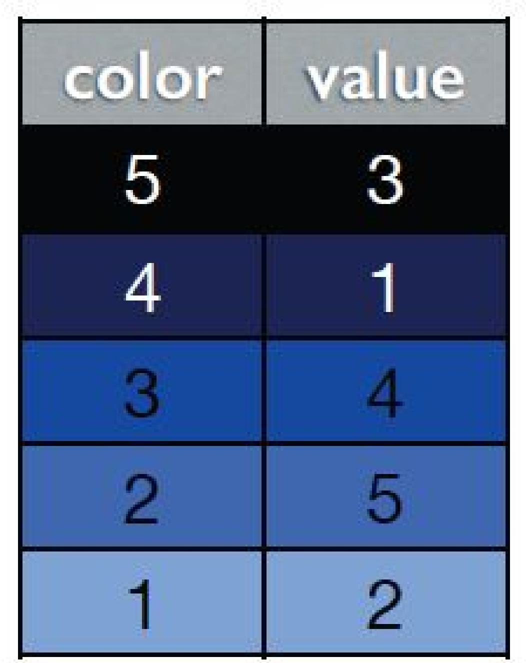
```
     color     value
2    1         2
5    2         5
4    3         4
1    4         1
3    5         3
```

arrange

```
arrange(df1, desc(color)) #Arranging the data in descending order.
```



color	value
4	1
1	2
5	3
3	4
2	5



color	value
5	3
4	1
3	4
2	5
1	2

arrange

Example

- Reorder the baby names dataset by prop in descending order.

```
arrange(bnames, desc(prop))[3,]
```

```
Source: local data frame [3 x 5]


     year     name     prop     sex      soundex
1    1880     John     0.0815   boy      J500
2    1881     John     0.0809   boy      J500
3    1880     William  0.0805   boy      W450
```

arrange

Example

- In what year was Vivian’s name the most popular?
  - (Hint: First filter the data by the name “Vivian”.)

```
arrange(filter(bnames, name == "Vivian"), desc(prop))[1,]
```

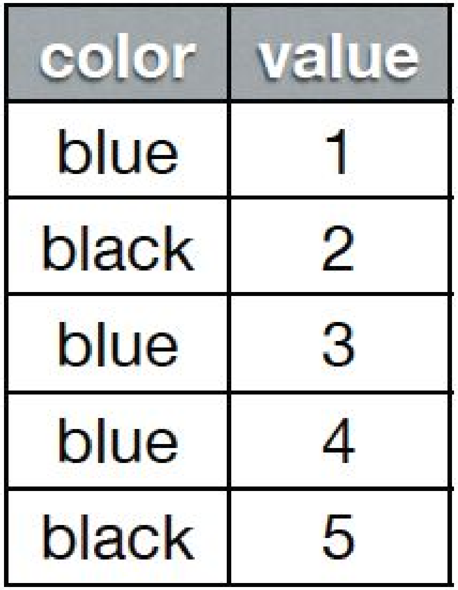
```
Source: local data frame [1 x 5]

     year     name     prop     sex      soundex
1    1920     Vivian   0.00332  girl     V150
```

mutate

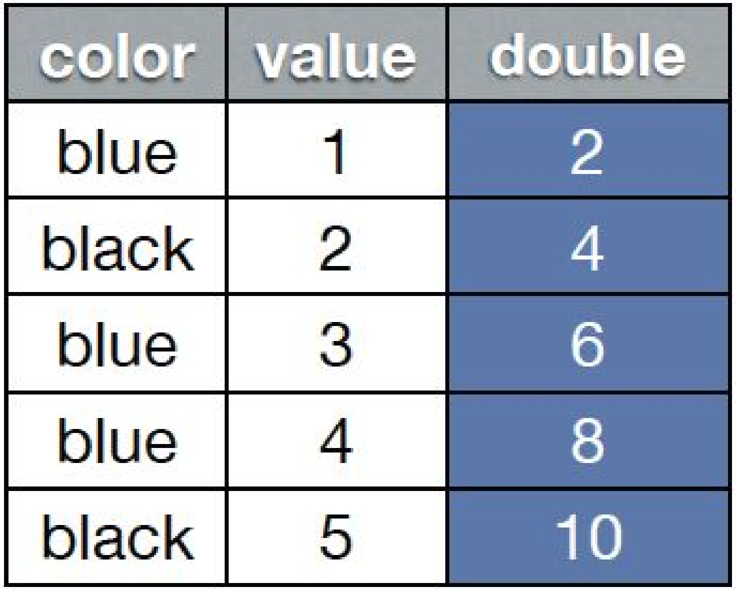
mutate

We can also add columns to datasets by manipulating existing variables.

```
mutate(tbl, double = 2 * value)
```



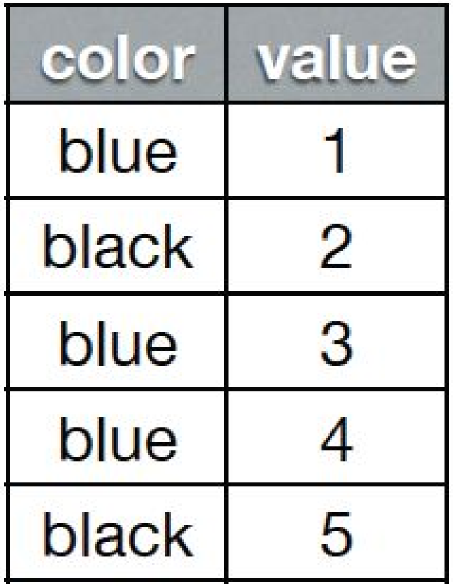
color	value
blue	1
black	2
blue	3
blue	4
black	5



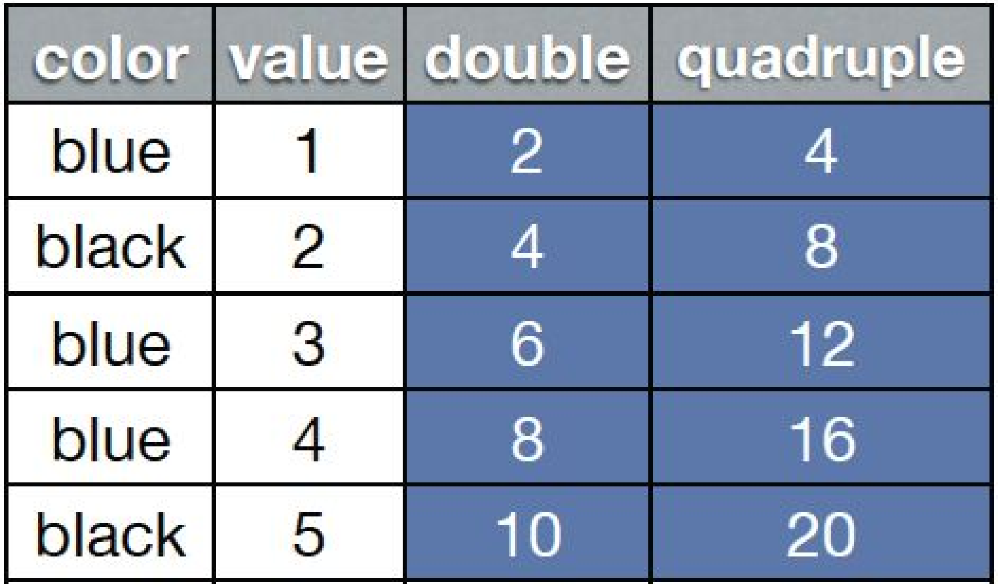
color	value	double
blue	1	2
black	2	4
blue	3	6
blue	4	8
black	5	10

mutate

```
mutate(tbl, double = 2 * value, quadruple = 4 * value)
```



color	value
blue	1
black	2
blue	3
blue	4
black	5



color	value	double	quadruple
blue	1	2	4
black	2	4	8
blue	3	6	12
blue	4	8	16
black	5	10	20

transmute

- A function which is similar to mutate.
- Drops old variables and only retains the newly defined variables.

```
transmute(tbl, double = 2 * value, quadruple = 4 * value)
```

```
Source: local data frame [5 x 2]

    double    quadruple
1   2         4
2   4         8
3   6         12
4   8         16
5   10        20
```

summarise

Aggregate Functions

Use summarise() with aggregate functions, which take a vector of values, and return a single number.

In base R : min(), max(), mean(), sum(), sd(), median(), IQR().

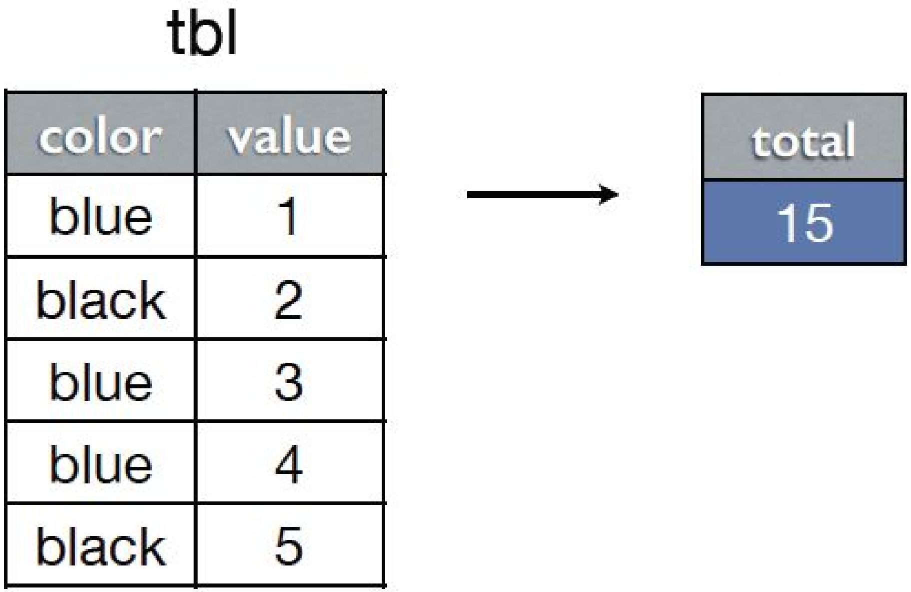
dplyr provides a handful of others:

- n(): number of observations in the current group.
- n_distinct(x): count the number of unique values in x.
- first(x), last(x) and nth(x, n) get the first, last and the nth x.

summarise

```
summarise(tbl, total = sum(value))
```

```
Source: local data frame [1 x 1]

    total
1   15
```



tbl

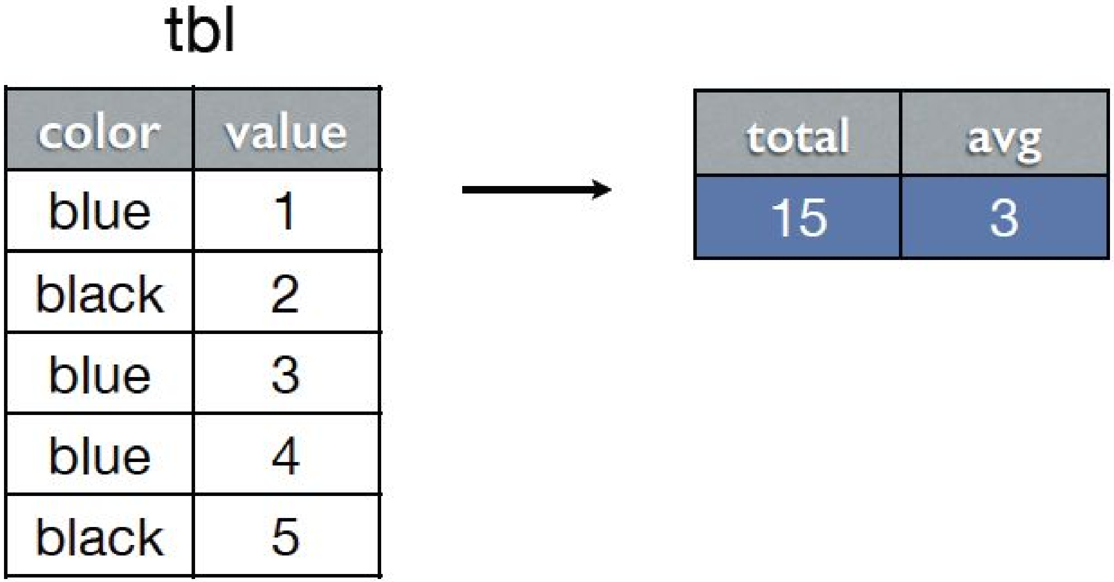
color	value
blue	1
black	2
blue	3
blue	4
black	5

total
15

summarise

```
summarise(tbl, total = sum(value), avg = mean(value))
```

```
Source: local data frame [1 x 2]

    total    avg
1   15       3
```



tbl

color	value
blue	1
black	2
blue	3
blue	4
black	5

total	avg
15	3

Operations to Change Datasets

- mutate:
  - Add new variables
- summarise:
  - Reduce variables to values
- arrange:
  - Reorder rows

Example

- With the vivian data frame:

a. Add a new column to the data that changes the prop to a percentage.

b. Create a summary that displays the min, mean, and max prop Vivian's name.

Answer

A. Add a new column to the data that changes the prop to a percentage.

```
head(
  mutate(vivian, perc = prop * 100)
    )
```

```
Source: local data frame [6 x 6]

     year   name     prop     sex    soundex     perc
1    1880   Vivian   5.9e-05  boy    V150        0.0059
2    1881   Vivian   8.3e-05  boy    V150        0.0083
3    1883   Vivian   6.2e-05  boy    V150        0.0062
4    1884   Vivian   9.8e-05  boy    V150        0.0098
5    1885   Vivian   5.2e-05  boy    V150        0.0052
6    1886   Vivian   5.0e-05  boy    V150        0.0050
```

Answer

B. Create a summary that displays the min, mean, and max prop for Vivian's name.

```
summarise(vivian,
        min = min(prop),
        mean = mean(prop),
        max = max(prop))
```

```
Source: local data frame [1 x 3]

     min          mean        max
1    4.2e-05      0.000888    0.00332
```

What Do These Functions Do Again?

1. filter
2. select
3. arrange
4. mutate
5. summarise

What Do These Functions Do Again?

1. filter: keep rows matching given criteria.
2. select: pick columns by name.
3. arrange: reorder rows.
4. mutate: add new variables. (Use transmute to drop old variables.)
5. summarise: reduce variables to values.

Joining Data Sets

Joining Data Sets

Example

- Why might prop be a bad way to compare names across different years?

```
births
```

```
Source: local data frame [260 x 3]
         year      sex       births
1        1880      boy       118405
2        1881      boy       108290
3        1882      boy       122034
4        1883      boy       112487
5        1884      boy       122745
6        1885      boy       115948
7        1886      boy       119046
8        1887      boy       109312
9        1888      boy       129914
10       1889      boy       119044
..       ...       ...       ...
```

Combine Two Data Sets

- How would you combine these data sets?
- Describe a strategy.

```
head(bnames)
```

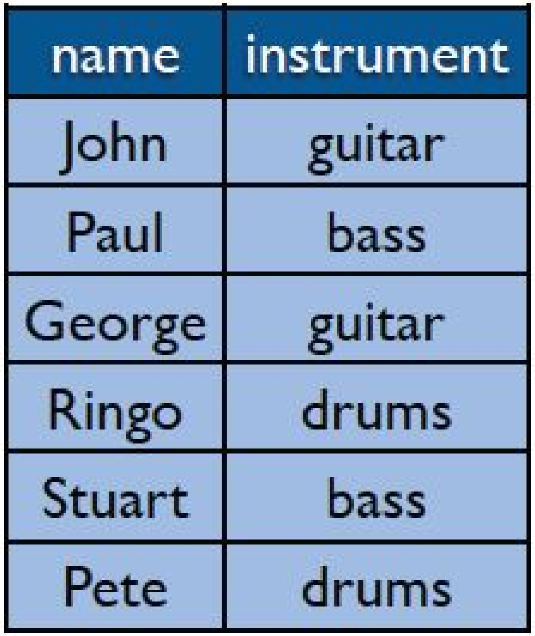
```
Source: local data frame [6 x 5]

  year  name    prop   sex  soundex
1 1880  John    0.0815 boy  J500
2 1880  William 0.0805 boy  W450
3 1880  James   0.0501 boy  J520
4 1880  Charles 0.0452 boy  C642
5 1880  George  0.0433 boy  G620
6 1880  Frank   0.0274 boy  F652
```

```
head(births)
```

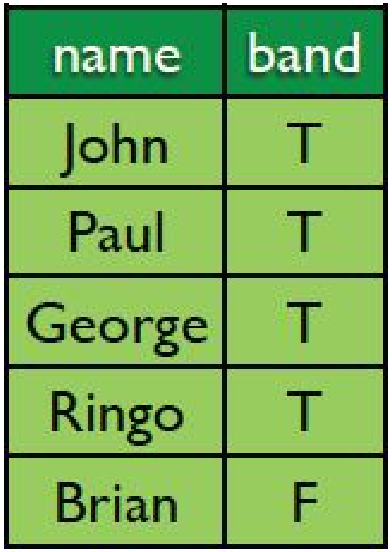
```
Source: local data frame [6 x 3]

      year    sex     births
  1   1880    boy     118405
  2   1881    boy     108290
  3   1882    boy     122034
  4   1883    boy     112487
  5   1884    boy     122745
  6   1885    boy     115948
```

Combine Two Data Sets

- How would you combine these data sets?
- Describe a strategy.



name	instrument
John	guitar
Paul	bass
George	guitar
Ringo	drums
Stuart	bass
Pete	drums



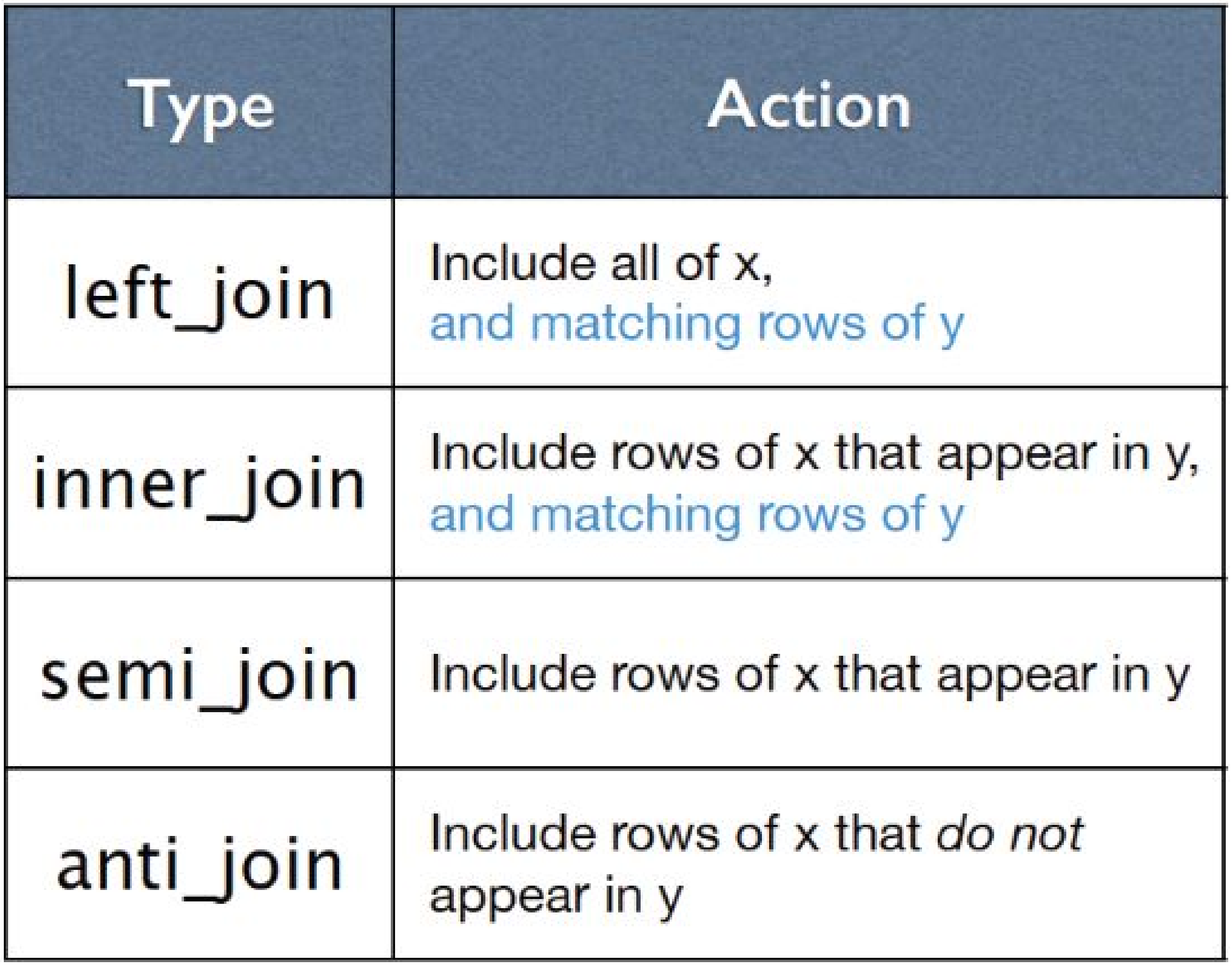
name	band
John	T
Paul	T
George	T
Ringo	T
Brian	F

Combine Two Data Sets

Initialize the demo data

```
x = data.frame(
   name = c("John", "Paul", "George", "Ringo", "Stuart", "Pete"),
   instrument = c("guitar", "bass", "guitar", "drums", "bass",
                 "drums"))
y = data.frame(
   name = c("John", "Paul", "George", "Ringo", "Brian"),
   band = c("TRUE", "TRUE", "TRUE", "TRUE", "FALSE"))
```

Combine Two Data Sets



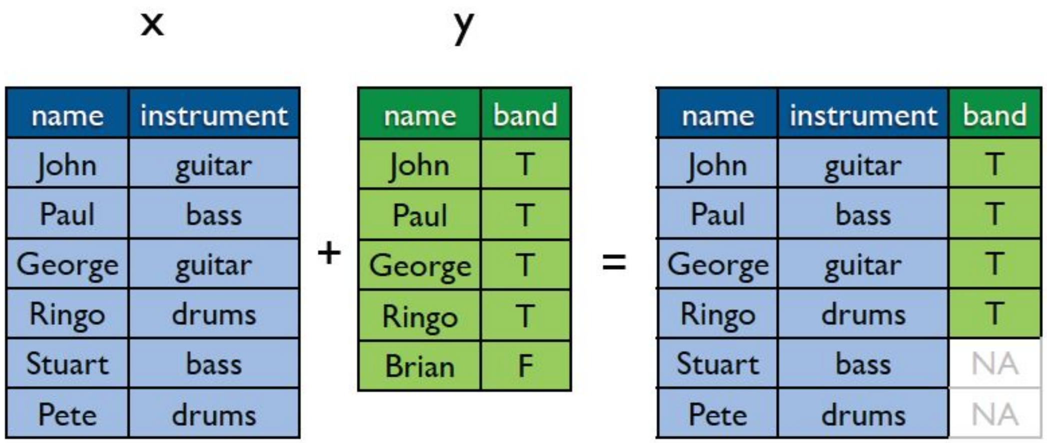
Type	Action
left_join	Include all of x, and matching rows of y
inner_join	Include rows of x that appear in y, and matching rows of y
semi_join	Include rows of x that appear in y
anti_join	Include rows of x that *do not* appear in y

Combine Two Data Sets

left_join

- Include all of x, and matching rows of y.

```
left_join(x, y, by = "name") #To which column is the error referring?
```



x

name	instrument
John	guitar
Paul	bass
George	guitar
Ringo	drums
Stuart	bass
Pete	drums

y

name	band
John	T
Paul	T
George	T
Ringo	T
Brian	F

name	instrument	band
John	guitar	T
Paul	bass	T
George	guitar	T
Ringo	drums	T
Stuart	bass	NA
Pete	drums	NA

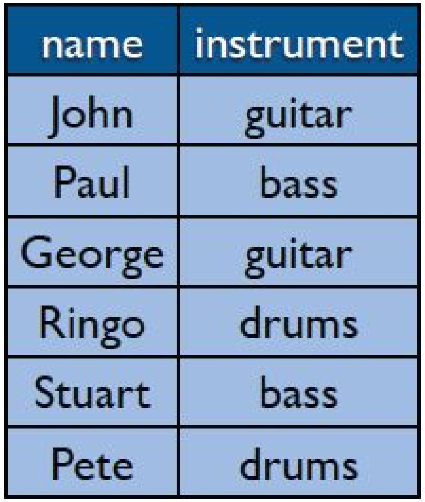
```
left_join(x, y, by = "name")
```

Combine Two Data Sets

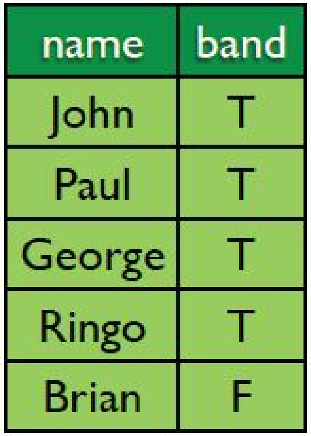
inner_join

- Include rows of x that appear in y, and matching rows of y

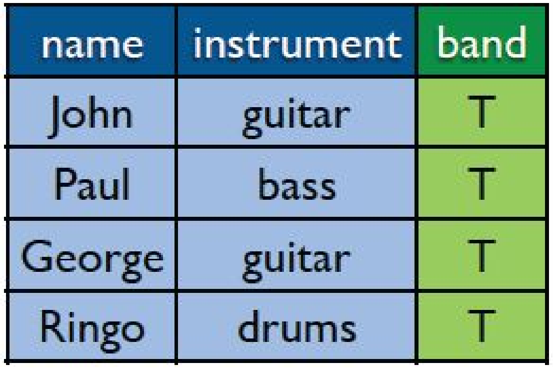
```
inner_join(x, y, by = "name")
```



name	instrument
John	guitar
Paul	bass
George	guitar
Ringo	drums
Stuart	bass
Pete	drums



name	band
John	T
Paul	T
George	T
Ringo	T
Brian	F



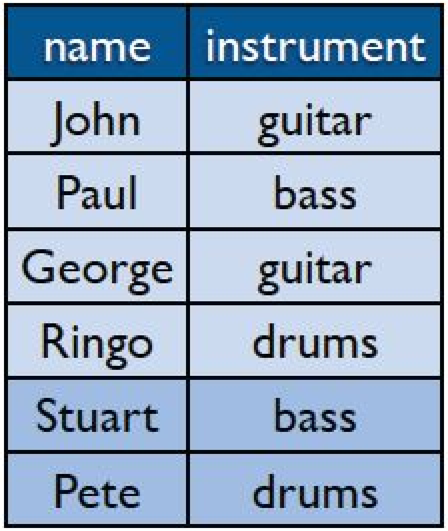
name	instrument	band
John	guitar	T
Paul	bass	T
George	guitar	T
Ringo	drums	T

Combine Two Data Sets

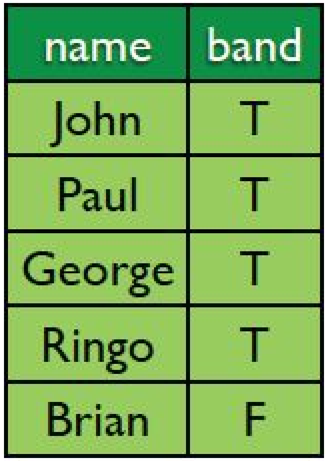
semi_join

- Include rows of x that appear in y

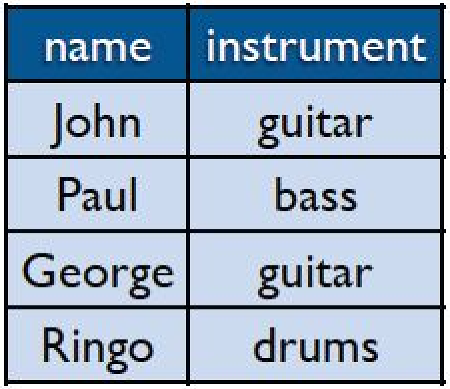
```
semi_join(x, y, by = "name")
```



name	instrument
John	guitar
Paul	bass
George	guitar
Ringo	drums
Stuart	bass
Pete	drums



name	band
John	T
Paul	T
George	T
Ringo	T
Brian	F



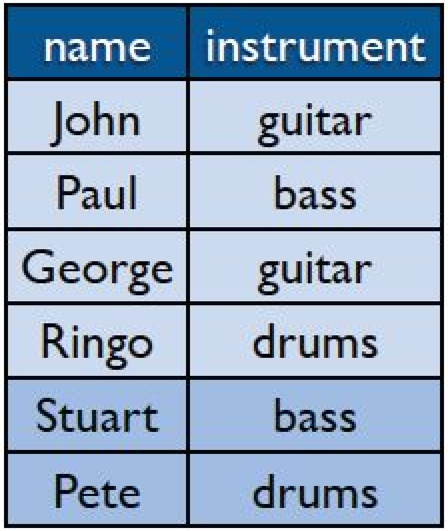
name	instrument
John	guitar
Paul	bass
George	guitar
Ringo	drums

Combine Two Data Sets

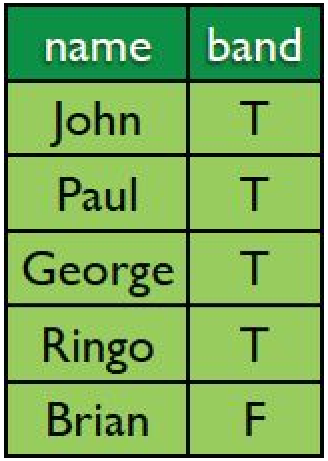
anti_join

- Include rows of x that do not appear in y

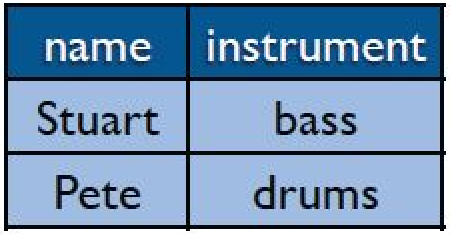
```
anti_join(x, y, by = "name")
```



name	instrument
John	guitar
Paul	bass
George	guitar
Ringo	drums
Stuart	bass
Pete	drums



name	band
John	T
Paul	T
George	T
Ringo	T
Brian	F



name	instrument
Stuart	bass
Pete	drums

Combine Two Data Sets

Example

- Combine bnames with births.
- Add a new column that shows the number of babies whose name is the corresponding name and born in the corresponding year.

For example:

```
     year   sex    name   prop       soundex births  n
1    1880   boy    John   0.081541   J500    118405  9655
```

There are 9655 babies born in 1880 and named John.

Combine Two Data Sets

Answer

- First combine bnames with births:

```
bnames2 = left_join(bnames, births, by = c("year","sex"))
bnames2
```

```
Source: local data frame [258,000 x 6]

     year    sex    name     prop        soundex  births
1    1880    boy    John     0.081541    J500     118405
2    1880    boy    William  0.080511    W450     118405
3    1880    boy    James    0.050057    J520     118405
4    1880    boy    Charles  0.045167    C642     118405
5    1880    boy    George   0.043292    G620     118405
...
```

Combine Two Data Sets

Answer

- Then create a new column that shows the total number of babies born each year for each name.

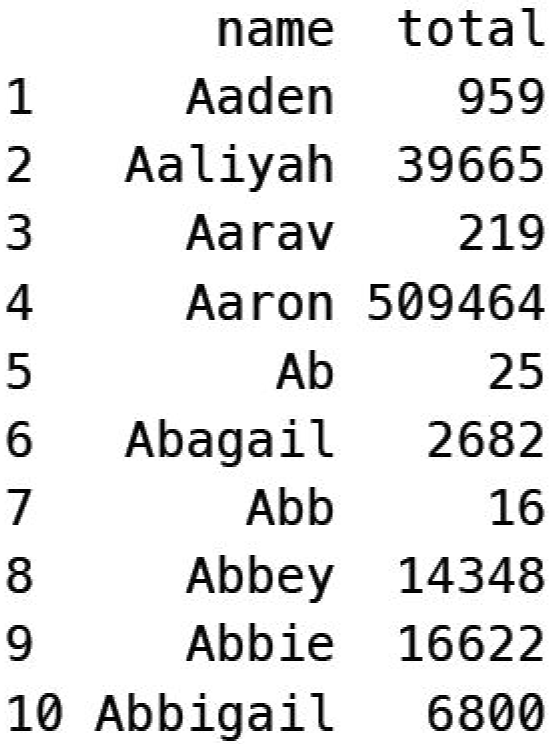
```
bnames2 = mutate(bnames2, n = round(prop * births))
bnames2
```

```
Source: local data frame [258,000 x 7]

     year   sex   name     prop       soundex  births  n
1    1880   boy   John     0.081541   J500     118405  9655
2    1880   boy   William  0.080511   W450     118405  9533
3    1880   boy   James    0.050057   J520     118405  5927
4    1880   boy   Charles  0.045167   C642     118405  5348
5    1880   boy   George   0.043292   G620     118405  5126
...
```

Groupwise Operations

Groupwise Operations

- Total number of people per name.
- Do we have enough information to calculate this?



```
         name  total
1       Aaden    959
2     Aaliyah  39665
3       Aarav    219
4       Aaron 509464
5          Ab     25
6     Abagail   2682
7         Abb     16
8       Abbey  14348
9       Abbie  16622
10 Abbigail    6800
```

Groupwise Operations

Example

- Start small. Using the bnames2 dataset, calculate the total for “Vivian”.

Groupwise Operations

Answer

- Using the bnames2 dataset, calculate the total for “Vivian”.

```
vivian = filter(bnames2, name == "Vivian")
sum(vivian$n)
```

```
[1] 183011
```

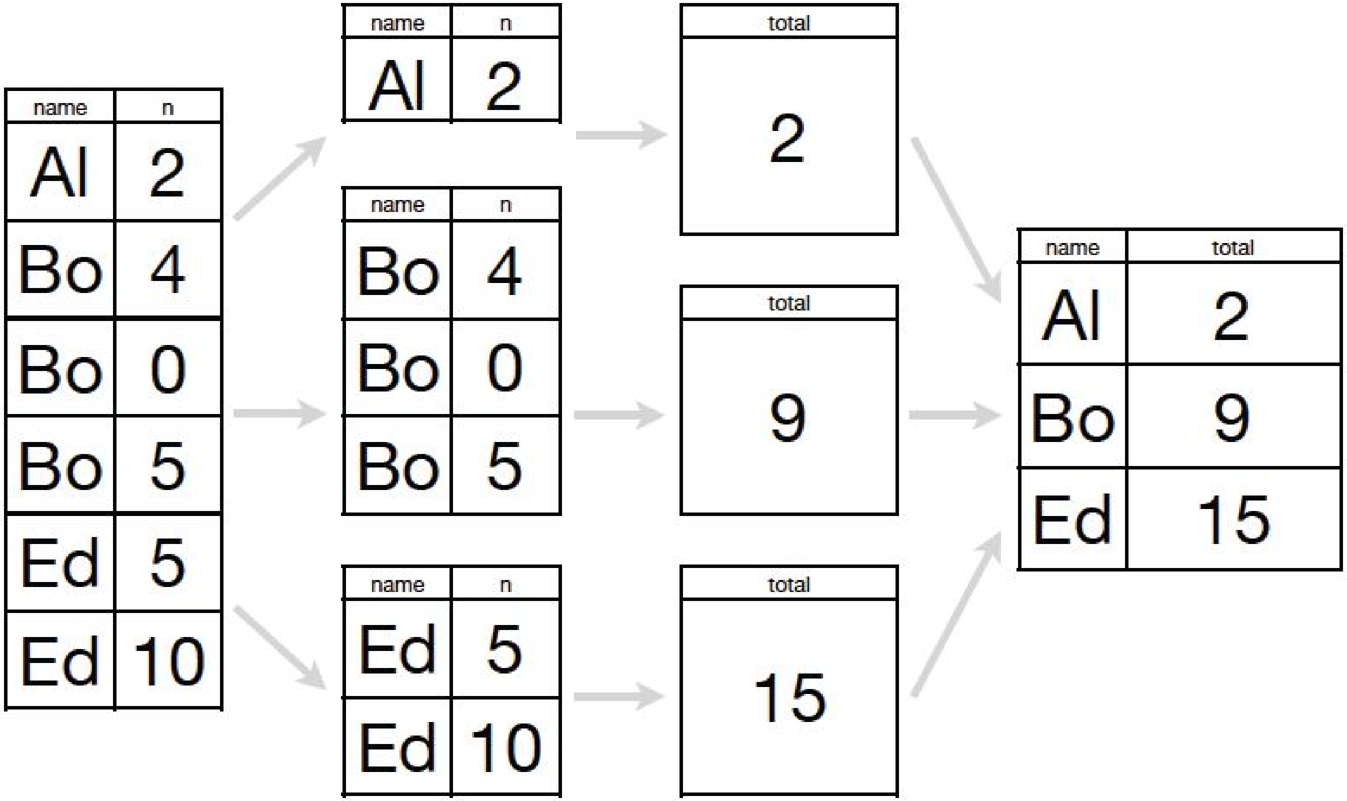
```
#We could have also used the summarise function.
summarise(vivian, total = sum(n))
```

```
Source: local data frame [1 x 1]

      total
1     183011
```

Groupwise Operations

Question

- What if we wanted to do this for every name in the dataset? Uh oh...



name	n
Al	2
Bo	4
Bo	0
Bo	5
Ed	5
Ed	10

name	n
Al	2

name	n
Bo	4
Bo	0
Bo	5

name	n
Ed	5
Ed	10

total
2

total
9

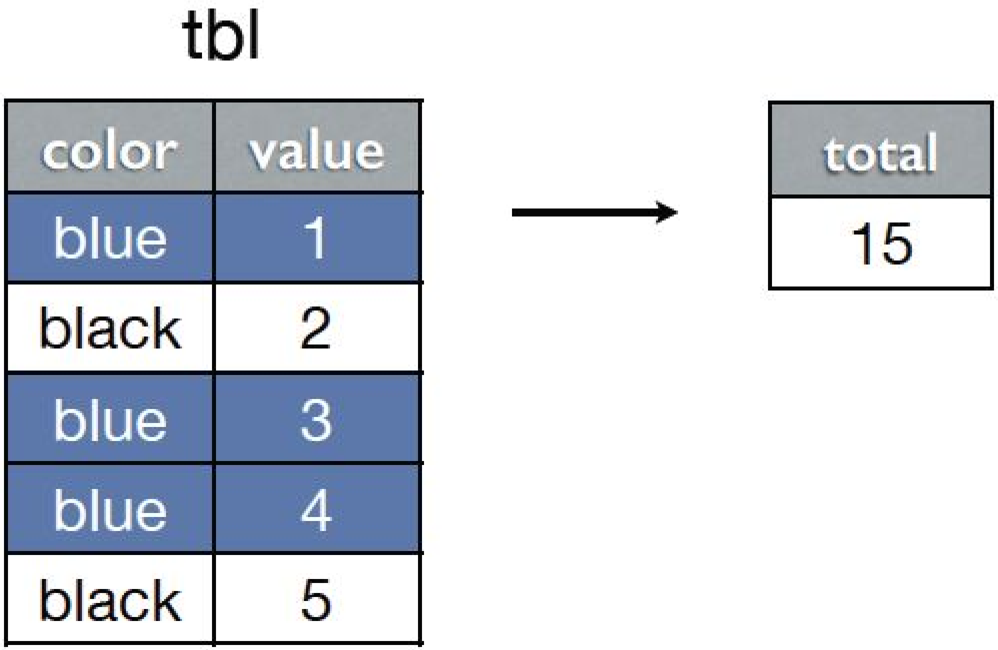
total
15

name	total
Al	2
Bo	9
Ed	15

group_by

group_by

```
summarise(tbl, total = sum(value))
```



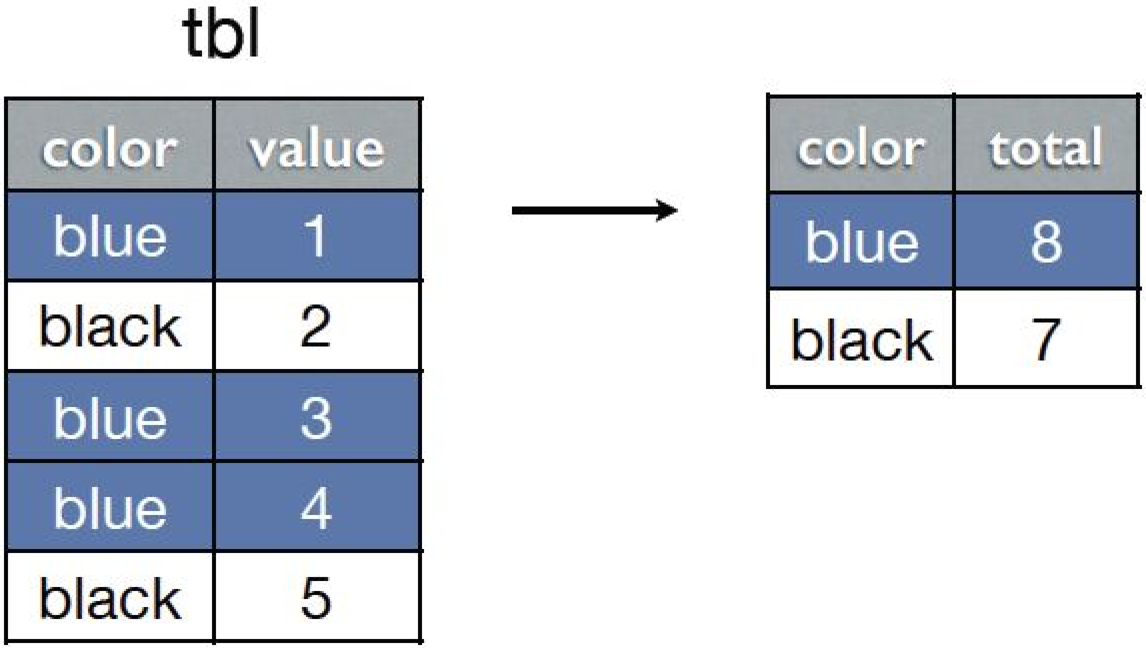
tbl

color	value
blue	1
black	2
blue	3
blue	4
black	5

total
15

group_by

```
by_color = group_by(tbl, color) #Has a new grouped table component.
summarise(by_color, total = sum(value))
```



tbl

color	value
blue	1
black	2
blue	3
blue	4
black	5

color	total
blue	8
black	7

group_by

```
group_by(bnames2, name) #This looks very similar to bnames2; what’s different?
```

```
Source: local data frame [258,000 x 7]
Groups: name

     year   name     prop    sex   soundex  births  n
1    1880   John     0.0815  boy   J500     118405  9655
2    1880   William  0.0805  boy   W450     118405  9533
3    1880   James    0.0501  boy   J520     118405  5927
4    1880   Charles  0.0452  boy   C642     118405  5348
5    1880   George   0.0433  boy   G620     118405  5126
..   ...    ...      ...     ...   ...      ...     ...
```

- Groups: name
- mutate, summarise, and arrange will execute groupwise on this variable.

group_by

```
by_name = group_by(bnames2, name)
totals = summarise(by_name, total = sum(n))
head(totals)
```

```
Source: local data frame [6 x 2]

     name      total
1    Aaden     959
2    Aaliyah   39665
3    Aarav     219
4    Aaron     509464
5    Ab        25
6    Abagail   2682
```

That was so much easier!

Interactions

Use multiple variables to create groups based on the interaction of variables.

```
group_by(bnames2, name, sex)
```

```
Source:     local     data     frame     [6     x     7]
Groups:                    name,                    sex

     year          name          prop   sex   soundex   births      n
1    1880          John    0.0815   boy           J500    118405   9655
2     1880    William    0.0805    boy          W450    118405   9533
3 1880   James 0.0501 boy   J520 118405 5927
```

- Groups: name, sex
- dplyr will treat each unique combination of these values as a separate group.

Interactions

Successive group_by calls will forget the old groups and replace them by the new.

```
by_name = group_by(bnames2, name)
group_by(by_name, sex) #Doesn’t yield what we really wanted...
```

```
Source: local data frame [258,000 x 7]
Groups: sex

     year    sex     name     prop        soundex  births   n
1    1880    boy     John     0.081541    J500     118405   9655
2    1880    boy     William  0.080511    W450     118405   9533
3    1880    boy     James    0.050057    J520     118405   5927
4    1880    boy     Charles  0.045167    C642     118405   5348
5    1880    boy     George   0.043292    G620     118405   5126
6    1880    boy     Frank    0.027380    F652     118405   3242
...
```

Interactions

Use summarise to solve this problem of trying to use multiple group_by statements.

```
name_sex = group_by(bnames2, name, sex)
totals2 = summarise(name_sex, total = sum(n))
head(totals2)
```

```
Source: local data frame [6 x 3]
Groups: name

     name     sex      total
1    Aaden    boy      959
2    Aaliyah  girl     39665
3    Aarav    boy      219
4    Aaron    boy      508094
5    Aaron    girl     1370
6    Ab       boy      25
```

Ungroup

Use ungroup to remove group specifications.

```
by_name_sex = group_by(bnames2, name, sex)
ungroup(by_name_sex)
```

```
Source: local data frame [258,000 x 7]

     year  sex  name     prop      soundex births  n
1    1880  boy  John     0.081541  J500    118405  9655
2    1880  boy  William  0.080511  W450    118405  9533
3    1880  boy  James    0.050057  J520    118405  5927
4    1880  boy  Charles  0.045167  C642    118405  5348
5    1880  boy  George   0.043292  G620    118405  5126
6    1880  boy  Frank    0.027380  F652    118405  3242
...
```

Examples

1. Calculate the total number of babies in each soundex.
2. What is the most popular soundex?
3. What names are in the most popular soundex?
4. Calculate the total number of boys and the total number of girls for each year.
5. Calculate the rank of each name within each year and within each gender. (Hint: Use a mutate statement with the new column `rank = rank(desc(prop))`.
6. Which names were ranked #1?
7. How many times did each of the #1 ranked names appear as the top ranked name? Order these names by the most frequent.

Answer

1. Calculate the total number of babies in each soundex.

```
by_soundex = group_by(bnames2, soundex)
stotals = summarise(by_soundex, total = sum(n))
stotals
```

```
Source: local data frame [1,392 x 2]

    soundex  total
1   A000     11
2   A100     193837
3   A120     15652
4   A124     256458
5   A130     11
6   A134     5181
7   A135     901
...
```

Answer

2. What is the most popular soundex?

```
arrange(stotals, desc(total))
```

```
Source: local data frame [1,392 x 2]

     soundex  total
1    J500     9991737
2    M240     5823791
3    M600     5553703
4    J520     5524958
5    R163     5047182
6    W450     4116109
```

Answer

3. What names are in the most popular soundex?

```
j500 = filter(bnames, soundex == "J500")
unique(j500$name)
```

```
[1] "John"     "Jim"      "Juan"     "Jimmie"   "Johnnie" "Johnny"   "Johnie"   "Jean"
 [9] "June"     "Jonah"    "Jennie"   "Jimmy"    "Johny"    "Jonnie"   "Johney"   "Jamie"
[17] "Jon"      "Joan"     "Jan"      "Jame"     "Jaime"    "Jamey"    "Jaimie"   "Jammie"
[25] "Jayme"    "Juwan"    "Johan"    "Jaheim"   "Jahiem"   "Jaheem" "Jane"     "Janie"
[33] "Johanna""Joanna"   "Jannie"   "Jenny"    "Jeanne"   "Johannah" "Juana"  "Junie"
[41] "Jinnie"   "Jeanie"   "Jeannie" "Junia"    "Janey"    "Jeane"    "Joanne"   "Joann"
[49] "Jayne"    "Jana"     "Janna"    "Jann"     "Joni"     "Joanie"   "Jeanna"   "Jami"
[57] "Johnna"   "Jeana"    "Jonna"    "Jena"     "Jenni"    "Jenna"    "Janae"    "Jaimee"
[65] "Janay"    "Joana"    "Janiya"   "Johana"   "Jamya"    "Janiyah" "Janiah"   "Jamiya"
```

Answer

4. Calculate the total number of boys and the total number of girls for each year.

```
year_sex = group_by(bnames2, year, sex)
ytotals = summarise(year_sex, births = sum(n))
ytotals
```

```
Source: local data frame [258 x 3]
Groups: year

      year    sex     births
1     1880    boy     110207
2     1880    girl    91227
3     1881    boy     100763
4     1881    girl    92204
5     1882    boy     113194
...
```

Answer

5. Calculate the rank of each name within each year and within each gender.

```
year_sex = group_by(bnames2, year, sex)
ranks = mutate(year_sex, rank = rank(desc(prop)))
ranks
```

```
Source: local data frame [258,000 x 8]
Groups: year, sex

     year   sex   name     prop    soundex births  n     rank
1    1880   boy   John     0.0815  J500    118405  9655  1
2    1880   boy   William  0.0805  W450    118405  9533  2
3    1880   boy   James    0.0501  J520    118405  5927  3
4    1880   boy   Charles  0.0452  C642    118405  5348  4
5    1880   boy   George   0.0433  G620    118405  5126  5
6    1880   boy   Frank    0.0274  F652    118405  3242  6
...
```

Answer

6. Which names were ranked number 1?

```
ones = filter(ranks, rank == 1)
ones = select(ones, year, name, sex)
unique(ones$name)
```

```
 [1] "John"     "Robert"   "James"    "Michael"  "David"    "Jacob"    "Mary"    
 [8] "Linda"    "Lisa"     "Jennifer" "Jessica"  "Ashley"   "Emily"    "Emma"    
```

Answer

7. How many times did each of the #1 ranked names appear as the top ranked name? Order these names by the most frequent.

```
arrange(summarise(group_by(ones, name), count = n()), desc(count))
```

```
Source: local data frame [14 x 2]

      name      count
1     Mary      76
2     John      44
3     Michael   44
4     Robert    17
5     Jennifer  15
...
```

Wow...that’s complicated!

Answer

Is there an easier way?

- Use the pipe function %>% with the period marker . to transmit the result of one call as an argument to the next call.

```
arrange(summarise(group_by(ones, name), count = n()), desc(count))
#Or...
group_by(ones,name) %>%
      summarise(.,count=n()) %>%
      arrange(.,desc(count))
```

```
Source: local data frame [14 x 2]
      name      count
1     Mary      76
2     John      44
3     Michael   44
4     Robert    17
```

Summarise

- “Unwrap” groups with summarise.
- Summarise will also remove one level of grouping from its output.

Summarise

```
bnames3 = select(bnames2,-soundex) #Dropping the soundex column.
name_sex = group_by(bnames3, name, sex)
name_sex
```

```
Source: local data frame [258,000 x 6]
Groups: name, sex
     year    name     prop     sex      births   n
1    1880    John     0.0815   boy      118405   9655
2    1880    William  0.0805   boy      118405   9533
3    1880    James    0.0501   boy      118405   5927
4    1880    Charles  0.0452   boy      118405   5348
5    1880    George   0.0433   boy      118405   5126
6    1880    Frank    0.0274   boy      118405   3242
7    1880    Joseph   0.0222   boy      118405   2632
8    1880    Thomas   0.0214   boy      118405   2534
9    1880    Henry    0.0206   boy      118405   2444
10   1880    Robert   0.0204   boy      118405   2416
..   ...     ...      ...      ...      ...      ...
```

Summarise

```
bnames3 = select(bnames2,-soundex)
name_sex = group_by(bnames3, name, sex)
summary1 = summarise(name_sex, total = sum(n))
summary1 #Summarises first by going across the sex group.
```

```
Source: local data frame [7,455 x 3]
Groups: name
       name      sex      total
1      Aaden     boy      959
2      Aaliyah   girl     39665
3      Aarav     boy      219
4      Aaron     boy      508094
5      Aaron     girl     1370
6      Ab        boy      25
7      Abagail   girl     2682
8      Abb       boy      16
9      Abbey     girl     14348
10     Abbie     boy      10
..     ...       ...      ...
```

Summarise

```
bnames3 = select(bnames2,-soundex)
name_sex = group_by(bnames3, name, sex)
summary1 = summarise(name_sex, total = sum(n))
summary2 = summarise(summary1, total = sum(total))
summary2 #Summarises second by going across the name group.
```

```
Source: local data frame [6,782 x 2]
      name       total
1     Aaden      959
2     Aaliyah    39665
3     Aarav      219
4     Aaron      509464
5     Ab         25
6     Abagail    2682
7     Abb        16
8     Abbey      14348
9     Abbie      16622
10    Abbigail   6800
..    ...        ...
```

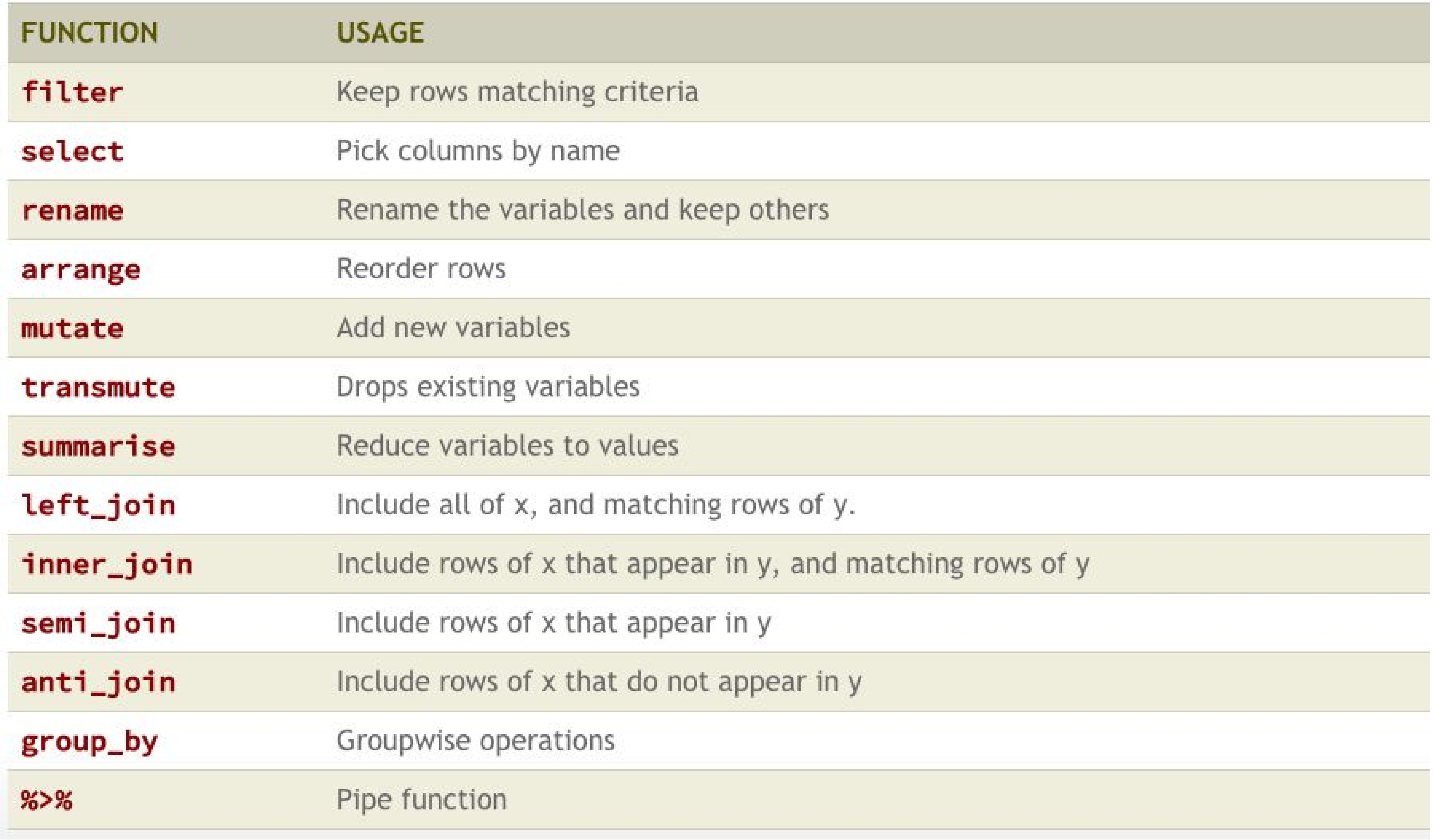
Summarise

```
bnames3 = select(bnames2,-soundex)
name_sex = group_by(bnames3, name, sex)
summary1 = summarise(name_sex, total = sum(n))
summary2 = summarise(summary1, total = sum(total))
summary3 = summarise(summary2, total = sum(total))
summary3 #Summarises by compressing the remaining information.
```

```
Source: local data frame [1 x 1]

     total
1    290255364
```

Summary

Function Reference

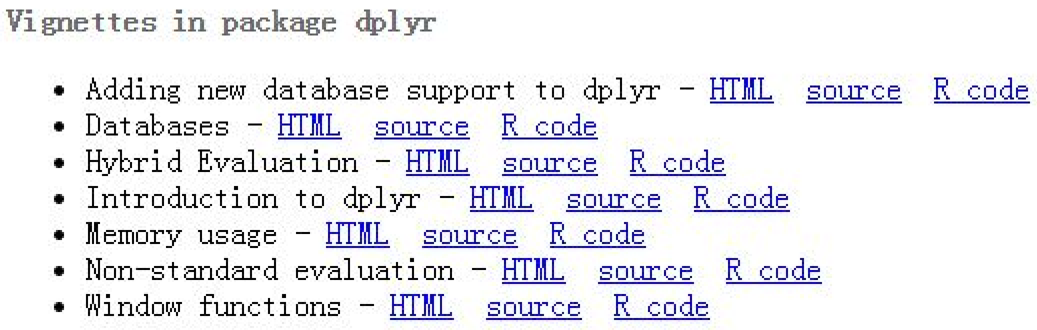


FUNCTION	USAGE
`filter`	Keep rows matching criteria
`select`	Pick columns by name
`rename`	Rename the variables and keep others
`arrange`	Reorder rows
`mutate`	Add new variables
`transmute`	Drops existing variables
`summarise`	Reduce variables to values
`left_join`	Include all of x, and matching rows of y.
`inner_join`	Include rows of x that appear in y, and matching rows of y
`semi_join`	Include rows of x that appear in y
`anti_join`	Include rows of x that do not appear in y
`group_by`	Groupwise operations
`%>%`	Pipe function

Vignettes

Read dplyr’s built in vignettes to learn more

```
browseVignettes(package = "dplyr")
```



Vignettes in package dplyr

- Adding new database support to dplyr - HTML source R code
- Databases - HTML source R code
- Hybrid Evaluation - HTML source R code
- Introduction to dplyr - HTML source R code
- Memory usage - HTML source R code
- Non-standard evaluation - HTML source R code
- Window functions - HTML source R code