Data wrangling with dplyr

Fall 2022

April 07 2023

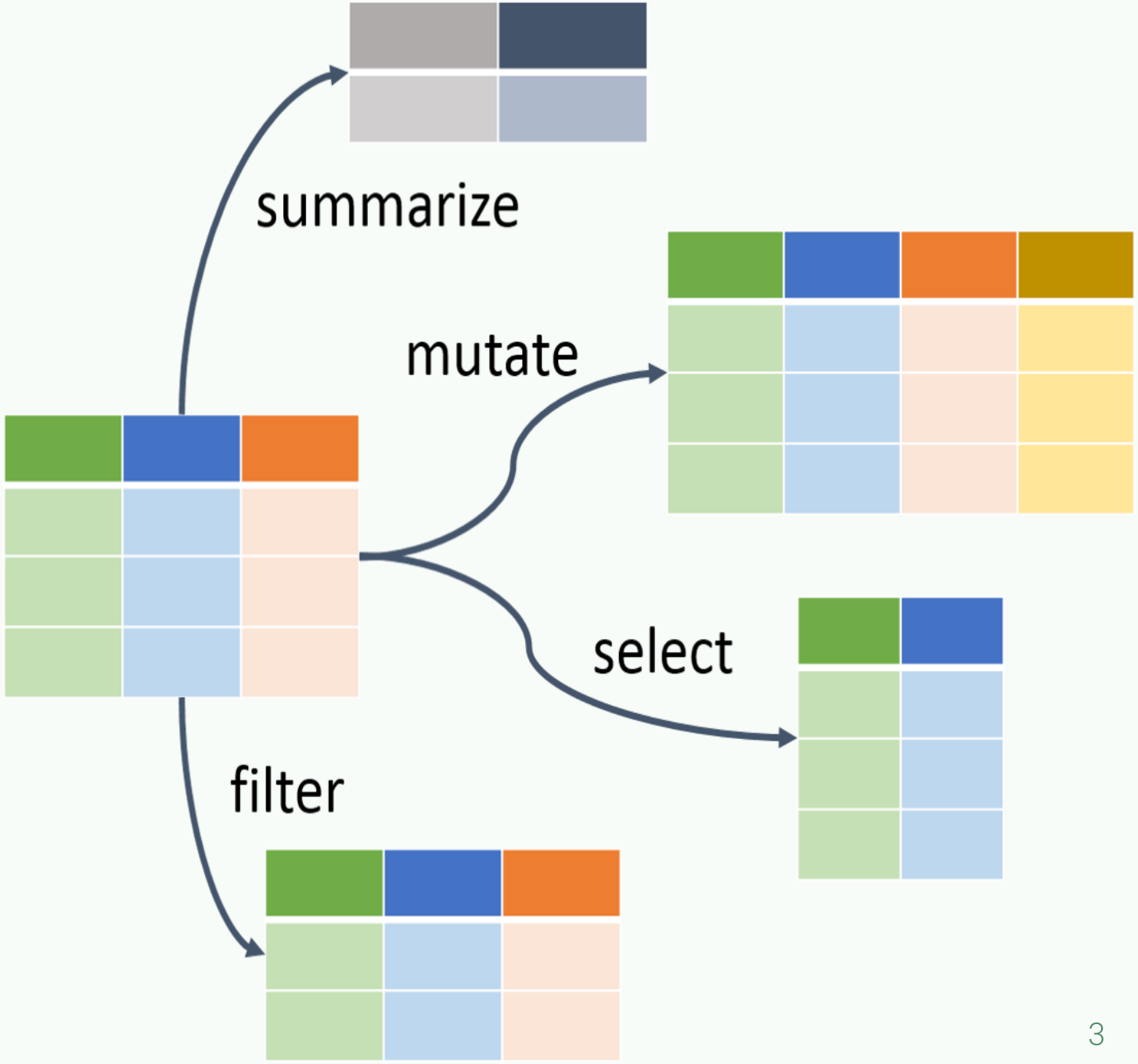
Data Wrangling

the process of cleaning and unifying messy and complex data sets for easy access and analysis

- "data janitor work"
- importing data
- cleaning data
- changing shape of data

- fixing errors and poorly formatted data elements
- transforming columns and rows
- filtering, subsetting


dplyr
www.rstudio.com


summarize
mutate
select
filter

The Five Verbs

Most of the operations on a data table can be achieved with

- ***select()*** ***: extract a subset of columns***
- ***filter()*** ***: extract a subset of rows***
- ***mutate()*** ***: create new columns***
- ***arrange()*** ***: order the rows from smallest to largest (or largest to smallest)***
- ***summarize()*** ***: compute a table of summary statistics***

Some Operators

Operator	Definition
`<`	less than
`<=`	less than or equal to
`>`	greater than
`>=`	greater than or equal to
`==`	exactly equal to
`!=`	not equal to
`x & y`	x AND y
`x %in% y`	test if x is in y

Find a subset of the columns using *select()*:

- `select()`: take a subset of the columns (variables/features)

```
library(babynames)
babynames %>%
  select(year, name, n) %>%
  head()
# A tibble: 6 × 3
   year name           n
  <dbl> <chr>      <int>
1  1880 Mary        7065
2  1880 Anna        2604
3  1880 Emma        2003
4  1880 Elizabeth   1939
5  1880 Minnie      1746
6  1880 Margaret    1578
```

Using %>% (pipe operator)

- %>% passes result on left into first argument of function on right
- Chaining functions together lets you read Left-to-right, top-to-bottom

```
babynames %>%                    # dataframe first and then...
  select(year, name, n) %>%
  head()
```

Using %>% (pipe operator)

- %>% passes result on left into first argument of function on right
- Chaining functions together lets you read Left-to-right, top-to-bottom

```
babynames %>%                       # dataframe first and then...
  select(year, name, n) %>%         # select columns `year`, `name`, and `n` and then...
  head()
```

Using %>% (pipe operator)

- %>% passes result on left into first argument of function on right
- Chaining functions together lets you read Left-to-right, top-to-bottom

```
babynames %>%                    # dataframe first and then...
  select(year, name, n) %>%      # select columns year, name, and n
  head()                         # display header of the data frame
```

Using %>% (pipe operator)

- %>% passes result on left into first argument of function on right
- Chaining functions together lets you read Left-to-right, top-to-bottom

```
babynames %>%                    # dataframe first and then...
  select(year, name, n) %>%      # select columns year, name, and n
  head()                         # display header of the data frame
```

```
# A tibble: 6 × 3
   year name           n
  <dbl> <chr>      <int>
1  1880 Mary        7065
2  1880 Anna        2604
3  1880 Emma        2003
4  1880 Elizabeth   1939
5  1880 Minnie      1746
6  1880 Margaret    1578
```

select() helpers

`:` select range of columns

```
select(gapminder, income:population)
```

`-` select every column but

```
select(gapminder, -c(income,population))
```

`starts_with()` select columns that start with...

```
select(gapminder, starts_with("p"))
```

`ends_with()` select columns that end with...

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

`contains()` select columns whose names contain...

```
select(gapminder, contains("e"))
```

Find a subset of the rows using *filter()*:

- `filter()`: take a subset of the rows (observations)

```
babynames %>%
  filter(name == "Bella") %>%
  head()
# A tibble: 6 × 5
   year sex   name      n      prop
  <dbl> <chr> <chr> <int>     <dbl>
1  1880 F     Bella    13 0.000133
2  1881 F     Bella    24 0.000243
3  1882 F     Bella    16 0.000138
4  1883 F     Bella    17 0.000142
5  1884 F     Bella    31 0.000225
6  1885 F     Bella    25 0.000176
```

Use both *filter()* and *select()*

```
bella <- babynames %>%
  filter(name == "Bella") %>%
  select(year, name, sex, n)
```

```
head(bella, 10)
# A tibble: 10 × 4
    year name  sex       n
   <dbl> <chr> <chr> <int>
 1  1880 Bella F        13
 2  1881 Bella F        24
 3  1882 Bella F        16
 4  1883 Bella F        17
 5  1884 Bella F        31
 6  1885 Bella F        25
 7  1886 Bella F        22
 8  1887 Bella F        26
 9  1888 Bella F        31
10  1889 Bella F        37
```

```
michael_selected_years <- babynames %>%
  filter(name == "Michael", sex == "M",
         year %in% c(1990, 2000, 2010)) %>%
  select(year, name, sex, n)
```

```
head(michael_selected_years, 10)
# A tibble: 3 × 4
   year name    sex       n
  <dbl> <chr>   <chr> <int>
1  1990 Michael M     65282
2  2000 Michael M     32035
3  2010 Michael M     17342
```

arrange()

Order rows from smallest to largest

```
arrange(babynames, n)
# A tibble: 1,924,665 × 5
    year sex   name           n      prop
   <dbl> <chr> <chr>      <int>     <dbl>
 1  1880 F     Adelle         5 0.0000512
 2  1880 F     Adina          5 0.0000512
 3  1880 F     Adrienne       5 0.0000512
 4  1880 F     Albertine      5 0.0000512
 5  1880 F     Alys           5 0.0000512
 6  1880 F     Ana            5 0.0000512
 7  1880 F     Araminta       5 0.0000512
 8  1880 F     Arthur         5 0.0000512
 9  1880 F     Birtha         5 0.0000512
10  1880 F     Bulah          5 0.0000512
# … with 1,924,655 more rows
```

desc()

Changes ordering from largest to smallest.

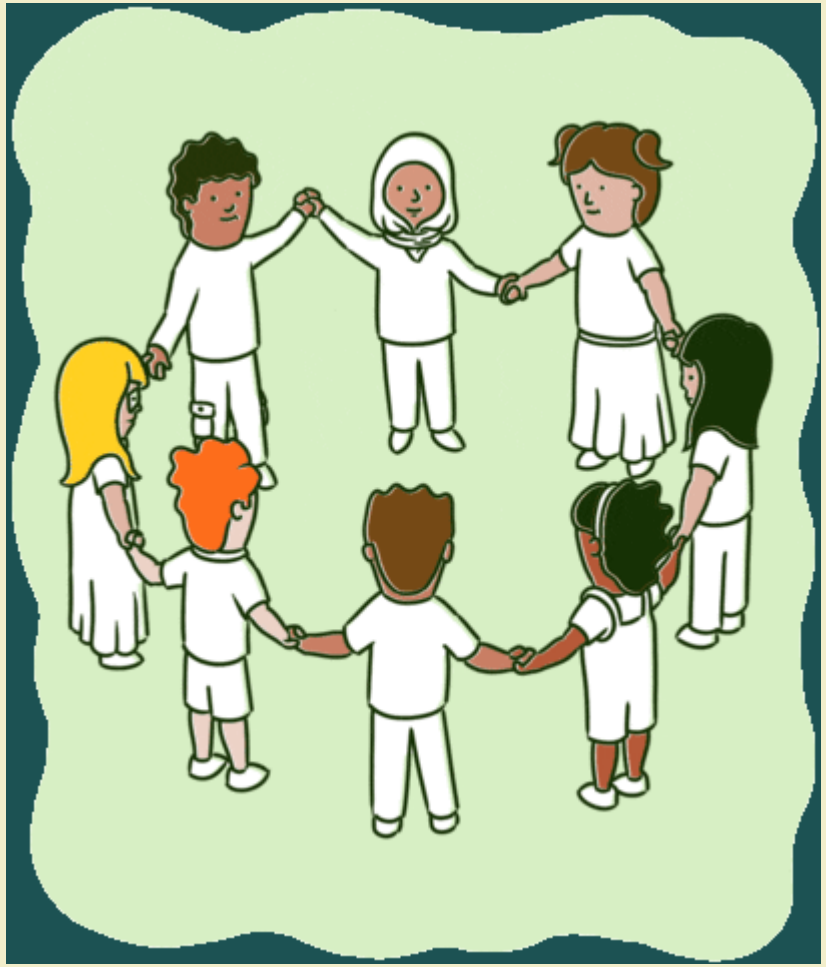
```
arrange(babynames, desc(n))
# A tibble: 1,924,665 × 5
    year sex   name        n   prop
   <dbl> <chr> <chr>   <int>  <dbl>
 1  1947 F     Linda   99686 0.0548
 2  1948 F     Linda   96209 0.0552
 3  1947 M     James   94756 0.0510
 4  1957 M     Michael 92695 0.0424
 5  1947 M     Robert  91642 0.0493
 6  1949 F     Linda   91016 0.0518
 7  1956 M     Michael 90620 0.0423
 8  1958 M     Michael 90520 0.0420
 9  1948 M     James   88588 0.0497
10  1954 M     Michael 88514 0.0428
# … with 1,924,655 more rows
```

Most common names in 1990

```
babynames %>%
  filter(year == 1990) %>%
  arrange(desc(prop))
# A tibble: 24,719 × 5
    year sex   name            n   prop
   <dbl> <chr> <chr>       <int>  <dbl>
 1  1990 M     Michael     65282 0.0303
 2  1990 M     Christopher 52332 0.0243
 3  1990 F     Jessica     46475 0.0226
 4  1990 F     Ashley      45558 0.0222
 5  1990 M     Matthew     44800 0.0208
 6  1990 M     Joshua      43216 0.0201
 7  1990 F     Brittany    36538 0.0178
 8  1990 F     Amanda      34408 0.0168
 9  1990 M     Daniel      33815 0.0157
10  1990 M     David       33742 0.0157
# … with 24,709 more rows
```

GROUP ACTIVITY 1

10:00



- *Let's go over to maize server/ local Rstudio and our class moodle*
- *Get the class activity 6.Rmd file*
- *Work on problems 1-3*
- *Ask me questions*

summarize() or *summarise()*

If we want to compare summary statistics, we might use summarize().

```
babynames %>%
  filter(name == "Bella", sex == "F") %>%
  summarise(total = sum(n), max = max(n), mean = mean(n))
# A tibble: 1 × 3
  total   max  mean
  <int> <int> <dbl>
1 57411  5121  416.
```

summarize()

```
babynames %>%
  filter(name == "Bella", sex == "F") %>%
  summarize(n = n())
# A tibble: 1 × 1
      n
  <int>
1   138
```

```
babynames %>%
  summarize(nname = n_distinct(name))
# A tibble: 1 × 1
  nname
  <int>
1 97310
```

Using *group_by()*

```
babynames %>%
  group_by(year, sex)
# A tibble: 1,924,665 × 5
# Groups:   year, sex [276]
    year sex   name           n   prop
   <dbl> <chr> <chr>      <int>  <dbl>
 1  1880 F     Mary        7065 0.0724
 2  1880 F     Anna        2604 0.0267
 3  1880 F     Emma        2003 0.0205
 4  1880 F     Elizabeth   1939 0.0199
 5  1880 F     Minnie      1746 0.0179
 6  1880 F     Margaret    1578 0.0162
 7  1880 F     Ida         1472 0.0151
 8  1880 F     Alice       1414 0.0145
 9  1880 F     Bertha      1320 0.0135
10  1880 F     Sarah       1288 0.0132
# … with 1,924,655 more rows
```

Using *group_by()* along with *summarize()*

```
babynames %>%
  group_by(year) %>%
  summarise(total = sum(n))
# A tibble: 138 × 2
    year  total
   <dbl>  <int>
 1  1880 201484
 2  1881 192696
 3  1882 221533
 4  1883 216946
 5  1884 243462
 6  1885 240854
 7  1886 255317
 8  1887 247394
 9  1888 299473
10  1889 288946
# … with 128 more rows
```

mutate()

- `mutate()` lets us create new variables based on manipulations of the old variables

```
babynames <- babynames %>%
  group_by(year) %>%
  mutate(percent = prop * 100)
head(babynames)
# A tibble: 6 × 6
# Groups:   year [1]
   year sex   name           n   prop percent
  <dbl> <chr> <chr>      <int>  <dbl>   <dbl>
1  1880 F     Mary        7065 0.0724    7.24
2  1880 F     Anna        2604 0.0267    2.67
3  1880 F     Emma        2003 0.0205    2.05
4  1880 F     Elizabeth   1939 0.0199    1.99
5  1880 F     Minnie      1746 0.0179    1.79
6  1880 F     Margaret    1578 0.0162    1.62
```

top_n()

Most common name in each year

```
babynames %>%
  group_by(year) %>%
  top_n(1, prop)
# A tibble: 138 × 6
# Groups:   year [138]
    year sex   name      n   prop percent
   <dbl> <chr> <chr> <int>  <dbl>   <dbl>
 1  1880 M     John   9655 0.0815    8.15
 2  1881 M     John   8769 0.0810    8.10
 3  1882 M     John   9557 0.0783    7.83
 4  1883 M     John   8894 0.0791    7.91
 5  1884 M     John   9388 0.0765    7.65
 6  1885 M     John   8756 0.0755    7.55
 7  1886 M     John   9026 0.0758    7.58
 8  1887 M     John   8110 0.0742    7.42
 9  1888 M     John   9247 0.0712    7.12
10  1889 M     John   8548 0.0718    7.18
# … with 128 more rows
```

min_rank() : A go to ranking function (ties share the lowest rank)

```
min_rank(c(50, 100, 1000))
[1] 1 2 3
```

```
min_rank(desc(c(50, 100, 1000)))
[1] 3 2 1
```

Slicing and selecting data

The slice_ operators let you slice (subset) rows:

- *slice_head(n=5) : view the first 5 rows*
- *slice_tail(n=5) : view the last 5 rows*
- *slice_sample(n=5) : view 5 random rows*
- *slice_min(column, n=5) : view the 5 smallest values of a column*
- *slice_max(column, n=5) : view the 5 largest values of a column*

slice()

```
library(gapminder)
slice(gapminder, 1:5)
# A tibble: 5 × 6
  country     continent  year lifeExp      pop gdpPercap
  <fct>       <fct>     <int>   <dbl>    <int>     <dbl>
1 Afghanistan Asia       1952    28.8  8425333      779.
2 Afghanistan Asia       1957    30.3  9240934      821.
3 Afghanistan Asia       1962    32.0 10267083      853.
4 Afghanistan Asia       1967    34.0 11537966      836.
5 Afghanistan Asia       1972    36.1 13079460      740.
```

slice_max()

```
gapminder %>% slice_max(gdpPercap, n=6)
# A tibble: 6 × 6
  country continent  year lifeExp     pop gdpPercap
  <fct>   <fct>     <int>   <dbl>   <int>     <dbl>
1 Kuwait  Asia       1957    58.0  212846   113523.
2 Kuwait  Asia       1972    67.7  841934   109348.
3 Kuwait  Asia       1952    55.6  160000   108382.
4 Kuwait  Asia       1962    60.5  358266    95458.
5 Kuwait  Asia       1967    64.6  575003    80895.
6 Kuwait  Asia       1977    69.3 1140357    59265.
```

summarize() vs. *mutate()*

summarize() : summarize collapses all variable values down to one number (by group)

```
gapminder %>%
  group_by(continent) %>%
  summarize(avg_life_expectancy = mean(lifeExp))
# A tibble: 5 × 2
  continent avg_life_expectancy
  <fct>                   <dbl>
1 Africa                   48.9
2 Americas                 64.7
3 Asia                     60.1
4 Europe                   71.9
5 Oceania                  74.3
```

summarize() vs. *mutate()*

mutate() : transforms all variable values but preserves the variable length (by group)

```
gapminder %>%
  group_by(continent) %>%
  mutate(meanPop = mean(pop)/1000000)
# A tibble: 1,704 × 7
# Groups:   continent [5]
   country     continent  year lifeExp      pop gdpPercap meanPop
   <fct>       <fct>     <int>   <dbl>    <int>     <dbl>   <dbl>
 1 Afghanistan Asia       1952    28.8  8425333       779.    77.0
 2 Afghanistan Asia       1957    30.3  9240934       821.    77.0
 3 Afghanistan Asia       1962    32.0 10267083       853.    77.0
 4 Afghanistan Asia       1967    34.0 11537966       836.    77.0
 5 Afghanistan Asia       1972    36.1 13079460       740.    77.0
 6 Afghanistan Asia       1977    38.4 14880372       786.    77.0
 7 Afghanistan Asia       1982    39.9 12881816       978.    77.0
 8 Afghanistan Asia       1987    40.8 13867957       852.    77.0
 9 Afghanistan Asia       1992    41.7 16317921       649.    77.0
10 Afghanistan Asia       1997    41.8 22227415       635.    77.0
# … with 1,694 more rows
```

group_by(var1, var2)

```
gapminder %>%
  group_by(continent, year) %>%
  summarise(avg_life_expectancy = mean(lifeExp)) %>%
  slice_max(avg_life_expectancy, n = 1)
# A tibble: 5 × 3
# Groups:   continent [5]
  continent  year avg_life_expectancy
  <fct>     <int>                <dbl>
1 Africa     2007                 54.8
2 Americas   2007                 73.6
3 Asia       2007                 70.7
4 Europe     2007                 77.6
5 Oceania    2007                 80.7
```

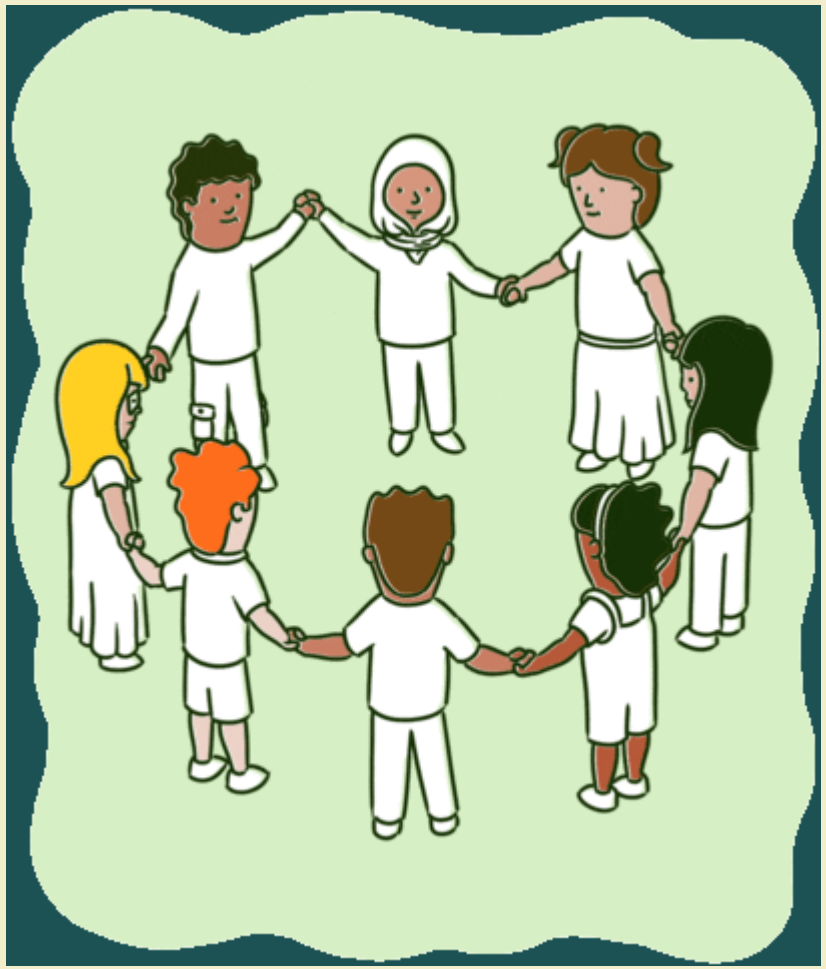
ungroup()

Any further mutations called on it would not use the grouping for aggregate statistics.

```
gapminder %>%
  group_by(continent, year) %>%
  summarise(avg_life_expectancy = mean(lifeExp)) %>%
  ungroup() %>%
  slice_max(avg_life_expectancy, n = 1)
# A tibble: 1 × 3
  continent  year avg_life_expectancy
  <fct>     <int>               <dbl>
1 Oceania    2007                80.7
```

GROUP ACTIVITY 2

10:00



- *Work on problems 4-6*
- *Ask me questions*