Wrangling data with dplyr

2021-10-23

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The main verbs of dplyr

select()

filter()

mutate()

arrange()

summarize()

group_by()

The main verbs of dplyr

select() = **Subset columns (variables)**

filter()

mutate()

arrange()

summarize()

group_by()

select()

```
select(<DATA>, <VARIABLES>)
```

select()

```
select(<DATA>, <VARIABLES>)
```

```
diamonds
```

```
## # A tibble: 53,940 × 10
##    carat cut       color clarity depth table price     x     y
##    <dbl> <ord>     <ord> <ord>   <dbl> <dbl> <int> <dbl> <dbl>
##  1  0.23 Ideal     E     SI2      61.5    55   326  3.95  3.98
##  2  0.21 Premium   E     SI1      59.8    61   326  3.89  3.84
##  3  0.23 Good      E     VS1      56.9    65   327  4.05  4.07
##  4  0.29 Premium   I     VS2      62.4    58   334  4.2   4.23
##  5  0.31 Good      J     SI2      63.3    58   335  4.34  4.35
##  6  0.24 Very G…   J     VVS2     62.8    57   336  3.94  3.96
##  7  0.24 Very G…   I     VVS1     62.3    57   336  3.95  3.98
##  8  0.26 Very G…   H     SI1      61.9    55   337  4.07  4.11
##  9  0.22 Fair      E     VS2      65.1    61   337  3.87  3.78
## 10  0.23 Very G…   H     VS1      59.4    61   338  4     4.05
## # … with 53,930 more rows, and 1 more variable: z <dbl>
```

new data alert!

diamonds

	carat	cut	color	clarity	depth	table	price	x	y	z
1	0.23	Ideal	E	SI2	61.5	55.0	326	3.95	3.98	2.43
2	0.21	Premium	E	SI1	59.8	61.0	326	3.89	3.84	2.31
3	0.23	Good	E	VS1	56.9	65.0	327	4.05	4.07	2.31
4	0.29	Premium	I	VS2	62.4	58.0	334	4.20	4.23	2.63
5	0.31	Good	J	SI2	63.3	58.0	335	4.34	4.35	2.75
6	0.24	Very Good	J	VVS2	62.8	57.0	336	3.94	3.96	2.48
7	0.24	Very Good	I	VVS1	62.3	57.0	336	3.95	3.98	2.47
8	0.26	Very Good	H	SI1	61.9	55.0	337	4.07	4.11	2.53
9	0.22	Fair	E	VS2	65.1	61.0	337	3.87	3.78	2.49
10	0.23	Very Good	H	VS1	59.4	61.0	338	4.00	4.05	2.39
11	0.30	Good	J	SI1	64.0	55.0	339	4.25	4.28	2.73
12	0.23	Ideal	J	VS1	62.8	56.0	340	3.93	3.90	2.46
13	0.22	Premium	F	SI1	60.4	61.0	342	3.88	3.84	2.33
14	0.31	Ideal	J	SI2	62.2	54.0	344	4.35	4.37	2.71
15	0.20	Premium	E	SI2	60.2	62.0	345	3.79	3.75	2.27
16	0.32	Premium	E	I1	60.9	58.0	345	4.38	4.42	2.68
17	0.30	Ideal	I	SI2	62.0	54.0	348	4.31	4.34	2.68
18	0.30	Good	J	SI1	63.4	54.0	351	4.23	4.29	2.70

Where does it come from?

`The ggplot2 R package`

How can I use it?

```
library(ggplot2)
View(diamonds)
```

it's invisible!

select()

```
select(diamonds, carat, cut, color, clarity)
```

select()

```
select(diamonds, carat, cut, color, clarity)
```

```
## # A tibble: 53,940 × 4
##    carat cut       color clarity
##    <dbl> <ord>     <ord> <ord>
##  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
## # … with 53,930 more rows
```

select()

```r
select(diamonds, carat, cut, color, clarity)

select(diamonds, carat:clarity)

select(diamonds, 1:4)

select(diamonds, starts_with("c"))

?select_helpers
```

gapminder

```
library(gapminder)
gapminder
```

```
## # A tibble: 1,704 × 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.
##  6 Afghanistan Asia       1977    38.4 14880372      786.
##  7 Afghanistan Asia       1982    39.9 12881816      978.
##  8 Afghanistan Asia       1987    40.8 13867957      852.
##  9 Afghanistan Asia       1992    41.7 16317921      649.
## 10 Afghanistan Asia       1997    41.8 22227415      635.
## # … with 1,694 more rows
```

new data alert!

gapminder

Filter

	country	continent	year	lifeExp	pop	gdpPercap
1	Afghanistan	Asia	1952	28.801	8425333	779.4453
2	Afghanistan	Asia	1957	30.332	9240934	820.8530
3	Afghanistan	Asia	1962	31.997	10267083	853.1007
4	Afghanistan	Asia	1967	34.020	11537966	836.1971
5	Afghanistan	Asia	1972	36.088	13079460	739.9811
6	Afghanistan	Asia	1977	38.438	14880372	786.1134
7	Afghanistan	Asia	1982	39.854	12881816	978.0114
8	Afghanistan	Asia	1987	40.822	13867957	852.3959
9	Afghanistan	Asia	1992	41.674	16317921	649.3414
10	Afghanistan	Asia	1997	41.763	22227415	635.3414
11	Afghanistan	Asia	2002	42.129	25268405	726.7341
12	Afghanistan	Asia	2007	43.828	31889923	974.5803
13	Albania	Europe	1952	55.230	1282697	1601.0561
14	Albania	Europe	1957	59.280	1476505	1942.2842
15	Albania	Europe	1962	64.820	1728137	2312.8890

Where does it come from?

`The gapminder R package`

How can I use it?

```
library(gapminder)
View(gapminder)
```

it's invisible!

Your turn 1

Alter the code to select just the `pop` column:

```
select(gapminder, year, lifeExp)
```

Your Turn 1

```
select(gapminder, pop)
```

```
## # A tibble: 1,704 × 1
##         pop
##       <int>
##  1  8425333
##  2  9240934
##  3 10267083
##  4 11537966
##  5 13079460
##  6 14880372
##  7 12881816
##  8 13867957
##  9 16317921
## 10 22227415
## # … with 1,694 more rows
```

Show of Hands

Which of these is NOT a way to select the country **and** continent **columns together?**

```
select(gapminder, -c(year, lifeExp, pop, gdpPercap))

select(gapminder, country:continent)

select(gapminder, starts_with("c"))

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

Show of Hands

Which of these is NOT a way to select the `country` **and** `continent` **columns together?**

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

```
## # A tibble: 1,704 × 1
##    continent
##    <fct>
##  1 Asia
##  2 Asia
##  3 Asia
##  4 Asia
##  5 Asia
##  6 Asia
##  7 Asia
##  8 Asia
##  9 Asia
## 10 Asia
## # … with 1,694 more rows
```

The main verbs of dplyr

select()

filter() = **Subset rows by value**

mutate()

arrange()

summarize()

group_by()

filter()

```
filter(<DATA>, <PREDICATES>)
```

Predicates: TRUE or FALSE statements

filter()

```
filter(<DATA>, <PREDICATES>)
```

Predicates: TRUE **or** FALSE **statements**

Comparisons: >, >=, <, <=, != (not equal), and == (equal).

filter()

```
filter(<DATA>, <PREDICATES>)
```

Predicates: TRUE **or** FALSE **statements**

Comparisons: >, >=, <, <=, != **(not equal), and** == **(equal).**

Operators: & is "and", | is "or", and ! is "not"

filter()

```
filter(<DATA>, <PREDICATES>)
```

Predicates: TRUE **or** FALSE **statements**

Comparisons: >, >=, <, <=, != **(not equal), and** == **(equal).**

Operators: & **is "and",** | **is "or", and** ! **is "not"**

%in%

```
"a" %in% c("a", "b", "c")
```

```
## [1] TRUE
```

filter()

```
filter(diamonds, cut == "Ideal", carat > 3)
```

filter()

```
filter(diamonds, cut == "Ideal", carat > 3)
```

```
## # A tibble: 4 × 10
##   carat cut   color clarity depth table price     x     y
##   <dbl> <ord> <ord> <ord>   <dbl> <dbl> <int> <dbl> <dbl>
## 1  3.22 Ideal I     I1       62.6    55 12545  9.49  9.42
## 2  3.5  Ideal H     I1       62.8    57 12587  9.65  9.59
## 3  3.01 Ideal J     SI2      61.7    58 16037  9.25  9.2 
## 4  3.01 Ideal J     I1       65.4    60 16538  8.99  8.93
## # … with 1 more variable: z <dbl>
```

Your turn 2

Show:

All of the rows where `pop` **is greater than or equal to 100000**

All of the rows for El Salvador

All of the rows that have a missing value for `year` **(no need to edit this code)**

Your turn 2

Show:

All of the rows where `pop` is greater than or equal to 100000

All of the rows for El Salvador

All of the rows that have a missing value for `year` (no need to edit this code)

```
filter(gapminder, pop >= 100000)
filter(gapminder, country == "El Salvador")
filter(gapminder, is.na(year))
```

filter()

```
filter(diamonds, cut == "Ideal" | cut == "Very Good", carat > 3)
```

```
## # A tibble: 6 × 10
##   carat cut       color clarity depth table price     x     y
##   <dbl> <ord>     <ord> <ord>   <dbl> <dbl> <int> <dbl> <dbl>
## 1  3.22 Ideal     I     I1       62.6    55 12545  9.49  9.42
## 2  3.5  Ideal     H     I1       62.8    57 12587  9.65  9.59
## 3  3.04 Very Go… I     SI2      63.2    59 15354  9.14  9.07
## 4  4    Very Go… I     I1       63.3    58 15984 10.0   9.94
## 5  3.01 Ideal     J     SI2      61.7    58 16037  9.25  9.2
## 6  3.01 Ideal     J     I1       65.4    60 16538  8.99  8.93
## # … with 1 more variable: z <dbl>
```

Your turn 3

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

El Salvador

Countries that had populations over 100000 in 1960 or earlier

```
filter(gapminder, country == "El Salvador" | country == "Oman")
filter(______, _______)
```

Your turn 3

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

El Salvador

Countries that had populations over 100000 in 1960 or earlier

```
filter(gapminder, country == "El Salvador")
filter(gapminder, pop > 100000, year <= 1960)
```

The main verbs of dplyr

select()

filter()

mutate() = **Change or add a variable**

arrange()

summarize()

group_by()

mutate()

```
mutate(<DATA>, <NAME> = <FUNCTION>)
```

mutate()

```
mutate(diamonds, log_price = log(price), log_pricesq = log_price^2)
```

mutate()

```
mutate(diamonds, log_price = log(price), log_pricesq = log_price^2)
```

```
## # A tibble: 53,940 × 12
##    carat cut     color clarity depth table price     x     y
##    <dbl> <ord>   <ord> <ord>   <dbl> <dbl> <int> <dbl> <dbl>
##  1  0.23 Ideal   E     SI2      61.5    55   326  3.95  3.98
##  2  0.21 Premium E     SI1      59.8    61   326  3.89  3.84
##  3  0.23 Good    E     VS1      56.9    65   327  4.05  4.07
##  4  0.29 Premium I     VS2      62.4    58   334  4.2   4.23
##  5  0.31 Good    J     SI2      63.3    58   335  4.34  4.35
##  6  0.24 Very G… J     VVS2     62.8    57   336  3.94  3.96
##  7  0.24 Very G… I     VVS1     62.3    57   336  3.95  3.98
##  8  0.26 Very G… H     SI1      61.9    55   337  4.07  4.11
##  9  0.22 Fair    E     VS2      65.1    61   337  3.87  3.78
## 10  0.23 Very G… H     VS1      59.4    61   338  4     4.05
## # … with 53,930 more rows, and 3 more variables: z <dbl>,
## #   log_price <dbl>, log_pricesq <dbl>
```

The main verbs of dplyr

select()

filter()

mutate()

arrange() = **Sort the data set**

summarize()

group_by()

arrange()

```
arrange(<DATA>, <SORTING VARIABLE>)
```

arrange()

```
arrange(diamonds, price)
```

```
## # A tibble: 53,940 × 10
##    carat cut     color clarity depth table price     x     y
##    <dbl> <ord>   <ord> <ord>   <dbl> <dbl> <int> <dbl> <dbl>
##  1  0.23 Ideal   E     SI2      61.5    55   326  3.95  3.98
##  2  0.21 Premium E     SI1      59.8    61   326  3.89  3.84
##  3  0.23 Good    E     VS1      56.9    65   327  4.05  4.07
##  4  0.29 Premium I     VS2      62.4    58   334  4.2   4.23
##  5  0.31 Good    J     SI2      63.3    58   335  4.34  4.35
##  6  0.24 Very G… J     VVS2     62.8    57   336  3.94  3.96
##  7  0.24 Very G… I     VVS1     62.3    57   336  3.95  3.98
##  8  0.26 Very G… H     SI1      61.9    55   337  4.07  4.11
##  9  0.22 Fair    E     VS2      65.1    61   337  3.87  3.78
## 10  0.23 Very G… H     VS1      59.4    61   338  4     4.05
## # … with 53,930 more rows, and 1 more variable: z <dbl>
```

arrange()

```
arrange(diamonds, cut, price)
```

```
## # A tibble: 53,940 × 10
##    carat cut   color clarity depth table price     x     y
##    <dbl> <ord> <ord> <ord>   <dbl> <dbl> <int> <dbl> <dbl>
##  1  0.22 Fair  E     VS2      65.1    61   337  3.87  3.78
##  2  0.25 Fair  E     VS1      55.2    64   361  4.21  4.23
##  3  0.23 Fair  G     VVS2     61.4    66   369  3.87  3.91
##  4  0.27 Fair  E     VS1      66.4    58   371  3.99  4.02
##  5  0.3  Fair  J     VS2      64.8    58   416  4.24  4.16
##  6  0.3  Fair  F     SI1      63.1    58   496  4.3   4.22
##  7  0.34 Fair  J     SI1      64.5    57   497  4.38  4.36
##  8  0.37 Fair  F     SI1      65.3    56   527  4.53  4.47
##  9  0.3  Fair  D     SI2      64.6    54   536  4.29  4.25
## 10  0.25 Fair  D     VS1      61.2    55   563  4.09  4.11
## # … with 53,930 more rows, and 1 more variable: z <dbl>
```

desc()

```
arrange(diamonds, cut, desc(price))
```

```
## # A tibble: 53,940 × 10
##    carat cut   color clarity depth table price     x     y
##    <dbl> <ord> <ord> <ord>   <dbl> <dbl> <int> <dbl> <dbl>
##  1  2.01 Fair  G     SI1      70.6    64 18574  7.43  6.64
##  2  2.02 Fair  H     VS2      64.5    57 18565  8     7.95
##  3  4.5  Fair  J     I1       65.8    58 18531 10.2  10.2
##  4  2    Fair  G     VS2      67.6    58 18515  7.65  7.61
##  5  2.51 Fair  H     SI2      64.7    57 18308  8.44  8.5
##  6  3.01 Fair  I     SI2      65.8    56 18242  8.99  8.94
##  7  3.01 Fair  I     SI2      65.8    56 18242  8.99  8.94
##  8  2.32 Fair  H     SI1      62      62 18026  8.47  8.31
##  9  5.01 Fair  J     I1       65.5    59 18018 10.7  10.5
## 10  1.93 Fair  F     VS1      58.9    62 17995  8.17  7.97
## # … with 53,930 more rows, and 1 more variable: z <dbl>
```

Your turn 4

Arrange gapminder by `year`. Add `lifeExp` as a second (tie breaking) variable to arrange on.

Which country had the lowest life expectancy in 1952?

Your turn 4

```
arrange(gapminder, year, lifeExp)
```

```
## # A tibble: 1,704 × 6
##    country       continent  year lifeExp     pop gdpPercap
##    <fct>         <fct>     <int>   <dbl>   <int>     <dbl>
##  1 Afghanistan   Asia       1952    28.8 8425333      779.
##  2 Gambia        Africa     1952    30    284320      485.
##  3 Angola        Africa     1952    30.0 4232095     3521.
##  4 Sierra Leone  Africa     1952    30.3 2143249      880.
##  5 Mozambique    Africa     1952    31.3 6446316      469.
##  6 Burkina Faso  Africa     1952    32.0 4469979      543.
##  7 Guinea-Bissau Africa     1952    32.5  580653      300.
##  8 Yemen, Rep.   Asia       1952    32.5 4963829      782.
##  9 Somalia       Africa     1952    33.0 2526994     1136.
## 10 Guinea        Africa     1952    33.6 2664249      510.
## # … with 1,694 more rows
```

Your turn 5

Use `desc()` **to find the country with the highest** `gdpPercap`**.**

Your turn 5

```
arrange(gapminder, desc(gdpPercap))
```

```
## # A tibble: 1,704 × 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.
##  7 Norway    Europe     2007    80.2 4627926    49357.
##  8 Kuwait    Asia       2007    77.6 2505559    47307.
##  9 Singapore Asia       2007    80.0 4553009    47143.
## 10 Norway    Europe     2002    79.0 4535591    44684.
## # … with 1,694 more rows
```

Detour: The Pipe

`%>%`

Passes the result on one function to another function

Detour: The Pipe

```
diamonds <- arrange(diamonds, price)
diamonds <- filter(diamonds, price > 300)
diamonds <- mutate(diamonds, log_price = log(price))

diamonds
```

Detour: The Pipe

```
diamonds <- diamonds %>%
  arrange(price) %>%
  filter(price > 300) %>%
  mutate(log_price = log(price))

diamonds
```

Keyboard shortcuts

Insert `<-` **with** alt/opt + -

Insert `%>%` **with** ctrl/cmd + shift + m

Your turn 6

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

1. Filter only countries that are in the continent of Oceania.

2. Select the `country`, `year` **and** `lifeExp` **columns**

3. Arrange the results so that the highest life expetency is at the top.

Your turn 6

```
gapminder %>%
  filter(continent == "Oceania") %>%
  select(country, year, lifeExp) %>%
  arrange(desc(lifeExp))
```

```
## # A tibble: 24 × 3
##    country      year lifeExp
##    <fct>       <int>   <dbl>
##  1 Australia    2007    81.2
##  2 Australia    2002    80.4
##  3 New Zealand  2007    80.2
##  4 New Zealand  2002    79.1
##  5 Australia    1997    78.8
##  6 Australia    1992    77.6
##  7 New Zealand  1997    77.6
##  8 New Zealand  1992    76.3
##  9 Australia    1987    76.3
## 10 Australia    1982    74.7
## # … with 14 more rows
```

Challenge!

1. Import the diabetes data from the importing data. A copy of the CSV file is available in this folder.

2. Add the variable `bmi` **to the data set using height and weight using the formula:** `(weight / height^2) * 703`

3. Select just `id`, `glyhb`, **and the new variable you created.**

4. Filter rows that have BMI > 35. How many rows and columns are in your new data set?

```r
diabetes <- read_csv("diabetes.csv")
diabetes %>%
  mutate(bmi = (weight / height^2) * 703) %>%
  select(id, glyhb, bmi) %>%
  filter(bmi > 35)
```

```r
diabetes <- read_csv("diabetes.csv")
diabetes %>%
  mutate(bmi = (weight / height^2) * 703) %>%
  select(id, glyhb, bmi) %>%
  filter(bmi > 35)
```

```
## # A tibble: 61 × 3
##        id glyhb   bmi
##     <dbl> <dbl> <dbl>
##  1  1001  4.44  37.4
##  2  1002  4.64  48.4
##  3  1022  5.78  35.8
##  4  1029  4.97  40.8
##  5  1253  4.67  36.0
##  6  1254 12.7   42.5
##  7  1280  5.10  38.3
##  8  1501  4.41  40.0
##  9  2753  5.57  35.3
## 10  2757  6.33  35.3
## # … with 51 more rows
```

The main verbs of dplyr

select()

filter()

mutate()

arrange()

summarize() = **Summarize the data**

group_by() = **Group the data**

summarize()

```
summarize(<DATA>, <NAME> = <FUNCTION>)
```

summarize()

```
summarize(diamonds, n = n(), mean_price = mean(price))
```

```
## # A tibble: 1 × 2
##       n mean_price
##   <int>      <dbl>
## 1 53940      3933.
```

Your turn 7

Use summarise() to compute these statistics about the gapminder data set:

1. The first (min()**) year in the data**

2. The last (max()**) year in the data**

3. The total number of observations (n()**) and the total number of unique countries in the data (**n_distinct()**)**

Your turn 7

```
gapminder %>%
  summarize(
    first = min(year),
    last = max(year),
    n = n(),
    n_countries = n_distinct(country)
  )
```

```
## # A tibble: 1 × 4
##   first  last     n n_countries
##   <int> <int> <int>       <int>
## 1  1952  2007  1704         142
```

group_by()

```
group_by(<DATA>, <VARIABLE>)
```

group_by()

```
diamonds %>%
  group_by(cut)
```

group_by()

```
diamonds %>%
  group_by(cut)
```

```
## # A tibble: 53,940 × 10
## # Groups:   cut [5]
##    carat cut       color clarity depth table price     x     y
##    <dbl> <ord>     <ord> <ord>   <dbl> <dbl> <int> <dbl> <dbl>
##  1  0.23 Ideal     E     SI2      61.5    55   326  3.95  3.98
##  2  0.21 Premium   E     SI1      59.8    61   326  3.89  3.84
##  3  0.23 Good      E     VS1      56.9    65   327  4.05  4.07
##  4  0.29 Premium   I     VS2      62.4    58   334  4.2   4.23
##  5  0.31 Good      J     SI2      63.3    58   335  4.34  4.35
##  6  0.24 Very G… J     VVS2     62.8    57   336  3.94  3.96
##  7  0.24 Very G… I     VVS1     62.3    57   336  3.95  3.98
##  8  0.26 Very G… H     SI1      61.9    55   337  4.07  4.11
##  9  0.22 Fair      E     VS2      65.1    61   337  3.87  3.78
## 10  0.23 Very G… H     VS1      59.4    61   338  4     4.05
## # … with 53,930 more rows, and 1 more variable: z <dbl>
```

group_by()

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

group_by()

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

```
## # A tibble: 5 × 3
##   cut           n mean_price
##   <ord>     <int>      <dbl>
## 1 Fair       1610      4359.
## 2 Good       4906      3929.
## 3 Very Good 12082      3982.
## 4 Premium   13791      4584.
## 5 Ideal     21551      3458.
```

group_by()

```
diamonds %>%
  group_by(cut) %>%
  mutate(n = n(), mean_price = mean(price))
```

group_by()

```
diamonds %>%
  group_by(cut) %>%
  mutate(n = n(), mean_price = mean(price))
```

```
## # A tibble: 53,940 × 12
## # Groups:   cut [5]
##    carat cut       color clarity depth table price     x     y
##    <dbl> <ord>     <ord> <ord>   <dbl> <dbl> <int> <dbl> <dbl>
##  1  0.23 Ideal     E     SI2      61.5    55   326  3.95  3.98
##  2  0.21 Premium   E     SI1      59.8    61   326  3.89  3.84
##  3  0.23 Good      E     VS1      56.9    65   327  4.05  4.07
##  4  0.29 Premium   I     VS2      62.4    58   334  4.2   4.23
##  5  0.31 Good      J     SI2      63.3    58   335  4.34  4.35
##  6  0.24 Very G… J     VVS2     62.8    57   336  3.94  3.96
##  7  0.24 Very G… I     VVS1     62.3    57   336  3.95  3.98
##  8  0.26 Very G… H     SI1      61.9    55   337  4.07  4.11
##  9  0.22 Fair      E     VS2      65.1    61   337  3.87  3.78
## 10  0.23 Very G… H     VS1      59.4    61   338  4     4.05
## # … with 53,930 more rows, and 3 more variables: z <dbl>,
## #   n <int>, mean_price <dbl>
```

Your turn 8

Extract the rows where `continent == "Europe"`. Then use `group_by()` to group by country. Finally, use `summarize()` to compute:

1. The total number of observations for each country in Europe

2. The lowest observed life expectancy for each country

Your turn 8

```
gapminder %>%
  filter(continent == "Europe") %>%
  group_by(country) %>%
  summarize(n = n(), min_le = min(lifeExp))
```

```
## # A tibble: 30 × 3
##    country                    n min_le
##    <fct>                  <int>  <dbl>
##  1 Albania                   12   55.2
##  2 Austria                   12   66.8
##  3 Belgium                   12   68  
##  4 Bosnia and Herzegovina    12   53.8
##  5 Bulgaria                  12   59.6
##  6 Croatia                   12   61.2
##  7 Czech Republic            12   66.9
##  8 Denmark                   12   70.8
##  9 Finland                   12   66.6
## 10 France                    12   67.4
## # … with 20 more rows
```

Your turn 9

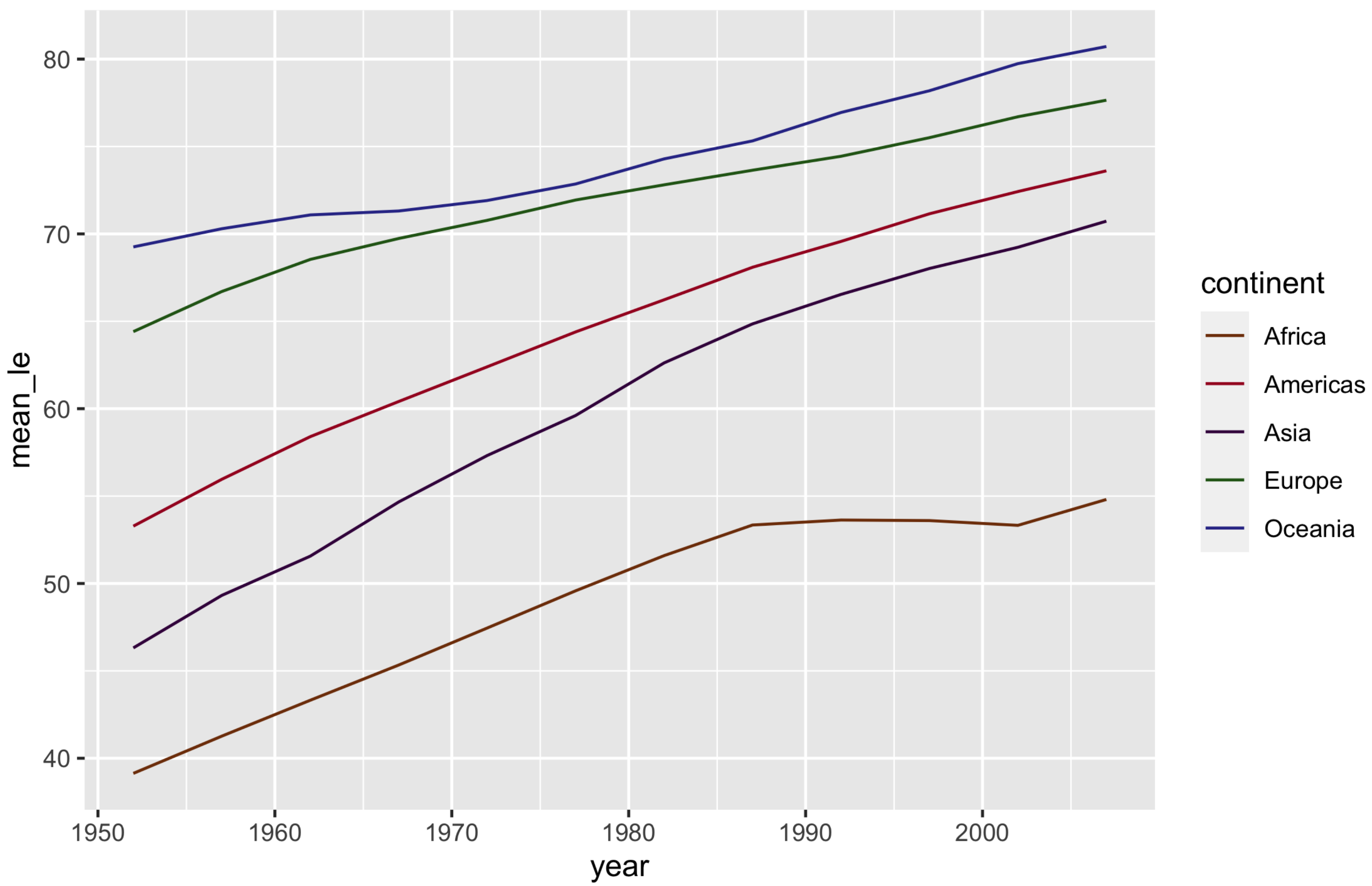
Use grouping to calculate the mean life expectancy for each continent and year. Call the mean life expectancy variable `mean_le`. Plot the life expectancy over time (no need to change the plot code).

```
gapminder %>%
  __________ %>%
  __________ %>%
  ggplot(aes(x = year, y = mean_le, col = continent)) +
    geom_line() +
    scale_color_manual(values = continent_colors)
```

Your turn 9

Use grouping to calculate the mean life expectancy for each continent and year. Call the mean life expectancy variable `mean_le`. Plot the life expectancy over time (no need to change the plot code).

```
gapminder %>%
  group_by(continent, year) %>%
  summarize(mean_le = mean(lifeExp)) %>%
  ggplot(aes(x = year, y = mean_le, col = continent)) +
    geom_line() +
    scale_color_manual(values = continent_colors)
```



80
70
60
50
40
mean_le
1950
1960
1970
1980
1990
2000
year
continent
Africa
Americas
Asia
Europe
Oceania

mutate(across())

```
mutate(
  <DATA>,
  across(c(<VARIABLES>), list(<NAMES> = <FUNCTIONS>))
)
```

```r
mutate(
  diamonds,
  across(c("carat", "depth"), list(sd = sd, mean = mean))
)
```

```r
mutate(
  diamonds,
  across(c("carat", "depth"), list(sd = sd, mean = mean))
)
```

```
## # A tibble: 53,940 × 14
##    carat cut     color clarity depth table price     x     y
##    <dbl> <ord>   <ord> <ord>   <dbl> <dbl> <int> <dbl> <dbl>
##  1  0.23 Ideal   E     SI2      61.5    55   326  3.95  3.98
##  2  0.21 Premium E     SI1      59.8    61   326  3.89  3.84
##  3  0.23 Good    E     VS1      56.9    65   327  4.05  4.07
##  4  0.29 Premium I     VS2      62.4    58   334  4.2   4.23
##  5  0.31 Good    J     SI2      63.3    58   335  4.34  4.35
##  6  0.24 Very G… J     VVS2     62.8    57   336  3.94  3.96
##  7  0.24 Very G… I     VVS1     62.3    57   336  3.95  3.98
##  8  0.26 Very G… H     SI1      61.9    55   337  4.07  4.11
##  9  0.22 Fair    E     VS2      65.1    61   337  3.87  3.78
## 10  0.23 Very G… H     VS1      59.4    61   338  4     4.05
## # … with 53,930 more rows, and 5 more variables: z <dbl>,
## #   carat_sd <dbl>, carat_mean <dbl>, depth_sd <dbl>,
## #   depth_mean <dbl>
```

mutate(across(where()))

```
mutate(
  gapminder,
  across(where(is.numeric), list(mean = mean, median = median))
)
```

```r
mutate(
  gapminder,
  across(where(is.numeric), list(mean = mean, median = median))
)
```

```
## # A tibble: 1,704 × 14
##    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.
##  6 Afghanistan Asia       1977    38.4 14880372      786.
##  7 Afghanistan Asia       1982    39.9 12881816      978.
##  8 Afghanistan Asia       1987    40.8 13867957      852.
##  9 Afghanistan Asia       1992    41.7 16317921      649.
## 10 Afghanistan Asia       1997    41.8 22227415      635.
## # … with 1,694 more rows, and 8 more variables:
## #   year_mean <dbl>, year_median <dbl>, lifeExp_mean <dbl>,
## #   lifeExp_median <dbl>, pop_mean <dbl>, pop_median <dbl>,
## #   …
```

Joining data

Use left_join(), right_join(), full_join()**, or** inner_join() **to join datasets**

Use semi_join() **or** anti_join() **to filter datasets against each other**

Resources

R for Data Science: A comprehensive but friendly introduction to the tidyverse. Free online.

RStudio Primers: Free interactive courses in the Tidyverse

10 dplyr tips: a Twitter thread on other useful aspects of dplyr