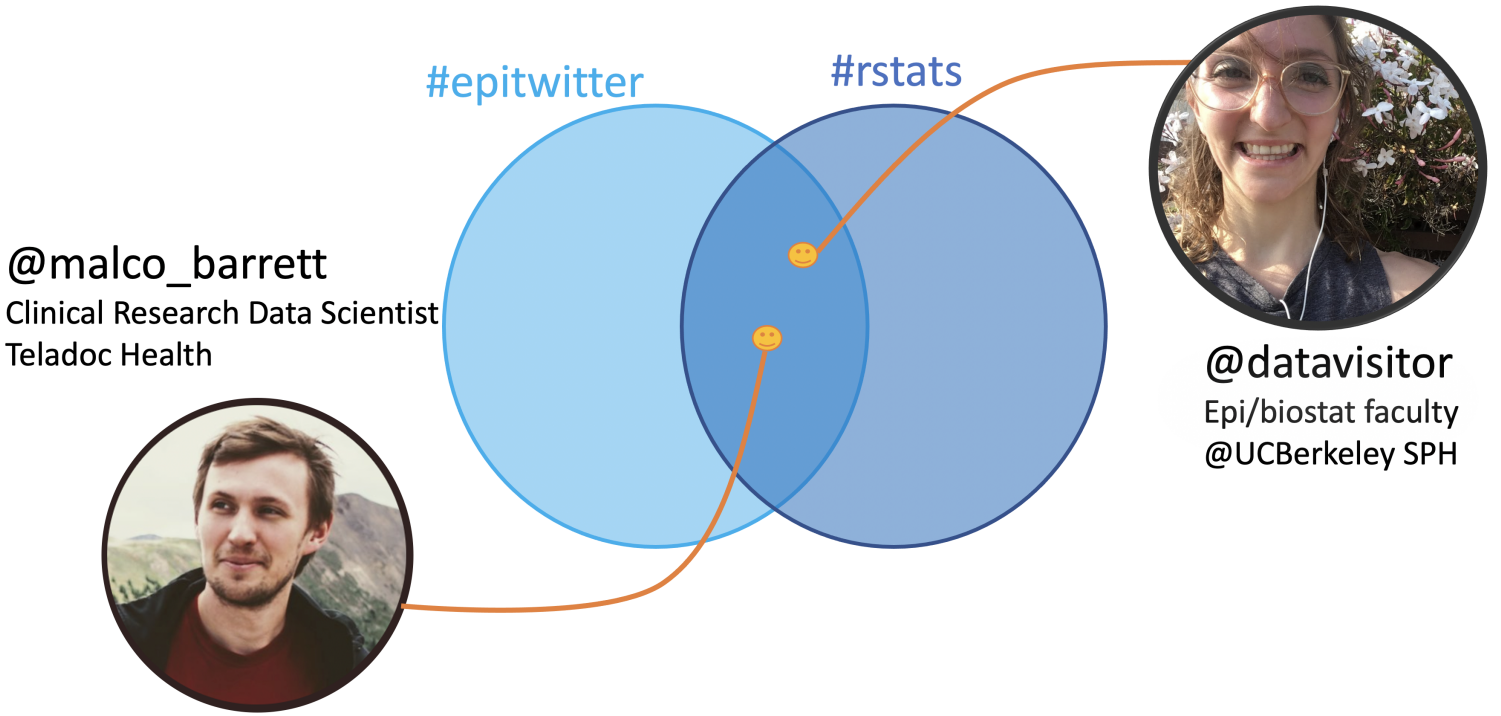
Wrangling data with dplyr

2020-10-31


#epitwitter
#rstats
@malco_barrett
Clinical Research Data Scientist
Teladoc Health
@datavisitor
Epi/biostat faculty
@UCBerkeley SPH


dplyr
ggplot2
tibble
readr
tidyr
purrr

Working with data in R

the tidyverse is a collection of friendly and consistent tools for data analysis and visualization.

Working with data in R

the tidyverse is a collection of friendly and consistent tools for data analysis and visualization.

They live as, R packages, each of which does one thing well.

library(tidyverse) will load the core packages:

ggplot2, for data visualisation.

dplyr, for data manipulation.

tidyr, for data tidying.

readr, for data import.

purrr, for functional programming.

tibble, for tibbles, a modern re-imagining of data frames.

stringr, for strings.

forcats, for factors.

Agenda (in Pacific Time)

9:00-10:00: Data manipulation using dplyr

10:00-11:30: Data visualization using ggplot2

11:00-11:15: Break

11:15-12:15: Data visualization team exercise

12:15-1:00: Reproducible reports and manuscripts using R markdown

readr

Function	Reads
read_csv()	Comma separated values
read_csv2()	Semi-colon separate values
read_delim()	General delimited files
read_fwf()	Fixed width files
read_log()	Apache log files
read_table()	Space separated files
read_tsv()	Tab delimited values

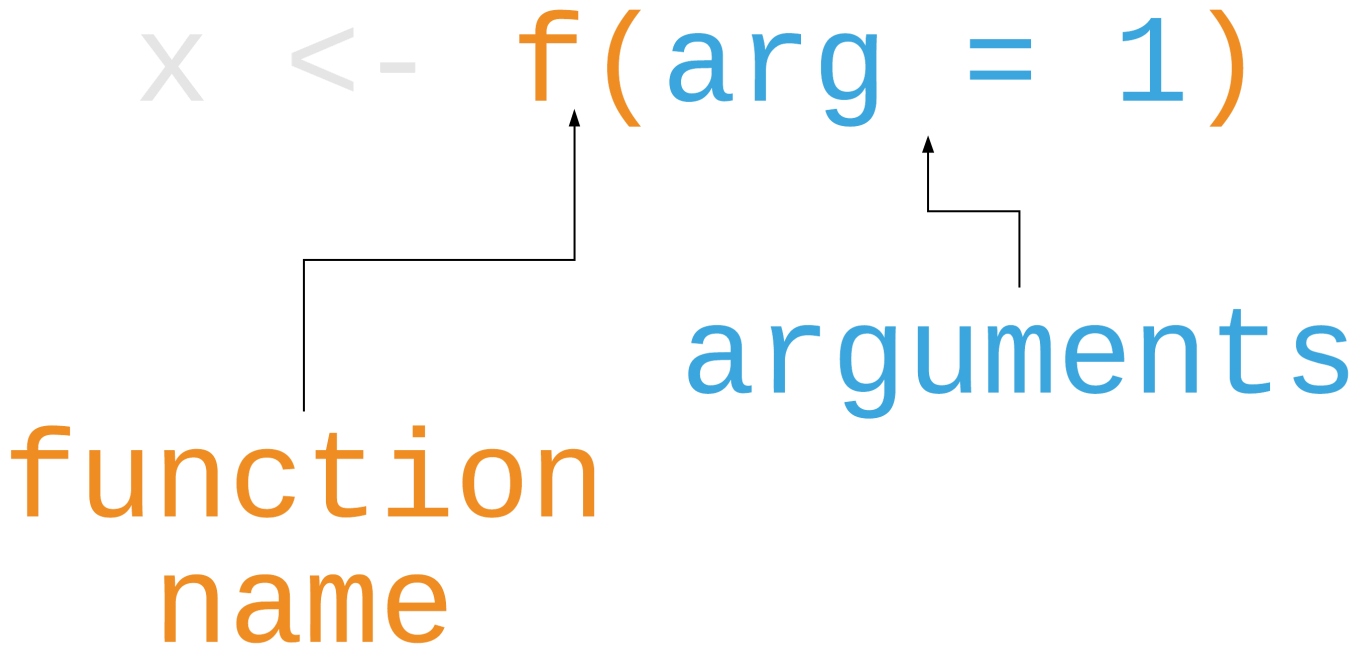
Importing Data

```
dataset <- read_csv("file_name.csv")
dataset
```

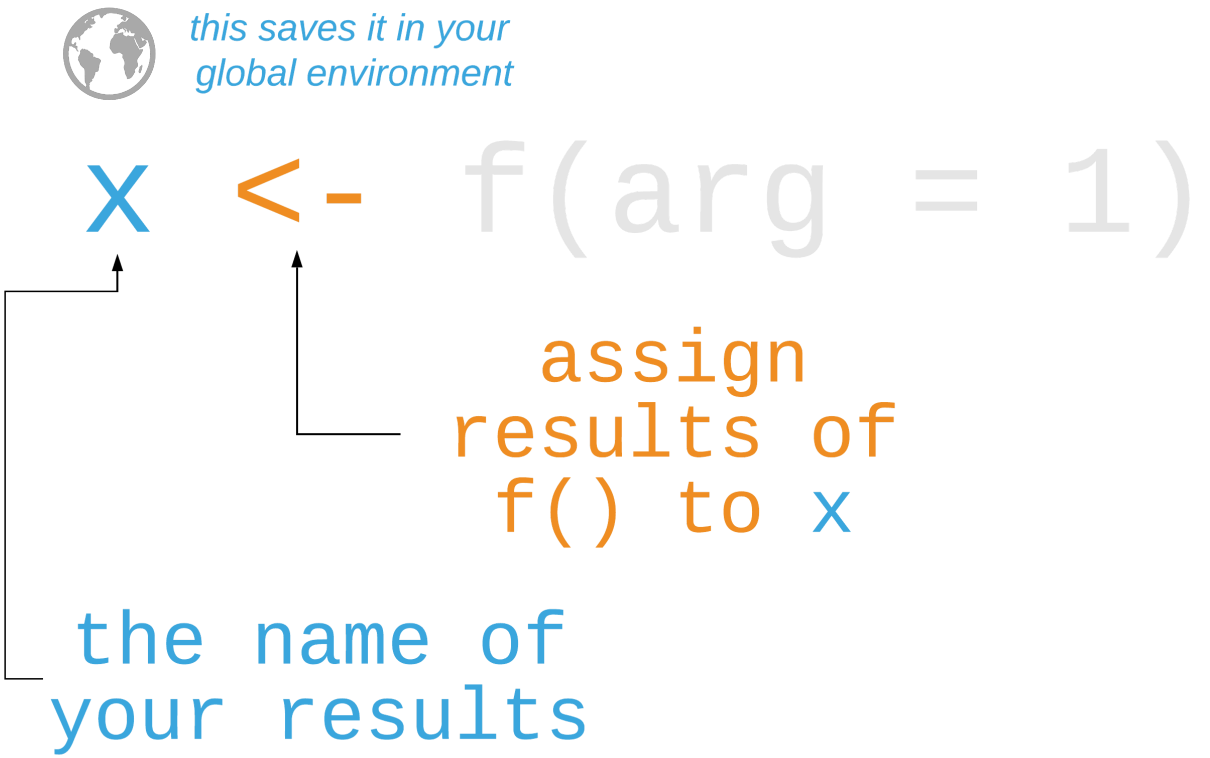
R functions

```
x <- f(arg = 1)
```

R functions



R functions


this saves it in your
global environment
x <- f(arg = 1)
assign
results of
f() to x
the name of
your results

```
diabetes <- read_csv("data/diabetes.csv")
diabetes
```

```
diabetes <- read_csv("data/diabetes.csv")
diabetes
```

```
## # A tibble: 403 x 19
##       id  chol stab.glu   hdl ratio glyhb location   age
##    <dbl> <dbl>    <dbl> <dbl> <dbl> <dbl> <chr>    <dbl>
##  1  1000   203       82    56  3.60  4.31 Bucking…    46
##  2  1001   165       97    24  6.90  4.44 Bucking…    29
##  3  1002   228       92    37  6.20  4.64 Bucking…    58
##  4  1003    78       93    12  6.5   4.63 Bucking…    67
##  5  1005   249       90    28  8.90  7.72 Bucking…    64
##  6  1008   248       94    69  3.60  4.81 Bucking…    34
##  7  1011   195       92    41  4.80  4.84 Bucking…    30
##  8  1015   227       75    44  5.20  3.94 Bucking…    37
##  9  1016   177       87    49  3.60  4.84 Bucking…    45
## 10  1022   263       89    40  6.60  5.78 Bucking…    55
## # … with 393 more rows, and 11 more variables:
## #   gender <chr>, height <dbl>, weight <dbl>, frame <chr>,
## #   bp.1s <dbl>, bp.1d <dbl>, …
```

Tibbles

data.frames are the basic form of rectangular data in R (columns of variables, rows of observations)

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read_csv() **reads the data into a** tibble**, a modern version of the data frame.**

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data.frames **are the basic form of rectangular data in R (columns of variables, rows of observations"**

read_csv() **reads the data into a** tibble**, a modern version of the data frame.**

a tibble is a data frame

haven

Function	Software
read_sas()	SAS
read_xpt()	SAS
read_spss()	SPSS
read_sav()	SPSS
read_por()	SPSS
read_stata()	Stata
read_dta()	Stata

haven

Function	Software
read_sas()	SAS
read_xpt()	SAS
read_spss()	SPSS
read_sav()	SPSS
read_por()	SPSS
read_stata()	Stata
read_dta()	Stata

haven is not a core member of the tidyverse. That means you need to load it with library(haven)**.**

```r
library(haven)
diabetes <- read_sas("data/diabetes.sas7bdat")
```

```
diabetes
```

```
## # A tibble: 403 x 19
##       id  chol stab_glu   hdl ratio glyhb location   age
##    <dbl> <dbl>    <dbl> <dbl> <dbl> <dbl> <chr>    <dbl>
##  1  1000   203       82    56  3.60  4.31 Bucking…    46
##  2  1001   165       97    24  6.90  4.44 Bucking…    29
##  3  1002   228       92    37  6.20  4.64 Bucking…    58
##  4  1003    78       93    12  6.5   4.63 Bucking…    67
##  5  1005   249       90    28  8.90  7.72 Bucking…    64
##  6  1008   248       94    69  3.60  4.81 Bucking…    34
##  7  1011   195       92    41  4.80  4.84 Bucking…    30
##  8  1015   227       75    44  5.20  3.94 Bucking…    37
##  9  1016   177       87    49  3.60  4.84 Bucking…    45
## 10  1022   263       89    40  6.60  5.78 Bucking…    55
## # … with 393 more rows, and 11 more variables:
## #   gender <chr>, height <dbl>, weight <dbl>, frame <chr>,
## #   bp_1s <dbl>, bp_1d <dbl>, …
```

Writing data

Function	Writes
write_csv()	Comma separated values
write_excel_csv()	CSV that you plan to open in Excel
write_delim()	General delimited files
write_file()	A single string, written as is
write_lines()	A vector of strings, one string per line
write_tsv()	Tab delimited values
write_rds()	A data type used by R to save objects
write_sas()	SAS .sas7bdat files
write_xpt()	SAS transport format, .xpt
write_sav()	SPSS .sav files
write_stata()	Stata .dta files

Writing data

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write_csv()	Comma separated values
write_excel_csv()	CSV that you plan to open in Excel
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write_file()	A single string, written as is
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write_tsv()	Tab delimited values
write_rds()	A data type used by R to save objects
write_sas()	SAS .sas7bdat files
write_xpt()	SAS transport format, .xpt
write_sav()	SPSS .sav files
write_stata()	Stata .dta files

```
write_csv(diabetes, path = "diabetes-clean.csv")
```

dplyr : go wrangling

Art by Allison Horst

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 x 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 0.290 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 x 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 0.290 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()

```
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 x 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)
```

03:00

Your Turn 1

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

```
## # A tibble: 1,704 x 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
```

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 x 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)**

03:00

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 x 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(______, _______)
```

03:00

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 x 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 0.290 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 x 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 0.290 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 x 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 x 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>
```

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 4

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.

05:00

Your turn 4

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

```
## # A tibble: 24 x 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
```

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 x 2
##       n mean_price
##   <int>      <dbl>
## 1 53940      3933.
```

Your turn 5

Use summarise() to compute three 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()**)**

03:00

Your turn 5

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

```
## # A tibble: 1 x 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 x 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 0.290 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 x 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 x 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 0.290 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 6

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).**

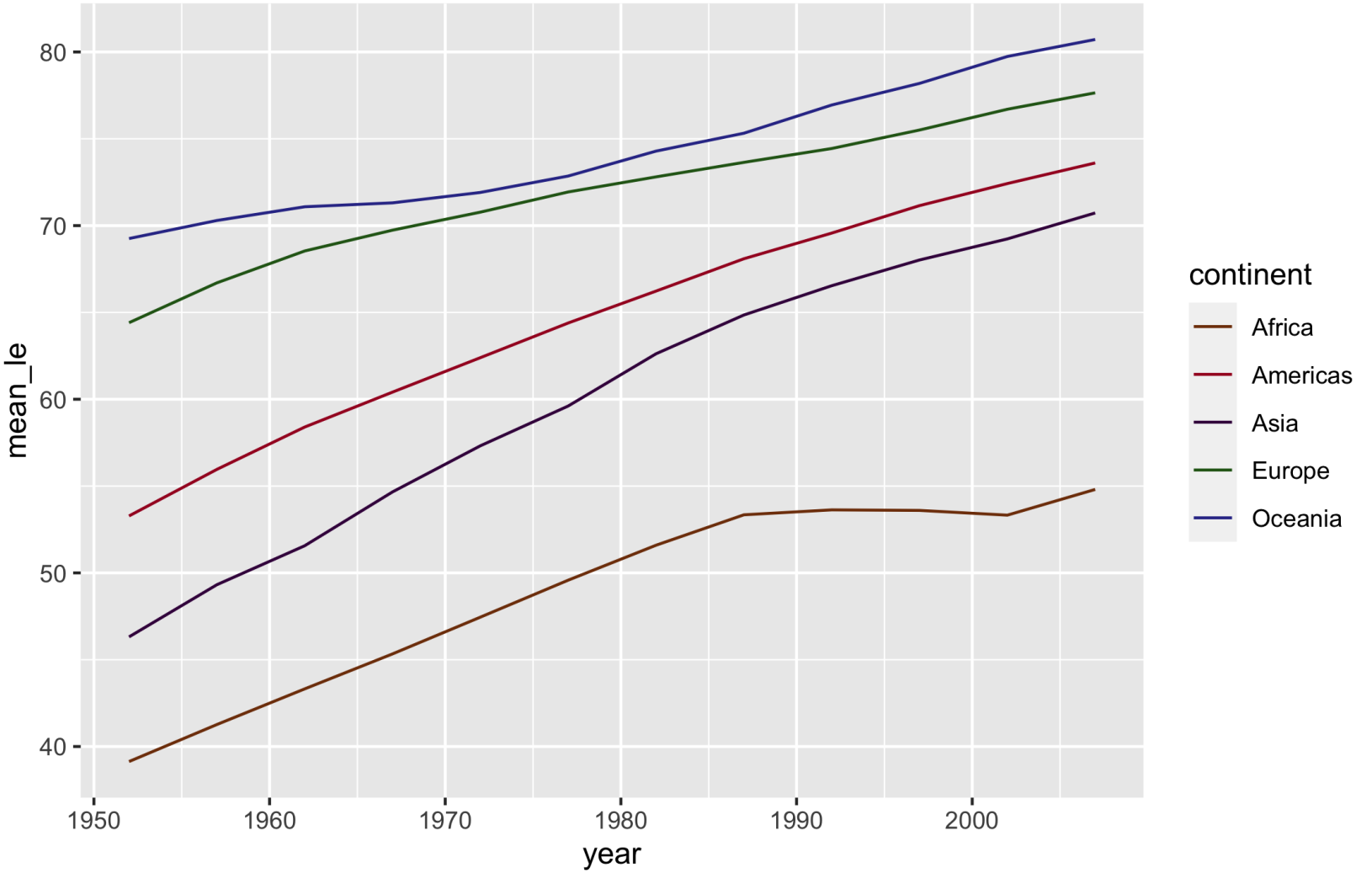
```
gapminder %>%
  __________ %>%
  __________ %>%
  ggplot(aes(x = year, y = mean_le, col = continent)) +
    geom_line() +
    scale_color_manual(values = continent_colors)
```

03:00

Your turn 6

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

What else can you do with dplyr?

What else can you do with dplyr?

Work across many columns (across())

What else can you do with dplyr?

Work across many columns (across())

Join many tables (left_join() and friends)

What else can you do with dplyr?

Work across many columns (across())

Join many tables (left_join() and friends)

Work seamlessly with databases (dbplyr)

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