Subsetting Data in R

Data Wrangling in R

Overview

We showed different ways to read data into R using:

```
readr::read_csv()
readr::read_delim()
readxl::read_excel()
```

In this module, we will show you how select rows and columns of datasets.

Setup

We will be using the dplyr package in the tidyverse.

Here are several resources on how to use `dplyr`:

- https://dplyr.tidyverse.org/
- https://r4ds.had.co.nz/
- https://cran.rstudio.com/web/packages/dplyr/vignettes/dplyr.html
- https://stat545.com/dplyr-intro.html

The `dplyr` package also interfaces well with tibbles.

Dataset

We will be using the `diamonds` dataset in the `ggplot2` package as an example (so make sure you initiate the `ggplot2` package if you are following along on your own).

```
head(diamonds)
```

```
# A tibble: 6 x 10
  carat cut       color clarity depth table price     x
  <dbl> <ord>     <ord> <ord>   <dbl> <dbl> <int> <dbl> <db
1  0.23 Ideal     E     SI2      61.5    55   326  3.95  3.
2  0.21 Premium   E     SI1      59.8    61   326  3.89  3.
3  0.23 Good      E     VS1      56.9    65   327  4.05  4.
4  0.29 Premium   I     VS2      62.4    58   334  4.2   4.
5  0.31 Good      J     SI2      63.3    58   335  4.34  4.
6  0.24 Very Good J     VVS2     62.8    57   336  3.94  3.
```

Selecting a single column of a `data.frame`:

To grab just the values from a single column, you would use the `pull` function. The output will be a vector (and not a `tibble`).

Since this is a long vector we will just show the first 6 values using the `head` function around the output of the `pull` function.

```
head(pull(diamonds,carat))
```

```
[1] 0.23 0.21 0.23 0.29 0.31 0.24
```

Using the `pipe` (comes with `dplyr`):

That was a lot of typing and nested functions, which can be confusing. Recently, the pipe %>% makes things such as this much more readable. It reads left side "pipes" into right side. RStudio `CMD/Ctrl + Shift + M` shortcut.

Using the pipe (comes with dplyr):

Pipe diamonds into select, then pipe that into pull, and then show the head:

```
diamonds %>% pull(carat) %>% head()
```

```
[1] 0.23 0.21 0.23 0.29 0.31 0.24
```

Selecting a single column of a `data.frame`:

The `pull` function is equivalent to using the `$` method (in base R).

Note that base R and tidyverse don't always play nice together.

```
head(pull(diamonds, carat))
```

```
[1] 0.23 0.21 0.23 0.29 0.31 0.24
```

```
head(diamonds$carat)
```

```
[1] 0.23 0.21 0.23 0.29 0.31 0.24
```

Note this does *not* return a `tibble` (or `data.frame`) but rather a vector.

Selecting a single column of a `data.frame`:

The `select` function extracts one or more columns from a `tibble` or `data.frame` and returns a `tibble` (not a vector).

```
select(diamonds, carat)
```

```
# A tibble: 53,940 x 1
   carat
   <dbl>
 1  0.23
 2  0.21
 3  0.23
 4  0.29
 5  0.31
 6  0.24
 7  0.24
 8  0.26
 9  0.22
10  0.23
# ... with 53,930 more rows
```

Selecting multiple columns of a `data.frame`:

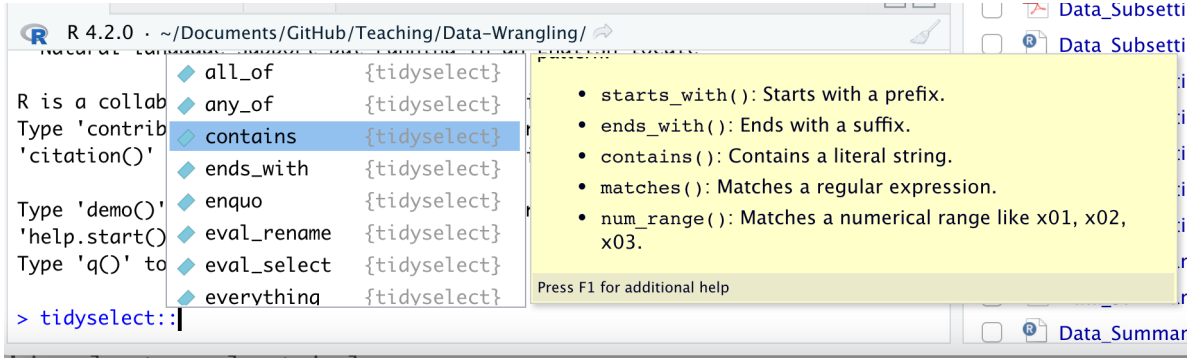
The `select` command from `dplyr` is very flexible. You just need to list all columns you want to extract separated by commas. You can use this as a way to just keep the columns you want for example.

```
select(diamonds, carat, depth)
```

```
# A tibble: 53,940 x 2
   carat depth
   <dbl> <dbl>
 1  0.23  61.5
 2  0.21  59.8
 3  0.23  56.9
 4  0.29  62.4
 5  0.31  63.3
 6  0.24  62.8
 7  0.24  62.3
 8  0.26  61.9
 9  0.22  65.1
10  0.23  59.4
```

See the Select "helpers"

Type `tidyselect::` to see functions available.



Here are a few:

```
last_col()
ends_with()
starts_with()
contains() # search for a pattern
everything()
```

Tidyselect helpers

For example, we can take all columns that start with a "c":

```
diamonds %>% select(starts_with("c"))
```

```
# 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  0.29 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
```

Tidyselect helpers

Or we can take all columns that end with an "e":

```
diamonds %>% select(ends_with("e"))
```

```
# A tibble: 53,940 x 2
   table price
   <dbl> <int>
 1    55   326
 2    61   326
 3    65   327
 4    58   334
 5    58   335
 6    57   336
 7    57   336
 8    55   337
 9    61   337
10    61   338
# ... with 53,930 more rows
```

Tidyselect helpers

We are going to cover "fancier" ways of matching column names (and strings more generally) in the data cleaning lecture.

Subset rows of a `data.frame`:

The command in `dplyr` for subsetting rows is `filter`. Try `?filter`.

The easiest way to filter is by testing whether numeric observations are greater than or less than some cutoff:

```
filter(diamonds, depth > 60)
```

```
# A tibble: 48,315 x 10
   carat cut       color clarity depth table price     x
   <dbl> <ord>     <ord> <ord>   <dbl> <dbl> <int> <dbl> <d
 1  0.23 Ideal     E     SI2      61.5    55   326  3.95  3
 2  0.29 Premium   I     VS2      62.4    58   334  4.2   4
 3  0.31 Good      J     SI2      63.3    58   335  4.34  4
 4  0.24 Very Good J     VVS2     62.8    57   336  3.94  3
 5  0.24 Very Good I     VVS1     62.3    57   336  3.95  3
 6  0.26 Very Good H     SI1      61.9    55   337  4.07  4
 7  0.22 Fair      E     VS2      65.1    61   337  3.87  3
 8  0.3  Good      J     SI1      64      55   339  4.25  4
```

Subset rows of a data.frame:

You can also using piping here:

```
diamonds %>% filter(depth > 60)
```

```
# A tibble: 48,315 x 10
   carat cut       color clarity depth table price     x
   <dbl> <ord>     <ord> <ord>   <dbl> <dbl> <int> <dbl> <
 1  0.23 Ideal     E     SI2      61.5    55   326  3.95  3
 2  0.29 Premium   I     VS2      62.4    58   334  4.2   4
 3  0.31 Good      J     SI2      63.3    58   335  4.34  4
 4  0.24 Very Good J     VVS2     62.8    57   336  3.94  3
 5  0.24 Very Good I     VVS1     62.3    57   336  3.95  3
 6  0.26 Very Good H     SI1      61.9    55   337  4.07  4
 7  0.22 Fair      E     VS2      65.1    61   337  3.87  3
 8  0.3  Good      J     SI1      64      55   339  4.25  4
 9  0.23 Ideal     J     VS1      62.8    56   340  3.93  3
10  0.22 Premium   F     SI1      60.4    61   342  3.88  3
# ... with 48,305 more rows
```

Subset rows of a `data.frame`:

You can combine filtering on multiple columns by separating the filter arguments with commas:

```
diamonds %>% filter(depth > 60, table > 60, price > 2775)
```

```
# A tibble: 1,704 x 10
   carat cut       color clarity depth table price     x
   <dbl> <ord>     <ord> <ord>   <dbl> <dbl> <int> <dbl> <
 1  0.72 Premium   F     SI1      61.8    61  2777  5.82  5
 2  0.72 Very Good H     VS1      60.6    63  2782  5.83  5
 3  0.81 Good      G     SI2      61      61  2789  5.94  5
 4  0.71 Premium   F     VS1      60.1    62  2790  5.77  5
 5  0.71 Premium   G     VS1      62.4    61  2803  5.7   5
 6  0.74 Fair      F     VS2      61.1    68  2805  5.82  5
 7  0.7  Good      F     VS1      62.8    61  2810  5.57  5
 8  0.7  Very Good F     VS2      60.9    61  2812  5.66  5
 9  0.71 Good      E     SI1      62.8    64  2817  5.6   5
10  0.7  Premium   E     VS2      62.4    61  2818  5.66  5
# ... with 1,694 more rows
```

Subset rows of a `data.frame`:

You can also filter character strings by a single value or category. Here we need quotes around character strings.

```
diamonds %>% filter(color == "I",
                    clarity == "SI2", cut == "Premium")
```

```
# A tibble: 312 x 10
   carat cut     color clarity depth table price     x
   <dbl> <ord>   <ord> <ord>   <dbl> <dbl> <int> <dbl> <dbl
 1  0.42 Premium I     SI2      61.5    59   552  4.78  4.8
 2  1    Premium I     SI2      58.2    60  2795  6.61  6.5
 3  0.9  Premium I     SI2      62.2    59  2826  6.11  6.0
 4  1.05 Premium I     SI2      58.3    57  2911  6.72  6.6
 5  0.91 Premium I     SI2      62      59  2913  6.18  6.2
 6  0.9  Premium I     SI2      62.5    58  2948  6.15  6.1
 7  0.9  Premium I     SI2      60.6    60  2948  6.28  6.2
 8  1.06 Premium I     SI2      61.5    57  2968  6.57  6.4
 9  0.91 Premium I     SI2      60.2    59  2981  6.29  6.2
10  0.9  Premium I     SI2      60.6    60  3001  6.23  6.2
```

Subset rows of a `data.frame`:

Sometimes you want to be able to filter on matching several values or categories. The %in% operator is useful here:

```
diamonds %>% filter(clarity %in% c("SI1", "SI2"))
```

```
# A tibble: 22,259 x 10
   carat cut       color clarity depth table price     x
   <dbl> <ord>     <ord> <ord>   <dbl> <dbl> <int> <dbl> <d
 1  0.23 Ideal     E     SI2      61.5    55   326  3.95  3
 2  0.21 Premium   E     SI1      59.8    61   326  3.89  3
 3  0.31 Good      J     SI2      63.3    58   335  4.34  4
 4  0.26 Very Good H     SI1      61.9    55   337  4.07  4
 5  0.3  Good      J     SI1      64      55   339  4.25  4
 6  0.22 Premium   F     SI1      60.4    61   342  3.88  3
 7  0.31 Ideal     J     SI2      62.2    54   344  4.35  4
 8  0.2  Premium   E     SI2      60.2    62   345  3.79  3
 9  0.3  Ideal     I     SI2      62      54   348  4.31  4
10  0.3  Good      J     SI1      63.4    54   351  4.23  4
# ... with 22,249 more rows
```

Subset rows of a `data.frame`:

You can mix and match filtering on numeric and categorical/character columns in the same `filter()` command:

```
diamonds %>% filter(clarity %in% c("SI1", "SI2"),
                    cut == "Premium", price > 3000)
```

```
# A tibble: 3,976 x 10
   carat cut     color clarity depth table price     x
   <dbl> <ord>   <ord> <ord>   <dbl> <dbl> <int> <dbl> <dbl
 1  0.9  Premium I     SI2      60.6    60  3001  6.23  6.2
 2  0.81 Premium F     SI1      61.9    58  3004  5.99  5.9
 3  0.92 Premium D     SI2      60.2    61  3004  6.32  6.2
 4  0.9  Premium D     SI1      62.2    60  3013  6.08  6.0
 5  0.96 Premium E     SI2      62.8    60  3016  6.3   6.2
 6  0.93 Premium G     SI2      61.4    56  3019  6.27  6.2
 7  0.78 Premium D     SI1      60.4    57  3019  6.02  5.9
 8  0.75 Premium E     SI1      61.7    60  3024  5.84  5.8
 9  0.75 Premium D     SI1      59.2    58  3024  5.96  5.9
10  1.02 Premium G     SI2      61.7    58  3027  6.46  6.4
```

Note about quotes and numbers

R will interpret quotes around numbers as the characters themselves and not their numeric meaning. Thus it's generally best to avoid quotes around numeric unless it is not being treated as a numeric value - for example levels or grades.

```
diamonds %>% filter(price > 3001) #This works
diamonds %>% filter(price > "3001") # This does not

diamonds %>% filter(price == 3001) # This works
diamonds %>% filter(price == "3001") # this works
```

Subset rows of a `data.frame`:

Other useful logical tests:

`&` : AND

`|` : OR

`<=` : less than or equals

`>=` : greater than or equals

`!=` : not equals

Subset rows of a `data.frame`:

The AND operator (`&`) is the what is being performed "behind the scenes" when chaining together filter statements with commas:

```
diamonds %>% filter(depth > 60 & table > 60 & price > 2775)
```

```
# A tibble: 1,704 x 10
   carat cut       color clarity depth table price     x
   <dbl> <ord>     <ord> <ord>   <dbl> <dbl> <int> <dbl> <
 1  0.72 Premium   F     SI1      61.8    61  2777  5.82  5
 2  0.72 Very Good H     VS1      60.6    63  2782  5.83  5
 3  0.81 Good      G     SI2      61      61  2789  5.94  5
 4  0.71 Premium   F     VS1      60.1    62  2790  5.77  5
 5  0.71 Premium   G     VS1      62.4    61  2803  5.7   5
 6  0.74 Fair      F     VS2      61.1    68  2805  5.82  5
 7  0.7  Good      F     VS1      62.8    61  2810  5.57  5
 8  0.7  Very Good F     VS2      60.9    61  2812  5.66  5
 9  0.71 Good      E     SI1      62.8    64  2817  5.6   5
10  0.7  Premium   E     VS2      62.4    61  2818  5.66  5
# ... with 1,694 more rows
```

Subset rows of a `data.frame`:

The OR operator (|) is more permissive than the AND operator:

```
diamonds %>% filter(depth > 60 | table > 60 | price > 2775)
```

```
# A tibble: 52,198 x 10
   carat cut       color clarity depth table price     x
   <dbl> <ord>     <ord> <ord>   <dbl> <dbl> <int> <dbl> <
 1  0.23 Ideal     E     SI2      61.5    55   326  3.95  3
 2  0.21 Premium   E     SI1      59.8    61   326  3.89  3
 3  0.23 Good      E     VS1      56.9    65   327  4.05  4
 4  0.29 Premium   I     VS2      62.4    58   334  4.2   4
 5  0.31 Good      J     SI2      63.3    58   335  4.34  4
 6  0.24 Very Good J     VVS2     62.8    57   336  3.94  3
 7  0.24 Very Good I     VVS1     62.3    57   336  3.95  3
 8  0.26 Very Good H     SI1      61.9    55   337  4.07  4
 9  0.22 Fair      E     VS2      65.1    61   337  3.87  3
10  0.23 Very Good H     VS1      59.4    61   338  4     4
# ... with 52,188 more rows
```

Subset rows of a `data.frame`:

The OR operator (|) can be a substitute for %in% (although it might take more typing):

```
diamonds %>% filter(clarity =="SI1" | clarity == "SI2") %>%
```

```
# A tibble: 2 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
```

```
diamonds %>% filter(clarity %in% c("SI1", "SI2")) %>% head(
```

```
# A tibble: 2 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
```

Combining `filter` and `select`:

You can combine `filter` and `select` to subset the rows and columns, respectively, of a `data.frame`:

```
diamonds %>%
  filter(clarity == "SI2") %>%
  select(starts_with("c"))
```

```
# A tibble: 9,194 x 4
   carat cut       color clarity
   <dbl> <ord>     <ord> <ord>
 1  0.23 Ideal     E     SI2
 2  0.31 Good      J     SI2
 3  0.31 Ideal     J     SI2
 4  0.2  Premium   E     SI2
 5  0.3  Ideal     I     SI2
 6  0.3  Good      I     SI2
 7  0.33 Ideal     I     SI2
 8  0.33 Ideal     I     SI2
 9  0.32 Good      H     SI2
```

Combining `filter` and `select`:

The order of these functions matters though, since you can remove columns that you might want to filter on.

```
diamonds %>%
  select(starts_with("c")) %>%
  filter(table > 60))
```

This will result in an error because the table column is now gone after the `select()` function!

Fancier filtering

Combining tidyselect helpers with regular selection

```
head(diamonds, 2)
```

```
# A tibble: 2 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
```

```
diamonds %>% select(price, starts_with("c"))
```

```
# A tibble: 53,940 x 5
   price carat cut       color clarity
   <int> <dbl> <ord>     <ord> <ord>
 1   326  0.23 Ideal     E     SI2
 2   326  0.21 Premium   E     SI1
 3   327  0.23 Good      E     VS1
 4   334  0.29 Premium   I     VS2
 5   335  0.31 Good      J     SI2
 6   336  0.24 Very Good J     VVS2
```

Multiple tidyselect functions

Follows OR logic.

```
diamonds %>% select(starts_with("c"), ends_with("e"))
```

```
# A tibble: 53,940 x 6
   carat cut       color clarity table price
   <dbl> <ord>     <ord> <ord>   <dbl> <int>
 1  0.23 Ideal     E     SI2        55   326
 2  0.21 Premium   E     SI1        61   326
 3  0.23 Good      E     VS1        65   327
 4  0.29 Premium   I     VS2        58   334
 5  0.31 Good      J     SI2        58   335
 6  0.24 Very Good J     VVS2       57   336
 7  0.24 Very Good I     VVS1       57   336
 8  0.26 Very Good H     SI1        55   337
 9  0.22 Fair      E     VS2        61   337
10  0.23 Very Good H     VS1        61   338
# ... with 53,930 more rows
```

Multiple patterns with tidyselect

Need to combine the patterns with the `c()` function.

```
diamonds %>% select(starts_with(c("c", "p")))
```

```
# A tibble: 53,940 x 5
   carat cut       color clarity price
   <dbl> <ord>     <ord> <ord>   <int>
 1  0.23 Ideal     E     SI2       326
 2  0.21 Premium   E     SI1       326
 3  0.23 Good      E     VS1       327
 4  0.29 Premium   I     VS2       334
 5  0.31 Good      J     SI2       335
 6  0.24 Very Good J     VVS2      336
 7  0.24 Very Good I     VVS1      336
 8  0.26 Very Good H     SI1       337
 9  0.22 Fair      E     VS2       337
10  0.23 Very Good H     VS1       338
# ... with 53,930 more rows
```

Common error for filter or select

If you try to filter or select for a column that does not exist it will not work:

- misspelled column name
- column that was already removed

Always good to check each step!

Did the filter work the way you expected? Did the dimensions change?

https://media.giphy.com/media/5b5OU7aUekfdSAER5I/giphy.gif

Lab

Link to Lab