

# Intro to R

## Subsetting Data in R

Introduction to R for Public Health Researchers

# Overview

We showed one way to read data into R using `read_csv` and `read.csv`. In this module, we will show you how to:

1. Select specific elements of an object by an index or logical condition
2. Renaming columns of a `data.frame`
3. Subset rows of a `data.frame`
4. Subset columns of a `data.frame`
5. Add/remove new columns to a `data.frame`
6. Order the columns of a `data.frame`
7. Order the rows of a `data.frame`

# Setup

We will show you how to do each operation in base R then show you how to use the `dplyr` package to do the same operation (if applicable).

Many resources on how to use `dplyr` exist and are straightforward:

- <https://cran.rstudio.com/web/packages/dplyr/vignettes/>
- [https://stat545-ubc.github.io/block009\\_dplyr-intro.html](https://stat545-ubc.github.io/block009_dplyr-intro.html)
- <https://www.datacamp.com/courses/dplyr-data-manipulation-r-tutorial>

The `dplyr` package also interfaces well with tibbles (a fancy tidyverse version of a data frame).

# Loading in dplyr and tidyverse

```
library(tidyverse)
```

— Attaching packages — tidyverse 1.3.1

✓ ggplot2 3.3.3	✓ purrr 0.3.4
✓ tibble 3.1.1	✓ stringr 1.4.0
✓ tidyr 1.1.3	✓ forcats 0.5.1
✓ readr 1.4.0	

— Conflicts — tidyverse\_conflicts()

```
x dplyr::filter() masks stats::filter()
x dplyr::lag()    masks stats::lag()
```

Note, when loading `dplyr`, it says objects can be “masked”/conflicts. That means if you use a function defined in 2 places, it uses the one that is loaded in **last**.

## Loading in dplyr and tidyverse

For example, if we print `filter`, then we see at the bottom `namespace:dplyr`, which means when you type `filter`, it will use the one from the `dplyr` package.

```
filter
```

```
function (.data, ..., .preserve = FALSE)
{
  UseMethod("filter")
}
<bytecode: 0x7ff589f96790>
<environment: namespace:dplyr>
```

## Loading in dplyr and tidyverse

A `filter` function exists by default in the `stats` package, however. If you want to make sure you use that one, you use `PackageName::Function` with the colon-colon ("`::`") operator.

```
head(stats::filter, 2)
```

```
1 function (x, filter, method = c("convolution", "recursive"),  
2      sides = 2L, circular = FALSE, init = NULL)
```

This is important when loading many packages, and you may have some conflicts/masking.

## Creating a `data.frame` to work with

Here we use one of the datasets that comes with the `jhur` package called `jhu_cars`, which is a (copy of another called `mtcars`). We will now create a toy `data.frame` named `df` using this data:

```
library(jhur)
data(jhu_cars)
df= jhu_cars # df is a copy of jhu_cars
head(df) # changing df does **not** change jhu_cars
```

	car	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
1	Mazda RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	4
2	Mazda RX4 Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	4
3	Datsun 710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	1
4	Hornet 4 Drive	21.4	6	258	110	3.08	3.215	19.44	1	0	3	1
5	Hornet Sportabout	18.7	8	360	175	3.15	3.440	17.02	0	0	3	2
6	Valiant	18.1	6	225	105	2.76	3.460	20.22	1	0	3	1

## Creating a `data.frame` to work with

If we would like to create a `tibble` ("fancy" `data.frame`), we can use `as_tbl` or `as_tibble`.

```
tbl = as_tibble(df)
tbl
```

```
# A tibble: 32 x 12
```

	car	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	car
	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
1	Mazda RX4	21	6	160	110	3.9	2.62	16.5	0	1	4	
2	Mazda RX4 ...	21	6	160	110	3.9	2.88	17.0	0	1	4	
3	Datsun 710	22.8	4	108	93	3.85	2.32	18.6	1	1	4	
4	Hornet 4 D...	21.4	6	258	110	3.08	3.22	19.4	1	0	3	
5	Hornet Spo...	18.7	8	360	175	3.15	3.44	17.0	0	0	3	
6	Valiant	18.1	6	225	105	2.76	3.46	20.2	1	0	3	
7	Duster 360	14.3	8	360	245	3.21	3.57	15.8	0	0	3	
8	Merc 240D	24.4	4	147.	62	3.69	3.19	20	1	0	4	
9	Merc 230	22.8	4	141.	95	3.92	3.15	22.9	1	0	4	
10	Merc 280	19.2	6	168.	123	3.92	3.44	18.3	1	0	4	

```
# ... with 22 more rows
```



## No rownames in tibbles!

In the “tidy” data format, all information of interest is a variable (not a name). **as of tibble 2.0, rownames are removed.** For example, `mtcars` has each car name as a row name. Here we use the `head()` function to see the first 2 rows of each.

```
head(mtcars, 2)
```

		mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda	RX4	21	6	160	110	3.9	2.620	16.46	0	1	4	4
Mazda	RX4 Wag	21	6	160	110	3.9	2.875	17.02	0	1	4	4

```
head(as_tibble(mtcars), 2)
```

```
# A tibble: 2 x 11
```

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
1	21	6	160	110	3.9	2.62	16.5	0	1	4	4
2	21	6	160	110	3.9	2.88	17.0	0	1	4	4

# Renaming Columns

## Renaming Columns of a `data.frame`: `dplyr`

To rename columns in `dplyr`, you use the `rename` command.

For example, let's rename `mpg` to `MPG`.

```
df = dplyr::rename(df, MPG = mpg)
head(df)
```

	car	MPG	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
1	Mazda RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	4
2	Mazda RX4 Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	4
3	Datsun 710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	1
4	Hornet 4 Drive	21.4	6	258	110	3.08	3.215	19.44	1	0	3	1
5	Hornet Sportabout	18.7	8	360	175	3.15	3.440	17.02	0	0	3	2
6	Valiant	18.1	6	225	105	2.76	3.460	20.22	1	0	3	1

## Renaming All Columns of a `data.frame`: `dplyr`

To rename all columns you use the `rename_all` command (with a function). In this case we will use `toupper()` to make all letters upper case. Could also use `tolower()` function.

```
df_upper = dplyr::rename_all(df, toupper)
head(df_upper, 3)
```

		CAR	MPG	CYL	DISP	HP	DRAT	WT	QSEC	VS	AM	GEAR	CARB
1		Mazda RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	4
2	Mazda RX4	Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	4
3	Datsun	710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	1

```
df = dplyr::rename_all(df, tolower)
head(df, 3)
```

		car	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
1		Mazda RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	4
2	Mazda RX4	Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	4
3	Datsun	710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	1

# Lab Part 1

[Website](#)

# Subsetting Columns

## Subset columns of a `data.frame`:

We can grab the `carb` column using the `$` operator. This is the base R way to do this:

```
df$carb
```

```
[1] 4 4 1 1 2 1 4 2 2 4 4 3 3 3 4 4 4 1 2 1 1 2 2 4 2 1 2 2 4 6 8 2
```

## Subset columns of a `data.frame` - tidyverse way:

To grab the `carb` column the tidyverse way we can use the `pull` function:

```
pull(df, carb)
```

```
[1] 4 4 1 1 2 1 4 2 2 4 4 3 3 3 4 4 4 1 2 1 1 2 2 4 2 1 2 2 4 6 8 2
```



## Subset columns of a `data.frame`: `dplyr`

The `select` command from `dplyr` allows you to subset (gives a `tibble`!)

```
select(df, mpg)
```

	mpg
1	21.0
2	21.0
3	22.8
4	21.4
5	18.7
6	18.1
7	14.3
8	24.4
9	22.8
10	19.2
11	17.8
12	16.4
13	17.3
14	15.2
15	10.4
16	10.4
17	14.7
18	32.4
19	30.4
20	33.9
21	21.5
22	15.5
23	15.2
24	13.3

## Subset columns of a `data.frame`: `dplyr`

Note that if you want a single vector (not a `tibble`), use `pull` or `$`:

```
pull(df, mpg)
```

```
[1] 21.0 21.0 22.8 21.4 18.7 18.1 14.3 24.4 22.8 19.2 17.8 16.4 17.3 15.2 10.4  
[16] 10.4 14.7 32.4 30.4 33.9 21.5 15.5 15.2 13.3 19.2 27.3 26.0 30.4 15.8 19.4  
[31] 15.0 21.4
```

```
# pull with select works too!
```

```
pull(select(df, mpg))
```

```
[1] 21.0 21.0 22.8 21.4 18.7 18.1 14.3 24.4 22.8 19.2 17.8 16.4 17.3 15.2 10.4  
[16] 10.4 14.7 32.4 30.4 33.9 21.5 15.5 15.2 13.3 19.2 27.3 26.0 30.4 15.8 19.4  
[31] 15.0 21.4
```

## Select columns of a `data.frame`: `dplyr`

The `select` command from `dplyr` allows you to subset columns matching strings:

```
select(df, mpg, cyl)
```

	mpg	cyl
1	21.0	6
2	21.0	6
3	22.8	4
4	21.4	6
5	18.7	8
6	18.1	6
7	14.3	8
8	24.4	4
9	22.8	4
10	19.2	6
11	17.8	6
12	16.4	8
13	17.3	8
14	15.2	8
15	10.4	8
16	10.4	8
17	14.7	8
18	32.4	4
19	30.4	4
20	33.9	4
21	21.5	4
22	15.5	8
23	15.2	8

## See the Select “helpers”

Run the command:

```
??tidyselect::select_helpers
```

Here are a few:

```
one_of()  
last_col()  
ends_with()  
contains() # like searching  
matches() # Matches a regular expression - cover later
```

# Lab Part 2

[Website](#)

# Subsetting Rows

## Subset rows of a `data.frame`: `dplyr`

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

```
filter(df, mpg > 20)
```

	car	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
1	Mazda RX4	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
2	Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
3	Datsun 710	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
4	Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
5	Merc 240D	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
6	Merc 230	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
7	Fiat 128	32.4	4	78.7	66	4.08	2.200	19.47	1	1	4	1
8	Honda Civic	30.4	4	75.7	52	4.93	1.615	18.52	1	1	4	2
9	Toyota Corolla	33.9	4	71.1	65	4.22	1.835	19.90	1	1	4	1
10	Toyota Corona	21.5	4	120.1	97	3.70	2.465	20.01	1	0	3	1
11	Fiat X1-9	27.3	4	79.0	66	4.08	1.935	18.90	1	1	4	1
12	Porsche 914-2	26.0	4	120.3	91	4.43	2.140	16.70	0	1	5	2
13	Lotus Europa	30.4	4	95.1	113	3.77	1.513	16.90	1	1	5	2
14	Volvo 142E	21.4	4	121.0	109	4.11	2.780	18.60	1	1	4	2

Note, no `$` or subsetting is necessary. R “knows” `mpg` refers to a column of `df`.

## Subset rows of a `data.frame`: dplyr

You can have multiple logical conditions using the following:

- `==` : equals to
- `!` : not/negation
- `!=` : not equal to
- `>` / `<` : greater than / less than
- `>=` or `<=` : greater than or equal to / less than or equal to
- `&` : AND
- `|` : OR



## Subset rows of a `data.frame`: `dplyr`

The `%in%` operator can be used find values from a pre-made list (using `c()`):

```
filter(df, mpg %in% c(20, 21, 22))
```

		car	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb	
1		Mazda	RX4	21	6	160	110	3.9	2.620	16.46	0	1	4	4
2	Mazda	RX4	Wag	21	6	160	110	3.9	2.875	17.02	0	1	4	4

## Subset rows of a `data.frame`: `dplyr`

By default, you can separate conditions by commas, and `filter` assumes these statements are joined by `&`:

```
filter(df, mpg > 20 & cyl == 4)
```

	car	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
1	Datsun 710	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
2	Merc 240D	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
3	Merc 230	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
4	Fiat 128	32.4	4	78.7	66	4.08	2.200	19.47	1	1	4	1
5	Honda Civic	30.4	4	75.7	52	4.93	1.615	18.52	1	1	4	2
6	Toyota Corolla	33.9	4	71.1	65	4.22	1.835	19.90	1	1	4	1
7	Toyota Corona	21.5	4	120.1	97	3.70	2.465	20.01	1	0	3	1
8	Fiat X1-9	27.3	4	79.0	66	4.08	1.935	18.90	1	1	4	1
9	Porsche 914-2	26.0	4	120.3	91	4.43	2.140	16.70	0	1	5	2
10	Lotus Europa	30.4	4	95.1	113	3.77	1.513	16.90	1	1	5	2
11	Volvo 142E	21.4	4	121.0	109	4.11	2.780	18.60	1	1	4	2

```
filter(df, mpg > 20, cyl == 4, mpg != 22.8)
```

	car	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
1	Merc 240D	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
2	Fiat 128	32.4	4	78.7	66	4.08	2.200	19.47	1	1	4	1
3	Honda Civic	30.4	4	75.7	52	4.93	1.615	18.52	1	1	4	2
4	Toyota Corolla	33.9	4	71.1	65	4.22	1.835	19.90	1	1	4	1
5	Toyota Corona	21.5	4	120.1	97	3.70	2.465	20.01	1	0	3	1
6	Fiat X1-9	27.3	4	79.0	66	4.08	1.935	18.90	1	1	4	1
7	Porsche 914-2	26.0	4	120.3	91	4.43	2.140	16.70	0	1	5	2

## Subset rows of a `data.frame`: `dplyr`

If you want OR statements, you need to do the pipe `|` explicitly:

```
filter(df, mpg > 20 | cyl == 4)
```

	car	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
1	Mazda RX4	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
2	Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
3	Datsun 710	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
4	Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
5	Merc 240D	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
6	Merc 230	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
7	Fiat 128	32.4	4	78.7	66	4.08	2.200	19.47	1	1	4	1
8	Honda Civic	30.4	4	75.7	52	4.93	1.615	18.52	1	1	4	2
9	Toyota Corolla	33.9	4	71.1	65	4.22	1.835	19.90	1	1	4	1
10	Toyota Corona	21.5	4	120.1	97	3.70	2.465	20.01	1	0	3	1
11	Fiat X1-9	27.3	4	79.0	66	4.08	1.935	18.90	1	1	4	1
12	Porsche 914-2	26.0	4	120.3	91	4.43	2.140	16.70	0	1	5	2
13	Lotus Europa	30.4	4	95.1	113	3.77	1.513	16.90	1	1	5	2
14	Volvo 142E	21.4	4	121.0	109	4.11	2.780	18.60	1	1	4	2

# Lab Part 3

[Website](#)

## Combining **filter** and **select**

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

```
select(filter(df, mpg > 20 & cyl == 4), cyl, hp)
```

	cyl	hp
1	4	93
2	4	62
3	4	95
4	4	66
5	4	52
6	4	65
7	4	97
8	4	66
9	4	91
10	4	113
11	4	109

In `R`, the common way to perform multiple operations is to wrap functions around each other in a nested way such as above.

# Assigning Temporary Objects

One can also create temporary objects and reassign them:

```
df2 = filter(df, mpg > 20 & cyl == 4)
df2 = select(df2, cyl, hp)
```

```
head(df2, 4)
```

	cyl	hp
1	4	93
2	4	62
3	4	95
4	4	66

## Using the **pipe** (comes with **dplyr**):

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. Pipe `df` into `filter`, then pipe that into `select`:

```
df %>% filter(mpg > 20 & cyl == 4) %>% select(cyl, hp)
```

	cyl	hp
1	4	93
2	4	62
3	4	95
4	4	66
5	4	52
6	4	65
7	4	97
8	4	66
9	4	91
10	4	113
11	4	109

# Adding/Removing Columns



## Adding new columns to a `data.frame`: base R

You can add a new column, called `newcol` to `df`, using the `$` operator:

```
df$newcol = df$wt/2.2  
head(df,3)
```

		car	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb	newcol	
1		Mazda	RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	4	1.190909
2	Mazda	RX4	Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	4	1.306818
3		Datsun	710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	1	1.054545

## Adding columns to a `data.frame`: `dplyr` (tidyverse way)

The `$` method is very common.

The `mutate` function in `dplyr` allows you to add or replace columns of a `data.frame`:

```
df = mutate(df, newcol = wt/2.2)
```

		car	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb	newcol
1	Mazda	RX4	21	6	160	110	3.9	2.620	16.46	0	1	4	4	1.190909
2	Mazda	RX4	Wag	21	6	160	110	3.9	2.875	17.02	0	1	4	1.306818

## Creating conditional variables

One frequently-used tool is creating variables with conditions.

A general function for creating new variables based on existing variables is the `ifelse()` function, which “returns a value with the same shape as test which is filled with elements selected from either yes or no depending on whether the element of test is TRUE or FALSE.”

```
ifelse(test, yes, no)
```

```
# test: an object which can be coerced  
#       to logical mode.
```

```
# yes: return values for true elements of test.
```

```
# no: return values for false elements of test.
```

## Adding columns to a `data.frame`: `dplyr`

Combined with `ifelse(condition, TRUE, FALSE)`, it can give you:

```
df = mutate(df,  
             disp_cat = ifelse(  
               disp <= 200,  
               "Low",  
               ifelse(disp <= 400,  
                     "Medium",  
                     "High")  
             )  
)  
head(df$disp_cat)
```

```
[1] "Low"    "Low"    "Low"    "Medium" "Medium" "Medium"
```

## Adding columns to a `data.frame`: dplyr

Alternatively, `case_when` provides a clean syntax as well:

```
df = mutate(df,  
             disp_cat2 = case_when(  
               disp <= 200 ~ "Low",  
               disp > 200 & disp <= 400 ~ "Medium",  
               disp > 400 ~ "High",  
             ))  
head(df$disp_cat2)
```

```
[1] "Low"    "Low"    "Low"    "Medium" "Medium" "Medium"
```

## Removing columns of a `data.frame`: base R

You can remove a column by assigning to `NULL`:

```
df$newcol = NULL  
head(df)
```

## Removing columns of a `data.frame`: dplyr

The `NULL` method is still very common.

The `select` function can remove a column with minus (-):

```
select(df, -newcol)
```

	car	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb	disp_cat
1	Mazda RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	4	Low
2	Mazda RX4 Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	4	Low
3	Datsun 710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	1	Low
4	Hornet 4 Drive	21.4	6	258	110	3.08	3.215	19.44	1	0	3	1	Medium
5	Hornet Sportabout	18.7	8	360	175	3.15	3.440	17.02	0	0	3	2	Medium
6	Valiant	18.1	6	225	105	2.76	3.460	20.22	1	0	3	1	Medium

  

	disp_cat2
1	Low
2	Low
3	Low
4	Medium
5	Medium
6	Medium

Or, you can simply select the columns you want to keep, ignoring the ones you want to remove.

## Removing columns to a `data.frame`: `dplyr`

The `one_of()` function checks for columns with the names indicated. If there are columns that match they will get removed. This is useful if you can't recall if the columns you want to remove are still present.

Otherwise you could use `c()` to list the columns to remove.

Remove `newcol` and `drat`:

```
select(df, -one_of("newcol", "drat"))  
select(df, -c("newcol", "drat"))
```

		car	mpg	cyl	disp	hp	wt	qsec	vs	am	gear	carb	disp_cat
1		Mazda RX4	21.0	6	160	110	2.620	16.46	0	1	4	4	Low
2		Mazda RX4 Wag	21.0	6	160	110	2.875	17.02	0	1	4	4	Low
3		Datsun 710	22.8	4	108	93	2.320	18.61	1	1	4	1	Low
4		Hornet 4 Drive	21.4	6	258	110	3.215	19.44	1	0	3	1	Medium
		disp_cat2											
1		Low											
2		Low											
3		Low											
4		Medium											



Ordering columns

## Ordering the columns of a `data.frame`: `dplyr`

The `select` function can reorder columns. Put `newcol` first, then select the rest of columns:

```
select(df, newcol, everything())
```

	newcol		car	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	car
1	1.190909		Mazda RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	
2	1.306818		Mazda RX4 Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	
3	1.054545		Datsun 710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	
4	1.461364		Hornet 4 Drive	21.4	6	258	110	3.08	3.215	19.44	1	0	3	
5	1.563636		Hornet Sportabout	18.7	8	360	175	3.15	3.440	17.02	0	0	3	
6	1.572727		Valiant	18.1	6	225	105	2.76	3.460	20.22	1	0	3	
	disp_cat		disp_cat2											
1	Low		Low											
2	Low		Low											
3	Low		Low											
4	Medium		Medium											
5	Medium		Medium											
6	Medium		Medium											

## Ordering the columns of a `data.frame`: `dplyr`

Put `newcol` at the end ("remove, everything, then add back in"):

```
select(df, -newcol, everything(), newcol)
```

	car	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb	disp_cat
1	Mazda RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	4	Low
2	Mazda RX4 Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	4	Low
3	Datsun 710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	1	Low
4	Hornet 4 Drive	21.4	6	258	110	3.08	3.215	19.44	1	0	3	1	Medium
5	Hornet Sportabout	18.7	8	360	175	3.15	3.440	17.02	0	0	3	2	Medium
6	Valiant	18.1	6	225	105	2.76	3.460	20.22	1	0	3	1	Medium

  

	disp_cat2	newcol
1	Low	1.190909
2	Low	1.306818
3	Low	1.054545
4	Medium	1.461364
5	Medium	1.563636
6	Medium	1.572727

Ordering rows

## Ordering the rows of a `data.frame`: `dplyr`

The `arrange` function can reorder rows By default, `arrange` orders in ascending order:

```
arrange(df, mpg)
```

	car	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
1	Cadillac Fleetwood	10.4	8	472.0	205	2.93	5.250	17.98	0	0	3	4
2	Lincoln Continental	10.4	8	460.0	215	3.00	5.424	17.82	0	0	3	4
3	Camaro Z28	13.3	8	350.0	245	3.73	3.840	15.41	0	0	3	4
4	Duster 360	14.3	8	360.0	245	3.21	3.570	15.84	0	0	3	4
5	Chrysler Imperial	14.7	8	440.0	230	3.23	5.345	17.42	0	0	3	4
6	Maserati Bora	15.0	8	301.0	335	3.54	3.570	14.60	0	1	5	8
7	Merc 450SLC	15.2	8	275.8	180	3.07	3.780	18.00	0	0	3	3
8	AMC Javelin	15.2	8	304.0	150	3.15	3.435	17.30	0	0	3	2
9	Dodge Challenger	15.5	8	318.0	150	2.76	3.520	16.87	0	0	3	2
10	Ford Pantera L	15.8	8	351.0	264	4.22	3.170	14.50	0	1	5	4
11	Merc 450SE	16.4	8	275.8	180	3.07	4.070	17.40	0	0	3	3
12	Merc 450SL	17.3	8	275.8	180	3.07	3.730	17.60	0	0	3	3
13	Merc 280C	17.8	6	167.6	123	3.92	3.440	18.90	1	0	4	4
14	Valiant	18.1	6	225.0	105	2.76	3.460	20.22	1	0	3	1
15	Hornet Sportabout	18.7	8	360.0	175	3.15	3.440	17.02	0	0	3	2
16	Merc 280	19.2	6	167.6	123	3.92	3.440	18.30	1	0	4	4
17	Pontiac Firebird	19.2	8	400.0	175	3.08	3.845	17.05	0	0	3	2
18	Ferrari Dino	19.7	6	145.0	175	3.62	2.770	15.50	0	1	5	6
19	Mazda RX4	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
20	Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
21	Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
22	Volvo 142E	21.4	4	121.0	109	4.11	2.780	18.60	1	1	4	2
23	Toyota Corona	21.5	4	120.1	97	3.70	2.465	20.01	1	0	3	1

# Ordering the rows of a `data.frame`: `dplyr`

Use the `desc` to arrange the rows in descending order:

```
arrange(df, desc(mpg))
```

	car	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
1	Toyota Corolla	33.9	4	71.1	65	4.22	1.835	19.90	1	1	4	1
2	Fiat 128	32.4	4	78.7	66	4.08	2.200	19.47	1	1	4	1
3	Honda Civic	30.4	4	75.7	52	4.93	1.615	18.52	1	1	4	2
4	Lotus Europa	30.4	4	95.1	113	3.77	1.513	16.90	1	1	5	2
5	Fiat X1-9	27.3	4	79.0	66	4.08	1.935	18.90	1	1	4	1
6	Porsche 914-2	26.0	4	120.3	91	4.43	2.140	16.70	0	1	5	2
7	Merc 240D	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
8	Datsun 710	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
9	Merc 230	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
10	Toyota Corona	21.5	4	120.1	97	3.70	2.465	20.01	1	0	3	1
11	Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
12	Volvo 142E	21.4	4	121.0	109	4.11	2.780	18.60	1	1	4	2
13	Mazda RX4	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
14	Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
15	Ferrari Dino	19.7	6	145.0	175	3.62	2.770	15.50	0	1	5	6
16	Merc 280	19.2	6	167.6	123	3.92	3.440	18.30	1	0	4	4
17	Pontiac Firebird	19.2	8	400.0	175	3.08	3.845	17.05	0	0	3	2
18	Hornet Sportabout	18.7	8	360.0	175	3.15	3.440	17.02	0	0	3	2
19	Valiant	18.1	6	225.0	105	2.76	3.460	20.22	1	0	3	1
20	Merc 280C	17.8	6	167.6	123	3.92	3.440	18.90	1	0	4	4
21	Merc 450SL	17.3	8	275.8	180	3.07	3.730	17.60	0	0	3	3
22	Merc 450SE	16.4	8	275.8	180	3.07	4.070	17.40	0	0	3	3
23	Ford Pantera L	15.8	8	351.0	264	4.22	3.170	14.50	0	1	5	4
24	Dodge Challenger	15.5	8	318.0	150	2.76	3.520	16.87	0	0	3	46/572

## Ordering the rows of a `data.frame`: `dplyr`

It is a bit more straightforward to mix increasing and decreasing orderings:

```
arrange(df, mpg, desc(hp))
```

	car	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
1	Lincoln Continental	10.4	8	460.0	215	3.00	5.424	17.82	0	0	3	4
2	Cadillac Fleetwood	10.4	8	472.0	205	2.93	5.250	17.98	0	0	3	4
3	Camaro Z28	13.3	8	350.0	245	3.73	3.840	15.41	0	0	3	4
4	Duster 360	14.3	8	360.0	245	3.21	3.570	15.84	0	0	3	4
5	Chrysler Imperial	14.7	8	440.0	230	3.23	5.345	17.42	0	0	3	4
6	Maserati Bora	15.0	8	301.0	335	3.54	3.570	14.60	0	1	5	8
7	Merc 450SLC	15.2	8	275.8	180	3.07	3.780	18.00	0	0	3	3
8	AMC Javelin	15.2	8	304.0	150	3.15	3.435	17.30	0	0	3	2
9	Dodge Challenger	15.5	8	318.0	150	2.76	3.520	16.87	0	0	3	2
10	Ford Pantera L	15.8	8	351.0	264	4.22	3.170	14.50	0	1	5	4
11	Merc 450SE	16.4	8	275.8	180	3.07	4.070	17.40	0	0	3	3
12	Merc 450SL	17.3	8	275.8	180	3.07	3.730	17.60	0	0	3	3
13	Merc 280C	17.8	6	167.6	123	3.92	3.440	18.90	1	0	4	4
14	Valiant	18.1	6	225.0	105	2.76	3.460	20.22	1	0	3	1
15	Hornet Sportabout	18.7	8	360.0	175	3.15	3.440	17.02	0	0	3	2
16	Pontiac Firebird	19.2	8	400.0	175	3.08	3.845	17.05	0	0	3	2
17	Merc 280	19.2	6	167.6	123	3.92	3.440	18.30	1	0	4	4
18	Ferrari Dino	19.7	6	145.0	175	3.62	2.770	15.50	0	1	5	6
19	Mazda RX4	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
20	Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
21	Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
22	Volvo 142E	21.4	4	121.0	109	4.11	2.780	18.60	1	1	4	2
23	Toyota Corona	21.5	4	120.1	97	3.70	2.465	20.01	1	0	3	1
24	Merc 230	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	47/572

# Transmutation

The `transmute` function in `dplyr` combines both the `mutate` and `select` functions. One can create new columns and keep the only the columns wanted:

```
transmute(df, newcol2 = wt/2.2, mpg, hp)
```

	newcol2	mpg	hp
1	1.1909091	21.0	110
2	1.3068182	21.0	110
3	1.0545455	22.8	93
4	1.4613636	21.4	110
5	1.5636364	18.7	175
6	1.5727273	18.1	105
7	1.6227273	14.3	245
8	1.4500000	24.4	62
9	1.4318182	22.8	95
10	1.5636364	19.2	123
11	1.5636364	17.8	123
12	1.8500000	16.4	180
13	1.6954545	17.3	180
14	1.7181818	15.2	180
15	2.3863636	10.4	205
16	2.4654545	10.4	215
17	2.4295455	14.7	230
18	1.0000000	32.4	66
19	0.7340909	30.4	52
20	0.8340909	33.9	65
21	1.1204545	21.5	97
22	1.6000000	15.5	150
23	1.5613636	15.2	150



# Lab Part 4

[Website](#)

Extra Slides

# Renaming Columns of a `data.frame`: base R

We can use the `colnames` function to extract and/or directly reassign column names of `df`:

```
colnames(df) # just prints
```

```
[1] "car"      "mpg"      "cyl"      "disp"     "hp"      "drat"
[7] "wt"      "qsec"     "vs"      "am"      "gear"     "carb"
[13] "newcol"   "disp_cat" "disp_cat2"
```

```
colnames(df)[1:3] = c("MPG", "CYL", "DISP") # reassigns
head(df)
```

		MPG	CYL	DISP	disp	hp	drat	wt	qsec	vs	am	gear	carb
1	Mazda RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	4	
2	Mazda RX4 Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	4	
3	Datsun 710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	1	
4	Hornet 4 Drive	21.4	6	258	110	3.08	3.215	19.44	1	0	3	1	
5	Hornet Sportabout	18.7	8	360	175	3.15	3.440	17.02	0	0	3	2	
6	Valiant	18.1	6	225	105	2.76	3.460	20.22	1	0	3	1	
	newcol	disp_cat	disp_cat2										
1	1.190909	Low	Low										
2	1.306818	Low	Low										
3	1.054545	Low	Low										
4	1.461364	Medium	Medium										
5	1.563636	Medium	Medium										
6	1.572727	Medium	Medium										

```
colnames(df)[1:3] = c("mpg", "cyl", "disp") #reset - just to keep consistent
```

## Renaming Columns of a `data.frame`: base R

We can assign the column names, change the ones we want, and then re-assign the column names:

```
cn = colnames(df)
cn[ cn == "drat" ] = "DRAT"
colnames(df) = cn
head(df)
```

		mpg	cyl	disp	disp	hp	DRAT	wt	qsec	vs	am	gear	carb
1		Mazda RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	4
2		Mazda RX4 Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	4
3		Datsun 710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	1
4		Hornet 4 Drive	21.4	6	258	110	3.08	3.215	19.44	1	0	3	1
5		Hornet Sportabout	18.7	8	360	175	3.15	3.440	17.02	0	0	3	2
6		Valiant	18.1	6	225	105	2.76	3.460	20.22	1	0	3	1
	newcol	disp_cat	disp_cat2										
1	1.190909	Low	Low										
2	1.306818	Low	Low										
3	1.054545	Low	Low										
4	1.461364	Medium	Medium										
5	1.563636	Medium	Medium										
6	1.572727	Medium	Medium										

```
colnames(df)[ colnames(df) == "DRAT" ] = "drat" #reset
```

## Subset rows of a `data.frame` with indices:

Let's select **rows** 1 and 3 from `df` using brackets:

```
df[ c(1, 3), ]
```

		mpg	cyl	disp	disp	hp	drat	wt	qsec	vs	am	gear	carb	newcol
1	Mazda	RX4	21.0	6	160	110	3.90	2.62	16.46	0	1	4	4	1.190909
3	Datsun	710	22.8	4	108	93	3.85	2.32	18.61	1	1	4	1	1.054545
		disp_cat		disp_cat2										
1		Low		Low										
3		Low		Low										

## Subset columns of a `data.frame`:

We can also subset a `data.frame` using the bracket `[, ]` subsetting.

For `data.frames` and matrices (2-dimensional objects), the brackets are `[rows, columns]` subsetting. We can grab the `x` column using the index of the column or the column name (`"carb"`)

```
df[, 11]
```

```
[1] 4 4 4 3 3 3 3 4 4 4 4 3 3 3 3 3 3 4 4 4 3 3 3 3 3 4 5 5 5 5 5 4
```

```
df[, "carb"]
```

```
[1] 4 4 1 1 2 1 4 2 2 4 4 3 3 3 4 4 4 1 2 1 1 2 2 4 2 1 2 2 4 6 8 2
```

## Biggest difference between `tbl` and `data.frame`:

Mostly, `tbl` (tibbles) are the same as `data.frame`s, except they don't print all lines. When subsetting only one column using brackets, a `data.frame` will return a vector, but a `tbl` will return a `tbl`

```
df[, 1]
```

```
[1] "Mazda RX4"           "Mazda RX4 Wag"       "Datsun 710"
[4] "Hornet 4 Drive"      "Hornet Sportabout"   "Valiant"
[7] "Duster 360"         "Merc 240D"           "Merc 230"
[10] "Merc 280"           "Merc 280C"           "Merc 450SE"
[13] "Merc 450SL"         "Merc 450SLC"         "Cadillac Fleetwood"
[16] "Lincoln Continental" "Chrysler Imperial"   "Fiat 128"
[19] "Honda Civic"         "Toyota Corolla"      "Toyota Corona"
[22] "Dodge Challenger"    "AMC Javelin"         "Camaro Z28"
[25] "Pontiac Firebird"    "Fiat X1-9"           "Porsche 914-2"
[28] "Lotus Europa"        "Ford Pantera L"      "Ferrari Dino"
[31] "Maserati Bora"       "Volvo 142E"
```

```
tbl[, 1]
```

```
# A tibble: 32 x 1
  car
  <chr>
1 Mazda RX4
2 Mazda RX4 Wag
3 Datsun 710
4 Hornet 4 Drive
5 Hornet Sportabout
```

## Subset columns of a `data.frame`:

We can select multiple columns using multiple column names:

```
df[, c("mpg", "cyl")]
```

		mpg	cyl
1	Mazda RX4	21.0	
2	Mazda RX4 Wag	21.0	
3	Datsun 710	22.8	
4	Hornet 4 Drive	21.4	
5	Hornet Sportabout	18.7	
6	Valiant	18.1	
7	Duster 360	14.3	
8	Merc 240D	24.4	
9	Merc 230	22.8	
10	Merc 280	19.2	
11	Merc 280C	17.8	
12	Merc 450SE	16.4	
13	Merc 450SL	17.3	
14	Merc 450SLC	15.2	
15	Cadillac Fleetwood	10.4	
16	Lincoln Continental	10.4	
17	Chrysler Imperial	14.7	
18	Fiat 128	32.4	
19	Honda Civic	30.4	
20	Toyota Corolla	33.9	
21	Toyota Corona	21.5	
22	Dodge Challenger	15.5	
23	AMC Javelin	15.2	
24	Camaro Z28	13.3	



## No rownames in tibbles!

If you run into losing a variable contained in your row names, use `rownames_to_column` to add it before turning it into a `tibble` to keep them:

```
head(rownames_to_column(mtcars, var = "car"), 2)
```

	car	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
1	Mazda RX4	21	6	160	110	3.9	2.620	16.46	0	1	4	4
2	Mazda RX4 Wag	21	6	160	110	3.9	2.875	17.02	0	1	4	4

```
head(as_tibble(rownames_to_column(mtcars, var = "car")), 2)
```

```
# A tibble: 2 x 12
```

	car	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
1	Mazda RX4	21	6	160	110	3.9	2.62	16.5	0	1	4	4
2	Mazda RX4 W...	21	6	160	110	3.9	2.88	17.0	0	1	4	4