What is the Tidyverse

The tidyverse is a collection of libraries for R, created by the same people, with a unified vision.

They are *extremely* useful for loading, transforming, exploring, and visualizing datasets.

Dataframe

Before we enter the tidyverse, we should review the dataframe:

A dataframe is a list, where each element in the list is a vector of equal length.

Dataframe

Dataframes have columns and rows.

```
> iris

    Sepal.Length Sepal.Width Petal.Length
1            5.1         3.5          1.4
2            4.9         3.0          1.4
3            4.7         3.2          1.3
4            4.6         3.1          1.5
5            5.0         3.6          1.4
6            5.4         3.9          1.7
7            4.6         3.4          1.4
...
```

Dataframe

Just like a list, subsetting is done with `[]`:

```
> iris[c("Sepal.Width", "Species")]

  Sepal.Width   Species
1         3.5    setosa
2         3.0    setosa
3         3.2    setosa
4         3.1    setosa
5         3.6    setosa
6         3.9    setosa
```

Dataframe

```
> iris[1:5,]
  Sepal.Length Sepal.Width Petal.Length
1          5.1         3.5          1.4
2          4.9         3.0          1.4
3          4.7         3.2          1.3
4          4.6         3.1          1.5
5          5.0         3.6          1.4
```

Dataframe

And columns are access with `$` or `[[]]`, which returns a vector:

```
> iris$Species

  [1] setosa      setosa      setosa
  [7] setosa      setosa      setosa
 [13] setosa      setosa      setosa
 [19] setosa      setosa      setosa
 ...
```

Tibbles

A tibble is a lot like a dataframe:

```
> library(tibble)
> tibble::as_tibble(iris)

# A tibble: 150 x 5
   Sepal.Length Sepal.Width Petal.Length
          <dbl>       <dbl>        <dbl>
 1          5.1         3.5          1.4
 2          4.9         3.0          1.4
 3          4.7         3.2          1.3
 4          4.6         3.1          1.5
 5          5.0         3.6          1.4
# ... with 145 more rows
```

Tibbles

But:

- ► Tibbles do not print all the rows!
- ► Tibbles print out the type of each column.
- ► Tibbles do not coerce types (dataframes will often coerce strings into factors, for example. bConstructing data as a tibble will avoid that headache).
- ► Subsetting a tibble (with []) will always return a tibble. Never a vector.

Tibbles

It's nicer to work with tibbles.

Loading Data

Reading csv's can be done with:

```
read.csv('path/to/myfile.csv')
```

But the Tidyverse gives us:

```
library(readr)
read_csv('path/to/myfile.csv')
```

Which will both tell us what it's doing, and return a tibble.

Loading Data

The Tidyverse also provides a library for reading excel files. We will use that to load some data:

```
> library(read_excel)
> read_excel('./bls_data/oesm10in4/nat3d_M2010_dl.xls')

# A tibble: 19,289 x 24
   NAICS NAICS_TITLE OCC_CODE OCC_TITLE
   <chr> <chr>       <chr>    <chr>
 1 1130... Forestry a... 00-0000  Industry...
 2 1130... Forestry a... 11-0000  Manageme...
 3 1130... Forestry a... 11-1021  General ...
 4 1130... Forestry a... 13-0000  Business...
 5 1130... Forestry a... 13-1023  Purchasi...
```

Grouping

We've loaded a dataset with information on professions in the US, downloaded from the US Bureau of Labor Statistics.

The first column are the NAICS codes. These classify the industries to which the professions belong.

Let's try and get a list of the top 15 most used NAICS codes in the BLS data we loaded via excel.

Dplyr

Dplyr can help us with that. Dplyr is a tidyverse library used for transforming our data. It consists of a bunch of functions, including:

```
filter()
arrange()
select()
rename()
mutate()
group_by()
summarise()
```

Grouping

Let's try to "group" our data by the NAICS code:

```
group_by(dat, NAICS)
```

Notice that we are not putting NAICS in quotes. We are treating it as though it were a variable, even though it is not.

Dplyr does something a little funky, but it's similar to how formulas work in R. You write variable names that don't exist in your current environment, as long as they are column names on your dataframe.

Grouping

```
> group_by(dat, NAICS)

# A tibble: 19,289 x 24
# Groups:    NAICS [88]
   NAICS NAICS_TITLE OCC_CODE OCC_TITLE
   <chr> <chr>       <chr>    <chr>
 1 1130... Forestry a... 00-0000  Industry...
 2 1130... Forestry a... 11-0000  Manageme...
 ...
```

Notice that grouping doesn't really do anything that we can see.
The only visible difference is an extra line that informs us about
the groups.

Grouping

Grouping is a way to split our dataframe into many "subsets". Each subset is a small dataframe (or tibble)!

What do we want to do with each of those small dataframes?

Very often, it can be helpful to look at one of the small dataframes to see what we can do to it.

Tidyr provides a helpful function that can be used for this: nest()

nest()

```
> nest(group_by(dat, NAICS))

# A tibble: 88 x 2
   NAICS data
   <chr> <list>
 1 113000 <tibble [56 × 23]>
 2 115000 <tibble [123 × 23]>
 3 211000 <tibble [169 × 23]>
 4 212000 <tibble [176 × 23]>
 ...
```

As the name suggests, we've created a big tibble which "nested"
the small tibbles inside of it!

nest()

Let's take a look at the first tibble.

We use the $ to access the column, which will return a list of all the small tibbles.

We then use [[1]] to extract the first element of the list.

```
nest(group_by(dat, NAICS))$data[[1]]

# A tibble: 56 x 23
   NAICS_TITLE OCC_CODE OCC_TITLE GROUP
   <chr>       <chr>    <chr>     <chr>
 1 Forestry a... 00-0000  Industry... total
 2 Forestry a... 11-0000  Manageme... major
 ...
```

What would [1] have returned?

Chaining

Notice that our notation is a bit nasty.

All the functions in Dplyr and Tidyr are "pure" functions, which is to say that they do not change anything in the global environment.

As such, they *do not* mutate the original variable/dataframe/tibble.

So we need to capture their return value, and do something with it. Sometimes, this means storing it in a variable. But often, we just want to send it on to another function.

Chaining

Dplyr comes with bundled with the magrittr package, which gives us the following handy infix operator:

%>%

An infix operator is just a fancy term for a function that is used the same way one uses + or - in arithmetic operations:

Chaining

The pipe operator allows us to pass the return value of one function into the first argument of the next function:

```
dat %>%
    group_by(NAICS) %>%
    nest() %>%
    .$data %>%
    .[[1]]
```

The . references the value that has been passed (in this case, a tibble and then a list).

Summarizing

But ok, what we wanted to do with each small dataframe was to measure the size of it.

It makes sense to output this information into another dataframe: one column can be the NAICS code, the other can be the size of the subset that includes that NAICS code.

Summarizing

summarize() is a function from dplyr that can be used either on a dataframe (tibble) or a grouped dataframe.

If used on a single dataframe, it collapses it into a single row.

A "summary", if you will.

If used on a grouped dataframe, it collapses each group into a single row.

Summarizing

summarize() can be used with a host of other dply functions:

```
mean()
median()
min()
max()
n()
...
```

Summarizing

n() is simple: it returns the number of rows of a dataframe (group)

```
dat %>%
    group_by(NAICS) %>%
    nest() %>%
    .$data %>%
    .[[1]] %>%
    summarize(size = n())

# A tibble: 1 x 1
   size
  <int>
1    56
```

Note that summarize() requires all arguments to be named: the name becomes the column of the returned dataframe row.

Summarizing

As mentioned, summarize() also works on grouped dataframes:

```
dat %>%
    group_by(NAICS) %>%
    summarize(size = n())

# A tibble: 88 x 2
   NAICS  size
   <chr>  <int>
 1 113000    56
 2 115000   123
 3 211000   169
 ...
```

Transforming

We're close. Now we just need to sort the dataframe by size, and get the top 15:

```r
dat %>%
    group_by(NAICS) %>%
    summarize(size = n()) %>%
    arrange(desc(size)) %>%
    head(15) %>%
    pull(NAICS)

 [1] "999000" "561000" "611000" "541000" "551000"
 ...
```

Voila!

Tidy Data

In addition to nest() and unnest(), Tidyr contains two other important functions:

```
spread()
gather()
```

Tidyr

gather() is used to turn data from "wide" to "long" (tidy) format.

spread() goes from "long" to "wide."

In tidy format, each column is a variable and each variable only belongs to one column.

This is a very important concept!