

# Lecture 7: Strings, Factors, and Dates



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BSDS 100 - Intro to Data Science with R

# Questions: Tibbles versus Tribbles



- We make data structures using **constructors**, which are special functions that return a data structure.

Constructor	Output
<code>c( )</code>	vector
<code>matrix( )</code>	matrix
<code>array( )</code>	array
<code>list( )</code>	list
<code>data.frame( )</code>	(generic) data frame
<code>tibble( )</code>	tibble
<code>tribble( )</code>	tibble

- Note: Both `tibble` and `tribble` construct a tibble, they are two different ways to make the same thing!



- Tibbles are a friendly "species" of data frame, like a golden retriever is a species of dog
- In general, use whichever you prefer (unless specifically stated in the question)
- Exception! If your employer or interviewer requires you to only use "base" R you will have to use generic data frames.



- Factors
- Strings
- Dates

# Part I: Factors



- Factors are less human-intuitive than strings, but useful for computing
- A factor is a vector of elements from a **discrete** set, and is used to store **categorical** (**ordinal** or **nominal**) data
- **Discrete**: the values do not overlap (e.g., you can be a freshman or a sophomore but not a freshmore)
- **Categorical**: Values like real numbers are continuous, values that fall into bins are categorical (though you can make a continuous value categorical by binning, e.g., "even" vs "odd" numbers)
  - **Ordinal** categories have intrinsic order (e.g., small dogs, medium dogs, big dogs) though there may not be equal distance between
  - **Nominal** categories have no intrinsic order (e.g., apple, microsoft, linux)



- Factors are built on top of **integer vectors** using two attributes:
  - 1 The `class()` 'factor': makes them behave differently from regular integer vectors
  - 2 The `levels()`: define the discrete set of permissible values
  - 3 We also have a useful argument `labels()` that we can use to give more human readable names to factors



- Although we (intelligent humans) have an inherent ability to understand the ordering of the ordinal categories below,  $\mathbb{R}$  does not, and unless told, will treat them as nominal categorical variables
- Nominal (unordered) factors are sorted automatically by  $\mathbb{R}$ , e.g., alphabetically, numerically, etc.
- **Note:** The terms *ordered* and *sorted* are **not** synonymous here





- $\mathbb{R}$  can "sort" nominal factors (e.g., alphabetically), so what does it mean that they are un-ordered?
- Operations like  $<$  will fail on nominal factors
- These will work on ordinal (ordered) factors
- If we omit the "levels" field  $\mathbb{R}$  will choose it's own ordering



Use the following code to create the variable `myCyl` using the dataset `mtcars`

```
myCyl <- mtcars$cyl
```

- 1 Create an ordered factor from `myCyl`, mapping the levels to 'Small', 'Medium' and 'Large'
- 2 How many observations have cylinders  $\leq$  'Medium'?



Be careful when adding items to factors, as items that don't belong to the original set of levels may cause errors

# Part II: Strings



- We have already encountered strings, which are character objects we build using `""`
- You can make strings with single quotes `'this is a string'` or double quotes `"this is a string"`
- If you forget to close your quotes, `R` thinks you are still writing a string and will give you the `+` continuation character
- You can put almost anything in a string, for special characters you will need to use the backslash
- When importing data, you will frequently see `"\n"` for new line and `"\t"` for tab.



- There are more manipulations you can do to strings with **regular expressions**, but you can go far with a few basic functions
- The library `stringr` provides an intuitive package for working with strings
- The function `str_length()` will tell you how long a string is
- The function `str_c()` will combine multiple strings into one string
- The function `str_sub()` takes a subset of a string, based on character index
- The function `str_to_lower()` and `str_to_upper` change capitalization



- The function `str_detect()` allows you to find strings that contain a particular substring
- We can use this to add columns to a data frame



- Today we will finish strings
- If we have time, we will cover dates (if not, dates on Thursday)
- Introduction of Case Study 1, and some time to form groups and work





- Another very common act is to extract numbers from a string
- The library `readr` provides the function `parse_number()` for this purpose



- The function `str_split` can be used to split strings on some character
- Can be used to split a sentence into words



- We've seen how `str_detect` can find if a pattern is present, what if we need to know where a pattern is in a word?
- The library `stringi` provides us with two functions for this purpose
- One, `stri_locate` is "lazy" or "eager," it will return the first match it finds
- The second, `stri_locate_all` is "greedy," it will return all matches
- These are useful in conjunction with `str_sub`



- If you are processing text input from users, you may find people use differing amounts of white space
- The function `str_trim` will remove whitespace from the beginning and end of a string
- The function `str_squish` will remove extra white spaces from within a string.



- You can count how many times something occurs in a string with `str_count`



- How much text manipulation you will need to do will depend on the quality of the data you start with
- If you start with well organized data, you may avoid text manipulation entirely!
- Consistency and planning ahead will save you time

## Part III: Dates



- Dates are exceedingly common in datasets (birthdays, date of data collection)
- Unfortunately, inconsistent date formatting (e.g., May 18, 1951, 5-18-51, 1951/05/18) makes dealing with dates a pain
- Fortunately, there is a handy library, `lubridate` that can save us lots of time and trouble





- See cheatsheet (!) on github for many lubridate functions
- Lubridate provides several functions for entering a date and returning a generic date object, pick the one that follows your day, month, year order
- There is also an option to get today by typing `today()`



- You can subtract two dates to find the number of days between them `today() - mdy("7-25-2015")`
- Getting other units is a little more awkward but still easier than without lubridate

```
bday <- mdy("7-25-15")  
interval(bday, today())/years(1)  
interval(bday, today())/months(1)
```

- There are many more functions of lubridate that you can find if they are useful to you including timezones, look into these if you end up at an international company!



- There are similar functions should you need to measure "time" (e.g., hours or minutes of battery life)
- Most commonly, `ymd_hms()` can be used if you have a date with a time and `hms()` can be used if you have a time.
- Similar to `today()`, `now()` gets the current time.
- Should you work with times for a final project or a job, look out for issues caused by time zones and daylight savings time!