Dates

David Gerard

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Learning Objectives

- Manipulating dates and times.
- Chapter 16 of RDS.
- Dates and Times Cheat Sheet.
- Lubridate Overview.

Parsing Dates

- The lubridate package has a bunch of convenience functions for working with dates. It is *not* a part of the tidyverse, so you need to load it separately.

```
library(tidyverse)
library(lubridate)
```

- There are three main classes for date/time data:
  - `Date` for just the date.
  - `POSIXct` for both the date and the time. "POSIXct" stands for "Portable Operating System Interface Calendar Time" (don't ask me where the "X" comes from). It is a part of a standardized system of representing time across many computing computing platforms.
  - `hms` from the hms R package for just the time. "hms" stands for "hours, minutes, and seconds."
- `today()` will give you the current date in the `Date` class.

```
today()
```

```
## [1] "2019-04-02"
```

```
class(today())
```

```
## [1] "Date"
```

- `now()` will give you the current date-time in the `POSIXct` class.

```
now()
```

```
## [1] "2019-04-02 09:10:43 EDT"
```

```
class(now())
```

```
## [1] "POSIXct" "POSIXt"
```

- There is no built-in R function to find the current time without the date. But you can use `hms::as.hms(now())` to get the current time.

```
hms::as.hms(now())
```

```
## 09:10:43.7751
```

```
class(hms::as.hms(now()))
```

```
## [1] "hms"      "difftime"
```

Parsing Dates

- You can use `parse_date()`, `parse_datetime()`, and `parse_time()` to parse a date/date-time/time from a string.

```
x <- parse_date("10/11/2020", format = "%m/%d/%Y")
x
```

```
## [1] "2020-10-11"
```

```
class(x)
```

```
## [1] "Date"
```

```
y <- parse_datetime("10/11/2020 11:59:20", format = "%m/%d/%Y %H:%M:%S")
y
```

```
## [1] "2020-10-11 11:59:20 UTC"
```

```
class(y)
```

```
## [1] "POSIXct" "POSIXt"
```

```
z <- parse_time("11:59:20", "%H:%M:%S")
z
```

```
## 11:59:20
```

```
class(z)
```

```
## [1] "hms"      "difftime"
```

- lubridate comes with a bunch of helper functions to parse dates more automatically. The helper function name itself specifies the order of the year, month, day, hours, minutes, and seconds.
- To parse dates, look at the help page of

```
help(ymd)
```

```
## Only the order of year, month, and day matters
ymd(c("2011/01-10", "2011-01/10", "20110110"))
```

```
## [1] "2011-01-10" "2011-01-10" "2011-01-10"
```

```
mdy(c("01/10/2011", "01 adsl; 10 df 2011", "January 10, 2011"))
```

```
## [1] "2011-01-10" "2011-01-10" "2011-01-10"
```

- To parse times, look at the help page of

```
help(ms)
```

```
## only the order of hours, minutes, and seconds matter
hms(c("10:40:10", "10 40 10"))
```

```
## [1] "10H 40M 10S" "10H 40M 10S"
```

- Note that `ms()`, `hm()`, and `hms()` won't recognize "-" as a separator because it treats it as negative time. So use `parse_time()` here.

```
ms("10-10")
```

```
## [1] "10M -10S"
```

- To parse date-times, look at the help page of

```
help(ymd_hms)
```

- **Exercise**: Parse the following date-times.

```
"05/26/2004 UTC 11:11:11.444"
"26 2004 05 UTC 11/11/11.444"
```

- **Exercise** (RDS 16.2.4.3): Use the appropriate lubridate function to parse each of the following dates:

```
d1 <- "January 1, 2010"
d2 <- "2015-Mar-07"
d3 <- "06-Jun-2017"
d4 <- c("August 19 (2015)", "July 1 (2015)")
d5 <- "12/30/14" # Dec 30, 2014
```

Dates from individual components

- If you have a vector of years, months, days, hours, minutes, or seconds, you can use `make_date()` or `make_datetime()` to create dates and date-times.

```
make_date(year = 1981, month = 6, day = 25)
```

```
## [1] "1981-06-25"
```

```
make_datetime(year = 1972, month = 2, day = 22, hour = 10, min = 9, sec = 01)
```

```
## [1] "1972-02-22 10:09:01 UTC"
```

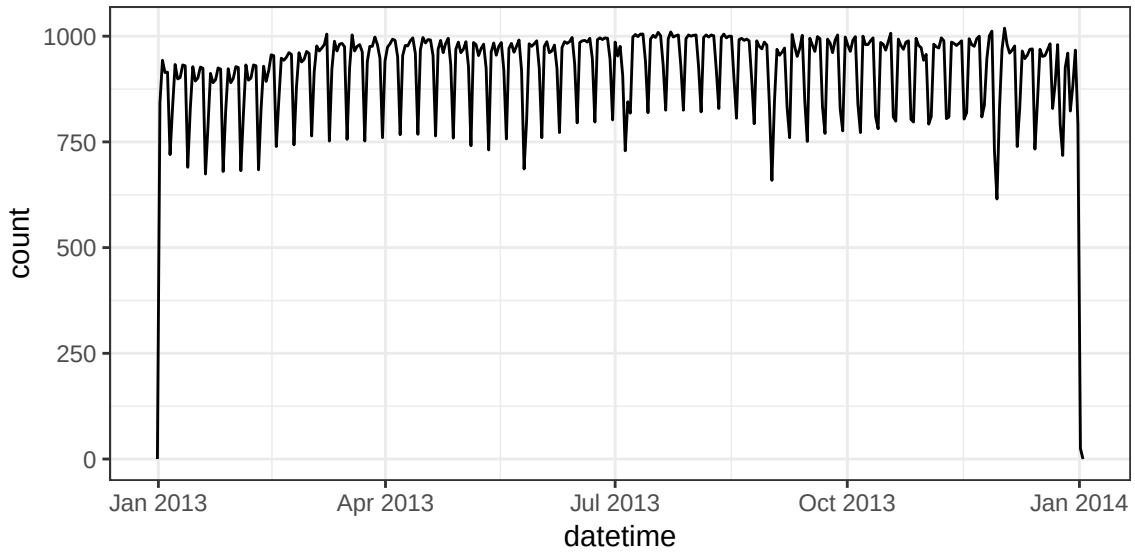
- nycflights13 example:

```
library(nycflights13)
data("flights")
flights %>%
  mutate(datetime = make_datetime(year   = year,
                                  month  = month,
                                  day    = day,
                                  hour   = hour,
                                  min = minute)) ->
  flights
  select(flights, datetime)
```

```
## # A tibble: 336,776 x 1
##    datetime
##    <dttm>
##  1 2013-01-01 05:15:00
##  2 2013-01-01 05:29:00
##  3 2013-01-01 05:40:00
##  4 2013-01-01 05:45:00
##  5 2013-01-01 06:00:00
##  6 2013-01-01 05:58:00
##  7 2013-01-01 06:00:00
##  8 2013-01-01 06:00:00
##  9 2013-01-01 06:00:00
## 10 2013-01-01 06:00:00
## # ... with 336,766 more rows
```

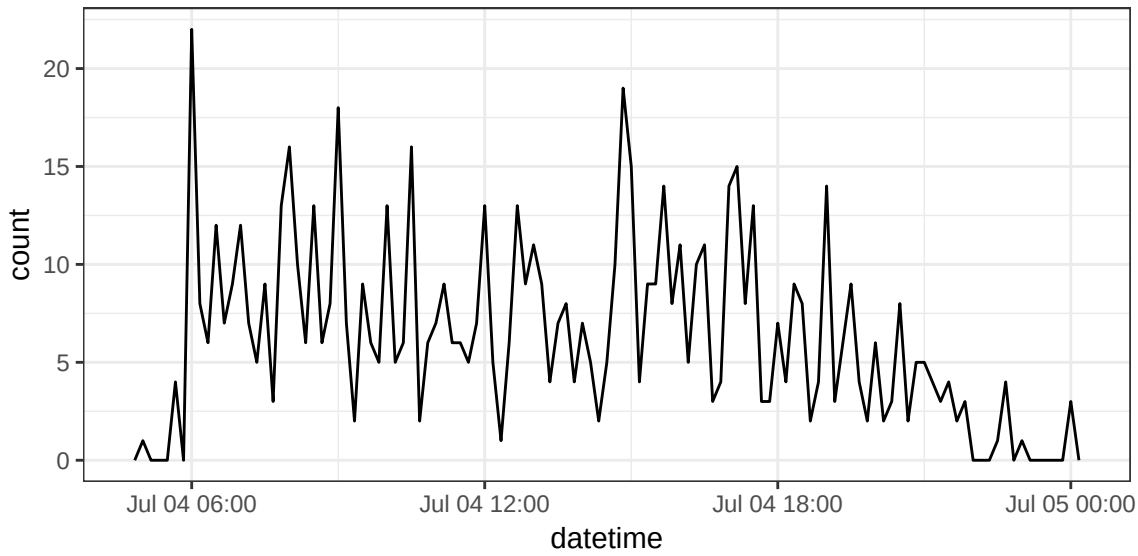
- Having it in the date-time format makes it easier to plot.

```
ggplot(flights, aes(x = datetime)) +
  geom_freqpoly(bins = 365)
```



- It makes it easier to filter by date

```
flights %>%
  filter(as_date(datetime) == ymd(20130704)) %>%
  ggplot(aes(x = datetime)) +
  geom_freqpoly(binwidth = 600)
```



- I used `as_date()` in the previous example. This function will try to coerce an object to a date. Sometimes successfully! It is particularly useful for extracting the date component of a `POSIXct` object.
- `as_datetime()` tries to coerce an object to a `POSIXct` object.

Extracting Components

- `year()` extracts the year.

- `month()` extracts the month.
- `week()` extracts the week.
- `mday()` extracts the day of the month (1, 2, 3, ...).
- `wday()` extracts the day of the week (Saturday, Sunday, Monday ...).
- `yday()` extracts the day of the year (1, 2, 3, ...)
- `hour()` extracts the hour.
- `minute()` extract the minute.
- `second()` extracts the second.

```
ddat <- mdy_hms("01/02/1970 03:51:44")
ddat
```

```
## [1] "1970-01-02 03:51:44 UTC"
```

```
year(ddat)
```

```
## [1] 1970
```

```
month(ddat, label = TRUE)
```

```
## [1] Jan
## 12 Levels: Jan < Feb < Mar < Apr < May < Jun < Jul < Aug < Sep < ... < Dec
```

```
week(ddat)
```

```
## [1] 1
```

```
mday(ddat)
```

```
## [1] 2
```

```
wday(ddat, label = TRUE)
```

```
## [1] Fri
## Levels: Sun < Mon < Tue < Wed < Thu < Fri < Sat
```

```
yday(ddat)
```

```
## [1] 2
```

```
hour(ddat)
```

```
## [1] 3
```

```
minute(ddat)
```

```
## [1] 51
```

```
second(ddat)
```

```
## [1] 44
```

- **Exercise**: Load the `wmata_ridership` data frame into R from https://dcgerard.github.io/stat_412_612/data/wmata_ridership.csv. For each month, calculate the proportion of rides made on a given day of the month. Then make box plots of the proportions of ridership vs day of the weak. But exclude any days from 2004.
- You can overwrite components.

```
ddat <- mdy_hms("01/02/1970 03:51:44")
ddat
```

```
## [1] "1970-01-02 03:51:44 UTC"
```

```
year(ddat) <- 1988
ddat
```

```
## [1] "1988-01-02 03:51:44 UTC"
```

- You can round components

```
ddat <- mdy_hms("01/02/1970 03:51:44")
ddat
```

```
## [1] "1970-01-02 03:51:44 UTC"
```

```
round_date(ddat, unit = "year")
```

```
## [1] "1970-01-01 UTC"
```

Time Spans

- To count the number of seconds between two dates, use a `duration`. You can read about durations using

```
help("Duration-class")
```

- We can find out how old Patrick Stewart is using durations

```
d1 <- ymd(19400713)
d2 <- today()
agesec <- as.duration(d2 - d1)
agesec
```

```
## [1] "2484172800s (~78.72 years)"
```

- You can create durations from years with `dyears()`, from days with `ddays()`, etc...

```
dyears(1)
```

```
## [1] "31536000s (~52.14 weeks)"
```

```
ddays(1)
```

```
## [1] "86400s (~1 days)"
```

```
dhours(1)
```

```
## [1] "3600s (~1 hours)"
```

```
dminutes(1)
```

```
## [1] "60s (~1 minutes)"
```

```
dseconds(1)
```

```
## [1] "1s"
```

- You can add durations to date-times, but you always add *seconds*, so if there is daylight savings you get weird results (add a day but the time is not the same as the time the previous day).

```
one_pm <- ymd_hms("2016-03-12 13:00:00", tz = "America/New_York")
one_pm
```

```
## [1] "2016-03-12 13:00:00 EST"
```

```
one_pm + ddays(1)
```

```
## [1] "2016-03-13 14:00:00 EDT"
```

- Adding a `period` takes into account daylight savings.

```
one_pm
```

```
## [1] "2016-03-12 13:00:00 EST"
```

```
one_pm + days(1)
```

```
## [1] "2016-03-13 13:00:00 EDT"
```

- You can read more about periods with

```
help("Period-class")
```

- Intervals are like durations, but they also have an associated start time. You can read more about intervals with

```
help("Interval-class")
```

- **Exercise**: How long of a time-span is covered in the WMATA ridership dataset?

Time Zones

- Time zones are specified using the `tz` or `tzone` arguments (for example, in the call to `ymd_hms()` above).
- Time zones are specified by "content/city." For example, `"America/New_York"` and `"Europe_Paris"`
- You can see a complete list of time zones with `OlsonNames()`.
- The default time zone is `UTC` (which has no daylight savings).
- You usually don't have to worry about timezones unless you loaded them in incorrectly. For example, R might think it's `UTC` even though it should be `America/New_York` and then forget daylight savings.
- If a date-time is labelled with the incorrect time zone, use `force_tz()`.

```
d1 <- ymd_hms("20140101 10:01:11")
d1
```

```
## [1] "2014-01-01 10:01:11 UTC"
```

```
force_tz(d1, tzone = "America/New_York")
```

```
## [1] "2014-01-01 10:01:11 EST"
```

- If the timezone is correct, but you want to change it, use `with_tz()`.

```
with_tz(d1, tzone = "America/New_York")
```

```
## [1] "2014-01-01 05:01:11 EST"
```