Dates and Times

Packages for this section

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

lubridate is the package that handles dates and times, but is
now part of the tidyverse, so no need to load separately.

Dates

▶ Dates represented on computers as "days since an origin", typically Jan 1, 1970, with a negative date being before the origin:

```
mydates <- c("1970-01-01", "2007-09-04", "1931-08-05")
(somedates <- tibble(text = mydates) %>%
  mutate(
    d = as.Date(text),
    numbers = as.numeric(d)
  ))
```

```
# A tibble: 3 x 3
  text       d          numbers
  <chr>      <date>       <dbl>
1 1970-01-01 1970-01-01       0
2 2007-09-04 2007-09-04   13760
3 1931-08-05 1931-08-05  -14029
```

Doing arithmetic with dates

► Dates are "actually" numbers, so can add and subtract (difference is 2007 date in `d` minus others):

```
somedates %>% mutate(plus30 = d + 30, diffs = d[2] - d)
```

```
# A tibble: 3 x 5
  text       d          numbers plus30     diffs
  <chr>      <date>        <dbl> <date>     <drtn>
1 1970-01-01 1970-01-01        0 1970-01-31 13760 days
2 2007-09-04 2007-09-04    13760 2007-10-04     0 days
3 1931-08-05 1931-08-05   -14029 1931-09-04 27789 days
```

Reading in dates from a file

▶ read_csv and the others can guess that you have dates, if you format them as year-month-day, like column 1 of this .csv:

```
date,status,dunno
2011-08-03,hello,August 3 2011
2011-11-15,still here,November 15 2011
2012-02-01,goodbye,February 1 2012
```

▶ Then read them in:

```
my_url <- "http://ritsokiguess.site/datafiles/mydates.csv"
ddd <- read_csv(my_url)
```

▶ read_csv guessed that the 1st column is dates, but not 3rd.

The data as read in

```
ddd
```

```
# A tibble: 3 x 3
  date       status     dunno
  <date>     <chr>      <chr>
1 2011-08-03 hello      August 3 2011
2 2011-11-15 still here November 15 2011
3 2012-02-01 goodbye    February 1 2012
```

Dates in other formats

- ▶ Preceding shows that dates should be stored as text in format yyyy-mm-dd (ISO standard).
- ▶ To deal with dates in other formats, use package lubridate and convert. For example, dates in US format with month first:

```
tibble(usdates = c("05/27/2012", "01/03/2016", "12/31/2015"
  mutate(iso = mdy(usdates))
```

```
# A tibble: 3 x 2
  usdates    iso
  <chr>      <date>
1 05/27/2012 2012-05-27
2 01/03/2016 2016-01-03
3 12/31/2015 2015-12-31
```

Trying to read these as UK dates

```r
tibble(usdates = c("05/27/2012", "01/03/2016", "12/31/2015"
  mutate(uk = dmy(usdates))
```

```
# A tibble: 3 x 2
  usdates    uk
  <chr>      <date>
1 05/27/2012 NA
2 01/03/2016 2016-03-01
3 12/31/2015 NA
```

▶ For UK-format dates with month second, one of these dates is legit, but the other two make no sense.

Our data frame's last column:

▶ Back to this:

```
ddd
```

```
# A tibble: 3 x 3
  date       status     dunno
  <date>     <chr>      <chr>
1 2011-08-03 hello      August 3 2011
2 2011-11-15 still here November 15 2011
3 2012-02-01 goodbye    February 1 2012
```

▶ Month, day, year in that order.

so interpret as such

```
(ddd %>% mutate(date2 = mdy(dunno)) -> d4)

# A tibble: 3 x 4
  date       status     dunno            date2
  <date>     <chr>      <chr>            <date>
1 2011-08-03 hello      August 3 2011    2011-08-03
2 2011-11-15 still here November 15 2011 2011-11-15
3 2012-02-01 goodbye    February 1 2012  2012-02-01
```

Are they really the same?

▶ Column date2 was correctly converted from column dunno:

```
d4 %>% mutate(equal = identical(date, date2))
```

```
# A tibble: 3 x 5
  date       status     dunno            date2      equal
  <date>     <chr>      <chr>            <date>     <lgl>
1 2011-08-03 hello      August 3 2011    2011-08-03 TRUE
2 2011-11-15 still here November 15 2011 2011-11-15 TRUE
3 2012-02-01 goodbye    February 1 2012  2012-02-01 TRUE
```

▶ The two columns of dates are all the same.

Making dates from pieces

Starting from this file:

```
year month day
1970 1 1
2007 9 4
1940 4 15
```

```
my_url <- "http://ritsokiguess.site/datafiles/pieces.txt"
dates0 <- read_delim(my_url, " ")
```

Making some dates

```
dates0
```

```
# A tibble: 3 x 3
   year month   day
  <dbl> <dbl> <dbl>
1  1970     1     1
2  2007     9     4
3  1940     4    15
```

```
dates0 %>%
  unite(dates, day, month, year) %>%
  mutate(d = dmy(dates)) -> newdates
```

The results

```
newdates
```

```
# A tibble: 3 x 2
  dates     d
  <chr>     <date>
1 1_1_1970  1970-01-01
2 4_9_2007  2007-09-04
3 15_4_1940 1940-04-15
```

▶ unite glues things together with an underscore between them
  (if you don't specify anything else). Syntax: first thing is new
  column to be created, other columns are what to make it out
  of.

▶ unite makes the original variable columns year, month, day
  disappear.

▶ The column dates is text, while d is a real date.

Extracting information from dates

```
newdates %>%
  mutate(
    mon = month(d),
    day = day(d),
    weekday = wday(d, label = TRUE)
  )

# A tibble: 3 x 5
  dates     d            mon   day weekday
  <chr>     <date>     <dbl> <int> <ord>
1 1_1_1970  1970-01-01     1     1 Thu
2 4_9_2007  2007-09-04     9     4 Tue
3 15_4_1940 1940-04-15     4    15 Mon
```

Dates and times

▶ Standard format for times is to put the time after the date, hours, minutes, seconds:

```
(dd <- tibble(text = c(
  "1970-01-01 07:50:01", "2007-09-04 15:30:00",
  "1940-04-15 06:45:10", "2016-02-10 12:26:40"
)))
```

```
# A tibble: 4 x 1
  text
  <chr>
1 1970-01-01 07:50:01
2 2007-09-04 15:30:00
3 1940-04-15 06:45:10
4 2016-02-10 12:26:40
```

Converting text to date-times:

▶ Then get from this text using `ymd_hms`:

```
dd %>% mutate(dt = ymd_hms(text)) %>% pull(dt)
```

```
[1] "1970-01-01 07:50:01 UTC" "2007-09-04 15:30:00 UTC"
[3] "1940-04-15 06:45:10 UTC" "2016-02-10 12:26:40 UTC"
```

Timezones

▶ Default timezone is "Universal Coordinated Time". Change it via tz= and the name of a timezone:

```
OlsonNames()
```

```
 [1] "Africa/Abidjan"          "Africa/Accra"
 [3] "Africa/Addis_Ababa"      "Africa/Algiers"
 [5] "Africa/Asmara"           "Africa/Bamako"
 [7] "Africa/Bangui"           "Africa/Banjul"
 [9] "Africa/Bissau"           "Africa/Blantyre"
[11] "Africa/Brazzaville"      "Africa/Bujumbura"
[13] "Africa/Cairo"            "Africa/Casablanca"
[15] "Africa/Ceuta"            "Africa/Conakry"
[17] "Africa/Dakar"            "Africa/Dar_es_Salaa
[19] "Africa/Djibouti"         "Africa/Douala"
[21] "Africa/El_Aaiun"         "Africa/Freetown"
[23] "Africa/Gaborone"         "Africa/Harare"
[25] "Africa/Johannesburg"     "Africa/Juba"
[27] "Africa/Kampala"          "Africa/Khartoum"
```

Extracting time parts

▶ As you would expect:

```
dd %>%
  select(-text) %>%
  mutate(
    h = hour(dt),
    sec = second(dt),
    min = minute(dt),
    zone = tz(dt)
  )
```

```
# A tibble: 4 x 5
  dt                      h   sec   min zone
  <dttm>              <int> <dbl> <int> <chr>
1 1970-01-01 07:50:01     7     1    50 America/Toronto
2 2007-09-04 15:30:00    15     0    30 America/Toronto
3 1940-04-15 06:45:10     6    10    45 America/Toronto
4 2016-02-10 12:26:40    12    40    26 America/Toronto
```

Same times, but different time zone:

```r
dd %>%
  select(dt) %>%
  mutate(oz = with_tz(dt, "Australia/Sydney"))
```

```
# A tibble: 4 x 2
  dt                  oz
  <dttm>              <dttm>
1 1970-01-01 07:50:01 1970-01-01 22:50:01
2 2007-09-04 15:30:00 2007-09-05 05:30:00
3 1940-04-15 06:45:10 1940-04-15 21:45:10
4 2016-02-10 12:26:40 2016-02-11 04:26:40
```

In more detail:

```r
dd %>%
  mutate(oz = with_tz(dt, "Australia/Sydney")) %>%
  pull(oz)
```

[1] "1970-01-01 22:50:01 AEST" "2007-09-05 05:30:00 AEST"

How long between date-times?

▶ We may need to calculate the time between two events. For example, these are the dates and times that some patients were admitted to and discharged from a hospital:

```
admit,discharge
1981-12-10 22:00:00,1982-01-03 14:00:00
2014-03-07 14:00:00,2014-03-08 09:30:00
2016-08-31 21:00:00,2016-09-02 17:00:00
```

Do they get read in as date-times?

▶ These ought to get read in and converted to date-times:

```
my_url <- "http://ritsokiguess.site/datafiles/hospital.csv"
stays <- read_csv(my_url)
stays
```

```
# A tibble: 3 x 2
  admit               discharge
  <dttm>              <dttm>
1 1981-12-10 22:00:00 1982-01-03 14:00:00
2 2014-03-07 14:00:00 2014-03-08 09:30:00
3 2016-08-31 21:00:00 2016-09-02 17:00:00
```

▶ and so it proves.

Subtracting the date-times

▶ In the obvious way, this gets us an answer:

```
stays %>% mutate(stay = discharge - admit)
```

```
# A tibble: 3 x 3
  admit               discharge           stay
  <dttm>              <dttm>              <drtn>
1 1981-12-10 22:00:00 1982-01-03 14:00:00 568.0 hours
2 2014-03-07 14:00:00 2014-03-08 09:30:00  19.5 hours
3 2016-08-31 21:00:00 2016-09-02 17:00:00  44.0 hours
```

▶ Number of hours; hard to interpret.

Days

▶ Fractional number of days would be better:

```
stays %>%
  mutate(
    stay_days = as.period(admit %--% discharge) / days(1))
```

```
# A tibble: 3 x 3
  admit               discharge           stay_days
  <dttm>              <dttm>                  <dbl>
1 1981-12-10 22:00:00 1982-01-03 14:00:00     23.7
2 2014-03-07 14:00:00 2014-03-08 09:30:00    0.812
3 2016-08-31 21:00:00 2016-09-02 17:00:00     1.83
```

Completed days

▶ Pull out with day() etc, as for a date-time:

```
stays %>%
  mutate(
    stay = as.period(admit %--% discharge),
    stay_days = day(stay),
    stay_hours = hour(stay)
    ) %>%
  select(starts_with("stay"))
```

```
# A tibble: 3 x 3
  stay          stay_days stay_hours
  <Period>          <dbl>      <dbl>
1 23d 16H 0M 0S        23         16
2 19H 30M 0S            0         19
3 1d 20H 0M 0S          1         20
```

Comments

▶ Date-times are stored internally as seconds-since-something, so that subtracting two of them will give, internally, a number of seconds.

▶ Just subtracting the date-times is displayed as a time (in units that R chooses for us).

▶ Convert to fractional times via a "period", then divide by `days(1)`, `months(1)` etc.

▶ These ideas useful for calculating time from a start point until an event happens (in this case, a patient being discharged from hospital).