

R - Practice 04

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Data Wrangle: dates / times (lubridate & hms)

Create dates / times

```
# Basic objects
d <- as_date(18992) # date
t <- as_hms(120) # time
dt <- as_datetime(1640952000) # datetime
```

```
# Parsing date/time: string or number conversion...
ymd_hms("2021-12-31 12:00:00") # %>% class()
```

```
## [1] "2021-12-31 12:00:00 UTC"
```

```
ymd_hm("2021-12-31 12:00")
```

```
## [1] "2021-12-31 12:00:00 UTC"
```

```
ymd_h("2021-12-31 12")
```

```
## [1] "2021-12-31 12:00:00 UTC"
```

```
ydm_hms("2021-31-12 11:30:00")
```

```
## [1] "2021-12-31 11:30:00 UTC"
```

```
ydm_hm("2021-31-12 11:30")
```

```
## [1] "2021-12-31 11:30:00 UTC"
```

```
ydm_h("2021-31-12 11")
```

```
## [1] "2021-12-31 11:00:00 UTC"
```

```
mdy_hms("12/31/2021 3:05:05")
```

```
## [1] "2021-12-31 03:05:05 UTC"
dmy_hms("31 Dec 2021 22/15:00")

## [1] "2021-12-31 22:15:00 UTC"
ymd("20211231")

## [1] "2021-12-31"
mdy("December 13st 2021")

## [1] "2021-12-13"
dmy("31st of December 21")

## [1] "2021-12-31"
yq("2021: Q4")

## [1] "2021-10-01"
hms::hms(seconds = 5, minutes = 1, hours = 0)

## 00:01:05
lubridate::hms("00:01:05")

## [1] "1M 5S"
# date_decimal() - Parse date stored as decimal number
d <- seq(2021,2022,0.25)
date_decimal(d)

## [1] "2021-01-01 00:00:00 UTC" "2021-04-02 06:00:00 UTC"
## [3] "2021-07-02 12:00:00 UTC" "2021-10-01 18:00:00 UTC"
## [5] "2022-01-01 00:00:00 UTC"
# fast_strptime() - Parse datetime
fast_strptime(x = "2021-12-31 12:00:00", format = "%Y-%m-%d %H:%M:%S")

## [1] "2021-12-31 12:00:00 UTC"
# parse_date_time() - Easier parse datetime
parse_date_time("2021-12-31 12:00:00", "ymd HMS")

## [1] "2021-12-31 12:00:00 UTC"
# Create date/time from individual components
flights

## # A tibble: 336,776 x 19
##   year month   day dep_time sched_dep_time dep_delay arr_time sched_arr_time
##   <int> <int> <int>   <int>         <int>         <dbl>     <int>         <int>
## 1  2013     1     1     517           515           2         830           819
## 2  2013     1     1     533           529           4         850           830
## 3  2013     1     1     542           540           2         923           850
## 4  2013     1     1     544           545          -1        1004          1022
## 5  2013     1     1     554           600          -6         812           837
## 6  2013     1     1     554           558          -4         740           728
## 7  2013     1     1     555           600          -5         913           854
## 8  2013     1     1     557           600          -3         709           723
```

```
## 9 2013 1 1 557 600 -3 838 846
## 10 2013 1 1 558 600 -2 753 745
## # i 336,766 more rows
## # i 11 more variables: arr_delay <dbl>, carrier <chr>, flight <int>,
## #   tailnum <chr>, origin <chr>, dest <chr>, air_time <dbl>, distance <dbl>,
## #   hour <dbl>, minute <dbl>, time_hour <dtm>
```

```
# Create datetime and date column using other components
flights %>%
  select(year, month, day, hour, minute) %>% # components
  mutate(datetime = make_datetime(year, month, day, hour, minute), # datetime create
         date = make_date(year, month, day)) # date create
```

```
## # A tibble: 336,776 x 7
##   year month day hour minute datetime date
##   <int> <int> <int> <dbl> <dbl> <dtm> <date>
## 1 2013 1 1 5 15 2013-01-01 05:15:00 2013-01-01
## 2 2013 1 1 5 29 2013-01-01 05:29:00 2013-01-01
## 3 2013 1 1 5 40 2013-01-01 05:40:00 2013-01-01
## 4 2013 1 1 5 45 2013-01-01 05:45:00 2013-01-01
## 5 2013 1 1 6 0 2013-01-01 06:00:00 2013-01-01
## 6 2013 1 1 5 58 2013-01-01 05:58:00 2013-01-01
## 7 2013 1 1 6 0 2013-01-01 06:00:00 2013-01-01
## 8 2013 1 1 6 0 2013-01-01 06:00:00 2013-01-01
## 9 2013 1 1 6 0 2013-01-01 06:00:00 2013-01-01
## 10 2013 1 1 6 0 2013-01-01 06:00:00 2013-01-01
## # i 336,766 more rows
```

```
# Create date/time from existing objects
# Current timestamp and todays date
now()
```

```
## [1] "2023-09-01 01:10:26 KST"
today()
```

```
## [1] "2023-09-01"
# Convert between datetime and date
as_date(now())
```

```
## [1] "2023-09-01"
as_datetime(today())
```

```
## [1] "2023-09-01 UTC"
# Different codes for datetimes components:
# Code Value
#-----#
# %d Day of the month (decimal number)
# %a Abbreviated weekday
# %m Month (decimal number)
# %A Full weekday
# %b Month (abbreviated)
# %I Decimal hour (12 hour)
# %B Month (full name)
# %j Decimal day of the year
```

```
# %y    Year (2 digits)
# %w    Decimal Weekday (0=Sunday)
# %Y    Year (4 digits)
# %W    Decimal week of the year (starting on Monday)
# %H    Decimal hour (24 hour)
# %p    Locale-specific AM/PM
# %M    Decimal minute
# %x    Locale-specific Date
# %S    Decimal second
# %X    Locale-specific Time
```

Components

```
# Extract different components of current time stamp
dt <- now()
dt
```

```
## [1] "2023-09-01 01:10:26 KST"
```

```
# Extract each piece of datetime
year(dt)
```

```
## [1] 2023
```

```
month(dt)
```

```
## [1] 9
```

```
day(dt)
```

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

```
hour(dt)
```

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

```
minute(dt)
```

```
## [1] 10
```

```
second(dt)
```

```
## [1] 26
```

```
# Some additional components
isoyear(dt)
```

```
## [1] 2023
```

```
epiyear(dt)
```

```
## [1] 2023
```

```
wday(dt)
```

```
## [1] 6
```

```
qday(dt)
```

```
## [1] 63
```

```

week(dt)

## [1] 35
isoweek(dt)

## [1] 35
epiweek(dt)

## [1] 35
quarter(dt)

## [1] 3
semester(dt)

## [1] 2
# Logicals
am(dt)

## [1] TRUE
pm(dt)

## [1] FALSE
dst(dt)

## [1] FALSE
leap_year(dt)

## [1] FALSE
# Store value of a component into column
flights %>%
  select(year, month, day, hour, minute) %>% # components
  mutate(datetime = make_datetime(year, month, day, hour, minute)) %>% # datetime create
  # extract week day, week and quarter
  mutate(wday = wday(datetime),
         week = week(datetime),
         Q = quarter(datetime))

## # A tibble: 336,776 x 9
##   year month   day hour minute datetime      wday week   Q
##   <int> <int> <int> <dbl> <dbl> <dtm>    <int> <int> <int>
## 1  2013     1     1     5     15 2013-01-01 05:15:00     3     1     1
## 2  2013     1     1     5     29 2013-01-01 05:29:00     3     1     1
## 3  2013     1     1     5     40 2013-01-01 05:40:00     3     1     1
## 4  2013     1     1     5     45 2013-01-01 05:45:00     3     1     1
## 5  2013     1     1     6      0 2013-01-01 06:00:00     3     1     1
## 6  2013     1     1     5     58 2013-01-01 05:58:00     3     1     1
## 7  2013     1     1     6      0 2013-01-01 06:00:00     3     1     1
## 8  2013     1     1     6      0 2013-01-01 06:00:00     3     1     1
## 9  2013     1     1     6      0 2013-01-01 06:00:00     3     1     1
## 10 2013     1     1     6      0 2013-01-01 06:00:00     3     1     1
## # i 336,766 more rows

```

Rounding values & setting component

```
# Rounding dates per month level
d <- today()
d

## [1] "2023-09-01"

floor_date(d, unit = "month") # round down to previous month

## [1] "2023-09-01"

ceiling_date(d, unit = "month") # round up to next month

## [1] "2023-10-01"

round_date(d, unit = "month") # mathematical rules for rounding

## [1] "2023-09-01"

rollback(d) # rollback to last day of previous month

## [1] "2023-08-31"

# It also works for other units
floor_date(d, unit = "year")

## [1] "2023-01-01"

ceiling_date(dt, unit = "day")

## [1] "2023-09-02 KST"

round_date(dt, unit = "minute")

## [1] "2023-09-01 01:10:00 KST"

# Updating components
# Update each component by assigning new values
dt

## [1] "2023-09-01 01:10:26 KST"

year(dt) <- 2022
month(dt) <- 12
day(dt) <- 31
hour(dt) <- 23
minute(dt) <- 59
second(dt) <- 59

# Update all components in one take with update()
update(dt, year = 2022, month = 12, day = 31, hour = 23, minute = 59, second = 59)

## [1] "2022-12-31 23:59:59 KST"

# Too great values rollback!
update(dt, month = 13) # 12 + 1 months = 1 year + 1 month

## [1] "2023-01-31 23:59:59 KST"

update(dt, hour = 25) # 24 + 1 hour = 1 day + 1 hour

## [1] "2023-01-01 01:59:59 KST"
```

Date-times arithmetics and durations

```
# Some basic date/time arithmetics
today <- Sys.Date()
today
```

```
## [1] "2023-09-01"
```

```
today + 1 # tomorrow
```

```
## [1] "2023-09-02"
```

```
today - 1 # yesterday
```

```
## [1] "2023-08-31"
```

```
now <- Sys.time()
now
```

```
## [1] "2023-09-01 01:10:27 KST"
```

```
now + 3600 # after 1 hour
```

```
## [1] "2023-09-01 02:10:27 KST"
```

```
now - 3600 # before 1 hour
```

```
## [1] "2023-09-01 00:10:27 KST"
```

```
# How old are you?
birth_date <- ymd("1987-05-28")
age <- today - birth_date
age
```

```
## Time difference of 13245 days
```

```
# Durations
# Convert age to duration
as.duration(age) # in seconds
```

```
## [1] "1144368000s (~36.26 years)"
```

```
# Durations constructor functions
x <- 1 # number of seconds
dyears(x)
```

```
## [1] "31557600s (~1 years)"
```

```
dmonths(x)
```

```
## [1] "2629800s (~4.35 weeks)"
```

```
dweeks(x)
```

```
## [1] "604800s (~1 weeks)"
```

```
ddays(x)
```

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

```
dhours(x)
```

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

```

dminutes(x)

## [1] "60s (~1 minutes)"
dpicoseconds(x)

## [1] "1e-12s"
is.duration(age)

## [1] FALSE
is.duration(as.duration(age))

## [1] TRUE
# Durations - arithmetics
dseconds(10) + dminutes(1) # addition

## [1] "70s (~1.17 minutes)"
dyears(1) - dweeks(27) # subtraction

## [1] "15228000s (~25.18 weeks)"
10 * dmonths(1) # multiplication

## [1] "26298000s (~43.48 weeks)"
# Inconsistent timeline behaviour (durations)
# Daylight Savings Time
dt <- ymd_hms("2016-03-12 13:00:00", tz = "America/New_York")
dt + ddays(1)

## [1] "2016-03-13 14:00:00 EDT"
# Leap year
dt <- ymd_hms("2019-02-28 23:00:00")
dt + dyears(1)

## [1] "2020-02-29 05:00:00 UTC"
# Periods
# Age as period
as.period(age)

## [1] "13245d 0H 0M 0S"
# Constructor functions
seconds(3600)

## [1] "3600S"
minutes(60)

## [1] "60M 0S"
hours(1)

## [1] "1H 0M 0S"
days(1)

## [1] "1d 0H 0M 0S"

```



```

months(12)

## [1] "12m 0d 0H 0M 0S"
weeks(54)

## [1] "378d 0H 0M 0S"
years(1)

## [1] "1y 0m 0d 0H 0M 0S"
period_to_seconds(years(1))

## [1] 31557600
seconds_to_period(3600)

## [1] "1H 0M 0S"
period(3600, units = "second")

## [1] "3600S"
# Periods - arithmetics
seconds(10) + minutes(1) # addition

## [1] "1M 10S"
years(1) - weeks(27) # subtraction

## [1] "1y 0m -189d 0H 0M 0S"
10 * months(1) # multiplication

## [1] "10m 0d 0H 0M 0S"
# Inconsistent timeline behaviour (periods)
# Daylight Savings Time
dt <- ymd_hms("2016-03-12 13:00:00", tz = "America/New_York")
dt + days(1)

## [1] "2016-03-13 13:00:00 EDT"
# Leap year
dt <- ymd_hms("2019-02-28 23:00:00")
dt + years(1)

## [1] "2020-02-28 23:00:00 UTC"

```

Intervals

```

# Create an interval
d1 <- ymd("2021-12-30")
d2 <- ymd("2021-12-31")

i1 <- interval(d1, d2)
i2 <- d2 %--% d1
i1

## [1] 2021-12-30 UTC--2021-12-31 UTC

```

```

i2

## [1] 2021-12-31 UTC--2021-12-30 UTC
# Extract boundaries
int_start(i1)

## [1] "2021-12-30 UTC"
int_end(i1)

## [1] "2021-12-31 UTC"
# Is time point within given interval
ymd_hms("2021-12-30 01:00:00") %within% i1

## [1] TRUE
ymd_hms("2021-12-29 23:00:00") %within% i1

## [1] FALSE
# Do intervals overlap
int_overlaps(i1, i2)

## [1] TRUE
int_overlaps(i1, ymd("2021-12-28") %--% ymd("2021-12-29"))

## [1] FALSE
# Create intervals form vector of dates
dates <- now() + days(1:365) # one year of dates
int_diff(dates) # daily intervals

## [1] 2023-09-02 01:10:28 KST--2023-09-03 01:10:28 KST
## [2] 2023-09-03 01:10:28 KST--2023-09-04 01:10:28 KST
## [3] 2023-09-04 01:10:28 KST--2023-09-05 01:10:28 KST
## [4] 2023-09-05 01:10:28 KST--2023-09-06 01:10:28 KST
## [5] 2023-09-06 01:10:28 KST--2023-09-07 01:10:28 KST
## [6] 2023-09-07 01:10:28 KST--2023-09-08 01:10:28 KST
## [7] 2023-09-08 01:10:28 KST--2023-09-09 01:10:28 KST
## [8] 2023-09-09 01:10:28 KST--2023-09-10 01:10:28 KST
## [9] 2023-09-10 01:10:28 KST--2023-09-11 01:10:28 KST
## [10] 2023-09-11 01:10:28 KST--2023-09-12 01:10:28 KST
## [11] 2023-09-12 01:10:28 KST--2023-09-13 01:10:28 KST
## [12] 2023-09-13 01:10:28 KST--2023-09-14 01:10:28 KST
## [13] 2023-09-14 01:10:28 KST--2023-09-15 01:10:28 KST
## [14] 2023-09-15 01:10:28 KST--2023-09-16 01:10:28 KST
## [15] 2023-09-16 01:10:28 KST--2023-09-17 01:10:28 KST
## [16] 2023-09-17 01:10:28 KST--2023-09-18 01:10:28 KST
## [17] 2023-09-18 01:10:28 KST--2023-09-19 01:10:28 KST
## [18] 2023-09-19 01:10:28 KST--2023-09-20 01:10:28 KST
## [19] 2023-09-20 01:10:28 KST--2023-09-21 01:10:28 KST
## [20] 2023-09-21 01:10:28 KST--2023-09-22 01:10:28 KST
## [21] 2023-09-22 01:10:28 KST--2023-09-23 01:10:28 KST
## [22] 2023-09-23 01:10:28 KST--2023-09-24 01:10:28 KST
## [23] 2023-09-24 01:10:28 KST--2023-09-25 01:10:28 KST
## [24] 2023-09-25 01:10:28 KST--2023-09-26 01:10:28 KST

```

```

## [25] 2023-09-26 01:10:28 KST--2023-09-27 01:10:28 KST
## [26] 2023-09-27 01:10:28 KST--2023-09-28 01:10:28 KST
## [27] 2023-09-28 01:10:28 KST--2023-09-29 01:10:28 KST
## [28] 2023-09-29 01:10:28 KST--2023-09-30 01:10:28 KST
## [29] 2023-09-30 01:10:28 KST--2023-10-01 01:10:28 KST
## [30] 2023-10-01 01:10:28 KST--2023-10-02 01:10:28 KST
## [31] 2023-10-02 01:10:28 KST--2023-10-03 01:10:28 KST
## [32] 2023-10-03 01:10:28 KST--2023-10-04 01:10:28 KST
## [33] 2023-10-04 01:10:28 KST--2023-10-05 01:10:28 KST
## [34] 2023-10-05 01:10:28 KST--2023-10-06 01:10:28 KST
## [35] 2023-10-06 01:10:28 KST--2023-10-07 01:10:28 KST
## [36] 2023-10-07 01:10:28 KST--2023-10-08 01:10:28 KST
## [37] 2023-10-08 01:10:28 KST--2023-10-09 01:10:28 KST
## [38] 2023-10-09 01:10:28 KST--2023-10-10 01:10:28 KST
## [39] 2023-10-10 01:10:28 KST--2023-10-11 01:10:28 KST
## [40] 2023-10-11 01:10:28 KST--2023-10-12 01:10:28 KST
## [41] 2023-10-12 01:10:28 KST--2023-10-13 01:10:28 KST
## [42] 2023-10-13 01:10:28 KST--2023-10-14 01:10:28 KST
## [43] 2023-10-14 01:10:28 KST--2023-10-15 01:10:28 KST
## [44] 2023-10-15 01:10:28 KST--2023-10-16 01:10:28 KST
## [45] 2023-10-16 01:10:28 KST--2023-10-17 01:10:28 KST
## [46] 2023-10-17 01:10:28 KST--2023-10-18 01:10:28 KST
## [47] 2023-10-18 01:10:28 KST--2023-10-19 01:10:28 KST
## [48] 2023-10-19 01:10:28 KST--2023-10-20 01:10:28 KST
## [49] 2023-10-20 01:10:28 KST--2023-10-21 01:10:28 KST
## [50] 2023-10-21 01:10:28 KST--2023-10-22 01:10:28 KST
## [51] 2023-10-22 01:10:28 KST--2023-10-23 01:10:28 KST
## [52] 2023-10-23 01:10:28 KST--2023-10-24 01:10:28 KST
## [53] 2023-10-24 01:10:28 KST--2023-10-25 01:10:28 KST
## [54] 2023-10-25 01:10:28 KST--2023-10-26 01:10:28 KST
## [55] 2023-10-26 01:10:28 KST--2023-10-27 01:10:28 KST
## [56] 2023-10-27 01:10:28 KST--2023-10-28 01:10:28 KST
## [57] 2023-10-28 01:10:28 KST--2023-10-29 01:10:28 KST
## [58] 2023-10-29 01:10:28 KST--2023-10-30 01:10:28 KST
## [59] 2023-10-30 01:10:28 KST--2023-10-31 01:10:28 KST
## [60] 2023-10-31 01:10:28 KST--2023-11-01 01:10:28 KST
## [61] 2023-11-01 01:10:28 KST--2023-11-02 01:10:28 KST
## [62] 2023-11-02 01:10:28 KST--2023-11-03 01:10:28 KST
## [63] 2023-11-03 01:10:28 KST--2023-11-04 01:10:28 KST
## [64] 2023-11-04 01:10:28 KST--2023-11-05 01:10:28 KST
## [65] 2023-11-05 01:10:28 KST--2023-11-06 01:10:28 KST
## [66] 2023-11-06 01:10:28 KST--2023-11-07 01:10:28 KST
## [67] 2023-11-07 01:10:28 KST--2023-11-08 01:10:28 KST
## [68] 2023-11-08 01:10:28 KST--2023-11-09 01:10:28 KST
## [69] 2023-11-09 01:10:28 KST--2023-11-10 01:10:28 KST
## [70] 2023-11-10 01:10:28 KST--2023-11-11 01:10:28 KST
## [71] 2023-11-11 01:10:28 KST--2023-11-12 01:10:28 KST
## [72] 2023-11-12 01:10:28 KST--2023-11-13 01:10:28 KST
## [73] 2023-11-13 01:10:28 KST--2023-11-14 01:10:28 KST
## [74] 2023-11-14 01:10:28 KST--2023-11-15 01:10:28 KST
## [75] 2023-11-15 01:10:28 KST--2023-11-16 01:10:28 KST
## [76] 2023-11-16 01:10:28 KST--2023-11-17 01:10:28 KST
## [77] 2023-11-17 01:10:28 KST--2023-11-18 01:10:28 KST
## [78] 2023-11-18 01:10:28 KST--2023-11-19 01:10:28 KST

```

[79] 2023-11-19 01:10:28 KST--2023-11-20 01:10:28 KST
[80] 2023-11-20 01:10:28 KST--2023-11-21 01:10:28 KST
[81] 2023-11-21 01:10:28 KST--2023-11-22 01:10:28 KST
[82] 2023-11-22 01:10:28 KST--2023-11-23 01:10:28 KST
[83] 2023-11-23 01:10:28 KST--2023-11-24 01:10:28 KST
[84] 2023-11-24 01:10:28 KST--2023-11-25 01:10:28 KST
[85] 2023-11-25 01:10:28 KST--2023-11-26 01:10:28 KST
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[340] 2024-08-06 01:10:28 KST--2024-08-07 01:10:28 KST
[341] 2024-08-07 01:10:28 KST--2024-08-08 01:10:28 KST
[342] 2024-08-08 01:10:28 KST--2024-08-09 01:10:28 KST
[343] 2024-08-09 01:10:28 KST--2024-08-10 01:10:28 KST
[344] 2024-08-10 01:10:28 KST--2024-08-11 01:10:28 KST
[345] 2024-08-11 01:10:28 KST--2024-08-12 01:10:28 KST
[346] 2024-08-12 01:10:28 KST--2024-08-13 01:10:28 KST
[347] 2024-08-13 01:10:28 KST--2024-08-14 01:10:28 KST
[348] 2024-08-14 01:10:28 KST--2024-08-15 01:10:28 KST


```
## [349] 2024-08-15 01:10:28 KST--2024-08-16 01:10:28 KST
## [350] 2024-08-16 01:10:28 KST--2024-08-17 01:10:28 KST
## [351] 2024-08-17 01:10:28 KST--2024-08-18 01:10:28 KST
## [352] 2024-08-18 01:10:28 KST--2024-08-19 01:10:28 KST
## [353] 2024-08-19 01:10:28 KST--2024-08-20 01:10:28 KST
## [354] 2024-08-20 01:10:28 KST--2024-08-21 01:10:28 KST
## [355] 2024-08-21 01:10:28 KST--2024-08-22 01:10:28 KST
## [356] 2024-08-22 01:10:28 KST--2024-08-23 01:10:28 KST
## [357] 2024-08-23 01:10:28 KST--2024-08-24 01:10:28 KST
## [358] 2024-08-24 01:10:28 KST--2024-08-25 01:10:28 KST
## [359] 2024-08-25 01:10:28 KST--2024-08-26 01:10:28 KST
## [360] 2024-08-26 01:10:28 KST--2024-08-27 01:10:28 KST
## [361] 2024-08-27 01:10:28 KST--2024-08-28 01:10:28 KST
## [362] 2024-08-28 01:10:28 KST--2024-08-29 01:10:28 KST
## [363] 2024-08-29 01:10:28 KST--2024-08-30 01:10:28 KST
## [364] 2024-08-30 01:10:28 KST--2024-08-31 01:10:28 KST
```

```
# Length of an interval / flip interval
i1
```

```
## [1] 2021-12-30 UTC--2021-12-31 UTC
```

```
int_flip(i1)
```

```
## [1] 2021-12-31 UTC--2021-12-30 UTC
```

```
int_length(i1)
```

```
## [1] 86400
```

Time zones

```
# What R sees as your time zone?
Sys.timezone()
```

```
## [1] "Asia/Seoul"
```

```
# Different time zones
OlsonNames()
```

```
## [1] "Africa/Abidjan" "Africa/Accra"
## [3] "Africa/Addis_Ababa" "Africa/Algiers"
## [5] "Africa/Asmara" "Africa/Asmera"
## [7] "Africa/Bamako" "Africa/Bangui"
## [9] "Africa/Banjul" "Africa/Bissau"
## [11] "Africa/Blantyre" "Africa/Brazzaville"
## [13] "Africa/Bujumbura" "Africa/Cairo"
## [15] "Africa/Casablanca" "Africa/Ceuta"
## [17] "Africa/Conakry" "Africa/Dakar"
## [19] "Africa/Dar_es_Salaam" "Africa/Djibouti"
## [21] "Africa/Douala" "Africa/El_Aaiun"
## [23] "Africa/Freetown" "Africa/Gaborone"
## [25] "Africa/Harare" "Africa/Johannesburg"
## [27] "Africa/Juba" "Africa/Kampala"
## [29] "Africa/Khartoum" "Africa/Kigali"
## [31] "Africa/Kinshasa" "Africa/Lagos"
## [33] "Africa/Libreville" "Africa/Lome"
```

## [35]	"Africa/Luanda"	"Africa/Lubumbashi"
## [37]	"Africa/Lusaka"	"Africa/Malabo"
## [39]	"Africa/Maputo"	"Africa/Maseru"
## [41]	"Africa/Mbabane"	"Africa/Mogadishu"
## [43]	"Africa/Monrovia"	"Africa/Nairobi"
## [45]	"Africa/Ndjamena"	"Africa/Niamey"
## [47]	"Africa/Nouakchott"	"Africa/Ouagadougou"
## [49]	"Africa/Porto-Novo"	"Africa/Sao_Tome"
## [51]	"Africa/Timbuktu"	"Africa/Tripoli"
## [53]	"Africa/Tunis"	"Africa/Windhoek"
## [55]	"America/Adak"	"America/Anchorage"
## [57]	"America/Anguilla"	"America/Antigua"
## [59]	"America/Araguaina"	"America/Argentina/Buenos_Aires"
## [61]	"America/Argentina/Catamarca"	"America/Argentina/ComodRivadavia"
## [63]	"America/Argentina/Cordoba"	"America/Argentina/Jujuy"
## [65]	"America/Argentina/La_Rioja"	"America/Argentina/Mendoza"
## [67]	"America/Argentina/Rio_Gallegos"	"America/Argentina/Salta"
## [69]	"America/Argentina/San_Juan"	"America/Argentina/San_Luis"
## [71]	"America/Argentina/Tucuman"	"America/Argentina/Ushuaia"
## [73]	"America/Aruba"	"America/Asuncion"
## [75]	"America/Atikokan"	"America/Atka"
## [77]	"America/Bahia"	"America/Bahia_Banderas"
## [79]	"America/Barbados"	"America/Belem"
## [81]	"America/Belize"	"America/Blanc-Sablon"
## [83]	"America/Boa_Vista"	"America/Bogota"
## [85]	"America/Boise"	"America/Buenos_Aires"
## [87]	"America/Cambridge_Bay"	"America/Campo_Grande"
## [89]	"America/Cancun"	"America/Caracas"
## [91]	"America/Catamarca"	"America/Cayenne"
## [93]	"America/Cayman"	"America/Chicago"
## [95]	"America/Chihuahua"	"America/Ciudad_Juarez"
## [97]	"America/Coral_Harbour"	"America/Cordoba"
## [99]	"America/Costa_Rica"	"America/Creston"
## [101]	"America/Cuiaba"	"America/Curacao"
## [103]	"America/Danmarkshavn"	"America/Dawson"
## [105]	"America/Dawson_Creek"	"America/Denver"
## [107]	"America/Detroit"	"America/Dominica"
## [109]	"America/Edmonton"	"America/Eirunepe"
## [111]	"America/El_Salvador"	"America/Ensenada"
## [113]	"America/Fort_Nelson"	"America/Fort_Wayne"
## [115]	"America/Fortaleza"	"America/Glace_Bay"
## [117]	"America/Godthab"	"America/Goose_Bay"
## [119]	"America/Grand_Turk"	"America/Grenada"
## [121]	"America/Guadeloupe"	"America/Guatemala"
## [123]	"America/Guayaquil"	"America/Guyana"
## [125]	"America/Halifax"	"America/Havana"
## [127]	"America/Hermosillo"	"America/Indiana/Indianapolis"
## [129]	"America/Indiana/Knox"	"America/Indiana/Marengo"
## [131]	"America/Indiana/Petersburg"	"America/Indiana/Tell_City"
## [133]	"America/Indiana/Vevay"	"America/Indiana/Vincennes"
## [135]	"America/Indiana/Winamac"	"America/Indianapolis"
## [137]	"America/Inuvik"	"America/Iqaluit"
## [139]	"America/Jamaica"	"America/Jujuy"
## [141]	"America/Juneau"	"America/Kentucky/Louisville"

## [143]	"America/Kentucky/Monticello"	"America/Knox_IN"
## [145]	"America/Kralendijk"	"America/La_Paz"
## [147]	"America/Lima"	"America/Los_Angeles"
## [149]	"America/Louisville"	"America/Lower_Princes"
## [151]	"America/Maceio"	"America/Managua"
## [153]	"America/Manaus"	"America/Marigot"
## [155]	"America/Martinique"	"America/Matamoros"
## [157]	"America/Mazatlan"	"America/Mendoza"
## [159]	"America/Menominee"	"America/Merida"
## [161]	"America/Metlakatla"	"America/Mexico_City"
## [163]	"America/Miquelon"	"America/Moncton"
## [165]	"America/Monterrey"	"America/Montevideo"
## [167]	"America/Montreal"	"America/Montserrat"
## [169]	"America/Nassau"	"America/New_York"
## [171]	"America/Nipigon"	"America/Nome"
## [173]	"America/Noronha"	"America/North_Dakota/Beulah"
## [175]	"America/North_Dakota/Center"	"America/North_Dakota/New_Salem"
## [177]	"America/Nuuk"	"America/Ojinaga"
## [179]	"America/Panama"	"America/Pangnirtung"
## [181]	"America/Paramaribo"	"America/Phoenix"
## [183]	"America/Port-au-Prince"	"America/Port_of_Spain"
## [185]	"America/Porto_Acre"	"America/Porto_Velho"
## [187]	"America/Puerto_Rico"	"America/Punta_Arenas"
## [189]	"America/Rainy_River"	"America/Rankin_Inlet"
## [191]	"America/Recife"	"America/Regina"
## [193]	"America/Resolute"	"America/Rio_Branco"
## [195]	"America/Rosario"	"America/Santa_Isabel"
## [197]	"America/Santarem"	"America/Santiago"
## [199]	"America/Santo_Domingo"	"America/Sao_Paulo"
## [201]	"America/Scoresbysund"	"America/Shiprock"
## [203]	"America/Sitka"	"America/St_Barthelemy"
## [205]	"America/St_Johns"	"America/St_Kitts"
## [207]	"America/St_Lucia"	"America/St_Thomas"
## [209]	"America/St_Vincent"	"America/Swift_Current"
## [211]	"America/Tegucigalpa"	"America/Thule"
## [213]	"America/Thunder_Bay"	"America/Tijuana"
## [215]	"America/Toronto"	"America/Tortola"
## [217]	"America/Vancouver"	"America/Virgin"
## [219]	"America/Whitehorse"	"America/Winnipeg"
## [221]	"America/Yakutat"	"America/Yellowknife"
## [223]	"Antarctica/Casey"	"Antarctica/Davis"
## [225]	"Antarctica/DumontD'Urville"	"Antarctica/Macquarie"
## [227]	"Antarctica/Mawson"	"Antarctica/McMurdo"
## [229]	"Antarctica/Palmer"	"Antarctica/Rothera"
## [231]	"Antarctica/South_Pole"	"Antarctica/Syowa"
## [233]	"Antarctica/Troll"	"Antarctica/Vostok"
## [235]	"Arctic/Longyearbyen"	"Asia/Aden"
## [237]	"Asia/Almaty"	"Asia/Amman"
## [239]	"Asia/Anadyr"	"Asia/Aqtou"
## [241]	"Asia/Aqtobe"	"Asia/Ashgabat"
## [243]	"Asia/Ashkhabad"	"Asia/Atyrau"
## [245]	"Asia/Baghdad"	"Asia/Bahrain"
## [247]	"Asia/Baku"	"Asia/Bangkok"
## [249]	"Asia/Barnaul"	"Asia/Beirut"

## [251]	"Asia/Bishkek"	"Asia/Brunei"
## [253]	"Asia/Calcutta"	"Asia/Chita"
## [255]	"Asia/Choibalsan"	"Asia/Chongqing"
## [257]	"Asia/Chungking"	"Asia/Colombo"
## [259]	"Asia/Dacca"	"Asia/Damascus"
## [261]	"Asia/Dhaka"	"Asia/Dili"
## [263]	"Asia/Dubai"	"Asia/Dushanbe"
## [265]	"Asia/Famagusta"	"Asia/Gaza"
## [267]	"Asia/Harbin"	"Asia/Hebron"
## [269]	"Asia/Ho_Chi_Minh"	"Asia/Hong_Kong"
## [271]	"Asia/Hovd"	"Asia/Irkutsk"
## [273]	"Asia/Istanbul"	"Asia/Jakarta"
## [275]	"Asia/Jayapura"	"Asia/Jerusalem"
## [277]	"Asia/Kabul"	"Asia/Kamchatka"
## [279]	"Asia/Karachi"	"Asia/Kashgar"
## [281]	"Asia/Kathmandu"	"Asia/Katmandu"
## [283]	"Asia/Khandyga"	"Asia/Kolkata"
## [285]	"Asia/Krasnoyarsk"	"Asia/Kuala_Lumpur"
## [287]	"Asia/Kuching"	"Asia/Kuwait"
## [289]	"Asia/Macao"	"Asia/Macau"
## [291]	"Asia/Magadan"	"Asia/Makassar"
## [293]	"Asia/Manila"	"Asia/Muscat"
## [295]	"Asia/Nicosia"	"Asia/Novokuznetsk"
## [297]	"Asia/Novosibirsk"	"Asia/Omsk"
## [299]	"Asia/Oral"	"Asia/Phnom_Penh"
## [301]	"Asia/Pontianak"	"Asia/Pyongyang"
## [303]	"Asia/Qatar"	"Asia/Qostanay"
## [305]	"Asia/Qyzylorda"	"Asia/Rangoon"
## [307]	"Asia/Riyadh"	"Asia/Saigon"
## [309]	"Asia/Sakhalin"	"Asia/Samarkand"
## [311]	"Asia/Seoul"	"Asia/Shanghai"
## [313]	"Asia/Singapore"	"Asia/Srednekolymsk"
## [315]	"Asia/Taipei"	"Asia/Tashkent"
## [317]	"Asia/Tbilisi"	"Asia/Tehran"
## [319]	"Asia/Tel_Aviv"	"Asia/Thimbu"
## [321]	"Asia/Thimphu"	"Asia/Tokyo"
## [323]	"Asia/Tomsk"	"Asia/Ujung_Pandang"
## [325]	"Asia/Ulaanbaatar"	"Asia/Ulan_Bator"
## [327]	"Asia/Urumqi"	"Asia/Ust-Nera"
## [329]	"Asia/Vientiane"	"Asia/Vladivostok"
## [331]	"Asia/Yakutsk"	"Asia/Yangon"
## [333]	"Asia/Yekaterinburg"	"Asia/Yerevan"
## [335]	"Atlantic/Azores"	"Atlantic/Bermuda"
## [337]	"Atlantic/Canary"	"Atlantic/Cape_Verde"
## [339]	"Atlantic/Faeroe"	"Atlantic/Faroe"
## [341]	"Atlantic/Jan_Mayen"	"Atlantic/Madeira"
## [343]	"Atlantic/Reykjavik"	"Atlantic/South_Georgia"
## [345]	"Atlantic/St_Helena"	"Atlantic/Stanley"
## [347]	"Australia/ACT"	"Australia/Adelaide"
## [349]	"Australia/Brisbane"	"Australia/Broken_Hill"
## [351]	"Australia/Canberra"	"Australia/Currie"
## [353]	"Australia/Darwin"	"Australia/Eucla"
## [355]	"Australia/Hobart"	"Australia/LHI"
## [357]	"Australia/Lindeman"	"Australia/Lord_Howe"

## [359]	"Australia/Melbourne"	"Australia/North"
## [361]	"Australia/NSW"	"Australia/Perth"
## [363]	"Australia/Queensland"	"Australia/South"
## [365]	"Australia/Sydney"	"Australia/Tasmania"
## [367]	"Australia/Victoria"	"Australia/West"
## [369]	"Australia/Yancowinna"	"Brazil/Acre"
## [371]	"Brazil/DeNoronha"	"Brazil/East"
## [373]	"Brazil/West"	"Canada/Atlantic"
## [375]	"Canada/Central"	"Canada/Eastern"
## [377]	"Canada/Mountain"	"Canada/Newfoundland"
## [379]	"Canada/Pacific"	"Canada/Saskatchewan"
## [381]	"Canada/Yukon"	"CET"
## [383]	"Chile/Continental"	"Chile/EasterIsland"
## [385]	"CST6CDT"	"Cuba"
## [387]	"EET"	"Egypt"
## [389]	"Eire"	"EST"
## [391]	"EST5EDT"	"Etc/GMT"
## [393]	"Etc/GMT-0"	"Etc/GMT-1"
## [395]	"Etc/GMT-10"	"Etc/GMT-11"
## [397]	"Etc/GMT-12"	"Etc/GMT-13"
## [399]	"Etc/GMT-14"	"Etc/GMT-2"
## [401]	"Etc/GMT-3"	"Etc/GMT-4"
## [403]	"Etc/GMT-5"	"Etc/GMT-6"
## [405]	"Etc/GMT-7"	"Etc/GMT-8"
## [407]	"Etc/GMT-9"	"Etc/GMT+0"
## [409]	"Etc/GMT+1"	"Etc/GMT+10"
## [411]	"Etc/GMT+11"	"Etc/GMT+12"
## [413]	"Etc/GMT+2"	"Etc/GMT+3"
## [415]	"Etc/GMT+4"	"Etc/GMT+5"
## [417]	"Etc/GMT+6"	"Etc/GMT+7"
## [419]	"Etc/GMT+8"	"Etc/GMT+9"
## [421]	"Etc/GMT0"	"Etc/Greenwich"
## [423]	"Etc/UCT"	"Etc/Universal"
## [425]	"Etc/UTC"	"Etc/Zulu"
## [427]	"Europe/Amsterdam"	"Europe/Andorra"
## [429]	"Europe/Astrakhan"	"Europe/Athens"
## [431]	"Europe/Belfast"	"Europe/Belgrade"
## [433]	"Europe/Berlin"	"Europe/Bratislava"
## [435]	"Europe/Brussels"	"Europe/Bucharest"
## [437]	"Europe/Budapest"	"Europe/Busingen"
## [439]	"Europe/Chisinau"	"Europe/Copenhagen"
## [441]	"Europe/Dublin"	"Europe/Gibraltar"
## [443]	"Europe/Guernsey"	"Europe/Helsinki"
## [445]	"Europe/Isle_of_Man"	"Europe/Istanbul"
## [447]	"Europe/Jersey"	"Europe/Kaliningrad"
## [449]	"Europe/Kiev"	"Europe/Kirov"
## [451]	"Europe/Kyiv"	"Europe/Lisbon"
## [453]	"Europe/Ljubljana"	"Europe/London"
## [455]	"Europe/Luxembourg"	"Europe/Madrid"
## [457]	"Europe/Malta"	"Europe/Mariehamn"
## [459]	"Europe/Minsk"	"Europe/Monaco"
## [461]	"Europe/Moscow"	"Europe/Nicosia"
## [463]	"Europe/Oslo"	"Europe/Paris"
## [465]	"Europe/Podgorica"	"Europe/Prague"

## [467]	"Europe/Riga"	"Europe/Rome"
## [469]	"Europe/Samara"	"Europe/San_Marino"
## [471]	"Europe/Sarajevo"	"Europe/Saratov"
## [473]	"Europe/Simferopol"	"Europe/Skopje"
## [475]	"Europe/Sofia"	"Europe/Stockholm"
## [477]	"Europe/Tallinn"	"Europe/Tirane"
## [479]	"Europe/Tiraspol"	"Europe/Ulyanovsk"
## [481]	"Europe/Uzhgorod"	"Europe/Vaduz"
## [483]	"Europe/Vatican"	"Europe/Vienna"
## [485]	"Europe/Vilnius"	"Europe/Volgograd"
## [487]	"Europe/Warsaw"	"Europe/Zagreb"
## [489]	"Europe/Zaporozhye"	"Europe/Zurich"
## [491]	"GB"	"GB-Eire"
## [493]	"GMT"	"GMT-0"
## [495]	"GMT+0"	"GMT0"
## [497]	"Greenwich"	"Hongkong"
## [499]	"HST"	"Iceland"
## [501]	"Indian/Antananarivo"	"Indian/Chagos"
## [503]	"Indian/Christmas"	"Indian/Cocos"
## [505]	"Indian/Comoro"	"Indian/Kerguelen"
## [507]	"Indian/Mahe"	"Indian/Maldives"
## [509]	"Indian/Mauritius"	"Indian/Mayotte"
## [511]	"Indian/Reunion"	"Iran"
## [513]	"Israel"	"Jamaica"
## [515]	"Japan"	"Kwajalein"
## [517]	"Libya"	"MET"
## [519]	"Mexico/BajaNorte"	"Mexico/BajaSur"
## [521]	"Mexico/General"	"MST"
## [523]	"MST7MDT"	"Navajo"
## [525]	"NZ"	"NZ-CHAT"
## [527]	"Pacific/Apia"	"Pacific/Auckland"
## [529]	"Pacific/Bougainville"	"Pacific/Chatham"
## [531]	"Pacific/Chuuk"	"Pacific/Easter"
## [533]	"Pacific/Efate"	"Pacific/Enderbury"
## [535]	"Pacific/Fakaofo"	"Pacific/Fiji"
## [537]	"Pacific/Funafuti"	"Pacific/Galapagos"
## [539]	"Pacific/Gambier"	"Pacific/Guadalcanal"
## [541]	"Pacific/Guam"	"Pacific/Honolulu"
## [543]	"Pacific/Johnston"	"Pacific/Kanton"
## [545]	"Pacific/Kiritimati"	"Pacific/Kosrae"
## [547]	"Pacific/Kwajalein"	"Pacific/Majuro"
## [549]	"Pacific/Marquesas"	"Pacific/Midway"
## [551]	"Pacific/Nauru"	"Pacific/Niue"
## [553]	"Pacific/Norfolk"	"Pacific/Noumea"
## [555]	"Pacific/Pago_Pago"	"Pacific/Palau"
## [557]	"Pacific/Pitcairn"	"Pacific/Pohnpei"
## [559]	"Pacific/Ponape"	"Pacific/Port_Moresby"
## [561]	"Pacific/Rarotonga"	"Pacific/Saipan"
## [563]	"Pacific/Samoa"	"Pacific/Tahiti"
## [565]	"Pacific/Tarawa"	"Pacific/Tongatapu"
## [567]	"Pacific/Truk"	"Pacific/Wake"
## [569]	"Pacific/Wallis"	"Pacific/Yap"
## [571]	"Poland"	"Portugal"
## [573]	"PRC"	"PST8PDT"

```
## [575] "ROC" "ROK"
## [577] "Singapore" "Turkey"
## [579] "UCT" "Universal"
## [581] "US/Alaska" "US/Aleutian"
## [583] "US/Arizona" "US/Central"
## [585] "US/East-Indiana" "US/Eastern"
## [587] "US/Hawaii" "US/Indiana-Starke"
## [589] "US/Michigan" "US/Mountain"
## [591] "US/Pacific" "US/Samoa"
## [593] "UTC" "W-SU"
## [595] "WET" "Zulu"
## attr(,"Version")
## [1] "2023c"
```

```
# How many different time zones
OlsonNames() %>% length()
```

```
## [1] 596
```

```
# "US" ~ "Europe" included in TZ
OlsonNames() %>% str_subset(pattern = "US")
```

```
## [1] "US/Alaska" "US/Aleutian" "US/Arizona"
## [4] "US/Central" "US/East-Indiana" "US/Eastern"
## [7] "US/Hawaii" "US/Indiana-Starke" "US/Michigan"
## [10] "US/Mountain" "US/Pacific" "US/Samoa"
```

```
OlsonNames() %>% str_subset(pattern = "Europe")
```

```
## [1] "Europe/Amsterdam" "Europe/Andorra" "Europe/Astrakhan"
## [4] "Europe/Athens" "Europe/Belfast" "Europe/Belgrade"
## [7] "Europe/Berlin" "Europe/Bratislava" "Europe/Brussels"
## [10] "Europe/Bucharest" "Europe/Budapest" "Europe/Busingen"
## [13] "Europe/Chisinau" "Europe/Copenhagen" "Europe/Dublin"
## [16] "Europe/Gibraltar" "Europe/Guernsey" "Europe/Helsinki"
## [19] "Europe/Isle_of_Man" "Europe/Istanbul" "Europe/Jersey"
## [22] "Europe/Kaliningrad" "Europe/Kiev" "Europe/Kirov"
## [25] "Europe/Kyiv" "Europe/Lisbon" "Europe/Ljubljana"
## [28] "Europe/London" "Europe/Luxembourg" "Europe/Madrid"
## [31] "Europe/Malta" "Europe/Mariehamn" "Europe/Minsk"
## [34] "Europe/Monaco" "Europe/Moscow" "Europe/Nicosia"
## [37] "Europe/Oslo" "Europe/Paris" "Europe/Podgorica"
## [40] "Europe/Prague" "Europe/Riga" "Europe/Rome"
## [43] "Europe/Samara" "Europe/San_Marino" "Europe/Sarajevo"
## [46] "Europe/Saratov" "Europe/Simferopol" "Europe/Skopje"
## [49] "Europe/Sofia" "Europe/Stockholm" "Europe/Tallinn"
## [52] "Europe/Tirane" "Europe/Tiraspol" "Europe/Ulyanovsk"
## [55] "Europe/Uzhgorod" "Europe/Vaduz" "Europe/Vatican"
## [58] "Europe/Vienna" "Europe/Vilnius" "Europe/Volgograd"
## [61] "Europe/Warsaw" "Europe/Zagreb" "Europe/Zaporozhye"
## [64] "Europe/Zurich"
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