Date times

Quiz

Does every year have 365 days?

Quiz

Does every day have 24 hours?

Quiz

Does every minute have 60 seconds?

Quiz

What does a month measure?

Most useful skills

1. Creating dates/times (i.e. *parsing*)
2. Access and change parts of a date
3. Deal with time zones
4. Do math with instants and time spans

Warm Up

Decide in your group:

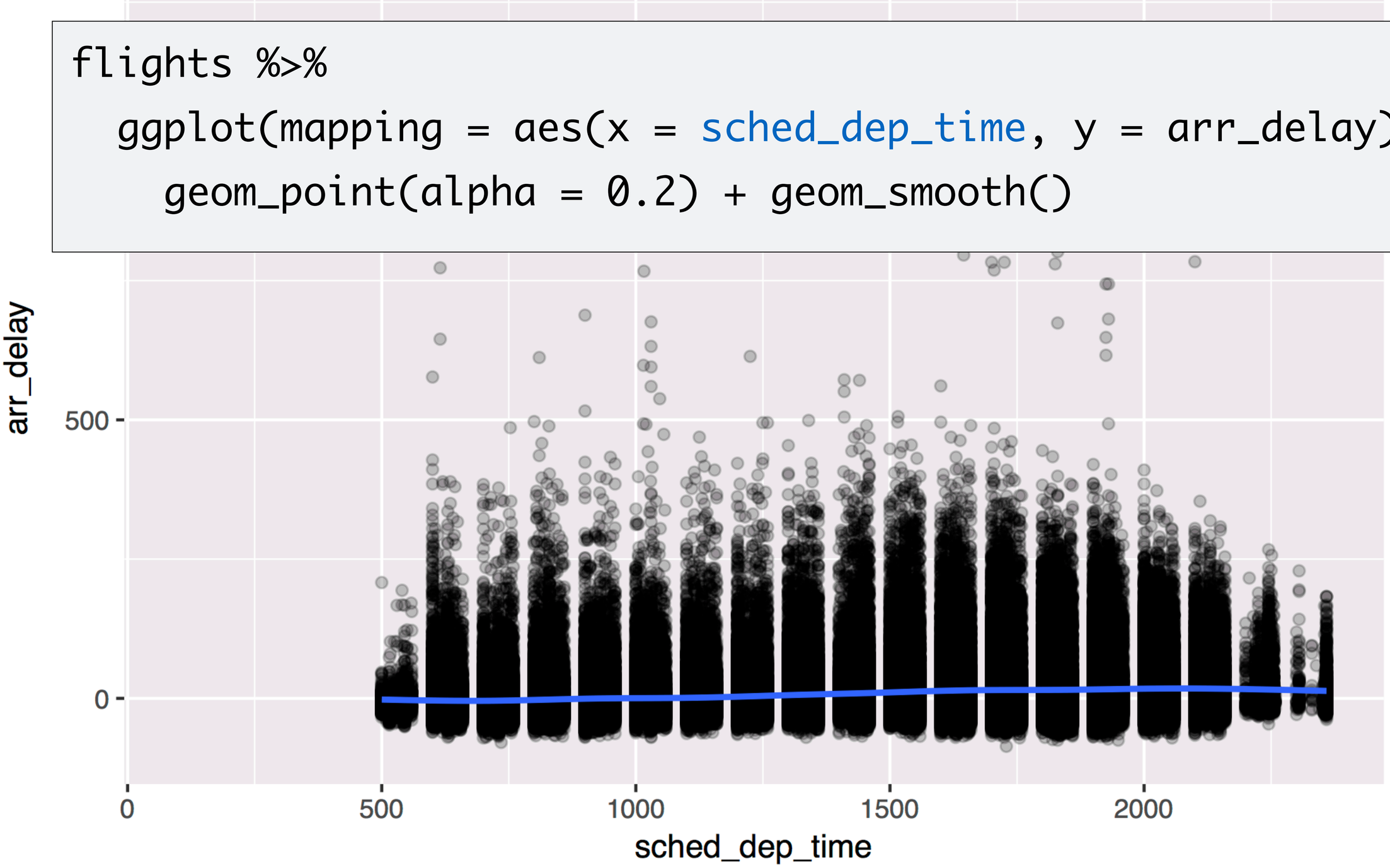
- What is the best time of day to fly?
- What is the best day of the week to fly?

```
flights %>% select(c(1, 2, 3, 17, 18, 5, 19))
```

year <int>	month <int>	day <int>	hour <dbl>	minute <dbl>	sched_dep_time <int>	time_hour <S3: POSIXct>
2013	1	1	5	15	515	2013-01-01 05:00:00
2013	1	1	5	29	529	2013-01-01 05:00:00
2013	1	1	5	40	540	2013-01-01 05:00:00
2013	1	1	5	45	545	2013-01-01 05:00:00
2013	1	1	6	0	600	2013-01-01 06:00:00
2013	1	1	5	58	558	2013-01-01 05:00:00
2013	1	1	6	0	600	2013-01-01 06:00:00
2013	1	1	6	0	600	2013-01-01 06:00:00
2013	1	1	6	0	600	2013-01-01 06:00:00
2013	1	1	6	0	600	2013-01-01 06:00:00

1–10 of 336,776 rows Previous 1 2 3 4 5 6 ... 100 Ne:

```
flights %>%
  ggplot(mapping = aes(x = sched_dep_time, y = arr_delay)) +
    geom_point(alpha = 0.2) + geom_smooth()
```



```
flights %>% select(c(1, 2, 3, 17, 18, 5, 19))
```

year <int>	month <int>	day <int>	hour <dbl>	minute <dbl>	sched_dep_time <int>	time_hour <S3: POSIXct>
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2013	1	1	6	0	600	2013-01-01 06:00:00
2013	1	1	6	0	600	2013-01-01 06:00:00

1–10 of 336,776 rows Previous 1 2 3 4 5 6 ... 100 Ne:

Creating dates and times

hms

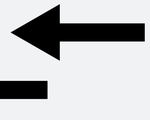
A class for representing just clock times.

```
# install.packages("tidyverse")
library(hms)
```


```
install.packages("tidyverse")
```

does the equivalent of

```
install.packages("ggplot2")
install.packages("dplyr")
install.packages("tidyr")
install.packages("readr")
install.packages("purrr")
install.packages("tibble")
install.packages("stringr")
install.packages("forcats")
install.packages("lubridate")
install.packages("hms")
install.packages("DBI")
install.packages("haven")
install.packages("httr")
install.packages("jsonlite")
install.packages("readxl")
install.packages("rvest")
install.packages("xml2")
install.packages("modelr")
install.packages("broom")
```



```
library("tidyverse")
```

does the equivalent of

```
library("ggplot2")
library("dplyr")
library("tidyr")
library("readr")
library("purrr")
library("tibble")
library("stringr")
library("forcats")
```

hms()

2017-01-01 12:34:56

```
hms(seconds, minutes, hours, days)
```

numbers of each unit to add to the time

* on a typical day

hms

2017-01-01 **12:34:56**

Stored as the number of seconds since 00:00:00.*

```
hms(seconds = 56, min = 34, hour = 12)
## 12:34:56

unclass(hms(56, 34, 12))
## 45296
```

* on a typical day

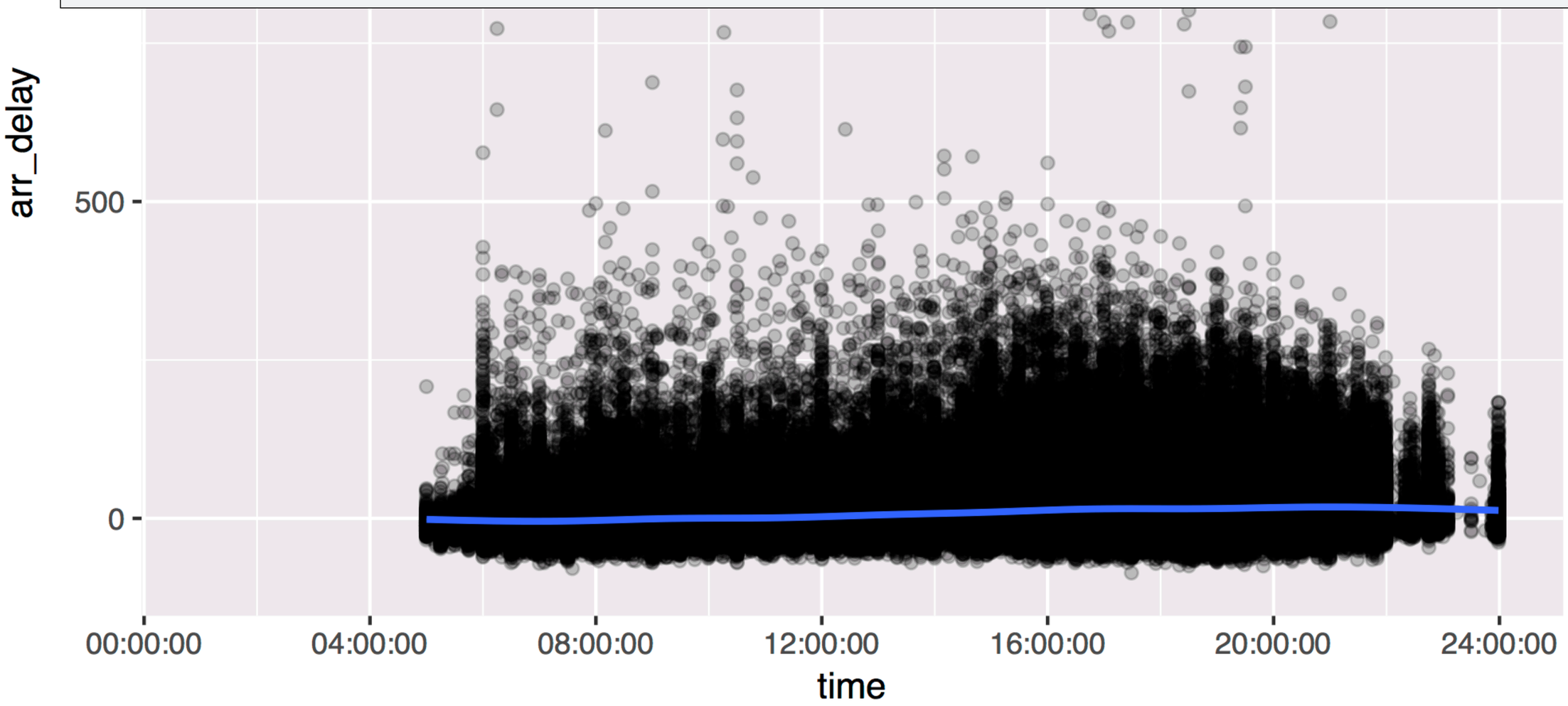
Your Turn 5

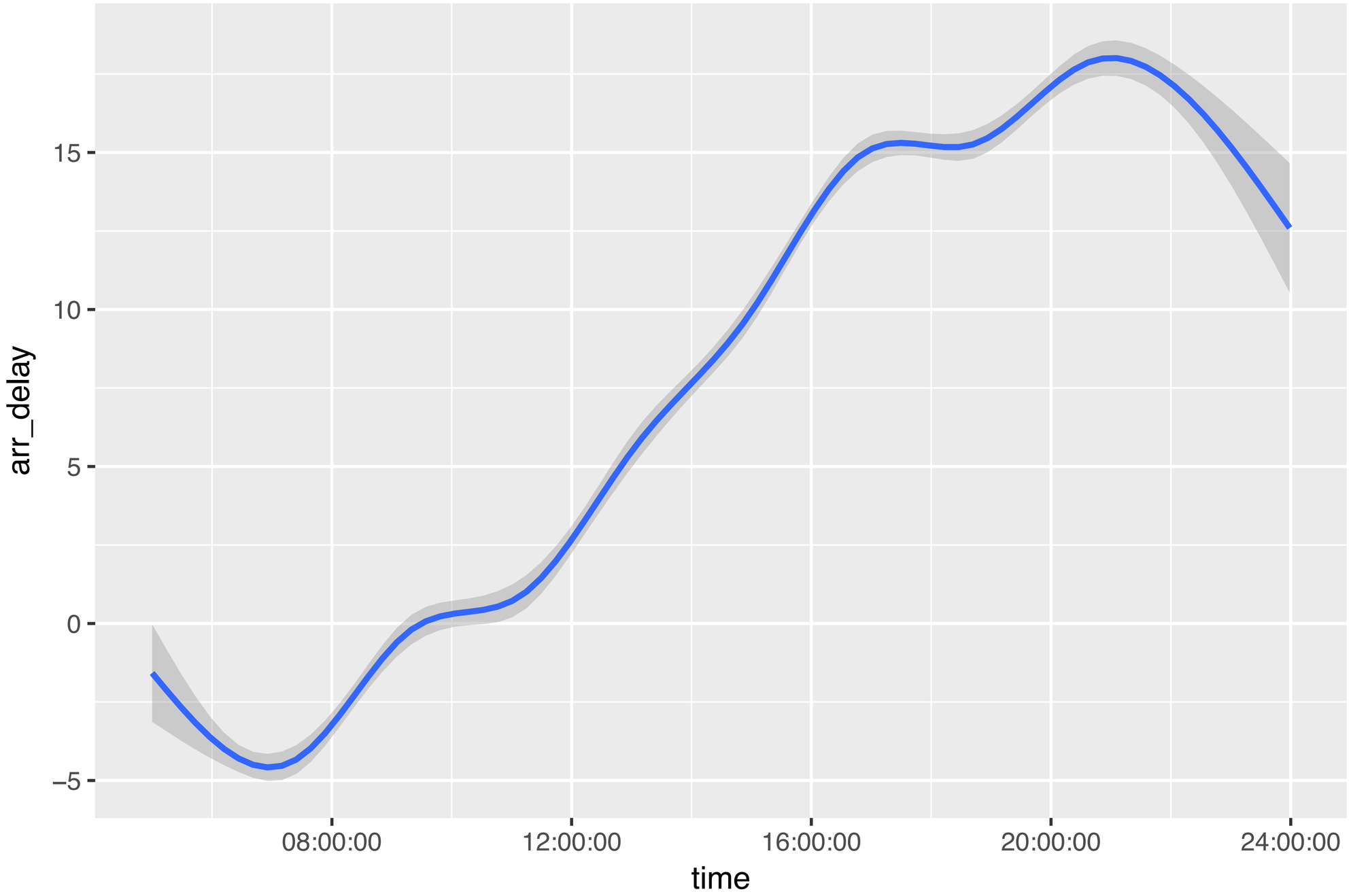
What is the best time of day to fly?

Use the **hour** and **minute** variables in flights to make a new variable that shows the **time** of each flight as an hms.

Then use a smooth line to plot the relationship between time of day and **arr_delay**.

```
flights %>%
  mutate(time = hms(hour = hour, minute = minute)) %>%
  ggplot(aes(time, arr_delay)) +
    geom_point(alpha = 0.2) + geom_smooth()
```




arr_delay
15
10
5
0
−5
08:00:00
12:00:00
16:00:00
20:00:00
24:00:00
time


hms

What is the best day of the week to fly?

Your Turn 6

Look at the code skeleton for Your Turn 7. Discuss with your neighbor:

- What does each line do?
- What will the missing parts need to do?

lubridate

Functions for working with dates and time spans

```
# install.packages("tidyverse")
library(lubridate)
```


ymd() family

```
2017-01-01 12:34:56
```

To parse strings as dates, use the function whose name is y, m, d, h, m, s in the correct order.

```
ymd("2012/01/11")
mdy("January 11, 2012")
ymd_hms("2012-01-11  01:30:55")
```

Parsing functions

function	parses to
ymd_hms(), ymd_hm(), ymd_h() ydm_hms(), ydm_hm(), ydm_h() dmy_hms(), dmy_hm(), dmy_h() mdy_hms(), mdy_hm(), mdy_h()	POSIXct
ymd(), ydm(), mdy() myd(), dmy(), dym(), yq()	Date (POSIXct if tz specified)
hms(), hm(), ms()	Period

Accessing and changing components

Accessing components

Extract components by name with a **singular** name

```
date <- ymd("2019-01-11")
year(date)
## 2019
```

Setting components

Use the same function to set components

```
date
## "2019-01-11"


year(date) <- 1999
date
## "1999-01-11"
```

Accessing date time components

function	extracts	extra arguments
year()	year	
month()	month	label = FALSE, abbr = TRUE
week()	week	
day()	day of month	
wday()	day of week	label = FALSE, abbr = TRUE
qday()	day of quarter	
yday()	day of year	
hour()	hour	
minute()	minute	
second()	second	

Accessing components

```
wday(ymd("2019-01-11"))
## 6
wday(ymd("2019-01-11"), label = TRUE)
## [1] Fri
## 7 Levels: Sun < Mon < Tues < Wed < Thurs < ... < Sat
wday(ymd("2019-01-11"), label = TRUE, abbr = FALSE)
## [1] Friday
## 7 Levels: Sunday < Monday < Tuesday < ... < Saturday
```

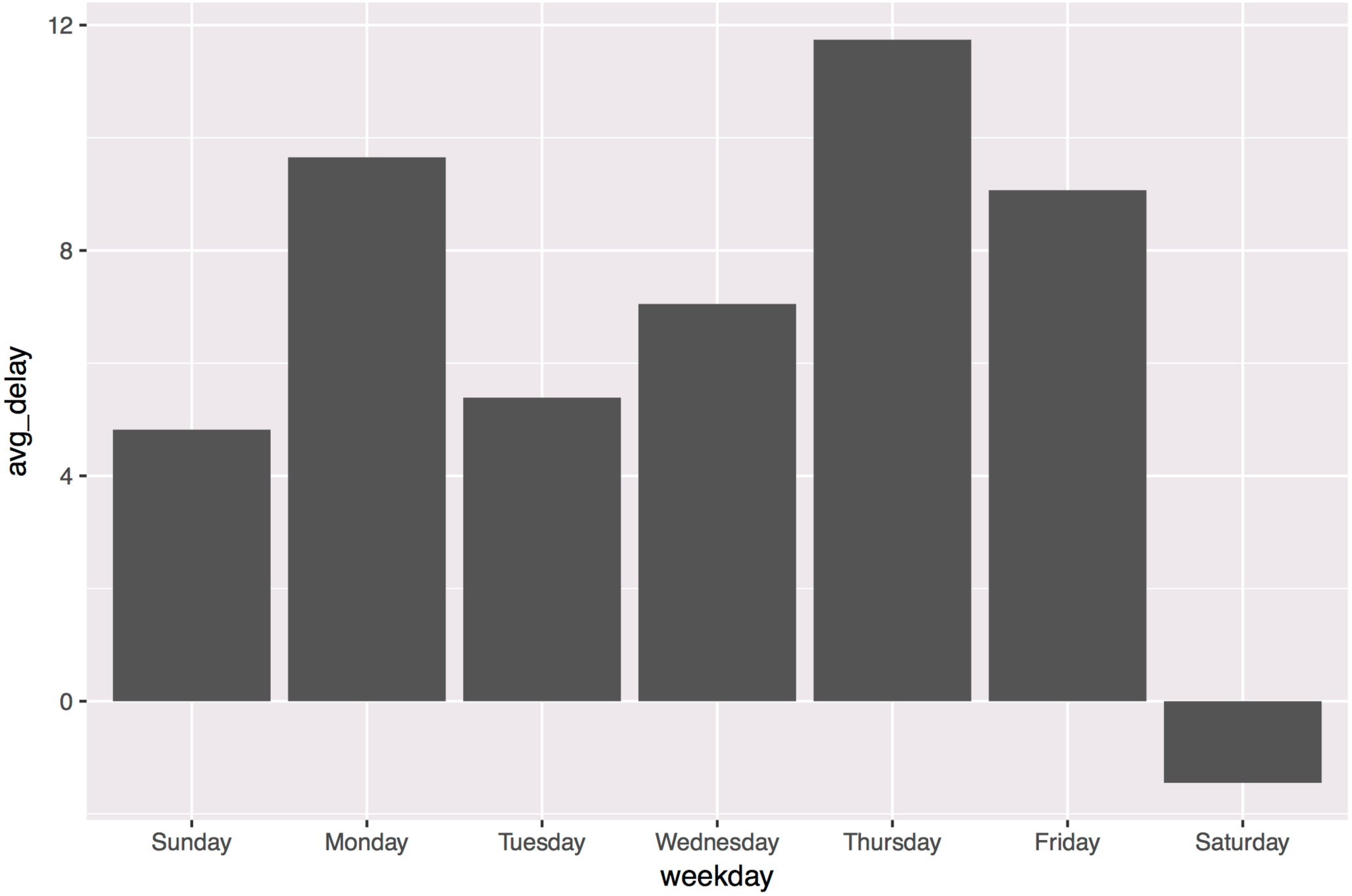
Your Turn 7

Fill in the blank to:

Extract the day of the week of each flight (as a full name) from **time_hour**.

Plot the average arrival delay by day as a column chart (bar chart).

```
flights %>%
  mutate(weekday = wday(time_hour, label = TRUE, abbr = FALSE)) %>%
  group_by(weekday) %>%
  filter(!is.na(arr_delay)) %>%
  summarise(avg_delay = mean(arr_delay)) %>%
  ggplot() +
    geom_col(mapping = aes(x = weekday, y = avg_delay))
```


12
8
4
0
avg_delay
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
weekday

Parsing functions

function	parses to
ymd_hms(), ymd_hm(), ymd_h() ydm_hms(), ydm_hm(), ydm_h() dmy_hms(), dmy_hm(), dmy_h() mdy_hms(), mdy_hm(), mdy_h()	POSIXct
ymd(), ydm(), mdy() myd(), dmy(), dym(), yq()	Date (POSIXct if tz specified)
hms(), hm(), ms()	Period

Parsing functions

function	parses to
ymd_hms(), ymd_hm(), ymd_h() ydm_hms(), ydm_hm(), ydm_h() dmy_hms(), dmy_hm(), dmy_h() mdy_hms(), mdy_hm(), mdy_h()	POSIXct
ymd(), ydm(), mdy() myd(), dmy(), dym(), yq()	Date (POSIXct if tz specified)
hms(), hm(), ms()	Period

Same name as hms() in hms

hms::hms()

package name

function name

* on a typical day

hms::hms()

lubridate::hms()

* on a typical day

hms()

```
hms::hms(seconds = 3, hours = 5)
```

Use the hms() function in the hms package

* on a typical day

Dates and Times

Dates and times with lubridate : : CHEAT SHEET

Date-times

`2017-11-28 12:00:00`

`2017-11-28 12:00:00`
A **date-time** is a point on the timeline, stored as the number of seconds since 1970-01-01 00:00:00 UTC

dt <- ***as_datetime****(1511870400)*
"2017-11-28 12:00:00 UTC"

`2017-11-28`
A **date** is a day stored as the number of days since 1970-01-01

d <- ***as_date****(17498)*
"2017-11-28"

`12:00:00`
An hms is a **time** stored as the number of seconds since 00:00:00

*t <- hms::****as.hms****(85)*
00:01:25

PARSE DATE-TIMES (Convert strings or numbers to date-times)

1. Identify the order of the year (**y**), month (**m**), day (**d**), hour (**h**), minute (**m**) and second (**s**) elements in your data.
2. Use the function below whose name replicates the order. Each accepts a wide variety of input formats.

`2017-11-28T14:02:00` **ymd_hms**(), **ymd_hm**(), **ymd_h**(). *ymd_hms("2017-11-28T14:02:00")*

`2017-22-12 10:00:00` **ydm_hms**(), **ydm_hm**(), **ydm_h**(). *ydm_hms("2017-22-12 10:00:00")*

`11/28/2017 1:02:03` **mdy_hms**(), **mdy_hm**(), **mdy_h**(). *mdy_hms("11/28/2017 1:02:03")*

`1 Jan 2017 23:59:59` **dmy_hms**(), **dmy_hm**(), **dmy_h**(). *dmy_hms("1 Jan 2017 23:59:59")*

`20170131` **ymd**(), **ydm**(). *ymd(20170131)*

`July 4th, 2000` **mdy**(), **myd**(). *mdy("July 4th, 2000")*

`4th of July '99` **dmy**(), **dym**(). *dmy("4th of July '99")*

`2001: Q3` **yq**() Q for quarter. *yq("2001: Q3")*

`2:01` hms::**hms**() Also lubridate::**hms**(), **hm**() and **ms**(), which return periods.* *hms::hms(sec = 0, min= 1, hours = 2)*

`2017.5` **date_decimal**(decimal, tz = "UTC") *date_decimal(2017.5)*

now(tzone = "") Current time in tz (defaults to system tz). *now()*

today(tzone = "") Current date in a tz (defaults to system tz). *today()*

fast_strptime() Faster strptime. *fast_strptime('9/1/01', '%y/%m/%d')*

parse_date_time() Easier strptime. *parse_date_time("9/1/01", "ymd")*

GET AND SET COMPONENTS

Use an accessor function to get a component.
d ## "2017-11-28"
day(d) ## 28

Assign into an accessor function to change a component in place.
day(d) <- 1
d ## "2017-11-01"

`2018-01-31 11:59:59` **date**(x) Date component. *date(dt)*

`2018-01-31 11:59:59` **year**(x) Year. *year(dt)*
isoyear(x) The ISO 8601 year.
epiyear(x) Epidemiological year.

`2018-01-31 11:59:59` **month**(x, label, abbr) Month. *month(dt)*

`2018-01-31 11:59:59` **day**(x) Day of month. *day(dt)*
wday(x,label,abbr) Day of week.
qday(x) Day of quarter.

`2018-01-31 11:59:59` **hour**(x) Hour. *hour(dt)*

`2018-01-31 11:59:59` **minute**(x) Minutes. *minute(dt)*

`2018-01-31 11:59:59` **second**(x) Seconds. *second(dt)*

week(x) Week of the year. *week(dt)*
isoweek() ISO 8601 week.
epiweek() Epidemiological week.

quarter(x, with_year = FALSE) Quarter. *quarter(dt)*

semester(x, with_year = FALSE) Semester. *semester(dt)*

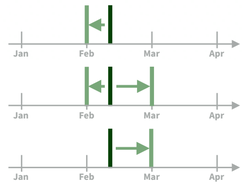
am(x) Is it in the am? *am(dt)*
pm(x) Is it in the pm? *pm(dt)*

dst(x) Is it daylight savings? *dst(d)*

leap_year(x) Is it a leap year? *leap_year(d)*

update(object, ..., simple = FALSE) *update(dt, mday = 2, hour = 1)*

Round Date-times



floor_date(x, unit = "second") Round down to nearest unit. *floor_date(dt, unit = "month")*

round_date(x, unit = "second") Round to nearest unit. *round_date(dt, unit = "month")*

ceiling_date(x, unit = "second", change_on_boundary = NULL) Round up to nearest unit. *ceiling_date(dt, unit = "month")*

rollback(dates, roll_to_first = FALSE, preserve_hms = TRUE) Roll back to last day of previous month. *rollback(dt)*

Stamp Date-times

stamp() Derive a template from an example string and return a new function that will apply the template to date-times. Also **stamp_date**() and **stamp_time**().

1. Derive a template, create a function
   sf <- stamp("Created Sunday, Jan 17, 1999 3:34")
2. Apply the template to dates
   sf(ymd("2010-04-05"))
   ## [1] "Created Monday, Apr 05, 2010 00:00"

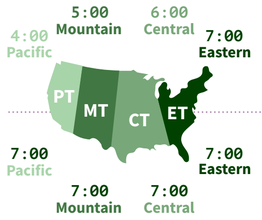
Tip: use a date with day > 12

Time Zones

R recognizes ~600 time zones. Each encodes the time zone, Daylight Savings Time, and historical calendar variations for an area. R assigns *one* time zone per vector.

Use the **UTC** time zone to avoid Daylight Savings.

OlsonNames() Returns a list of valid time zone names. *OlsonNames()*



with_tz(time, tzone = "") Get the **same date-time** in a new time zone (a new clock time). *with_tz(dt, "US/Pacific")*

force_tz(time, tzone = "") Get the **same clock time** in a new time zone (a new date-time). *force_tz(dt, "US/Pacific")*

* on a typical day

Data types with