Data preprocessing for analysis

Signal detection of spontaneous medical device reports over time

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1 Set up

1.1 Packages

```
suppressPackageStartupMessages({
  library("readr")
  library("dplyr")
  library("tidyr")
  library("lubridate") # way to handle dates better than default R way
  library("ggplot2")
  library("ggrepel")
  library("knitr")
  library("foreach")
  library("arrow") # read/write parquet files
})



# here are the functions written for this project
source("r/_funcs.R")
```

1.2 Constants

```
# arbitrarily, let's go with minimum cell count of 1
arbitrary_cell_min <- 1

# these are the thresholds for pain_topic to be pain == TRUE
# thresholds <- c(0.010, 0.025, 0.05, 0.075, 0.100)
thresholds <- seq(0.010, 0.100, by = 0.005) #, 0.150)


col_pal <- c("cyan4", "darkorange", "purple", "dodgerblue")


target_lst <-
  list(
    "pelvic_mesh",
    "pelvic_mesh",
    "pelvic_mesh",
```

```
    "hernia_mesh",
    c("hernia_mesh", "other_mesh")
  )

compar_lst <-
  list(
    "hernia_mesh",
    c("hernia_mesh", "other_mesh"),
    c("hernia_mesh", "other_mesh", "other_device"),
    "other_mesh",
    "other_device"
  )
```

2 Data wrangling

2.1 Read data

```
clean_data_cols <-
  cols(
    Report_ID = col_double(),
    Date = col_date(format = ""),
    pain_word = col_logical(),
    pain_topic = col_double(),
    type = col_character()
  )

clean_data <- read_csv("dat/clean_data.csv", col_types = clean_data_cols)
```

2.2 Clean/remove duplicates

```
### all look like duplicates
inner_join(
  clean_data,
  clean_data %>%
    group_by(Report_ID) %>%
    summarise(n = n(), .groups = "drop") %>%
    dplyr::filter(n > 1),
  "Report_ID"
) %>%
  arrange(Report_ID) %>%
  print(., n = nrow(.))
```

```
# A tibble: 26 x 6
   Report_ID Date       pain_word pain_topic type             n
       <dbl> <date>     <lgl>          <dbl> <chr>        <int>
 1     29914 2014-07-03 TRUE          0.0270 other_device     2
 2     29914 2014-07-03 TRUE          0.0270 other_device     2
 3     31508 2014-07-03 TRUE          0.0882 other_device     2
 4     31508 2014-07-03 TRUE          0.0882 other_device     2
 5     32629 2014-07-03 FALSE         0      other_device     2
 6     32629 2014-07-03 FALSE         0      other_device     2
 7     36586 2015-03-25 FALSE         0      other_device     2
```

8	36586	2015-03-25	FALSE	0	other_device	2
9	36677	2015-06-26	FALSE	0	other_device	2
10	36677	2015-06-26	FALSE	0	other_device	2
11	36953	2015-06-06	FALSE	0	other_device	2
12	36953	2015-06-06	FALSE	0	other_device	2
13	41788	2016-12-08	FALSE	0	other_device	2
14	41788	2016-12-08	FALSE	0	other_device	2
15	43614	2016-12-13	FALSE	0	other_device	2
16	43614	2016-12-13	FALSE	0	other_device	2
17	45287	2017-06-04	FALSE	0	other_device	2
18	45287	2017-06-04	FALSE	0	other_device	2
19	45369	2017-05-20	FALSE	0	other_device	2
20	45369	2017-05-20	FALSE	0	other_device	2
21	45749	2017-10-06	FALSE	0	other_device	2
22	45749	2017-10-06	FALSE	0	other_device	2
23	46029	2017-10-06	FALSE	0	other_device	2
24	46029	2017-10-06	FALSE	0	other_device	2
25	46030	2017-09-06	FALSE	0	other_device	2
26	46030	2017-09-06	FALSE	0	other_device	2

```r
# make dup free
clean_data <-
  clean_data %>%
  arrange(Report_ID, Date, desc(pain_word)) %>% # pain first in dups
  group_by(Report_ID) %>%
  dplyr::filter(row_number() == 1) %>%
  ungroup(.) %>%
  arrange(Date, Report_ID, desc(pain_word), desc(pain_topic))


clean_data %>%
  dplyr::filter(type == "other_mesh") %>%
  # select(Report_ID) %>%
  write_csv("out/other_mesh_ids.csv")
```

2.3 Inspect and summarise data

```r
cat("First 10 rows of raw data\n")
```

First 10 rows of raw data

```
clean_data %>%
  arrange(Date) %>%
  dplyr::filter(row_number() < 11) %>%
  kable(.)
```

Report_ID	Date	pain_word	pain_topic	type
26696	2012-01-08	FALSE	0.0555556	other_device
27722	2012-01-08	FALSE	0.0000000	other_device
28827	2012-01-10	FALSE	0.0000000	other_device
28828	2012-01-10	TRUE	0.0500000	other_device
28452	2012-01-11	FALSE	0.0000000	other_device
28758	2012-01-11	FALSE	0.0000000	other_device
28826	2012-01-11	FALSE	0.0400000	other_device
29097	2012-01-11	FALSE	0.0000000	other_device
29100	2012-01-11	FALSE	0.0000000	other_device
29101	2012-01-11	FALSE	0.0000000	other_device

```
# clean_data <-
#   clean_data %>%
#   dplyr::filter(
#     type %in% c("pelvic_mesh", "hernia_mesh")
#   )


clean_data %>%
  with(., table(type, pain_word)) %>%
  knitr::kable(.)
```

	FALSE	TRUE
hernia_mesh	42	4
other_device	12741	1184
other_mesh	52	32
pelvic_mesh	32	70

```
clean_data %>%
  with(., table(type, pain_topic >= 0.05)) %>%
```

```
  knitr::kable(.)
```

	FALSE	TRUE
hernia_mesh	38	8
other_device	12386	1539
other_mesh	47	37
pelvic_mesh	25	77

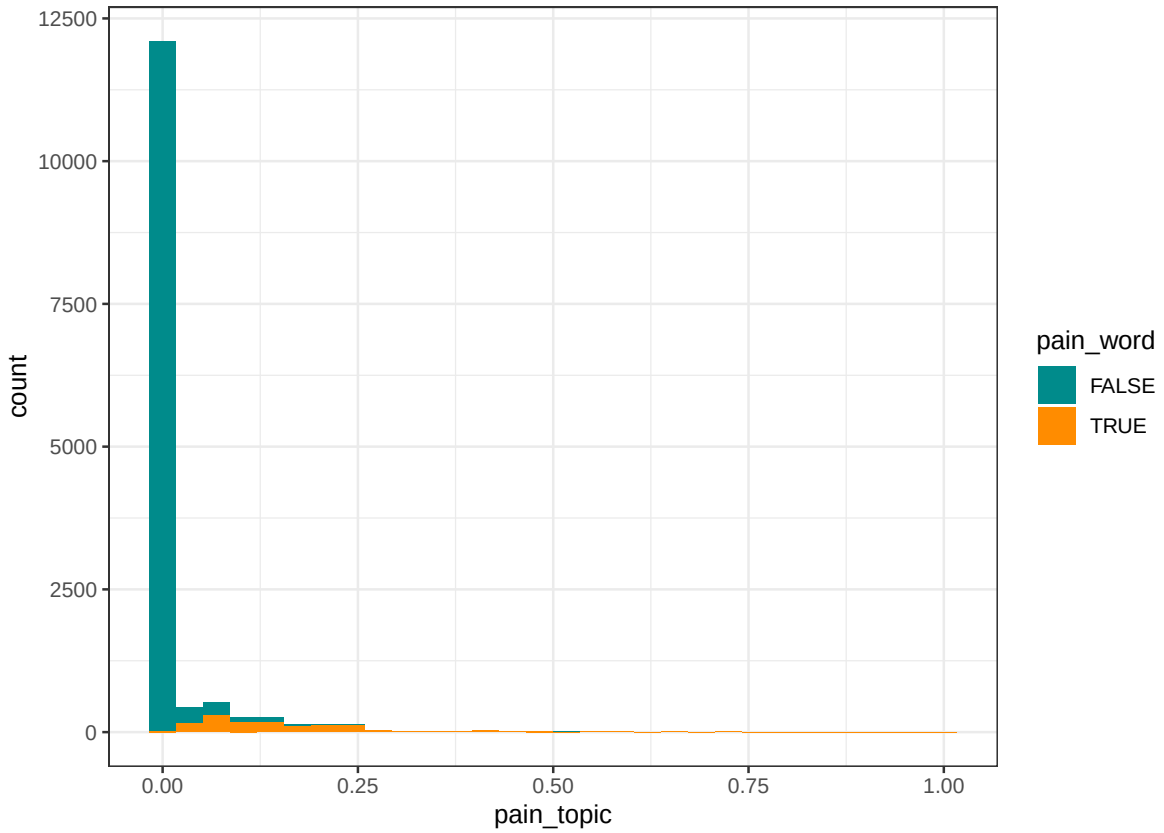
```
# These are the device groups and subgroups.
clean_data %>%
  group_by(type) %>%
  summarise(count = n()) %>%
  kable(.)
```

type	count
hernia_mesh	46
other_device	13925
other_mesh	84
pelvic_mesh	102

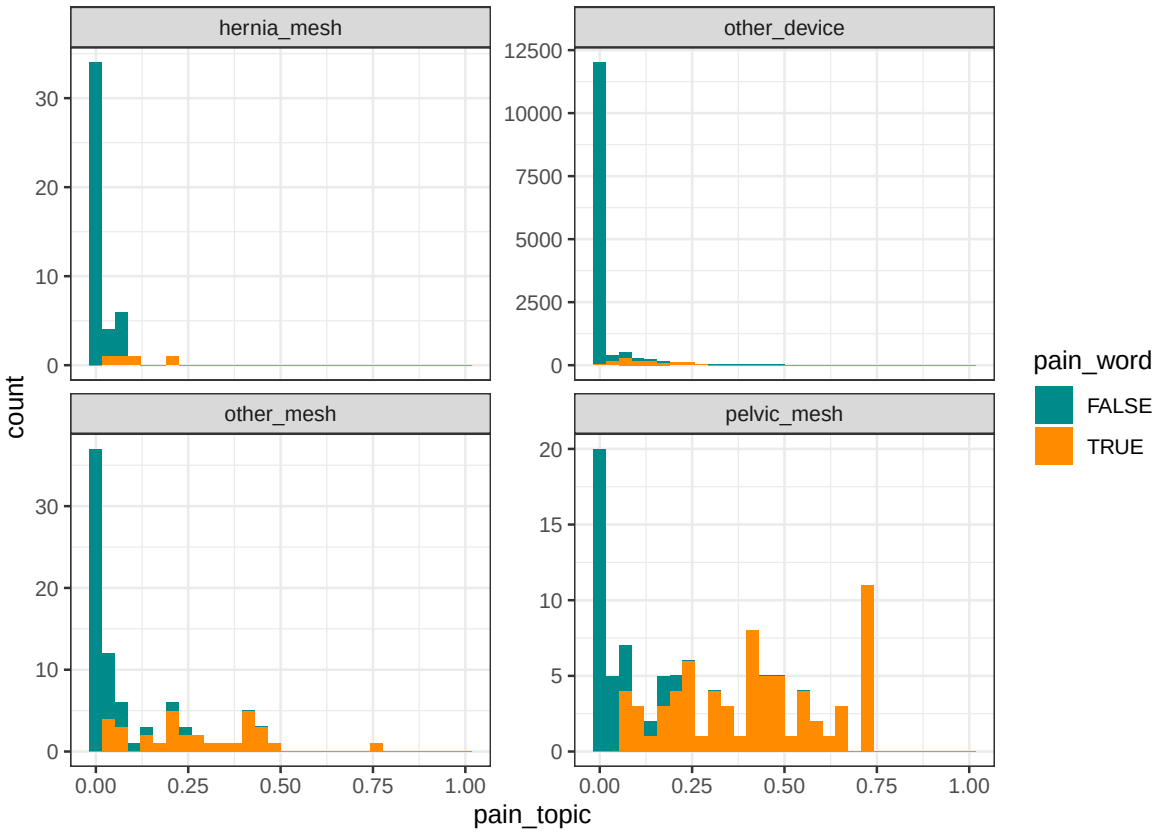
```
cat("\n\n## Histogram of `pain_word` (boolean) v `pain_topic` (score)")
```

Histogram of `pain_word` (boolean) v `pain_topic` (score)

```
clean_data %>%
  ggplot(., aes(pain_topic, fill = pain_word)) +
  geom_histogram(bins = 30) +
  scale_fill_manual(values = col_pal[1:2]) +
  theme_bw()
```




```
clean_data %>%
  dplyr::filter(
    type %in% c("pelvic_mesh", "hernia_mesh", "other_mesh", "other_device")
  ) %>%
  ggplot(., aes(pain_topic, fill = pain_word)) +
  geom_histogram(bins = 30) +
  scale_fill_manual(values = col_pal[1:2]) +
  facet_wrap(~ type, scales = "free_y") +
  theme_bw()
```


hernia_mesh
other_device
other_mesh
pelvic_mesh
count
pain_topic
pain_word
FALSE
TRUE
0
10
20
30
2500
5000
7500
10000
12500
5
15
0.00
0.25
0.50
0.75
1.00

3 Create data for analysis from raw data

3.1 Creation of analysis data

```
### testing: example 1
# Use pelvic mesh as group 1 and hernia_mesh mesh devices as group 2.
# The value of interest is the pain topic, being above the threshold of 0.05.
# (i.e. 5% of the document contains words from the pain topic)
# You can adjust the topic threshold if you want to balance the groups more.
# A higher topic_threshold will look for documents that discuss "pain" more, and
# hence find less pain documents.

# get_signal_dat(
#   g1 = "pelvic_mesh",
#   g2 = "hernia_mesh",
#   pain_type = "pain_topic",
#   thresh = 0.05,
#   cell_min = 1,
#   cumul = TRUE,
#   verbose = FALSE
# ) %>%
#   bind_cols(., thresh = 0.05)



# takes ~ 20 sec
cumul_dat <-
  foreach(i = 1:length(target_lst), .combine = bind_rows, .packages = "dplyr") %do% {
    foreach(th_j = thresholds, .combine = bind_rows, .packages = "dplyr") %do% {

      get_signal_dat(
        g1 = target_lst[[i]],
        g2 = compar_lst[[i]],
        pain_type = "pain_topic",
        thresh = th_j,
        cell_min = 1,
        cumul = TRUE,
        verbose = FALSE
      ) %>%
        mutate(
          grps =
```

```
            paste0(
              paste(target_lst[[i]], collapse = "/"),
              " v ",
              paste(compar_lst[[i]], collapse = "/")
            ),
          dat_type = "cumulative",
          thresh = th_j
        ) %>%
          select(grps, dat_type, thresh, everything())

    }
  }
cumul_dat
```

```
# A tibble: 4,523 x 8
   grps                      dat_type   thresh mnth       nA    nB    nC    nD
   <chr>                     <chr>       <dbl> <chr>   <dbl> <dbl> <dbl> <dbl>
 1 pelvic_mesh v hernia_mesh cumulative   0.01 2013-01     3     7     1     2
 2 pelvic_mesh v hernia_mesh cumulative   0.01 2013-02     3     7     1     4
 3 pelvic_mesh v hernia_mesh cumulative   0.01 2013-04     3     7     1     5
 4 pelvic_mesh v hernia_mesh cumulative   0.01 2013-05     4    10     1     5
 5 pelvic_mesh v hernia_mesh cumulative   0.01 2013-07     4    11     1     7
 6 pelvic_mesh v hernia_mesh cumulative   0.01 2013-08     5    11     1     7
 7 pelvic_mesh v hernia_mesh cumulative   0.01 2013-09     5    11     2     9
 8 pelvic_mesh v hernia_mesh cumulative   0.01 2013-11     8    11     2     9
 9 pelvic_mesh v hernia_mesh cumulative   0.01 2013-12     9    11     2     9
10 pelvic_mesh v hernia_mesh cumulative   0.01 2014-03     9    11     2    10
# ... with 4,513 more rows
```

```
# takes ~ 20 sec
snpsh_dat <-
  foreach(i = 1:length(target_lst), .combine = bind_rows, .packages = "dplyr") %do% {
    foreach(th_j = thresholds, .combine = bind_rows, .packages = "dplyr") %do% {

      get_signal_dat(
        g1 = target_lst[[i]],
        g2 = compar_lst[[i]],
        pain_type = "pain_topic",
        thresh = th_j,
        cell_min = 1,
```

```
        cumul = FALSE,
        verbose = FALSE
      ) %>%
        mutate(
          grps =
            paste0(
              paste(target_lst[[i]], collapse = "/"),
              " v ",
              paste(compar_lst[[i]], collapse = "/")
            ),
          dat_type = "snapshot",
          thresh = th_j
        ) %>%
        select(grps, dat_type, thresh, everything())

    }
  }
snpsh_dat
```

```
# A tibble: 4,523 x 8
   grps                      dat_type thresh mnth       nA    nB    nC    nD
   <chr>                     <chr>     <dbl> <chr>   <dbl> <dbl> <dbl> <dbl>
 1 pelvic_mesh v hernia_mesh snapshot   0.01 2013-01     3     7     1     2
 2 pelvic_mesh v hernia_mesh snapshot   0.01 2013-02     0     0     0     2
 3 pelvic_mesh v hernia_mesh snapshot   0.01 2013-04     0     0     0     1
 4 pelvic_mesh v hernia_mesh snapshot   0.01 2013-05     1     3     0     0
 5 pelvic_mesh v hernia_mesh snapshot   0.01 2013-07     0     1     0     2
 6 pelvic_mesh v hernia_mesh snapshot   0.01 2013-08     1     0     0     0
 7 pelvic_mesh v hernia_mesh snapshot   0.01 2013-09     0     0     1     2
 8 pelvic_mesh v hernia_mesh snapshot   0.01 2013-11     3     0     0     0
 9 pelvic_mesh v hernia_mesh snapshot   0.01 2013-12     1     0     0     0
10 pelvic_mesh v hernia_mesh snapshot   0.01 2014-03     0     0     0     1
# ... with 4,513 more rows
```

3.2 Check analysis data

```
nrow(cumul_dat)
```

```
[1] 4523
```

```r
if (nrow(cumul_dat) != nrow(snpsh_dat)) {
  stop("logic of creating analysis data producing different # rows in data")
}


chk_start_vals <-
  inner_join(
    cumul_dat %>%
      group_by(grps, dat_type, thresh) %>%
      dplyr::filter(row_number() == 1) %>%
      ungroup(.),
    snpsh_dat %>%
      group_by(grps, dat_type, thresh) %>%
      dplyr::filter(row_number() == 1) %>%
      ungroup(.),
    c("grps", "thresh")
  ) %>%
    mutate(
      mnth_same = (mnth.x == mnth.y),
      counts_same = (nA.x = nA.y) & (nB.x = nB.y) & (nC.x = nC.y) & (nD.x = nD.y)
    )

chk_start_vals %>%
  select(grps, thresh, dat_type.x, dat_type.y, mnth_same, counts_same)
```

```
# A tibble: 95 x 6
   grps                      thresh dat_type.x dat_type.y mnth_same counts_same
   <chr>                      <dbl> <chr>      <chr>      <lgl>     <lgl>
 1 pelvic_mesh v hernia_mesh  0.01  cumulative snapshot   TRUE      TRUE
 2 pelvic_mesh v hernia_mesh  0.015 cumulative snapshot   TRUE      TRUE
 3 pelvic_mesh v hernia_mesh  0.02  cumulative snapshot   TRUE      TRUE
 4 pelvic_mesh v hernia_mesh  0.025 cumulative snapshot   TRUE      TRUE
 5 pelvic_mesh v hernia_mesh  0.03  cumulative snapshot   TRUE      TRUE
 6 pelvic_mesh v hernia_mesh  0.035 cumulative snapshot   TRUE      TRUE
 7 pelvic_mesh v hernia_mesh  0.04  cumulative snapshot   TRUE      TRUE
 8 pelvic_mesh v hernia_mesh  0.045 cumulative snapshot   TRUE      TRUE
 9 pelvic_mesh v hernia_mesh  0.05  cumulative snapshot   TRUE      TRUE
10 pelvic_mesh v hernia_mesh  0.055 cumulative snapshot   TRUE      TRUE
# ... with 85 more rows
```

```r
with(chk_start_vals, table(mnth_same, counts_same, useNA = "ifany"))
```

```
          counts_same
mnth_same TRUE
     TRUE   95
```

```r
# check the first + second row in snapshot == second row in cumulative data
inner_join(
  cumul_dat %>%
    group_by(grps, thresh) %>%
    dplyr::filter(row_number() %in% 1:2) %>%
    ungroup(.),
  snpsh_dat %>%
    group_by(grps, thresh) %>%
    dplyr::filter(row_number() %in% 1:2) %>%
    ungroup(.),
  c("grps", "thresh", "mnth")
)
```

```
# A tibble: 190 x 13
   grps   dat_t~1 thresh mnth   nA.x  nB.x  nC.x  nD.x dat_t~2  nA.y  nB.y  nC.y
   <chr>  <chr>    <dbl> <chr> <dbl> <dbl> <dbl> <dbl> <chr>   <dbl> <dbl> <dbl>
 1 pelvi~ cumula~  0.01  2013~     3     7     1     2 snapsh~     3     7     1
 2 pelvi~ cumula~  0.01  2013~     3     7     1     4 snapsh~     0     0     0
 3 pelvi~ cumula~  0.015 2013~     3     7     1     2 snapsh~     3     7     1
 4 pelvi~ cumula~  0.015 2013~     3     7     1     4 snapsh~     0     0     0
 5 pelvi~ cumula~  0.02  2013~     5    11     1    10 snapsh~     5    11     1
 6 pelvi~ cumula~  0.02  2013~     8    11     1    10 snapsh~     3     0     0
 7 pelvi~ cumula~  0.025 2013~     5    11     1    10 snapsh~     5    11     1
 8 pelvi~ cumula~  0.025 2013~     8    11     1    10 snapsh~     3     0     0
 9 pelvi~ cumula~  0.03  2013~     5    11     1    10 snapsh~     5    11     1
10 pelvi~ cumula~  0.03  2013~     8    11     1    10 snapsh~     3     0     0
# ... with 180 more rows, 1 more variable: nD.y <dbl>, and abbreviated variable
#   names 1: dat_type.x, 2: dat_type.y
```

3.3 Export analysis data

```r
# all spontaneous report analysis data
sra_dat <-
  bind_rows(
    cumul_dat,
    snpsh_dat
  )

sra_dat %>%
  write_parquet(., sink = "dat/sra_dat.parquet")
```

4 Session information

```
format(Sys.time(), '%d %b %Y')
```

```
[1] "19 Jun 2023"
```

```
Sys.info() %>% as.data.frame(.)
```

```
                              .
sysname                 Windows
release                  10 x64
version              build 19044
nodename         DESKTOP-R5P5N23
machine                  x86-64
login                        ty
user                         ty
effective_user               ty
```

```
sessionInfo()
```

```
R version 4.2.2 (2022-10-31 ucrt)
Platform: x86_64-w64-mingw32/x64 (64-bit)
Running under: Windows 10 x64 (build 19044)

Matrix products: default

locale:
[1] LC_COLLATE=English_Australia.utf8  LC_CTYPE=English_Australia.utf8
[3] LC_MONETARY=English_Australia.utf8 LC_NUMERIC=C
[5] LC_TIME=English_Australia.utf8

attached base packages:
[1] stats     graphics  grDevices utils     datasets  methods   base

other attached packages:
[1] arrow_11.0.0.2  foreach_1.5.2   knitr_1.42      ggrepel_0.9.3
[5] ggplot2_3.4.1   lubridate_1.9.2 tidyr_1.3.0     dplyr_1.1.0
```

```
[9] readr_2.1.4

loaded via a namespace (and not attached):
 [1] Rcpp_1.0.10      pillar_1.8.1     compiler_4.2.2   iterators_1.0.14
 [5] tools_4.2.2      bit_4.0.5        digest_0.6.31    jsonlite_1.8.4
 [9] evaluate_0.20    lifecycle_1.0.3  tibble_3.1.8     gtable_0.3.1
[13] timechange_0.2.0 pkgconfig_2.0.3  rlang_1.0.6      cli_3.6.0
[17] rstudioapi_0.14  parallel_4.2.2   yaml_2.3.7       xfun_0.37
[21] fastmap_1.1.0    withr_2.5.0      generics_0.1.3   vctrs_0.5.2
[25] hms_1.1.2        bit64_4.0.5      grid_4.2.2       tidyselect_1.2.0
[29] glue_1.6.2       R6_2.5.1         fansi_1.0.4      vroom_1.6.1
[33] rmarkdown_2.20   farver_2.1.1     tzdb_0.3.0       purrr_1.0.1
[37] magrittr_2.0.3   codetools_0.2-18 scales_1.2.1     ellipsis_0.3.2
[41] htmltools_0.5.4  assertthat_0.2.1 colorspace_2.1-0 labeling_0.4.2
[45] utf8_1.2.3       munsell_0.5.0    crayon_1.5.2
```