Special data types

01-14-2020

Today, we will spend some time talking about some special data types in R. - factors - data and time

Factors

When importing data to R, base R has a burning desire to turn character information into factor. See for example, `read.table`, and `read.csv`.

```
library(tidyverse)
```

```
# to illustrate the issue of `read.csv`, let's write a csv file out of the gapminder dataset
write_csv(gss_cat, "gss_cat.csv")
```

```
# base R function, character variables are automatically converted to factors
read.csv("gss_cat.csv")
```

```
# readr function, character variables are imported as is
read_csv("gss_cat.csv")
# there are several workarounds,
# 1. we could use `mutate_if` to force the conversion
read_csv("gss_cat.csv") %>% mutate_if(is.character, as_factor)

# 2. we could specify the column types
read_csv("gss_cat.csv", col_types="dfdffffd")

# 3. use the rstudio import interface
```

Factor inspection

```
class(gss_cat$partyid)
```

```
## [1] "factor"
```

```
levels(gss_cat$partyid)
```

```
##  [1] "No answer"          "Don't know"         "Other party"
##  [4] "Strong republican"  "Not str republican" "Ind,near rep"
##  [7] "Independent"        "Ind,near dem"       "Not str democrat"
## [10] "Strong democrat"
```

```
nlevels(gss_cat$partyid)
```

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

```r
gss_cat %>% count(partyid)
```

```
## # A tibble: 10 x 2
##    partyid               n
##    <fct>             <int>
##  1 No answer           154
##  2 Don't know            1
##  3 Other party         393
##  4 Strong republican  2314
##  5 Not str republican 3032
##  6 Ind,near rep       1791
##  7 Independent        4119
##  8 Ind,near dem       2499
##  9 Not str democrat   3690
## 10 Strong democrat    3490
```

```r
fct_count(gss_cat$partyid, sort = TRUE)
```

```
## # A tibble: 10 x 2
##    f                     n
##    <fct>             <int>
##  1 Independent        4119
##  2 Not str democrat   3690
##  3 Strong democrat    3490
##  4 Not str republican 3032
##  5 Ind,near dem       2499
##  6 Strong republican  2314
##  7 Ind,near rep       1791
##  8 Other party         393
##  9 No answer           154
## 10 Don't know            1
```

Dropping unused levels

The number of levels won't change even all the rows corresponding to specific factor level are dropped.

```r
gss_cat2 <- gss_cat %>%
  filter(partyid %in% c("Independent", "Strong democrat", "Strong republican"))
nlevels(gss_cat2$partyid)
```

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

```r
# drop a specific factor
gss_cat2$partyid <- gss_cat2$partyid%>% fct_drop()
levels(gss_cat2$partyid )
```

```
## [1] "Strong republican" "Independent"       "Strong democrat"
```

```
# drop all the factors in a data frame
gss_cat2 <- gss_cat2 %>% droplevels()
```

Change order of the levels

```
gss_cat$partyid %>%
  levels()
```

```
##  [1] "No answer"          "Don't know"         "Other party"
##  [4] "Strong republican"  "Not str republican" "Ind,near rep"
##  [7] "Independent"        "Ind,near dem"       "Not str democrat"
## [10] "Strong democrat"
```

```
## order by frequency
gss_cat %>% mutate(partyid = partyid %>% fct_infreq())
```

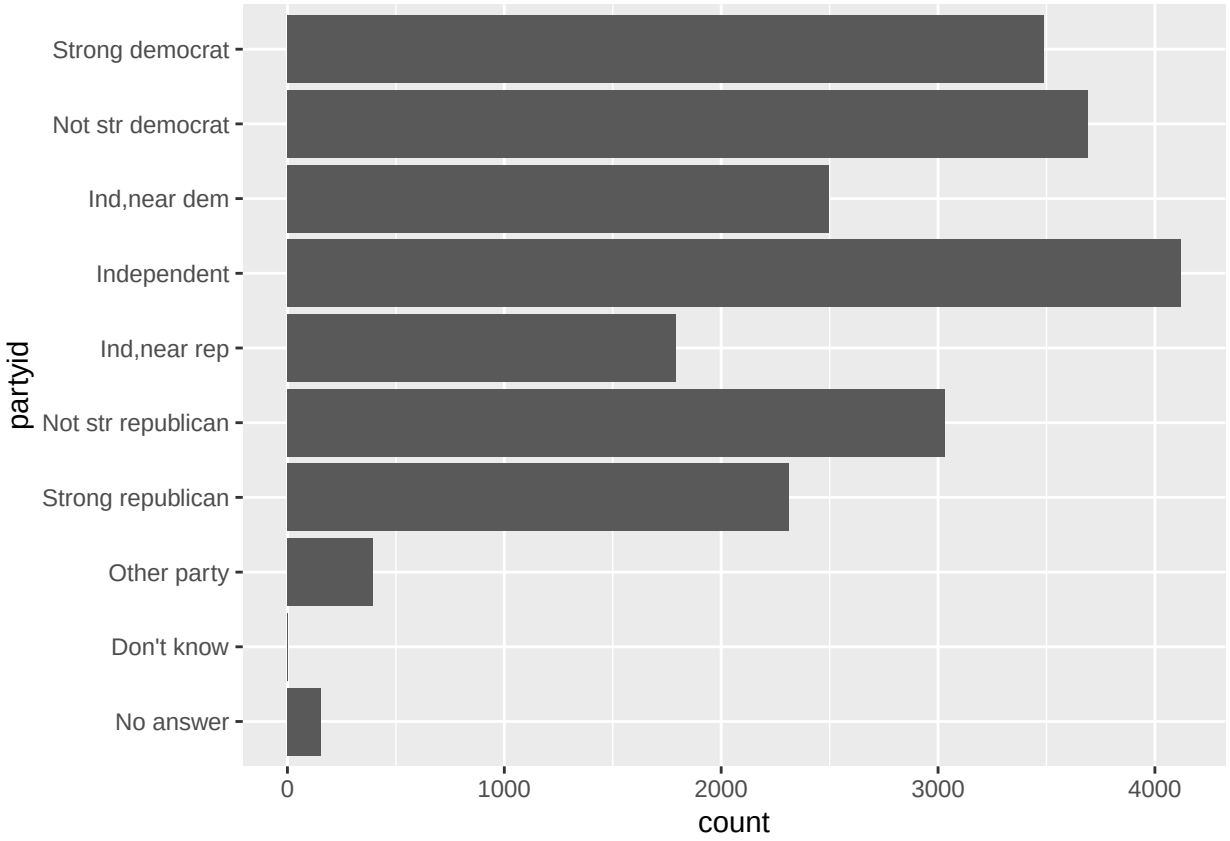
```
## # A tibble: 21,483 x 9
##     year marital     age race  rincome    partyid     relig     denom    tvhours
##    <int> <fct>     <int> <fct> <fct>      <fct>       <fct>     <fct>      <int>
##  1  2000 Never ma~    26 White $8000 to ~ Ind,near r~ Protesta~ Souther~      12
##  2  2000 Divorced     48 White $8000 to ~ Not str re~ Protesta~ Baptist~      NA
##  3  2000 Widowed      67 White Not appli~ Independent Protesta~ No deno~       2
##  4  2000 Never ma~    39 White Not appli~ Ind,near r~ Orthodox~ Not app~       4
##  5  2000 Divorced     25 White Not appli~ Not str de~ None      Not app~       1
##  6  2000 Married      25 White $20000 - ~ Strong dem~ Protesta~ Souther~      NA
##  7  2000 Never ma~    36 White $25000 or~ Not str re~ Christian Not app~       3
##  8  2000 Divorced     44 White $7000 to ~ Ind,near d~ Protesta~ Luthera~      NA
##  9  2000 Married      44 White $25000 or~ Not str de~ Protesta~ Other          0
## 10  2000 Married      47 White $25000 or~ Strong rep~ Protesta~ Souther~       3
## # ... with 21,473 more rows
```

```
## backwards!
gss_cat %>% mutate(partyid = partyid %>% fct_infreq() %>% fct_rev())
```

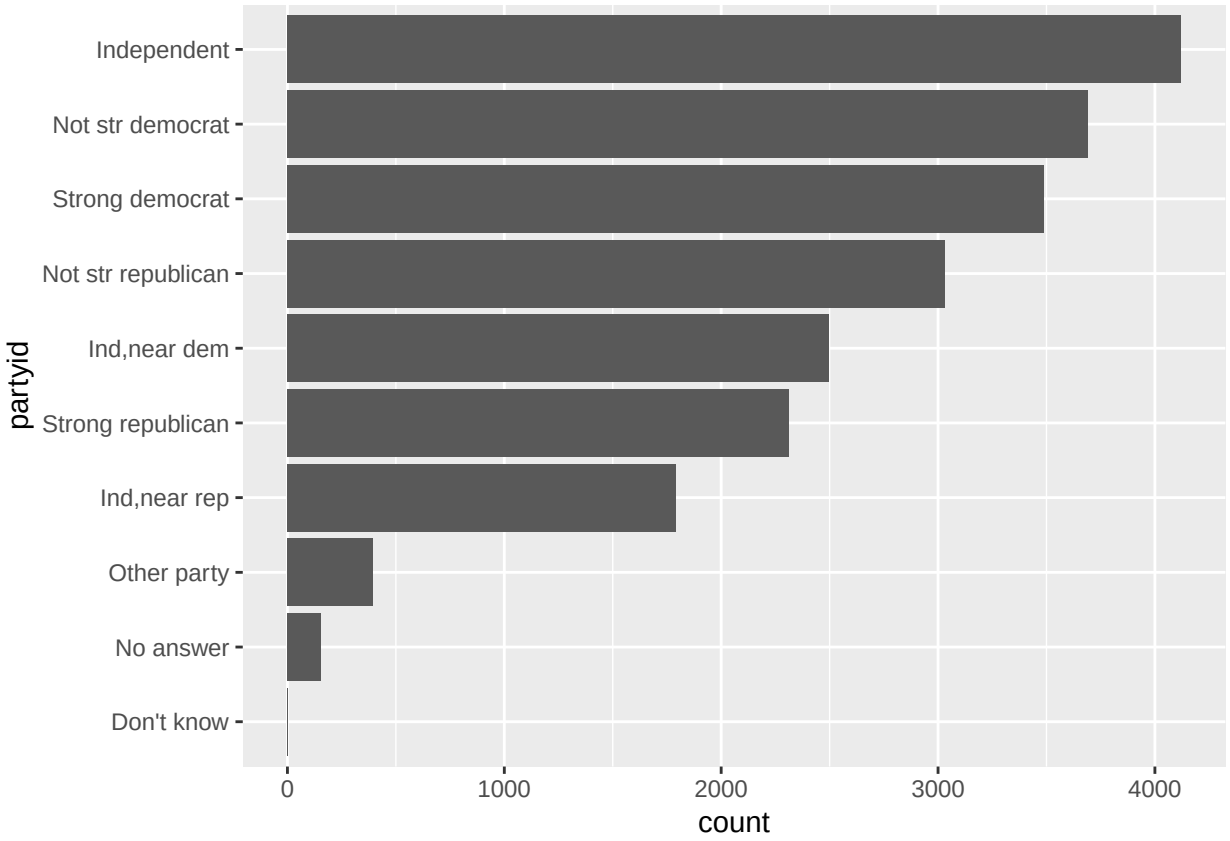
```
## # A tibble: 21,483 x 9
##     year marital     age race  rincome    partyid     relig     denom    tvhours
##    <int> <fct>     <int> <fct> <fct>      <fct>       <fct>     <fct>      <int>
##  1  2000 Never ma~    26 White $8000 to ~ Ind,near r~ Protesta~ Souther~      12
##  2  2000 Divorced     48 White $8000 to ~ Not str re~ Protesta~ Baptist~      NA
##  3  2000 Widowed      67 White Not appli~ Independent Protesta~ No deno~       2
##  4  2000 Never ma~    39 White Not appli~ Ind,near r~ Orthodox~ Not app~       4
##  5  2000 Divorced     25 White Not appli~ Not str de~ None      Not app~       1
##  6  2000 Married      25 White $20000 - ~ Strong dem~ Protesta~ Souther~      NA
##  7  2000 Never ma~    36 White $25000 or~ Not str re~ Christian Not app~       3
##  8  2000 Divorced     44 White $7000 to ~ Ind,near d~ Protesta~ Luthera~      NA
##  9  2000 Married      44 White $25000 or~ Not str de~ Protesta~ Other          0
## 10  2000 Married      47 White $25000 or~ Strong rep~ Protesta~ Souther~       3
## # ... with 21,473 more rows
```

Why?

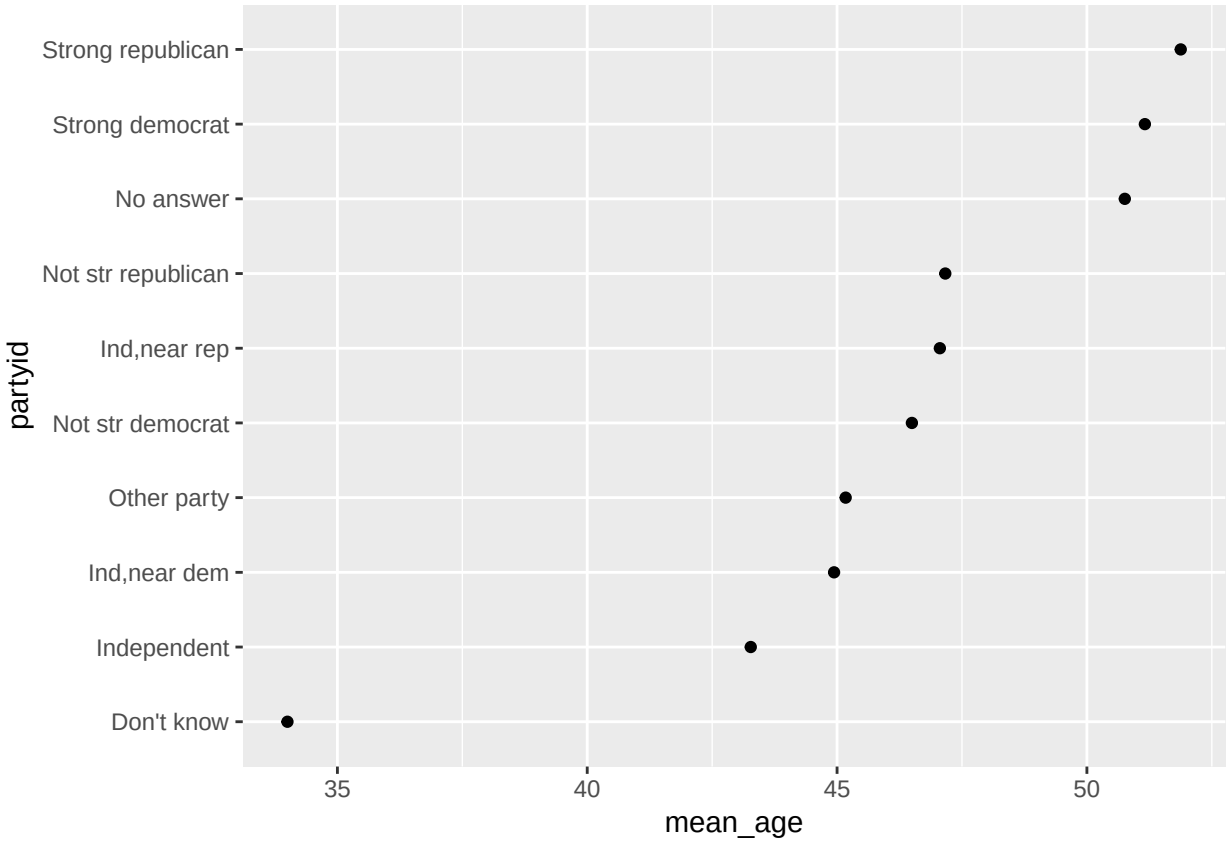
```
ggplot(gss_cat) + geom_bar(aes(partyid)) + coord_flip()
```




```
ggplot(gss_cat) + geom_bar(aes(partyid %>% fct_infreq() %>% fct_rev())) +
  xlab("partyid") + coord_flip()
```




```
# reorder factor according to values of another variable
gss_cat %>%
  group_by(partyid) %>%
  summarize(mean_age = mean(age, na.rm = TRUE)) %>%
  ggplot(aes(x = mean_age, y = fct_reorder(partyid, mean_age))) +
  geom_point() + ylab("partyid")
```



Change to any order

```
gss_cat$partyid %>% levels()
```

```
##  [1] "No answer"          "Don't know"         "Other party"
##  [4] "Strong republican"  "Not str republican" "Ind,near rep"
##  [7] "Independent"        "Ind,near dem"       "Not str democrat"
## [10] "Strong democrat"
```

```
gss_cat$partyid %>% fct_relevel("Strong republican", "Strong democrat") %>% levels()
```

```
##  [1] "Strong republican"  "Strong democrat"    "No answer"
##  [4] "Don't know"         "Other party"        "Not str republican"
##  [7] "Ind,near rep"       "Independent"        "Ind,near dem"
## [10] "Not str democrat"
```

```
# use mutate verb to modifly the data frame
gss_cat %>% mutate(partyid = partyid %>% fct_relevel("Strong republican", "Strong democrat"))
```

```
## # A tibble: 21,483 x 9
##     year marital     age race  rincome    partyid     relig     denom    tvhours
##    <int> <fct>     <int> <fct> <fct>      <fct>       <fct>     <fct>      <int>
```

```
##  1  2000 Never ma~    26 White $8000 to ~ Ind,near r~ Protesta~ Souther~      12
##  2  2000 Divorced     48 White $8000 to ~ Not str re~ Protesta~ Baptist~      NA
##  3  2000 Widowed      67 White Not appli~ Independent Protesta~ No deno~       2
##  4  2000 Never ma~    39 White Not appli~ Ind,near r~ Orthodox~ Not app~       4
##  5  2000 Divorced     25 White Not appli~ Not str de~ None      Not app~       1
##  6  2000 Married      25 White $20000 - ~ Strong dem~ Protesta~ Souther~      NA
##  7  2000 Never ma~    36 White $25000 or~ Not str re~ Christian Not app~       3
##  8  2000 Divorced     44 White $7000 to ~ Ind,near d~ Protesta~ Luthera~      NA
##  9  2000 Married      44 White $25000 or~ Not str de~ Protesta~ Other         0
## 10  2000 Married      47 White $25000 or~ Strong rep~ Protesta~ Souther~       3
## # ... with 21,473 more rows
```

Recode levelsx

```
gss_cat$partyid %>% levels()
```

```
##  [1] "No answer"          "Don't know"         "Other party"
##  [4] "Strong republican"  "Not str republican" "Ind,near rep"
##  [7] "Independent"        "Ind,near dem"       "Not str democrat"
## [10] "Strong democrat"
```

```
gss_cat$partyid %>%
  fct_recode(
    "Independent,near rep" = "Ind,near rep",
    "Independent,near dem" = "Ind,near dem") %>%
  levels()
```

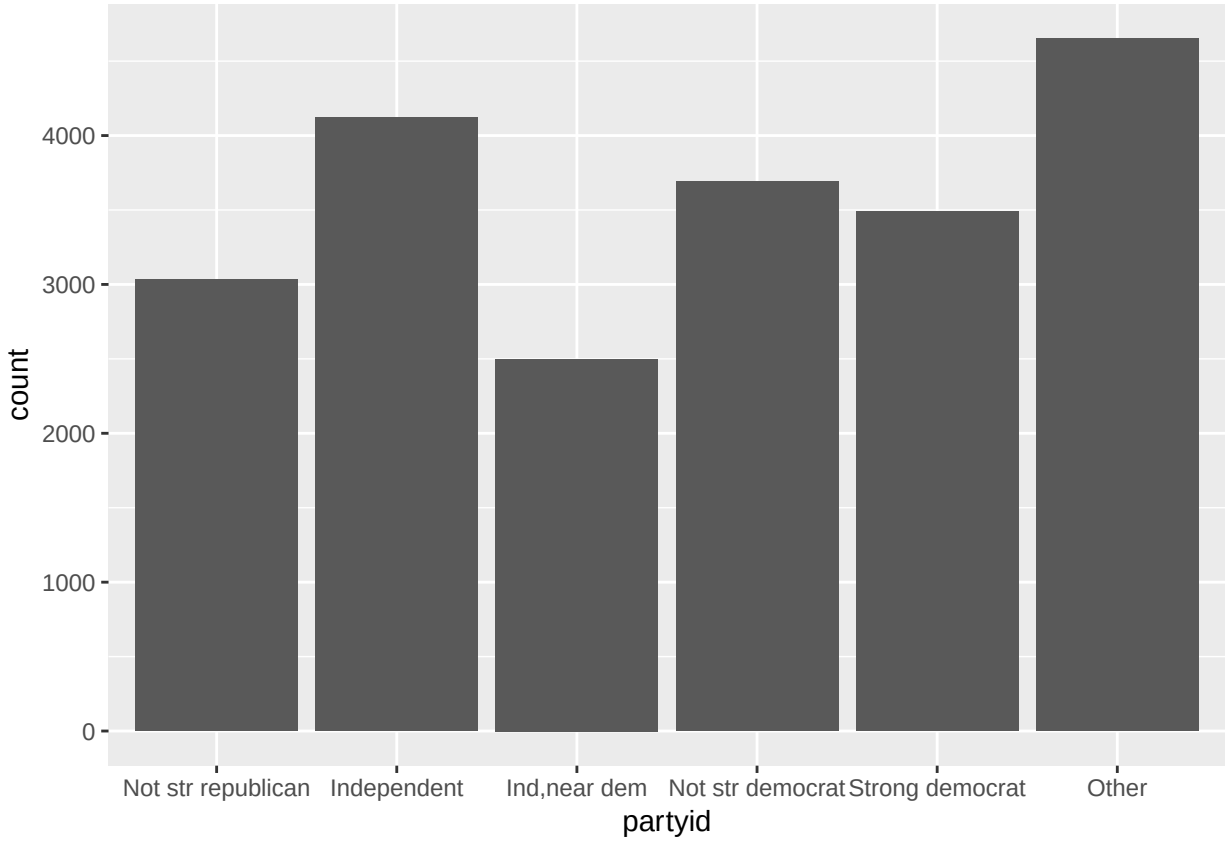
```
##  [1] "No answer"            "Don't know"           "Other party"
##  [4] "Strong republican"    "Not str republican"   "Independent,near rep"
##  [7] "Independent"          "Independent,near dem" "Not str democrat"
## [10] "Strong democrat"
```

```
# if we need to modifly the data frame, then
gss_cat %>% mutate(partyid = partyid %>%
                     fct_recode(
                       "Independent,near rep" = "Ind,near rep",
                       "Independent,near dem" = "Ind,near dem")
                   )
```

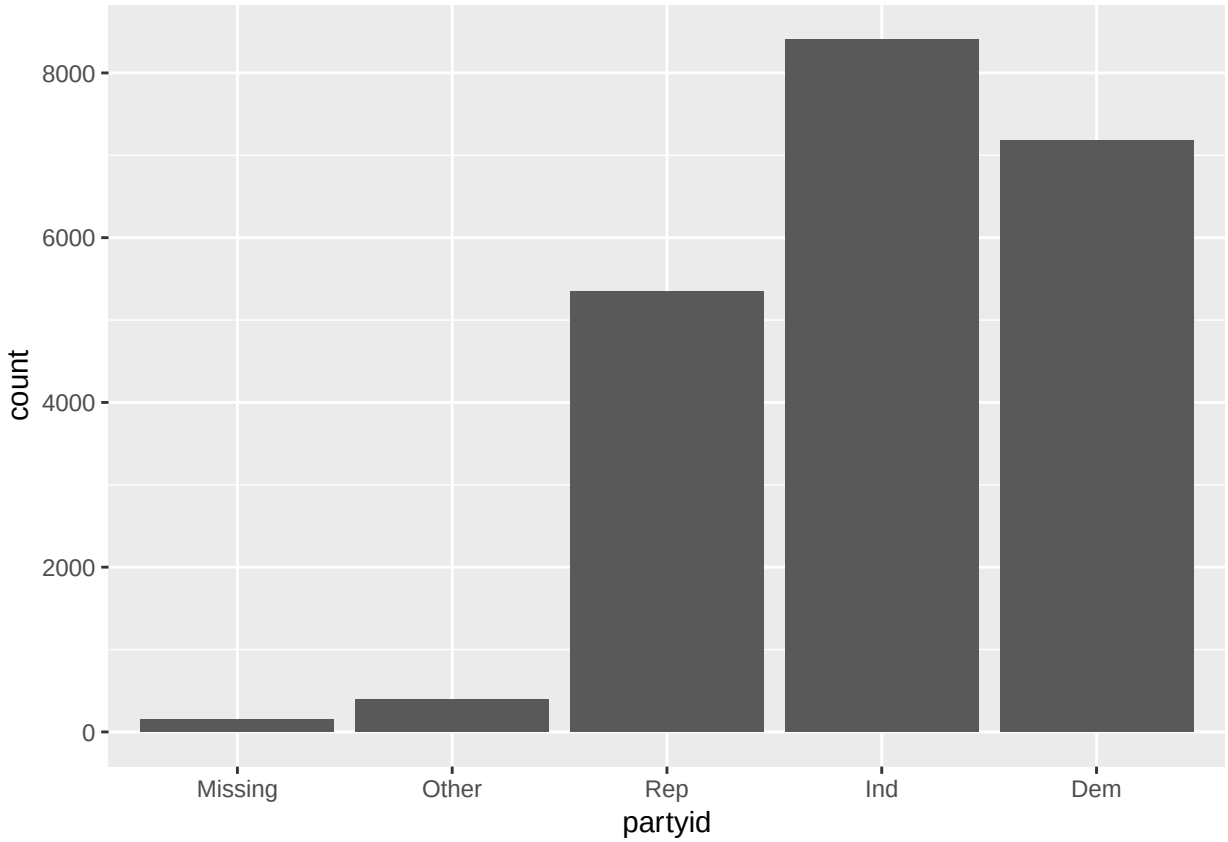
```
## # A tibble: 21,483 x 9
##     year marital     age race  rincome    partyid     relig     denom    tvhours
##    <int> <fct>     <int> <fct> <fct>      <fct>       <fct>     <fct>      <int>
##  1  2000 Never ma~    26 White $8000 to ~ Independen~ Protesta~ Souther~      12
##  2  2000 Divorced     48 White $8000 to ~ Not str re~ Protesta~ Baptist~      NA
##  3  2000 Widowed      67 White Not appli~ Independent Protesta~ No deno~       2
##  4  2000 Never ma~    39 White Not appli~ Independen~ Orthodox~ Not app~       4
##  5  2000 Divorced     25 White Not appli~ Not str de~ None      Not app~       1
##  6  2000 Married      25 White $20000 - ~ Strong dem~ Protesta~ Souther~      NA
##  7  2000 Never ma~    36 White $25000 or~ Not str re~ Christian Not app~       3
##  8  2000 Divorced     44 White $7000 to ~ Independen~ Protesta~ Luthera~      NA
##  9  2000 Married      44 White $25000 or~ Not str de~ Protesta~ Other         0
## 10  2000 Married      47 White $25000 or~ Strong rep~ Protesta~ Souther~       3
## # ... with 21,473 more rows
```

Collapse levels

```
# collapse automatically
gss_cat %>%
  mutate(partyid = partyid %>% fct_lump(5)) %>%
  ggplot() + geom_bar(aes(partyid))
```




```
# collapse manually
gss_cat %>% mutate(partyid = partyid %>% fct_collapse(
    Missing = c("No answer", "Don't know"),
    Rep = c("Strong republican", "Not str republican"),
    Ind = c("Ind,near rep", "Independent", "Ind,near dem"),
    Dem = c("Not str democrat", "Strong democrat"),
    Other = c("Other party")
  )) %>%
  ggplot() + geom_bar(aes(partyid))
```



Remark: there is a bug in forcats v0.4.0 such that the argument `group_other` in `fct_collapse` is malfunction.

Date and time

```
library(lubridate)
```

```
##
## Attaching package: 'lubridate'
```

```
## The following object is masked from 'package:base':
##
##     date
```

```
today()
```

```
## [1] "2020-01-15"
```

```
now()  # in UTC (Coordinated Universal Time)
```

```
## [1] "2020-01-15 23:05:09 PST"
```

```
ymd("2017-01-31")
```

```
## [1] "2017-01-31"
```

```
mdy("January 31st, 2017")
```

```
## [1] "2017-01-31"
```

```
dmy("31-Jan-2017")
```

```
## [1] "2017-01-31"
```

```
ymd_hms("2017-01-31 20:11:59")
```

```
## [1] "2017-01-31 20:11:59 UTC"
```

```
mdy_hm("01/31/2017 08:01")
```

```
## [1] "2017-01-31 08:01:00 UTC"
```

```
mdy_hm("01/31/2017 08:01", tz = "America/New_York")
```

```
## [1] "2017-01-31 08:01:00 EST"
```

```
# all the time zone names
OlsonNames
```

```
## function (tzdir = NULL)
## {
##     if (is.null(tzdir)) {
##         if (.Platform$OS.type == "windows")
##             tzdir <- Sys.getenv("TZDIR", file.path(R.home("share"),
##                 "zoneinfo"))
##         else {
##             tzdirs <- c(Sys.getenv("TZDIR"), file.path(R.home("share"),
##                 "zoneinfo"), "/usr/share/zoneinfo", "/share/zoneinfo",
##                 "/usr/share/lib/zoneinfo", "/usr/lib/zoneinfo",
##                 "/usr/local/etc/zoneinfo", "/etc/zoneinfo", "/usr/etc/zoneinfo")
##             tzdirs <- tzdirs[file.exists(tzdirs)]
##             if (!length(tzdirs)) {
##                 warning("no Olson database found")
##                 return(character())
##             }
##             else tzdir <- tzdirs[1L]
##         }
##     }
##     else if (!dir.exists(tzdir))
##         stop(sprintf("%s is not a directory", sQuote(tzdir)),
##             domain = NA)
```

```
##     x <- list.files(tzdir, recursive = TRUE)
##     ver <- if (file.exists(vf <- file.path(tzdir, "VERSION")))
##         readLines(vf, warn = FALSE)
##     else if (file.exists(vf <- file.path(tzdir, "+VERSION")))
##         readLines(vf, warn = FALSE)
##     x <- setdiff(x, "VERSION")
##     ans <- grep("^[ABCDEFGHIJKLMNOPQRSTUVWXYZ]", x, value = TRUE)
##     if (!is.null(ver))
##         attr(ans, "Version") <- ver
##     ans
## }
## <bytecode: 0x7fb9394cb3f0>
## <environment: namespace:base>
```

```
(t1 <- mdy_hm("01/31/2017 08:01", tz = "America/New_York"))
```

```
## [1] "2017-01-31 08:01:00 EST"
```

```
# convert timezone
with_tz(t1, tzone = "America/Los_Angeles")
```

```
## [1] "2017-01-31 05:01:00 PST"
```

```
# fix a timezone
force_tz(t1, tzone = "America/Los_Angeles")
```

```
## [1] "2017-01-31 08:01:00 PST"
```

From individual components

```
library(nycflights13)
flights %>%
  select(year, month, day, hour, minute)
```

```
## # A tibble: 336,776 x 5
##     year month   day  hour minute
##    <int> <int> <int> <dbl>  <dbl>
##  1  2013     1     1     5     15
##  2  2013     1     1     5     29
##  3  2013     1     1     5     40
##  4  2013     1     1     5     45
##  5  2013     1     1     6      0
##  6  2013     1     1     5     58
##  7  2013     1     1     6      0
##  8  2013     1     1     6      0
##  9  2013     1     1     6      0
## 10  2013     1     1     6      0
## # ... with 336,766 more rows
```

```
(flights_dt <- flights %>%
  select(year, month, day, hour, minute) %>%
  mutate(
    date = make_date(year, month, day),
    time = make_datetime(year, month, day, hour, minute)))
```

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

Remark: something was wrong above!

Get components

```
datetime <- ymd_hms("2016-07-08 12:34:56")

year(datetime)
```

```
## [1] 2016
```

```
month(datetime)
```

```
## [1] 7
```

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

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

```
mday(datetime)
```

```
## [1] 8
```

```
yday(datetime)
```

```
## [1] 190
```

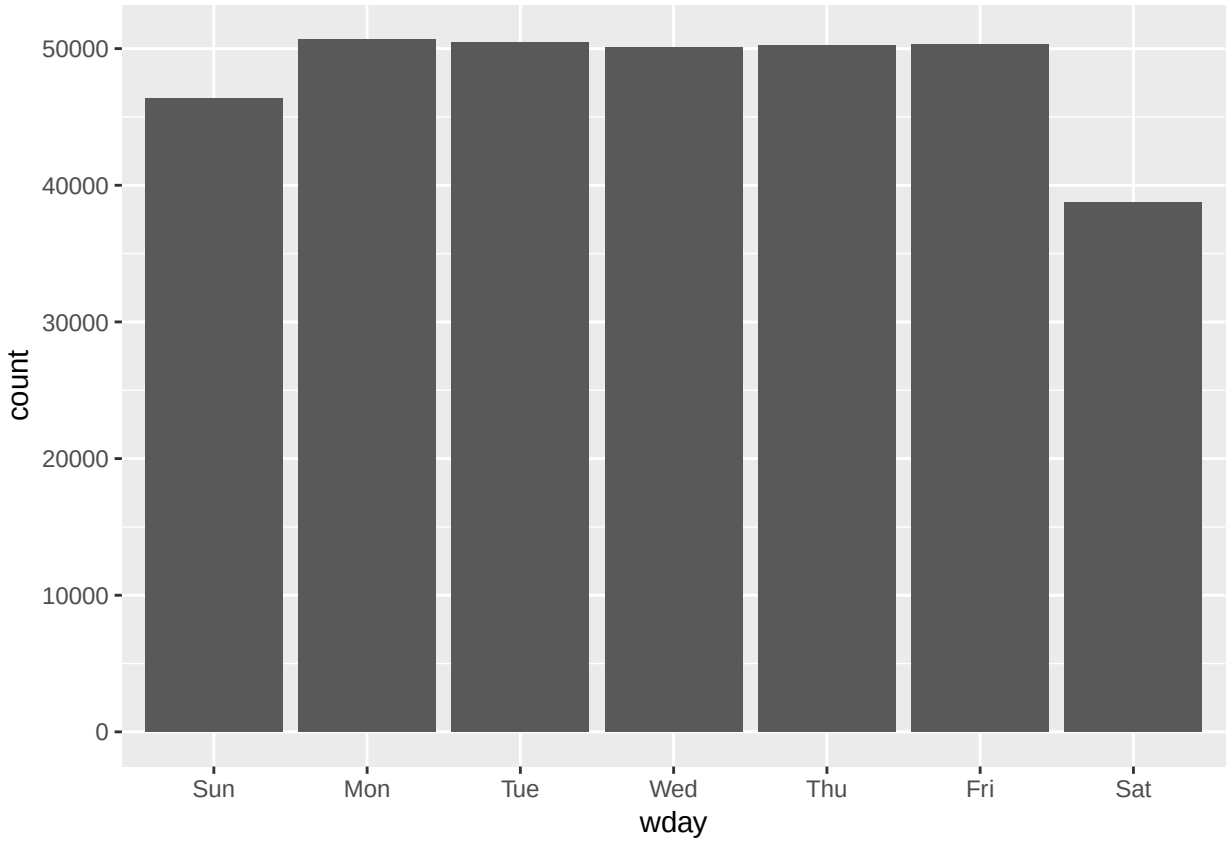
```r
wday(datetime)
```

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

```r
wday(datetime, label = TRUE, abbr = FALSE)
```

```
## [1] Friday
## 7 Levels: Sunday < Monday < Tuesday < Wednesday < Thursday < ... < Saturday
```

```r
flights_dt %>%
  mutate(wday = wday(time, label = TRUE)) %>%
  ggplot(aes(x = wday)) +
    geom_bar()
```



References

https://r4ds.had.co.nz https://lubridate.tidyverse.org/ https://forcats.tidyverse.org/