Manipulating Tables with dplyr (contd)

Data Wrangling: Session 3

Kieran Healy
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Window functions and moving averages

Load our libraries

```
library(here)      # manage file paths
library(socviz)    # data and some useful functions
library(tidyverse) # your friend and mine
```

dplyr's window functions

Ranking and cumulation within groups.

```r
## Data on COVID-19
library(covdata)

covnat_weekly
```

```
## # A tibble: 4,020 × 11
##    date       year_week cname  iso3      pop cases deaths cu_ca…¹ cu_de…² r14_c…³
##    <date>     <chr>     <chr>  <chr>   <dbl> <dbl>  <dbl>   <dbl>   <dbl>   <dbl>
##  1 2019-12-30 2020-01   Austr… AUT    8.93e6     0      0       0       0  NA    
##  2 2020-01-06 2020-02   Austr… AUT    8.93e6     0      0       0       0   0    
##  3 2020-01-13 2020-03   Austr… AUT    8.93e6     0      0       0       0   0    
##  4 2020-01-20 2020-04   Austr… AUT    8.93e6     0      0       0       0   0    
##  5 2020-01-27 2020-05   Austr… AUT    8.93e6     0      0       0       0   0    
##  6 2020-02-03 2020-06   Austr… AUT    8.93e6     0      0       0       0   0    
##  7 2020-02-10 2020-07   Austr… AUT    8.93e6     0      0       0       0   0    
##  8 2020-02-17 2020-08   Austr… AUT    8.93e6     0      0       0       0   0    
##  9 2020-02-24 2020-09   Austr… AUT    8.93e6    12      0      12       0   0.134
## 10 2020-03-02 2020-10   Austr… AUT    8.93e6   114      0     126       0   1.41 
## # … with 4,010 more rows, 1 more variable: r14_deaths <dbl>, and abbreviated
## #   variable names ¹cu_cases, ²cu_deaths, ³r14_cases
```

dplyr's window functions

cumsum() gives cumulative sums

```
covnat_weekly |>
  filter(iso3 == "FRA") |>
  select(date, cname, iso3, cases) |>
  mutate(cumulative = cumsum(cases))
```

```
## # A tibble: 134 × 5
##    date       cname  iso3  cases cumulative
##    <date>     <chr>  <chr> <dbl>      <dbl>
##  1 2019-12-30 France FRA       0          0
##  2 2020-01-06 France FRA       0          0
##  3 2020-01-13 France FRA       0          0
##  4 2020-01-20 France FRA       3          3
##  5 2020-01-27 France FRA       3          6
##  6 2020-02-03 France FRA       6         12
##  7 2020-02-10 France FRA       0         12
##  8 2020-02-17 France FRA       4         16
##  9 2020-02-24 France FRA     133        149
## 10 2020-03-02 France FRA     981       1130
## # … with 124 more rows
```

dplyr's **window** functions

cume_dist() gives the proportion of values less than or equal to the current value.

```
covnat_weekly |>
  select(date, cname, iso3, deaths) |>
  filter(iso3 == "FRA") |>
  filter(cume_dist(desc(deaths)) < 0.1) # i.e. Top 10%
```

```
## # A tibble: 13 × 4
##    date       cname  iso3  deaths
##    <date>     <chr>  <chr>  <dbl>
##  1 2020-10-26 France FRA     3517
##  2 2020-11-02 France FRA     5281
##  3 2020-11-09 France FRA     6018
##  4 2020-11-16 France FRA     6208
##  5 2020-11-23 France FRA     5215
##  6 2020-11-30 France FRA     4450
##  7 2020-12-07 France FRA     4257
##  8 2020-12-14 France FRA     3786
##  9 2020-12-21 France FRA     3560
## 10 2021-01-04 France FRA     3851
## 11 2021-01-11 France FRA     3833
## 12 2021-01-18 France FRA     3754
## 13 2021-01-25 France FRA     3535
```

The `dplyr` vignette on Window functions is good.

An application

```
covus |>
  filter(measure == "death") |>
  group_by(state) |>
  arrange(state, desc(date)) |>
  filter(state %in% "NY")
```

```
## # A tibble: 371 × 7
## # Groups:   state [1]
##    date       state fips  data_quality_grade measure count measure_label
##    <date>     <chr> <chr> <lgl>              <chr>   <dbl> <chr>
##  1 2021-03-07 NY    36    NA                 death   39029 Deaths
##  2 2021-03-06 NY    36    NA                 death   38970 Deaths
##  3 2021-03-05 NY    36    NA                 death   38891 Deaths
##  4 2021-03-04 NY    36    NA                 death   38796 Deaths
##  5 2021-03-03 NY    36    NA                 death   38735 Deaths
##  6 2021-03-02 NY    36    NA                 death   38660 Deaths
##  7 2021-03-01 NY    36    NA                 death   38577 Deaths
##  8 2021-02-28 NY    36    NA                 death   38497 Deaths
##  9 2021-02-27 NY    36    NA                 death   38407 Deaths
## 10 2021-02-26 NY    36    NA                 death   38321 Deaths
## # … with 361 more rows
```

Here the `count` measure is *cumulative* deaths. What if we want to recover the daily count for all the states in the data?

An application

dplyr has **lead()** and **lag()** functions. These allow you to access the previous and next values in a vector. You can calculate offsets this way.

```
my_vec <- c(1:20)
my_vec
```

```
##  [1]  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20
```

```
lag(my_vec) # first element has no lag
```

```
##  [1] NA  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19
```

```
my_vec - lag(my_vec)
```

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

An application

We can write the expression directly:

```
covus |>
  select(-data_quality_grade) |>
  filter(measure == "death") |>
  group_by(state) |>
  arrange(date) |>
  mutate(deaths_daily = count - lag(count, order_by = date)) |>
  arrange(state, desc(date)) |>
  filter(state %in% "NY")
```

```
## # A tibble: 371 × 7
## # Groups:   state [1]
##    date       state fips  measure count measure_label deaths_daily
##    <date>     <chr> <chr> <chr>   <dbl> <chr>                <dbl>
##  1 2021-03-07 NY    36    death   39029 Deaths                  59
##  2 2021-03-06 NY    36    death   38970 Deaths                  79
##  3 2021-03-05 NY    36    death   38891 Deaths                  95
##  4 2021-03-04 NY    36    death   38796 Deaths                  61
##  5 2021-03-03 NY    36    death   38735 Deaths                  75
##  6 2021-03-02 NY    36    death   38660 Deaths                  83
##  7 2021-03-01 NY    36    death   38577 Deaths                  80
##  8 2021-02-28 NY    36    death   38497 Deaths                  90
##  9 2021-02-27 NY    36    death   38407 Deaths                  86
## 10 2021-02-26 NY    36    death   38321 Deaths                  94
## # … with 361 more rows
```

Writing our own functions

But we could also write a function to do this.

We write functions using the special `function()` function.*

```r
my_fun <- function(x) {
  x + 1
}

my_fun # we've created the function; it's just an object
```

```
## function(x) {
##   x + 1
## }
```

```r
my_fun(x = 1) # But we can supply it with an input!
```

```
## [1] 2
```

```r
my_fun(10)
```

```
## [1] 11
```

*Nerds love this sort of stuff.

Writing our own functions

We write our function. It's just the expression we originally wrote, wrapped up.

```
get_daily_count <- function(count, date){
  count - lag(count, order_by = date)
}
```

This function has no generality, error-handling, or anything else. It's a once-off.

Writing our own functions

Now we can use it like any other:

```r
covus |>
  filter(measure == "death") |>
  select(-data_quality_grade) |>
  group_by(state) |>
  arrange(date) |>
  mutate(deaths_daily = get_daily_count(count, date)) |>
  arrange(state, desc(date)) |>
  filter(state %in% "NY")
```

```
## # A tibble: 371 × 7
## # Groups:   state [1]
##    date       state fips  measure count measure_label deaths_daily
##    <date>     <chr> <chr> <chr>   <dbl> <chr>                <dbl>
##  1 2021-03-07 NY    36    death   39029 Deaths                  59
##  2 2021-03-06 NY    36    death   38970 Deaths                  79
##  3 2021-03-05 NY    36    death   38891 Deaths                  95
##  4 2021-03-04 NY    36    death   38796 Deaths                  61
##  5 2021-03-03 NY    36    death   38735 Deaths                  75
##  6 2021-03-02 NY    36    death   38660 Deaths                  83
##  7 2021-03-01 NY    36    death   38577 Deaths                  80
##  8 2021-02-28 NY    36    death   38497 Deaths                  90
##  9 2021-02-27 NY    36    death   38407 Deaths                  86
## 10 2021-02-26 NY    36    death   38321 Deaths                  94
## # … with 361 more rows
```

Not super-useful quite yet, but if our task had more steps …

Tidy moving averages with `slider`

`dplyr`'s window functions don't include moving averages.

There are several options, notably `RcppRoll`

We'll use the `slider` package.

```r
# install.packages("slider")
library(slider)
```

Tidy moving averages with slider

```
covus |>
  filter(measure == "death") |>
  select(-data_quality_grade) |>
  group_by(state) |>
  arrange(date) |>
  mutate(
    deaths_daily = get_daily_count(count, date),
    deaths7 = slide_mean(deaths_daily,
                         before = 7,
                         na_rm = TRUE)) |>
  arrange(state, desc(date)) |>
  filter(state %in% "NY")
```

```
## # A tibble: 371 × 8
## # Groups:   state [1]
##    date       state fips  measure count measure_label deaths_daily deaths7
##    <date>     <chr> <chr> <chr>   <dbl> <chr>                <dbl>   <dbl>
##  1 2021-03-07 NY    36    death   39029 Deaths                  59    77.8
##  2 2021-03-06 NY    36    death   38970 Deaths                  79    81.1
##  3 2021-03-05 NY    36    death   38891 Deaths                  95    83
##  4 2021-03-04 NY    36    death   38796 Deaths                  61    82.6
##  5 2021-03-03 NY    36    death   38735 Deaths                  75    88
##  6 2021-03-02 NY    36    death   38660 Deaths                  83    89.9
##  7 2021-03-01 NY    36    death   38577 Deaths                  80    90.8
##  8 2021-02-28 NY    36    death   38497 Deaths                  90    90.1
##  9 2021-02-27 NY    36    death   38407 Deaths                  86    91.5
## 10 2021-02-26 NY    36    death   38321 Deaths                  94    95.6
## # … with 361 more rows
```

Tidy moving averages with `slider`

```r
    deaths7 = slide_mean(deaths_daily,
                         before = 7,
                         na_rm = TRUE)) |>
```

Notice the Tidyverse-style `na_rm` argument rather than the usual base `na.rm`

The package provides a lot of different functions, from general-purpose **`slide_max()`**, **`slide_min()`** to more specialized sliding functions. In particular note e.g. **`slide_index_mean()`** that addresses some subtleties in averaging over dates with gaps.

Tidy up after yourself with `relocate()`

```r
gss_sm
```

```
## # A tibble: 2,867 × 32
##     year    id ballot   age childs sibs  degree race  sex   region incom…¹ relig
##    <dbl> <dbl> <labe> <dbl>  <dbl> <lab> <fct>  <fct> <fct> <fct>  <fct>   <fct>
##  1  2016     1 1         47      3 2     Bache… White Male  New E… $17000… None
##  2  2016     2 2         61      0 3     High … White Male  New E… $50000… None
##  3  2016     3 3         72      2 3     Bache… White Male  New E… $75000… Cath…
##  4  2016     4 1         43      4 3     High … White Fema… New E… $17000… Cath…
##  5  2016     5 3         55      2 2     Gradu… White Fema… New E… $17000… None
##  6  2016     6 2         53      2 2     Junio… White Fema… New E… $60000… None
##  7  2016     7 1         50      2 2     High … White Male  New E… $17000… None
##  8  2016     8 3         23      3 6     High … Other Fema… Middl… $30000… Cath…
##  9  2016     9 1         45      3 5     High … Black Male  Middl… $60000… Prot…
## 10  2016    10 3         71      4 1     Junio… White Male  Middl… $60000… None
## # … with 2,857 more rows, 20 more variables: marital <fct>, padeg <fct>,
## #   madeg <fct>, partyid <fct>, polviews <fct>, happy <fct>, partners <fct>,
## #   grass <fct>, zodiac <fct>, pres12 <labelled>, wtssall <dbl>,
## #   income_rc <fct>, agegrp <fct>, ageq <fct>, siblings <fct>, kids <fct>,
## #   religion <fct>, bigregion <fct>, partners_rc <fct>, obama <dbl>, and
## #   abbreviated variable name ¹income16
```

Shuffle columns around

```
gss_sm
```

```
## # A tibble: 2,867 × 32
##     year    id ballot   age childs sibs  degree race  sex   region incom…¹ relig
##    <dbl> <dbl> <labe> <dbl>  <dbl> <lab> <fct>  <fct> <fct> <fct>  <fct>   <fct>
##  1  2016     1 1         47      3 2     Bache… White Male  New E… $17000… None
##  2  2016     2 2         61      0 3     High … White Male  New E… $50000… None
##  3  2016     3 3         72      2 3     Bache… White Male  New E… $75000… Cath…
##  4  2016     4 1         43      4 3     High … White Fema… New E… $17000… Cath…
##  5  2016     5 3         55      2 2     Gradu… White Fema… New E… $17000… None
##  6  2016     6 2         53      2 2     Junio… White Fema… New E… $60000… None
##  7  2016     7 1         50      2 2     High … White Male  New E… $17000… None
##  8  2016     8 3         23      3 6     High … Other Fema… Middl… $30000… Cath…
##  9  2016     9 1         45      3 5     High … Black Male  Middl… $60000… Prot…
## 10  2016    10 3         71      4 1     Junio… White Male  Middl… $60000… None
## # … with 2,857 more rows, 20 more variables: marital <fct>, padeg <fct>,
## #   madeg <fct>, partyid <fct>, polviews <fct>, happy <fct>, partners <fct>,
## #   grass <fct>, zodiac <fct>, pres12 <labelled>, wtssall <dbl>,
## #   income_rc <fct>, agegrp <fct>, ageq <fct>, siblings <fct>, kids <fct>,
## #   religion <fct>, bigregion <fct>, partners_rc <fct>, obama <dbl>, and
## #   abbreviated variable name ¹income16
```

Shuffle columns around

```r
gss_sm |>
  select(region, bigregion, year,
         id:region,
         starts_with("p"),
         contains("income"))
```

```
## # A tibble: 2,867 × 19
##    region bigre…¹  year    id ballot   age childs sibs  degree race  sex   padeg
##    <fct>  <fct>   <dbl> <dbl> <labe> <dbl>  <dbl> <lab> <fct>  <fct> <fct> <fct>
##  1 New E… Northe…  2016     1 1         47      3 2     Bache… White Male  Grad…
##  2 New E… Northe…  2016     2 2         61      0 3     High … White Male  Lt H…
##  3 New E… Northe…  2016     3 3         72      2 3     Bache… White Male  High…
##  4 New E… Northe…  2016     4 1         43      4 3     High … White Fema… <NA>
##  5 New E… Northe…  2016     5 3         55      2 2     Gradu… White Fema… Bach…
##  6 New E… Northe…  2016     6 2         53      2 2     Junio… White Fema… <NA>
##  7 New E… Northe…  2016     7 1         50      2 2     High … White Male  High…
##  8 Middl… Northe…  2016     8 3         23      3 6     High … Other Fema… Lt H…
##  9 Middl… Northe…  2016     9 1         45      3 5     High … Black Male  Lt H…
## 10 Middl… Northe…  2016    10 3         71      4 1     Junio… White Male  High…
## # … with 2,857 more rows, 7 more variables: partyid <fct>, polviews <fct>,
## #   partners <fct>, pres12 <labelled>, partners_rc <fct>, income16 <fct>,
## #   income_rc <fct>, and abbreviated variable name ¹bigregion
```

Shuffle columns around

```r
gss_sm |>
  select(region, bigregion, year,
         id:region,
         starts_with("p"),
         contains("income")) |>
  rename(children = childs,
         siblings = sibs)
```

```
## # A tibble: 2,867 × 19
##    region    bigre…¹  year    id ballot   age child…² sibli…³ degree race  sex
##    <fct>     <fct>   <dbl> <dbl> <labe> <dbl>   <dbl> <label> <fct>  <fct> <fct>
##  1 New Engl… Northe…  2016     1 1         47       3 2       Bache… White Male
##  2 New Engl… Northe…  2016     2 2         61       0 3       High … White Male
##  3 New Engl… Northe…  2016     3 3         72       2 3       Bache… White Male
##  4 New Engl… Northe…  2016     4 1         43       4 3       High … White Fema…
##  5 New Engl… Northe…  2016     5 3         55       2 2       Gradu… White Fema…
##  6 New Engl… Northe…  2016     6 2         53       2 2       Junio… White Fema…
##  7 New Engl… Northe…  2016     7 1         50       2 2       High … White Male
##  8 Middle A… Northe…  2016     8 3         23       3 6       High … Other Fema…
##  9 Middle A… Northe…  2016     9 1         45       3 5       High … Black Male
## 10 Middle A… Northe…  2016    10 3         71       4 1       Junio… White Male
## # … with 2,857 more rows, 8 more variables: padeg <fct>, partyid <fct>,
## #   polviews <fct>, partners <fct>, pres12 <labelled>, partners_rc <fct>,
## #   income16 <fct>, income_rc <fct>, and abbreviated variable names ¹bigregion,
## #   ²children, ³siblings
```

Shuffle columns around

```r
gss_sm |>
  select(region, bigregion, year,
         id:region,
         starts_with("p"),
         contains("income")) |>
  rename(children = childs,
         siblings = sibs) |>
  relocate(id)
```

```
## # A tibble: 2,867 × 19
##       id region     bigre…¹  year ballot   age child…² sibli…³ degree race  sex
##    <dbl> <fct>      <fct>   <dbl> <labe> <dbl>   <dbl> <label> <fct>  <fct> <fct>
##  1     1 New Engl… Northe…  2016 1         47       3 2       Bache… White Male
##  2     2 New Engl… Northe…  2016 2         61       0 3       High … White Male
##  3     3 New Engl… Northe…  2016 3         72       2 3       Bache… White Male
##  4     4 New Engl… Northe…  2016 1         43       4 3       High … White Fema…
##  5     5 New Engl… Northe…  2016 3         55       2 2       Gradu… White Fema…
##  6     6 New Engl… Northe…  2016 2         53       2 2       Junio… White Fema…
##  7     7 New Engl… Northe…  2016 1         50       2 2       High … White Male
##  8     8 Middle A… Northe…  2016 3         23       3 6       High … Other Fema…
##  9     9 Middle A… Northe…  2016 1         45       3 5       High … Black Male
## 10    10 Middle A… Northe…  2016 3         71       4 1       Junio… White Male
## # … with 2,857 more rows, 8 more variables: padeg <fct>, partyid <fct>,
## #   polviews <fct>, partners <fct>, pres12 <labelled>, partners_rc <fct>,
## #   income16 <fct>, income_rc <fct>, and abbreviated variable names ¹bigregion,
## #   ²children, ³siblings
```

Shuffle columns around

```r
gss_sm |>
  select(region, bigregion, year,
         id:region,
         starts_with("p"),
         contains("income")) |>
  rename(children = childs,
         siblings = sibs) |>
  relocate(id) |>
  select(-ballot)
```

```
## # A tibble: 2,867 × 18
##       id region      bigre…¹  year   age child…² sibli…³ degree race  sex   padeg
##    <dbl> <fct>       <fct>   <dbl> <dbl>   <dbl> <label> <fct>  <fct> <fct> <fct>
##  1     1 New Engla… Northe…  2016    47       3 2       Bache… White Male  Grad…
##  2     2 New Engla… Northe…  2016    61       0 3       High … White Male  Lt H…
##  3     3 New Engla… Northe…  2016    72       2 3       Bache… White Male  High…
##  4     4 New Engla… Northe…  2016    43       4 3       High … White Fema… <NA>
##  5     5 New Engla… Northe…  2016    55       2 2       Gradu… White Fema… Bach…
##  6     6 New Engla… Northe…  2016    53       2 2       Junio… White Fema… <NA>
##  7     7 New Engla… Northe…  2016    50       2 2       High … White Male  High…
##  8     8 Middle At… Northe…  2016    23       3 6       High … Other Fema… Lt H…
##  9     9 Middle At… Northe…  2016    45       3 5       High … Black Male  Lt H…
## 10    10 Middle At… Northe…  2016    71       4 1       Junio… White Male  High…
## # … with 2,857 more rows, 7 more variables: partyid <fct>, polviews <fct>,
## #   partners <fct>, pres12 <labelled>, partners_rc <fct>, income16 <fct>,
## #   income_rc <fct>, and abbreviated variable names ¹bigregion, ²children,
## #   ³siblings
```

Shuffle columns around

```r
gss_sm |>
  select(region, bigregion, year,
         id:region,
         starts_with("p"),
         contains("income")) |>
  rename(children = childs,
         siblings = sibs) |>
  relocate(id) |>
  select(-ballot) |>
  relocate(where(is.numeric),
           .before = where(is.factor))
```

```
## # A tibble: 2,867 × 18
##       id  year   age children siblings  pres12 region bigre…¹ degree race  sex
##    <dbl> <dbl> <dbl>    <dbl> <labelle> <labe> <fct>  <fct>   <fct>  <fct> <fct>
##  1     1  2016    47        3 2          3     New E… Northe… Bache… White Male
##  2     2  2016    61        0 3          1     New E… Northe… High … White Male
##  3     3  2016    72        2 3          2     New E… Northe… Bache… White Male
##  4     4  2016    43        4 3          2     New E… Northe… High … White Fema…
##  5     5  2016    55        2 2          1     New E… Northe… Gradu… White Fema…
##  6     6  2016    53        2 2          1     New E… Northe… Junio… White Fema…
##  7     7  2016    50        2 2         NA     New E… Northe… High … White Male
##  8     8  2016    23        3 6         NA     Middl… Northe… High … Other Fema…
##  9     9  2016    45        3 5         NA     Middl… Northe… High … Black Male
## 10    10  2016    71        4 1          2     Middl… Northe… Junio… White Male
## # … with 2,857 more rows, 7 more variables: padeg <fct>, partyid <fct>,
## #   polviews <fct>, partners <fct>, partners_rc <fct>, income16 <fct>,
## #   income_rc <fct>, and abbreviated variable name ¹bigregion
```

Shuffle columns around

```r
gss_sm |>
  select(region, bigregion, year,
         id:region,
         starts_with("p"),
         contains("income")) |>
  rename(children = childs,
         siblings = sibs) |>
  relocate(id) |>
  select(-ballot) |>
  relocate(where(is.numeric),
           .before = where(is.factor)) |>
  relocate(contains("region"),
           .after = year)
```

```
## # A tibble: 2,867 × 18
##       id  year region    bigre…¹   age child…² sibli…³ pres12 degree race  sex
##    <dbl> <dbl> <fct>     <fct>   <dbl>   <dbl> <label> <labe> <fct>  <fct> <fct>
##  1     1  2016 New Engl… Northe…    47       3 2        3     Bache… White Male
##  2     2  2016 New Engl… Northe…    61       0 3        1     High … White Male
##  3     3  2016 New Engl… Northe…    72       2 3        2     Bache… White Male
##  4     4  2016 New Engl… Northe…    43       4 3        2     High … White Fema…
##  5     5  2016 New Engl… Northe…    55       2 2        1     Gradu… White Fema…
##  6     6  2016 New Engl… Northe…    53       2 2        1     Junio… White Fema…
##  7     7  2016 New Engl… Northe…    50       2 2       NA     High … White Male
##  8     8  2016 Middle A… Northe…    23       3 6       NA     High … Other Fema…
##  9     9  2016 Middle A… Northe…    45       3 5       NA     High … Black Male
## 10    10  2016 Middle A… Northe…    71       4 1        2     Junio… White Male
## # … with 2,857 more rows, 7 more variables: padeg <fct>, partyid <fct>,
## #   polviews <fct>, partners <fct>, partners_rc <fct>, income16 <fct>,
## #   income_rc <fct>, and abbreviated variable names ¹bigregion, ²children,
## #   ³siblings
```

Example: UK Election Data

```r
library(ukelection2019)

ukvote2019
```

```
## # A tibble: 3,320 × 13
##    cid       const…¹ elect…² party…³ candi…⁴ votes vote_…⁵ vote_…⁶ total…⁷ vrank
##    <chr>     <chr>     <int> <chr>   <chr>   <int>   <dbl>   <dbl>   <int> <int>
##  1 W07000049 Aberav…   50747 Labour  Stephe… 17008    53.8   -14.3   31598     1
##  2 W07000049 Aberav…   50747 Conser… Charlo…  6518    20.6     2.9   31598     2
##  3 W07000049 Aberav…   50747 The Br… Glenda…  3108     9.8     9.8   31598     3
##  4 W07000049 Aberav…   50747 Plaid … Nigel …  2711     8.6     0.3   31598     4
##  5 W07000049 Aberav…   50747 Libera… Sheila…  1072     3.4     1.6   31598     5
##  6 W07000049 Aberav…   50747 Indepe… Captai…   731     2.3     2.3   31598     6
##  7 W07000049 Aberav…   50747 Green   Giorgi…   450     1.4     1.4   31598     7
##  8 W07000058 Aberco…   44699 Conser… Robin … 14687    46.1     1.5   31865     1
##  9 W07000058 Aberco…   44699 Labour  Emily … 12653    39.7    -2.9   31865     2
## 10 W07000058 Aberco…   44699 Plaid … Lisa G…  2704     8.5    -1.4   31865     3
## # … with 3,310 more rows, 3 more variables: turnout <dbl>, fname <chr>,
## #   lname <chr>, and abbreviated variable names ¹constituency, ²electorate,
## #   ³party_name, ⁴candidate, ⁵vote_share_percent, ⁶vote_share_change,
## #   ⁷total_votes_cast
```

Example: UK Election Data

Use `sample_n()` to sample n rows of your tibble.

```r
library(ukelection2019)

ukvote2019 |>
  sample_n(10)
```

```
## # A tibble: 10 × 13
##    cid       const…¹ elect…² party…³ candi…⁴ votes vote_…⁵ vote_…⁶ total…⁷ vrank
##    <chr>     <chr>     <int> <chr>   <chr>   <int>   <dbl>   <dbl>   <int> <int>
##  1 E14000699 Fareham   78337 Green   Nick L…  2412     4.2     1.9   57250     4
##  2 E14000702 Filton…   74016 Conser… Jack L… 26293    48.9    -1.1   53752     1
##  3 E14000952 Norfol…   78455 Conser… Liz Tr… 35507    69       6.2   51466     1
##  4 E14001053 Workin…   61370 Conser… Mark J… 20488    49.3     7.5   41599     1
##  5 E14000617 Cambri…   79951 Labour  Daniel… 25776    48      -3.9   53729     1
##  6 E14000864 Norwic…   77845 Labour  Clive … 27766    53.7    -7.2   51673     1
##  7 E14000552 Bedford   71579 Green   Adrian…   960     2       0     47301     4
##  8 E14001029 West B…   62111 The Br… Christ…  1475     4.1     4.1   35975     3
##  9 E14000792 Lincoln   74778 Labour  Karen … 20753    41      -6.9   50629     2
## 10 E14000632 Cheste…   70994 Conser… Leigh … 16720    37       2.2   45186     2
## # … with 3 more variables: turnout <dbl>, fname <chr>, lname <chr>, and
## #   abbreviated variable names ¹constituency, ²electorate, ³party_name,
## #   ⁴candidate, ⁵vote_share_percent, ⁶vote_share_change, ⁷total_votes_cast
```

Example: UK Election Data

A vector of unique constituency names

```
ukvote2019 |>
  distinct(constituency)
```

```
## # A tibble: 650 × 1
##    constituency
##    <chr>
##  1 Aberavon
##  2 Aberconwy
##  3 Aberdeen North
##  4 Aberdeen South
##  5 Aberdeenshire West & Kincardine
##  6 Airdrie & Shotts
##  7 Aldershot
##  8 Aldridge-Brownhills
##  9 Altrincham & Sale West
## 10 Alyn & Deeside
## # … with 640 more rows
```

Example: UK Election Data

Tally them up

```
ukvote2019 |>
  distinct(constituency) |>
  tally()
```

```
## # A tibble: 1 × 1
##       n
##   <int>
## 1   650
```

```
# Base R / non-pipeline version

length(unique(ukvote2019$constituency))
```

```
## [1] 650
```

Example: UK Election Data

Which parties fielded the most candidates?

```r
ukvote2019 |>
  count(party_name) |>
  arrange(desc(n))
```

```
## # A tibble: 69 × 2
##    party_name                     n
##    <chr>                      <int>
##  1 Conservative                 636
##  2 Labour                       631
##  3 Liberal Democrat             611
##  4 Green                        497
##  5 The Brexit Party             275
##  6 Independent                  224
##  7 Scottish National Party       59
##  8 UKIP                          44
##  9 Plaid Cymru                   36
## 10 Christian Peoples Alliance    29
## # … with 59 more rows
```

Example: UK Election Data

Top 5

```
ukvote2019 |>
  count(party_name) |>
  slice_max(order_by = n, n = 5)
```

```
## # A tibble: 5 × 2
##   party_name           n
##   <chr>            <int>
## 1 Conservative       636
## 2 Labour             631
## 3 Liberal Democrat   611
## 4 Green              497
## 5 The Brexit Party   275
```

Example: UK Election Data

Top 5

```
ukvote2019 |>
  count(party_name) |>
  slice_max(order_by = n, n = 5)
```

```
## # A tibble: 5 × 2
##   party_name           n
##   <chr>            <int>
## 1 Conservative       636
## 2 Labour             631
## 3 Liberal Democrat   611
## 4 Green              497
## 5 The Brexit Party   275
```

Bottom 5

```
ukvote2019 |>
  count(party_name) |>
  slice_min(order_by = n, n = 5)
```

```
## # A tibble: 25 × 2
##    party_name                              n
##    <chr>                               <int>
##  1 Ashfield Independents                   1
##  2 Best for Luton                          1
##  3 Birkenhead Social Justice Party         1
##  4 British National Party                  1
##  5 Burnley & Padiham Independent Party     1
##  6 Church of the Militant Elvis Party      1
##  7 Citizens Movement Party UK              1
##  8 CumbriaFirst                            1
##  9 Heavy Woollen District Independents     1
## 10 Independent Network                     1
## # … with 15 more rows
```

Example: UK Election Data

How many constituencies are there?

```
ukvote2019 |>
  count(constituency)
```

```
## # A tibble: 650 × 2
##    constituency                          n
##    <chr>                             <int>
##  1 Aberavon                              7
##  2 Aberconwy                             4
##  3 Aberdeen North                        6
##  4 Aberdeen South                        4
##  5 Aberdeenshire West & Kincardine      4
##  6 Airdrie & Shotts                      5
##  7 Aldershot                             4
##  8 Aldridge-Brownhills                   5
##  9 Altrincham & Sale West                6
## 10 Alyn & Deeside                        5
## # … with 640 more rows
```

Example: UK Election Data

How many constituencies are there?

```
ukvote2019 |>
  count(constituency)
```

```
## # A tibble: 650 × 2
##    constituency                          n
##    <chr>                             <int>
##  1 Aberavon                              7
##  2 Aberconwy                             4
##  3 Aberdeen North                        6
##  4 Aberdeen South                        4
##  5 Aberdeenshire West & Kincardine       4
##  6 Airdrie & Shotts                      5
##  7 Aldershot                             4
##  8 Aldridge-Brownhills                   5
##  9 Altrincham & Sale West                6
## 10 Alyn & Deeside                        5
## # … with 640 more rows
```

```
ukvote2019 |>
  distinct(constituency) |>
  count()
```

```
## # A tibble: 1 × 1
##       n
##   <int>
## 1   650
```

```
# Base R style ...
length(unique(ukvote2019$constituency))
```

```
## [1] 650
```

Counting Twice Over

```r
ukvote2019 |>
  count(constituency) |>
  count(n)
```

```
## # A tibble: 8 × 2
##       n    nn
##   <int> <int>
## 1     3    21
## 2     4   194
## 3     5   226
## 4     6   139
## 5     7    49
## 6     8    18
## 7     9     2
## 8    12     1
```

Counting Twice Over

```r
ukvote2019
```

```
## # A tibble: 3,320 × 13
##    cid       const…¹ elect…² party…³ candi…⁴ votes vote_…⁵ vote_…⁶ total…⁷ vrank
##    <chr>     <chr>     <int> <chr>   <chr>   <int>   <dbl>   <dbl>   <int> <int>
##  1 W07000049 Aberav…   50747 Labour  Stephe… 17008    53.8   -14.3   31598     1
##  2 W07000049 Aberav…   50747 Conser… Charlo…  6518    20.6     2.9   31598     2
##  3 W07000049 Aberav…   50747 The Br… Glenda…  3108     9.8     9.8   31598     3
##  4 W07000049 Aberav…   50747 Plaid … Nigel …  2711     8.6     0.3   31598     4
##  5 W07000049 Aberav…   50747 Libera… Sheila…  1072     3.4     1.6   31598     5
##  6 W07000049 Aberav…   50747 Indepe… Captai…   731     2.3     2.3   31598     6
##  7 W07000049 Aberav…   50747 Green   Giorgi…   450     1.4     1.4   31598     7
##  8 W07000058 Aberco…   44699 Conser… Robin … 14687    46.1     1.5   31865     1
##  9 W07000058 Aberco…   44699 Labour  Emily … 12653    39.7    -2.9   31865     2
## 10 W07000058 Aberco…   44699 Plaid … Lisa G…  2704     8.5    -1.4   31865     3
## # … with 3,310 more rows, 3 more variables: turnout <dbl>, fname <chr>,
## #   lname <chr>, and abbreviated variable names ¹constituency, ²electorate,
## #   ³party_name, ⁴candidate, ⁵vote_share_percent, ⁶vote_share_change,
## #   ⁷total_votes_cast
```

Counting Twice Over

```r
ukvote2019 |>
  count(constituency, name = "n_cands")
```

```
## # A tibble: 650 × 2
##    constituency                    n_cands
##    <chr>                             <int>
##  1 Aberavon                              7
##  2 Aberconwy                             4
##  3 Aberdeen North                        6
##  4 Aberdeen South                        4
##  5 Aberdeenshire West & Kincardine       4
##  6 Airdrie & Shotts                      5
##  7 Aldershot                             4
##  8 Aldridge-Brownhills                   5
##  9 Altrincham & Sale West                6
## 10 Alyn & Deeside                        5
## # … with 640 more rows
```

Counting Twice Over

```r
ukvote2019 |>
  count(constituency, name = "n_cands") |>
  count(n_cands, name = "n_const")
```

```
## # A tibble: 8 × 2
##   n_cands n_const
##     <int>   <int>
## 1       3      21
## 2       4     194
## 3       5     226
## 4       6     139
## 5       7      49
## 6       8      18
## 7       9       2
## 8      12       1
```

Recapping Yesterday and Looking Ahead

Data Wrangling

Kieran Healy
Statistical Horizons, December 2022

Recapping and Looking Ahead

Coding as gardening

Working in RStudio with RMarkdown documents

Recapping and Looking Ahead

Core `dplyr` verbs

Subset your table: `filter()` rows, `select()` columns
Logically `group_by()` one or more columns
Add columns with `mutate()`
Summarize (by group, or the whole table) with `summarize()`

Recapping and Looking Ahead

Expand your `dplyr` actions

Count up rows with `n()`, `tally()` or `count()`

Calculate quantities with `sum()`, `mean()`, `min()`, etc

Subset rows with logical expressions or `slice` functions

Conditionally select columns by name directly, with `%in%` or `%nin%`, or with tidy selectors like `starts_with()`, `ends_with()`, `contains()`

Conditionally select columns by *type* with `where()` and some criterion, e.g. `where(is.numeric)`

Conditionally select and then *act* on columns with `across(where(<condition>), <action>)`

Recapping and Looking Ahead

Expand your `dplyr` actions

Tidy up columns with `relocate()` and `rename()`

Tidy up rows with `arrange()`

Recapping and Looking Ahead

Today's sessions

Two dplyr gotchas

1. Comparisons filtering on proportions

Let's say you are working with proportions ...

```
df
```

```
## # A tibble: 4 × 3
##   id    prop1 prop2
##   <chr> <dbl> <dbl>
## 1 A       0.1  0.2 
## 2 B       0.1  0.21
## 3 C       0.11 0.2 
## 4 D       0.1  0.1 
```

1. Comparisons filtering on proportions

And you want to focus on cases where `prop1` *plus* `prop2` is greater than 0.3:

1. Comparisons filtering on proportions

And you want to focus on cases where `prop1` *plus* `prop2` is greater than 0.3:

```
df |>
  filter(prop1 + prop2 > 0.3)
```

```
## # A tibble: 3 × 3
##   id    prop1 prop2
##   <chr> <dbl> <dbl>
## 1 A      0.1   0.2 
## 2 B      0.1   0.21
## 3 C      0.11  0.2 
```

The row with `id` **`A`** shouldn't have been included there.

1. Comparisons filtering on proportions

And you want to focus on cases where `prop1` *plus* `prop2` is greater than 0.3:

```
df |>
  filter(prop1 + prop2 > 0.3)
```

```
## # A tibble: 3 × 3
##   id    prop1 prop2
##   <chr> <dbl> <dbl>
## 1 A      0.1   0.2 
## 2 B      0.1   0.21
## 3 C      0.11  0.2 
```

The row with `id` **`A`** shouldn't have been included there.

This is not dlpyr's fault. It's our floating point friend again.

1. Comparisons filtering on proportions

```r
df |>
  filter(prop1 + prop2 == 0.3)
```

```
## # A tibble: 0 × 3
## # … with 3 variables: id <chr>, prop1 <dbl>, prop2 <dbl>
```

The row with `id` **A** *should* have been included here!

1. Comparisons filtering on proportions

This won't give the right behavior either:

```
df |>
  mutate(prop3 = prop1 + prop2) |>
  filter(prop3 == 0.3)
```

```
## # A tibble: 0 × 4
## # … with 4 variables: id <chr>, prop1 <dbl>, prop2 <dbl>, prop3 <dbl>
```

1. Comparisons filtering on proportions

So, beware.

```
df |>
  filter(prop1*100 + prop2*100 == 0.3*100)
```

```
## # A tibble: 1 × 3
##   id    prop1 prop2
##   <chr> <dbl> <dbl>
## 1 A       0.1   0.2
```

Better:

```
df |>
  filter(near(prop1 + prop2, 0.3))
```

```
## # A tibble: 1 × 3
##   id    prop1 prop2
##   <chr> <dbl> <dbl>
## 1 A       0.1   0.2
```

2. Zero Counts in dplyr

```r
df <- read_csv(here("data", "first_terms.csv"))

df
```

```
## # A tibble: 280 × 4
##      pid start_year party      sex
##    <dbl> <date>     <chr>      <chr>
##  1  3160 2013-01-03 Republican M
##  2  3161 2013-01-03 Democrat   F
##  3  3162 2013-01-03 Democrat   M
##  4  3163 2013-01-03 Republican M
##  5  3164 2013-01-03 Democrat   M
##  6  3165 2013-01-03 Republican M
##  7  3166 2013-01-03 Republican M
##  8  3167 2013-01-03 Democrat   F
##  9  3168 2013-01-03 Republican M
## 10  3169 2013-01-03 Democrat   M
## # … with 270 more rows
```

2. Zero Counts in dplyr

```
df |>
    group_by(start_year, party, sex) |>
    summarize(N = n()) |>
    mutate(freq = N / sum(N))
```

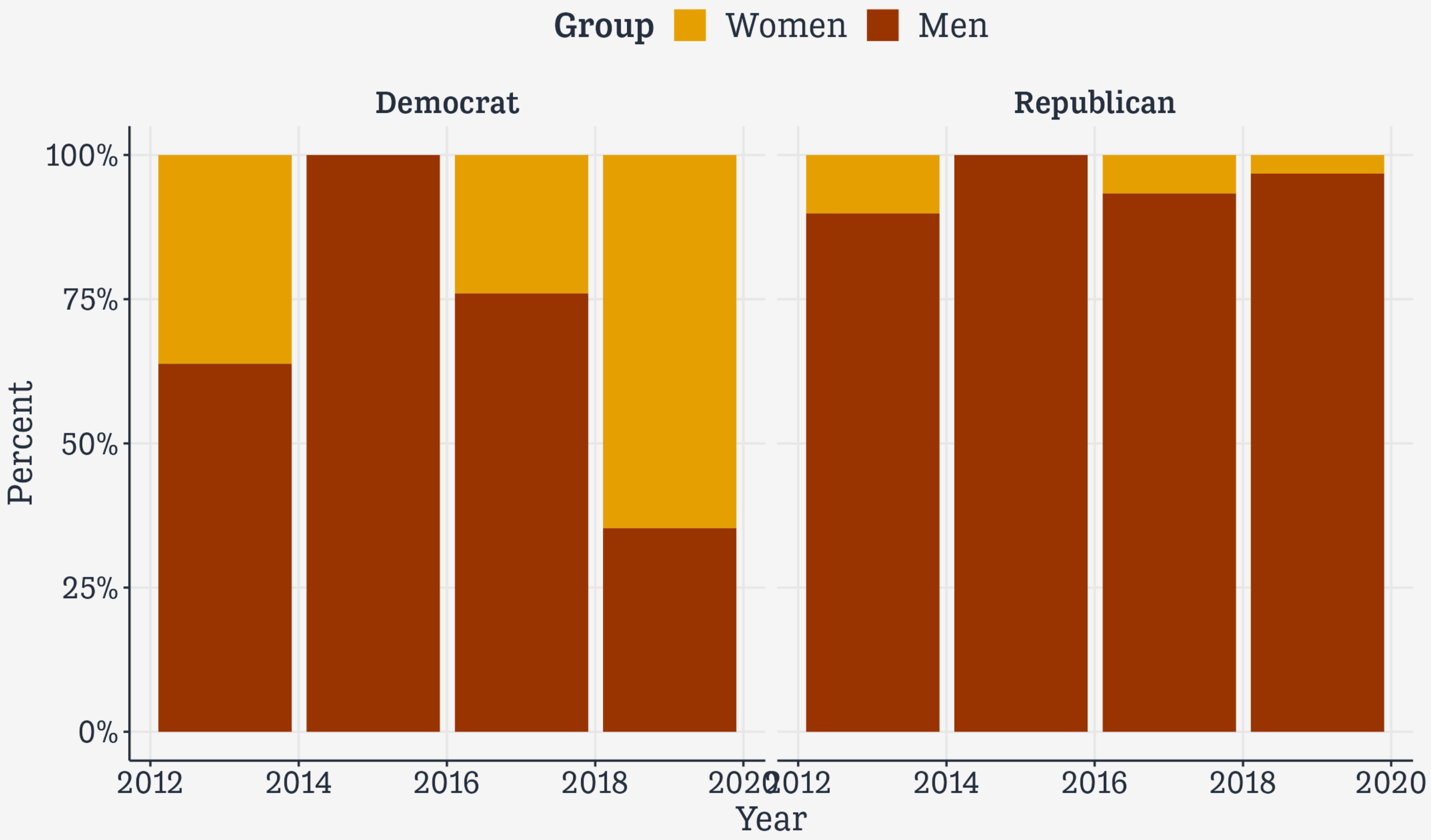
```
## # A tibble: 14 × 5
## # Groups:   start_year, party [8]
##    start_year party      sex       N   freq
##    <date>     <chr>      <chr> <int>  <dbl>
##  1 2013-01-03 Democrat   F        21 0.362
##  2 2013-01-03 Democrat   M        37 0.638
##  3 2013-01-03 Republican F         8 0.101
##  4 2013-01-03 Republican M        71 0.899
##  5 2015-01-03 Democrat   M         1 1
##  6 2015-01-03 Republican M         5 1
##  7 2017-01-03 Democrat   F         6 0.24
##  8 2017-01-03 Democrat   M        19 0.76
##  9 2017-01-03 Republican F         2 0.0667
## 10 2017-01-03 Republican M        28 0.933
## 11 2019-01-03 Democrat   F        33 0.647
## 12 2019-01-03 Democrat   M        18 0.353
## 13 2019-01-03 Republican F         1 0.0323
## 14 2019-01-03 Republican M        30 0.968
```

2. Zero Counts in dplyr

```r
p_col <- df |>
    group_by(start_year, party, sex) |>
    summarize(N = n()) |>
    mutate(freq = N / sum(N)) |>
    ggplot(aes(x = start_year,
               y = freq,
               fill = sex)) +
    geom_col() +
    scale_y_continuous(labels = scales::percent) +
    scale_fill_manual(values = sex_colors, labels = c("Women", "Men")) +
    labs(x = "Year", y = "Percent", fill = "Group") +
    facet_wrap(~ party)
```

2. Zero Counts in dplyr

```
p_col
```

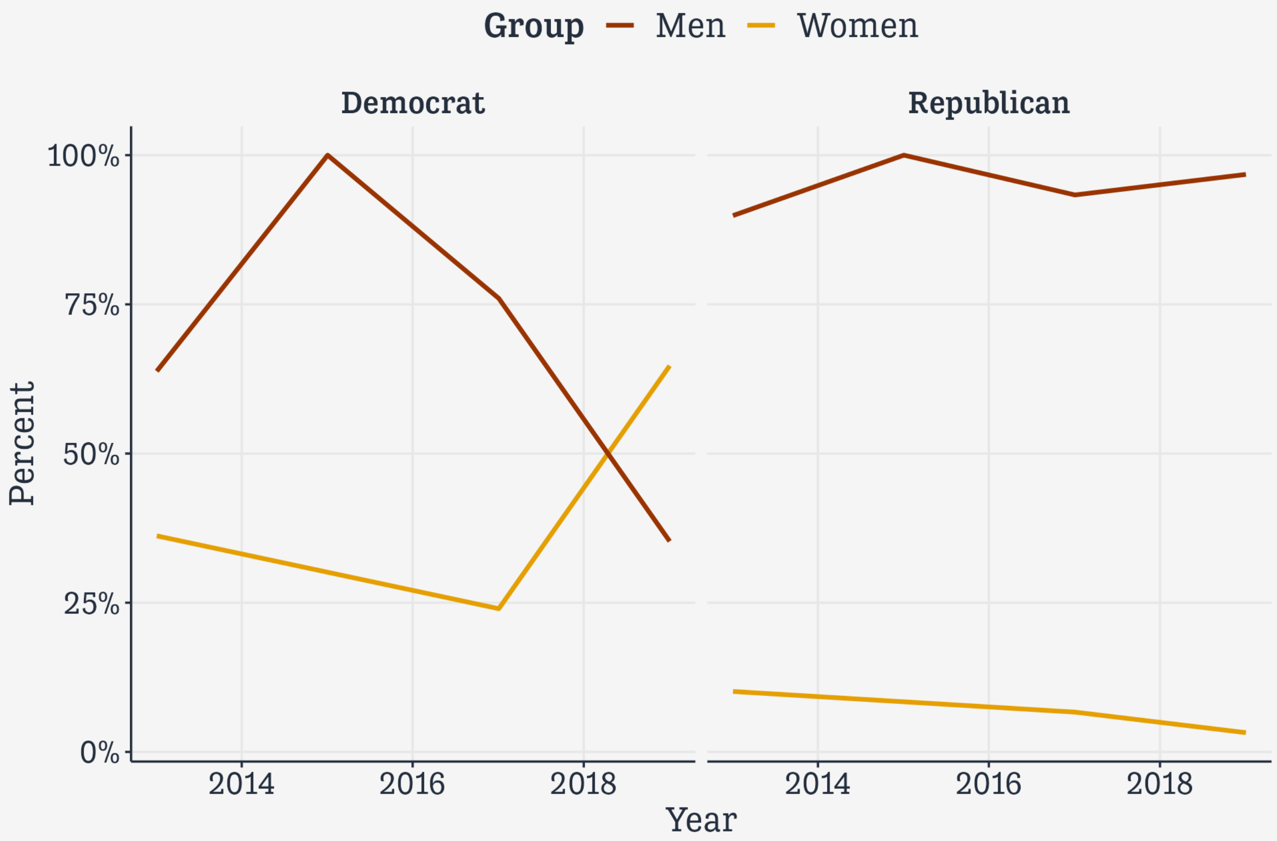


Zero Counts in dplyr

```r
p_line <- df |>
    group_by(start_year, party, sex) |>
    summarize(N = n()) |>
    mutate(freq = N / sum(N)) |>
    ggplot(aes(x = start_year,
               y = freq,
               color = sex)) +
    geom_line(size = 1.1) +
    scale_y_continuous(labels = scales::percent) +
    scale_color_manual(values = sex_colors, labels = c("Women", "Men")) +
    guides(color = guide_legend(reverse = TRUE)) +
    labs(x = "Year", y = "Percent", color = "Group") +
    facet_wrap(~ party)
```

2. Zero Counts in dplyr

```
p_line
```



Option 1: factors and `.drop`

Factors are for categorical variables and are stored differently from characters.

This can matter when modeling, and also now.

```r
df_f <- df |>
  mutate(party_f = factor(party))

df_f
```

```
## # A tibble: 280 × 5
##      pid start_year party      sex   party_f
##    <dbl> <date>     <chr>      <chr> <fct>
##  1  3160 2013-01-03 Republican M     Republican
##  2  3161 2013-01-03 Democrat   F     Democrat
##  3  3162 2013-01-03 Democrat   M     Democrat
##  4  3163 2013-01-03 Republican M     Republican
##  5  3164 2013-01-03 Democrat   M     Democrat
##  6  3165 2013-01-03 Republican M     Republican
##  7  3166 2013-01-03 Republican M     Republican
##  8  3167 2013-01-03 Democrat   F     Democrat
##  9  3168 2013-01-03 Republican M     Republican
## 10  3169 2013-01-03 Democrat   M     Democrat
## # … with 270 more rows
```

Option 1: factors and .drop

```
df_f |>
  group_by(party_f) |>
  tally()
```

```
## # A tibble: 2 × 2
##   party_f        n
##   <fct>      <int>
## 1 Democrat     135
## 2 Republican   145
```

Factors are integer values with named labels, or *levels*:

```
typeof(df_f$party_f)
```

```
## [1] "integer"
```

```
levels(df_f$party_f)
```

```
## [1] "Democrat"   "Republican"
```

Option 1: factors and .drop

By default, unused levels won't display:

```
df_f <- df |>
  mutate(party_f = factor(party,
                          levels = c("Democrat",
                                     "Republican",
                                     "Libertarian")))

df_f |>
  group_by(party_f) |>
  tally()
```

```
## # A tibble: 2 × 2
##   party_f        n
##   <fct>      <int>
## 1 Democrat     135
## 2 Republican   145
```

```
levels(df_f$party_f)
```

```
## [1] "Democrat"    "Republican"  "Libertarian"
```

Option 1: factors and `.drop`

By default, unused levels won't display:

```
df |>
  mutate(across(where(is.character), as_factor)) |>
  group_by(start_year, party, sex) |>
  summarize(N = n()) |>
  mutate(freq = N / sum(N))
```

```
## # A tibble: 14 × 5
## # Groups:   start_year, party [8]
##    start_year party      sex       N   freq
##    <date>     <fct>      <fct> <int>  <dbl>
##  1 2013-01-03 Republican M        71 0.899
##  2 2013-01-03 Republican F         8 0.101
##  3 2013-01-03 Democrat   M        37 0.638
##  4 2013-01-03 Democrat   F        21 0.362
##  5 2015-01-03 Republican M         5 1
##  6 2015-01-03 Democrat   M         1 1
##  7 2017-01-03 Republican M        28 0.933
##  8 2017-01-03 Republican F         2 0.0667
##  9 2017-01-03 Democrat   M        19 0.76
## 10 2017-01-03 Democrat   F         6 0.24
## 11 2019-01-03 Republican M        30 0.968
## 12 2019-01-03 Republican F         1 0.0323
## 13 2019-01-03 Democrat   M        18 0.353
## 14 2019-01-03 Democrat   F        33 0.647
```

Option 1: factors and .drop

You can make dplyr keep empty factor levels though:

```
df |>
  mutate(across(where(is.character), as_factor)) |>
  group_by(start_year, party, sex, .drop = FALSE) |>
  summarize(N = n()) |>
  mutate(freq = N / sum(N))
```

```
## # A tibble: 16 × 5
## # Groups:   start_year, party [8]
##    start_year party      sex       N   freq
##    <date>     <fct>      <fct> <int>  <dbl>
##  1 2013-01-03 Republican M        71 0.899
##  2 2013-01-03 Republican F         8 0.101
##  3 2013-01-03 Democrat   M        37 0.638
##  4 2013-01-03 Democrat   F        21 0.362
##  5 2015-01-03 Republican M         5 1
##  6 2015-01-03 Republican F         0 0
##  7 2015-01-03 Democrat   M         1 1
##  8 2015-01-03 Democrat   F         0 0
##  9 2017-01-03 Republican M        28 0.933
## 10 2017-01-03 Republican F         2 0.0667
## 11 2017-01-03 Democrat   M        19 0.76
## 12 2017-01-03 Democrat   F         6 0.24
## 13 2019-01-03 Republican M        30 0.968
## 14 2019-01-03 Republican F         1 0.0323
## 15 2019-01-03 Democrat   M        18 0.353
## 16 2019-01-03 Democrat   F        33 0.647
```

Option 2: ungroup() and complete()

Maybe you don't want to deal with factors.

```
df_c <- df |>
    group_by(start_year, party, sex) |>
    summarize(N = n()) |>
    mutate(freq = N / sum(N)) |>
    ungroup() |>
    complete(start_year, party, sex,
             fill = list(N = 0, freq = 0))
```

Option 2: ungroup() and complete()

```
df_c
```

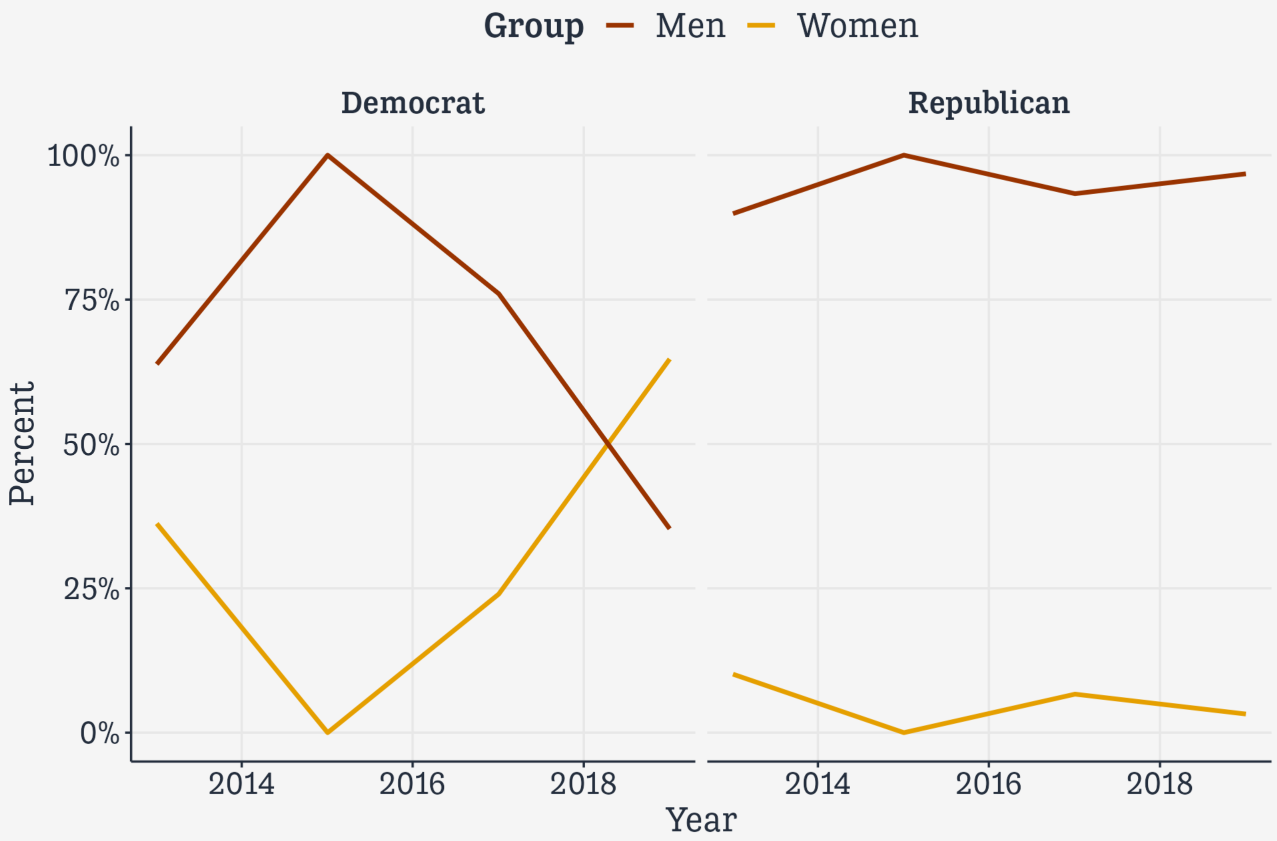
```
## # A tibble: 16 × 5
##    start_year party      sex       N   freq
##    <date>     <chr>      <chr> <int>  <dbl>
##  1 2013-01-03 Democrat   F        21 0.362
##  2 2013-01-03 Democrat   M        37 0.638
##  3 2013-01-03 Republican F         8 0.101
##  4 2013-01-03 Republican M        71 0.899
##  5 2015-01-03 Democrat   F         0 0
##  6 2015-01-03 Democrat   M         1 1
##  7 2015-01-03 Republican F         0 0
##  8 2015-01-03 Republican M         5 1
##  9 2017-01-03 Democrat   F         6 0.24
## 10 2017-01-03 Democrat   M        19 0.76
## 11 2017-01-03 Republican F         2 0.0667
## 12 2017-01-03 Republican M        28 0.933
## 13 2019-01-03 Democrat   F        33 0.647
## 14 2019-01-03 Democrat   M        18 0.353
## 15 2019-01-03 Republican F         1 0.0323
## 16 2019-01-03 Republican M        30 0.968
```

Option 2: ungroup() and complete()

```
p_out <- df_c |>
  ggplot(aes(x = start_year,
             y = freq,
             color = sex)) +
    geom_line(size = 1.1) +
    scale_y_continuous(labels = scales::percent) +
    scale_color_manual(values = sex_colors, labels = c("Women", "Men")) +
    guides(color = guide_legend(reverse = TRUE)) +
    labs(x = "Year", y = "Percent", color = "Group") +
    facet_wrap(~ party)
```

Option 2: ungroup() and complete()

```r
p_out
```


Group
Men
Women
Democrat
Republican
Percent
Year