Going deeper with dplyr

王小二 20190001

2019-10-04

1 Loading dplyr and the nycflights13 dataset

```
# load packages
suppressMessages(library(dplyr))
library(nycflights13)

# print the flights dataset from nycflights13
flights
```

```
## # A tibble: 336,776 x 19
##     year month   day dep_time sched_dep_time dep_delay arr_time
##    <int> <int> <int>    <int>          <int>     <dbl>    <int>
##  1  2013     1     1      517            515         2      830
##  2  2013     1     1      533            529         4      850
##  3  2013     1     1      542            540         2      923
##  4  2013     1     1      544            545        -1     1004
##  5  2013     1     1      554            600        -6      812
##  6  2013     1     1      554            558        -4      740
##  7  2013     1     1      555            600        -5      913
##  8  2013     1     1      557            600        -3      709
##  9  2013     1     1      557            600        -3      838
## 10  2013     1     1      558            600        -2      753
## # ... with 336,766 more rows, and 12 more variables: sched_arr_time <int>,
## #   arr_delay <dbl>, carrier <chr>, flight <int>, tailnum <chr>,
## #   origin <chr>, dest <chr>, air_time <dbl>, distance <dbl>, hour <dbl>,
## #   minute <dbl>, time_hour <dttm>
```

2 Choosing columns: select, rename

```r
# besides just using select() to pick columns...
flights %>% select(carrier, flight)
```

```
## # A tibble: 336,776 x 2
##    carrier flight
##    <chr>    <int>
##  1 UA        1545
##  2 UA        1714
##  3 AA        1141
##  4 B6         725
##  5 DL         461
##  6 UA        1696
##  7 B6         507
##  8 EV        5708
##  9 B6          79
## 10 AA         301
## # ... with 336,766 more rows
```

```r
# ...you can use the minus sign to hide columns
flights %>% select(-month, -day)
```

```
## # A tibble: 336,776 x 17
##     year dep_time sched_dep_time dep_delay arr_time sched_arr_time
##    <int>    <int>          <int>     <dbl>    <int>          <int>
##  1  2013      517            515         2      830            819
##  2  2013      533            529         4      850            830
##  3  2013      542            540         2      923            850
##  4  2013      544            545        -1     1004           1022
##  5  2013      554            600        -6      812            837
##  6  2013      554            558        -4      740            728
##  7  2013      555            600        -5      913            854
##  8  2013      557            600        -3      709            723
##  9  2013      557            600        -3      838            846
## 10  2013      558            600        -2      753            745
## # ... with 336,766 more rows, and 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 <dttm>
```

```r
# hide a range of columns
flights %>% select(-(dep_time:arr_delay))

# hide any column with a matching name
flights %>% select(-contains("time"))
```

```r
# pick columns using a character vector of column names
cols <- c("carrier", "flight", "tailnum")
flights %>% select(one_of(cols))
```

```
## # A tibble: 336,776 x 3
##    carrier flight tailnum
##    <chr>    <int> <chr>
##  1 UA        1545 N14228
##  2 UA        1714 N24211
##  3 AA        1141 N619AA
##  4 B6         725 N804JB
##  5 DL         461 N668DN
##  6 UA        1696 N39463
##  7 B6         507 N516JB
##  8 EV        5708 N829AS
##  9 B6          79 N593JB
## 10 AA         301 N3ALAA
## # ... with 336,766 more rows
```

```r
# select() can be used to rename columns, though all columns not mentioned are dropped
flights %>% select(tail = tailnum)
```

```
## # A tibble: 336,776 x 1
##    tail
##    <chr>
##  1 N14228
##  2 N24211
##  3 N619AA
##  4 N804JB
##  5 N668DN
##  6 N39463
##  7 N516JB
##  8 N829AS
##  9 N593JB
## 10 N3ALAA
## # ... with 336,766 more rows
```

```
# rename() does the same thing, except all columns not mentioned are kept
flights %>% rename(tail = tailnum)
```

```
## # A tibble: 336,776 x 19
##     year month   day dep_time sched_dep_time dep_delay arr_time
##    <int> <int> <int>    <int>          <int>     <dbl>    <int>
##  1  2013     1     1      517            515         2      830
##  2  2013     1     1      533            529         4      850
##  3  2013     1     1      542            540         2      923
##  4  2013     1     1      544            545        -1     1004
##  5  2013     1     1      554            600        -6      812
##  6  2013     1     1      554            558        -4      740
##  7  2013     1     1      555            600        -5      913
##  8  2013     1     1      557            600        -3      709
##  9  2013     1     1      557            600        -3      838
## 10  2013     1     1      558            600        -2      753
## # ... with 336,766 more rows, and 12 more variables: sched_arr_time <int>,
## #   arr_delay <dbl>, carrier <chr>, flight <int>, tail <chr>,
## #   origin <chr>, dest <chr>, air_time <dbl>, distance <dbl>, hour <dbl>,
## #   minute <dbl>, time_hour <dttm>
```

3 Choosing rows: filter, between, slice, sample_n, top_n, distinct

```
# filter() supports the use of multiple conditions
flights %>% filter(dep_time >= 600, dep_time <= 605)
```

```
## # A tibble: 2,460 x 19
##     year month   day dep_time sched_dep_time dep_delay arr_time
##    <int> <int> <int>    <int>          <int>     <dbl>    <int>
##  1  2013     1     1      600            600         0      851
##  2  2013     1     1      600            600         0      837
##  3  2013     1     1      601            600         1      844
##  4  2013     1     1      602            610        -8      812
##  5   2013     1     1      602          605         -3      821
##  6   2013     1     2      600          600          0      814
##  7   2013     1     2      600          605         -5      751
##  8   2013     1     2      600          600          0      819
##  9   2013     1     2      600          600          0      846
## 10   2013     1     2      600          600          0      737
## # ... with 2,450 more rows, and 12 more variables: sched_arr_time <int>,
## #   arr_delay <dbl>, carrier <chr>, flight <int>, tailnum <chr>,
## #   origin <chr>, dest <chr>, air_time <dbl>, distance <dbl>, hour <dbl>,
## #   minute <dbl>, time_hour <dttm>
```

```
# between() is a concise alternative for determing if numeric values fall in a range
flights %>% filter(between(dep_time, 600, 605))

# side note: is.na() can also be useful when filtering
flights %>% filter(!is.na(dep_time))
```

```
# slice() filters rows by position
flights %>% slice(1000:1005)
```

```
## # A tibble: 6 x 19
##    year month   day dep_time sched_dep_time dep_delay arr_time
##   <int> <int> <int>    <int>          <int>     <dbl>    <int>
## 1  2013     1     2      809            810        -1      950
## 2  2013     1     2      810            800        10     1008
## 3  2013     1     2      811            815        -4     1100
## 4  2013     1     2      811            815        -4     1126
## 5  2013     1     2      811            820        -9      944
## 6  2013     1     2      815            815         0     1109
## # ... with 12 more variables: sched_arr_time <int>, arr_delay <dbl>,
## #   carrier <chr>, flight <int>, tailnum <chr>, origin <chr>, dest <chr>,
## #   air_time <dbl>, distance <dbl>, hour <dbl>, minute <dbl>,
## #   time_hour <dttm>
```

```
# keep the first three rows within each group
flights %>%
  group_by(month, day) %>%
  slice(1:3)
```

```
## # A tibble: 1,095 x 19
## # Groups:   month, day [365]
##     year month   day dep_time sched_dep_time dep_delay arr_time
##    <int> <int> <int>    <int>          <int>     <dbl>    <int>
##  1  2013     1     1      517            515         2      830
##  2  2013     1     1      533            529         4      850
##  3  2013     1     1      542            540         2      923
##  4  2013     1     2       42           2359        43      518
##  5  2013     1     2      126           2250       156      233
##  6  2013     1     2      458            500        -2      703
##  7  2013     1     3       32           2359        33      504
##  8  2013     1     3       50           2145       185      203
##  9  2013     1     3      235           2359       156      700
## 10  2013     1     4       25           2359        26      505
## # ... with 1,085 more rows, and 12 more variables: sched_arr_time <int>,
## #   arr_delay <dbl>, carrier <chr>, flight <int>, tailnum <chr>,
## #   origin <chr>, dest <chr>, air_time <dbl>, distance <dbl>, hour <dbl>,
## #   minute <dbl>, time_hour <dttm>
```

```r
# sample three rows from each group
flights %>%
  group_by(month, day) %>%
  sample_n(3)
```

```
## # A tibble: 1,095 x 19
## # Groups:   month, day [365]
##     year month   day dep_time sched_dep_time dep_delay arr_time
##    <int> <int> <int>    <int>          <int>     <dbl>    <int>
##  1  2013     1     1     1130           1125         5     1301
##  2  2013     1     1     1127           1129        -2     1303
##  3  2013     1     1     1935           1930         5     2223
##  4  2013     1     2     1907           1820        47     2037
##  5  2013     1     2     1648           1635        13     1843
##  6  2013     1     2       NA           1330        NA       NA
##  7  2013     1     3     2005           1925        40     2308
##  8  2013     1     3     2008           1540       268     2339
##  9  2013     1     3     2058           2100        -2     2202
## 10  2013     1     4      909            904         5     1234
## # ... with 1,085 more rows, and 12 more variables: sched_arr_time <int>,
## #   arr_delay <dbl>, carrier <chr>, flight <int>, tailnum <chr>,
## #   origin <chr>, dest <chr>, air_time <dbl>, distance <dbl>, hour <dbl>,
## #   minute <dbl>, time_hour <dttm>
```

```
# keep three rows from each group with the top dep_delay
flights %>%
  group_by(month, day) %>%
  top_n(3, dep_delay)
```

```
## # A tibble: 1,108 x 19
## # Groups:   month, day [365]
##     year month   day dep_time sched_dep_time dep_delay arr_time
##    <int> <int> <int>    <int>          <int>     <dbl>    <int>
##  1  2013     1     1      848           1835       853     1001
##  2  2013     1     1     1815           1325       290     2120
##  3  2013     1     1     2343           1724       379      314
##  4  2013     1     2     1412            838       334     1710
##  5  2013     1     2     1607           1030       337     2003
##  6  2013     1     2     2131           1512       379     2340
##  7  2013     1     3     2008           1540       268     2339
##  8  2013     1     3     2012           1600       252     2314
##  9  2013     1     3     2056           1605       291     2239
## 10  2013     1     4     2058           1730       208        2
## # ... with 1,098 more rows, and 12 more variables: sched_arr_time <int>,
## #   arr_delay <dbl>, carrier <chr>, flight <int>, tailnum <chr>,
## #   origin <chr>, dest <chr>, air_time <dbl>, distance <dbl>, hour <dbl>,
## #   minute <dbl>, time_hour <dttm>
```

```
# also sort by dep_delay within each group
flights %>%
  group_by(month, day) %>%
  top_n(3, dep_delay) %>%
  arrange(desc(dep_delay))
```

```
## # A tibble: 1,108 x 19
## # Groups:   month, day [365]
##     year month   day dep_time sched_dep_time dep_delay arr_time
##    <int> <int> <int>    <int>          <int>     <dbl>    <int>
##  1  2013     1     9      641            900      1301     1242
##  2  2013     6    15     1432           1935      1137     1607
##  3  2013     1    10     1121           1635      1126     1239
##  4  2013     9    20     1139           1845      1014     1457
##  5  2013     7    22      845           1600      1005     1044
##  6  2013     4    10     1100           1900       960     1342
##  7  2013     3    17     2321            810       911      135
##  8  2013     6    27      959           1900       899     1236
##  9  2013     7    22     2257            759       898      121
## 10  2013    12     5      756           1700       896     1058
## # ... with 1,098 more rows, and 12 more variables: sched_arr_time <int>,
## #   arr_delay <dbl>, carrier <chr>, flight <int>, tailnum <chr>,
## #   origin <chr>, dest <chr>, air_time <dbl>, distance <dbl>, hour <dbl>,
## #   minute <dbl>, time_hour <dttm>
```

```r
# unique rows can be identified using unique() from base R
flights %>%
  select(origin, dest) %>%
  unique()
```

```
## # A tibble: 224 x 2
##    origin dest
##    <chr>  <chr>
##  1 EWR    IAH
##  2 LGA    IAH
##  3 JFK    MIA
##  4 JFK    BQN
##  5 LGA    ATL
##  6 EWR    ORD
##  7 EWR    FLL
##  8 LGA    IAD
##  9 JFK    MCO
## 10 LGA    ORD
## # ... with 214 more rows
```

```r
# dplyr provides an alternative that is more "efficient"
flights %>%
  select(origin, dest) %>%
  distinct()

# side note: when chaining, you don't have to include the parentheses if there are no arguments
flights %>%
  select(origin, dest) %>%
  distinct()
```

4 Adding new variables: mutate, transmute, add_rownames

```
# mutate() creates a new variable (and keeps all existing variables)
flights %>% mutate(speed = distance / air_time * 60)
```

```
## # A tibble: 336,776 x 20
##     year month   day dep_time sched_dep_time dep_delay arr_time
##    <int> <int> <int>    <int>          <int>     <dbl>    <int>
##  1  2013     1     1      517            515         2      830
##  2  2013     1     1      533            529         4      850
##  3  2013     1     1      542            540         2      923
##  4  2013     1     1      544            545        -1     1004
##  5  2013     1     1      554            600        -6      812
##  6  2013     1     1      554            558        -4      740
##  7  2013     1     1      555            600        -5      913
##  8  2013     1     1      557            600        -3      709
##  9  2013     1     1      557            600        -3      838
## 10  2013     1     1      558            600        -2      753
## # ... with 336,766 more rows, and 13 more variables: sched_arr_time <int>,
## #   arr_delay <dbl>, carrier <chr>, flight <int>, tailnum <chr>,
## #   origin <chr>, dest <chr>, air_time <dbl>, distance <dbl>, hour <dbl>,
## #   minute <dbl>, time_hour <dttm>, speed <dbl>
```

```
# transmute() only keeps the new variables
flights %>% transmute(speed = distance / air_time * 60)
```

```
## # A tibble: 336,776 x 1
##    speed
##    <dbl>
##  1  370.
##  2  374.
##  3  408.
##  4  517.
##  5  394.
##  6  288.
##  7  404.
##  8  259.
##  9  405.
## 10  319.
## # ... with 336,766 more rows
```

```r
# example data frame with row names
mtcars %>% head()
```

```
##                     mpg cyl disp  hp drat    wt  qsec vs am gear carb
## Mazda RX4         21.0   6  160 110 3.90 2.620 16.46  0  1    4    4
## Mazda RX4 Wag     21.0   6  160 110 3.90 2.875 17.02  0  1    4    4
## Datsun 710        22.8   4  108  93 3.85 2.320 18.61  1  1    4    1
## Hornet 4 Drive    21.4   6  258 110 3.08 3.215 19.44  1  0    3    1
## Hornet Sportabout 18.7   8  360 175 3.15 3.440 17.02  0  0    3    2
## Valiant           18.1   6  225 105 2.76 3.460 20.22  1  0    3    1
```

```r
# add_rownames() turns row names into an explicit variable
mtcars %>%
  add_rownames("model") %>%
  head()
```

```
## Warning: Deprecated, use tibble::rownames_to_column() instead.
```

```
## # A tibble: 6 x 12
##   model     mpg   cyl  disp    hp  drat    wt  qsec    vs    am  gear  carb
##   <chr>   <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1 Mazda ~  21        6   160   110  3.9    2.62  16.5     0     1     4     4
## 2 Mazda ~  21        6   160   110  3.9    2.88  17.0     0     1     4     4
## 3 Datsun~  22.8      4   108    93  3.85   2.32  18.6     1     1     4     1
## 4 Hornet~  21.4      6   258   110  3.08   3.22  19.4     1     0     3     1
## 5 Hornet~  18.7      8   360   175  3.15   3.44  17.0     0     0     3     2
## 6 Valiant  18.1      6   225   105  2.76   3.46  20.2     1     0     3     1
```

```r
# side note: dplyr no longer prints row names (ever) for local data frames
mtcars %>% tbl_df()
```

```
## # A tibble: 32 x 11
##      mpg   cyl  disp    hp  drat    wt  qsec    vs    am  gear  carb
##    <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
##  1  21       6  160    110  3.9   2.62  16.5     0     1     4     4
##  2  21       6  160    110  3.9   2.88  17.0     0     1     4     4
##  3  22.8     4  108     93  3.85  2.32  18.6     1     1     4     1
##  4  21.4     6  258    110  3.08  3.22  19.4     1     0     3     1
##  5  18.7      8  360     175  3.15  3.44  17.0      0      0      3      2
##  6  18.1      6  225     105  2.76  3.46  20.2      1      0      3      1
##  7  14.3      8  360     245  3.21  3.57  15.8      0      0      3      4
##  8  24.4      4  147.     62  3.69  3.19  20        1      0      4      2
##  9  22.8      4  141.     95  3.92  3.15  22.9      1      0      4      2
## 10  19.2      6  168.    123  3.92  3.44  18.3      1      0      4      4
## # ... with 22 more rows
```

5 Grouping and counting: summarise, tally, count, group_size, n_groups, ungroup

```
# summarise() can be used to count the number of rows in each group
flights %>%
  group_by(month) %>%
  summarise(cnt = n())
```

```
## # A tibble: 12 x 2
##    month   cnt
##    <int> <int>
##  1     1 27004
##  2     2 24951
##  3     3 28834
##  4     4 28330
##  5     5 28796
##  6     6 28243
##  7     7 29425
##  8     8 29327
##  9     9 27574
## 10    10 28889
## 11    11 27268
## 12    12 28135
```

```
# tally() and count() can do this more concisely
flights %>%
  group_by(month) %>%
  tally()
flights %>% count(month)
```

```
# you can sort by the count
flights %>%
  group_by(month) %>%
  summarise(cnt = n()) %>%
  arrange(desc(cnt))
```

```
## # A tibble: 12 x 2
##    month   cnt
##    <int> <int>
##  1     7 29425
##  2     8 29327
##  3    10 28889
##  4     3 28834
##  5     5 28796
##  6     4 28330
##  7     6 28243
##  8    12 28135
##  9     9 27574
## 10    11 27268
## 11     1 27004
## 12     2 24951
```

```
# tally() and count() have a sort parameter for this purpose
flights %>%
  group_by(month) %>%
  tally(sort = TRUE)
flights %>% count(month, sort = TRUE)
```

```
# you can sum over a specific variable instead of simply counting rows
flights %>%
  group_by(month) %>%
  summarise(dist = sum(distance))
```

```
## # A tibble: 12 x 2
##    month     dist
##    <int>    <dbl>
##  1     1 27188805
##  2     2 24975509
##  3     3 29179636
##  4     4 29427294
##  5     5 29974128
##  6     6 29856388
##  7     7 31149199
##  8     8 31149334
##  9     9 28711426
## 10    10 30012086
## 11    11 28639718
## 12    12 29954084
```

```r
# tally() and count() have a wt parameter for this purpose
flights %>%
  group_by(month) %>%
  tally(wt = distance)
flights %>% count(month, wt = distance)
```

```r
# group_size() returns the counts as a vector
flights %>%
  group_by(month) %>%
  group_size()
```

```
##  [1] 27004 24951 28834 28330 28796 28243 29425 29327 27574 28889 27268
## [12] 28135
```

```r
# n_groups() simply reports the number of groups
flights %>%
  group_by(month) %>%
  n_groups()
```

```
## [1] 12
```

```r
# group by two variables, summarise, arrange (output is possibly confusing)
flights %>%
  group_by(month, day) %>%
  summarise(cnt = n()) %>%
  arrange(desc(cnt)) %>%
  print(n = 40)
```

```
## # A tibble: 365 x 3
## # Groups:   month [12]
##    month   day   cnt
##    <int> <int> <int>
##  1    11    27  1014
##  2     7    11  1006
##  3     7     8  1004
##  4     7    10  1004
##  5    12     2  1004
##  6     7    18  1003
##  7     7    25  1003
##  8     7    12  1002
##  9     7     9  1001
## 10     7    17  1001
## 11     7    31  1001
## 12     8     7  1001
## 13     8     8  1001
## 14     8    12  1001
## 15     7    22  1000
## 16     7    24  1000
## 17     8     1  1000
## 18     8     5  1000
## 19     8    15  1000
## 20    11    21  1000
## 21     7    15   999
## 22     7    19   999
## 23     7    26   999
## 24     7    29   999
## 25     8     2   999
## 26     8     9   999
## 27    11    22   999
## 28     8    16   998
## 29     7    23   997
## 30     7    30   997
## 31     8    14   997
## 32     7    16   996
## 33     8     6   996
## 34     8    19   996
## 35     9    13   996
## 36     9    26   996
## 37      9    27   996
## 38      4    15   995
## 39      6    20   995
## 40      6    26   995
## # ... with 325 more rows
```

```
# ungroup() before arranging to arrange across all groups
flights %>%
  group_by(month, day) %>%
  summarise(cnt = n()) %>%
  ungroup() %>%
  arrange(desc(cnt))
```

```
## # A tibble: 365 x 3
##    month   day   cnt
##    <int> <int> <int>
##  1    11    27  1014
##  2     7    11  1006
##  3     7     8  1004
##  4     7    10  1004
##  5    12     2  1004
##  6     7    18  1003
##  7     7    25  1003
##  8     7    12  1002
##  9     7     9  1001
## 10     7    17  1001
## # ... with 355 more rows
```

6 Creating data frames: data_frame

`data_frame()` is a better way than `data.frame()` for creating data frames. Benefits of `data_frame()`:

- You can use previously defined columns to compute new columns.
- It never coerces column types.
- It never munges column names.
- It never adds row names.
- It only recycles length 1 input.
- It returns a local data frame (a tbl_df).

```
# data_frame() example
data_frame(a = 1:6, b = a * 2, c = "string", "d+e" = 1) %>% glimpse()
```

```
## Warning: `data_frame()` is deprecated, use `tibble()`.
## This warning is displayed once per session.

## Observations: 6
## Variables: 4
## $ a     <int> 1, 2, 3, 4, 5, 6
## $ b     <dbl> 2, 4, 6, 8, 10, 12
## $ c     <chr> "string", "string", "string", "string", "string", "string"
## $ `d+e` <dbl> 1, 1, 1, 1, 1, 1
```

```
# data.frame() example
data.frame(a = 1:6, c = "string", "d+e" = 1) %>% glimpse()
```

```
## Observations: 6
## Variables: 3
## $ a   <int> 1, 2, 3, 4, 5, 6
## $ c   <fct> string, string, string, string, string, string
## $ d.e <dbl> 1, 1, 1, 1, 1, 1
```

7 Viewing more output: print, View

```
# specify that you want to see more rows
flights %>% print(n = 15)
```

```
## # A tibble: 336,776 x 19
##     year month   day dep_time sched_dep_time dep_delay arr_time
##    <int> <int> <int>    <int>          <int>     <dbl>    <int>
##  1  2013     1     1      517            515         2      830
##  2  2013     1     1      533            529         4      850
##  3  2013     1     1      542            540         2      923
##  4  2013     1     1      544            545        -1     1004
##  5  2013     1     1      554            600        -6      812
##  6  2013     1     1      554            558        -4      740
##  7  2013     1     1      555            600        -5      913
##  8  2013     1     1      557            600        -3      709
##  9  2013     1     1      557            600        -3      838
## 10  2013     1     1      558            600        -2      753
## 11  2013     1     1      558            600        -2      849
## 12  2013     1     1      558            600        -2      853
## 13  2013     1     1      558            600        -2      924
## 14  2013     1     1      558            600        -2      923
## 15  2013     1     1      559            600        -1      941
## # ... with 3.368e+05 more rows, and 12 more variables:
## #   sched_arr_time <int>, arr_delay <dbl>, carrier <chr>, flight <int>,
## #   tailnum <chr>, origin <chr>, dest <chr>, air_time <dbl>,
## #   distance <dbl>, hour <dbl>, minute <dbl>, time_hour <dttm>
```

```
# specify that you want to see ALL rows (don't run this!)
flights %>% print(n = Inf)
```

```
# specify that you want to see all columns
flights %>% print(width = Inf)
```

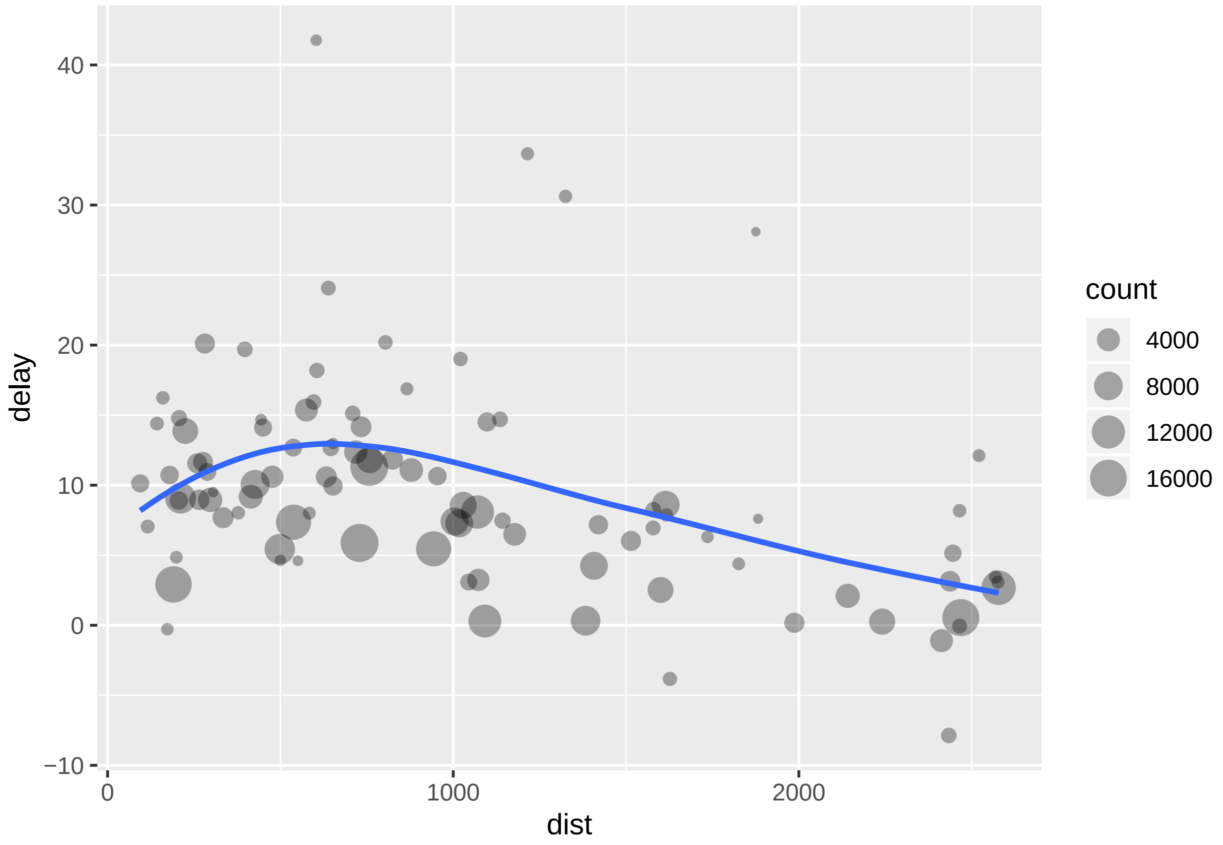
```
## # A tibble: 336,776 x 19
##     year month   day dep_time sched_dep_time dep_delay arr_time
##    <int> <int> <int>    <int>          <int>     <dbl>    <int>
##  1  2013     1     1      517            515         2      830
##  2  2013     1     1      533            529         4      850
##  3  2013     1     1      542            540         2      923
##  4  2013     1     1      544            545        -1     1004
##  5  2013     1     1      554            600        -6      812
##  6  2013     1     1      554            558        -4      740
##  7  2013     1     1      555            600        -5      913
##  8  2013     1     1      557            600        -3      709
##  9  2013     1     1      557            600        -3      838
## 10  2013     1     1      558            600        -2      753
##    sched_arr_time arr_delay carrier flight tailnum origin dest  air_time
##             <int>     <dbl> <chr>    <int> <chr>   <chr>  <chr>    <dbl>
##  1            819        11 UA        1545 N14228  EWR    IAH        227
##  2            830        20 UA        1714 N24211  LGA    IAH        227
##  3            850        33 AA        1141 N619AA  JFK    MIA        160
##  4           1022       -18 B6         725 N804JB  JFK    BQN        183
##  5            837       -25 DL         461 N668DN  LGA    ATL        116
##  6            728        12 UA        1696 N39463  EWR    ORD        150
##  7            854        19 B6         507 N516JB  EWR    FLL        158
##  8            723       -14 EV        5708 N829AS  LGA    IAD           53
##  9            846        -8 B6          79 N593JB  JFK    MCO          140
## 10            745         8 AA         301 N3ALAA  LGA    ORD          138
##    distance  hour minute time_hour
##       <dbl> <dbl>  <dbl> <dttm>
##  1     1400     5     15 2013-01-01 05:00:00
##  2     1416     5     29 2013-01-01 05:00:00
##  3     1089     5     40 2013-01-01 05:00:00
##  4     1576     5     45 2013-01-01 05:00:00
##  5      762     6      0 2013-01-01 06:00:00
##  6      719     5     58 2013-01-01 05:00:00
##  7     1065     6      0 2013-01-01 06:00:00
##  8      229     6      0 2013-01-01 06:00:00
##  9      944     6      0 2013-01-01 06:00:00
## 10      733     6      0 2013-01-01 06:00:00
## # ... with 336,766 more rows
```

```
# show up to 1000 rows and all columns
flights %>% View()

# set option to see all columns and fewer rows
options(dplyr.width = Inf, dplyr.print_min = 6)

# reset options (or just close R)
options(dplyr.width = NULL, dplyr.print_min = 10)
```

8 plot

```
library(ggplot2)

flights %>%
  group_by(dest) %>%
  summarize(
    count = n(),
    dist = mean(distance, na.rm = TRUE),
    delay = mean(arr_delay, na.rm = TRUE)
  ) %>%
  filter(delay, count > 20, dest != "HNL") %>%
  ggplot(mapping = aes(x = dist, y = delay)) +
  geom_point(aes(size = count), alpha = 1 / 3) +
  geom_smooth(se = FALSE)
```

```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```


delay
dist
count
● 4000
● 8000
● 12000
● 16000