Lab sheet 7a: Data Science Basics

Data transformation

```
library(nycflights13)
library(tidyverse)
```

dplyr basics

filter()

```
flights |>
  filter(dep_delay > 120)
```

```
## # A tibble: 9,723 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      848           1835       853     1001
##  2  2013     1     1      957            733       144     1056
##  3  2013     1     1     1114            900       134     1447
##  4  2013     1     1     1540           1338       122     2020
##  5  2013     1     1     1815           1325       290     2120
##  6  2013     1     1     1842           1422       260     1958
##  7  2013     1     1     1856           1645       131     2212
##  8  2013     1     1     1934           1725       129     2126
##  9  2013     1     1     1938           1703       155     2109
## 10  2013     1     1     1942           1705       157     2124
## # i 9,713 more rows
## # i 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>
```

```
# Flights that departed on January 1
flights |>
  filter(month == 1 & day == 1)
```

```
## # A tibble: 842 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
## # i 832 more rows
## # i 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>
```

```
# Flights that departed in November or December
flights |>
  filter(month == 11 | month == 12)
```

```
## # A tibble: 55,403 x 19
##     year month   day dep_time sched_dep_time dep_delay arr_time
##    <int> <int> <int>    <int>          <int>     <dbl>    <int>
##  1  2013    11     1        5           2359         6      352
##  2  2013    11     1       35           2250       105      123
##  3  2013    11     1      455            500        -5      641
##  4  2013    11     1      539            545        -6      856
##  5  2013    11     1      542            545        -3      831
##  6  2013    11     1      549            600       -11      912
##  7  2013    11     1      550            600       -10      705
##  8  2013    11     1      554            600        -6      659
##  9  2013    11     1      554            600        -6      826
## 10  2013    11     1      554            600        -6      749
## # i 55,393 more rows
## # i 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>
```

```
# Flights that departed in November or December: another way
flights |>
  filter(month %in% c(11,12))
```

```
## # A tibble: 55,403 x 19
##     year month   day dep_time sched_dep_time dep_delay arr_time
##    <int> <int> <int>    <int>          <int>     <dbl>    <int>
##  1  2013    11     1        5           2359         6      352
##  2  2013    11     1       35           2250       105      123
##  3  2013    11     1      455            500        -5      641
##  4  2013    11     1      539            545        -6      856
##  5  2013    11     1      542            545        -3      831
##  6  2013    11     1      549            600       -11      912
##  7  2013    11     1      550            600       -10      705
##  8  2013    11     1      554            600        -6      659
##  9  2013    11     1      554            600        -6      826
## 10  2013    11     1      554            600        -6      749
## # i 55,393 more rows
## # i 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>
```

arrange()

```
flights |>
  arrange(year, month, day, dep_time)
```

```
## # 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
## # i 336,766 more rows
## # i 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>
```

```
flights |>
  arrange(desc(dep_delay))
```

```
## # 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     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
## # i 336,766 more rows
## # i 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>
```

distinct()

```
# Remove duplicate rows, if any
flights |>
  distinct()
```

```
## # 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
## # i 336,766 more rows
## # i 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>
```

```
flights |>
  distinct(origin, dest, .keep_all = TRUE)
```

```
## # A tibble: 224 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
## # i 214 more rows
## # i 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>
```

```
flights |>
  count(origin, dest, sort = TRUE)
```

```
## # A tibble: 224 x 3
##    origin dest      n
##    <chr>  <chr> <int>
##  1 JFK    LAX   11262
##  2 LGA    ATL   10263
##  3 LGA    ORD    8857
##  4 JFK    SFO    8204
##  5 LGA    CLT    6168
##  6 EWR    ORD    6100
##  7 JFK    BOS    5898
##  8 LGA    MIA    5781
##  9 JFK    MCO    5464
## 10 EWR    BOS    5327
## # i 214 more rows
```

mutate()

```
flights |>
  mutate(
    gain = dep_delay - arr_delay,
    speed = distance / air_time * 60
  )
```

```
## # A tibble: 336,776 x 21
##     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
## # i 336,766 more rows
## # i 14 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>, gain <dbl>, speed <dbl>
```

```
flights |>
  mutate(
    gain = dep_delay - arr_delay,
    speed = distance / air_time * 60,
    .before = 1
  )
```

```
flights |>
  mutate(
    gain = dep_delay - arr_delay,
    speed = distance / air_time * 60,
    .after = day
  )
```

```
flights |>
  mutate(
    gain = dep_delay - arr_delay,
    hours = air_time / 60,
    gain_per_hour = gain / hours,
    .keep = "used"
  )
```

Piping

```
flights |>
  filter(dest == "IAH") |>
  mutate(speed = distance / air_time * 60) |>
  select(year:day, dep_time, carrier, flight, speed) |>
```

```
  arrange(desc(speed))
```

```
## # A tibble: 7,198 x 7
##     year month   day dep_time carrier flight speed
##    <int> <int> <int>    <int> <chr>    <int> <dbl>
##  1  2013     7     9      707 UA         226  522.
##  2  2013     8    27     1850 UA        1128  521.
##  3  2013     8    28      902 UA        1711  519.
##  4  2013     8    28     2122 UA        1022  519.
##  5  2013     6    11     1628 UA        1178  515.
##  6  2013     8    27     1017 UA         333  515.
##  7  2013     8    27     1205 UA        1421  515.
##  8  2013     8    27     1758 UA         302  515.
##  9  2013     9    27      521 UA         252  515.
## 10  2013     8    28      625 UA         559  515.
## # i 7,188 more rows
```

Groups

```
flights |>
  group_by(month)
```

```
## # A tibble: 336,776 x 19
## # Groups:   month [12]
##     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
## # i 336,766 more rows
## # i 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>
```

```
flights |>
  group_by(month) |>
  summarize(
    avg_delay = mean(dep_delay)
  )
```

```
## # A tibble: 12 x 2
##    month avg_delay
##    <int>     <dbl>
##  1     1        NA
##  2     2        NA
##  3     3        NA
##  4     4        NA
```

```
##  5     5        NA
##  6     6        NA
##  7     7        NA
##  8     8        NA
##  9     9        NA
## 10    10        NA
## 11    11        NA
## 12    12        NA
```

```
flights |>
  group_by(month) |>
  summarize(
    delay = mean(dep_delay, na.rm = TRUE)
  )
```

```
## # A tibble: 12 x 2
##    month delay
##    <int> <dbl>
##  1     1 10.0
##  2     2 10.8
##  3     3 13.2
##  4     4 13.9
##  5     5 13.0
##  6     6 20.8
##  7     7 21.7
##  8     8 12.6
##  9     9  6.72
## 10    10  6.24
## 11    11  5.44
## 12    12 16.6
```

```
flights |>
  group_by(month) |>
  summarize(
    delay = mean(dep_delay, na.rm = TRUE),n=n()
  )
```

```
## # A tibble: 12 x 3
##    month delay     n
##    <int> <dbl> <int>
##  1     1 10.0  27004
##  2     2 10.8  24951
##  3     3 13.2  28834
##  4     4 13.9  28330
##  5     5 13.0  28796
##  6     6 20.8  28243
##  7     7 21.7  29425
##  8     8 12.6  29327
##  9     9  6.72 27574
## 10    10  6.24 28889
## 11    11  5.44 27268
## 12    12 16.6  28135
```