MDSR Ch 15: Database querying using SQL

You can download this .qmd file from here. Just hit the Download Raw File button.

The .qmd file above walks us through many of the examples in MDSR Chapter 15, but that code and output is not replicated below. Instead, we present here a set of practice exercises in converting from the tidyverse to SQL.

```
library(tidyverse)
library(mdsr)
library(dbplyr)
library(DBI)
```

```
# connect to the scidb server on Amazon Web Services - the airlines
# database lives on a remote server
db <- dbConnect_scidb("airlines")
flights <- tbl(db, "flights")
planes <- tbl(db, "planes")
```

On Your Own - Extended Example from MDSR

Refer to Section 15.5 in MDSR, where they attempt to replicate FiveThirtyEight's plot of slowest and fastest airports in the section below Figure 15.1. Instead of using *target time*, which has a complex definition, we will use *arrival time*, which oversimplifies the situation but gets us in the ballpark.

The MDSR authors provide a mix of SQL and R code to perform their analysis, but the code will not work if you simply cut-and-paste as-is into R. Your task is to convert the book code into something that actually runs. [Hint: use `dbGetQuery()`]

On Your Own - Practice with SQL

These problems are based on class exercises from MSCS 164 in Fall 2023, so you've already solved them in R! Now we're going to try to duplicate those solutions in SQL.

```
# Read in 2013 NYC flights data
library(nycflights13)
flights_nyc13 <- nycflights13::flights
planes_nyc13 <- nycflights13::planes
```

1. Summarize carriers flying to MSP by number of flights and proportion that are cancelled (assuming that a missing arrival time indicates a cancelled flight). [This was #4 in 17_longer_pipelines.Rmd.]

```
# Original solution from MSCS 164
flights_nyc13 |>
  mutate(carrier = fct_collapse(carrier, "Delta +" = c("DL", "9E"),
                                         "American +"= c("AA", "MQ"),
                                        "United +" = c("EV", "OO", "UA"))) |>
  filter(dest == "MSP") |>
  group_by(origin, carrier) |>
  summarize(n_flights = n(),
            num_cancelled = sum(is.na(arr_time)),
            prop_cancelled = mean(is.na(arr_time)))
```

```
# A tibble: 5 x 5
# Groups:   origin [3]
  origin carrier    n_flights num_cancelled prop_cancelled
  <chr>  <fct>          <int>         <int>          <dbl>
1 EWR    Delta +          598            10         0.0167
2 EWR    United +        1779           105         0.0590
3 JFK    Delta +         1095            41         0.0374
4 LGA    Delta +         2420            25         0.0103
5 LGA    American +      1293            62         0.0480
```

First duplicate the output above, then check trends across all years and origins. Here are a few hints:

- use flights instead of flights_nyc13
- remember that flights_nyc13 only contained 2013 and 3 NYC origin airports (EWR, JFK, LGA)
- is.na can be replaced with CASE WHEN arr_time = 'NA' THEN 1 ELSE 0 END

- CASE WHEN can also be used replace fct_collapse

Duplicate 2013 NYC analysis:

```
SELECT carrier, dest, arr_time, origin, year,
  SUM(1) AS n_flights,
  SUM(CASE WHEN arr_time = 'NA' THEN 1 ELSE 0 END) AS num_cancelled,
  AVG(CASE WHEN arr_time = 'NA' THEN 1 ELSE 0 END) AS prop_cancelled,
  CASE WHEN (carrier = "DL" OR carrier = "9E") THEN 'Delta +'
    WHEN (carrier = "AA" OR carrier = "MQ") THEN 'American +'
    WHEN (carrier = "EV" OR carrier = "OO" OR carrier = "UA") THEN 'United +'
    ELSE 'Other' END AS new_carrier
FROM flights
WHERE dest = "MSP" AND year = 2013 AND (origin = "EWR" OR origin = "JFK" OR origin = "LGA"
GROUP BY origin, new_carrier
ORDER BY prop_cancelled DESC;
```

Table 1: 5 records

carrier	dest	arr_time	origin	year	n_flights	num_cancelled	prop_cancelled	new_carrier
EV	MSP	800	EWR	2013	1779	105	0.0590	United +
MQ	MSP	847	LGA	2013	1293	62	0.0480	American +
9E	MSP	954	JFK	2013	1095	41	0.0374	Delta +
DL	MSP	1007	EWR	2013	598	10	0.0167	Delta +
DL	MSP	751	LGA	2013	2420	25	0.0103	Delta +

See trends across all years and origins (similar for other two problems - just remove year and origin from WHERE and re-run):

```
SELECT carrier, dest, arr_time, origin, year,
  SUM(1) AS n_flights,
  SUM(CASE WHEN arr_time = 'NA' THEN 1 ELSE 0 END) AS num_cancelled,
  AVG(CASE WHEN arr_time = 'NA' THEN 1 ELSE 0 END) AS prop_cancelled,
  CASE WHEN (carrier = "DL" OR carrier = "9E") THEN 'Delta +'
    WHEN (carrier = "AA" OR carrier = "MQ") THEN 'American +'
    WHEN (carrier = "EV" OR carrier = "OO" OR carrier = "UA") THEN 'United +'
    ELSE 'Other' END AS new_carrier
FROM flights
WHERE dest = "MSP"
GROUP BY origin, new_carrier
```

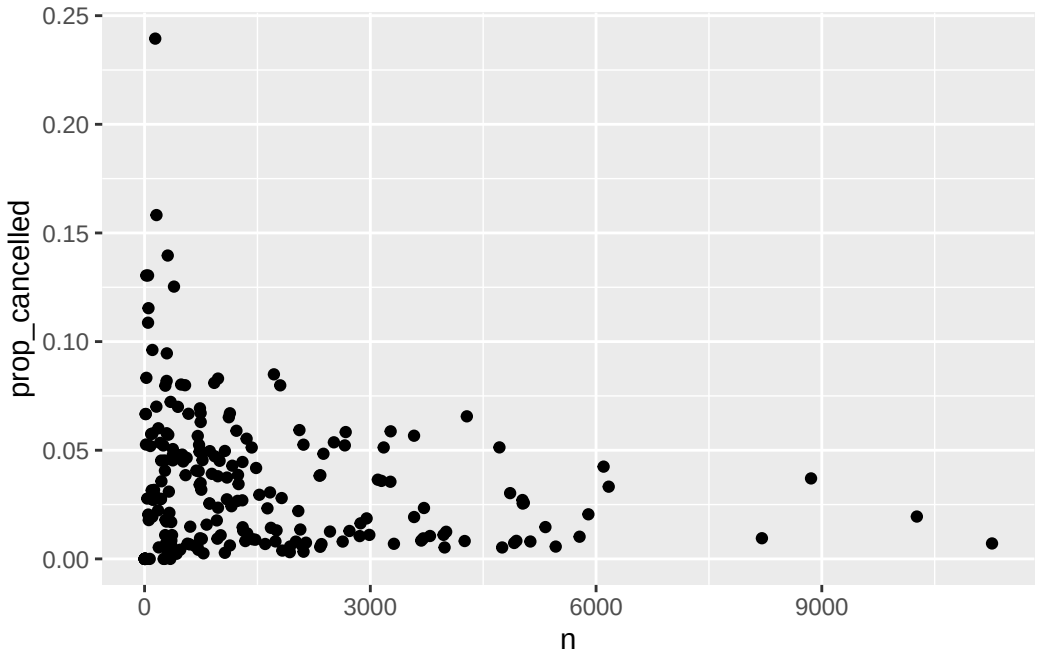
```
ORDER BY prop_cancelled DESC;
```

Table 2: Displaying records 1 - 10

carrier	dest	arr_time	origin	year	n_flights	num_cancelled	prop_cancelled	new_carrier
OO	MSP	1559	ASE	2015	43	7	0.1628	United +
EV	MSP	1902	TYS	2013	61	6	0.0984	United +
EV	MSP	800	EWR	2013	4220	286	0.0678	United +
MQ	MSP	847	LGA	2013	1612	107	0.0664	American +
EV	MSP	1024	MSY	2013	135	8	0.0593	United +
EV	MSP	836	LGA	2015	18	1	0.0556	United +
OO	MSP	850	MSO	2015	91	4	0.0440	United +
EV	MSP	1220	DFW	2014	815	35	0.0429	United +
EV	MSP	818	ALB	2013	125	5	0.0400	United +
OO	MSP	827	DLH	2013	1966	78	0.0397	United +

2. Plot number of flights vs. proportion cancelled for every origin-destination pair (assuming that a missing arrival time indicates a cancelled flight). [This was #7 in 17_longer_pipelines.Rmd.]

```
# Original solution from MSCS 164
flights_nyc13 |>
  group_by(origin, dest) |>
  summarize(n = n(),
            prop_cancelled = mean(is.na(arr_time))) |>
  filter(prop_cancelled < 1) |>
  ggplot(aes(n, prop_cancelled)) +
  geom_point()
```



First duplicate the plot above, then check trends across all years and origins. Do all of the data wrangling in SQL. Here are a few hints:

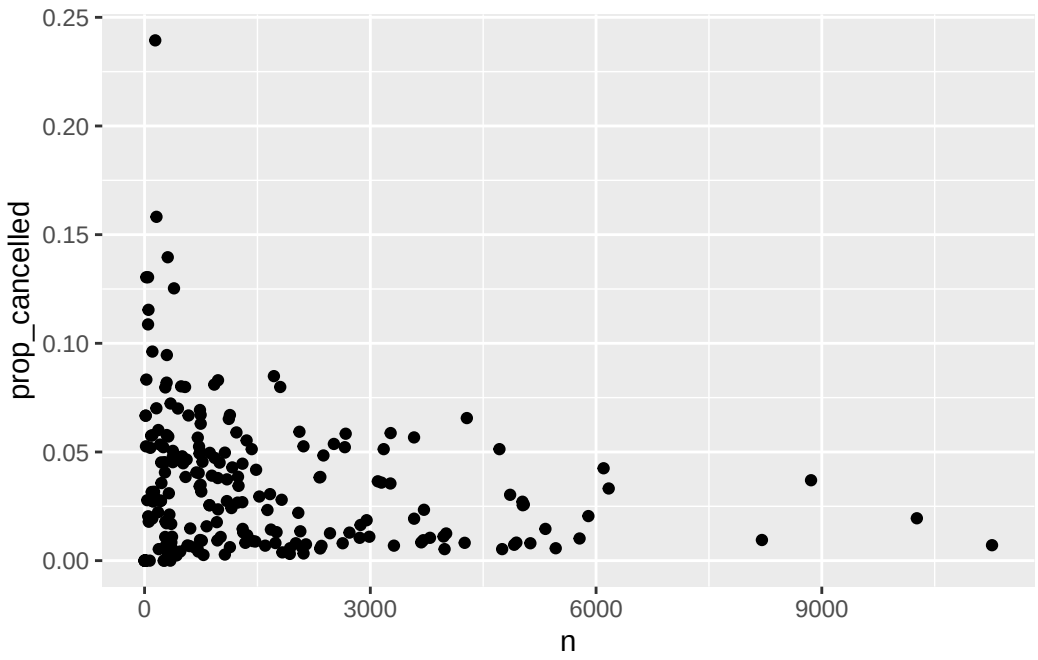
- use flights instead of flights_nyc13
- remember that flights_nyc13 only contained 2013 and 3 NYC origin airports (EWR, JFK, LGA)
- use an `sql` chunk and an `r` chunk
- include `connection =` and `output.var =` in your sql chunk header (this doesn't seem to work with dbGetQuery()…)

Duplicate 2013 NYC analysis:

```sql
SELECT origin, dest, arr_time,
  SUM(1) AS n,
  AVG(CASE WHEN arr_time = 'NA' THEN 1 ELSE 0 END) AS prop_cancelled
FROM flights
WHERE year = 2013 AND (origin = "EWR" OR origin = "JFK" OR origin = "LGA")
GROUP BY origin, dest
HAVING prop_cancelled < 1
```

```r
plot_data |>
  ggplot(aes(n, prop_cancelled)) +
```

```
  geom_point()
```



3. Produce a table of weighted plane age by carrier, where weights are based on number of flights per plane. [This was #6 in 26_more_joins.Rmd.]

```
# Original solution from MSCS 164
flights_nyc13 |>
  left_join(planes_nyc13, join_by(tailnum)) |>
  mutate(plane_age = 2013 - year.y) |>
  group_by(carrier) |>
  summarize(unique_planes = n_distinct(tailnum),
            mean_weighted_age = mean(plane_age, na.rm =TRUE),
            sd_weighted_age = sd(plane_age, na.rm =TRUE)) |>
  arrange(mean_weighted_age)
```

```
# A tibble: 16 x 4
   carrier unique_planes mean_weighted_age sd_weighted_age
   <chr>           <int>             <dbl>           <dbl>
 1 HA                 14              1.55            1.14
 2 AS                 84              3.34            3.07
 3 VX                 53              4.47            2.14
```

```
 4 F9                26             4.88           3.67
 5 B6               193             6.69           3.29
 6 OO                28             6.84           2.41
 7 9E               204             7.10           2.67
 8 US               290             9.10           4.88
 9 WN               583             9.15           4.63
10 YV                58             9.31           1.93
11 EV               316            11.3            2.29
12 FL               129            11.4            2.16
13 UA               621            13.2            5.83
14 DL               629            16.4            5.49
15 AA               601            25.9            5.42
16 MQ               238            35.3            3.13
```

First duplicate the output above, then check trends across all years and origins. Do all of the data wrangling in SQL. Here are a few hints:

- use flights instead of flights_nyc13
- remember that flights_nyc13 only contained 2013 and 3 NYC origin airports (EWR, JFK, LGA)
- you'll have to merge the flights dataset with the planes dataset
- you can use DISTINCT inside a COUNT()

Duplicate 2013 NYC analysis:

```
SELECT carrier,
  COUNT(DISTINCT o.tailnum) AS unique_planes,
  AVG(o.year - p.year) AS mean_weighted_age,
  STDDEV_SAMP(o.year - p.year) AS sd_weighted_age
FROM flights AS o
LEFT JOIN planes p ON o.tailnum = p.tailnum
WHERE o.year = 2013 AND (origin = "EWR" OR origin = "JFK" OR origin = "LGA")
GROUP BY carrier
ORDER BY mean_weighted_age ASC;
```

```
test
```

```
   carrier unique_planes mean_weighted_age sd_weighted_age
1       HA            14            1.5484        1.138861
2       AS            84            3.3366        3.070986
3       VX            53            4.4736        2.135272
4       F9            26            4.8787        3.667932
```

5	B6	193	6.6867	3.289492
6	OO	28	6.8438	2.411122
7	9E	204	7.1011	2.669642
8	US	290	9.1037	4.881910
9	WN	583	9.1461	4.626059
10	YV	58	9.3138	1.927391
11	EV	316	11.3090	2.289370
12	FL	129	11.3858	2.161103
13	UA	621	13.2077	5.833495
14	DL	629	16.3722	5.489888
15	AA	601	25.8694	5.416478
16	MQ	238	35.3190	3.132899