

Assignment 4

Due at 11:59pm on November 4.

This is an individual assignment. Turn in this assignment as an HTML or PDF file to ELMS. Make sure to include the R Markdown or Quarto file that was used to generate it. Include the GitHub link for the repository containing these files.

```
library(tidyverse)
```

```
Warning: package 'tibble' was built under R version 4.3.3
```

```
Warning: package 'purrr' was built under R version 4.3.3
```

```
-- Attaching core tidyverse packages ----- tidyverse 2.0.0 --
v dplyr     1.1.4     v readr     2.1.4
v forcats   1.0.0     v stringr   1.5.1
v ggplot2   3.4.3     v tibble    3.3.0
v lubridate  1.9.2     v tidyr    1.3.0
v purrr     1.0.4
-- Conflicts ----- tidyverse_conflicts() --
x dplyr::filter() masks stats::filter()
x dplyr::lag()   masks stats::lag()
i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become non-conflicting
```

```
library(DBI)
library(dbplyr)
```

```
Attaching package: 'dbplyr'
```

```
The following objects are masked from 'package:dplyr':
```

```
ident, sql
```

```
library(bigrquery)

# Github working Repo URL: https://github.com/TroyLiuUofM/SurvMeth-727-a4.git
```

In this notebook we will use Google BigQuery, “Google’s fully managed, petabyte scale, low cost analytics data warehouse”. Some instruction on how to connect to Google BigQuery can be found here: <https://db.rstudio.com/databases/big-query/>.

You will need to set up a Google account with a project to be able to use this service. We will be using a public dataset that comes with 1 TB/mo of free processing on Google BigQuery. As long as you do not repeat the work in this notebook constantly, you should be fine with just the free tier.

Go to <https://console.cloud.google.com> and make sure you are logged in a non-university Google account. **This may not work on a university G Suite account because of restrictions on those accounts.** Create a new project by navigating to the dropdown menu at the top (it might say “Select a project”) and selecting “New Project” in the window that pops up. Name it something useful.

After you have initialized a project, paste your project ID into the following chunk.

```
project <- "survmeth"
```

We will connect to a public database, the Chicago crime database, which has data on crime in Chicago.

```
con <- dbConnect(
  bigrquery::bigrquery(),
  project = "bigquery-public-data",
  dataset = "chicago_crime",
  billing = project
)
con
```



```
<BigQueryConnection>
Dataset: bigquery-public-data.chicago_crime
Billing: survmeth
```

We can look at the available tables in this database using `dbListTables`.

Note: When you run this code, you will be sent to a browser and have to give Google permissions to Tidyverse API Packages. **Make sure you select all to give access or else your code will not run.**

```
dbListTables(con)
```

i Suitable tokens found in the cache, associated with these emails:

```
* 'liushengkun0128@gmail.com'
```

```
* 'shengkun@umich.edu'
```

Defaulting to the first email.

! Using an auto-discovered, cached token.

To suppress this message, modify your code or options to clearly consent to the use of a cached token.

See `gargle`'s "Non-interactive auth" vignette for more details:

```
<https://gargle.r-lib.org/articles/non-interactive-auth.html>
```

i The `bigrquery` package is using a cached token for
'liushengkun0128@gmail.com'.

```
[1] "crime"
```

Information on the 'crime' table can be found here:

```
https://cloud.google.com/bigquery/public-data/chicago-crime-data
```

Write a first query that counts the number of rows of the 'crime' table in the year 2016. Use code chunks with {sql connection = con} in order to write SQL code within the document.

```
SELECT count(primary_type) AS primary_count, count(*) AS overall_count -- counting non-missing
FROM crime
WHERE year = 2016
LIMIT 10;
```

Table 1: 1 records

primary_count	overall_count
269939	269939

Next, count the number of arrests grouped by `primary_type` in 2016. Note that is a somewhat similar task as above, with some adjustments on which rows should be considered. Sort the results, i.e. list the number of arrests in a descending order.

```
SELECT DISTINCT arrest
FROM crime;
```

Table 2: 2 records

arrest
FALSE
TRUE

```
SELECT
primary_type,
count(primary_type) AS arrest_count_by_type
FROM crime
WHERE year = 2016
AND arrest = TRUE
GROUP BY primary_type
ORDER BY arrest_count_by_type DESC
LIMIT 10;
```

Table 3: Displaying records 1 - 10

primary_type	arrest_count_by_type
NARCOTICS	13327
BATTERY	10334
THEFT	6522
CRIMINAL TRESPASS	3724
ASSAULT	3494
OTHER OFFENSE	3416
WEAPONS VIOLATION	2510
CRIMINAL DAMAGE	1669

primary_type	arrest_count_by_type
PUBLIC PEACE VIOLATION	1116
MOTOR VEHICLE THEFT	1098

We can also use the `date` for grouping. Count the number of arrests grouped by hour of the day in 2016. You can extract the latter information from `date` via `EXTRACT(HOUR FROM date)`. Which time of the day is associated with the most arrests?

```
SELECT
    EXTRACT(HOUR FROM date) AS hour_of_day,
    COUNT(primary_type) AS arrest_count_by_date
FROM crime
WHERE year = 2016
AND arrest = TRUE
GROUP BY hour_of_day
ORDER BY arrest_count_by_date DESC
LIMIT 10;
```

Table 4: Displaying records 1 - 10

hour_of_day	arrest_count_by_date
19	3843
18	3482
20	3303
21	2962
16	2933
22	2896
11	2894
17	2821
12	2788
14	2775

Focus only on HOMICIDE and count the number of arrests for this incident type, grouped by year. List the results in descending order.

```
SELECT
    year,
    COUNT(*) AS arrest_count_by_homicide
FROM crime
```

```

WHERE primary_type = 'HOMICIDE'
    AND arrest = TRUE
GROUP BY year
ORDER BY arrest_count_by_homicide DESC;

```

Table 5: Displaying records 1 - 10

year	arrest_count_by_homicide
2001	431
2002	428
2003	386
2020	356
2022	321
2021	296
2004	294
2016	292
2008	288
2005	284

Find out which districts have the highest numbers of arrests in 2015 and 2016. That is, count the number of arrests in 2015 and 2016, grouped by year and district. List the results in descending order.

```

SELECT
district,
year,
COUNT(primary_type) AS arrest_count
From crime
WHERE arrest = TRUE
    AND year IN (2015, 2016)
GROUP BY district, year
ORDER BY arrest_count DESC;

```

Table 6: Displaying records 1 - 10

district	year	arrest_count
11	2015	8975
11	2016	6578
7	2015	5549

district	year	arrest_count
15	2015	4514
6	2015	4476
25	2015	4451
4	2015	4326
8	2015	4115
7	2016	3656
10	2015	3628

- district No. 11 has the highest numbers of arrests in both 2015 and 2016.

Lets switch to writing queries from within R via the DBI package. Create a query object that counts the number of arrests grouped by `primary_type` of district 11 in year 2016. The results should be displayed in descending order.

```
query <- "
SELECT
    primary_type,
    COUNT(primary_type) AS arrest_count
FROM crime
WHERE district = 11
    AND year = 2016
    AND arrest = TRUE
GROUP BY primary_type
ORDER BY arrest_count DESC;
"
```

Execute the query.

```
result_D11 <- dbGetQuery(con, query)
result_D11
```

```
# A tibble: 27 x 2
  primary_type              arrest_count
  <chr>                      <int>
1 NARCOTICS                  3634
2 BATTERY                     635
3 PROSTITUTION                 511
4 WEAPONS VIOLATION            303
5 OTHER OFFENSE                   255
6 ASSAULT                       207
```

7 CRIMINAL TRESPASS	205
8 PUBLIC PEACE VIOLATION	135
9 INTERFERENCE WITH PUBLIC OFFICER	119
10 CRIMINAL DAMAGE	106
# i 17 more rows	

Try to write the very same query, now using the `dplyr` package. For this, you need to first map the `crime` table to a tibble object in R.

```
# map the table in R
crime_dplyr_tbl <- tbl(con, "crime")
```

Again, count the number of arrests grouped by `primary_type` of district 11 in year 2016, now using `dplyr` syntax.

```
query_dplyr <- crime_dplyr_tbl %>%
  filter(district == 11, year == 2016, arrest == TRUE) %>%
  group_by(primary_type) %>%
  summarise(arrest_count = n()) %>%
  arrange(desc(arrest_count))
```

```
query_dplyr
```

```
# Source:      SQL [?? x 2]
# Database:   BigQueryConnection
# Ordered by: desc(arrest_count)
  primary_type              arrest_count
  <chr>                      <int>
1 NARCOTICS                  3634
2 BATTERY                     635
3 PROSTITUTION                 511
4 WEAPONS VIOLATION            303
5 OTHER OFFENSE                  255
6 ASSAULT                      207
7 CRIMINAL TRESPASS                205
8 PUBLIC PEACE VIOLATION            135
9 INTERFERENCE WITH PUBLIC OFFICER        119
10 CRIMINAL DAMAGE                   106
# i more rows
```

Count the number of arrests grouped by `primary_type` and `year`, still only for district 11. Arrange the result by `year`.

```
query_dplyr_2 <- crime_dplyr_tbl %>%
  filter(district == 11, arrest == TRUE) %>%
  group_by(primary_type, year) %>%
  summarise(arrest_count = n(), .groups = "drop") %>%
  arrange(year)
```

```
query_dplyr_2
```

```
# Source:      SQL [?? x 3]
# Database:   BigQueryConnection
# Ordered by: year
# # # # #
primary_type          year arrest_count
<chr>                  <int>      <int>
1 PUBLIC PEACE VIOLATION 2001        34
2 CRIM SEXUAL ASSAULT    2001        17
3 SEX OFFENSE            2001        19
4 ROBBERY                2001        97
5 KIDNAPPING             2001         4
6 CRIMINAL DAMAGE        2001       163
7 PROSTITUTION            2001       424
8 OTHER OFFENSE           2001       266
9 BURGLARY                2001        42
10 HOMICIDE               2001        49
# i more rows
```

Assign the results of the query above to a local R object.

```
result_query_dplyr_2 <- collect(query_dplyr_2)
```

Confirm that you pulled the data to the local environment by displaying the first ten rows of the saved data set.

```
head(result_query_dplyr_2, 10)
```

```
# A tibble: 10 x 3
primary_type          year arrest_count
<chr>                  <int>      <int>
1 ROBBERY                2001        97
2 OFFENSE INVOLVING CHILDREN 2001        44
3 INTERFERENCE WITH PUBLIC OFFICER 2001        14
```

4 STALKING	2001	1
5 INTIMIDATION	2001	3
6 PUBLIC PEACE VIOLATION	2001	34
7 CRIMINAL TRESPASS	2001	389
8 BURGLARY	2001	42
9 THEFT	2001	419
10 BATTERY	2001	962

Close the connection.

```
dbDisconnect(con)
```