Introduction to SQL

Greg Ridgeway   Ruth Moyer   Li Sian Goh

2025-08-21

Table of contents

1 Introduction

Some datasets are far too large for R to handle by itself. Structured Query Language ("SQL") is a widely used international standard language for managing data stored in a relational database management system (RDMS). A relational database management system itself is an approach to managing data using a structure that can be contrasted against the "flat file" approach we have been using thus far with R. Why use SQL? R does not work very well with really huge datasets. A relational database management system offers a way of storing large amounts of information more efficiently and reducing the size of the dataset that we are working with. There are numerous relational database management systems such as Oracle DBMS, Microsoft Access, Microsoft SQL Server, PostgreSQL, and MySQL. We are going to use SQLite, which is probably the most widely deployed database system. SQLite is in your phone, car, airplanes, thermostats, and numerous appliances. We are going to hook up SQLite to R so that R can handle large datasets.

These are some basic clauses in a SQL query that we will explore:

- SELECT fields or functions of fields
- FROM tables queried
- WHERE conditions for selecting a record
- GROUP BY list of fields to group
- ORDER BY list of fields to sort by

However, before being able to use SQL as a tool in R, it will first be necessary to load the `sqldf` package.

```
library(dplyr)
library(sqldf)
```

2 Getting the data into proper form

We will be working with Chicago crime data, which is accessible comma-separated value (csv) format. Before we can even being learning SQL, we are going to have to do a fair bit of work to acquire the dataset, format it so that it is ready for SQLite, and then load it into the SQLite database.

Navigate to the Chicago open data website to get the data. Click the "Export" button and select the "CSV" option, or directly download from here

The Chicago crime data is huge, more than 2.0 Gb. It contains over 8.3 million records on all crimes reported to the Chicago police department since 2001. R does not handle really large datasets well. By using SQL, you will learn how to more efficiently work with large datasets and learn a data language that is used absolutely everywhere.

Let's use `scan()` to just peek at the first five rows of the file.

```
scan(what="", file="Crimes_-_2001_to_present.csv", nlines=5, sep="\n")
```

```
[1] "ID,Case Number,Date,Block,IUCR,Primary Type,Description,Location Description,Arrest,Dome
[2] "13311263,JG503434,07/29/2022 03:39:00 AM,023XX S TROY ST,1582,OFFENSE INVOLVING CHILDRE
[3] "13053066,JG103252,01/03/2023 04:44:00 PM,039XX W WASHINGTON BLVD,2017,NARCOTICS,MANUFAC
[4] "12131221,JD327000,08/10/2020 09:45:00 AM,015XX N DAMEN AVE,0326,ROBBERY,AGGRAVATED VEHI
[5] "11227634,JB147599,08/26/2017 10:00:00 AM,001XX W RANDOLPH ST,0281,CRIM SEXUAL ASSAULT,N
```

`scan()` is a very basic R function that reads in plain text files. We have told it to read in text (`what=""`), the name of the file, to only read in 5 lines (`nlines=5`), and to start a new row whenever it reaches a line feed character (`sep="\n"`). Using `scan()` without `nlines=5` would cause R to try to read in the whole dataset and that could take a lot of time and you might run out of memory.

You can see that the first row contains the column names. The second row contains the first reported crime in the file. You can see date and time, address, crime descriptions, longitude and latitude of the crime, and other information.

Let's try to load this file into a SQLite database. There are two steps. First, using `dbConnect()` we need to tell R to make a connection to a new SQLite database that we will call `chicagocrime.db`. This will be a file in your working folder that SQLite will use to store the data.

```
# create a connection to the database
con <- dbConnect(SQLite(), dbname="chicagocrime.db")
```

Then using `dbWriteTable()` we tell R to read in the csv file and store its contents in a new table in the database. We will call that new table `crime`. Make sure that your path is set to the correct folder where you want the database to be stored.

```
# write a table called "crime" into the SQLite database
dbWriteTable(con,
             "crime", # the new table in the database
             "Crimes_-_2001_to_present.csv",
             row.names=FALSE,
             header=TRUE)     # first row has column names
```

```
Error in connection_import_file(conn@ptr, name, value, sep, eol, skip): RS_sqlite_import: Cr
```

Looks like there is a problem with the dataset. SQLite was expecting 22 columns, but row 4 had 23. Notice from when we ran `scan()` earlier, the fourth row has a `"(41.908417822, -87.67740693)"`. SQLite thinks that these two numbers belong in two different columns instead of a single `Location` column.

SQLite is very particular about the formatting of a file. It can easily read in a csv file, but this dataset has some commas in places that confuse SQLite. For example, there is a row in this file that looks like this:

```
[1] "10000153,HY189345,03/18/2015 12:20:00 PM,091XX S UNIVERSITY AVE,0483,BATTERY,AGG PRO.EMI
```

You see that the location description for this crime is `"SCHOOL, PUBLIC, BUILDING"`. Those commas inside the quotes are going to cause SQLite problems. SQLite is going to think that `SCHOOL`, `PUBLIC`, and `BUILDING` are all separate columns rather than in one column describing the location.

To resolve this, we are going to change all the commas that separate the columns into something else besides commas, leaving the commas in elements like `"SCHOOL, PUBLIC, BUILDING"` alone. It does not matter what we use to separate the fields, but it should be an unusual character that would not appear anywhere else in the dataset. Popular choices include the vertical bar (`|`) and the semicolon (`;`). So let's take a slight detour to find out how to convert a comma-separated file into a semicolon separated file.

You will know if you need to convert your file if, when you try to set up your SQL database, you receive an error message about an "extra column."

We are going to use a `while` loop to read in 1,000,000 rows of the CSV file at a time. R can handle 1,000,000 rows. With 1,000,000 rows read in, we will use a regular expression to replace all the commas used for separating columns with semicolons. Then we will write out the resulting cleaned up rows into a new file. It is a big file so this code can take a few minutes to run to completion.

```
infile  <- file("Crimes_-_2001_to_present.csv", 'r')       # 'r' for 'read'
outfile <- file("Crimes_-_2001_to_present-clean.csv", 'w') # 'w' for 'write'

# fix the Row #1 with the columns names
readLines(infile, n=1) |>
   gsub(",", ";", x=_) |> # separate with ;
   gsub(" ", "", x=_)  |> # SQL doesn't like field names with .,-,space
   writeLines(con=outfile)

cLines <- 0 # just a counter for the number of lines read

# read in 1000000 lines. keep going if more than 0 lines read
while ((length(a <- readLines(infile, n=1000000)) > 0))
{
   cLines <- cLines + length(a) # increase the line counter
   cLines |> format(big.mark=",", scientific=FALSE) |> message()
   # remove any semicolons if they are there
   a <- gsub(";", "", a)
   # use ?= to "lookahead" for paired quotes
   a <- gsub(",(?=([^\"]|\"[^\"]*\")*$)", ";", a, perl=TRUE)
   # write the cleaned up data to storage
   writeLines(a, con=outfile)
}
```

```
1,000,000

2,000,000

3,000,000

4,000,000

5,000,000

6,000,000

7,000,000

8,000,000

8,377,991
```

```r
close(infile)
close(outfile)
```

Now, let's take a look at the first five lines of the new file we just created.

```r
scan(what="",file="Crimes_-_2001_to_present-clean.csv",nlines=5,sep="\n")
```

```
[1] "ID;CaseNumber;Date;Block;IUCR;PrimaryType;Description;LocationDescription;Arrest;Domesti
[2] "13311263;JG503434;07/29/2022 03:39:00 AM;023XX S TROY ST;1582;OFFENSE INVOLVING CHILDREN
[3] "13053066;JG103252;01/03/2023 04:44:00 PM;039XX W WASHINGTON BLVD;2017;NARCOTICS;MANUFACT
[4] "12131221;JD327000;08/10/2020 09:45:00 AM;015XX N DAMEN AVE;0326;ROBBERY;AGGRAVATED VEHIC
[5] "11227634;JB147599;08/26/2017 10:00:00 AM;001XX W RANDOLPH ST;0281;CRIM SEXUAL ASSAULT;NO
```

You now see that semicolons separate the columns rather than commas. That previous record that had the location description "SCHOOL, PUBLIC, BUILDING" now looks like this:

```
[1] "10000153;HY189345;03/18/2015 12:20:00 PM;091XX S UNIVERSITY AVE;0483;BATTERY;AGG PRO.EMP
```

Note that the commas are still there inside the quotes. Now we will be able to tell SQLite to look for semicolons to separate the columns.

3 Setting up the database

Now that the csv file containing the data is ready, we can load it into SQLite.

```
# peek at the first few rows of the dataset
a <- read.table("Crimes_-_2001_to_present-clean.csv",
                sep=";",nrows=5,header=TRUE)
# ask SQLite what data type it plans to use to store each column (eg number, text)
variabletypes <- dbDataType(con, a)
# make sure these features are stored as TEXT
variabletypes[c("IUCR","FBICode","Ward","District","CommunityArea")] <- "TEXT"

# just in case you already created a "crime" table, delete it
if(dbExistsTable(con, "crime")) dbRemoveTable(con, "crime")
# import the data file into the database
dbWriteTable(con, "crime",                            # create crime table
             "Crimes_-_2001_to_present-clean.csv", # from our cleaned up file
             row.names=FALSE,
             header=TRUE,                             # first row has column names
             field.types=variabletypes,
             sep=";")                                 # columns separated with ;
# does the table exist?
dbListTables(con)
```

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

```
# a quick check to see if all the columns are there
dbListFields(con,"crime")
```

```
 [1] "ID"                   "CaseNumber"           "Date"
 [4] "Block"                "IUCR"                 "PrimaryType"
 [7] "Description"          "LocationDescription" "Arrest"
[10] "Domestic"             "Beat"                 "District"
[13] "Ward"                 "CommunityArea"        "FBICode"
[16] "XCoordinate"          "YCoordinate"          "Year"
[19] "UpdatedOn"            "Latitude"             "Longitude"
[22] "Location"
```

```
# disconnect from the database to finalize
dbDisconnect(con)
```

You will know if the database has been successfully set up if you find a chicagocrime.db file that has about 2 Gb of data in it. If the file size is 0 or really small, then you may be looking in the wrong folder or the data cleaning and import did not finish.

```
# how many gigabytes?
(file.size("chicagocrime.db")/10^9) |>
   round(1) |>
   format(nsmall=1, scientific=FALSE)
```

```
[1] "1.9"
```

Once you have successfully set up your database, there is no reason to run these lines of code again. You should never again need to turn commas into semicolons or run `dbWriteTable()`. Instead, every time you want to work with your database, you can simply need to reconnect to the database with:

```
con <- dbConnect(SQLite(), dbname="chicagocrime.db")
```

Note that if you are using a cloud-based backup service like iCloud, OneDrive, or Google Drive, you might need to wait until your "db" file has completely synced before you can access your database. For this reason I typically put my SQLite databases in a folder that does not get backed up. If I accidentally delete it, then I just rerun the code to rebuild the database.

4 SQL queries (`SELECT`, `WHERE`, `FROM`)

You have now created a database chicagocrime.db containing a table called `crime` that contains those 8 million crime records.

Two important clauses with an SQL query are `SELECT` and `FROM`. Unlike R, SQL queries are not case-sensitive and column names are not case-sensitive. So if we were to type "SELECT" as "select" or "Description" as "dEsCrIpTiOn", the SQL query would do the same thing. However, the tradition is to put SQL keywords in all uppercase to make it easier to distinguish them from table and column names.

The `SELECT` clause tells SQL which columns in particular you would like to see. The `FROM` clause simply tells SQL from which table it should pull the data. In this query, we are interested in only the `ID` and `Description` columns.

```
dbGetQuery(con,
   "SELECT ID, Description
    FROM crime",
    n = 10) # just the first 10 rows
```

```
         ID                     Description
1  13311263               CHILD PORNOGRAPHY
2  13053066  MANUFACTURE / DELIVER - CRACK
3  12131221 AGGRAVATED VEHICULAR HIJACKING
4  11227634                  NON-AGGRAVATED
5  13203321                      TO VEHICLE
6  13204489                       OVER $500
7  11695116                  UNLAWFUL ENTRY
8  12419690 SEXUAL EXPLOITATION OF A CHILD
9  12729745 ATTEMPT STRONG ARM - NO WEAPON
10 12835559                      AUTOMOBILE
```

`dbGetQuery()` pulls the selected rows (first 10) from the selected columns (`ID` and `Description`). Sometimes it is preferable to get large datasets in smaller chunks using `dbSendQuery()` and `dbFetch()`.

```
res <- dbSendQuery(con, "
  SELECT ID,Description
  FROM crime")
# pull the first 10 lines
dbFetch(res, n = 10)
```

```
         ID                     Description
1  13311263               CHILD PORNOGRAPHY
2  13053066  MANUFACTURE / DELIVER - CRACK
3  12131221 AGGRAVATED VEHICULAR HIJACKING
4  11227634                  NON-AGGRAVATED
5  13203321                      TO VEHICLE
6  13204489                       OVER $500
7  11695116                  UNLAWFUL ENTRY
8  12419690 SEXUAL EXPLOITATION OF A CHILD
9  12729745 ATTEMPT STRONG ARM - NO WEAPON
10 12835559                      AUTOMOBILE
```

```
# pull the next 10 lines
dbFetch(res, n = 10)
```

```
         ID                                                     Description
1  13003649                                                  FORCIBLE ENTRY
2  13061203                                         DOMESTIC BATTERY SIMPLE
3  13256787                                         DOMESTIC BATTERY SIMPLE
```

```
4   13116982                                             RECKLESS HOMICIDE
5   13364090 "PROTECTED EMPLOYEE - HANDS, FISTS, FEET, NO / MINOR INJURY"
6   13376308    "AGGRAVATED P.O. - HANDS, FISTS, FEET, NO / MINOR INJURY"
7      27382                                           FIRST DEGREE MURDER
8      27547                                           FIRST DEGREE MURDER
9    6255892                                               ARMED - HANDGUN
10   6272641                                         STRONG ARM - NO WEAPON
```

```
# when finished, clear the rest of the results
dbClearResult(res)
```

`dbClearResult(res)` tells SQLite that we are all done with this query. We have displayed the first 20 rows. SQLite is standing by with another 8 million rows to show us, but `dbClearResult(res)` tells SQLite that we are no longer interested in this query and it can clear out whatever it has stored for us.

In the previous SQL query we just asked for `ID` and `Description`. Typing out all of the column names would be tiresome, so SQL lets you use a `*` to select all the columns. If we want to look at the first 10 rows but all of the columns, we would use this query:

```
dbGetQuery(con, "
  SELECT *
  FROM crime",
  n = 3)
```

```
Warning: Column `XCoordinate`: mixed type, first seen values of type string,
coercing other values of type integer

Warning: Column `YCoordinate`: mixed type, first seen values of type string,
coercing other values of type integer

Warning: Column `Latitude`: mixed type, first seen values of type string,
coercing other values of type real

Warning: Column `Longitude`: mixed type, first seen values of type string,
coercing other values of type real

        ID CaseNumber                   Date                  Block IUCR
1 13311263   JG503434 07/29/2022 03:39:00 AM         023XX S TROY ST 1582
2 13053066   JG103252 01/03/2023 04:44:00 PM 039XX W WASHINGTON BLVD 2017
3 12131221   JD327000 08/10/2020 09:45:00 AM       015XX N DAMEN AVE 0326
```

```
                 PrimaryType                    Description LocationDescription
1 OFFENSE INVOLVING CHILDREN              CHILD PORNOGRAPHY           RESIDENCE
2                  NARCOTICS  MANUFACTURE / DELIVER - CRACK            SIDEWALK
3                    ROBBERY AGGRAVATED VEHICULAR HIJACKING              STREET
  Arrest Domestic Beat District Ward CommunityArea FBICode XCoordinate
1   true    false 1033      010   25            30      17
2   true    false 1122      011   28            26      18
3   true    false 1424      014    1            24      03     1162795
  YCoordinate Year              UpdatedOn     Latitude    Longitude
1             2022 04/18/2024 03:40:59 PM
2             2023 01/20/2024 03:41:12 PM
3     1909900 2020 05/17/2025 03:40:52 PM 41.908417822 -87.67740693
                        Location
1                             \r
2                             \r
3 "(41.908417822, -87.67740693)"\r
```

In addition to showing us the first three rows in their entirety, we get some warnings here regarding the coordinates of the crime that we will have to deal with later. The issue involves how SQL stores missing values.

Just as `SELECT` filters the columns, the `WHERE` clause filters the rows. Note the use of `AND` and `OR` in the `WHERE` clause. Here we select three columns: `ID`, `Description`, and `LocationDescription`. Also, we want only rows where

- the value in the `Beat` column is “611”
- the value in the `Arrest` column is “true”
- the value in the `IUCR` column is either “0486” or “0498”

Importantly, note the use of single (not double) quotation marks in the `WHERE` line. The reason is that if we used double quotes, then R will think that the double quote signals the end of the query.

```r
a <- dbGetQuery(con, "
    SELECT ID, Description, LocationDescription
    FROM crime
    WHERE ((Beat=611) AND
          (Arrest='true')) AND
          ((IUCR='0486') OR (IUCR='0498'))")
# show the first few rows of the results
head(a, 3)
```

```
        ID              Description LocationDescription
```

```
1 13248950 DOMESTIC BATTERY SIMPLE           APARTMENT
2 13254239 DOMESTIC BATTERY SIMPLE            SIDEWALK
3 13287327 DOMESTIC BATTERY SIMPLE           APARTMENT
```

SQLite allows regular expressions in the `WHERE` clause. First you have to initialize the regular expression SQL extension. Then you can insert a regular expression after the keyword `REGEXP`.

```
# once per R session initialize regexp
initExtension(con, "regexp")
# get crimes from beats that start with "12"
a <- dbGetQuery(con, "
  SELECT Beat
  FROM   crime
  WHERE  Beat REGEXP '^[12]..$'",
  n = -1)

unique(a$Beat)
```

```
 [1] 122 123 224 232 133 222 132 215 124 211 221 114 225 214 131 231 112 113 233
[20] 111 234 235 121 213 223 212 134
```

There is a full list of all available SQLite extensions. Frankly, I have only ever used the `REGEXP` extension.

SQL does not like column names with special characters. Only letters (first character *must* be a letter), numbers, and underscores (_). Column names also cannot be a SQL keyword, like SELECT or WHERE. If you happen to have a table with any special characters, like periods, hyphens, or spaces, you can "protect" the column name in square brackets. For example, `SELECT [incident id], [text-description], [location.description], [where]`.

4.1 Exercises

1. Select records from Beat 234
2. Select Beat, District, Ward, and Community Area for all "ASSAULT"s
3. Select records on assaults from Beat 234
4. Make a table of the number of assaults (IUCR 0560) by Ward

5 GROUP_BY and aggregation functions

We have already covered SQL clauses SELECT, WHERE, and FROM. The SQL function COUNT(*) and GROUP BY are also very useful. For example, the following query counts how many assaults (IUCR 0560) occurred by ward. COUNT() is a SQL "aggregate" function, a function that performs a calculation on a group of values and returns a single number. Other SQL aggregate functions include AVG(), MIN(), MAX(), and SUM(). This query will group all the records by Ward and then apply the aggregate function COUNT() and report that value in a column called crimecount. AS allows us to give clear column names in the results. Without the AS crimecount column of counts would be called COUNT(*), which has several characters about which SQL will complain.

```r
a <- dbGetQuery(con, "
   SELECT COUNT(*) AS crimecount,
          Ward
   FROM crime
   WHERE IUCR='0560'
   GROUP BY Ward")
print(a)
```

```
   crimecount Ward
1       29470
2        5294    1
3        8084   10
4        5069   11
5        4269   12
6        3845   13
7        4248   14
8        9540   15
9       11296   16
10      13640   17
11       6116   18
12       3539   19
13      10769    2
14      13080   20
15      11463   21
16       4336   22
17       4078   23
18      12580   24
19       5298   25
20       6472   26
21      11677   27
```

```
22        15108   28
23         8886   29
24        11755    3
25         4443   30
26         4497   31
27         3240   32
28         2999   33
29        11092   34
30         4457   35
31         3727   36
32         9332   37
33         3418   38
34         2929   39
35         8537    4
36         3728   40
37         3227   41
38         9674   42
39         2185   43
40         3163   44
41         3609   45
42         5186   46
43         2689   47
44         3954   48
45         5184   49
46         9245    5
47         3320   50
48        12902    6
49        11773    7
50        11697    8
51        11710    9
```

The `GROUP BY` clause is critical. If you forget it then the result is not well defined. That is, different implementations of SQL may produce different results. The rule you should remember is that "every non-aggregated column in the `SELECT` clause should appear in the `GROUP BY` clause." Here `Ward` is not part of the aggregate function `COUNT()` so it must appear in the `GROUP BY` clause.

5.1 Exercises

5. Count the number of crimes by `PrimaryType`
6. Count the number of crimes resulting in arrest

7. Count the number of crimes by `LocationDescription`. `LocationDescription` is the variable that tells us where (e.g., a parking lot, a barbershop, a fire station, a CTA train, or a motel) a crime occurred

6 `ORDER_BY` and `UPDATE`

`MAX`, `MIN`, `SUM`, `AVG` are common (and useful) aggregating functions. The `ORDER BY` clause sorts the results for us. It is the SQL version of the `sort()` or `arrange()` functions. Here is an illustration that gives the range of beat numbers in each policing district.

```
dbGetQuery(con, "
   SELECT MIN(Beat) AS min_beat,
          MAX(Beat) AS max_beat,
          District
   FROM crime
   GROUP BY District
   ORDER BY District")
```

```
   min_beat max_beat District
1       124     2535
2       111     2535      001
3       131     2232      002
4       133     2222      003
5       324     2514      004
6       333     2233      005
7       123     2424      006
8       233     2431      007
9       333     2411      008
10      131     2522      009
11      133     2534      010
12      624     2535      011
13      111     2525      012
14      411     2535      014
15      726     2533      015
16      811     2521      016
17      734     2523      017
18      111     2533      018
19      112     2533      019
20      112     2433      020
21     2112     2112      021
22      214     2234      022
```

```
23       123      2433       024
24       725      2535       025
25       124      2535       031
26      1614      1614        16
```

Remember that the `GROUP BY` clause should include every element of the `SELECT` clause that is not involved with an aggregate function. We have `MIN()` and `MAX()` operating on `Beat`, but `District` is on its own and should be placed in the `GROUP BY` clause.

Let's look at our `Latitude` and `Longitude` columns, which will be extremely useful for mapping data points. The following query will give unexpected results.

```
dbGetQuery(con, "
   SELECT MIN(Latitude)  AS min_lat,
          MAX(Latitude)  AS max_lat,
          MIN(Longitude) AS min_lon,
          MAX(Longitude) AS max_lon,
          District
   FROM crime
   GROUP BY District
   ORDER BY District")
```

```
Warning: Column `max_lat`: mixed type, first seen values of type real, coercing
other values of type string

Warning: Column `max_lon`: mixed type, first seen values of type real, coercing
other values of type string

    min_lat  max_lat   min_lon   max_lon District
1  41.69991 42.00030 -87.87742 -87.59533
2  36.61945  0.00000 -91.68657   0.00000      001
3  36.61945  0.00000 -91.68657   0.00000      002
4  36.61945  0.00000 -91.68657   0.00000      003
5  36.61945  0.00000 -91.68657   0.00000      004
6  36.61945  0.00000 -91.68657   0.00000      005
7  36.61945  0.00000 -91.68657   0.00000      006
8  36.61945  0.00000 -91.68657   0.00000      007
9  36.61945  0.00000 -91.68657   0.00000      008
10 36.61945  0.00000 -91.68657   0.00000      009
11 36.61945  0.00000 -91.68657   0.00000      010
12 36.61945  0.00000 -91.68657   0.00000      011
13 36.61945  0.00000 -91.68657   0.00000      012
```

```
14 36.61945  0.00000 -91.68657   0.00000      014
15 36.61945  0.00000 -91.68657   0.00000      015
16 36.61945  0.00000 -91.68657   0.00000      016
17 36.61945  0.00000 -91.68657   0.00000      017
18 36.61945  0.00000 -91.68657   0.00000      018
19 41.80933  0.00000 -87.76791   0.00000      019
20 41.79145  0.00000 -87.76303   0.00000      020
21 41.83790 41.83790 -87.62192 -87.62192      021
22 36.61945  0.00000 -91.68657   0.00000      022
23 36.61945  0.00000 -91.68657   0.00000      024
24 36.61945  0.00000 -91.68657   0.00000      025
25 41.64619 42.01939 -87.93973 -87.53528      031
26 41.98531 41.98552 -87.83047 -87.82900       16
```

We get some strange results here. `max_lat` equal to 0.0 is on the equator! It is doubtful that Chicago reported any equatorial crimes. The problem is that we have some blank values in `Longitude` and `Latitude`. Here are some of them.

```
dbGetQuery(con, "SELECT * FROM crime WHERE Longitude=''", n=3)
```

```
        ID CaseNumber                   Date                   Block IUCR
1 13311263   JG503434 07/29/2022 03:39:00 AM         023XX S TROY ST 1582
2 13053066   JG103252 01/03/2023 04:44:00 PM 039XX W WASHINGTON BLVD 2017
3 11227634   JB147599 08/26/2017 10:00:00 AM     001XX W RANDOLPH ST 0281
                 PrimaryType                   Description LocationDescription
1 OFFENSE INVOLVING CHILDREN             CHILD PORNOGRAPHY           RESIDENCE
2                  NARCOTICS MANUFACTURE / DELIVER - CRACK            SIDEWALK
3        CRIM SEXUAL ASSAULT                NON-AGGRAVATED         HOTEL/MOTEL
  Arrest Domestic Beat District Ward CommunityArea FBICode XCoordinate
1   true    false 1033      010   25            30      17
2   true    false 1122      011   28            26      18
3  false    false  122      001   42            32      02
  YCoordinate Year             UpdatedOn Latitude Longitude Location
1             2022 04/18/2024 03:40:59 PM                         \r
2             2023 01/20/2024 03:41:12 PM                         \r
3             2017 02/11/2018 03:57:41 PM                         \r
```

Note that the `Latitude` and the `Longitude` columns are blank. Also, look at these

```
dbGetQuery(con, "SELECT * FROM crime where Latitude<36.61946", n=3)
```

```
    ID CaseNumber                   Date               Block IUCR PrimaryType
1 1482   HH367441 05/13/2002 05:00:00 AM 061XX S ARTESIAN ST 0110    HOMICIDE
2  838    G311269 05/29/2001 11:35:00 PM   059XX S MORGAN AV 0110    HOMICIDE
3  637    G005960 01/06/2001 10:35:00 AM  014XX N HARDING ST 0110    HOMICIDE
          Description LocationDescription Arrest Domestic Beat District Ward
1 FIRST DEGREE MURDER               HOUSE   true    false  825      008
2 FIRST DEGREE MURDER            DUMPSTER   true    false  712      007
3 FIRST DEGREE MURDER              STREET   true    false 2535      025
  CommunityArea FBICode XCoordinate YCoordinate Year              UpdatedOn
1                   01A           0           0 2002 01/28/2024 03:40:59 PM
2                   01A           0           0 2001 01/28/2024 03:40:59 PM
3                   01A           0           0 2001 01/28/2024 03:40:59 PM
  Latitude Longitude                          Location
1 36.61945 -91.68657 "(36.619446395, -91.686565684)"\r
2 36.61945 -91.68657 "(36.619446395, -91.686565684)"\r
3 36.61945 -91.68657 "(36.619446395, -91.686565684)"\r
```

The point (-91.68657, 36.61945) lands in Brandsville, Missouri, also a highly unlikely location for Chicago crime.

We can tell SQLite to make the empty or missing values `NULL`, a more proper way to encode that these rows have missing coordinates. The `UPDATE` clause edits our table. R will read in `NULL` values as `NA`. After we do the update, we can rerun the `MIN()`, `MAX()` query. We can also assign `NULL` to latitudes and longitudes that are very close to 0.

Note that we use `dbExecute()` when updating since we are not asking for any rows of data to come back to us.

```r
dbExecute(con, "
   UPDATE crime SET Latitude=NULL
   WHERE (Latitude='') OR (ABS(Latitude-0.0) < 0.01) OR (Latitude < 36.7)")
```

```
[1] 93577
```

```r
dbExecute(con, "
   UPDATE crime SET Longitude=NULL
   WHERE (Longitude='') OR (ABS(Longitude-0.0) < 0.01) OR (Longitude < -91.6)")
```

```
[1] 93577
```

Let's rerun that query and check that we get more sensible results.

```r
dbGetQuery(con, "
   SELECT MIN(Latitude)  AS min_lat,
          MAX(Latitude)  AS max_lat,
          MIN(Longitude) AS min_lon,
          MAX(Longitude) AS max_lon,
          District
   FROM crime
   GROUP BY District
   ORDER BY District")
```

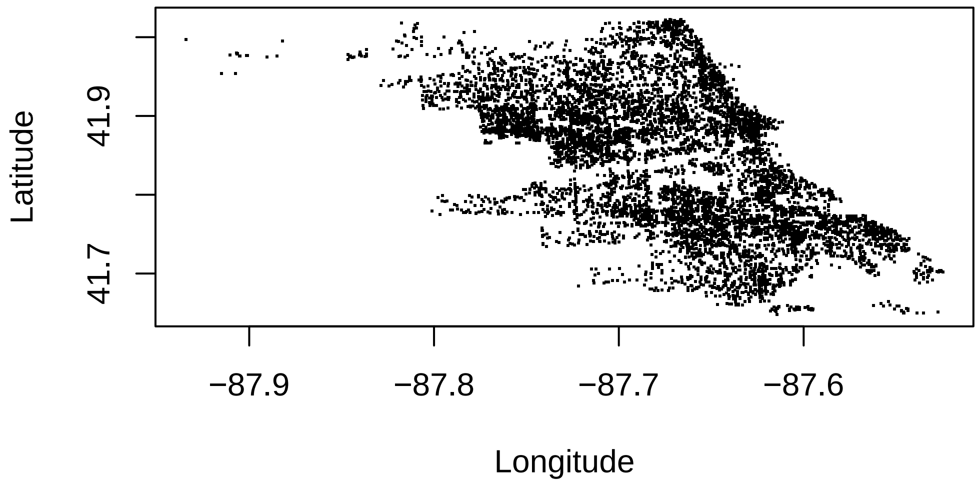
```
    min_lat  max_lat   min_lon   max_lon District
1  41.69991 42.00030 -87.87742 -87.59533
2  41.72827 41.98740 -87.84349 -87.54925      001
3  41.73298 41.97608 -87.70277 -87.56954      002
4  41.71424 41.79946 -87.73941 -87.55261      003
5  41.64467 41.79220 -87.72436 -87.52453      004
6  41.64459 41.88693 -87.73145 -87.54348      005
7  41.69249 42.01876 -87.77138 -87.55810      006
8  41.66806 42.01369 -87.68723 -87.57906      007
9  41.73453 42.01765 -87.80161 -87.55239      008
10 41.77015 41.97645 -87.71397 -87.60282      009
11 41.68357 41.94304 -87.74364 -87.61895      010
12 41.77163 41.90624 -87.76332 -87.62328      011
13 41.68544 41.96539 -87.76321 -87.60502      012
14 41.77688 42.01938 -87.80222 -87.65657      014
15 41.76641 41.94234 -87.77535 -87.63087      015
16 41.78464 42.01938 -87.93457 -87.58256      016
17 41.77950 42.01390 -87.75780 -87.66131      017
18 41.85952 41.96879 -87.76313 -87.60136      018
19 41.80933 41.98397 -87.76791 -87.58775      019
20 41.79145 42.00458 -87.76303 -87.62992      020
21 41.83790 41.83790 -87.62192 -87.62192      021
22 41.67709 41.85572 -87.74328 -87.58965      022
23 41.75988 42.02291 -87.79757 -87.62545      024
24 41.83930 41.94586 -87.81648 -87.64093      025
25 41.64619 42.01939 -87.93973 -87.53528      031
26 41.98531 41.98552 -87.83047 -87.82900       16
```

Now we have results that are more in line with where Chicago actually is. Make it a habit to do some checks of your data before doing too much analysis.

And what city does the following plot have the shape of? Let's plot the location of these crimes. Plotting all 8 million would be overkill, so let's take a random sample of 10,000 crimes. Here is a SQL query that will randomly order the rows and select just the first 10,000. Does the shape of the plot look right?

```
a <- dbGetQuery(con, "
   SELECT Longitude, Latitude
   FROM crime
   ORDER BY RANDOM() -- scramble the order of the rows
   LIMIT 10000")

plot(Latitude~Longitude, data=a,
     pch=".",
     xlab="Longitude", ylab="Latitude")
```



6.1 Exercises

8. Plot the longitude and latitude of all "ASSAULT"s for Ward 22
9. What is the most common (Long,Lat) for assaults in Ward 22? Add the point to your plot using the `points()` function. `points()` simply draws a point (or sequence of points) at the specified coordinates

7 Solutions to the exercises

1. Select records from Beat 234

```
dbGetQuery(con, "
   SELECT *
   FROM crime
   WHERE Beat=234",
   n=5)
```

```
Warning: Column `XCoordinate`: mixed type, first seen values of type integer,
coercing other values of type string
```

```
Warning: Column `YCoordinate`: mixed type, first seen values of type integer,
coercing other values of type string
```

```
        ID CaseNumber                   Date                 Block IUCR
1 13208531   JG408244 08/01/2023 12:00:00 PM 054XX S EAST VIEW PARK 0820
2 13203370   JG415497 09/07/2023 07:30:00 PM    051XX S KENWOOD AVE 1310
3 13207450   JG420345 09/07/2023 01:54:00 PM 054XX S BLACKSTONE AVE 0890
4 13203210   JG415469 09/07/2023 06:30:00 PM 052XX S BLACKSTONE AVE 0890
5 13206379   JG418537 01/01/2007 04:40:00 PM       053XX S SHORE DR 1153
         PrimaryType                        Description LocationDescription
1              THEFT                     $500 AND UNDER              STREET
2    CRIMINAL DAMAGE                        TO PROPERTY           APARTMENT
3              THEFT                      FROM BUILDING           APARTMENT
4              THEFT                      FROM BUILDING           APARTMENT
5 DECEPTIVE PRACTICE FINANCIAL IDENTITY THEFT OVER $ 300
  Arrest Domestic Beat District Ward CommunityArea FBICode XCoordinate
1  false    false  234      002    5            41      06     1188934
2  false     true  234      002    4            41      14     1185980
3  false    false  234      002    5            41      06     1186841
4  false    false  234      002    4            41      06     1186800
5  false    false  234      002    5            41      11           0
  YCoordinate Year              UpdatedOn Latitude Longitude
1     1869643 2023 09/14/2023 03:41:59 PM 41.79736 -87.58268
2     1871242 2023 09/15/2023 03:42:23 PM 41.80182 -87.59346
3     1869253 2023 09/15/2023 03:42:23 PM 41.79634 -87.59037
4     1870814 2023 09/15/2023 03:42:23 PM 41.80063 -87.59047
5           0 2007 09/16/2023 03:42:58 PM       NA        NA
                          Location
```

```
1  "(41.79736226, -87.582679493)"\r
2 "(41.801820311, -87.593461583)"\r
3 "(41.796341968, -87.590367054)"\r
4  "(41.80062644, -87.590467932)"\r
5                              \r
```

2. Select Beat, District, Ward, and Community Area for all "ASSAULT"s

```
dbGetQuery(con, "
   SELECT Beat, District, Ward, CommunityArea, PrimaryType
   FROM crime
   WHERE PrimaryType='ASSAULT'",
   n=5)
```

```
  Beat District Ward CommunityArea PrimaryType
1 2515      025   36            19     ASSAULT
2 1713      017   33            14     ASSAULT
3  631      006    6            44     ASSAULT
4  322      003    6            69     ASSAULT
5 1533      015   29            25     ASSAULT
```

3. Select records on assaults from Beat 234

```
dbGetQuery(con, "
   SELECT *
   FROM crime
   WHERE (Beat=234) AND (PrimaryType='ASSAULT')",
   n=5)
```

```
        ID CaseNumber                   Date                  Block IUCR
1 13276965   JG502615 11/10/2023 09:00:00 AM 015XX E HYDE PARK BLVD 0560
2 13207370   JG420456 09/10/2023 05:19:00 PM 053XX S HYDE PARK BLVD 0560
3 13210166   JG421339 09/12/2023 01:30:00 PM        015XX E 53RD ST 0560
4 13273166   JG499223 11/10/2023 04:39:00 PM        015XX E 53RD ST 0560
5 13225905   JG442370 09/11/2023 04:15:00 PM    054XX S CORNELL AVE 0560
  PrimaryType Description LocationDescription Arrest Domestic Beat District
1     ASSAULT      SIMPLE       ATHLETIC CLUB  false    false  234      002
2     ASSAULT      SIMPLE           APARTMENT  false    false  234      002
3     ASSAULT      SIMPLE              STREET  false    false  234      002
4     ASSAULT      SIMPLE  SMALL RETAIL STORE  false    false  234      002
5     ASSAULT      SIMPLE           APARTMENT  false    false  234      002
  Ward CommunityArea FBICode XCoordinate YCoordinate Year
```

```
1    4            41     08A     1187293     1871488 2023
2    5            41     08A     1188556     1870311 2023
3    4            41     08A     1187634     1870434 2023
4    5            41     08A     1187748     1870436 2023
5    5            41     08A     1188178     1869513 2023
               UpdatedOn Latitude Longitude                          Location
1 11/18/2023 03:40:25 PM 41.80246 -87.58864 "(41.802464238, -87.588638554)"\r
2 09/18/2023 03:42:32 PM 41.79920 -87.58404 "(41.799204348, -87.584044296)"\r
3 09/20/2023 03:42:29 PM 41.79956 -87.58742 "(41.799563873, -87.587421525)"\r
4 11/18/2023 03:40:25 PM 41.79957 -87.58700   "(41.799566646, -87.5870034)"\r
5 09/30/2023 03:41:20 PM 41.79702 -87.58546 "(41.797023613, -87.585455951)"\r
```

4. Make a table of the number of assaults (IUCR 0560) by Ward

We could select all the IUCR codes and ward with SQL and then filter and tabulate the data in R.

```r
# system.time() reports how long it takes to run the SQL query
#   How long if we retrieve data from SQL and tabulate in R?
system.time(
{
   data <- dbGetQuery(con, "
                    SELECT IUCR,Ward
                    FROM crime")
   data |>
      filter(IUCR=="0560") |>
      count(Ward)
})
```

```
   user  system elapsed
   6.35    5.21   15.47
```

Or we could make SQL do all the work selecting and tabulating.

```r
#   How long if we make SQL do all the work?
system.time(
{
   a <- dbGetQuery(con, "
      SELECT COUNT(*) AS crimecount,
             Ward
      FROM crime
      WHERE IUCR='0560'
      GROUP BY Ward")
})
```

```
   user  system elapsed 
   1.61    5.60   11.55 
```

Generally, SQL will be much faster for general selecting, filtering, tabulating, and linking data.

5. Count the number of crimes by `PrimaryType`

```
dbGetQuery(con, "
   SELECT COUNT(*) AS crimecount,
          PrimaryType
   FROM crime
   GROUP BY PrimaryType")
```

```
   crimecount                       PrimaryType
1       14354                             ARSON
2      560071                           ASSAULT
3     1526524                           BATTERY
4      443249                          BURGLARY
5        1609 CONCEALED CARRY LICENSE VIOLATION
6       27303               CRIM SEXUAL ASSAULT
7      952792                   CRIMINAL DAMAGE
8       11111           CRIMINAL SEXUAL ASSAULT
9      225607                 CRIMINAL TRESPASS
10     384905                DECEPTIVE PRACTICE
11          1                 DOMESTIC VIOLENCE
12      14660                          GAMBLING
13      13883                          HOMICIDE
14        136                 HUMAN TRAFFICKING
15      20050  INTERFERENCE WITH PUBLIC OFFICER
16       5067                      INTIMIDATION
17       7478                        KIDNAPPING
18      15348               LIQUOR LAW VIOLATION
19     427418               MOTOR VEHICLE THEFT
20     762440                         NARCOTICS
21         38                    NON - CRIMINAL
22        190                      NON-CRIMINAL
23          9  NON-CRIMINAL (SUBJECT SPECIFIED)
```

```
24      942                          OBSCENITY
25    60129          OFFENSE INVOLVING CHILDREN
26      162             OTHER NARCOTIC VIOLATION
27   522174                       OTHER OFFENSE
28    70363                        PROSTITUTION
29      215                    PUBLIC INDECENCY
30    54573              PUBLIC PEACE VIOLATION
31       24                           RITUALISM
32   313479                             ROBBERY
33    33970                         SEX OFFENSE
34     6032                            STALKING
35  1777761                               THEFT
36   123924                   WEAPONS VIOLATION
```

6. Count the number of crimes resulting in arrest

```
dbGetQuery(con, "
   SELECT COUNT(*) AS crimecount, PrimaryType
   FROM crime
   WHERE Arrest='true'
   GROUP BY PrimaryType")
```

```
   crimecount                       PrimaryType
1        1769                             ARSON
2      113606                           ASSAULT
3      330925                           BATTERY
4       25340                          BURGLARY
5        1554 CONCEALED CARRY LICENSE VIOLATION
6        4365                CRIM SEXUAL ASSAULT
7       62027                   CRIMINAL DAMAGE
8         811           CRIMINAL SEXUAL ASSAULT
9      153567                 CRIMINAL TRESPASS
10      47726                DECEPTIVE PRACTICE
11          1                 DOMESTIC VIOLENCE
12      14554                          GAMBLING
13       6659                          HOMICIDE
14         13                 HUMAN TRAFFICKING
15      18365   INTERFERENCE WITH PUBLIC OFFICER
16        731                      INTIMIDATION
17        798                        KIDNAPPING
18      15199               LIQUOR LAW VIOLATION
19      32501               MOTOR VEHICLE THEFT
```

```
20     757507                          NARCOTICS
21          6                     NON - CRIMINAL
22         18                       NON-CRIMINAL
23          3  NON-CRIMINAL (SUBJECT SPECIFIED)
24        699                          OBSCENITY
25      11627         OFFENSE INVOLVING CHILDREN
26        108           OTHER NARCOTIC VIOLATION
27      92239                      OTHER OFFENSE
28      70052                       PROSTITUTION
29        211                   PUBLIC INDECENCY
30      34078            PUBLIC PEACE VIOLATION
31          3                         RITUALISM
32      28982                           ROBBERY
33       8656                       SEX OFFENSE
34        730                          STALKING
35     192818                             THEFT
36      89935                 WEAPONS VIOLATION
```

Or, if we were not interested in differentiating based on the `PrimaryType`, we could simply do the following:

```
dbGetQuery(con, "
   SELECT COUNT(*) AS crimecount
   FROM crime
   WHERE Arrest='true'")
```

```
  crimecount
1    2118183
```

7. Count the number of crimes by `LocationDescription`

```
dbGetQuery(con, "
   SELECT COUNT(*) AS crimecount, LocationDescription
   FROM crime
   GROUP BY LocationDescription
   ORDER BY crimecount DESC")
```

```
    crimecount                                   LocationDescription
1      2188634                                                STREET
2      1378068                                             RESIDENCE
3       992559                                             APARTMENT
```

```
4        759893                                   SIDEWALK
5        269956                                      OTHER
6        202933            PARKING LOT/GARAGE(NON.RESID.)
7        186576                                      ALLEY
8        167776                          SMALL RETAIL STORE
9        146370               "SCHOOL, PUBLIC, BUILDING"
10       140579                                 RESTAURANT
11       135280                            RESIDENCE-GARAGE
12       132667                    VEHICLE NON-COMMERCIAL
13       124167                   RESIDENCE PORCH/HALLWAY
14       110654                            DEPARTMENT STORE
15       104657                          GROCERY FOOD STORE
16        93505                                 GAS STATION
17        75140             RESIDENTIAL YARD (FRONT/BACK)
18        68975              COMMERCIAL / BUSINESS OFFICE
19        63192                               PARK PROPERTY
20        56098                   CHA PARKING LOT/GROUNDS
21        46948                               BAR OR TAVERN
22        44351     PARKING LOT / GARAGE (NON RESIDENTIAL)
23        41231                                CTA PLATFORM
24        40395                               CHA APARTMENT
25        39543                                  DRUG STORE
26        34321                                   CTA TRAIN
27        33028                                        BANK
28        30249                "SCHOOL, PUBLIC, GROUNDS"
29        29723                                 HOTEL/MOTEL
30        27614                           CONVENIENCE STORE
31        27368                                     CTA BUS
32        25021            CHA HALLWAY/STAIRWELL/ELEVATOR
33        24679                              VACANT LOT/LAND
34        24623                      DRIVEWAY - RESIDENTIAL
35        22836                              OTHER (SPECIFY)
36        22458                          TAVERN/LIQUOR STORE
37        22189                  HOSPITAL BUILDING/GROUNDS
38        18560             POLICE FACILITY/VEH PARKING LOT
39        17570                 RESIDENCE - PORCH / HALLWAY
40        16296                            AIRPORT/AIRCRAFT
41        15488           CHURCH/SYNAGOGUE/PLACE OF WORSHIP
42        15153             RESIDENCE - YARD (FRONT / BACK)
43        14757               GOVERNMENT BUILDING/PROPERTY
44        14671
45        14656               NURSING HOME/RETIREMENT HOME
46        14357                          RESIDENCE - GARAGE
```

47	14324	CONSTRUCTION SITE
48	14182	"SCHOOL, PRIVATE, BUILDING"
49	12404	CURRENCY EXCHANGE
50	12174	ABANDONED BUILDING
51	10697	WAREHOUSE
52	10276	CTA GARAGE / OTHER PROPERTY
53	10238	ATHLETIC CLUB
54	8800	CTA BUS STOP
55	8772	BARBERSHOP
56	8705	ATM (AUTOMATIC TELLER MACHINE)
57	7814	TAXICAB
58	7803	CTA STATION
59	7553	SCHOOL - PUBLIC BUILDING
60	7453	LIBRARY
61	7429	MEDICAL/DENTAL OFFICE
62	7395	HOSPITAL BUILDING / GROUNDS
63	6892	FACTORY/MANUFACTURING BUILDING
64	6703	SCHOOL - PUBLIC GROUNDS
65	6656	HOTEL / MOTEL
66	5930	OTHER RAILROAD PROP / TRAIN DEPOT
67	5787	COLLEGE/UNIVERSITY GROUNDS
68	5627	AIRPORT TERMINAL UPPER LEVEL - SECURE AREA
69	5615	VEHICLE-COMMERCIAL
70	5333	CLEANING STORE
71	5290	SPORTS ARENA/STADIUM
72	4292	"SCHOOL, PRIVATE, GROUNDS"
73	4195	POLICE FACILITY / VEHICLE PARKING LOT
74	4051	NURSING / RETIREMENT HOME
75	3849	VACANT LOT / LAND
76	3760	DAY CARE CENTER
77	3600	CAR WASH
78	3567	OTHER COMMERCIAL TRANSPORTATION
79	2800	TAVERN / LIQUOR STORE
80	2732	MOVIE HOUSE/THEATER
81	2676	GOVERNMENT BUILDING / PROPERTY
82	2668	AIRPORT TERMINAL LOWER LEVEL - NON-SECURE AREA
83	2594	APPLIANCE STORE
84	2351	CHA PARKING LOT / GROUNDS
85	2343	CHURCH / SYNAGOGUE / PLACE OF WORSHIP
86	1865	AIRPORT PARKING LOT
87	1652	MEDICAL / DENTAL OFFICE
88	1630	AUTO / BOAT / RV DEALERSHIP
89	1528	AIRPORT BUILDING NON-TERMINAL - NON-SECURE AREA

```
90        1497                                SCHOOL - PRIVATE GROUNDS
91        1399                       COLLEGE/UNIVERSITY RESIDENCE HALL
92        1387                                                    AUTO
93        1318         AIRPORT TERMINAL UPPER LEVEL - NON-SECURE AREA
94        1309                                            FIRE STATION
95        1304                                 JAIL / LOCK-UP FACILITY
96        1301                      AIRPORT EXTERIOR - NON-SECURE AREA
97        1272                                    VEHICLE - COMMERCIAL
98        1181                          LAKEFRONT/WATERFRONT/RIVERBANK
99        1168                                   COIN OPERATED MACHINE
100       1153              AIRPORT TERMINAL LOWER LEVEL - SECURE AREA
101       1133                               SCHOOL - PRIVATE BUILDING
102       1085                                      HIGHWAY/EXPRESSWAY
103       1076                                        FEDERAL BUILDING
104       1012                           AIRPORT VENDING ESTABLISHMENT
105       1003                                               POOL ROOM
106        977                                                AIRCRAFT
107        962                                          DELIVERY TRUCK
108        920             AIRPORT BUILDING NON-TERMINAL - SECURE AREA
109        910                                         ANIMAL HOSPITAL
110        909               CTA PARKING LOT / GARAGE / OTHER PROPERTY
111        890                      CHA HALLWAY / STAIRWELL / ELEVATOR
112        825                                           BOWLING ALLEY
113        761                                               PAWN SHOP
114        749                                  SPORTS ARENA / STADIUM
115        734                   OTHER RAILROAD PROPERTY / TRAIN DEPOT
116        720                        FACTORY / MANUFACTURING BUILDING
117        705                                                   HOUSE
118        698                                         BOAT/WATERCRAFT
119        593                          AIRPORT EXTERIOR - SECURE AREA
120        592                                            CREDIT UNION
121        589 "VEHICLE - OTHER RIDE SHARE SERVICE (LYFT, UBER, ETC.)"
122        518                                                  BRIDGE
123        514                      LAKEFRONT / WATERFRONT / RIVERBANK
124        472                                         FOREST PRESERVE
125        467 "VEHICLE - OTHER RIDE SHARE SERVICE (E.G., UBER, LYFT)"
126        436                                                CEMETARY
127        426                                VEHICLE - DELIVERY TRUCK
128        407                                                   PORCH
129        403                          COLLEGE / UNIVERSITY - GROUNDS
130        395                                        SAVINGS AND LOAN
131        382                                   MOVIE HOUSE / THEATER
132        331                            VEHICLE - OTHER RIDE SERVICE
```

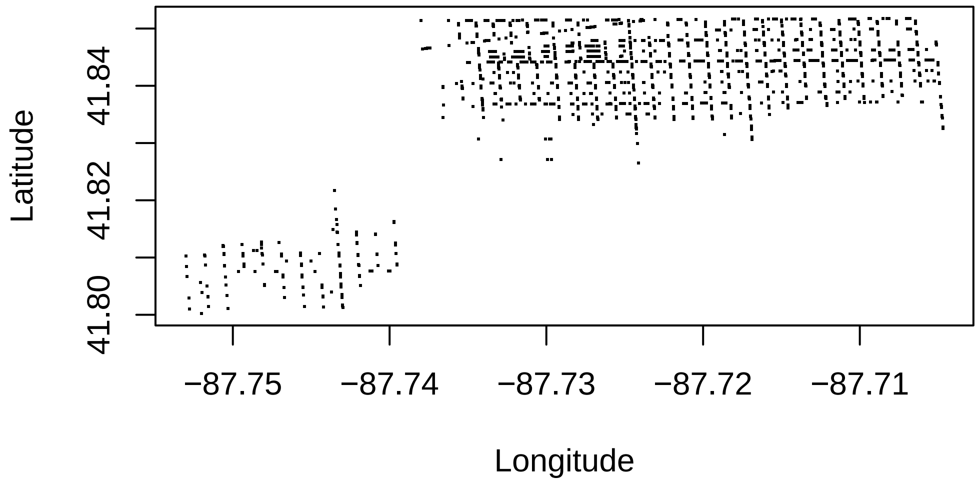
133	330	YARD
134	282	PARKING LOT
135	269	HIGHWAY / EXPRESSWAY
136	245	NEWSSTAND
137	202	CTA TRACKS - RIGHT OF WAY
138	174	AIRPORT TRANSPORTATION SYSTEM (ATS)
139	157	BOAT / WATERCRAFT
140	152	AIRPORT TERMINAL MEZZANINE - NON-SECURE AREA
141	144	VACANT LOT
142	122	COLLEGE / UNIVERSITY - RESIDENCE HALL
143	111	HALLWAY
144	103	RETAIL STORE
145	79	CASINO/GAMBLING ESTABLISHMENT
146	75	GARAGE
147	75	GANGWAY
148	71	GAS STATION DRIVE/PROP.
149	60	CHA PARKING LOT
150	51	CHA GROUNDS
151	40	TAVERN
152	39	CHA HALLWAY
153	35	BASEMENT
154	28	VESTIBULE
155	28	DRIVEWAY
156	27	STAIRWELL
157	27	HOTEL
158	27	BARBER SHOP/BEAUTY SALON
159	22	OFFICE
160	20	VEHICLE - COMMERCIAL: TROLLEY BUS
161	20	KENNEL
162	19	HOSPITAL
163	18	RAILROAD PROPERTY
164	18	CLUB
165	17	VEHICLE - COMMERCIAL: ENTERTAINMENT / PARTY BUS
166	17	SCHOOL YARD
167	13	LIQUOR STORE
168	13	"CTA ""L"" PLATFORM"
169	11	GARAGE/AUTO REPAIR
170	11	FARM
171	11	"CTA ""L"" TRAIN"
172	10	VEHICLE-COMMERCIAL - TROLLEY BUS
173	10	VEHICLE-COMMERCIAL - ENTERTAINMENT/PARTY BUS
174	10	CTA PROPERTY
175	10	CHA STAIRWELL

176	9	TRUCK
177	9	CHA LOBBY
178	7	WOODED AREA
179	7	MOTEL
180	7	DUMPSTER
181	6	TAXI CAB
182	6	RIVER BANK
183	6	NURSING HOME
184	6	CHURCH
185	5	LAKE
186	4	TRAILER
187	4	RIVER
188	4	CHA PLAY LOT
189	3	YMCA
190	3	SEWER
191	3	HORSE STABLE
192	3	COACH HOUSE
193	3	CHA ELEVATOR
194	3	CHA BREEZEWAY
195	2	ROOMING HOUSE
196	2	PUBLIC HIGH SCHOOL
197	2	PUBLIC GRAMMAR SCHOOL
198	2	PRAIRIE
199	2	LIVERY STAND OFFICE
200	2	LAUNDRY ROOM
201	2	GOVERNMENT BUILDING
202	2	FACTORY
203	2	ELEVATOR
204	2	CTA SUBWAY STATION
205	2	COUNTY JAIL
206	2	CHURCH PROPERTY
207	2	BANQUET HALL
208	1	TRUCKING TERMINAL
209	1	ROOF
210	1	POOLROOM
211	1	POLICE FACILITY
212	1	LOADING DOCK
213	1	LIVERY AUTO
214	1	LAGOON
215	1	JUNK YARD/GARBAGE DUMP
216	1	FUNERAL PARLOR
217	1	EXPRESSWAY EMBANKMENT
218	1	CLEANERS/LAUNDROMAT

```
219           1                                                 BEACH
```

8. Plot the longitude and latitude of all “ASSAULT”s for Ward 22

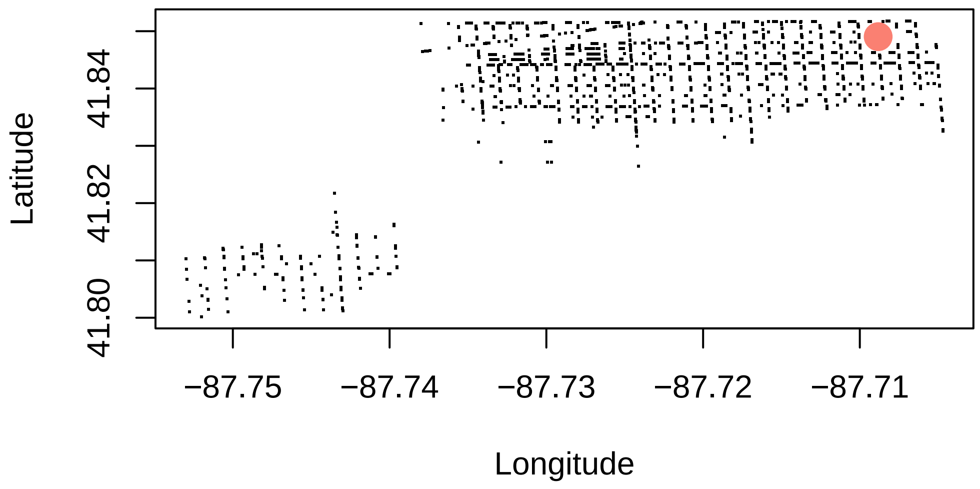
```
a <- dbGetQuery(con, "
   SELECT Latitude, Longitude
   FROM crime
   WHERE PrimaryType='ASSAULT' AND Ward='22'")
plot(Latitude~Longitude, data=a, pch=".")
```



9. What is the most common (Long,Lat) for assaults in Ward 22?

```
b <- dbGetQuery(con, "
   SELECT COUNT(*) AS crimecount,
          Latitude, Longitude
   FROM   crime
   WHERE  PrimaryType='ASSAULT' AND Ward=22
   GROUP BY Latitude, Longitude
   ORDER BY crimecount DESC
   LIMIT 1")

plot(Latitude~Longitude, data=a, pch=".")
points(Latitude~Longitude,
       data=b,
       pch=16,
       col="salmon",
       cex=2)
```



```
b
```

```
  crimecount Latitude Longitude
1        229 41.84905 -87.70883
```