Class 17 - Covid

Sarah Tareen

Getting Started

```
# Import vaccination data
vax <- read.csv("covid19vaccinesbyzipcode_test (1).csv")
head(vax)
```

```
  as_of_date zip_code_tabulation_area local_health_jurisdiction     county
1 2021-01-05                   93704                     Fresno     Fresno
2 2021-01-05                   95684                  El Dorado  El Dorado
3 2021-01-05                   92273                   Imperial   Imperial
4 2021-01-05                   93662                     Fresno     Fresno
5 2021-01-05                   95673                 Sacramento Sacramento
6 2021-01-05                   93668                     Fresno     Fresno
  vaccine_equity_metric_quartile                 vem_source
1                              1 Healthy Places Index Score
2                              2 Healthy Places Index Score
3                              1 Healthy Places Index Score
4                              1 Healthy Places Index Score
5                              2 Healthy Places Index Score
6                              1    CDPH-Derived ZCTA Score
  age12_plus_population age5_plus_population tot_population
1               24803.5                27701          29740
2                2882.9                 3104           3129
3                1633.1                 1763           2010
4               24501.3                28311          30725
5               13671.7                15453          16636
6                1013.4                 1199           1219
  persons_fully_vaccinated persons_partially_vaccinated
1                       NA                           NA
2                       NA                           NA
```

```
3                       NA                            NA
4                       NA                            NA
5                       NA                            NA
6                       NA                            NA
  percent_of_population_fully_vaccinated
1                                     NA
2                                     NA
3                                     NA
4                                     NA
5                                     NA
6                                     NA
  percent_of_population_partially_vaccinated
1                                         NA
2                                         NA
3                                         NA
4                                         NA
5                                         NA
6                                         NA
  percent_of_population_with_1_plus_dose booster_recip_count
1                                     NA                  NA
2                                     NA                  NA
3                                     NA                  NA
4                                     NA                  NA
5                                     NA                  NA
6                                     NA                  NA
  bivalent_dose_recip_count eligible_recipient_count
1                        NA                        5
2                        NA                        0
3                        NA                        1
4                        NA                        1
5                        NA                        3
6                        NA                        0
  eligible_bivalent_recipient_count
1                                 5
2                                 0
3                                 0
4                                 1
5                                 3
6                                 0
                                                                                                redacted
1 Information redacted in accordance with CA state privacy requirements
2 Information redacted in accordance with CA state privacy requirements
3 Information redacted in accordance with CA state privacy requirements
```

```
4 Information redacted in accordance with CA state privacy requirements
5 Information redacted in accordance with CA state privacy requirements
6 Information redacted in accordance with CA state privacy requirements
```

Q1. What column details the total number of people fully vaccinated?

persons_fully_vaccinated

Q2. What column details the Zip code tabulation area?

zip_code_tabulation_area

Q3. What is the earliest date in this dataset?

```
min(vax$as_of_date)
```

```
[1] "2021-01-05"
```

Q4. What is the latest date in this dataset?

```
vax[nrow(vax),1]
```

```
[1] "2023-05-30"
```

Let's take a look at the data.

```
library(skimr)
skimr::skim_without_charts(vax)
```

Table 1: Data summary

Name	vax
Number of rows	222264
Number of columns	19
Column type frequency:	
character	5
numeric	14
Group variables	None

Variable type: character

skim_variable	n_missing	complete_rate	min	max	empty	n_unique	whitespace
as_of_date	0	1	10	10	0	126	0
local_health_jurisdiction	0	1	0	15	630	62	0
county	0	1	0	15	630	59	0
vem_source	0	1	15	26	0	3	0
redacted	0	1	2	69	0	2	0

Variable type: numeric

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100
zip_code_tabulation_area	0	1.00	93665.11	817.38	90001	92257.75	93658.50	95380.50	97635.0
vaccine_equity_metric_quartile	10962	0.95	2.44	1.11	1	1.00	2.00	3.00	4.0
age12_plus_population	0	1.00	18895.04	18993.87	0	1346.95	13685.10	31756.18	88556.7
age5_plus_population	0	1.00	20875.22	21105.96	0	1460.50	15364.00	34877.00	101902.0
tot_population	10836	0.95	23372.77	22628.50	12	2126.00	18714.00	38168.00	111165.0
persons_fully_vaccinated	17848	0.92	14299.49	15281.94	11	957.00	9034.00	23818.00	87721.0
persons_partially_vaccinated	17848	0.92	1712.08	2075.03	11	164.00	1204.00	2551.00	43152.0
percent_of_population_fully_vaccinated	22720	0.90	0.58	0.25	0	0.44	0.62	0.75	1.0
percent_of_population_partially_vaccinated	22720	0.90	0.08	0.09	0	0.05	0.06	0.08	1.0
percent_of_population_with_1_plus_dose	26883	0.88	0.65	0.24	0	0.50	0.68	0.82	1.0
booster_recip_count	74543	0.66	6417.22	7795.13	11	331.00	3135.00	10344.00	60058.0
bivalent_dose_recip_count	160089	0.28	3438.22	4034.61	11	225.00	1863.00	5532.00	29593.0
eligible_recipient_count	0	1.00	13145.14	15144.22	0	537.00	6691.00	22558.00	87442.0
eligible_bivalent_recipient_count	0	1.00	13038.24	15218.39	0	263.00	6583.00	22550.00	87442.0

Q5. How many numeric columns are in this dataset?

14 numeric columns as we can see from the `skim` result.

```
# check how the data frame is structured
str(vax)
```

```
'data.frame':   222264 obs. of  19 variables:
 $ as_of_date                                : chr  "2021-01-05" "2021-01-05" "2021-01-05" "2
 $ zip_code_tabulation_area                  : int  93704 95684 92273 93662 95673 93668 9226
 $ local_health_jurisdiction                 : chr  "Fresno" "El Dorado" "Imperial" "Fresno"
 $ county                                    : chr  "Fresno" "El Dorado" "Imperial" "Fresno"
 $ vaccine_equity_metric_quartile            : num  1 2 1 1 2 1 2 4 3 2 ...
 $ vem_source                                : chr  "Healthy Places Index Score" "Healthy Pla
 $ age12_plus_population                     : num  24804 2883 1633 24501 13672 ...
```

```
$ age5_plus_population                          : int  27701 3104 1763 28311 15453 1199 27406 41
$ tot_population                                : num  29740 3129 2010 30725 16636 ...
$ persons_fully_vaccinated                      : num  NA NA NA NA NA NA NA 12 NA NA ...
$ persons_partially_vaccinated                  : num  NA NA NA NA NA ...
$ percent_of_population_fully_vaccinated        : num  NA NA NA NA NA NA NA 0.000278 NA NA ...
$ percent_of_population_partially_vaccinated: num  NA NA NA NA NA ...
$ percent_of_population_with_1_plus_dose        : num  NA NA NA NA NA ...
$ booster_recip_count                           : num  NA NA NA NA NA NA NA NA NA NA ...
$ bivalent_dose_recip_count                     : num  NA NA NA NA NA NA NA NA NA NA ...
$ eligible_recipient_count                      : int  5 0 1 1 3 0 3 12 0 1 ...
$ eligible_bivalent_recipient_count             : int  5 0 0 1 3 0 3 12 0 1 ...
$ redacted                                      : chr  "Information redacted in accordance with
```

```
#check a specific column
class(vax$persons_fully_vaccinated)
```

```
[1] "numeric"
```

Q6. Note that there are "missing values" in the dataset. How many `NA` values there in the `persons_fully_vaccinated` column?

```
sum(is.na(vax$persons_fully_vaccinated))
```

```
[1] 17848
```

Q7. What percent of `persons_fully_vaccinated` values are missing (to 2 significant figures)?

```
(17711 / 220500)*100
```

```
[1] 8.0322
```

Q8. [Optional]: Why might this data be missing?

Individual data points are not perfect and working with a huge amount of data has outliers which are not super important to the overall trend.

Working with dates

```
library(lubridate)
```

```
Attaching package: 'lubridate'

The following objects are masked from 'package:base':

    date, intersect, setdiff, union
```

What is today's date?

```
today()
```

```
[1] "2023-05-31"
```

```
# Specify that we are using the year-month-day format
vax$as_of_date <- ymd(vax$as_of_date)
```

```
today() - vax$as_of_date[1]
```

```
Time difference of 876 days
```

Q9. How many days have passed since the last update of the dataset?

```
today() - vax$as_of_date[nrow(vax)]
```

```
Time difference of 1 days
```

Q10. How many unique dates are in the dataset (i.e. how many different dates are detailed)?

```
length(unique(vax$as_of_date))
```

```
[1] 126
```

Working with ZIP codes

```
library(zipcodeR)
```

```
geocode_zip('92037')
```

```
# A tibble: 1 x 3
  zipcode   lat   lng
  <chr>   <dbl> <dbl>
1 92037    32.8 -117.
```

We can find the distance between the centers of any two ZIP codes in miles.

```
zip_distance('92037','92109')
```

```
  zipcode_a zipcode_b distance
1     92037     92109     2.33
```

We can find information about specific zip codes.

```
reverse_zipcode(c('92037', "92109") )
```

```
# A tibble: 2 x 24
  zipcode zipcode_type major_city post_office_city common_city_list county state
  <chr>   <chr>        <chr>      <chr>                     <blob> <chr>  <chr>
1 92037   Standard     La Jolla   La Jolla, CA           <raw 20 B> San D~ CA
2 92109   Standard     San Diego  San Diego, CA          <raw 21 B> San D~ CA
# i 17 more variables: lat <dbl>, lng <dbl>, timezone <chr>,
#   radius_in_miles <dbl>, area_code_list <blob>, population <int>,
#   population_density <dbl>, land_area_in_sqmi <dbl>,
#   water_area_in_sqmi <dbl>, housing_units <int>,
#   occupied_housing_units <int>, median_home_value <int>,
#   median_household_income <int>, bounds_west <dbl>, bounds_east <dbl>,
#   bounds_north <dbl>, bounds_south <dbl>
```

```
# Pull data for all ZIP codes in the dataset
#zipdata <- reverse_zipcode( vax$zip_code_tabulation_area )
```

Focus on the San Diego area

There are two ways to focus on the San Diego area:

We can use base R functions.

```
# Subset to San Diego county only areas
sd <- vax[ vax$"county" == "San Diego",]
```

Or we can use the `dplyr` package.

```
library(dplyr)
```

```
Attaching package: 'dplyr'

The following objects are masked from 'package:stats':

    filter, lag

The following objects are masked from 'package:base':

    intersect, setdiff, setequal, union
```

```
sd <- filter(vax, county == "San Diego")

nrow(sd)
```

```
[1] 13482
```

`dplyr` is useful when you want multiple filters...

```
sd.10 <- filter(vax, county == "San Diego" &
                age5_plus_population > 10000)
```

Q11. How many distinct zip codes are listed for San Diego County?

```
length(unique(sd$zip_code_tabulation_area))
```

```
[1] 107
```

107 unique zip codes for San Diego county.

> Q12. What San Diego County Zip code area has the largest population in this dataset?

```
largest_zip_code <- sd[sd$tot_population == max(sd$tot_population,
                                                na.rm = TRUE),]

unique(largest_zip_code$zip_code_tabulation_area)
```

```
[1]    NA 92154
```

92154 has the largest San Diego population.

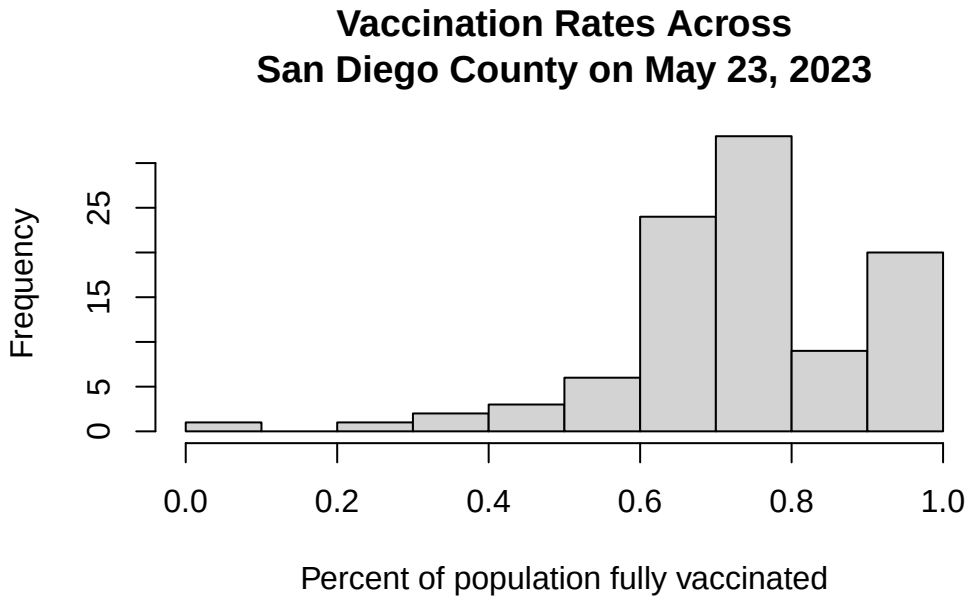
> **Q13.** What is the overall average (with 2 decimal numbers) "Percent of Population Fully Vaccinated" value for all San Diego "County" as of "2023-05-23"?

```
sd_recent <- filter(sd, as_of_date == "2023-05-23")
mean(sd_recent$percent_of_population_fully_vaccinated, na.rm = TRUE)
```

```
[1] 0.7419992
```

> **Q14.** Using either ggplot or base R graphics make a summary figure that shows the distribution of Percent of Population Fully Vaccinated values as of "2023-05-23"?

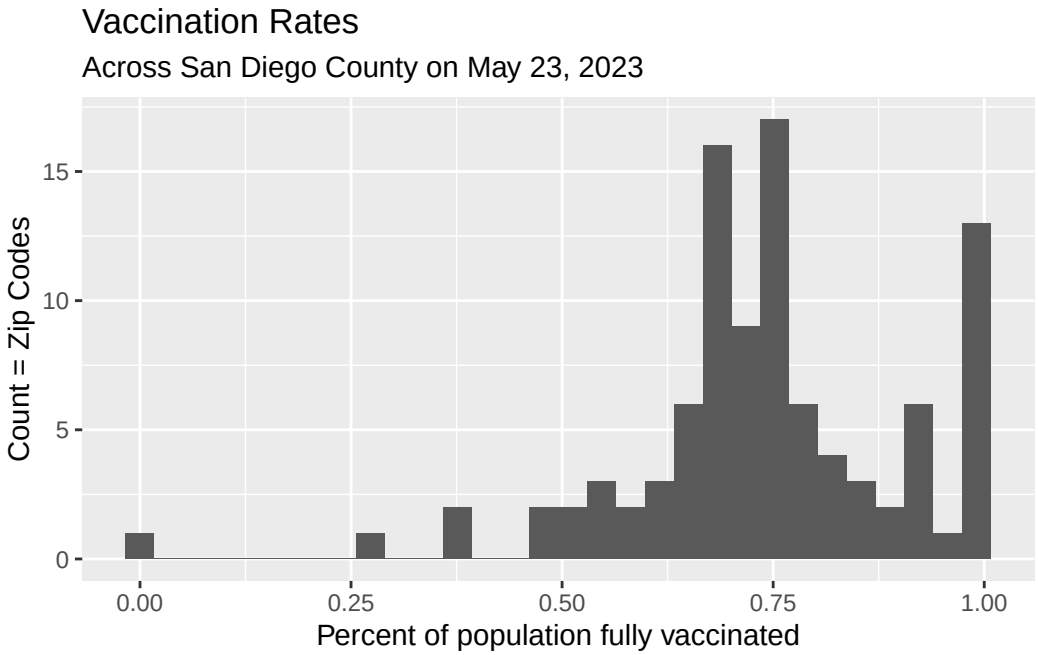
```
#Base R
hist(sd_recent$percent_of_population_fully_vaccinated,
     xlab = "Percent of population fully vaccinated",
     main = "Vaccination Rates Across\nSan Diego County on May 23, 2023")
```




```
#ggplot2
library(ggplot2)
ggplot(sd_recent) + aes(x = percent_of_population_fully_vaccinated) + geom_histogram() +
  labs(x= "Percent of population fully vaccinated",
       y = "Count = Zip Codes",
       title = "Vaccination Rates",
       subtitle = "Across San Diego County on May 23, 2023")
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

```
Warning: Removed 8 rows containing non-finite values (`stat_bin()`).
```



Focus on UCSD/La Jolla

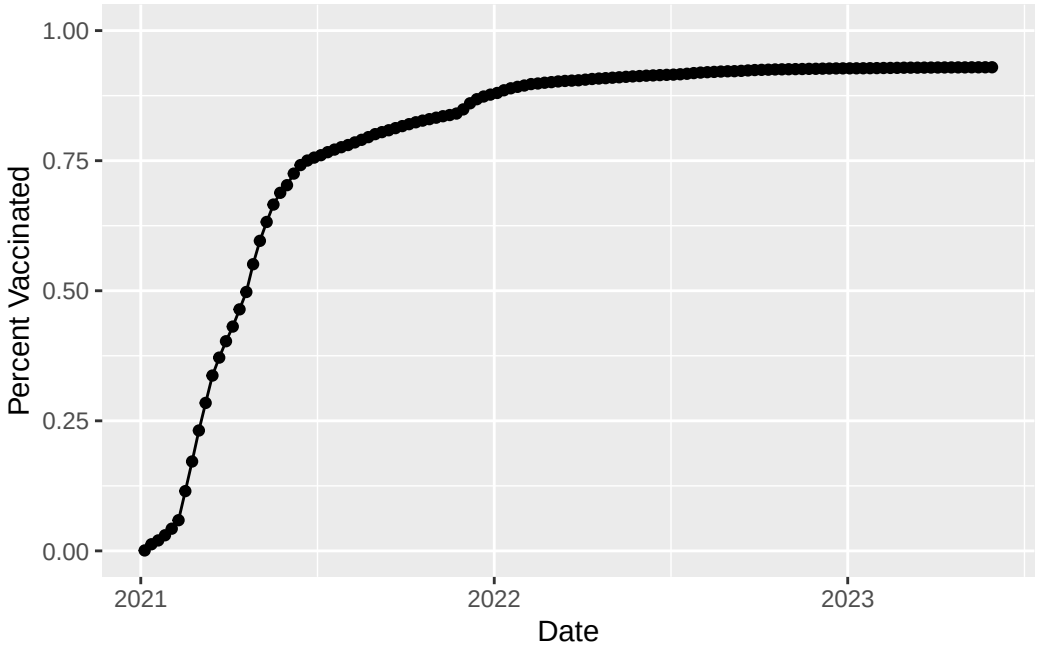
Let's filter to the UC San Diego in the 92037 ZIP code area and with an age 5+ population size of 36,144.

```
ucsd <- filter(sd, zip_code_tabulation_area=="92037")
ucsd[1,]$age5_plus_population
```

```
[1] 36144
```

Q15. Using **ggplot** make a graph of the vaccination rate time course for the 92037 ZIP code area:

```
plot_92037 <- ggplot(ucsd) +
  aes(x=as_of_date,
      y=percent_of_population_fully_vaccinated) +
  geom_point() +
  geom_line(group=1) +
  ylim(c(0,1)) +
  labs(x="Date", y="Percent Vaccinated")
plot_92037
```



Comparing to similar sized areas

Q16. Calculate the mean *"Percent of Population Fully Vaccinated"* for ZIP code areas with a population as large as 92037 (La Jolla) *as_of_date* "2023-05-23". Add this as a straight horizontal line to your plot from above with the `geom_hline()` function?

```
# Subset to all CA areas with a population as large as 92037
vax.36 <- filter(vax, age5_plus_population > 36144 &
                 as_of_date == "2023-05-23")

head(vax.36)
```

```
  as_of_date zip_code_tabulation_area local_health_jurisdiction      county
1 2023-05-23                   90805                Long Beach Los Angeles
2 2023-05-23                   93257                    Tulare      Tulare
3 2023-05-23                   90004               Los Angeles Los Angeles
4 2023-05-23                   90808                Long Beach Los Angeles
5 2023-05-23                   95355                Stanislaus  Stanislaus
6 2023-05-23                   90802                Long Beach Los Angeles
  vaccine_equity_metric_quartile                vem_source
1                              1 Healthy Places Index Score
```

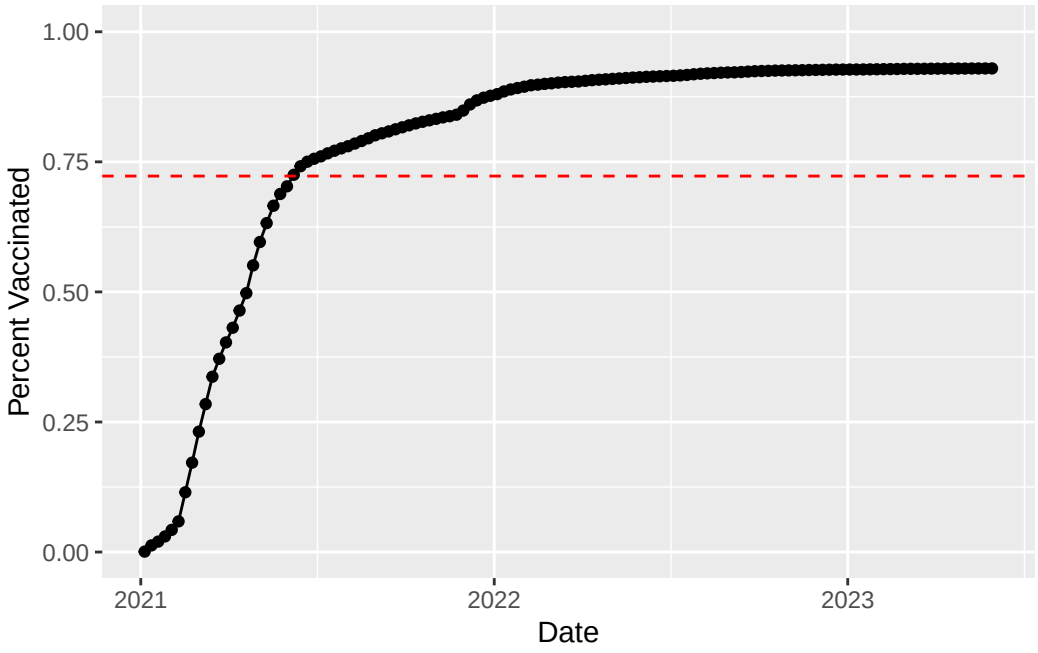
```
2                            1 Healthy Places Index Score
3                            1 Healthy Places Index Score
4                            4 Healthy Places Index Score
5                            2 Healthy Places Index Score
6                            1 Healthy Places Index Score
  age12_plus_population age5_plus_population tot_population
1               77165.9                88279          95995
2               61519.8                70784          76519
3               52412.5                57024          60541
4               33952.3                37179          39330
5               50941.6                56248          59621
6               35238.1                37017          38962
  persons_fully_vaccinated persons_partially_vaccinated
1                    62829                         6949
2                    45117                         5629
3                    47272                         5963
4                    30283                         2375
5                    39616                         3210
6                    28152                         3711
  percent_of_population_fully_vaccinated
1                               0.654503
2                               0.589618
3                               0.780826
4                               0.769972
5                               0.664464
6                               0.722550
  percent_of_population_partially_vaccinated
1                                   0.072389
2                                   0.073563
3                                   0.098495
4                                   0.060386
5                                   0.053840
6                                   0.095247
  percent_of_population_with_1_plus_dose booster_recip_count
1                               0.726892               33175
2                               0.663181               22223
3                               0.879321               29130
4                               0.830358               20463
5                               0.718304               22873
6                               0.817797               17033
  bivalent_dose_recip_count eligible_recipient_count
1                     10919                    62713
2                      5297                    45104
```

```
3                      12081                     47148
4                       9676                     30203
5                       8291                     39588
6                       7169                     28107
  eligible_bivalent_recipient_count redacted
1                             62713       No
2                             45104       No
3                             47148       No
4                             30203       No
5                             39588       No
6                             28107       No
```

```
mean(vax.36$percent_of_population_fully_vaccinated)
```

```
[1] 0.7226674
```

```
plot_92037 + geom_hline(yintercept=0.7226674, linetype="dashed", color="red")
```



Q17. What is the 6 number summary (Min, 1st Qu., Median, Mean, 3rd Qu., and Max) of the *"Percent of Population Fully Vaccinated"* values for ZIP code areas with a population as large as 92037 (La Jolla) *as_of_date* "2023-05-23"?

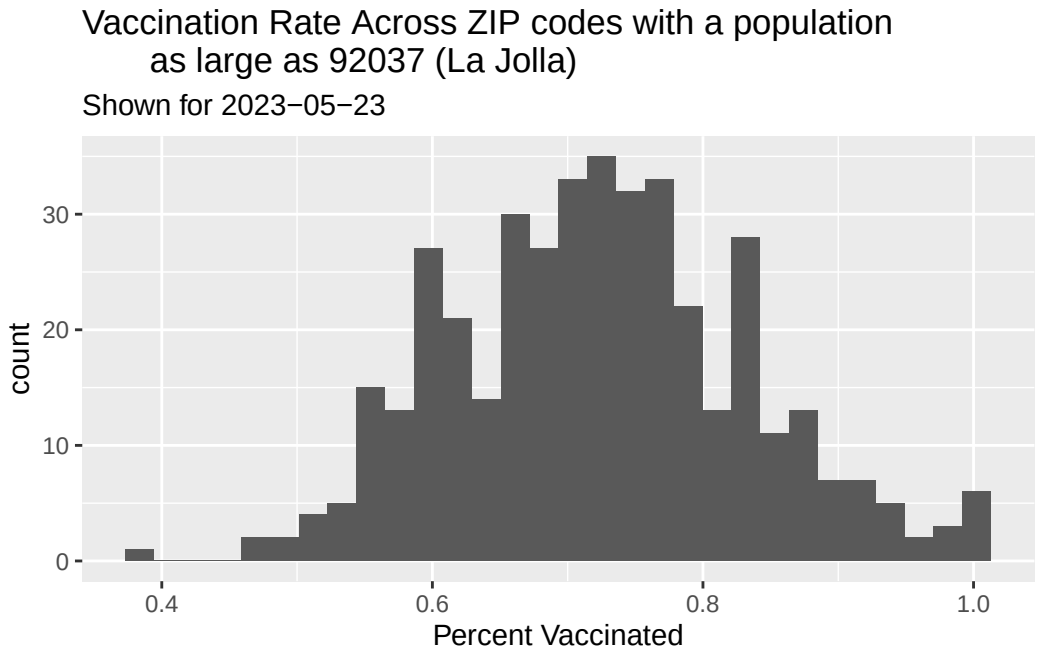
```
summary(vax.36$percent_of_population_fully_vaccinated)
```

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
 0.3815  0.6470  0.7208  0.7227  0.7923  1.0000
```

Q18. Using ggplot generate a histogram of this data.

```
ggplot(vax.36) + aes(x=percent_of_population_fully_vaccinated) + geom_histogram() +
  labs(x="Percent Vaccinated",
       title="Vaccination Rate Across ZIP codes with a population
       as large as 92037 (La Jolla)",
       subtitle= "Shown for 2023-05-23")
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



Q19. Is the 92109 and 92040 ZIP code areas above or below the average value you calculated for all these above?

```
vax %>% filter(as_of_date == "2023-05-23") %>%
  filter(zip_code_tabulation_area=="92040") %>%
```

```
  select(percent_of_population_fully_vaccinated)
```

```
  percent_of_population_fully_vaccinated
1                               0.552499
```

```
 vax %>% filter(as_of_date == "2023-05-23") %>%
   filter(zip_code_tabulation_area=="92109") %>%
   select(percent_of_population_fully_vaccinated)
```

```
  percent_of_population_fully_vaccinated
1                               0.694763
```

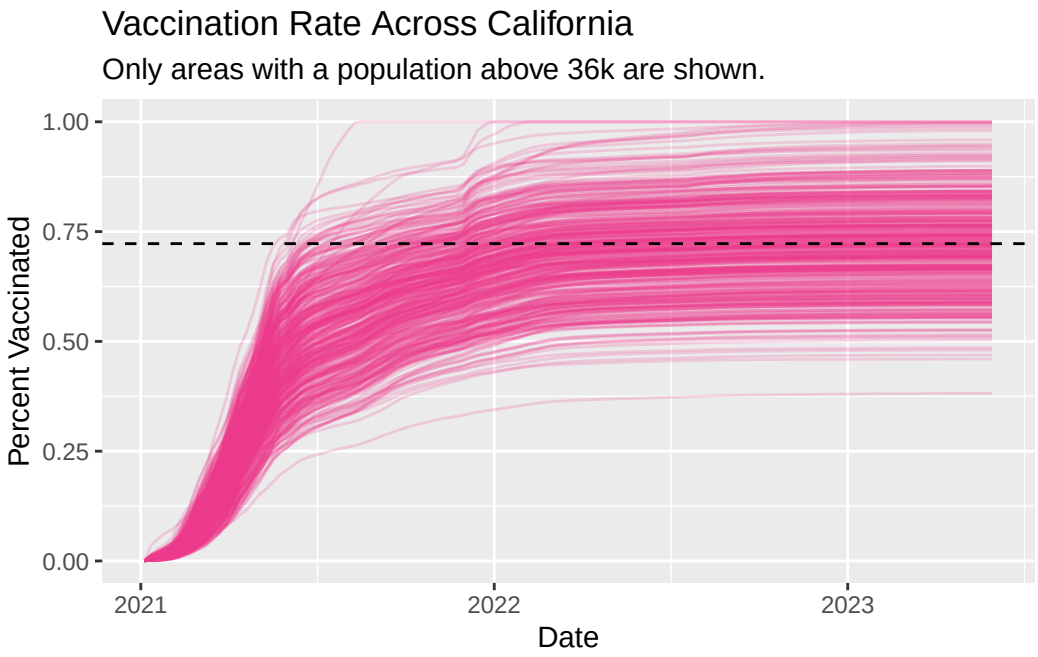
The percentage of people fully vaccinated for the 92109 and 92040 ZIP code areas are below the average value of the ZIP code areas with a population as large as 92037 (La Jolla).

Q20. Finally make a time course plot of vaccination progress for all areas in the full dataset with a `age5_plus_population > 36144`.

```
 vax.36.all <- filter(vax, age5_plus_population > 36144)


 ggplot(vax.36.all) +
   aes(x=as_of_date,
       y=percent_of_population_fully_vaccinated,
       group=zip_code_tabulation_area) +
   geom_line(alpha=0.2, color="violetred2") +
   ylim(c(0,1)) +
   labs(x="Date", y="Percent Vaccinated",
        title="Vaccination Rate Across California",
        subtitle= "Only areas with a population above 36k are shown.") +
   geom_hline(yintercept = 0.7225892, linetype= "dashed")
```

```
Warning: Removed 185 rows containing missing values (`geom_line()`).
```


Vaccination Rate Across California
Only areas with a population above 36k are shown.
Percent Vaccinated
1.00
0.75
0.50
0.25
0.00
2021
2022
2023
Date