# Class 17: Mini Project

Patrick Tran

The goal of this hands-on mini-project is to examine and compare the Covid-19 vaccination rates around San Diego.

We will start by downloading the most recently dated "Statewide COVID-19 Vaccines Administered by ZIP Code" CSV file from: https://data.ca.gov/dataset/covid-19-vaccine-progress-dashboard-data-by-zip-code

## Data Import

```r
vax <- read.csv("covid19vaccinesbyzipcode_test.csv")
head(vax)
```

```
  as_of_date zip_code_tabulation_area local_health_jurisdiction    county
1 2021-01-05                    95446                    Sonoma    Sonoma
2 2021-01-05                    96014                  Siskiyou  Siskiyou
3 2021-01-05                    96087                    Shasta    Shasta
4 2021-01-05                    96008                    Shasta    Shasta
5 2021-01-05                    95410                 Mendocino Mendocino
6 2021-01-05                    95527                   Trinity   Trinity
  vaccine_equity_metric_quartile                 vem_source
1                              2 Healthy Places Index Score
2                              2    CDPH-Derived ZCTA Score
3                              2    CDPH-Derived ZCTA Score
4                             NA           No VEM Assigned
5                              3    CDPH-Derived ZCTA Score
6                              2    CDPH-Derived ZCTA Score
  age12_plus_population age5_plus_population tot_population
1                4840.7                 5057           5168
2                 135.0                  135            135
3                 513.9                  544            544
```

```
4             1125.3                 1164             NA
5              926.3                  988            997
6              476.6                  485            499
  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                        0
2                        NA                        0
3                        NA                        2
4                        NA                        2
5                        NA                        0
6                        NA                        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?

vax$persons_fully_vaccinated

> Q2. What column details the Zip code tabulation area?

vax$zip_code_tabulation_area

> Q3. What is the earliest date in this dataset?

```r
vax$as_of_date[1]
```

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

> Q4. What is the latest date in this dataset?

```r
vax$as_of_date[nrow(vax)]
```

```
[1] "2023-02-28"
```

We can use the skim() function for a quick overview of a new dataset like this:

```r
skimr::skim(vax)
```

Table 1: Data summary

| | |
|---|---|
| Name | vax |
| Number of rows | 199332 |
| Number of columns | 18 |
| Column type frequency: | |
| character | 5 |
| numeric | 13 |
| 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 | 113 | 0 |
| local_health_jurisdiction | 0 | 1 | 0 | 15 | 565 | 62 | 0 |
| county | 0 | 1 | 0 | 15 | 565 | 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 | hist |
|---|---|---|---|---|---|---|---|---|---|---|
| zip_code_tabulation_area | 0 | 1.00 | 93665.11 | 1817.38 | 90001 | 92257.75 | 93658.50 | 95380.50 | 97635.0 | |
| vaccine_equity_metric_quartile | 9831 | 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 | 31756.12 | 88556.7 | |
| age5_plus_population | 0 | 1.00 | 20875.24 | 21105.97 | 0 | 1460.50 | 15364.00 | 34877.00 | 101902.0 | |
| tot_population | 9718 | 0.95 | 23372.77 | 22628.51 | 12 | 2126.00 | 18714.00 | 38168.00 | 111165.0 | |
| persons_fully_vaccinated | 16525 | 0.92 | 13962.33 | 15054.09 | 11 | 930.00 | 8566.00 | 23302.00 | 87566.0 | |
| persons_partially_vaccinated | 16525 | 0.92 | 1701.64 | 2030.18 | 11 | 165.00 | 1196.00 | 2535.00 | 39913.0 | |
| percent_of_population_fully_vaccinated | 20825 | 0.90 | 0.57 | 0.25 | 0 | 0.42 | 0.60 | 0.74 | 1.0 | |
| percent_of_population_partially_vaccinated | 20825 | 0.90 | 0.08 | 0.09 | 0 | 0.05 | 0.06 | 0.08 | 1.0 | |
| percent_of_population_with_1_plus_dose | 21859 | 0.89 | 0.63 | 0.24 | 0 | 0.49 | 0.67 | 0.81 | 1.0 | |
| booster_recip_count | 72872 | 0.63 | 5837.31 | 7165.81 | 11 | 297.00 | 2748.00 | 9438.25 | 59553.0 | |
| bivalent_dose_recip_count | 158664 | 0.20 | 2924.93 | 3583.45 | 11 | 190.00 | 1418.00 | 4626.25 | 27458.0 | |
| eligible_recipient_count | 0 | 1.00 | 12801.84 | 14908.33 | 0 | 504.00 | 6338.00 | 21973.00 | 87234.0 | |

Q5. How many numeric columns are in this dataset?

13

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

```
fullyVacNAtotal <- sum(is.na(vax$persons_fully_vaccinated))
fullyVacNAtotal
```

```
[1] 16525
```

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

```r
fullyVacNotNAtotal <- sum(!is.na(vax$persons_fully_vaccinated))
round(fullyVacNAtotal/(fullyVacNAtotal+fullyVacNotNAtotal) * 100, digits=1)
```

```
[1] 8.3
```

```r
# You can also use `nrow(vax)` to get total rows
```

### Working with dates

The lubridate package makes working with dates and times in R much less of a pain.Let's have a first play with this package here.

```r
library(lubridate)
```

```
Attaching package: 'lubridate'

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

    date, intersect, setdiff, union
```

```r
today()
```

```
[1] "2023-03-07"
```

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

Now we can magically do math with dates

```r
today() - ymd("2021-01-05")
```

```
Time difference of 791 days
```

How old am I

```r
today() - ymd("2002-06-07")
```

```
Time difference of 7578 days
```

How many days have passed since the first vaccination reported in this dataset?

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

```
Time difference of 791 days
```

How many days does the dataset span?

```r
vax$as_of_date[nrow(vax)] - vax$as_of_date[1]
```

```
Time difference of 784 days
```

> Q9. How many days ago was the dataset updated?

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

```
Time difference of 7 days
```

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

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

```
[1] 113
```

## Working with ZIP codes

ZIP codes are also rather annoying things to work with as they are numeric but not in the conventional sense of doing math.

Just like dates we have special packages to help us work with ZIP codes.

```r
library(zipcodeR)
```

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

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

Calculate the distance between the centroids of any two ZIP codes in miles, e.g.

```r
zip_distance('92037','92127')
```

```
  zipcode_a zipcode_b distance
1     92037     92127    15.56
```

More usefully, we can pull census data about ZIP code areas (including median household income etc.). For example:

```r
reverse_zipcode(c('92037', "92127") )
```

```
# A tibble: 2 x 24
  zipcode zipcode_~1 major~2 post_~3 common_c~4 county state   lat   lng timez~5
  <chr>   <chr>      <chr>   <chr>       <blob> <chr>  <chr> <dbl> <dbl> <chr>
1 92037   Standard   La Jol~ La Jol~ <raw 20 B> San D~ CA     32.8 -117. Pacific
2 92127   Standard   San Di~ San Di~ <raw 21 B> San D~ CA     33.0 -117. Pacific
# ... with 14 more variables: 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>, and abbreviated variable names
#   1: zipcode_type, 2: major_city, 3: post_office_city, ...
```

## Focus on the San Diego area

Let's now focus in on the San Diego County area by restricting ourselves first to vax$county == "San Diego" entries. We have two main choices on how to do this. The first using base R the second using the dplyr package:

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

```
[1] 12091
```

It is time to revisit the most awesome **dplyr** package.

```r
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
```

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

nrow(sd)
```

```
[1] 12091
```

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

nrow(sd.10)
```

```
[1] 8588
```

How many ZIP code areas are we dealing with?

```r
n_distinct(sd.10$zip_code_tabulation_area)
```

```
[1] 76
```

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

```r
n_distinct(sd$zip_code_tabulation_area)
```

```
[1] 107
```

Q12. What San Diego County Zip code area has the largest 12 + Population in this dataset?

```r
ind <- which.max(sd$age12_plus_population)
sd$zip_code_tabulation_area[ind]
```

```
[1] 92154
```

```r
reverse_zipcode("92154")
```

```
# A tibble: 1 x 24
  zipcode zipcode_~1 major~2 post_~3 common_c~4 county state   lat   lng timez~5
  <chr>   <chr>      <chr>   <chr>       <blob> <chr>  <chr> <dbl> <dbl> <chr>
1 92154   Standard   San Di~ San Di~ <raw 21 B> San D~ CA     32.6  -117 Pacific
# ... with 14 more variables: 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>, and abbreviated variable names
#   1: zipcode_type, 2: major_city, 3: post_office_city, ...
```

Q13. What is the overall average "Percent of Population Fully Vaccinated" value for all San Diego "County" as of THE MOST RECENT DATE -"2022-11-15"-?

```r
vax$as_of_date[nrow(vax)]
```

```
[1] "2023-02-28"
```

```
# Base R method
mean(na.omit(sd$percent_of_population_fully_vaccinated[sd$as_of_date == "2023-02-28"]))*10
```

```
[1] 74.00878
```

```
## sd$as_of_date
sd.today <- filter(sd, as_of_date == "2023-02-28")
sd.today$percent_of_population_fully_vaccinated
```

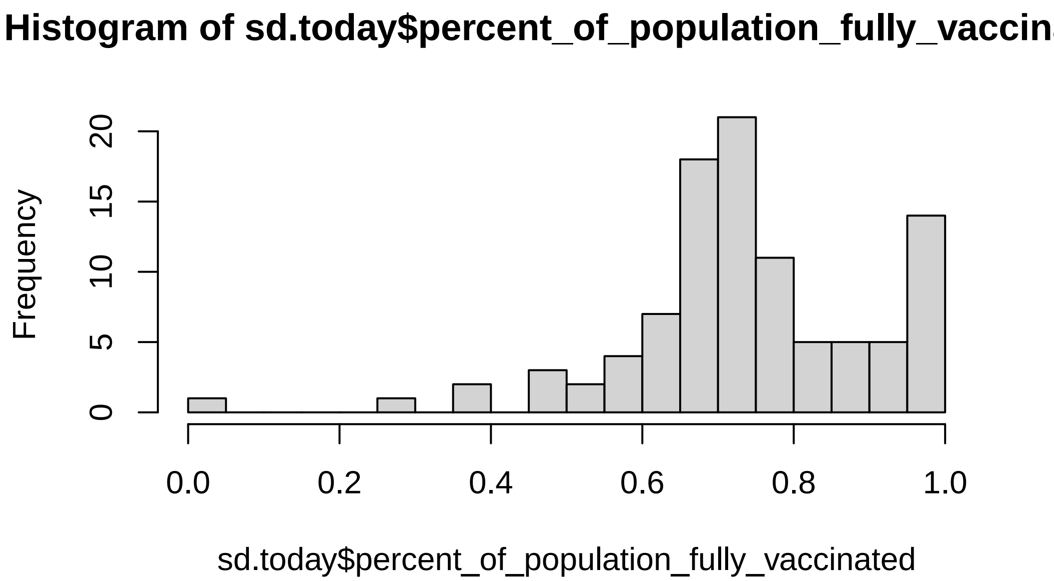
```
  [1] 1.000000 1.000000 1.000000 0.984120 0.726054 0.920272 0.734358 0.700946
  [9] 0.734790 0.638003 0.759673 0.787543 0.663165 1.000000 0.807560 1.000000
 [17] 0.734300 0.736979 0.670901 1.000000 0.737450 0.765885 0.636239 0.651027
 [25] 0.538707 0.711592 0.578497 0.790538 0.672144 0.720655       NA 0.486705
 [33] 0.666286 0.997774 0.491870 0.835292       NA 1.000000 0.929570 0.712216
 [41] 0.971820 0.851489 0.264069 0.797235 0.630450 0.801880       NA 0.769643
 [49] 0.885968 0.008840 0.675936 0.380369 0.759775 0.557065 0.989647 0.821669
 [57] 0.532749       NA 0.698135 0.684678 0.761721       NA 0.740617       NA
 [65]       NA       NA 0.694732 0.796063 0.825653 0.747976 0.690588 0.907481
 [73] 0.643372 0.884224 0.669047 0.930439 0.560752 0.682451 0.668887 0.685905
 [81] 0.728650 1.000000 0.867612 0.647183 0.763726 0.669399 0.625292 0.712209
 [89] 0.675998 0.968281 0.694572 0.899551 0.715753 0.738527 0.740673 0.776934
 [97] 0.550296 0.602507 0.717638 0.358891 1.000000 0.716221 0.936865 0.735863
[105] 0.492547 0.695887 0.745186
```

```
mean(sd.today$percent_of_population_fully_vaccinated, na.rm=T)
```

```
[1] 0.7400878
```

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 THE MOST RECENT DATE “2023-02-28”?

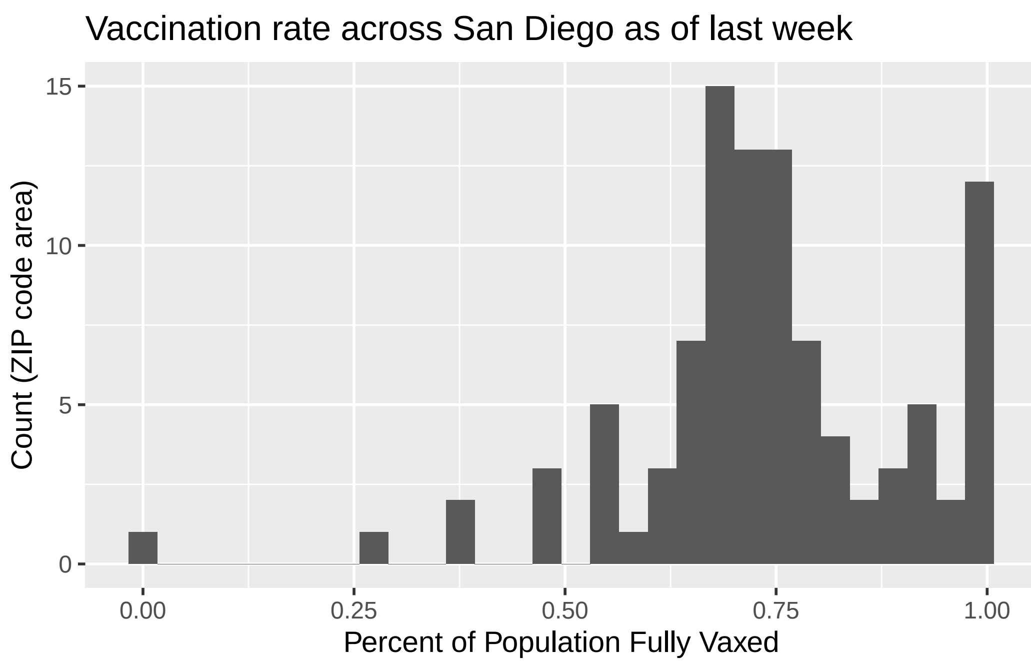
```
# Using base R graphics
hist(sd.today$percent_of_population_fully_vaccinated, breaks=20)
```




```r
library(ggplot2)

ggplot(sd.today) +
  aes(percent_of_population_fully_vaccinated) +
  geom_histogram() +
  labs(title="Vaccination rate across San Diego as of last week",
       x="Percent of Population Fully Vaxed",
       y="Count (ZIP code area)")
```

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

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



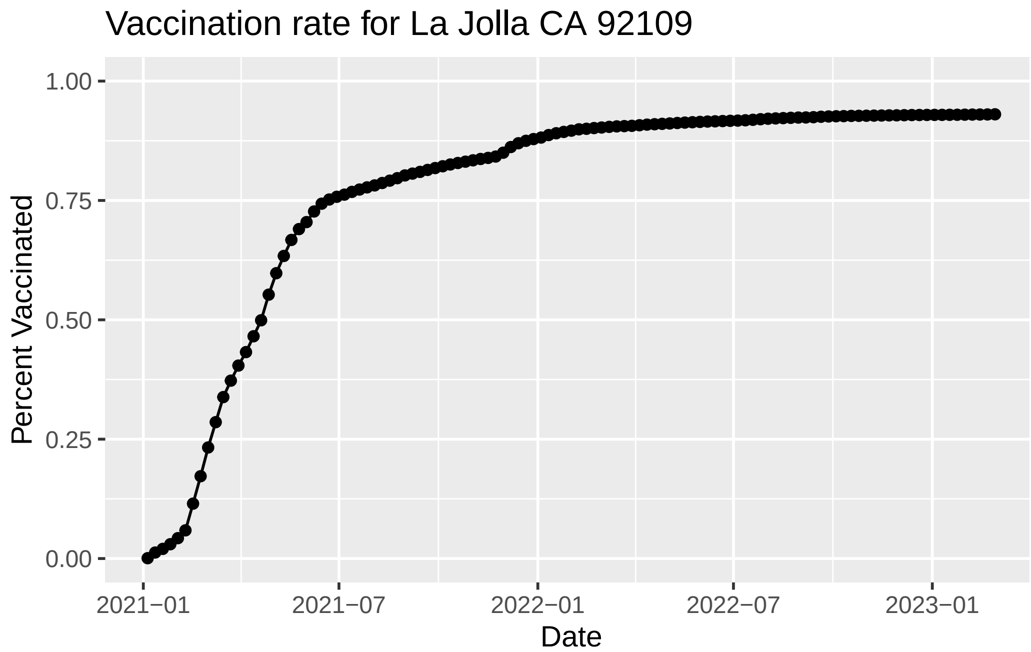

## Focus on UCSD/La Jolla

```
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:

```
ucplot <- ggplot(ucsd) +
  aes(x=as_of_date,
      y=percent_of_population_fully_vaccinated) +
  geom_point() +
  geom_line(group=1) +
  ylim(c(0,1)) +
  labs(title="Vaccination rate for La Jolla CA 92109", x= "Date", y="Percent Vaccinated")
ucplot
```




## Comparing to similar sized areas

Look across every zip code area with a population at least as large as that of 92037 on `as_of_date"2023-02-28"`

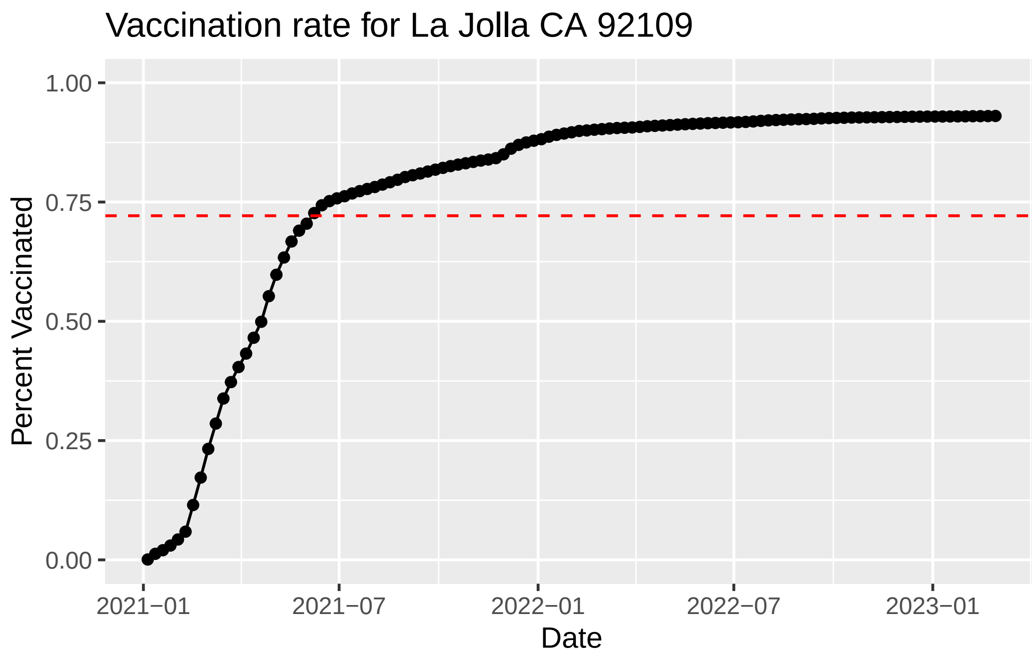
```
# Subset to all CA areas with a population as large as 92037
vax.36 <- filter(vax, age5_plus_population > 36144 &
                as_of_date == "2023-02-28")

#head(vax.36)
```

> 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 "2023-02-28". Add this as a straight horizontal line to your plot from above with the geom_hline() function?

```
ave <- mean(vax.36$percent_of_population_fully_vaccinated)
ave
```

```
[1] 0.7213331
```

```
ucplot + geom_hline(yintercept = ave, color = "red", linetype=2)
```




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 "2023-02-28"?

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

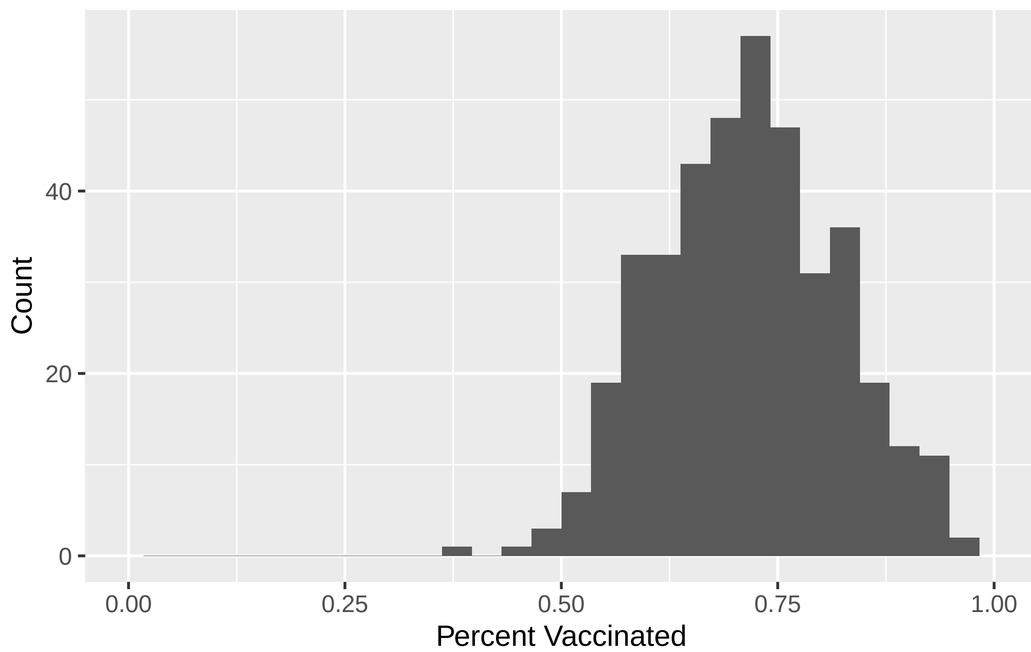
```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
 0.3804  0.6457  0.7181  0.7213  0.7907  1.0000 
```

Q18. Using ggplot generate a histogram of this data.

```
ggplot(vax.36) +
  aes(percent_of_population_fully_vaccinated) +
  geom_histogram() +
  xlim(0,1) +
  labs(x="Percent Vaccinated", y="Count")
```

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

```
Warning: Removed 2 rows containing missing values (`geom_bar()`).
```




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 == "2023-02-28") %>%
  #filter(zip_code_tabulation_area=="92109") %>%
  #select(percent_of_population_fully_vaccinated)

#vax %>% filter(as_of_date == "2023-02-28") %>%
  #filter(zip_code_tabulation_area=="92040") %>%
  #select(percent_of_population_fully_vaccinated)

x <- filter(vax.36, zip_code_tabulation_area %in% c("92109", "92040"))
x$percent_of_population_fully_vaccinated
```

```
[1] 0.694572 0.550296
```

The ZIP code areas are below the average value.

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

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


ggplot(vax.36.all) +
  aes(as_of_date,
      percent_of_population_fully_vaccinated,
      group=zip_code_tabulation_area) +
  geom_line(alpha=0.2, color="blue") +
  ylim(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 = ave, linetype=2)
```

```
Warning: Removed 6549 rows containing missing values (`geom_line()`).
```