Mini-Project: COVID-19 Vaccination Rates

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Getting Started

Import and examine the vaccination data.

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

```
##   as_of_date zip_code_tabulation_area local_health_jurisdiction         county
## 1 2021-01-05                   92549                 Riverside      Riverside
## 2 2021-01-05                   92130                 San Diego      San Diego
## 3 2021-01-05                   92397           San Bernardino San Bernardino
## 4 2021-01-05                   94563             Contra Costa   Contra Costa
## 5 2021-01-05                   94519             Contra Costa   Contra Costa
## 6 2021-01-05                   91042              Los Angeles    Los Angeles
##   vaccine_equity_metric_quartile                vem_source
## 1                              3 Healthy Places Index Score
## 2                              4 Healthy Places Index Score
## 3                              3 Healthy Places Index Score
## 4                              4 Healthy Places Index Score
## 5                              3 Healthy Places Index Score
## 6                              2 Healthy Places Index Score
##   age12_plus_population age5_plus_population persons_fully_vaccinated
## 1                2348.4                 2461                       NA
## 2               46300.3                53102                       61
## 3                3695.6                 4225                       NA
## 4               17216.1                18896                       NA
## 5               16861.2                18678                       NA
## 6               23962.2                25741                       NA
##   persons_partially_vaccinated percent_of_population_fully_vaccinated
## 1                           NA                                     NA
## 2                           27                                0.001149
## 3                           NA                                     NA
## 4                           NA                                     NA
## 5                           NA                                     NA
## 6                           NA                                     NA
##   percent_of_population_partially_vaccinated
## 1                                         NA
## 2                                   0.000508
## 3                                         NA
## 4                                         NA
## 5                                         NA
```

```
## 6                                         NA
##   percent_of_population_with_1_plus_dose booster_recip_count
## 1                                     NA                  NA
## 2                                0.001657                 NA
## 3                                     NA                  NA
## 4                                     NA                  NA
## 5                                     NA                  NA
## 6                                     NA                  NA
##                                                                 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?

The column is called "persons_fully_vaccinated".

Q2. What column details the Zip code tabulation area?

The column is "zip_code_tabulation_area".

Q3. What is the earliest date in this dataset?

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

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

The earliest date is "2021-01-05".

Q4. What is the latest date in this dataset?

```
vax$as_of_date[length(vax$as_of_date)]
```

```
## [1] "2022-03-01"
```

The latest date is "2022-03-01".

Use the skim() function to get an overview of the data.

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

Table 1: Data summary

Name	vax
Number of rows	107604
Number of columns	15
Column type frequency:	
character	5
numeric	10

Table 1: Data summary

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	61	0
local_health_jurisdiction	0	1	0	15	305	62	0
county	0	1	0	15	305	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	1817.39	90001	92257.75	93658.50	95380.50	97635.0	
vaccine_equity_metric_quartile	307	0.95	2.44	1.11	1	1.00	2.00	3.00	4.0	
age12_plus_population	0	1.00	18895.04	8993.91	0	13468.50	18685.50	23756.25	58556.7	
age5_plus_population	0	1.00	20875.24	9106.02	0	14605.50	15364.00	24877.00	101902.0	
persons_fully_vaccinated	18338	0.83	12155.61	13063.88	11	1066.25	7374.50	20005.00	77744.0	
persons_partially_vaccinated	18338	0.83	831.74	1348.68	11	76.00	372.00	1076.00	34219.0	
percent_of_population_fully_vaccinated	18338	0.83	0.51	0.26	0	0.33	0.54	0.70	1.0	
percent_of_population_partially_vaccinated	18338	0.83	0.05	0.09	0	0.01	0.03	0.05	1.0	
percent_of_population_with_1_plus_dose	18338	0.83	0.54	0.28	0	0.36	0.58	0.75	1.0	
booster_recip_count	64317	0.40	4100.55	5900.21	11	176.00	1136.00	6154.50	50602.0	

Q5. How many numeric columns are in this dataset?

There are 9 numeric columns.

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] 18338
```

There are 18338 NA values for "persons_fully_vaccinated".

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

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

```
## [1] 0.1704212
```

About 17.04% of the values in "persons_fully_vaccinated" are missing.

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

Missing values may be due to no records being collected from a given county.

Working with Dates

The lubridate package let's us use date data in a useful manner. Convert dates into lubridate formate and perform math operations with it!

```
library(lubridate)
today()
```

```
## [1] "2022-03-07"
```

```
#specify the year-month-day format when converting
vax$as_of_date <- ymd(vax$as_of_date)
```

```
#how many days have passed since the first vaccination?
today() - vax$as_of_date[1]
```

```
## Time difference of 426 days
```

```
#how many days does the dataset span?
vax$as_of_date[nrow(vax)] - vax$as_of_date[1]
```

```
## Time difference of 420 days
```

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

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

```
## Time difference of 6 days
```

5 days have passed since the last update of the dataset.

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

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

```
## [1] 61
```

There are 61 different dates in the dataset.

Working with ZIP Codes

In R, we can use the zipcodeR package to make working with ZIP codes - a postal code used by the United States Postal Service (USPS) - easier.

```
library(zipcodeR)

#calculate the distance between the centroids of two zip codes in miles
zip_distance('92037','92109')
```

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

```
#pull census data for zip code areas
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
## # ... with 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>
```

Focus on the San Diego Area

Use the dplyr package to restrict the data to only the San Diego area.

```
library(dplyr)

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

```
## [1] 6527
```

The dplyr package can also be useful when trying to subset with multiple criteria. For example:

```
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
```

There are 107 unique zip codes for the San Diego County.

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

```
sd$zip_code_tabulation_area[which.max(sd$age12_plus_population)]
```

```
## [1] 92154
```

The '92154' zip code area has the largest 12+ population.

Select all San Diego "county" entries on "as_of_date" "2022-02-22" and use this for the following questions.

```
sd.feb <- filter(vax, county == "San Diego" & as_of_date == "2022-02-22")
```

Q13. What is the overall average "Percent of Population Fully Vaccinated" value for all San Diego "County" as of "2022-02-22"?

```
mean(sd.feb$percent_of_population_fully_vaccinated, na.rm = TRUE)
```

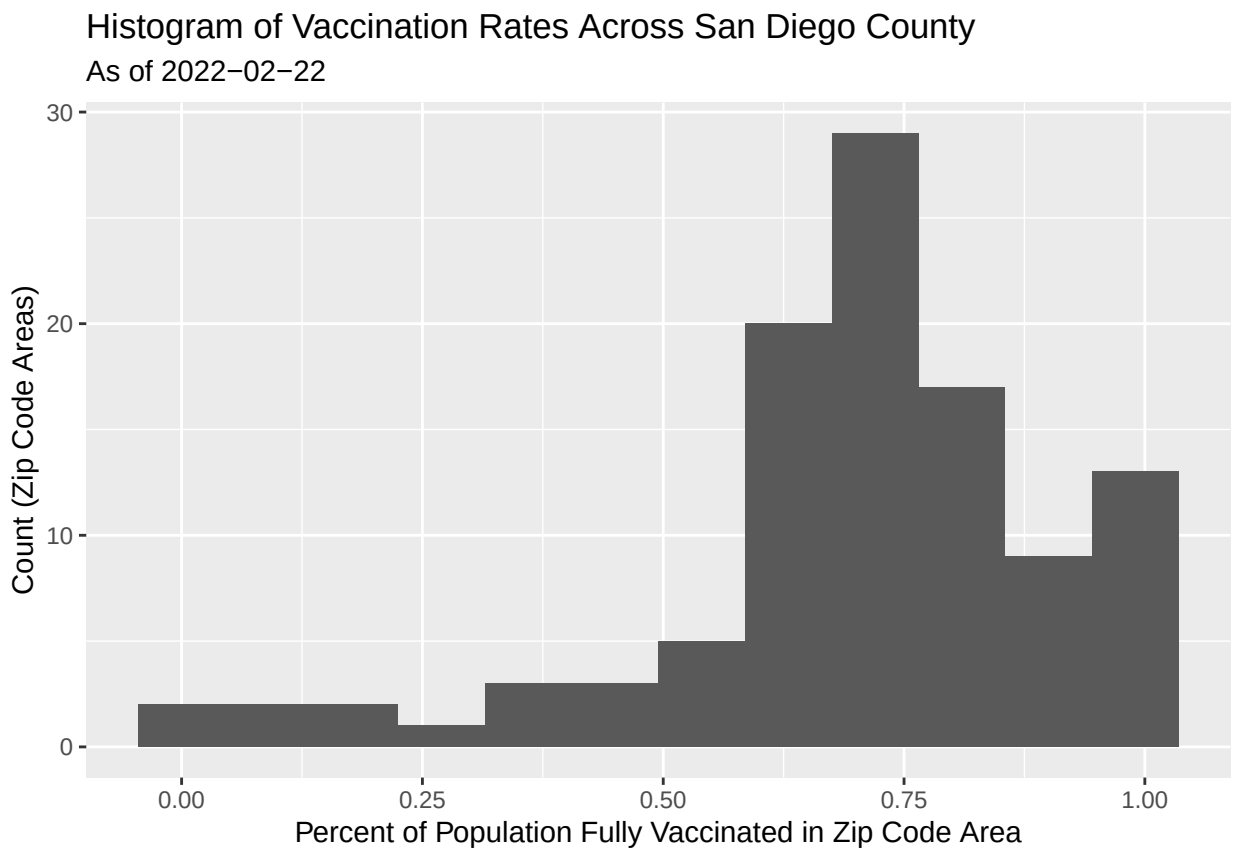
```
## [1] 0.7041551
```

The average percent of population fully vaccinated in the San Diego County as of 2022-02-22 is 70.42%.

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 "2022-02-22"?

```
library(ggplot2)

ggplot(sd.feb) +
  aes(x = percent_of_population_fully_vaccinated) +
  geom_histogram(bins = 12) +
  labs(title = "Histogram of Vaccination Rates Across San Diego County",
       subtitle = "As of 2022-02-22",
       x = "Percent of Population Fully Vaccinated in Zip Code Area",
       y = "Count (Zip Code Areas)")
```



Focus on UCSD/La Jolla

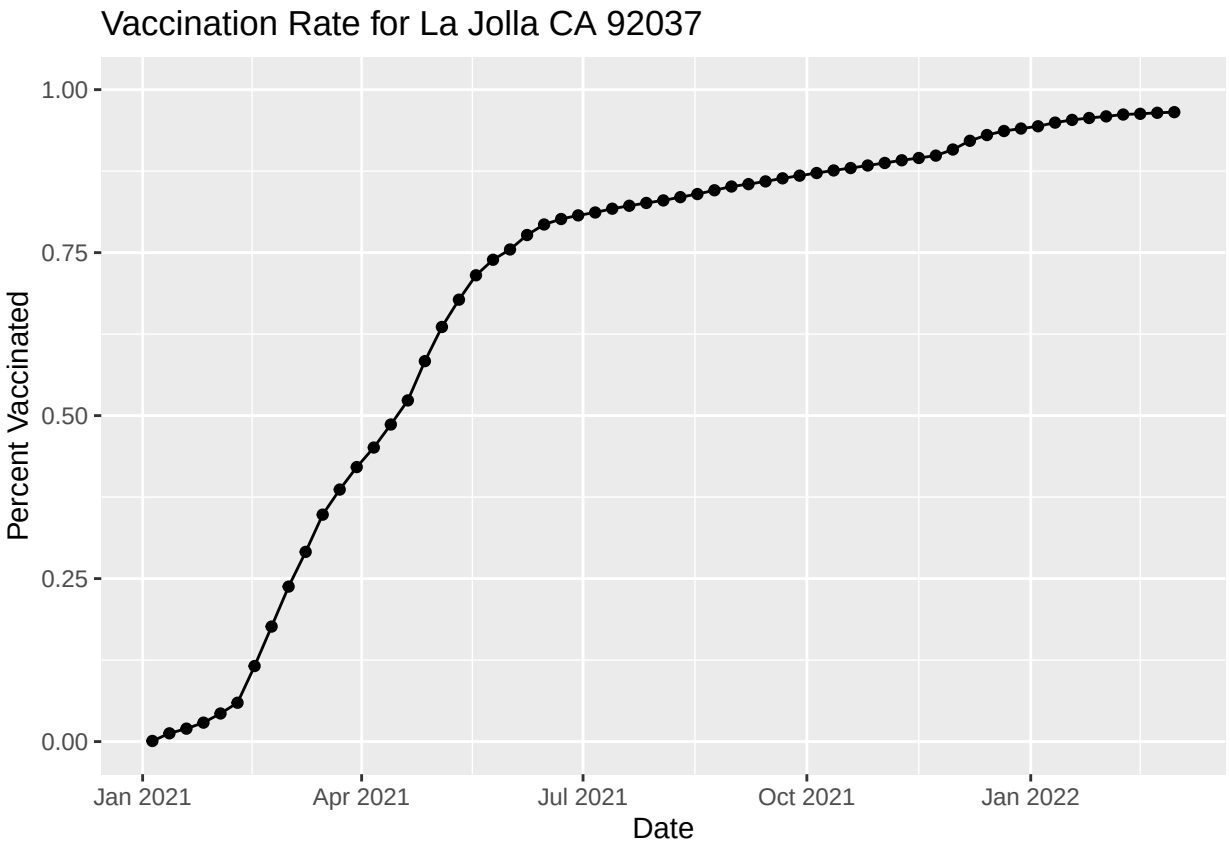
UC San Diego resides in the 92037 ZIP code area and is listed with an age 5+ population size of 36,144. Use this information to subset the data and check that it's done correctly.

```
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.

```
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 92037",
       x = "Date", y = "Percent Vaccinated")
```



Comparing to Similar Size Areas

Look across every zip code area with a population at least as large as that of 92037 on as_of_date "2022-02-22".

```
vax.36 <- filter(vax, age5_plus_population > 36144 & as_of_date == "2022-02-22")

head(vax.36)
```

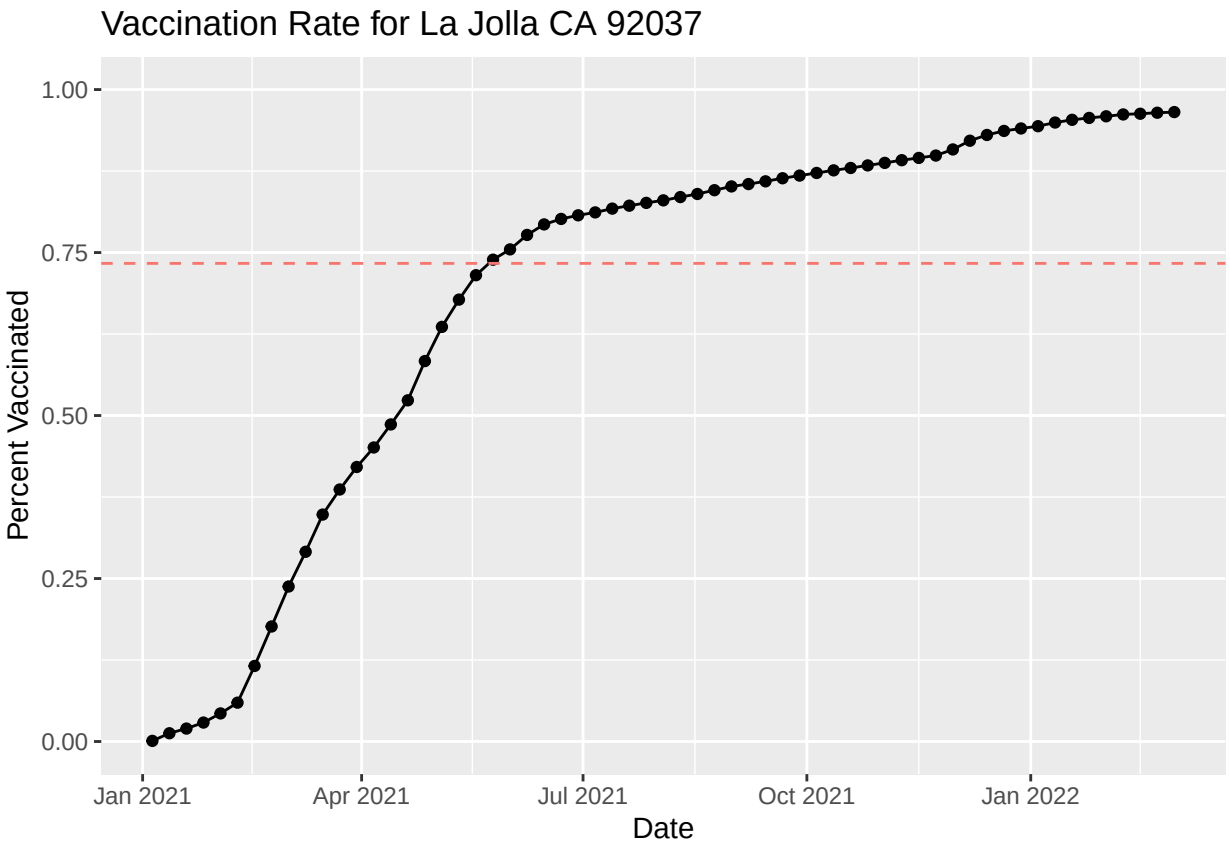
```
##   as_of_date zip_code_tabulation_area local_health_jurisdiction      county
## 1 2022-02-22                   92840                    Orange      Orange
## 2 2022-02-22                   92064                 San Diego   San Diego
## 3 2022-02-22                   92508                 Riverside   Riverside
## 4 2022-02-22                   95403                    Sonoma      Sonoma
## 5 2022-02-22                   90001               Los Angeles Los Angeles
## 6 2022-02-22                   92802                    Orange      Orange
##   vaccine_equity_metric_quartile               vem_source
## 1                              2 Healthy Places Index Score
## 2                              4 Healthy Places Index Score
## 3                              3 Healthy Places Index Score
## 4                              3 Healthy Places Index Score
## 5                              1 Healthy Places Index Score
## 6                              2 Healthy Places Index Score
##   age12_plus_population age5_plus_population persons_fully_vaccinated
## 1               47302.5                51902                    40725
## 2               42177.1                46855                    34266
## 3               32415.3                36303                    21925
## 4               38545.9                42294                    33158
## 5               47175.7                54805                    43075
## 6               35113.6                39393                    29268
##   persons_partially_vaccinated percent_of_population_fully_vaccinated
## 1                         4324                                0.784652
## 2                         6861                                0.731320
## 3                         1714                                0.603945
## 4                         2833                                0.783988
## 5                        13917                                0.785968
## 6                         6138                                0.742975
##   percent_of_population_partially_vaccinated
## 1                                   0.083311
## 2                                   0.146430
## 3                                   0.047214
## 4                                   0.066983
## 5                                   0.253937
## 6                                   0.155814
##   percent_of_population_with_1_plus_dose booster_recip_count redacted
## 1                               0.867963               20654       No
## 2                               0.877750               15499       No
## 3                               0.651159               10753       No
## 4                               0.850971               18659       No
## 5                               1.000000               13408       No
## 6                               0.898789               12816       No
```

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 "2022-02-22". Add this as a straight horizontal line to your plot from above with the geom_hline() function?

```
avg.per <- mean(vax.36$percent_of_population_fully_vaccinated, na.rm = TRUE)
avg.per
```

```
## [1] 0.733385
```

```
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 92037",
       x = "Date", y = "Percent Vaccinated") +
  geom_hline(aes(yintercept = avg.per, color = "red"),
             linetype = "dashed", show.legend = FALSE)
```



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 "2022-02-22"?

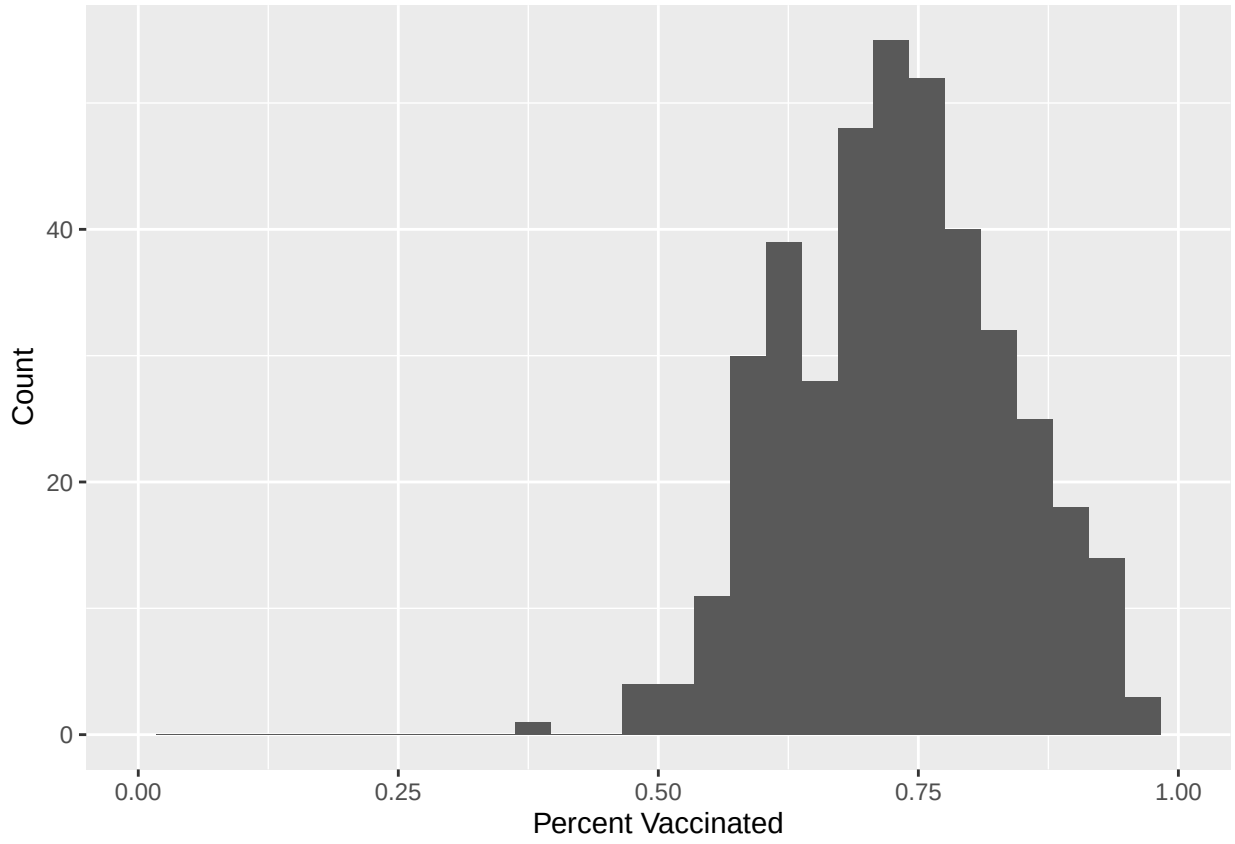
```
summary(vax.36$percent_of_population_fully_vaccinated)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.3881  0.6539  0.7333  0.7334  0.8027  1.0000
```

Q18. Using ggplot generate a histogram of this data.

```
ggplot(vax.36) +
  aes(x = percent_of_population_fully_vaccinated) +
  geom_histogram(bins = 30) +
  labs(x = "Percent Vaccinated", y = "Count") +
  xlim(c(0, 1))
```

```
## 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?

```
#92109
vax %>% filter(as_of_date == "2022-02-22") %>%
  filter(zip_code_tabulation_area=="92109") %>%
  select(percent_of_population_fully_vaccinated)
```

```
##   percent_of_population_fully_vaccinated
## 1                               0.723044
```

```
#92040
vax %>% filter(as_of_date == "2022-02-22") %>%
  filter(zip_code_tabulation_area == "92040") %>%
  select(percent_of_population_fully_vaccinated)
```

```
##   percent_of_population_fully_vaccinated
## 1                               0.551304
```

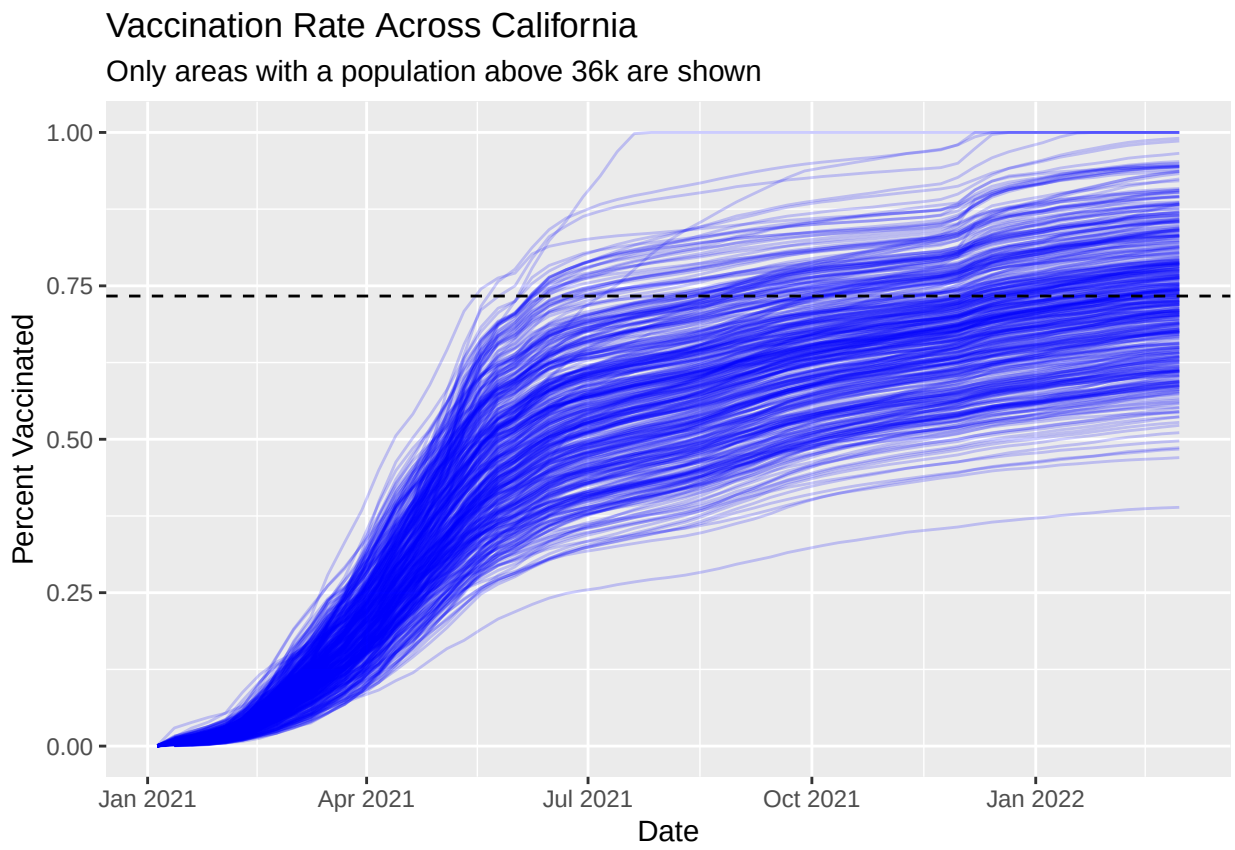
Both zip code areas are below the average value calculated.

Q20. Finally make a time course plot of vaccination progress for all areas in the full dataset with 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 = "blue") +
  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 = avg.per, linetype = "dashed")
```

```
## Warning: Removed 311 row(s) containing missing values (geom_path).
```



Q21. How do you feel about traveling for Spring Break and meeting for in-person class afterwards?

I would not feel comfortable traveling for break considering that nearly half of the largely populated areas don't have a great majority of their population vaccinated. This would make having in-person classes after break riskier since we can't guarantee that each location everyone traveled to was safe.