Class 17: Mini Project

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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

```
# Import 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                   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?

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

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

```
head(sort(vax$as_of_date, decreasing=FALSE))
```

```
[1] "2021-01-05" "2021-01-05" "2021-01-05" "2021-01-05" "2021-01-05"
[6] "2021-01-05"
```

2021-01-05

Q4. What is the latest date in this dataset?

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

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

```
head(sort(vax$as_of_date, decreasing=TRUE))
```

```
[1] "2023-02-28" "2023-02-28" "2023-02-28" "2023-02-28" "2023-02-28"
[6] "2023-02-28"
```

2023-02-28

We can use the skim() function fro a quick overview of a new data set like this

```
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	13685.13	31756.12	88556.7	
age5_plus_population	0	1.00	20875.22	21105.97	0	1460.50	15364.00	34877.00	101902.0	
tot_population	9718	0.95	23372.72	22628.51	12	2126.00	18714.00	38168.00	111165.0	
persons_fully_vaccinated	16525	0.92	13962.38	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?

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

```
 FALSE   TRUE
182807  16525
```

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

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

```
[1] 16525
```

```
round((n.missing/nrow(vax))*100,2)
```

```
[1] 8.29
```

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

Some zipcodes are not available (e.x. military) that are not recorded, so there are a few missing NAs

Working with dates

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

```
library(lubridate)
```

```
Attaching package: 'lubridate'

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

    date, intersect, setdiff, union
```

```
today()
```

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

We can now magically do math with dates

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

```
Time difference of 791 days
```

How old am I

```
today()-ymd("2001-02-06")
```

```
Time difference of 8064 days
```

Let's treat the whole column as a date format

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

Q. How many days does the data set span.

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

```
Time difference of 784 days
```

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

```
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)?

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

```
[1] 113
```

```
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
```

```
n_distinct(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 with ZIP codes.

```
library(zipcodeR)
```

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

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

```
geocode_zip('92691')
```

```
# A tibble: 1 x 3
  zipcode   lat   lng
  <chr>   <dbl> <dbl>
1 92691    33.6 -118.
```

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

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

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

```
reverse_zipcode(c('92037', "92691") )
```

```
# 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 92691   Standard   Missio~ Missio~ <raw 48 B> Orang~ CA     33.6 -118. 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:

```
# 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 **dyplr** package.

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

nrow(sd)
```

```
[1] 12091
```

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

```
[1] 8588
```

Q. How many distinct zip codes are listed with population > 10,000

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

```
[1] 76
```

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

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

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?

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

```
[1] 92154
```

```
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 "2022-11-15"?

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

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

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

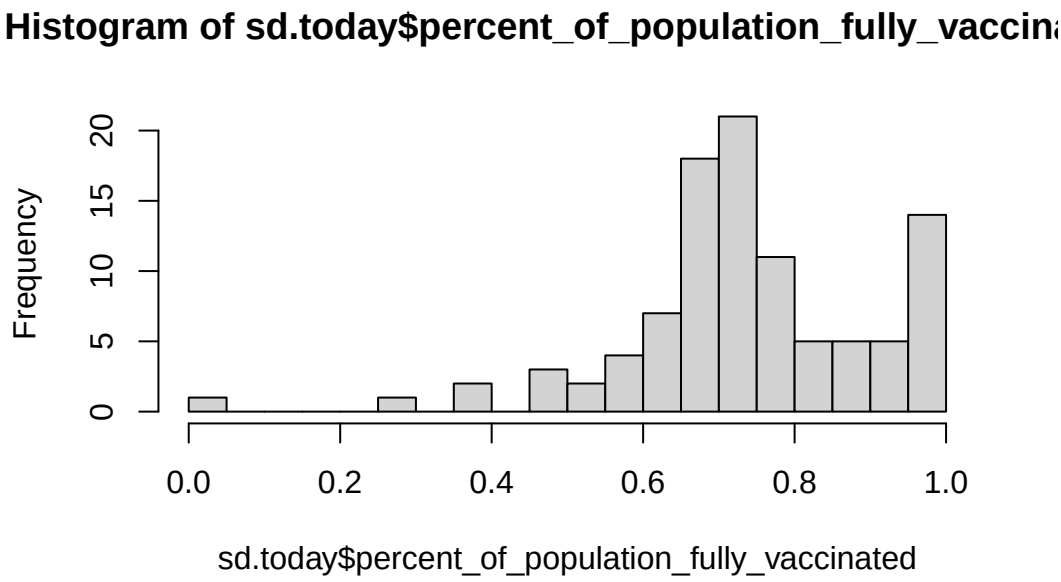
```
  [1] 1.000000 1.000000 1.000000 0.984120 0.726054 0.920272 0.734358 0.700946
  [9] 0.734790 0.638003 0.759673 0.787543 0.663165 1.000000 0.807560 1.000000
 [17] 0.734300 0.736979 0.670901 1.000000 0.737450 0.765885 0.636239 0.651027
 [25] 0.538707 0.711592 0.578497 0.790538 0.672144 0.720655       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
```

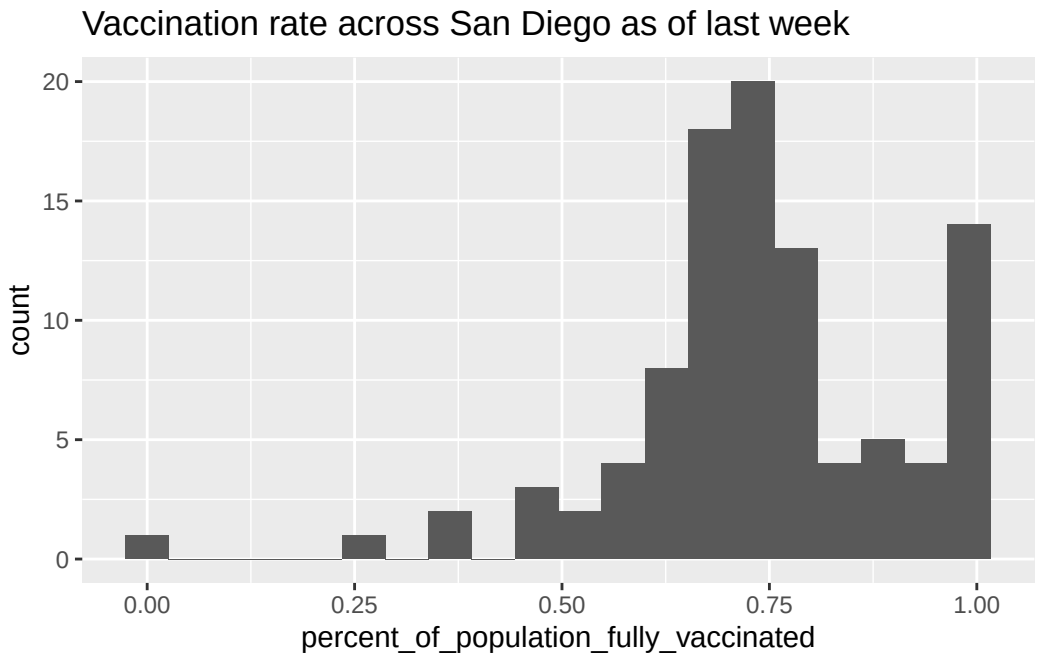
Q14. Using either ggplot or base R graphics make a summary figure that shows the distribution of Percent of Population Fully Vaccinated values as of "2022-11-15"?

```
hist(sd.today$percent_of_population_fully_vaccinated, breaks=20)
```




```
library(ggplot2)

ggplot(sd.today) +
  aes(percent_of_population_fully_vaccinated) +
  geom_histogram(bins=20) +
  labs(title="Vaccination rate across San Diego as of last week",
       xlab= "Percent of Population Fully Vaxxed",
       ylab="Count (ZIP code area)")
```

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



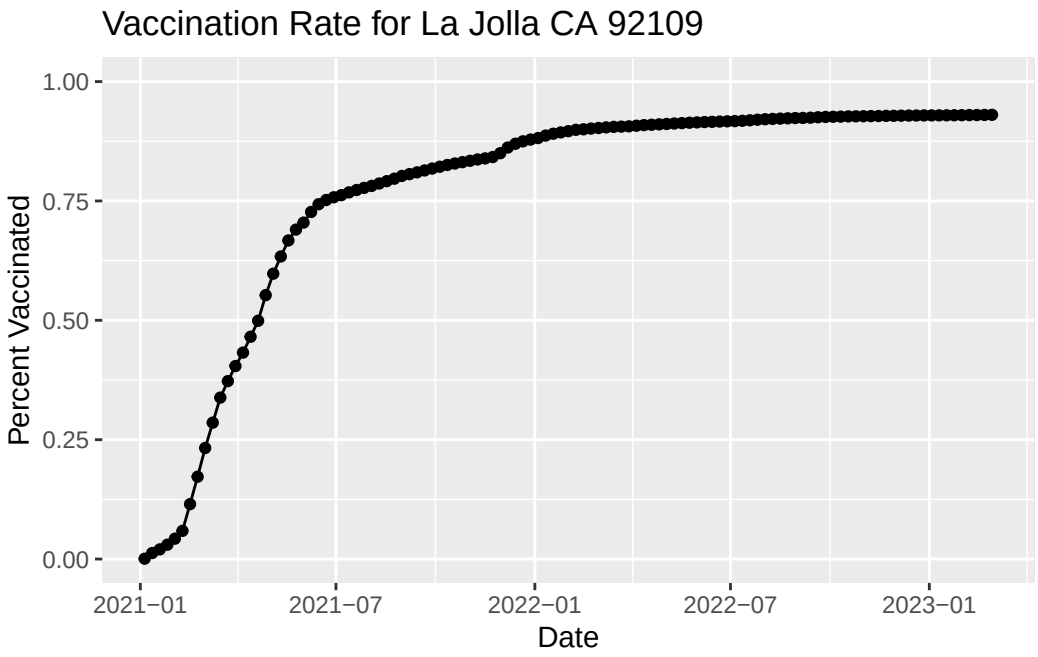
Focus on UCSD/ La Jolla

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

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

```
[1] 36144
```

```
ucplot <- ggplot(ucsd) +
  aes(as_of_date,
      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

Let's return to the full dataset and look across every zip code area with a population at least as large as that of 92037 on as_of_date "2022-02-22".

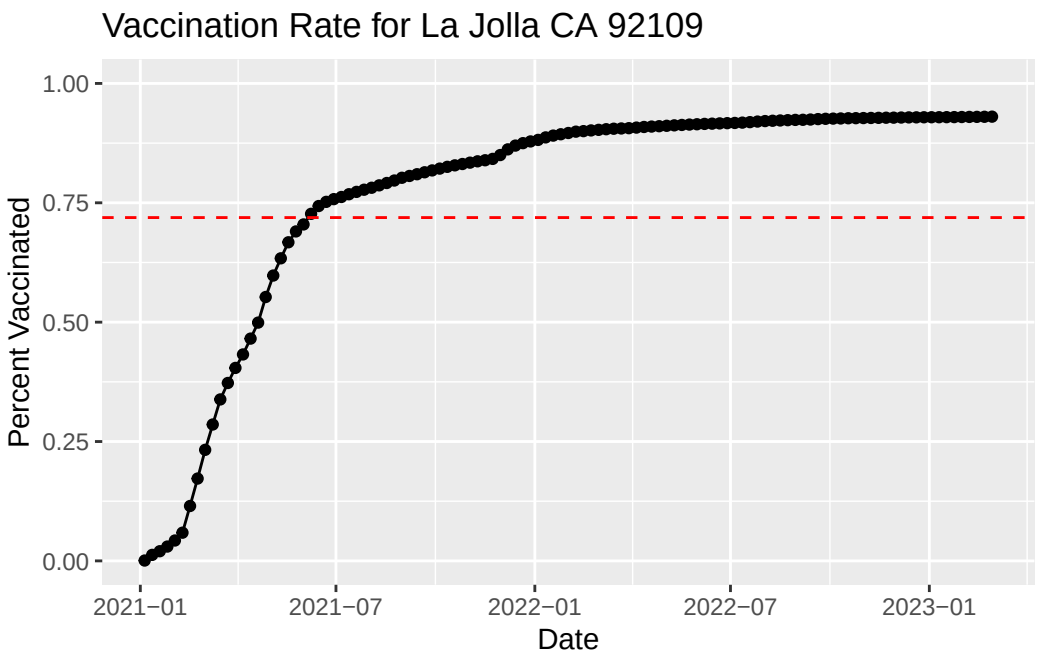
```
# Subset to all CA areas with a population as large as 92037
vax.36 <- filter(vax, age5_plus_population > 36144 &
                 as_of_date == "2022-11-15")

#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 "2022-11-15". 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] 0.7190515
```

```
ucplot + geom_hline(yintercept=ave,col="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 "2022-11-15"?

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

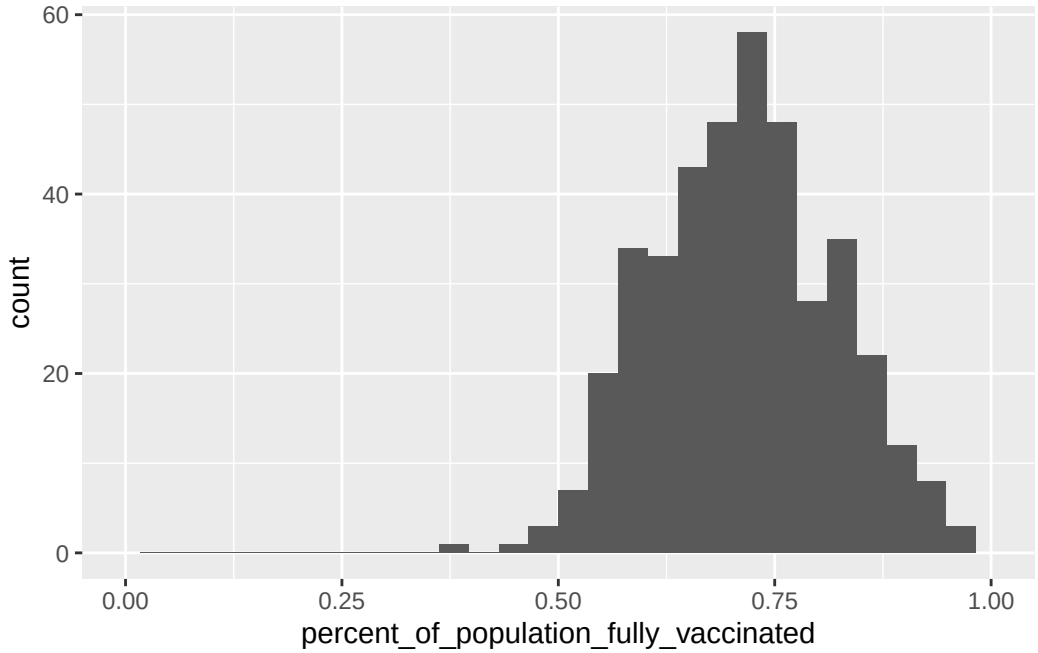
```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
 0.3784  0.6444  0.7162  0.7191  0.7882  1.0000 
```

Q18. Using ggplot generate a histogram of this data.

```
ggplot(vax.36)+
  aes(percent_of_population_fully_vaccinated) +
  geom_histogram() +
  xlim(0,1)
```

```
`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 == "2022-11-15") %>%
  filter(zip_code_tabulation_area=="92040") %>%
  select(percent_of_population_fully_vaccinated)
```

```
  percent_of_population_fully_vaccinated
1                               0.548849
```

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

```
[1] 0.548849 0.692874
```

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(as_of_date,
      percent_of_population_fully_vaccinated,
      group=zip_code_tabulation_area) +
  geom_line(alpha=0.2, color="red") +
  ylim(0,1) +
  labs(x="Date", y="Percent Vaccination",
       title="Vaccination Rate Across CA",
       subtitle="Only areas with a population above 36k are shown") +
  geom_hline(yintercept = 0.7213, linetype=2)
```

```
Warning: Removed 183 rows containing missing values (`geom_line()`).
```