Class 17: Covid-19 Vaccination Rates

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Background

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

```
# Import vaccination data
vax <- read.csv("covid19.csv")
head(vax)
```

```
##   as_of_date zip_code_tabulation_area local_health_jurisdiction    county
## 1 2021-01-05                    92804                    Orange    Orange
## 2 2021-01-05                    92626                    Orange    Orange
## 3 2021-01-05                    92250                  Imperial  Imperial
## 4 2021-01-05                    92637                    Orange    Orange
## 5 2021-01-05                    92155                 San Diego San Diego
## 6 2021-01-05                    92259                  Imperial  Imperial
##   vaccine_equity_metric_quartile                 vem_source
## 1                              2 Healthy Places Index Score
## 2                              3 Healthy Places Index Score
## 3                              1 Healthy Places Index Score
## 4                              3 Healthy Places Index Score
## 5                             NA            No VEM Assigned
## 6                              1    CDPH-Derived ZCTA Score
##   age12_plus_population age5_plus_population persons_fully_vaccinated
## 1               76455.9                84200                       19
## 2               44238.8                47883                       NA
## 3                7098.5                 8026                       NA
## 4               16027.4                16053                       NA
## 5                 456.0                  456                       NA
## 6                 119.0                  121                       NA
##   persons_partially_vaccinated percent_of_population_fully_vaccinated
## 1                         1282                               0.000226
## 2                           NA                                     NA
## 3                           NA                                     NA
## 4                           NA                                     NA
## 5                           NA                                     NA
## 6                           NA                                     NA
##   percent_of_population_partially_vaccinated
## 1                                   0.015226
## 2                                         NA
## 3                                         NA
## 4                                         NA
## 5                                         NA
## 6                                         NA
##   percent_of_population_with_1_plus_dose
## 1                               0.015452
## 2                                     NA
## 3                                     NA
## 4                                     NA
## 5                                     NA
## 6                                     NA
##                                                                 redacted
## 1                                                                     No
## 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
```

Ensure the data column is useful

We will use the **lubridate** package to make life a lot easier when dealing with dates and times

```
library(lubridate)
```

```
##
## Attaching package: 'lubridate'
```

```
## The following objects are masked from 'package:base':
##
##     date, intersect, setdiff, union
```

```
today()
```

```
## [1] "2021-11-23"
```

Here we make our 'as_of_date' column lubridate format…

```
#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 322 days
```

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

```
colnames(vax)
```

```
##  [1] "as_of_date"
##  [2] "zip_code_tabulation_area"
##  [3] "local_health_jurisdiction"
##  [4] "county"
##  [5] "vaccine_equity_metric_quartile"
##  [6] "vem_source"
##  [7] "age12_plus_population"
##  [8] "age5_plus_population"
##  [9] "persons_fully_vaccinated"
## [10] "persons_partially_vaccinated"
## [11] "percent_of_population_fully_vaccinated"
## [12] "percent_of_population_partially_vaccinated"
## [13] "percent_of_population_with_1_plus_dose"
## [14] "redacted"
```

column 9

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

column 2

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

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

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

earliest is 01/05/2021

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

```
nrow(vax)
```

```
## [1] 81144
```

```
vax$as_of_date[81144]
```

```
## [1] "2021-11-16"
```

lastest is 11/16/2021

Skimr

As done previously, call skim() function from skimr package to get quick overview of data.

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

Table 1: Data summary

Name	vax
Number of rows	81144
Number of columns	14
Column type frequency:	
character	4
Date	1
numeric	9
Group variables	None

Variable type: character

skim_variable	n_missing	complete_rate	min	max	empty	n_unique	whitespace
local_health_jurisdiction	0	1	0	15	230	62	0
county	0	1	0	15	230	59	0
vem_source	0	1	15	26	0	3	0
redacted	0	1	2	69	0	2	0

Variable type: Date

skim_variable	n_missing	complete_rate	min	max	median	n_unique
as_of_date	0	1	2021-01-05	2021-11-16	2021-06-11	46

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	4002	0.95	2.44	1.11	1	1.00	2.00	3.00	4.0	
age12_plus_population	0	1.00	18895.04	18993.94	0	1346.95	13685.10	31756.12	88556.7	
age5_plus_population	0	1.00	20875.24	21106.05	0	1460.50	15364.00	34877.00	101902.0	
persons_fully_vaccinated	8256	0.90	9456.49	11498.25	11	506.00	4105.00	15859.00	71078.0	
persons_partially_vaccinated	8256	0.90	1900.61	2113.07	11	200.00	1271.00	2893.00	20185.0	
percent_of_population_fully_vaccinated	8256	0.90	0.42	0.27	0	0.19	0.44	0.62	1.0	
percent_of_population_partially_vaccinated	8256	0.90	0.10	0.10	0	0.06	0.07	0.11	1.0	
percent_of_population_with_1_plus_dose	8256	0.90	0.50	0.26	0	0.30	0.53	0.70	1.0	

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 are there in the persons_fully_vaccinated columns?

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

```
## [1] 8256
```

There are 8256 missing values

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

```
signif((sum(is.na(vax$persons_fully_vaccinated)))/nrow(vax), 2)
```

```
## [1] 0.1
```

> Q8. Why might this data be missing?

The data could be redacted for privacy

> Q9. How many days since the first entry and the last entry?

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

```
## Time difference of 315 days
```

```
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] 46
```

This sounds good

```
46 * 7
```

```
## [1] 322
```

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.
```

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

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

```
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>
```

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

Focus on SD county

```
table(vax$county)
```

```
## 
##                         Alameda          Alpine          Amador           Butte 
##             230            2254              46             552             828 
##       Calaveras          Colusa    Contra Costa       Del Norte       El Dorado 
##             828             322            1978             184            1012 
##          Fresno           Glenn        Humboldt        Imperial            Inyo 
##            2530             276            1610             690             460 
##            Kern           Kings            Lake          Lassen     Los Angeles 
##            2254             322             644             598           13340 
##          Madera           Marin        Mariposa       Mendocino          Merced 
##             552            1288             368            1196             874 
##           Modoc            Mono        Monterey            Napa          Nevada 
##             506             322            1288             460             552 
##          Orange          Placer          Plumas       Riverside      Sacramento 
##            4048            1334             736            3220            2484 
##      San Benito  San Bernardino       San Diego   San Francisco     San Joaquin 
##             184            4094            4922            1242            1472 
## San Luis Obispo       San Mateo   Santa Barbara     Santa Clara      Santa Cruz 
##            1012            1334            1058            2668             782 
##          Shasta          Sierra        Siskiyou          Solano          Sonoma 
##            1196             322             966             690            1656 
##      Stanislaus          Sutter          Tehama         Trinity          Tulare 
##            1104             414             598             598            1518
##        Tuolumne         Ventura            Yolo            Yuba
##             598            1242             782             506
```

We will subset with base R

```
inds <- vax$county == "San Diego"

head(vax[inds, ])
```

```
##    as_of_date zip_code_tabulation_area local_health_jurisdiction    county
## 5  2021-01-05                    92155                 San Diego San Diego
## 14 2021-01-05                    92147                 San Diego San Diego
## 16 2021-01-05                    92124                 San Diego San Diego
## 24 2021-01-05                    92145                 San Diego San Diego
## 34 2021-01-05                    91935                 San Diego San Diego
## 36 2021-01-05                    92102                 San Diego San Diego
##    vaccine_equity_metric_quartile                 vem_source
## 5                              NA            No VEM Assigned
## 14                             NA            No VEM Assigned
## 16                              3 Healthy Places Index Score
## 24                             NA            No VEM Assigned
## 34                              3 Healthy Places Index Score
## 36                              1 Healthy Places Index Score
##    age12_plus_population age5_plus_population persons_fully_vaccinated
## 5                  456.0                  456                       NA
## 14                 518.0                  518                       NA
## 16               25422.4                29040                       29
## 24                1603.5                 1821                       NA
## 34                7390.0                 8101                       NA
## 36               37042.3                41033                       29
##    persons_partially_vaccinated percent_of_population_fully_vaccinated
## 5                            NA                                     NA
## 14                           NA                                     NA
## 16                          573                               0.000999
## 24                           NA                                     NA
## 34                           NA                                     NA
## 36                         1495                               0.000707
##    percent_of_population_partially_vaccinated
## 5                                          NA
## 14                                         NA
## 16                                   0.019731
## 24                                         NA
## 34                                         NA
## 36                                   0.036434
##    percent_of_population_with_1_plus_dose
## 5                                      NA
## 14                                     NA
## 16                               0.020730
## 24                                     NA
## 34                                     NA
## 36                               0.037141
##                                                                  redacted
## 5  Information redacted in accordance with CA state privacy requirements
## 14 Information redacted in accordance with CA state privacy requirements
## 16                                                                    No
## 24 Information redacted in accordance with CA state privacy requirements
## 34 Information redacted in accordance with CA state privacy requirements
## 36                                                                    No
```

```
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] 4922
```

```
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
```

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

```
which.max(sd$age12_plus_population)
```

```
## [1] 23
```

```
sd[23, ]
```

```
##    as_of_date zip_code_tabulation_area local_health_jurisdiction    county
## 23 2021-01-05                    92154                 San Diego San Diego
##    vaccine_equity_metric_quartile                 vem_source
## 23                              2 Healthy Places Index Score
##    age12_plus_population age5_plus_population persons_fully_vaccinated
## 23               76365.2                82971                       32
##    persons_partially_vaccinated percent_of_population_fully_vaccinated
## 23                         1336                                0.000386
##    percent_of_population_partially_vaccinated
## 23                                    0.016102
##    percent_of_population_with_1_plus_dose redacted
## 23                               0.016488       No
```

```r
#or

inds <- which.max(sd$age12_plus_population)
sd[inds,]
```

```
##    as_of_date zip_code_tabulation_area local_health_jurisdiction    county
## 23 2021-01-05                    92154                 San Diego San Diego
##    vaccine_equity_metric_quartile                 vem_source
## 23                              2 Healthy Places Index Score
##    age12_plus_population age5_plus_population persons_fully_vaccinated
## 23               76365.2                82971                       32
##    persons_partially_vaccinated percent_of_population_fully_vaccinated
## 23                         1336                                0.000386
##    percent_of_population_partially_vaccinated
## 23                                    0.016102
##    percent_of_population_with_1_plus_dose redacted
## 23                               0.016488       No
```

92154

What is the population in the 92037 ZIP code area?

```r
filter(sd, zip_code_tabulation_area == 92037)[1, ]
```

```
##   as_of_date zip_code_tabulation_area local_health_jurisdiction    county
## 1 2021-01-05                    92037                 San Diego San Diego
##   vaccine_equity_metric_quartile                 vem_source
## 1                              4 Healthy Places Index Score
##   age12_plus_population age5_plus_population persons_fully_vaccinated
## 1               33675.6                36144                       44
##   persons_partially_vaccinated percent_of_population_fully_vaccinated
## 1                         1265                                0.001217
##   percent_of_population_partially_vaccinated
## 1                                    0.034999
##   percent_of_population_with_1_plus_dose redacted
## 1                               0.036216       No
```

> Q13. What is the overall average "Percent of Population Fully Vaccinated" value for all San Diego "County" as of "2021-11-09"?

```r
sd.now <- filter(vax, county == "San Diego", as_of_date == "2021-11-09")

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

```
## [1] 0.6727567
```

We can look at the 6-number summary

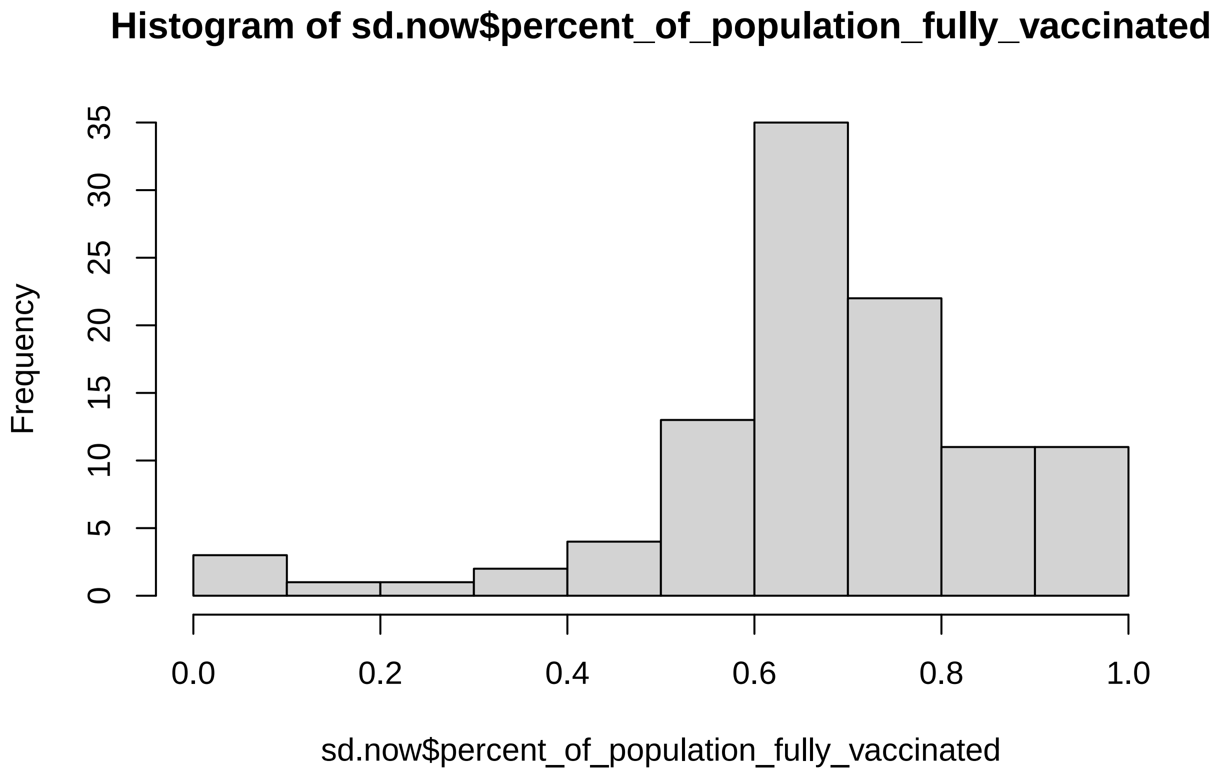
```
summary(sd.now$percent_of_population_fully_vaccinated)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's 
## 0.01017 0.60776 0.67700 0.67276 0.76164 1.00000       4 
```

> 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 "2021-11-09"?

Using base R plot

```
hist(sd.now$percent_of_population_fully_vaccinated)
```

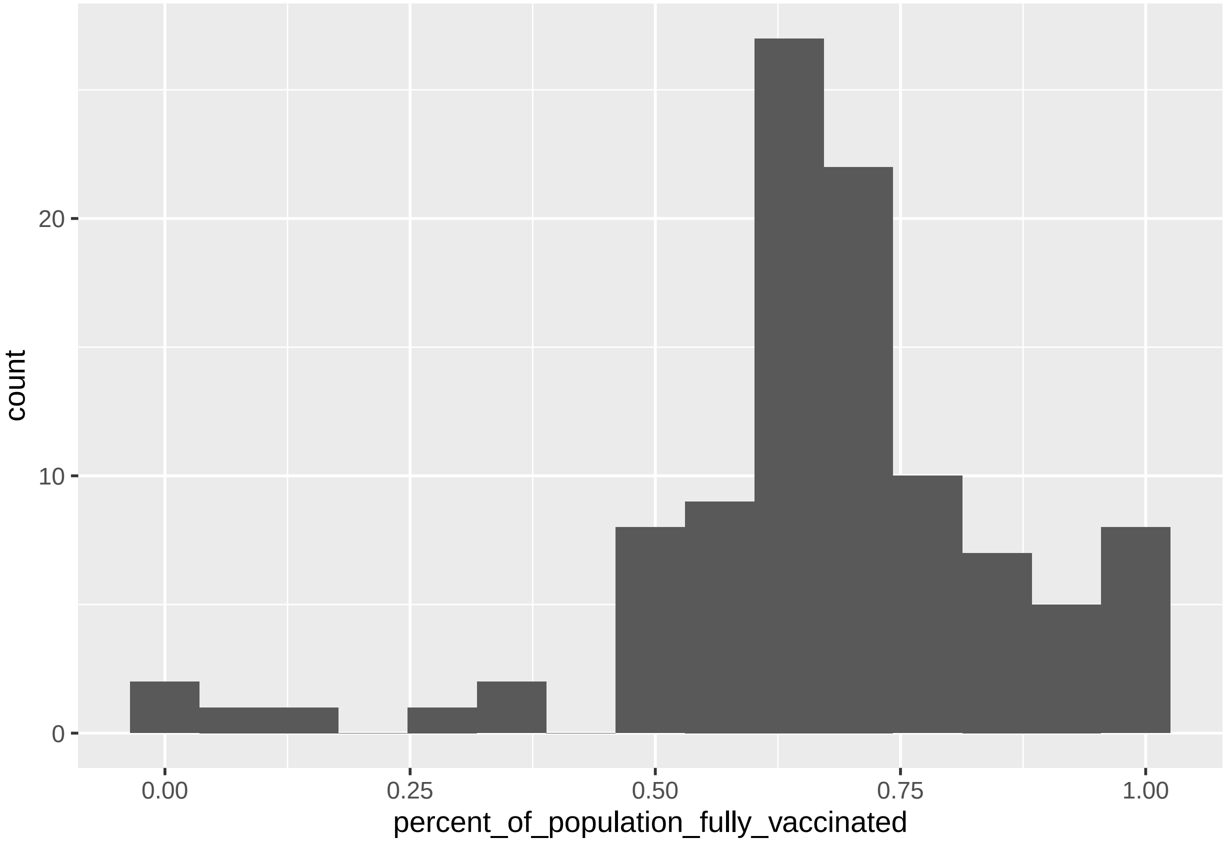


Using ggplot

```
library(ggplot2)
```

```
ggplot(sd.now) + aes(percent_of_population_fully_vaccinated) + geom_histogram(bins = 15)
```

```
## Warning: Removed 4 rows containing non-finite values (stat_bin).
```



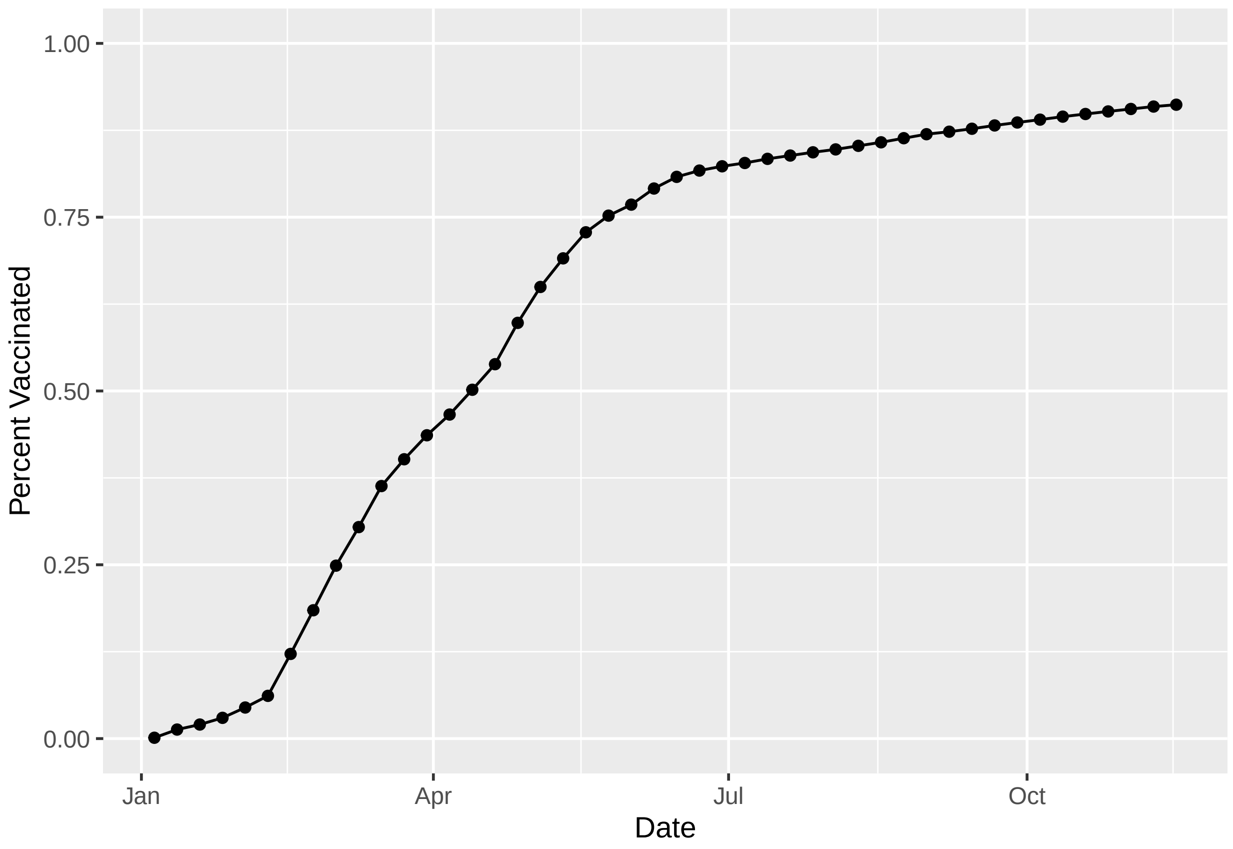
What about 92037 - UCSD/La Jolla?

```
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:

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



Comparing 92037 to other similar sized areas?

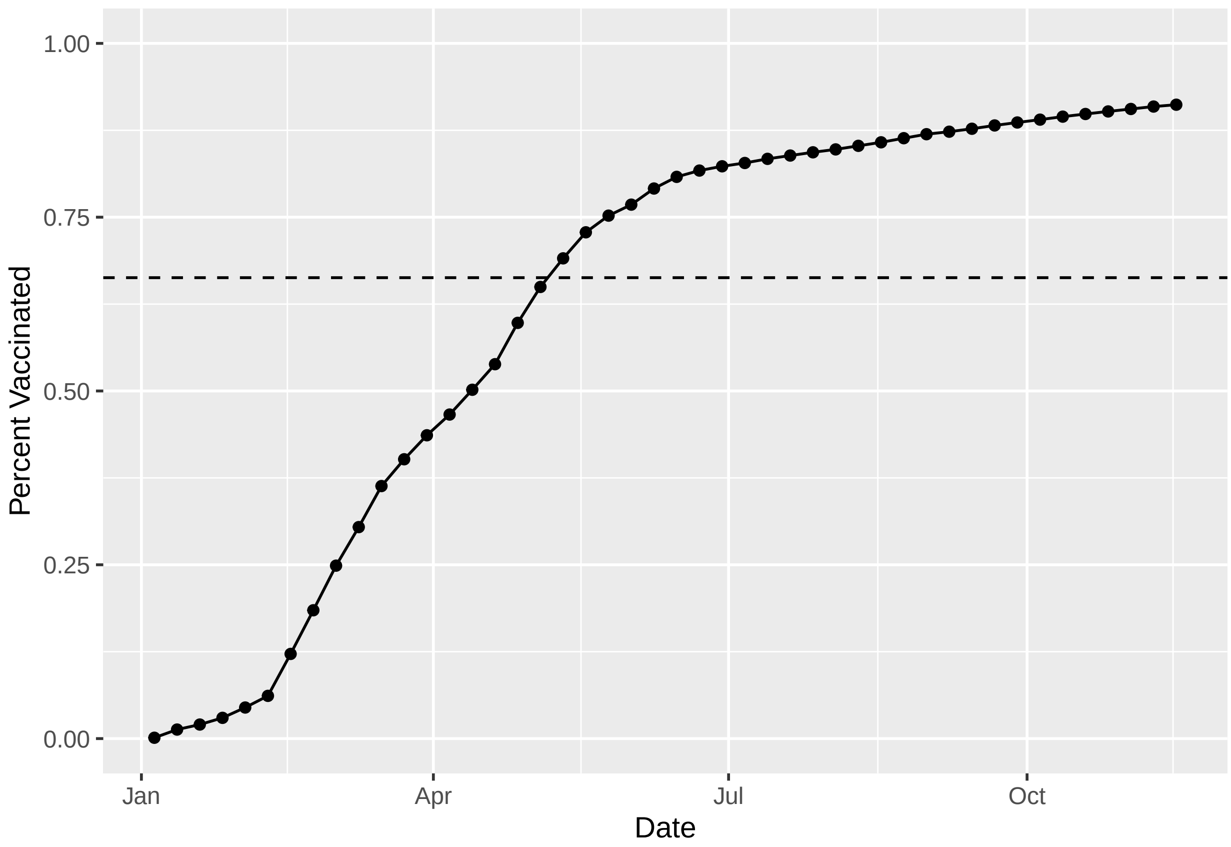
```
#Subset to all CA areas with a population as large as 92037
vax.36 <- filter(vax, age5_plus_population > 36144 &
                as_of_date == "2021-11-16")
head(vax.36)
```

```
##   as_of_date zip_code_tabulation_area local_health_jurisdiction         county
## 1 2021-11-16                    92833                    Orange         Orange
## 2 2021-11-16                    92234                 Riverside      Riverside
## 3 2021-11-16                    92507                 Riverside      Riverside
## 4 2021-11-16                    92555                 Riverside      Riverside
## 5 2021-11-16                    92345            San Bernardino San Bernardino
## 6 2021-11-16                    91306               Los Angeles    Los Angeles
##   vaccine_equity_metric_quartile                 vem_source
## 1                              3 Healthy Places Index Score
## 2                              1 Healthy Places Index Score
## 3                              1 Healthy Places Index Score
## 4                              2 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               43985.4                48623                    34668
## 2               46401.1                51202                    34191
## 3               51432.5                55253                    31704
## 4               36725.7                41446                    23776
## 5               66047.5                75539                    35332
## 6               42671.1                46573                    31858
##   persons_partially_vaccinated percent_of_population_fully_vaccinated
## 1                         3377                               0.712996
## 2                         3966                               0.667767
## 3                         3434                               0.573797
## 4                         2424                               0.573662
## 5                         4428                               0.467732
## 6                         3372                               0.684044
##   percent_of_population_partially_vaccinated
## 1                                   0.069453
## 2                                   0.077458
## 3                                   0.062150
## 4                                   0.058486
## 5                                   0.058619
## 6                                   0.072402
##   percent_of_population_with_1_plus_dose redacted
## 1                               0.782449       No
## 2                               0.745225       No
## 3                               0.635947       No
## 4                               0.632148       No
## 5                               0.526351       No
## 6                               0.756446       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 "2021-11-16". Add this as a striaght horizontal line to your plot from above with the geom_hline() function

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

```
p <- ggplot(ucsd) +
  aes(as_of_date, percent_of_population_fully_vaccinated) +
  geom_point() +
  geom_line(group=1) +
  ylim(c(0,1)) +
  labs(x = "Date", y="Percent Vaccinated")
p + geom_hline(yintercept = int, linetype = "dashed")
```



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 "2021-11-16"?

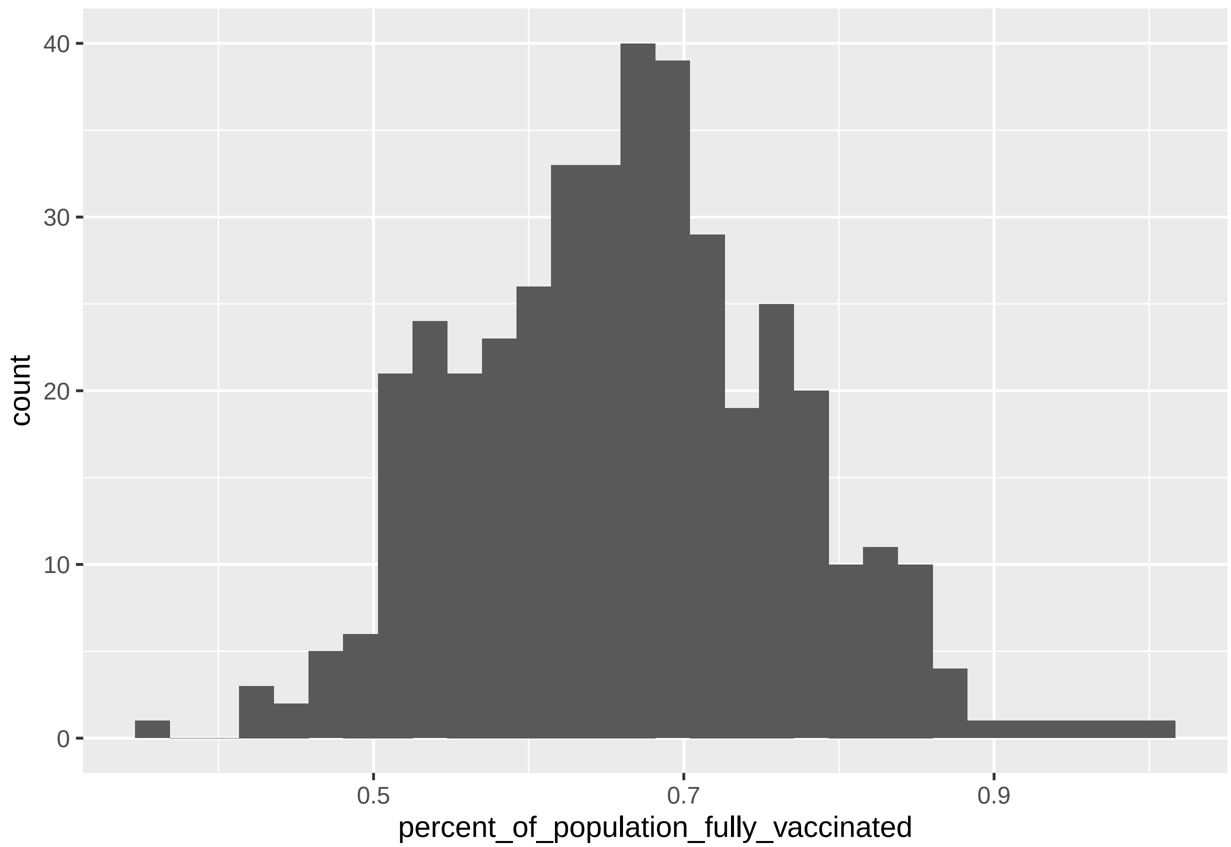
```
summary(vax.36$percent_of_population_fully_vaccinated)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
##  0.3519  0.5891  0.6649  0.6630  0.7286  1.0000
```

Q18. Using ggplot generate a histogram of this data.

```
ggplot(vax.36) + aes(percent_of_population_fully_vaccinated) + geom_histogram()
```

```
## `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 == "2021-11-16") %>%
  filter(zip_code_tabulation_area=="92040") %>%
  select(percent_of_population_fully_vaccinated)
```

```
##   percent_of_population_fully_vaccinated
## 1                               0.520463
```

92040 is below average

```
vax %>% filter(as_of_date == "2021-11-16") %>%
  filter(zip_code_tabulation_area=="92109") %>%
  select(percent_of_population_fully_vaccinated)
```

```
##   percent_of_population_fully_vaccinated
## 1                               0.687763
```

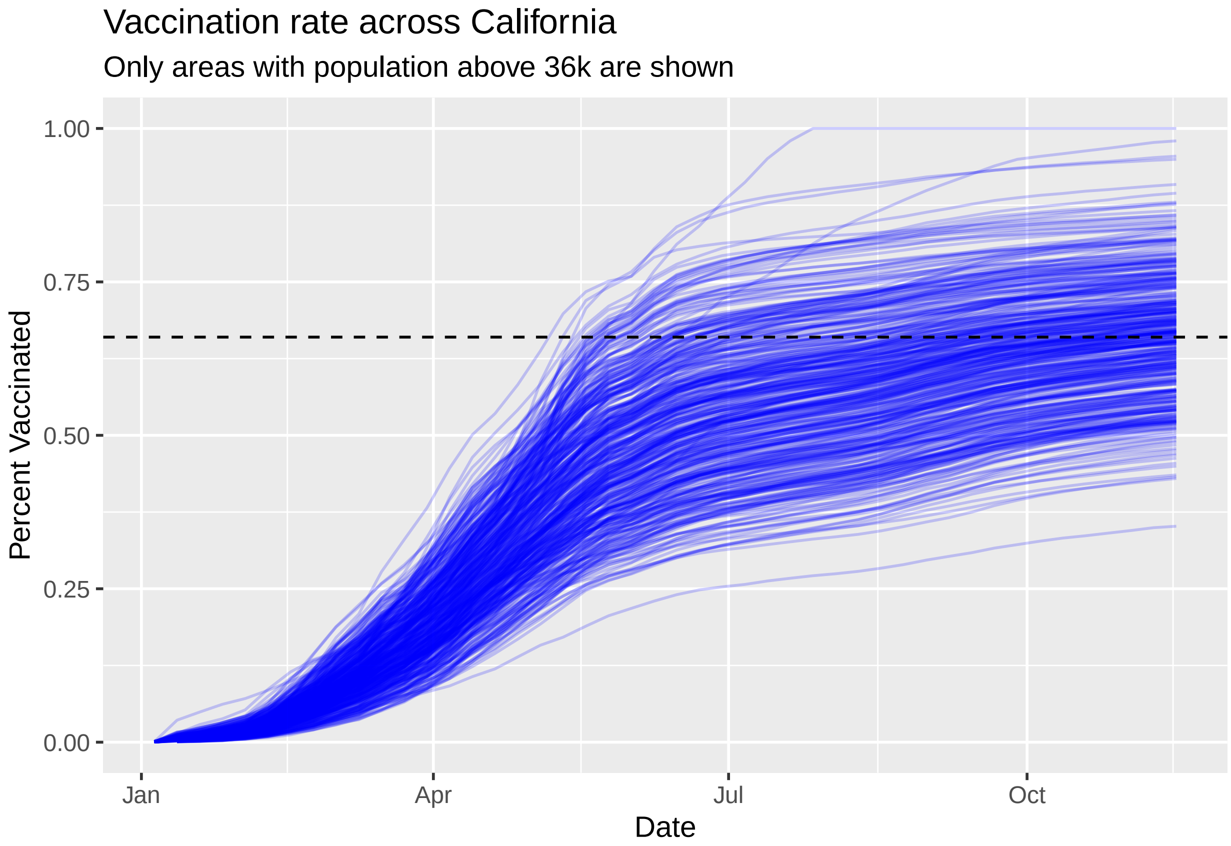
92109 is above average

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="blue") +
  labs(x= "Date", y= "Percent Vaccinated",
       title = "Vaccination rate across California",
       subtitle = "Only areas with population above 36k are shown") +
  geom_hline(yintercept = 0.66, linetype = "dashed")
```

```
## Warning: Removed 180 row(s) containing missing values (geom_path).
```



Q21. How do you feel about traveling for Thanksgiving and meeting for in-person class next Week?

okay for remote Tuesday and in-person the rest of the week