class17.Rmd

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11/23/2021

##Background

As we approach a period of travel and larger gatherings, lets have a look at vaccination rates across the US. We will take data from the data.ca.gov site under "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.

##Dowload Data

```
# 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                   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 date column is useful

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?

2021-01-05

```
#look at first and last dates in column
#vax$as_of_date
```

Q4. What is the latest date in this dataset?

2021-11-16

```
#install.packages("lubridate")
library(lubridate)
```

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

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

```
today()
```

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

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

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

Now I can do useful math with dates more easily:

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

```
## Time difference of 322 days
```

How many days since the first entry?

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

```
## Time difference of 7 days
```

Q5. How many numeric columns are in this dataset?

9

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

8256

Q7. What percent of persons_fully_vaccinated values are missing?

10.2% or, 10%

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

under-reporting, non-compliance during data collection, user error

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

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

```
#sum( is.na(vax$persons_fully_vaccinated) )/ sum(vax$persons_fully_vaccinated, na.rm=TRUE)
```

```
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	1002	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_12_plus_dose	8256	0.90	0.50	0.26	0	0.30	0.53	0.70	1.0	

```
1-0.898
```

```
## [1] 0.102
```

How many days does this set span?

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

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

7

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
```

46

This makes sense.

```
46*7
```

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

Working with Zip Codes

```
#install.packages("zipcodeR")
#library(zipcodeR)
```

Focus on San Diego 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
```

But let's use the **dyplr** package and it's **filer()** function:

```
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")

head(sd)
```

```
##   as_of_date zip_code_tabulation_area local_health_jurisdiction    county
## 1 2021-01-05                   92155                San Diego San Diego
## 2 2021-01-05                   92147                San Diego San Diego
## 3 2021-01-05                   92124                San Diego San Diego
## 4 2021-01-05                   92145                San Diego San Diego
## 5 2021-01-05                   91935                San Diego San Diego
## 6 2021-01-05                   92102                San Diego San Diego
##   vaccine_equity_metric_quartile               vem_source
## 1                             NA           No VEM Assigned
## 2                             NA           No VEM Assigned
## 3                              3 Healthy Places Index Score
## 4                             NA           No VEM Assigned
## 5                              3 Healthy Places Index Score
## 6                              1 Healthy Places Index Score
##   age12_plus_population age5_plus_population persons_fully_vaccinated
## 1                 456.0                  456                       NA
## 2                 518.0                  518                       NA
## 3               25422.4                29040                       29
## 4                1603.5                 1821                       NA
## 5                7390.0                 8101                       NA
## 6               37042.3                41033                       29
##   persons_partially_vaccinated percent_of_population_fully_vaccinated
```

```
## 1                            NA                                    NA
## 2                            NA                                    NA
## 3                           573                              0.000999
## 4                            NA                                    NA
## 5                            NA                                    NA
## 6                          1495                              0.000707
##   percent_of_population_partially_vaccinated
## 1                                         NA
## 2                                         NA
## 3                                   0.019731
## 4                                         NA
## 5                                         NA
## 6                                   0.036434
##   percent_of_population_with_1_plus_dose
## 1                                     NA
## 2                                     NA
## 3                               0.020730
## 4                                     NA
## 5                                     NA
## 6                               0.037141
##                                                                  redacted
## 1 Information redacted in accordance with CA state privacy requirements
## 2 Information redacted in accordance with CA state privacy requirements
## 3                                                                     No
## 4 Information redacted in accordance with CA state privacy requirements
## 5 Information redacted in accordance with CA state privacy requirements
## 6                                                                     No
```

How many entries are there for San Diego county?

```
nrow(sd)
```

```
## [1] 4922
```

Using dplyr is often more convenient when we are subsetting across multiple criteria - for example all San Diego county areas with a population of over 10,000.

```
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

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

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

```
##    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?

```
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"?

67.28% average

```
sd.now <- filter(sd, as_of_date=="2021-11-09")

head(sd.now)
```

```
##   as_of_date zip_code_tabulation_area local_health_jurisdiction    county
## 1 2021-11-09                   92075                San Diego San Diego
## 2 2021-11-09                   92130                San Diego San Diego
## 3 2021-11-09                   92060                San Diego San Diego
## 4 2021-11-09                   92091                San Diego San Diego
## 5 2021-11-09                   92020                San Diego San Diego
## 6 2021-11-09                   92004                San Diego San Diego
```

```
##   vaccine_equity_metric_quartile                vem_source
## 1                              4 Healthy Places Index Score
## 2                              4 Healthy Places Index Score
## 3                              3    CDPH-Derived ZCTA Score
## 4                              4    CDPH-Derived ZCTA Score
## 5                              2 Healthy Places Index Score
## 6                              2 Healthy Places Index Score
##   age12_plus_population age5_plus_population persons_fully_vaccinated
## 1               11136.3                12177                      9504
## 2               46300.3                53102                     45517
## 3                 166.0                  166                       153
## 4                1238.3                 1303                      1159
## 5               49284.5                54991                     34904
## 6                2151.8                 2186                      2582
##   persons_partially_vaccinated percent_of_population_fully_vaccinated
## 1                         1623                                0.780488
## 2                         6642                                0.857162
## 3                           34                                0.921687
## 4                          221                                0.889486
## 5                         4688                                0.634722
## 6                          514                                1.000000
##   percent_of_population_partially_vaccinated
## 1                                   0.133284
## 2                                   0.125080
## 3                                   0.204819
## 4                                   0.169609
## 5                                   0.085250
## 6                                   0.235133
##   percent_of_population_with_1_plus_dose redacted
## 1                               0.913772       No
## 2                               0.982242       No
## 3                               1.000000       No
## 4                               1.000000       No
## 5                               0.719972       No
## 6                               1.000000       No
```

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

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

We can look at the 6-number summary

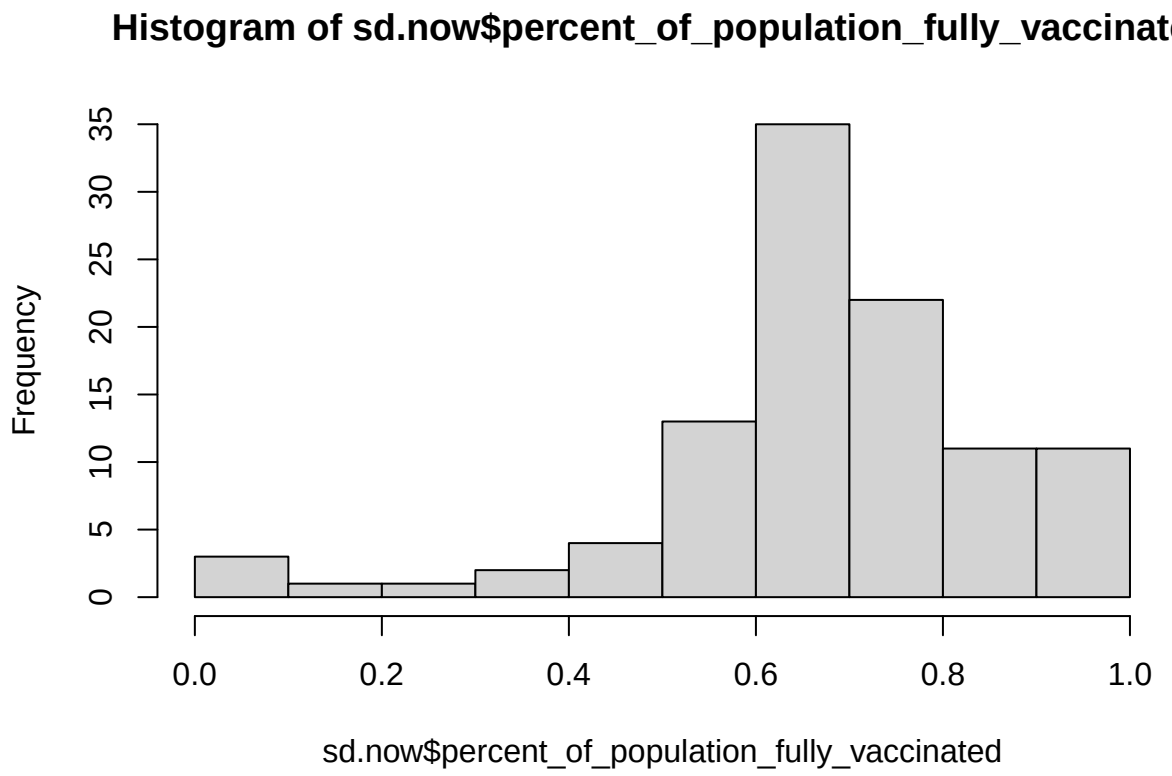
```
summary(sd.now$percent_of_population_fully_vaccinated)
```

```
##    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 graphics

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

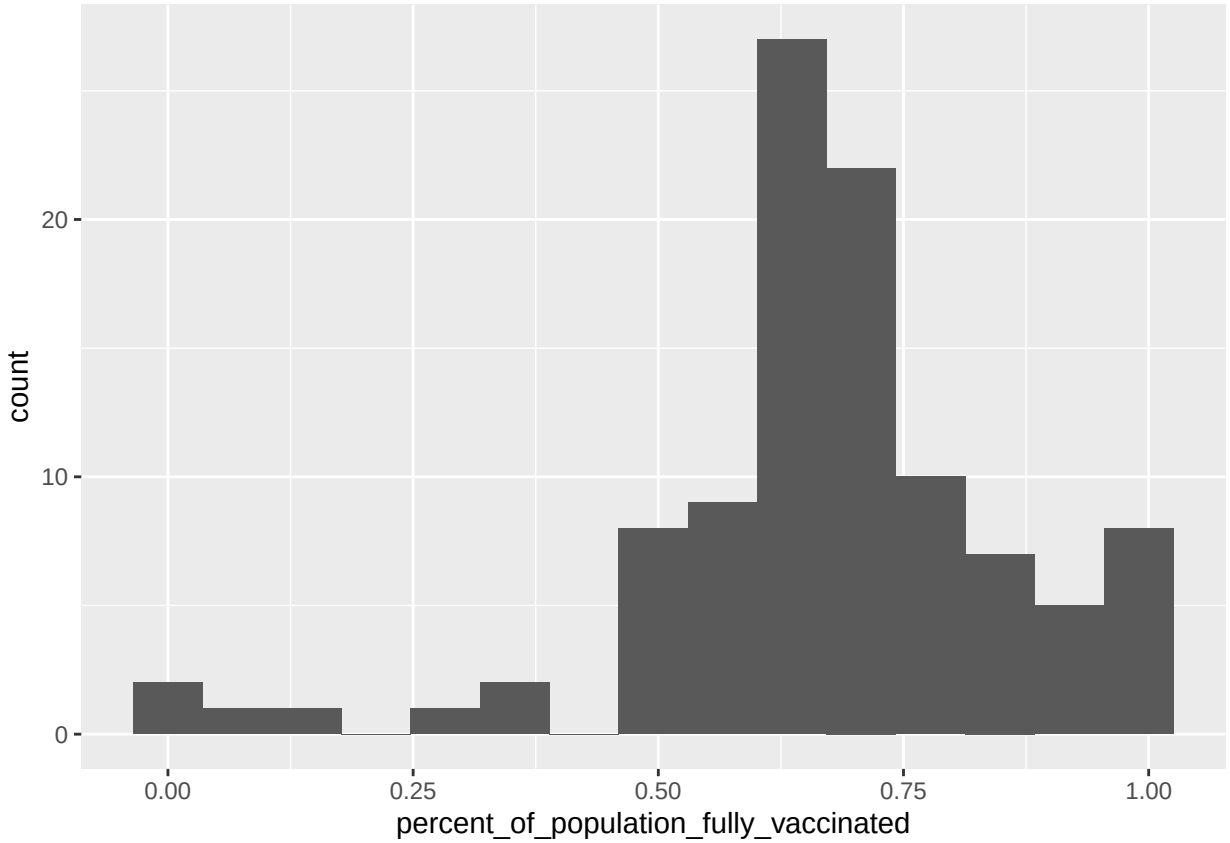


Using ggplot

```
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?

```
filter(sd.now, zip_code_tabulation_area == "92037")
```

```
##   as_of_date zip_code_tabulation_area local_health_jurisdiction    county
## 1 2021-11-09                   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                    32859
##   persons_partially_vaccinated percent_of_population_fully_vaccinated
## 1                         6354                                0.909114
##   percent_of_population_partially_vaccinated
## 1                                   0.175797
##   percent_of_population_with_1_plus_dose redacted
## 1                                      1       No
```

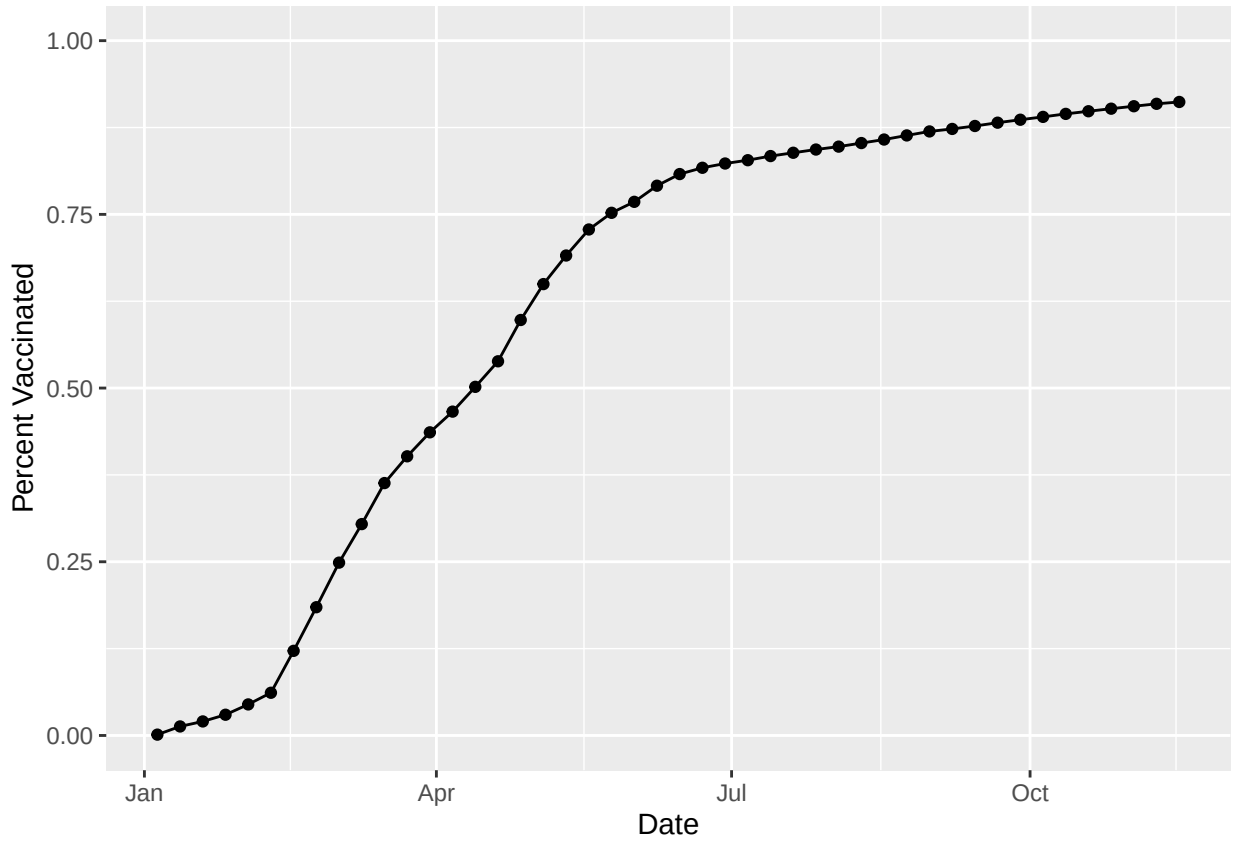
91% fully vaccinated!

```
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")
```



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 "2021-11-16".

```
# 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
```

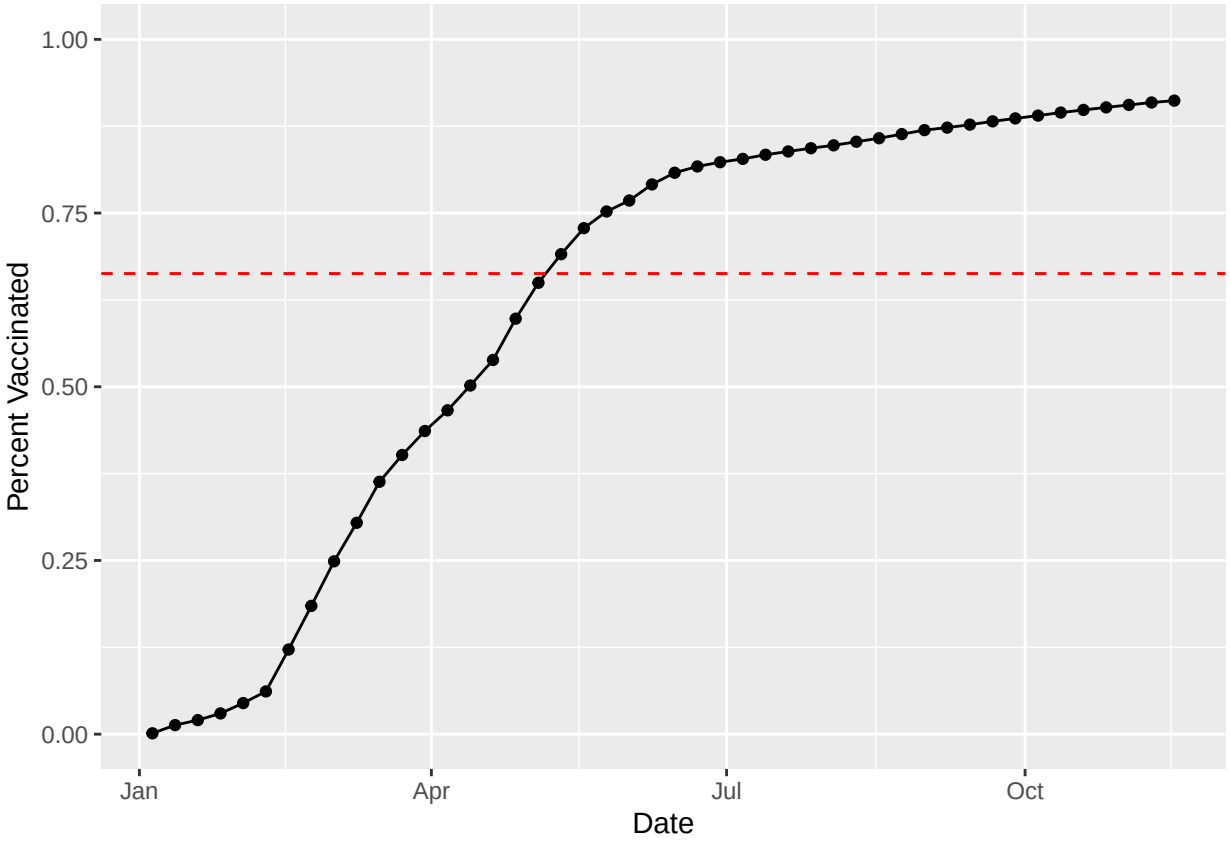
```
## 2                              1 Healthy Places Index Score
## 3                              1 Healthy Places Index Score
## 4                              2 Healthy Places Index Score
## 5                              1 Healthy Places Index Score
## 6                              2 Healthy Places 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 straight horizontal line to your plot from above with the geom_hline() function?

```
mean1 <- mean(vax.36$percent_of_population_fully_vaccinated)
mean1
```

```
## [1] 0.6629812
```

```
ggplot(ucsd) +
 aes(as_of_date, percent_of_population_fully_vaccinated) +
  geom_point() +
  geom_line(group=1) +
  geom_hline(yintercept=0.6629812, color = "red", linetype = "dashed") +
  ylim(c(0,1)) +
  labs(x="Date", y="Percent Vaccinated")
```



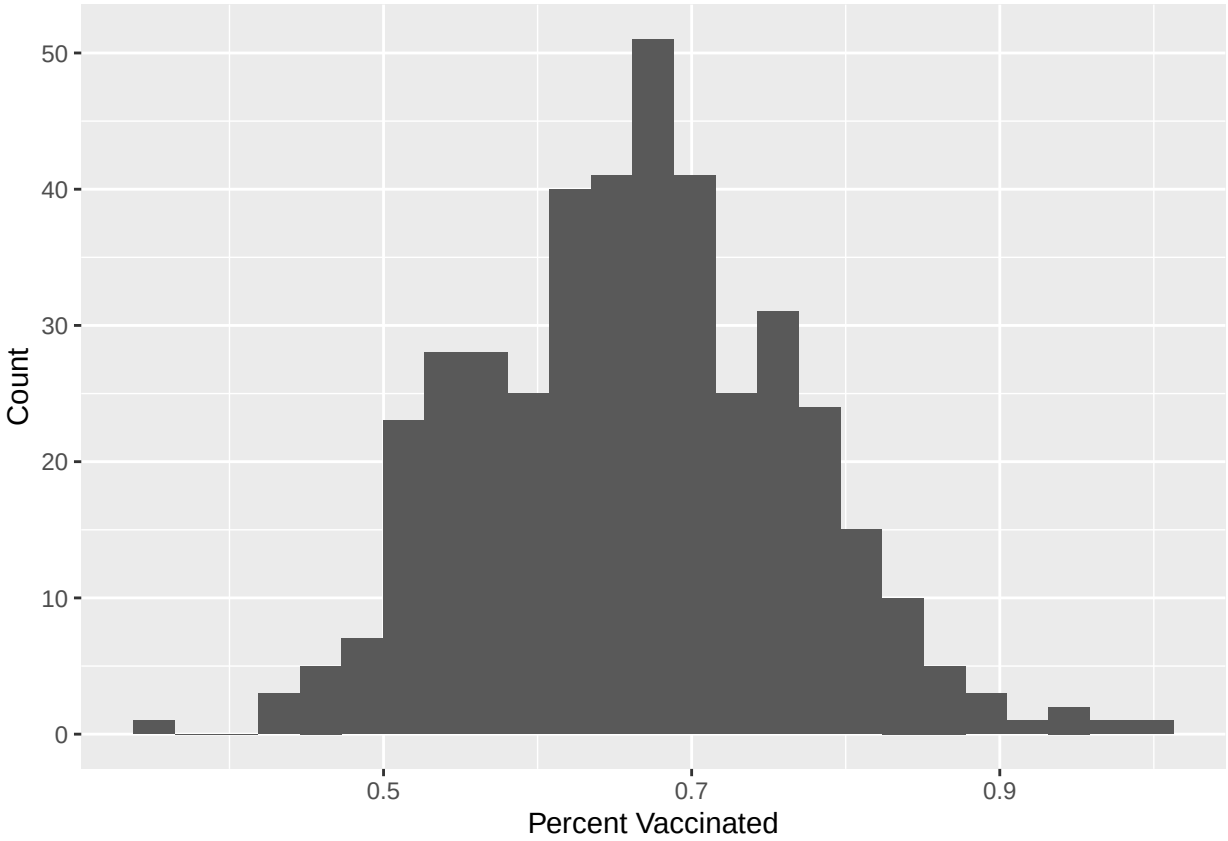
Q17. What is the 6 number summary (Min, 1st Qu., Median, Mean, 3rd Qu., and Max) of the "Percent of Population Fully Vaccinated" values for ZIP code areas with a population as large as 92037 (La Jolla) as_of_date "2021-11-16"?

```
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(bins=25) +
  labs(x="Percent Vaccinated", y="Count")
```



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

92109-above 92040-below

```
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
```

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

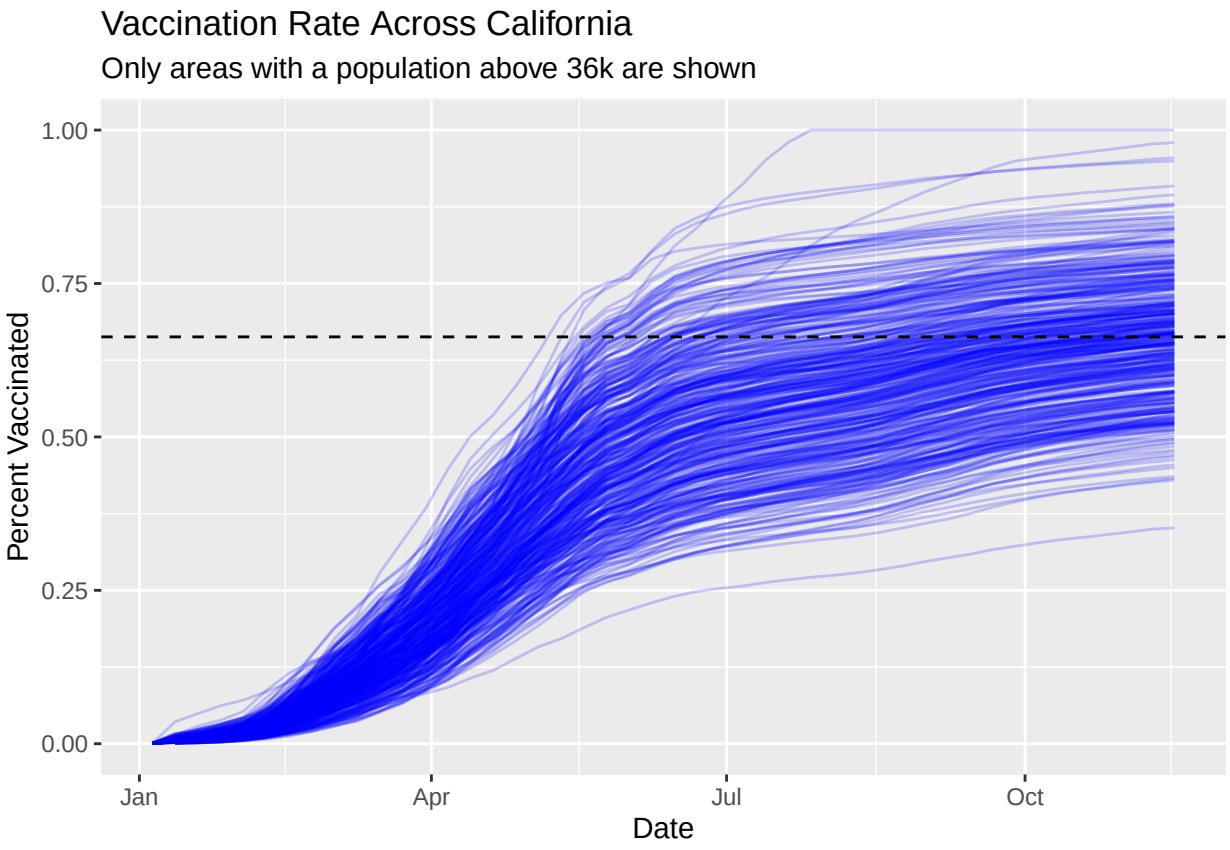
```
##   percent_of_population_fully_vaccinated
## 1                               0.520463
```

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") +
  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 = 0.6629812, 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?

I think it will be ok, so long as people take the neccessary measures while traveling (masks, vaccination standing, distancing when able, isolation if positive).