Class 17: COVID-19 Vaccination Rate Mini Project

Barry (PID: 911)

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Background

As we approach a period of travel and larger gatherings lets have a look at vaccination rates across the State.

We will take data from the CA.gov site here: - "Statewide COVID-19 Vaccines Administered by ZIP Code" https://data.ca.gov/dataset/covid-19-vaccine-progress-dashboard-data-by-zip-code

```
vax <- read.csv("covid19vaccinesbyzipcode.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
```

Quick look at data structure

As before we can use the **skim()** function to quickly overview and summarize the various columns of the dataset.

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

Table 1: Data summary

Name	vax
Number of rows	81144
Number of columns	14
Column type frequency:	
character	5
numeric	9
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	46	0
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: 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	

Ensure the date column is useful

We will use the **lubridate** package to make life allot 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-mont-day format
vax$as_of_date <- ymd(vax$as_of_date)
```

Now I can do useful math with dates more easily:

Q. How many days since the first entry?

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

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

Q. How many days since the last entry?

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

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

Q9. **How many days between the first and last entry in the dataset?**

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

```
## Time difference of 315 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

We will use the **zipcodeR** package to help make sense of zip codes. For example:

```
library(zipcodeR)

geocode_zip('92037')
```

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

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

```
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 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 can 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 **dplyr** package and it's **filter()** 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
```

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 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
```

Q. **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"?

```
sd.now <- filter(sd, 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

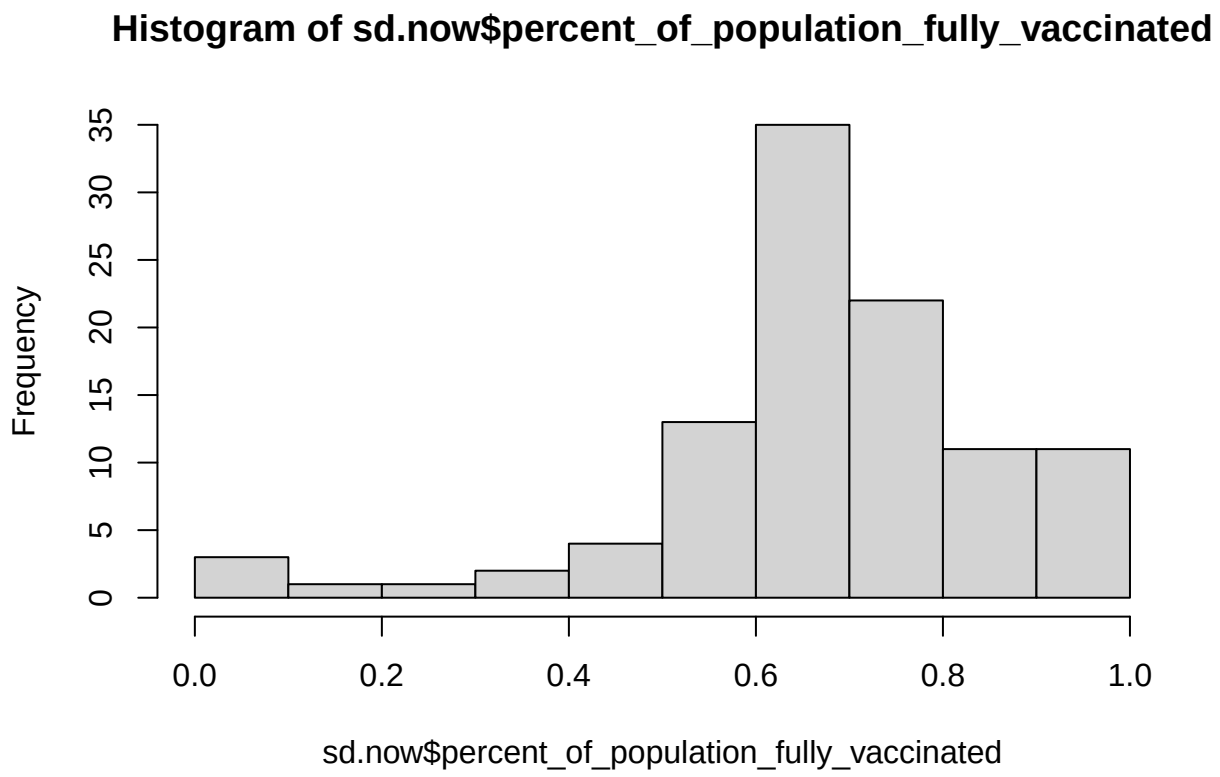
```
summary( sd.now$percent_of_population_fully_vaccinated )
```

```
##    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 plots

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

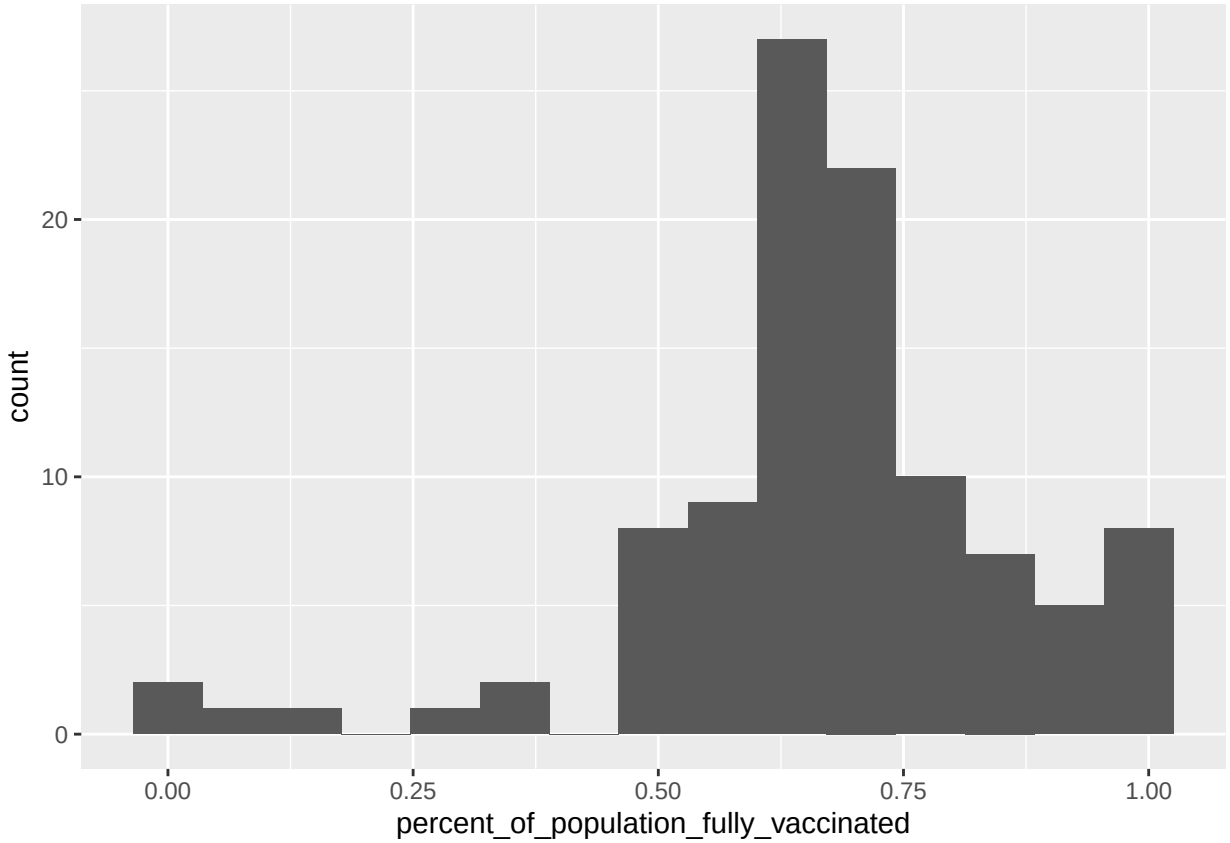


Using ggplot

```
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")
```

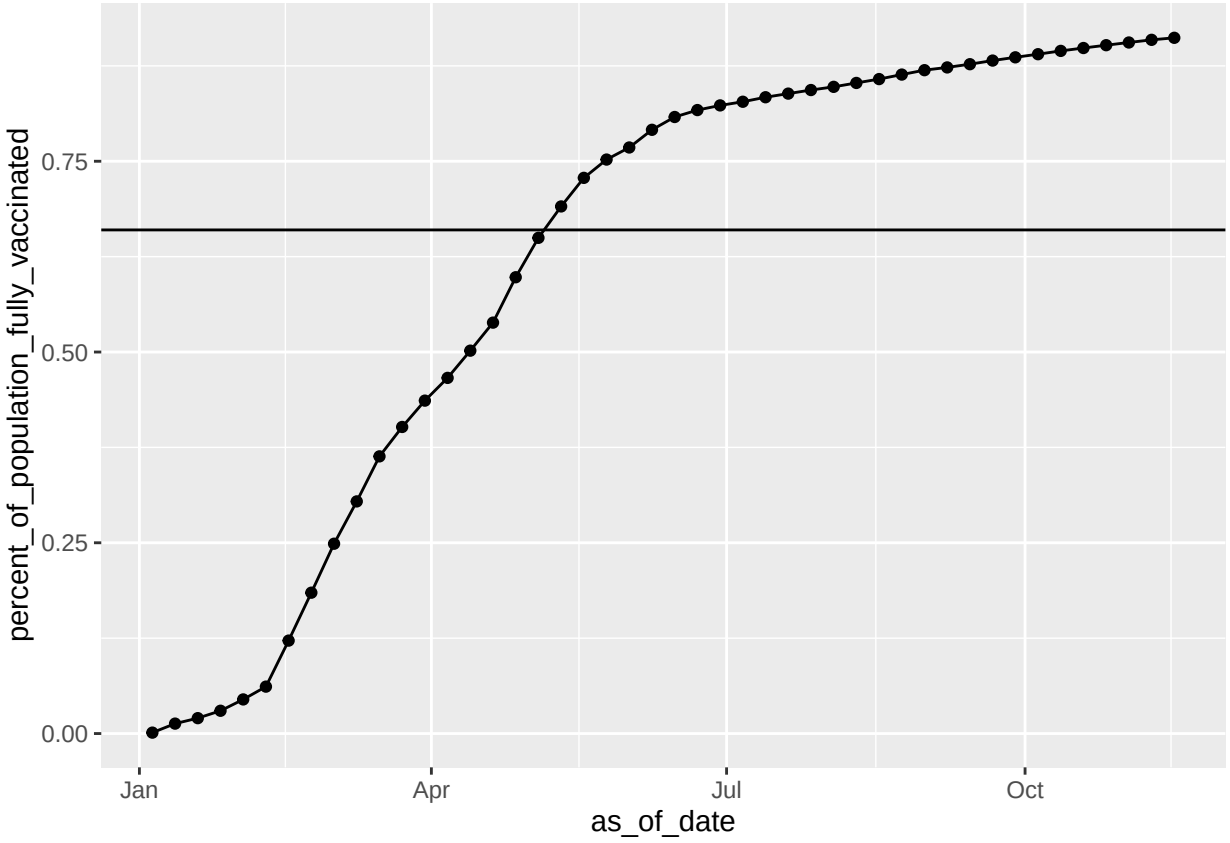
```
##   as_of_date zip_code_tabulation_area local_health_jurisdiction    county
## 1 2021-11-09                   92037                San Diego San Diego
##   vaccine_equity_metric_quartile                vem_source
## 1                              4 Healthy Places Index Score
##   age12_plus_population 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
```

Time series of vaccination rate for 92037

First select all data for the UCSD 92037 area

```
ucsd <- filter(vax, zip_code_tabulation_area == "92037")
```

```
ggplot(ucsd) +
  aes(as_of_date, percent_of_population_fully_vaccinated) +
  geom_point() +
  geom_line(group=1) +
  geom_hline(yintercept = 0.66)
```



Population in the 92037 ZIP code area

```
ucsd[1,]$age5_plus_population
```

```
## [1] 36144
```

First we need to subset the full `vax` dataset to include only ZIP code areas with a population as large as 92037

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

```
## [1] 18906
```

How many unique zip codes have a population as large as 92037?

```
length(unique( vax.36.all$zip_code_tabulation_area ))
```

```
## [1] 411
```

Lets make a final figure that shows all these ZIP areas.

```
ggplot(vax.36.all) +
  aes(as_of_date,
      percent_of_population_fully_vaccinated,
      group=zip_code_tabulation_area) +
  geom_line( alpha=0.2 ) +
  geom_hline(yintercept = 0.66, col="red") +
  labs(x="Date", y="Percent of Area Vaccinated")
```

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