class17.Rmd

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COVID-19 Vaccination Rates

```
# 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                   92395            San Bernardino San Bernardino
## 2 2021-01-05                   93206                      Kern           Kern
## 3 2021-01-05                   91006                 Los Angeles    Los Angeles
## 4 2021-01-05                   91901                   San Diego      San Diego
## 5 2021-01-05                   92230                   Riverside      Riverside
## 6 2021-01-05                   92662                      Orange         Orange
##   vaccine_equity_metric_quartile                vem_source
## 1                              1 Healthy Places Index Score
## 2                              1 Healthy Places Index Score
## 3                              3 Healthy Places Index Score
## 4                              3 Healthy Places Index Score
## 5                              1 Healthy Places Index Score
## 6                              4 Healthy Places Index Score
##   age12_plus_population age5_plus_population persons_fully_vaccinated
## 1               35915.3                40888                       NA
## 2                1237.5                 1521                       NA
## 3               28742.7                31347                       19
## 4               15549.8                16905                       12
## 5                2320.2                 2526                       NA
## 6                2349.5                 2397                       NA
##   persons_partially_vaccinated percent_of_population_fully_vaccinated
## 1                           NA                                     NA
## 2                           NA                                     NA
## 3                          873                                0.000606
## 4                          271                                0.000710
## 5                           NA                                     NA
## 6                           NA                                     NA
##   percent_of_population_partially_vaccinated
## 1                                         NA
## 2                                         NA
## 3                                   0.027850
## 4                                   0.016031
```

```
## 5                                        NA
## 6                                        NA
##   percent_of_population_with_1_plus_dose
## 1                                     NA
## 2                                     NA
## 3                                0.028456
## 4                                0.016741
## 5                                     NA
## 6                                     NA
##                                                                        redacted
## 1 Information redacted in accordance with CA state privacy requirements
## 2 Information redacted in accordance with CA state privacy requirements
## 3                                                                            No
## 4                                                                            No
## 5 Information redacted in accordance with CA state privacy requirements
## 6 Information redacted in accordance with CA state privacy requirements
```

How many entries do we have?

```
nrow(vax)
```

```
## [1] 82908
```

We can use the **skimr** package and the `skim()` function to get a quick overview of the structure of the dataset:

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

Table 1: Data summary

Name	vax
Number of rows	82908
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	47	0
local_health_jurisdiction	0	1	0	15	235	62	0
county	0	1	0	15	235	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	1089	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	21106.04	0	1460.50	15364.00	34877.00	101902.0	
persons_fully_vaccinated	8355	0.90	9585.35	11609.12	11	516.00	4210.00	16095.00	71219.0	
persons_partially_vaccinated	8355	0.90	1894.87	2105.55	11	198.00	1269.00	2880.00	20159.0	
percent_of_population_fully_vaccinated	8355	0.90	0.43	0.27	0	0.20	0.44	0.63	1.0	
percent_of_population_partially_vaccinated	8355	0.90	0.10	0.10	0	0.06	0.07	0.11	1.0	
percent_of_population_with_1_plus_dose	8355	0.90	0.51	0.26	0	0.31	0.53	0.71	1.0	

We noticed that one of these columns is a date column. Working with time and dates get's annoying quickly, and there's a package to help with this called **lubridate**:

```
library(lubridate)
```

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

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

```
today()
```

```
## [1] "2021-11-24"
```

How many days since the first entry in the dataset?

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

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

We need to change the data column from character to numerical:

```
# today() - vax$as_of_date[1] won't work

d <- ymd(vax$as_of_date)
d[1]
```

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

```
today() - d[1]
```

```
## Time difference of 323 days
```

I will make the `as_of_date` column Date format:

```
vax$as_of_date <- ymd(vax$as_of_date)
```

When was the dataset last updated? What is the last date in this dataset? OR How many days since the last update?

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

```
## Time difference of 1 days
```

How many days does the dataset span?

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

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

Working with ZIP codes

How many different Zip code areas are recorded in this dataset?

```
length(unique(vax$zip_code_tabulation_area))
```

```
## [1] 1764
```

To work with Zip codes we can use the **zipcodeR** package:

```
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>
```

Focus on the San Diego area

We want to subset the full CA vax data down to just San Diego county. We can do it with base R:

```
# Subset to San Diego county only areas
inds <- vax$county == "San Diego"
nrow(vax[inds,])
```

```
## [1] 5029
```

But much better with the **dplyr** package to make things easier and faster and be able to subset by:

```
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
```

```
# Use `filter()` function to do our subsetting:
sd <- filter(vax, county == "San Diego")
nrow(sd)
```

```
## [1] 5029
```

More complicated filtering:

```
sd.20 <- filter(vax, county == "San Diego" &
                age5_plus_population > 20000)
nrow(sd.20)
```

```
## [1] 3055
```

What is the average vaccination rate of San Diego county as of the last updated date?

```
sd.now <- filter(vax, county == "San Diego" &
                 as_of_date == "2021-11-23")
head(sd.now)
```

```
##   as_of_date zip_code_tabulation_area local_health_jurisdiction    county
## 1 2021-11-23                   92120                San Diego San Diego
## 2 2021-11-23                   91962                San Diego San Diego
## 3 2021-11-23                   92155                San Diego San Diego
## 4 2021-11-23                   92147                San Diego San Diego
```

```
## 5 2021-11-23                    91913                San Diego San Diego
## 6 2021-11-23                    92114                San Diego San Diego
##   vaccine_equity_metric_quartile                vem_source
## 1                              4 Healthy Places Index Score
## 2                              3 Healthy Places Index Score
## 3                             NA            No VEM Assigned
## 4                             NA            No VEM Assigned
## 5                              3 Healthy Places Index Score
## 6                              2 Healthy Places Index Score
##   age12_plus_population age5_plus_population persons_fully_vaccinated
## 1               26372.9                28414                    21234
## 2                1758.7                 2020                      948
## 3                 456.0                  456                       70
## 4                 518.0                  518                       NA
## 5               43514.7                50461                    37974
## 6               59050.7                64945                    43708
##   persons_partially_vaccinated percent_of_population_fully_vaccinated
## 1                         3198                                0.747308
## 2                          126                                0.469307
## 3                           20                                0.153509
## 4                           NA                                      NA
## 5                         6690                                0.752542
## 6                         6261                                0.673000
##   percent_of_population_partially_vaccinated
## 1                                   0.112550
## 2                                   0.062376
## 3                                   0.043860
## 4                                         NA
## 5                                   0.132578
## 6                                   0.096405
##   percent_of_population_with_1_plus_dose
## 1                               0.859858
## 2                               0.531683
## 3                               0.197369
## 4                                     NA
## 5                               0.885120
## 6                               0.769405
##                                                                redacted
## 1                                                                    No
## 2                                                                    No
## 3                                                                    No
## 4 Information redacted in accordance with CA state privacy requirements
## 5                                                                    No
## 6                                                                    No
```

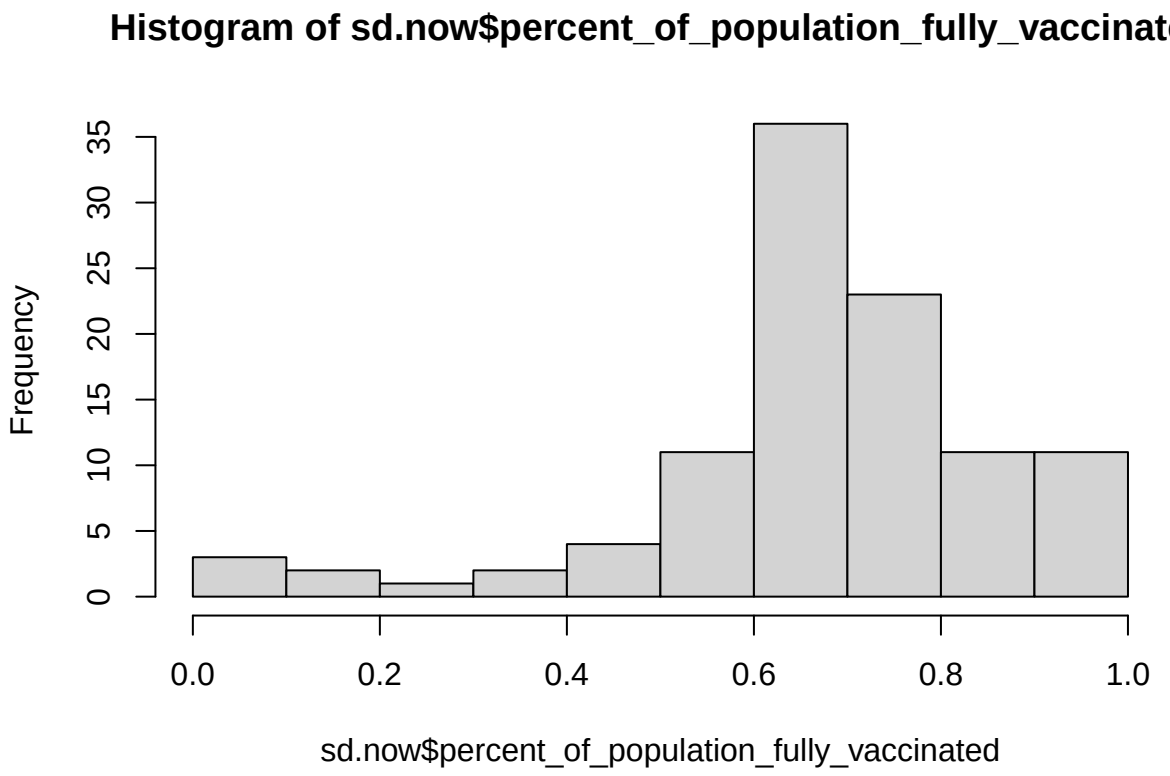
```
# `summary` function is a good way to get mean, median... fast
summary(sd.now$percent_of_population_fully_vaccinated)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
## 0.01017 0.61301 0.67965 0.67400 0.76932 1.00000       3
```

Make a histogram of sd.now

Base R histogram:

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



This is going to be very susceptible to be skewed to small population zip codes, where vaccinated or unvaccinated people will have a very big effect on small numbers.

Focus on UCSD/La Jolla

What is the population of the 92037 Zip code?

Using Zip code 92037

```
lj <- filter(sd.now, zip_code_tabulation_area=="92037")
lj$age5_plus_population
```

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

What is the average vaccination for this Zip code?

```
lj$percent_of_population_fully_vaccinated
```

```
## [1] 0.916196
```

What about this Zip code 92122?

```
lj2 <- filter(sd.now, zip_code_tabulation_area=="92122")
lj2$age5_plus_population
```

```
## [1] 45951
```

```
lj2$percent_of_population_fully_vaccinated
```

```
## [1] 0.771474
```

What about 91942?

```
lj3 <- filter(sd.now, zip_code_tabulation_area=="91942")
lj3$age5_plus_population
```

```
## [1] 37483
```

```
lj3$percent_of_population_fully_vaccinated
```

```
## [1] 0.683163
```

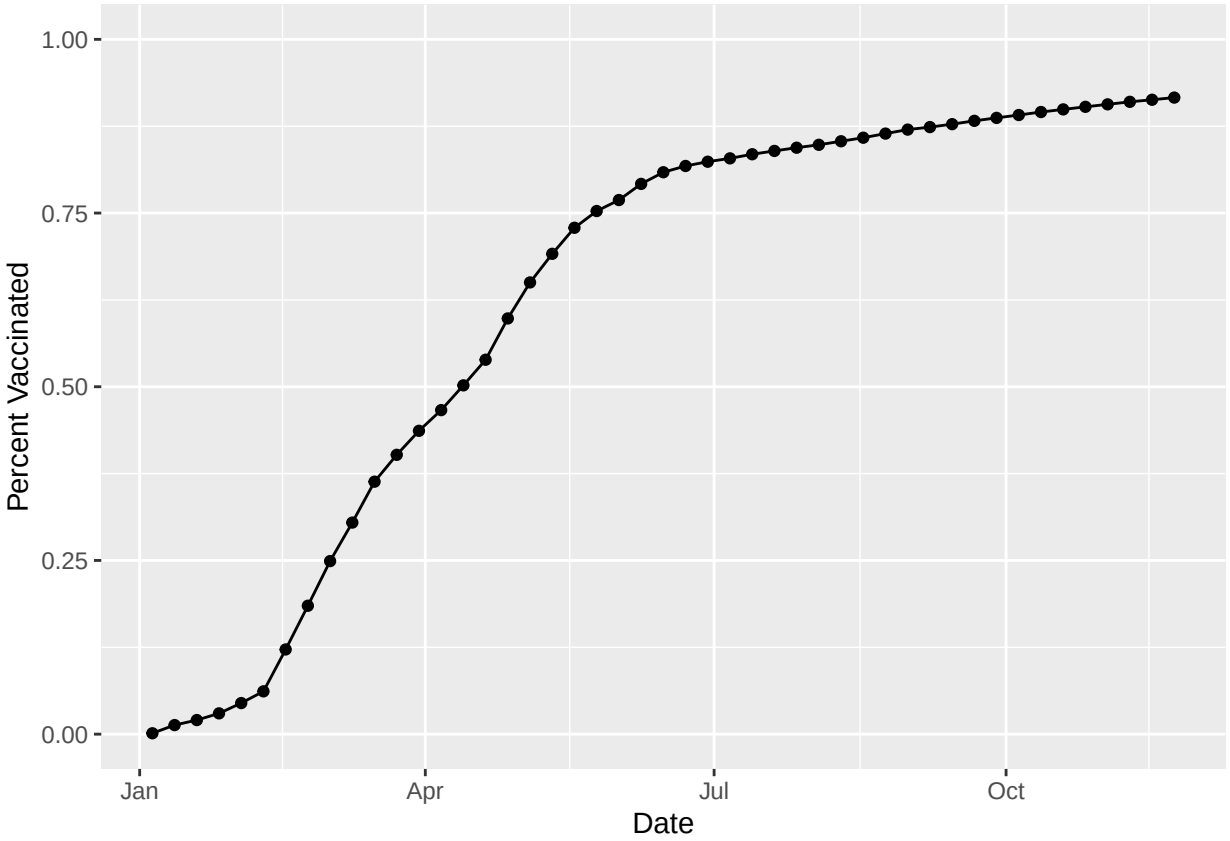
We'll do a time series of vaccination rate for a given Zip code area: La Jolla Start with 92037.

```
# We need to go back to full vax dataset, as the sd.now only has yesterday's date on it.

lajolla <- filter(vax, zip_code_tabulation_area=="92037")

library(ggplot2)

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



Comparing to similar sized areas

Let's make this plot for all San Diego county areas with populations at lease as large as the Zip code 92037.

```
sd.36 <- filter(vax, county=="San Diego", age5_plus_population > 36144)
head(sd.36)
```

```
##   as_of_date zip_code_tabulation_area local_health_jurisdiction    county
## 1 2021-01-05                   92058                San Diego San Diego
## 2 2021-01-05                   92078                San Diego San Diego
## 3 2021-01-05                   92019                San Diego San Diego
## 4 2021-01-05                   92117                San Diego San Diego
## 5 2021-01-05                   92057                San Diego San Diego
## 6 2021-01-05                   91913                San Diego San Diego
##   vaccine_equity_metric_quartile                vem_source
## 1                              1 Healthy Places Index Score
## 2                              3 Healthy Places Index Score
## 3                              3 Healthy Places Index Score
## 4                              3 Healthy Places Index Score
## 5                              2 Healthy Places Index Score
## 6                              3 Healthy Places Index Score
##   age12_plus_population age5_plus_population persons_fully_vaccinated
## 1               34956.0                39695                       NA
## 2               41789.5                47476                       37
## 3               37439.4                40464                       25
```

```
## 4               50041.6                53839                        42
## 5               51927.0                56906                        22
## 6               43514.7                50461                        37
##   persons_partially_vaccinated percent_of_population_fully_vaccinated
## 1                           NA                                     NA
## 2                          688                                0.000779
## 3                          610                                0.000618
## 4                         1143                                0.000780
## 5                          691                                0.000387
## 6                         1993                                0.000733
##   percent_of_population_partially_vaccinated
## 1                                         NA
## 2                                   0.014492
## 3                                   0.015075
## 4                                   0.021230
## 5                                   0.012143
## 6                                   0.039496
##   percent_of_population_with_1_plus_dose
## 1                                     NA
## 2                               0.015271
## 3                               0.015693
## 4                               0.022010
## 5                               0.012530
## 6                               0.040229
##                                                                  redacted
## 1 Information redacted in accordance with CA state privacy requirements
## 2                                                                      No
## 3                                                                      No
## 4                                                                      No
## 5                                                                      No
## 6                                                                      No
```

How many Zip code areas in SD county have a population bigger than 92037?

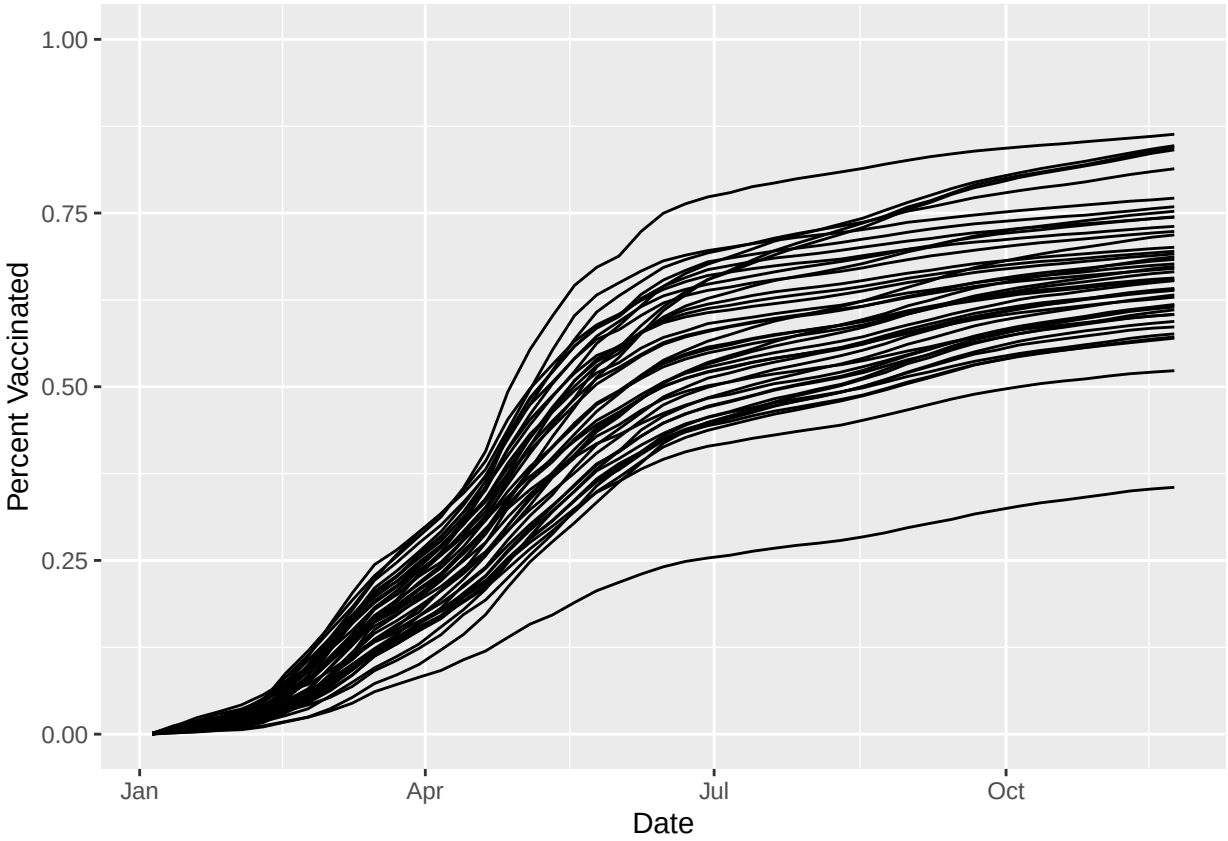
```
length(unique(sd.36$zip_code_tabulation_area))
```

```
## [1] 43
```

Let's make this plot with all the Zip codes:

```
ggplot(sd.36) +
  aes(x=as_of_date,
      y=percent_of_population_fully_vaccinated,
      group=zip_code_tabulation_area) +
  geom_line() +
  ylim(c(0,1)) +
  labs(x="Date", y="Percent Vaccinated")
```

```
## Warning: Removed 1 row(s) containing missing values (geom_path).
```



Make a plot for the whole state of CA for all Zip code areas with population at least as large as La Jolla

```
ca <- filter(vax, age5_plus_population > 36144)
```

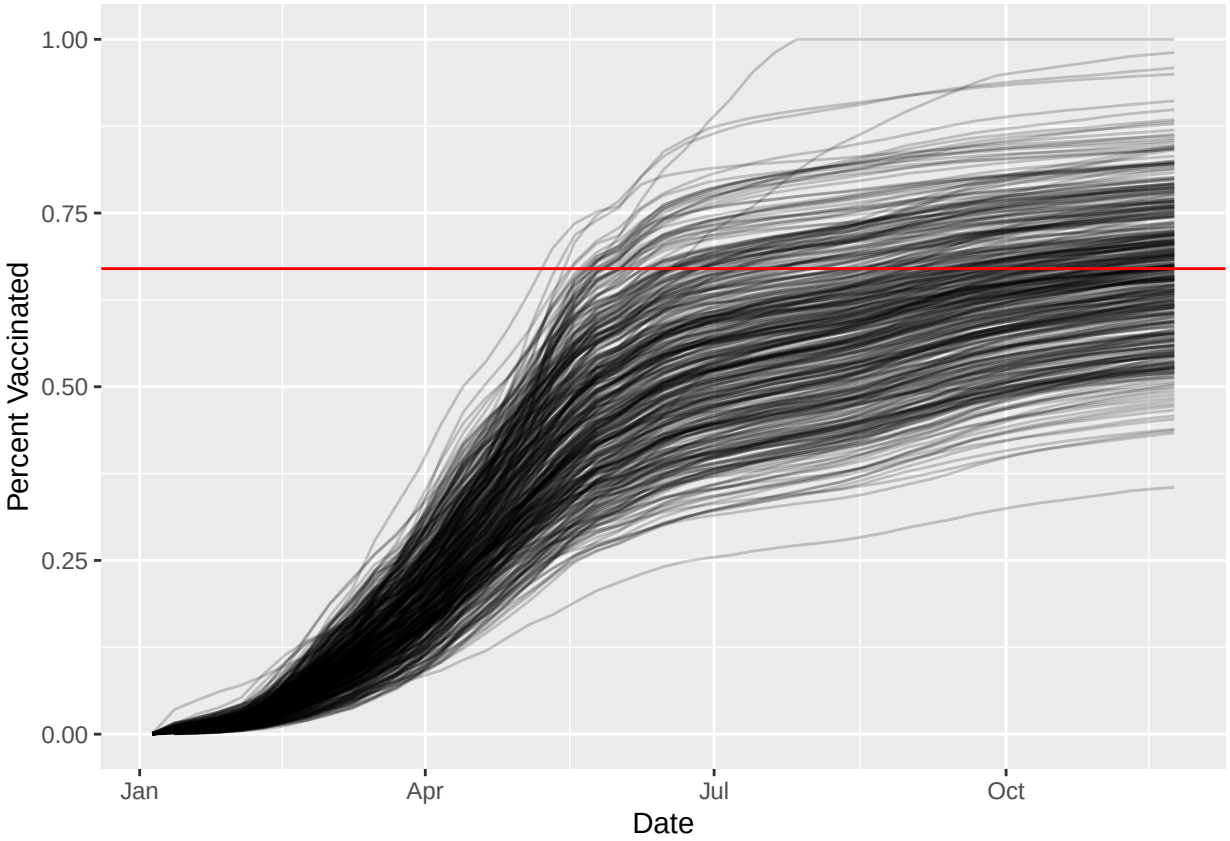
How many Zip codes are we talking about?

```
length(unique(ca$zip_code_tabulation_area))
```

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

```
ggplot(ca) +
  aes(x=as_of_date,
      y=percent_of_population_fully_vaccinated,
      group=zip_code_tabulation_area) +
  geom_line(alpha=0.2) +
  ylim(c(0,1)) +
  labs(x="Date", y="Percent Vaccinated") +
  geom_hline(yintercept = 0.67, color="red")
```

```
## Warning: Removed 176 row(s) containing missing values (geom_path).
```



What is the mean across the state for these 36k + population areas?

```
# The mean line was applied in the plot above.
ca.now <- filter(ca, as_of_date=="2021-11-23")
summary(ca.now$percent_of_population_fully_vaccinated)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.3552  0.5939  0.6696  0.6672  0.7338  1.0000
```

About this document

```
sessionInfo()
```

```
## R version 4.1.1 (2021-08-10)
## Platform: x86_64-apple-darwin17.0 (64-bit)
## Running under: macOS Catalina 10.15.7
##
## Matrix products: default
## BLAS:   /Library/Frameworks/R.framework/Versions/4.1/Resources/lib/libRblas.0.dylib
## LAPACK: /Library/Frameworks/R.framework/Versions/4.1/Resources/lib/libRlapack.dylib
##
## locale:
```

```
## [1] en_US.UTF-8/en_US.UTF-8/en_US.UTF-8/C/en_US.UTF-8/en_US.UTF-8
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
## other attached packages:
## [1] ggplot2_3.3.5   dplyr_1.0.7     zipcodeR_0.3.3  lubridate_1.8.0
##
## loaded via a namespace (and not attached):
##  [1] httr_1.4.2         tidyr_1.1.4        bit64_4.0.5        jsonlite_1.7.2
##  [5] sp_1.4-5           highr_0.9          blob_1.2.2         yaml_2.2.1
##  [9] tidycensus_1.1     pillar_1.6.3       RSQLite_2.2.8      lattice_0.20-44
## [13] glue_1.4.2         uuid_1.0-3         digest_0.6.28      rvest_1.0.2
## [17] colorspace_2.0-2   htmltools_0.5.2    pkgconfig_2.0.3    raster_3.5-2
## [21] purrr_0.3.4        scales_1.1.1       terra_1.4-11       tzdb_0.2.0
## [25] tigris_1.5         tibble_3.1.5       proxy_0.4-26       farver_2.1.0
## [29] generics_0.1.0     ellipsis_0.3.2     withr_2.4.2        cachem_1.0.6
## [33] repr_1.1.3         skimr_2.1.3        cli_3.0.1          magrittr_2.0.1
## [37] crayon_1.4.1       memoise_2.0.0      maptools_1.1-2     evaluate_0.14
## [41] fansi_0.5.0        xml2_1.3.2         foreign_0.8-81     class_7.3-19
## [45] tools_4.1.1        hms_1.1.1          lifecycle_1.0.1    stringr_1.4.0
## [49] munsell_0.5.0      compiler_4.1.1     e1071_1.7-9        rlang_0.4.11
## [53] classInt_0.4-3     units_0.7-2        grid_4.1.1         rstudioapi_0.13
## [57] rappdirs_0.3.3     labeling_0.4.2     base64enc_0.1-3    rmarkdown_2.11
## [61] gtable_0.3.0       codetools_0.2-18   DBI_1.1.1          curl_4.3.2
## [65] R6_2.5.1           knitr_1.36         rgdal_1.5-27       fastmap_1.1.0
## [69] bit_4.0.4          utf8_1.2.2         KernSmooth_2.23-20 readr_2.0.2
## [73] stringi_1.7.5      Rcpp_1.0.7         vctrs_0.3.8        sf_1.0-4
## [77] tidyselect_1.1.1   xfun_0.26
```