Class 17: Vaccination Rate Mini-Project

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Data Import

```r
vax <- read.csv("covid19vaccinesbyzipcode_test.csv")
head(vax)
```

```
  as_of_date zip_code_tabulation_area local_health_jurisdiction    county
1 2021-01-05                    95446                    Sonoma    Sonoma
2 2021-01-05                    96014                  Siskiyou  Siskiyou
3 2021-01-05                    96087                    Shasta    Shasta
4 2021-01-05                    96008                    Shasta    Shasta
5 2021-01-05                    95410                 Mendocino Mendocino
6 2021-01-05                    95527                   Trinity   Trinity
  vaccine_equity_metric_quartile                 vem_source
1                              2 Healthy Places Index Score
2                              2    CDPH-Derived ZCTA Score
3                              2    CDPH-Derived ZCTA Score
4                             NA            No VEM Assigned
5                              3    CDPH-Derived ZCTA Score
6                              2    CDPH-Derived ZCTA Score
  age12_plus_population age5_plus_population tot_population
1                4840.7                 5057           5168
2                 135.0                  135            135
3                 513.9                  544            544
4                1125.3                 1164             NA
5                 926.3                  988            997
6                 476.6                  485            499
  persons_fully_vaccinated persons_partially_vaccinated
1                       NA                           NA
2                       NA                           NA
3                       NA                           NA
```

```
4                      NA                            NA
5                      NA                            NA
6                      NA                            NA
  percent_of_population_fully_vaccinated
1                                     NA
2                                     NA
3                                     NA
4                                     NA
5                                     NA
6                                     NA
  percent_of_population_partially_vaccinated
1                                         NA
2                                         NA
3                                         NA
4                                         NA
5                                         NA
6                                         NA
  percent_of_population_with_1_plus_dose booster_recip_count
1                                     NA                  NA
2                                     NA                  NA
3                                     NA                  NA
4                                     NA                  NA
5                                     NA                  NA
6                                     NA                  NA
  bivalent_dose_recip_count eligible_recipient_count
1                        NA                        0
2                        NA                        0
3                        NA                        2
4                        NA                        2
5                        NA                        0
6                        NA                        0
                                                             redacted
1 Information redacted in accordance with CA state privacy requirements
2 Information redacted in accordance with CA state privacy requirements
3 Information redacted in accordance with CA state privacy requirements
4 Information redacted in accordance with CA state privacy requirements
5 Information redacted in accordance with CA state privacy requirements
6 Information redacted in accordance with CA state privacy requirements
```

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

```
#vax$persons_fully_vaccinated
```

The "persons_fully_vaccinated" column contains this information.

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

```
#vax$zip_code_tabulation_area
```

The column "zip_code_tabulation_area" contains this information.

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

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

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

The earliest date in this dataset is 2021-01-05.

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

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

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

The latest date in this dataset is 2023-02-28.

We can use the `skim()` function for a quick overview of a new dataset like this one:

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

Table 1: Data summary

Name	vax
Number of rows	199332
Number of columns	18
Column type frequency:	
character	5
numeric	13
Group variables	None

Variable type: character

skim_variable	n_missing	complete_rate	min	max	empty	n_unique	whitespace
as_of_date	0	1	10	10	0	113	0
local_health_jurisdiction	0	1	0	15	565	62	0
county	0	1	0	15	565	59	0
vem_source	0	1	15	26	0	3	0
redacted	0	1	2	69	0	2	0

Variable type: numeric

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
zip_code_tabulation_area	0	1.00	93665.11	1817.38	90001	92257.75	93658.50	95380.50	97635.0	
vaccine_equity_metric_quartile	9831	0.95	2.44	1.11	1	1.00	2.00	3.00	4.0	
age12_plus_population	0	1.00	18895.04	18993.87	0	1346.95	13685.10	31756.12	88556.7	
age5_plus_population	0	1.00	20875.24	21105.97	0	1460.50	15364.00	34877.00	101902.0	
tot_population	9718	0.95	23372.77	22628.51	12	2126.00	18714.00	38168.00	111165.0	
persons_fully_vaccinated	16525	0.92	13962.33	15054.09	11	930.00	8566.00	23302.00	87566.0	
persons_partially_vaccinated	16525	0.92	1701.64	2030.18	11	165.00	1196.00	2535.00	39913.0	
percent_of_population_fully_vaccinated	20825	0.90	0.57	0.25	0	0.42	0.60	0.74	1.0	
percent_of_population_partially_vaccinated	20825	0.90	0.08	0.09	0	0.05	0.06	0.08	1.0	
percent_of_population_with_1_plus_dose	21859	0.89	0.63	0.24	0	0.49	0.67	0.81	1.0	
booster_recip_count	72872	0.63	5837.31	7165.81	11	297.00	2748.00	9438.25	59553.0	
bivalent_dose_recip_count	158664	0.20	2924.93	3583.45	11	190.00	1418.00	4626.25	27458.0	
eligible_recipient_count	0	1.00	12801.84	14908.33	0	504.00	6338.00	21973.00	87234.0	

> Q5. How many numeric columns are in this dataset?

There are 13 numeric columns in this dataset.

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

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

```
[1] 16525
```

There are 16525 NA values in the persons_fully_vaccinated column.

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

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

```
[1] 8.29
```

8.29% of "persons_fully_vaccinated" values are missing.

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

Since there are military bases in Southern California, these rates are not reported and that data is not available.

Working with Dates:

The lubridate package makes working with dates and times in R much less of a pain.

```r
library(lubridate)
```

```

Attaching package: 'lubridate'

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

    date, intersect, setdiff, union
```

```r
today()
```

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

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

We can now do math with dates since we have specified the date format.

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

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

```
Time difference of 7 days
```

It has been 7 days since the last update to the dataset.

> Q. How many total days are in the dataset?

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

```
Time difference of 784 days
```

> Q10. How many unique dates are in the dataset (i.e. how many different dates are detailed)?

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

```
[1] 113
```

There are 113 unique dates in this dataset.

Working with ZIP Codes:

ZIP codes are also rather annoying things we work with as they are numeric but not in the conventional sense of doing math. We can use the `zipcodeR()` package to help deal with this:

```r
library(zipcodeR)
```

```r
geocode_zip("92101")
```

```
# A tibble: 1 x 3
  zipcode   lat   lng
  <chr>   <dbl> <dbl>
1 92101    32.7 -117.
```

Calculate the distance between the centroids of any two ZIP codes in miles:

```r
zip_distance("92101","92131")
```

```
  zipcode_a zipcode_b distance
1     92101     92131    13.95
```

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

```
reverse_zipcode(c("92101","92131"))
```

```
# A tibble: 2 x 24
  zipcode zipcode_~1 major~2 post_~3 common_c~4 county state   lat   lng timez~5
  <chr>   <chr>      <chr>   <chr>        <blob> <chr>  <chr> <dbl> <dbl> <chr>
1 92101   Standard   San Di~ San Di~ <raw 21 B> San D~ CA     32.7 -117. Pacific
2 92131   Standard   San Di~ San Di~ <raw 21 B> San D~ CA     32.9 -117. Pacific
# ... with 14 more variables: radius_in_miles <dbl>, area_code_list <blob>,
#   population <int>, population_density <dbl>, land_area_in_sqmi <dbl>,
#   water_area_in_sqmi <dbl>, housing_units <int>,
#   occupied_housing_units <int>, median_home_value <int>,
#   median_household_income <int>, bounds_west <dbl>, bounds_east <dbl>,
#   bounds_north <dbl>, bounds_south <dbl>, and abbreviated variable names
#   1: zipcode_type, 2: major_city, 3: post_office_city, ...
```

Focus on the San Diego Area:

Let's now focus in on the San Diego County area by restricting ourselves first to `vax$county == "San Diego"` entries. We have two main choices on how to do this. The first using base R the second using the dplyr package:

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

```
[1] 12091
```

We can perform this same step using the `dplyr()` package:

```
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
```

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

nrow(sd)
```

```
[1] 12091
```

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

> Q. How many ZIP code areas are we dealing with?

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

```
[1] 76
```

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

```r
n_distinct(sd$zip_code_tabulation_area)
```

```
[1] 107
```

There are 107 distinct zip codes in San Diego County.

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

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

```
[1] 92154
```

The San Diego County ZIP code area with the largest 12+ population is 92154.

```r
reverse_zipcode("92154")
```

```
# A tibble: 1 x 24
  zipcode zipcode_~1 major~2 post_~3 common_c~4 county state   lat   lng timez~5
  <chr>   <chr>      <chr>   <chr>       <blob> <chr>  <chr> <dbl> <dbl> <chr>
1 92154   Standard   San Di~ San Di~ <raw 21 B> San D~ CA     32.6  -117 Pacific
# ... with 14 more variables: radius_in_miles <dbl>, area_code_list <blob>,
#   population <int>, population_density <dbl>, land_area_in_sqmi <dbl>,
#   water_area_in_sqmi <dbl>, housing_units <int>,
#   occupied_housing_units <int>, median_home_value <int>,
#   median_household_income <int>, bounds_west <dbl>, bounds_east <dbl>,
#   bounds_north <dbl>, bounds_south <dbl>, and abbreviated variable names
#   1: zipcode_type, 2: major_city, 3: post_office_city, ...
```

> Q13. What is the overall average "Percent of Population Fully Vaccinated" value for all San Diego "County" as of "2023-02-28" (i.e the most recent date)?

```r
library(dplyr)
```

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

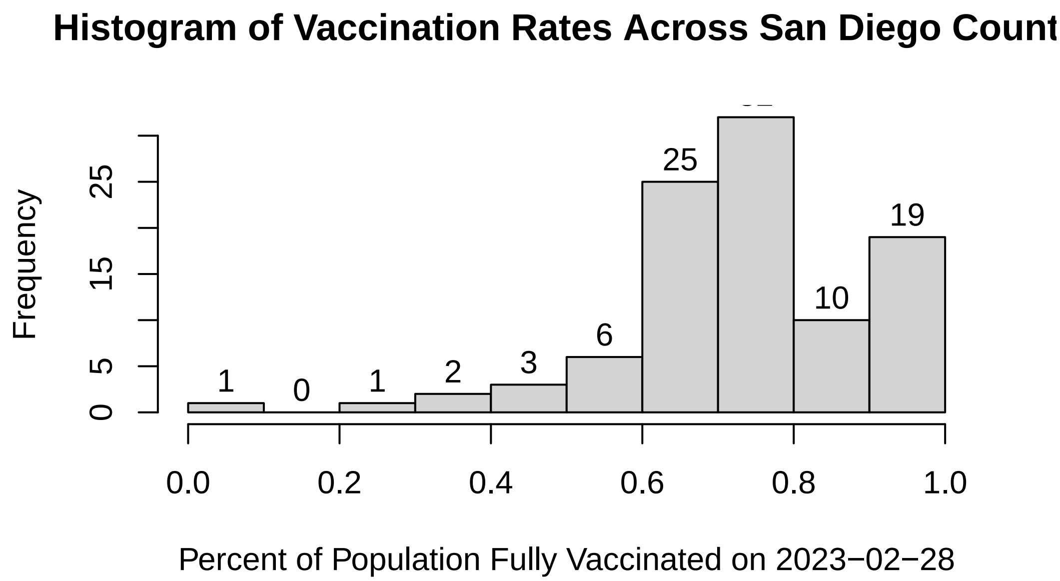
```r
mean(sd.today$percent_of_population_fully_vaccinated, na.rm=T) * 100
```

```
[1] 74.00878
```

As of 2023-02-28, 74% of San Diego County was fully vaccinated.

> 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 "2023-02-28"?

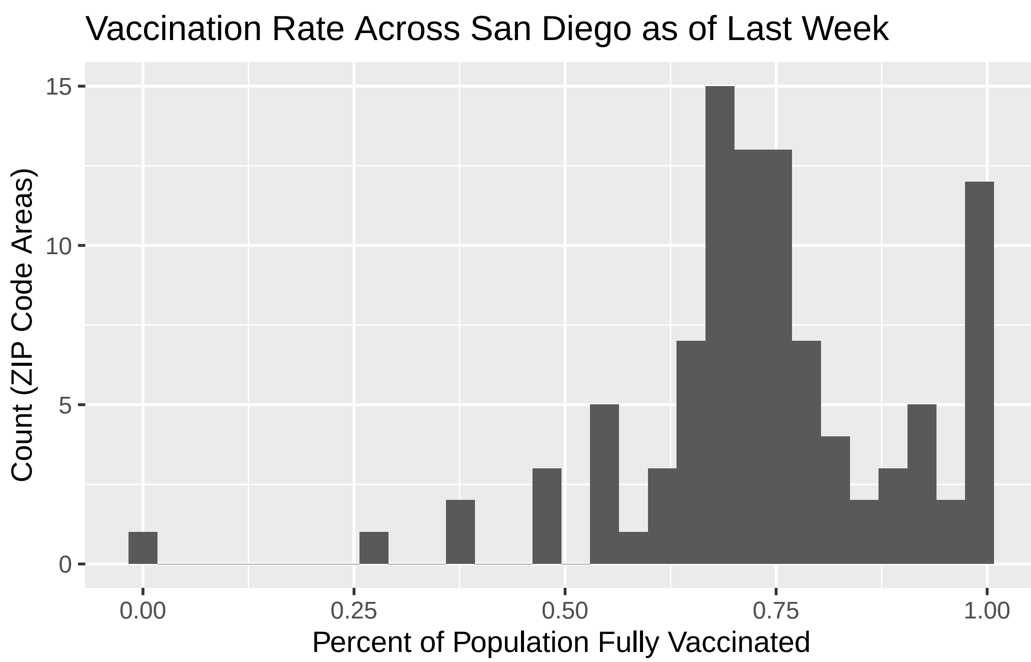
```r
hist(sd.today$percent_of_population_fully_vaccinated, labels=T,main="Histogram of Vaccinat
```




```r
library(ggplot2)
ggplot(sd.today) + aes(percent_of_population_fully_vaccinated) + geom_histogram() + ggtitl
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

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



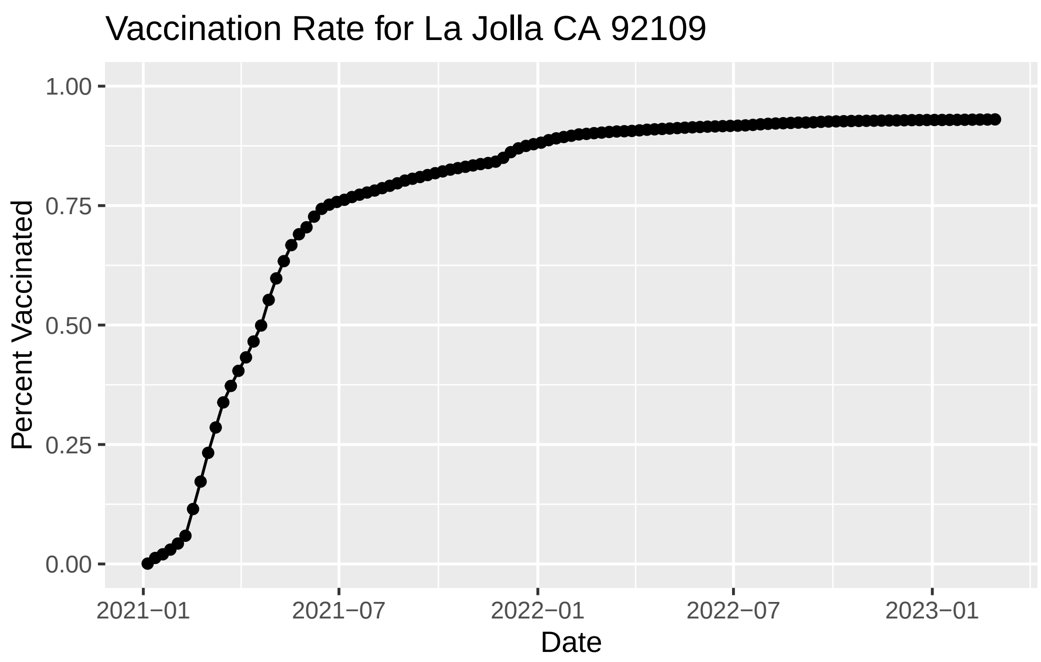
Focus on UCSD/La Jolla:

```
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:

```
ucplot <- ggplot(ucsd) +
  aes(as_of_date,percent_of_population_fully_vaccinated) +
  geom_point() +
  geom_line(group=1) +
  ylim(c(0,1)) +
  labs(title="Vaccination Rate for La Jolla CA 92109", y="Percent Vaccinated", x="Date")
ucplot
```



Comparing to Similar Sized Areas:

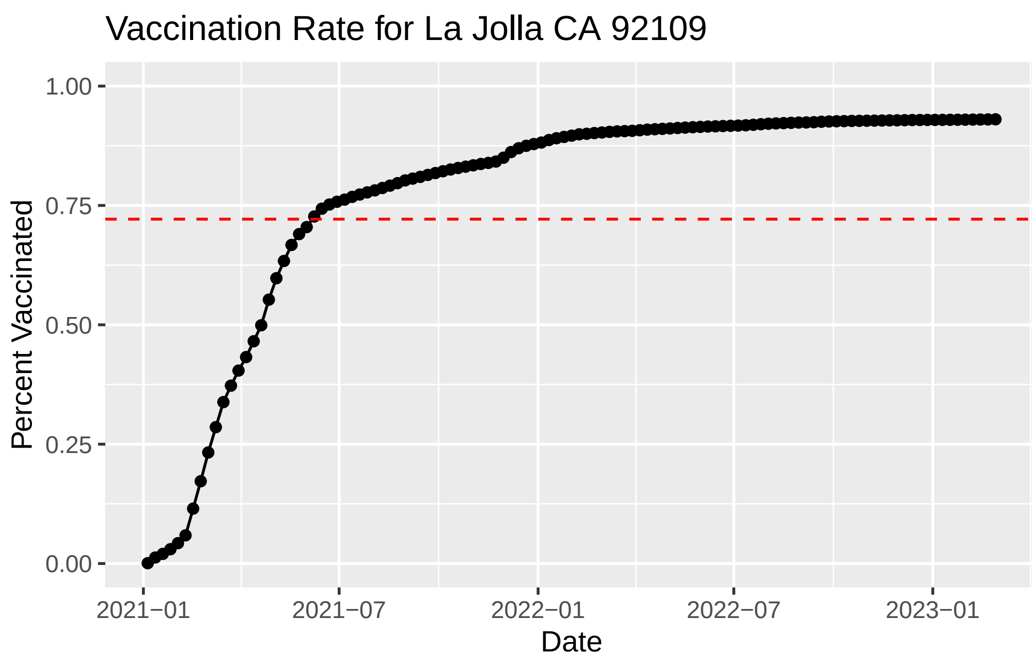
```
# Subset to all CA areas with a population as large as 92037
vax.36 <- filter(vax, age5_plus_population > 36144 &
                 as_of_date == "2023-02-28")
```

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 "2023-02-28". Add this as a straight horizontal line to your plot from above with the geom_hline() function?

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

```
[1] 0.7213331
```

```
ucplot + geom_hline(yintercept=ave, color="red", linetype=2)
```



Q17. What is the 6 number summary (Min, 1st Qu., Median, Mean, 3rd Qu., and Max) of the "Percent of Population Fully Vaccinated" values for ZIP code areas with a population as large as 92037 (La Jolla) as_of_date "2023-02-28"?

```
sum <- summary(vax.36$percent_of_population_fully_vaccinated)
sum
```

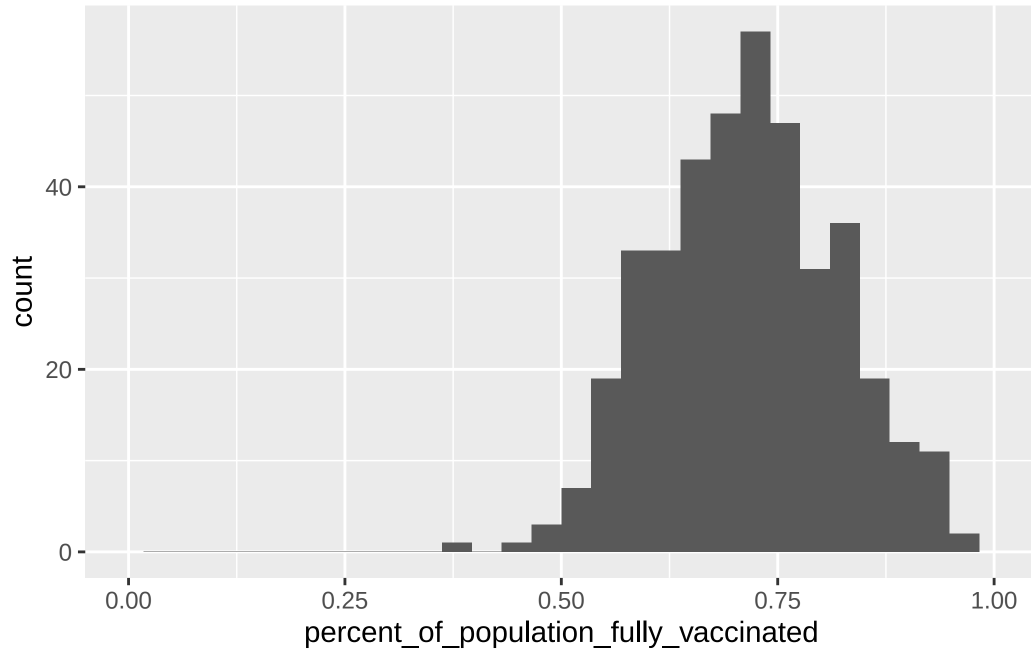
```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
 0.3804  0.6457  0.7181  0.7213  0.7907  1.0000 
```

Q18. Using ggplot generate a histogram of this data.

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

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

```
Warning: Removed 2 rows containing missing values (`geom_bar()`).
```



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

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

```
[1] 0.694572 0.550296
```

Both of these ZIP codes (92109 and 92040) are both below the average I calculated previously.

> 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="purple") +
```

```
  ylim(c(0,1)) +
  labs(x="Date", y="Percent Vaccinated",
       title="Vaccination Rates Across California",
       subtitle="Only areas with a population above 36k are shown") +
  geom_hline(yintercept = ave, linetype=2, color="black")
```

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