

# Homework 2 - Report

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The data set `calif_penn_2011.csv` contains information about the housing stock of California and Pennsylvania, as of 2011. Information is aggregated into “Census tracts”, geographic regions of a few thousand people which are supposed to be fairly homogeneous economically and socially.

## 1. Loading and cleaning

a. Load the data into a dataframe called `ca_pa`.

```
library(tidyverse)

## -- Attaching packages ----- tidyverse 1.3.0 --
## v ggplot2 3.3.2      v purrr   0.3.4
## v tibble  3.0.1      v dplyr   1.0.0
## v tidyr   1.1.0      v stringr 1.4.0
## v readr   1.3.1      v forcats 0.5.0

## -- Conflicts ----- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()     masks stats::lag()

ca_pa <- read_csv("../data/calif_penn_2011.csv")

## Warning: Missing column names filled in: 'X1' [1]

## Parsed with column specification:
## cols(
##   .default = col_double(),
##   STATEFP = col_character(),
##   COUNTYFP = col_character(),
##   TRACTCE = col_character(),
##   GEO.display.label = col_character()
## )

## See spec(...) for full column specifications.
```

b. How many rows and columns does the dataframe have?

```
rows <- dim(ca_pa)[1]
columns <- dim(ca_pa)[2]
```

c. Run this command, and explain, in words, what this does:

**Ans:** this command can figure out the number of missing values in every column.

```
colSums(apply(ca_pa, c(1,2), is.na))
```

```
##                X1                GEO.id2
##                0                0
```

```
##          STATEFP          COUNTYFP
##          0          0
##          TRACTCE          POPULATION
##          0          0
##          LATITUDE          LONGITUDE
##          0          0
##          GEO.display.label          Median_house_value
##          0          599
##          Total_units          Vacant_units
##          0          0
##          Median_rooms          Mean_household_size_owners
##          157          215
##          Mean_household_size_renters          Built_2005_or_later
##          152          98
##          Built_2000_to_2004          Built_1990s
##          98          98
##          Built_1980s          Built_1970s
##          98          98
##          Built_1960s          Built_1950s
##          98          98
##          Built_1940s          Built_1939_or_earlier
##          98          98
##          Bedrooms_0          Bedrooms_1
##          98          98
##          Bedrooms_2          Bedrooms_3
##          98          98
##          Bedrooms_4          Bedrooms_5_or_more
##          98          98
##          Owners          Renters
##          100          100
##          Median_household_income          Mean_household_income
##          115          126
```

- d. The function `na.omit()` takes a dataframe and returns a new dataframe, omitting any row containing an NA value. Use it to purge the data set of rows with incomplete data.

```
ca_pa <- na.omit(ca_pa)
```

- e. How many rows did this eliminate?

```
rows - dim(ca_pa)[1]
```

```
## [1] 670
```

- f. Are your answers in (c) and (e) compatible? Explain.

**Ans:** They are compatible. The command in (c) check the number of missing values in every column, and the command in (e) check the number of rows with incomplete data. We can infer that after purging, the number of missing values in every column will be zero. And we can use the command below to check out the truth.

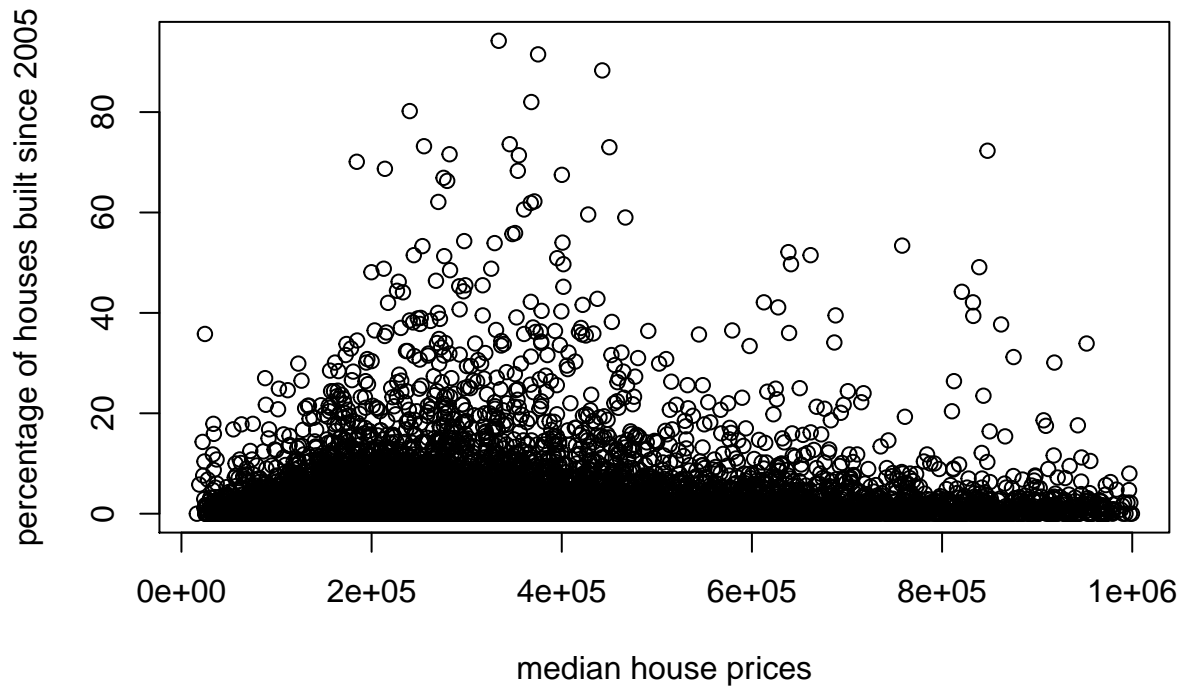
```
sum(colSums(apply(ca_pa,c(1,2),is.na)))
```

```
## [1] 0
```

## 2. *This Very New House*

- a. The variable `Built_2005_or_later` indicates the percentage of houses in each Census tract built since 2005. Plot median house prices against this variable.

```
plot(ca_pa$Median_house_value, ca_pa$Built_2005_or_later,
     xlab = "median house prices",
     ylab = "percentage of houses built since 2005")
```



- b. Make a new plot, or pair of plots, which breaks this out by state. Note that the state is recorded in the STATEFP variable, with California being state 6 and Pennsylvania state 42.

```
# 分别画两个州
```

### 3. Nobody Home

The vacancy rate is the fraction of housing units which are not occupied. The dataframe contains columns giving the total number of housing units for each Census tract, and the number of vacant housing units.

- a. Add a new column to the dataframe which contains the vacancy rate. What are the minimum, maximum, mean, and median vacancy rates?

```
Vacancy_rate <- ca_pa$Vacant_units / ca_pa$Total_units
ca_pa <- data.frame(ca_pa, Vacancy_rate)
max(Vacancy_rate)
```

```
## [1] 0.965311
```

```
min(Vacancy_rate)
```

```
## [1] 0
```

```
mean(Vacancy_rate)
```

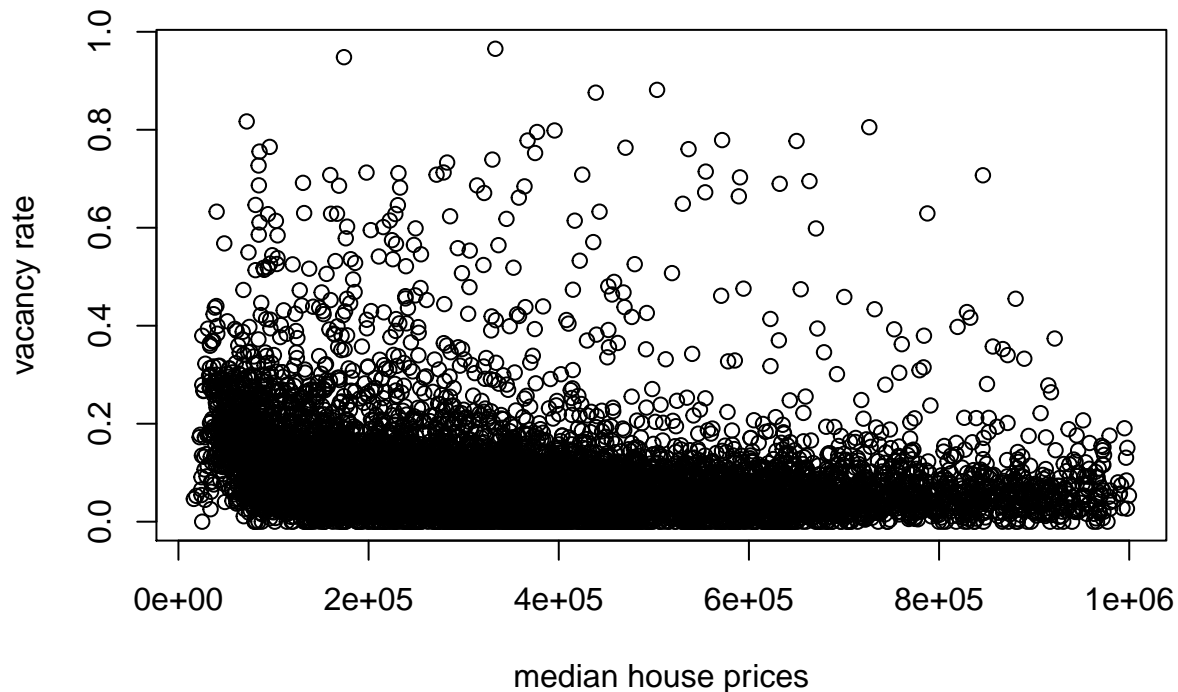
```
## [1] 0.08888789
```

```
median(Vacancy_rate)
```

```
## [1] 0.06767283
```

b. Plot the vacancy rate against median house value.

```
plot(ca_pa$Median_house_value, ca_pa$Vacancy_rate,  
     xlab = "median house prices",  
     ylab = "vacancy rate")
```



c. Plot vacancy rate against median house value separately for California and for Pennsylvania. Is there a difference?

```
# 分别画两个州
```

4. The column `COUNTYFP` contains a numerical code for counties within each state. We are interested in Alameda County (county 1 in California), Santa Clara (county 85 in California), and Allegheny County (county 3 in Pennsylvania).

- Explain what the block of code at the end of this question is supposed to accomplish, and how it does it.
- Give a single line of R which gives the same final answer as the block of code. Note: there are at least two ways to do this; you just have to find one.
- For Alameda, Santa Clara and Allegheny Counties, what were the average percentages of housing built since 2005?
- The `cor` function calculates the correlation coefficient between two variables. What is the correlation between median house value and the percent of housing built since 2005 in (i) the whole data, (ii) all of

California, (iii) all of Pennsylvania, (iv) Alameda County, (v) Santa Clara County and (vi) Allegheny County?

- e. Make three plots, showing median house values against median income, for Alameda, Santa Clara, and Allegheny Counties. (If you can fit the information into one plot, clearly distinguishing the three counties, that's OK too.)