Assignment1

February 5, 2022

1 Does a Relationship Exist Between Restaurant Density and Personal Income Per Capita?

1.1 1. Introduction

It is no question that fast food restaurants make up a generous portion of the United States' GDP. Due to it's low production cost and great taste, fast food is sold at a low cost, further increasing it's vast popularity. According to specific assumptions made in microeconomics, fast food is an inferior good; meaning as an individual's income increases the rate of purchases that are made on fast food will deccrease. Restaurant density is the proportion of restaurants to population. This shows the concentration of restaurants in a given area. Also, burgers are reported to be the most common purchased fast food. Thus, I want to investigate the correlation between restaurant density(independant variable) and income per capita(outcome) in a given state. I will also investigate burger restaurant density(independant variable) in order to observe it's relationship with income per capita has with restaurant_density.

The original fast food dataset was imported from Kaggle. Due to the absence of the variable income per capita, it is necesserry to import online datasets that contain population and per capita income. Additionally, using the Bureau of Economic Analysis database, I was able to import and eventually merge this dataframe to a new dataset consisting of all necessary variables to solve this question.

NOTE: I originally wanted to investigate the correlation between restaurant density and income per capita in a given city instead of a state in order to have more datapoints; however, I ran in to difficulties. I will first outline my original process and show what happened, in order to prove that it was most feasible to group corresponding data frames by state instead.

1.2 2. Import Packages

[ ]:
```python
import pandas as pd
from matplotlib import pyplot as plt
import numpy as np
```

1.3 3. Import and Read in Datasets

[ ]:
```python
restaurants = pd.read_csv('Datasets/Datafiniti_Fast_Food_Restaurants_May19.csv')
income = pd.read_csv('Datasets/county_income.csv')
```

```
[ ]: print(restaurants.shape)
     pd.set_option("max_colwidth",200)
     restaurants.head()
```

```
(10000, 16)
```

```
[ ]:                      id             dateAdded           dateUpdated  \
     0  AWrSh_KgsVYjT2BJAzaH  2019-05-19T23:58:05Z  2019-05-19T23:58:05Z
     1  AWEKlA-LIxWefVJwxG9B  2018-01-18T18:30:23Z  2019-05-19T23:45:05Z
     2  AWrSfAcYsVYjT2BJAzPt  2019-05-19T23:45:04Z  2019-05-19T23:45:04Z
     3  AWrSa3NAQTFama1Xpkbz  2019-05-19T23:26:58Z  2019-05-19T23:26:58Z
     4  AWrSaVGzZ4Yw-wtdgcaB  2019-05-19T23:24:38Z  2019-05-19T23:24:38Z

                      address  \
     0       2555 11th Avenue
     1  2513 Highway 6 And 50
     2    1125 Patterson Road
     3    3455 N Salida Court
     4   5225 E Colfax Avenue

                                                                         categories  \
     0                 Fast Food Restaurants,Hamburgers and Hot Dogs,Restaurants
     1          Restaurant,Mexican Restaurants,Fast Food Restaurants,Restaurants
     2     Sandwich Shops,Fast Food Restaurants,Restaurants,Take Out Restaurants
     3  Fast Food Restaurants,Mexican Restaurants,Restaurants,Take Out Restaurants
     4                     Fast Food Restaurants,Mexican Restaurants,Restaurants

                    primaryCategories            city country  \
     0  Accommodation & Food Services         Greeley      US
     1  Accommodation & Food Services  Grand Junction      US
     2  Accommodation & Food Services  Grand Junction      US
     3  Accommodation & Food Services          Aurora      US
     4  Accommodation & Food Services          Denver      US

                                                     keys  latitude  longitude  \
     0             us/co/greeley/255511thavenue/554191587  40.39629 -104.69699
     1   us/co/grandjunction/2513highway6and50/1550891556  39.08135 -108.58689
     2  us/co/grandjunction/1125pattersonroad/-2137447852  39.09148 -108.55411
     3           us/co/aurora/3455nsalidacourt/1143321601  39.76369 -104.77671
     4          us/co/denver/5225ecolfaxavenue/-864103396  39.74044 -104.92636

                         name postalCode province  \
     0             Carl's Jr.      80631       CO
     1               Del Taco      81505       CO
     2             Which Wich      81506       CO
     3  Chipotle Mexican Grill      80011       CO
     4              Taco Bell      80220       CO
```

```
                                sourceURLs  \
0
https://www.yellowpages.com/greeley-co/mip/carls-jr-7001402
1  http://www.citysearch.com/profile/772076870/grand_junction_co/del_taco.html,h
ttps://www.yellowpages.com/grand-junction-co/mip/del-
taco-475739804,https://www.tripadvisor.com/Restaurant_Review-g3345…
2
https://www.yellowpages.com/grand-junction-co/mip/which-wich-481453650
3
https://www.yellowpages.com/aurora-co/mip/chipotle-mexican-grill-537241840
4
https://www.yellowpages.com/denver-co/mip/taco-bell-459444587

         websites
0
https://www.carlsjr.com/?utm_source=Yextandutm_medium=Visit%20Websiteandutm_camp
aign=Homepage
1
http://www.deltaco.com
2
http://www.whichwich.com
3
http://www.chipotle.com
4  https://locations.tacobell.com/co/denver/5225-e-colfax-ave.html?utm_source=ye
xtandutm_campaign=yextpowerlistingsandutm_medium=referralandutm_term=004051andut
m_content=website
```

```
[ ]: print(income.shape)
     income.head()
```

```
(9420, 5)
```

```
[ ]:   GeoFips      GeoName  LineCode                              Description  \
     0     1001  Autauga, AL         1   Personal income (thousands of dollars)
     1     1001  Autauga, AL         2                Population (persons) 1/
     2     1001  Autauga, AL         3  Per capita personal income (dollars) 2/
     3     1003  Baldwin, AL         1   Personal income (thousands of dollars)
     4     1003  Baldwin, AL         2                Population (persons) 1/

            2019
     0   2474364
     1     55769
     2     44368
     3  10791564
     4    223565
```

It is evident that some of the data must be cleaned in our income dataframe. Firstly, it is evident that the values of the ‘Description’ variables should be columns and the newly added columns will take values corresponding to the ‘2019’ column.

[ ]:

```
income = income.pivot(values='2019', index='GeoName', columns='Description').
 ↪reset_index()
income.head()
```

[ ]:

```
Description        GeoName Per capita personal income (dollars) 2/  \
0           Abbeville, SC                                   35065
1              Acadia, LA                                   37337
2            Accomack, VA                                   49695
3                 Ada, ID                                   54506
4               Adair, IA                                   51911

Description Personal income (thousands of dollars) Population (persons) 1/
0                                           862034                  24584
1                                          2322653                  62207
2                                          1606389                  32325
3                                         26265476                 481880
4                                           368672                   7102
```

Now, I want to find the number of restaurants grouped by each city and create a new data frame that contains values of a given city in the United states and the number of restaurants that city contains.

[ ]:

```
rest_count = restaurants.groupby(['city', 'province']).size().reset_index()
rest_count['GeoName'] = rest_count['city'] + ", " + rest_count['province']
rest_count = rest_count.rename({0: 'num_restaurants'}, axis = 1)
rest_count = rest_count[['GeoName', 'num_restaurants']]
rest_count
```

[ ]:

```
              GeoName  num_restaurants
0       Abbeville, AL                2
1       Abbeville, SC                1
2        Aberdeen, MD                1
3        Aberdeen, NC                1
4        Aberdeen, WA                3
…                 …              …
3412   Zanesville, OH                6
3413      Zebulon, GA                1
3414   Zelienople, PA                1
3415  Zephyrhills, FL                1
3416         Zion, IL                1

[3417 rows x 2 columns]
```

Finally, I can merge the income dataframe and the rest_count data frame. Notice once I merge, I lose alot of data as there are now only 284 rows. This means that the income database and the original dataset(‘restaurants’) only have 284 common cities. Due to the loss of data, it is unfeasible to work with an even smaller sample size. Therefore, I grouped by state instead of city.

[ ]:

```
Rest_city = pd.merge(income, rest_count, on="GeoName")
Rest_city
```

[ ]:

```
           GeoName Per capita personal income (dollars) 2/  \
0    Abbeville, SC                                   35065   
1        Aiken, SC                                   44503   
2       Aitkin, MN                                   41614   
3      Alameda, CA                                   78839   
4      Alamosa, CO                                   38403   
..             …                                     …   
279  Winnebago, IL                                   43972   
280     Yakima, WA                                   43910   
281    Yankton, SD                                   51910   
282       York, NE                                   50703   
283       York, PA                                   52015   

    Personal income (thousands of dollars) Population (persons) 1/  \
0                                   862034                   24584   
1                                  7623405                  171300   
2                                   659213                   15841   
3                                131535494                 1668412   
4                                   622131                   16200   
..                                     …                     …   
279                               12420505                  282465   
280                               11045587                  251552   
281                                1185459                   22837   
282                                 690164                   13612   
283                               23372369                  449341   

     num_restaurants  
0                  1  
1                  4  
2                  1  
3                  3  
4                  1  
..               …  
279                1  
280               11  
281                1  
282                1  
283                8  

[284 rows x 5 columns]
```

The Bureau of Econbomic Analysis Database allowed me to import the same dataset grouped by state instead of city. I import the files and organize/clean the data using similar methods with the previous dataframe.

```
[ ]: income_state = pd.read_csv("Datasets/income_state.csv")
     income_state["State"] = income_state.GeoName.str.replace(" \*", "")
     state = pd.read_csv("Datasets/state_abbreviations.csv")
     income_state = pd.merge(income_state, state, on='State')
     income_state = income_state.pivot(values='2019', index='Code',␣
      ↪columns='Description').reset_index()
     print(income_state.shape)
     income_state.head()
```

```
(51, 4)

/var/folders/dl/pkdj8n7n6ps84w7d_v3vr0200000gn/T/ipykernel_9390/4290504551.py:2:
FutureWarning: The default value of regex will change from True to False in a
future version.
  income_state["State"] = income_state.GeoName.str.replace(" \*", "")
```

```
[ ]: Description Code  Disposable personal income (millions of dollars)  \
     0             AK                                           41899.7
     1             AL                                          196131.2
     2             AR                                          122878.1
     3             AZ                                          300174.7
     4             CA                                         2172607.7

     Description  Per capita disposable personal income (dollars) 2/  \
     0                                                      57115.0
     1                                                      39962.0
     2                                                      40675.0
     3                                                      41166.0
     4                                                      55090.0

     Description  Population (persons) 1/
     0                            733603.0
     1                           4907965.0
     2                           3020985.0
     3                           7291843.0
     4                          39437610.0
```

Now that I cleaned the dataframe grouped by state, I found the number of restaurants for each state. Then, I merged 'income_state' dataframe and the 'rest_count' dataframe which contains the number of restaurants in a given state.

```
[ ]: rest_count = restaurants.groupby(['province']).size().reset_index()
     rest_count.columns = ['Code', 'num_restaurants']
     temp = pd.merge(income_state, rest_count, on='Code', how="outer")
     temp.head()
```

```
[ ]:   Code  Disposable personal income (millions of dollars)  \
     0   AK                                           41899.7
     1   AL                                          196131.2
```

```
2   AR                                      122878.1
3   AZ                                      300174.7
4   CA                                     2172607.7

   Per capita disposable personal income (dollars) 2/  \
0                                             57115.0
1                                             39962.0
2                                             40675.0
3                                             41166.0
4                                             55090.0

   Population (persons) 1/  num_restaurants
0                 733603.0             64.0
1                4907965.0            635.0
2                3020985.0            124.0
3                7291843.0            186.0
4               39437610.0            727.0
```

Furthermore, I have found the number of burger restaurants in a given state. I included this data in to the previous dataframe. additionally, I have mutated two columns, 'rest_burger_density' and 'restaurant_density'. I finally initialized my main dataframe as it contains all variables I need to perform data analysis, visualizations and predictions.

```
[ ]: burger_restaurants = restaurants.loc[restaurants.categories.str.lower().str.
      ↪contains("burger")]
     burger_restaurants = burger_restaurants.groupby('province').size().reset_index()
     burger_restaurants.columns = ['Code', 'num_burger_restaurants']
     df_main = pd.merge(temp, burger_restaurants, on='Code')
     df_main['restaurant_density'] = df_main['num_restaurants'] /␣
      ↪df_main['Population (persons) 1/']
     df_main['burger_rest_density'] = df_main['num_burger_restaurants'] /␣
      ↪df_main['Population (persons) 1/']
     df_main.head()
```

```
[ ]:   Code  Disposable personal income (millions of dollars)  \
     0   AK                                       41899.7
     1   AL                                      196131.2
     2   AR                                      122878.1
     3   AZ                                      300174.7
     4   CA                                     2172607.7

        Per capita disposable personal income (dollars) 2/  \
     0                                             57115.0
     1                                             39962.0
     2                                             40675.0
     3                                             41166.0
     4                                             55090.0
```

```
   Population (persons) 1/  num_restaurants  num_burger_restaurants  \
0                 733603.0             64.0                      14
1                4907965.0            635.0                     221
2                3020985.0            124.0                      49
3                7291843.0            186.0                      81
4               39437610.0            727.0                     237

   restaurant_density  burger_rest_density
0            0.000087             0.000019
1            0.000129             0.000045
2            0.000041             0.000016
3            0.000026             0.000011
4            0.000018             0.000006
```

1.4 3. Summary Statistics

Lets view the summary statistics on ‘num_restaurants’ and ‘restaurant_density’ in order to later analyze which one is a better predictor

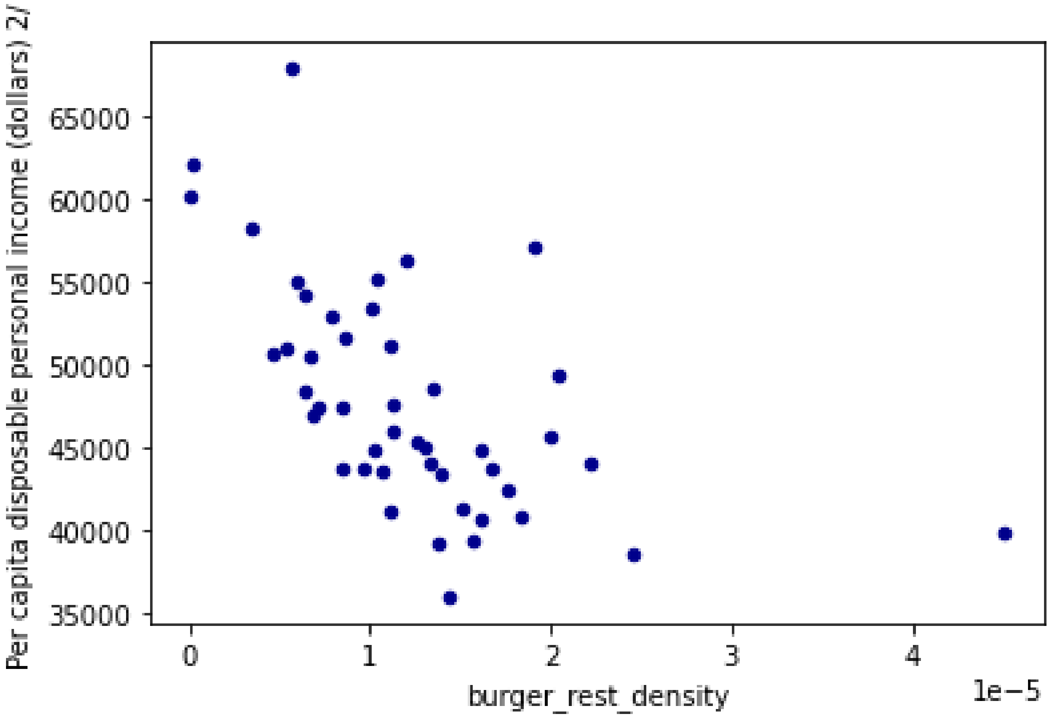
```
[ ]: df_main[['Per capita disposable personal income (dollars) 2/',␣
      ↪'restaurant_density', 'burger_rest_density']].describe()
```

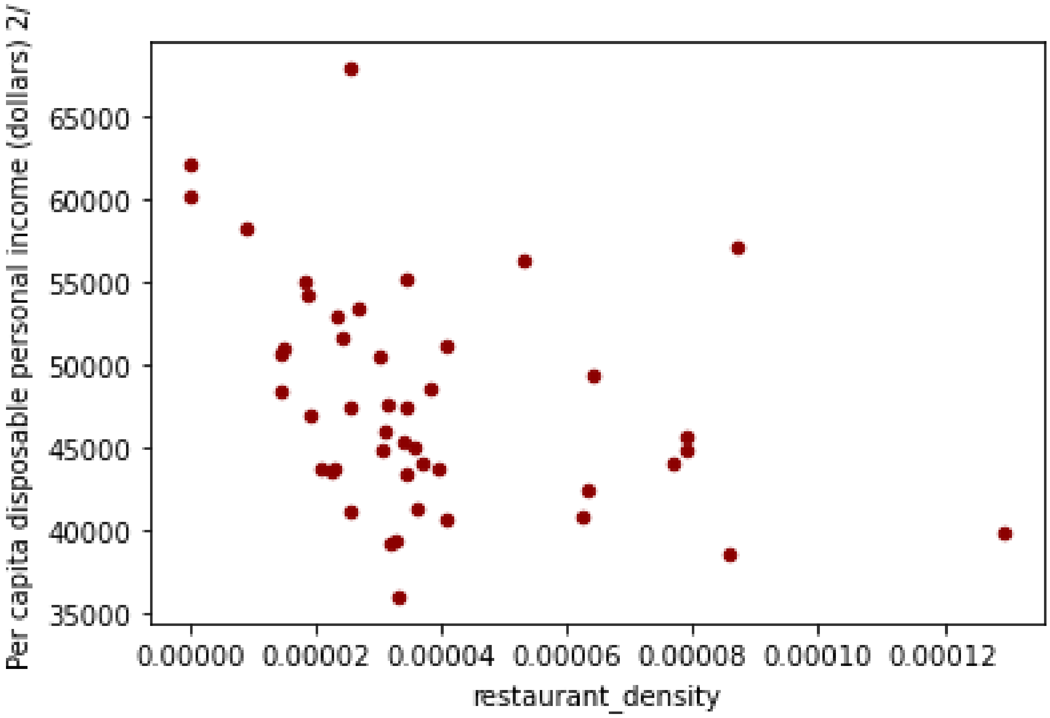
```
[ ]:        Per capita disposable personal income (dollars) 2/  restaurant_density  \
     count                                          46.000000        4.600000e+01
     mean                                        47868.543478        3.774336e-05
     std                                          6798.918328        2.522020e-05
     min                                         36031.000000        2.249400e-07
     25%                                         43585.750000        2.321761e-05
     50%                                         46491.500000        3.230678e-05
     75%                                         51511.750000        4.043670e-05
     max                                         67854.000000        1.293815e-04

            burger_rest_density
     count         4.600000e+01
     mean          1.223233e-05
     std           7.367714e-06
     min           1.124700e-07
     25%           7.339480e-06
     50%           1.121617e-05
     75%           1.556070e-05
     max           4.502885e-05
```

1.5 4. Visualization

```
[ ]: df_main.plot.scatter(x='burger_rest_density', y='Per capita disposable personal␣
     ↪income (dollars) 2/', c='DarkBlue')
     df_main.plot.scatter(x='restaurant_density', y='Per capita disposable personal␣
     ↪income (dollars) 2/', c='DarkRed')
```

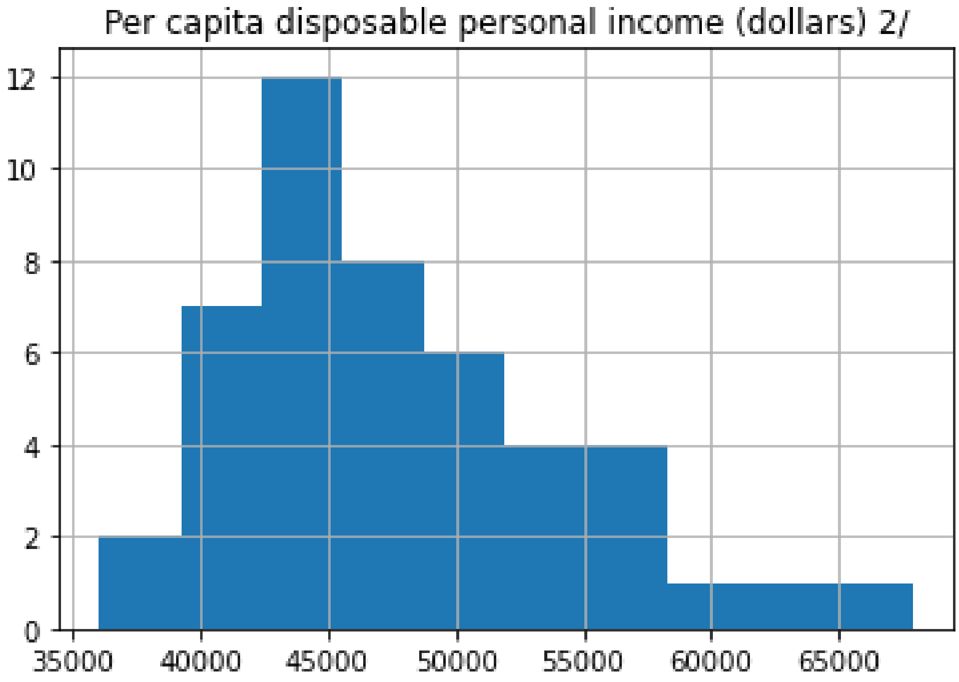
```
[ ]: <AxesSubplot:xlabel='restaurant_density', ylabel='Per capita disposable personal
     income (dollars) 2/'>
```

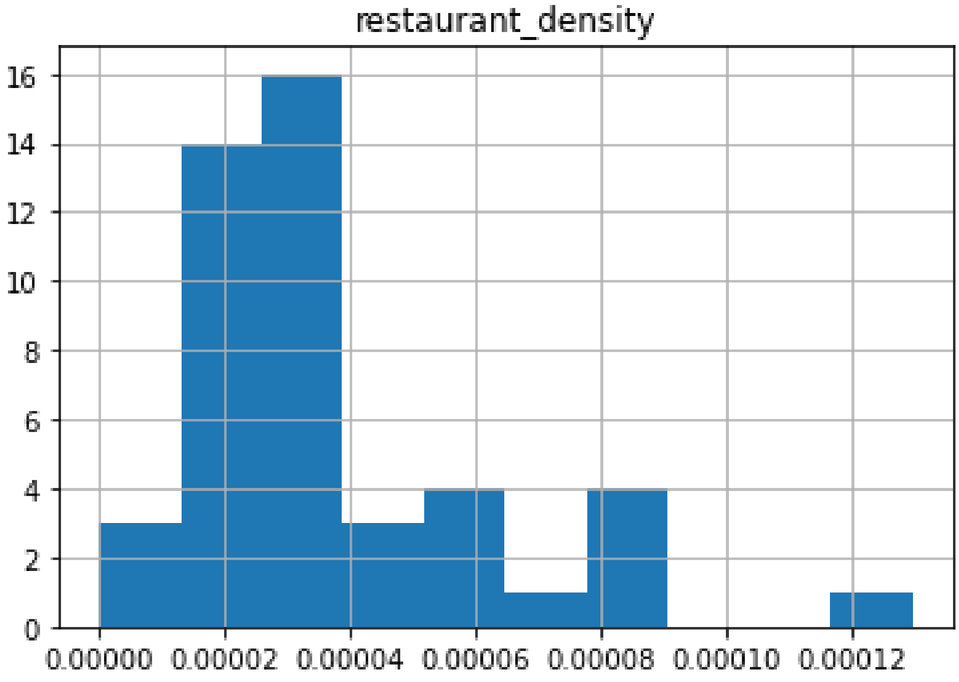


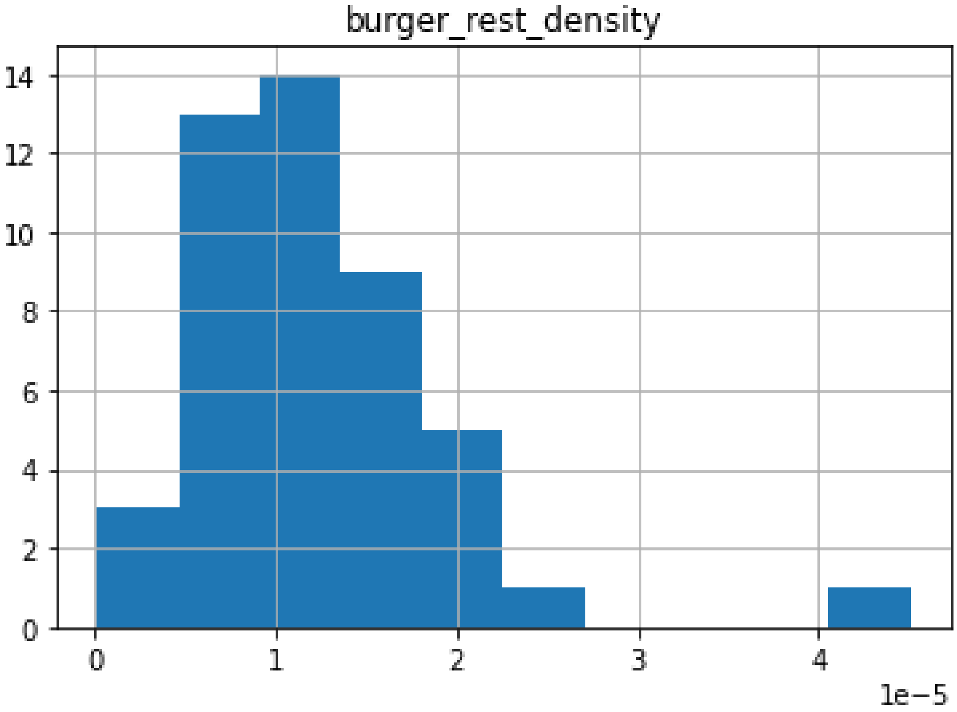


```
[ ]: df_main.hist(column='Per capita disposable personal income (dollars) 2/')
     df_main.hist(column = 'restaurant_density')
     df_main.hist(column= 'burger_rest_density')
```

```
[ ]: array([[<AxesSubplot:title={'center':'burger_rest_density'}>]],
           dtype=object)
```


Per capita disposable personal income (dollars) 2/
0
2
4
6
8
10
12
35000
40000
45000
50000
55000
60000
65000


restaurant_density
0
2
4
6
8
10
12
14
16
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
0.00012


burger_rest_density
14
12
10
8
6
4
2
0
0
1
2
3
4
1e−5

```
[ ]:
```