Commuting CO2 Emissions at UCDMC

2016 ESTIMATES

Joseph Lacap and Ernst Oehninger
UNIVERSITY OF CALIFNORNIA, DAVIS | DAVIS, CA

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4 Introduction

The University of California, Davis Medical Center (UCDMC) in Sacramento has a large population of commuters, resulting in significant annual carbon emissions. The population of the campus is approximately 13,500, most of which commute via personal occupancy vehicle (POV). The goal of this report was to quantify the CO_2 emissions resulting from the annual transport of the large UCDMC population. Working with the UCDMC Transportation and Parking Services (TPS), data and information regarding commuting habits and the Green Commuter Program (GCP) was gathered.

4.1 The Green Commuter Program

The Green Commuter Program at UCDMC is a combination of several incentives to entice commuters to consider alternate modes of transportation [1]. The goal of the program is to reduce the carbon footprint of the UCDMC by reducing the number of vehicles on the road. The program includes those commuters who are willing to commute by carpooling, Sacramento Regional Transit (RT), UCDMC shuttles, Amtrak, ZipCar, vanpools, walking, or biking.

There are several benefits to all members of the Green Commuter Program. All are eligible to access free rides home six times a year in case of emergency, with a very generous definition of “emergency”. Members of carpools and vanpools are each offered a free ride share pass which allows them to dive alone to UCDMC 24 times per fiscal year. An additional 24 days can be purchased for $3.50 per day [1,2]. Anyone commuting by transit can get $65 subsidized off of the $100 monthly pass for RT, or other transit agencies. Should a member of the Green Commuter Program register with the Sacramento Regional Commuter Club and log their trips, they earn raffle entries for prizes such as gift cards.

While the Green Commuter Program does not provide benefits solely for those commuting to work via zero carbon fashion (i.e. biking, walking or telecommuting), it advocates methods with a lower carbon intensity than driving alone. While these incentives will work to reduce the carbon footprint of the UCDMC, they will not be sufficient to reduce commuting emissions to zero.

4.2 Baseline Definition

At the request of the sponsor, the baseline CO_2 emissions were defined to be the emissions that would result if all commuters drove alone. While this is not a realistic scenario, it allows estimation of the avoided CO_2 emissions of the current mode split of the campus commuters. Effectiveness of the Green Commuter Program in terms of further reducing CO_2 beyond the no-incentive mode split will be assessed in a separate report.

4.3 Assumptions

Several assumptions had to be made during the data analysis process, they were:

1. All commutes are less than 100 mi.
    a. There was some data showing longer distances, these were considered in error. See section 2.1
2. The average commuter travels to the UCDMC 4 times a week.
    a. Longer work days result in fewer work days per week at the hospital.
3. Carpools consist of 2 people.
    a. This is an underestimate, but 3 people would likely be an over-estimate since most carpools are 2 people.
4. All commutes originate from the center of the given zip code, and go to: UC Davis Medical Center, 2315 Stockton Boulevard, Sacramento, CA 95817.
    a. No more detailed data was available.
    b. The exception was for people commuting from a location on campus, where the distance was assumed to be 0.5mi.
5. Fuel Economy is equivalent to the EPA city MPG rating.
6. Fuel Economy of public transit is 6 MPG
7. There are 18 people per ‘transit’ (bus occupancy)
    a. This is the average number of people commuting by transit from a given zip code
8. All personal vehicles and carpools run off gasoline
9. All transit vehicle run off of diesel

5 The Data

Commute data was obtained from parking permit applications and the 2014 campus travel survey [3].

5.1 Parking Permit Data

Parking permit data was the primary data source used in the analysis. Some limitations of this data included that the population was self-selecting for those who were more likely to want to drive. The data also included those who were members of the GCP, but this was unlikely to capture all those who commute via “green” methods. Additionally, it was known to the UCDMC TPS that there were a substantial number of campus affiliates who drove alone and parked on public streets around the campus to avoid paying for parking permits. (Some also admitted to this in our survey). These drivers were not taken into account as there was no way to collect reliable data on them.

The parking permit data was a list of all parking permits distributed to UCDMC affiliates. It included parking permit numbers, zip codes of the applicants, and the permit type. Below is a list of permit types that had zip codes associated with them:

1. CP: Carpool Permits
    a. 1 Permit per carpool group, but with each person in the carpool tagged as CP.
2. BIKE: Permits that allow regular bikers to drive to work a limited number of times per year.
3. PDBR: Type B permit for resident doctors
4. PDD: Type D permit, for parking garage
5. PDB: Type B permit
6. SHMO: Inter-campus shuttle pass
7. TRANS: Transit permit
    a. For those taking public transit other than Sacramento RT.
8. RTMO: Regional Transit Monthly Pass
    a. For those taking Regional Transit

The parking permit data for those who usually walk to campus did not include zip code data.

There were several issues with the parking permit data. There were permits with missing zip codes, which meant commute distance could not be calculated. There were several zip codes that were outside of the US, or unreasonably far from campus. It was suspected that some permit applicants used their permanent address when applying for permits rather than the address from which they commute to campus. This issue was resolved by assumption 1, that all commutes are less than 100 miles.

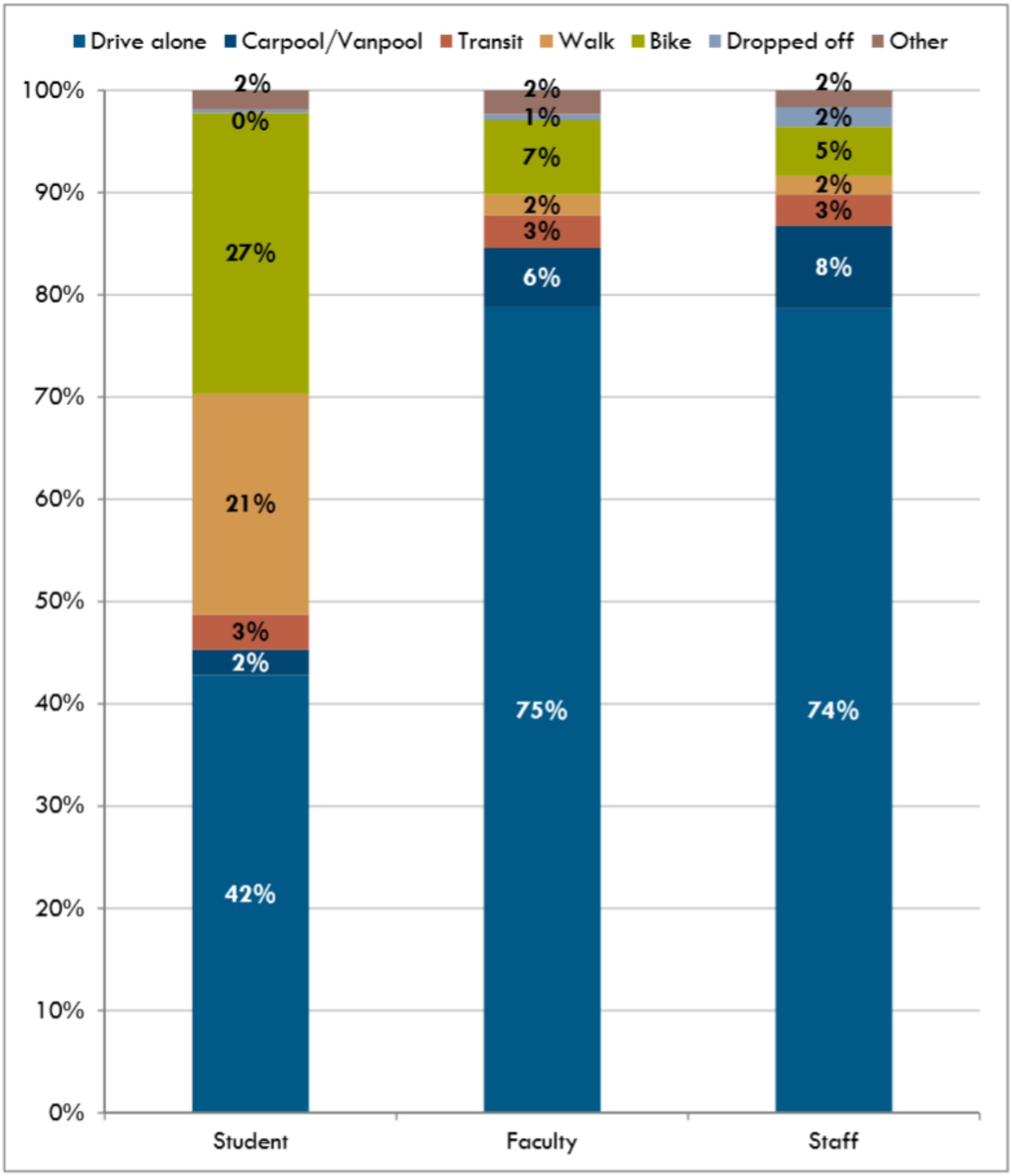
5.2 Parking Lot Data

In order to calculate the CO_2 resulting from commuting a given distance, fuel economy data was needed. This was not available from the parking permit data or the transportation survey. To collect this data, 197 vehicles across four UCDMC parking lots were identified. Pictures were taken of the rear of the vehicle, then the model and year were looked up to obtain EPA City MPG. The city MPG was used for all vehicles despite many commutes occurring on the highway. This one done because vehicles tend to get worse than advertised fuel economy, especially if they are old, and traffic during commute hours significantly reduces duel economy. The weighted (for number of each vehicle type) average fuel economy was found to be 24.4 MPG. This was in good agreement with the average fuel economy in California of 25.2MPG [9].

5.3 Transportation Survey Data

The UCDMC 2014 Travel Survey was the secondary source of data for the analysis. It provided a check for overall mode share, as well as a less self-selecting group of commuters, since it was not restricted to those who applied for a parking permit. The survey represented 4802 responses, a ~32% response rate. Unfortunately, the data used for the transportation survey was not available due to it having been conducted by an external consulting firm, so only the summary results could be analyzed. The mode share results from the travel survey are shown below in Figure 1.

Figure 7-5 Survey Respondent Mode Share by Campus Affiliation



N = 320 (student); 334 (faculty); 3,793 (staff)

Figure 1: Mode split results from the 2014 travel survey. Source [3].

Another advantage of the travel survey was that it separated students from the faculty and staff in the mode split and travel distance analysis. As can be seen from the mode split results in Figure 1, the student mode share is significantly different (and 'greener') than the faculty and staff. Part of the reason for this can be seen in the travel distance distribution in Figure 2. More than half of the students travel from less than 2 miles from campus, whereas only 12% of the faculty and staff travel from less than 2 miles from campus. This alone is enough to significantly reduce the number of people who are willing to walk or bike commute rather than drive.

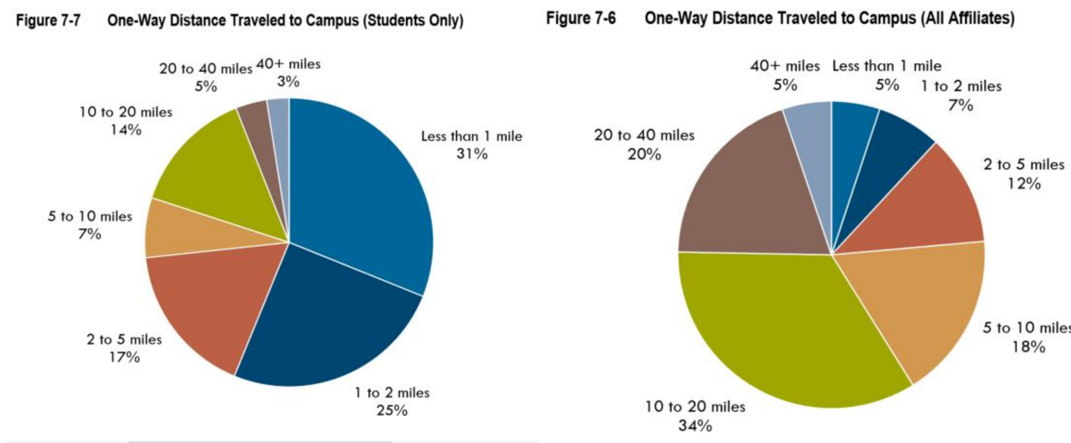


Figure 2: Travel distance to campus of students (left) and of faculty and staff (right). Source [3].

5.4 Shuttle Data

Additional data was obtained regarding the shuttles operated by UCDMC. The TPS provided fuel usage data for the shuttles, allowing relatively accurate calculation of the CO_2 emissions resulting from shuttle operations. The data was given in terms of gallons of diesel and gasoline purchased.

6 Data Analysis

6.1 Parking Permit Data

The parking permit data was processed using Matlab R2014a [5]. The data was first reformatted into a form more workable with Matlab.

6.1.1 Zip Codes

The list of zip codes associated with a parking permit was used to create a list of unique zip codes. For data validation, this list was checked against a list of all US zip codes [4], zip codes that failed this check were marked as invalid and their data was ignored. Using the MapQuest directions service API [6], the driving distance and driving time from each of the unique zip codes to the UCDMC was found. The directions look up was set to find the route with the fastest travel time.

6.1.2 Travel Modes (Permit Types)

The permit types were equated with travel mode. To determine the travel mode split for each zip code, each permit's zip code was compared against the list of unique zip codes, and when a match was found, that zip code was given a 'tick' for the given travel mode. To make the data more legible, the zip codes were binned by distance from the UCDMC. The distance bins (in miles) are show in Table 1.

1	2	3	5	7	10	15	20	25	30	35	40	45	50	60	70	80	90	100

Table 1: Distance bins for zip codes in driving miles to UCDMC.

These values were the upper limit of each bin, so for example, $1 => 0 - 1\ mi$ and $100 => 90 - 100\ mi$ from campus. The values used for the distance of each bin from the UCDMC was the weighted average of the distance of all the zip codes that fell within each bin, weighted for the number of people in each zip code. The result was a list of zip codes with the corresponding driving distances from campus, and the number of each permit type for that zip code. This data was then exported to Excel 2016 for final analysis.

6.2 Travel Survey

The travel survey data was entered into Excel 2016 from the Figure 1 and Figure 2. The primary purpose of the travel survey data was to check if the parking permit data aligned with its results reasonably well, and to provide an estimate for including those who walk in the parking permit data.

6.3 Mode Split and CO_2 Analysis

From the data in Appendix A6: Binned Zip Code and Permit Data mode split data was calculated. For each mode, the fraction of commutes using that mode were calculated for each distance (mode distance distribution). Additionally, the fraction of all commutes at a given distance that were done by a given mode was calculated (mode split by distance). The mode split data was then used for CO_2 calculations.

6.3.1 Baseline CO_2 Calculations

To estimate CO_2 emissions from a vehicle, distance traveled and fuel economy are needed. The distance was provided by the zip code data, and the MPG was found from the parking lot survey. According to the U.S. EIA (Energy Information Administration) [7], for every gallon of gasoline combusted, 8.89kg CO_2 is released, and for every gallon of diesel, 10.16kg CO_2 is released. Combined with MPG, the kg CO_2/mi can be calculated:

$$\frac{8.89\frac{kgCO_2}{gal}}{24.4\frac{mi}{gal}} = 0.364\frac{kgCO_2}{mi}$$

A similar calculation can be done for diesel, but the baseline emissions assume everyone drives.

The population of the UCDMC is 13,333. This was multiplied by the driving distance distribution (the fraction of all driving trips that occur at each distance), to obtain the total number of people commuting from each distance. The commute distance was the multiplied by 2, since people also have to go home at the end of the day. In accordance with assumption 2, this number was multiplied by 4 (four commute days per week), and then by 52 work weeks per year. This provides the total number of miles driven per year in the baseline case, which is converted to CO_2 based on the above 0.364 $kgCO_2$/mi.

6.3.2 Current Mode Split CO_2 Calculations

The calculations for the current mode split CO_2 emissions were done using the mode share by distance data. This calculates the number of people commuting by each mode at each distance from campus. The carpool data counted the total number of people who carpool, not the number of carpools from each zip code. So using assumption 3, when carpool miles were calculated, they were divided by 2. Similarly, for transit, the miles traveled were divided by the number of people on each vehicle. Since people who registered for green commuting parking permits were allowed to drive 24 days per year, this CO_2 was also added to account for green commuters not always commuting 'greenly'.

The total CO_2 emissions generated by the campus shuttles is known, so calculating the shuttle miles and estimating CO_2 emissions via MPG was unnecessary. This however brought up another question about the scope of these calculations. If the scope were to only include emissions directly from commuting, then the MPG would be used to extract only the fuel used for commuting to or from work. But the shuttles run even when there are not commuters, may be empty, and have to drive when not in service. This still results in emissions related to commuting that UCDMC is responsible for, but may not be directly related to the commuting of affiliates as a standard means of transportation.

As a compromise solution, the full fuel use for the shuttles was included in both the 'everyone drives' baseline scenario, and the current mode split data. The reasoning being that even if everyone drove to work, the shuttles would still be running for guests of the UCDMC, or to transport affiliates around the campus. This means that if a driver from the baseline case switched their primary mode to taking the shuttle, a car would have been removed from the road at no cost. So this approach amplifies the benefit of a commuter switching to a greener mode, but also increases the total emissions for which UCDMC is responsible.

7 Results

7.1 Shuttles

From the shuttle operational data, the fuel use and CO_2 emissions based on the fuel type are shown in table (Table 2).

	Fuel (gal)	CO2 (kg)
Gasoline	3174.2	28219
Diesel	25432.9	258398
Total	28607.1	286616

Table 2: Shuttle operational data from, total fuel used during 2014 by fuel type.

7.2 Baseline Case

The simplest case is the baseline case. All commuters at a given distance were assumed to drive, giving the following commute distance distribution (Figure 3: Commute distance distribution for the baseline case (everyone drives). This is also the overall distribution of how far affiliates live from campus.), which can also be used as an overall measure of how far away people live from campus. Note the first smaller peak before the main peak of the distribution. Comparing this to the results of the travel survey (Figure 4), it can be seen that this peak is mostly due to the 800 students who study at UCDMC.

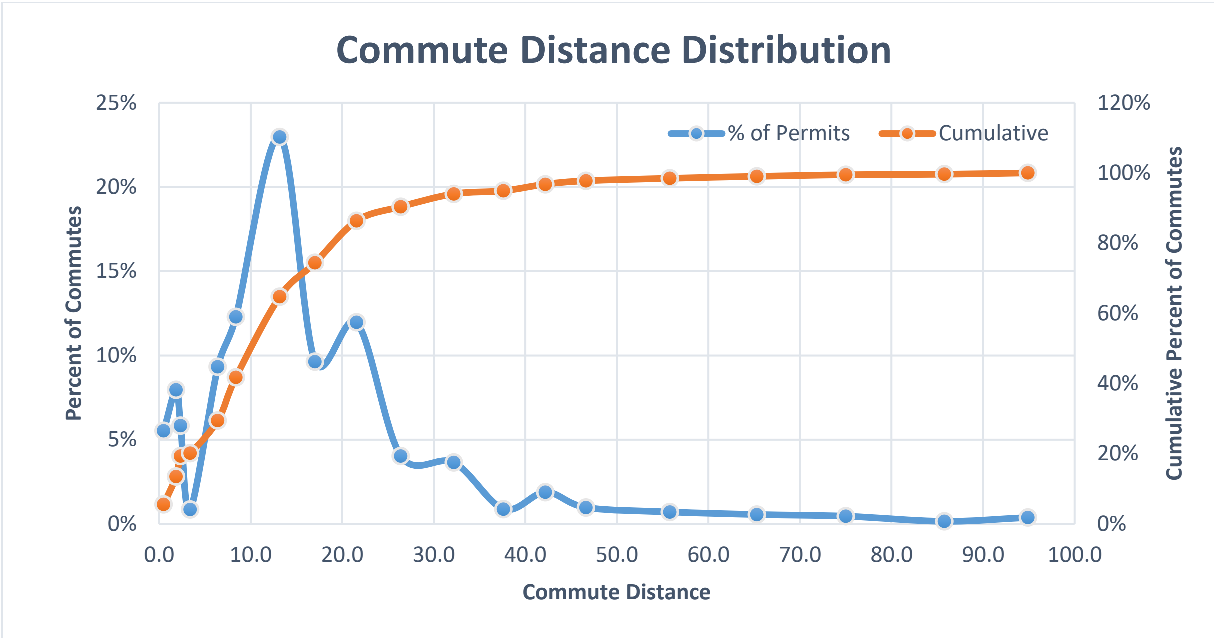


Figure 3: Commute distance distribution for the baseline case (everyone drives). This is also the overall distribution of how far affiliates live from campus.

Multiplying this curve by the total population of the UCDMC gives the total commute miles of 199,000 miles, for one day, one way. Over a year of commutes 4 times a week both ways, this becomes **82.9 million annual commute miles**. At 24.4 MPG, this uses **3.4 million gallons of gasoline**, and emits **30.2 million kg of CO_2.** Adding the shuttle related CO_2 from Table 2, the total baseline CO_2 emissions were found to be **30.5 million kg CO_2.**

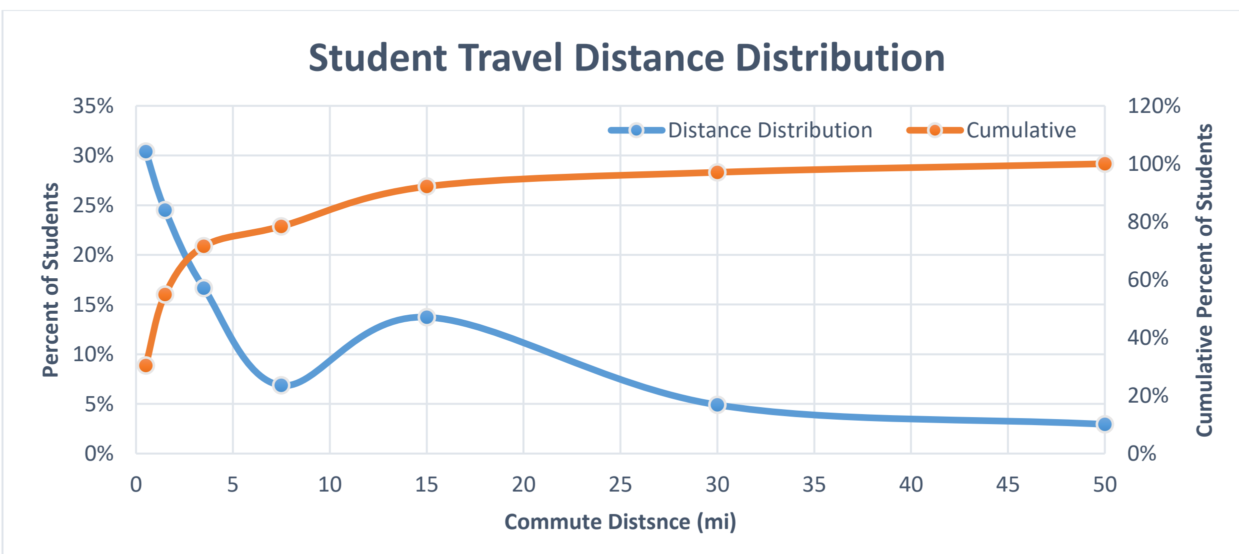


Figure 4: Distance from campus that the 800 students commute from. Students live closer to campus than employees and staff.

7.3 Current Mode Split

The current mode split as measured by parking permit applications did not include the zip codes for those who walk to campus, and the travel survey provided little detail, giving only the overall mode split. However, they agreed, generally, on the overall fraction of commuters who walked (2%). The advantage of the travel survey was that it separated data out specifically for students. The survey done on members of the Green Commuter Program was used to estimate the walking distance mode share. Based on the UC Davis (main campus) travel survey [8] and the UCDMC travel survey, the walking distribution was approximated, while ensuring that the total number of people predicted to walk remained as close as possible to the overall mode split found by the UCDMC travel survey. Both the distributions according to the parking permit data (Figure 5), and the corrected version (Figure 6) are shown below.

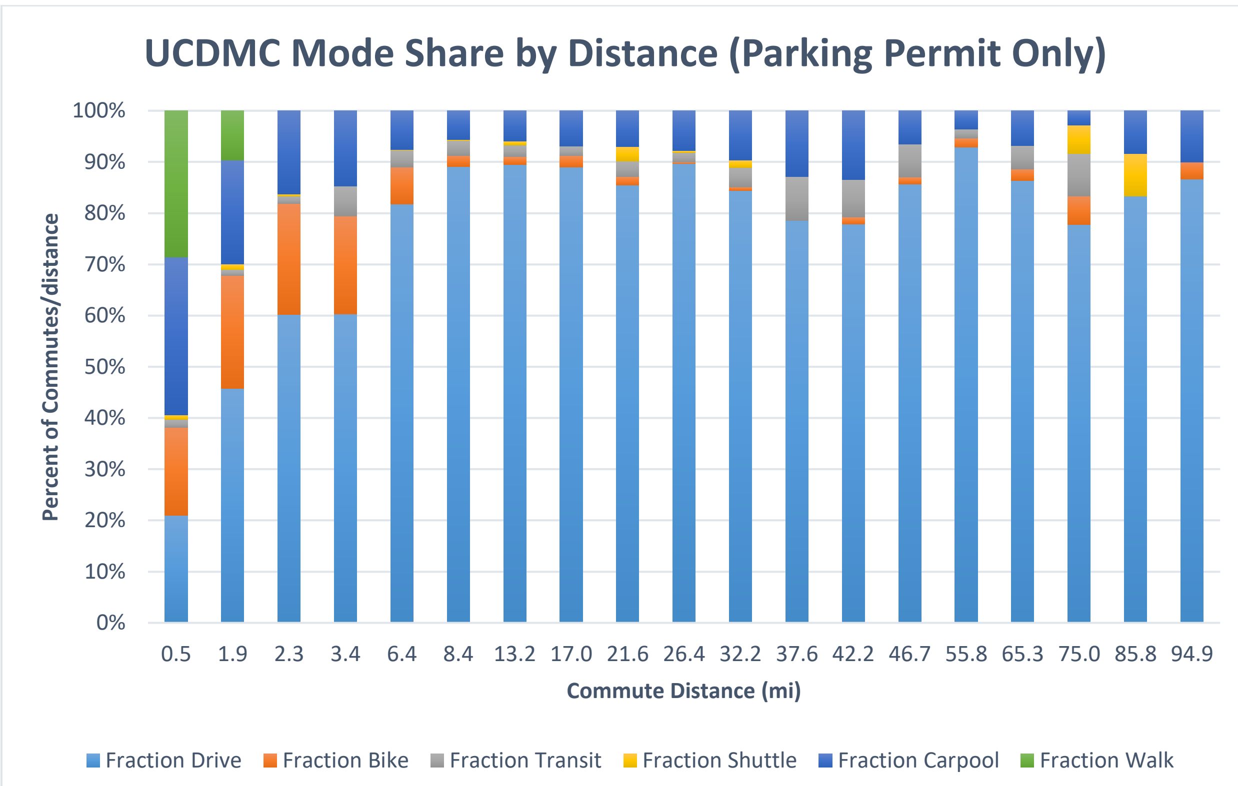


Figure 5: Travel mode share by distance from UCDMC based on only the parking permit data.

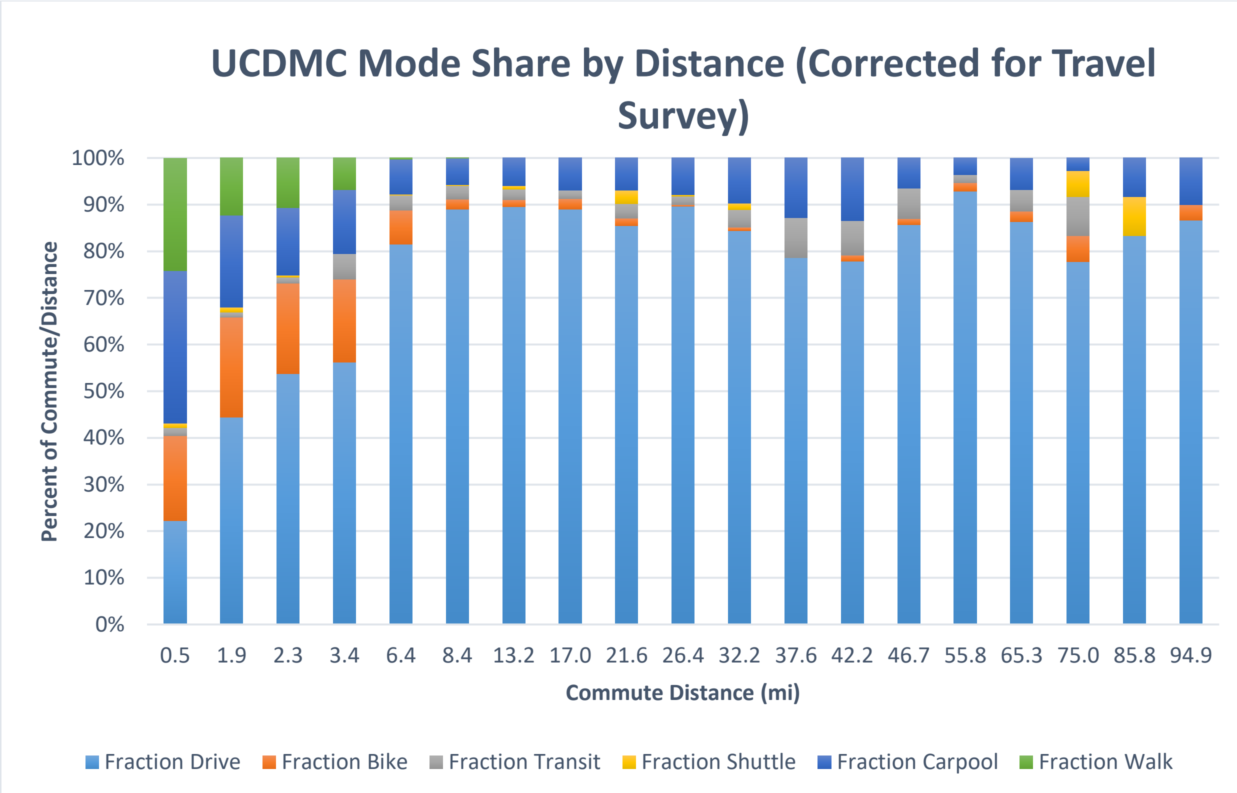


Figure 6: Travel mode share by distance from UCDMC based on the parking permit data and corrected to account for the travel survey.

Another way to look at the mode split is to see how each mode changes with distance. Figure 7 shows what fraction of each mode occurs at each distance from the UCDMC. This data multiplied by the percent of all trips that are from each distance and the population provides the number of people commuting by each mode from each distance, and thus the total commute miles of each mode as shown in Table 3. Note that there are two very large peaks in the number of commuters taking the UCDMC shuttle at 13 and 21 miles. This is because both the zip codes associated with those distances were located in Davis, CA where the shuttle stops were at UC Davis. It made sense then that a large number of commuters would take the inter-campus shuttle at those distances. This also explains why such a large number of the total commuters, as seen in Figure 3 commute from 13 miles, since this was the zip code for northern Davis.

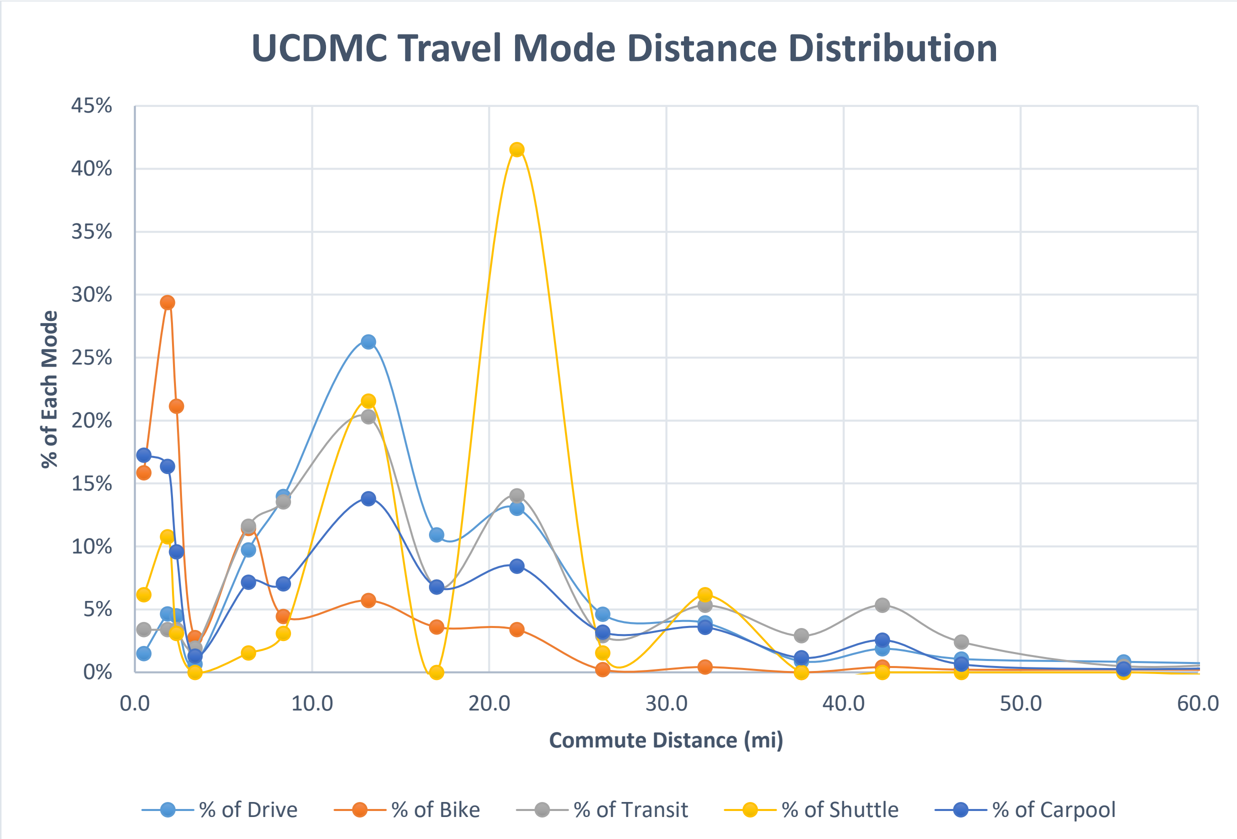


Figure 7: Distance distribution of each travel mode.

Distance	Drive Miles	Carpool miles	Transit miles	Shuttle Miles
0.5	79.2	46.5	0.3	0.3
1.9	921.8	163.3	1.2	2.2
2.3	1124.6	121.4	1.6	0.8
3.4	239.9	23.4	1.3	0.0
6.4	6673.7	247.5	14.7	1.1
8.4	12544.5	317.9	22.5	2.9
13.2	37002.7	980.7	53.0	31.8
17.0	19921.1	622.0	22.8	0.0
21.6	30105.4	981.2	59.9	100.4
26.4	13011.1	454.9	15.2	4.5
32.2	13531.0	621.1	33.9	22.2
37.6	3565.0	233.3	21.6	0.0
42.2	8432.4	581.5	44.4	0.0
46.7	5304.1	160.7	22.3	0.0
55.8	4998.7	76.9	5.3	0.0
65.3	4275.2	135.0	12.5	0.0

75.0	3618.8	51.7	21.5	25.8
85.8	1477.6	59.1	0.0	14.8
94.9	4251.3	196.2	0.0	0.0
Sum (mi)	**171,078**	**6074**	**354**	**206**
CO_2 (kg)	**62,331**	**2213**	**600**	**525**

Table 3: One-way commute miles of each mode, parking permit data only.

The CO_2 emissions from one way commuting, including only shuttle emissions related to commuting to and from work was 65,670 kg CO_2. Over a year of two way commuting four times a day, 52 weeks a year, this was 27.07 million kg CO_2. Counting all shuttle CO_2 emissions from Table 2, the current mode split CO_2 emissions were **27.1 million kg CO_2 per year**. The CO_2 emissions avoided compared to the baseline case was **2.7 million kg CO_2/year**.

Correcting the distributions shown in Figure 7 according to the travel survey, as in Figure 6 adds 610 'walk miles' to the daily commute, or 254,000 walk miles per year, reducing yearly commute related CO_2 emissions to **26.1 million kg CO_2**. This was a reduction of **2.6 million kg CO_2 per year** over the corrected baseline value. Note that the savings in the corrected case were found to be lower than the uncorrected case. This is because the corrected case included students who do not commute as far, which significantly reduced the carbon footprint of the corrected baseline case. Even though the relative savings compared to the corrected bassline were smaller, the total emissions were much lower than the emissions from the uncorrected case.

Summary of Results	**CO_2 (Mkg/year)**	**Reduction from Baseline (Mkg/year)**
Baseline	**29.8**	**0**
Baseline (Corrected)	**28.7**	**0**
Current	**27.1**	**2.7**
Current (Corrected)	**26.1**	**2.6**

Table 4: Summary of CO2 reduction from baseline case.

8 Conclusions

The UCDMC was found to be avoiding the emission on 2.7 million kg of CO_2 per year from the baseline case of everyone driving to UCDMC. While this is not a particularly realistic approach to calculating real reductions in CO_2, it provides a measure of the 'green-ness' on the current mode split. To evaluate the 'actual' CO_2 savings the UCDMC gets, a measure of the Green Commuter Program's effectiveness is required. This will be addressed using the results of the survey in the next report.

The campus travel survey results are far too imprecise to accurately calculate CO_2 emissions. Either the raw data from travel surveys should be made available, or the results summary should include plots such as Figure 5. This will enable more accurate calculation of CO_2 emissions.

9 References

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10 Appendix

10.1 A1: Matlab Code to Extract Data from Original Excel Format

```
%% Import Zip Code Data from Excel
%Joe Lacap 4-19-2016 jhlacap@ucdavis.edu

%This script loads the UCDMC Parking permit data provided by Sarah Janus
% (stjanus@ucdavis.edu) at the UCDMC Transpiration and Parking Services.
%It loads the data and formats it to make it easier to parse in other
%Matlab codes and in Excel. This includes: 1) finding the total number of
%occurrences of each zip code. 2) Removing text from numerical data columns.
%3) Removing NaN values from numeric data. 4) Extract the list of zip codes
%that have a distance from campus listed next to them, and associate that
%distance with the zip code. 5) Estimate the total commute miles at everyone
%at UCDMC based on the zip code distances provided.

clear

%% Read Spreadsheet
data = xls2struct('Zip_Codes.xls');
Zips = data.Zips;
Dist = data.Distance;

%% Parse the Zip Code Data

%Extract Carpool Info
CP = data.I; %Store Column with Permit types
CP_zips = zeros(length(CP),1); %Store zip codes with CP permits
CP_people = zeros(length(CP),1); %Number of people in each zip code who
carpool


for i = 1:length(CP)
    if length(CP{i}) > 61
        %Error checking
        text = (CP{i});
        test = strfind(text, 'CARPOOL');
        star = strfind(text, '*');
        %Save the number of people and the zip codes for the carpools.
        if and(~isempty(test),isempty(star))
            in = strfind(text, 'in');
            equal = strfind(text, '=');
            par = strfind(text, '(');
            CP_zips(i) = str2num(text(in+3:in+8)); %32:36 is where the zip
code is in the string
            CP_people(i) = str2num(text(equal+2:par-1));
        end
    end
end


%Throw away the zeros.
i = find(CP_zips);
CP_zips = CP_zips(i);
```

```
i = find(CP_people);
CP_people=CP_people(i);



%rename NAN, ZIP, and NO ZIP to 0.
for i = 1:length(Zips)
    if strcmp(Zips{i}, 'ZIP')
        Zips(i) = {'00000'};
    end

    if strcmp(Zips{i}, '*NO ZIP*')
        Zips(i) = {'00000'};
    end

    if isnan(Zips{i})
        Zips(i) = {'00000'};
    end

    Zips{i} = str2double(Zips{i});

end

Zips = cell2mat(Zips);

%Throw away things that aren't zip codes
ind = find(Zips);
Cleaned = Zips(ind);
clear Zips
zips = Cleaned;
clear Cleaned ind i;

%% Clean up and parse distance data

for i = 1:length(Dist)
    if isnumeric(Dist{i})
        Temp(i) = Dist{i};
    end
end
clear Dist
%Remove NaN's
Dist = NoNaNs(Temp);
clear Temp
%Dist is now a double

%% Extract Zip Codes Coresponding to Distance

%Get only numeric data
zipDist=data.Zip_Dist;
for i = 1:length(zipDist)
    if isnumeric(zipDist{i})
        Zip_Dist(i) = zipDist{i};
    end
end
```

```
%Remove strings
ind = find(Zip_Dist);
Cleaned = Zip_Dist(ind);
clear Zip_Dist ind
zipDist=Cleaned;
clear Cleaned

%remove NaN's
Zip_Dist = NoNaNs(zipDist);



clear ind i zipDist

%Zip Dist is now a list of zip codes assosiated with the distances in Dist

%% Find Occurances of Each Zip Code
data = xlsread('NiceZipCodeData.xlsx');
y = data(:,1);  %Zip code for each permit
data(:,6)=0;
for i = 1:length(y);
    ind = find(data(:,5)==y(i));
    data(ind,6) = data(ind,6)+1;
end


%% Estimate Total Commute Miles

miles = nansum(data(:,4).*data(:,6));
```

10.2 A2: Matlab Code to Look Up Driving Distance

```
%% Use Google Maps to find the distance between the listed unique zipcodes
and the medical center
%Joseph Lacap, jhlacap@ucdavis.edu, 5/7/2016

%The purpose of this script is to do a mass lookup of the driving distance
%between a given zipcode and the UCDMC. This script looks up driving
%directions on Mapquest.com to calculate the driving distance, not the
%straight line distance between a zipcode and the UCDMC. The list of unique
%and valid US zip codes from parking permit holders at UCDMC is used. The
%script also uses "USzip_code_database.xls" obtaied from
%http://www.unitedstateszipcodes.org/zip-code-database/ under the
%University Research Lisence to check that zipcodes provided to Mapquest
%are valid zipcodes. The script will consider any zipcode that Mapquest
%fails to find driving directions for to be an invalid zipcode. This means
%zipcodes from Hawaii, for example, will be considered invalid.

%% Import Zip codes
data= xlsread('NiceZipCodeData.xlsx');
zips = data(1:316,5);
clear data

%Load database of US Zipcodes
data = xlsread('USzip_code_database.xls');
USzips = data(:,1);
clear data

%Check which zips are real zip codes
validZips=ismember(zips, USzips);
%Mapquest
%http://www.mapquestapi.com/directions/v2/route?key=YOUR_KEY_HERE&callback=re
nderAdvancedNarrative&ambiguities=ignore&avoidTimedConditions=false&doReverse
Geocode=true&outFormat=json&routeType=fastest&timeType=1&enhancedNarrative=fa
lse&shapeFormat=raw&generalize=0&locale=en_US&unit=m&from=95693&to=UC Davis
Medical Center, 2315 Stockton Boulevard, Sacramento, CA
95817&drivingStyle=2&highwayEfficiency=21.0
%% Look up the zip codes distance on Mapquest
%length(zips)
key = 'kmFGzJlLnS74eSDuSLz12890fGhcwYoi';  %Mapquest ID key

%The UCDMC in Sacramento. This can be any address.
from = 'UC Davis Medical Center, 2315 Stockton Boulevard, Sacramento, CA
95817';

modes = [{'fastest'}, {'shortest'}, {'pedestrian'}, {'multimodal'},
{'bicycle'}];
selectedMode = modes{1};
%Possible calculation methods. Multimodal includes transit. Default is
%fastest.

MPG = 24; %Miles Per Gallon


Dists = zeros(length(zips),1); %Distances for each zipcode, mi
```

```
%travelTime = zeros(length(zips),1);%travel time from each zipcode, sec
invalidZips = zeros(length(zips),1); %Store the index of invalid zip codes


for i = 1:length(zips)

    if and(validZips(i), zips(i) > 10000) %Make sure is a 5 digit zipcode

        if zips(i) == 95817; %This is the UCDMC zipcode
            Dists(i) =0.5;
            TravelTime{i} = '120';

        else %If this is NOT the UCDMC zip code

            %Put the zipcode in the search
            to = num2str(zips(i));
            %url =
strcat('http://www.mapquestapi.com/directions/v2/route?key=', key,
'&callback=renderAdvancedNarrative&ambiguities=ignore&avoidTimedConditions=fa
lse&doReverseGeocode=true&outFormat=json&routeType=',selectedMode,'&timeType=
1&enhancedNarrative=false&shapeFormat=raw&generalize=0&locale=en_US&unit=m&fr
om=', from,'&to=',to,'&drivingStyle=2&highwayEfficiency=', num2str(MPG));
            url =
strcat('http://www.mapquestapi.com/directions/v2/route?key=', key,
'&callback=renderAdvancedNarrative&ambiguities=ignore&avoidTimedConditions=fa
lse&doReverseGeocode=true&outFormat=json&routeType=',selectedMode,'&timeType=
1&narrativeType=html&enhancedNarrative=true&generalize=0&locale=en_US&unit=m&
from=', from,'&to=',to,'&drivingStyle=2&highwayEfficiency=', num2str(MPG));
            %Get the data from Mapquest
            Mapquest = urlread(url);

            %% Parse the URL

            %error checking
               noRoute = 'We are unable to route with the given locations';
               ohNo = strfind(Mapquest, noRoute);
               if and(exist('ohNo'), ~isempty(ohNo)) %Invalid zipcode
                   Dists(i) = 0;
                   travelTime{i} = '0';
                   invalidZips(i) = i;
                   clear ohNo
               else %There is a route

            %Find the driving distance
            distIndex = strfind(Mapquest,'distance');
            Dists(i) = str2num(Mapquest(distIndex(1)+10:distIndex(1)+14));

            %Find the travel time
            timeInd = strfind(Mapquest, 'realTime');
            travelTime{i} = Mapquest(timeInd+10:timeInd+13);
               end
        end

    else %If the zipcode is invalid
        Dists(i)=0;
```

```
        travelTime{i} = '0';
        invalidZips(i) = i; %Store the index of invalid zip codes
    end
    pause(5); %Wait 5 seconds to avoid overloading Mapquest server
end

%% Find all the invalid zipcodes
invalidZipcodes(:,1) = find(invalidZips);
for i=1:length(invalidZipcodes)
    invalidZipcodes(i,2) = invalidZips(invalidZipcodes(i,1));
end
%InvalidZipcodes stores the index of the bad zip codes in column 1, and the
%value of the invalid zipcode in column 2.

clear distIndex i key Mapquest modes timeInd url noRoute
```

10.3 A3: Matlab Code to Bin Zip Codes by Distance and Determine Mode Split

```
%% Analyze Mode Distribution for UCDMC
%Joseph Lacap 5/7/2016 jhlacap@ucdavis.edu

%This uses the data saved in the spreadsheet "NiceZipCodeData" that was
%generated using "ParseZipData.m", then modified a little manually. It also
%uses data from "ZipCodeDistanceMapQuest.m", which was saved to a Matlab
%data file manually (as in the save command is not part of that script).
%The purpose of this script is to: 1) count the number of each permit type
%held in each zipcode. 2) Bin the zipcodes that are similar distances away
%from the UCDMC campus to make data analysis easier. The results from this
%spreadsheet were manually saved using xlswrite() and can be seen in
%"UCDMCModeDist3.xlsx".

clear
%% Load Data
data = xlsread('NiceZipCodeData.xlsx');
data2 = xls2struct('NiceZipCodeData.xlsx');
data3 = load('MapquestDistanceCalculation.mat');


%% Filter Mode Data
modes = ['PDB  '; 'CP   '; 'BIKE '; 'PDBR '; 'PDD  '; 'SHMO '; 'TRANS'; 'RTMO '];
modes=cellstr(modes);
modeData = data2.Mode0x2FPermit;

checkPermit = ismember(modeData, modes);


%% Get Valid Zipcodes
uniZips = data3.zips;  %all unique zip codes
invalid = data3.invalidZips;


%% Loop throuh all zip codes
sorted = zeros(length(uniZips),length(modes)+2);
%Sorted = [Zipcode, distance, PDB, CP, Bike, PDBR, PDD, SHMO, Trans, RTMO]

sorted(:,1) = uniZips;
sorted(:,2) = data3.Dists;

%Look for each mode, then add ticks to each zip for each mode found
for i = 1:length(modeData)
    index = find(uniZips== data(i,1));

    if and(invalid(index) ==0, checkPermit(i)) %If this is a valid zipcode and permit type

        %Determine the mode
        x=strcmp(modes, modeData(i));
        modeInd = find(x);
        sorted(index,modeInd+2) = sorted(index,modeInd+2)+1;
```

```
    else
        %Do something if invalid zipcodes or permits?
        %If the permit is invalid, ignore it.

        if invalid(index) %If the zipcode is invalid, set values to -1
        sorted(index,2:10) =-1;
        end

    end
end

%% Make sure all entries are unique
sorted = unique(sorted, 'rows');

%% Sum values for similar distance zip codes
%bins = linspace(0,100,50); %Bins of distance, 2mi each
bins = [1,2,3,5,7,10,15,20,25,30,35,40,45,50,60,70,80,90,100]; %Bins of
distance
%These are the upper limits of the bins

sorted = sortrows(sorted,2);
for i = 1:length(bins)
    if i ==1 %To avoid accessing bins(0)
        ind = find(and(sorted(:,2)<=1, sorted(:,2)>=0));
        if length(ind) <2
            binned(i,:)=sorted(ind,:);
        else
            binned(i,:)=sum(sorted(ind,:));
        end
    else %This is not the first loop

        ind = find(and(sorted(:,2) >bins(i-1), sorted(:,2) <=bins(i)));

         %check if there is only 1 or less values in the bin
         if length(ind) <=1
             if length(ind) ==1  %If there is one, set it equal to sorted
             binned(i,:) = sorted(ind,:);
             else %if there are no elements in the bin, set to zero.
                 binned(i,:) = zeros(1,10);
             end
         else %There is more than 1 element in the bin

        binned(i,:)=sum(sorted(ind(1):ind(end),:));
        %Sum the data for distances in the bin

        %fix the distance col, set it to weighted average
        totDist =0;
        totPermits =0;
        for k = 1:length(ind)
            totDist = totDist + sorted(ind(k),2)*sum(sorted(ind(k),(3:10)));
            totPermits = totPermits + sum(sorted(ind(k),(3:10)));
        end
        d = totDist/totPermits;
        binned(i,2) = d; %The distance is now the weighted average
```

```
            end


        end

    end
```

10.4 A4: Vehicle Type Survey Table

Maker	Model	Year	MPG (EPA City)	#	Weighted MPG
Hyundai	Elantra	2010	24	1	24
Lexus	RX 330	2006	18	2	36
Toyota	Carolla LE	2008	28	11	308
Nissan	Altima SL	2013	27	1	27
Mercedes	E320 4matic	2004	17	1	17
Nissan	Rogue	2014	26	1	26
Honda	Insight	2014	41	1	41
Honda	Accord	2005	29	3	87
Honda	Accord	2007	26	3	78
Kia	Optima Gdi	2015	20	1	20
BMW	335i	2012	23	1	23
Mercedes	C300	2012	17	1	17
Lexus	ES 350	2007	21	3	63
Nissan	Pathfinder	2005	16	1	16
Honda	Civic	2012	29	4	116
GMC	Envoy XL	2006	16	1	16
Nissan	Altima S	2012	23	4	92
Honda	Prius	2014	51	5	255
Subaru	Outback	2015	25	2	50
Honda	Accord	2012	23	4	92
Nissan	Pathfinder Platinum	2013	20	1	20
Lexus	RX 400h	2006	33	1	33
Mazda	3	2013	28	4	112
Mercury	Mariner	2008	20	1	20
Chrysler	PT Cruiser	2004	21	3	63
Infiniti	EX 35	2012	17	1	17
Toyota	Camry SE	2012	25	6	150
Dodge	Durango	2011	16	1	16
Subaru	Outback 3.6R	2015	20	1	20
Mercury	Sable LS	2005	20	1	20
Chevy	Traverse LT	2009	17	1	17
Nissan	Sentra GXE	2003	28	2	56
Honda	Civic Hybrid	2015	44	1	44
Jeep	Grand Cherokee	2013	17	1	17
Toyota	Tacoma PreRunner V6	2015	17	2	34
Ford	Edge	2013	21	1	21
Ford	Fiesta	2014	26	2	52

Infiniti	G37 S	2010	17	1	17
Mazda	6	2012	22	1	22
Honda	CRV	2011	21	1	21
Ford	Escape	2011	23	2	46
Subaru	Forester	2014	24	1	24
Nissan	Altima SV	15	22	1	22
VW	GTI 2.0T	2008	20	1	20
Hyundai	Elantra	2005	27	2	54
Honda	Accord	2004	26	1	26
Nissan	Cube	2013	27	1	27
BMW	328i	2013	23	1	23
Subaru	WRX	2012	19	1	19
Chevy	Malibu	2008	22	1	22
dodge	Grand Caravan	2012	17	1	17
MINI	Cooper	2015	29	2	58
Lexus	IS 250C	2013	21	1	21
Honda	Civic	2005	36	2	72
Lexus	GS 300	2002	18	1	18
Hyundai	Sonata	2013	24	5	120
Chevy	Sonic LT	2013	29	1	29
Nissan	Versa	2009	27	2	54
VW	Jetta 2.5	2008	22	1	22
Pontiac	Vibe	2009	26	2	52
Toyota	Rav 4	2011	22	4	88
Nissan	350Z	2007	20	1	20
Honda	Accord Crossover	2011	18	1	18
Jeep	Liberty Limited	2010	16	1	16
Toyota	Carolla LE	2011	26	3	78
VW	Jetta TDI	2013	30	1	30
Toyota	Carolla LE	2002	32	1	32
Hyundai	Elantra GT	2004	26	1	26
Chevy	Impala LT	2011	19	1	19
Volvo	S60	2013	21	1	21
Honda	Pilot Touring	2016	20	1	20
Mazda	CX-5	2013	26	1	26
Nissan	Frontier	2010	19	1	19
Toyota	Highlander V6	2007	19	2	38
Hyundai	Elantra GLS	2004	26	1	26
Honda	Pilot	2008	16	2	32
Honda	Fit	2011	28	2	56
Lexus	RX 350	2010	18	3	54

Buick	La Sabre	2004	20	1	20
Honda	Civic	2015	31	2	62
VW	GTI 2.0T	2014	24	1	24
Toyota	Highlander	2012	17	1	17
Pontiac	Vibe	2005	29	1	29
Kia	Rio	2008	27	1	27
Infiniti	I30	2003	20	1	20
Honda	Civic Hybrid	2010	40	1	40
Subaru	Outback	2003	22	1	22
Scion	xB	2011	22	1	22
Honda	Acura	2008	18	1	18
Toyota	Rav 4	2014	24	1	24
Jeep	Compass	2012	23	1	23
Toyota	Tacoma PreRunner V6	2010	20	1	20
Toyota	4Runner	2014	17	2	34
Chevy	Camaro	2013	19	1	19
Toyota	Camry SE	2005	24	2	48
Nissan	Sentra SV	2014	30	1	30
Subaru	Outback	2013	24	1	24
Honda	Acura	2013	16	1	16
Chevy	Equinox	2012	22	1	22
Honda	Acura TL	2008	18	1	18
Dodge	Avenger	2008	21	1	21
Infiniti	G35	2003	20	1	20
Chrysler	Sebring	2007	24	1	24
Nissan	Rogue	2008	22	2	44
Ford	Fusion	2007	23	2	46
VW	Passat	2012	31	1	31
Nissan	Versa	2012	30	2	60
Mazda	3	2041	30	1	30
Honda	CRV	2005	23	1	23
Honda	Pilot	2013	18	1	18
Ford	Fusion	2013	22	1	22
Scion	xB	2005	31	1	31
Toyota	Camry LE	2008	21	1	21
Ford	Ranger	2002	24	1	24
Lexus	GS 350	2011	19	1	19
Dodge	RAM	2013	18	1	18
Hyundai	Santa Fe	2010	21	2	42
Honda	Acura	2000	19	1	19
Volvo	XC 90	2014	16	1	16

Toyota	Solara	2000	23	1	23
Subaru	Empreza	2012	27	2	54
Honda	Accord V6	2006	20	1	20
Chevy	TrailBlazer	2006	16	1	16
Hyundai	Tucson	2012	22	1	22
BMW	325i	2005	20	1	20

10.5 A5: Permits per Zip Code Table

ZipCode	Travel Dist (mi)	PDB	CP	Bike	PDBR	PDD	SHMO	Trans	RTMO	Total Permits
95817	0.5	57	133	75	5	30	4	2	5	311
95820	1.753	81	60	45	6	32	4	0	6	234
95816	1.919	80	74	94	31	59	3	0	1	342
95818	2.033	59	17	38	4	42	0	0	2	162
95819	2.46	57	57	61	9	63	1	1	1	250
95824	2.803	31	2	1	0	13	1	0	3	51
95811	3.397	18	10	13	14	9	0	0	4	68
95813	5.009	0	0	0	0	1	0	0	0	1
95851	5.009	1	0	0	0	1	0	0	0	2
95860	5.009	1	0	0	0	0	0	0	0	1
95814	5.338	31	21	7	3	7	0	0	4	73
95815	5.948	21	1	0	3	1	0	0	1	27
95822	6.191	72	12	8	1	42	0	0	5	140
95826	6.462	92	12	23	6	35	0	0	6	174
95605	6.526	22	5	2	2	6	0	0	0	37
95828	6.799	105	8	2	2	28	0	2	4	151
95825	6.816	71	7	12	21	29	1	0	2	143
95691	7.23	134	15	8	5	38	0	0	5	205
95833	7.713	59	9	2	8	39	0	0	4	121
95864	8.251	59	7	5	4	87	1	0	0	163
95838	8.641	31	0	1	0	15	0	0	2	49
95823	8.668	123	19	0	0	40	0	0	8	190
95827	8.711	38	14	2	1	16	0	0	6	77
95821	9.691	52	5	1	3	21	1	0	3	86
95834	9.702	60	10	2	4	31	0	0	0	107
95831	10.21	99	11	3	12	75	0	0	3	203
95652	11.16	0	0	0	0	1	0	0	0	1
95660	11.89	20	2	0	0	5	0	0	1	28
95841	12.03	19	0	0	0	10	0	0	0	29
95832	12.04	10	2	0	0	4	0	0	4	20
95759	12.19	2	0	0	0	3	0	0	0	5
95608	12.28	81	6	3	2	76	0	0	2	170
95741	12.32	0	1	1	0	0	0	0	1	3
95673	12.34	10	4	0	0	11	0	0	1	26
95835	12.34	129	15	1	7	51	0	0	1	204

95829	13.18	68	19	0	2	36	1	1	1	128
95830	13.38	1	0	0	0	2	0	0	0	3
95670	13.72	90	18	1	3	42	0	0	15	169
95758	13.75	181	30	6	3	94	0	2	3	319
95655	13.83	11	0	0	0	4	0	0	0	15
95842	13.86	23	1	0	0	9	0	0	3	36
95624	14.59	140	39	3	0	70	1	2	0	255
95618	14.6	107	19	7	8	108	12	1	1	263
95611	14.87	1	1	2	0	0	0	0	0	4
95837	15.69	1	0	0	0	0	0	0	0	1
95843	16.09	73	13	1	0	23	0	0	0	110
95621	16.14	41	1	4	0	19	0	0	0	65
95742	16.68	43	2	2	2	13	0	0	2	64
95628	16.89	67	12	3	1	35	0	0	4	122
95757	17.02	184	42	4	3	81	0	3	2	319
95610	17.96	25	3	3	1	12	0	0	3	47
95612	19.24	1	0	0	1	0	0	0	0	2
95661	19.67	27	7	0	1	25	0	0	0	60
95626	20.18	7	0	0	0	5	0	0	0	12
95662	20.35	44	3	2	1	16	0	0	1	67
95747	21.19	104	24	1	0	39	0	4	0	172
95763	21.21	0	1	0	0	2	0	0	1	4
95630	21.28	119	21	3	0	84	0	0	17	244
95678	21.29	40	3	0	0	12	0	1	0	56
95671	21.6	0	2	0	0	0	0	0	0	2
95616	21.95	104	23	7	9	72	26	0	0	241
95683	22.03	11	0	0	0	18	0	0	1	30
95776	22.11	33	3	0	0	5	1	2	0	44
95677	22.4	19	6	2	0	10	0	0	0	37
95617	22.7	4	2	0	0	2	0	0	0	8
95746	23	27	9	1	0	23	0	1	1	62
95632	25.27	31	2	0	0	16	0	2	0	51
95668	25.49	2	0	0	0	1	0	0	0	3
95765	25.61	44	17	0	0	25	0	1	0	87
95650	26.44	9	4	0	0	6	0	0	0	19
95693	26.72	13	3	0	0	2	0	0	0	18
95762	27.09	50	12	1	2	47	0	2	1	115
95620	27.28	23	2	0	0	11	1	0	0	37

95615	27.69	0	0	0	0	1	0	0	0	1
95663	28.92	3	2	0	0	0	0	0	0	5
95695	30.2	24	5	1	1	17	3	3	0	54
95638	31.31	1	2	0	0	1	0	1	1	6
95658	31.39	4	4	0	0	4	0	0	0	12
95648	31.5	43	13	0	0	11	0	1	0	68
95682	31.54	29	11	1	0	19	0	0	4	64
95258	32.7	1	0	0	0	1	0	0	0	2
95220	33.31	1	0	0	0	3	0	0	0	4
95672	33.35	5	1	0	0	4	0	0	1	11
95690	33.82	6	0	0	0	2	0	0	0	8
95241	34.04	0	0	0	0	1	0	0	0	1
95694	34.44	6	0	0	0	4	0	0	0	10
95603	34.71	13	0	0	0	7	0	0	0	20
95688	34.76	22	4	0	1	11	1	0	0	39
95604	34.79	1	0	0	0	0	0	0	0	1
95625	34.86	1	0	0	0	0	0	0	0	1
95669	35.82	1	0	0	0	0	0	0	0	1
95240	36.27	2	3	0	0	2	0	2	0	9
95698	36.76	0	0	0	0	1	0	0	0	1
95687	36.79	19	4	0	0	8	0	0	0	31
95640	38.86	2	2	0	0	1	0	1	1	7
95664	38.93	0	1	0	0	0	0	0	1	2
95242	39.04	14	1	0	0	5	0	1	0	21
95961	40.21	12	0	0	0	3	0	0	0	15
95212	40.86	4	4	0	0	1	0	1	0	10
95619	41.18	1	1	1	0	3	0	0	0	6
95703	41.57	2	0	0	0	0	0	0	0	2
95623	41.64	1	3	1	0	1	0	0	0	6
95667	41.7	19	6	0	0	14	0	0	1	40
95681	42.1	1	0	0	0	0	0	0	0	1
95602	42.12	3	8	0	0	4	0	3	0	18
95722	42.33	2	0	0	0	1	0	0	0	3
95991	42.52	4	2	0	0	3	0	4	0	13
95614	42.54	1	0	0	0	1	0	0	0	2
95210	43.44	3	1	0	0	0	0	0	0	4
95209	43.49	7	1	0	0	5	0	1	0	14
95651	43.5	1	0	0	0	0	0	0	0	1

95685	43.98	1	1	0	0	2	0	1	0	5
94533	44.51	12	0	0	0	4	0	0	0	16
95993	45.13	7	0	0	0	6	0	1	0	14
95627	45.29	0	0	0	0	1	0	0	0	1
95692	45.32	1	0	0	0	1	0	0	0	2
95205	45.57	0	0	0	0	1	0	0	0	1
95219	46.12	14	1	1	1	4	0	1	0	22
95629	46.52	1	0	0	0	1	0	0	0	2
95207	46.8	3	3	0	0	2	0	1	0	9
95642	47.2	1	0	0	0	0	0	0	0	1
95656	47.31	3	0	0	0	0	0	0	0	3
94534	47.32	10	0	0	0	3	0	0	0	13
95204	48.66	1	1	0	0	1	0	1	0	4
94571	49.23	0	0	0	1	0	0	0	0	1
95949	49.56	2	0	0	0	0	0	0	0	2
95709	49.81	0	1	0	0	0	0	1	0	2
95215	49.83	0	0	0	0	1	0	0	0	1
95713	50.35	2	0	0	0	3	0	0	0	5
94585	50.75	0	0	0	1	0	0	0	0	1
95912	51.11	0	0	0	0	1	0	0	0	1
95633	52.05	1	0	0	0	1	0	0	0	2
95901	52.16	8	0	0	0	2	0	0	0	10
95982	54.19	1	0	0	0	0	0	0	0	1
95206	54.52	1	0	0	0	0	0	0	0	1
95726	55.62	6	0	0	0	0	0	0	0	6
95336	55.87	5	0	0	0	1	0	0	0	6
94503	56.89	1	0	0	0	0	0	0	0	1
95606	56.93	1	0	0	0	0	0	0	0	1
94589	58.78	1	0	0	0	0	0	0	0	1
94590	59.4	1	0	0	0	0	0	0	0	1
95631	59.51	2	2	0	0	3	0	0	0	7
95634	59.54	1	0	1	0	1	0	0	0	3
94591	59.6	5	0	0	0	3	0	0	0	8
95330	59.95	0	1	0	0	0	0	1	0	2
95252	60.01	1	0	0	0	0	0	0	0	1
94510	61.09	2	0	1	0	0	0	0	0	3
95684	61.37	1	0	0	0	0	0	0	0	1
95948	61.72	0	1	0	0	0	0	1	0	2

94559	61.85	1	0	0	0	1	0	0	0	2
95337	61.92	2	0	0	0	0	0	0	0	2
95945	62.58	2	2	0	0	1	0	0	0	5
95366	62.78	2	0	0	0	0	0	0	0	2
95245	64.64	0	0	0	0	1	0	0	0	1
95320	65.02	1	0	0	0	0	0	0	0	1
95946	65.4	1	0	0	0	1	0	0	0	2
95918	66.12	0	0	0	0	2	0	0	0	2
95959	67	2	1	0	0	0	0	1	0	4
95917	67.03	1	0	0	0	0	0	0	0	1
94558	67.32	2	0	0	0	3	0	0	0	5
95987	67.77	1	0	0	0	0	0	0	0	1
95304	68.59	1	0	0	0	0	0	0	0	1
94509	68.73	3	0	0	0	0	0	0	0	3
94505	69.42	1	0	0	0	0	0	0	0	1
94531	69.47	2	0	0	0	0	0	0	0	2
95356	69.77	0	0	0	0	1	0	0	0	1
94553	69.95	2	0	0	0	0	0	0	0	2
95376	70.16	2	0	0	0	0	0	0	0	2
94523	70.17	1	0	0	0	0	1	0	0	2
95932	72.1	1	0	0	0	0	0	0	0	1
94597	72.19	2	0	0	0	0	0	0	0	2
94518	72.36	1	0	0	0	1	0	0	0	2
95962	72.94	0	1	1	0	1	0	0	0	3
95358	73.96	1	0	0	0	0	0	0	0	1
94521	74.15	0	0	0	1	0	0	0	0	1
94598	74.38	1	0	0	0	0	0	1	0	2
95351	75.05	2	0	0	0	0	0	0	0	2
94530	75.21	3	0	0	0	0	0	0	0	3
95355	75.52	1	0	0	0	1	0	0	0	2
94596	76.13	0	0	0	0	0	0	1	0	1
94706	77.14	0	0	0	0	0	0	1	0	1
95385	77.29	0	0	0	0	1	0	0	0	1
94945	77.38	0	0	0	0	1	0	0	0	1
94565	78.5	1	0	0	0	0	0	0	0	1
95391	78.57	2	0	0	0	0	0	0	0	2
94954	78.73	1	0	1	0	0	1	0	0	3
95361	78.89	2	0	0	0	0	0	0	0	2

95307	79.15	1	0	0	0	0	0	0	0	1
94703	80.19	1	0	0	0	0	1	0	0	2
94563	80.8	0	0	0	0	1	0	0	0	1
94583	85.47	1	0	0	0	0	0	0	0	1
94506	86.24	1	1	0	0	0	0	0	0	2
94602	86.4	0	0	0	0	1	0	0	0	1
95310	87.76	0	0	0	0	1	0	0	0	1
94103	88.57	1	0	0	0	0	0	0	0	1
94582	88.72	0	0	0	0	1	0	0	0	1
95988	88.83	1	0	0	0	0	0	0	0	1
94551	89.89	1	0	0	0	0	0	0	0	1
94117	90.83	0	1	0	0	0	0	0	0	1
95323	91.51	0	2	0	0	0	0	0	0	2
94568	91.56	1	0	0	0	0	0	0	0	1
95404	92.03	1	0	0	0	0	0	0	0	1
95926	92.14	2	0	0	0	1	0	0	0	3
95967	92.26	1	0	0	0	0	0	0	0	1
94131	92.51	0	0	0	0	1	0	0	0	1
94134	92.57	1	0	0	0	0	0	0	0	1
94941	92.82	0	0	0	0	2	0	0	0	2
94122	93.72	1	0	0	0	0	0	0	0	1
94928	93.96	1	0	0	0	0	0	0	0	1
94112	94.01	1	0	0	0	0	0	0	0	1
95728	94.59	1	0	0	0	0	0	0	0	1
95473	94.76	1	0	0	0	0	0	0	0	1
94578	95.04	1	0	0	0	0	0	0	0	1
96151	95.9	1	0	0	0	0	0	0	0	1
95472	96.52	0	0	0	0	1	0	0	0	1
94015	97.65	1	0	0	0	1	0	0	0	2
94080	98.42	1	0	0	0	1	0	0	0	2
96150	98.63	1	1	1	0	0	0	0	0	3
95973	99.53	1	0	0	0	0	0	0	0	1
95223	99.73	1	0	0	0	0	0	0	0	1
96158	99.92	1	0	0	0	0	0	0	0	1
95403	100.6	0	0	0	0	1	0	0	0	1
94545	101	1	0	0	0	0	0	0	0	1
94544	101.6	1	0	0	0	0	0	0	0	1
94066	102.1	1	0	0	0	0	0	0	0	1

94542	102.5	0	2	0	0	0	0	0	0	2
94030	102.6	1	0	0	0	0	0	0	0	1
96161	102.9	1	0	0	0	1	0	0	0	2
94010	104.4	1	0	0	0	0	0	0	0	1
95492	106.3	1	0	0	0	0	0	0	0	1
94539	106.4	0	1	0	0	0	0	0	0	1
94538	107.6	1	0	0	0	0	0	0	0	1
94536	108.1	1	0	0	0	0	0	0	0	1
95035	112.3	0	0	0	0	1	0	0	0	1
95348	112.4	1	0	0	0	0	0	0	0	1
95134	114.3	1	0	0	0	0	0	0	0	1
95341	115.1	2	0	0	0	0	0	0	0	2
95132	116.1	1	0	0	0	0	0	0	0	1
94019	116.5	1	0	0	0	0	0	0	0	1
94061	116.5	1	0	0	0	0	0	0	0	1
89450	119	1	0	0	0	0	0	0	0	1
94085	119.3	0	0	0	1	0	0	0	0	1
95128	121	1	0	0	0	0	0	0	0	1
95158	121.9	1	0	0	0	0	0	0	0	1
94043	122	1	0	0	0	0	0	0	0	1
95148	122.3	0	0	0	0	1	0	0	0	1
95008	124.9	0	1	0	0	0	0	0	0	1
95111	125.1	1	0	0	0	0	0	0	0	1
95014	126.5	2	0	0	0	0	0	0	0	2
95118	127.5	1	0	0	0	0	0	0	0	1
95120	131.5	0	1	0	0	0	0	0	0	1
89506	142.8	0	0	0	0	1	0	0	0	1
96122	151.5	1	0	0	0	0	0	0	0	1
96007	154.9	1	0	0	0	0	0	0	0	1
96002	161.1	1	0	0	0	0	0	0	0	1
96001	168	1	0	0	0	0	0	0	0	1
96003	170.3	3	0	0	0	0	0	0	0	3
95456	193.5	1	0	0	0	0	0	0	0	1
93927	216.8	1	0	0	0	0	0	0	0	1
95519	329.6	1	0	0	0	0	0	0	0	1
90049	380.9	0	0	0	0	1	0	0	0	1
90045	389.5	0	1	0	0	0	0	0	0	1
91803	391.7	0	1	0	0	0	0	0	0	1

90805	403	0	1	1	0	0	0	0	0	2
90620	407.4	1	0	0	0	0	0	0	0	1
91766	414.6	1	0	0	0	0	0	0	0	1
92604	425	1	0	0	0	0	0	0	0	1
92354	444.7	0	0	0	1	0	0	0	0	1
92130	490.3	0	0	0	0	1	0	0	0	1
92122	497	0	0	1	1	0	0	0	0	2
92128	505.8	1	0	0	0	0	0	0	0	1
80238	1184	0	0	1	0	0	0	0	0	1
80124	1201	1	0	0	0	0	0	0	0	1
60523	2032	0	0	0	0	1	0	0	0	1
60077	2053	1	0	0	0	0	0	0	0	1
49048	2182	0	0	0	1	0	0	0	0	1
44106	2383	0	0	0	1	0	0	0	0	1
30080	2469	1	0	0	0	0	0	0	0	1
20903	2728	1	0	0	0	0	0	0	0	1

10.6 A6: Binned Zip Code and Permit Data

0.5	57	135	75	5	30	4	2	5	313
1.9	161	128	139	37	91	7	0	7	570
2.3	147	75	100	13	118	2	1	6	462
3.4	18	10	13	14	9	0	0	4	68
6.4	416	56	54	38	150	1	2	22	739
8.4	556	55	21	25	287	2	0	28	974
13.2	992	108	27	37	601	14	6	36	1821
17.0	462	53	17	9	208	0	3	11	763
21.6	512	66	16	10	288	27	8	21	948
26.4	175	25	1	2	109	1	5	1	319
32.2	157	28	2	2	85	4	5	6	289
37.6	38	9	0	0	17	0	4	2	70
42.2	74	20	2	0	42	0	10	1	149
46.7	43	5	1	2	21	0	5	0	77
55.8	36	2	1	1	15	0	1	0	56
65.3	28	3	1	0	10	0	2	0	44
75.0	22	1	2	1	5	2	3	0	36
85.8	6	1	0	0	4	1	0	0	12
94.9	19	3	1	0	7	0	0	0	30