# Customer Referral Using Zip Code

Loan X. Nguyen, Southern California Gas Company, CA


## ABSTRACT

This paper presents an application that uses the SAS® System for the PC to refer customers to the nearest payment office. The application uses Base SAS and SAS Macro Language to calculate direct distances among zip codes in the service area. It ranks payment offices by proximity, and the result is then uploaded to an automated voice system for access using a touch-tone phone.


## INTRODUCTION

The Southern California Gas Company operates an automated phone system called Interactive Voice Response Unit (IVRU) to direct more than 1 million calls to the call center for service each year. As a first line of customer support, the system also provides pre-recorded messages to frequently asked questions, which can be accessed simply by pressing the numbers on the touch-tone phone.

Customer service representatives at the call center were spending considerable time responding to questions such as "Where is the nearest payment center?" Payment centers are walk-in offices that offer personalized service for paying gas bills. The call center not only had to handle such questions with "live" representatives, but also had to provide callers with addresses of the nearest payment centers from more than 130 centers throughout the service area.

By integrating the "payment center locator" with the IVRU, we achieved the following:

1. Improved waiting time for customers;
2. Provided higher level of accuracy for referral;
3. Reduced workload for customer service representatives.

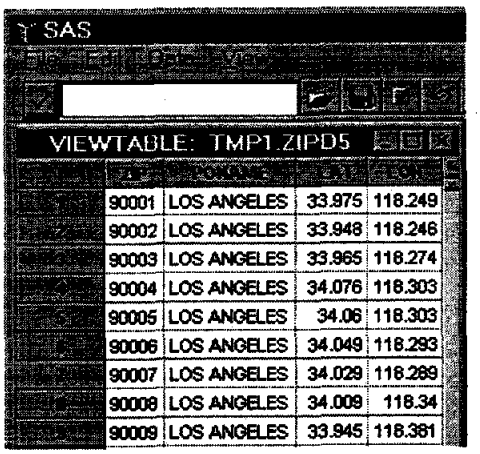
To locate the nearest payment center using the IVRU, a customer enters his or her 5-digit zip code using the numeric buttons on the touch-tone phone. This application is very common for companies that have service centers, stores or branch offices. Furthermore, the result from this SAS application can be adapted inexpensively for the Internet, thus, avoiding the need to pay thousand of dollars to mapping companies for similar service.

## THE METHODOLOGY

The methodology consists of running the SAS System to perform the preliminary geocoding that calculates direct line distances among all zip codes, and produces a list that ranks payment centers by proximity to all zip codes in the service area. Then the IVRU queries the list for the zip code entered and displays the nearest payment centers.

This application refers customers to the nearest payment centers using minimum direct line distance instead of driving distance. Direct line distance is measured using geographic coordinates; whereas driving distance relies on street addresses and driving route.

Geocoding requires longitude and latitude coordinates. These can be purchased from a mapping company starting at approximately $400 depending on the frequency of updates. The following fields/variables are required: zip code, city name, latitude and longitude coordinates.


SAS

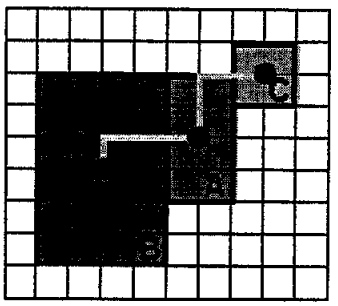
VIEWTABLE: TMP1.ZIPD5

| | ZIP | CITY | LAT | LON |
|---|---|---|---|---|
| | 90001 | LOS ANGELES | 33.975 | 118.249 |
| | 90002 | LOS ANGELES | 33.948 | 118.246 |
| | 90003 | LOS ANGELES | 33.965 | 118.274 |
| | 90004 | LOS ANGELES | 34.076 | 118.303 |
| | 90005 | LOS ANGELES | 34.06 | 118.303 |
| | 90006 | LOS ANGELES | 34.049 | 118.293 |
| | 90007 | LOS ANGELES | 34.029 | 118.289 |
| | 90008 | LOS ANGELES | 34.009 | 118.34 |
| | 90009 | LOS ANGELES | 33.945 | 118.381 |

Latitude and longitudes are treated as x,y coordinates on a Cartesian plain. The coordinates usually mark the geographic center or the delivery-based center. The

geographic center is a location at the center of the zip code; whereas, the delivery-based center is weighted by the number of residential deliveries. I find that using the delivery-based center improves accuracy in non-uniformly populated areas.

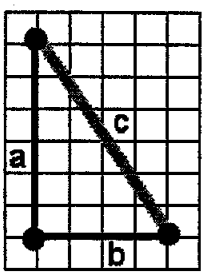
Referring to the graph below, suppose you're at the center rectangle (A) and want to know if the rectangle on the left (B) or the square on the right (C) is closer to you. Distance from these areas can be estimated by adding the lightly shaded solid lines, which seem to tell you that they are equally spaced at 4 cells apart.




However, if direct distance is measured by connecting dot-to-dot, the square on the right (C) is discovered to be closer to the center rectangle (A) than the rectangle on the left (B).

The Pythagorean theorem provides the foundation for this approach. Assuming that longitude and latitude coordinates form a right triangle(90°) at their intersections, one can estimate direct line distance (c) using the Pythagorean theorem:

$a^2 + b^2 = c^2$




The SAS code to run this application is attached in the next page. The program reads an Excel file containing a list of payment centers, addresses, and zip codes. It then match merges the zip codes of the payment centers with zip codes in the service area, and produces three nearest payment centers for each zip code. Finally, the program writes to a CSV (Comma Separator Variable) for upload to the IVRU.

The attached image displays a snap shot of the output in Excel. It contains the zip code for referral which repeats at least three times for at least the three nearest payment centers. If more than three payment centers are located in one zip code, the referral program lists all of those payment centers located in that particular zip code.

Microsoft Excel - output.csv

| | ZipR | R | ZipRCity | Name | PSid | zip |
|---|---|---|---|---|---|---|
| 2 | 90001 | 1 | LOS ANG | Quick Co | PS0061 | 90001 |
| 3 | 90001 | 2 | LOS ANG | Watts Br | PS0197 | 90002 |
| 4 | 90001 | 3 | LOS ANG | Huntingto | PS0062 | 90255 |
| 5 | 90002 | 1 | LOS ANG | Watts Br | PS0197 | 90002 |
| 6 | 90002 | 2 | LOS ANG | Watts La | PS0334 | 90059 |
| 7 | 90002 | 3 | LOS ANG | Quick Co | PS0061 | 90001 |
| 8 | 90003 | 1 | LOS ANG | Quick Co | PS0061 | 90001 |
| 9 | 90003 | 2 | LOS ANG | Watts Br | PS0197 | 90002 |
| 10 | 90003 | 3 | LOS ANG | Watts La | PS0334 | 90059 |

The last page of this paper demonstrates how one would integrate the result of this application on the web.

## CONCLUSION

Southern California Gas Company's implementation of the IVRU and payment center locator application provides customers with useful information in a convenient way. The SAS application provides the IRVU with an up-to-date list of the nearest payment centers for each zip code in the service area. All customers need to know is their zip code (at home, work, or wherever they happen to be when paying the bill), and they can receive this information 24 hours a day, 7 days a week. As a result, companies using this program can improve the efficiency of their operations while improving their customer service.

## REFERENCES

SAS Institute, Inc. (1996) *Companion for the Microsoft Windows Environment* Version 6, Second Edition, Cary, NC: SAS Institute Inc.

SAS Institute, Inc. (1997) *SAS Macro Language: Reference*, First Edition, Cary, NC: SAS Institute, Inc.

PBS Web site – NOVA on the Pythagorean theorem at http://www.pbs.org/wgbh/nova/proof/puzzle/

## AUTHOR

Loan X. Nguyen
Southern California Gas Company
555 West 5th Street, ML 28A4
Los Angeles, CA 90013-1011

Phone: (213) 244-3606
e-mail: lnguyen@socalgas.com

```
/*************************************************************/
/* Filename: pay\payzip.sas                                  */
/* Date: January 19, 1999                                    */
/* Author: Loan Nguyen                                       */
/* This program finds at least three nearest payment offices*/
/* from each zip codes served by SoCalGas and create a flat */
/* file to update to IVR for the Call Center.                */
/*************************************************************/
options nodate nonumber nonotes;
libname  pay   'l:\pay\';
filename list  dde "excel|[QueryExportMaster.xls]QueryExportMaster!R2C1:R229C11";
filename out   'l:\pay\output.csv';

**** Read payment office list from Excel  ****;
data offices;
     infile list dlm='09'x notab dsd missover;
     informat region $2. name $50. address $40. city $20. zip $5.
              cross $20. psid $6.;
     input zip region name address city cross psid;
run;

**** Count the number of occurences of payment offices at each zipcode ****;
proc freq data=offices;
     tables zip / out=count noprint;
run;

**** Order the payment center list by zip code ****;
proc sort data=offices;
     by zip;
run;

**** Set up a one-line header for the output file ****;
data _null_;
     file out lrecl=300;
     put @1
         'ZipR ,'
         'Rank ,'
         'Region ,'
         'Name ,'
         'Address ,'
         'City ,'
         'Cross ,'
         'PSid ,'
         'zip';
run;

%macro giveme;
**** Set up a macro variable to represent ****;
**** all zip codes served in service area ****;

data _null_;
     set pay.zipd5 end=eof;
     call symput ('zz'||left(_n_), put (zip,$5.));
     call symput ('dd'||left(_n_), put (_n_,2.));
     call symput ('cc'||left(_n_), put (poname,$28.));
     if eof then call symput ('eof',_n_);
run;

**** Read zip code files with longitude and latitude and   ****;
**** select the desired zip code created by macro variable ****;
%do i = 1 %to &eof;
data getzip;
     set apa.zipd5;
        if zip = "&&zz&i";
     zipdeal = zip;
     lat_zip = lat;
     lon_zip = lon;
     rezip = "&&zz&i";
     zipRCity = "&&cc&i";
     keep lat_zip lon_zip zipdeal rezip zipRCity;
run;
```

```
**** Calculate distance nearest to desired ****;
**** zip code using the Pythagoras theorem ****;
data nearest;
     set pay.zipd5;
     if _n_ = 1 then set getzip;
     lat_sq = (lat - lat_zip)**2;
     lon_sq = (lon - lon_zip)**2;
     distance = sqrt(lat_sq + lon_sq);
     drop lat_sq lon_sq;
run;

proc sort data=nearest;
     by zip;
run;

**** Match the nearest zip code with payment offices ****;
data nearpay;
     merge nearest offices count;
     by zip;
     if distance ne . and name ne ' ';
run;

proc print;
run;

**** Rank payment offices from nearest to farthest distance ****;
proc sort data=nearpay;
     by distance;
run;

**** Pick at least three nearest payment officess ****;
data dd&i;
     set nearpay;
     if count <= 3 then minimum = 3;
        else minimum = count;
     rank = left(_n_);
     if rank <= minimum;

run;

**** Output the result to a flat file for upload to IVR ****;
data _null_;
     file out mod;
     set dd&i;
     put @1
         ZipR ','
         Rank ','
         region ','
         '"'name'",'
         '"'address'",'
         city ','
         cross ','
         psid ','
         zip;
run;
%end;
%mend;
%giveme
```

APA/BO Referral by Zip Code(Main) - Microsoft Internet Explorer

http://efacts.pacent.com/zipapa/default.htm

MASS MARKETS

Home

What's New | Programs | Free Brochures | Contact Us | Search | Feedback

APA Referral by

Enter a five-digit zip code and hit Enter to locate three nearest payment(APA) locations.

Click on Yahoo! Maps to see map of location. To plot driving instructions, click on **"Driving Directions"** at the bottom of map then enter the starting address. The APA location is automatically the destination address. Click here for City State and Zip Code Association.

90001

Submit

Reset

Three nearest payment locations to zipcode **90001** in LOS ANGELES.

| | | | | | |
|---|---|---|---|---|---|
| Quick Connect Check Cashing | 7210 S. Compton Ave. | Los Angeles | 90001 | Florence | A Yahoo! |
| Watts Branch Office | 1665 E. 103rd St. | Los Angeles | 90002 | Compton Ave. | B Yahoo! |
| Huntington Park Branch Office | 6018 Pacific Blvd. | Huntington Park | 90255 | Randolph | B Yahoo! |

Code: A for Agency, B for Branch Office and D for Drop Box.