

Macro Method to use Google Maps™ and SAS® to Geocode a Location by Name or Address

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ABSTRACT

Google Maps™ is a very useful tool in finding driving directions between addresses and defining a geographic representation of an address (geocoding) which can be used in many applications in research. Using macro and data step SAS® code, the latitude and longitude of a location can be found by searching the html code resulting from a Google Maps™ search, which can be developed using SAS® v9.4 for Windows®.

INTRODUCTION

The methods introduced will allow a SAS® Programmer, with basic SAS® programming skills, to use Google™ and SAS® to isolate the latitude and longitude of any location by name or address search in Google Maps™.

FORMAT LOCATIONS AND ADDRESSES FOR GOOGLE MAPS™

The source SAS® data set contains a record number (RecNum) identifier, a Hospital Name, and its address. Both the Hospital Name and Address will be used for the Google Maps™ search and will need to be formatted to remove any special characters and add plus (+) signs as spaces. The code also counts the number of observations in the data set for later use in the macro execution.

RecNum	Hospital Name	Hospital Address
001	Access Hospital Dayton - Dayton	2611 Wayne Ave, Dayton, OH 45420
002	Barnesville Hospital - Barnesville	639 W Main St, Barnesville, OH 43713
003	Christ Hospital - Cincinnati	2139 Auburn Ave, Cincinnati, OH 45219
004	Dayton Children’s Medical Center - Dayton	1 Childrens Plaza, Dayton, OH 45404
005	East Liverpool City Hospital - East Liverpool	425 W 5th St, East Liverpool, OH 43920
006	Fairfield Medical Center - Lancaster	401 N Ewing St, Lancaster, OH 43130
007	Good Samaritan Hospital - Cincinnati	375 Dixmyth Ave, Cincinnati, OH 45220
008	Harrison Community Hospital - Cadiz	951 E Market St, Cadiz, OH 43907
009	Indu and Raj Soin Medical Center - Beavercreek	3535 Pentagon Blvd, Beavercreek, OH 45431
010	Jewish Hospital - Kenwood	4777 E Galbraith Rd, Cincinnati, OH 45236
011	Kettering Behavioral Medicine Center - Kettering	5350 Lamme Rd, Dayton, OH 45439
012	Lake Health West Medical Center	36000 Euclid Ave, Willoughby, OH 44094
013	Madison Health - London	210 N Main St, London, OH 43140
014	Nationwide Children’s Hospital - Columbus	700 Children’s Dr, Columbus, OH 43205
015	Ohio Valley Medical Center - Springfield	100 W Main St, Springfield, OH 45502
016	Paulding County Hospital - Paulding	1035 W Wayne St, Paulding, OH 45879
017	University Hospitals Rainbow Babies & Children’s Hospital	11100 Euclid Ave, Cleveland, OH 44106
018	Saint Luke’s Hospital - Maumee	5901 Monclova Rd, Maumee, OH 43537
019	The Bellevue Hospital - Bellevue	1400 W Main St, Bellevue, OH 44811
020	The Ohio State University Hospital East	181 Taylor Ave, Columbus, OH 43203
021	The Richard M. Ross Heart Hospital - Columbus	452 W 10th Ave, Columbus, OH 43210
022	ProMedica Toledo Hospital	2142 N Cove Blvd, Toledo, OH 43606
023	Union Hospital - Dover	659 Boulevard St, Dover, OH 44622
024	Summa Health Wadsworth-Rittman Medical Center	195 Wadsworth Rd, Wadsworth, OH 44281
025	Cincinnati Children’s Hospital Burnet Campus	3333 Burnet Ave, Cincinnati, OH 45229

Display 1. Source SAS® data set

```

/*Adjust format of hospital name and address to be Google Maps™ friendly
and retain the number of observations in a macro variable*/
data Hospitals (keep=RecNum Hospital_Name HospitalNm Hospaddr
Hospital_Address);
    length HospitalNm Hospaddr $200.;
    format HospitalNm Hospaddr $200.;
    informat HospitalNm Hospaddr $200.;
    set HospitalsX nobs=obsnum;
*Remove special charaters;
iiHospitalNm=compress(Hospital_Name,"-,&'." );
*Replace spaces with +'s in Hospital Name;
iHospitalNm=tranwrd(left(trim(iiHospitalNm)),",","");
HospitalNm=tranwrd(left(trim(iHospitalNm)),",++","");
*Replace spaces with +'s in Hospital Address;
iiHospaddr=compress(Hospital_Address,"-,&'." );
iHospaddr=tranwrd(left(trim(iiHospaddr)),",","");
Hospaddr=tranwrd(left(trim(iHospaddr)),",++","");
*Assign macro variable obsnum=number of observations;
call symput('obsnum1',trim(strip(left(put(obsnum,8.)))));
run;

```

RecNum	HospitalNm	Hospaddr
001	Access+Hospital+Dayton+Dayton	2611+Wayne+Ave+Dayton+OH+45420
002	Barnesville+Hospital+Barnesville	639+W+Main+St+Barnesville+OH+43713
003	Christ+Hospital+Cincinnati	2139+Auburn+Ave+Cincinnati+OH+45219
004	Dayton+Childrens+Medical+Center+Dayton	1+Childrens+Plaza+Dayton+OH+45404
005	East+Liverpool+City+Hospital+East+Liverpool	425+W+5th+St+East+Liverpool+OH+43920
006	Fairfield+Medical+Center+Lancaster	401+N+Ewing+St+Lancaster+OH+43130
007	Good+Samaritan+Hospital+Cincinnati	375+Dixmyth+Ave+Cincinnati+OH+45220
008	Harrison+Community+Hospital+Cadiz	951+E+Market+St+Cadiz+OH+43907
009	Indu+and+Raj+Soin+Medical+Center+Beavercree	3535+Pentagon+Blvd+Beavercreek+OH+45431
010	Jewish+Hospital+Kenwood	4777+E+Galbraith+Rd+Cincinnati+OH+45236
011	Kettering+Behavioral+Medicine+Center+Kettering	5350+Lamme+Rd+Dayton+OH+45439
012	Lake+Health+West+Medical+Center	36000+Euclid+Ave+Willoughby+OH+44094
013	Madison+Health+London	210+N+Main+St+London+OH+43140
014	Nationwide+Childrens+Hospital+Columbus	700+Childrens+Dr+Columbus+OH+43205
015	Ohio+Valley+Medical+Center+Springfield	100+W+Main+St+Springfield+OH+45502
016	Paulding+County+Hospital+Paulding	1035+W+Wayne+St+Paulding+OH+45879
017	University+Hospitals+Rainbow+Babies+Childrens+	11100+Euclid+Ave+Cleveland+OH+44106
018	Saint+Lukes+Hospital+Maumee	5901+Monclova+Rd+Maumee+OH+43537
019	The+Bellevue+Hospital+Bellevue	1400+W+Main+St+Bellevue+OH+44811
020	The+Ohio+State+University+Hospital+East	181+Taylor+Ave+Columbus+OH+43203
021	The+Richard+M+Ross+Heart+Hospital+Columbus	452+W+10th+Ave+Columbus+OH+43210
022	ProMedica+Toledo+Hospital	2142+N+Cove+Blvd+Toledo+OH+43606
023	Union+Hospital+Dover	659+Boulevard+St+Dover+OH+44622
024	Summa+Health+WadsworthRittman+Medical+Cent	195+Wadsworth+Rd+Wadsworth+OH+44281
025	Cincinnati+Childrens+Hospital+Burnet+Campus	3333+Burnet+Ave+Cincinnati+OH+45229

Display 2. Reformatted Source SAS® variables

GEOCODE BY LOCATION NAME/ADDRESS

SAS® can use Google Maps™ to find a map location given the name of the location or an address. The reformatted location name or address from the source data set is defined as a macro variable and assigned into a filename statement for a Google Maps™ url. An infile statement is used to read in the html code from the Google Maps™ search result page in 1000 character substrings. Using the FIND function, each substring is searched for the unique character string ("],[null,null,) that always proceeds the latitude and longitude corresponding to the location defined and the observation is retained. The numeric latitude (lat)

and longitude (long) are defined by using the SCAN function with the substring to isolate the numeric value of each. Observations with latitude/longitude pairs are appended into a data set to contain all source data corresponding pairs. Always be sure to disassociate current assigned url before the next search.

```

/*Macro to Geocode data by specified variable*/
%macro Geocode(j=,var=);
*Create datasets to append latitudes and longitudes;
data Geocode&var;
run;
*Create loop to access each observation;
%do i=1 %to &j;
*Assign macro variables needed (Addresses and Subject ID);
data _null_;
set Hospitals;
if _n_=&i then do;
call symput("hosp",trim(strip(&var)));
call symput("Name",trim(strip(Hospital_Name)));
call symput("Address",trim(strip(Hospital_Address)));
call symput("RecNum",trim(strip(RecNum)));
end;
run;

/*Find Latitude and longitude in sitecode*/
*Define Google Maps url with starting addresses;
filename gmaps url "http://maps.google.com/maps?daddr=&hosp";
*Define sitecode as 1000 character parts of location html for
starting address;
data Geocode&var.&i (drop=sitecode markst);
infile gmaps recfm=f lrecl=1000 end=eof;
input sitecode $1000.;
*Find text preceding latitude and longitude in html code for
starting address;
if find(sitecode,'"',[null,null,']) then do;
*Assign variable to starting location of proceeding text
for starting address;
markst=find(sitecode,'"',[null,null,']);
*Scan substring starting with proceeding text for starting
address latitude and longitude;
lat=input(scan(substr(sitecode,markst),4,","),best12.);
long=input(scan(substr(sitecode,markst),5,","),best12.);
length Name Address $200.;
format Name Address $200.;
Name="&Name";
Address="&Address";
RecNum="&RecNum";
output;
end;
run;
*Eliminate duplicates that could result from location name
search;
proc sort nodupkey data=Geocode&var.&i; by RecNum; run;
*Append observation to dataset of starting address lat/long;
data Geocode&var;
set Geocode&var
Geocode&var.&i;
if lat^=.;

```

```

label RecNum='Record Number'
      Name='Location Name'
      Address='Address'
      lat="Hospital latitude"
      long="Hospital longitude";

run;
proc sort data=Geocode&var; by RecNum; run;
*Disassociate current assigned gmaps;
filename gmaps clear;

%end;
%mend;

```

```

/*Execute Macro on each Location and Address*/
%Geocode(j=&obsnum1,var=HospitalNm);

```

Record Number	Location Name	Address	Hospital latitude	Hospital longitude
001	Access Hospital Dayton - Dayton	2611 Wayne Ave, Dayton, OH 45420	39.735918	-84.15424899
002	Barnesville Hospital - Barnesville	639 W Main St, Barnesville, OH 43713	39.993111	-81.1890643
003	Christ Hospital - Cincinnati	2139 Auburn Ave, Cincinnati, OH 45219	39.1211392	-84.51035399
004	Dayton Children's Medical Center - Dayton	1 Childrens Plaza, Dayton, OH 45404	39.7742909	-84.16760619
005	East Liverpool City Hospital - East Liverpool	425 W 5th St, East Liverpool, OH 43920	40.6219146	-80.5857511
006	Fairfield Medical Center - Lancaster	401 N Ewing St, Lancaster, OH 43130	39.717277	-82.57775359
007	Good Samaritan Hospital - Cincinnati	375 Dixmyth Ave, Cincinnati, OH 45220	39.139754	-84.521727
008	Harrison Community Hospital - Cadiz	951 E Market St, Cadiz, OH 43907	40.2574287	-80.9770918
009	Indu and Raj Soin Medical Center - Beavercreek	3535 Pentagon Blvd, Beavercreek, OH 45431	39.7709515	-84.06265139
010	Jewish Hospital - Kenwood	4777 E Galbraith Rd, Cincinnati, OH 45236	39.2058695	-84.3810129
011	Kettering Behavioral Medicine Center - Kettering	5350 Lamme Rd, Dayton, OH 45439	39.6753839	-84.2111398
012	Lake Health West Medical Center	36000 Euclid Ave, Willoughby, OH 44094	41.625765	-81.432182
013	Madison Health - London	210 N Main St, London, OH 43140	39.8924807	-83.4543884
014	Nationwide Children's Hospital - Columbus	700 Children's Dr, Columbus, OH 43205	39.9531241	-82.9795743
015	Ohio Valley Medical Center - Springfield	100 W Main St, Springfield, OH 45502	39.925385	-83.812816
016	Paulding County Hospital - Paulding	1035 W Wayne St, Paulding, OH 45879	41.1351495	-84.6023345
017	University Hospitals Rainbow Babies & Children's Hospital	11100 Euclid Ave, Cleveland, OH 44106	41.5041946	-81.6058122
018	Saint Luke's Hospital - Maumee	5901 Monclova Rd, Maumee, OH 43537	41.557113	-83.681681
019	The Bellevue Hospital - Bellevue	1400 W Main St, Bellevue, OH 44811	41.2880793	-82.8815915
020	The Ohio State University Hospital East	181 Taylor Ave, Columbus, OH 43203	39.9706009	-82.9628067
021	The Richard M. Ross Heart Hospital - Columbus	452 W 10th Ave, Columbus, OH 43210	39.994599099	-83.0184263
022	ProMedica Toledo Hospital	2142 N Cove Blvd, Toledo, OH 43606	41.6761555	-83.59491749
023	Union Hospital - Dover	659 Boulevard St, Dover, OH 44622	40.515302	-81.45570699
024	Summa Health Wadsworth-Rittman Medical Center	195 Wadsworth Rd, Wadsworth, OH 44281	41.0278353	-81.7505084
025	Cincinnati Children's Hospital Burnet Campus	3333 Burnet Ave, Cincinnati, OH 45229	39.1413496	-84.50167519

Display 3. Geocoding by Name of Location SAS® data set

%Geocode (j=&obsnum1 , var=hospaddr) ;

Record Number	Location Name	Address	Hospital latitude	Hospital longitude
001	Access Hospital Dayton - Dayton	2611 Wayne Ave, Dayton, OH 45420	39.736137	-84.1536069
002	Barnesville Hospital - Barnesville	639 W Main St, Barnesville, OH 43713	39.992998	-81.1889599
003	Christ Hospital - Cincinnati	2139 Auburn Ave, Cincinnati, OH 45219	39.1208511	-84.50856069
004	Dayton Children's Medical Center - Dayton	1 Childrens Plaza, Dayton, OH 45404	39.774902999	-84.16721
005	East Liverpool City Hospital - East Liverpool	425 W 5th St, East Liverpool, OH 43920	40.6218488	-80.5861388
006	Fairfield Medical Center - Lancaster	401 N Ewing St, Lancaster, OH 43130	39.717606	-82.5775809
007	Good Samaritan Hospital - Cincinnati	375 Dixmyth Ave, Cincinnati, OH 45220	39.1400349	-84.52067269
008	Hamison Community Hospital - Cadiz	951 E Market St, Cadiz, OH 43907	40.2576352	-80.9777783
009	Indu and Raj Soin Medical Center - Beavercreek	3535 Pentagon Blvd, Beavercreek, OH 45431	39.7710585	-84.0628267
010	Jewish Hospital - Kenwood	4777 E Galbraith Rd, Cincinnati, OH 45236	39.2059813	-84.38103049
011	Kettering Behavioral Medicine Center - Kettering	5350 Lamme Rd, Dayton, OH 45439	39.6753212	-84.2111467
012	Lake Health West Medical Center	36000 Euclid Ave, Willoughby, OH 44094	41.6254453	-81.4323802
013	Madison Health - London	210 N Main St, London, OH 43140	39.8924807	-83.4543884
014	Nationwide Children's Hospital - Columbus	700 Children's Dr, Columbus, OH 43205	39.953126999	-82.979489
015	Ohio Valley Medical Center - Springfield	100 W Main St, Springfield, OH 45502	39.925385	-83.812816
016	Paulding County Hospital - Paulding	1035 W Wayne St, Paulding, OH 45879	41.134223899	-84.6011025
017	University Hospitals Rainbow Babies & Children's Hospital	11100 Euclid Ave, Cleveland, OH 44106	41.5065812	-81.60496209
018	Saint Luke's Hospital - Maumee	5901 Monclova Rd, Maumee, OH 43537	41.5571451	-83.68168109
019	The Bellevue Hospital - Bellevue	1400 W Main St, Bellevue, OH 44811	41.2880793	-82.8815915
020	The Ohio State University Hospital East	181 Taylor Ave, Columbus, OH 43203	39.9706525	-82.96196119
021	The Richard M. Ross Heart Hospital - Columbus	452 W 10th Ave, Columbus, OH 43210	39.9947428	-83.01822
022	ProMedica Toledo Hospital	2142 N Cove Blvd, Toledo, OH 43606	41.6730403	-83.5949906
023	Union Hospital - Dover	659 Boulevard St, Dover, OH 44622	40.5148163	-81.4555357
024	Summa Health Wadsworth-Rittman Medical Center	195 Wadsworth Rd, Wadsworth, OH 44281	41.0274352	-81.7544559
025	Cincinnati Children's Hospital Bumet Campus	3333 Bumet Ave, Cincinnati, OH 45229	39.1404509	-84.50206299

Display 4. Geocoding by Address SAS® data set

FIND SHORTEST DRIVING DISTANCES/DRIVE TIMES BETWEEN 2 ADDRESSES

Similar to the method used above, SAS® can also use Google Maps™ to find driving distances and driving times between a pair of addresses. Both addresses will need to be reformatted for the Google Maps™ search.

RecNum	Starting	StartingAdd	Ending	EndingAdd
001	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	2611 Wayne Ave, Dayton, OH 45420	2611+Wayne+Ave+Dayton+OH+45420
002	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	639 W Main St, Barnesville, OH 43713	639+W+Main+St+Barnesville+OH+43713
003	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	2139 Auburn Ave, Cincinnati, OH 45219	2139+Auburn+Ave+Cincinnati+OH+45219
004	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	1 Childrens Plaza, Dayton, OH 45404	1+Childrens+Plaza+Dayton+OH+45404
005	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	425 W 5th St, East Liverpool, OH 43920	425+W+5th+St+East+Liverpool+OH+43920
006	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	401 N Ewing St, Lancaster, OH 43130	401+N+Ewing+St+Lancaster+OH+43130
007	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	375 Dixmyth Ave, Cincinnati, OH 45220	375+Dixmyth+Ave+Cincinnati+OH+45220
008	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	951 E Market St, Cadiz, OH 43907	951+E+Market+St+Cadiz+OH+43907
009	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	3535 Pentagon Blvd, Beavercreek, OH 45431	3535+Pentagon+Blvd+Beavercreek+OH+45431
010	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	4777 E Galbraith Rd, Cincinnati, OH 45236	4777+E+Galbraith+Rd+Cincinnati+OH+45236
011	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	5350 Lamme Rd, Dayton, OH 45439	5350+Lamme+Rd+Dayton+OH+45439
012	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	36000 Euclid Ave, Willoughby, OH 44094	36000+Euclid+Ave+Willoughby+OH+44094
013	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	210 N Main St, London, OH 43140	210+N+Main+St+London+OH+43140
014	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	700 Children's Dr, Columbus, OH 43205	700+Childrens+Dr+Columbus+OH+43205
015	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	100 W Main St, Springfield, OH 45502	100+W+Main+St+Springfield+OH+45502
016	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	1035 W Wayne St, Paulding, OH 45879	1035+W+Wayne+St+Paulding+OH+45879
017	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	11100 Euclid Ave, Cleveland, OH 44106	11100+Euclid+Ave+Cleveland+OH+44106
018	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	5901 Monclova Rd, Maumee, OH 43537	5901+Monclova+Rd+Maumee+OH+43537
019	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	1400 W Main St, Bellevue, OH 44811	1400+W+Main+St+Bellevue+OH+44811
020	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	181 Taylor Ave, Columbus, OH 43203	181+Taylor+Ave+Columbus+OH+43203
021	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	452 W 10th Ave, Columbus, OH 43210	452+W+10th+Ave+Columbus+OH+43210
022	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	2142 N Cove Blvd, Toledo, OH 43606	2142+N+Cove+Blvd+Toledo+OH+43606
023	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	659 Boulevard St, Dover, OH 44622	659+Boulevard+St+Dover+OH+44622
024	3333 Bumet Ave, Cincinnati, OH 45229	3333+Bumet+Ave+Cincinnati+OH+45229	195 Wadsworth Rd, Wadsworth, OH 44281	195+Wadsworth+Rd+Wadsworth+OH+44281

Display 5. Reformatted Source Address Pairs

The reformatted addresses from this source data set are defined as macro variables and assigned into a filename statement for a Google Maps™ url. An infile statement is used the same as above resulting in 1000 character substring values. Using the FIND function, each substring is searched for a distance measure (miles) and that observation is retained. The numeric driving distance is isolated using the SCAN function. The numeric drive time for the distance is also isolated by hour (hr) and minutes (min) or just minutes (min) using the FIND function. All hour values are converted to minutes for the final dataset. The shortest distance with time is retained. Again, always be sure to disassociate current assigned url before the next search.

```
%macro ShortDrDist(j=);
  *Create loop to access each observation;
  %do i=1 %to &j;

    *Assign macro variables needed (Addresses and Subject ID);
    data _null_;
      set Address;
      if _n_=&i then do;
        call symput('addr1',trim(strip(StartingAdd)));
        call symput('addr2',trim(strip(EndingAdd)));
        call symput('RecNum',RecNum);
        call symput('AddStart',trim(strip(Starting)));
        call symput('AddEnd',trim(strip(Ending)));
      end;
    run;

    /*Find Road distances*/
    *Define Google Maps url with starting and ending addresses;
    filename gmaps url
    http://maps.google.com/maps?daddr=&addr1.%nrstr(&saddr)=&addr2";
    *Find all driving distances Google provides;
    data drdistX&i (drop=sitecode idrivdist rdstart);
      length AddEnd AddStart $200.;
      infile gmaps recfm=f lrecl=1000 end=eof;
      input sitecode $1000.;
    RecNum="&RecNum";
    AddStart="&AddStart";
    AddEnd="&AddEnd";
    *Search html code for the word miles, keep only those entries;
    if find(sitecode,'miles');
    *Find column where word 'miles' starts;
    idrivdist=find(sitecode,'miles');
    *Define length of substring to keep, ending right before miles
    start;
    rdstart=idrivdist-1;
    *Scan the substring ending right before miles and keep the
    numeric value right before miles;
    drivdist=input(compress(scan(substr(sitecode,1,rdstart),1,'
      ','bc'),' '),best12.);
    if scan(scan(substr(sitecode,rdstart),3,' '),2,"")='h' then
      drivtm=sum(input(scan(scan(substr(sitecode,rdstart)
        ,3,' '),1,""),best12.)*60,input(scan(scan(
          substr(sitecode,rdstart),3,' '),1,""),best12.));
    else drivtm=input(scan(scan(substr(sitecode,rdstart),3,' '),1
      ,""),best12.);
    run;
    *Keep observation with the shortest distance;
```

```

proc sort data=drdist&i; by drivdist drivtm; run;
proc sort nodupkey data=drdist&i; by RecNum; run;
*Add observation to final driving distances dataset;
data drdist;
    set drdist
        drdist&i;
if drivdist^=.;
label AddStart='Starting Address'
    AddEnd='Ending Address'
    drivtm='Shortest Driving Time (min)'
    drivdist='Shortest Driving Distance (miles)'
    RecNum='Subject Id';
run;
*Disassociate current assigned gmaps;
filename gmaps clear;
%end;
%mend;

```

```

/*Execute Macro*/
%ShortDrDist(j=&obsnum2);

```

Record Number	Starting Address	Ending Address	Shortest Driving Distance (miles)	Shortest Driving Time (min)
001	3333 Bumet Ave, Cincinnati, OH 45229	2611 Wayne Ave, Dayton, OH 45420	52	59
002	3333 Bumet Ave, Cincinnati, OH 45229	639 W Main St, Barnesville, OH 43713	211	183
003	3333 Bumet Ave, Cincinnati, OH 45229	2139 Auburn Ave, Cincinnati, OH 45219	1.8	8
004	3333 Bumet Ave, Cincinnati, OH 45229	1 Childrens Plaza, Dayton, OH 45404	52.9	58
005	3333 Bumet Ave, Cincinnati, OH 45229	425 W 5th St, East Liverpool, OH 43920	267	244
006	3333 Bumet Ave, Cincinnati, OH 45229	401 N Ewing St, Lancaster, OH 43130	133	122
007	3333 Bumet Ave, Cincinnati, OH 45229	375 Dixmyth Ave, Cincinnati, OH 45220	1.6	6
008	3333 Bumet Ave, Cincinnati, OH 45229	951 E Market St, Cadiz, OH 43907	224	183
009	3333 Bumet Ave, Cincinnati, OH 45229	3535 Pentagon Blvd, Beavercreek, OH 45431	57	61
010	3333 Bumet Ave, Cincinnati, OH 45229	4777 E Galbraith Rd, Cincinnati, OH 45236	9.3	19
011	3333 Bumet Ave, Cincinnati, OH 45229	5350 Lamme Rd, Dayton, OH 45439	45.3	51
012	3333 Bumet Ave, Cincinnati, OH 45229	36000 Euclid Ave, Willoughby, OH 44094	260	183
013	3333 Bumet Ave, Cincinnati, OH 45229	210 N Main St, London, OH 43140	86.5	61
014	3333 Bumet Ave, Cincinnati, OH 45229	700 Children's Dr, Columbus, OH 43205	105	61
015	3333 Bumet Ave, Cincinnati, OH 45229	100 W Main St, Springfield, OH 45502	76.4	61
016	3333 Bumet Ave, Cincinnati, OH 45229	1035 W Wayne St, Paulding, OH 45879	163	183
017	3333 Bumet Ave, Cincinnati, OH 45229	11100 Euclid Ave, Cleveland, OH 44106	251	183
018	3333 Bumet Ave, Cincinnati, OH 45229	5901 Monclova Rd, Maumee, OH 43537	193	183
019	3333 Bumet Ave, Cincinnati, OH 45229	1400 W Main St, Bellevue, OH 44811	206	183
020	3333 Bumet Ave, Cincinnati, OH 45229	181 Taylor Ave, Columbus, OH 43203	109	61
021	3333 Bumet Ave, Cincinnati, OH 45229	452 W 10th Ave, Columbus, OH 43210	107	61
022	3333 Bumet Ave, Cincinnati, OH 45229	2142 N Cove Blvd, Toledo, OH 43606	202	183
023	3333 Bumet Ave, Cincinnati, OH 45229	659 Boulevard St, Dover, OH 44622	222	183
024	3333 Bumet Ave, Cincinnati, OH 45229	195 Wadsworth Rd, Wadsworth, OH 44281	215	183

Display 6. Driving Distance and Drive Time

CONCLUSION

The macro presented allows the user to extract latitude and longitude, drive distances and drive times using SAS® and Google Maps™. A few things to note: Running this code against 25 observations takes longer than usual. If a location name is too general, it may result in multiple latitude and longitude pairs, so it is best to specify the desired region, city, or neighborhood association if multiple locations exist. For example, if a location name is 'Mercy Health' and you desire the West side location, it is best to search 'Mercy Health West'. Also, you may notice the pairs may not be exactly the same when searching by address compared

to searching by location name. Google Maps™ geocodes locations by the center of the location not necessarily by the address.

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