User's Guide

Geo*Data

MELISSA DATA®

GEO*Data

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Melissa Data Corporation

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Dear Programmer,

I would like to take this opportunity to introduce you to Melissa Data Corporation. We specialize in mail automation software. Since 1985, we have been helping mail order companies, telemarketers, mailing list brokers, and other related businesses cut the high cost of mailing and improve their customer service.

Melissa Data Corporation began by marketing demographic, nutrition, financial, and ZIP Code databases for the PC environment. Responding to customer demand, our company has focused on mail automation software since 1989. Melissa Data products allow businesses of all sizes to access and use information previously available only on mainframe computers.

Melissa Data products are designed to help you reduce your mailing expenses despite the rising price of postage. We help customers from all sectors of the business community to reduce the amount they spend on postage and printing. Whether you send 200 pieces of mail or have a bustling mailroom, Melissa Data products can save you time and money.

Your feedback is always important to me. Please don't hesitate to e-mail your comments or suggestions to ray@MelissaData.com. I look forward to hearing from you.

Best Wishes,

Raymond F. Melissa
President

Contents

Chapter 1

Introduction

GEO*Data is a geographic database in fixed length (ASCII) format. The GEO*Data database includes every state within the United States. You can use the ZIP file of your desired state (i.e. CA.ZIP) to add geographic data to your mailing list. GEO*Data also contains ZIP Code and county information.

Product Updates

GEO*Data is updated semiannually to ensure that its geographic data is as current as possible. To find out when the next update will be, call Melissa Data at 1-800-MELISSA (1-800-635-4772).

Hardware Requirements

If you copy all the geographic data on the GEO*Data CD-ROM, you will need up to 1.2 gigabytes of free space on your hard drive. Your space requirements will be less if you only copy a portion of the state data.

CD Layout

The GEO*Data installation CD contains the following directories and files:

Root Directory

ZDJ.DAT	ZIP Code Database
CNTY.DAT	County Database
PLACENAME.DAT	Place Name Database

Headers

DBF

ZDJ.DBF	ZIP Code Database header
CNTY.DBF	County Name Database header
GEODATA.DBF	GEO*Data Database header
PLACENAME.DBF	Place Name Database Header

MDB

GEODATA.MDB — Access database that contains the following tables:

- CNTY
- ZDJ
- GEO

Txt

*.ZIP	GEO*Data Database by state abbreviation (for example, CA.ZIP, OR.ZIP, WA.ZIP, and so on)

Utils

PKUNZIP.EXE	Use this utility to decompress the zipped GEO*Data Database files.

Chapter 2

Record Layout

GEODATA Database

The GEODATA database is made up of individual state records (i.e. CA.ZIP, OR.ZIP, WA.ZIP, etc.), and each record is made up fields.

The fields in the GEODATA database are:

FIELD NAME	LENGTH	TYPE
ZIP Code	5	Character
Plus 4	4	Character
Latitude	10	Character
Longitude	11	Character
Census Tract	6	Character
Block	4	Character
FIPS Code	5	Character
Place Code	7	Character
Congressional District	2	Character
Lat Level	1	Character

ZIP Code — ZIP Codes identify a specific geographic delivery area. A ZIP Code can represent an area within a state or a single building.

Plus 4 — This 4-digit expanded code designates the ZIP Code sector and segment.

Latitude — This 10-digit field contains the latitude coordinate.

Longitude — This 11-digit field contains the longitude coordinate.

Census Tract — This field contains the identification code for the Census Tract in which the address is located.

Block — Census blocks are areas bounded on all sides by visible features, such as streets, roads, streams, and railroad tracks, and by invisible boundaries, such as city, town, township, and county limits, property lines, and short, imaginary extensions of streets and roads. A block may represent an area as small as a city block within a densely populated urban center or a large, sparsely populated urban area.

A block number has four digits. The first digit is the block group to which the block belongs with the remaining three being the block number within that group. For instance, 3022 would represent the twenty-second block within the third block group in a Census Tract.

County FIPS — The Federal Information Processing Standard (FIPS) is a 5-digit number assigned to each county in the U.S. by the Census Bureau. The first 2-digits are the state code, and the last 3-digits are the county number.

Place Code — This is a census field designating a physical location of an address. Because the post office does not distinguish city limits very well, this may differ from the city name that a post office designates for an address.

Congressional District — This field will contain the congressional district number, accurate to the ZIP+4 level.

Lat Level — This field will indicate the level of accuracy of the latitude and longitude information.

LAT LEVEL	EXPLANATION
9	Latitude and longitude are accurate to the ZIP+4 level.
7	Latitude and longitude are accurate to the ZIP+2 level.
5	Latitude and longitude are accurate to the 5-digital ZIP Code level only.

ZIP DATABASE

The ZIP database (`ZDJ.DAT`) is included so users can view the relationship between a GEO*Data file ZIP Code and a city/state name. It is composed of a series of records, and each record is made up fields.

The fields in the ZIP database are:

FIELD NAME	LENGTH	TYPE
ZIP Code	5	Character
State	2	Character
City	28	Character
Type	1	Character
County FIPS	5	Character
County Name	25	Character
Area Code	3	Character
CR + LR	2	Character

ZIP Code — ZIP Codes identify a specific geographic delivery area. A ZIP Code can represent an area within a state or a single building.

State — The Postal Service 2-letter state or territory abbreviation.

City — The city, community, station or other name by which a 5-digit ZIP area is known.

Type — Defines the type of ZIP Code for delivery purposes.

- P = A ZIP Code used only for Post Office Boxes. Only one record is listed per PO BOX code.
- U = A unique ZIP Code. Unique ZIP Codes are assigned to specific organizations (e.g. Reader's Digest), educational institutions, and postal facilities.
- M = Identifies an APO/FPO ZIP Code. APO's are Army and Air Force Post Offices and FPO's are Navy Fleet Post Offices. There is only one record per APO/FPO.

County FIPS — The Federal Information Processing Standard number assigned to each county in the U.S.

County Name — The name of the county in which the ZIP is located.

Area Code — The 3-digit telephone area code.

COUNTY NAME DATABASE

The County Name database (CNTY.DAT) is included so users can view the relationship between a GEO*Data file FIPS Code and a County Name. It is composed of a series of records and each record is made up fields.

The fields in the County Name database are:

FIELD NAME	LENGTH	TYPE
FIPS Code	5	Character
County Name	25	Character
State	2	Character
Time Zone	2	Character
County Type	1	Character
County Seat	28	Character
Name Type	1	Character
Elevation	5	Numeric
Persons per Household	4	Numeric (DEC=2)
Population	8	Numeric
Area	6	Numeric
Households	8	Numeric
White	8	Numeric
Black	8	Numeric
Hispanic	8	Numeric
Average Income	8	Numeric
Average House	8	Numeric Value

FIPS Code — The Federal Information Processing Standard (FIPS) is a 5-digit number assigned to each county in the U.S. by the Census Bureau. The first 2 digits are the state code, and the last 3 digits are the county number.

County Name — The name of the county, borough, or parish.

State — The standard 2-letter abbreviation for the state or province.

Time Zone — The number representing the hours past UTC Time Standard. All Melissa Data products express time zones in UTC (Coordinated Universal Time). The time zones are:

HOURS	TIME ZONE
4	Atlantic
5	Eastern
6	Central
7	Mountain
8	Pacific
9	Alaska
10	Hawaii-Aleutian
11	Samoa

In the U.S., the time of each zone is advanced 1 hour every year on the second Sunday in March. On the first Sunday in November the time is turned back 1 hour. The states and territories exempted from this observance are Arizona, Hawaii, the counties of Indiana in the Eastern Time Zone, and Puerto Rico.

The counties that are split between time zones are:

- Gulf, FL
- Alieutian Islands, AK
- Idaho, ID
- Cherry, NE
- McKenzie, ND
- Morton, ND
- Sioux, ND
- Jones, SD
- Stanley, SD

County Type — The letter code assigned to the county by population size.

- A = All counties located within the 25 largest MSA's.
- B = All counties not included in "A" with a population over 150,000 or located within an MSA having a population over 150,000.
- C = All counties not included in "A" or "B" with a population over 35,000 or located within an MSA having a population over 35,000.
- D = All other counties not included in "A," "B," or "C."

County Seat — The county government capital. Data is not available for all counties.

County Name Type — The letter code assigned for the name of the county.

LETTER	NAME
A	Census Area
B	Borough
C	County
D	District
M	Municipio

LETTER	NAME
P	Parish

Elevation — The elevation of the county seat in feet above sea level.

Persons Per Household — The average number of persons per household.

Population — Estimate of the county population.

Area — The county area in square miles.

Households — The number of households within the county.

White — Estimate of the White population within the county.

Black — Estimate of the Black population within the county.

Hispanic — Estimate of the Hispanic population within the county.

Average Income — The average household income earned within the county.

Average Household Value — The average value of a home within the county.

PLACE NAME DATABASE

The Place Name database (PLACENAME.DAT) matches the place code to the name describing the place represented by the code.

Occasionally, ZIP Code boundaries will overlap with city limits, placing part of a city or unincorporated area within a ZIP Code normally associated with a neighboring city.

FIELD NAME	LENGTH	TYPE
Place Code	7	Character
Place Name	60	Character

Place Name — The official Census name for the area described by the ZIP + 4 code. This may differ from the city name in the ZIP Code database.

Place Code — Matches up with the Place Code field in the GEODATA databases.

Chapter 3

Distance Calculation

Any point on the earth's surface can be located by its latitude and longitude coordinates.

Latitude is the angle above or below the equator in degrees. The equator is zero degrees, the north pole is north 90 degrees latitude, and the south pole is south 90 degrees latitude. The continental United States falls between 25 and 50 degrees north.

Longitude is the angle east or west of the Greenwich meridian. The continental United States is between 70 and 125 degrees west.

Approximate Solutions

One degree of latitude is equal to 69.1 miles. One degree of longitude is equal to 69.1 miles at the equator. North or south of the equator, 1 degree of longitude is a smaller distance. It's reduced by the cosine of the latitude. Dividing the latitude number by 57.3 converts it to radians.

DistLat = 69.1 * (Lat2-Lat1)

DistLong = 69.1 * (Lg2-Lg1) * cos(Lat1 / 57.3)

Dist = (DistLat2 + DistLong2) 0.5

If you don't want to use the COS function, then a good approximate solution is:

DistLat = 69.1 * (Lat2-Lat1)

DistLg = 53 * (Lg2 - Lg1)

Dist = $(DistLat^2 + DistLong^2)^{0.5}$

EXACT SOLUTIONS

To calculate the exact distance between points requires spherical geometry.

The basic formula is:

D = 3959arccos[sin(Lat1)sin(Lat2)+

cos(Lat1)cos(Lat2)cos(Lg2-Lg1)]

The above formula has 1 major problem: most computer languages do not support the arccosine function. Therefore a different form is necessary, one that uses the arctangent function that most languages embrace.

D = $3959atn [(1-A^2)^{0.5}$ / A]

where A is equal to:

A = sin(Lat1)sin(Lat2)+
cos(Lat1)cos(Lat2)cos(Lg2-Lg1)

Most computer languages compute the sine and cosine function with the angle given in radians. To convert degrees to radians, divide degrees by the constant 57.3 (180/pi).

In BASIC this would be programmed as follows:

C = 57.3

A = sin(Lat1/C)*sin(Lat2/C) + cos(Lat1/C)*
cos(Lat2/C)*cos(Lg2/C - Lg1/C)

D = 3959*atn(SQR(1-A^2)/A)

Where:

D = distance in statue miles from the first to the second point.

C = degrees to radians constant 57.3 (180/pi).

Lat1 = latitude of the first point in degrees.

Lg1 = longitude of the first point in degrees.

Lat2 = latitude of the second point in degrees.

Lg2 = longitude of the second point in degrees.

NOTE: Dividing the latutude number by 57.3 converts it to radians.

Since all ZIP Code points in the United States are north latitude and west longitude, there is no need to check the sines (positive and negative) of the latitudes and longitudes.

Some programming languages, such as dBASE II/III, do not have the functions of the sine, cosine and arctangent. Also, the formulas given are time consuming to calculate. A simpler but less accurate method is given here:

```
D = 69.1 * SQR [ (LAT2-LAT1)2 +0.6*
(LG2-LG1)2 ]
```

Although this formula is not as accurate as the first great circle method, it will give good results for most applications.

In Basic it is written as follows:

```
D = 69.1 * SQR [(LAT2-LAT1)^2 +
.6*(LONG2-LONG1)^2]
```

In dBASE III it is written as follows:

```
D = 69.1 * SQRT [(LAT2-LAT1)^2 + 0.6 *
(LONG2-LONG1)^2]
```

To make using the database easier, the latitudes and longitudes are given in the decimal format instead of the degree, minute and second format. The latter would require the additional steps of converting seconds to fractions of a minute and then minutes to a fraction of a degree.

BEARING FORMULA

The bearing is the direction from the first point to the second point. It is expressed as an angle from north in degrees. Due north is a bearing of zero degrees, east is a bearing of 90 degrees, south is 180, and west is 270.

The bearing from the first point to the second is calculated with:

$$B = \text{ArcTan} \frac{\sin(Lat1)*\sin(Lg2-Lg1)}{\sin(Lat2)*\cos(Lat1)-\cos(Lat2)*\sin(Lat1)*\cos(Lg2-Lg1)}$$

Since the ARCTAN function gives the angle in radians, it is necessary to convert B to degrees by multiplying by 57.3 (180/Pi).

To use this equation requires some special considerations. This example assumes that Lat1, Lat2, Lng1, Lng2 have been converted to radians.

Use the following steps:

N = sin(Lat1)* sin(Lng1-Lng2)

D = sin(Lat2)* cos(Lat1) –
cos(Lat2)* sin(Lat1)* cos(Lng1-Lng2)

B = 57.3 * ARCTAN(N/D)

If D>0 then B=360+B

If D<0 then B=180+B

If B<0 then then B = 360 + B

Where:

N is the Numerator.

D is the Denominator.

B is the Bearing.

EXAMPLES

The following examples should give you a feel for the numbers. For these examples we will use the points of Schenectady, NY and Los Angeles, CA.

First Point is in **Schenectady, NY 12345**

Lat1 = 42.8145

Lng1 = 73.9380

Second Point is in **Los Angeles, CA 90001**

Lat2 = 34.0515

Lng2 = 118.2420

Example 1: Approximate Formula (1)

Lat Dist = 69.1 (Lat2 - Lat1) = 605.5

Lng Dist = 69.1 * (Lng2 - Lng1) *
COS (42.8145/57.3) = 2245.8

Dist = 2326.0 miles

Example 2: Approximate Formula (2)

Lat Dist = 69.1 (Lat2 - Lat1) = 605.5

Lng Dist = 53 * (Lng2 - Lng1) = 2348.1

Dist = 2424.9 miles

Example 3: Exact Solution Formula (3)

A1 = sin(Lat1/57.3) * sin(Lat2/57.3) = 0.3805

A2 = cos(Lat1/57.3) * cos(Lat2/57.3) *
cos(Lng2/57.3-Lng1/57.3)

A2 = 0.4350

A = A1 + A2 = 0.8155

Dist = 3959 * ATN[(1 - A2)0.5/A]

Dist = 2443.4 miles

Example 4: Bearing Formula (4)

N = sin(Lat1/57.3) * sin(Lng2/57.3 -
Lng1/57.3) = 0.4747

D1 = sin(Lat2/57.3) * cos(Lat1/57.3) = 0.4107

D2 = cos(Lat2/57.3) * sin(Lat1/57.3) *
cos(Lng2/57.3 - Lng1/57.3)

D2 = 0.4029

B = 57.3 * ATN(N/(D1 - D2)) = -89.1 Degrees

Bearing = 360 + B = 360 - 89.1

Bearing = 270.9 degrees from North.

Chapter 4

State Abbreviations

ABBREVIATION	CODE	STATE
AL	01	Alabama
AK	02	Alaska
AZ	04	Arizona
AR	05	Arkansas
CA	06	California
CO	08	Colorado
CT	09	Connecticut
DE	10	Delaware
DC	11	District Columbia
FL	12	Florida
GA	13	Georgia
HI	15	Hawaii
ID	16	Idaho

ABBREVIATION	CODE	STATE
IL	17	Illinois
IN	18	Indiana
IA	19	Iowa
KS	20	Kansas
KY	21	Kentucky
LA	22	Louisiana
ME	23	Maine
MD	24	Maryland
MA	25	Massachusetts
MI	26	Michigan
MN	27	Minnesota
MS	28	Mississippi
MO	29	Missouri
MT	30	Montana
NE	31	Nebraska
NV	32	Nevada
NH	33	New Hampshire
NJ	34	New Jersey
NM	35	New Mexico
NY	36	New York
NC	37	North Carolina
ND	38	North Dakota
OH	39	Ohio
OK	40	Oklahoma
OR	41	Oregon
PA	42	Pennsylvania
RI	44	Rhode Island
SC	45	South Carolina
SD	46	South Dakota
TN	47	Tennessee
TX	48	Texas
UT	49	Utah
VT	50	Vermont
VA	51	Virginia
WA	53	Washington
WV	54	West Virginia
WI	55	Wisconsin
WY	56	Wyoming

ABBREVIATION	CODE	STATE
GU	66	Guam
PR	72	Puerto Rico