CENTERS
OF POPULATION COMPUTATION
FOR **1950, 1960, 1970, 1980, 1990** and **2000**

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General Explanation

Introduction

This documents the procedure used to compute the population center of the states and the District of Columbia of the United States in 1950, 1960, 1970, 1980, 1990 and 2000, based on counts of population obtained in the corresponding decennial censuses. Although Alaska and Hawaii became states during the 1950s, for historical comparability some computations may not include them.

This document provides information for many U.S. Census Bureau data users, some of whom have sought this information in unpublished form in the past. It is not meant to champion the gravity center of population concept as a pre-eminent measure for analyzing population distribution and change. Because there are many ways of measuring distribution, as well as change, this documents the method long used by the Census Bureau to determine the center of population.

Computation of Centers

The concept of the center of population as used by the U.S. Census Bureau is that of a balance point. That is, the center of population is the point at which an imaginary, weightless, rigid, and flat (no elevation effects) surface representation of the 48 conterminous states and the District of Columbia (or 50 states as appropriate to the computation) would balance if weights of identical size were placed on it so that each weight represented the location on one person. This is a somewhat technical point in that this is different from the use of the term "center of population" to denote a place where half the population is to one side and half to the other side, likewise, above and below. Such a median population point, in a certain sense, is a center of population; it is not, however, the method used for this calculation. This difference is discussed further in the section Median verses Mean Population Point.

Method Used in Determining the 1910 to 1950 Centers of Population

The United States centers of population for the 1910 through the 1950 decennial censuses were computed in the following manner: In making the computations for the location of the center of population, the assumption was made that the center was at a certain point. Through this point a parallel and a meridian were drawn, crossing the entire country. In making the computations for the 1950 census, this intersection was assumed to be where the parallel of 39° North latitude intersected the meridian of 86° West longitude, which lines were taken as the axes of moments. This was the same meridian and parallel used since the 1910 census.

The product of the population of a given area by its distance from the assumed parallel is called a north or south moment, and the product of the population of the area by its distance from the assumed meridian is called an east or west moment. In calculating north and south moments the distances were measured in minutes of arc; in calculating east and west moments miles were used due to the unequal length of the degrees and minutes in different latitudes.

The population of the country was grouped by square degrees - that is, by areas included between consecutive parallels and meridians - as they were considered convenient units with which to work. The population of the cities of 25,000 inhabitants or more then was deducted from that of the respective square degrees in which they lay and treated separately. The center of population of each square degree was assumed to be at its geographical center except where such an assumption is manifestly incorrect; in these cases, the position of the center of population of the square degree was estimated as nearly as possible. The population of each square degree north and south of the assumed parallel was multiplied by the distance of its center from that parallel; a similar calculation is made for the cities of 25,000 inhabitants or more; and the sum of the north moments and the sum of the south moments were ascertained. The center moves north or south, and east or west, of the assumed parallel and meridian, depending upon which product is in excess. The difference between the north and south sums (moments or product), divided by

the total population of the country, gives the number of degrees that the center is north or south of the assumed parallel, while the difference between the east and west sums (moments or product), divided by the total population of the country, gives the number of miles that the center is east or west of the assumed meridian. The degrees of latitude so obtained were reduced to miles and the number of miles to degrees, these results being the distance north or south, east or west, of the assumed parallel and meridian which, in this instance, were the parallel of 39° North latitude and the meridian of 86° West longitude.

Method Used in Determining the 1960, 1970, 1980, 1990 and 2000 Centers of Population

The computation of the center of population by the U.S. Census Bureau in the 1960 through 2000 decennial censuses was based on the population of small geographic areas (43,000 areas in 1960, 250,000 or more areas in 1970 through 1980, over 7,000,000 for 1990 and more than 8,000,000 for 2000) for which centers of population had been estimated[1]. For 1970, the population centers and the population counts for each of these areas were recorded on punched cards and then transferred to magnetic tape for processing through an electronic computer. For 1980, the population centers and the population counts were recorded on magnetic tape by special coordinate digitizing equipment. For 1990 and 2000, the population counts were recorded in a database[2] that already had the coordinates for all the geographic areas, including an 'internal point'. In each instance, a computer program was executed that controlled the mathematical processes that the computer executed.

To avoid unduly complex factors in the computations, the mathematical formulae used were those that would be precise for a true sphere. On such a sphere, the north-south distances between parallels of latitude are identical and distances in degrees may be used as units of distance. On the other hand, distances between meridians on longitude lines, are not constant but decrease from the equator toward the poles. However, if the length of one degree along the equator is used as the unit of measurement, then the length in degrees of an east-west line at any other latitude can be adjusted to the measurement standard by multiplying by the cosine of the latitude.

The center of population computed by the Census Bureau is the point whose latitude ($\overline{\phi}$) and longitude ($\overline{\lambda}$) satisfy the equations[3]

$$\overline{\phi} = \frac{\sum w_i \phi_i}{\sum w_i} \qquad \overline{\lambda} = \frac{\sum w_i \lambda_i Cos(\phi_i)}{\sum w_i Cos(\phi_i)}$$

where ϕ_i , λ_i , w_i are the latitude, longitude, and population attached to the basic small units of area used in the computation.

Stated in less mathematical form, the latitude of the center of population was determined by multiplying the population of each unit of area by the latitude of its population center, then adding all these products and dividing this total by the total population of the United States. The result is the latitude of the population center.

East-west distances were measured, or computed, in substantially the same manner, but with the inclusion of a correction for latitude[3]. For these distances, a degree of longitude at the equator was the unit of measurement. East-west distances along the equator could be measured in degrees, but any east-west degree distance north of the equator -- where all the United States is located -- had to be adjusted to recognize the convergence of meridians toward the poles. This adjustment required that each east-west distance, stated in degrees of longitude, be multiplied by the cosine of the latitude. This mathematical relationship is precise for a sphere and a very close approximation for the earth.

The computation required that the longitude of each of the thousands of selected points be multiplied by the cosine of the latitude of the point and by the population associated with the point. These products were added and divided by the sum of the products for the same thousands of points, each of which was obtained

by multiplying the cosine of the latitude of a point by the appropriate population figure. The result was the longitude of the center of population[3].

Method Used in Determining State and County Centers of Population

The same methods and formulae used for determining the center of population for the Nation were applied to the computation of state and county centers. It is of historical interest that the 1880 Census of Population was the first to include computations of the centers of the population for each of the states.

Past Centers of Population of the United States

Table A gives past centers of population of the United States from the first Census of Population in 1790 up through Census 2000. For ease of use in computer systems, the latitude and longitude positions are given in decimal degree equivalents rather than traditional degrees/minutes/seconds.

Table A. **Mean Center of Population of the United States: 1790 through 2000**

Census year	North latitude	West longitude	Approximate location
United States:			
2000	37.69699	91.80957	Phelps County, MO, 2.8 miles east of Edgar Springs
1990	37.87222	91.21528	Crawford County, MO, 9.7 miles southeast of Steelville.
1980	38.13694	90.57389	Jefferson County, MO, 1/4 mile west of DeSoto.
1970	38.46306	89.70611	St. Clair County, IL, 5 miles east-southeast of Mascoutah.
1960	38.59944	89.20972	Clinton County, IL, 6-1/2 miles northwest of Centralia.
1950	38.80417	88.36889	Clay County, IL, 3 miles northeast of Louisville.
Conterminous United States[1]			
1950	38.83917	88.15917	Richland County, IL, 8 miles north-northwest of Olney.
1940	38.94833	87.37639	Sullivan County, IN, 2 miles southeast by east of Carlisle.
1930	39.06250	87.13500	Greene County, IN, 3 miles northeast of Linton.
1920	39.17250	86.72083	Owen County, IN, 8 miles south-southeast of Spencer.
1910	39.17000	86.53889	Monroe County, IN, in the city of Bloomington.
1900	39.16000	85.81500	Bartholomew County, IN, 6 miles southeast of Columbus.
1890	39.19889	85.54806	Decatur County, IN, 20 miles east of Columbus.
1880	39.06889	84.66111	Boone County, KY, 8 miles west by south of Cincinnati, OH.
1870	39.20000	83.59500	Highland County, OH, 48 miles east by north of Cincinnati.
1860	39.00667	82.81333	Pike County, OH, 20 miles south by east of Chillcothe.
1850	38.98333	81.31667	Wirt County, WV, 23 miles southeast of Parkersburg [2].
1840	39.03333	80.30000	Upshur County, WV, 16 miles south of Clarksburg. Upshur County was formed from parts of Barbour, Lewis, and Randolph Counties in 1851[2].
1830	38.96500	79.28167	Grant County, WV, 19 miles west-southwest of Morefiled. Grant County was formed from part of Hardy County in 1866 [2].
1820	39.09500	78.55000	Hardy County, WV, 16 miles east of Moorefield [2].
1810	39.19167	77.62000	Loudoun County, VA, 40 miles northwest by west of Washington, DC.
1800	39.26833	76.94167	Howard County, MD, 18 miles west of Baltimore. Howard County was formed from part of Anne Arundel County in 1851.
1790	39.27500	76.18667	Kent County, MD, 23 miles east of Baltimore.

[1] Conterminous United States excludes Alaska and Hawaii.

[2] West Virginia was set off from Virginia, December 31, 1862, and admitted as a State June 19, 1863.

To convert from decimal degrees to degrees/minutes/seconds, use the procedure in following example:

Say you wish to convert the 1990 latitude from 37.87222 to its degrees/minutes/seconds equivalent.
First, set the degrees to be the part of the number left of the decimal, e.g., degrees = 37.
Then remove the degrees from the decimal value and you are left with the minutes/seconds part.
Multiply this remainder by 60 to get the minutes value, e.g., 0.87222 times 60 = 52.3332.
Set the minutes to be the part of the number left of the decimal, e.g., minutes = 52.
Then, taking the decimal value multiply it by 60 to get the seconds, e.g., 0.3332 * 60 = 19.99.
Generally, this is rounded to the nearest whole number; in this case, 20. This is the seconds part.

Median verses Mean Population Point

There are points different in character that may be termed the "center of population," but at each decennial census, the term "center of population" has been applied to the point that may be considered as the population center of gravity of the United States. This is sometimes confused with another point that is termed the "median point." The median point, which may be described as the numerical center of population, is in no sense a center of gravity. In determining the median point, distance is not taken into account and the location of the units of population is considered only in relation to the intersecting median lines -- as being north or south of the median parallel and east or west of the median meridian.

It is evident that extensive changes in the geographical distribution of the population may take place without affecting the position of the median point. In this respect, the median point differs essentially from the center of population, which responds to the slightest population change in any section of the country. To illustrate, assume the east-west population median meridian goes through St. Louis, Missouri. If a million persons moved from Kansas to California, the median point would not change, but the mean center of population would shift dramatically to the west.

Median Center of Population

The Census 2000 median center of population is located at 38.75644 North latitude, 86.93074 West longitude, in Van Buren township, Daviess County, Indiana, about 13 miles Northeast of Washington, IN. Table B lists the median center of population for the United States from 1880 up through 2000.

Table B. **Median Center of Population of the United States: 1880 through 2000**

Census year	North latitude	West longitude
United States:		
2000	38.75644	86.93074
1990	38.96528	86.53139
1980	39.31667	86.13750
1970	39.79528	85.52861
1960	39.94028	85.28333
1950	40.00333	85.03917
Conterminous United States*		
1950	40.00333	84.94750
1940	40.07167	84.66973
1930	40.19778	84.60973
1920	40.19778	84.73334
1910	40.12583	85.03333
1900	40.05889	84.81694
1890	40.04751	84.66694
1880	39.95000	84.12000
* Conterminous United States excludes Alaska and Hawaii.		

Geographic Center of Area

The geographic center of area is the point at which the surface of the United States would balance if it were a plane of uniform weight per unit of area. That point, approximately 44.967 North latitude and 103.767 West longitude, is located West of Castle Rock in Butte County, South Dakota, as it has been since Alaska and Hawaii became States. The geographic center of the conterminous United States (48 States and the District of Columbia) is located near Lebanon in Smith County, Kansas at approximately 39.833 North latitude and 98.583 West longitude.

References

Bureau of the Census, *Statistical Atlas of the United States*, U.S. Department of Commerce, Bureau of the Census, Washington, DC, 1925.

Bureau of the Census, *Centers of Population for States and Counties, 1950, 1960, and 1970*, U.S. Department of Commerce, Bureau of the Census, Washington, DC, issued 1974.

U.S. Geological Survey, web site: *Elevations and Distances in the United States*, April 2001. http://mac.usgs.gov/mac/isb/pubs/booklets/elvadist/elvadist.html

[1] For 1970 and 1980, the geographic areas used were a combination of census enumeration districts outside major urban centers and block groups in the more urban areas. For 1990 and 2000, individual census blocks were used and a point within each block was automatically determined by computer program; not, however, related to the population distribution within the block.

[2] The database was the U.S. Census Bureau's Topologically Integrated Geographic Encoding and Referencing (TIGER®) database that contained the coordinates, geographic codes, and names of all the geographic features, and all governmental and statistical entities, recognized by the Census Bureau in its data tabulations. There were more than seven million blocks in the database.

[3] The equations used for calculation of the 1990 center did not include the cosine function. This resulted in a slight shift of less than 10 miles from the point that would have been computed if the cosine function had been applied.