Spatial Measures of Central Tendency:

The Median Center

The Median Center is the cartographic equivalent of the center of gravity in geometry.

It's a very simple way to determine where most of the points are clustered, and is applicable to any geographical feature that forms a point distribution (ie, NOT a line or area), such as the distribution of cities, factories, shops, high-rise buildings, etc.

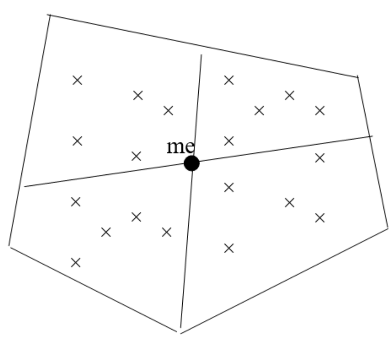
To find the Median Center:

Plot the points on a map

Draw a line North-South leaving an equal number of points on each side (left/right)

Draw a line East-West leaving an equal number of points on each side (top/bottom)

The intersection of both lines is the Median Center.



It can be used to find a suitable location for something that needs to be centrally located. The Median Center will gravitate towards an area with the most features.

The Median Center is good for finding the most accessible location.

Example

The following points represent weather stations centers.

find the spatial mediator for them.

weather stations centers	X	Y
1	10	4
2	16	8
3	8	9
4	24	12
5	18	16
6	28	13
7	11	10
8	30	20

The solution

First: calculate the median of the Y-coordinate as follows:

a) We arrange the coordinates in ascending or descending order.

4, 8, 9, 10, 12, 13, 16, 20

$$\text{Median1} = \frac{n}{2} = \frac{8}{2} = 4^{th}$$

$$\text{Median2} = \frac{n}{2} + 1 = \frac{8}{2} + 1 = 5^{th}$$

Median = Median1 + Median2

$$= \frac{10+12}{2} = 11$$

Second: calculate the median of the X-coordinate as follows:

We arrange the coordinates in ascending or descending order.

8,10,11,16,18,24,28,30

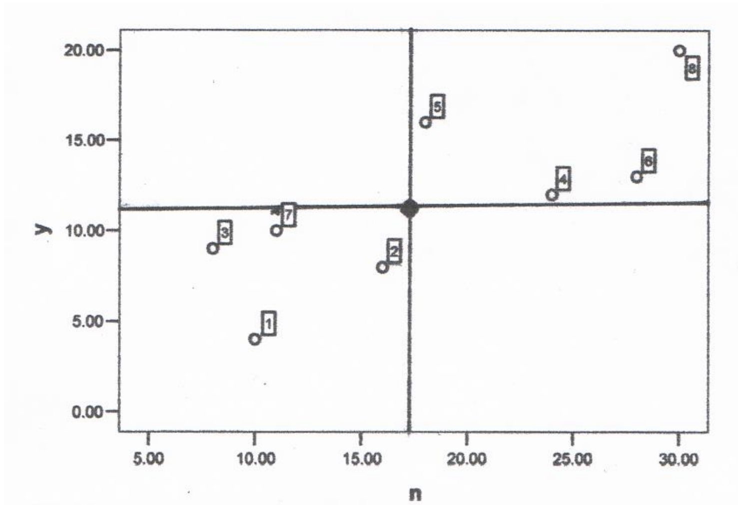
$$\text{Median1} = \frac{n}{2} = \frac{8}{2} = 4^{th}$$

$$\text{Median2} = \frac{n}{2} + 1 = \frac{8}{2} + 1 = 5^{th}$$

Median = Median1 + Median2

$$= \frac{16+18}{2} = 17$$

Therefore, the median position (spatial median) (x , y) of the weather stations centers is (17 , 11) After that, the median position "spatial median" can be determined by the point of intersection of the vertical and horizontal events, as shown in the following figure:



The figure shows that the spatial median is in the middle of the weather stations centers, so that half of them fell at the top of the horizontal axis and the other half fell at the bottom, in addition to that half of them fell to the east of the vertical axis and the other half fell to its west.

Spatial Measures of Dispersion

Standard Distance

Just as the mean center serves as a locational analogue to the mean, standard distance is the spatial equivalent of standard deviation (table 4.1). Standard distance measures the amount of absolute dispersion in a point pattern. After the locational coordinates of the mean center have been determined, the standard distance statistic incorporates the straight-line or Euclidean dis- tance of each point from the mean center. In its most basic form, standard distance (Sp) is written as follows:

$$S.D = \sqrt{\frac{\sum (X_i + \bar{X}_c)^2 + (X_i + \bar{Y}_c)^2}{n}} \quad \ldots..1$$

Equation 1 can be modified algebraically to reduce the number of required computations considerably:

$$S_D = \sqrt{\left(\frac{\sum X_i^{\,2}}{n} - \bar{X}_c^{\,2}\right) + \left(\frac{\sum Y_i^{\,2}}{n} - \bar{Y}_c^{\,2}\right)}$$

Using the same point pattern as in the earlier example (figure 4.1), the standard distance is calculated (table 2) and shown as the radius of a circle whose center is the mean center (figure 4.5).

Table 2 :Work Table for Calculating Standard Distance

Point	X_i	Y_i	$X_i^{\,2}$	$Y_i^{\,2}$
A	2.8	1.5	7.84	2.25
B	1.6	3.8	2.56	14.44
C	3.5	3.3	12.25	10.89
D	4.4	2.0	19.36	4.00
E	4.3	1.1	18.49	1.21
F	5.2	2.4	27.04	5.76
G	4.9	3.5	24.01	12.25
n= 7	$\sum X_i$ = 26.7	$\sum Y_i$ = 17.6	$\sum$ = 111.55	$\sum$ = 50.8

$\bar{X}_c = \frac{\sum x_i}{n} = \frac{26.7}{7} = 3.81$ $\quad \bar{X}_c^{\,2} = 14.51$

$\bar{Y}_c = \frac{\sum y_i}{n} = \frac{17.6}{7} = 2.51$ $\quad \bar{Y}_c^{\,2} = 6.30$

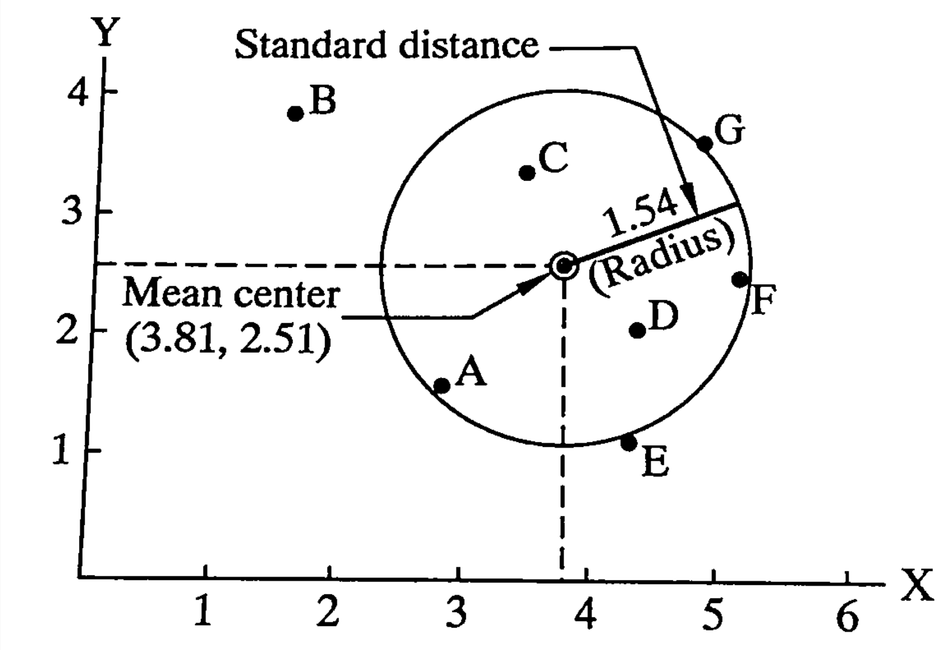
n = 7 …. $\sum X_i^{\,2} = 111.55$ …. $\sum Y_i^{\,2} = 50.8$

$$S_D = \sqrt{\left(\frac{\sum X_i^{\,2}}{n} - \bar{X}_c^{\,2}\right) + \left(\frac{\sum Y_i^{\,2}}{n} - \bar{Y}_c^{\,2}\right)}$$

$$S_D = \sqrt{\left(\frac{111.55}{7} - 14.52\right) + \left(\frac{50.8}{7} - 6.30\right)}$$

$$S_D = 1.54$$

Figure 4.5 Graph of Point Locations, Mean Center, and Standard Distance



Like standard deviation, standard distance is strongly influenced by extreme or peripheral locations. Because distances about the mean center are squared, "un-centered" or atypical points have a dominating impact on the magnitude of the standard distance.

Weighted standard distance is appropriate for those geographic applications requiring a weighted mean center. The definitional formula for weighted standard distance (Swp) is:

which may be rewritten in computationally-simple from as:

Point	f_i	X_i	Y_i	X_i^2	$f_i\ (X_i)^2$	Y_i^2	$f_i\ (Y_i)^2$
A	5	2.8	1.5	7.84	39.20	2.25	11.25
B	20	1.6	3.8	2.56	51.20	14.44	288.8
C	8	3.5	3.3	12.25	98.00	10.89	87.12
D	4	4.4	2.0	19.36	77.44	4.00	16.0
E	6	4.3	1.1	18.49	110.94	1.21	7.26
F	5	5.2	2.4	27.04	135.20	5.76	28.8
G	3	4.9	3.5	24.01	72.03	12.25	36.75
n= 7	**51**	**$\sum X_i$ = 26.7**	**17.6**	**111.55**	**584.01**	**50.8**	**475.98**

$\bar{X}_c$= 3.10

$\bar{Y}_c$= 2.88

($\bar{X}$c) 2 = 9.61

($\bar{Y}$c) 2 = 8.29

$\sum$ fi = 51

$\sum$ fi (Xi)2 = 584.01

$\sum$ fi (Yi)2 = 475.98

$$S_{wD} = \sqrt{\left(\frac{\sum fi\,(X_i^{\,2})}{\sum \text{fi}} - \bar{X}_c^{\,2}\right) + \left(\frac{\sum fi\,(Y_i^{\,2})}{\sum \text{fi}} - \bar{Y}_c^{\,2}\right)}$$

$$S_{wD} = \sqrt{\left(\frac{584.01}{51} - 9.61\right) + \left(\frac{475.98}{51} - 8.29\right)}$$

$$S_{wD} = 1.70$$