Spatial Pattern

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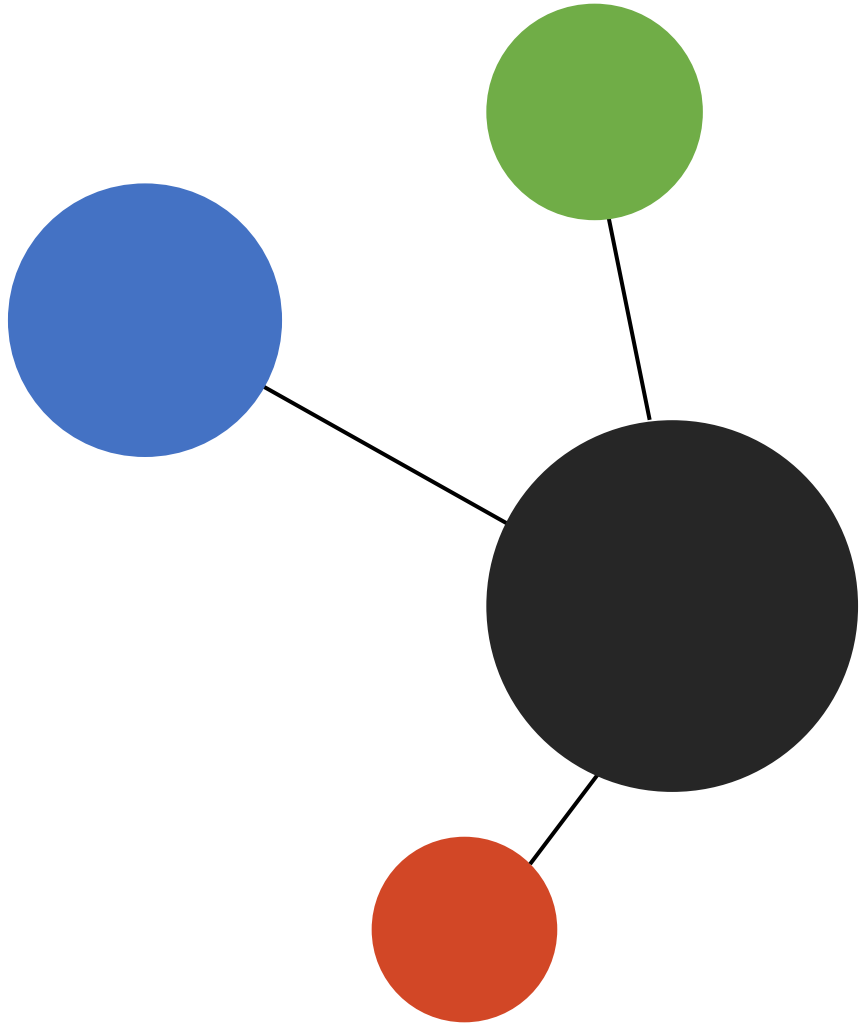


What is Spatial Pattern ?

definition

Spatial pattern analysis methods provide insights about where things occur, how the distribution of incidents or the arrangement of data aligns with other features in the landscape, and what the patterns may reveal about potential connections and correlations

Lauren M Scott, 2015

Metode analisis pola spasial memberikan gambaran tentang :

- ***di mana** sesuatu terjadi ?*
- ***bagaimana sebaran** kejadian atau rangkaian sebaran data selaras dengan fitur lain di lapangan?*
- ***pola apa** yang dapat mengungkapkan potensi koneksi dan korelasi ?*

What is Spatial Pattern ?

coverages

Spatial Pattern Analysis

1. **Identifying, describing, and measuring the shape,**
2. **Arrangement**
3. **Location**
4. **Configuration**
5. **Trend**
6. **Relationships**

geographic data

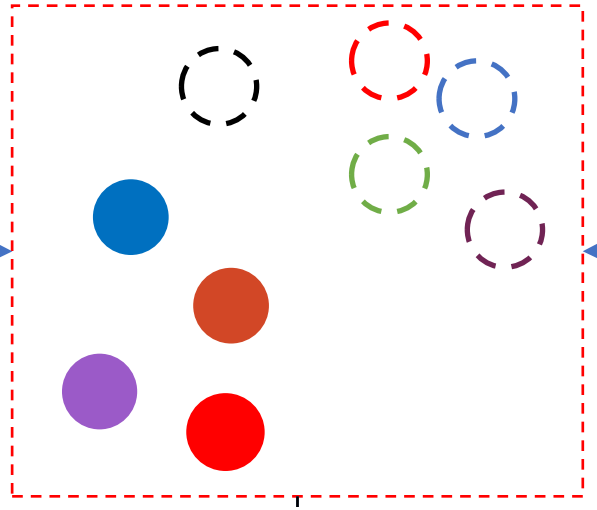
- ✓ Discernable pattern ?
- ✓ Order ?
- ✓ Structure associated ?

Descriptive
Spatial
Pattern
Analysis

Inferential
Spatial
Pattern
Analysis

Descriptive Spatial Pattern Analysis

Analysis object



Key Characteristics

Properties

Mean Center

Describe the central tendency of the feature

- Which resource is most accessible?
- Has the center of innovation changed over time?
- What is the primary direction of migration?

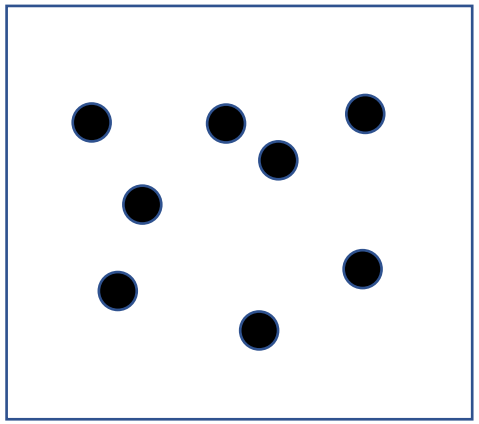
Standard Deviation of Ellips

Describe the spatial distribution and orientation around mean center

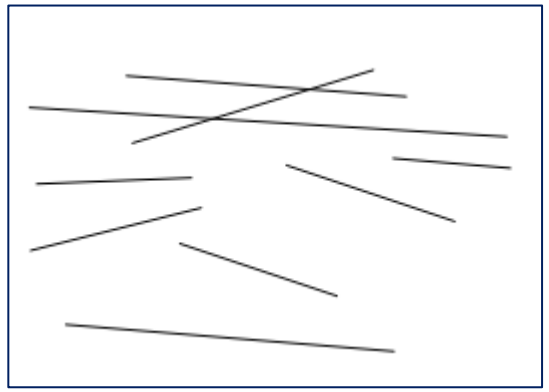
- How quickly and widely is a disease spreading through the village ?
- Where are the core areas for particular language dialects ?
- How integrated are they and which have the broadest spatial extent ?

Descriptive Spatial Pattern Analysis

Objects measured



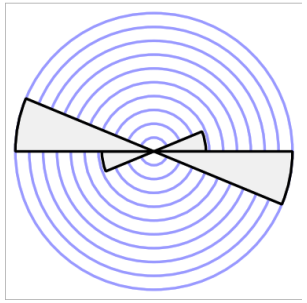
Point Feature → Average of X and Y coordinates



Line Feature

Central Tendency

- Mean Direction
- Mean Orientation
- Mean Line Length
- Mean Center Point
- Circular Variance



Inferential Spatial Pattern Analysis

Inferential method type

1. **Average Nearest Neighbor**
2. **Quadrat Analysis**
3. **Kernel Density**
4. **Spatial Autocorrelation**
   Moran's I, Geary Contiguity

Computing the mean distance to each feature's closest neighbor and then comparing that distance to the distance that would be obtained for a random distribution of those same features

Does the spatial pattern of a disease mirror the spatial pattern of the population at risk?

Is the new virus remaining geographicallyfixed or is it spreading to surrounding communities?

Is there a discernible spatial pattern or not?

compare local statistical properties of an attribute to global properties

Average Nearest Neighbor

The average nearest neighbor ratio is calculated as the observed average distance divided by the expected average distance

$$ANN = \frac{\overline{D}_O}{\overline{D}_E}$$

$$\overline{D}_O = \frac{\sum_{i=1}^{n} d_i}{n} \qquad \overline{D}_E = \frac{0.5}{\sqrt{n/A}}$$

$\overline{D}_O$: the observed mean distance between each feature and its nearest neighbor
$\overline{D}_E$: the expected mean distance for the features given in a random pattern
d_i : equals distance between feature I and it's nearest neighboring feature
A : area of minimum enclosing rectangle around all features, or user specified area value
n : number of features

ANN ratio < 1 : Clustered, ANN ratio > 1 : dispersed

https://pro.arcgis.com/en/pro-app/latest/tool-reference/spatial-statistics/h-how-average-nearest-neighbor-distance-spatial-st.htm accessed 14-09-2023, 16:50 WIB

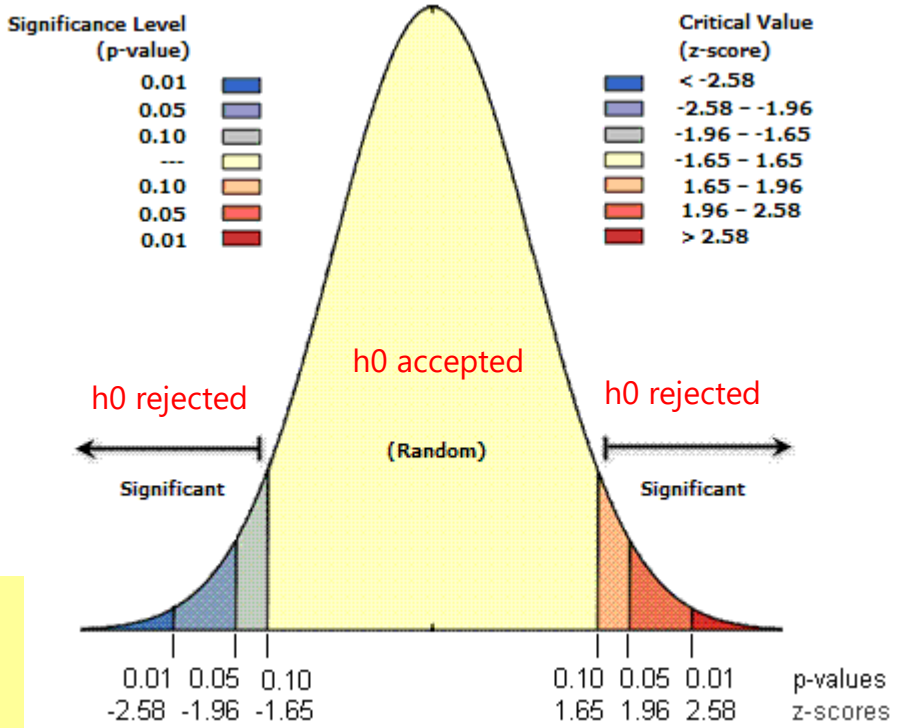
Spatial Pattern Analysis

Average Nearest Neighbor

The average nearest neighbor ratio is calculated as the observed average distance divided by the expected average distance

$$z = \frac{\bar{D}_O - \bar{D}_E}{SE}$$

$$SE = \frac{0.26136}{\sqrt{n^2/A}}$$



Provision...!!!!

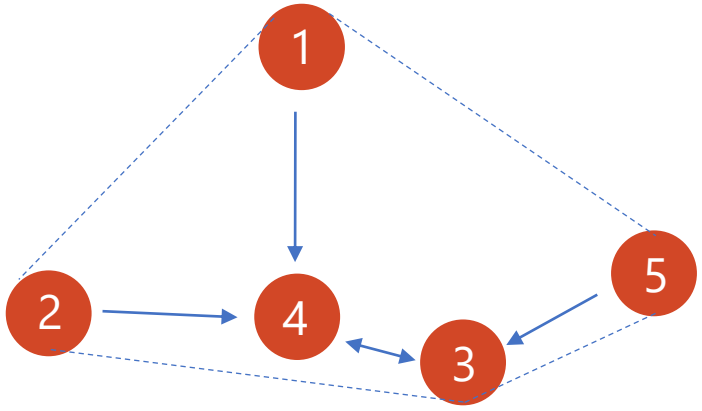
h0 : Random / Dispersion Significant

Sign 99%, z < -2,58 or z > 2,58 -> h0 rejected : clustered significant
Sign 95%, z < -1,96 or z > 1,96 -> h0 rejected : clustered significant

https://pro.arcgis.com/en/pro-app/latest/tool-reference/spatial-statistics/what-is-a-z-score-what-is-a-p-value.htm accessed 15-09-2023, 09:23 WIB

Average Nearest Neighbor

The average nearest neighbor ratio is calculated as the observed **average distance** divided by the **expected average distance**



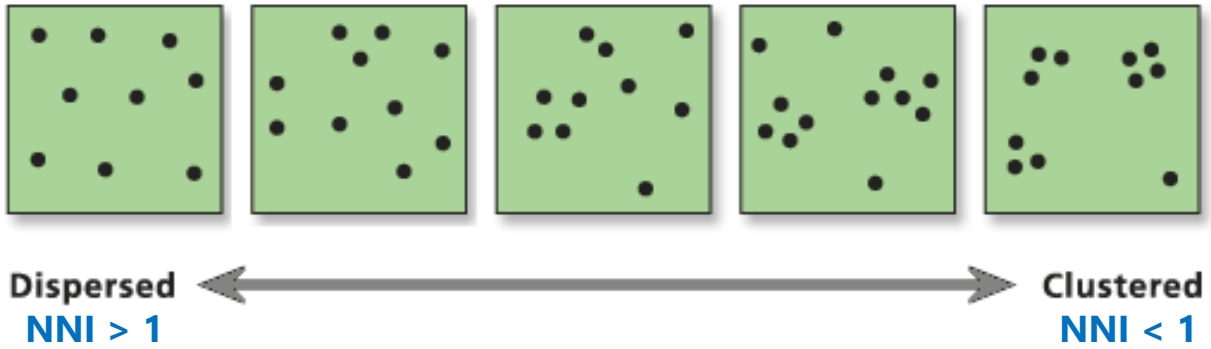
- 3 is the nearest neighbor of 5
- 3 is the nearest neighbor of 4 and vice versa
- 4 is the nearest neighbor of 1
- 4 is the nearest neighbor of 2

$$\overline{D}_O = \frac{\sum_{i=1}^{n} d_i}{n} \qquad \overline{D}_E = \frac{0.5}{\sqrt{n/A}}$$

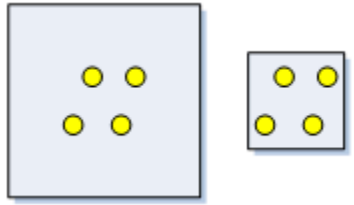
$$\text{Average Nearest Neighbor Distance} = \frac{distance_{5-3}+distance_{3-4}+distance_{1-4}+distance_{2-4}}{4}$$

Average Nearest Neighbor

The average nearest neighbor ratio is calculated as the observed average distance divided by the expected average distance



The average nearest neighbor method is very sensitive to the Area value

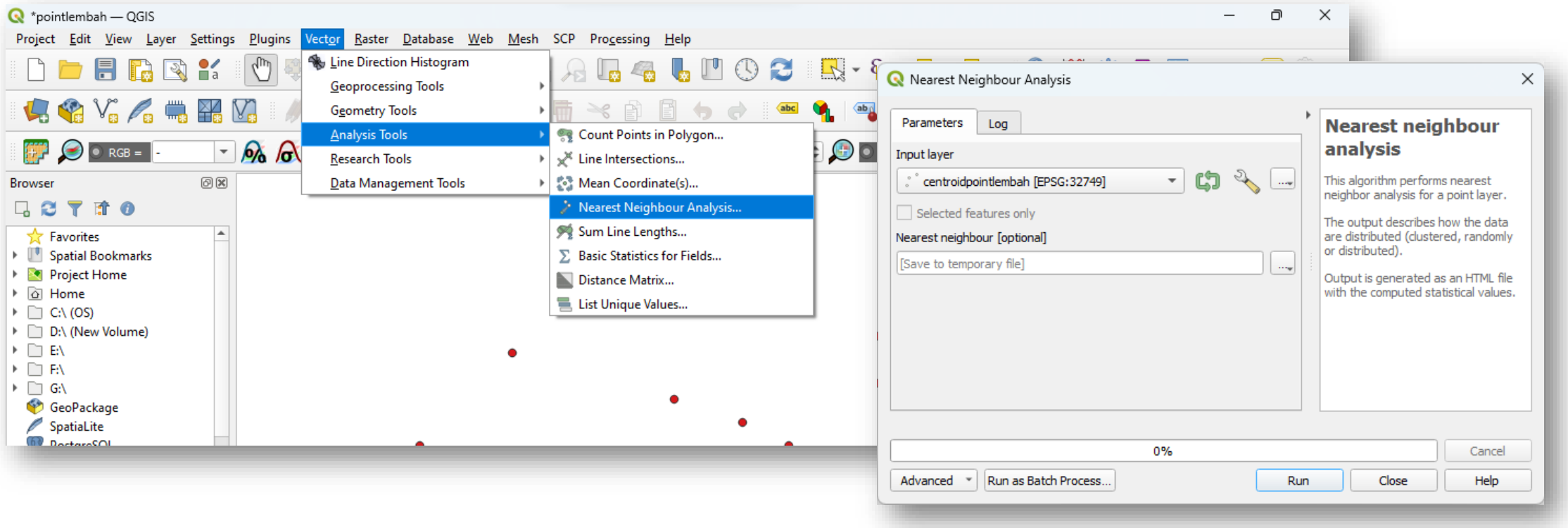


https://pro.arcgis.com/en/pro-app/latest/tool-reference/spatial-statistics/average-nearest-neighbor.htm accessed 14-09-2023, 17:00 WIB

Average Nearest Neighbor

NNA process with QGIS software

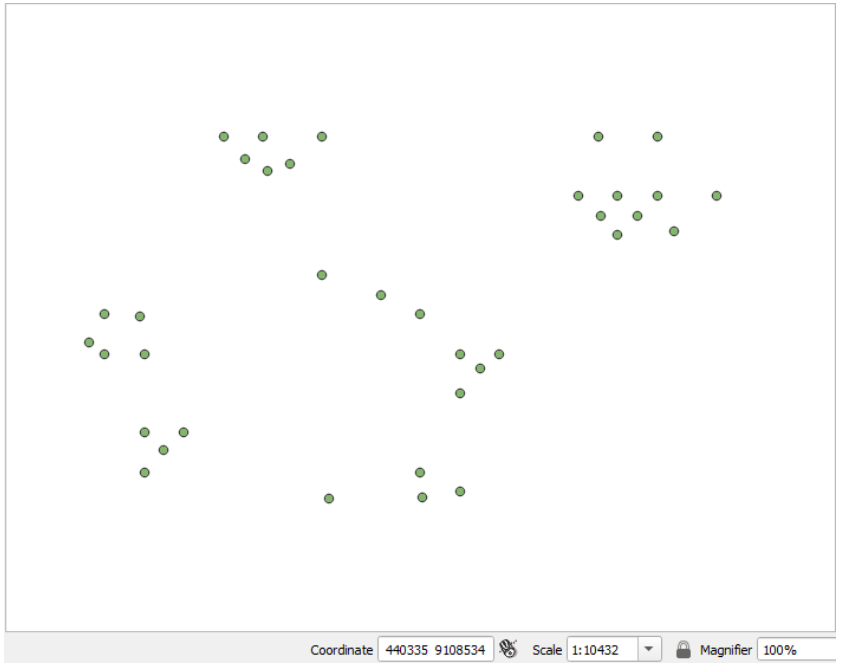
Vector -> Analysis Tools -> Nearest Neighbour Analysis



Spatial Pattern Analysis

Spatial Pattern

Average Nearest Neighbor



Observed mean distance: 80.48985620950

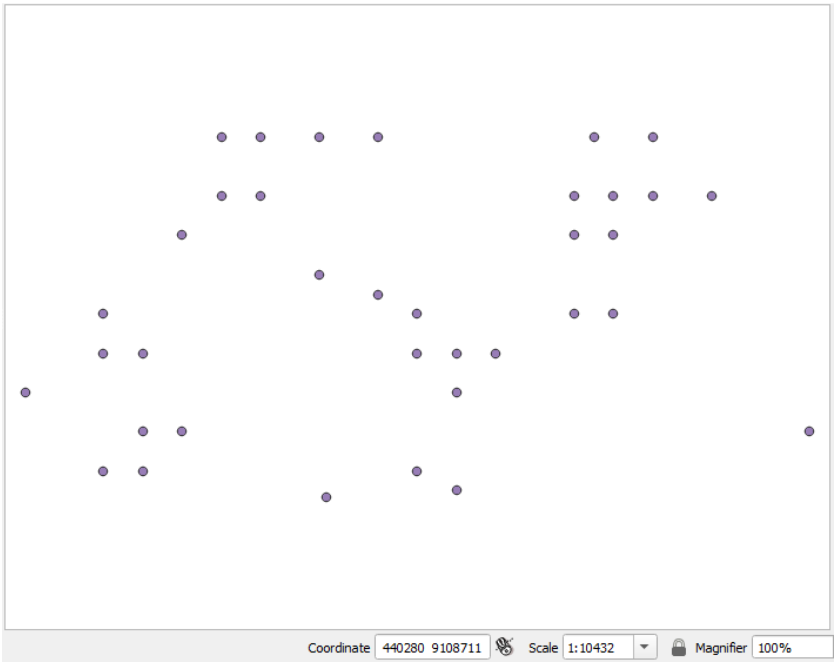
Expected mean distance: 103.94032025276

Nearest neighbour index: 0.77438530124 **NNI < 1 : Clustered**

Number of points: 36

Z-Score: -2.58970039904

z < -2,58 -> h0 accepted : clustered significant in 99% sign



Observed mean distance: 121.19203739246

Expected mean distance: 103.94032025276

Nearest neighbour index: 1.16597714051 **NNI > 1 : Dispersed**

Number of points: 36

Z-Score: 1.90515542372

z < 1,96 -> h0 accepted : Dispersed significant in 95% sign

Task

Let you learn Kernel Density and Moran's I formulation as the spatial pattern method

Thank You