# Point Patterns

## Terminology

* Attraction / association
* Isotropic plane
* Network distance
* Population at risk / case control (proxy) design / background heterogeneity
  + Classic analysis: Lancashire cancers
* Concentration of events
* Patten and process (causation)
* Ripley-Rasson transformation to bounding box and convex hull
  + Push out the bounding by specific ratio
* Intensity
* CSR (Complete spatial randomness) - Use as reference

## Homogeneous planar Poisson process

It is one way to simulate the CSR pattern, which used as a reference

* Each location has equal probability for an event
* Location of events are independent
* , is Intensity, equal to , is area

We could use it to generate the probability map as follows (Dark area means the number of events is extremely lower than the expected value):

A picture containing map

Description automatically generated

## Kernel density

Kernel density is one famous None-parametric-approach for heterogeneity intensity investigating

* + - Intensity function (expected number) vs density function (probability of an event)
    - *, u* is any location, b is bandwidth, K is kernel function.
    - Usually, we would use gaussian kernel function

## Simulation envelope

Simulation envelope-mimic the point pattern under spatial randomness (dark area)

Chart

Description automatically generated

## Nearest Neighbor Statistics

### G-event to event, F- event to point, J-combination of both

They all investigate the global property about one point pattern process

function is very similar to G function, but it calculates the distance between events (interested points) to points (CSR Points). G function measures the events to events distances.

From the Homogeneous planar Poisson process, when , we could get . So, the probability of “observe at least one event within the buffer ” is . So, we compare the observed probability under with theoretical one, and plot against

Chart

Description automatically generated

function is the ratio between and function, it normalized the line under the CRS setting

Chart, histogram

Description automatically generated

### Drawbacks

1. do not capture the property of the whole process
2. cannot measure the interaction between events from two different approach

## Global K function and local K

### Global K

Global function does not suggest the location of clusters.