

Group A - Spatial Statistics



Key idea: Looking for evidence of a systematic pattern in a group of points in \mathbb{R}^2

H_0 : **Complete Spatial Randomness** -

- (a) the mean of the pattern follows a Poisson process (global trend)
- (b) the process is homogeneous over the area (stationarity)

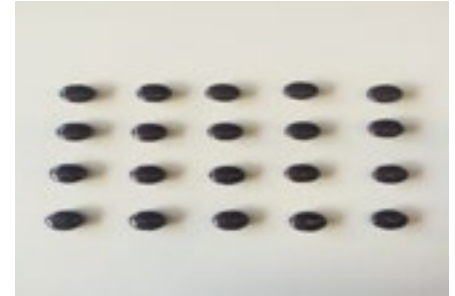
Three common patterns: clustered, random, regular.



clustered



random



regular

Our analysis uses R-package **spatstat**

First Order Methods: consider the global variation in intensity

1 - Quadrat Methods

Divide area into k cells. Consider difference in observed and expected values. Use function `quadrat.test` to perform a 2-sided chi-squared test ($k-1$ df). Small test statistic implies regularity; large test statistic implies clustering.

2 - Kernel Density Estimation

Visual exploratory data analysis, 2D equivalent of the base function density in R.

Second Order Methods: highlight local spatial dependence

1 - Nearest Neighbour (G-Function)

Consider distance between point and nearest neighbour. Plot cumulative distribution function.

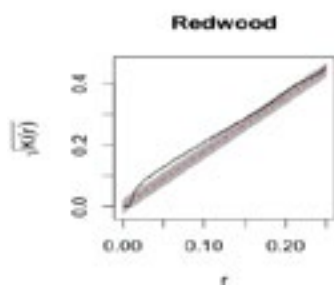
2 - Ripley's K-Function (preferred method)

For increasing distance r , consider average number of points with distance r of each point.

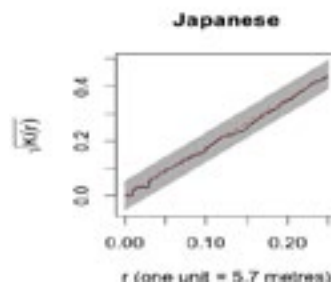
G-Function relates each point to one other point; K-Function relates each point to all other points.

Plot of $\sqrt{K/\pi}$ against r , CSR follows line $y=x$, clustered K increases too quickly, regular too slowly.

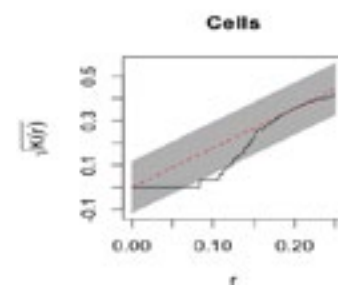
We use Monte Carlo simulation to produce 95% CI around line $y=x$ to give test against null hypothesis.



clustered



random



regular

All R-code used in our implementation and presentation detail can be found here:
<https://github.com/falsecard/Spatial-Statistics>

Key References:

Diggle, PJ. (2003) Statistical Analysis of Spatial Point Patterns. 2nd Ed. Arnold.

Venables, WN. & Ripley, BD. (2002) Modern Statistics with S. 4th Ed. Springer.

Dixon, PM. (2002) Ripley's K function. Encyclopaedia of Environmetrics. (3). pp 1796-1803

Adrian Baddeley, Rolf Turner (2005). spatstat: An R Package for Analyzing Spatial Point Patterns. Journal of Statistical Software 12(6), 1-42. URL <http://www.jstatsoft.org/v12/i06/>.