4. 事件點的空間群聚

Spatial Point Clustering

https://ceiba.ntu.edu.tw/1062_Geog5016

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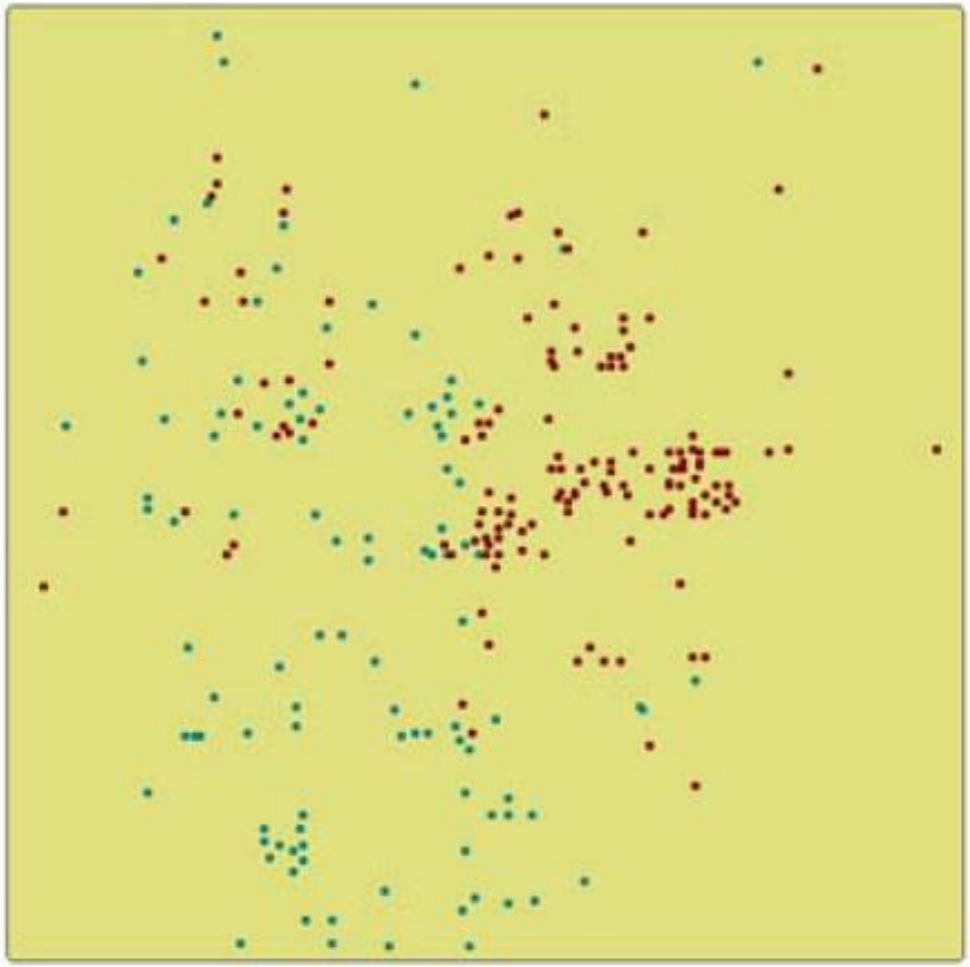
Bivariate K function: Spatial dependency of two data set of point events

Is the distribution of one set of events related to the distribution of the other?

Black (red dots) and white (blue dots) crimes in Oklahoma



Data Types (binary)

- Case data
- Control data

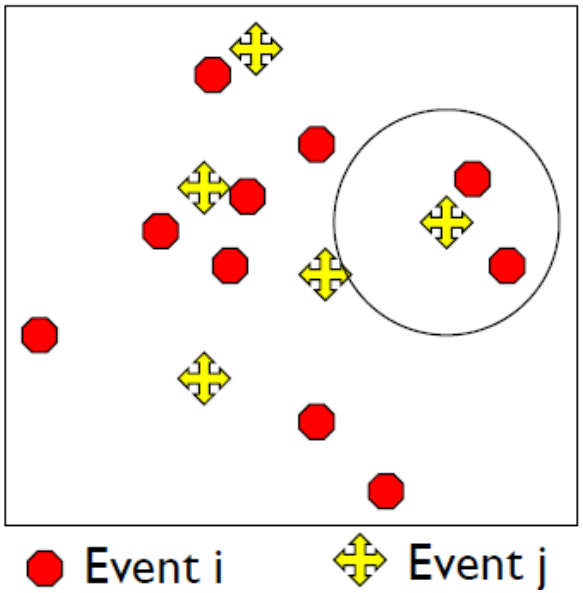
Bivariate K function (or Cross K function)

- The function assesses the spatial relationship between two event points under the null hypothesis of spatial independence and uses the same method as a univariate analysis to test statistical significance.
- The bivariate K function is defined as the expected number of points for event A within a given distance to arbitrary points of event B divided by the overall density of event A points.

Bivariate K function: a Case-Control design

$$K_{ij}(d) = \frac{1}{\lambda_j} \mathrm{E}(\#\,\text{points of type j} \le \text{distance r of point type i}$$

$$\lambda_j = \text{intensity of type j events}$$



If type j and i events are independent of each other:

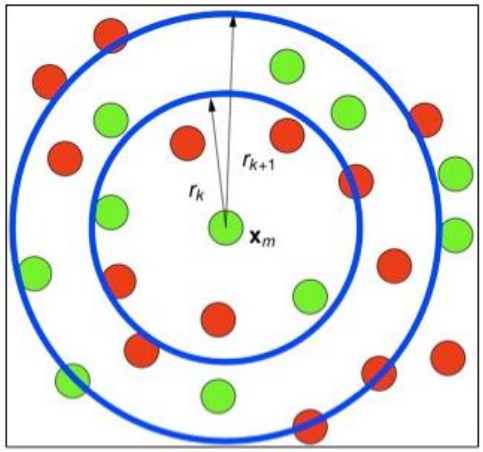
The distribution of j events should be random with respect to type i events

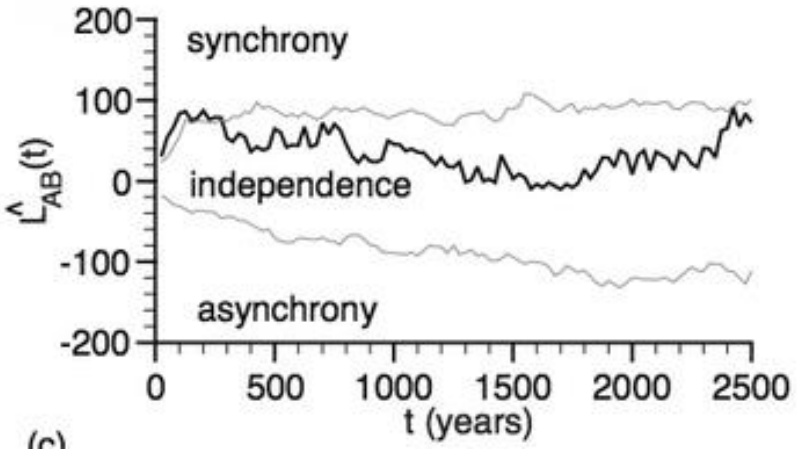
Calculate the cross-K function and examine significance using simulated "envelopes"

Pattern i represents cases of a disease and Pattern j represents the population

Bivariate K function: Mathematical Equation

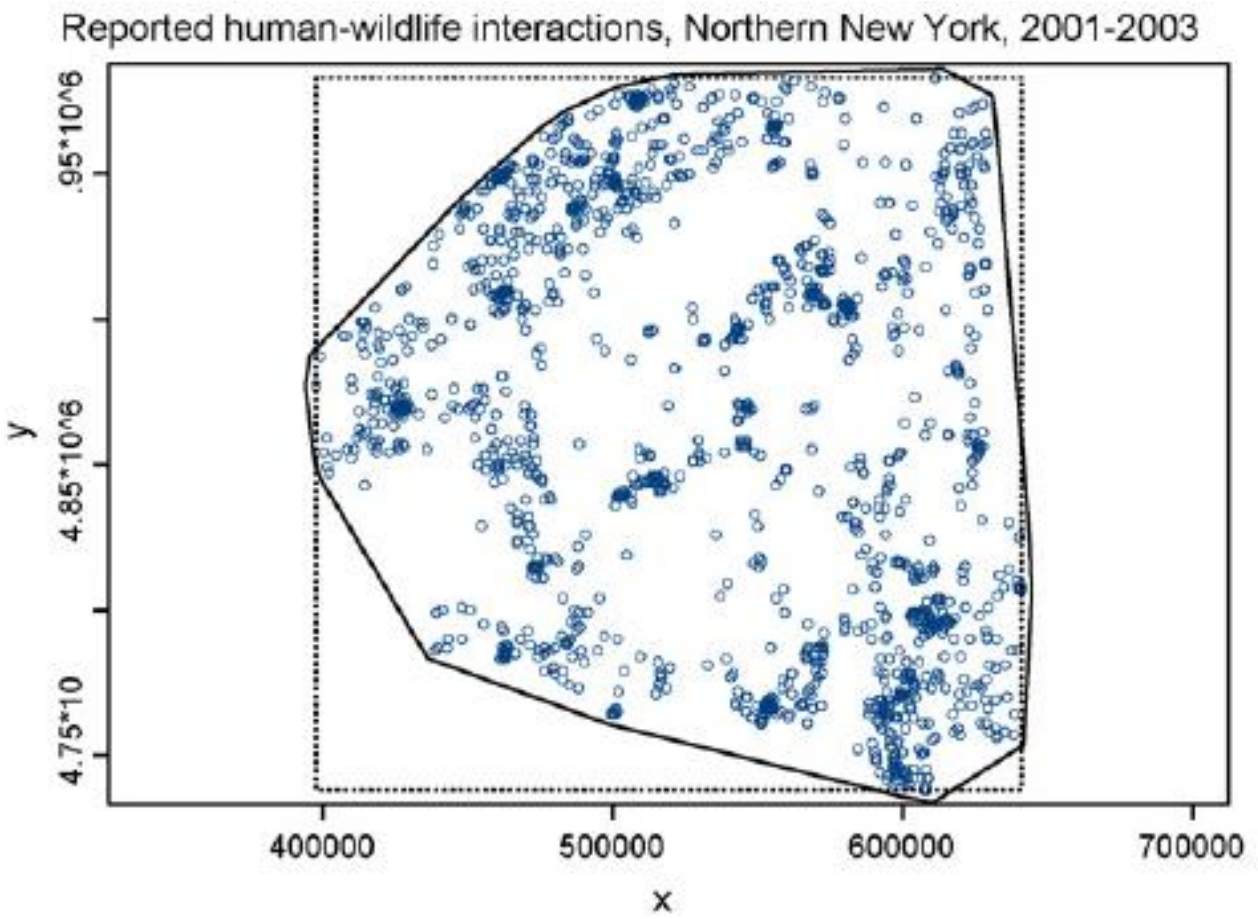
$$\hat{K}^{(12)}(h) = (\hat{\lambda}_1 \hat{\lambda}_2)^{-1} \sum_{i=1}^{n_1} \sum_{j=1}^{n_2} \times \frac{w(s_i^{(1)}, s_j^{(2)})^{-1} I(||s_i^{(1)} - s_j^{(2)}|| \leq h)}{N}, \quad h > 0$$



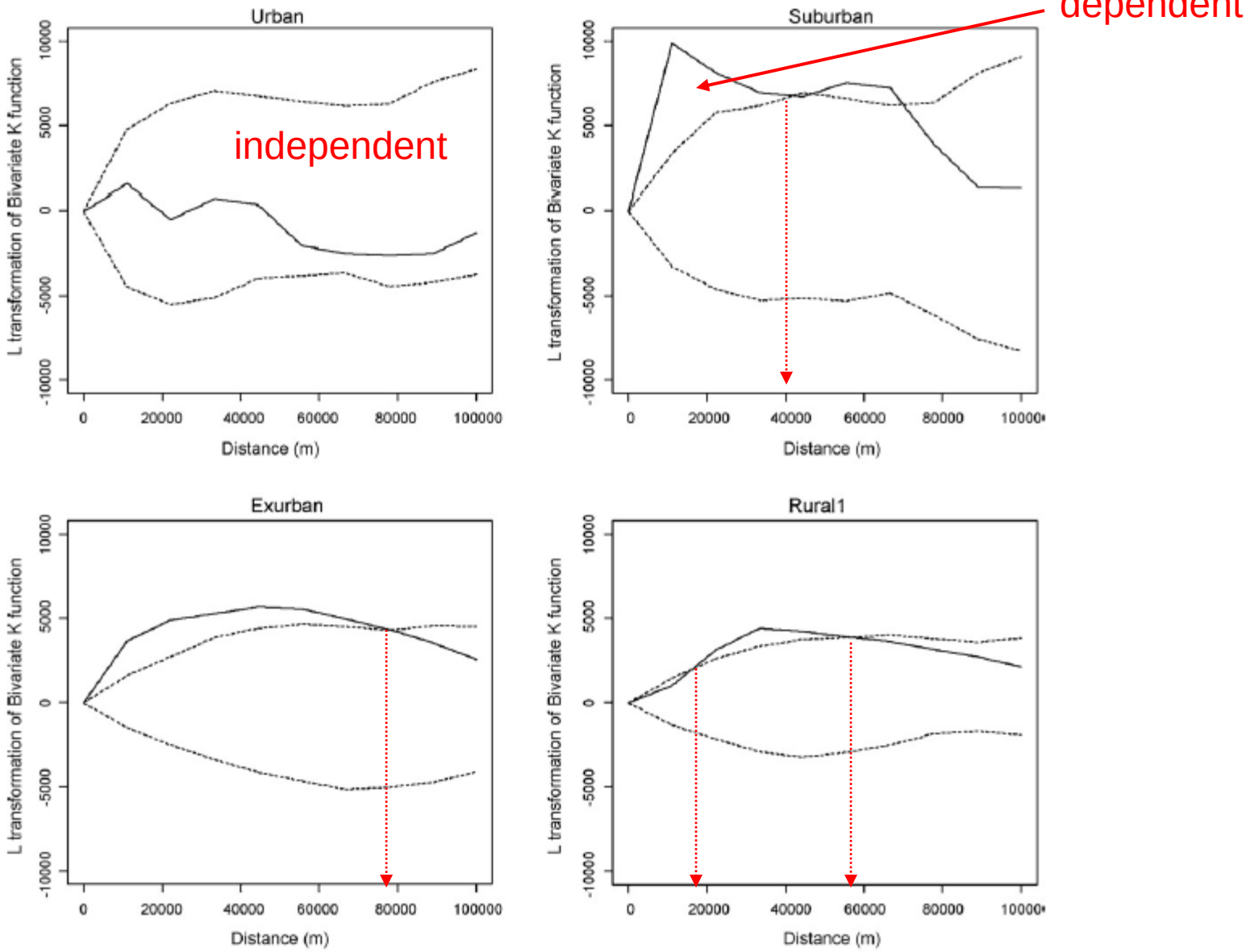


Application: human–wildlife interactions

Kretser, et. al. (2008)



Kretser, et. al. (2008) Housing density as an indicator of spatial patterns of reported human – wildlife interactions in Northern New York, *Landscape and Urban Planning* 8 : 282 – 292


Urban
independent
Suburban
dependent
Exurban
Rural1
L transformation of Bivariate K function
Distance (m)
10000
5000
0
-5000
-10000
0
20000
40000
60000
80000
100000

作業 2: 速食店位置是否群聚於鄰近的小學附近?!

- 利用 bivariate k-function 檢定速食店是否群聚於私立小學？或公立小學？

- 作業/加分題 繳交規定
  - 截止日期：2018. 5. 03 (Thu.) 12:00pm
  - 繳交格式 ：用R Markdown編寫的html格式；

    將作業1與2彙整在同一個html檔

k12hat *Bivariate K-function*

Description

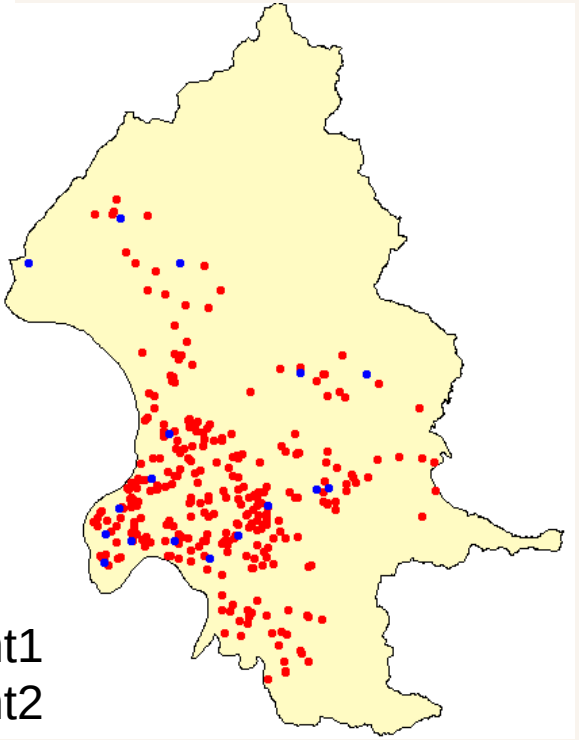
Calculates an estimate of the bivariate K-function

Usage

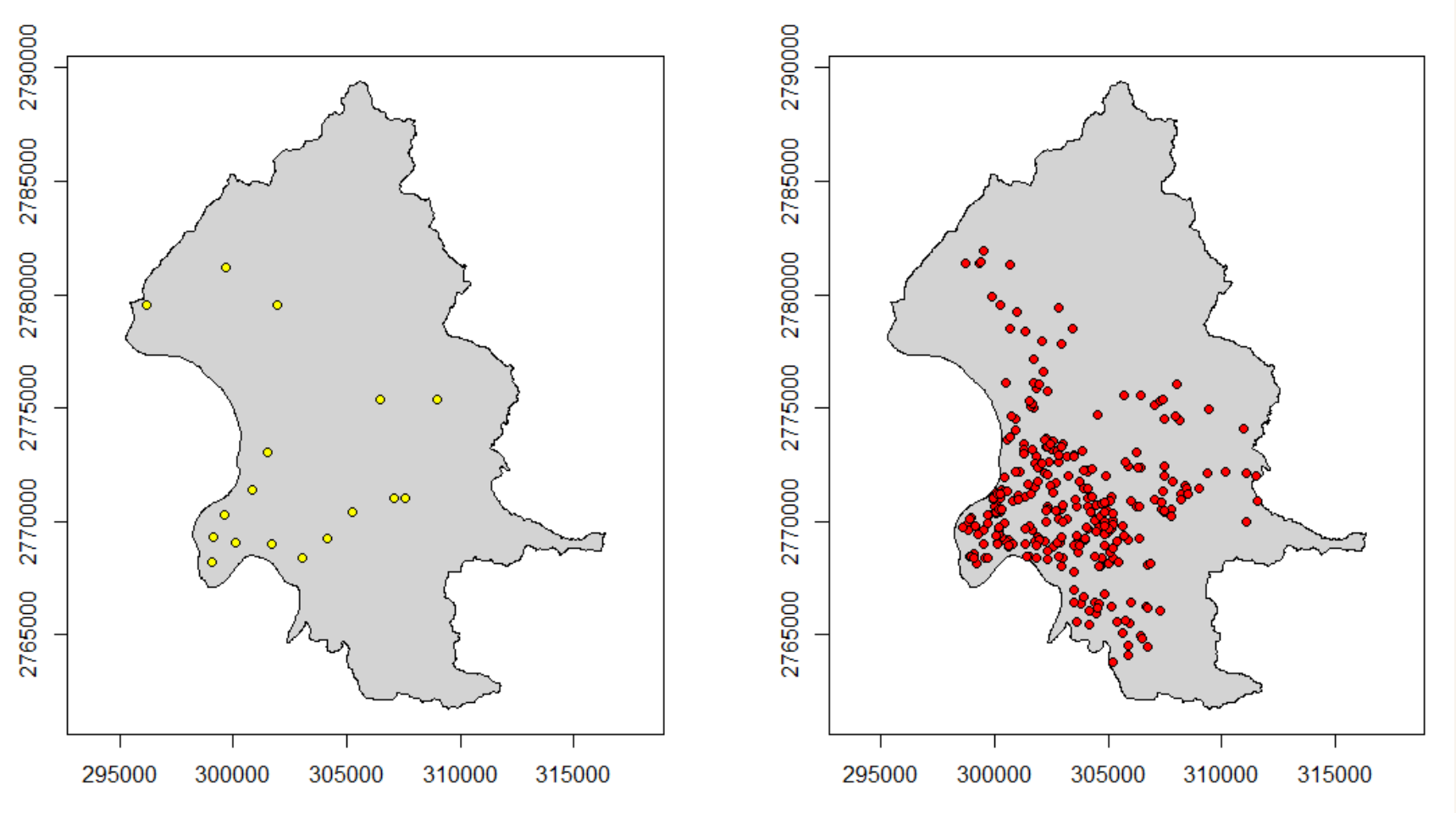
```
k12hat(pts1,pts2,poly,s)
```

Arguments

pts1,pts2	Two points data sets
poly	A polygon containing the points
s	A vector of distances at which to estimate the K12 function



Sample Data


2790000
2785000
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295000
300000
305000
310000
315000
2790000
2785000
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2775000
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310000
315000

R code

```
s <- seq(0, 5000 ,50)
tpe.kl2 <-kl2hat(Pts1, Pts2, Pts_bnd, s)
plot(s, tpe.kl2, type="l",xlab="distance", ylab="K(d)",
main="Bivariate K function")
env12<-Kenv.tor(Pts1, Pts2, Pts_bnd, nsim=49, s)
lines(s, env12$upper, col="red", lty=3)
lines(s, env12$lower, col="blue",lty=3)

plot(s, sqrt(tpe.kl2/pi)-s, type="l", ylim=c(-
4000,4000),xlab="distance", ylab="D(d)", main="D
function")
lines(s, sqrt(env12$upper/pi)-s, col="red", lty=3)
lines(s, sqrt(env12$lower/pi)-s, col="blue",lty=3)
```

R code: Kenv.tor()

Envelope of K12hat from random toroidal shifts of two point patterns

Description

Compute envelope of K12hat from random toroidal shifts of two point patterns.

Usage

```
Kenv.tor(pts1,pts2,poly,nsim,s,quiet=FALSE)
```

Arguments

`pts1`	First point data set.
`pts2`	Second point data set.
`poly`	Polygon containing the points.
`nsim`	Number of random toroidal shifts to do.
`s`	Vector of distances at which to calculate the envelope.
`quiet`	If FALSE, print a message after every simulation for progress monitoring. If true, print no messages.

R code: Results