Spatial homogeneity of point-patterns

Roberto Molowny-Horas (CREAF-EMF)

March 16th-17th, 2022

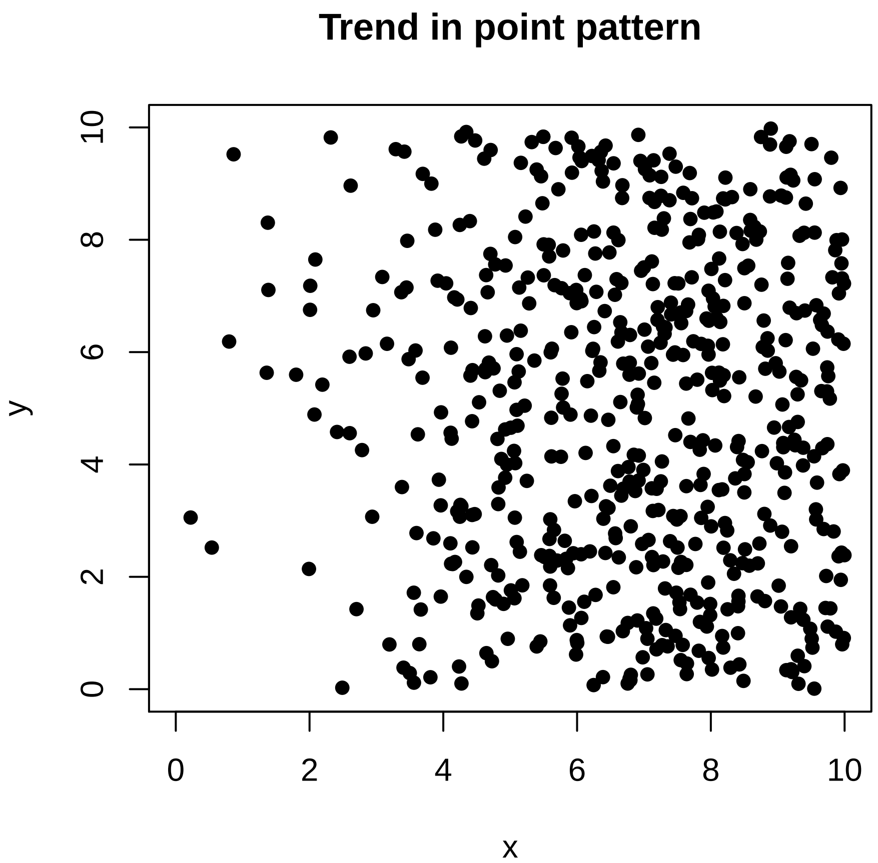
Spatial homogeneity: Poisson process

1. The mean number of events per spatial unit is constant (i.e. no trends).
2. All spatial events (i.e. point locations) are independent of each other (i.e. no clustering/dispersal).

Trends

Trends in point patterns can arise, for example, when we sample locations across a landscape which is progressively more difficult to work at. Increasing slopes from plain to mountain, or progressively thicker vegetation across the study area, all may give rise to that kind of trend. We can easily simulate such a trend with a few R commands.

```
np <- 1000                          # Initial number of points.
x <- runif(np,min=0,max=10)         # Generation of randomly distributed points.
y <- runif(np,min=0,max=10)
prob <- 1/(1+exp(-(x-4)))           # Sigmoidal probability increasing along X.
inhomo <- rbinom(np,1,prob)
x <- x[inhomo==1]                   # Selection of points.
y <- y[inhomo==1]
plot(x,y,xlim=c(0,10),ylim=c(0,10),pch=16,main="Trend in point pattern")
```

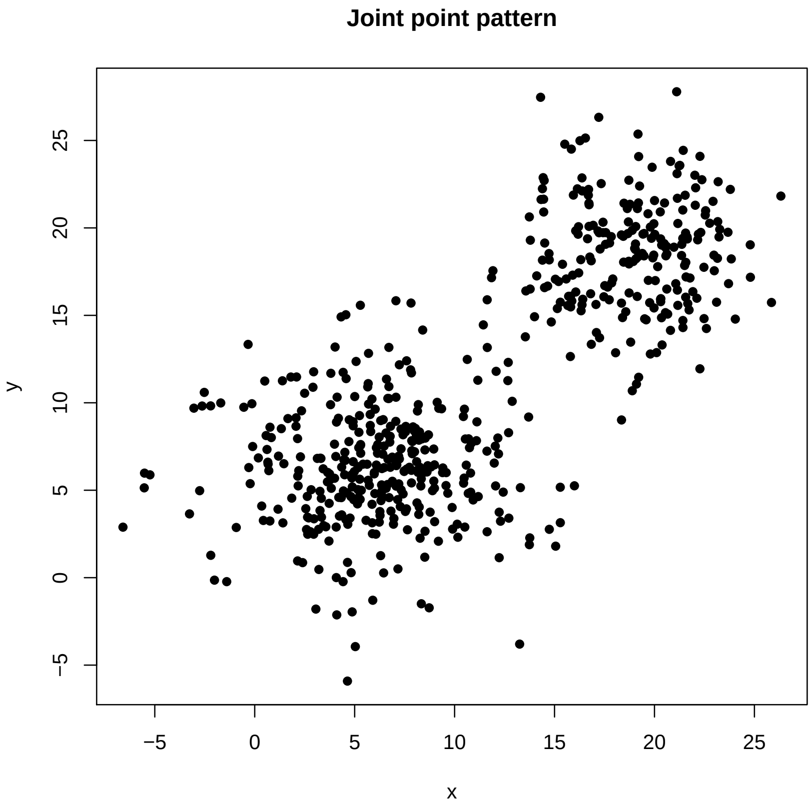


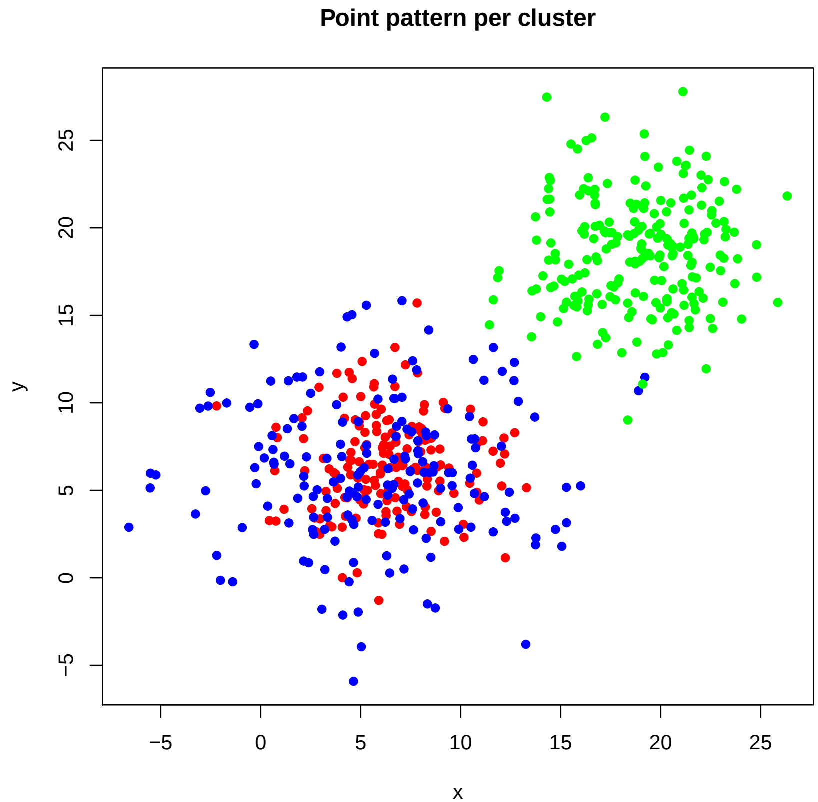
Condition 1 is fulfilled, but condition 2 is not.

Clustering

In this case, spatial events are not independent of each other, i.e. they tend to group together or to "shy away" from each other. Sample locations may be clustered in patches because observers did not move far apart from cities, or because sampling took place along road networks.

```
mx <- my <- runif(3,0,20)
sx <- sy <- runif(3,1,5)
n <- rpois(3,200)
x <- c(rnorm(n[1],mx[1],sx[1]),rnorm(n[2],mx[2],sx[2]),rnorm(n[3],mx[3],sx[3]))
y <- c(rnorm(n[1],my[1],sy[1]),rnorm(n[2],my[2],sy[2]),rnorm(n[3],my[3],sy[3]))
par(mfrow=c(1,2))
plot(x,y,pch=16,main="Joint point pattern")
plot(x,y,type="n",main="Point pattern per cluster")
cn <- cumsum(n)
points(x[1:cn[1]],y[1:cn[1]],pch=16,col="red")
points(x[(cn[1]+1):(cn[2])],y[(cn[1]+1):(cn[2])],pch=16,col="blue")
points(x[(cn[2]+1):(cn[3])],y[(cn[2]+1):(cn[3])],pch=16,col="green")
par(mfrow=c(1,1))
```





Condition 2 is fulfilled, but condition 1 is not.