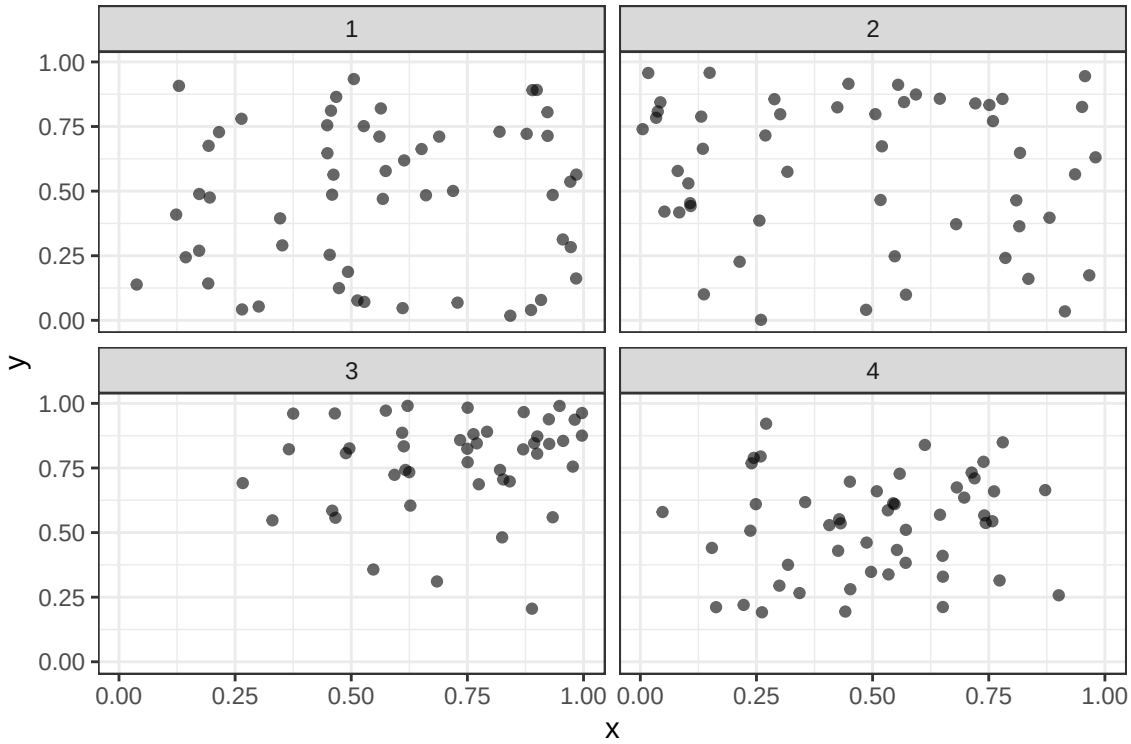
# PP Hypothesis Tests

**Hypothesis Tests for CSR**



**G and F Functions** One way to describe a spatial point process, is to consider the probability of being a certain distance from a point or similarly, the number of points expected in a distance from a point.

A similar statistic is the $F(d)$ function. Whereas $G(d)$ is centered at the observed $\boldsymbol{s}_i$, $F(d)$ is defined at any arbitrary point.

Discuss how to create an empirical estimate of $\hat{G}(d)$, given a realization of a point process.

With bounded area, edge correction procedures are necessary.

$$\hat{G}(d) = \frac{\sum_i 1(d_i \leq d < b_i)}{\sum_i 1(d < b_i)},$$

The empirical estimates of $G$ or $H$ can be compared with $G$ or $F$ using a QQ-plot.

- **Discuss:** What would be the implications of shorter tails or longer tails than expected under CSR?

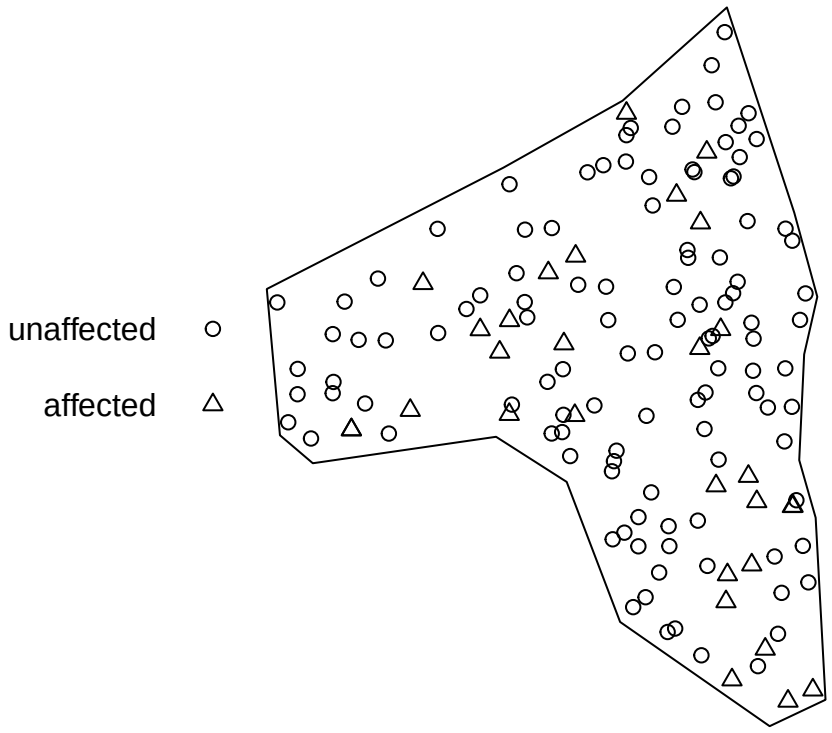
Describe a natural process that might cluster and another than might repel

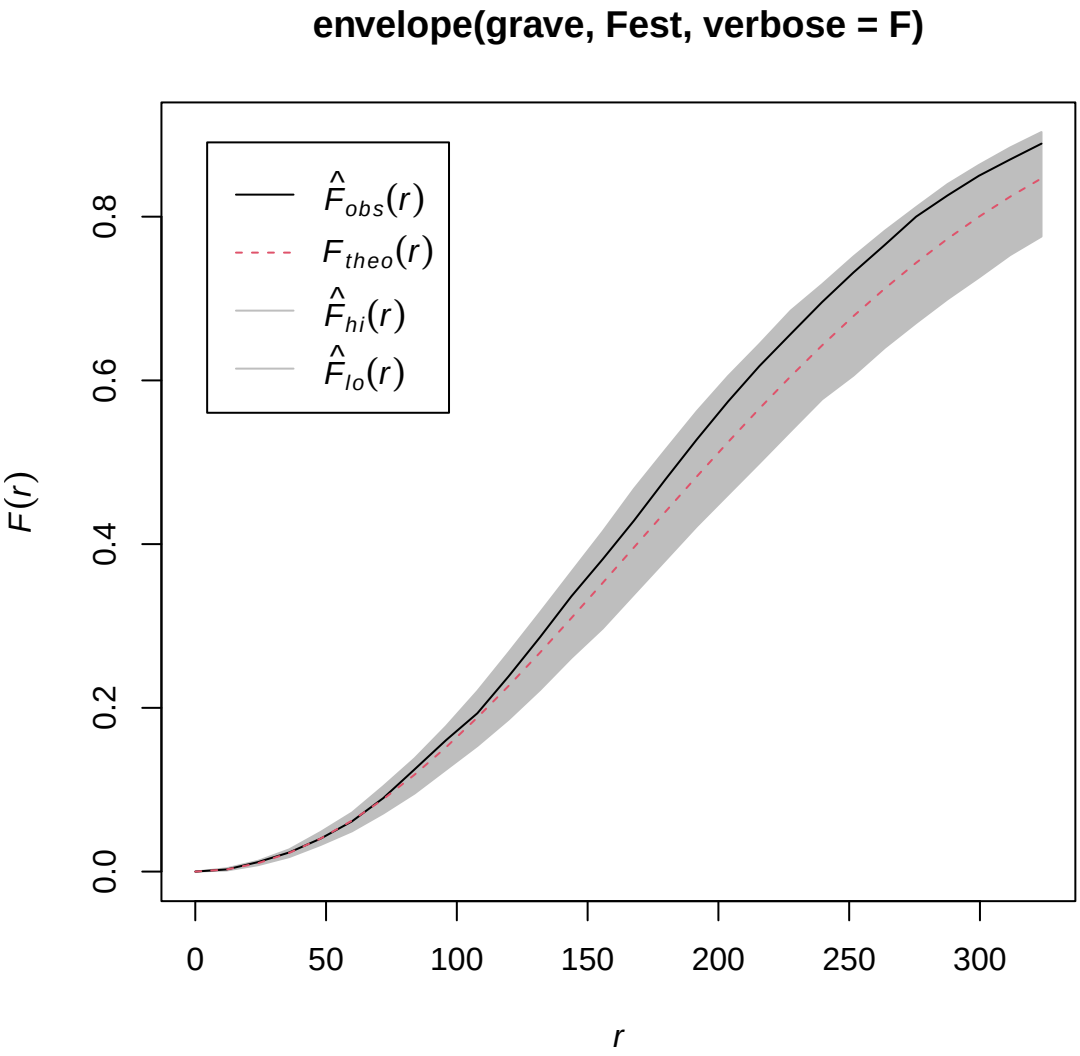
## spatstat

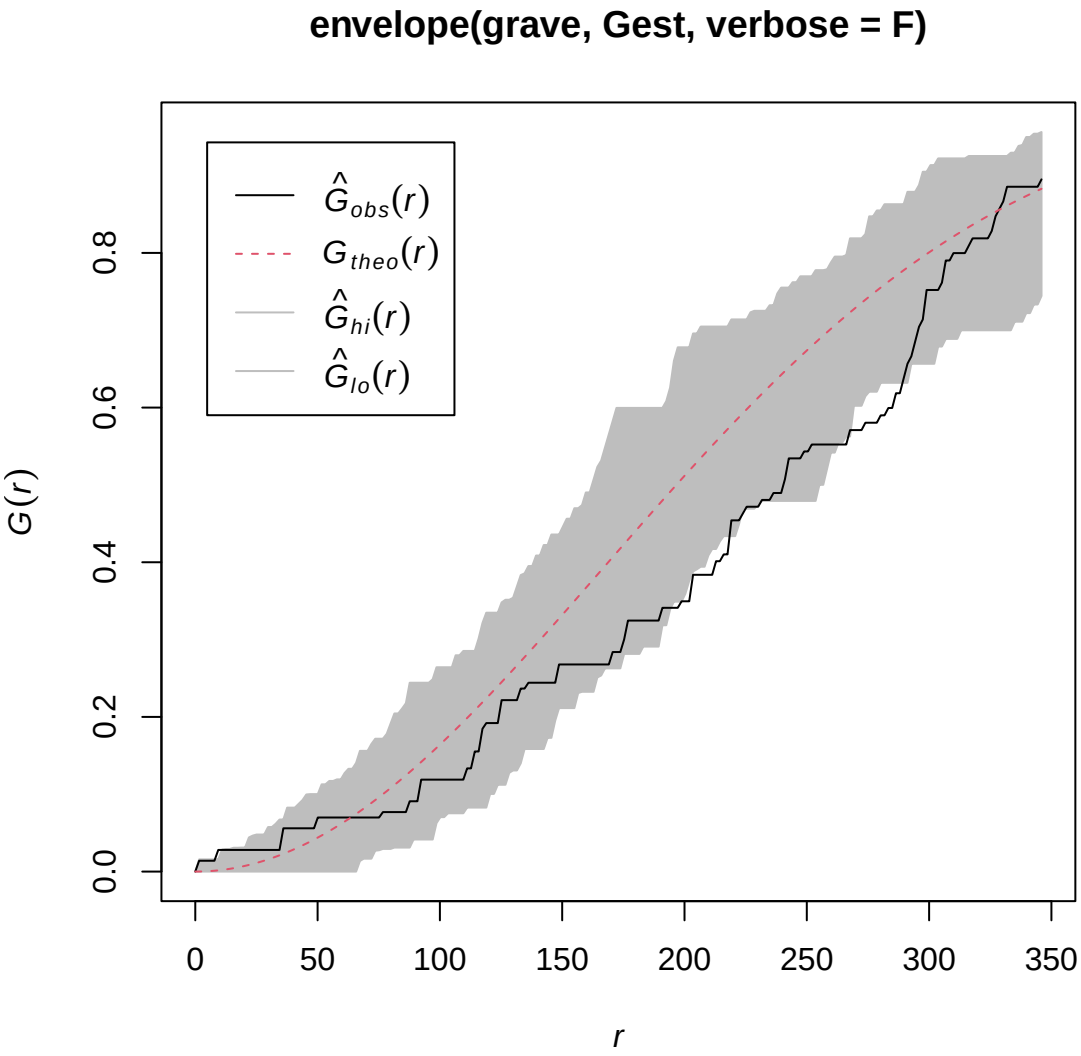
Consider a dataset with medieval grave site information.

```
## Marked planar point pattern:  143 points
## Average intensity 5.70489e-06 points per square unit
##
## Coordinates are integers
## i.e. rounded to the nearest unit
##
## Multitype:
##            frequency proportion   intensity
## unaffected       113  0.7902098 4.50806e-06
## affected          30  0.2097902 1.19683e-06
##
## Window: polygonal boundary
## single connected closed polygon with 16 vertices
## enclosing rectangle: [4376.579, 10511.88] x [2809.612, 10702.971] units
##                      (6135 x 7893 units)
## Window area = 25066200 square units
## Fraction of frame area: 0.518
```

**grave**




envelope(grave, Fest, verbose = F)
$\hat{F}_{obs}(r)$
$F_{theo}(r)$
$\hat{F}_{hi}(r)$
$\hat{F}_{lo}(r)$
F(r)
0.0
0.2
0.4
0.6
0.8
0
50
100
150
200
250
300
r

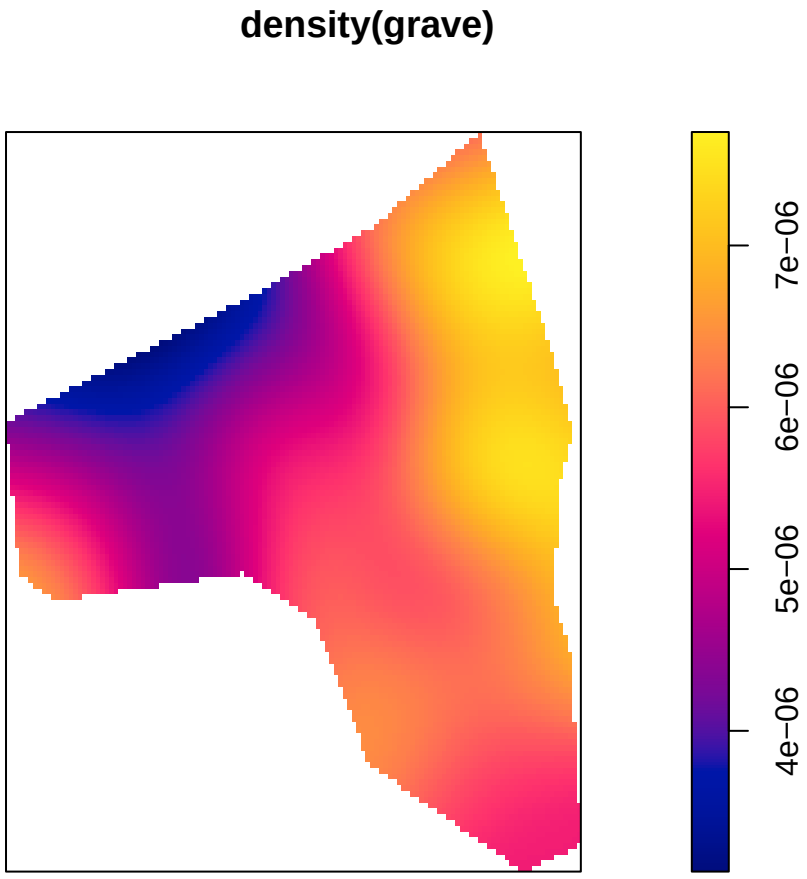

envelope(grave, Gest, verbose = F)
$\hat{G}_{obs}(r)$
$G_{theo}(r)$
$\hat{G}_{hi}(r)$
$\hat{G}_{lo}(r)$
G(r)
0.0
0.2
0.4
0.6
0.8
0
50
100
150
200
250
300
350
r

**Estimating the intensity Function**

- With CSR, the intensity function is trivial

- **Discuss:** given a realization of a point process, how could an intensity function be estimated?

Now using the `plot(density(.))` function, plot and interpret the empirical intensity for the grave dataset along with the four synthetic examples.



Now let's return to the four datasets we looked at earlier. You can use `envelope` and `density` but first need to create `ppp` objects.