STAT 534 - Lecture 23:

K function

- We previously looked at the $F(d)$ and $G(d)$ functions, which corresponded to
- Another interesting feature of a point process is the number of points in a specified area.
- Consider $E(Num(\boldsymbol{s}, d, \boldsymbol{S}))$, the expected number of points in $\delta_d \boldsymbol{s}$, a circle of radius d centered at $\boldsymbol{s}$.
- *Ripley's*
- With CSR, $K(d)$
- To estimate $K(d)$,
- The empirical K statistic is compared with πd^2.
- Similar to the G and F functions, edge correction is typically applied.

spatstat Intro

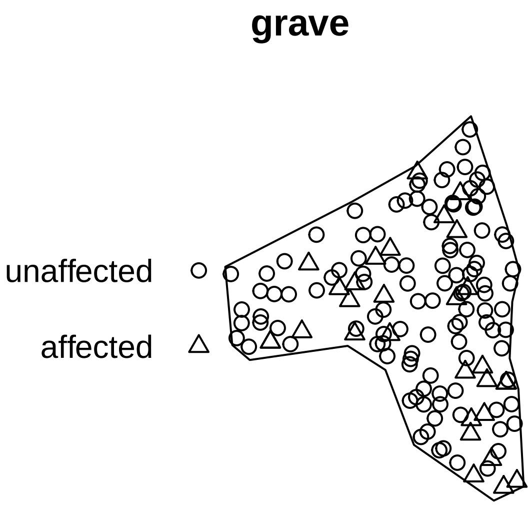
- The spatstat package is a comprehensive R package for point process data. It has a website and a nice vignette.

- Consider a dataset with medieval grave site information.

```
data(grave)
summary(grave)
```

```
## 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
## Window area = 25066200 square units
## Fraction of frame area: 0.518
```

```
plot(grave)
```



- Explore the Fest(), Gest(), and Kest() functions in spatstat and summarize the results for the grave dataset. (Also look at the envelope function for plots.)

- Next convert the point processes from early classes to `ppp` objects and explore `Fest()`/`Kest()`.

```
set.seed(04082019)
n <- rpois(4, 50)
x <- c(rbeta(n[1], 1, 1), rbeta(n[2], 1, 1), rbeta(n[3], 3, 1),rbeta(n[4], 3, 3))
y <- c(rbeta(n[1], 1, 1), rbeta(n[2], 1, 1), rbeta(n[3], 3, 1),rbeta(n[4], 3, 3))

comb.df <- data.frame(group = c(rep(1, n[1]), rep(2, n[2]), rep(3, n[3]), rep(4, n[4])), x = x, y = y)

df1 <- comb.df %>% filter(group ==1)
df2 <- comb.df %>% filter(group ==2)
df3 <- comb.df %>% filter(group ==3)
df4 <- comb.df %>% filter(group ==4)
```

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?

- *One option*

- *An alternative*

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