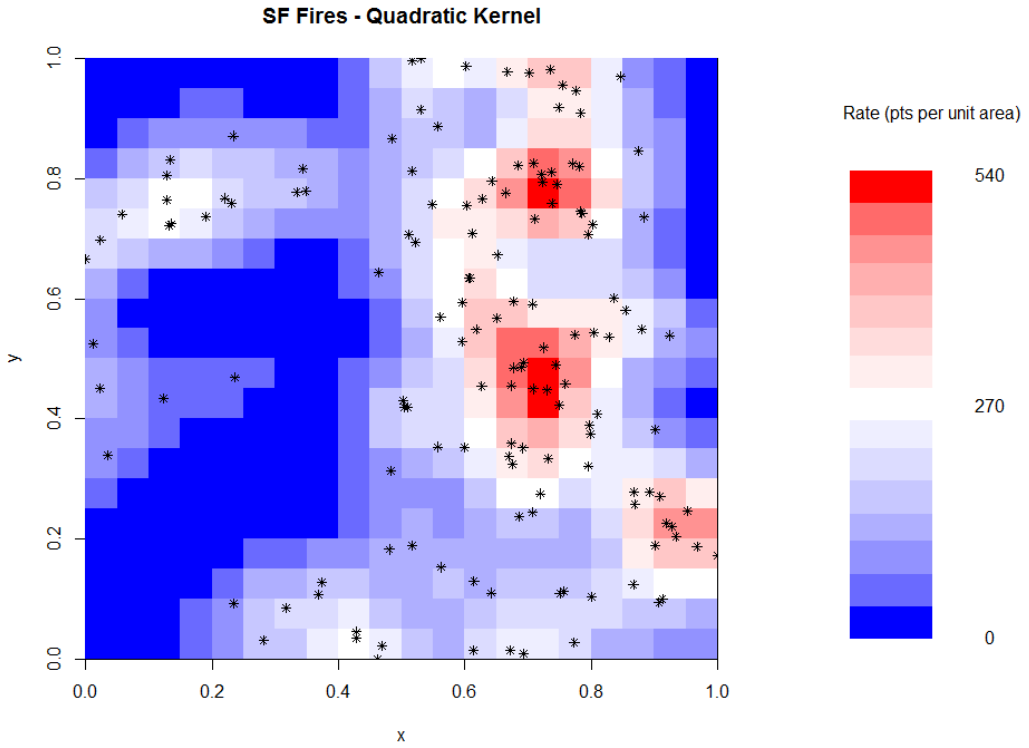
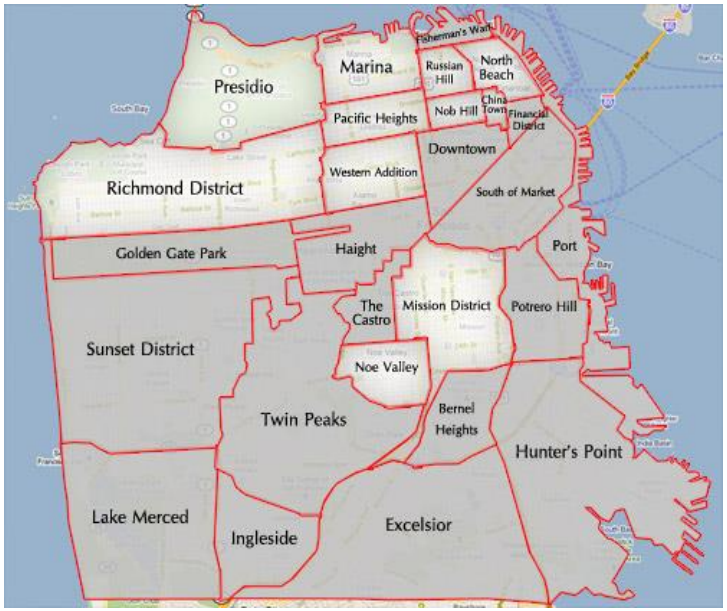
POINT PROCESS ANALYSIS OF SAN FRANCISCO PROPERTY FIRES

DATA

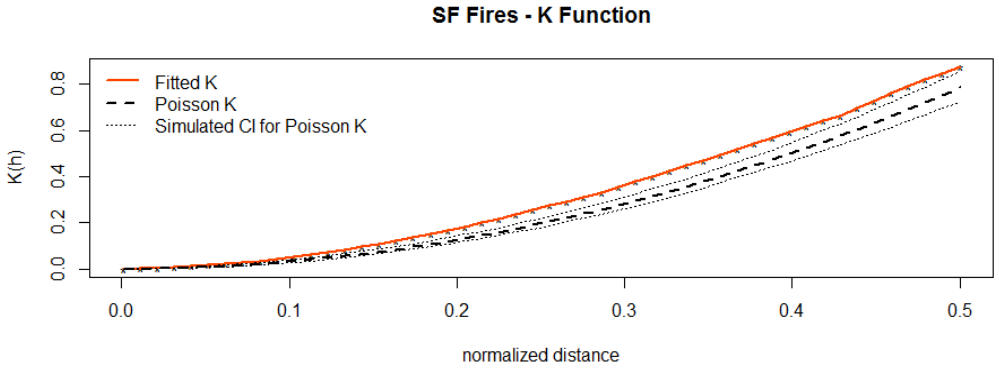
- Obtained all SFPD data from 2016 from San Francisco city website
- Sorted on reports of fires, removed entries with estimated damages at or above $10,000
- Total of 145 points

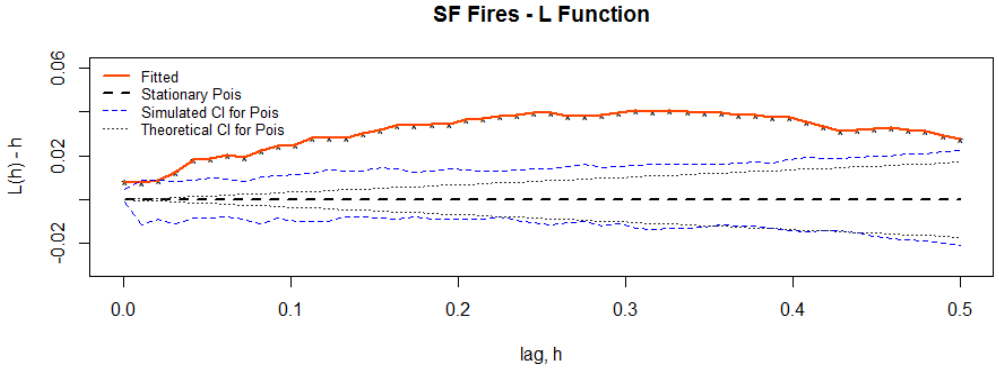
DENSITY PLOT OF DATA

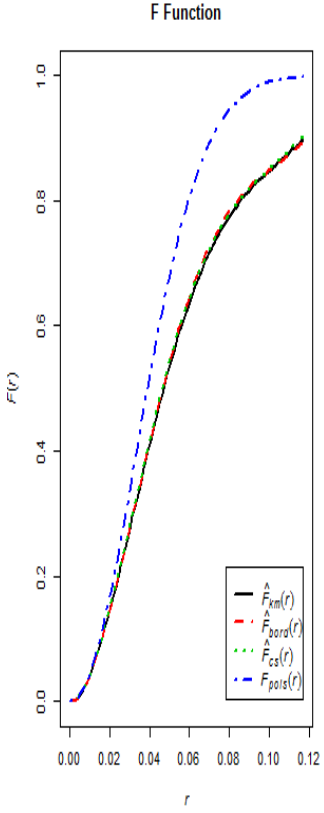


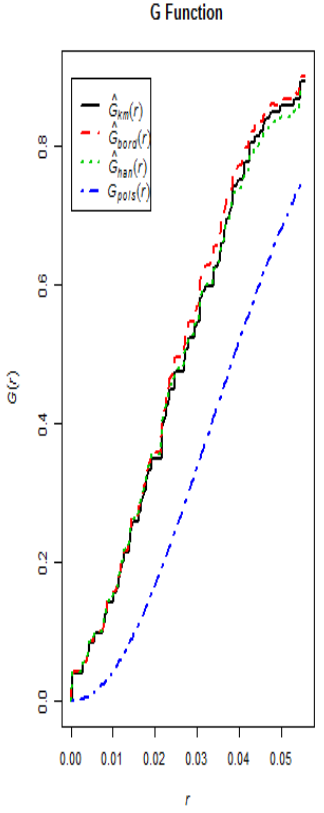


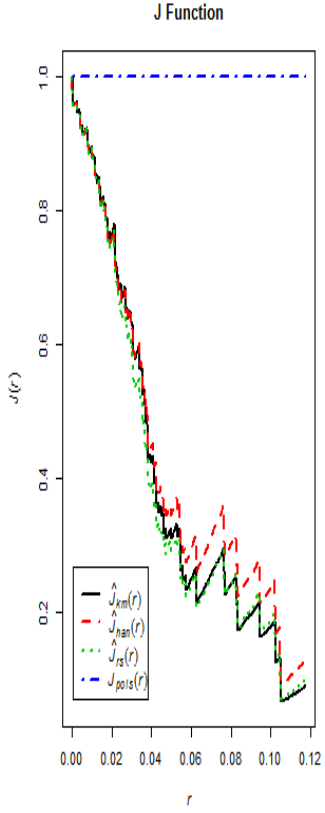
EVIDENCE OF CLUSTERING







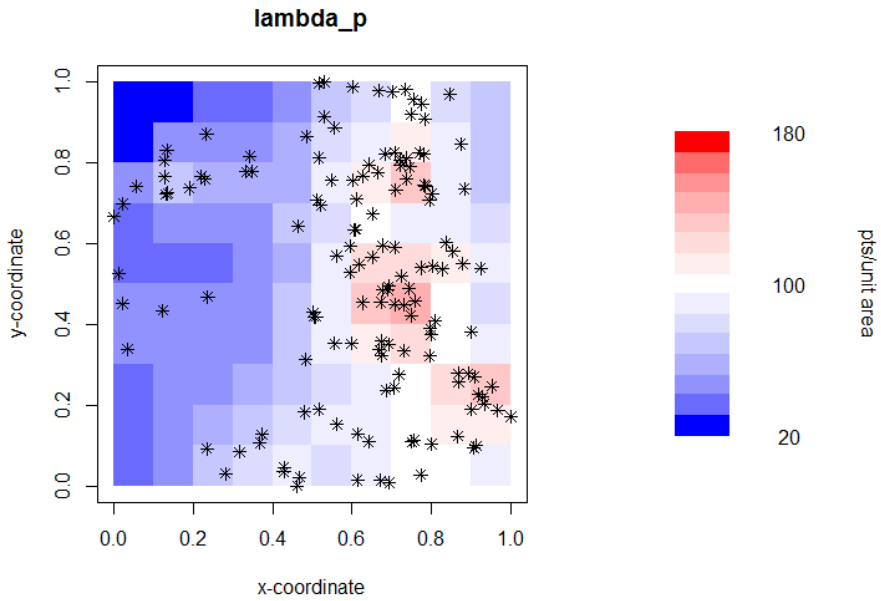


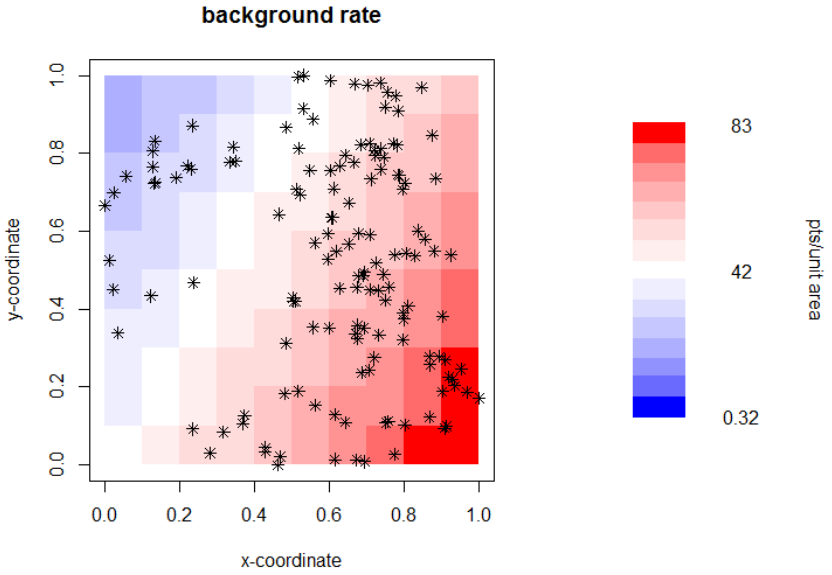


MODEL FITTING: PSEUDO-LIKELIHOOD

$$\lambda(z|z_1,\ldots,z_k) = \mu + \alpha x + \beta y + \gamma \sum_{i=1}^{k} \frac{a_1 e^{-a_1 D(z_i, z)}}{2\pi D(z_i, z)} \quad \text{where} \quad z = (x, y)$$

Parameter	μ	α	β	γ	a1
Estimate	40.0677	46.3967	-25.5232	0.6668	22.9478
SE	23.5418	40.2591	35.5214	0.1382	5.5774

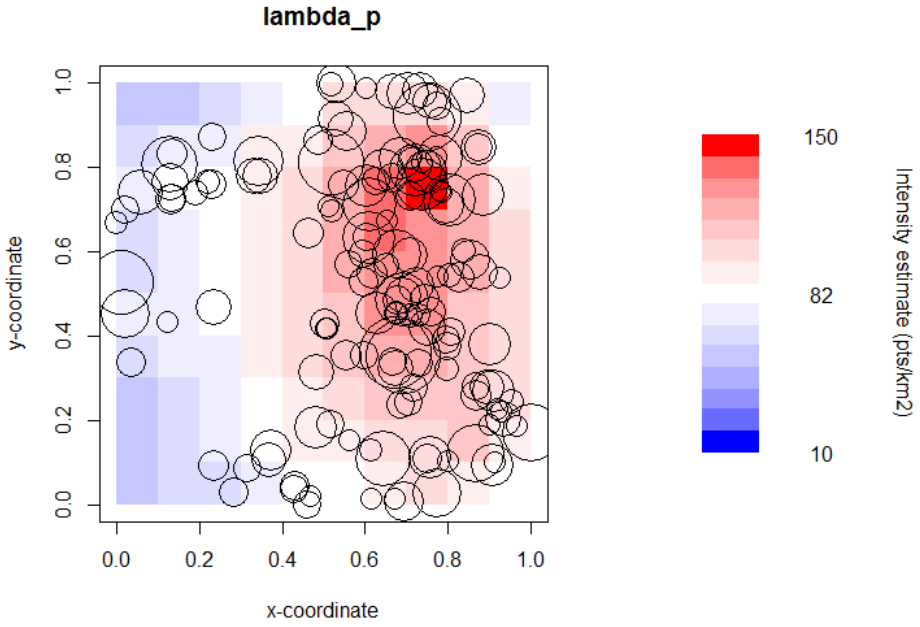


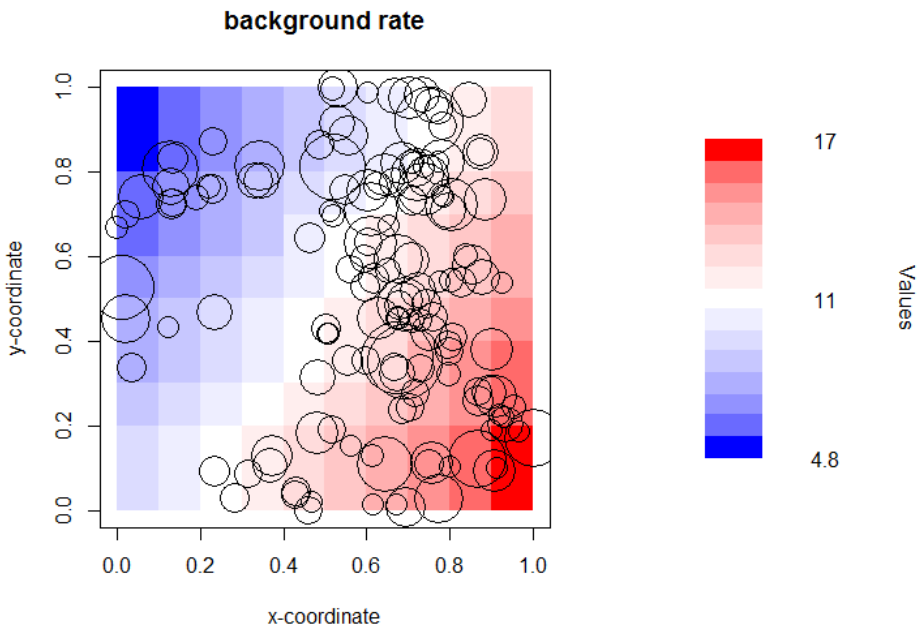


MODEL FITTING: MARKED PSEUDO-LIKELIHOOD

$\lambda(s|s_1, \ldots, s_k) = \mu + \alpha x + \beta y + \gamma \sum_{i=1}^{k} a_1 e^{-a_1 z_i D(s_i, s)}$ where $s = (x, y)$, $z = damage$ ($thousands)

Parameter	μ	α	β	γ	a1
Estimate	9.6308	8.3263	-5.4937	0.8870	0.0949
SE	10.8862	12.1349	15.7862	0.1033	0.0136





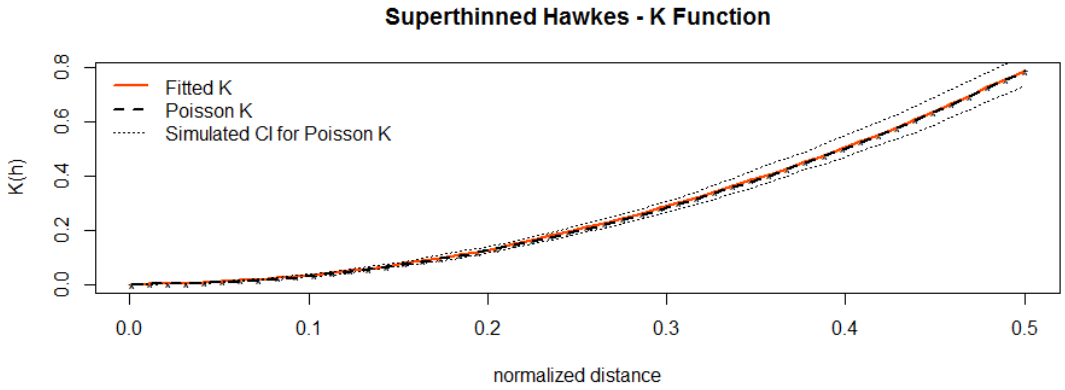
MODEL FITTING: HAWKES PROCESS

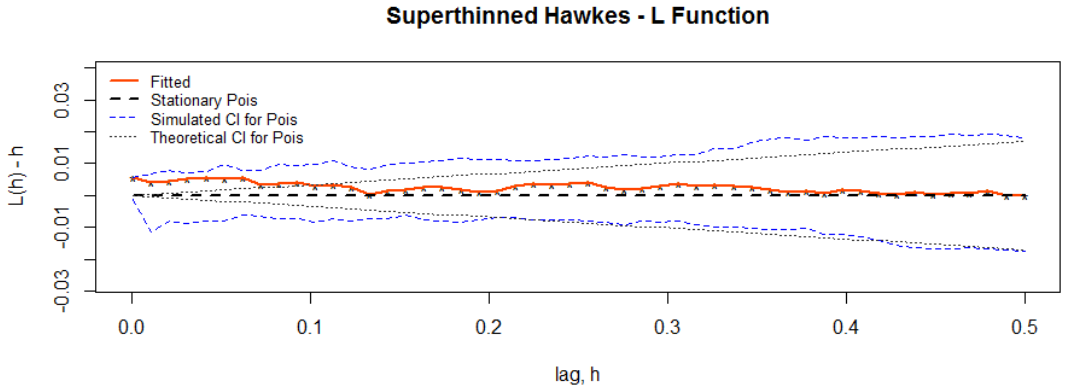
$$\lambda(t,x,y) = \mu(x,y) + k\int_{t'<t} g(t-t', x-x', y-y')dN(t',x',y')$$

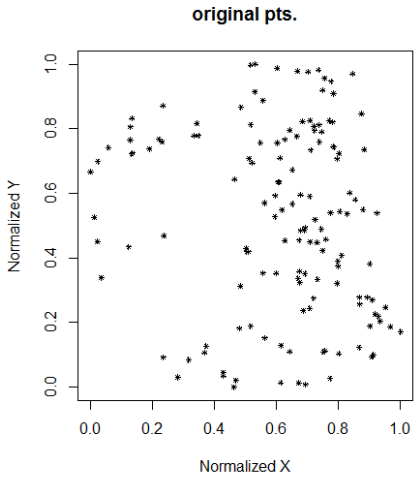
Parameter	μ	K	α	β
Estimate	0.0180	0.8187	29.8745	0.0345
SE	0.0078	0.0807	5.3949	0.0068

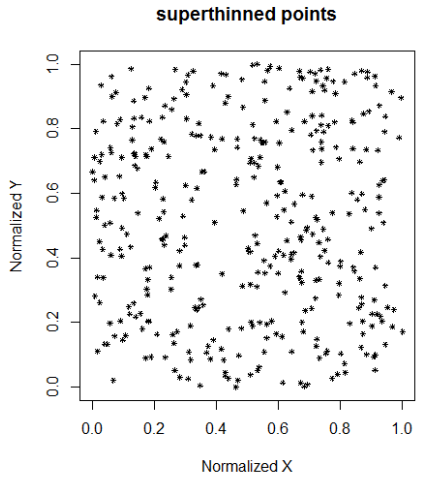
- Low background rate
- Very high k suggests only about 1/5 of the points are background points

MODEL FITTING: HAWKES PROCESS









DISCUSSION OF RESULTS

- Probability model for appearance of fires appears to be somewhat different than model for total damages, but more data should be added to reduce variance
- Hawkes process seems to fit well when analyzing superthinned results, but large triggering intensity is suspicious

Future areas of study

- Inclusion of potential covariates such as crime, housing density, neighborhood, median property values
- Relationship between fire damage and distance from nearest fire station
- Looking at point patterns for fires in other cities