# Solutions to Lab 3

**Assignment I:** Kernel estimation

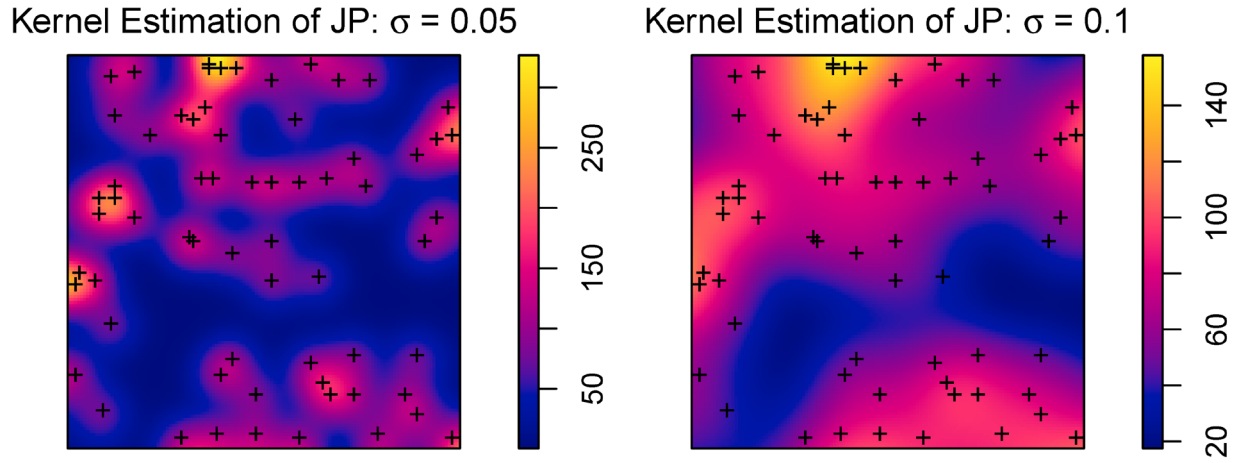
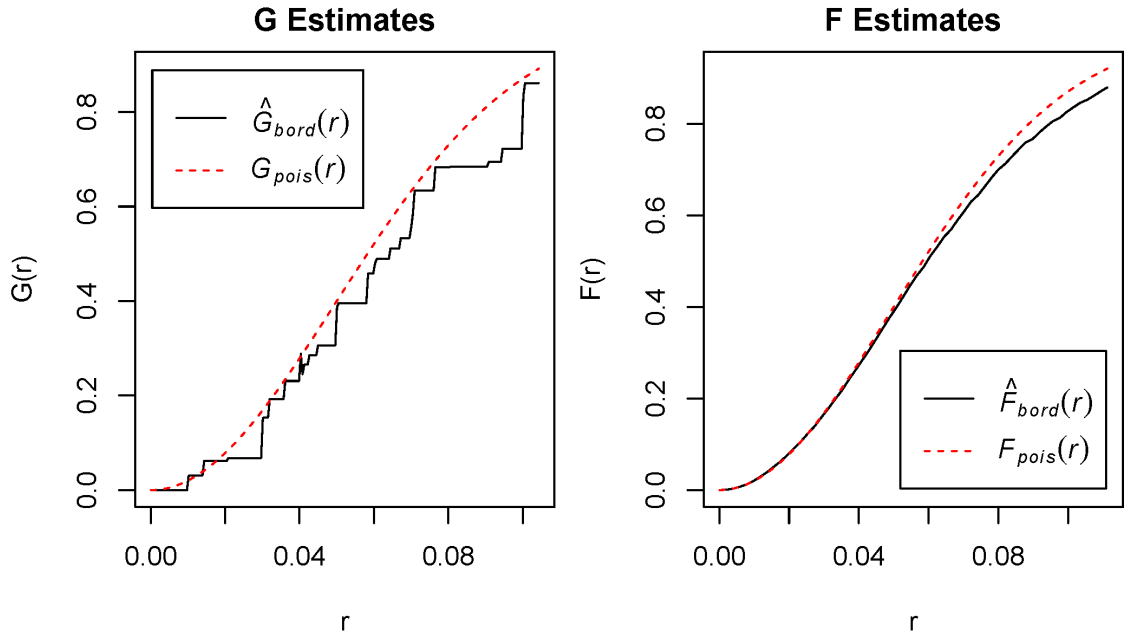
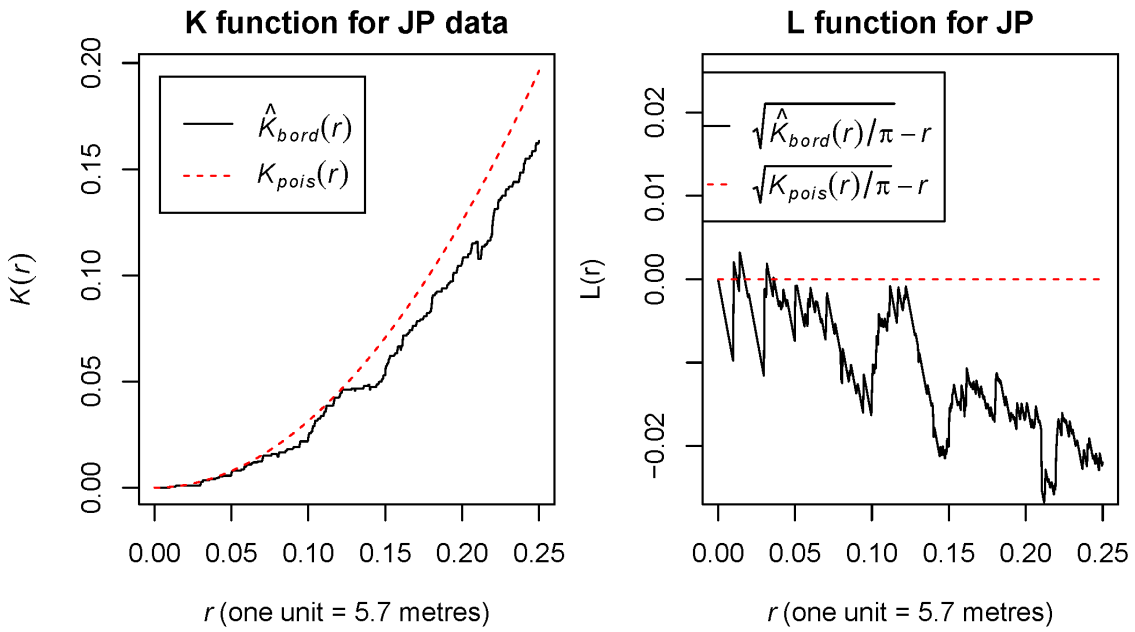



Figure 1 Kernel estimation for Japanese pine saplings using different bandwidths

When $\sigma = 0.05$, the estimated intensity is mainly concentrated around observed locations and the map appears to be localized. In contrast, the estimated intensity with $\sigma = 0.1$ is much smoother and the map seems to capture the general trend. Compared with $\sigma = 0.1$, the range of intensity with $\sigma = 0.05$ is two times larger (300 vs. 160).

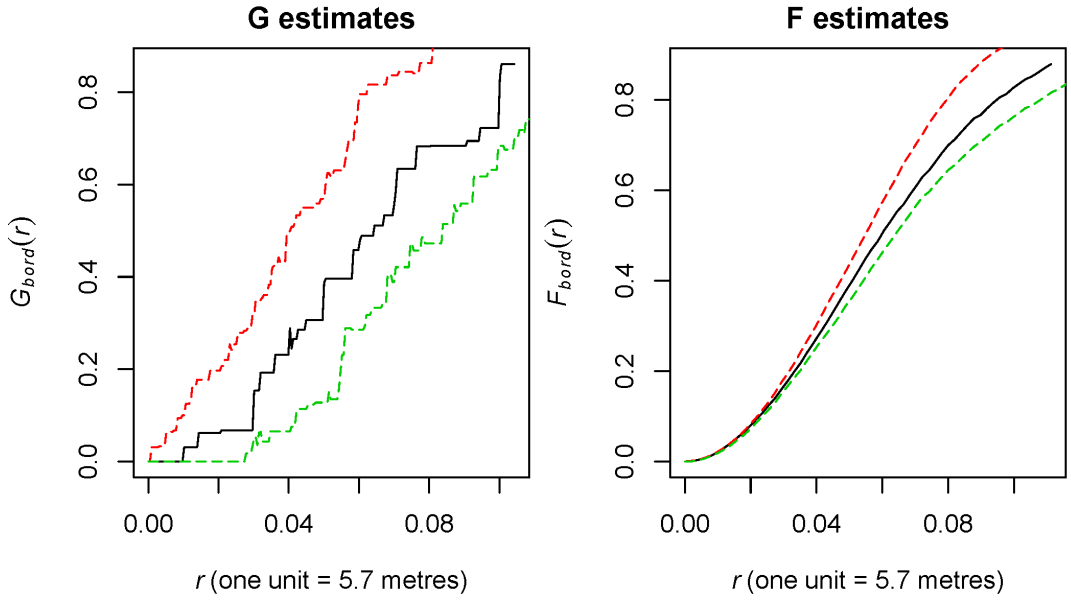
**Assignment II:** Estimate the second order effect





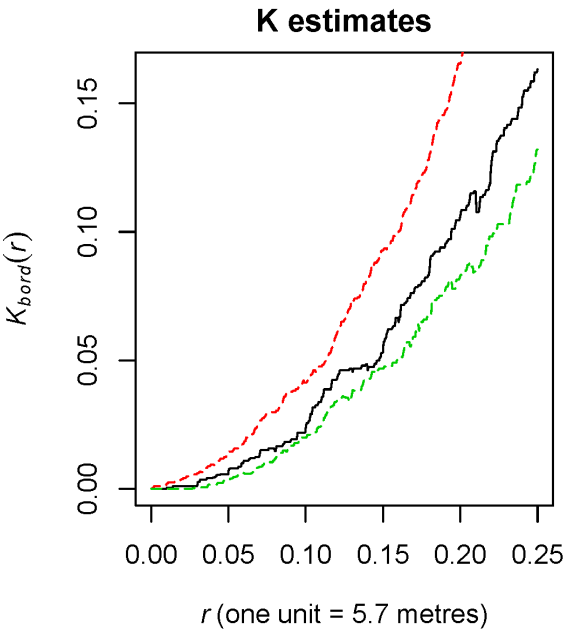

From the plots of Ghat and Fhat, we can see that both Ghat and Fhat are very close to the theoretical one, which may indicate that the point pattern is most likely random. From the plots of Khat and Lhat, we can see that the estimate is a little lower than the theoretical one. While this may indicate some regularity of the point pattern, it should be noted that the absolute range of Lhat is very small. Confidence bounds by Monte Carlo simulation are needed before we can draw any definite conclusion regarding the point pattern.

**Assignment III:** Test for the second order effect using F function and G function



From the plots of Ghat and Fhat, we can see both curves are between the upper and lower bounds, so we can conclude that the observed point pattern is not different from a random one (CSR).

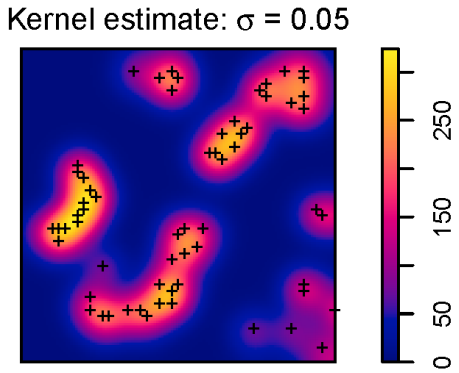
**Assignment IV:** Test of the second order effect using K function

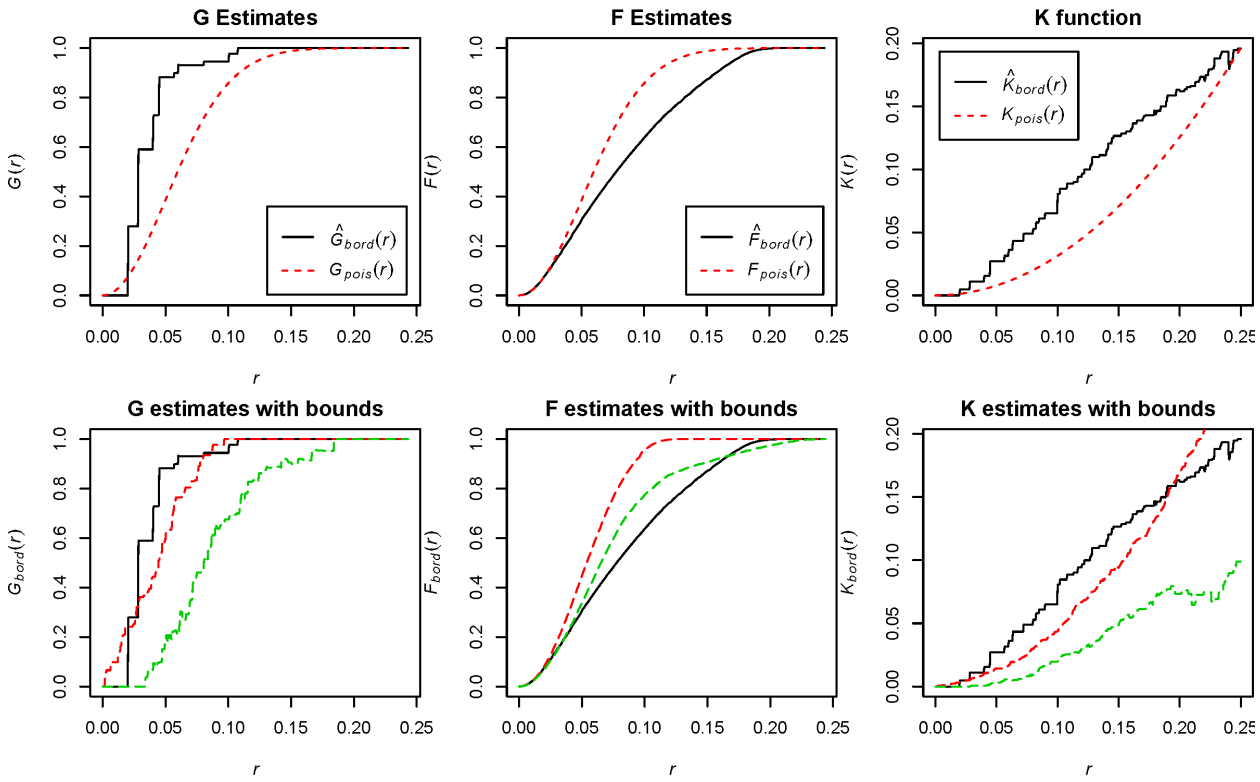



The curve for Khat is between the upper and lower bounds, so the point pattern is a realization of CSR.

**Assignment V:** Point pattern analysis for two other datasets

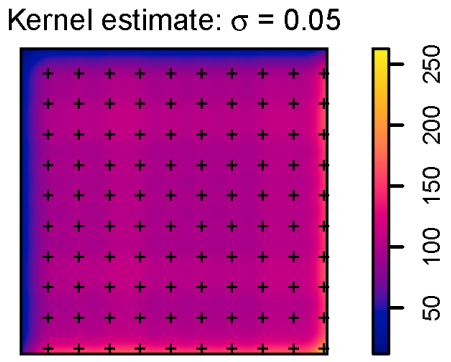
**1. Redwood data**

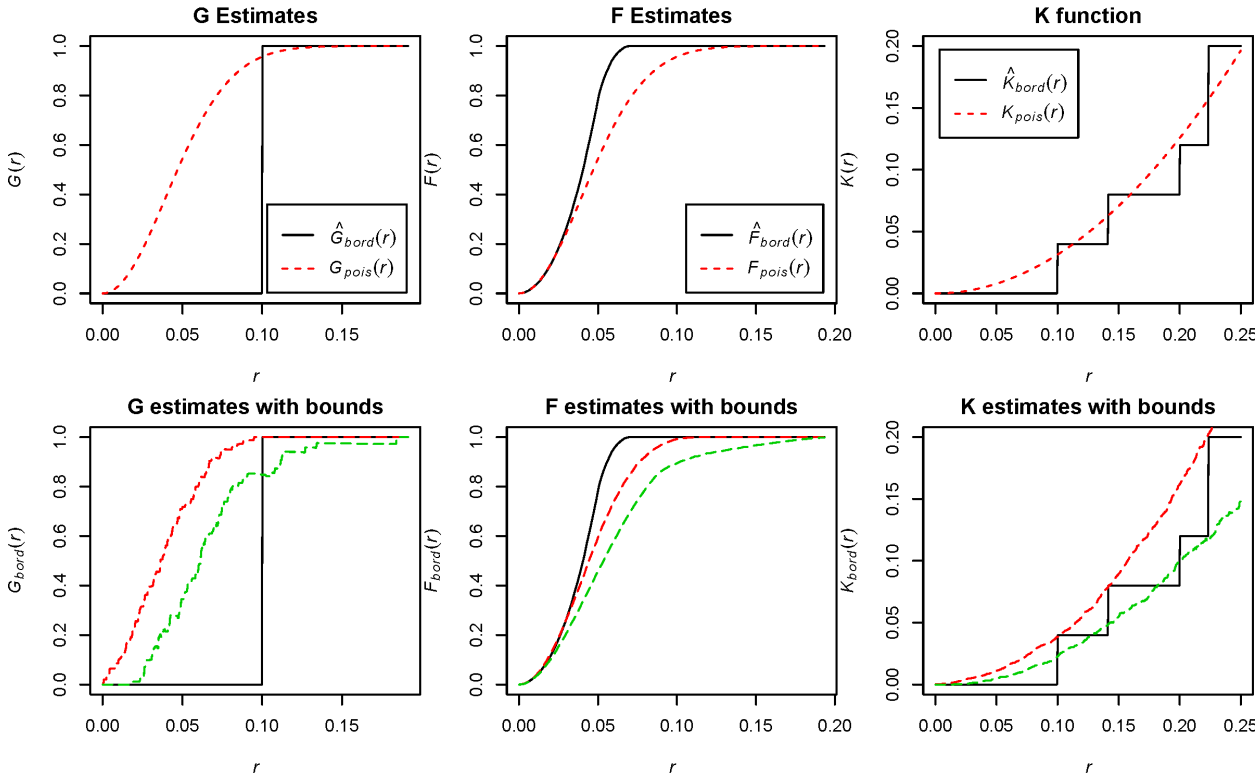





Ghat and Khat are significantly above the simulated upper bound; Fhat is significantly below the simulated lower bound. Therefore, the redwood dataset is clustered.

## 2. Simulated regular data






Ghat and Khat are significantly below simulated lower bound; Fhat is significantly above the simulated upper bound. Therefore, the above plots all show a regular pattern separated by the distance $r = 0.1$.

We can also use the K function built in the R package. The result is shown below.