Homework 7 - Spatial Point Process

Due November 7 at 9:00am

Name Ben Iuliano

Worksheet: Spatial point process

Please turn in the assignment as a link to a GitHub repo containing this worksheet as a PDF file and your code.

Background
We're going to simulate and analyze data from a clustered spatial point process. The file generate_clustered_pt_proc.R will be used to generate the data. We will use the Kest() and envelope() functions from the spatstat package to analyze the data.

Q1: Simulate some data using generate_clustered_pt_proc.R.

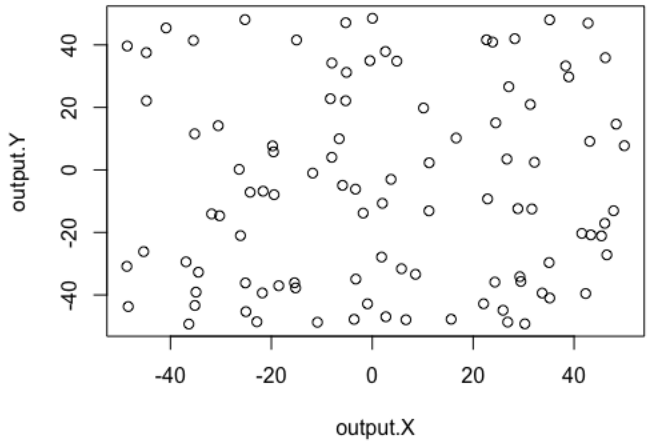
Q1.1: Which parameter(s) control the spatial extent of clusters
The Xmin, Xmax, Ymin, and Ymax parameters control the spatial extent of the area on which the points/clusters can appear; the values in the centers matrix determine the centroid of the clusters within that extent, and the effect.range parameter controls how large the clusters are.

Q1.2: Which parameter(s) control the strength of clustering (i.e., density within clusters relative to outside of clusters)
The background parameter controls the strength of the clustering, with smaller values indicating stronger clustering

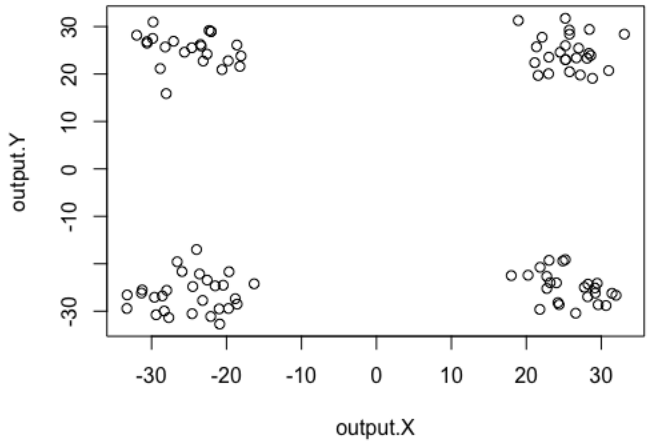
Q1.3 Generate point pattern data from a complete spatial randomness (CSR) process

and a clustered process and paste the two plots below.

CSR



Clustered



Q2: Use the quadrat test to determine whether each of these plots differs significantly from CSR. You can either code this yourself or, if that seems daunting, use the quadrat.test() function in the spatstat library. Report the Chi-square statistic and p value for each plot above.

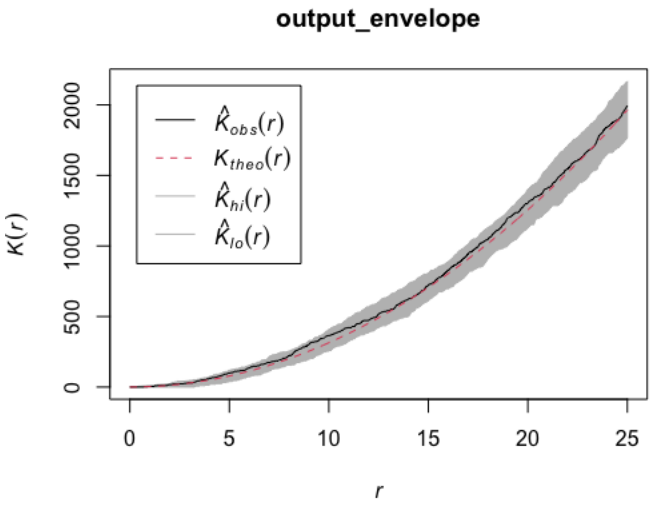
	Chi-square	p-value
CSR	23	0.960
Clustered	308	<0.001

Q3: Describe the degree of clustering at different spatial scales using a Ripley's K plot. Either code it yourself using eq. 2.8 from Fortin and Dale or use the Kest()

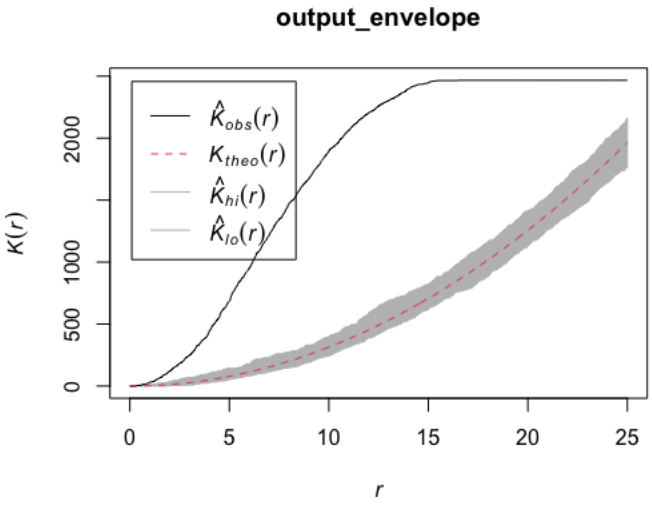
function in the spatstat library and the envelope() function to generate an envelope for the null expectation for K for CSR data. Paste the plot below.

Based upon the Ripley's K plot, the CSR data is not clustered at any spatial scale, while the clustered data is at all scales

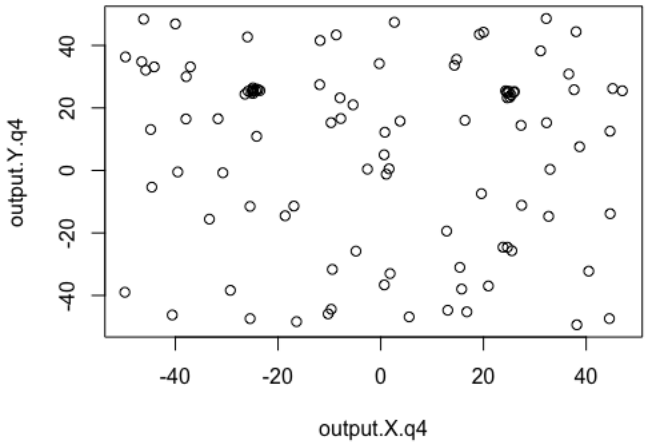
CSR

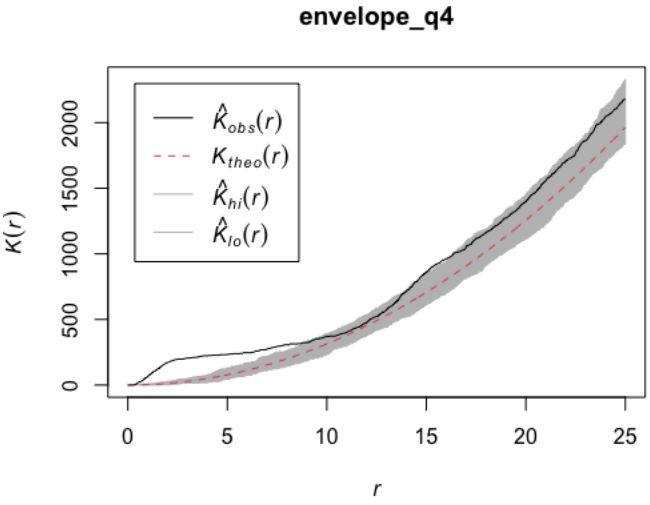


Clustered



Q4: Can you generate spatial point process data that are clustered at smaller spatial scales but random at larger scales? Paste a plot of the spatial point pattern and a plot of Ripley's K below.


output.Y.q4
40
20
0
-20
-40
-40
-20
0
20
40
output.X.q4


envelope_q4
$\hat{K}_{obs}(r)$
$K_{theo}(r)$
$\hat{K}_{hi}(r)$
$\hat{K}_{lo}(r)$
K(r)
0
500
1000
1500
2000
0
5
10
15
20
25
r