**Homework 7 - Spatial Point Process**

**Due November 7 at 9:00am**

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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

**Ymin, ymax, xmin, xmaxm, and the distance matrix**

Q1.2: Which parameter(s) control the strength of clustering (i.e., density within clusters relative to outside of clusters)

**The value at the center, the effect range, and the background all control the strength of clustering**

Q1.3 Generate point pattern data from a complete spatial randomness (CSR) process and a clustered process and paste the two plots below.

Clustered:

Chart, scatter chart

Description automatically generated

CSR:

Chart, scatter chart

Description automatically generated

# 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.

**For the random data:**

Chi-squared test of CSR using quadrat counts

data: pppRand

X2 = 20.5, df = 24, p-value = 0.664

alternative hypothesis: two.sided

Quadrats: 5 by 5 grid of tiles

***Does not differ from CSR***

**For the clustered data:**

Chi-squared test of CSR using quadrat counts

data: output\_ppp

X2 = 317, df = 24, p-value < 2.2e-16

alternative hypothesis: two.sided

Quadrats: 5 by 5 grid of tiles

***Significantly different from CSR***

# 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.

**CSR, where there is no leveling off so no clustering:**

Chart, line chart

Description automatically generated

**Versus the clustered data, which level off, indicating clustering at around 12 or 13 units away:**

Chart, line chart

Description automatically generated

# 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.

Chart, scatter chart

Description automatically generated

Chart

Description automatically generated