INFSCI 2809-PROJECT -3

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PART A: AUTOCORRELATION

Analysis and Results:

I have implemented Moran’s I technique which is an Index of Spatial Autocorrelation

Moran’s I translates non-spatial correlation measure to a spatial correlation measure.

Autocorrelation observed is 0.1276045.

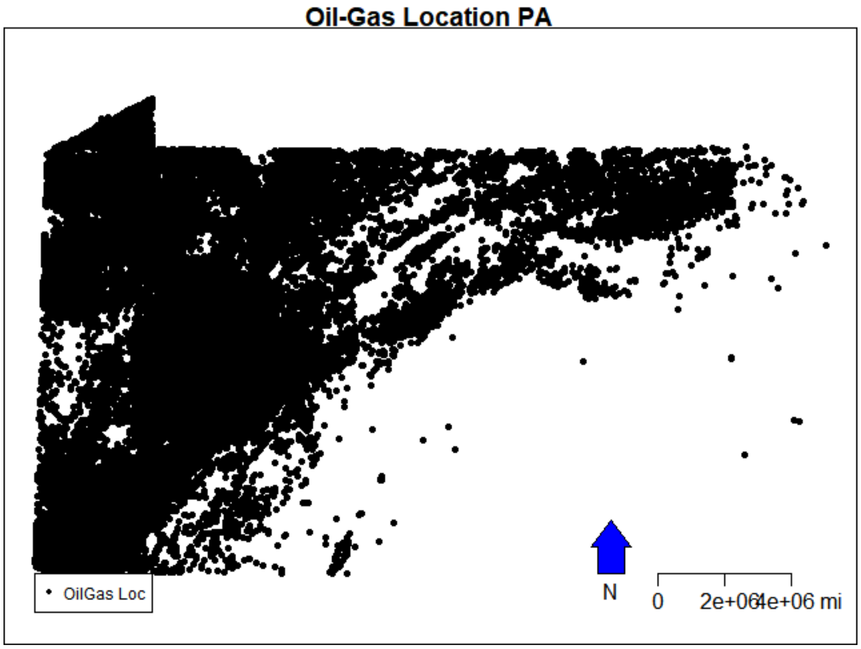
As we observe from the results the data are positively correlated i.e. most pairs of the adjacent locations have the values on the same side of the mean and Moran’s I has a positive value.

Thus, positive value indicates positive autocorrelation. Another point to be noted is that it’s not strongly correlated because the index score is not 0.3 or more or -0.3 or less.

PART B: DISTANCE BASED TECHNIQUES

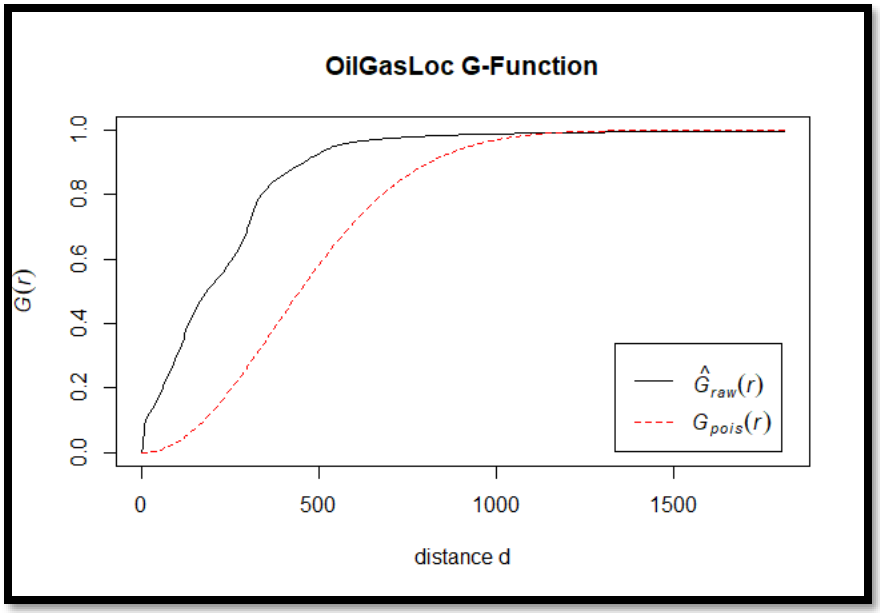
1.OilGasLocation PA

- **Map of the OilGasLocationPA**

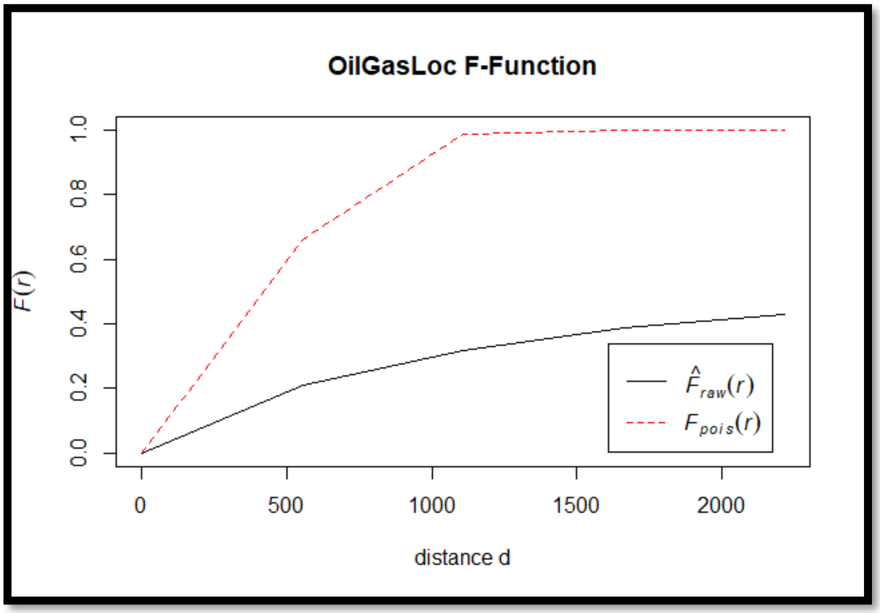


Below are the G, F, K and L function plots for Oil Gas Location PA

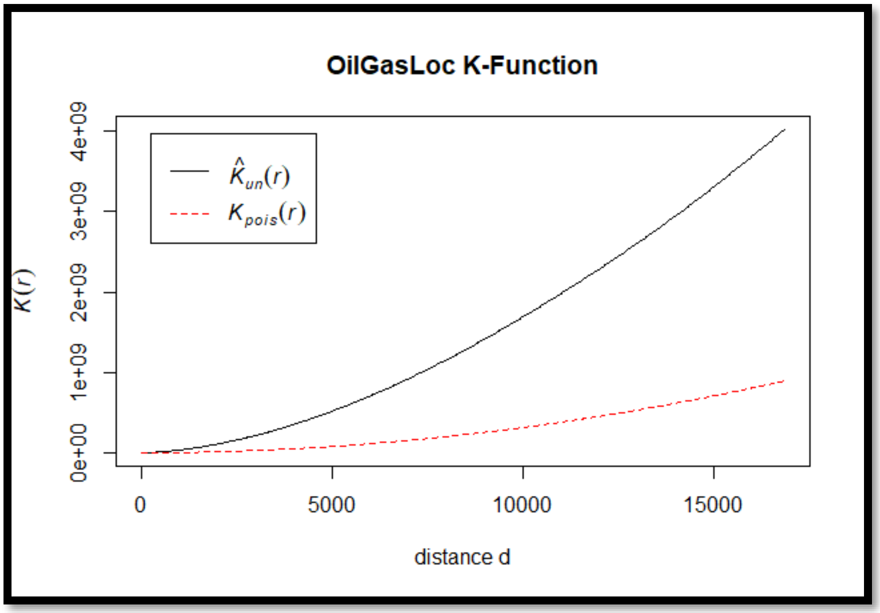
- **G-function**



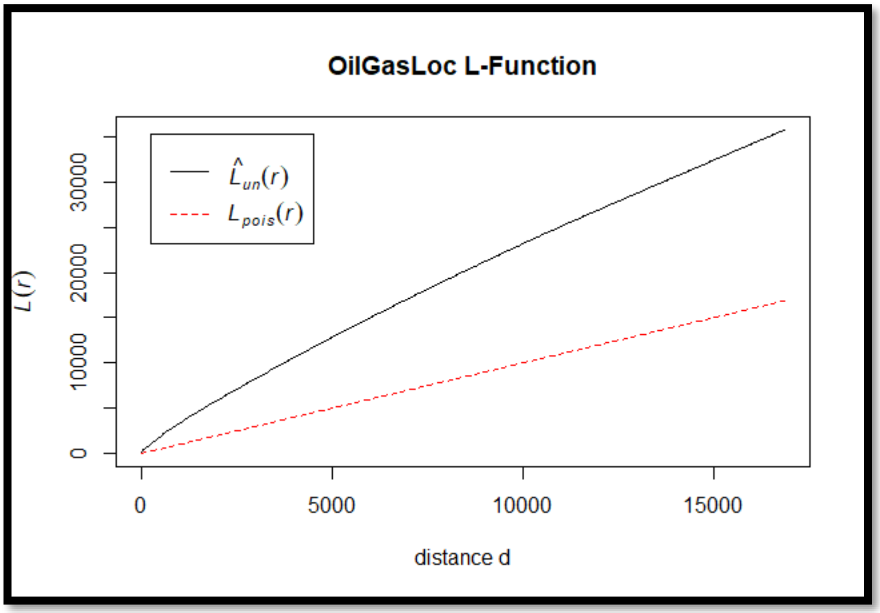
- **F-Function**



- **K-Function**



- **L-function**



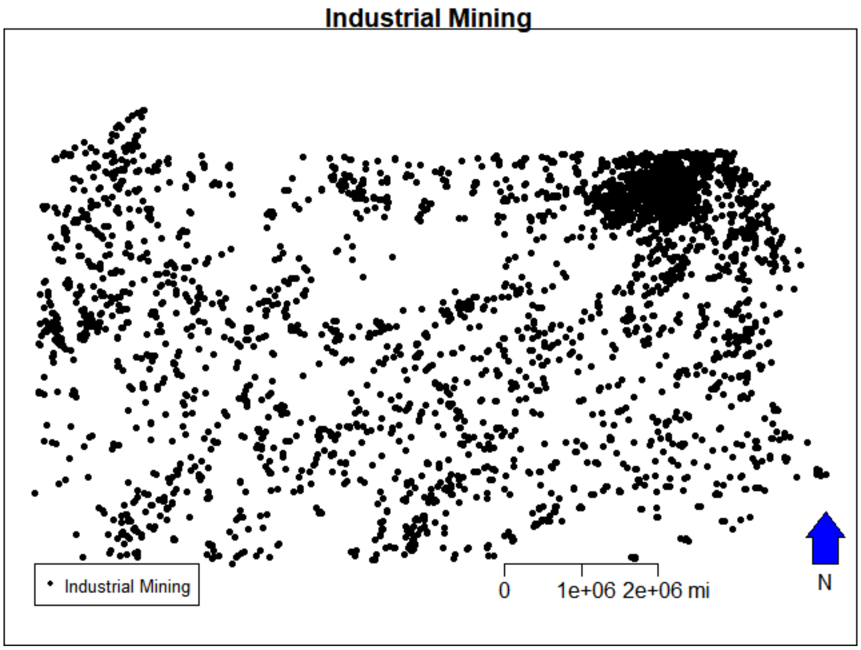
In all the plots for each of G, F, K and L functions, I have the observed functions plotted (black curve) along with expected theoretical value (red curve) of each function assuming it to be a Poisson process.

G function increases rapidly at short distances and then goes on to remain constant. This clearly indicates that the datapoints are clustered. When we compare F and G functions, we can clearly see that observed function of G is above the expected function and for F function, it's below the expected value. Also, F function rises slowly across shorter distances whereas for G, K and L functions it increases more rapidly at shorter distances.

Thus, we can conclude that there is clustering in this dataset.

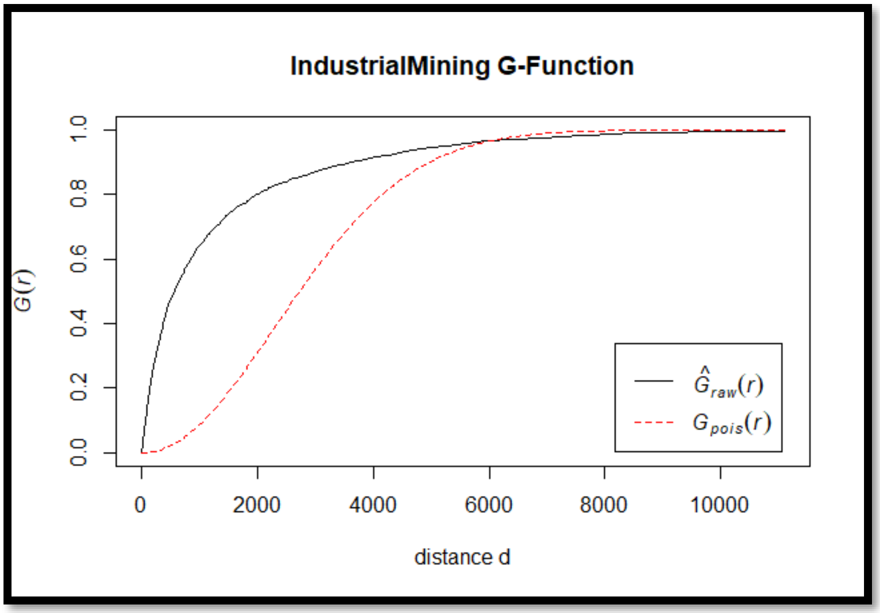
2.**Industrial Mining**

- **Map of Industrial Mining**

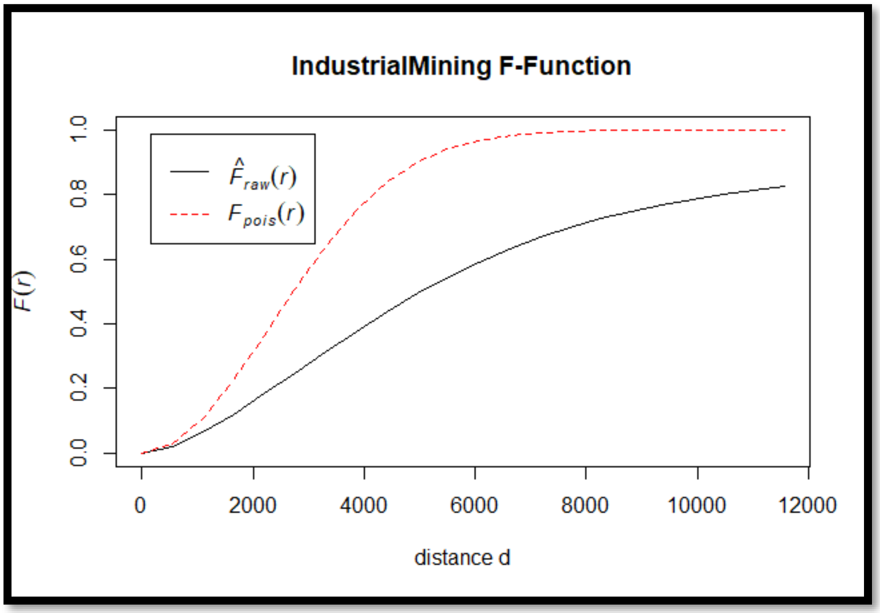


Below are the G,F,K,L function plots for Industrial Mining dataset

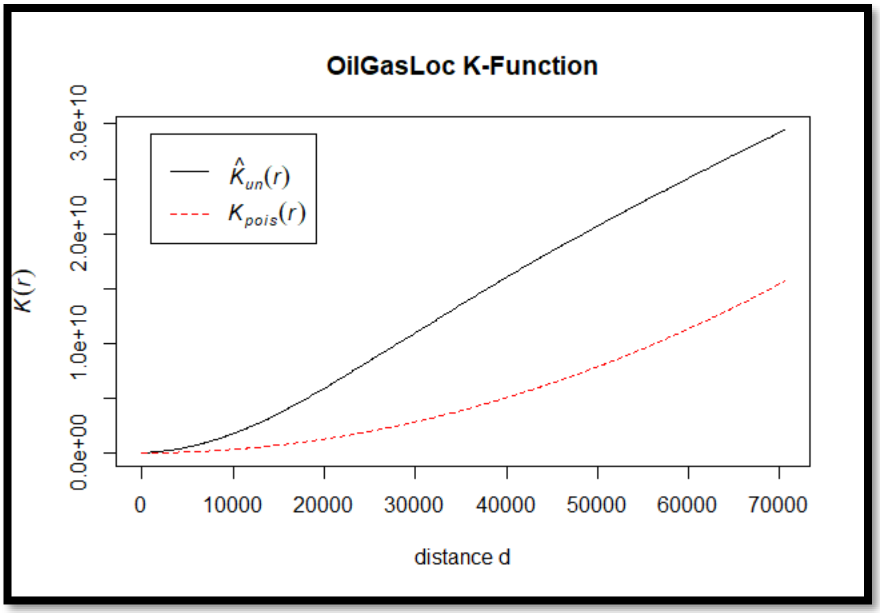
- **G-function**



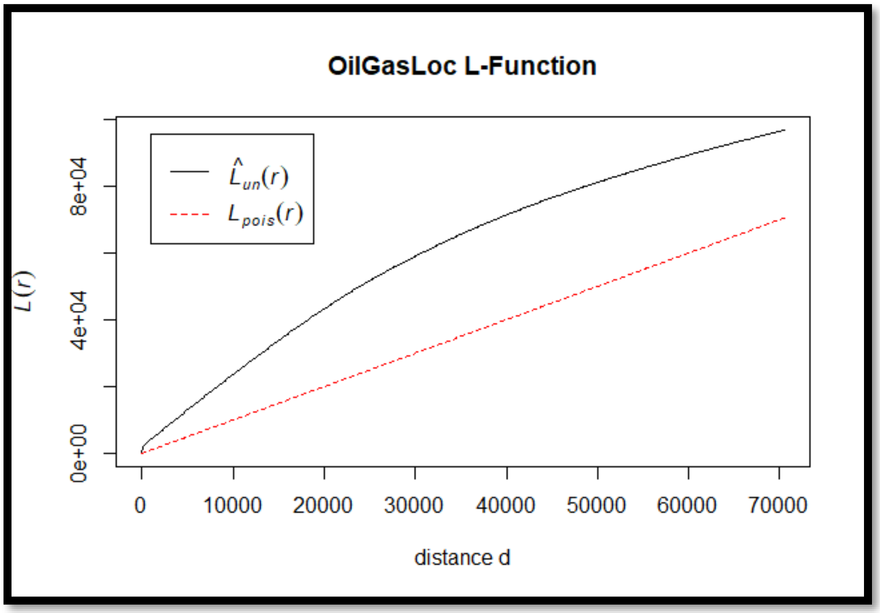
- **F-Function**



- **K-Function**



- **L-function**



In the plot for each of G, F, K and L functions, I have the observed functions plotted (black curve) along with expected theoretical value (red curve) of each function assuming it to be a Poisson process.

G function increases rapidly at short distances and then goes on to remain constant. This clearly indicates that the datapoints are clustered. When we compare F and G functions, we can clearly see that observed function of G is above the expected function and for F function, it’s below the expected value. Also, F function rises slowly across shorter distances whereas for G, K and L functions it increases more rapidly at shorter distances.

Thus, we can conclude that there is clustering in this dataset.

Codes:

```
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#Part-A(Morans'I technique implementation)


#Read the datafile
particlem=read.csv("http://gis40.exp.sis.pitt.edu/INFSCI2809_data/ParticulateMatter.csv", sep=",", header=T)
#reading longitude and latitude as distance matrix
particle_dists=as.matrix(dist(cbind(particlem$Lon, particlem$Lat)))
#Taking inverse distance matrix
particle_dists_inv=1/particle_dists
#setting the diagonal to zero
diag(particle_dists_inv)=0
#read obseravations
no_of_obs=length(particlem$PM25)
#divide inverse matrix by rowsum
particle_dists_inv=particle_dists_inv/rowSums(particle_dists_inv)
#sum of inverse distance matrix
sum_of_inv=sum(particle_dists_inv)
#mean of PM25 attribute
m=mean(particlem$PM25)
#difference of attribute from mean
y=particlem$PM25-m
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#sum of squared differences
v=sum(y^2)
#Perform outer cross product
z=sum(particle_dists_inv*y %o% y)
#Apply autocorrelation using the formula
autocorrelation=(no_of_obs/sum_of_inv)*((z)/v)
print(autocorrelation)

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#Part-B (Oil-Gas Location PA)
#loading all the packages required
library(raster)
library(rgdal)#read the shape file
library(spatstat)
library(sp)
library(maptools)

#setting the working directory

setwd("C:/Users/rvais/Wdirectory/SPA2/gasoil")
dir(getwd())

#Loading the shape file and processing the data
locPA<- readOGR(dsn= getwd(), layer = "OilGasLocationPA")

#finding the min and max co-ordinates of the shape file(x1min,x2min,x1max,x2max)
x1min=min(locPA@coords[,1])
x2min=min(locPA@coords[,2])
```

```
x1max=max(locPA@coords[,1])
x2max=max(locPA@coords[,2])

#Position plot and this is only for Map plotting.For each of G,F,K and L,I will have to comment this else it doesn't plot properly
par(mai=c(0,0,0.2,0))
#plotting map
plot(locPA, main="Oil-Gas Location PA", pch=20)
#adding legend
legend(x1min,x2min, legend="OilGas Loc", col="black", pch=20, cex=0.75)
#Detaching the package GISTools and calling maps right before calling map.scale() because this function map.scale()is used for both maps and GISTools and hence getting masked.
detach(package:GISTools)
library(maps)
#setting scale using map.scale after detach
map.scale(x=x1max-100000, y=x2min+100, ratio=FALSE, metric=FALSE)
library(GISTools)
#North arrow
north.arrow(xb=x1max/2, yb=x2min+100, len=8000, lab="N", col='Blue')
#adding axes
map.axes(cex.axis=0.8)

#Store coordinates as list and make matrix for the coordinates
coord=list(x=locPA@coords[,1], y=locPA@coords[,2])
matx=matrix(unique(c(locPA@coords[,1],locPA@coords[,2])), ncol=2)

#Create an object of class "ppp" representing a point pattern dataset in the two-dimensional plane.
locPA_owin=as.owin(c(x1min,x1max,x2min,x2max))
locPA_unique=unique(locPA@coords)
```

```
locPA_ppp=ppp(locPA_unique[,1], locPA_unique[,2], locPA_owin)


#G-function
G_FUNC=Gest(locPA_ppp, correction="none")
plot(G_FUNC, ylim=c(0,1), main="OilGasLoc G-Function", xlab ="distance d")
#F-function
F_FUNC=Fest(locPA_ppp, correction="none")
plot(F_FUNC, ylim=c(0,1), main="OilGasLoc F-Function",xlab="distance d")
#K-function
K_FUNC=Kest(locPA_ppp, correction="none")
plot(K_FUNC,main="OilGasLoc K-Function", xlab ="distance d")
#L-function
L_FUNC=Lest(locPA_ppp, correction="none")
plot(L_FUNC,main="OilGasLoc L-Function", xlab ="distance d")
---------------------------------------------------------------------------------------------------------------
#Part B (Industrial Mining)
#loading all the packages required
library(raster)
library(rgdal)#read the shape file
library(spatstat)
library(sp)
library(maptools)

#setting the working directory

setwd("C:/Users/rvais/Wdirectory/SPA2/mining")
dir(getwd())

#Loading the shape file and processing the data
```

```
Indmin<- readOGR(dsn= getwd(), layer = "IndustrialMineralMiningOperations2014_10")


#finding the min and max co-ordinates of the shape file(x1min,x2min,x1max,x2max)

x1min=min(Indmin@coords[,1])

x2min=min(Indmin@coords[,2])

x1max=max(Indmin@coords[,1])

x2max=max(Indmin@coords[,2])


#Position plot and this is only for Map plotting.For each of G,F,K and L,I will have to comment this else it doesn't plot properly

par(mai=c(0,0,0.2,0))

#plotting map

plot(Indmin, main="Industrial Mining", pch=20)

#adding legend

legend(x1min, x2min, legend="Industrial Mining", col="black", pch=20, cex=0.8)

#Detaching the package GISTools and calling maps right before calling map.scale() because this function map.scale()is used for both maps and GISTools and hence getting masked.

detach(package:GISTools)

library(maps)

#setting scale using map.scale

map.scale(x=x1max-200000, y=x2min+200, ratio=FALSE, metric=FALSE)

library(GISTools)

#North arrow

north.arrow(xb=x1max, yb=x2min+100, len=8000, lab="N", col='Blue')

#adding axes

map.axes(cex.axis=0.8)


#Store coordinates as list and make matrix for the coordinates

coord=list(x=Indmin@coords[,1], y=Indmin@coords[,2])
```

```
matx=matrix(unique(c(Indmin@coords[,1],Indmin@coords[,2])), ncol=2)

#Create an object of class "ppp" representing a point pattern dataset in the two-dimensional plane.
Indmin_owin=as.owin(c(x1min,x1max,x2min,x2max))
Indmin_unique=unique(Indmin@coords)
Indmin_ppp=ppp(Indmin_unique[,1], Indmin_unique[,2], Indmin_owin)

#G-function
G_FUNC=Gest(Indmin_ppp, correction="none")
plot(G_FUNC, ylim=c(0,1), main="IndustrialMining G-Function", xlab ="distance d")

#F-function
F_FUNC=Fest(Indmin_ppp, correction="none")
plot(F_FUNC, ylim=c(0,1), main="IndustrialMining F-Function",xlab="distance d")

#K-function
K_FUNC=Kest(Indmin_ppp, correction="none")
plot(K_FUNC, main="OilGasLoc K-Function", xlab ="distance d")

#L-function
L_FUNC=Lest(Indmin_ppp, correction="none")
plot(L_FUNC, main="OilGasLoc L-Function", xlab ="distance d")
```