STA5001 Exam Michael Le 21689299

2024-06-10

# Question 1.

#a. Produce a quick summary of the data locations. Visualize the locations in the x-y plane.   
  
library(geoR)

## Warning: package 'geoR' was built under R version 4.3.3

## --------------------------------------------------------------  
## Analysis of Geostatistical Data  
## For an Introduction to geoR go to http://www.leg.ufpr.br/geoR  
## geoR version 1.9-4 (built on 2024-02-14) is now loaded  
## --------------------------------------------------------------

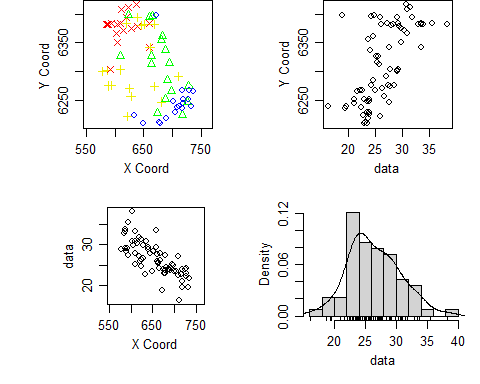
data(kattegat)  
summary(kattegat)

## Number of data points: 70   
##   
## Coordinates summary  
## x.utm y.utm  
## min 578.0956 6209.819  
## max 736.0690 6416.335  
##   
## Distance summary  
## min max   
## 0.645182 212.147470   
##   
## Data summary  
## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 16.21048 23.67496 25.86793 26.43352 29.10185 38.23964   
##   
## Other elements in the geodata object  
## [1] "call" "dk"

#a. Produce a quick summary of the data locations. Visualize the locations in the x-y plane.   
  
library(geoR)  
data(kattegat)  
summary(kattegat)

## Number of data points: 70   
##   
## Coordinates summary  
## x.utm y.utm  
## min 578.0956 6209.819  
## max 736.0690 6416.335  
##   
## Distance summary  
## min max   
## 0.645182 212.147470   
##   
## Data summary  
## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 16.21048 23.67496 25.86793 26.43352 29.10185 38.23964   
##   
## Other elements in the geodata object  
## [1] "call" "dk"

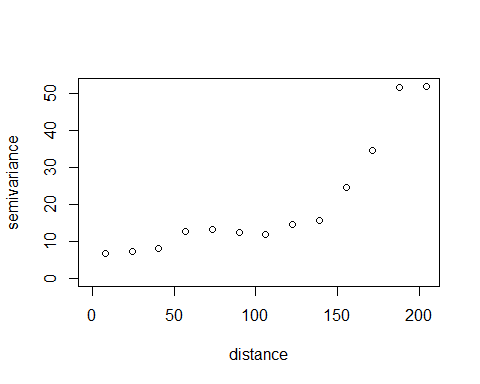
plot(kattegat)



#b. Compute and plot a sample variogram.  
bin <- variog(kattegat)

## variog: computing omnidirectional variogram

plot(bin)



#c. Fit spherical and exponential variograms to the data by using ordinary least squares.   
  
#HINT: use the initial values (100,5) and zero nugget.  
  
ols.ne <- variofit(bin, ini = c(100,5), nugget=0, weights="equal", cov.model = "exponential")

## variofit: covariance model used is exponential   
## variofit: weights used: equal   
## variofit: minimisation function used: optim

ols.ns <- variofit(bin, ini = c(100,5), nugget=0, weights="equal",cov.model = "spherical")

## variofit: covariance model used is spherical   
## variofit: weights used: equal   
## variofit: minimisation function used: optim

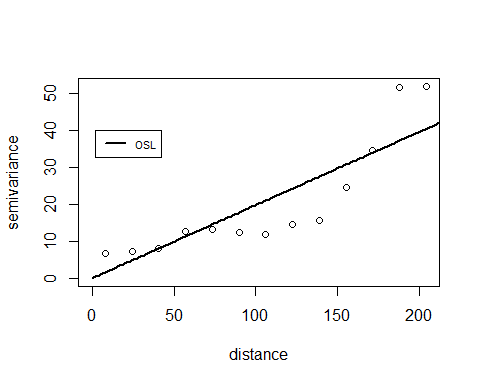
#d. What are numerical values for the estimated range parameter in the spherical and exponential sample variograms?  
  
#For the exponential, the range is 2288724  
ols.ne

## variofit: model parameters estimated by OLS (ordinary least squares):  
## covariance model is: exponential  
## parameter estimates:  
## tausq sigmasq phi   
## 0.0 151450.9 763994.7   
## Practical Range with cor=0.05 for asymptotic range: 2288724  
##   
## variofit: minimised sum of squares = 765.1929

#For the spherical is, range = 5  
  
ols.ns

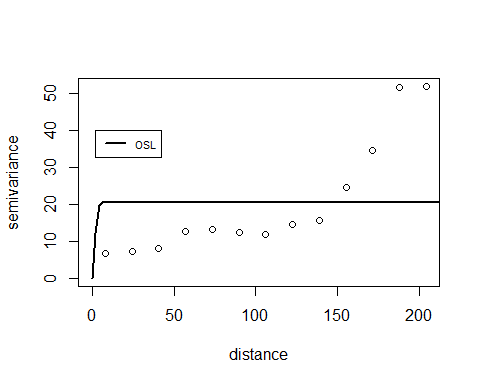
## variofit: model parameters estimated by OLS (ordinary least squares):  
## covariance model is: spherical  
## parameter estimates:  
## tausq sigmasq phi   
## 0.000 20.419 5.000   
## Practical Range with cor=0.05 for asymptotic range: 5  
##   
## variofit: minimised sum of squares = 2996.27

#e. Plot the fitted variograms from (c) against the sample variogram.  
  
#For the exponential variogram  
plot(bin)  
lines(ols.ne,lwd=2)  
legend(2,40,legend=c("OSL"),lty=c(1,1),lwd=c(2,1),cex=0.7)



#For the spherical variogram

plot(bin)  
lines(ols.ns,lwd=2)  
legend(2,40,legend=c("OSL"),lty=c(1,1),lwd=c(2,1),cex=0.7)

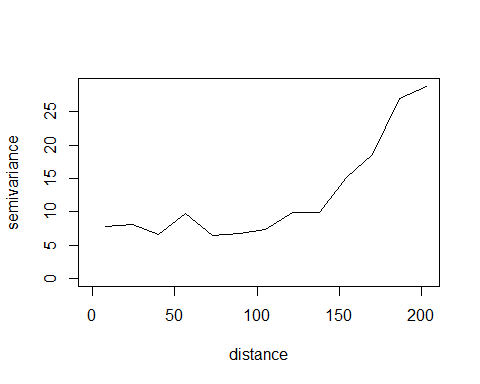


#f. Compare the fitted spherical and exponential models. Which of these models do you think is better? Provide your justification.  
  
#The exponential variogram best fits the model for the ordinary least squares compared to the spherical. (For visual comparison)

#g. Plot the empirical directional variogram for 20 degrees with a tolerance angle 45 degrees as a line plot.  
vario<- variog(kattegat,direction=pi/9,tolerance = pi/4)

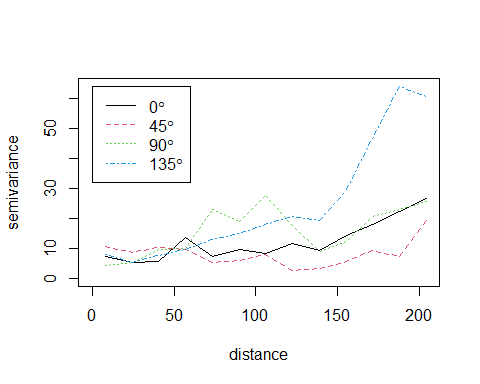
## variog: computing variogram for direction = 20 degrees (0.349 radians)  
## tolerance angle = 45 degrees (0.785 radians)

plot(vario,type="l")



#g. Plot a multidirectional variogram (computed for 0, 45, 90, and 135 degrees). What does this plot suggest?   
plot(variog4(kattegat), legend = TRUE)

## variog: computing variogram for direction = 0 degrees (0 radians)  
## tolerance angle = 22.5 degrees (0.393 radians)  
## variog: computing variogram for direction = 45 degrees (0.785 radians)  
## tolerance angle = 22.5 degrees (0.393 radians)  
## variog: computing variogram for direction = 90 degrees (1.571 radians)  
## tolerance angle = 22.5 degrees (0.393 radians)  
## variog: computing variogram for direction = 135 degrees (2.356 radians)  
## tolerance angle = 22.5 degrees (0.393 radians)  
## variog: computing omnidirectional variogram

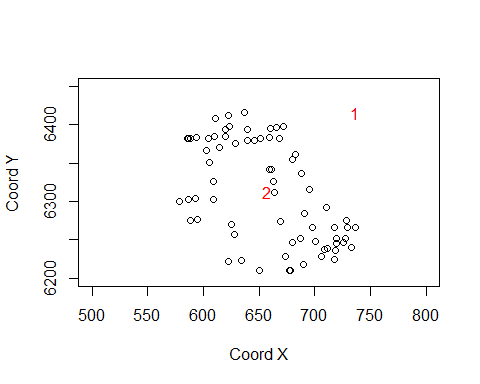
 #Question 2.

#a. Compute the mean values of the first and second coordinates of the locations, denoted later as xmean and ymean.  
  
summary(kattegat$coords)

## x.utm y.utm   
## Min. :578.1 Min. :6210   
## 1st Qu.:619.4 1st Qu.:6252   
## Median :660.7 Median :6303   
## Mean :657.4 Mean :6312   
## 3rd Qu.:694.3 3rd Qu.:6382   
## Max. :736.1 Max. :6416

xmean = 657.4  
ymean = 6312

#b. Plot the locations of the data in the x-y plane in black color. Add the locations of the last point from the data set and the point with coordinates (xmean,ymean) in red colour on the same plot.  
plot(kattegat$coords,xlab="Coord X", ylab="Coord Y",xlim=c(500,800),ylim=c(6200,6450))   
loci <- matrix(c(xmean,ymean), ncol=2)  
loci2<- matrix(c(736.1,6416), ncol=2)  
text(loci, as.character(2), col="red")   
text(loci2, as.character(1), col="red")



#c. What are the predicted values by kriging at these two points? and   
#d. What are the predicted variance values at these two points  
  
library(gstat)

## Warning: package 'gstat' was built under R version 4.3.3

library(geoR)  
library(sp)

## Warning: package 'sp' was built under R version 4.3.3

kc <- krige.conv(kattegat,locations=loci,krige=krige.control(obj.m=ols.ne)) #(xmean,ymean)

## krige.conv: model with constant mean  
## krige.conv: Kriging performed using global neighbourhood

kc

## $predict  
## data   
## 26.20676   
##   
## $krige.var  
## [1] 2.066593  
##   
## $beta.est  
## beta   
## 25.16816   
##   
## $distribution  
## [1] "normal"  
##   
## $message  
## [1] "krige.conv: Kriging performed using global neighbourhood"  
##   
## $call  
## krige.conv(geodata = kattegat, locations = loci, krige = krige.control(obj.m = ols.ne))  
##   
## attr(,"sp.dim")  
## [1] "2d"  
## attr(,"prediction.locations")  
## loci  
## attr(,"parent.env")  
## <environment: R\_GlobalEnv>  
## attr(,"data.locations")  
## kattegat$coords  
## attr(,"class")  
## [1] "kriging"

#Predicted: 26.20676  
#Variance: 2.066593

kc2 <- krige.conv(kattegat,locations=loci2,krige=krige.control(obj.m=ols.ne))

## krige.conv: model with constant mean  
## krige.conv: Kriging performed using global neighbourhood

kc2

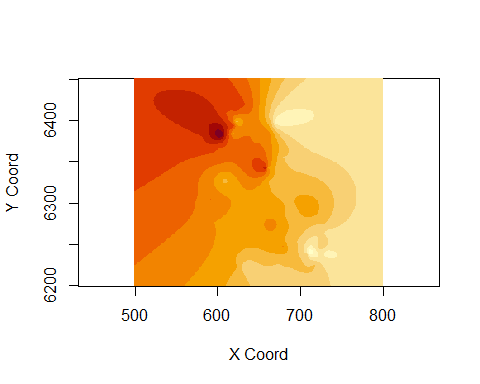
## $predict  
## data   
## 20.36188   
##   
## $krige.var  
## [1] 21.46485  
##   
## $beta.est  
## beta   
## 25.16816   
##   
## $distribution  
## [1] "normal"  
##   
## $message  
## [1] "krige.conv: Kriging performed using global neighbourhood"  
##   
## $call  
## krige.conv(geodata = kattegat, locations = loci2, krige = krige.control(obj.m = ols.ne))  
##   
## attr(,"sp.dim")  
## [1] "2d"  
## attr(,"prediction.locations")  
## loci2  
## attr(,"parent.env")  
## <environment: R\_GlobalEnv>  
## attr(,"data.locations")  
## kattegat$coords  
## attr(,"class")  
## [1] "kriging"

#Predicted: 20.36188  
#Variance: 21.46485

#e. Perform prediction on a grid covering the observation area, display the result as an image.  
  
  
#First one  
pred.grid<- expand.grid(seq(500,800),seq(6200,6450))  
kc2 <- krige.conv(kattegat,locations=pred.grid,krige=krige.control(obj.m=ols.ne))

## krige.conv: model with constant mean  
## krige.conv: Kriging performed using global neighbourhood

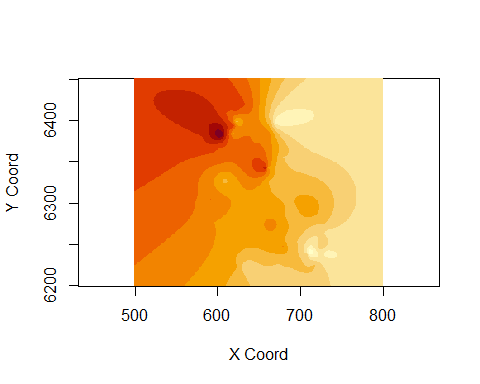
image(kc2,loc=pred.grid)



#Second  
pred.grid<- expand.grid(seq(500,800),seq(6200,6450))  
kc <- krige.conv(kattegat,locations=pred.grid,krige=krige.control(obj.m=ols.ne))

## krige.conv: model with constant mean  
## krige.conv: Kriging performed using global neighbourhood

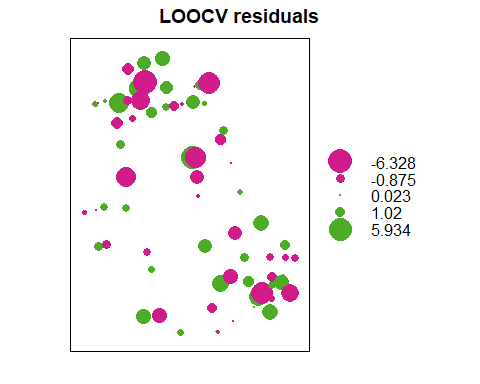
image(kc,loc=pred.grid)



#f. Explain the plot obtained in (e). # The kringing result demonstrates that are three regions when we move far away from the observations, the color does change as all points contribute approximately equally to the predicted value.

#g. Cross-validate your model by using the leave-one-out cross-validation. Produce a bubble plot of the result.   
  
a<- as.data.frame(kattegat$data)  
s <- SpatialPointsDataFrame(kattegat$coords, a,   
proj4string=CRS(projargs=as.character(NA)), match.ID=TRUE)   
v.fit<- as.vgm.variomodel(ols.ne)   
cvLOOCV<- krige.cv(kattegat.data~1,s,v.fit,nfold=nrow(s))

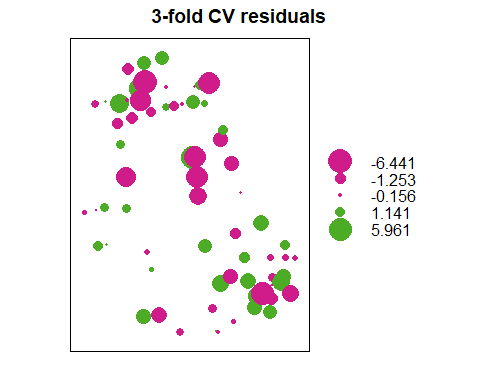
bubble(cvLOOCV,"residual",main="LOOCV residuals")



#h. Explain the results in the plot obtained in (g). #As large circles assuming they are not uniformly distributed over the region, the cross-validation analysis shows that are regions performing worse than other regions.

#i. Cross-validate your model by using 3-fold cross validation. Produce a bubble plot of the result. Compare the results with (g) and explain them.   
  
cv3 <-krige.cv(kattegat.data~1,s,v.fit,nfold=3)

bubble(cv3,"residual",main="3-fold CV residuals")



#The plots are rather different in certain regions, shows that a 3 fold CV may not provide accuracy in terms of results. It is better not to use the small number of folds for this case.

#j. Optimize the monitoring network using the criterion of minimum mean kriging variances. Which two data points have the minimum mean kringing variance?  
  
m1<-sapply(1:length(s),function(x) mean(krige(kattegat.data~1,s[-x,],s,v.fit)$var1.var))

## [using ordinary kriging]  
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## [using ordinary kriging]

#Minimum  
which(m1==min(m1))

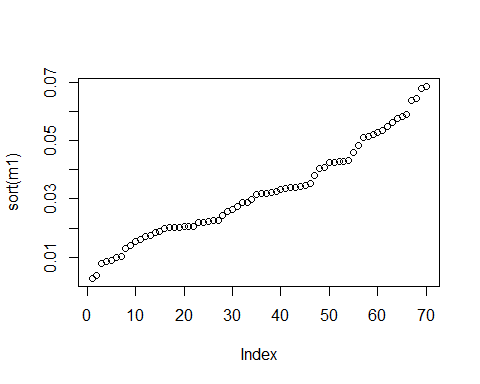
## [1] 3

#Answer: 3  
  
#Maximum  
which(m1==max(m1))

## [1] 41

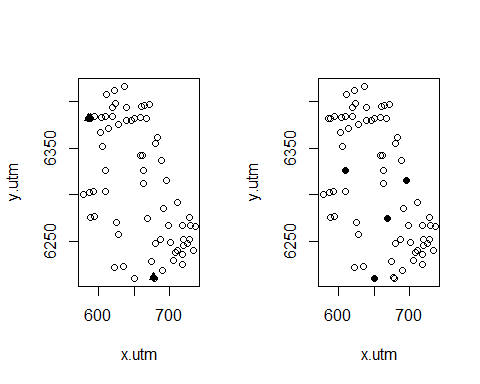
#Answer: 41

#k. Plot the sorted mean kriging variances. Explain the obtained plot.   
plot(sort(m1))



#Explaination: It seems there are group of points between 0-3 and 41 are the first possible candidates for removal.

#l. Plot points with top and bottom 5% mean kriging variance (use different point shapes for top and bottom points).  
  
layout(matrix(1:2,1,2))  
plot(kattegat$coords)  
points(kattegat$coords[m1<quantile(m1,.05),],pch=17)  
plot(kattegat$coords)  
points(kattegat$coords[m1>quantile(m1,.95),],pch=16)



#Question 3.

library(spatstat)

## Warning: package 'spatstat' was built under R version 4.3.3

## Loading required package: spatstat.data

## Warning: package 'spatstat.data' was built under R version 4.3.3

## Loading required package: spatstat.geom

## Warning: package 'spatstat.geom' was built under R version 4.3.3

## spatstat.geom 3.2-9

## Loading required package: spatstat.random

## Warning: package 'spatstat.random' was built under R version 4.3.3

## spatstat.random 3.2-3

## Loading required package: spatstat.explore

## Warning: package 'spatstat.explore' was built under R version 4.3.3

## Loading required package: nlme

## spatstat.explore 3.2-6

##   
## Attaching package: 'spatstat.explore'

## The following object is masked from 'package:gstat':  
##   
## idw

## Loading required package: spatstat.model

## Warning: package 'spatstat.model' was built under R version 4.3.3

## Loading required package: rpart

## spatstat.model 3.2-10

## Loading required package: spatstat.linnet

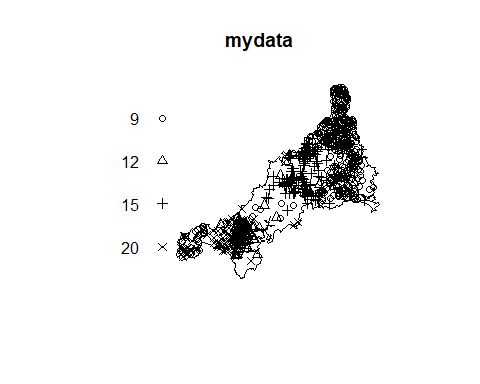
## Warning: package 'spatstat.linnet' was built under R version 4.3.3

## spatstat.linnet 3.1-4

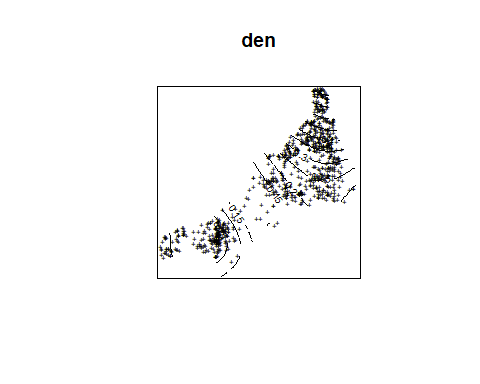
##   
## spatstat 3.0-7   
## For an introduction to spatstat, type 'beginner'

data(btb)  
mydata<- unmark(btb)  
marks(mydata)<-marks(btb)$spoligotype

#a. Plot the spatial locations of the data  
  
plot(mydata)



#b. Produce a contour plot for the estimated intensity.  
den<-density(mydata)  
contour(den)  
points(mydata,cex=0.5,pch="+")

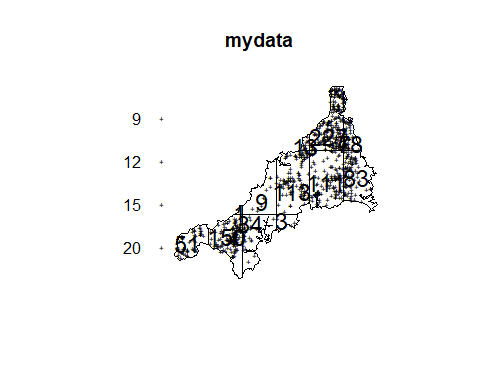


#c. Investigate the intensity of the data set. #Do you think that the intensity is constant? Why? #The intensity is not constant across the x coordinate as x increases and similarly for the y coordinate.

#d. Perform quadrat counting by dividing the data area into quadrats. Do you think that the point process is stationary? Explain your reasons.   
quadratcount(mydata,nx=6,ny=3)

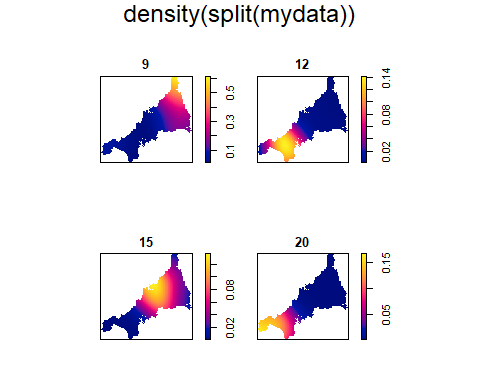
## tile  
## Tile row 1, col 4 Tile row 1, col 5 Tile row 1, col 6 Tile row 2, col 2   
## 13 227 78 1   
## Tile row 2, col 3 Tile row 2, col 4 Tile row 2, col 5 Tile row 2, col 6   
## 9 113 111 83   
## Tile row 3, col 1 Tile row 3, col 2 Tile row 3, col 3 Tile row 3, col 4   
## 51 150 34 3

Q<-quadratcount(mydata,nx=6,ny=3)  
plot(mydata,cex=0.5,pch="+")  
plot(Q,add=TRUE,cex=1.5)



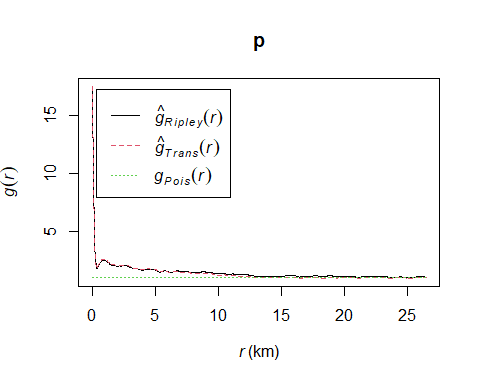
#According to the analysis, it seems to appear that #the instensity of not constant along the x coordinate as well as the #y coordinate as well. Hence, the intensity is not stable and constant across all regions.

#e. Separate the data into the sub-patterns of the points due to their marks and plot their intensities. Do you think that the intensities are constant? Why?  
plot(density(split(mydata)))



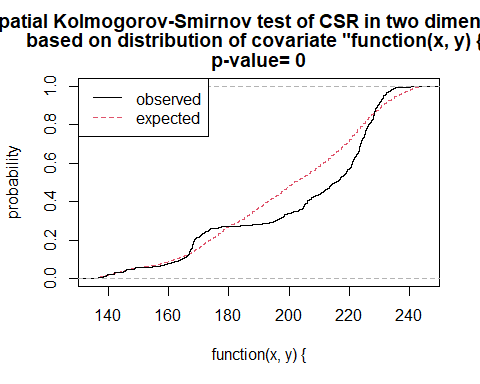
#Refer from Parts c and d.

#f. Plot the cross-type pair correlation function for "9" and "12" marks. Explain the plot and findings.   
p<- pcf(mydata,"9","12")  
plot(p)



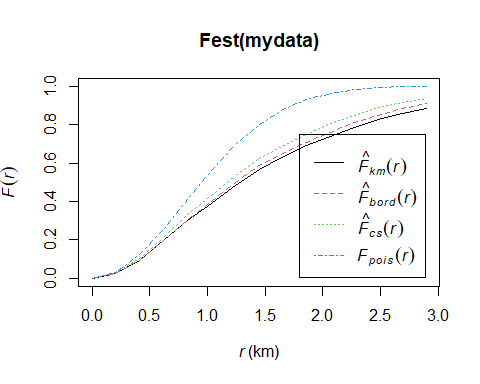
#For the cross type pair function between 9 and 12, indiciates inhibition at very large distances and no inhibition at other distances.

#g. Remove the marks from the point pattern and perform the spatial Kolmogorov-Smirnov test for the uniform distribution of the x coordinate. Summarize their findings.  
  
testx<-cdf.test(mydata,function(x,y){x})  
plot(testx)  
legend(2,40,legend=c("observed","expected"),lty=c(1,1),lwd=c(2,1),cex=0.7)

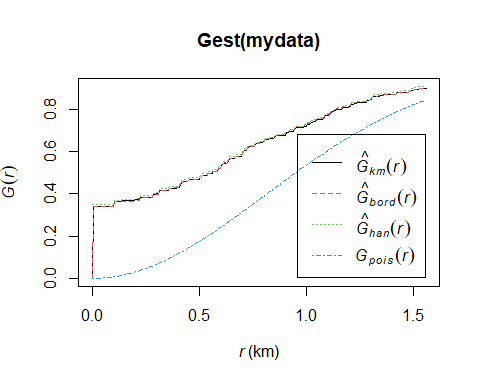


#The result given the p value is 0, suggests that the Kolmogorov-Smirnov test does reject complete spatial randomness. Therefore, this pattern can be classfied as completely spatially random.

#h. Investigate the point pattern from item (g) using F and G functions. Explain the results.  
  
plot(Fest(mydata))  
legend(2,40,legend=c("observed","expected"),lty=c(1,1),lwd=c(2,1),cex=0.7)



plot(Gest(mydata))  
legend(2,40,legend=c("observed","expected"),lty=c(1,1),lwd=c(2,1),cex=0.7)



#Both functions shows the clustering behaviour as the theoretical curve G is under empirical esimators and similarly for F as well.

#Question 4.

#a. Write a code to simulate this Poisson process.  
  
library(stpp)

## Warning: package 'stpp' was built under R version 4.3.3

## Loading required package: rpanel

## Warning: package 'rpanel' was built under R version 4.3.3

## Loading required package: tcltk

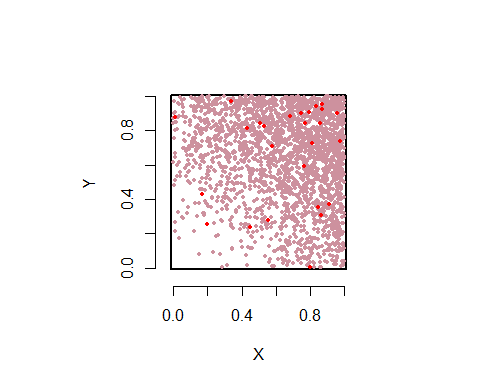
## Package `rpanel', version 1.1-5: type help(rpanel) for summary information

## Loading required package: splancs

## Warning: package 'splancs' was built under R version 4.3.3

##   
## Spatial Point Pattern Analysis Code in S-Plus  
##   
## Version 2 - Spatial and Space-Time analysis

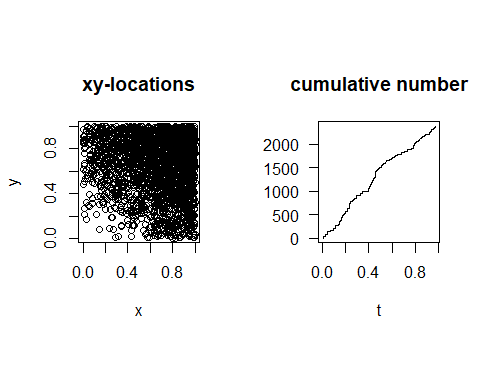
lbda1<- function(x,y,t){100\*(x+y)^2 \*(5-t)^2}  
ipp1<-rpp(lambda=lbda1)  
animation(ipp1$xyt,runtime=20)



#b. Give a static display of the result  
df1 <- ipp1$xyt[complete.cases(ipp1$xyt), ]   
X1<-as.3dpoints(df1)  
X1

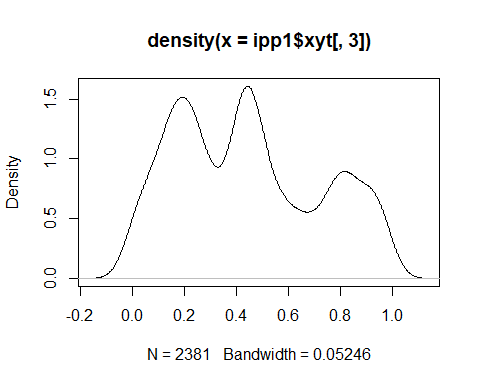
## x y t  
## [1,] 0.6926522660 0.355455828 0.003124633  
## [2,] 0.6339993409 0.783018048 0.003124633  
## [3,] 0.8445691422 0.573110825 0.003124633  
## [4,] 0.7387532648 0.401828661 0.003124633  
## [5,] 0.9996842952 0.757178459 0.003124633  
## [6,] 0.7560070800 0.753760542 0.003124633  
## [7,] 0.6137673876 0.851815192 0.003124633  
## [8,] 0.9738957083 0.788750952 0.003124633  
## [9,] 0.7837398071 0.399392359 0.003124633  
## [10,] 0.8974032307 0.588364194 0.003124633  
## [11,] 0.4009313453 0.833394637 0.003124633  
## [12,] 0.9025304767 0.970770834 0.003124633  
## [13,] 0.8431864295 0.877086853 0.003124633  
## [14,] 0.9950025894 0.644957555 0.003124633  
## [15,] 0.3485937652 0.228646767 0.003124633  
## [16,] 0.0310285441 0.876523881 0.003124633  
## [17,] 0.3832421561 0.731991450 0.003124633  
## [18,] 0.4148213395 0.715531683 0.003124633  
## [19,] 0.9311579862 0.537501938 0.003124633  
## [20,] 0.8822835137 0.736663800 0.003124633  
## [21,] 0.9055956893 0.769842348 0.003124633  
## [22,] 0.0417135581 0.996797743 0.003124633  
## [23,] 0.5881014036 0.961126182 0.003124633  
## [24,] 0.3107036485 0.936648367 0.003124633  
## [25,] 0.1787458127 0.616335484 0.003124633  
## [26,] 0.6746482078 0.038755895 0.003124633  
## [27,] 0.7872524860 0.761993141 0.003124633  
## [28,] 0.9718124662 0.722281165 0.003124633  
## [29,] 0.0138554359 0.910641299 0.003124633  
## [30,] 0.5528765148 0.962650888 0.003124633  
## [31,] 0.7663489634 0.216633048 0.003124633  
## [32,] 0.5330597563 0.957343796 0.003124633  
## [33,] 0.7631458938 0.939887598 0.003124633  
## [34,] 0.1043302710 0.941130218 0.020231365  
## [35,] 0.6036499899 0.956632371 0.020231365  
## [36,] 0.6312283166 0.806880569 0.020231365  
## [37,] 0.6390782832 0.876275600 0.020231365  
## [38,] 0.9445431442 0.562547769 0.020231365  
## [39,] 0.7826592934 0.756995932 0.020231365  
## [40,] 0.5355266829 0.069458435 0.020231365  
## [41,] 0.7248103530 0.610366388 0.020231365  
## [42,] 0.9345728974 0.801050381 0.020231365  
## [43,] 0.9767691812 0.588287438 0.020231365  
## [44,] 0.6745283327 0.619610730 0.020231365  
## [45,] 0.1582731812 0.461034271 0.020231365  
## [46,] 0.9560312750 0.814169797 0.020231365  
## [47,] 0.1671757975 0.998482649 0.020231365  
## [48,] 0.8491908554 0.391439674 0.020231365  
## [49,] 0.9336755706 0.990310099 0.020231365  
## [50,] 0.9057978159 0.994817738 0.020231365  
## [51,] 0.7345315304 0.768115237 0.020231365  
## [52,] 0.4516245578 0.797867528 0.020231365  
## [53,] 0.7027163855 0.959843826 0.020231365  
## [54,] 0.9386661195 0.926544453 0.020231365  
## [55,] 0.6250275583 0.497942992 0.020231365  
## [56,] 0.8269614836 0.254035192 0.020231365  
## [57,] 0.7235410523 0.739226832 0.020231365  
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## [62,] 0.8845872991 0.541601093 0.020231365  
## [63,] 0.8918684621 0.380698213 0.020231365  
## [64,] 0.9264740075 0.763858041 0.020231365  
## [65,] 0.3926616481 0.831088586 0.020231365  
## [66,] 0.3555350183 0.808402951 0.020231365  
## [67,] 0.7244979555 0.803792586 0.020231365  
## [68,] 0.8891557658 0.837355926 0.025796406  
## [69,] 0.5916355846 0.988106439 0.025796406  
## [70,] 0.5910774358 0.761587244 0.025796406  
## [71,] 0.5505411269 0.796868219 0.025796406  
## [72,] 0.8625799171 0.508158445 0.025796406  
## [73,] 0.6731418245 0.907874290 0.025796406  
## [74,] 0.9624930462 0.841114880 0.025796406  
## [75,] 0.8070078641 0.934472128 0.025796406  
## [76,] 0.5393290382 0.757145509 0.025796406  
## [77,] 0.5127184812 0.596345582 0.025796406  
## [78,] 0.9737524020 0.864020084 0.025796406  
## [79,] 0.5212190491 0.264652328 0.025796406  
## [80,] 0.6341706843 0.962127178 0.025796406  
## [81,] 0.6346984035 0.830356128 0.025796406  
## [82,] 0.6540852687 0.747077130 0.025796406  
## [83,] 0.7324024348 0.143173325 0.025796406  
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## [85,] 0.8241765110 0.673483342 0.025796406  
## [86,] 0.7887273931 0.885918971 0.025796406  
## [87,] 0.5219128963 0.450182209 0.025796406  
## [88,] 0.9783595204 0.477207051 0.041303037  
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## [93,] 0.8552140831 0.985993410 0.041303037  
## [94,] 0.5184553121 0.330529292 0.041303037  
## [95,] 0.9047726328 0.937394253 0.041303037  
## [96,] 0.9744680484 0.929674368 0.041303037  
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## [109,] 0.9737027227 0.218874952 0.041303037  
## [110,] 0.6704464438 0.373320110 0.041303037  
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## [136,] 0.4261107678 0.711816060 0.041628818  
## [137,] 0.6300079434 0.930523065 0.041628818  
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## [139,] 0.7078996077 0.746795063 0.066898589  
## [140,] 0.9039558393 0.437352583 0.066898589  
## [141,] 0.9797499585 0.979524878 0.066898589  
## [142,] 0.9630525527 0.680239070 0.066898589  
## [143,] 0.7137443919 0.461852627 0.066898589  
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## [163,] 0.9899858111 0.130496474 0.066898589  
## [164,] 0.9632662679 0.893478434 0.089505743  
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## [219,] 0.3901694007 0.944839145 0.090651383  
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## [221,] 0.9331365728 0.626164845 0.108911269  
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## [227,] 0.3767646779 0.817253893 0.108911269  
## [228,] 0.9208120094 0.617400890 0.108911269  
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## [260,] 0.8771063085 0.533951466 0.112367883  
## [261,] 0.9399383850 0.884808486 0.112367883  
## [262,] 0.5976454138 0.368584706 0.112367883  
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## [264,] 0.8768225333 0.519761134 0.112367883  
## [265,] 0.3027158736 0.686366519 0.112367883  
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## [267,] 0.5117170946 0.235169147 0.112367883  
## [268,] 0.8618409450 0.473736943 0.112367883  
## [269,] 0.7003835018 0.665938564 0.112367883  
## [270,] 0.4824704623 0.517538153 0.112367883  
## [271,] 0.9589631732 0.280339434 0.112367883  
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## [282,] 0.0710507373 0.578981839 0.139382386  
## [283,] 0.4735837679 0.497864789 0.139382386  
## [284,] 0.9622927394 0.979894300 0.139382386  
## [285,] 0.9915857646 0.604152051 0.139382386  
## [286,] 0.7259004475 0.247921996 0.139382386  
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## [289,] 0.5839084962 0.629538945 0.139382386  
## [290,] 0.4871538365 0.895804256 0.139382386  
## [291,] 0.8728399612 0.797083645 0.139382386  
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## [295,] 0.9755289264 0.225967656 0.139382386  
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## [298,] 0.0242849318 0.597138451 0.139382386  
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## [2379,] 0.0098433143 0.881076400 0.974128040  
## [2380,] 0.8603694052 0.844047562 0.974128040  
## [2381,] 0.5540248211 0.275780477 0.974128040  
## attr(,"class")  
## [1] "stpp"

#c. Produce a two-panels plot showing spatial locations and cumulative time of events  
plot(X1)



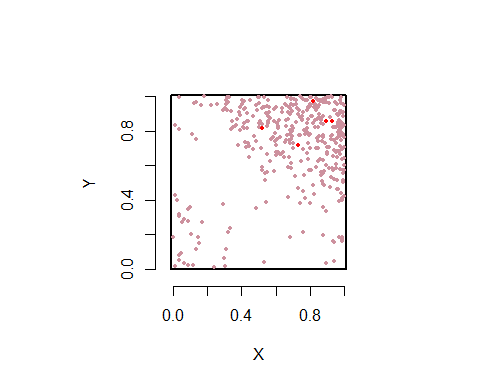
#d. Explain the plot from (c). #According to the intensity function that was given as time increases the number of locations where the number of xy-locations occurs less frequently on the bottom left.

#e. Estimate and plot the temporal intensity function of the process.   
  
plot(density(ipp1$xyt[,3]))

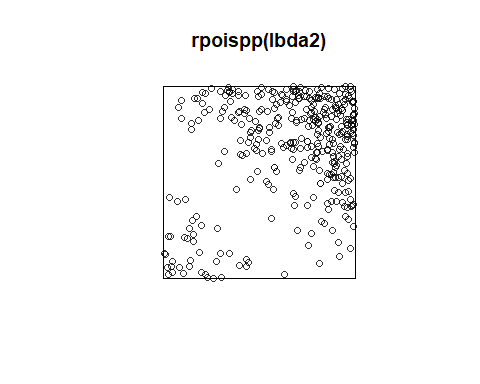


#f. Explain the plot from (e). # The temporal intensity function estimated from the ipp1 dataset shows the intensity in time.

#g. Use the intensity at time t=1, i.e. lambda(x,y,1), to simulate a spatial Poisson process in a square window [0.5,1] x [0,1]. Repeat this simulation twice and produce two plots of simulation spatial points.   
  
#First simulation  
library(stpp)  
library(spatstat)  
a<-runif(4,min=0.5,max=1)  
a1<-runif(4,min=0,max=1)  
  
lbda2<- function(x,y,t){100\*(as.numeric(x-a[1])+(y-a1[2]))^2 \*(4)^2+as.numeric((x-a[3])+(y-a1[4]))^2 \*(4)^2}  
ipp2<-rpp(lambda=lbda2)  
  
  
animation(ipp2$xy,runtime=20)

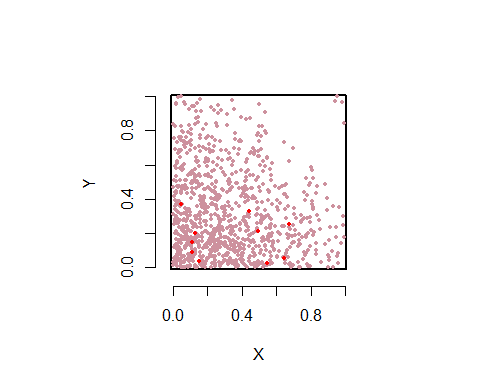


plot(rpoispp(lbda2),win=owin(c(0.5,1),c(0,1)))



#Second simulation

library(stpp)  
library(spatstat)  
a<-runif(4,min=0.5,max=1)  
a1<-runif(4,min=0,max=1)  
  
lbda<- function(x,y,t){100\*(as.numeric(x-a[1])+(y-a1[2]))^2 \*(4)^2+as.numeric((x-a[3])+(y-a1[4]))^2 \*(4)^2}  
ipp2<-rpp(lambda=lbda2)  
  
  
animation(ipp2$xy,runtime=20)



plot(rpoispp(lbda),win=owin(c(0.5,1),c(0,1)))

