Lab 5 Kriging

Due October 14th, 2014

1. Start R and set up dataset

   There are several packages for Kriging. In this exercise, we will use gstat package First, get a dataset for the lab exercise. The dataset named meuse is provided with sp package. Zinc ppm data will be used for Kriging.

   library(sp)
   data(meuse) #data provided with sp package
   ?meuse #information about the dataset
   coords<-cbind(meuse$x, meuse$y) #read coordinates
   meuse.df<-SpatialPointsDataFrame(coords, meuse)
   bubble(meuse.df, "zinc") #plot points with zinc column

   Loading a dataset for locations at which Kriging prediction will be made. Then plot the location dataset

   data(meuse.grid)
   meuse.grid$ffreq<-as.factor(meuse.grid$ffreq)
   m.grid.df<-SpatialPixelsDataFrame(points=meuse.grid[c("x", "y")],
   data=meuse.grid)
   pts=list("sp.points", meuse.df, pch=4, col="white")
   spplot(m.grid.df, "ffreq", col.regions=1:3, sp.layout=list(pts))

2. Load gstat package and conduct Kriging

   Loading gstat package and set theoretical variogram model

   library(gstat)

variogram cloud

   cvgm<-variogram(zinc ~ 1, data=meuse.df, width=100, cutoff=1000, cloud=T)
   plot(cvgm)

#Aggregated

   cvgm<-variogram(zinc ~ 1, data=meuse.df, width=100, cutoff=1000)
   plot(cvgm)

Fit the observation to the theoretical model
#Use exponential model
vgm.md<-vgm(psill=1, model="Exp", range =100, nugget=1)
efitted<-fit.variogram(cvgm, model=vgm.md)
efitted
plot(cvgm, model=efitted)

Using the fitted variogram conduct ordinary Kriging
#fit ordinary kriging

OK_fit<-gstat(id="OK_fit", formula=zinc ~ 1, data=meuse.df, model=efitted)

#cross-validation
pe<-gstat.cv(OK_fit, nfold=155, debug.level=0, random=FALSE)$residual
round(sqrt(mean(pe^2)),2)
z<-predict(OK_fit, newdata=m.grid.df, debug.level=0)
m.grid.df $OK_pred <-z$OK_fit.pred #Kriging prediction
m.grid.df $OK_se<-sqrt(z$OK_fit.var) #Kriging standard error

3. Plot the results of Kriging

Set environment to plot the prediction and standard errors

library(maptools)
bluepal<-colorRampPalette(c("azure1","steelblue4"))
brks<-c(0, 130, 155, 195, 250, 330, 450, 630, 890, 1270, 1850)
cols<-bluepal(length(brks)-1)
sepal<-colorRampPalette(c("peachpuff1", "tomato3"))
brks.se<-c(0, 240, 250, 260, 270, 280, 290, 300, 350, 400, 1000)
cols.se<-sepal(length(brks.se)-1)
scols<-c("green", "red")

Plot the Kriging prediction

image (m.grid.df, "OK_pred", breaks=brks, col=cols)
symbols(coordinates(meuse.df), circles=sqrt(abs(pe)), fg="black", bg=scols[(pe<0)+1], inches=FALSE, add=TRUE)
legend("topleft",fill=cols, legend=leglabs(brks), bty ="n", cex=0.8)

Plot the Kriging standard errors
image (m.grid.df, "OK_se", breaks=brks.se, col=cols.se)
symbols(coordinates(meuse.df), circles=sqrt(abs(pe)), fg="black", bg=scols[(pe<0)+1], inches=FALSE, add=TRUE)
legend("topleft", fill=cols.se, legend=leglabs(brks.se), bty="n", cex=0.8)

Assignment

(a) Include all graphical outputs: buble plot, spplot, variogram, Kriging predictions, and Kriging standard errors
(b) Describe the Kriging prediction and standard errors.