Appendix: R code

rm(list = ls())

setwd("C:/Users/tuj53509/Dropbox/docs/Temple/Advanced Statistics for Urban Applications/Final Project")

#load reqiured libraries

library(GISTools)

library(maptools)

library(spgwr)

library(spdep)

library(lm.beta)

library(pastecs)

#load data

philly <- readShapeSpatial("data/narc\_join")

philly\_acs <- read.csv("R11739357\_SL140.csv")

#join CSV data to philly DF

philly@data <- data.frame(philly@data, philly\_acs[match(philly@data[,"GEOID10"],philly\_acs[,"Geo\_FIPS"]),])

#SE\_T083\_001: per capita income

#SE\_T131\_001 pop vet status 18 and over

#SE\_T095\_003 vacant houses

#SE\_T033\_006 unemployment pop over 16 - not used

#SE\_T140\_003 service job - not used

#SE\_T145\_002 no health insurance coverage - not significant

#SE\_T098\_001 median year structure built - unused

#normalize the count of narcotics incidents

philly$popinthousands <- philly$SE\_T001\_001 / 1000

philly$narcnorm2 <- philly$Count\_ / philly$popinthousands

#unemployment

philly$unempnorm <- philly$SE\_T033\_006 / philly$SE\_T033\_001

#veteran

philly$vetnorm <- philly$SE\_T131\_002 / philly$SE\_T131\_001

#vacant houses

philly$vacantnorm <- philly$SE\_T095\_003 / philly$SE\_T095\_001

#service jobs

philly$servnorm <- philly$SE\_T140\_003 / philly$SE\_T140\_001

#remove bad values from data created by 0 population tracts

na.inf <- function (x) {

x[is.infinite(x)] <- 0

return(x)

}

na.zero <- function (x) {

x[is.na(x)] <- 0

return(x)

}

philly$narcnorm2 <- na.zero(philly$narcnorm2)

philly$unempnorm <- na.zero(philly$unempnorm)

philly$vetnorm <- na.zero(philly$vetnorm)

philly$vacantnorm <- na.zero(philly$vacantnorm)

philly$servnorm <- na.zero(philly$servnorm)

philly$incomefix <- na.zero(philly$SE\_T083\_001)

philly$narcnorm2 <- na.inf(philly$narcnorm2)

philly$unempnorm <- na.inf(philly$unempnorm)

philly$vetnorm <- na.inf(philly$vetnorm)

philly$vacantnorm <- na.inf(philly$vacantnorm)

philly$servnorm <- na.inf(philly$servnorm)

vals <- cbind(philly$narcnorm2, philly$vetnorm, philly$incomefix, philly$servnorm)

stat.desc(vals)

summary(vals)

pdf(file = "f1.narcoticsarrestschoropleth.pdf")

narcnorm.shades <- auto.shading(philly$narcnorm2, cols=brewer.pal(5,"Greens"))

choropleth(philly, philly$narcnorm2, shading = narcnorm.shades)

title("Figure 1: Narcotics Arrests, 2012-2016")

choro.legend(2725857,238144, narcnorm.shades, title = "arrests per thousand")

dev.off()

#create our linear model

# lm01 <- lm(philly$Count\_ ~ philly$SE\_T033\_001)

# lm02 <- lm(philly$Count\_ ~ philly$SE\_T033\_001 + philly$SE\_T083\_001)

# lm03 <- lm(philly$narcnorm2 ~ philly$SE\_T033\_001 + philly$SE\_T083\_001 + philly$SE\_T131\_001 + philly$SE\_T095\_003 + philly$SE\_T140\_003)

#lm04 <- lm(philly$narcnorm2 ~ philly$vetnorm + philly$incomefix + philly$vacantnorm )

lm04 <- lm(philly$narcnorm2 ~ philly$vetnorm + philly$incomefix + philly$servnorm )

summary(lm04)

#add standardized betas

lm04.std <- lm.beta(lm04)

summary(lm04.std)

#dianostic plots for lm04

pdf(file = "f2.lm04diag.pdf")

par(mar=c(2,2,2,2),mfrow=c(2,2))

plot(lm04)

par(mfrow=c(1,1))

dev.off()

#lm04 residuals

lm04residshades = auto.shading(lm04$residuals, cols=brewer.pal(5,"Greens"))

pdf(file = "f3.lm04residchoropleth.pdf")

choropleth(philly, lm04$residuals, shading = lm04residshades)

title("Figure 3: Residuals from linear model lm04")

choro.legend(2729559,251723.8, lm04residshades, title = "residuals")

dev.off()

#create neighbor list and plot

philly\_neighbors <- poly2nb(philly)

pdf(file = "f4.neighbormap.pdf")

plot(philly, main = "Figure 4: Neighbor plot of Philadelphia Census Tracts")

plot(philly\_neighbors, coordinates(philly), add=T, col='blue')

dev.off()

#create lagged means

philly\_neigh\_lw <- nb2listw(philly\_neighbors)

narclag <- lag.listw(philly\_neigh\_lw, philly$narcnorm2)

#create lagged means plot

laggedmeanshades = auto.shading(narclag, cols=brewer.pal(5,"Greens"))

pdf(file = "f5.laggedmeanchoropleth.pdf")

choropleth(philly, narclag, shading =laggedmeanshades)

title("Figure 5: Lagged Means plot of Philadelphia Narcotics Arrests")

choro.legend(2729559,251723.8, laggedmeanshades, title = "Lagged Means")

dev.off()

#Moran's I

moran.range <- function(lw) {

wmat <- listw2mat(lw)

return(range(eigen((wmat + t(wmat))/2)$values))

}

moran.range(philly\_neigh\_lw)

#approximate test statistic using normal distribution

moran.test(philly$narcnorm2, philly\_neigh\_lw)

#calculate the test statistic using 10,000 random trials

moran.mc(philly$narcnorm2, philly\_neigh\_lw, 10000)

#Moran's Plot

pdf(file = "f6.moransplotnorm.pdf")

moran.plot(philly$narcnorm2, philly\_neigh\_lw)

title("Figure 6: Moran's Plot: Normalized Arrests")

dev.off()

pdf(file = "f7.moransplotraw.pdf")

moran.plot(philly$Count\_, philly\_neigh\_lw)

title("Figure 7: Moran's Plot: Raw Arrest Count")

dev.off()

#GWR

philly.bw <- gwr.sel(philly$narcnorm2 ~ philly$vetnorm + philly$incomefix + philly$servnorm, data = philly, gweight = gwr.Gauss)

philly.gwr <- gwr(philly$narcnorm2 ~ philly$vetnorm + philly$incomefix + philly$servnorm, data = philly, bandwidth = philly.bw, gweight = gwr.Gauss, hatmatrix = T)

gwr.df <- slot(philly.gwr$SDF, "data")

summary(philly.gwr)

names(philly.gwr)

names(philly.gwr$SDF)

print(philly.gwr)

anova(philly.gwr)

#calculate the t-score and p value

gwr.df$vet\_tval <- gwr.df$philly.vetnorm / gwr.df$philly.vetnorm\_se

gwr.df$vet\_pval <-pt(gwr.df$vet\_tval, 380, lower.tail = FALSE)

gwr.df$income\_tval <- gwr.df$philly.incomefix / gwr.df$philly.incomefix\_se

gwr.df$income\_pval <- pt(gwr.df$income\_tval, 380, lower.tail = FALSE)

gwr.df$serv\_tval <- gwr.df$philly.servnorm / gwr.df$philly.servnorm\_se

gwr.df$serv\_pval <- pt(gwr.df$serv\_tval, 380, lower.tail = FALSE)

pdf(file = "f8.vetparamchoropleth.pdf")

vetparamshades = auto.shading(gwr.df$philly.vetnorm, cols=brewer.pal(5,"Greens"))

choropleth(philly, gwr.df$philly.vetnorm, shading=vetparamshades)

title("Figure 8: GWR Parameter Estimate for Veteran Status")

choro.legend(2729559,251723.8, vetparamshades, title = "vet status")

dev.off()

pdf(file = "f9.vetpvalchoro.pdf")

vetpvalshades <- shading(c(0.005, 0.01, 0.05), cols = rev(brewer.pal(4, "Greens")))

choropleth(philly, gwr.df$vet\_pval, shading = vetpvalshades)

title("Figure 9: P-Value for Veteran Status")

choro.legend(2729559,251723.8, vetpvalshades, title = "p-value")

dev.off()

pdf(file = "f10.incomeparamchoropleth.pdf")

par(mar=c(1,1,2,1))

incomeparamshades = auto.shading(gwr.df$philly.incomefix, cols=brewer.pal(5,"Greens"))

choropleth(philly, gwr.df$philly.incomefix, shading=incomeparamshades)

title("Figure 10: GWR Parameter Estimate for Per Capita Income")

choro.legend(2711398,241846.7, incomeparamshades, title = "per cap income")

dev.off()

pdf(file = "f11.incomepvalchoro.pdf")

incomepvalshades <- shading(c(0.005, 0.01, 0.05), cols = rev(brewer.pal(4, "Greens")))

choropleth(philly, gwr.df$income\_pval, shading = incomepvalshades)

title("Figure 11: P-Value for Per Capita Income")

choro.legend(2729559,251723.8, incomepvalshades, title = "p-value")

dev.off()

pdf(file = "f12.servparamchoropleth.pdf")

servparamshades = auto.shading(gwr.df$philly.servnorm, cols=brewer.pal(5,"Greens"))

choropleth(philly, gwr.df$philly.servnorm, shading=servparamshades)

title("Figure 12: GWR Parameter Estimate for Service Jobs")

choro.legend(2729559,251723.8, servparamshades, title = "service jobs")

dev.off()

pdf(file = "f13.servpvalchoro.pdf")

servpvalshades <- shading(c(0.005, 0.01, 0.05), cols = rev(brewer.pal(4, "Greens")))

choropleth(philly, gwr.df$serv\_pval, shading=servpvalshades)

title("Figure 13: P-Value for Service Jobs")

choro.legend(2729559,251723.8, servpvalshades, title = "p-value")

dev.off()

#R^2

pdf(file = "f14.localr2.pdf")

localr2shades = auto.shading(gwr.df$localR2, cols=brewer.pal(5,"Greens"))

choropleth(philly, gwr.df$localR2, shading=localr2shades)

title("Figure 14: GWR Local R² values")

choro.legend(2729559,251723.8, localr2shades, title = "Local R²")

dev.off()

#Spatial Autoregressive Models

lm04.lag <- lagsarlm(philly$narcnorm2 ~ philly$vetnorm + philly$incomefix + philly$servnorm, data = philly, philly\_neigh\_lw)

summary(lm04.lag)

anova(lm04.lag, lm04)