Homework 7 - Stat 534
Due Monday, March 6, 2017

1. A data set (`wheat.txt`) has been sent to you. The data set contains yields of wheat recorded at spatial coordinates. Note that the header is x, y, and z with z being the yields. We will need a couple of different data object types. Pay attention to the R code below. Do not worry about anisotropy.

```
wheat.geodat<-as.geodata(wheat,coords.col=1:2,data.col=3)
wheat.grid<-expand.grid(seq(0,50,l=25),seq(0,30,l=25))
```

   (a) Plot the data and comment on the results.

```
plot(wheat.geodat)
```

   (b) Produce a plot of the empirical semivariogram of the wheat yields. Can this plot be trusted for estimation of semivariogram parameters to be used in kriging. Why or why not?

   (c) We will use the `surf.ls` function in the `spatial` library to fit a quadratic trend model to the yields by ordinary least squares and plot the empirical semivariogram of the residuals.

```
require(spatial)
wheat.ls<-surf.ls(2,wheat.dat) # fits a second order polynomial trend surface
resid.dat<-cbind(wheat.dat$x,wheat.dat$y,residuals(wheat.ls))
resid.geodat<-as.geodata(resid.dat,coords.col=1:2,data.col=3)
```

   Fit an appropriate semivariogram model to the semivariogram using your method of choice. Justify your final selection.

   (d) Predict yields using universal kriging and ordinary kriging. Use the parameter estimates from the residual semivariogram when you do ordinary kriging. Plot the results along with a plot of the kriging standard errors. Remember to be careful of that range parameter - what you enter depends on which semivariogram model you used.

```
# Note trend=2,m0="kt" in the argument list when doing universal kriging.
wheat.uk<-ksline(wheat.geodat,locations=wheat.grid,cov.model="exponential",
          cov.pars=c(effective sill,range parameter),
          nugget=nug,trend=2,m0="kt")
wheat.ok<-ksline(wheat.geodat,locations=wheat.grid,cov.model="exponential",
           cov.pars=c(effective sill,range parameter),nugget=nug)
```

   Compare the results and comment.

2. We looked at this example in class. We have a one-dimensional process with point to point covariance function

$$C(s_i, s_j) = \exp\left(-\frac{3|s_i - s_j|}{5}\right).$$

The nugget effect is 0, the sill is 1 and the practical range is 5. The region B is defined to be the interval $B = (2, 4)$ with $|B| = 2$. The point to block covariance function is

$$\sigma(B, s) = \text{Cov}\left(Z(B), Z(s)\right) = \frac{1}{2}\int_2^4 \exp\left(-\frac{3|u-s|}{5}\right) du.$$

(a) Find the covariance function.

(b) Find $\sigma(B, B)$.