University of California, Los Angeles
Department of Statistics

Statistics C173/C273 **Instructor: Nicolas Christou**

Homework 2

Exercise 1:
Access the following data sets:

```
a1 <- read.table("http://www.stat.ucla.edu/~nchristo/statistics_c173_c273/
      o3.txt", header=T)

a2 <- read.table("http://www.stat.ucla.edu/~nchristo/statistics_c173_c273/
      soil.txt", header=TRUE)

a3 <- read.table("http://www.stat.ucla.edu/~nchristo/statistics_c173_c273/
      swiss_rainfall_data_all.txt", header=TRUE)
```

Description of data sets:

1. California ozone data: Ozone levels were measured at 175 location in California on 08 August 2005. Variables: `date, site, lat, lon, o3`.
2. Maas river data: Concentration of lead and zinc were measured at 155 locations on the flooded banks of the Maas river in the Netherlands. Variables `x, y, lead, zinc`.
3. Swiss rainfall data: Rainfall measures at 467 location in Switzerland were taken on 08 May 1986. Variables: `x, y, data`.

For each data set above:

a. Perform a non-spatial exploratory analysis (summary statistics, histograms, etc.).

b. Create a geodata object using `geoR`.

c. Use the command `plot` and `points` to construct and print the appropriate graphs.

d. Compute and plot the sample variograms (classical and robust). You can compute omnidirectional variograms and variograms by choosing different values for the arguments `dir` and `tol`.

e. Try to fit a model variogram (exponential, spherical, etc.) by eye to any of the sample variograms you constructed in (d) using the command `lines.variomodel`. Print the graphs that show the fitted model variograms.

Exercise 2:
Let $X \sim \chi^2_1$. Find the probability density function of $Y = X^{\frac{1}{4}}$. Draw this density in `R` and verify that it is approximately symmetrical (see figure on page 2 of handout 3).

Exercise 3:
Suppose that Z is a second order stationary process with $E[Z(s)] = 0$ and with spherical semivariogram:

$$\gamma(h;\boldsymbol{\theta}) = \begin{cases} 0, & h = 0 \\ 0.5 + 4\left(\frac{3}{2}(\frac{h}{30}) - \frac{1}{2}(\frac{h}{30})^3\right), & 0 < h \leq \alpha \\ 4.5, & h > \alpha \end{cases}$$

a. What is the sill of Z?

b. What is the nugget effect of Z?

c. Draw this variogram (approximately). Make sure you place some important number on the graph.

d. Compute $\gamma(5)$.

e. Write the covariance function $C(h;\boldsymbol{\theta})$ that corresponds to the spherical semivariogram above.