Stat 544 – Spring 2005
Homework assignment 6

Due on Friday, April 15 in TA's office by 5:00 pm

Problem 1

In exercise 2 of homework 5 you were asked to compare eight different models. The comparison criterion that you were asked to use consisted in calculating for each model the following quantity:

$$C^2 = \sum_{i=1}^{n} [\{E(Z_i) - y_i\}^2 + \text{Var}(Z_i)]$$

You were instructed to interpret such a quantity as follows:

> *"Better models will have smaller values of C^2, or of its square root C. Thus, if for example we have two models: model 1 and model 2, model 1 will be better than model 2 if*
>
> $$C^2_{(1)} - C^2_{(2)} = \sum_{i=1}^{n} [\{E(Z_{1i}) - y_i\}^2 - \{E(Z_{2i}) - y_i\}^2] < 0$$
>
> *where $C^2_{(j)}$ and Z_{ji} represent the criterion and the replicates obtained under model j ($j = 1, 2$) respectively. Alternatively, model 1 is better than model 2 if $C_{(1)} - C_{(2)} < 0$ where $C_{(j)}$ stands for $\sqrt{C^2_{(j)}}$."*

So, to solve the problem perhaps you did the following:

- a- You wrote your program in WinBUGS to calculate the quantity C^2 (or its square root) for each one of the eight models.
- b- You iterated the Gibbs sampler m times.
- c- After your program iterated m times, you calculated the posterior mean of C^2 (or C) for each model in consideration. Perhaps you found that your results were:

	Model							
Criterion	1	2	3	4	5	6	7	8
C	11.59	11.61	11.79	11.95	11.89	12.86	13.18	42.88

- d- Since, the minimum value of C its attained for model 1, perhaps you concluded that model 1 was the best model.

Due to the arrival of the warm weather, the Stat 544 grader has been in such a good mood that he accepted the previous reasoning as right when in fact it is wrong. Why is the above reasoning wrong? You may answer this question by means of a counterexample considering only two models. [The answer to this problem can be given on one line.]

Problem 2

Consider the following basic kriging model:

$$Y \sim N(\mu, \Sigma + v^2 I) \quad \text{with} \quad \mu = X\beta$$

Where I is a $n \times n$ identity matrix, $\Sigma = w^2 H(\phi)$ such that $H(\phi)_{ij} = \exp(-\phi d_{ij})$, where d_{ij} represents the distance between locations i and j.

- a- Using WinBUGS fit the kriging model within a Bayesian framework. You should use two different approaches:
  - a.1- Build the $H(\phi)$ matrix explicitly.
  - a.2- Use the intrinsic `spatial.exp` function.

  Assign noninformative priors of your choice to model parameters.
- b- Do your results from the two different approaches coincide? You can download the dataset that you have to use from the class web page.
- c- How do the runtimes compare?

Please note, the file `Hw6-pr2.txt` contains the data needed to do both parts a.1 and a.2. There are things that you need only for part a.1, and no for part a.2 and vice versa. So, when you write your program for part a.1 you should delete anything that you will not use. The same applies when you write your program for part a.2. Obviously, there are parts that are needed for both a.1 and a.2.