Readings: Chapter 4 in Kitanidis is the most relevant to what we will be discussing.

1. Do the following 20 times: simulate a Gaussian random field with mean $0$ and autocovariance function 
   \[ K(x) = \exp(-|x|/5) \] 
   on a $10 \times 10$ square grid with spacing between neighbors of 1. (Save your simulations
   for question 2!) Consider the model that the random field has unknown constant mean $\mu$ and autoco-
   variance function $K(x) = \theta \exp(-|x|/\phi)$ and estimate the parameters $\mu$, $\theta$ and $\phi$ using some method that
   is available in whatever statistical package you are using. (If you are using geoR, I suggest you use the
   program likfit with the REML option. Note that the default in geoR is to assume there is a nugget, which
   you don’t want here.) Make a scatterplot of your 20 values for $(\hat{\theta}, \hat{\phi})$. Describe your results. Now plot
   $(\hat{\theta}, \hat{\phi}/\hat{\phi})$. Describe your results. How does what you have found relate to what we have discussed about
   the local behavior of random fields?

2. Redo your estimates using the same 20 simulations except now add the mean function $0.05x_1 - 0.05x_2$ to
   them (with $x = (x_1, x_2)$). That is, still assume that the mean is an unknown constant even though the
   true mean is not constant. Again give scatterplots of $(\hat{\theta}, \hat{\phi})$ and $(\hat{\theta}, \hat{\theta}/\hat{\phi})$. Describe how the estimates have
   changed.

3. If you are a student in Statistics, do the following question. Using the simulations from Exercise 1,
   estimate the parameters of the Matérn model (you can do this in geoR by using likfit and using the option
   “fix.kappa = FALSE”). Display your results for $(\hat{\theta}, \hat{\phi}, \hat{\kappa})$ and describe what you have found. Are there
   certain functions of the parameters that are estimated particularly well?

4. If you are not a student in Statistics, come to class on October 23 prepared to give a brief (at most 15
   minutes) presentation on a dataset from your discipline that has a spatial aspect to it. The plan will be
   for you to pair up with a Statistics student and use this dataset as the basis for a jointly done project for
   the course.