Environmental and Resource Modeling and Decision Analysis
Homework 1
<Problem Identification>
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Dealing with biological data, that is such as managing forest always facing the problem of incomplete data or imperfect data. Measurements and model always accompany with error from everywhere. We can't make decisions under the such uncertainty. Traditional regression model return a value that somehow represent the mean or the expected value. However, it is not easy to derive the error, namely the uncertainty from this kind of model. In the future, I think the return of a state-of-art model shouldn't return not only a single expected value of the observations, but also the error. Then first come to my mind is returning distribution. Instead of several value return, the model return a whole distribution. Distribution is the product of the probability model. In term of probability, there cotain events and sample space. Thus, we should first get many many events to construct the sample space.

After 1940s, with the imporvement of computer equitment. If the problem consist of latent error, we can simulate this kind of problem by using the capability of computer. This simulation method is called Monte Carlo Method, namely statistical analogy method. It is a numerical calculation method, using random number or pseudo random number and lots of computer calculations to solve problems. I believe it will be the ways to modern modeling, or the way to construct sample space.

There is a method call "Particle Filter" which is based on Monte Carlo Method. It can estimate the situation of a dynamic system through a series of random sample from lossy and incomplete observation sequence. In dynamic system, we need two model, one for describing the situation when time changing and the other one for describing the noise at every states. Both of them represent by probability. At the beginning, particle filter can only handle the linear problem with the Gaussian noise. But after several improvement, particle filter can now handle the nonlinear problem with any type of noise. And this method can help decision making under uncertainty.

This project will base on *Propagating probability distributions of stand variables using sequential Monte Carlo methods* (2009 Jeffrey H.) which seen growth of trees as dynamic system and using particle filter method for predicting the basal area of the forest stand. Reproduce the result, learning the technique of Bayes modeling and seeking the breakthrough of growth and yield model are the goal of this project and hopely can be finished in this semester.