The New School for Social Research
Advanced Econometrics 1
Spring 2017
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Assignment 4

Due Oct 23 (Mon) 6:00 pm

1. Intro to Rstan: Read the attached paper *Stan: A probabilistic programming language for Bayesian inference and optimization* and answer the following questions

   (a) Generate fake data (N=20) from a normal distribution with mean μ of 2.5 and standard deviation σ of 2. Use **set.seed(102)**.

   (b) Fit a normal model to the simulated data using Stan. Try with 1) a non-informative prior (a uniform prior), 2) a normal priors for μ with mean of 2.5 and standard deviation of 15 (keep the uniform prior for σ), and 3) a normal prior for μ with mean of 15 and standard deviation of 2. 1000 iterations (500 warm-ups) and 3 chains are preferred.
   *A normal model and a normal prior can be conveniently coded by using a built-in sampling distribution **normal()** in Stan.

   (c) Compare the three different log-posterior densities by reporting the mean, sd and a few quantiles of estimated parameters (μ, σ). You might want to use **print()** function.

   (d) Report $\hat{R}$ and check if chains are mixed properly. Visualize the result by using **plot()** function.

   (e) Explain in a few sentences in which way different priors affect the posterior density of parameters in this example.

2. Programming Metropolis-Hasting algorithm

   (a) Generate fake data (N=50) from a normal distribution with mean μ of 2 and standard deviation σ of 1. Use **set.seed(102)**. Fit a normal model to the simulated data using Metropolis-Hasting algorithm. Report the posterior distribution of μ and σ, and the convergence plot of the parameters.