Stat 532   **Name:** _____
HW 4
Due 10/10/16

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Please prepare your solutions using LaTeX or another word processing software.

1. (5 points) How do Monte Carlo and Markov Chain Monte Carlo (MCMC) procedures differ?

2. (5 points) How are the full conditional distributions used in a Gibbs Sampler?

3. (5 points) How do the marginal and conditional posterior distributions differ?

4. (5 points) How do you visually assess convergence of an MCMC algorithm?

5. (5 points) Explain the idea of the effective sample size of an MCMC algorithm.

6. (15 points) Sketch out the steps for a Gibbs sampler algorithm.

7. Simulating data is a key step in verifying your algorithms are working correctly. This will be more apparent as we start studying sophisticated hierarchical models.

   (a) (10 points) Simulate 100 observations from a standard normal distribution and plot a histogram of your data.

   (b) (10 points) Select and state prior distributions for θ the mean of the normal distribution and σ^2 the variance (or alternatively you may parameterize your model using the precision term).

   (c) (20 points) Implement a Gibbs sampler to simulate from the joint posterior distribution $p(\theta, \sigma^2 | y_1, \ldots, y_{100})$. Create a plot of the joint posterior distribution.

   (d) (10 points) Plot trace plots and histograms of the marginal posterior distributions for θ and σ^2. Include the true values on these figures. Comment on the figures.

   (e) (10 points) Use your MCMC samples to create a posterior predictive distribution. Compare the data and your posterior predictive distribution using a QQ plot `qqnorm(.)`. Comment on the figure.