Statistics 651: Introduction to Applied Bayesian Methods
Mini-Project # 2
Due: 10 October 2008, 10pm

Student evaluations of professors provide information to administrators who are making tenure decisions for faculty members. Evaluations are made on a 7 point scale (1 = poor, ..., 7 = outstanding). The "benchmark" for faculty performance is the overall teacher rating. One measure of faculty teaching is the average score for that question (averaged across students). The website `http://madison.byu.edu/bayes/faculty.dat` represents a sample of Fall 2002 faculty members.

- Choose and *justify* a choice for the likelihood function.
- Choose a prior distribution for the parameters of the likelihood function. *Justify* this prior distribution!
- Using a rejection sampling approach (and get *at least* 50000 draws from the posterior distribution!):
    1. Choose an appropriate envelope function and tell me what it is and why you think it is an appropriate envelope function.
    2. Calculate the posterior distribution (joint, if applicable) of the parameters of your model. If there are two parameters, you may either present the distribution in its bivariate form or as marginal distributions.
    3. Calculate $E[\Theta|\mathbf{Y}]$, the posterior mean.
    4. Calculate $V[\Theta|\mathbf{Y}]$, the poserior variance.
    5. Calculate $\sqrt{V[\Theta|\mathbf{Y}]}$, the posterior standard deviation.
    6. Calculate the predictive distribution of the "next" average faculty evaluation.
    7. In general, it is considered "good" to score a 5 or better. Calculate the probability that a randomly selected professor gets a 5 or better in her next evaluation.

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- Using an importance sampling approach (with 100000 iterations):

    1. Choose an appropriate importance function ($I(\Theta)$) and tell me what features it exhibits that makes it "good" (don't just list what I told you in class, tell me what makes *yours* good).
    2. Calculate $E[\Theta|\mathbf{Y}]$, the posterior mean.
    3. Calculate $V[\Theta|\mathbf{Y}]$, the poserior variance.
    4. Calculate $\sqrt{V[\Theta|\mathbf{Y}]}$, the posterior standard deviation.
    5. Calculate the normalizing constant of your model. Discuss what interpretation you might place on the normalizing constant.

- Compare and contrast the two approaches:

    1. as general computational procedures,
    2. with respect to the estimates that they produced,
    3. with respect to difficulty of implementation.