

## STAT6106 - Assignment 4: sampling

due on 19th November 2019 at 11:30pm (email to TA)

**A. Sampling by transformation:** How to use random numbers from standard Normal distribution to generate random numbers from F distribution with  $df1=2$  and  $df2=3$ ? Provide the code, draw a histogram of your sample and compare with the real density of the distribution.

**B. Integration:** Use Monte carlo method to estimate the following integration. You are only allowed to use random numbers from either  $\text{uniform}(0,1)$  or  $N(0,1)$ . Submit your program source code and ten estimates, together with mean and standard deviation of your ten estimates.

1.  $\int_0^4 e^{-x^2} dx$
2.  $\int_0^\pi \sin(x) dx$

**C. Code and Sampling:** Sample from the following distributions, submit your program source code (which should be directly executable by copy and paste), the histogram or 2D scatter plot or contour plot (showing the empirical density), the summary statistics (marginal mean and variance, correlation between  $x$  and  $y$ ), and the auto-correlation function (ACF plot) of your samples.

1.  $p(x) \propto \sin(x)$ , where  $0 < x < \pi$
2.  $p(x, y) \propto e^{-(x^2+xy+y^2)}$ , where  $-\infty < x, y < +\infty$
3.  $p(x, y) \propto e^{-(x^3+xy+y^2)}$ , where  $-\infty < y < +\infty$ ,  $0 < x < +\infty$
4.  $p(x, y) \propto e^{-(x^3+xy+y^3)}$ , where  $0 < x, y < +\infty$

note: if you simulate data from the density 3 or 4 without requiring  $x$  to be bounded away from  $-\infty$ , theoretically you know the integral under the curve cannot be 1 no matter how you scale it by a normalizing constant, practically your MCMC chain won't converge, i.e., keep drifting.