NERS544: (Introduction to) Monte Carlo Methods

Assignment 3: **Sampling** Two week assignment, single weight Fall 2016

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Due: Thursday Oct. 06, 2016 before class

The following problems are to be solved on computer. You must use the template Matlab script M-file provided via a link on the class website. Submit your codes to me (bundled in a single M-file). how to do this will be clear from the template. The code will be demonstrated in class.

Q3.0, 0% This is solved for you. Use option "0".

Use the probability distribution:

$$p(x) = 2x \quad ; \quad 0 \le x \le 1$$

As a function of the number of histories, $N_{\rm h}$, over the range $1 \le N_{\rm h} \le 10,000$, plot sampled $\langle x \rangle$, $\langle x^2 \rangle$, s_x^2, and $s_{\overline{x}}^2$, as well as the theoretical values.

Q3.1, 25% Write a code to sample the Cauchy probability distribution:

$$p(x) = \frac{1}{\pi}\frac{1}{1+x^2} \quad ; \quad -\infty < x < \infty.$$

As a function of the number of histories, $N_{\rm h}$, over the range $1 \le N_{\rm h} \le 10,000$, plot sampled $\langle x \rangle$, $\langle x^2 \rangle$, s_x^2, and $s_{\overline{x}}^2$, as well as the theoretical values. Discuss convergence and the existence of moments.

Q3.2, 25% Write a code to sample the small angle form of the Rutherfordian probability distribution:

$$p(x) = \frac{2x}{(x^2+1)^2} \quad ; \quad 0 \le x < \infty,$$

As a function of the number of histories, $N_{\rm h}$, over the range $1 \le N_{\rm h} \le 10,000$, plot sampled $\langle x \rangle$, $\langle x^2 \rangle$, s_x^2, and $s_{\overline{x}}^2$, as well as the theoretical values. Discuss convergence and the existence of moments.

Q3.3, 25% Write a code to sample the probability distribution:

$$p(x) = \frac{4x}{(x^2+1)^3} \quad ; \quad 0 \le x < \infty,$$

As a function of the number of histories, $N_{\rm h}$, over the range $1 \le N_{\rm h} \le 10,000$, plot sampled $\langle x \rangle$, $\langle x^2 \rangle$, s_x^2, and $s_{\overline{x}}^2$, as well as the theoretical values. Discuss convergence and the existence of moments.

Q3.4, 25% Write a code to sample the probability distribution:

$$p(x) = e^{-x} \quad ; \quad 0 \le x < \infty,$$

As a function of the number of histories, $N_{\rm h}$, over the range $1 \le N_{\rm h} \le 10,000$, plot sampled $\langle x \rangle$, $\langle x^2 \rangle$, s_x^2, and $s_{\overline{x}}^2$, as well as the theoretical values. Discuss convergence and the existence of moments.