CDA6530: Performance Models of Computers and Networks (Fall 2015)

Project 1: Random Variables Simulation and Analysis

(assigned Sept. 21st; submit by Sept. 30th midnight via WebCourse)

In this project, everything simulation program be done in Matlab platform in order for you to learn using this useful tool (or Octave if you do not have access to Matlab).

Note that you are required to NOT use any statistical functions provided by Matlab and its toolbox (no use of mean(), std(), var(), etc). You should use what I introduced in class lecture to generate random variables (the inverse transform method or polar method), and you need to calculate distribution by your own code (no use of pdf(), cdf(), hist3(), etc). You should ONLY use the basic Matlab operations and matrix/vector operations I introduced in lecture. When drawing figures, you should only use plot() function, not hist(). Using Matlab's statistical functions will be treated as not completing the assignment!

What to submit: Submit a report containing all required figures and computation results (you should have at least captions for those figures and brief explanation!). In addition, submit your matlab code (.m files). You can put all files in a .zip file to submit in webcourse.

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1. (**Discrete Random Variable**) Generate 1000 samples for each of the following discrete random variables:
     (a). Binomial distribution with n=40, p=0.7
     (b). Poisson distribution with $\lambda = 8$ (simulate the random number to be no bigger than 30, i.e., if the simulated number is bigger than 30, then just treat it as 30)
   For each class of the above distribution, plot probability mass function and also plot the corresponding analytical results (probability mass function curve based on distribution formulas) on the same figure. In this way, you can verify whether your simulated random variables match with analytical results. Use "legend" to denote each curve, and use different line style and color for each curve (see help on plot()).

2. (**Continuous Random Variable**) Generate 1000 samples for each of the following continuous random variables:
     (a). Exponential distribution with $\lambda = 2$
     (b). Normal distribution with $\mu = 20, \sigma^2 = 50$
     For each class of the above distribution, plot the cumulative distribution function. Compute the mean value and variance based on your 1000 simulated samples.

3. (**Random Permutation**) A deck of 100 cards --- numbered 1,2,3,…, 100 --- is shuffled and then turned over one card at a time until all cards have been turned over. Define "hit" occurs whenever card i is the i-th to be turned over, $i=1,2,…, 100$. Record the number of hits in this card turning over procedure. Write the simulation program to conduct 1000 simulation runs, each run starts with a new shuffle of those 100 cards and go through the card turning over procedure.
     (a). Compute the mean value and variance of the total number of hits in card turning over procedure, based on your 1000 simulation runs' results.
     (b). Since each simulation run provides one instance of the number of hits, please sort those 1000 numbers, and draw the sorted 1000 data points in a figure according to ascending order.

4. (**Dice Rolling Simulation**) Define one simulation run as rolling four fair dices continually until all the possible outcomes 4,5,6,…, 24 have occurred at least once. Record the number of rolling for each simulation run. Make your simulation program to run 1000 simulation runs. Repeat the required tasks in Question 3 for this question.

     Note: If you have no access to Matlab (all UCF in-campus computers have Matlab), you can use Octave (http://www.gnu.org/software/octave/) to do this project. The programming should be identical.