

AGEC 643
Applied Simulation
Homework 1
Due September 24, 2008

Your homework problems 1-7 are to be done in Excel. Print all pages showing the calculations documented by =VFORMULA(). Show row numbers and column numbers on EVERY page. Minimize the pages printed but do not make the characters smaller than 2 mm so I can read it.

1. Prove Simetar is a Pseudo Random Number Generator by comparing =RAND() in Excel to =Uniform(). Run the model two times and save the results for the two runs in one worksheet. Generate two different samples of 500 random values for $X \sim U(0,1)$, compare statistics for the four samples (that is two for RAND() and two for Uniform() samples) and print a table with the first 25 sampled values for the four samples of X. Explain why Simetar is pseudo random and why Excel is not, based on the results.
2. Compare Monte Carlo to Latin Hypercube sampling by generating two 500 iteration samples of $X \sim N(20,6)$, one as Monte Carlo and one as LHC. Compare the summary statistics and the CDFs for the two samples vs. the “true” uniform distribution. The true distribution is an equal increment column of 500 values starting at 0.0 and extending to 1.00, equal set increment for the true distribution are equal to 1/499. Explain why they are different.
3. Calculate the root means square error (RMSE) and the CDFDEV between the Rand() and Uniform() distributions simulated in problem 1 to the “true” distribution on problem 2. Explain which distribution is the best method to simulate a uniform random number.
4. Write an Excel program to simulate 500 random values for random variable $X \sim U(0,1)$ using the congruential method described in class. Use VFORMULA to show each calculation in your program. Report the program and four separate samples of your random number generator each using different seeds: 25, 51, 31527, 2101. Print the first 25 random values for each of the samples and the summary statistics.
5. Given the data for random variable X, estimate the parameters and simulate it using the UPES in Simetar and also simulate X with an Empirical distribution. Make sure you use the common random number for the EMP as you use for other distributions. Print this part of your model with VFORMULA showing the calculations you made. Simulate the random variables and compare their simulated results to the original historical X distribution below using a CDF and the CDFDEV. Explain which is best. $X \sim (25.0, 30.0, 18.1, 16.5, 28.1, 33.3, 45.0, 40.0, 35.0, 19.0, 25.0, 37.0)$. Which distribution is best for simulating the X variable?
6. Program a simulation model and document the model that estimates the amount of rain water a tank will collect over the course of 31 days if the following parameters are known.
 - Probability of rain is independent from day to day and the probability of rainfall is 0.12 on any day.
 - The amount of rain on days when it rains is distributed Normal(1.0 inches, 0.3 inches).
 - One acre of land drains into the tank or 43, 560 square feet.
 - One inch of rainfall on an acre is equivalent to 22,610 gallons of water.
 - The ground absorbs 20% of the rain that falls.Simulate this model for 500 iterations and report: summary statistics for water collected in the tank and the CDF of total water collected over a 31 day period.
Calculate the probability of zero water accumulation, $P(\text{Sum Water} < 50,000)$, $P(\text{Sum Water} < 100,000)$, $P(50,000 < \text{Sum Water} < 100,000)$

7. Simulate a simple farm model using the data below:

	Corn	Soybean	Wheat
Yields bu/acre			
Average Yield	190	65	50
Std Dev Yield	30	15	20
Prices \$/bu.			
Average Yield	3.90	6.00	4.20
Std Dev Yield	.30	.40	.50
Cost of Production			
\$/acre	150.00	100.00	65.00
\$/bushel	0.20	0.25	0.30
Acres Planted			
Scenario 1	100	60	40
Scenario 2	80	80	40
Scenario 3	100	100	0
Scenario 4	50	110	40

The Key Output Variable (KOV) is net returns for the farm. Simulate the 4 scenarios using the =SCENARIO() function in Simetar and report the summary statistics, CDFs and PDFs for the KOV. Be sure to document your model with =VFORMULA() for all of your equations.

Make sure the yields and prices never go negative.