ACSC/STAT 4703, Actuarial Models II
Fall 2015
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Homework Sheet 8
Due: Friday 4th December: 10:30 PM

For each question that asks you to simulate a small number of samples from a distribution, use the following simulated uniform values, starting from the first, and using as many numbers as needed for the question. Go back to the first value at the start of each part question.

```
0.58665797 0.12487271 0.87530540 0.49197147 0.55262301 0.14644543
0.89151074 0.46559276 0.42856173 0.63507522 0.78161985 0.69613284
0.37786683 0.51447243 0.48952100 0.28195163 0.62179048 0.66186936
0.42715830 0.70003263 0.59328856 0.97308150 0.14087141 0.08049598
0.98662077 0.91974635 0.56037580 0.07804151 0.48363702 0.33763780
```

Basic Questions

1. Use the method of inversion to simulate two random samples from
   (a) a normal distribution with $\mu = 4$, $\sigma = 1$.
   (b) a Pareto distribution with $\alpha = 7$, $\Theta = 9280$.

2. An insurance company classifies individuals into four classes, each with a different claim frequency distribution, as shown in the following table:

Class	Probability	Frequency Distribution	Parameters
1	0.20	Binomial	$n = 44, p = 0.007$
2	0.15	Poisson	$\lambda = 0.06$
3	0.25	Negative Binomial	$r = 7, \beta = 0.3$
4	0.40	Negative Binomial	$r = 30, \beta = 0.07$

   (a) Simulate 3 claim frequencies from 3 random individuals.
   (b) Simulate 3 claim frequencies from a single individual.

3. A car insurance policy has three types of claim with probabilities in the table below:

Claim Type	Probability
Collision (no fault)	0.39
Collision (at fault)	0.43
Comprehensive.	0.08

   Simulate the number of each type from a sample of 821 claims.

4. Use a stochastic process method to simulate 3 samples from each of the following distributions:

(a) A binomial distribution with $n = 32$ and $p = 0.07$.

(b) A negative binomial distribution with $r = 4$ and $\beta = 0.65$.

5. Simulate 6 samples from a normal distribution with $\mu = 4$ and $\sigma = 3$ using

   (a) A Box-Muller transformation.

   (b) The polar method.

Standard Questions

6. An insurance company models total claim frequency as following a negative binomial distribution with $r = 15$ and $\beta = 4.7$. Claim severity is independent of frequency and follows a Pareto distribution with $\alpha = 4$ and $\theta = \$3,680$. The insurance company plans to set the policy limit so that the probability that the aggregate loss on these policies exceeds \$100,000 is at most 0.01. Use a simulation to determine what this policy limit should be, explaining carefully how you determine the simulation size so that the relative error in the estimated probability that the aggregate loss exceeds \$100,000 is less than 1% with probability 0.95.

7. An insurance company's aggregate losses are a sum of 3 random variables. The first follows a Gamma distibution with $\alpha = 5$ and $\theta = 973$; the second follows a Weibull distribution with $\tau = 4$ and $\theta = 704$; the third follows a Pareto distribution with $\alpha = 4$ and $\theta = 1266$. By simulating 200,000 aggregate loss values, estimate the TVaR of these aggregate losses at the 0.95 level.