Performance Analysis and Simulation of Communication Systems: Project A

Adam Temmel (adte1700) & Fredrik Sellgren (frse1700)

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1 PRNG and Random Variables

1.1 Create a function that implements a linear congruential generator (LCG), accepting as input the parameters: seed, m, a,and c.

We implemented our LCG as a class in order to keep it somewhat similiar to the STL generators. The code used is as follows:

```
class Lcg {
public:
    using seed_t = uint32_t;

    Lcg(seed_t seed, seed_t m = 100, seed_t a = 13,
        seed_t c = 1)
        : seed(seed), m(m), a(a), c(c) {}

    seed_t operator()() {
        seed = ((a * seed) + c) % m;
        return seed;
    }

    // These are kept public to make it easier to change
    // them later in the lab, a more authentic generator
    // would probably keep them private.
    seed_t seed, m, a, c;
};
```

Figure 1: LCG Class

1.2 Generate 1000 values uniformly distributed in the range [0,1] using your PRNG. For this case use m=100, a=13 c=1and seed =1;

1.3 Compare the distribution of your values with the distribution of values generated using the `UniformRandomVariable()` of ns-3.

1.4 Comment on the difference in the results and propose values of m, a,and cwhich gives you better results.

1.5 What PRNG does ns-3 use? What method does ns-3 use to generate a normal random variable?

1.6 Using the `time` system command of Linux compare the execution time for the generation of the uniform distribution using your function and ns-3 function

```
# our class:
time ./waf --run scratch/project  2.54s user 0.20s
system 107% cpu 2.547 total
# their class:
time ./waf --run scratch/project  2.59s user 0.17s
system 107% cpu 2.556 total
```

Figure 2: The results from timing a program that generated 1000 random numbers using `time`
As we can see, our implementation is slightly faster (around 0.01 seconds) than the Ns3 implementation.

1.7 **Write a second function that generatesan exponential distributionwith mean $\beta > 0$ from auniform distributiongenerated using the LCG;Choose one of the methods for generating RV covered in the course and motivate your choice with respect to the specific task.**

1.8 **Compare your exponential distribution with ns-3** `ExponentialRandomVariable()` **and the theoretical expression of the probability density function.**