AALTO UNIVERSITY
Department of Communications and Networking
S-38.3148 Simulation of data networks

Examination
20.1.2014
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1. Compare simulation and analytical approach as tools for performance analysis. (6p)

2. The random variable X obeys a distribution with the probability density function

$$f(x) = \begin{cases} \frac{1}{4}, & 0 \leq x < 1, \\ x - \frac{3}{4}, & 1 \leq x \leq 2. \end{cases}$$

   Show how one can generate values of X from this distribution using a) the inverse transform (inverse distribution function) method and b) the acceptance-rejection method, where the candidate samples are generated from the distribution $g(x) = x/4+1/4$. (6p)

3. Describe one method for the generation of values of a discrete random variable X obeying a Poisson distribution with parameter a, i.e., $\mathrm{P}\{X = n\} = \frac{a^n}{n!} e^{-a}$, $n = 0, 1, \ldots$. (3p)

4. a) What is the so called initial transient and what causes it? Give one method to be used in steady state simulation for estimating the length of the so called initial transient?(3p)

   b) In the simulation of a system one has observed the average waiting time of customers arriving within a 2 hour interval; in four independent runs one has obtained the average values (3.74, 4.53, 3.84, 3.98) min. One wishes to obtain an estimate for the average waiting time such that at 95 % confidence level the error is at most 0.2 min. How can you estimate the number required simulation runs to achieve this accuracy? As a basis for the estimate you can use the fractile value $z_{0.975} = 1.96$ of the standard $N(0, 1)$ distribution. Justify your answer! (6p)

5. a) What are so called variance reduction methods? Mention at least two examples. (3p)

   b) Compare CNCL and ns2 as tools for discrete event simulation. (3p)