Aalto University School of Electrical Engineering
Department of Communications and Networking
S-38.3184 Network traffic measurements and analysis IV/2015

Exam 10.4.2015
Hyytiä & Peuhkuri

1. **Explain** the following terms and **discuss** their roles in network measurements: (6 p)
   a) Scatterplot
   b) Inter-arrival times
   c) Outlier
   d) Zipf's Law
   e) Stratified sampling
   f) Clustering

2. Two independent measurements for the number of web page accesses gave

t_i	n_i
1 min	2
5 min	8

   where t_i is the length of the measurement period and n_i is the number of web page accesses. You can assume that $N_i \sim \text{Poisson}(\lambda t_i)$, where λ is the unknown access rate to be estimated using the maximum likelihood (ML) method. (For $X \sim \text{Poisson}(a)$, the point probabilities are $\mathbb{P}\{X = i\} = (a^i/i!)e^{-a}$.)
   a) Write down the likelihood function $L = L(\lambda)$. (2 p)
   b) Find ML estimate for λ by maximizing $L(\lambda)$. (2 p)
   c) How does the result relate to the average rate $(2+8)/6$ min and why? (2 p)

Following answers to a separate paper.

3. Explain the difference between active and passive network measurements. Which one is more suitable for: (6 p)
   a) Monitoring available capacity in network link serving VoIP call center
   b) Identifying traffic sources contributing most of traffic
   c) Identifying applications contributing most of traffic
   d) Building view about number of links and delays to a set of destination hosts

4. Define flow. Why a flow is important concept in network measurements? What roles granularity and timeout have with flows? (6 p)

5. Describe methods for clock syncronisation. What kind of clock errors there exists? List four different type of network measurements and how important clock syncronisation is in those considering different types of clock errors. (6 p)