

# DISI – UNIVERSITY OF TRENTO

Master in Computer Science AA 2014/2015

Simulation and Performance Evaluation

Assignment 1 (11 points available)

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March 30, 2015

This assignment consists in the estimation, and presentation of the methodology used to do so (and of all possible plots you think are useful to represent the problem and help understanding its solution), of the parameters of a SP model of a system that has been measured.

The outcome of the measure are samples which we know are i.i.d. The samples represent the failure time of an electronic component that fails after a given number of “shocks”, whatever shock means. And we also know (from our textbook, and the lesson!) that these systems fail with a random distribution that is represented by  $\Gamma$  distribution. Finally, we are told that measures are affected by simple white Gaussian noise.

The gamma is characterized by a shape parameter  $\alpha$  and a rate parameter  $\lambda$  (careful:  $\lambda$  is the rate,  $\frac{1}{\lambda}$  is the scale), while the normal has a mean  $\mu = 0$  and a standard deviation  $\sigma$ .

More formally:

$$Z = X + Y, \quad f_X(x) = \Gamma(\alpha, \lambda), \quad f_Y(y) = N(0, \sigma). \quad (1)$$

## Assignment:

1. Verify that the dataset is iid;
2. Estimate the values of  $\alpha$ ,  $\lambda$ , and  $\sigma$ ;
3. Estimate the confidence of your results;
4. Plot some functions, like histograms, CDFs, etc. of the dataset that supports and explain the results.

The assignment must be no more than 2 pages in the format given with the report example.

We will provide you with a dataset in a text file (one per student) which includes 100 000 samples that you can use to estimate the parameters. Such report needs to be uploaded in *Moodle*, the online web tool you find in Esse3 (<http://www.esse3.unitn.it>) under *DidatticaOnLine*. You can work together, but remember we will ask you questions about the assignment at the exam, so simple copy-paste without understanding won't be enough ... and the parameters to estimate are different for each student. You will need to use a mathematical tool to estimate the parameters from the samples. You can use the tool you prefer, but we think **R** is a good tool for statistical processing.

Some hints on how to solve the exercise:

- There exists no `findParametersOfGammaPlusNormal` function in statistical tools (as far as we know). You will need to write down some formulas to reason and find a way to solve this. If you find a magic function which solves the problem, you are still required to understand and explain how it works.
- Can you compute the mean and the variance of the sum of two independent random variables?
- Think about what you can directly estimate using the samples.
- There are higher moments as well, not only mean and variance.

The deadline for this assignment is April 29 (2015!!). If you deliver the assignment within this date, we will correct it and give you the chance to refine it before the exam, otherwise we will consider the work “as is”. If you have some doubts, just write us an email.

**Good luck!**