

Queueing Systems Assistance in Action

*J. Sztrik*¹, *Z. Szilágyi*² *Cs. Kölcsei*³

¹University of Debrecen, Debrecen, Hungary, sztrik.janos@inf.unideb.hu

²University of Debrecen, Debrecen, Hungary, zoltan.szilagyi.cse@gmail.com

³University of Debrecen, Debrecen, Hungary, kcsanad98@gmail.com

The goal of the present paper is to introduce an application called Queueing Systems Assistance (QSA). The software is integrated into a lecture note with the aim to calculate and visualize the main performance measures. In addition, it helps to minimize a quite general mean total cost per unit time with linear objective function. Several examples are given to illustrate the advantage of the graphical module included in the package. The greatest advantage of this application that these scripts can run in all modern devices including smart phones, too, thus the application is very convenient for students and improve the efficiency of a teacher.

To solve practical problems the first step is to identify the appropriate queueing system and then to calculate the performance measures. Of course the level of modeling heavily depends on the assumptions. It is recommended to start with a simple system and then if the results do not fit to the problem continue with a more complicated one. Various software packages help the interested readers in different level. The following links worth a visit

<http://web2.uwindsor.ca/math/hlynka/qsoft.html>

A reasonable choice for calculations in teaching is the usage of spreadsheets. We highly recommend an Excel-based software package called QTSPPlus to determine the main performance measures of basic models. It is associated to the book of Gross, Shortle, Thompson and Harris [1] and can be downloaded here

ftp://ftp.wiley.com/public/sci_tech_med/queueing_theory/

For application and problem solving oriented teaching courses we have also developed a software package called QSA (**Queueing Systems Assistance**) see, Szilágyi *et. al.* [2] to calculate and visualize the performance measures together with optimal decisions not only for elementary but more advanced queueing systems as well. It was released in February of 2021 and it is available at

<https://qsa.inf.unideb.hu>

The **main advantages** of QSA over QTSPlus are the following

- It runs on desktops, laptops, mobile devices
- It calculates not only the mean but the variance of the corresponding random variables
- It gives the distribution function of the waiting/response times (if possible)
- It visualizes all the main performance measures
- It graphically supports the decision making

QSA is a user interface, a web-based application written in TypeScript. Any browser (Firefox, Chrome, Edge, etc.) on every platform (Windows, Linux, Android, iOS) is supported, which means one can use mobile and desktop devices for performing any calculations which are executed on the server. There are no hardware limitations, the source code is available on GitHub, under the MIT license, so anyone interested in can check out the code or help to develop the application. QSA is integrated into the lecture note of Sztrik [3].

One of the special features of the software is that the performance measures of $M/G/1/K/K$ systems with deterministic, Erlang, Hypo-exponential, Hyper-exponential, and gamma distributed service times are calculated. Distribution function of the waiting/response times of the $M/M/c/K$, $M/M/c/m/K$ systems and the performance measures of $M/M/c/K$, $M/M/c/m/K$ with balking and reneging are determined as well. It was our aim determine, where it is possible, the distribution function of the waiting/response time to solve decision problems. In addition, not only the mean but the variances of the measures are derived. What is also unique is the calculation of the mean total cost per unit time in steady-state.

Acknowledgements The work/publication of J. Sztrik is supported by the EFOP-3.6.1-16-2016-00022 project. The project is co-financed by the European Union and the European Social Fund.

References

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