Lab 1: Queue simulation

Emanuele Pietropaolo

Matricola: 329501

Introduction

The objective of this lab is to simulate a queueing system with a finite number of servers. We consider a system where we have arrivals governed by a Poisson process and the service time is exponentially distributed with mean 1, we have mapped a system with a limited queue capacity. Queueing systems are well known in probability theory and follow expected behaviour, and a system with these properties is called an ***M/M/c/K queue***. It is a stochastic process described only by the number of clients currently in the system, including those in service.

Expected behaviour

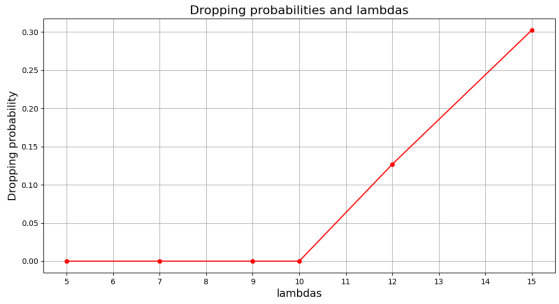
An *M/M/c/K queue* is a version of the ***M/M/c queue*** in which a limited capacity (K) is imposed on the size of the queue. This means that some consideration can be made about the system. Knowing that a *M/M/c queue* is stable if:

$$\lambda < c \cdot \mu = \lambda < 10 \cdot 1.0$$

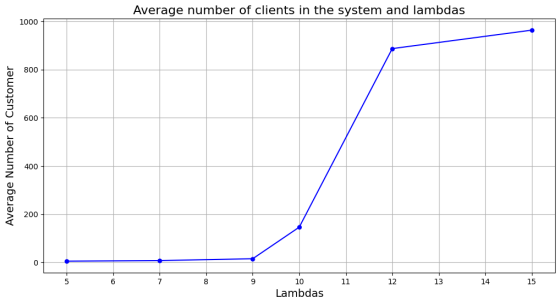
we can suppose that the system will tend to fill the queue more and more when lambda is greater than 10 because it can not process the clients fast enough. We have six different Poisson arrival distributions, two of which are greater than 10 and one of which is exactly 10.

Simulation results

The simulation results confirm the hypothesis that two of the six arrival distributions would cause the queue to reach full capacity. In fact, we can see in image 1(a) how the dropping probability increases when lambda exceeds the value 10. This is because the rate at which users arrive exceeds the rate at which the system can process them. We can also see in image 1(b) how the average number of users in the system is close to full capacity when clients arrive with these distributions.



(a) Dropping probability with different Poisson distributions.



(b) Average numbers of clients with different Poisson distributions.

Figure 1: Simulation results

Conclusions

We can conclude that the simulation is able to capture the expected behaviour of an *M/M/c/K queueing* system.