**Automatic Ticketing Machine**

Consider an automatic ticket machine, placed in a very crowded area. We can consider that as soon as a costumer completes her transaction, a new one is immediately available to start a new purchase.


The costumer first starts interacting with the Graphical User Interface of the machine. The time required to complete her choice, is Hyper-exponential distributed with the characteristics shown in row A of the table I below. 20% of the costumers does not buy a ticket and leave immediately the machine. The other 80% who purchases a ticket, pays it either with cash (35%) or with an electronic transaction (65%). The length of two operations is different, and it is reported respectively in rows B and C of table I below. When payment has been completed, the system prints the ticket, with a time that follows row D of table I below. Table II shows the cost of the tickets, with the probability that the corresponding document is issued.

Analyze the considered scenario:

1. Draw a state machine of the system.
2. Compute the probability that it is either: waiting for user input, handling a cash transaction, handling an electronic transaction, printing a ticket
3. Compute the average duration of a transaction – the time (expressed in minutes) the machine is used by a costumer.
4. Compute the average cash collected by the machine in 20 hours of operation.

| *Case* | *Description* | *Distribution* |
|---|---|---|
| A | GUI time | 2 stage Hyper-exponential with:<br>$p_1 = 0.8$, $\lambda_1 = 0.4\ min^{-1}$<br>$p_2 = 0.2$, $\lambda_2 = 0.1\ min^{-1}$ |
| B | Cash payment | Exponential with $\lambda = 0.4\ min^{-1}$ |
| C | Electronic payment | Erlang $k = 4$, and $\lambda = 2\ min^{-1}$ |
| D | Printing | 2 stage Hyper-Erlang:<br>$p_1 = 0.95$, $k_1 = 2$, $\lambda_1 = 10\ min^{-1}$<br>$p_2 = 0.05$, $k_2 = 1$, $\lambda_2 = 0.1\ min^{-1}$ |

**Table I : Distributions**

| **Ticket type** | **Fare** | **Probability** |
|---|---|---|
| Urban | 2.50 € | 90% |
| Area I | 4.00 € | 6% |
| Area II | 6.00 € | 4% |

**Table II : Fares and their distribution**