Queueing, version 1.0, 2017-06-15

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This program simulates a single waiting line at a bank teller. In queueing theory, this model is called M/M/1. The first M (Markov) in M/M/1 means that customers arrive with exponentially distributed interarrival times of  *α* seconds in the mean. The second M means that they are served at the teller in an exponentially distributed time of β seconds in the mean. The 1 means that there is 1 serving unit. There is an even simpler model, M/D/1, where D stands for degenerate and means that the service time is fixed.

Define:

λ=1/*α* (the mean arrival rate),

μ=1/β (mean service rate),

ρ=λ/μ (the utilization factor).

L= expected number of customers in the queueing system (service unit included)

W=expected waiting time in system (includes service time).

If ρ<1, the system will reach, after some time, a steady state condition. This means that the relative frequencies of the different states of the system (the number of customers in the system) have become nearly constant.

Queueing theory then predicts:

For both models: L=λ\*W (Little’s formula)

For M/M/1: , W=

For M/D/1: ),

If you choose for example α=3 and β=2, you will get ρ=2/3 and L=2 for M/M/1 and L=4/3 for M/D/1. The more time steps you take, the better the mean number of customers in the system and the mean sojourn time will approach their theoretical values L and W.

For more information, see Hillier and Lieberman: Introduction to Operations Research.

Controls:

Input screen:

[Tab]: toggle between OK and Cancel button

[Enter] press hightlighted button

[d] or [f] toggle between mean/fixed serving time

[+] or [-} increase/decrease highlighted value by 10

[Esc] back to show screen

Show screen:

[d] or [f] toggle between mean/fixed serving time

[Esc] go to input screen

[Enter] go ahead 60 seconds

[m] go ahead 60 seconds

[h] go ahead 1 hour

[s] take 1 time step (=1 arrival or 1 customer served)

[d] or [f] toggle between mean/fixed serving time

[n] restart from time 0