DEFICIT SCHEDULER

Performance evaluation of computer systems and networks

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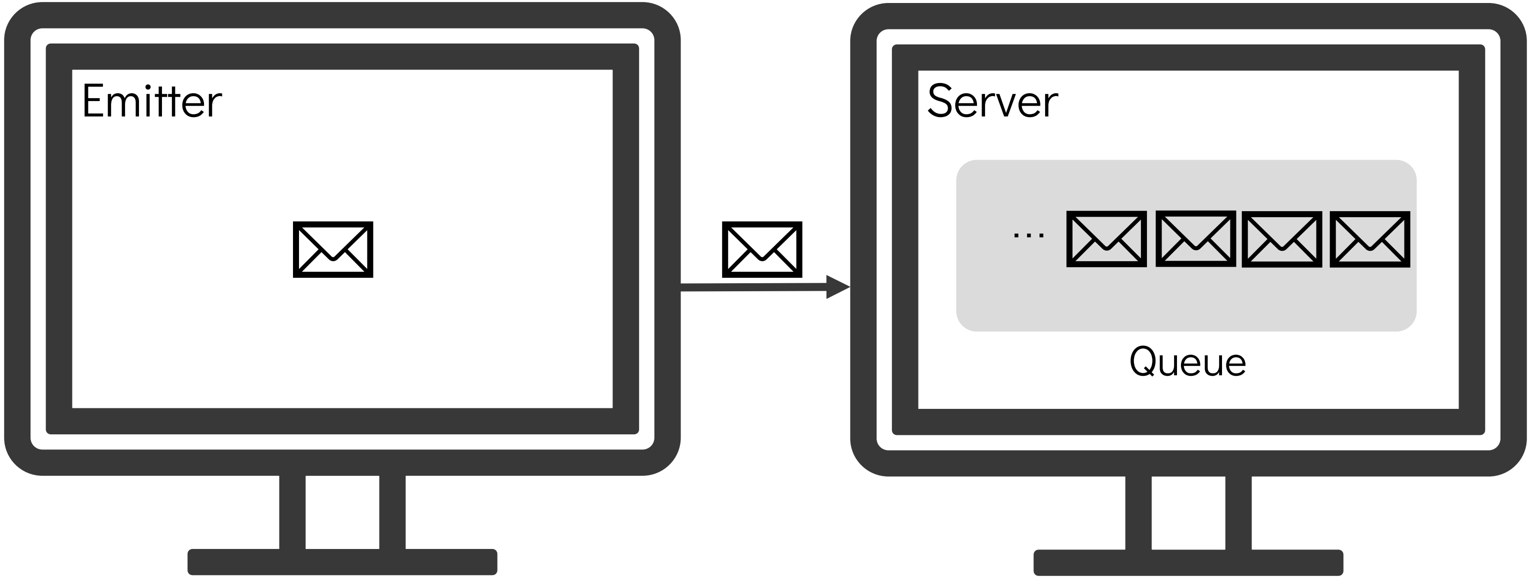
OMNET++ MODEL



- Service time
- Inter-arrival time

- Turn time Q
- Vacation

QUEUEING THEORY

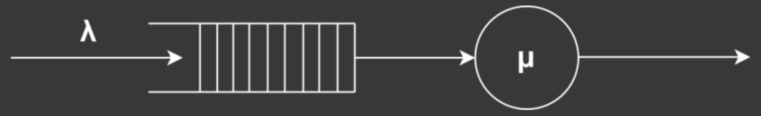
Simplifications:

- no vacations $\rightarrow E[t_S] = \frac{1}{\mu} = S_t$

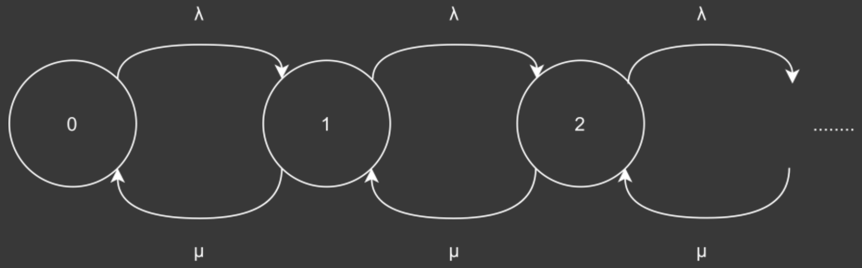
Mean performance indexes:

- $E[N] = \frac{\rho}{1-\rho} = \frac{\frac{\lambda}{\mu}}{1-\frac{\lambda}{\mu}} = \frac{S_t}{I_t - S_t\ I_t}$
- $E[R] = \frac{E[N]}{\bar{\lambda}} = \frac{1}{\mu-\lambda} = \frac{S_t\ I_t}{I_t - S_t}$

M/M/1



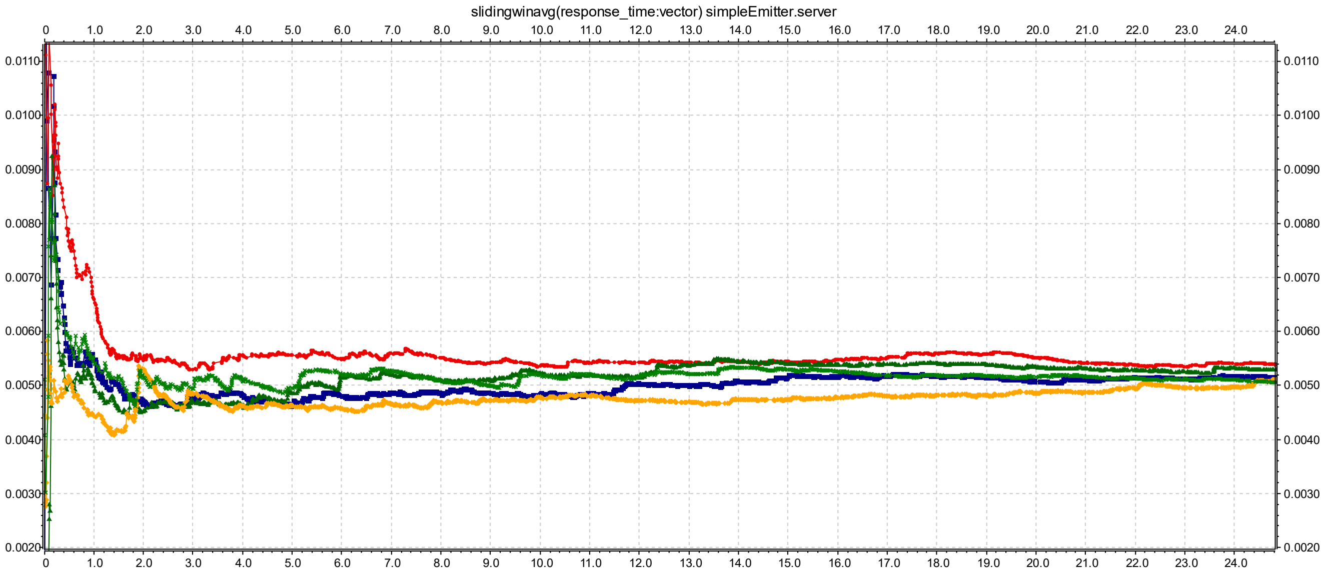
CTMC



Stability condition

$$\lambda < \mu$$

WARMUP PERIOD



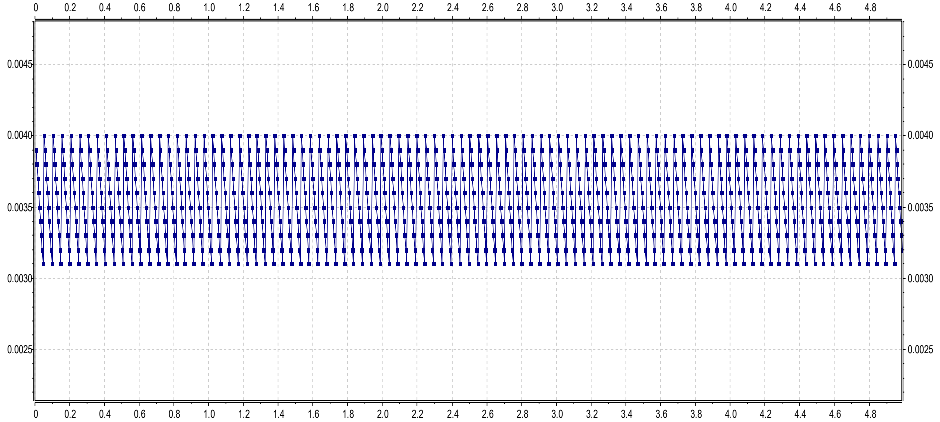
3s

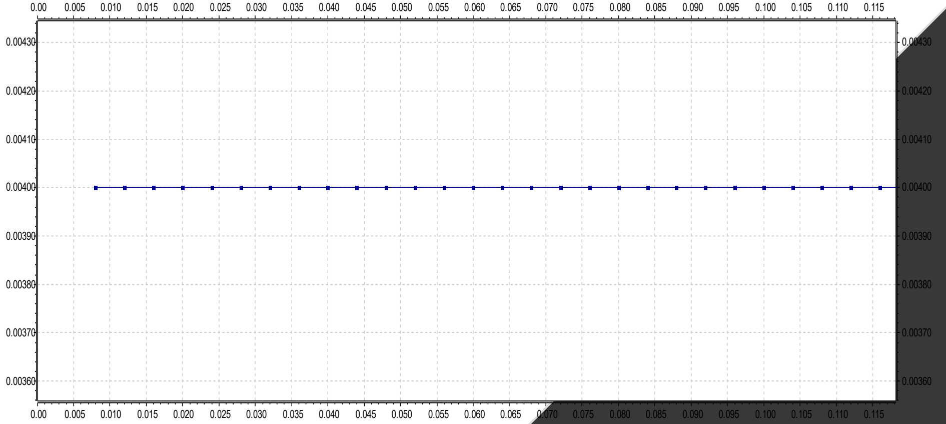
of warmup period

Constant case

In this case we used **constant values** for inter-arrival time (I_t), service time (S_t) and vacation (V) and we found out the **stability condition** was:

$$I_t \geq V \cdot \frac{S_t}{Q} + S_t$$



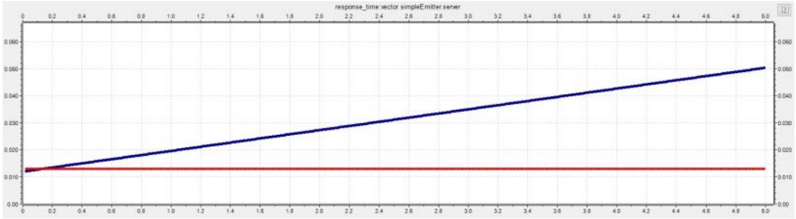


Constant case - Simulations

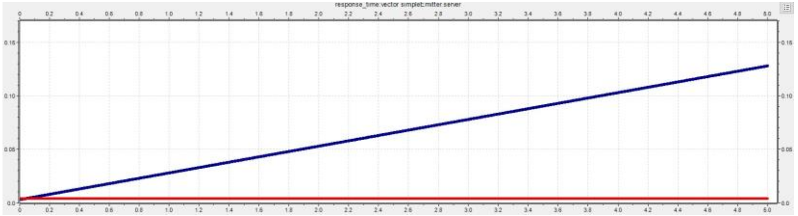
Chart Legend

- Case: $I_t < V \cdot \frac{S_t}{Q} + S_t$
- Case: $I_t = V \cdot \frac{S_t}{Q} + S_t$

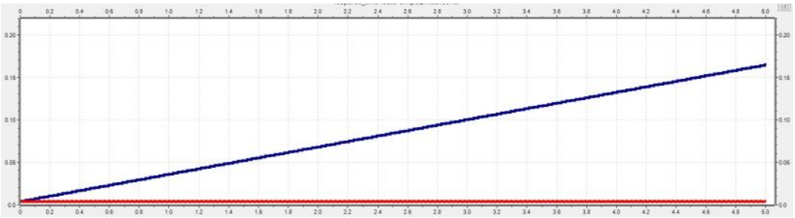
Q=0.3ms



Q=3ms



Q=30ms

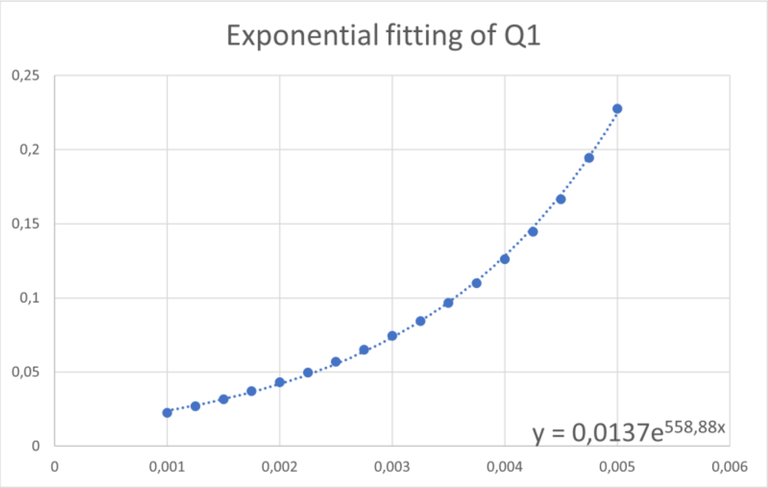


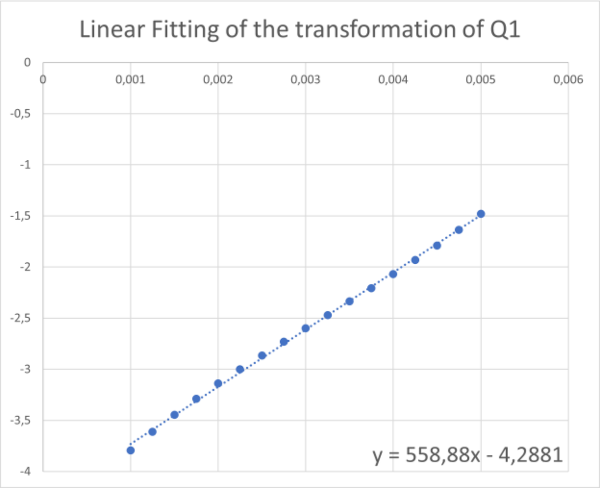
Exponential Case

FACTORS							
Q	I_t	S_t	V	I_tS_t	I_tV	S_tV	I_tS_tV
0.1 S_t	0.38%	2.04%	95.29%	0.0%	0.36%	1.17%	0.0%
0.5 S_t	3.34%	18.65%	65.74%	1.28%	2.7%	7.12%	1.02%
1 S_t	4.48%	33.83%	48.39%	2.37%	2.59%	6.87%	1.31%
5 S_t	12.11%	61.26%	11.72%	10%	1.38%	2.30%	1.15%
10 S_t	15.96%	62.25%	5.67%	13.96%	0.61%	0.87%	0.56%

EXPONENTIAL CASE

From the data analysis we observed that almost every case could be fitted to an exponential model, which we transformed into a linear model.





Tuning | $2^k r$ analysis | **Data analysis**

Exponential Case

Q	Factor	Initial Model	Linear model	R^2
0.1 S_t	V	y = 0,0137$e^{558,88x}$	y = 558,88x - 4,2881	0,99875496
0.5 S_t	V	y = 0,0118$e^{350,1x}$	y = 350,1x - 4,4355	0,979680008
1 S_t	V	y = 0,0121$e^{293,65x}$	y = 293,65x - 4,4114	0,999270512
1 S_t	S_t	y = 0,0096$e^{240,41x}$	y = 240,41x - 4,6422	0,996240496
1 S_t	$\mathrm{V} + S_t$	y = 0,0022$e^{266,04x}$	y = 266,04x - 6,1372	0,989121491
5S_t	S_t	y = 0,0034$e^{352,67x}$	y = 352,67x - 5,6813	0,987409707
5 S_t	S_t/I_t	y = 0,0044$e^{3140,1x}$	y = 3140,1x - 5,4198	0,981626638
10S_t	I_t	y = 2E-06$x^{-2,166}$	y = -2,1656x - 13,316	0,958509257
10 S_t	S_t	y = 0,0028$e^{390,98x}$	y = 390,98x - 5,8954	0,977938511
10S_t	S_t/I_t	y = 0,004$e^{3017,3x}$	y = 3017,3x - 5,5222	0,968857788

Conclusions

Depending on how the ratio $\frac{S_t}{Q}$ changes the system will behave in different ways:

- If it's close to one, the mean response time will mostly depend on V and S_t
- The more it gets smaller than one, the more it will be affected by V
- When it gets bigger than one, V will be less meaningful, while S_t and I_t become more significant