



or-13. 待ち行列を解く オンラインサイト supositorio.com の紹介

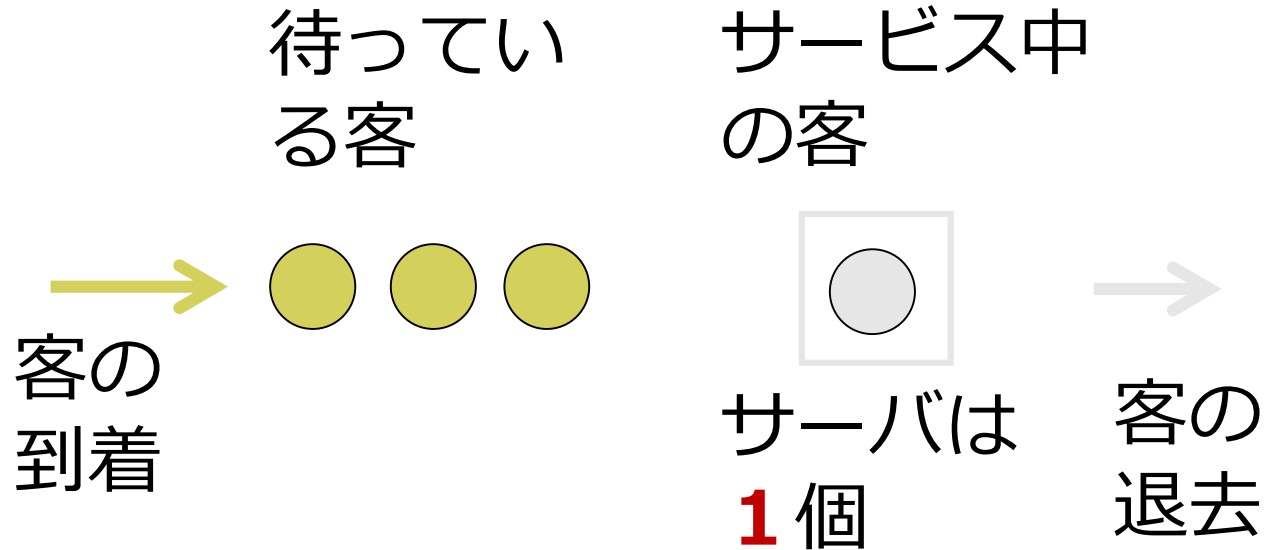
(Excel によるオペレーションズリサーチ演習)

URL: <https://www.kkaneko.jp/cc/or/index.html>

金子邦彦



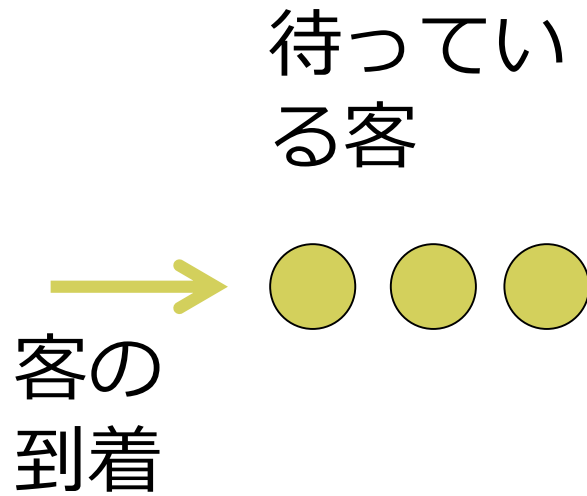
M/M/1 型の待ち行列



客は**ランダム**
に到着

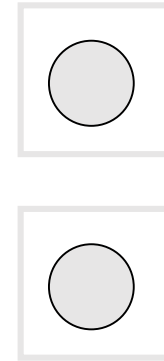
サービスの所要時
間も**ランダム**

M/M/2 型の待ち行列



客は**ランダム**
に到着

サービス中
の客



サーバは
2個



サービスの所要時
間も**ランダム**

混雑や滞留の例



- 人
 窓口, 売り場
- もの
 車の渋滞, 倉庫への預け入れと取り出し
- 情報
 インターネットのパケット
 オペレーティングシステムのプロセス

演習

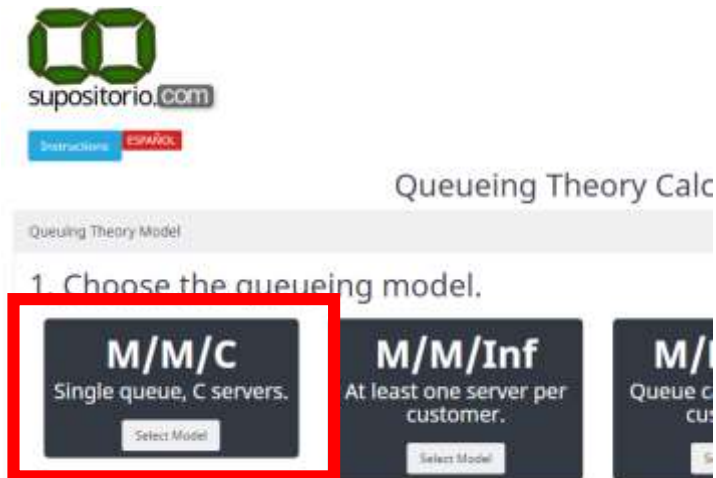


① ウェブブラウザを起動する

② 次の URL を開く

<https://www.supositorio.com/rcalc/rcalclite.htm>

③ 「M/M/C」 をクリック



④ 次のように設定

2. Input all the values required.



C

Number of Servers
Number of servers in parallel open to attend customers.

サーバは **2**個



Arrival and Service rates

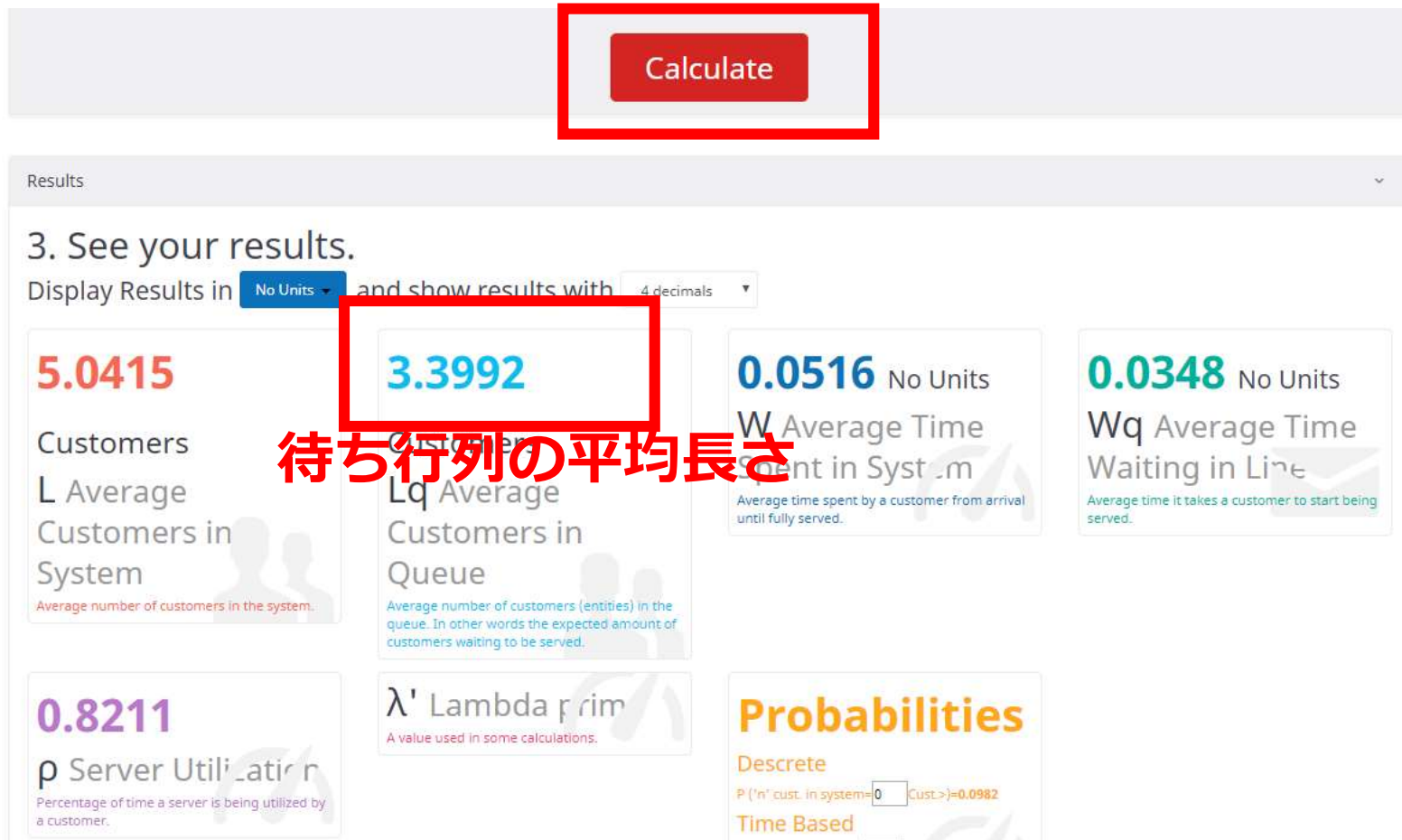
λ No Units
 No Units

μ No Units
 No Units

サービス時間の平均は **97.78**

到着間隔の平均は **59.54**

⑤ 「Calculate」 をクリックすると、結果が出る



Calculate

Results

3. See your results.

Display Results in **No Units** and show results with **4 decimals**

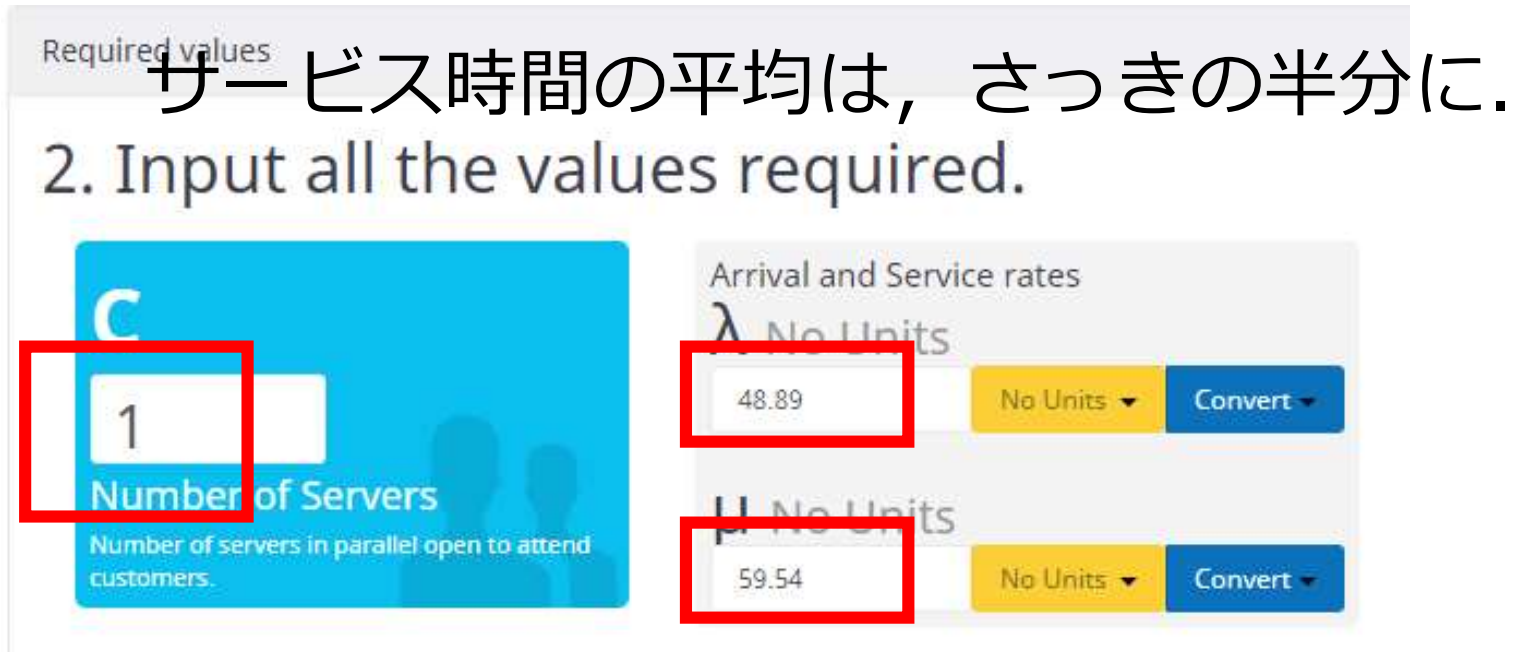
Metric	Value
L Average Customers in System	5.0415
Lq Average Customers in Queue	3.3992
W Average Time Spent in System	0.0516 No Units
Wq Average Time Waiting in Line	0.0348 No Units
ρ Server Utilization	0.8211
λ' Lambda prim	A value used in some calculations.
Probabilities	Discrete P ('n' cust. in system) = 0 Cust.>)=0.0982 Time Based

待ち行列の平均長さ

⑥ 今度は、次のように設定
サーバは1個に。

Required values

サービス時間の平均は、さっきの半分に。
2. Input all the values required.



The screenshot shows a simulation software interface with the following elements:

- A blue box on the left titled "Number of Servers" with a subtext "Number of servers in parallel open to attend customers." The input field contains the value "1".
- A section titled "Arrival and Service rates" with two rows of input fields. The first row is for arrival rate λ with a value of "48.89". The second row is for service rate μ with a value of "59.54".
- Each rate input field has a "No Units" dropdown menu and a "Convert" button.

サーバは **1** 個

サービス時間の平均は **48.89**

到着間隔の平均は **59.54**

⑦ 「Calculate」をクリックすると、結果が出る

Calculate

Results

3. See your results.

Display Results in **No Units** and show results with **4 decimals**

4.5906 Customers L Average Customers in System <small>Average number of customers in the system.</small>	3.7695 Customers W Average Customers in Queue <small>Average number of customers (entities) in the queue. In other words the expected amount of customers waiting to be served.</small>	0.0939 No Units W Average Time Spent in System <small>Average time spent by a customer from arrival until fully served.</small>	0.0771 No Units Wq Average Time Waiting in Line <small>Average time it takes a customer to start being served.</small>
0.8211 ρ Server Utilization <small>Percentage of time a server is being utilized by a customer.</small>	λ' Lambda prim <small>A value used in some calculations.</small>	Probabilities Discrete P ('n' cust. in system = 0 Cust. >) = 0.1789 Time Based P (time in system <= 0 No Units) = 0 P (time in queue <= 0 No Units) = 0.1789	

待ち行列の平均長さ

結果の比較



サーバの個数	サービス時間の平均	到着間隔の平均	待ち行列の平均長さ
2	97.78	59.54	3.3992
1	48.89	59.54	3.7695

**半分の性能のサーバが2個あった方が、
待たせずに済みそう**



- ⑧ 今度は、次のように設定
客が20%減 (到着間隔は 1.25倍)

2. Input all the values required.

The screenshot shows a simulation interface with two main sections. On the left, a blue box labeled 'C' contains a text input field with the value '1' and the label 'Number of Servers'. Below it, a smaller text box says 'Number of servers in parallel open to attend customers.' On the right, a grey box titled 'Arrival and Service rates' contains two rows of input fields. The first row has a text input field with '48.89', a dropdown menu set to 'No Units', and a 'Convert' button. The second row has a text input field with '74.425', a dropdown menu set to 'No Units', and a 'Convert' button. Red boxes highlight the '1' in the server count and the '48.89' and '74.425' values in the arrival and service rate fields.

サーバは **1**個

サービス時間の平均は **48.89**

到着間隔の平均は **74.425**

⑨ 「Calculate」 をクリックすると，結果が出る

Calculate

Results

3. See your results.

Display Results in **No Units** and show results with **4 decimals**

1.9146 Customers L Average Customers in System <small>Average number of customers in the system.</small>	1.2577 Customers W Average Customers in Queue <small>Average number of customers (entities) in the queue. In other words the expected amount of customers waiting to be served.</small>	0.0392 No Units W Average Time in System <small>Average time spent by a customer from arrival until fully served.</small>	0.0257 No Units Wq Average Time Waiting in Line <small>Average time it takes a customer to start being served.</small>
0.6569 ρ Server Utilization <small>Percentage of time a server is being utilized by a customer.</small>	λ' Lambda prime <small>A value used in some calculations.</small>	Probabilities Discrete P (n' customers in system) = 0 Cust. Val = 0.3431 Time Based P (time in system) = 0 No Units = 0 P (time in queue) = 0 No Units = 0.3431	

待ち行列の平均長さ

結果の比較



サーバの個 数	サービス時間 の平均	到着間隔 の平均	待ち行列の 平均長さ
2	97.78	59.54	3.3992
1	48.89	59.54	3.7695
1	48.89	74.425	1.2577

客が20%減っただけで、待ち行列が約1/3になる