

### Data Table in Excel Review – Post Office Problem:

The Data Table is a tool in Excel that will automate the completion of a table that is driven by formulas, when the inputs/outputs (to the formulas) will change. For example, in our queuing template if we wanted to build a data table that was dependent upon the number of servers (a yellow cell), then we could automate this process using the Data Table tool in Excel.

Data Table for Post Office Problem:

The screenshot shows an Excel spreadsheet with the following data:

Input Data		per	Operating Characteristics	
Arrival rate ( $\lambda$ )	100	hour	Average server utilization ( $\rho$ )	74.1%
Service rate ( $\mu$ )	45	hour	Average number of customers in the queue ( $L_q$ )	1.581
Number of servers ( $s$ )	3	nmbr	Average number of customers in the system ( $L$ )	3.804
Cost of Service	30	hour	Average waiting time in the queue ( $W_q$ )	0.016
Cost of Waiting	10	minute	Average time in the system ( $W$ )	0.038
			Probability (% of time) system is empty ( $P_0$ )	0.078

  

Probabilities						
Number in System	Prob	Cum. Prob				
0	0.0785	0.0785				
1	0.1743	0.2528				
2	0.1937	0.4465				
3	0.1435	0.5900				
4	0.1063	0.6963				
5	0.0787	0.7750				
6	0.0583	0.8334				
7	0.0432	0.8766				
8	0.0320	0.9086				
9	0.0237	0.9323				

  

	Cs	Cw	Total Cost (Cs + Cw)
s = 3	\$ 2,372.16	\$ 90.00	\$ 2,462.16
s = 4			
s = 5			
s = 6			
s = 7			

Notice I've setup a table in the lower right of the template.

The formula for Cs is  $\$30/\text{hr} * \text{\# of servers}$ . The # of servers is cell B5.

The formula for Cw is  $\$600/\text{hr} * L$ . L is cell E5.

Below are the formulas:

(Notice that I have formulas for  $C_s$  and  $C_w$  and the Total Cost for 3 servers; linked to the yellow and green cells at the top of the template)

Q3-Post Office - Class.xlsx - Microsoft Excel							
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D18							
Template MMs							
1	Input Data			Operating Characteristics			
2	Arrival rate ( $\lambda$ )	100	per hour	Average server utilization ( $\rho$ )	=B3/(B4*B5)	%	
3	Service rate ( $\mu$ )	45	hour	Average number of customers in the queue ( $L_q$ )	=VLOOKUP(\$B\$5,\$A\$3:\$G\$5,3)	in queue	
4	Number of servers ( $s$ )	3	nmbr	Average number of customers in the system ( $L$ )	=E4+B3/B4	in system	
5	Cost of Service	30	hour	Average waiting time in the queue ( $W_q$ )	=E4/B3	=C3	
6	Cost of Waiting	10	minute	Average time in the system ( $W$ )	=E6+1/B4	=C3	
7				Probability (% of time) system is empty ( $P_0$ )	=VLOOKUP(\$B\$5,\$A\$3:\$G\$5,4)	empty	
8	=IF(ISNUMBER(B4*B5),IF(B3<B4*B5,"",E6PC						
9							
10							
11							
12	Probabilities						
13	Number in System	Prob	Cum. Prob				
14	0	=VLOOKUP(B5,\$A:\$G,2)		3	s	=G13+H13	
15	=A14+1	=IF(A15<=B5,\$H:\$I=C14+B15		4			
16	=A15+1	=IF(A16<=B5,\$H:\$I=C15+B16		5			
17	=A16+1	=IF(A17<=B5,\$H:\$I=C16+B17		6			
18	=A17+1	=IF(A18<=B5,\$H:\$I=C17+B18		7			
19	=A18+1	=IF(A19<=B5,\$H:\$I=C18+B19					
20	=A19+1	=IF(A20<=B5,\$H:\$I=C19+B20					
21	=A20+1	=IF(A21<=B5,\$H:\$I=C20+B21					
22	=A21+1	=IF(A22<=B5,\$H:\$I=C21+B22					
23	=A22+1	=IF(A23<=B5,\$H:\$I=C22+B23					
24	=A23+1	=IF(A24<=B5,\$H:\$I=C23+B24					
25	=A24+1	=IF(A25<=B5,\$H:\$I=C24+B25					
26	=A25+1	=IF(A26<=B5,\$H:\$I=C25+B26					
27	=A26+1	=IF(A27<=B5,\$H:\$I=C26+B27					
28	=A27+1	=IF(A28<=B5,\$H:\$I=C27+B28					
29	=A28+1	=IF(A29<=B5,\$H:\$I=C28+B29					
30	=A29+1	=IF(A30<=B5,\$H:\$I=C29+B30					
31	=A30+1	=IF(A31<=B5,\$H:\$I=C30+B31					
32	=A31+1	=IF(A32<=B5,\$H:\$I=C31+B32					
33	=A32+1	=IF(A33<=B5,\$H:\$I=C32+B33					
34	=A33+1	=IF(A34<=B5,\$H:\$I=C33+B34					
35	Computations						
36	$\rho$	( $\lambda/\mu$ )/ $n$	Cumsum( $n-1$ )	term2	$P_0(s)$	$\rho(h)$	$L_q(s)$
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Now, we could continue building this table one line at a time, but it is faster to do a Data Table in Excel.

Now to create a Data Table for our Total Cost table, we need to highlight the entire table area starting with the 3 server row; and then select “Data Table.”

Select “Data” ; “What-If Analysis”; then “Data Table.”

The screenshot shows the Microsoft Excel interface with the 'Data' tab selected. The 'What-If Analysis' dropdown menu is open, and 'Data Table...' is highlighted. The spreadsheet contains the following data:

Template MMs			Operating Characteristics	
Input Data	per			
Arrival rate (λ)	100	hour	74.1%	%
Service rate (μ)	45	hour	1.581	in queue
Number of servers (s)	3	nbr	3.804	in system
Cost of Service	30	hour	0.016	hour
Cost of Waiting	10	minute	0.038	hour
			0.078	empty

  

Probabilities	Number In System	Prob	Cum. Prob
0	0.0785	0.0785	
1	0.1743	0.2528	
2	0.1937	0.4465	
3	0.1435	0.5900	
4	0.1063	0.6963	
5	0.0787	0.7750	
6	0.0583	0.8334	
7	0.0432	0.8766	
8	0.0320	0.9086	
9	0.0237	0.9323	
10	0.0176	0.9498	
11	0.0130	0.9628	
12	0.0096	0.9725	
13	0.0071	0.9796	
14	0.0053	0.9849	
15	0.0039	0.9888	
16	0.0029	0.9917	
17	0.0021	0.9938	
18	0.0016	0.9955	
19	0.0012	0.9966	
20	0.0009	0.9975	

  

	Cs	Cw	Total Cost (Cs + Cw)
3	2,372.16	90.00	2,462.16
4			
5			
6			
7			

For our table, we need to select “Column Input Cell” and change it to B5 which is the number of servers.

(Note, it will label it as \$B\$5 in the cell once B5 is selected.)

Then click “OK”

[Leave “Row Input Cell” empty.]

And now you have your data table.

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2 Input Data															
3 Arrival rate (λ) 100 hour															
4 Service rate (μ) 45 hour															
5 Number of servers (s) 3 nmbr															
6 Cost of Service 30 hour															
7 Cost of Waiting 10 minute															
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12 Operating Characteristics															
13 Average server utilization (ρ) 74.1% %															
14 Average number of customers in the queue (Lq) 1.581 in queue															
15 Average number of customers in the system (L) 3.804 in system															
16 Average waiting time in the queue (Wq) 0.016 hour															
17 Average time in the system (W) 0.038 hour															
18 Probability (% of time) system is empty (P0) 0.078 empty															
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Note, the above example is for Total Cost of the system. Where Cs is service cost and Cw is the cost of total time in the system. If, we were interested in only time in the queue (or time in line); then we would have used Lq (cell E4) instead of L (cell E5).