
Project 2

Team PZQZ

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Issue 1 New ideas

Mean: 55.97266177152
 Variance: 272.5821023809
 Standard deviation: 16.5100604134
 Number of observations: 30
 Confidence interval +/-: 6.164957868318
 Relative CI error: 0.110142302924
☐ Quantiles:

Average cycle time:
 55 mins
 Throughput: 36

Model

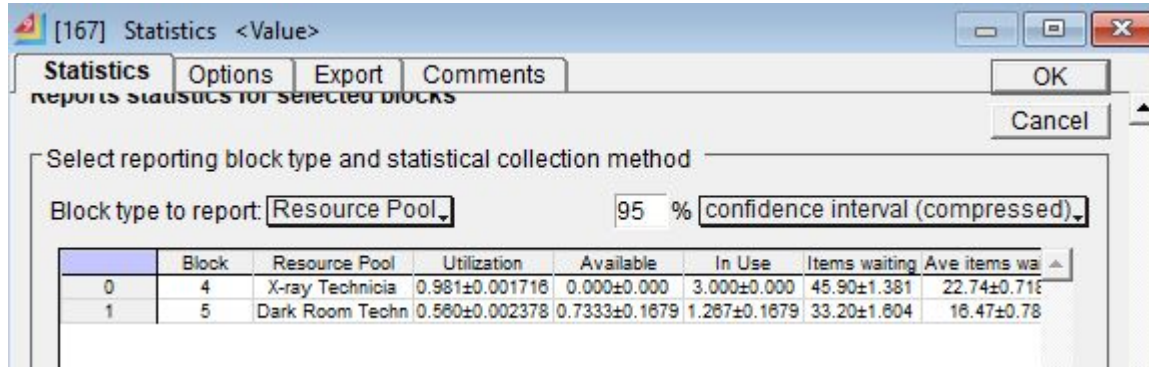
Previous						
Block Name	Block	Average Wait	Max Wait	Arrivals	Departures	Utilization
Collect 5 X-ray	Queue Matching	±	±	±	±	±
Orderlie Q	Queue	1.905±0.09806	5.000±0.000	92.50±1.172	54.87±2.077	0.2885±0.01099
Patients at off	Queue	10.97±1.089	79.51±10.21	53.63±2.067	52.83±2.007	0.4564±0.03107
Priority Q	Queue	33.57±2.217	89.83±5.086	99.53±1.660	88.83±1.345	0.844±0.01832
Wait at lab	Queue	2.581±0.6009	21.48±3.731	54.97±2.086	54.53±2.084	0.1021±0.01565
Wait at office	Queue	82.71±12.66	182.6±21.52	121.9±3.424	94.63±1.265	0.916±0.03035
X-ray at office	Queue	1.517±0.4191	18.40±3.841	52.67±1.945	52.47±1.948	0.06176±0.01187
Current						
Block Name	Block	Average Wait	Max Wait	Arrivals	Departures	Utilization
Orderlie Q	Queue	2.224±0.1469	5.000±0.000	70.67±0.023	40.10±0.488	0.2449±0.02208
Patients at off	Queue	0.000±0.000	0.000±0.000	42.10±0.436	42.10±0.436	0.000±0.000
Priority Q	Queue	50.89±0.772	370.3±4.44	114.6±0.189	85.03±0.633	0.9592±0.006998
Wait at lab	Queue	0.7094±0.4859	10.01±0.027	39.47±0.553	39.47±0.553	0.02913±0.01737
Wait at Office	Queue	4.511±0.692	44.83±4.49	72.60±0.441	71.83±0.149	0.2329±0.06634

Table 1.1 Queue block statistical data

Previous							
Block Name	Block	Average Wait	Max Wait	Arrivals	Departure	Number in Service	Utilization
Check Clarity	Workstation	19.21±1.567	64.97±4.865	78.43±2.174	73.83±2.444	0.2333±0.1606	0.2054±0.006764
Develop X-ray	Workstation	38.47±5.006	97.63±11.28	87.43±1.410	78.43±2.174	0.8667±0.1291	0.8239±0.02671
Filling Forms	Workstation	35.25±2.160	90.73±5.488	92.50±1.172	80.67±1.381	0.500±0.1899	0.5638±0.01071
Current							
Block Name	Block	Average Wait	Max Wait	Arrivals	Departure	Number in Service	Utilization
Check Clarity	Workstation	5.472±0.097	41.17±0.636	56.07±0.197	55.43±0.095	0.100±0.1139	0.1541±0.003044
Develop X-ray	Workstation	51.44±0.102	209.4±6.56	84.77±0.292	56.07±0.197	1.000±0.000	0.9606±0.004316
Filling Forms	Workstation	94.79±0.404	373.0±8.67	165.5±0.555	100.4±0.877	0.6667±0.2468	0.234±0.006913

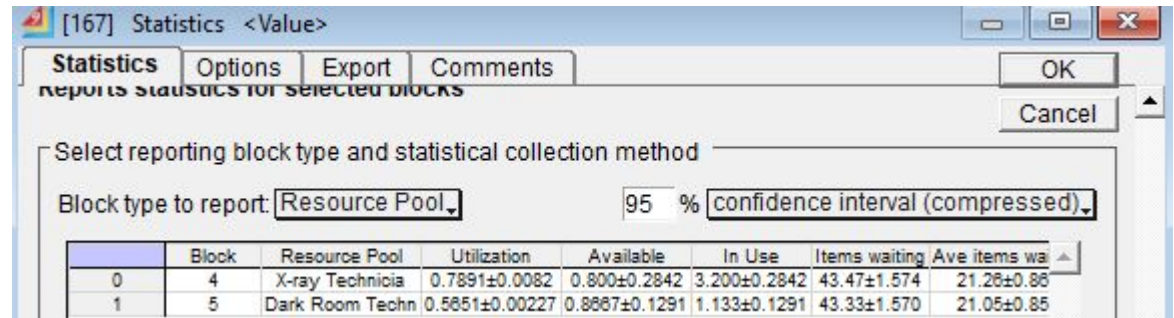
Table 1.2 Workstation block statistical data

Issue 2 - Technicians & Rooms



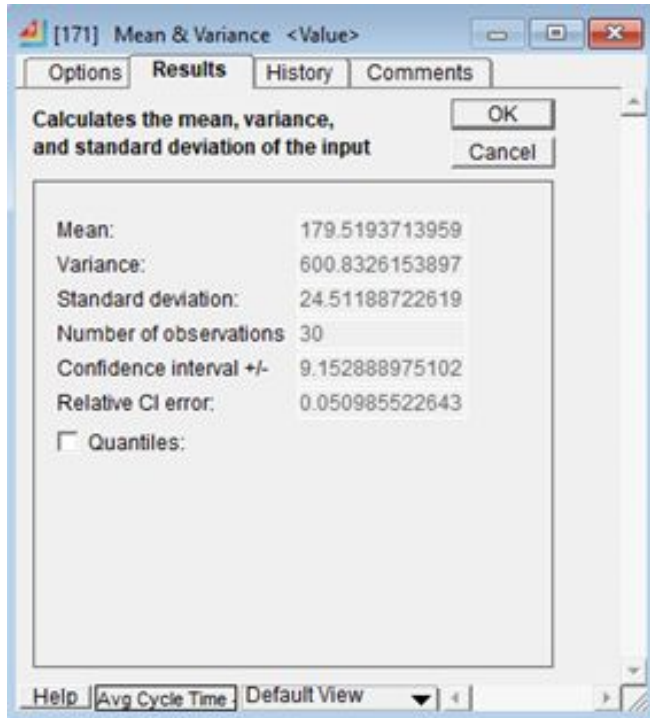
The utilization for X-ray technician is almost 1 based on Project 1 model.

We add one more X-ray technician, and the utilization decreased to 0.79.

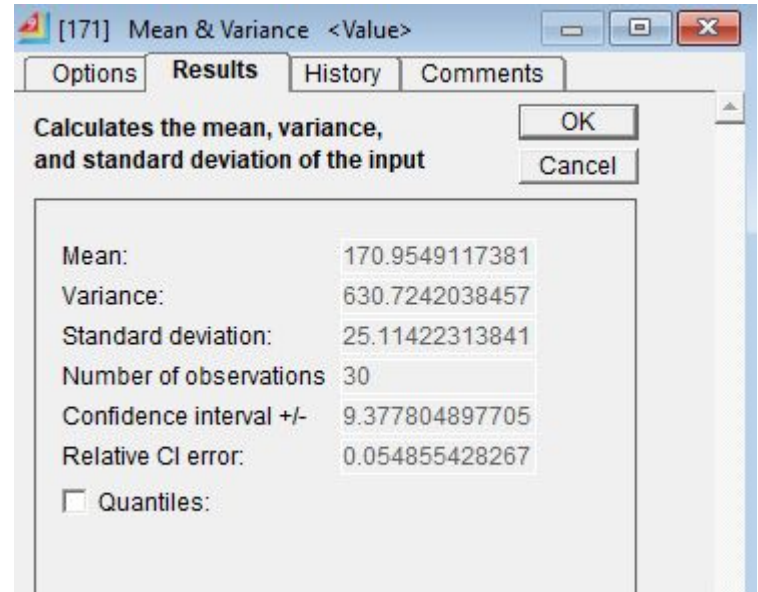


Issue 2 - Technicians & Rooms

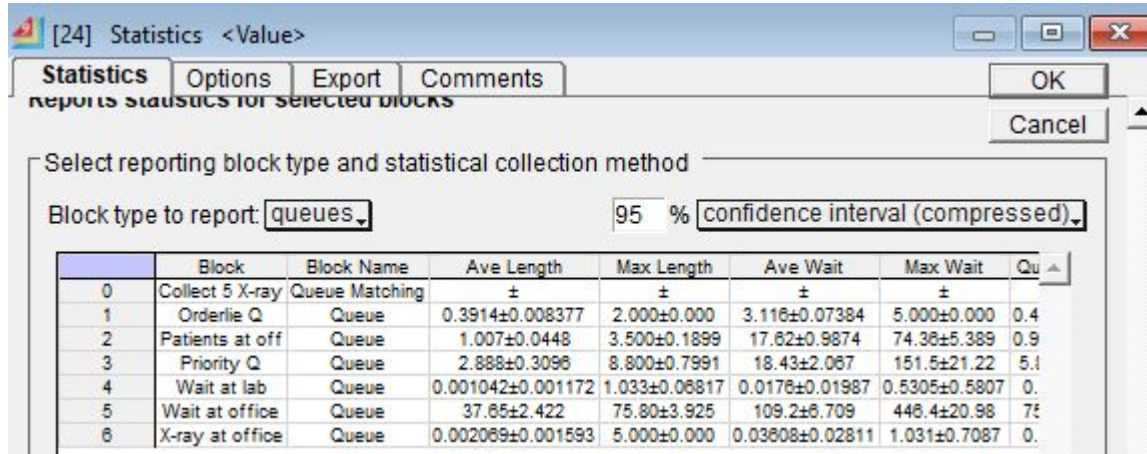
Average Cycle Time in Project 1



After add one more X-ray technician



Issue 2 - Technicians & Rooms



[24] Statistics <Value>

Statistics Options Export Comments OK Cancel

reports Statistics for selected blocks

Select reporting block type and statistical collection method

Block type to report: queues 95 % confidence interval (compressed)

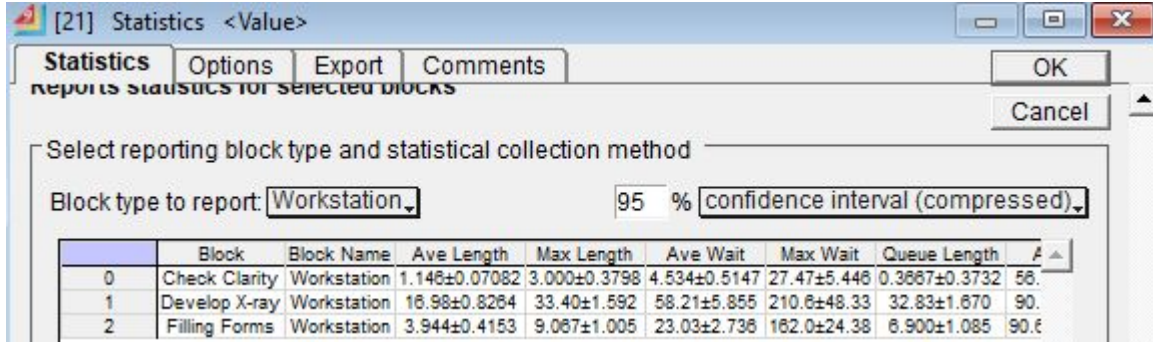
	Block	Block Name	Ave Length	Max Length	Ave Wait	Max Wait	Qu
0	Collect 5 X-ray	Queue Matching	±	±	±	±	
1	Orderlie Q	Queue	0.3914±0.008377	2.000±0.000	3.116±0.07384	5.000±0.000	0.4
2	Patients at off	Queue	1.007±0.0448	3.500±0.1899	17.62±0.9874	74.36±5.389	0.9
3	Priority Q	Queue	2.888±0.3098	8.800±0.7991	18.43±2.067	151.5±21.22	5.1
4	Wait at lab	Queue	0.001042±0.001172	1.033±0.06817	0.0176±0.01987	0.5305±0.5807	0.
5	Wait at office	Queue	37.65±2.422	75.80±3.925	109.2±6.709	446.4±20.98	7.5
6	X-ray at office	Queue	0.002069±0.001593	5.000±0.000	0.03808±0.02811	1.031±0.7087	0.

After filling the form, patient need wait 18.43 minutes in average, but the average maximum wait time is 151.5.

The long wait time may cause some butterfly effects, so we add one more X-ray lab.

However..

Issue 2 - Technicians & Rooms



[21] Statistics <Value>

Statistics Options Export Comments

reports statistics for selected blocks

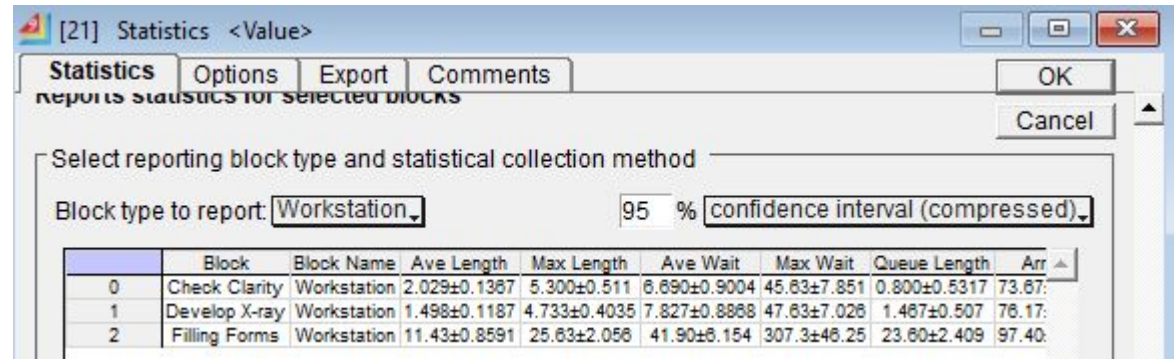
Select reporting block type and statistical collection method

Block type to report: Workstation 95 % confidence interval (compressed)

	Block	Block Name	Ave Length	Max Length	Ave Wait	Max Wait	Queue Length	Arr
0	Check Clarity	Workstation	1.146±0.07082	3.000±0.3798	4.534±0.5147	27.47±5.446	0.3667±0.3732	56.
1	Develop X-ray	Workstation	16.98±0.8264	33.40±1.592	58.21±5.855	210.6±48.33	32.83±1.670	90.
2	Filling Forms	Workstation	3.944±0.4153	9.067±1.005	23.03±2.738	162.0±24.38	6.900±1.085	90.6

The average wait time for develop X-ray is 58.21 minutes.

After add one more dark room, the average time decreased to 7.83 minutes. The average cycle time decreased by 17 minutes, and throughput rate increase by 1.87%.



[21] Statistics <Value>

Statistics Options Export Comments

reports statistics for selected blocks

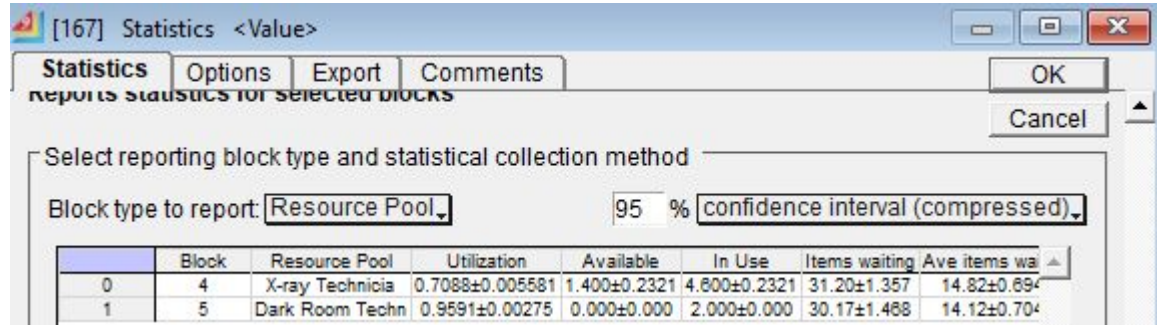
Select reporting block type and statistical collection method

Block type to report: Workstation 95 % confidence interval (compressed)

	Block	Block Name	Ave Length	Max Length	Ave Wait	Max Wait	Queue Length	Arr
0	Check Clarity	Workstation	2.029±0.1387	5.300±0.511	6.690±0.9004	45.63±7.851	0.800±0.5317	73.67
1	Develop X-ray	Workstation	1.498±0.1187	4.733±0.4035	7.827±0.8868	47.63±7.026	1.467±0.507	76.17
2	Filling Forms	Workstation	11.43±0.8591	25.63±2.056	41.90±6.154	307.3±46.25	23.60±2.409	97.40

Issue 2 - Technicians & Rooms

After we combined those changes and we found the utilization for Dark Room technicians is 0.9591, and there are 14 patients waiting for them in average.



The screenshot shows a 'Statistics' window with a table of utilization data. The window has tabs for 'Statistics', 'Options', 'Export', and 'Comments'. The 'Statistics' tab is active, showing 'reports statistics for selected blocks'. Below this, there are fields for 'Block type to report' (set to 'Resource Pool') and '95 % confidence interval (compressed)'. The table below displays data for two blocks: Block 4 (X-ray Technicians) and Block 5 (Dark Room Technicians). The columns include Block, Resource Pool, Utilization, Available, In Use, Items waiting, and Ave items waiting.

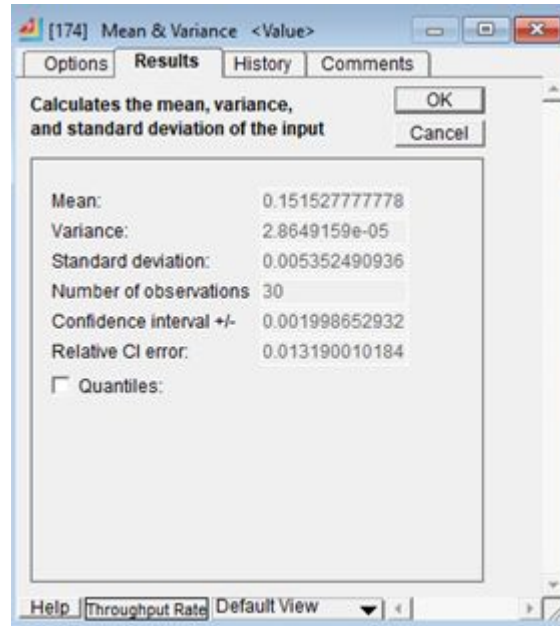
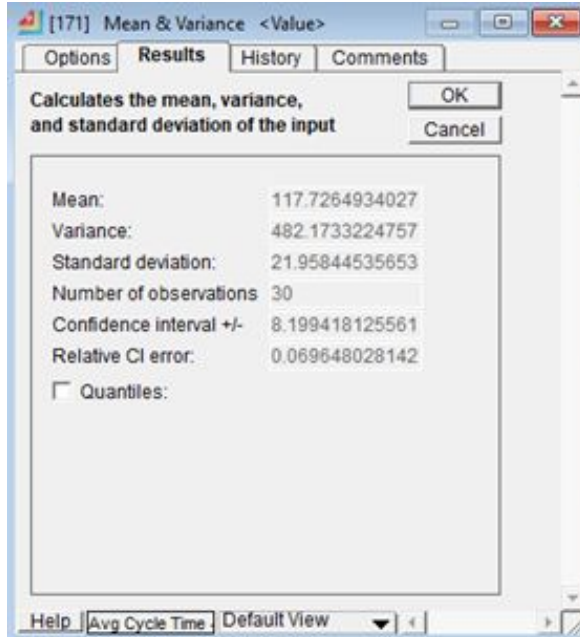
	Block	Resource Pool	Utilization	Available	In Use	Items waiting	Ave items waiting
0	4	X-ray Technicians	0.7088±0.005581	1.400±0.2321	4.600±0.2321	31.20±1.357	14.82±0.694
1	5	Dark Room Technicians	0.9591±0.00275	0.000±0.000	2.000±0.000	30.17±1.488	14.12±0.704

Issue 2 - Technicians & Rooms

Summary:

	Before	After
X-ray Technician	3	8
Dark Room Technician	2	4
X-ray	2	3
Dark Room	2	4

Issue 2 - Technicians & Rooms

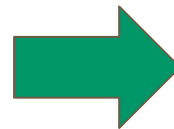


	Utilization
X-ray Technician	0.7384
Dark Room Technician	0.7321
X-ray	0.7141
Dark Room	0.6282

Issue 3 - Orderlie

	# of orderlie	Avg Cycle Time	Avg NE Cycle Time	Avg EM Cycle Time	Avg Wait at Office	Max Wait at Office	Avg Wait at Lab	Max Wait at Lab
Original	3	159.7±3.761	211.8±40.33	150.9±13.65	101.7±7.565	421.3±22.86	0.04318±0.0342	1.406±1.026
Reneged after 2	3	168.0±2.328	236.3±49.57	159.5±10.70	96.38±7.114	357.7±26.51	0.08758±0.0717	2.021±1.255
Reneged after 5	5	162.2±2.103	190.2±35.45	144.7±12.70	20.62±5.113	82.30±12.29	0.01835±0.0163	0.7224±0.6745
Reneged after 2	5	160.3±2.064	209.8±49.18	146.3±10.86	5.153±1.344	35.95±6.142	0.1391±0.1245	3.600±2.751
Reneged after 5	6	158.4±2.934	178.8±44.55	148.3±10.02	3.129±0.7555	26.33±4.318	0.02789±0.0324	0.9006±1.113

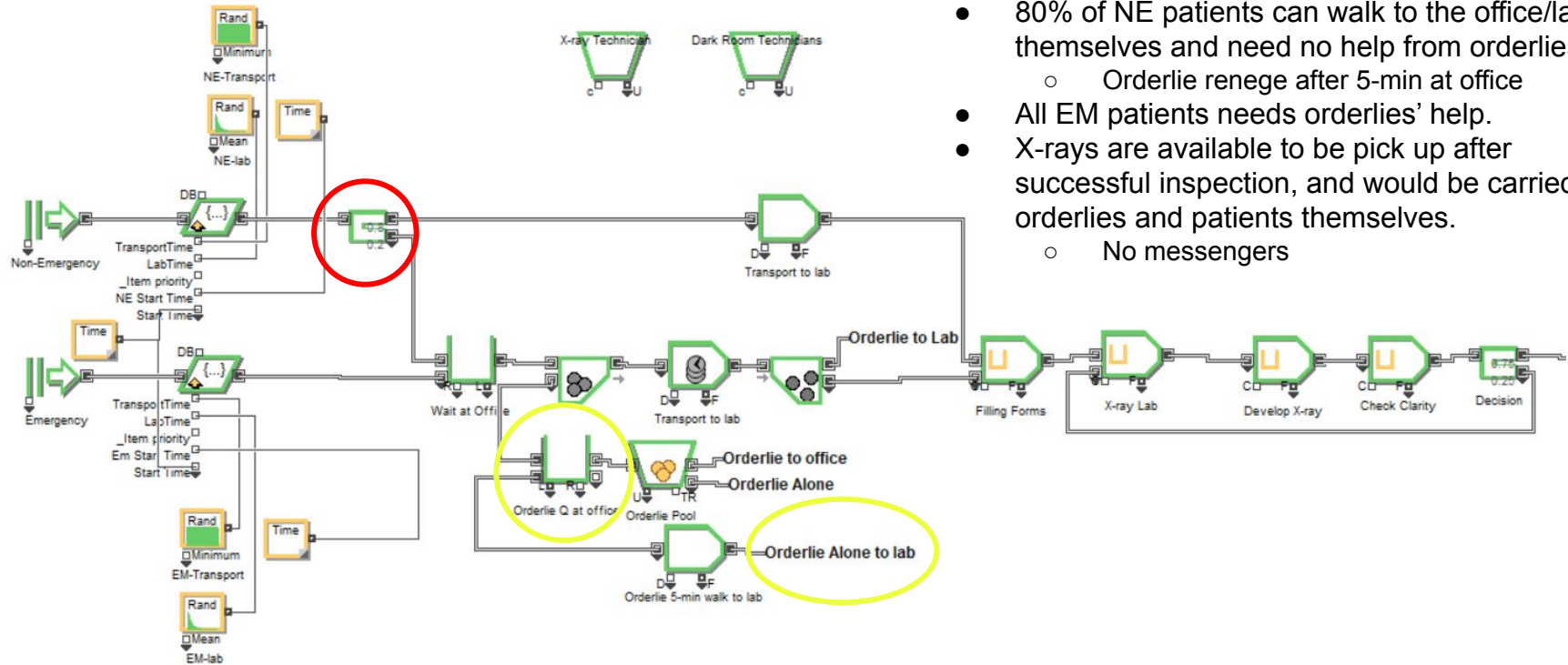
- Previous Major Problem
 - 1 hour more avg. cycle time for NE than EM - due to priority
 - 100 times more waiting time at office than at lab - cause more anxious
- Solution
 - Shorten reneging time to 2-min (avg. waiting time)
 - Shorten waiting time at office (minor effect)
 - More workload for each orderlie
 - ✓ Add more orderlies
 - Shorten avg. non-emergency cycle time (major effect)
 - Cost for hiring more personal



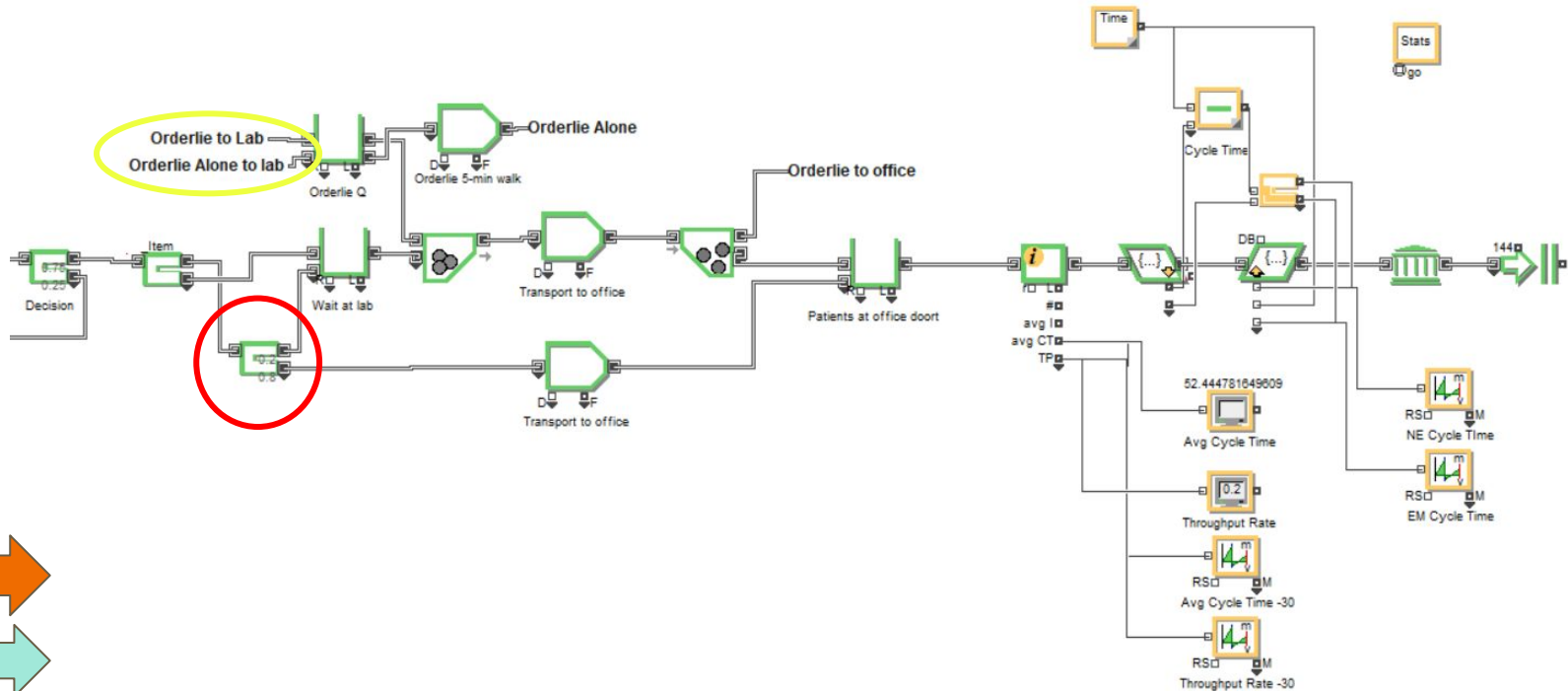
Overall - Improved Model - 1

New Assumptions:

- No cost for adding more resources.
- 80% of NE patients can walk to the office/lab by themselves and need no help from orderlies.
 - Orderlie renege after 5-min at office
- All EM patients needs orderlies' help.
- X-rays are available to be pick up after successful inspection, and would be carried by orderlies and patients themselves.
 - No messengers



Overall -Improved Model - 2



Issue 1

Issue 3

Statistical Improvement

- No cost for adding more resources.
 - 4 X-Ray Lab Rooms
 - 4 Dark Rooms
 - 12 X-ray Technicians
 - 6 Dark-room Technicians
 - 5 Orderlies
 - Throughput 20.96%
 - Avg Cycle Time 67.41 mins
 - EM Cycle Time 54 mins
 - NE Cycle Time 69 mins
- X-Ray technician resource utilization 67.5%
- Dark room utilization 65.6%
- Throughput rate 7.36%
- Activity 4 filling form 9.44%
- Activity 6 develop X-Ray 84.5%
- X-Ray lab utilization of 75.8%

Thank You!
