

Case 9.8.5

Performance Analysis and
Improvement of an Internet
Ordering Process



Introduction

Dad Jokes Unlimited wants to understand the performance of its web order processing.

DJU sells software that can either be purchased as a software version or via a CD. There are two employees that process and fill the orders (a clerk & an accountant) and a range of activities that have various completion time distributions.

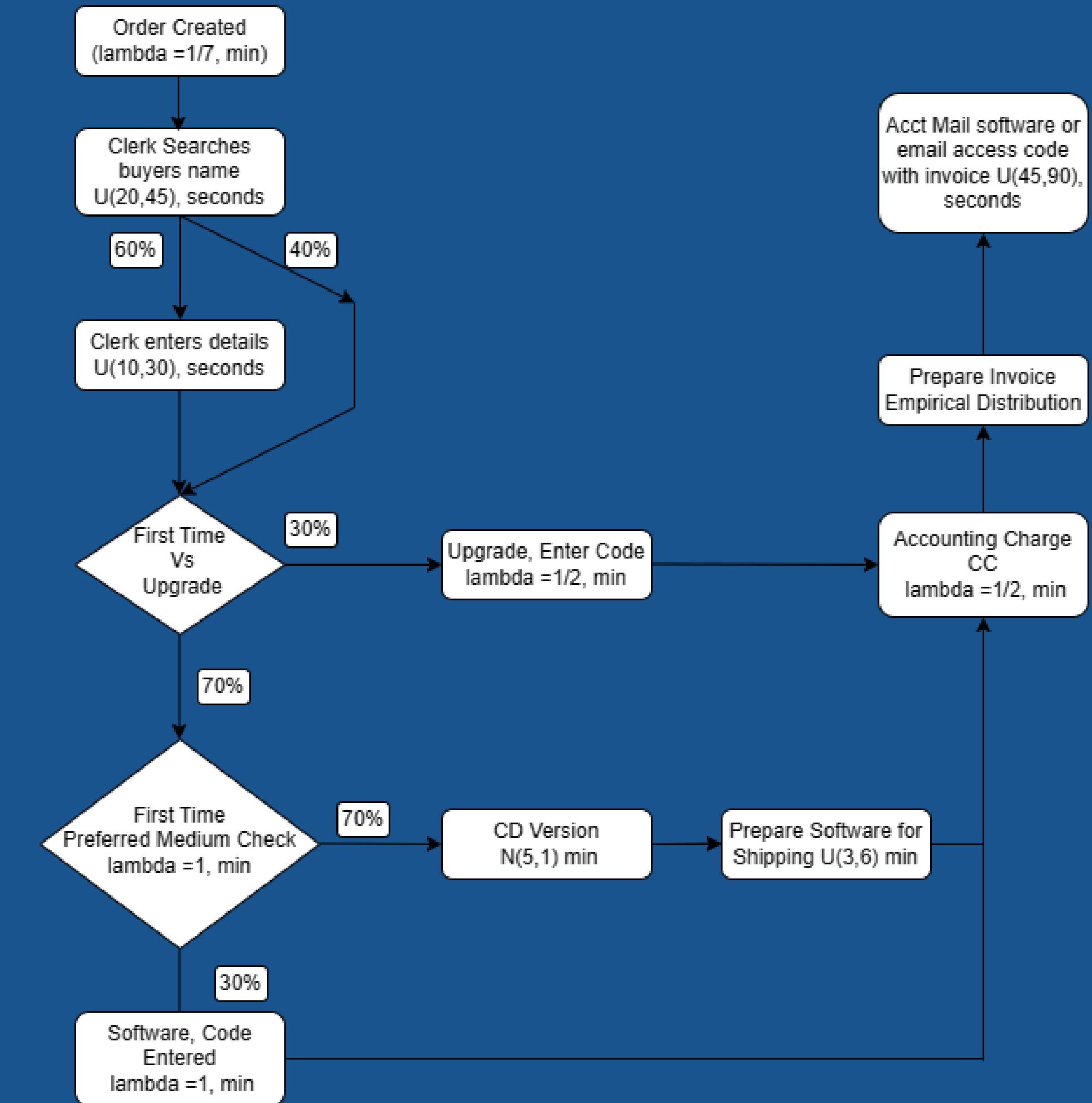




PROJECT PLAN

Understand	Simulate	Optimize
Create visuals to better understand the problem holistically.	Develop simulation in order to understand how the process times vary	Use built-in optimization to improve desired metrics

Process Flow Chart



Motivation

Allocate resources correctly to minimize cycle time





Assumptions

01

BUSINESS PROCESSES FIXED

Efficiency generating alterations
are not available.

02

ACTIVITY DISTRIBUTIONS STATIC

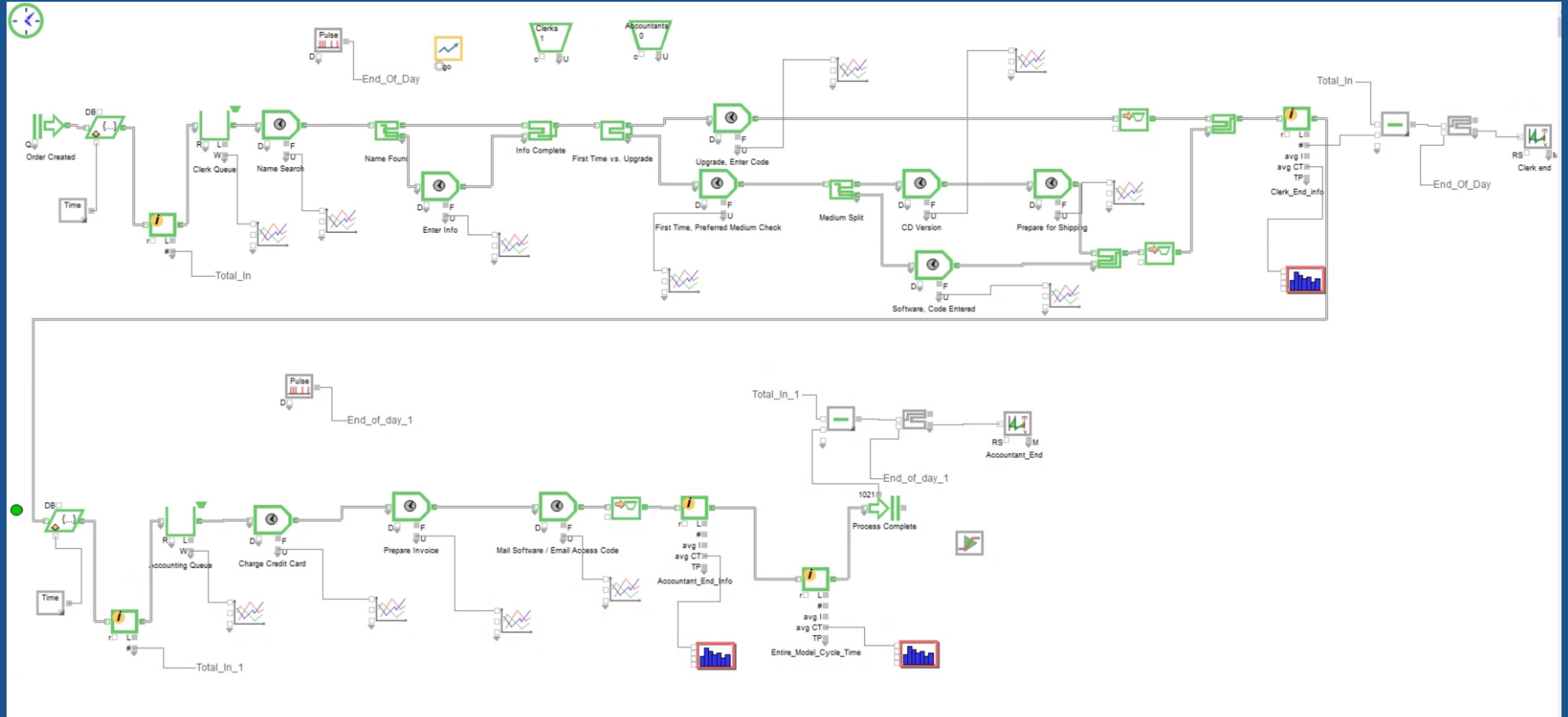
Activity and arrival distributions are
understood and not subject to
change.

03

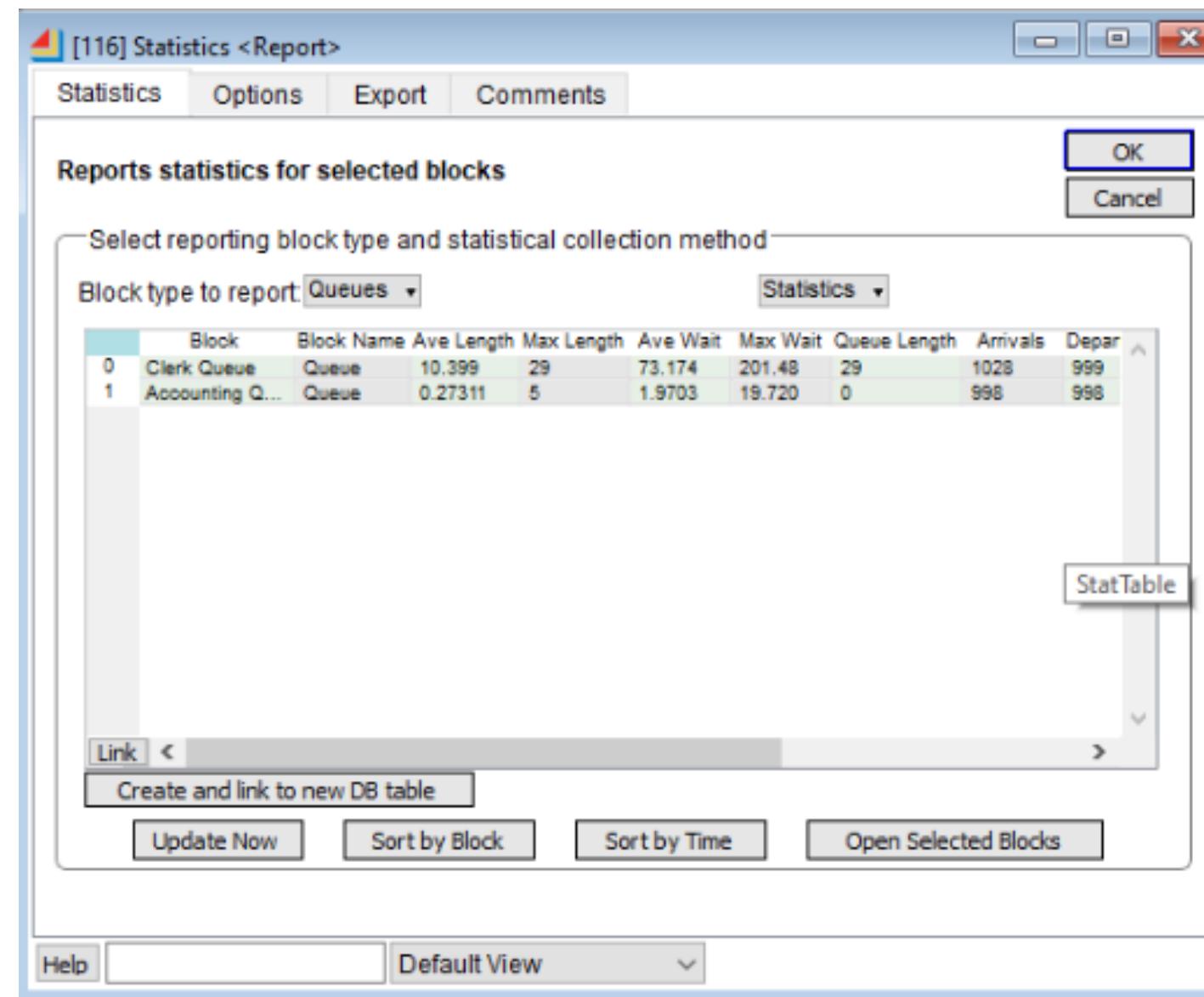
CYCLE TIME MINIMIZATION

Cost function in the
optimization portion is focused
on minimizing cycle time.

Model



Analysis



AVERAGE WAIT TIME:

37x Differential

Clerk: 73.17

Accountant: 1.97

BOTTLENECK

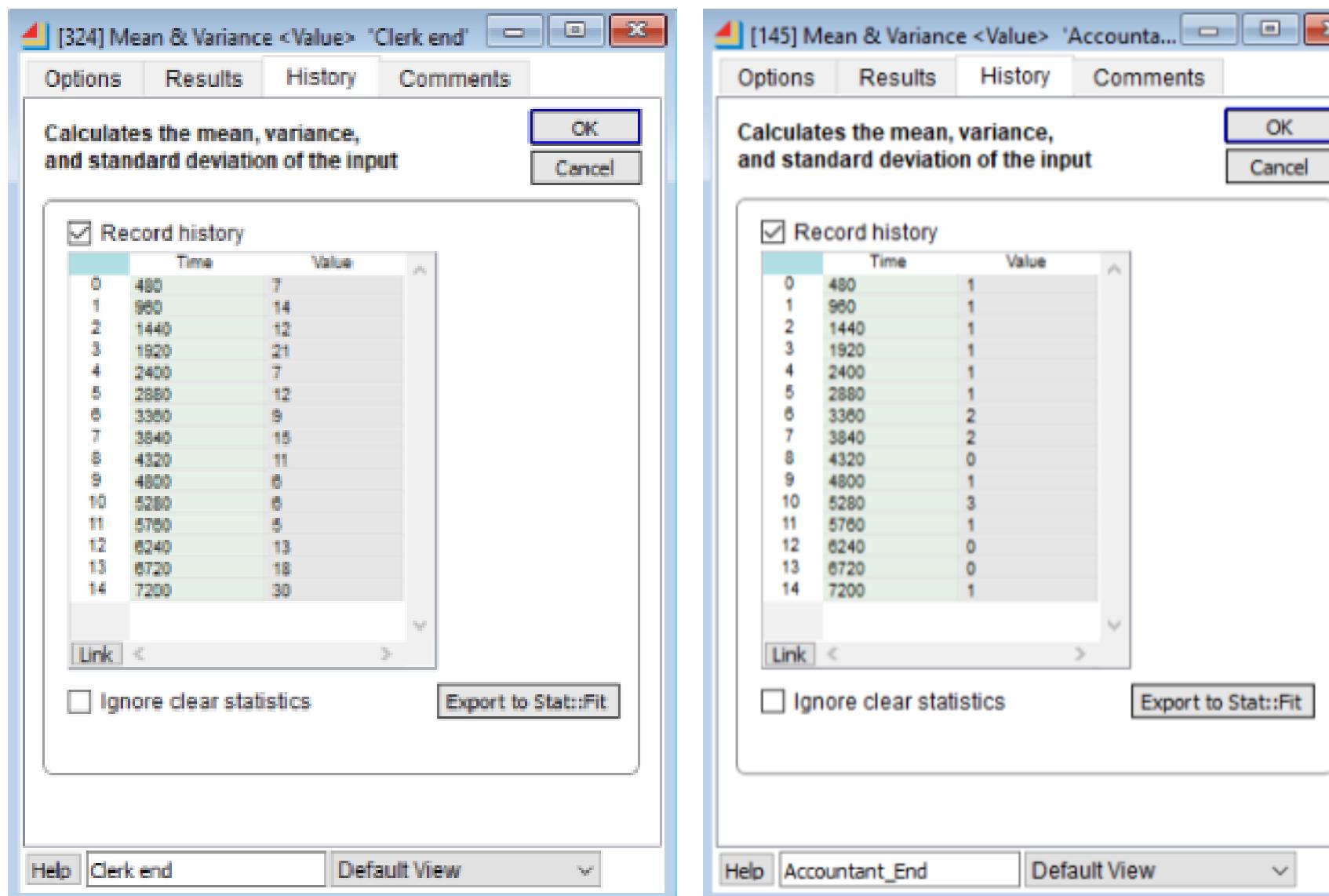
AVERAGE QUEUE LENGTH: 38x Differential

Clerk: 10.40

Accountant: .27

AVERAGE CYCLE TIME: 86.2

Analysis



CLERK AVERAGE WIP

12.4

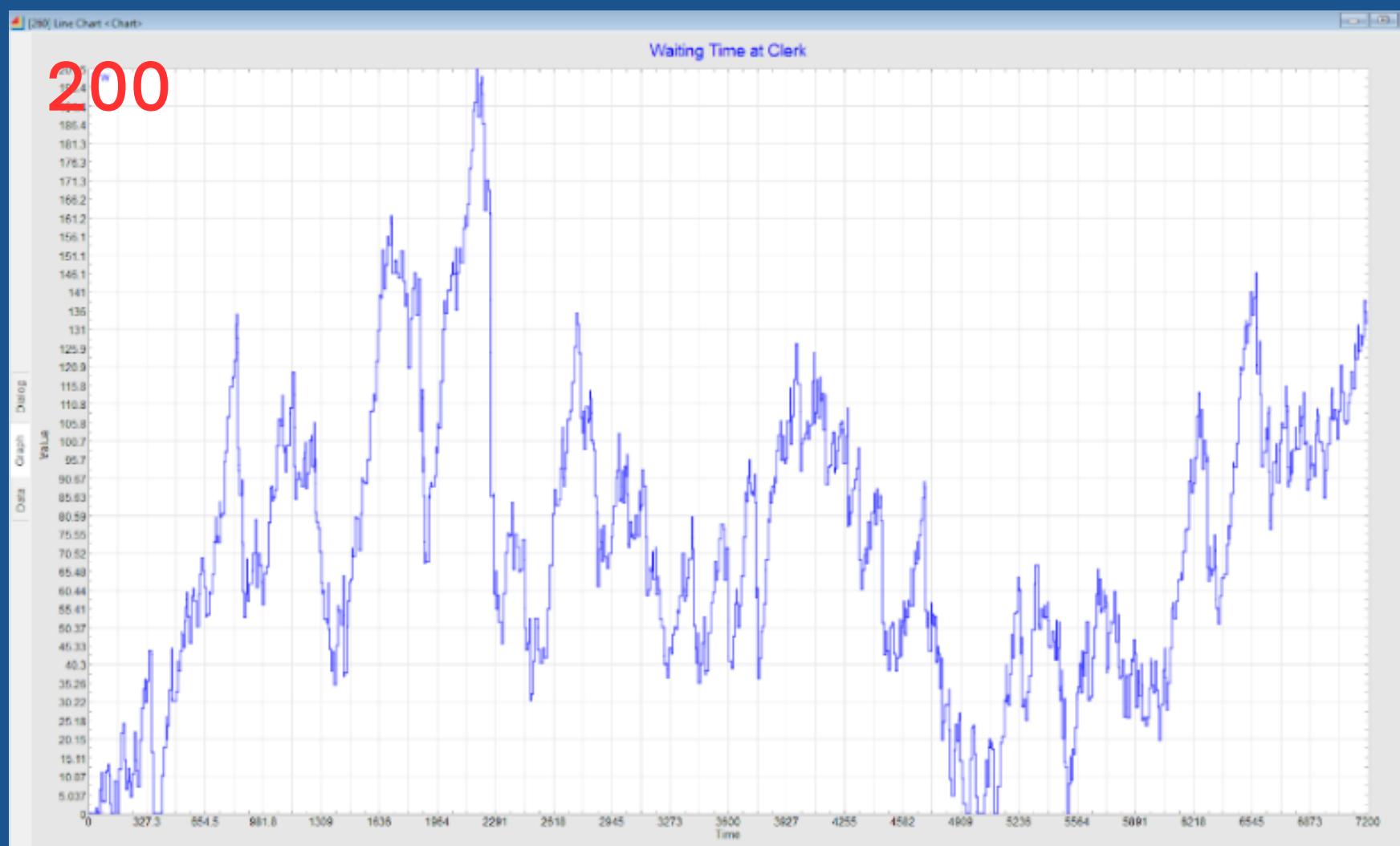
ACCOUNTANT AVERAGE WIP

1.6

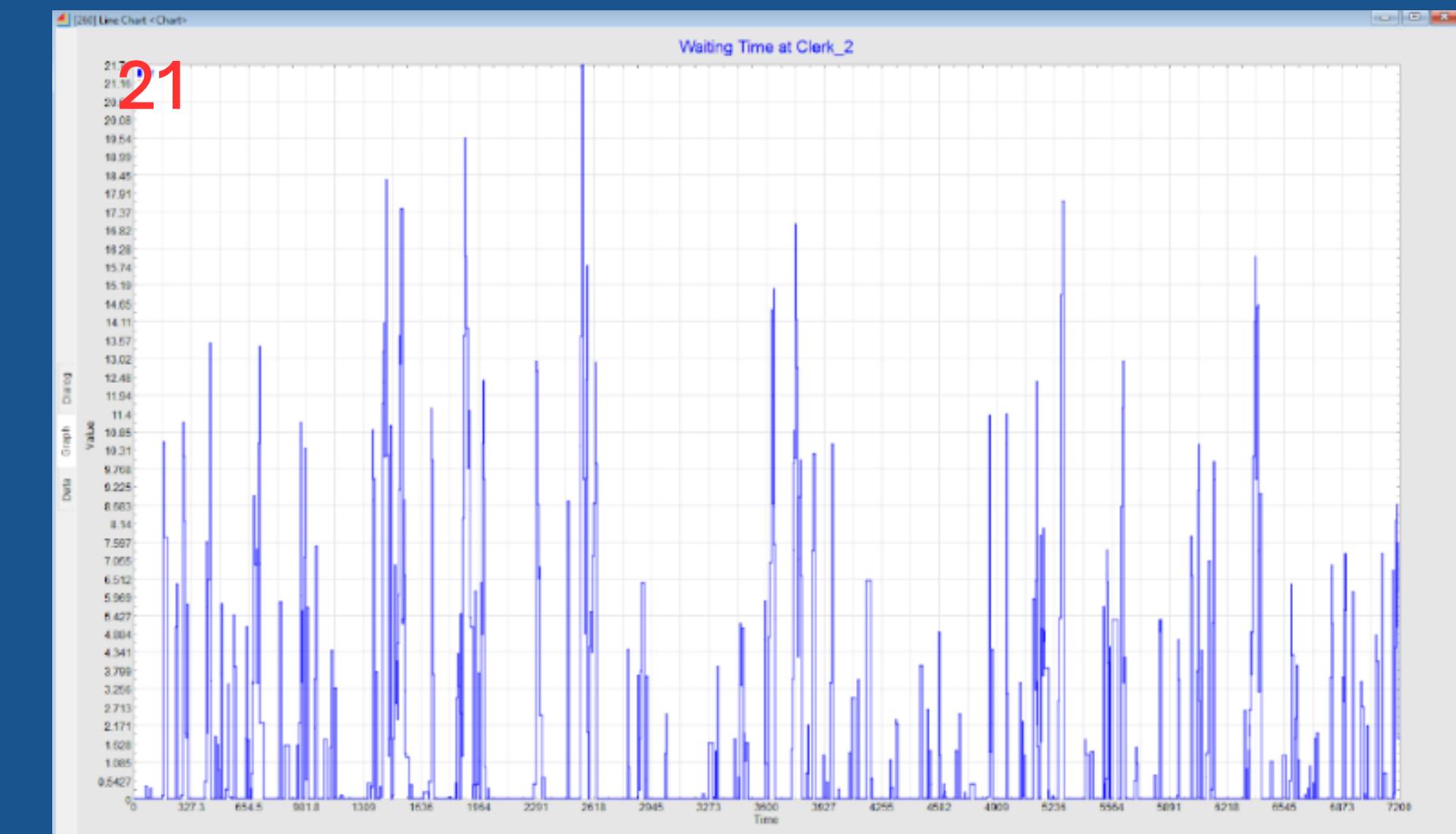
Recommendation:

Add another clerk.

Waiting time with 1 Clerk



Waiting time with 2 Clerks

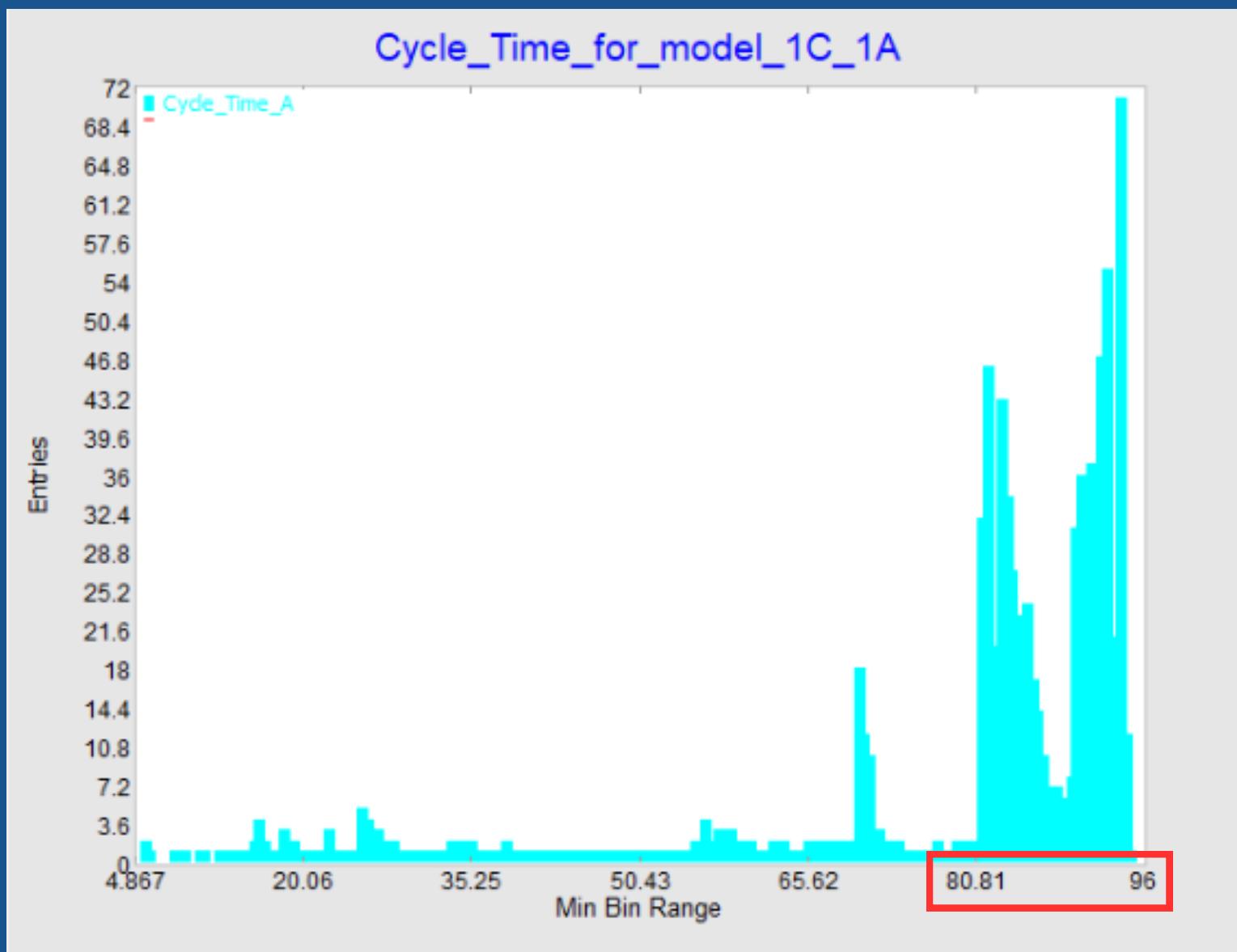


Note scale in red.

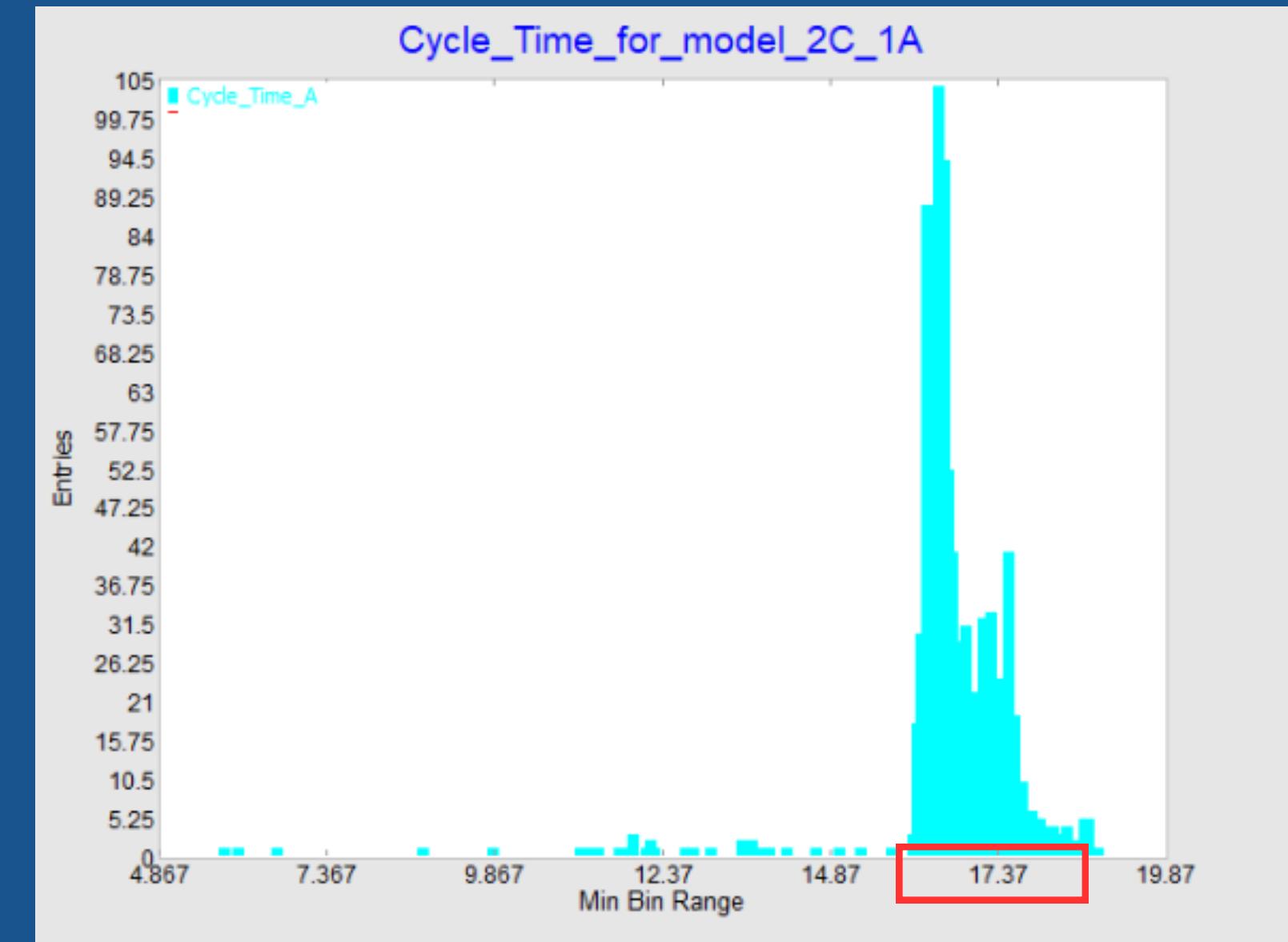
Recommendation:

Add another clerk.

Cycle Time with 1 Clerk



Cycle Time with 2 Clerks



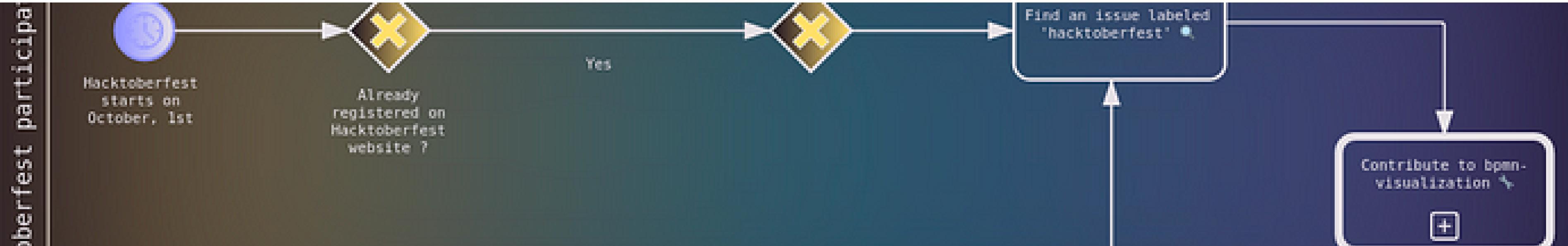


Extension

Optimized Model to Understand Limits

Limiting staff count to 8, a minimum average cycle time of 13.01 is achieved with 5 Clerks and 3 Accountants.

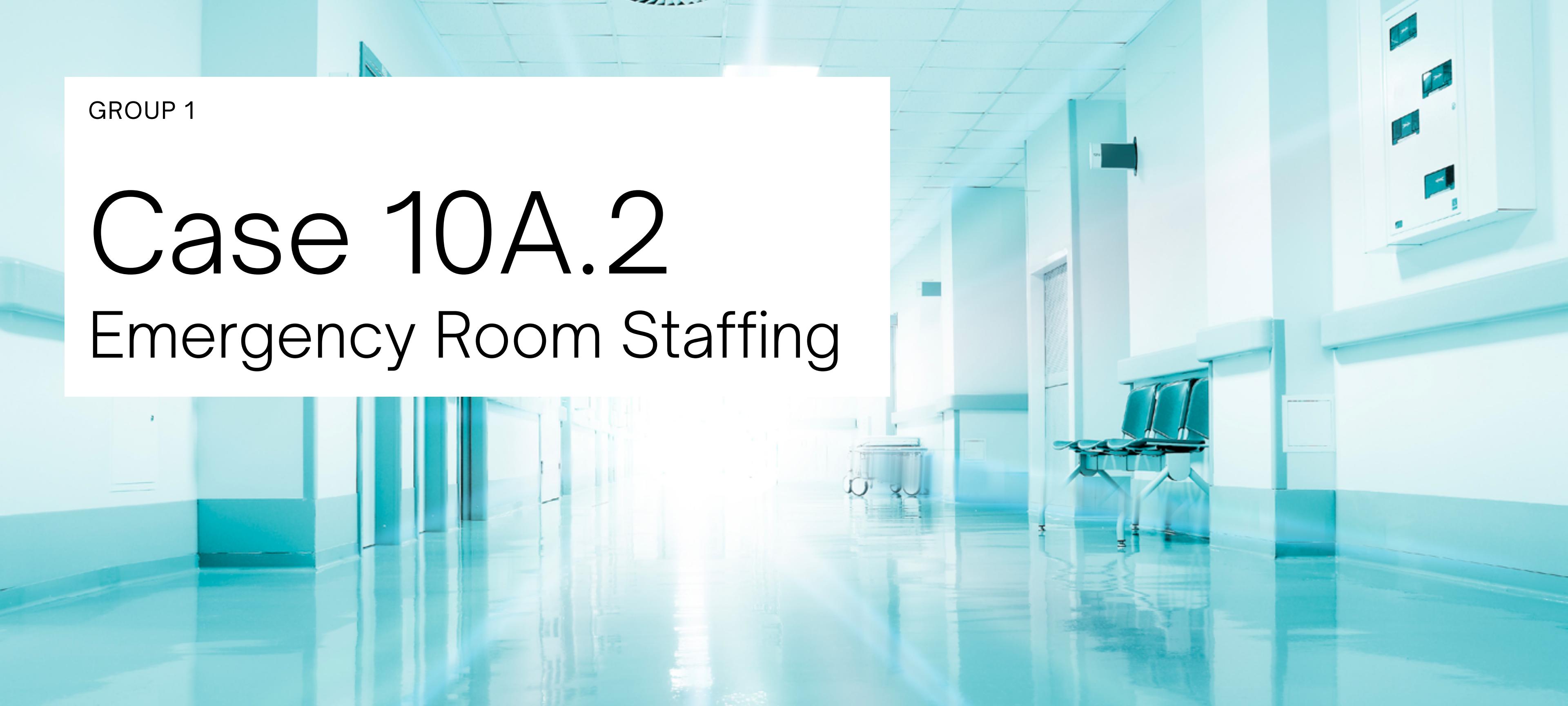
Important to consider improvement versus cost



GROUP 1

Case 10A.2

Emergency Room Staffing



Introduction

Eastern Maine Medical Center wants to understand the performance of its emergency room such that it can most efficiently allocate resources in order to minimize the cycle time of critical patients.

EMMC has a limited number of employees that it can staff and wants to understand how best to allocate employees such that the critical patients get the best care as quickly as possible.



A vertical photograph on the left side of the slide shows a healthcare worker from the waist up, wearing a blue surgical gown, a white hairnet, a white face mask, and a clear plastic face shield. They are wearing blue nitrile gloves and holding a clear plastic syringe with a red liquid at the tip. The background is a solid blue.

PROJECT PLAN

Understand

Create visuals to better understand the problem holistically.

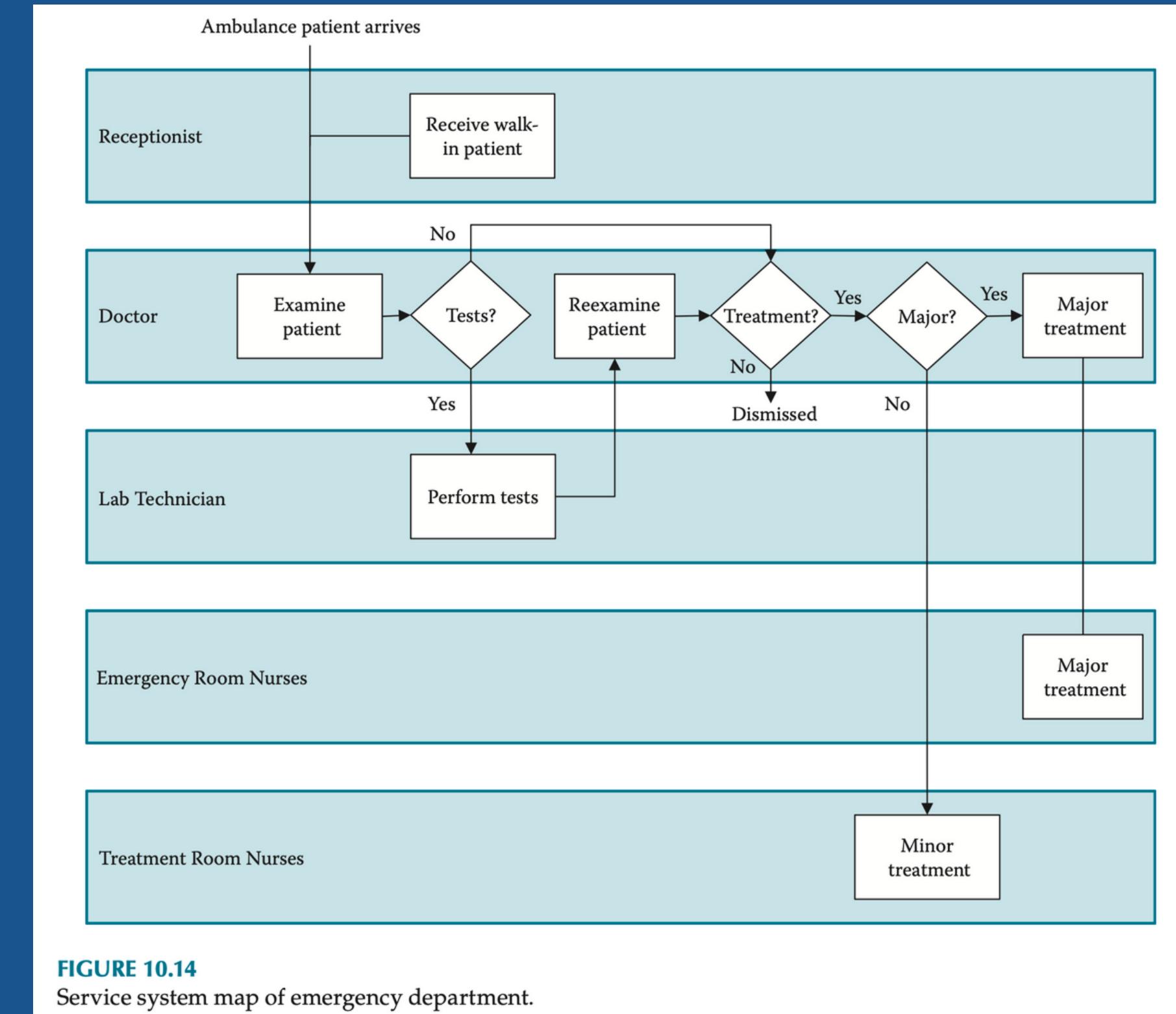
Simulate

Develop simulation in order to understand how the process times vary

Optimize

Use built-in optimization to improve desired metrics

Emergency Room System Service Map



Motivation

EMMC is striving to maximize care while minimizing cost





Potential Paths

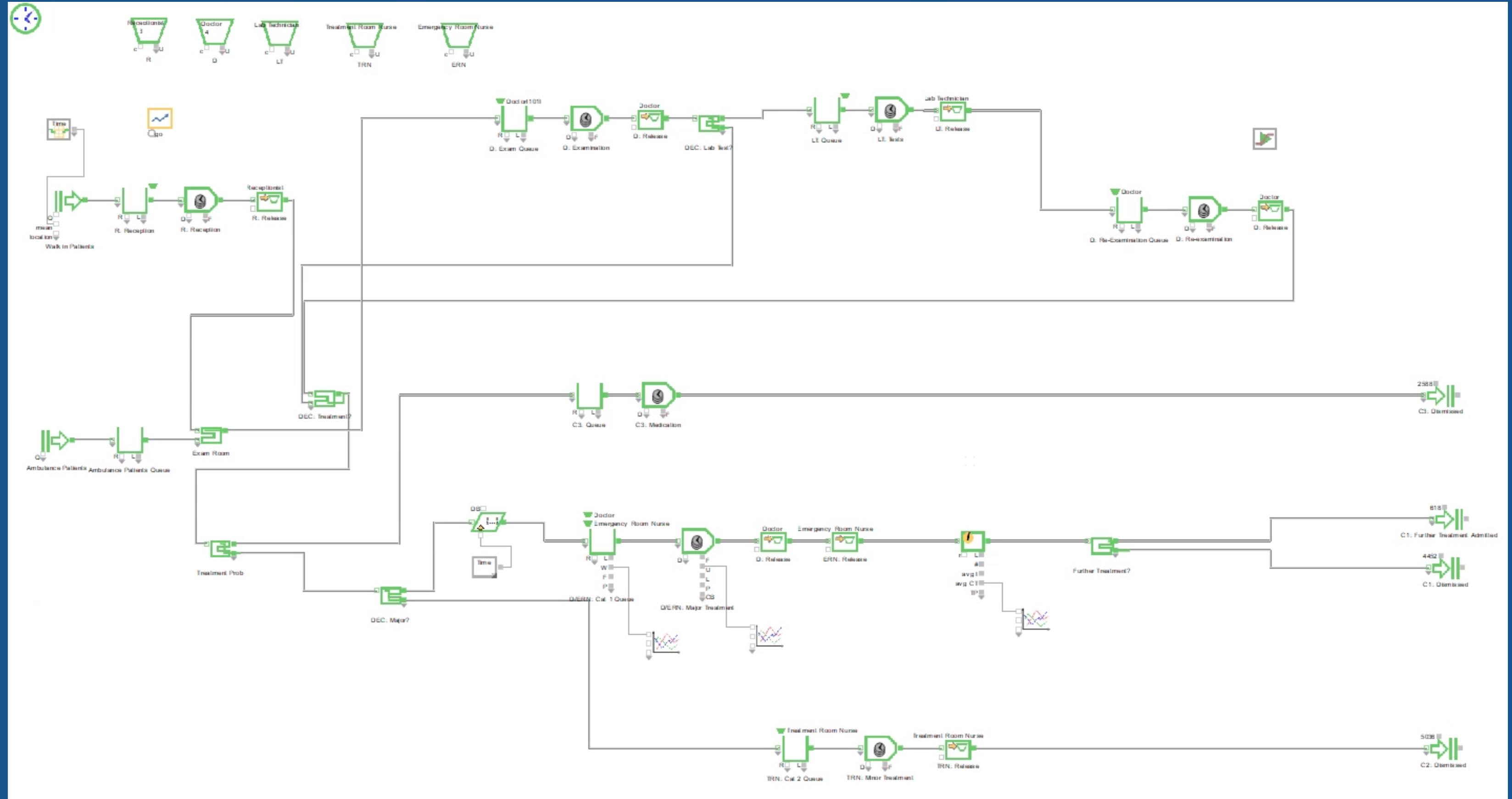
01

MINIMIZE COSTS UNDER CONSTRAINT OF CYCLE TIME THRESHOLD

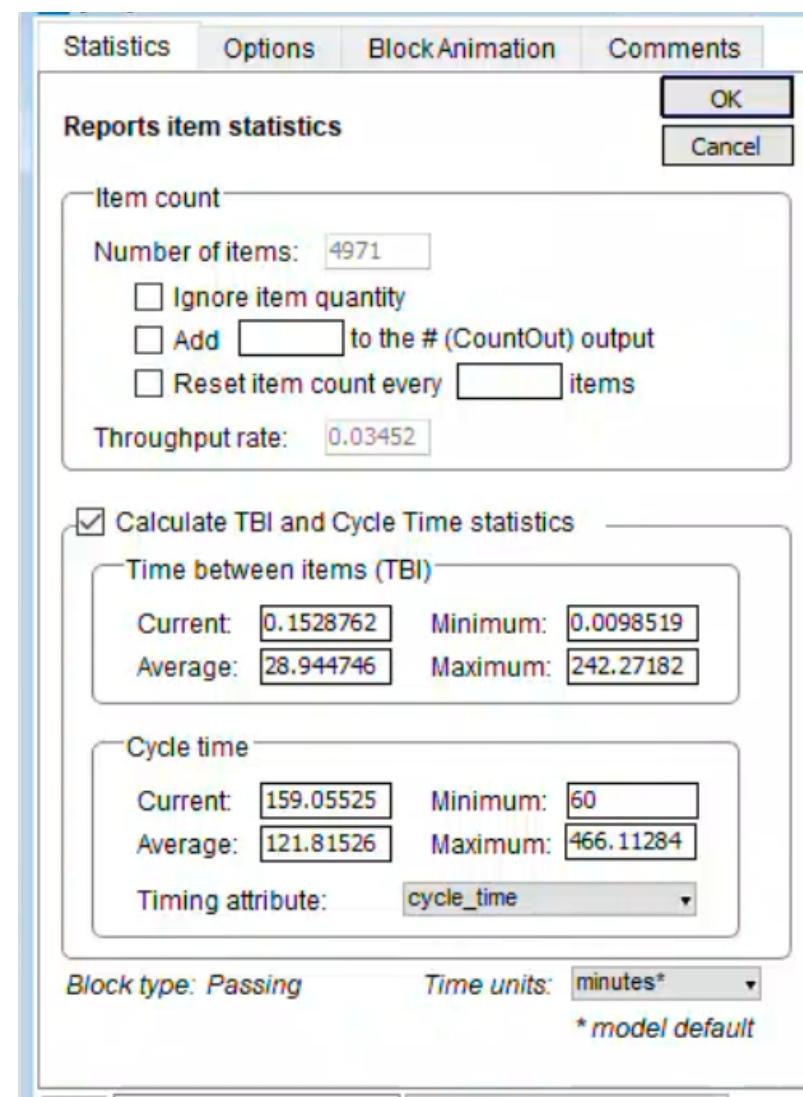
02

MINIMIZE CYCLE TIME UNDER CONSTRAINT OF BUDGET UNITS

Model



Analysis



MINIMUM RESOURCE ALLOCATION

RESOURCES	MAXIMUM RESOURCES	PART A
Receptionist	3	1
Doctor	6	6
Lab Technicians	3	1
Treatment Nurses	3	1
Emergency Nurses	8	4

AVERAGE CYCLE TIME : 121.81

Analysis

OPTIMIZATION RESULT : 30 DAY RUN

[Optimizer <Value>

Objectives Run Parameters Constraints Results Comments

Finds the optimum value (maximum profit or minimum cost) Show Graph OK
New Run Continue Cancel

BEST	Receptionist_Cnt	Doctor_cnt	Lab_tech_cnt	TR_Nurse_cnt	ER_Nurse_cnt	C1_avg_ct	MinCost
0	1	6	1	1	5	99.319823	
1	1	6	1	1	5	99.8511803	
2	1	6	1	1	5	100.181174	
3	1	6	1	1	5	100.629918	
4	1	6	1	1	5	101.180499	
5	1	6	1	1	5	101.411188	
6	1	6	1	1	5	101.811831	
7	1	6	1	1	5	101.96158	
8	1	6	1	1	5	102.347259	
9	1	6	1	2	4	111.506988	
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24							

[436] Information <Item>

Statistics Options BlockAnimation Comments

Reports item statistics OK Cancel

Item count

Number of items: 1509

Ignore item quantity

Add [] to the # (CountOut) output

Reset item count every [] items

Throughput rate: 0.03493

Calculate TBI and Cycle Time statistics

Time between items (TBI)

Current: 23.470097 Minimum: 0.0266777

Average: 28.583031 Maximum: 190.10487

Cycle time

Current: 114.99303 Minimum: 60

Average: 98.544263 Maximum: 184.77622

Timing attribute: cycle_time

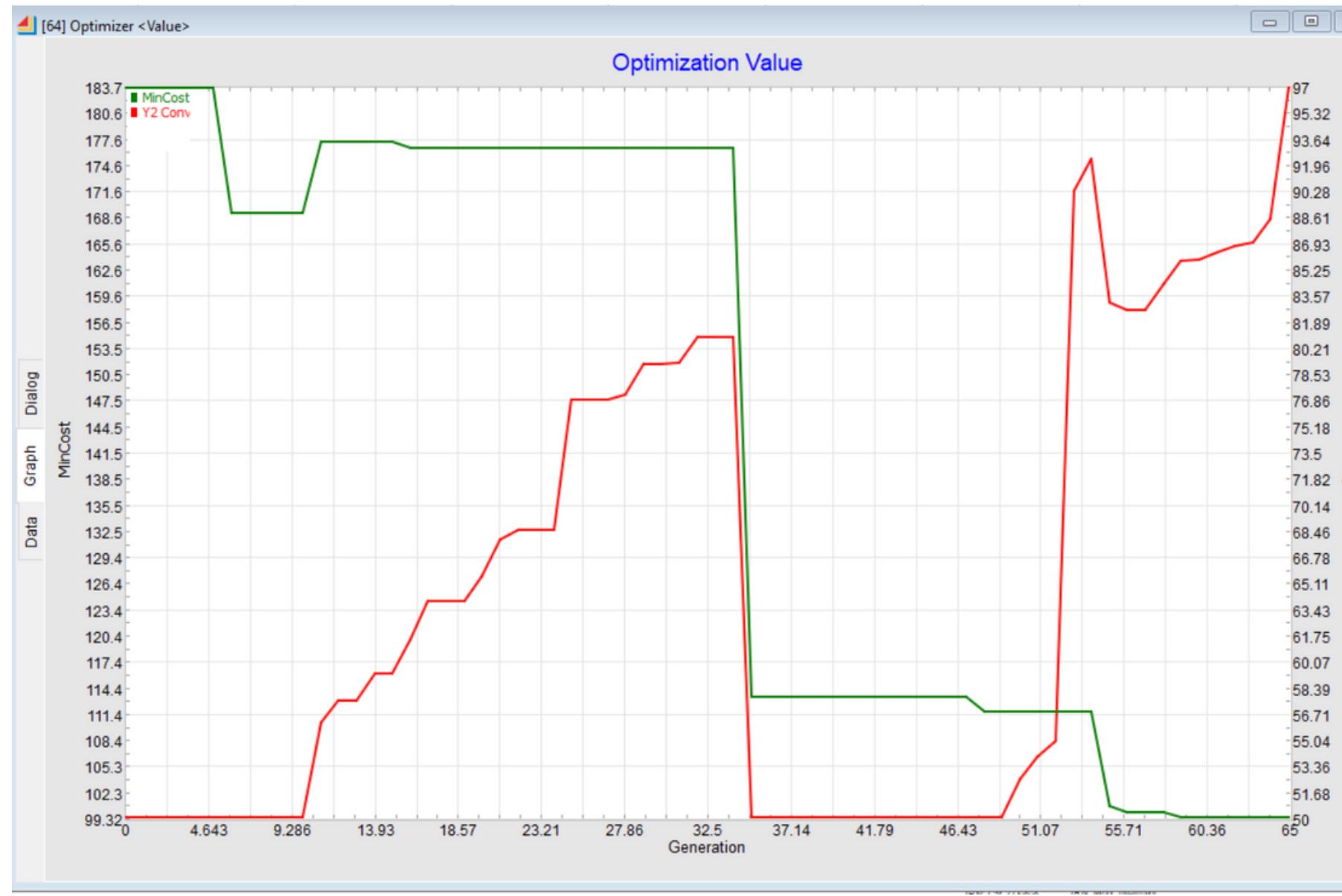
Block type: Passing Time units: minutes* * model default

Help Left to right

AVERAGE CYCLE TIME:
98.54

Analysis

OPTIMIZATION RESULT : 30 DAY RUN



Optimizer <Value>

Objectives Run Parameters Constraints Results Comments

Finds the optimum value (maximum profit or minimum cost)

Define constraint equations (equations are evaluated from top to bottom)

Note: For individual constraint equations use: EquationVariable = (calculate constrained value).
For global constraints use: if(conditions) Reject=TRUE;

```
if(.4*Receptionist_Cnt+1.2*Doctor_cnt+5*Lab_tech_cnt+3*TR_Nurse_cnt + 3*ER_Nurse_cnt > 10)
Reject = TRUE;
```

Dialog Data Graph

Optimizer <Value>

Objectives Run Parameters Constraints Results Comments

Finds the optimum value (maximum profit or minimum cost)

Enter minimum and maximum limits for the variables to be optimized (leave blank for model outputs)

Equation Variable	Block	Block Variable	Row,Column	Minimum Limit	Maximum Limit	Current Value
0 Receptionist_Cnt	R	NumServ	1	3	1	
1 Doctor_cnt	D	NumServ	1	6	6	
2 Lab_tech_cnt	LT	NumServ	1	3	1	
3 TR_Nurse_cnt	TRN	NumServ	1	3	1	
4 ER_Nurse_cnt	ERN	NumServ	1	8	5	
5 C1_avg_ct	498	AveCycleTime	1	98.544262583...		
6						
7						
8						
9						

Enter an equation in the form: MinCost (or MaxProfit) = equationVar...

MinCost = C1_avg_ct;

OK Cancel Continue Run New Run Dialog Data Graph

Constraints

Objective Function

Analysis

RESULT COMPARISON : 100 DAY RUN

PART A

[436] Information <Item>

Statistics Options BlockAnimation Comments OK Cancel

Reports item statistics

Item count

Number of items: 4971

Ignore item quantity

Add [] to the # (CountOut) output

Reset item count every [] items

Throughput rate: 0.03452

Calculate TBI and Cycle Time statistics

Time between items (TBI)

Current:	0.1528762	Minimum:	0.0098519
Average:	28.944746	Maximum:	242.27182

Cycle time

Current:	150.05525	Minimum:	60
Average:	121.81526	Maximum:	466.11284

Timing attribute: cycle_time

Block type: Passing Time units: minutes* * model default

AVERAGE CYCLE TIME

MAXIMUM CYCLE TIME

PART B

[436] Information <Item>

Statistics Options BlockAnimation Comments OK Cancel

Reports item statistics

Item count

Number of items: 5181

Ignore item quantity

Add [] to the # (CountOut) output

Reset item count every [] items

Throughput rate: 0.03598

Calculate TBI and Cycle Time statistics

Time between items (TBI)

Current:	25.629284	Minimum:	0
Average:	27.777862	Maximum:	244.92163

Cycle time

Current:	71	Minimum:	60
Average:	104.76393	Maximum:	267.51705

Timing attribute: cycle_time

Block type: Passing Time units: minutes* * model default

Analysis

RESULT COMPARISON : 100 DAY RUN : RESOURCE UTILIZATION

BLOCK NAME	PART A	PART B
Reception	0.0414	0.0412
Doctor Examination	0.1323	0.1319
Lab Technician Tests	0.04211	0.04377
Doctor Re-Examination	0.04109	0.04253
Treatment Nurses: Minor Treatments	0.08986	0.08628
Doctor and Emergency Nurses: Major Treatments	0.3119	0.3248
Category 3: Medication	0.0017	0.0017

Analysis

RESULT COMPARISON : 100 DAY RUN : COST COMPARISON

RESOURCES	MAXIMUM RESOURCES	PART A	PART B	BU COSTS	TOTAL COSTS (A)	TOTAL COSTS (B)
Receptionist	3	1	1	0.4	0.4	0.4
Doctor	6	6	6	1.2	7.2	7.2
Lab Technicians	3	1	1	0.5	0.5	0.5
Treatment Nurses	3	1	1	0.3	0.3	0.3
Emergency Nurses	8	4	5	0.3	1.2	1.5

Total Costs:

9.6

9.9

Recommendation:

Given the drastic difference in performance and the minimal difference in cost, we recommend that the hospital employ a 5th Emergency Nurse.

	Part A (min)	Part A (hr)	Part B (min)	Part B (hr)	Comparison A/B
Average	121.82	2	104.76	1.75	16.28%
Maximum	466.11	7.75	267.52	4.5	74.23%
Cost (BU)	9.6		9.9		-3.03%

Thank
you!