IE3081 - PROJECT

PTT SIMULATION

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Description of Model Topic

Nowadays, waiting in line is a big problem for customers. With the increasing in the population, organizations may be insufficient in this regard. Customer satisfaction is very important for organizations. If the customer is satisfied with the service, the customer continues to prefer that company.

The biggest problem for customers is waiting in the queue. Because they want to get things done and leave without wasting time. If there are long queues at a company with no specified method, the customer begins to complain. Companies try to find solutions to prevent them. One of these companies is postal organizations is PTT (T.C. Posta ve Telgraf Teşkilatı Genel Müdürlüğü) can be an example for this.

There are many transactions such as money transfer, cargo sending, receiving cargo in PTT.

In order to provide better services, the queue problem will be tried to be solved in this project.

System components

ENTITIES

- Customer
- Teller
- Ticket Machine
- ATM

ATTRIBUTES

1-Customer

- SSN (Social Security Number)
- Name
- Surname
- Address
- Other identity informations.

2-Tellers

- Name
- Surname
- Employee Number
- Signature
- Stamp (to accept the operation)

3-Ticket Machine

- Tickets
- Button
- Number of total customers records

4-ATM

- Card Entry
- Money

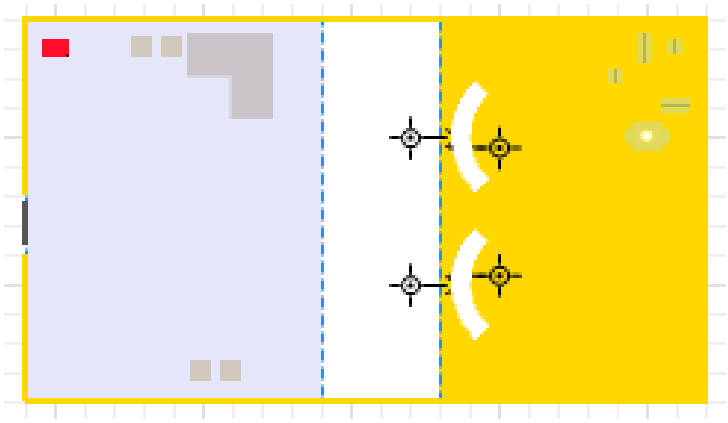
The relations between system components

These are the steps of the process. It shows the relations between system components (entities,attributes,activities,events,state variables).

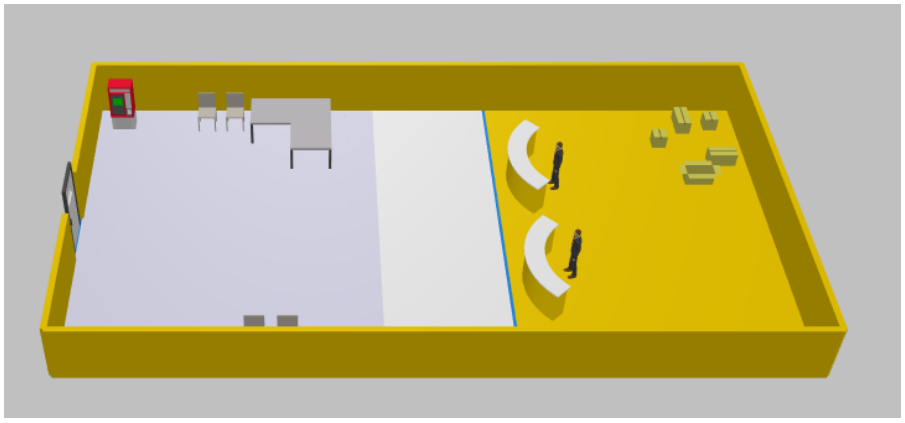
A customer comes to PTT. The customer takes a sequence number from the queue machine and waits for its turn to come. In this case, since each incoming customer will receive a sequence number, a queue is created automatically. Customers whose numbers are lit on the screen at the counter proceed to the counter to make the transaction. After performing the transaction, the customer leaves the institution and the next customer's sequence number lights up on the screen. In this way, customers take turns making their transactions. The system works with FIFO (First in first out).

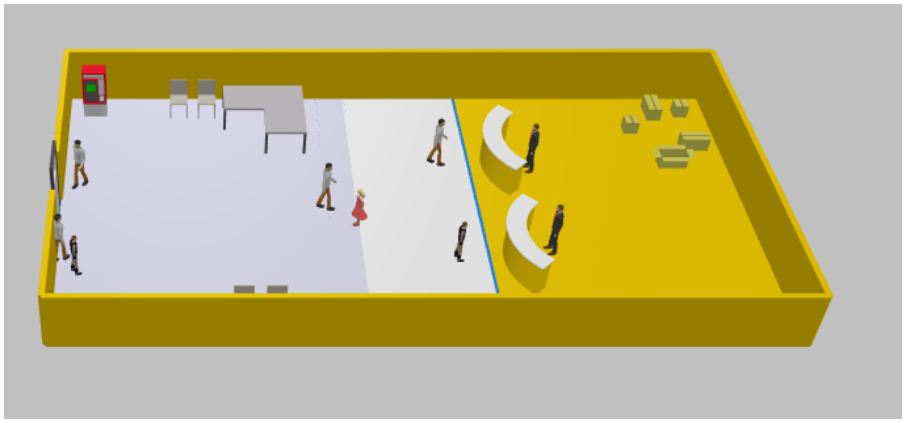
FIRST MODEL

2D view of the model



3D view of the model





The input variables (describe as the decision variables and uncontrollable variables)

EXOGENOUS (INPUT) VARIABLES

1-DECISION VARIABLES

- Number of tellers
- Number of ATM

2-UNCONTROLLABLE VARIABLES

- Customer arrivals
- Technique problems

ENDOGENOUS (OUTPUT) VARIABLES:

- Average waiting time in queue
- Average service time
- Average waiting time in system
- Customer checkout time
- Total customer entered to service
- Total customer which completed service

FIRST MODEL CALCULATIONS

SEEDS	AVG waiting time in queue (minute)	AVG service time (minute)	AVG waiting time in system (minute)	Total Customer entered to system	Total Customer entered to service	Total Customer which completed service	Simulation Time (minute)
SEED 1	62.86	14.64	77.5	80	66	62	480
SEED 2	58	14.7	72.7	88	66	62	480
SEED 3	34.88	14.3	49.18	83	63	59	480
SEED 4	77.08	14.65	91.73	95	66	62	480
SEED 5	64.71	13.975	78.685	109	63	59	480
SEED 6	42.61	14.43	57.04	78	63	59	480
SEED 7	83.58	14.075	97.655	102	66	62	480
SEED 8	62.83	14.458	77.288	99	64	60	480
SEED 9	63.36	14.16	77.52	104	66	62	480
SEED 10	49.35	13.81	63.16	94	66	62	480

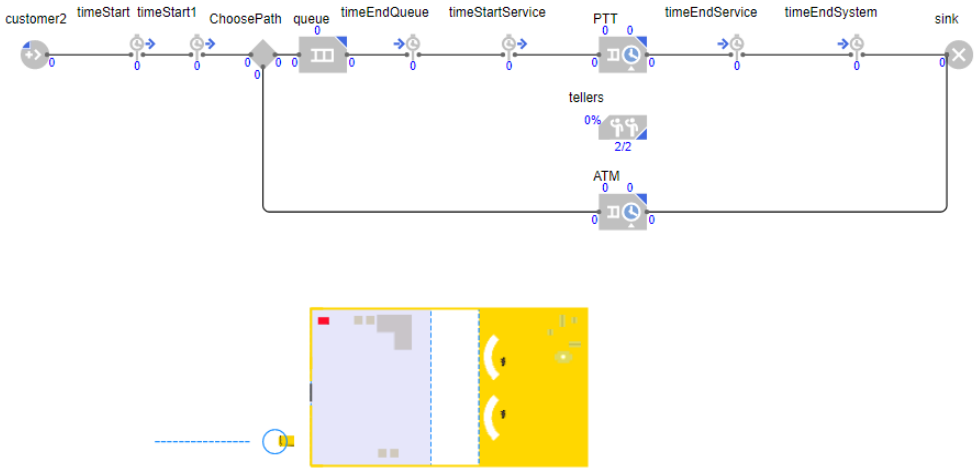
	AVG waiting time in queue (minute)	AVG service time (minute)	AVG waiting time in system (minute)	Total Customer entered to system	Total Customer entered to service	Total Customer which completed service
Sample	10	10	10	10	10	10
Sample Mean	59.926	14.3198	74.2458	93.2	64.9	60.9
Std. Deviation	14.71280334	0.307678331	14.73309923	10.63328109	1.449137675	1.449137675
Confidence Interval	50.8 to 69	14.1 to 14.54	65.1 to 83.4	86.6 to 99.8	64 to 65.8	60 to 61.8
CI %95	±9.1	±0.22	±9.145	±6.6	±0.898	±0.898
CI %95 * 0.1	0.91	0.022	0.9145	0.66	0.0898	0.0898
new CI	±8.19	±0.198	±8.2305	±5.94	±0.808	±0.808
%10 narrowed CI	51.736 to 68.116	14.122 to 14.517	66 to 82.48	87.26 to 99.14	64.09 to 65.7	60.09 to 61.7
Prediction Interval	21.976 to 97.876	13.53 to 15.113	36.24 to 112.25	65.76 to 120.63	61.16 to 68.63	57.16 to 64.64

SECOND MODEL

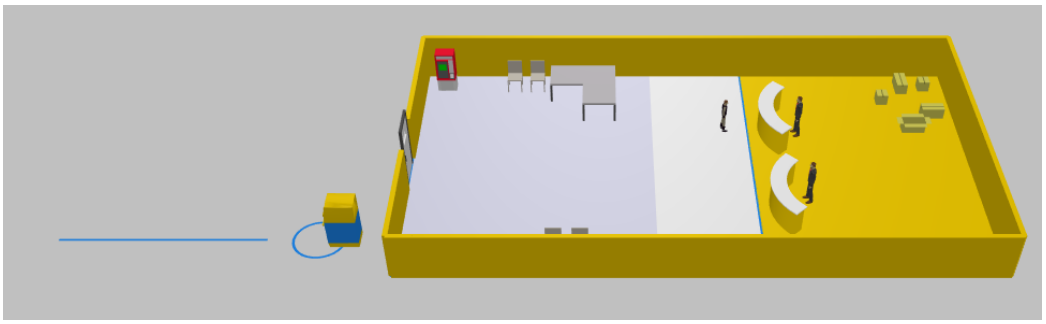
Waiting time was long in our first model. Most of the customers were waiting in the queue. We preferred to use a machine to find a solution to this. Because machine can run faster than humans, It saves time. Customers who come for some money transactions can do their job at the ATM in our second model.

Increasing the number of tellers can only be efficient for large PTT locations. But since PTTs are generally small, instead of increasing the number of tellers, we can supplement machines (instead of using manpower). Bill payment and money transfer can be done with fast machine. (etc. ATM)

2D



3D



SECOND MODEL CALCULATIONS

SEEDS	AVG waiting time in queue (minute)	AVG service time (minute)	AVG waiting time in system (minute)	Total Customer entered to system	Total Customer entered to service	Total Customer which completed service	Simulation Time (minute)
SEED 1	16.83	10.57	27.4	96	95	91	480
SEED 2	6.73	9.66	16.39	87	87	86	480
SEED 3	18.91	10.86	29.77	102	96	92	480
SEED 4	8.6	10.96	19.56	106	96	102	480
SEED 5	9.61	10.13	19.74	99	99	96	480
SEED 6	1.71	9.83	11.54	79	79	76	480
SEED 7	2.66	10.03	12.69	96	92	88	480
SEED 8	6.75	9.53	16.28	84	84	82	480
SEED 9	10.76	9.86	20.62	111	110	105	480
SEED 10	11.95	10.35	22.3	101	100	95	480

	AVG waiting time in queue (minute)	AVG service time (minute)	AVG waiting time in system (minute)	Total Customer entered to system	Total Customer entered to service	Total Customer which completed service
Sample	10	10	10	10	10	10
Sample Mean	9.451	10.178	19.629	96.1	93.8	91.3
Std. Deviation	5.511304443	0.49380158	5.837144374	10.04932281	8.841819823	8.807194029
Confidence Interval	6.036 to 12.86	9.872 to 10.48	16.012 to 23.246	89.87 to 102.3	88.3 to 99.28	85.85 to 96.75
Confidence Interval %95	±3.415	±0.306	±3.617	±6.228	±5.48	±5.45
CI %95 * 0.1	0.3415	0.036	0.3617	0.6228	0.548	0.545
Required Half-width	±3.0735	±0.2754	±3.2553	±5.61	±4.932	±4.905
Replication Needed	12.346	12.351	12.353	12.324	12.346	12.385
%10 narrowed CI	6.3775 to 12.52	9.926 to 10.448	16.379 to 22.9	90.49 to 101.71	88.9 to 98.7	86.4 to 96.2
Prediction Interval	0 to 22.64	8.904 to 11.45	4.57 to 34.68	70.17 to 122.02	70.99 to 116.61	68.58 to 114.02

COMPARISON

Our second model performance is greater than the first model. Putting an ATM increased efficiency.

AVG waiting time in queue

	AVERAGE WAITING TIME IN QUEUE		
Replication	MODEL 1	MODEL 2	Observed Difference
1	62.86	16.83	46.03
2	58	6.73	51.27
3	34.88	18.91	15.97
4	77.08	8.6	68.48
5	64.71	9.61	55.1
6	42.61	1.71	40.9
7	83.58	2.66	80.92
8	62.83	6.75	56.08
9	63.36	10.76	52.6
10	49.35	11.95	37.4
Sample Mean	59.926	9.451	50.475
Sample Variance	216.466582	30.37447667	309.1135167
Standart Deviation	14.7128033	5.511304443	17.5816244
Confidence Interval (Model1-Model2) 95 % ±			12.57626264
Interval	37.8987374 to 63.05126264		

The confidence interval does not include zero. It means that two systems are different each other. The shorter the waiting time, the more customers will come. For this reason,if the waiting time is less, the system is better in this respect. When we look at the table, all the waiting times of model 2 are less than the waiting times of model 1. So model 2 is better than model 1 in terms of waiting time.

AVG service time

	AVERAGE SERVICE TIME		
Replication	MODEL 1	MODEL 2	Observed Difference
1	14.64	10.57	4.07
2	14.7	9.66	5.04
3	14.3	10.86	3.44
4	14.65	10.96	3.69
5	13.975	10.13	3.845
6	14.43	9.83	4.6
7	14.075	10.03	4.045
8	14.458	9.53	4.928
9	14.16	9.86	4.3
10	13.81	10.35	3.46
Sample Mean	14.3198	10.178	4.1418
Sample Variance	0.094665956	0.24384	0.324884622
Standart Deviation	0.307678331	0.49380158	0.569986511
Confidence Interval (Model1-Model2) 95 % ±			0.407715459
Interval	3.734084541 to 4.549515459		

The confidence interval does not include zero. It means that two systems are different each other. Short service time affects waiting time, which results in more customers coming. Less service time indicates that the model is better. Customer satisfaction is provided. When we look at the table, we can see that model 2's service time is less than model 1. In this respect, model 2 is better than model 1.

AVG waiting time in the system

	AVERAGE WAITING TIME IN THE SYSTEM		
Replication	MODEL 1	MODEL 2	Observed Difference
1	77.5	27.4	50.1
2	72.7	16.39	56.31
3	49.18	29.77	19.41
4	91.73	19.56	72.17
5	78.685	19.74	58.945
6	57.04	11.54	45.5
7	97.655	12.69	84.965
8	77.288	16.28	61.008
9	77.52	20.62	56.9
10	63.16	22.3	40.86
Sample Mean	74.2458	19.629	54.6168
Sample Variance	217.064213	34.07225444	314.3416213
Standart Deviation	14.7330992	5.837144374	17.72968193
Confidence Interval (Model1-Model2) 95 % ±			12.68216926
Interval	41.9346307 to 67.29896926		

The confidence interval does not include zero. It means that two systems are different each other. If a customer completes the job in the system in a short time, this shows that the system is better. We see that model 2 is better for the results in the table.

Total customer entered to the service

	TOTAL CUSTOMER ENTERED TO THE SERVICE		
Replication	MODEL 1	MODEL 2	Observed Difference
1	66	95	-29
2	66	87	-21
3	63	96	-33
4	66	96	-30
5	63	99	-36
6	63	79	-16
7	66	92	-26
8	64	84	-20
9	66	110	-44
10	66	100	-34
Sample Mean	64.9	93.8	-28.9
Sample Variance	2.1	78.17777778	70.98888889
Standart Deviation	1.44913767	8.841819823	8.425490424
Confidence Interval (Model1-Model2) 95 % ±			6.026814021
Interval	-34.926814 to -22.87318598		

The confidence interval does not include zero. It means that two systems are different each other. The increase in the number of customers leaving the waiting queue and going to the teller indicates that the system works faster. Model 2 is better than model 1. The number of people entering the service is higher in model 2, which indicates that model 2 is better in this side.

RESULTS

We added ATM in the second model.

Results :

- Average waiting time in queue was decreased.
- Average spent time in system was decreased.
- AVG service time is decreased.
- Completed jobs are increased.
- Number of customers are increased.