MARMARAUNIVERSITY

FACULTY OF ENGINEERING COMPUTER SCIENCE

&

ENGINEERING DEPARTMENT

IE3081

Modeling and Discrete Simulation

2021-2022 Fall

Project

Resul Akçakaya - 150119663

Hamza Kavak - 150118886

Alperen Gönül - 150119637

MODERN SHARED OFFICE SYSTEM

In this project, we used the modern shared office system. People who want to use the office can come and do their work/study. There is an optional online reserve or queue waiting system. Those who do not want to wait in queue can make an online reservation in advance or wait in queue depending on the occupancy of the office.

THE SCENARIO

There are two types of spaces in our office system. The area where people come with the online reserve and the area where people come with the regular ticket system. If all rooms are occupied in the online reservation section, the system does not allow further online reservations. In normal rooms, if the rooms are full, customers can wait in line or log out of the system. They pay when they leave the building.

COMPONENTS OF THE SYSTEMS AND THEIR RELATIONSHIPS

- 1x source
- 1x sink
- 3x select output
- 4x delay
- 2x queue
- 2x restrictedAreaStart
- 2x restrictedAreaEnd
- 2x timeMeasureStart
- 2x timeMeasureEnd
- 2x wait

RELATIONSHIPS

Contacts from the resource are subject to selectOutput:isOnlineReserved. If you have an online reservation here, it goes directly to the Wait:StudyRooma area. If there is no online reservation, we pass it to SelectOutput: ticketMachine. There may be other people waiting here. (row: waiting room).

Queue: If the waitRoom is empty, it means there is space inside and it moves to the work areas without waiting any longer.

More than one person in the queue: if waitRoom is waiting in line, the newcomerdecides if he wants to wait, if not he goes to selectOutput:buildingExit and leaves the building without stopping by the checkout point.

Use the rooms, when someone selectsOutput:buildingExit, they leave the building after going to the payment queue: PaymentQueue
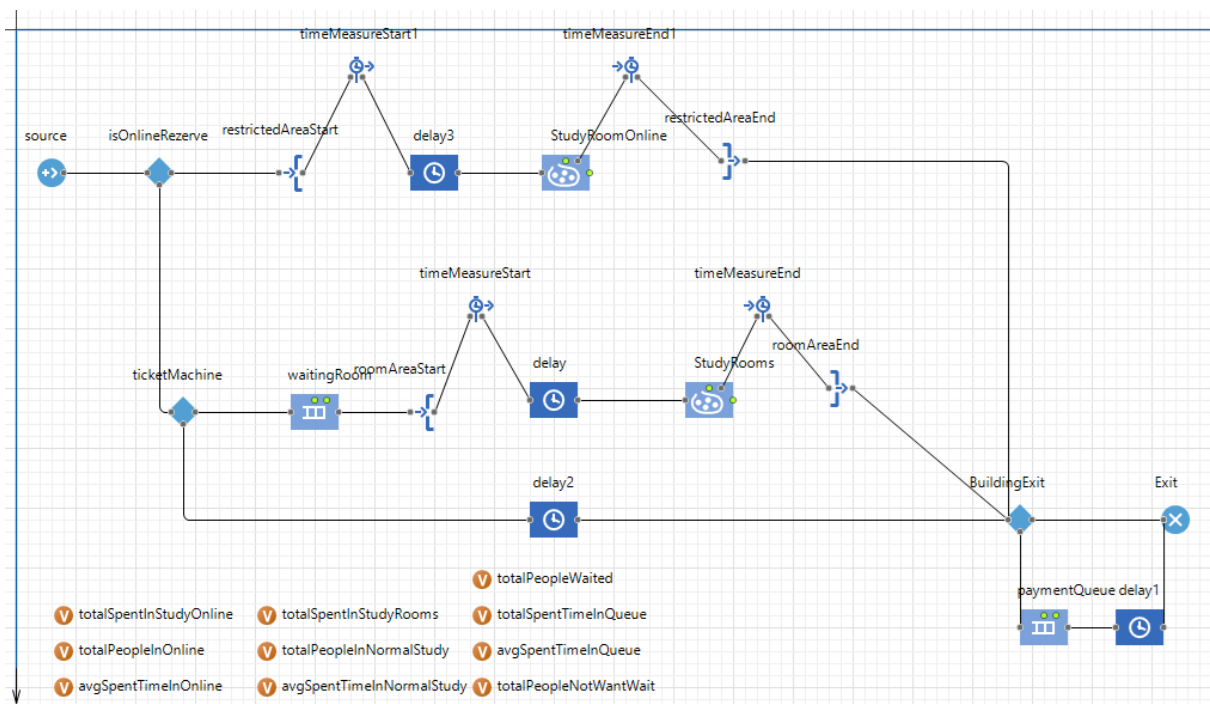
INPUT AND OUTPUT PARAMETERS AND THE VALUES OF THE INPUT VALUES

Input and Values

Our input will be number of the people entering the system, that is 1000 people

Output and Values

TotalSpentInStudyOnline :Total time worked by people who came with online reservation

TotalPeopleInOnlıne: Total number of people in the online system

avgSpentTımeInOnlıne: Average time worked by people who make an online reservation

totalSpentInStudyRooms: Total time people spend in the system

TotalPeopleInNormalStudy:Number of people who came without making an online reservation

AvgSpentTımeInNormalStudy:Average time worked by people who come without making an online reservation

totalPeopleWaited:The number of people who prefer to wait in queue when normal study rooms are full

totalSpentTımeInQueue: Total wait time in queue

avgSpentTimeInQueue: Average time waiting in queue

totalPeopleNotWantWait: The number of people who do not prefer to wait when normal rooms are full
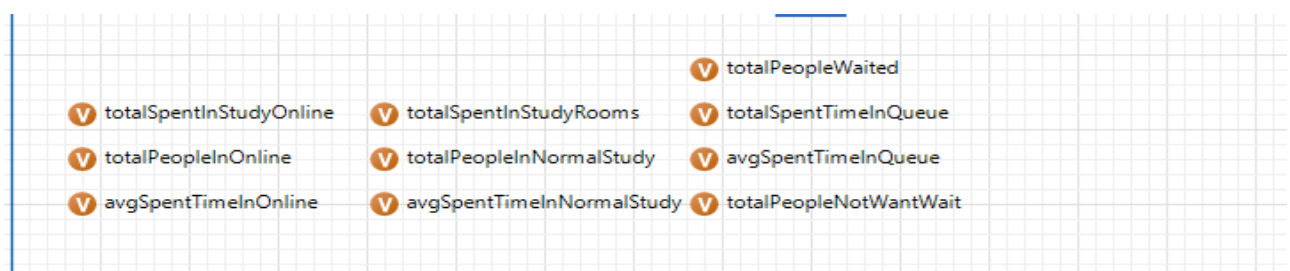
FORMULAS

We first calculated the mean and standard deviation of our outputs with these formulas.

Population Mean	Sample Mean
$$\mu = \frac{\sum_{i=1}^{N} x_i}{N}$$	$$\overline{X} = \frac{\sum_{i=1}^{n} x_i}{n}$$
N = number of items in the population	n = number of items in the sample

We ran the simulation several times with different seed values. We calculated the mean and standard deviations and then recorded them in the table.

For our prediction interval, we used this piece of formula in order to decide our prediction interval bounds.

$$\overline{Y} \pm t_{\alpha/2, n-1} S \sqrt{1 + \frac{1}{n}}$$

Also we will compute the 95% confidence intervals for the output parameters which means $\alpha = 0.05$. We can calculate with this formula.

$$\overline{Y} \pm t_{\alpha/2, n-1} S / \sqrt{n}$$

Y means the mean and t value will be our significance level which is 2.447. S is our standard deviation and n will be our sample size.

CALCULATIONS

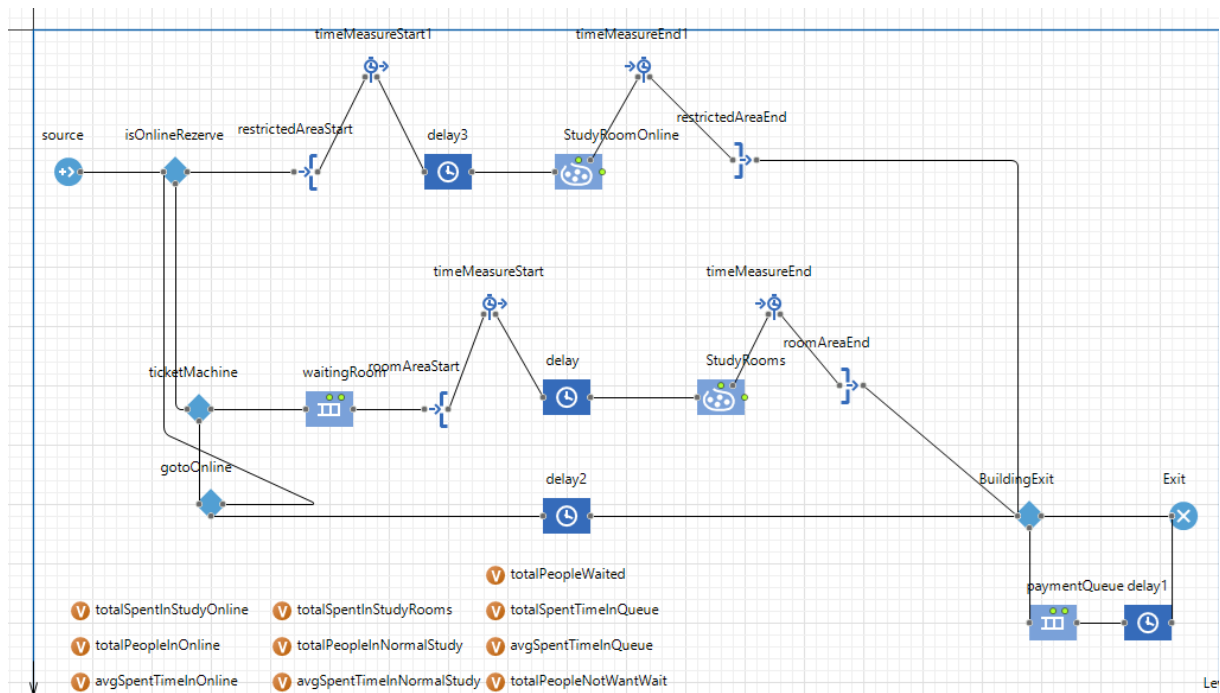We run our simulation with 7 seed values with 1000 people.

Seed Values / Variables	Total Spent In Study Online	Total People In Online	Avg Spent TimeIn Online	Total Spent InStudy Rooms	Total People InNormal Study	Avg Spent TimeIn Normal Study	Total People Waited	Total Spent TimeIn Queue	avgSpent TimeIn Queue	totalPeople NotWant Wait
1	36,022	119	302.709	217,224	657	330.631	446	12,641	28.344	224
2	38,444	123	312.558	216,692	698	310.447	437	12,587	28.805	179
3	36,865	128	288.009	220,946	678	325.88	427	16,767	39.269	194
4	29,671	105	282.59	217,247	692	313.941	468	11,672	24.941	203
5	32,077	106	302.621	227,578	694	327.92	465	14,468	31.115	200
6	41,627	141	295.231	214,759	708	303.333	375	9,922	26.461	151
7	39,901	116	343.981	211,336	642	329.184	504	14,551	28.871	242
MEAN	36,372	119.7	303.957	217,968	681.286	320.191	446.49	13229.7	29.6851	199
STD DEV	4244.2	12.59	20.274	5134.9	23.852	10.803	39.31	2233.03	4.6558	29.49

For two tailed test, our alpha value will be **α** = 0.025, our t value will be 2.447.

Names	Total Spent In, Study Online	Total People In Study Online	Avg Spent Time in Online	Total Spent In Study Rooms	Total People in Normal Study	avg spent Time In Normal Study	TotalPeople Waited	TotalSpent Time In Queue	Avg Spent Time In Queue	Total People Not Want Wait
Confidence Intervals 95%	[32446.62 , 40297.37]	[108.05 , 131.34]	[285.20, 322.70]	[213218.83, 222717.16]	[659.22 , 703.34]	[310.199, 330.182]	[410.13, 482.84]	[11164.41 , 15294.98]	[25.379, 33.991]	[171.725, 226.27]
Prediction Intervals 95%	[25269.3 , 47474.62]	[86.76, 152.63]	[250.92 , 356.99]	[204535.34 , 231400.6]	[618.89, 743.68]	[291.93, 348.45]	[343.656 , 549.323]	[7388.19, 19071.20]	[17.505, 41.864]	[121.85 , 276.14]

CHANGES IN THE SYSTEM

In our first system, the customer could not benefit from this option if the customer did not have an online reservation before. As a system change, if there is a queue in the normal rooms and the customer does not want to wait (in case there is a vacancy in the online rooms), they are included in the system by making a reservation from there. Thus, it uses the online room, not the regular rooms.

Seed Values /Variables	Total Spent In Study Online	Total People In Online	Avg Spent TimeIn Online	Total Spent InStudy Rooms	Total People InNormal Study	Avg Spent TimeIn Normal Study	Total People Waited	Total Spent TimeIn Queue	avgSpent TimeIn Queue	totalPeople NotWant Wait
1	40,846	132	309.446	210,646	683	308.414	388	10,596	27.311	242
2	44,378	139	319.269	218,467	677	322.699	416	15,995	38.45	243
3	36,765	128	287.232	217,491	673	323.168	503	14,408	28.645	236
4	35,148	114	308.319	221,746	671	330.471	488	18,680	38.279	269
5	43,325	136	318.573	221,356	666	332.367	470	15,354	32.669	239
6	38,364	130	295.11	216,742	720	301.031	344	8,549	24.855	189
7	39,902	126	316.685	209,571	620	338.019	510	18,388	36.056	310
MEAN	39,818	129.285	307.804	216,574	672.857	322.309	445.57	14,567	32.323	246.857
STD DEV	3351	8.0976	12.339	4800.22	29.4019	13.299	63.707	3790.02	5.49981	36.612

The decision about the goodness of the systems is calculated according to the total number of people using online rooms. We made this choice because we aim to serve more people.

Seed values / Variables	First System	Changed System	Difference
	Total People In Online	Total People In Online	
1	119	132	13
2	123	139	16
3	128	128	0
4	105	114	9
5	106	136	30
6	141	130	-11
7	116	126	10
Mean			9.571
Standart Dev			12.817

Confidence interval = [-23.957, 43.099]. This means that our systems are statistically different from each other. This confidence intervals shows that our second sistem is better