Chick-fil-A's Simulation

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Submitted to

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Company Overview:

The company started in 1946 at Hapeville, Georgia. Credited with inventing Chick-fil-A's boneless breast chicken sandwich. In the 1960s, Chick-fil-A pioneered the establishment of restaurants in shopping malls with the opening of the first Chick-fil-A Restaurant at a mall in suburban Atlanta in 1967. Since then, Chick-fil-A has steadily grown to become the second largest quick-service chicken restaurant chain in the United States, with over 1,700 locations in 39 states and Washington, D.C. In 2012, annual sales were over $4.6 billion. Chick-fil-A is still privately held and family owned.

Innovative Concepts:

Chick-fil-A created seven different types of concepts to improve the quality of their services to generate more profit. They intend to carry out a comprehensive analysis to estimate a proper concept to improve their quality services. They purport the following concepts:

1) **Mall/In-Line Restaurants**: Recognized as the pioneer in quick-service mall food, Chick-fil-A still considers mall-based restaurants an integral part of its business. More than 300 major shopping mall restaurants are in operation today.

2) **Stand-alone Restaurants**: In response to customer demand for convenience and accessibility, Chick-fil-A began opening stand-alone restaurants in high-traffic locations starting in 1986. The chain now has over 1,000 stand-alone locations.

3) **Drive-Thru Only Outlets**: These outlets offer fast service and added convenience to the customer. Chick-fil-A currently has 33 drive-thru-only restaurants across the country.

4) **Dwarf House®**: Truett's original, full-service restaurants offer an extensive menu and provide customers a choice of table service, walk-up counter service or a drive-thru window. Eleven Chick-fil-A Dwarf House restaurants currently operate in the metro Atlanta area.

5) **Truett's Grill®**: Truett's Grill is a full-service '50s diner-themed concept that features the full Chick-fil-A menu, as well as select items from Truett Cathy's original Dwarf Grill restaurant, which he and his brother opened in Hapeville, Georgia, in 1946. Featuring a streamline diner design with unique decor, Truett's Grill offers counter service, seated dine-in service and drive-thru service. The first Truett's Grill opened in 1996 in Morrow, Georgia, to commemorate Truett's 50th Anniversary as a restaurateur. In May 2003, a second restaurant was opened in McDonough, Georgia, and a third Truett's Grill opened in Griffin, Georgia, in October 2006 in celebration of Truett's 60 years in the restaurant industry.

6) **Licensed, Non-Traditional Outlets**: Chick-fil-A has established this licensing program to enable licensees to serve delicious Chick-fil-A food in settings such as college campuses, hospitals, airports, and businesses and industry locations. For these outlets, the Chick-fil-A brand is licensed to established institutional contract foodservice providers or self-operated foodservice providers. There are approximately 237 licensed locations currently.

7) **Satellite/"Lunch-Counter"**: Satellite or "lunch-counter" concepts offer fast service to customers in office buildings and high-traffic locations during peak lunch hours. There are 6 satellite locations currently.

Problem Definition:

In order to simulate the preferred concept for our project, we chose the Chick-fil-A located on St. Mary's university campus and we found this restaurant uses the Mall/In-Line and

Satellite/"Lunch-Counter concepts. This simulation study concentrates on the effects of a number of cashiers to optimize the required number of resources and to reduce the process time for customers in order to provide the best quality of services to the customers. Some data is collected, analyzed and utilized in a simulation model to provide feasible recommendations for the business owners as a real life example of using a simulation as problem solving tools.

Assumption:

Several logical assumptions were theorized to fill any lack of familiarity of real life waiting time problem and to concentrate on the project's objective not to enlarge the projects perspectives and scope. These assumptions are shown in a list below:

- The restaurant is open 18 hours
- Data collection includes interarrive time and the processing time until getting the order
- It's double servers with one queue
- 95% of customers order when entering the restaurant.
- 70% of customer eat in the restaurant

Data Selecting:

We selected 94 data points during open hours for three different days which includes arrival time, interarrival time, service time and process time provided in table 1, 2, 3.

No.	Arrival Time	Interarrival time	Service Time	Processing Time
1	3	6	3.03	0.03
2	3.02	2	3.06	0.04
3	3.07	5	3.11	0.04
4	3.14	7	3.16	0.02
5	3.21	7	3.24	0.03

6	3.25	4	3.29	0.04
7	3.27	2	3.3	0.03
8	3.32	5	3.36	0.04
9	3.37	5	3.42	0.05
10	3.4	3	3.45	0.05
11	3.45	5	3.49	0.04
12	3.47	2	3.51	0.04
13	3.5	3	3.55	0.05
14	3.55	5	3.6	0.05
15	3.58	3	3.6	0.02
16	3.64	6	3.69	0.05
17	3.7	6	3.75	0.05
18	3.72	2	3.74	0.02
19	3.73	1	3.76	0.03
20	3.78	5	3.81	0.03
21	3.8	2	3.84	0.04
22	3.84	4	3.87	0.03
23	3.87	3	3.9	0.03
24	3.91	4	3.94	0.03
25	3.93	2	3.97	0.04
26	3.94	1	3.98	0.04
27	4	3	4.04	0.04
28	4.05	5	4.08	0.03
29	4.08	3	4.12	0.04
30	4.09	1	4.09	0

Table 1

No.	Arrival Time	Interarrival time	Service Time	Processing Time
1	3	1	3.04	0.04
2	3.02	2	3.05	0.03
3	3.05	3	3.09	0.04
4	3.09	4	3.13	0.04
5	3.16	7	3.18	0.02
6	3.2	4	3.23	0.03
7	3.23	3	3.27	0.04
8	3.26	3	3.29	0.03
9	3.3	4	3.34	0.04
10	3.32	2	3.37	0.05
11	3.33	1	3.38	0.05
12	3.37	4	3.41	0.04

13	3.43	6	3.47	0.04
14	3.45	2	3.5	0.05
15	3.48	3	3.53	0.05
16	3.54	6	3.56	0.02
17	3.58	4	3.63	0.05
18	4.02	4	4	0.05
19	4.08	6	4.01	0.02
20	4.13	5	4.16	0.03
21	4.2	7	4.23	0.03
22	4.25	5	4.29	0.04
23	4.29	4	4.32	0.03
24	4.34	5	4.37	0.03
25	4.4	6	4.43	0.03
26	4.42	2	4.46	0.04
27	4.43	1	4.47	0.04
28	4.46	3	4.5	0.04
29	4.52	6	4.55	0.03
30	4.55	3	4.59	0.04

Table 2

No.	Arrival Time	Interarrival time	Service Time	Processing Time
1	3	5	3.04	0.04
2	3.03	3	3.06	0.03
3	3.05	2	3.09	0.04
4	3.11	6	3.15	0.04
5	3.14	3	3.16	0.02
6	3.19	5	3.22	0.03
7	3.23	4	3.27	0.04
8	3.26	3	3.29	0.03
9	3.3	4	3.34	0.04
10	3.34	4	3.39	0.05
11	3.38	4	3.43	0.05
12	3.43	5	3.47	0.04
13	3.46	3	3.5	0.04
14	3.49	3	3.54	0.05
15	3.53	4	3.58	0.05
16	3.56	3	3.58	0.02
17	3.59	3	4.04	0.05
18	4.03	4	4.08	0.05
19	4.05	2	4.07	0.02

20	4.09	4	4.12	0.03
21	4.12	3	4.15	0.03
22	4.05	4	4.09	0.04
23	4.11	6	4.14	0.03
24	4.16	5	4.19	0.03
25	4.2	4	4.23	0.03
26	4.25	5	4.29	0.04
27	4.29	4	4.33	0.04
28	4.28	4	4.32	0.04
29	4.34	5	4.37	0.03
30	4.36	2	4.39	0.03
31	4.39	4	4.44	0.05
32	4.43	4	4.46	0.03
33	4.48	3	4.53	0.05
34	4.54	4	4.57	0.03

Table 3

Data Analysis:

In order to determine the preferred delivery method for the restaurant, we carried out a comprehensive analysis to estimate a proper solution for the waiting problem. We purport to implement the following methods:

1- goodness-of-fit analysis: to determine which probability distributions would be used to model demand data by using area input analysis ®.

2- simulation by arena®: to conduct what-if analysis of time proposed.

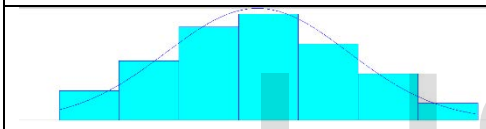
Methods:

Goodness of fit

The goodness-of-fit hypothesis-testing procedure is designed for problems in which the population or probability distribution is unknown. We conducted goodness-of-fit analysis on process time and interarrive time. For calculation ease a software package called Input

Analyzer® was utilized. Input Analyzer® is provided as a companion to the Arena simulation package. Analysis included the Chi-Squared, Anderson-Darling, and Kolmogorov-Smirnov tests. The hypothesis is that data could be modeled using normal distribution for processing time and interarrive time. In Table 4 and 5 we show the Arena Input Analyzer® output conducted on 94 points of data. The fact that the *P*-values for the tests ranged from .442 to .634 in normal distribution, gave us confidence that the use of the normal distribution to model interarrive time and process time were indeed a good decision. Thus, we concluded that a normal distribution would be an appropriate way to simulate the process time and the interarrive time. The simulation was carried on Arena and is described in the following section.

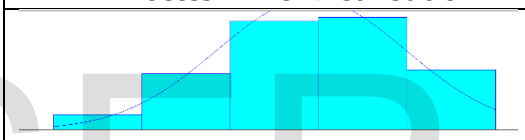
Interarrive Time Distribution



Distribution: Normal
Expression: NORM(3.81, 1.53)
Square Error: 0.000974
Chi Square Test
Number of intervals = 5
Degrees of freedom = 2
Test Statistic = 0.953
Corresponding p-value = 0.634
Data Summary
Number of Data Points = 94
Min Data Value = 1
Max Data Value = 7
Sample Mean = 3.81
Sample Std Dev = 1.53
Histogram Summary
Histogram Range = 0.5 to 7.5
Number of Intervals = 7

Table 4

Process Time Distribution



Distribution: Normal
Expression: NORM(3.41, 1.08)
Square Error: 0.002364
Chi Square Test
Number of intervals = 4
Degrees of freedom = 1
Test Statistic = 1.38
Corresponding p-value = 0.244
Data Summary
Number of Data Points = 94
Min Data Value = 1
Max Data Value = 5
Sample Mean = 3.41
Sample Std Dev = 1.08
Histogram Summary
Histogram Range = 0.5 to 5.5
Number of Intervals = 5

Table 5

Simulation:

The simulation model was based on the assumption that the application of financial modeling can benefit strategic decisions on whether the restaurant should improve their service or not. Using the result from the input analyzer, we analyzed the restaurant Arena software to conduct the analysis for the restaurant. We show now the simulation steps on Arena model.

- Create block named “Create 1” with expression (3.81, 1.53) minutes arrival rate, an entity per arrival and infinite maximum arrival.

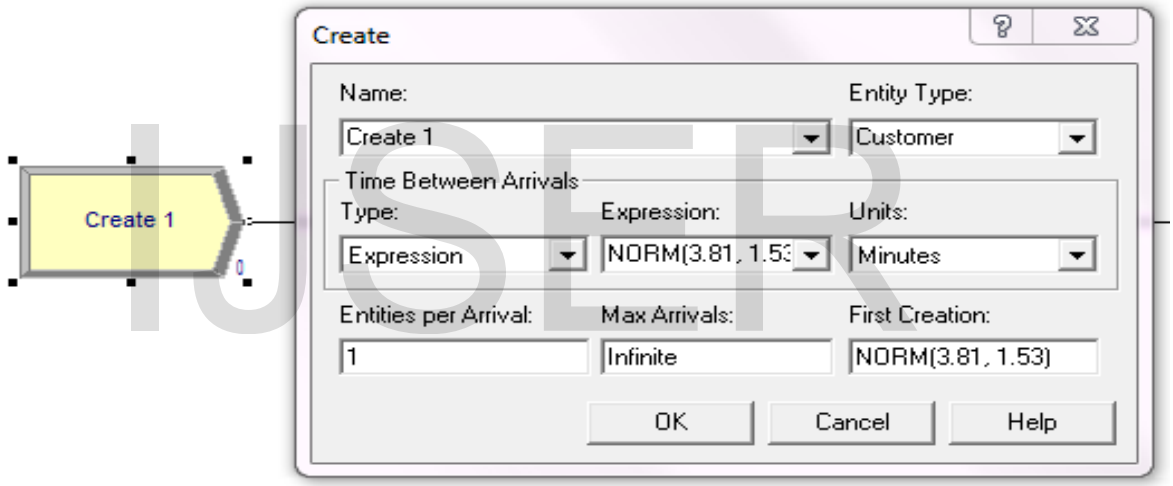


Figure 1

- Decide block named “Decide” with 2-way by chance type to select the path for the customers (entities) based on the two possible situations:
    - ✓ Customer makes an order (95%).
    - ✓ Customer leave right away with no order (5%)

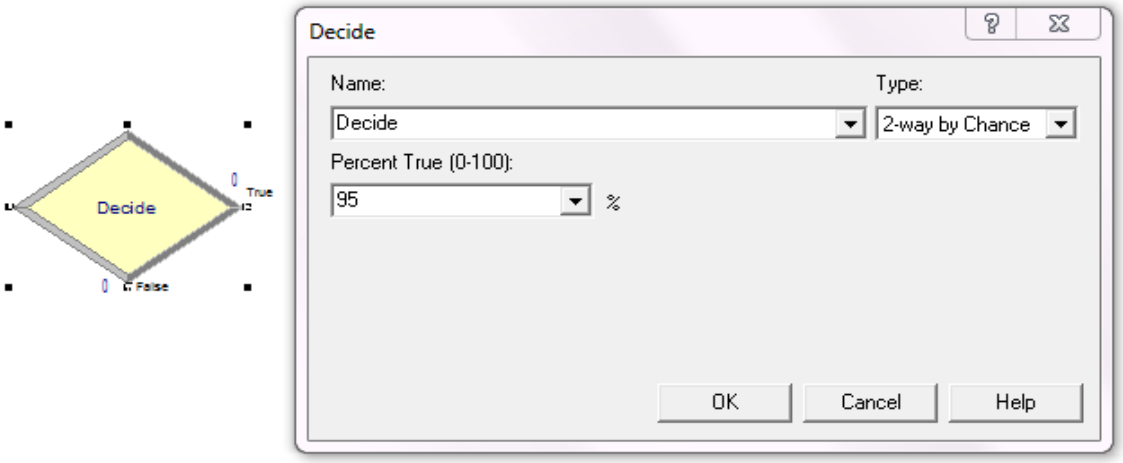


Figure 2

- Record block named “Leaving” with count type has counter named customer leaving to collect the number of customers leaving.

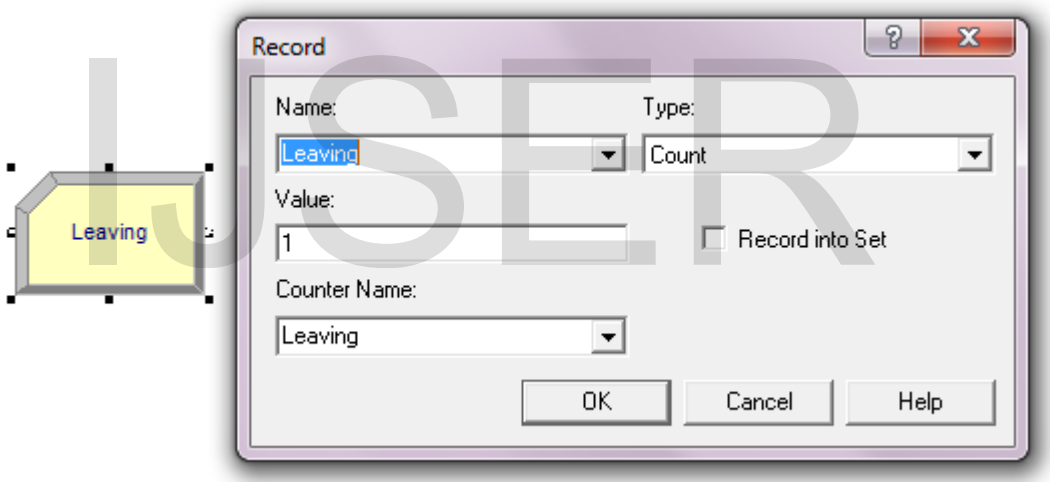


Figure 3

- Process block named “Process 1” with Seize Delay Release action. When the customer (entity) arrives to this process, two resource types named Suzan and Dian are required for processing. The delay type is determined by a normal distribution that includes mean 3.41 and standard deviation 1.08.

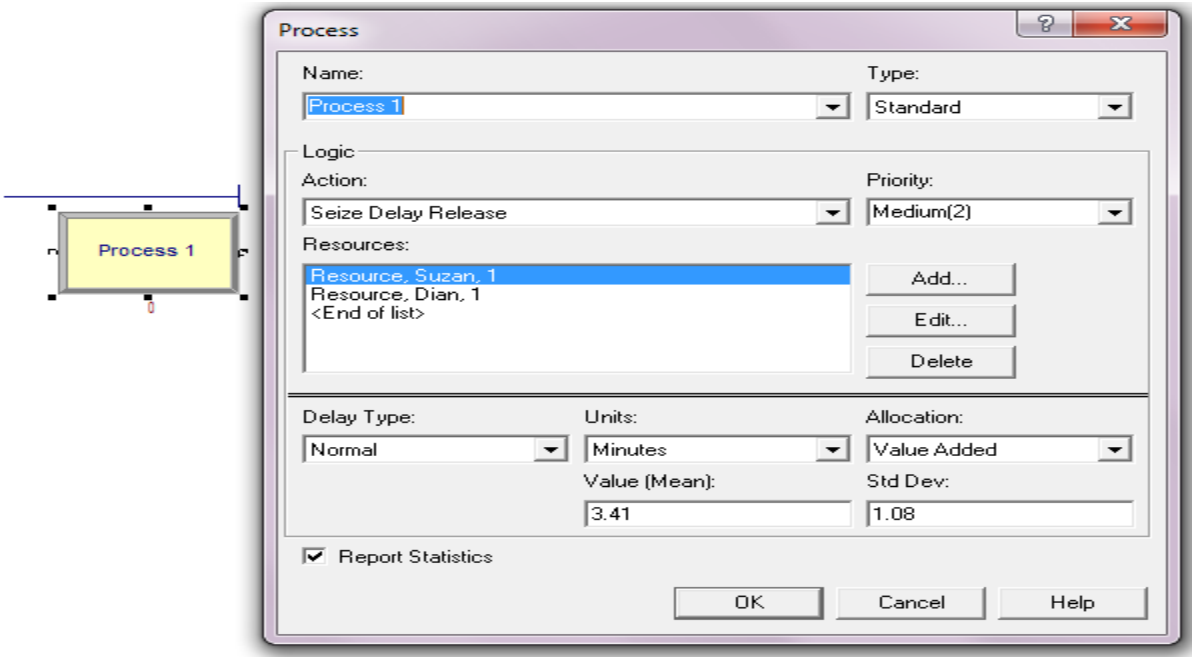


Figure 4

- Decide block named "Decide 2" with 2-way by chance type to select the path for the customers (entities) based on the two possible situations:
    - ✓ Customer who want to eat in the restaurant (70%).
    - ✓ Customer who order to take away (5 %).

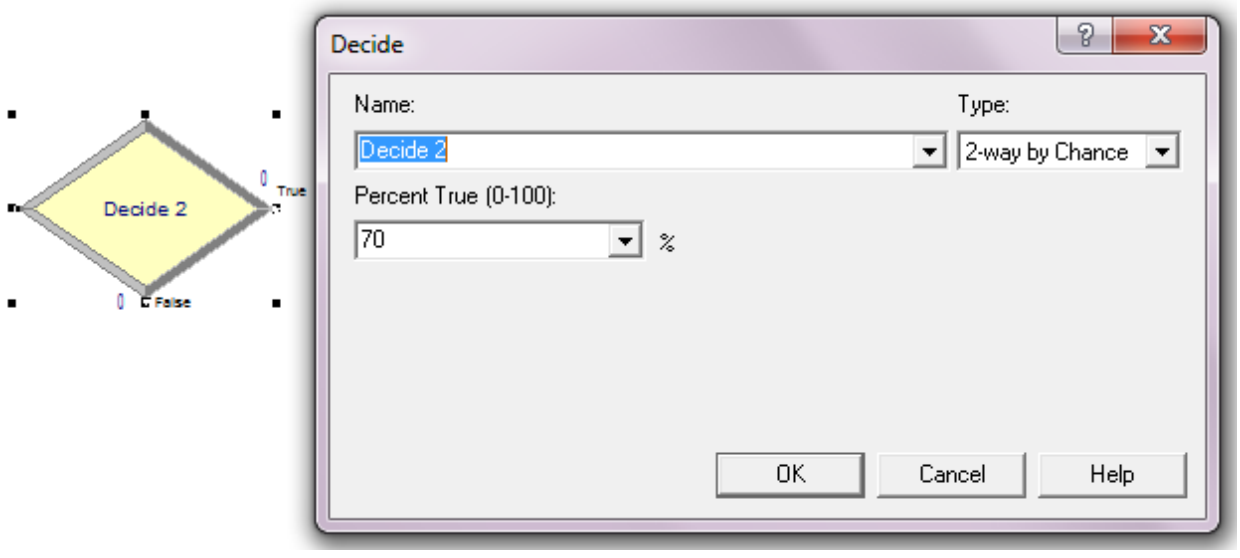


Figure 5

- Record block named “Setting on Table” with count type has counter named setting on table to collect the number of who eat in the restaurant.

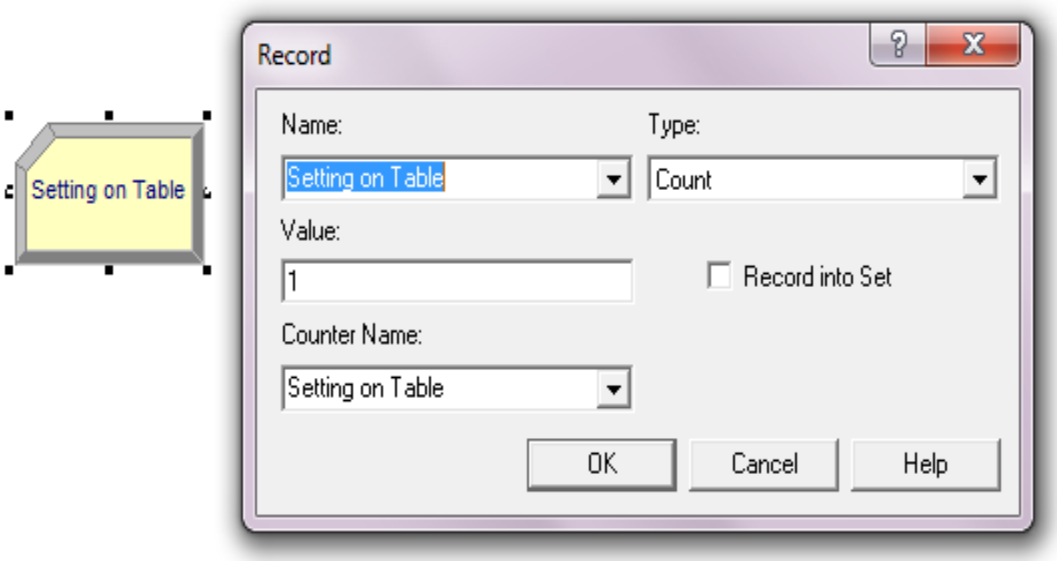


Figure 6

- Record block named “2 GO” with count type has counter named 2 GO to collect the number of who take the order away.

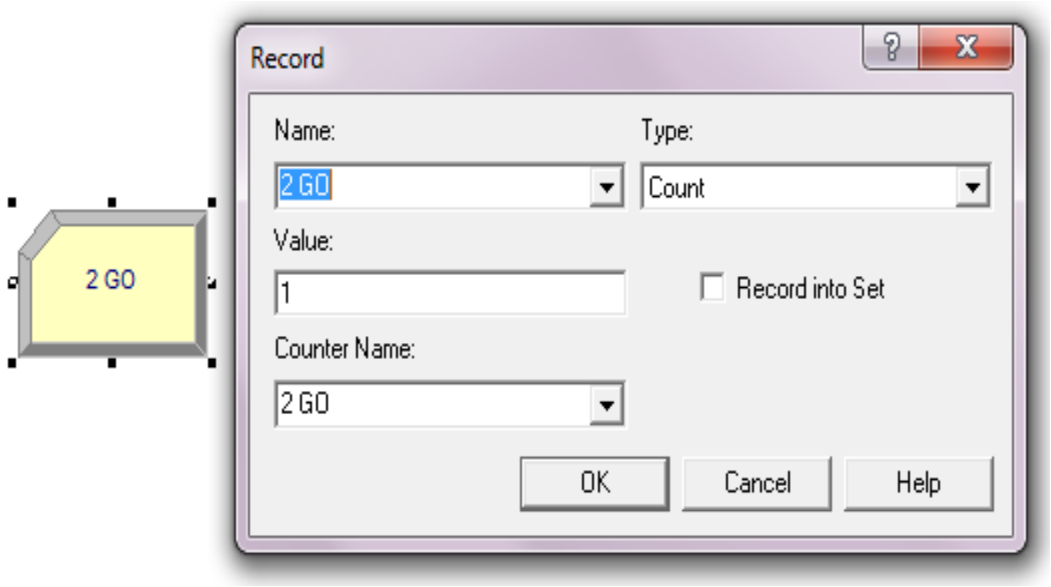


Figure 7

- Dispose block named “Dispose 1, 2, 3” to dispose all entities.

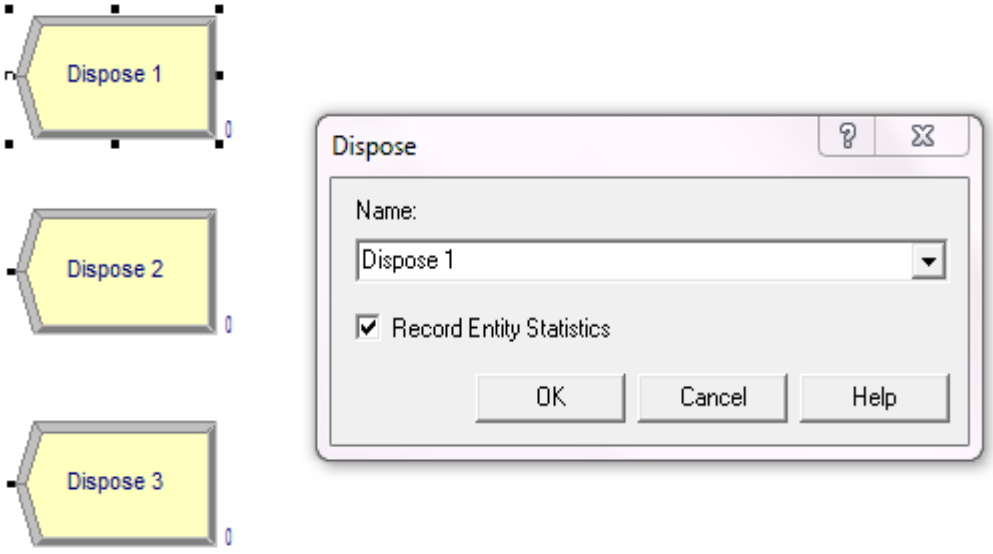


Figure 8

- The model setup is one replication, with a length 120 days.
- Final layout for our model.

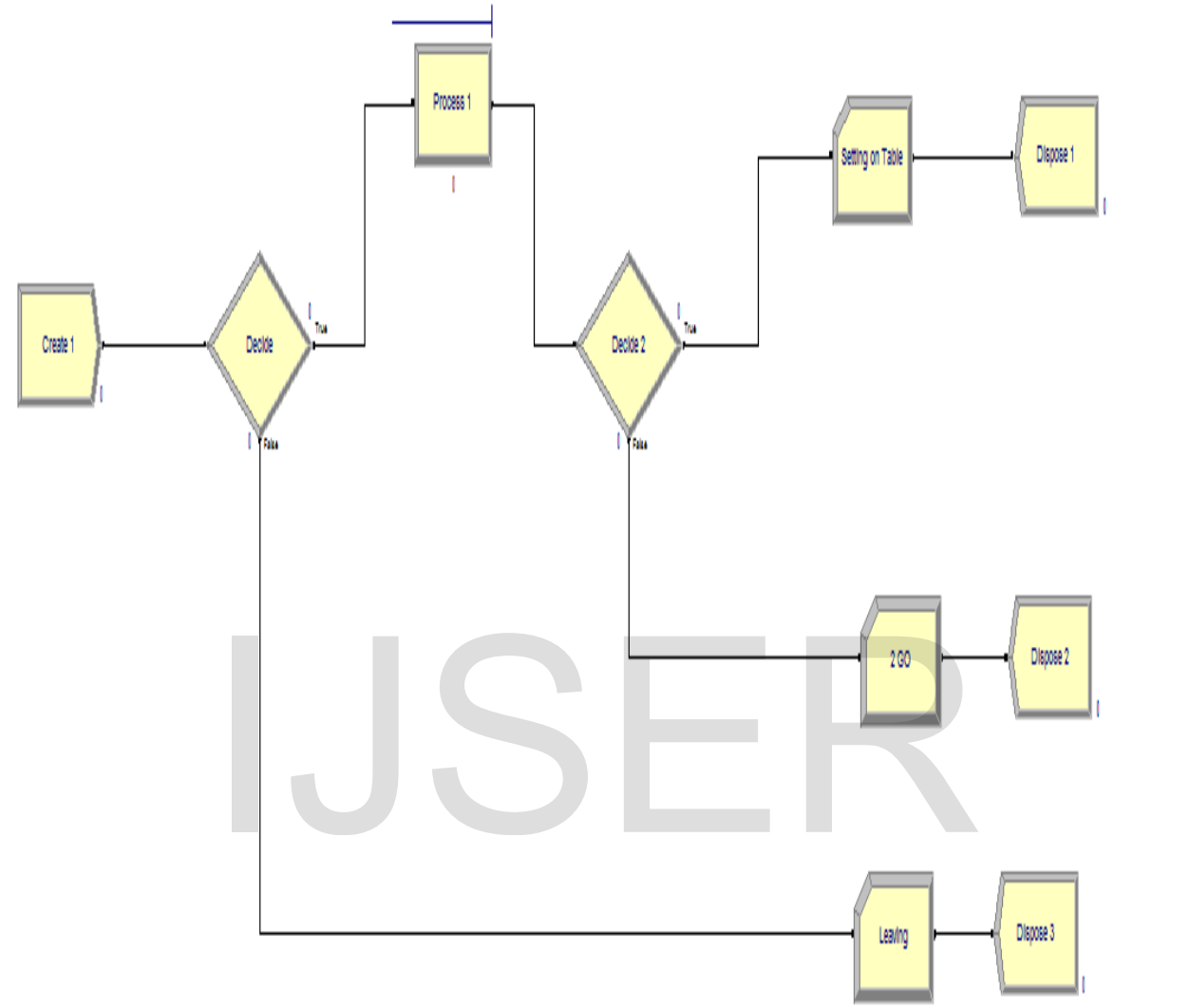


Figure 9

Results:

According to the modeling report shown in table 6, we found that the number out of system is 33,845 customers. And the average waiting time is 2.1564 min and the maximum is 28.94 min and the average waiting time in process one queue is 2.27 and the utilization for Dian and Suzan are 85% for both.

Replication 1	
System	
Number out	Value
System	33,845
Counter	
Count	Value
2 GO	9,735
Leaving	1,670
Setting on Table	22,440
Entity	
Time	Average
VA time	3.2387
Waiting time	2.1564
Total time	5.3951
Queue	
Time	Average
Waiting time process	2.2683
Resource	
Usage	Average
Dian utilization	.8458
Suzan utilization	.8458

Table 6

Conclusion:

This work is deeply related with some important findings that have been covered by an analysis of the simulation. Firstly, this work confirms the findings highlighted through the models, so that the acquisition of a new cashier is recommended. Through a discussion of academic and result evidence. This is evident also if we consider how the restaurant has been critical and determinant in reducing waiting time. We know that adding another cashier could cost a lot of money, but it could be a very beneficial solution to the restaurant in order to reduce the process time. As stressed by many business reports, this incentivizes an optimization of the existing offering, so a new cashier is a consequence of the need to ensure timely service to customers.

References:

(n.d.). Retrieved from http://www.chick-fil-a.com/Company/Highlights-Fact-Sheets

Appendix:

9:30:42PM **Category by Replication** November 30, 2013

Exam 1 St.Mary Replications: 1

Replication 1 Start Time: 0.00 Stop Time: 129,600.00 Time Units: Minutes

Entity

Time

VA Time	Average	Half Width	Minimum	Maximum
Customer	3.2387	0.017016880	0	7.5734

NVA Time	Average	Half Width	Minimum	Maximum
Customer	0	0.000000000	0	0

Wait Time	Average	Half Width	Minimum	Maximum
Customer	2.1564	0.160180735	0	28.9400

Transfer Time	Average	Half Width	Minimum	Maximum
Customer	0	0.000000000	0	0

Other Time	Average	Half Width	Minimum	Maximum
Customer	0	0.000000000	0	0

Total Time	Average	Half Width	Minimum	Maximum
Customer	5.3951	0.170059169	0	32.7278

Other

Number In	Value
Customer	33,847

Number Out	Value
Customer	33,845

WIP	Average	Half Width	Minimum	Maximum
Customer	1.4090	0.049649649	0	9.0000

Queue

Time

Model Filename: C:\Users\Vaio\Downloads\Project (1) Page 1 of 3

9:30:42PM **Category by Replication** November 30, 2013

Exam 1 St.Mary Replications: 1

Replication 1 Start Time: 0.00 Stop Time: 129,600.00 Time Units: Minutes

Queue

Time

Waiting Time	Average	Half Width	Minimum	Maximum
Process 1.Queue	2.2683	0.186541769	0	28.9400

Other

Number Waiting	Average	Half Width	Minimum	Maximum
Process 1.Queue	0.5632	0.045206421	0	8.0000

Resource

Usage

Instantaneous Utilization	Average	Half Width	Minimum	Maximum
Dian	0.8458	0.005940599	0	1.0000
Suzan	0.8458	0.005940599	0	1.0000

Number Busy	Average	Half Width	Minimum	Maximum
Dian	0.8458	0.005940599	0	1.0000
Suzan	0.8458	0.005940599	0	1.0000

Number Scheduled	Average	Half Width	Minimum	Maximum
Dian	1.0000	(Insufficient)	1.0000	1.0000
Suzan	1.0000	(Insufficient)	1.0000	1.0000

Scheduled Utilization	Value
Dian	0.8458
Suzan	0.8458

Total Number Seized	Value
Dian	32,176.00
Suzan	32,176.00

System

Model Filename: C:\Users\Vaio\Downloads\Project (1) Page 2 of 3

9:30:42PM **Category by Replication** November 30, 2013

Exam 1 St.Mary Replications: 1

Replication 1 Start Time: 0.00 Stop Time: 129,600.00 Time Units: Minutes

System

Other

Number Out	Value
System	33,845

User Specified

Counter

Count	Value
2 GO	9,735.00
Leaving	1,670.00
Setting on Table	22,440.00

Model Filename: C:\Users\Vaio\Downloads\Project (1) Page 3 of 3