Dunkin Simulation Model

Prepared By : Goutham Yallapu

Sai Kiran Chandu

Sri Nikita Desetty

Trilok Dhanekula

Sandhula Varsha

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1. EXECUTIVE SUMMARY

Purpose: This project's goal is to determine which method of placing an order—walk-in or drive-through—is more effective.

Methodology:

Dunkin', is an American multinational coffee and doughnut company, as well as a quick service restaurant. It was founded by Bill Rosenberg in Quincy, Massachusetts, in 1950.

There are two methods for taking consumer orders:

1. **In Person**: When a customer places an order in person.

2. **Drive-Thru:** This is where a consumer pulls up in their automobile, enters the drive-thru, and calls in their order. while driving, he engages in conversation and picks up the order next to the pickup window.

Data was gathered from 7:00 a.m. to 9:00 a.m in the morning totalling to 70 observations consisting of 36 for Walk In observations and 34 for Drive Thru Observations. For both walk-in and drive-through customers, we have gathered arrival, order placement, and service times. For each server, we have executed the fitting probability distribution stages. performed statistical analysis for queue length and usage.

3.Result:

The efficiency of the business's walk-in and drive-thru service procedures differs in different ways. Customers using the drive-through are having to wait longer to order and pick up their food, and the system appears to be busier as evidenced by the increased average line lengths. Although the Drive-thru procedure has greater utilization rates in some areas, its overall throughput is still inferior to that of the Walk-in approach. To increase the drive-thru method's effectiveness and customer pleasure, the task is to pinpoint the underlying causes and optimize it.

4.Suggestions:

Make sure the technology is user-friendly and effective before adding more ordering kiosks or stations so that many cars may place orders at once.

To have enough staff to accommodate the flow of drive-thru customers, from taking orders to serving food to delivering it to staffing numbers should be adjusted during peak hours.

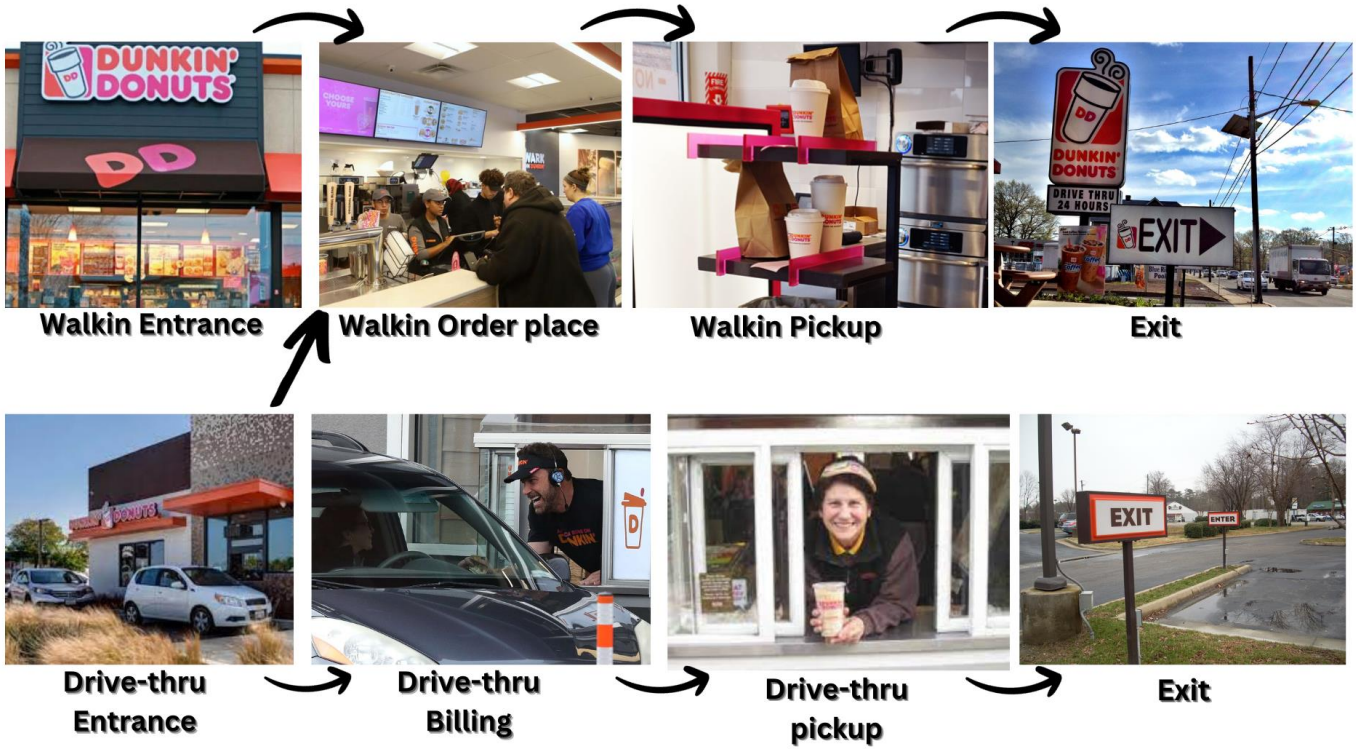
2. PROBLEM DESCRIPTION

The efficiency of the business's walk-in and drive-thru service procedures differs. The system appears more congested as seen by the higher average queue lengths, and drive-thru customers are dealing with greater wait times for both ordering and pickups. Although the Drive-thru procedure has some areas with greater utilization rates, the overall throughput is still below that of the Walk-in technique. In order to improve the drive-thru method's effectiveness and client satisfaction, the difficulty is to pinpoint the underlying problems.

3. MODEL IMPLEMENTATION

3.1 Process Flow

- Customer enters the store or the drive-thru section, whichever comes first.
- Places the order over the phone or drive-thru at the store's counter.
- Customers pick up their orders inside the store or at the drive-thru order pickup window.
- Patrons remain in or leave Dunkin.



3.2 Data Collection and Statistical Analysis:

Data Collection:

Name of Column	Data collection	Description
No. of Customers	Collected	Numbered serially from the point of arrival of Customers
Arrival Time	Collected	Time when customer arrives Inside the shop./in drive thru lane
Order Placing Time	Collected	Time When Person places Its Order at Server inside / at Telephonic booth of drive thru lane
Order Pick Up Time	Collected	Time When Person Collects its order inside/ collects Its order outside in the Drive Thru Window.
Arrival Time in	Calculated	Difference between Arrival time of Customers Converted in minutes (number format)
Service Time in	Calculated	Difference between Service time to Customers Converted in minutes (number format)

Statistical Analysis:

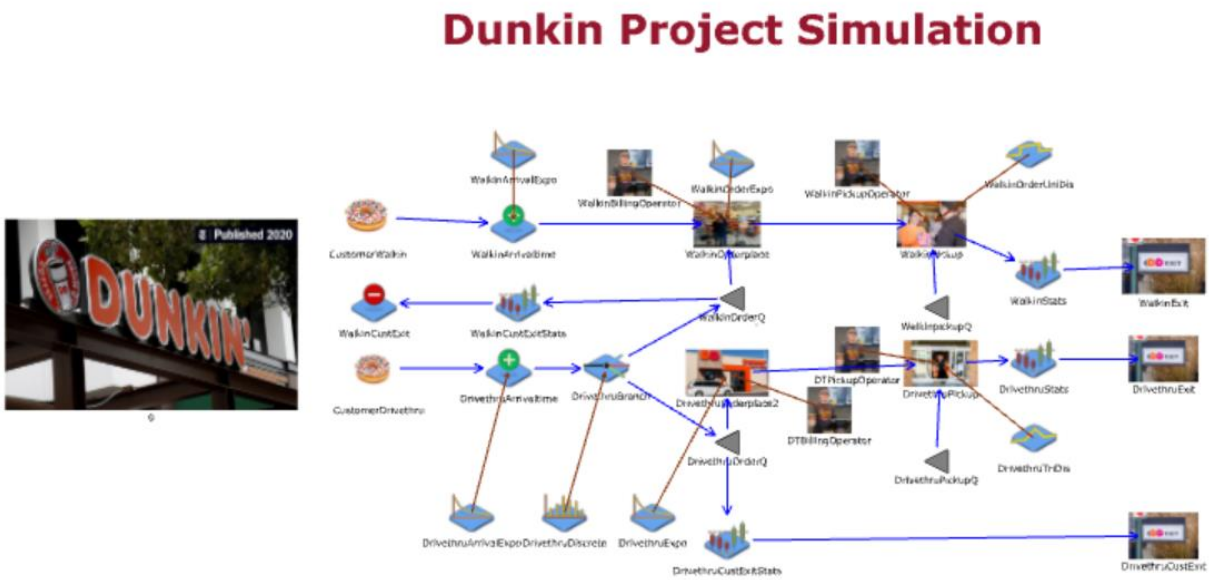
To understand the probability distribution (normal, uniform, exponential, and triangular) of the arrival, order placement time, and service time, we have coded in Python. Failure to reject the null in distribution tests implies that the data adhere to the predicted distribution. The probability distribution is exponential (walk in and drive through) for the arrival point. According to the histogram graph, the probability distribution for order placement time is exponential (walk in and drive through). The probability distribution for service time is uniform (for walk-ins) and triangular (for drive-throughs).

3.3 Assumptions:

Based on our observations and interactions with customers and shop management, we made the following assumptions for our project:

1. For our consideration, we have considered timing 7 a.m. to 9 a.m. because the Dunkin Donuts store is popular at those times.
2. We witnessed only one operator inside the store for walk in and drive thru each and two operators for serving the customers inside taking orders and one operator at the Drive Thru counter.
3. We noticed that if there were more than 5 cars in the Drive Thru line, people departed and did not order. If there is a line of more than six people, the client will not order and will depart.
4. We observed that some people who joined the drive-thru queue eventually switched to the walk-in line after realizing the line was long. Based on our observations and interactions with shop managers, we estimate that 5% of consumers exit the Drive Thru before making an order and walk inside the shop to do so.
5. We also observed that if queue line is greater than 6, customers exited from the walk-in order placing queue.

3.4 SIMULATION MODEL:



Objects used:

1. **Sim Entity:** Two sim entities for each Walk-In and Drive Thru. Sim Entity is the start points for the customers.
2. **Entity Generator:** There are two Entity Generators used for the Walk In and Drive Thru processes. Entity Generator represents Arrival Point. WalkinArrivalTime is for walk-ins and DriveThruArrivalTime is for drive-throughs.
3. **Entity Processor:** We have used 4 Entity Processors which consists of 2 for Walk in and 2 for Drive Thru
   For Order Placing Server – WalkinOrderplace, DrivethruOrderlace2.
   For Service/Pick Up Server - WalkinPickup, DrivethruPickup
4. **Queue:** 4 Queue's have been used
   For Order Placing Server – WalkinOrderQ

For Service/Pick Up Server – DrivethruOrderQ

5. **Exponential Distribution:** For both Arrival Times and Ordering time of Walkin and Drivethru - difference between arrival time of two customers and Order Placing Servers. Time difference between arrival time of shop and order placing time of each customer.
6. **Triangular Distribution:** For Drive Thru Pick Up Server – time difference between order placing & order pickup of customer (service time in minutes).
7. **Uniform Distribution:** For Walkin Pick Up Server - time difference between order placing and order pickup of customer (service time in minutes).
8. **Statistics:** Determine the average time in the system for the customers (both Walk In and Drive Thru)
9. **Entity Sink:** Customer Exit for both the process. We have used 4 Exits.
10. **Resources:** No. of Operators for each server. We have used 4 Operators consists of 2 Walk In and 2 Drive Thru
11. **Branch and Discrete probability Distribution:** To represent that 5% of all customers that arrive through the drive-through reroute to the walk-in. Thus, the Discrete Probability is 95% (Drive Thru) and 5% (Walk In).
12. **Renege:** There are two Renege, For WalkInOrderplace server (Walk In) if the que is longer than 6, customers exit the model. For DriveThruOrderplace if the que is longer than 5, customers exit the model.

3.5 SIMULATION RUN:

We have run the model for 120 minutes with 10 replications. Time unit – Minutes

4. SIMULATION RESULTS

		Walk-in									
Scenario	Replication	[WalkinOrderQ].AverageQueueTime/1[min]	[WalkinOrderQ].QueueLengthAverage	[WalkinOrderplace].Utilisation	[WalkinOrderplace].NumberProcessed	[WalkinpickupQ].AverageQueueTime/1[min]	[WalkinpickupQ].QueueLengthAverage	[WalkinPickup].Utilisation	[WalkinPickup].NumberProcessed	[WalkinStats].SampleAverage/1[min]	[WalkinCustExitStats].NumberProcessed
1	1	0.04	0.01	0.11	27.00	4.27	0.96	0.92	27.00	11.79	0.00
1	2	0.23	0.10	0.25	49.00	15.43	6.30	0.95	34.00	20.02	0.00
1	3	0.08	0.03	0.17	39.00	12.08	3.93	0.99	32.00	19.73	0.00
1	4	0.19	0.05	0.15	32.00	2.24	0.60	0.97	30.00	8.88	0.00
1	5	0.14	0.04	0.21	38.00	9.41	2.98	0.89	31.00	16.10	0.00
1	6	0.02	0.00	0.15	28.00	1.02	0.24	0.89	27.00	7.74	0.00
1	7	0.12	0.04	0.23	43.00	7.23	2.59	0.98	36.00	13.28	0.00
1	8	0.04	0.02	0.22	47.00	22.72	8.90	1.00	30.00	29.00	0.00
1	9	0.06	0.02	0.20	45.00	12.46	4.67	1.00	33.00	20.31	0.00
1	10	0.05	0.02	0.16	41.00	6.72	2.30	0.93	33.00	13.11	0.00
1		**0.10**	**0.03**	**0.18**	**38.90**	**9.36**	**3.35**	**0.95**	**31.30**	**16.00**	**0.00**

		Drivethru									
Scenario	Replication	[DrivethruOrderQ].AverageQueueTime/1[min]	[DrivethruOrderQ].QueueLengthAverage	[DrivethruOrderplace2].Utilisation	[DrivethruOrderplace2].NumberProcessed	[DrivethruPickupQ].AverageQueueTime/1[min]	[DrivethruPickupQ].QueueLengthAverage	[DrivethruPickup].Utilisation	[DrivethruPickup].NumberProcessed	[DrivethruStats].SampleAverage/1[min]	[DrivethruCustExitStats].NumberProcessed
1	1	0.29	0.08	0.31	35.00	24.79	7.23	0.99	21.00	28.66	0.00
1	2	1.31	0.31	0.50	27.00	9.88	2.22	0.89	20.00	17.82	0.00
1	3	1.15	0.34	0.45	36.00	21.98	6.59	1.00	18.00	30.95	0.00
1	4	0.22	0.06	0.32	33.00	19.28	5.30	0.90	18.00	22.02	0.00
1	5	0.33	0.07	0.39	25.00	8.04	1.68	0.86	19.00	15.73	0.00
1	6	0.70	0.17	0.47	29.00	13.33	3.22	0.86	17.00	19.67	0.00
1	7	0.45	0.12	0.42	33.00	24.46	6.73	0.98	21.00	27.89	0.00
1	8	0.58	0.18	0.36	37.00	25.05	7.72	0.99	22.00	34.80	0.00
1	9	2.49	0.48	0.34	23.00	18.84	3.61	0.98	21.00	28.70	0.00
1	10	2.71	0.90	0.62	40.00	27.00	9.00	0.98	21.00	35.81	0.00
1		**1.02**	**0.27**	**0.42**	**31.80**	**19.27**	**5.33**	**0.94**	**19.80**	**26.21**	**0.00**

4.1 PERFORMANCE INDICATORS

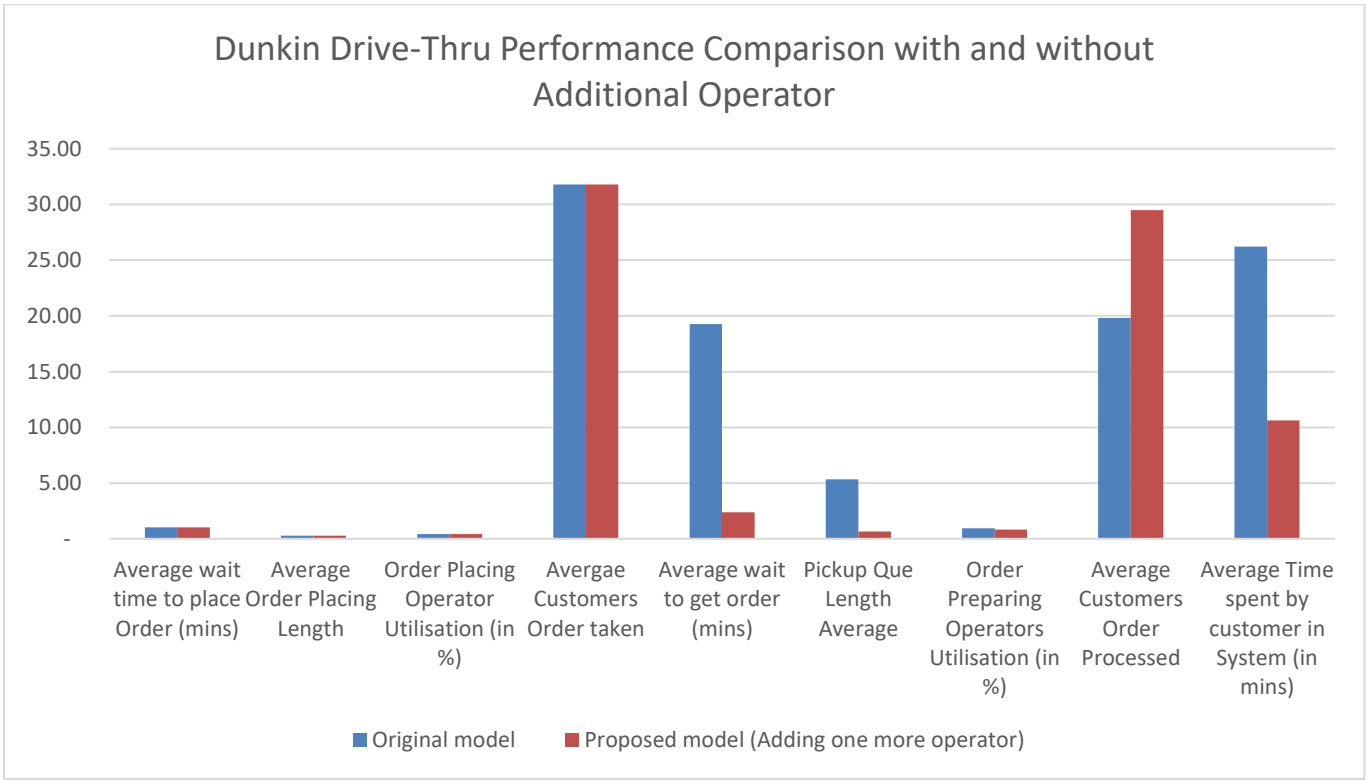
1. Average Queue Length: Average number of customers standing in the queue
2. Average Queue Time: The average time each customer waited in the Queue.
3. Utilization: The fraction of calendar time (excluding the initialisation period) that this object is in the Working state. Includes any completed cycles.
4. Sample Average- The Average of the values that were recorded.
5. Number Processed-Number of Customers Processed in that server.

4.2 OBSERVATIONS:

1. The average wait time to place an order is 0.10 minutes for walk-in customers and 1.02 minutes for drive-thru customers. Therefore, walk-in is quicker.
2. Order Queue Length: Compared to Drive-thru (0.27), the average walk-in queue is shorter (0.03). As a result, drive thru appears to be less busy.
3. Utilisation & Processing for Order Placement: When compared to Drive-thru, Walk-in has a significantly lower utilization for order placement. For walk-in, more orders are handled, though.
4. Drive-thru customers wait for pickups for a considerable amount longer (19.27 min) than walk-in customers (9.36 min). Faster is walk-in.
5. The average pickup line is longer for drive-thru customers compared to walk-in customers.
6. Utilization & Processing for Pickup: Both are utilized roughly equally for pickups, although More pickups are processed at walk-in.
7. Sample Average: Drive-thru takes 26.21 minutes to service an order which is longer than walk-in (16.00 minutes).
8. Number Processed at Exit: Number of customers processed in Walk in has higher number(31) when compared to Drive Thru(20).

According to the provided metrics, the walk-in strategy in this case seems to be more effective. In comparison to the drive-thru, it often processes more orders and pickups, has shorter line times, and is less congested.

5. CONCLUSION AND RECOMMENDATION



5.1 CONCLUSION:

The suggested drive-thru approach has undergone numerous significant adjustments as a result of the addition of a second operator. Among these are shorter wait times for consumers placing orders, noticeably quicker order pickups, enhanced order processing capacity, and a markedly shorter average customer dwell time. The benefits of optimizing worker numbers in drive-thru operations are highlighted by these improvements, which show that the proposed model is more effective and user-friendly.

5.2 RECOMMENDATION:

a) Start the hiring and training procedure for the additional operator to make sure they adhere to the business's service standards.
b) Check the drive-thru's physical layout to make sure it can handle the adjustments without creating bottlenecks.
c) After making the modification, closely watch the new procedure for a predetermined amount of time. To discover any unforeseen problems or potential areas for improvement, get input from both consumers and workers.
d) In conclusion, adding only one more operator might significantly improve the drive-thru procedure, providing customers with better service and possibly boosting revenue for the company.