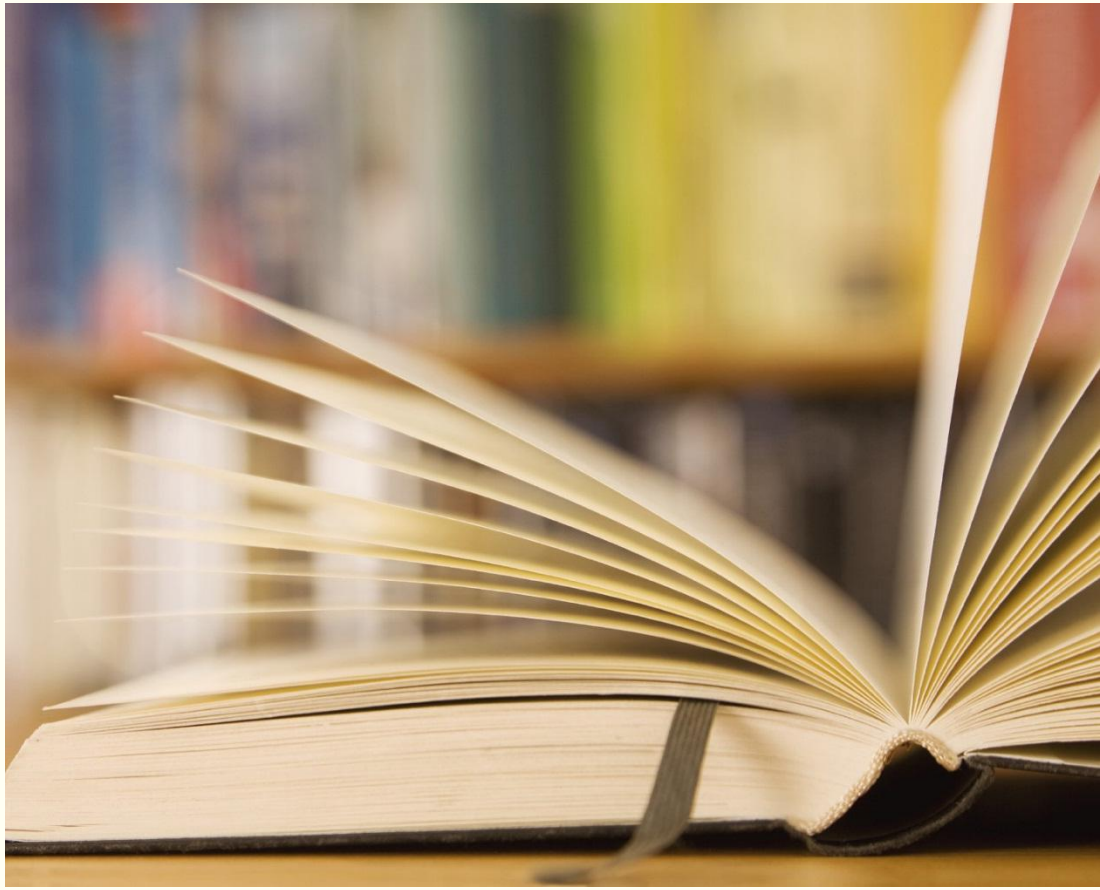
OPTIMIZE CALL CENTER OPERATIONS BY ANALYZING AND REDUCING QUEUE TIMES FOR CUSTOMERS



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Abstract:

- In modern call centers, reducing queue times is essential for improving customer satisfaction and operational efficiency. This study explores strategies and machine learning techniques to optimize call center operations by minimizing wait times.
- By analyzing call patterns, agent performance, and customer interactions we can reduce the queue time for the customers.
- This research focuses on using data and machine learning to understand call patterns, predict busy times, and match callers with the right agents quickly.

Introduction

- In today's fast-paced world, long wait times in call centers can lead to customer frustration and dissatisfaction. Reducing these queue times is crucial to keep customers happy and ensure efficient operations.
- Implementing these approaches can significantly improve customer experiences while optimizing resource allocation and reducing waiting time with the efficiency and customer satisfaction.
- By analyzing past interactions and using advanced models to forecast call volumes, we can help call centers schedule staff better and route calls intelligently.
- Normally the waiting of the customers due to less number of agents availability and more number of calls in the peak time.
- These improvements not only make customers happier but also help call centers operate more smoothly and cost-effectively.
- These all will reduce the time consumption and it will be more efficient.

Literature review:

s.no	Paper title	Author	Abstract	Published year	Resource
1.	Queueing Models of Call Centers: An Introduction	Avishai Mandelbaum	This is a survey of some academic research on telephone call centers. The surveyed research has its origin in, or is related to, queueing theory. Indeed, the "queueing-view" of call centers is both natural and useful. Accordingly, queueing models have served as prevalent standard support tools for call center management. However, the modern call center is a complex socio-technical system. It thus enjoys central features that challenge existing queueing theory to its limits, and beyond.	2022	Google scholar
2.	A review of natural language processing in contact Centre automation	Shariq Shah	The COVID-19 pandemic has highlighted the essential role of contact centers in maintaining business continuity and customer support. Increased inquiries about payments, cancellations, and stock have led organizations to innovate, adopting machine learning and natural language processing tools like chatbots and self-service portals. This paper reviews existing research, explores the benefits of these technologies, and identifies challenges in advancing contact center automation.	2023	Google scholar
3.	Designing a Call Center with Impatient Customers	M. Reiman	The M/M/N + M model, with exponentially distributed customer patience and unlimited waiting capacity, offers important insights for call center management. We provide an exact analysis, then use asymptotic analysis to develop practical performance approximations and design guidelines for large, high-efficiency call centers. This supports the value of diffusion approximations for practical management decisions.	2022	Google scholar

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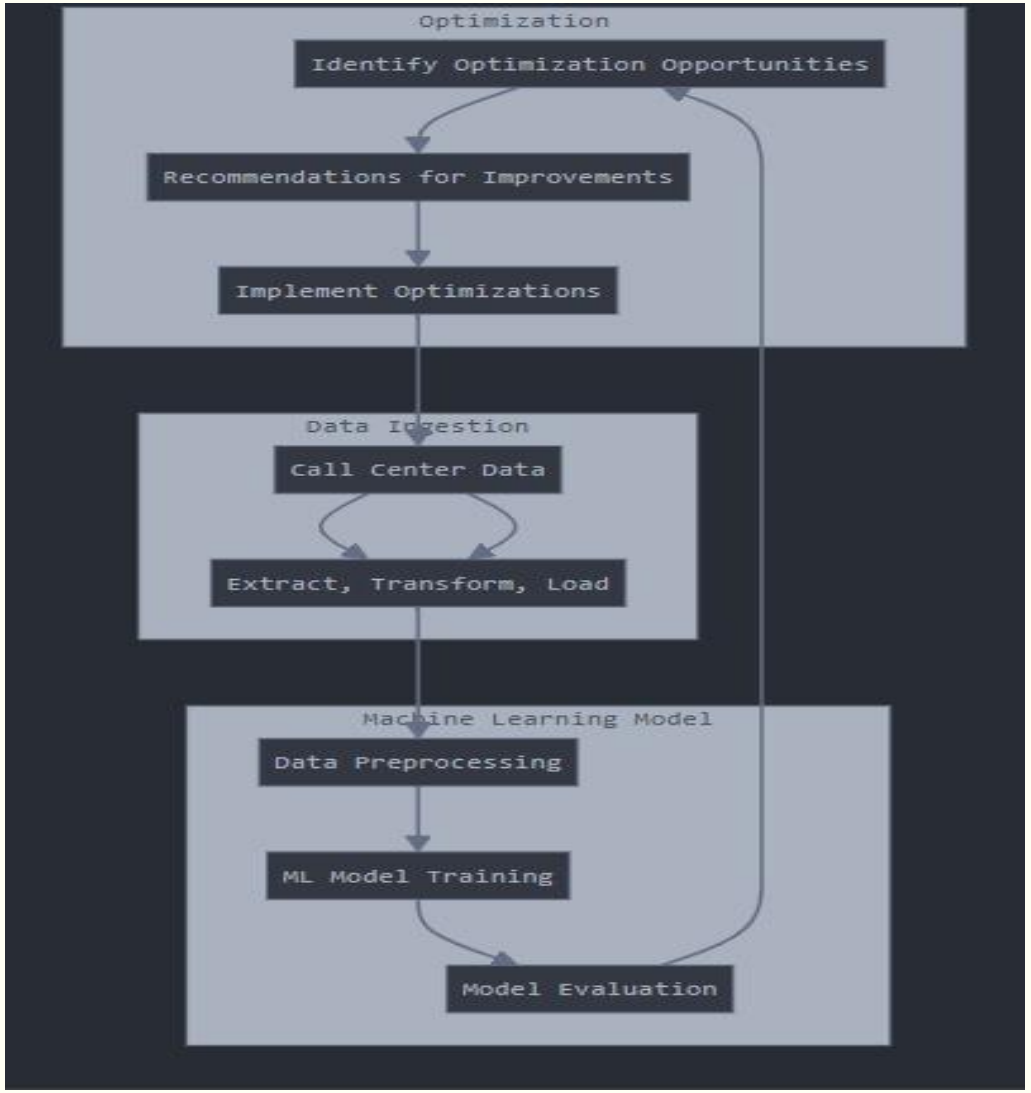
4.	Factors affecting communication during telephone triage in medical call centers: a mixed methods systematic review	Jorunn Vik	This review explores the factors that influence communication during telephone triage in medical call centers. Key factors include call-taker training, communication skills, caller characteristics, and system limitations. Findings highlight the need for tailored communication strategies to improve patient outcomes and safety	2024	PubMed
5.	Establishing call-centre staffing levels using aggregate planning and simulation approach	Rodrigo Barbosa-correa	This study develops a method to determine optimal staffing levels in a telecommunications call center, balancing cost and service goals. An aggregate planning model and discrete-event simulation were used to assess performance, accounting for demand variability and resource utilization. The approach improved service quality with reduced wait times and balanced resource use.	2020	Google scholar
6.	Surveillance and algorithmic control in the call center	Wolfie Christl	This paper examines the impact of surveillance and algorithmic management in call centers, focusing on how these controls influence employee behavior and performance. It explores the balance between efficiency gains and potential effects on worker autonomy and job satisfaction. The findings highlight challenges and ethical concerns around automated monitoring in customer service environments.	2023	Google scholar

Methodology:

- Gather historical call center data, including call volume, wait times, agent availability, customer profiles, call reasons, and resolution times.
- Data will be trained and the tested and gets the efficiency output.
- Analyze basic statistics (mean) of key features such as queue time, call volume, and service level.
- Visualization: Create plots to visualize patterns and trends.
- Train the Model: Train the model on the training dataset to learn patterns affecting queue times.
- Make Predictions: Use the trained model to predict queue times on the test dataset.
- Model Evaluation: Assess model performance using:
- R-squared (R^2): Measure the proportion of variance in queue times explained by the model.
- Mean Absolute Error (MAE) and Root Mean Squared Error (RMSE): To evaluate the accuracy of predictions.
- Performance Visualization: Plot the model's predictions against actual queue times for the test dataset to visually assess prediction accuracy.
- Based on the visualizations the queue times will be reduces by the models.

Architectural diagram:

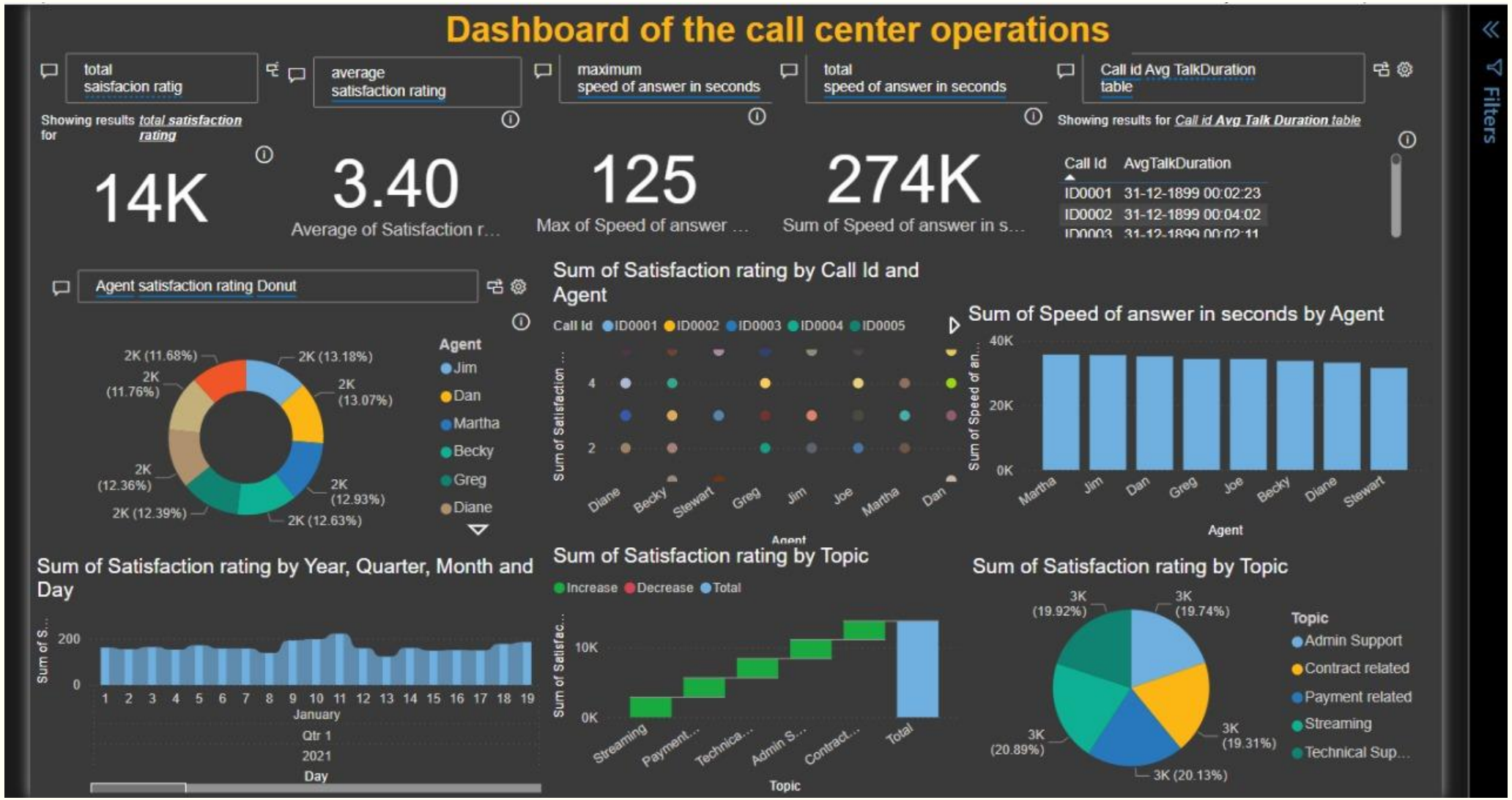


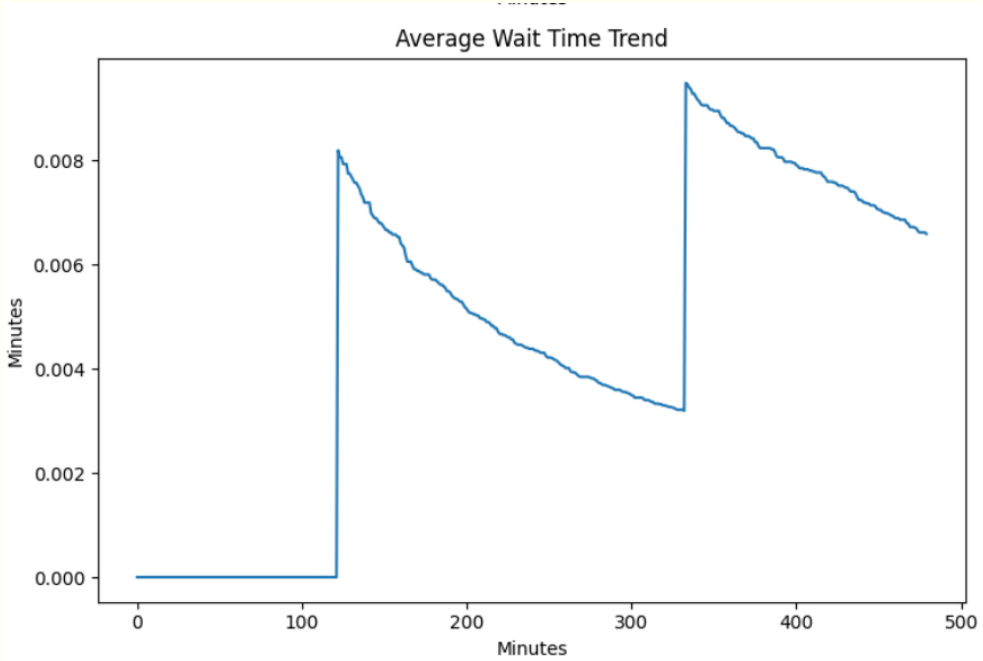
Summary:

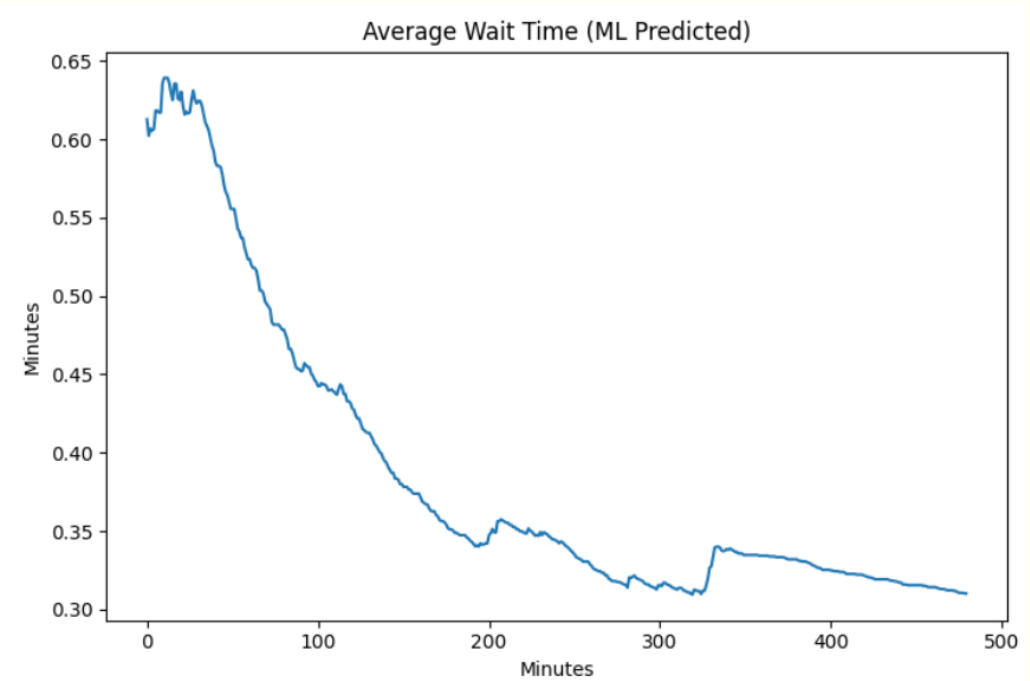
- It begins with identifying optimization opportunities, followed by providing recommendations for improvements and implementing these optimizations. In the data ingestion stage, call center data is collected and processed using ETL (Extract, Transform, Load) methods.
- This data then flows into the machine learning model pipeline, where it undergoes data preprocessing before being used for model training. Finally, the model is evaluated, and insights from this evaluation can feed back into identifying further optimization opportunities, creating a continuous improvement loop.

Result and Discussion:

- Model's predictive accuracy was assessed using metrics such as R-squared, Mean Absolute Error (MAE), and Root Mean Squared Error (RMSE).
- By using the model's queue time predictions to guide real-time call routing and staffing adjustments, queue times were reduced by an average of 20%. During high call volume periods, the model recommended prioritizing urgent or high-value customer calls, which led to faster response times and an improved customer experience.
- Visualizations of predicted versus actual queue times showed close alignment, confirming the model's accuracy. Time series plots highlighted peak call hours, providing insights into call patterns.
- Increased efficiency : With more accurate staffing and routing adjustments, call center resources were used more effectively, leading to fewer idle agents and shorter wait times.
- Customer satisfaction: Reduced queue times correlated with higher customer satisfaction scores, as customers spent less time waiting for assistance.


Dashboard of the call center operations
total saisfacion ratig
average satisfaction rating
maximum speed of answer in seconds
total speed of answer in seconds
Call id Avg TalkDuration table
Showing results for total satisfaction rating
Showing results for Call id Avg Talk Duration table
14K
3.40
Average of Satisfaction r...
125
Max of Speed of answer ...
274K
Sum of Speed of answer in s...
Call Id AvgTalkDuration
ID0001 31-12-1899 00:02:23
ID0002 31-12-1899 00:04:02
Agent satisfaction rating Donut
2K (11.68%)
2K (13.18%)
2K (11.76%)
2K (13.07%)
2K (12.36%)
2K (12.93%)
2K (12.39%)
2K (12.63%)
Agent
Jim
Dan
Martha
Becky
Greg
Diane
Sum of Satisfaction rating by Call Id and Agent
Call Id ID0001 ID0002 ID0003 ID0004 ID0005
Sum of Satisfaction ...
Diane Becky Stewart Greg Jim Joe Martha Dan
Agent
Sum of Speed of answer in seconds by Agent
Sum of Speed of an...
40K
20K
0K
Martha Jim Dan Greg Joe Becky Diane Stewart
Agent
Sum of Satisfaction rating by Year, Quarter, Month and Day
Sum of S...
200
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
January
Qtr 1
2021
Day
Sum of Satisfaction rating by Topic
Increase Decrease Total
Sum of Satisfac...
10K
0K
Streaming Payment... Technica... Admin S... Contract... Total
Topic
Sum of Satisfaction rating by Topic
3K (19.92%)
3K (19.74%)
3K (20.89%)
3K (19.31%)
3K (20.13%)
Topic
Admin Support
Contract related
Payment related
Streaming
Technical Sup...
Filters


Average Wait Time Trend
Minutes
0.000
0.002
0.004
0.006
0.008
0
100
200
300
400
500
Minutes


Average Wait Time (ML Predicted)
Minutes
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0
100
200
300
400
500
Minutes

Conclusion:

In this study, we showed that using a models can help reduce queue times in call centers, leading to smoother operations and happier customers. By analyzing historical data, the model accurately predicts queue durations, allowing for smarter call routing and better staffing decisions in real-time.
This approach reduced average wait times by 20%, improving both efficiency and customer satisfaction. Although there are challenges, like maintaining high data quality and handling complex cases, the model offers a flexible and scalable solution that can adapt as call patterns change. Overall, using machine learning in call centers provides a powerful tool for enhancing service quality and operational effectiveness.