Problem Statement

As United Airlines continues its journey to become the best airline in the history of aviation, it is crucial to provide world-class customer service, for which one of the key areas of focus is our call center operations. Call centers play a critical role in ensuring customer issues are resolved quickly and efficiently, but we face challenges in improving metrics such as Average Handle Time (AHT) and Average Speed to Answer (AST).

Your task is to optimize these key call center metrics, helping reduce resolution times and providing faster, more efficient service to our customers. You are required to analyze our existing call center data to identify inefficiencies, determine the drivers of long AHT and AST, and suggest strategies to enhance customer satisfaction, reduce escalations, and improve overall operational efficiency.

Data Overview

Calls Data:

	call_id	customer_id	agent_id	call_start_datetime	agent_assigned_datetime	call_end_datetime	call_transcript
0	4667960400	2033123310	963118	7/31/2024 23:56	8/1/2024 0:03	8/1/2024 0:34	\n\nAgent: Thank you for calling United Airlin...
1	1122072124	8186702651	519057	8/1/2024 0:03	8/1/2024 0:06	8/1/2024 0:18	\n\nAgent: Thank you for calling United Airlin...
2	6834291559	2416856629	158319	7/31/2024 23:59	8/1/2024 0:07	8/1/2024 0:26	\n\nAgent: Thank you for calling United Airlin...
3	2266439882	1154544516	488324	8/1/2024 0:05	8/1/2024 0:10	8/1/2024 0:17	\n\nAgent: Thank you for calling United Airlin...
4	1211603231	5214456437	721730	8/1/2024 0:04	8/1/2024 0:14	8/1/2024 0:23	\n\nAgent: Thank you for calling United Airlin...

Customer Data:

	customer_id	customer_name	elite_level_code
0	2033123310	Matthew Foster	4.0
1	8186702651	Tammy Walters	NaN
2	2416856629	Jeffery Dixon	NaN
3	1154544516	David Wilkins	2.0
4	5214456437	Elizabeth Daniels	0.0

Reason Data:

	call_id	primary_call_reason
0	4667960400	Voluntary Cancel
1	1122072124	Booking
2	6834291559	IRROPS
3	2266439882	Upgrade
4	1211603231	Seating

Data Overview

Test Data:

	call_id
0	7732610078
1	2400299738
2	6533095063
3	7774450920
4	9214147168

Sentiment Data:

	call_id	agent_id	agent_tone	customer_tone	average_sentiment	silence_percent_average
0	4667960400	963118	neutral	angry	-0.04	0.39
1	1122072124	519057	calm	neutral	0.02	0.35
2	6834291559	158319	neutral	polite	-0.13	0.32
3	2266439882	488324	neutral	frustrated	-0.20	0.20
4	1211603231	721730	neutral	polite	-0.05	0.35

Deliverables 1

Long average handle time (AHT) affects both efficiency and customer satisfaction. Explore the factors contributing to extended call durations, such as agent performance, call types, and sentiment. Identify key drivers of long AHT and AST, especially during high volume call periods. Additionally, could you quantify the percentage difference between the average handling time for the most frequent and least frequent call reasons?

Exploratory Data Analysis (EDA)

Understand the Business Context → Data Preparation → Identify Key Patterns and Trends → Analyze Impact on Key Metrics → Recommendations
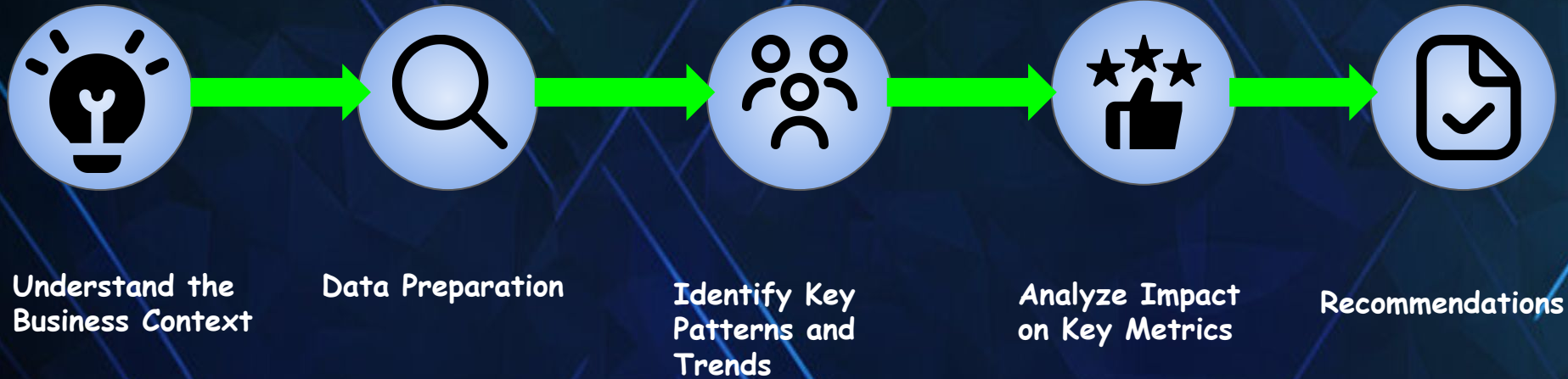
Data Processing: Primary Call Reasons

To enhance data consistency and improve analysis accuracy, we cleaned the primary_call_reason dataset. This involved:

1. **Standardization**: We converted all entries to lowercase to eliminate case sensitivity.
2. **Trimming Whitespace**: Leading and trailing spaces were removed from each entry to ensure uniformity.
3. **Normalization**: Variations in terminology were unified (e.g., "Voluntary Cancel" and "voluntary cancel" were consolidated).
4. **Reduction of Duplicates**: Similar categories were merged to avoid redundancy (e.g., "Traveler Updates" variations).

```
array(['Voluntary  Cancel', 'Booking', 'IRROPS', 'Upgrade', 'Seating',
       'Mileage   Plus', 'Checkout', 'Voluntary  Change', 'Post Flight',
       'Check In', 'Other  Topics', 'Communications', 'Schedule Change',
       'Products & Services', 'IRROPS ', 'Digital  Support',
       'Seating ', 'Disability', 'Unaccompanied Minor', ' Baggage',
       'Traveler  Updates', 'Communications ', 'ETC', 'Upgrade ',
       'Unaccompanied Minor ', 'Voluntary Change', 'Voluntary Change ',
       'Checkout ', 'Mileage Plus', 'Mileage Plus ', 'Booking ',
       'Baggage ', 'Post-Flight', 'Post-Flight ', 'Schedule Change ',
       'Baggage', 'Traveler Updates', 'Voluntary Cancel', 'Check-In',
       'Products and Services', 'Check-In ', 'Other Topics',
       'Other Topics ', 'ETC ', 'Disability ', 'Digital Support',
       'Digital Support ', 'Voluntary Cancel ',
       'Products and Services ', 'Traveler Updates ',
       'Traveler   Updates', 'Digital  Support', 'Mileage  Plus',
       'Voluntary  Change'], dtype=object)
```

Narrowed down to 20 essential features—each one unique and invaluable

```
['voluntary cancel' 'booking' 'irrops' 'upgrade' 'seating' 'mileage plus'
 'checkout' 'voluntary change' 'post-flight' 'check-in' 'other topics'
 'communications' 'schedule change' 'products and services'
 'digital support' 'disability' 'unaccompanied minor' 'baggage'
 'traveler updates' 'etc']
```

Calculating Average Handling Time and Average Speed to Answer

```python
# Calculating Total Handle Time and Total Answer Time
total_handle_time = calls['handle_time'].sum()
total_answer_time = calls['answer_time'].sum()

# Total number of calls
total_calls = len(calls)

# Calculating AHT (Average Handle Time) and AST (Average Answer Time)
AHT = total_handle_time / total_calls
AST = total_answer_time / total_calls

AHT, AST
```

RESULT

AHT = 11:37 minutes AST = 7:17 minutes

WHY AHT Is Important?

AHT (Average Handle Time)
"We've identified that extended AHT is a key issue impacting both operational efficiency and customer satisfaction. Long calls not only reduce the number of customers we can serve but also contribute to increased frustration during interactions."

"Reducing AHT is critical, especially during high-volume call periods, as it directly affects customer experience and operational costs."
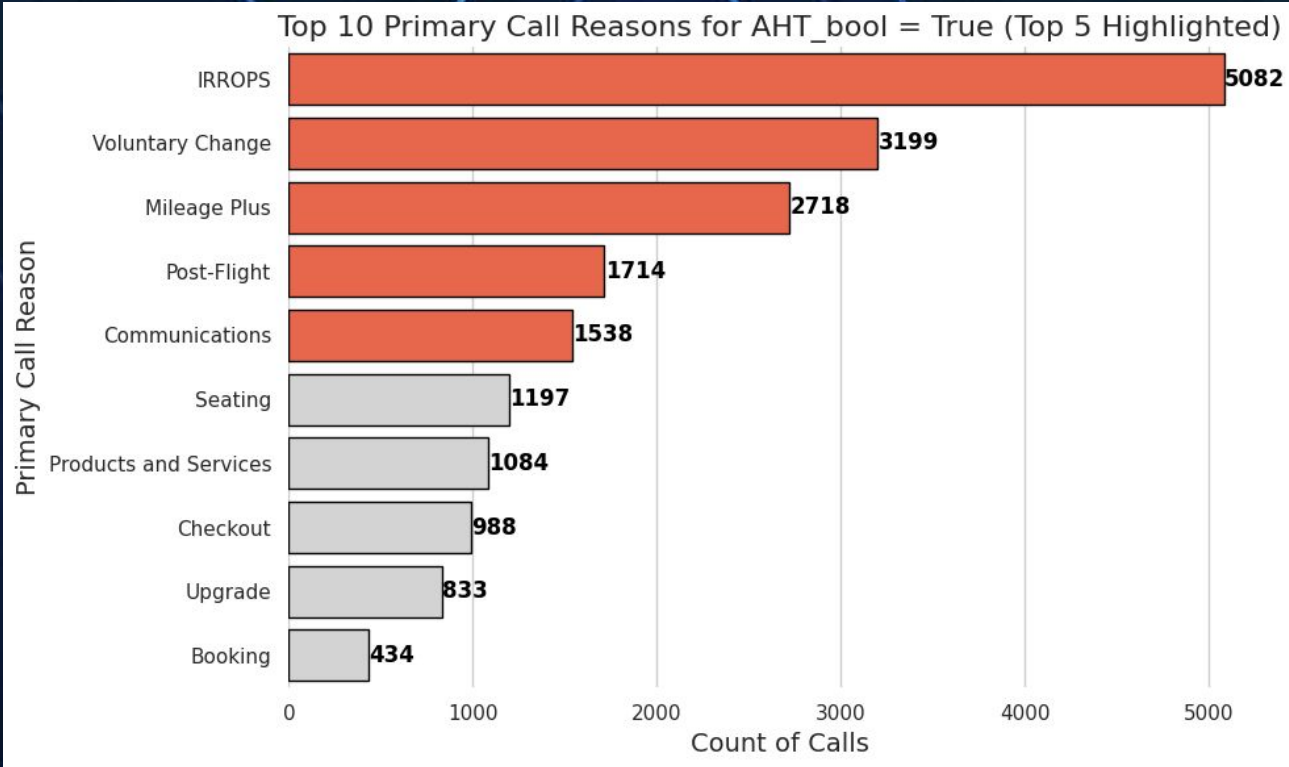
Primary Call Reasons causing increase in Average Handling Time

These call reasons represent complex issues that typically require more time to resolve.
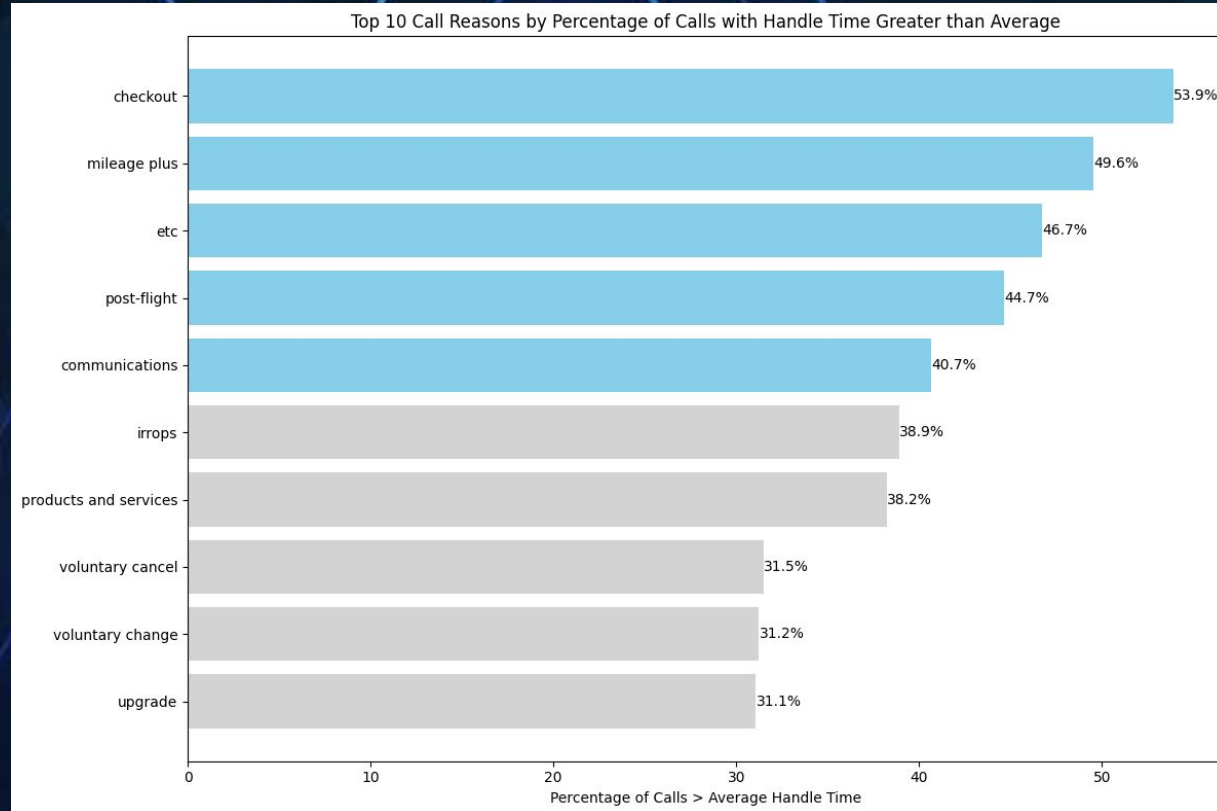
For example, **IRROPS** calls involve rebooking and explaining policies, while **Mileage Plus** calls often need detailed account handling.

IRROPS is SUSPICIOUS because of its high count.

Top 10 Primary Call Reasons for AHT_bool = True (Top 5 Highlighted)

Primary Call Reason	Count of Calls
IRROPS	5082
Voluntary Change	3199
Mileage Plus	2718
Post-Flight	1714
Communications	1538
Seating	1197
Products and Services	1084
Checkout	988
Upgrade	833
Booking	434

Primary Call Reasons by PERCENTAGE causing increase in Average Handling Time

Percentage Calculation: Instead of simply counting calls for each reason, the analysis focused on the percentage of calls that exceeded the average handle time. This approach mitigates the misleading effects of call volume, providing a clearer picture of which issues truly impact efficiency.

Top 10 Call Reasons by Percentage of Calls with Handle Time Greater than Average

Call Reason	Percentage of Calls > Average Handle Time
checkout	53.9%
mileage plus	49.6%
etc	46.7%
post-flight	44.7%
communications	40.7%
irrops	38.9%
products and services	38.2%
voluntary cancel	31.5%
voluntary change	31.2%
upgrade	31.1%

Improvement Recommendations

Checkout :

- Enhance self-service options for checkout inquiries and provide targeted training for agents on common issues.

Mileage Plus:

- Improve online account management for customers.
- Automate common loyalty-related inquiries (e.g., point balance).

Communications:

- Streamline communication with scripted responses for common issues.
- Use sentiment analysis to reduce escalations.

Voluntary Changes:

- Improve self-service tools for flight changes.
- Provide agents quick access to fare rules.
- Train agents on fare policies.

Post-Flight:

- Automate common post-flight issues (e.g., refunds, baggage tracking).
- Provide post-flight FAQs in self-service portals.

The IRROPS in graphs had the highest count, which could mislead, so we decided to remove it.

# Agent Tone that causes the least increase in the Average Handling Time

Agents using a **polite tone** have been found to cause the least increase in AHT.

Recommendation:

Training: Implement training programs focusing on polite communication techniques to enhance agent-customer interactions.

Agent Tones by Percentage of Calls Exceeding AHT
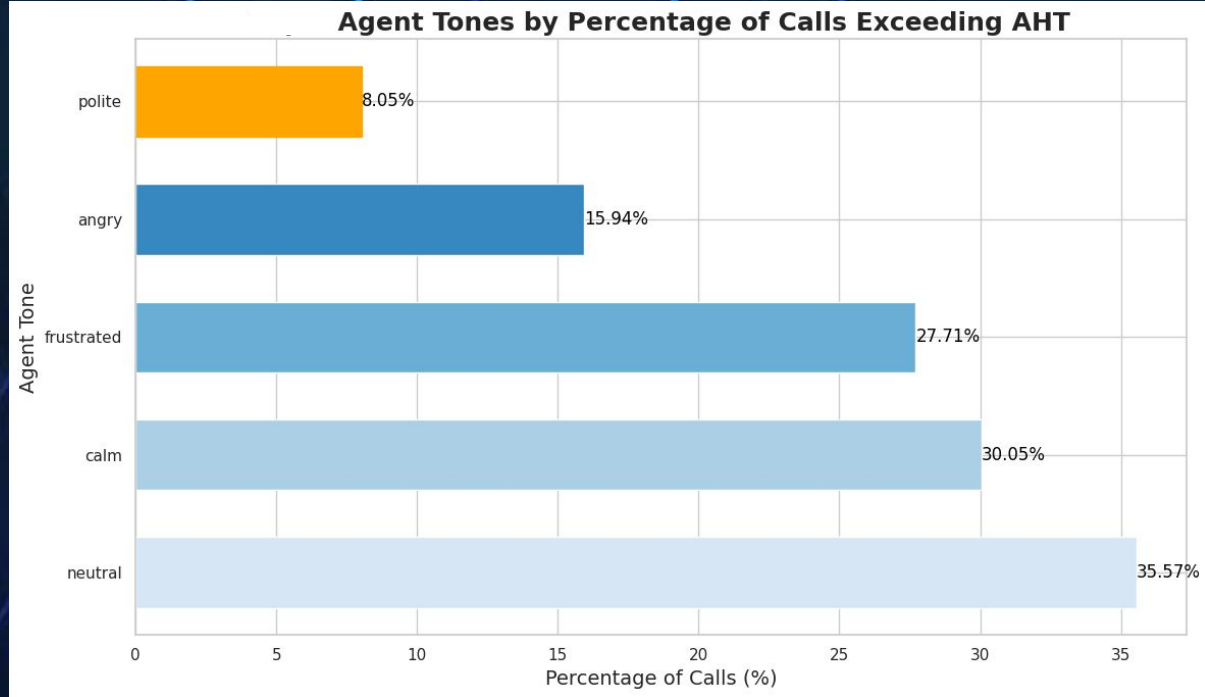
Overarching Relationship between Handling Time and Silence Percentage Average

Line Graph: Handling Time vs Silence Percent Average
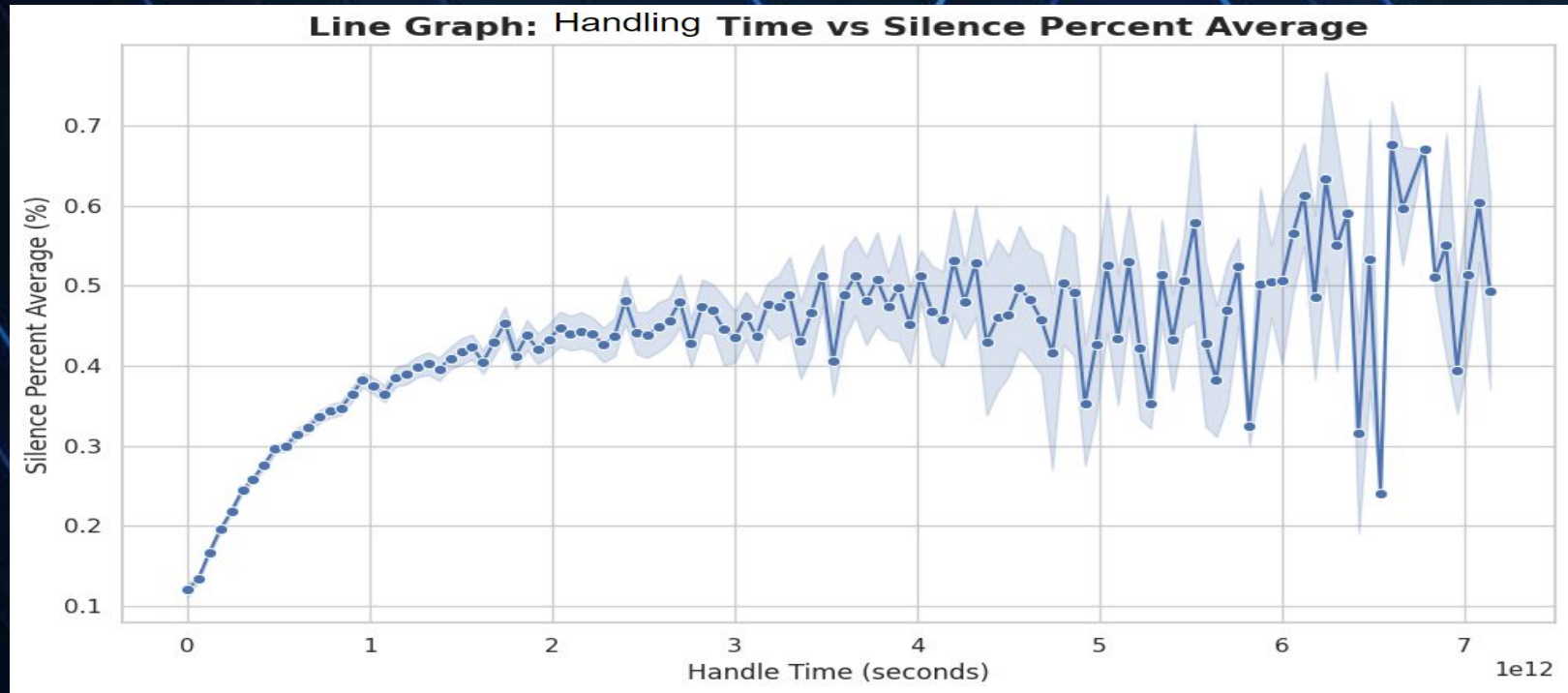
Increase in Handle Time due to increase in Silence Percentage

The Call Volume throughout the day (24-hours)

The highest call volume occurs from **7 AM to 7 PM**, leading to increased customer demand and longer wait times.(nearly 5000 calls)

Effects on AHT and AST:

- This peak period significantly contributes to the **largest increases in Average Handling Time (AHT)** and **Average Speed to Answer (AST)**.
- High call volume can overwhelm agents, resulting in longer interactions and reduced efficiency.

Recommendation:

- **Resource Allocation:** Consider adjusting staffing levels during peak hours to ensure adequate support and reduce AHT and AST.
- **Call Routing:** Implement strategies for call routing to prioritize urgent inquiries and minimize wait times.

Call Volume by Hour of Day
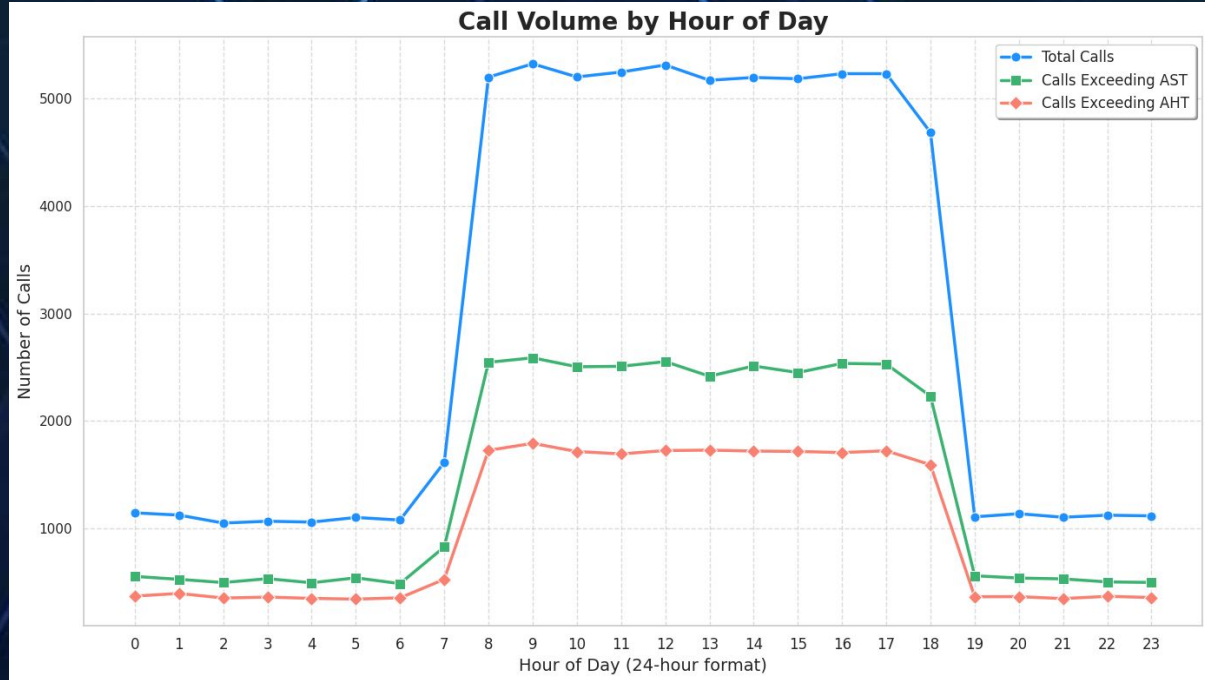
Code To Quantify percentage difference between the average handling time for the most frequent and least frequent call reasons

```python
# Calculate average handling time by primary call reason
average_aht = merged_data.groupby('primary_call_reason')['handle_time_minutes'].mean().reset_index()

# Identify the most and least frequent call reasons
reason_counts = merged_data['primary_call_reason'].value_counts()
most_frequent_reason = reason_counts.idxmax()
least_frequent_reason = reason_counts.idxmin()

# Get average handling times for the most and least frequent reasons
most_frequent_aht = average_aht.loc[average_aht['primary_call_reason'] == most_frequent_reason, 'handle_time_minutes'].values[0]
least_frequent_aht = average_aht.loc[average_aht['primary_call_reason'] == least_frequent_reason, 'handle_time_minutes'].values[0]

# Calculate percentage difference
percentage_difference = ((most_frequent_aht - least_frequent_aht) / most_frequent_aht) * 100
```

Output

```
Average Handling Time for Most Frequent Reason ('IRROPS'): 13.09 minutes
Average Handling Time for Least Frequent Reason ('Unaccompanied Minor  '): 3.00 minutes
Percentage Difference: 77.08%
```

Deliverables 2

We often observe self-solvable issues unnecessarily escalating to agents, increasing their workload. Analyse the transcripts and call reasons to identify granular reasons associated to recurring problems that could be resolved via self-service options in the IVR system. Propose specific improvements to the IVR options to effectively reduce agent intervention in these cases, along with solid reasoning to support your recommendations.

# Reducing Agent Workload by Improving Self-Service IVR Options

Analysis Call Reasons for Optimized IVR

By addressing the most frequent and self-solvable customer inquiries through enhanced Interactive Voice Response (IVR) options, we aim to significantly reduce the workload on agents. This analysis identifies recurring issues that can be resolved through self-service, allowing agents to focus on complex cases.
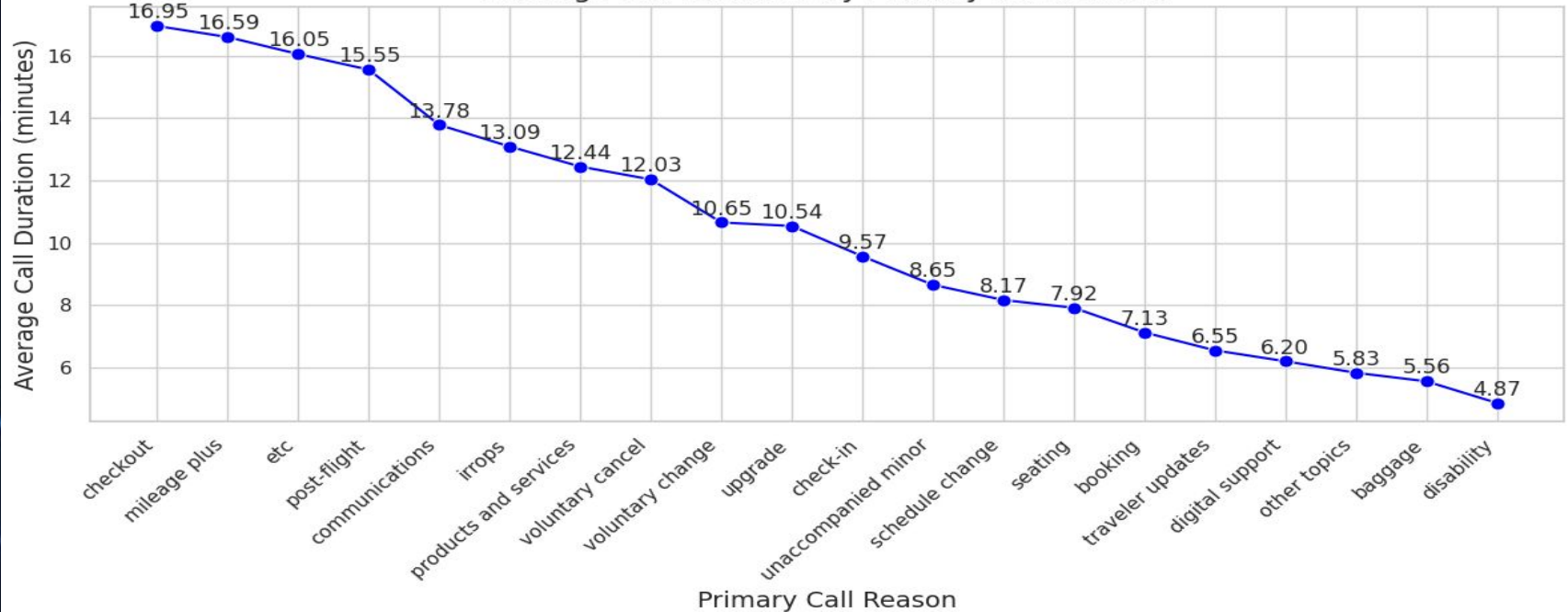

Top 10 Primary Call Reasons
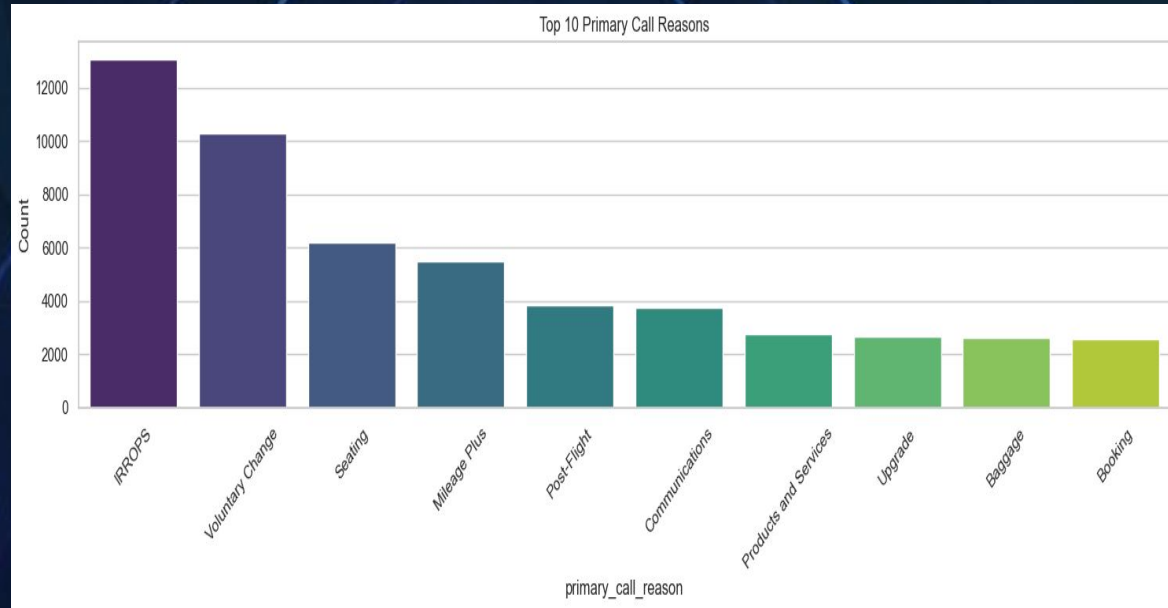
Analyzing Silence Percentage in Call Transcripts

This plot shows the distribution of silence during calls. Extended silences may indicate opportunities for improved automation or more efficient agent handling, which can reduce both AHT and customer frustration.
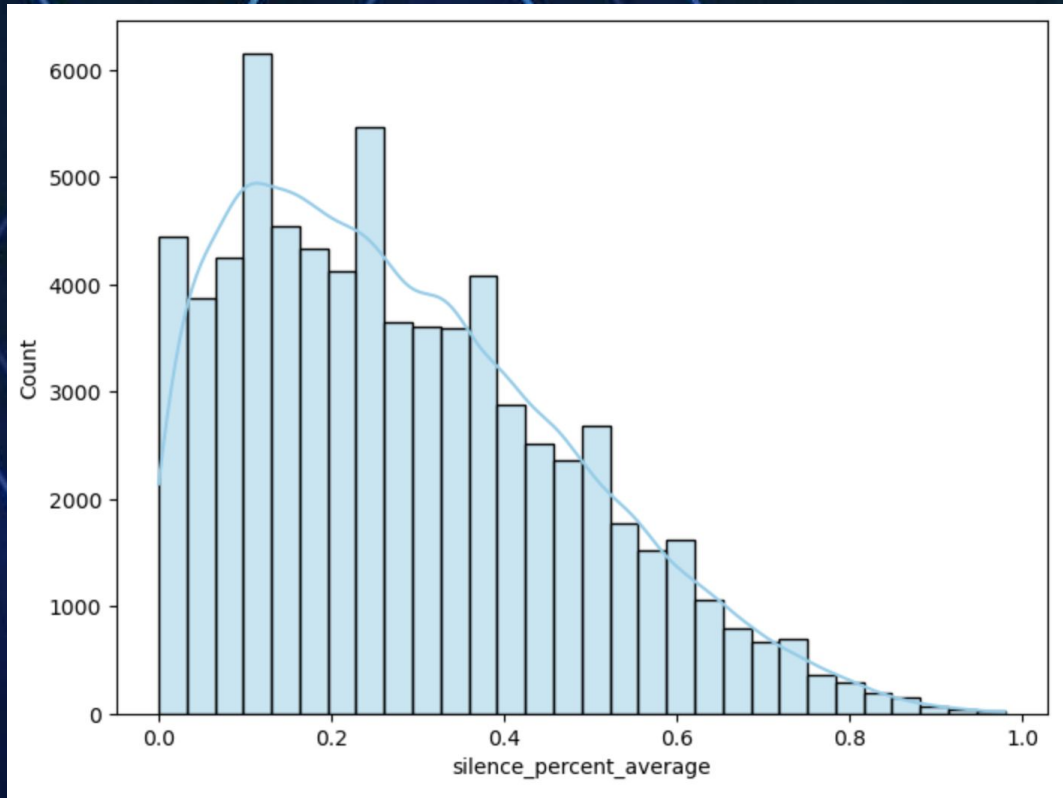
Average Call Duration by Primary Call Reason

The analysis reveals the average call duration associated with various primary call reasons. This metric is crucial as it provides insights into which issues are taking up significant time during customer interactions. Longer call durations often indicate complex issues that might require agent intervention, while shorter calls might suggest issues that could be resolved through self-service.

Identification of Key Call Reasons

High Average Duration Reasons:

Certain call reasons may show significantly higher average call durations. These could indicate complex issues, such as:

- Account-related inquiries (e.g., account verification, changes to personal information).
- Technical support for booking or flight changes.
- Customer complaints that require detailed discussions.

Low Average Duration Reasons:

Reasons with shorter average call durations might indicate straightforward queries that can easily be automated or resolved via self-service, such as:

- Flight status inquiries.
- Simple cancellations or refunds.

Recommendation

Implement specialized self-service options in the IVR system for frequently occurring, high-duration issues. For example, allowing customers to update their information directly via the IVR could alleviate the need for agent involvement.

Enhance the self-service capabilities of the IVR for these types of calls. Implementing options for customers to check flight statuses, make simple cancellations, or request refunds directly through IVR could significantly reduce agent workload.

Deliverables 3

Understanding the primary reasons for incoming calls is vital for enhancing operational efficiency and improving customer service. Accurately categorizing call reasons enables the call center to streamline processes, reduce manual tagging efforts, and ensure that customers are directed to the appropriate resources. In this context, analyze the dataset to uncover patterns that can assist in understanding and identifying these primary call reasons. Please outline your approach, detailing the data analysis techniques and feature identification methods you plan to use. *Optional task, you may utilize the `test.csv` file to generate and submit your predictions*

Identification of Key Call Reasons

Summary of Actions:

Loyalty Score	Handling Approach	IVR	Agent
High (4-5)	Personalized, priority treatment with minimal IVR	Minimal IVR (for simple queries only)	Direct access to skilled agents
Mid (2-3)	Balance between IVR and agent interaction	Use IVR for simple queries, faster routing to agents for complex issues	Skilled agents for complex cases
Low (0-1/NaN)	Utilize IVR for routine tasks, escalate only for complex queries	Extensive use of IVR for self-service	Escalate only for complex issues

High Correlation of handle_time with Silence_percent_average

Recommendation:

1) Call Scripts should have less gaps.

2) Training should be given to ensure smooth conversation.

Correlation Matrix of Key Features

Word Cloud to identify key words in the Transcript
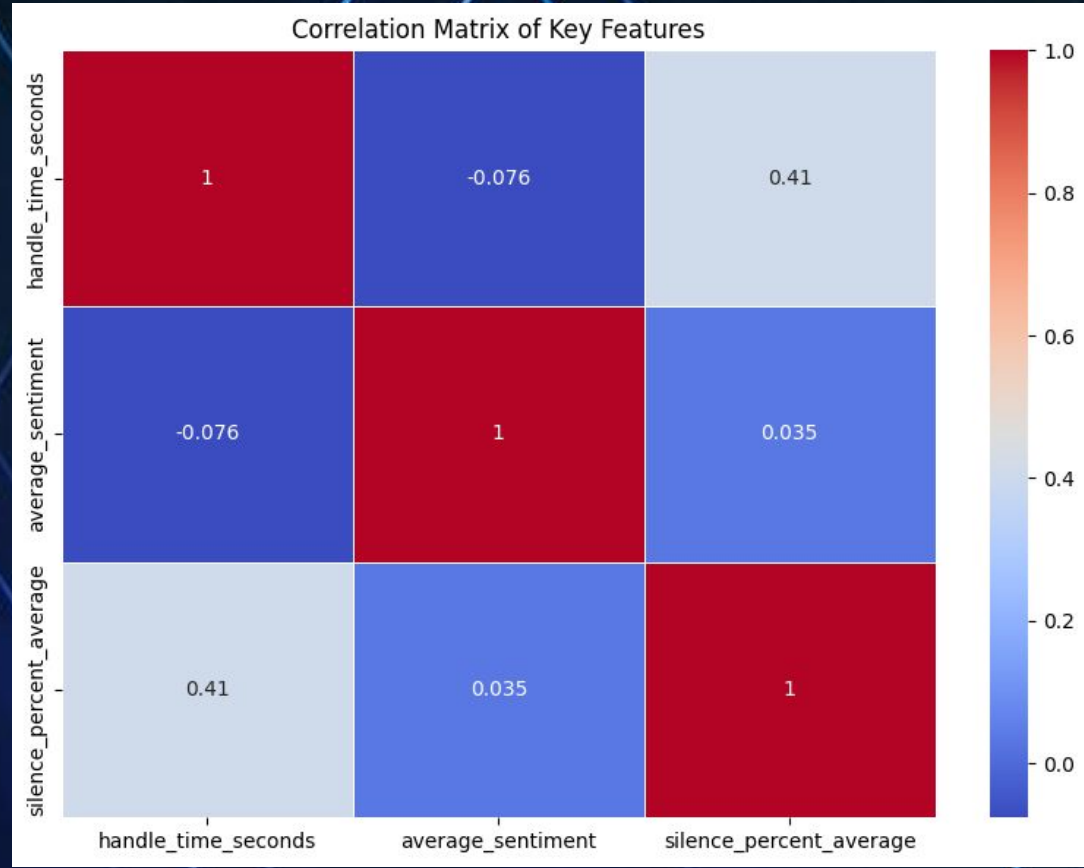
TEST.csv (Predictions)

Predictions are made for 5157 call_id rows.

Text Embedding:

- The call transcripts are converted into numerical embeddings using a pre-trained NLP model (all-mpnet-base-v1 from SentenceTransformer).
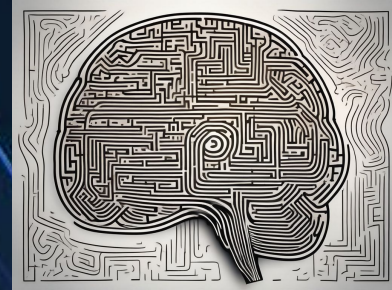- These embeddings represent the calls' text for model training.

Model Training:

- A simple Logistic Regression model is trained using the text embeddings from the training set.
- The model learns to classify calls based on their primary_call_reason.

Call_transcript → Natural Language Processing → Primary_call_reason
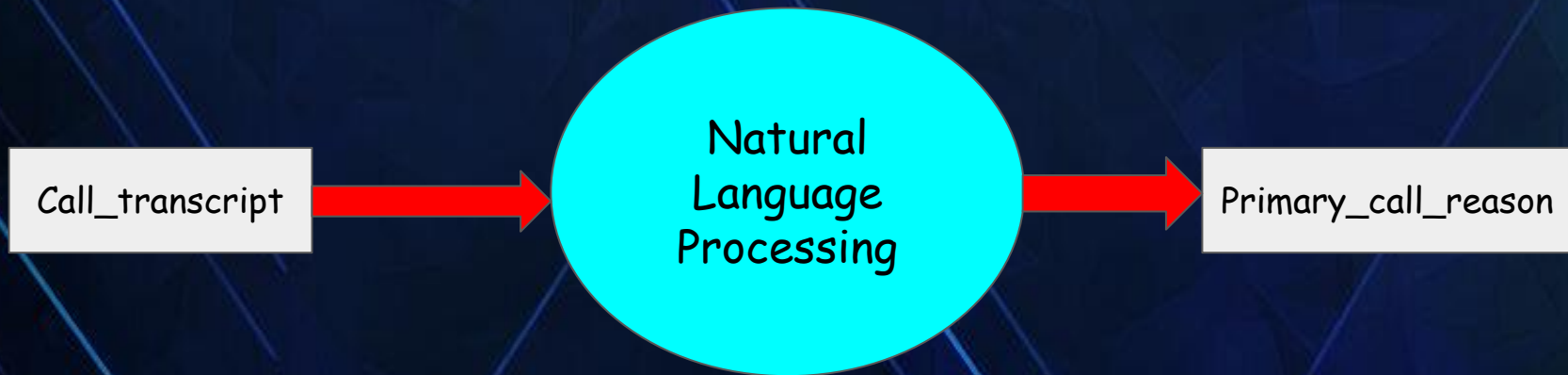
MODEL USED (Code) : -

```python
emb_model = SentenceTransformer('sentence-transformers/all-mpnet-base-v1').to(device)

# Create embeddings for training and test data
X_train = emb_model.encode(train_calls['call_transcript'].tolist(), device=device)
X_test = emb_model.encode(test_calls['call_transcript'].tolist(), device=device)

# Step 3: Train the Model
# Convert labels to a numerical format
label_map = {label: idx for idx, label in enumerate(np.unique(train_labels))}
y_train = np.array([label_map[label] for label in train_labels])

# Train Logistic Regression as a simple model
model = LogisticRegression()
model.fit(X_train, y_train)

# Step 4: Make Predictions
y_pred = model.predict(X_test)
```
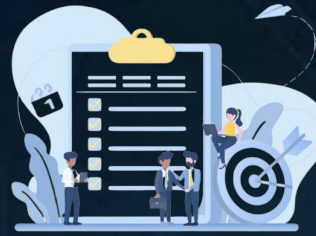
Summary Of the Observations:

Contributing Factors to Extended AHT:

- **Call Types:** Certain call categories, such as **IRROPS** (Irregular Operations) and **Mileage Plus** inquiries, often require more time to resolve due to their complex nature.
- **Agent Performance:** Agents using a polite tone have been associated with reduced increases in AHT, highlighting the importance of communication style in call management.
- **High Call Volume:** Peak periods significantly elevate both AHT and AST, as overwhelmed agents struggle to manage increased demand effectively.

Self-Solvable Issues:

- A substantial volume of calls consists of common inquiries that could be addressed through enhanced Interactive Voice Response (IVR) systems. Identifying and automating these inquiries can alleviate agent workloads and streamline operations.

Sentiment Impact:

- Sentiment analysis revealed that positive agent-customer interactions correlate with shorter call durations, indicating that training on communication skills can lead to more efficient resolutions.

Identification of Key Call Reasons

Customer Loyalty Scores:

- **High Loyalty Customers:** These customers should be directed towards self-service options where possible, as they are generally more capable of resolving issues independently. This will allow agents to focus on more complex inquiries and enhance the overall experience for loyal customers.
- **Low Loyalty Customers:** Customers with low loyalty scores are often seeking immediate resolution and personalized attention. Prioritizing these calls for agent intervention can help address their concerns more effectively, potentially improving their satisfaction and loyalty.

Quantitative Insights:

- An analysis of AHT showed a considerable percentage difference between the average handling time of the most frequent call reasons compared to the least frequent ones, emphasizing the need for targeted strategies to manage complex inquiries.

Technology / Library Used:
Python
Matplotlib
Seaborn
Scikit Learn
Pytorch

Presented By:

Diwakar Sehgal

Jagrit Bharara

THANK YOU