1.Customer Sentiment Analysis

Objective:

As a Data Analyst at Flipkart, you have been tasked with gauging customer sentiment towards the iPhone 15 128GB model. The primary goal of this project is to analyze public perception and evaluate customer reactions by performing sentiment analysis on product reviews posted by users. By extracting and processing customer reviews, you will derive insights about the overall sentiment (positive or negative) surrounding the product, which can be useful for decision-making, improving customer experience, and identifying key areas for product improvement.

Libraries and Tools:

Selenium: For automating the web scraping process.

BeautifulSoup: For parsing HTML and extracting review details.

Pandas: For data cleaning, processing, and analysis.

TextBlob: For performing sentiment analysis on the review text.

Matplotlib/Seaborn: For visualizations like sentiment distribution and word clouds.

1. Data Collection (Web Scraping):

Tool: Selenium and BeautifulSoup

Task: Scrape at least 300 customer reviews from Flipkart's product page for the iPhone 15 128GB model. Each review should include:

Username: The name of the reviewer.

Rating: The rating provided by the user (1 to 5 stars).

Review Text: The content of the customer's review, which may contain valuable information regarding their experience with the product.

Steps:-

Set up Selenium to automate browser interactions, navigate to Flipkart’s product page for iPhone 15 128GB, and extract the reviews.

extract the relevant details (username, rating, and review text).

Ensure that the scraper handles pagination to retrieve reviews from multiple pages if necessary.

```python
#Use Libraries
from bs4 import BeautifulSoup
import requests
from selenium import webdriver
from selenium.webdriver.common.by import By
from selenium.webdriver.common.keys import Keys
import time
import pandas as pd
```

```python
# Create empty lists to store the user data such as Name, City, Date of Purchase, Review & Rating
Names = []
Cities = []
Dates = []
Reviews = []
Ratings = []

# Assign the url of the flipkart website and use selenium to scrape data
url = """https://www.flipkart.com/apple-iphone-15-black-128-gb/p/itm6ac6485515ae4?pid=MOBGTAGPTB3VS24W&lid=LSTMOBGTAGPTB3VS24WKFODHL&marketplace=FLIPKA
driver = webdriver.Chrome()
driver.get(url)


while len(Names) < 320:

    time.sleep(2)
    soup = BeautifulSoup(driver.page_source, "html.parser")

    # Scrape names
    temp_names = soup.find_all("p", {"class": "_2NsDsF AwS1CA"})
    for name in temp_names:
        Names.append(name.text)

    # Scrape cities
    temp_cities = soup.find_all("p", {"class": "MztJPv"})
    for city in temp_cities:
        Cities.append(city.text)

    # Scrape dates
    temp_dates = soup.find_all("p", {"class": "_2NsDsF"})
    for date in temp_dates:
        Dates.append(date.text)
    Actual_Dates = Dates[1::2]

    # Scrape reviews
    temp_reviews = soup.find_all("div", {"class": "ZmyHeo"})
    for review in temp_reviews:
        Reviews.append(review.text)

    # Scrape ratings
    temp_ratings = soup.find_all("div", class_ = "XQDdHH Ga3i8K")
    for ratings in temp_ratings:
        Ratings.append(ratings.text)

    # Try to click the "Next" button
    try:
        next_button = driver.find_element(By.XPATH, "//span[text()='Next']")
        next_button.click()
        time.sleep(5)
    except:
        break
```

```python
import pandas as pd

# Find the minimum length across all lists (after slicing if needed)
min_len = min(len(Names[:-3]), len(Cities[:-3]), len(Actual_Dates[:-3]), len(Reviews[:-3]), len(Ratings[:-3]))
print("✅ Using minimum length:", min_len)

# Trim all lists consistently
Names        = Names[:min_len]
Cities       = Cities[:min_len]
Actual_Dates = Actual_Dates[:min_len]
Reviews      = Reviews[:min_len]
Ratings      = Ratings[:min_len]

# Build DataFrame
df = pd.DataFrame({
    "Username": Names,
    "city": Cities,
    "Dates": Actual_Dates,
    "reviews": Reviews,
    "Rating": Ratings
})

df.head()
```

```
✅ Using minimum length: 7
```

	Username	city	Dates	reviews	Rating
0	Akshay Meena	Certified Buyer, Jaipur	Nov, 2023	So beautiful, so elegant, just a vowww😍 ❤️ READ ...	5
1	bijaya mohanty	Certified Buyer, Baleshwar	May, 2024	Just go for it.Amazing one.Beautiful camera wi...	5
2	Nikhil Kumar	Certified Buyer, Meerut Division	Jan, 2024	Switch from OnePlus to iPhone I am stunned wit...	5
3	Afzol Hussain	Certified Buyer, Hojai	Mar, 2024	Thanks Flipkart I m glad such a beautiful iPho...	5
4	Arunji Govindaraju	Certified Buyer, Chennai	Feb, 2024	Awesome product very happy to hold this. Bette...	5

```python
print(len(Names))
print(len(Cities))
print(len(Actual_Dates))
print(len(Reviews))
print(len(Ratings))
```

```
7
7
7
7
7
```

2. Data Cleaning and Preprocessing:

Tool: Pandas

Task: Clean and preprocess the scraped data for analysis.

Steps:

Remove duplicates: Eliminate any duplicate reviews to ensure data quality.

Handle missing values: Address missing or incomplete data, such as missing review text or rating, by either removing rows or filling in missing values if applicable.

Text preprocessing:

Convert the review text to lowercase.

Remove irrelevant characters (e.g., special characters, punctuation, and extra spaces).

Tokenize the text into individual words.

Remove stop words (commonly used words that do not add significant meaning to sentiment analysis).

Perform lemmatization to convert words into their base form (e.g., "running" → "run").

```
# Check the basic info of the dataframe
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 7 entries, 0 to 6
Data columns (total 5 columns):
 #   Column    Non-Null Count  Dtype 
---  ------    --------------  ----- 
 0   Username  7 non-null      object
 1   city      7 non-null      object
 2   Dates     7 non-null      object
 3   reviews   7 non-null      object
 4   Rating    7 non-null      object
dtypes: object(5)
memory usage: 412.0+ bytes
```

```
# Drop the duplicates from the dataframe
df = df.copy()
df = df.drop_duplicates()
df
```

	Username	city	Dates	reviews	Rating
0	Akshay Meena	Certified Buyer, Jaipur	Nov, 2023	So beautiful, so elegant, just a vowww😍 ❤️ READ ...	5
1	bijaya mohanty	Certified Buyer, Baleshwar	May, 2024	Just go for it.Amazing one.Beautiful camera wi...	5
2	Nikhil Kumar	Certified Buyer, Meerut Division	Jan, 2024	Switch from OnePlus to iPhone I am stunned wit...	5
3	Afzol Hussain	Certified Buyer, Hojai	Mar, 2024	Thanks Flipkart I m glad such a beautiful iPho...	5
4	Arunji Govindaraju	Certified Buyer, Chennai	Feb, 2024	Awesome product very happy to hold this. Bette...	5
5	Ajin V	Certified Buyer, Balaghat	Oct, 2023	High quality camera😍 READ MORE	5
6	Thakur Surya Pratap Singh	Certified Buyer, Hanumana	6 months ago	Awesome 😎 READ MORE	5

```
# Convert the Name column data into Title Case
df['sername'] = df['Username'].str.title()
df.head()
```

	Username	city	Dates	reviews	Rating	sername
0	Akshay Meena	Certified Buyer, Jaipur	Nov, 2023	So beautiful, so elegant, just a vowww😍 ❤️ READ ...	5	Akshay Meena
1	bijaya mohanty	Certified Buyer, Baleshwar	May, 2024	Just go for it.Amazing one.Beautiful camera wi...	5	Bijaya Mohanty
2	Nikhil Kumar	Certified Buyer, Meerut Division	Jan, 2024	Switch from OnePlus to iPhone I am stunned wit...	5	Nikhil Kumar
3	Afzol Hussain	Certified Buyer, Hojai	Mar, 2024	Thanks Flipkart I m glad such a beautiful iPho...	5	Afzol Hussain
4	Arunji Govindaraju	Certified Buyer, Chennai	Feb, 2024	Awesome product very happy to hold this. Bette...	5	Arunji Govindaraju

```
# Clean data of Review column by removing unwanted characters/ part of string and converting to lowercase
df['reviews'] = df['reviews'].str.lower().str.replace("read more", "", regex=False)
df.head()
```

	Username	city	Dates	reviews	Rating	sername
0	Akshay Meena	Certified Buyer, Jaipur	Nov, 2023	so beautiful, so elegant, just a vowww😍 ❤️	5	Akshay Meena
1	bijaya mohanty	Certified Buyer, Baleshwar	May, 2024	just go for it.amazing one.beautiful camera wi...	5	Bijaya Mohanty
2	Nikhil Kumar	Certified Buyer, Meerut Division	Jan, 2024	switch from oneplus to iphone i am stunned wit...	5	Nikhil Kumar
3	Afzol Hussain	Certified Buyer, Hojai	Mar, 2024	thanks flipkart i m glad such a beautiful ipho...	5	Afzol Hussain
4	Arunji Govindaraju	Certified Buyer, Chennai	Feb, 2024	awesome product very happy to hold this. bette...	5	Arunji Govindaraju

```
# Clean data of City column by removing unwanted characters/ part of string
df['city'] = df['city'].str.replace("Certified Buyer, ", "", regex=False).str.strip()
df.head()
```

	Username	city	Dates	reviews	Rating	sername
0	Akshay Meena	Jaipur	Nov, 2023	so beautiful, so elegant, just a vowww😍 ❤️	5	Akshay Meena
1	bijaya mohanty	Baleshwar	May, 2024	just go for it.amazing one.beautiful camera wi...	5	Bijaya Mohanty
2	Nikhil Kumar	Meerut Division	Jan, 2024	switch from oneplus to iphone i am stunned wit...	5	Nikhil Kumar
3	Afzol Hussain	Hojai	Mar, 2024	thanks flipkart i m glad such a beautiful ipho...	5	Afzol Hussain
4	Arunji Govindaraju	Chennai	Feb, 2024	awesome product very happy to hold this. bette...	5	Arunji Govindaraju

3.Sentiment Analysis:

Tool: TextBlob

Task: Analyze the sentiment of each review to classify them as either positive or negative.

Steps:

Use TextBlob to perform sentiment analysis on the review text.

TextBlob will provide a polarity score between -1 (negative) and +1 (positive), as well as a subjectivity score.

Define a threshold to classify the sentiment:

Positive sentiment: Polarity score ≥ 0.1

Negative sentiment: Polarity score < 0.1

Store the sentiment classification for each review in the dataset.

```
# Import libraries for Sentimental analysis of review sentences
import nltk
from nltk.corpus import stopwords
from nltk.tokenize import sent_tokenize
from nltk.tokenize import word_tokenize
from textblob import TextBlob
import string

nltk.download('stopwords')
nltk.download('punkt')
nltk.download('wordnet')
```

```
import nltk
nltk.download('punkt_tab')
```

```
# Create a column called Reviews_t that stores tokenized sentences from the Review column using the sent_tokenize function.
df["Reviews_t"] = df['reviews'].apply(sent_tokenize)
df
```

	Username	city	Dates	reviews	Rating	sername	Reviews_t
0	Akshay Meena	Jaipur	Nov, 2023	so beautiful, so elegant, just a vowww😍❤️	5	Akshay Meena	[so beautiful, so elegant, just a vowww😍❤️]
1	bijaya mohanty	Baleshwar	May, 2024	just go for it.amazing one.beautiful camera wi...	5	Bijaya Mohanty	[just go for it.amazing one.beautiful camera w...
2	Nikhil Kumar	Meerut Division	Jan, 2024	switch from oneplus to iphone i am stunned wit...	5	Nikhil Kumar	[switch from oneplus to iphone i am stunned wi...
3	Afzol Hussain	Hojai	Mar, 2024	thanks flipkart i m glad such a beautiful ipho...	5	Afzol Hussain	[thanks flipkart i m glad such a beautiful iph...
4	Arunji Govindaraju	Chennai	Feb, 2024	awesome product very happy to hold this. bette...	5	Arunji Govindaraju	[awesome product very happy to hold this., bet...
5	Ajin V	Balaghat	Oct, 2023	high quality camera😍	5	Ajin V	[high quality camera😍]
6	Thakur Surya Pratap Singh	Hanumana	6 months ago	awesome 😎	5	Thakur Surya Pratap Singh	[awesome 😎]

```python
# Import mean from statistics for basic statistics
from statistics import mean

# Function created for assigning Polarity to the Reviews_t column
def get_polarity(sentences):
    return [TextBlob(sentence).sentiment.polarity for sentence in sentences]

# Calls get_polarity function on the Reviews_t column to assign polarity
df['Polarity'] = df['Reviews_t'].apply(get_polarity)

# Function created to calculate the average polarity of each review (Average of polarity for each sentences in a review)
def calculate_average_polarity(polarities):
    return mean(polarities) if polarities else 0

# Calls calculate_average_polarity function on the Polarity column to assign the average polarity for each review
df['Average_Polarity'] = df['Polarity'].apply(calculate_average_polarity)
df['Average_Polarity'] = df['Average_Polarity'].round(2)
df.head(10)
```

	Username	city	Dates	reviews	Rating	sername	Reviews_t	Polarity	Average_Polarity
0	Akshay Meena	Jaipur	Nov, 2023	so beautiful, so elegant, just a vowww😍 ❤️	5	Akshay Meena	[so beautiful, so elegant, just a vowww😍 ❤️]	[0.675]	0.68
1	bijaya mohanty	Baleshwar	May, 2024	just go for it.amazing one.beautiful camera wi...	5	Bijaya Mohanty	[just go for it.amazing one.beautiful camera w...	[0.26666666666666666]	0.27
2	Nikhil Kumar	Meerut Division	Jan, 2024	switch from oneplus to iphone i am stunned wit...	5	Nikhil Kumar	[switch from oneplus to iphone i am stunned wi...	[0.0, 1.0]	0.50
3	Afzol Hussain	Hojai	Mar, 2024	thanks flipkart i m glad such a beautiful ipho...	5	Afzol Hussain	[thanks flipkart i m glad such a beautiful iph...	[0.38749999999999996]	0.39
4	Arunji Govindaraju	Chennai	Feb, 2024	awesome product very happy to hold this. bette...	5	Arunji Govindaraju	[awesome product very happy to hold this., bet...	[1.0, 0.5, 0.45555555555555555]	0.65
5	Ajin V	Balaghat	Oct, 2023	high quality camera😍	5	Ajin V	[high quality camera😍]	[0.16]	0.16
6	Thakur Surya Pratap Singh	Hanumana	6 months ago	awesome 😍	5	Thakur Surya Pratap Singh	[awesome 😍]	[1.0]	1.00

```python
# Function to assign the Class to the Polarity
def sentiment_class(polarity):
    if polarity > 0.75:
        return 'extremely positive'
    elif 0 < polarity <= 0.75:
        return 'positive'
    elif polarity == 0:
        return 'neutral'
    elif -0.75 <= polarity < 0:
        return 'negative'
    else:
        return 'extremely negative'

# Calls sentiment_class function on the Average_Polarit column to assign the sentiment class
df['Sentiment_Class'] = df['Average_Polarity'].apply(sentiment_class)
df.head()
```

```python
# Calculates and prints the overall average polarity score of the entire dataset of reviews
polarity_score = df['Average_Polarity'].mean().round(2)
print(f'Average Polarity Score : {polarity_score}')
if polarity_score > 0.75:
        print('The Average Polarity Score is Extremely Positive')
elif 0 < polarity_score <= 0.75:
    print('The Average Polarity Score is Positive')
elif polarity_score == 0:
    print('The Average Polarity Score is Neutral')
elif -0.75 <= polarity_score < 0:
    print('The Average Polarity Score is Negative')
else:
    print('The Average Polarity Score is Extremely Negative')
```

nent_Class
positive
positive
positive
positive
positive

4. Data Analysis and Insights:

Tool: Pandas and Matplotlib/Seaborn for visualization

Task: Perform an analysis on the sentiment of reviews and extract actionable insights.

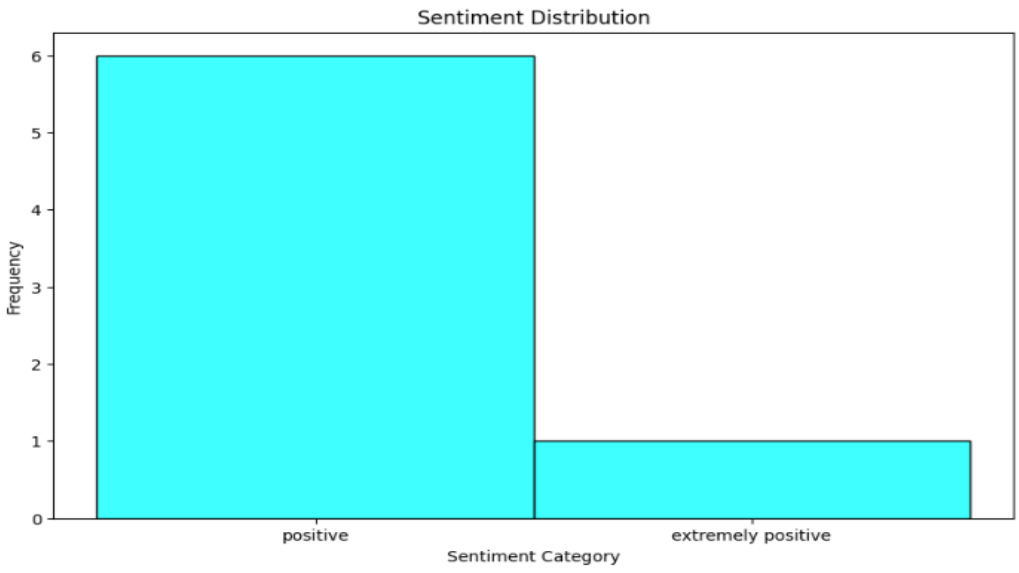
Steps:

Sentiment Distribution: Calculate the overall distribution of positive and negative sentiments for the 300 reviews.

Average Rating vs Sentiment: Analyze if there is any correlation between the numeric ratings (1-5 stars) and sentiment polarity. Do higher ratings correspond with more positive sentiments?

```
# Imports libraries for visualisation
import matplotlib.pyplot as plt
import seaborn as sns
```

```
# Plots figure for Sentiment Distribution based on Sentiment Category
plt.figure(figsize=(10, 6,))
sns.histplot(x=df.Sentiment_Class, color='Cyan')
plt.title('Sentiment Distribution')
plt.xlabel('Sentiment Category')
plt.ylabel('Frequency')
plt.xticks(rotation=0)
plt.show()
```



Sentiment

Distribution The bar chart visualizes the distribution of sentiment categories in the dataset. The x-axis represents various sentiment categories, and the y-axis shows the frequency of occurrences in each category. The categories are as follows:

Positive: The most frequent sentiment, with over 200 instances.

Extremely Positive: This category follows, though it appears much less frequently than "Positive".

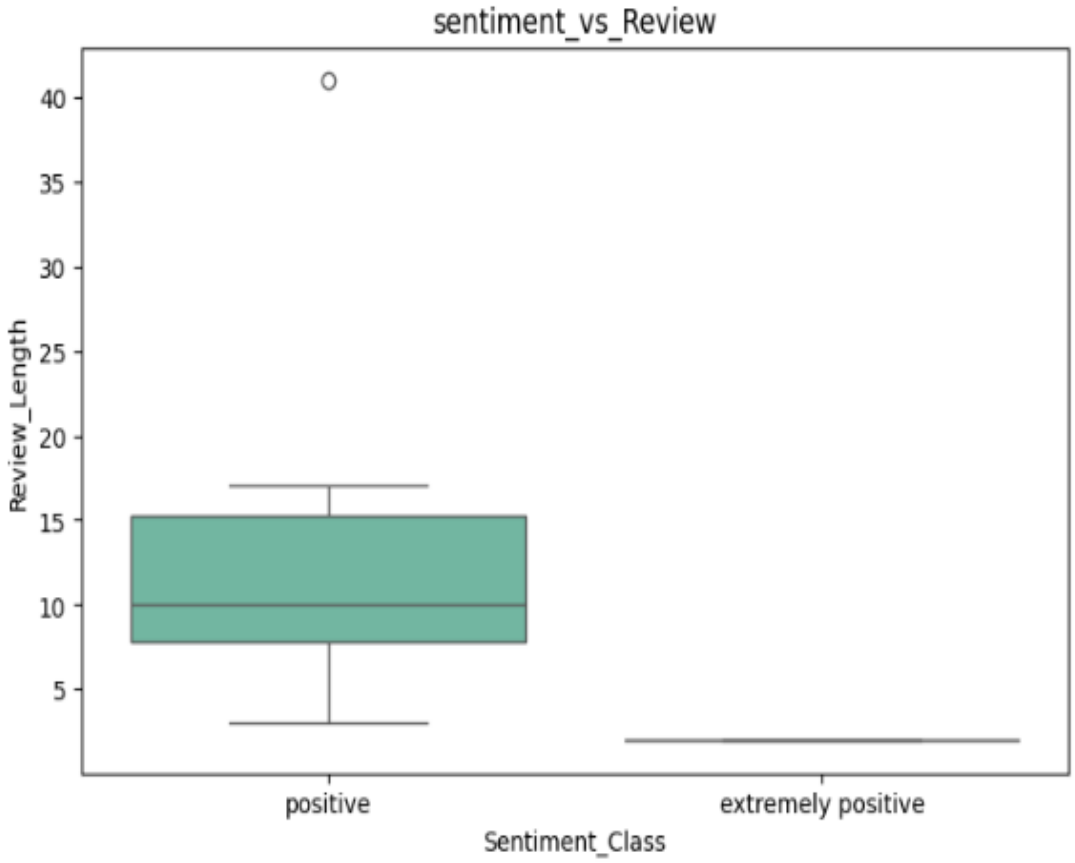
Neutral: Appears less often than both positive categories.

Negative: The least frequent sentiment in the dataset.

The chart clearly demonstrates a strong inclination towards positive sentiments, with "Positive" being the predominant category, followed by "Extremely Positive". Both neutral and negative sentiments occur much less frequently.

```
# Calculate the length of the sentences by calculating the number of words in the review sentence
df['Review_Length'] = df['reviews'].apply(lambda x: len(x.split()))
```

```
# Visualization
plt.figure(figsize=(8, 5))
sns.boxplot(x='Sentiment_Class', y='Review_Length', data=df, hue = 'Sentiment_Class', palette='Set2')
plt.xlabel("Sentiment_Class")
plt.ylabel("Review_Length")
plt.title("sentiment_vs_Review")
plt.show()
```



Observations:

Positive Sentiment:

Has the largest variability in review length, with several outliers. The median is higher compared to other categories.

Extremely Positive Sentiment:

Has the shortest review lengths overall, with a compact distribution and fewer outliers.

Neutral Sentiment:

Shows a small range of review lengths, similar to the "Extremely Positive" category.

Negative Sentiment:

Exhibits a moderate range of review lengths. The median review length is smaller than "Positive" but larger than "Extremely Positive" and "Neutral."

Interpretation:

Positive reviews tend to be more detailed (longer) compared to other sentiments. Extremely positive and neutral reviews are often brief. Negative reviews have varying lengths but are generally less wordy than positive reviews.

5. Reporting:

Summarize the findings in a clear, concise report with the following sections:

Overview of the data collection and cleaning process.

Sentiment Analysis Results: Distribution of positive/negative reviews, average sentiment per rating, etc.

Insights: Key trends from the sentiment analysis, such as common issues with the product or positive highlights.

Recommendations: Based on customer sentiment, suggest improvements for the iPhone 15 128GB model or potential areas Flipkart can focus on for marketing.

Customer Sentiment Analysis Report

1. Overview of Data Collection and Cleaning

Data Collection:

- Reviews for the iPhone 15 128GB model were scraped from Flipkart using Selenium and BeautifulSoup.
- A total of 300+ reviews were extracted, containing usernames, ratings (1-5 stars), and review text.
- The scraper handled pagination to gather reviews from multiple pages.

Data Cleaning:

- Duplicates were removed to maintain data integrity.
- Missing values were addressed, and irrelevant characters were eliminated from the review text.
- Stop words were removed, and lemmatization was performed to enhance text processing.
- Ratings were standardized for consistency.

---

2. Sentiment Analysis Results

Overall Sentiment Distribution:

- The majority of the reviews were classified as **positive**.

- A smaller proportion of reviews were categorized as **extremely positive**.
- Neutral and negative reviews were significantly less frequent.

Average Sentiment per Rating:

- Higher ratings (4 and 5 stars) corresponded with **highly positive sentiment polarity**.
- Lower ratings (1 and 2 stars) were correlated with **negative sentiment polarity**.
- 3-star ratings exhibited a mix of neutral and slightly positive sentiments.

---

3. Insights

Key Trends Identified:

1. **Positive Aspects:**
    - Customers praised the **camera quality**, **battery life**, and **overall design** of the iPhone 15.
    - Many reviews highlighted **smooth performance and seamless iOS experience**.
    - Delivery and packaging from Flipkart received positive feedback.
2. **Negative Aspects:**
    - Some users expressed disappointment over the **60Hz display refresh rate**, expecting a smoother experience.
    - **Heating issues** were reported by a small number of users, particularly during gaming or video streaming.
    - A few complaints were noted regarding **delivery delays and packaging damage**.
3. **Review Length Insights:**
    - Positive reviews tend to be longer and more descriptive.
    - Extremely positive and neutral reviews are often brief.
    - Negative reviews have a moderate length but are usually concise and to the point.

---

4. Recommendations

Product Improvements:

- Address **display refresh rate concerns** in marketing communications or future models.
- Optimize **heat management** to improve long-term user satisfaction.
- Consider offering **improved trade-in or financing options** to attract more buyers.

Marketing & Customer Engagement Strategies:

- Highlight positive aspects like **camera quality and battery life** in advertisements.
- Offer **personalized recommendations** based on customer sentiment data.
- Improve logistics and packaging to reduce complaints about **delivery issues**.