

iPhone Insights: Decoding Consumer Sentiments Across Apple's Latest Models

1) Data Preprocessing for iPhone Review Analysis

```
In [1]: import pandas as pd  
import os  
  
os.listdir('..')
```

```
Out[1]: ['.ipynb_checkpoints',  
 'Apple iPhone 13.csv',  
 'Apple iPhone 14 Pro Max.csv',  
 'Apple iPhone 14.csv',  
 'Apple iPhone 15 Pro Max.csv',  
 'Apple iPhone 15 Pro.csv',  
 'Apple iPhone 15.csv',  
 'iphone_analysis.ipynb']
```

```
In [2]: df1 = pd.read_csv('Apple iPhone 13.csv')  
df2 = pd.read_csv('Apple iPhone 14.csv')  
df3 = pd.read_csv('Apple iPhone 14 Pro Max.csv')  
df4 = pd.read_csv('Apple iPhone 15.csv')  
df5 = pd.read_csv('Apple iPhone 15 Pro.csv')  
df6 = pd.read_csv('Apple iPhone 15 Pro Max.csv')
```

```
In [3]: df1.head()
```

	Name	Rating	Date	Type	Details	Title	Review
0	Jnan Shetty	5.0 out of 5 stars	30-Dec-23	Apple iPhone 13	Colour: BlueSize: 128 GB	Using after 3 months honest review	This is my first iPhone and it always feels go...
1	Pankaj Kumar	5.0 out of 5 stars	24-Feb-24	Apple iPhone 13	Colour: StarlightSize: 128 GB	Redefining Excellence: A Review of the iPhone ...	The iPhone 13 128GB has surpassed my expectati...
2	Adeeb	4.0 out of 5 stars	19-Aug-24	Apple iPhone 13	Colour: PinkSize: 128 GB	Stunning Design and a Beautiful Pink!	I finally upgraded from my trusty iPhone 5s to...
3	manoj	5.0 out of 5 stars	24-Jul-24	Apple iPhone 13	Colour: BlueSize: 128 GB	Redefining Excellence: A Review of the iPhone ...	The iPhone 13 128GB has surpassed my expectati...
4	loading	5.0 out of 5 stars	22-Jun-24	Apple iPhone 13	Colour: PinkSize: 128 GB	Still one of best base flagships out there in ...	Things I liked:1. Solid Build Quality and very...

```
In [4]: df2.head()
```

	Name	Rating	Date	Type	Details	Title	Review
0	meemansa s.	5.0 out of 5 stars	19-Jul-24	Apple iPhone 14	Colour: PurpleSize: 128 GB	BEST PURCHASE!!!	It is genuine apple , I conformed it with the ...
1	Vijay A.	5.0 out of 5 stars	16-Jul-24	Apple iPhone 14	Colour: BlueSize: 128 GB	Vijay Kumar	Very niceCamera quality is really goodHandy an...
2	Krishanu	4.0 out of 5 stars	10-Aug-24	Apple iPhone 14	NaN	Nice product	Genuine product, verified from Apple Site as w...
3	Gajendra Singh	5.0 out of 5 stars	12-Jun-24	Apple iPhone 14	Colour: PurpleSize: 128 GB	Nothing beats an iPhone	Genuine apple product, delivered as promised b...
4	Crystal	5.0 out of 5 stars	21-Jul-24	Apple iPhone 14	Colour: BlueSize: 128 GB	Great phone	Very happy with the phone and love the colour.

```
In [5]: df3.head()
```

	Name	Rating	Date	Type	Details	Title	Review
0	Peeyoosh Kumar	5.0 out of 5 stars	28-Jul-23	Apple iPhone 14 Pro Max	NaN	The iPhone 14 Pro Max: An Epitome of Excellence	Here is my review of the iPhone 14 Pro Max aft...
1	Benu	5.0 out of 5 stars	25-May-23	Apple iPhone 14 Pro Max	NaN	The Apple Pro Max 14: A Powerful Beast That De...	The Apple Pro Max 14 is the latest addition to...
2	Rohit D.	5.0 out of 5 stars	21-Sep-22	Apple iPhone 14 Pro Max	NaN	Welcome to "Dynamic Island"	The delivery was a bit delayed considering I p...
3	Harsh Singh	5.0 out of 5 stars	25-Nov-22	Apple iPhone 14 Pro Max	NaN	Best iPhone yet.	Upgraded from my galaxy S8+ so I could feel a ...
4	balyogesh	4.0 out of 5 stars	16-Nov-23	Apple iPhone 14 Pro Max	NaN	Very useful phone	Ghb

In [6]: df4.head()

	Name	Rating	Date	Type	Details	Title	Review
0	Sandy Cariappa	5.0 out of 5 stars	07-Oct-23	Apple iPhone 15	Colour: BlueSize: 128 GB	iPhone XR to iPhone 15	Just made the transition and here's my POV on ...
1	Rohan narvekar	5.0 out of 5 stars	24-Jul-24	Apple iPhone 15	Colour: BlueSize: 128 GB	Iphone from Apple as usual top in quality and ...	First of it looks very very prime quality and ...
2	HINDUSTAN ELECTRICALS	5.0 out of 5 stars	06-Oct-23	Apple iPhone 15	Colour: BlackSize: 128 GB	iPhone 15 A solid upgrade and value for money	DesignOne of the most noticeable changes to th...
3	stuti	4.0 out of 5 stars	31-Jul-24	Apple iPhone 15	Colour: BlueSize: 128 GB	Good one	After so many follow ups finally received a pr...
4	Shiv	5.0 out of 5 stars	14-Aug-24	Apple iPhone 15	Colour: BlackSize: 128 GB	It's an iPhone...	It was a gift for my 16th bday, what would you...

In [7]: df5.head()

	Name	Rating	Date	Type	Details	Title	Review
0	Arghya Mukherjee	5.0 out of 5 stars	15-Aug-24	Apple iPhone 15 Pro	Colour: Black TitaniumSize: 256 GB	15 pro	Fantastic Mindblowing Wonderful.Upgrade my SE(...
1	Neeraj Thakur	5.0 out of 5 stars	30-Jul-24	Apple iPhone 15 Pro	Colour: Black TitaniumSize: 128 GB	iPhone	iPhone
2	Vineet Sharma	4.0 out of 5 stars	15-Apr-24	Apple iPhone 15 Pro	Colour: Black TitaniumSize: 256 GB	iPhone is Awesome	Performance is good,battery is good,camera sup...
3	satwik mohanty	5.0 out of 5 stars	31-May-24	Apple iPhone 15 Pro	Colour: Blue TitaniumSize: 128 GB	Product Review	I got the phone just today the delivery and th...
4	Radhakrishnan	1.0 out of 5 stars	18-Feb-24	Apple iPhone 15 Pro	Colour: Blue TitaniumSize: 256 GB	Please get a protector for your camera as soon...	Before using iPhone 15 pro, I used iPhone 12 P...

In [8]: df6.head()

	Name	Rating	Date	Type	Details	Title	Review
0	shobhit srivastava	5.0 out of 5 stars	31-Aug-24	Apple iPhone 15 Pro Max	Colour: White TitaniumSize: 256 GB	Smooth and Professional	The iPhone 15 Pro Max is a really great phone...
1	vikash bhardwaj	5.0 out of 5 stars	15-May-24	Apple iPhone 15 Pro Max	Colour: Black TitaniumSize: 256 GB	phone camera	The iPhone 15 Pro Max is a powerhouse device, ...
2	Jay Prakash	5.0 out of 5 stars	01-Sep-24	Apple iPhone 15 Pro Max	Colour: Blue TitaniumSize: 256 GB	Nice	Nice product
3	vikas batra	5.0 out of 5 stars	09-Aug-24	Apple iPhone 15 Pro Max	Colour: Blue TitaniumSize: 256 GB	Well delivered in great packaging	No regrets. It is as if I bought from a showro...
4	Slim Kells	1.0 out of 5 stars	15-Jun-24	Apple iPhone 15 Pro Max	Colour: Blue TitaniumSize: 256 GB	Device screen not responding.	Recently, I updated to the latest version of 1...

In [9]: # Combine all DataFrames into one

```
all_data = pd.concat([df1, df2, df3, df4, df5, df6], ignore_index=True)
```

In [10]: `all_data.sample(5)`

	Name	Rating	Date	Type	Details	Title	Review
372	Harshit jaggi	4.0 out of 5 stars	30-Jan-24	Apple iPhone 15	Colour: BlueSize: 128 GB	Verdict	The iPhone 15 is a solid upgrade with improvem...
221	darshan	5.0 out of 5 stars	04-Jul-23	Apple iPhone 14 Pro Max	NaN	Amazing	This is my first apple phone and i have to adm...
539	Himanshu	5.0 out of 5 stars	22-Feb-24	Apple iPhone 15 Pro Max	Colour: Natural TitaniumSize: 256 GB	Best Camera Phone in the market.	30 people found this helpful
492	Placeholder	5.0 out of 5 stars	06-Apr-24	Apple iPhone 15 Pro	Colour: Blue TitaniumSize: 256 GB	I liked this phone but camera is blur	Best phone I have ever seen . It is better the...
487	Amazon Customer	1.0 out of 5 stars	29-Nov-23	Apple iPhone 15 Pro	Colour: Natural TitaniumSize: 256 GB	Worst product	Hanging issue ...never I seen in iPhone ...since u...

In [11]: `all_data.info()`

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 600 entries, 0 to 599
Data columns (total 7 columns):
 #   Column      Non-Null Count  Dtype  
--- 
 0   Name        600 non-null    object 
 1   Rating      600 non-null    object 
 2   Date        600 non-null    object 
 3   Type        600 non-null    object 
 4   Details     449 non-null    object 
 5   Title       600 non-null    object 
 6   Review      600 non-null    object 
dtypes: object(7)
memory usage: 32.9+ KB
```

In [12]: `all_data.describe()`

	Name	Rating	Date	Type	Details	Title	Review
count	600	600	600	600	449	600	600
unique	551	5	328	6	31	503	566
top	Placeholder	5.0 out of 5 stars	10-Aug-24	Apple iPhone 13	Colour: BlueSize: 128 GB	Good	Good
freq	19	388	7	100	69	31	9

In [13]: `all_data.shape`

Out[13]: (600, 7)

In [14]: `# Returns a DataFrame with True where values are missing
all_data.isnull()`

```
Out[14]:
```

	Name	Rating	Date	Type	Details	Title	Review
0	False	False	False	False	False	False	False
1	False	False	False	False	False	False	False
2	False	False	False	False	False	False	False
3	False	False	False	False	False	False	False
4	False	False	False	False	False	False	False
...
595	False	False	False	False	False	False	False
596	False	False	False	False	False	False	False
597	False	False	False	False	False	False	False
598	False	False	False	False	False	False	False
599	False	False	False	False	False	False	False

600 rows × 7 columns

```
In [15]: # Sum of missing values in each column  
all_data.isnull().sum()
```

```
Out[15]:
```

Name	0
Rating	0
Date	0
Type	0
Details	151
Title	0
Review	0

dtype: int64

```
In [16]: # Handle NaN values by filling them with a placeholder  
all_data['Details'] = all_data['Details'].fillna('No Details')
```

```
In [17]: # Sum of missing values in each column  
all_data.isnull().sum()
```

```
Out[17]:
```

Name	0
Rating	0
Date	0
Type	0
Details	0
Title	0
Review	0

dtype: int64

```
In [18]: all_data.describe()
```

```
Out[18]:
```

	Name	Rating	Date	Type	Details	Title	Review
count	600	600	600	600	600	600	600
unique	551	5	328	6	32	503	566
top	Placeholder	5.0 out of 5 stars	10-Aug-24	Apple iPhone 13	No Details	Good	Good
freq	19	388	7	100	151	31	9

```
In [19]: all_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>  
RangeIndex: 600 entries, 0 to 599  
Data columns (total 7 columns):  
 #   Column   Non-Null Count  Dtype     
---  --    
 0   Name     600 non-null    object    
 1   Rating   600 non-null    object    
 2   Date     600 non-null    object    
 3   Type     600 non-null    object    
 4   Details  600 non-null    object    
 5   Title    600 non-null    object    
 6   Review   600 non-null    object    
dtypes: object(7)  
memory usage: 32.9+ KB
```

```
In [20]: all_data.sample(5)
```

Out[20]:								
	Name	Rating	Date	Type	Details		Title	Review
290	Bhanu	5.0 out of 5 stars	26-Feb-23	Apple iPhone 14 Pro Max	No Details	Good and Genuine so far	5 people found this helpful	
164	Siddharth	5.0 out of 5 stars	23-Jul-23	Apple iPhone 14	Colour: Red Size: 128 GB	Strong built	No need to buy covers/case/lens protectionTru...	
91	Toni	4.0 out of 5 stars	14-Jul-24	Apple iPhone 13	Colour: Starlight Size: 128 GB	The rear camera is the best thing about this i...	37 people found this helpful	
227	Manjunath.S	5.0 out of 5 stars	03-Oct-22	Apple iPhone 14 Pro Max	No Details	Worth upgrading?	Worth is subjective and differs from person to...	
124	Kunaal	4.0 out of 5 stars	12-Dec-23	Apple iPhone 14	Colour: Purple Size: 128 GB	Buttery smooth	Using iphone 14 for over a week now, its just ...	

```
In [21]: import matplotlib.pyplot as plt
import seaborn as sns
from wordcloud import WordCloud

# Combine all reviews into a single string
text = ' '.join(all_data['Review'])

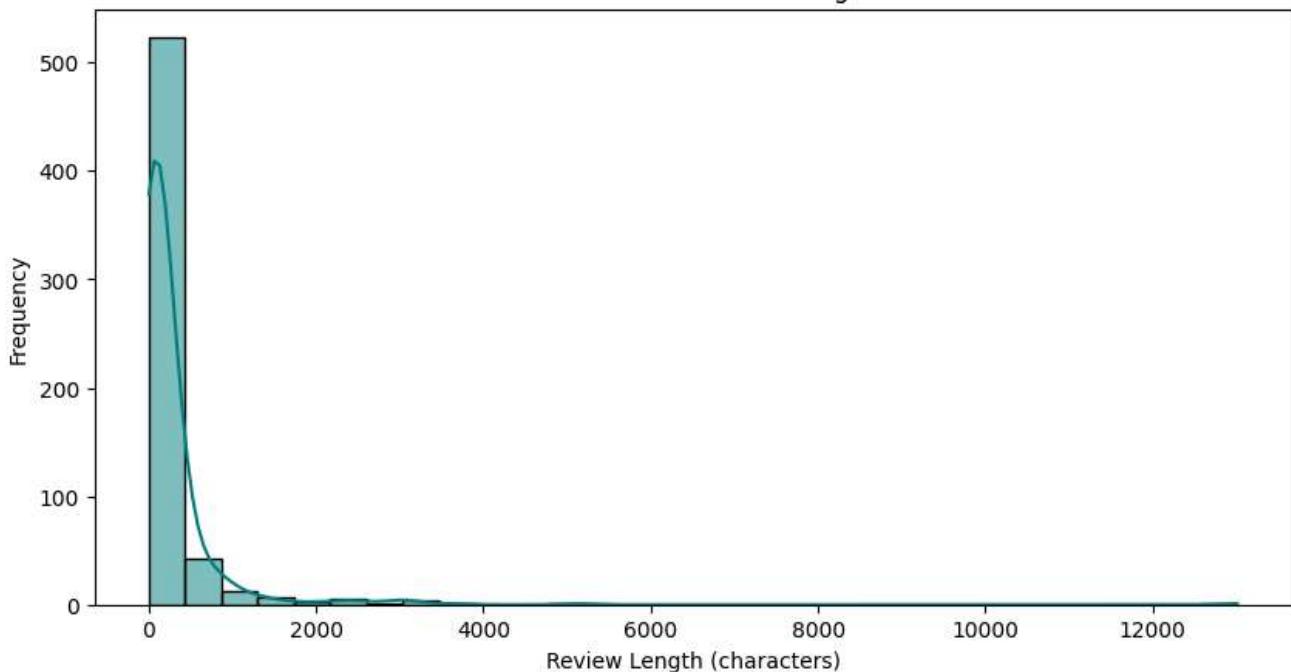
# Generate a word cloud
plt.figure(figsize=(12, 8))
wordcloud = WordCloud(width=800, height=400, background_color='white').generate(text)
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis('off')
plt.title('Word Cloud of Reviews')
plt.show()
```



```
In [22]: # Calculate the Length of each review
```

```
# Plot the distribution of review lengths
plt.figure(figsize=(10, 5))
sns.histplot(all_data['Review_Length'], bins=30, color='teal', kde=True)
plt.title('Distribution of Review Lengths')
plt.xlabel('Review Length (characters)')
plt.ylabel('Frequency')
plt.show()
```

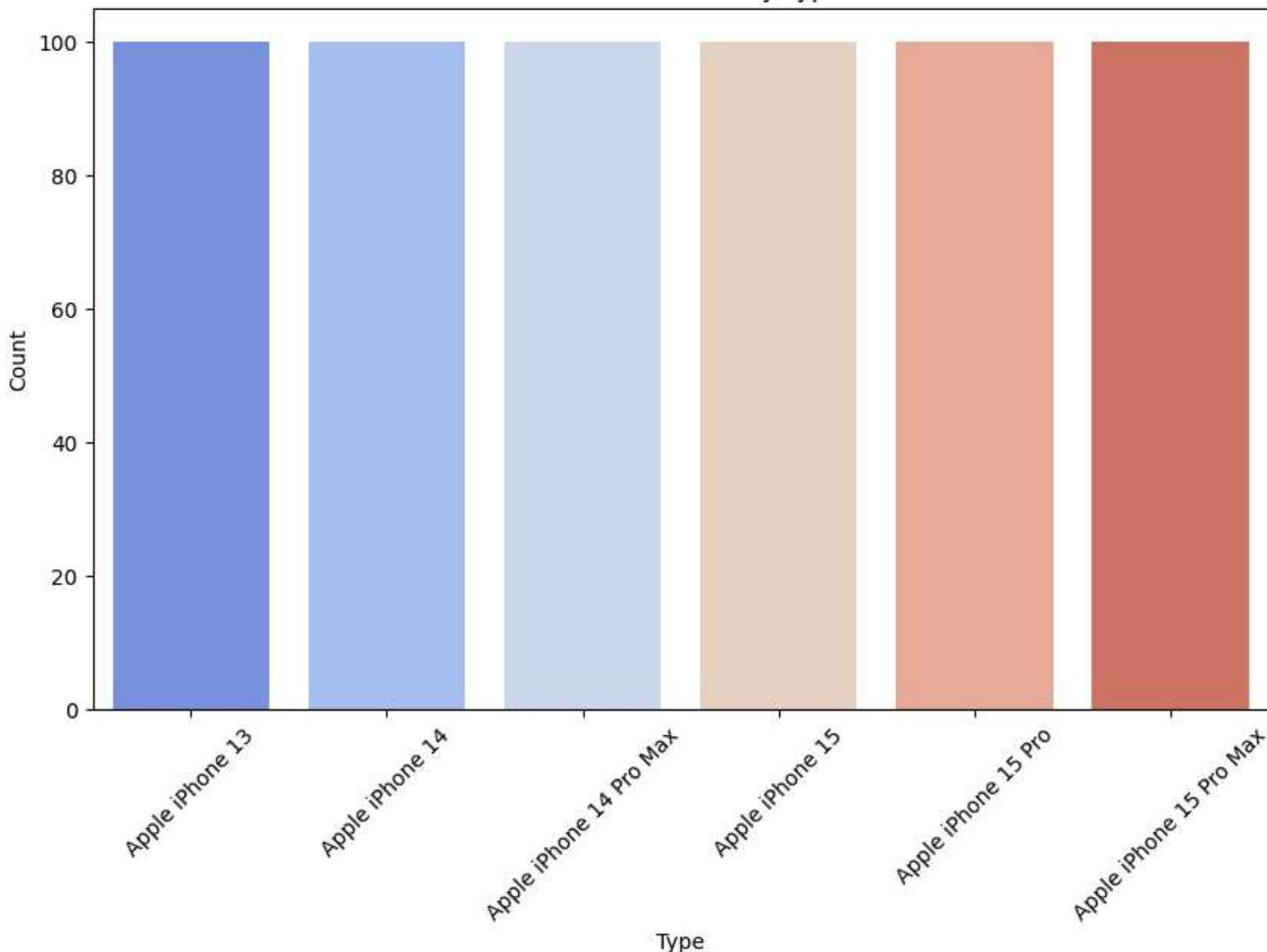
Distribution of Review Lengths



In [23]:

```
# Plot the count of reviews by type
plt.figure(figsize=(10, 6))
sns.countplot(x='Type', data=all_data, hue='Type', palette='coolwarm')
plt.title('Count of Reviews by Type')
plt.xlabel('Type')
plt.ylabel('Count')
plt.xticks(rotation=45)
plt.show()
```

Count of Reviews by Type



In [24]:

```
# Save cleaned combined DataFrame
all_data.to_csv('cleaned_iphone_reviews.csv', index=False)
```

2) Review and Inspect the Sentiment Analysis Results

```
In [25]: # Load the sentiment analysis results
sentiment_df = pd.read_csv('sentiment_analysis_results.csv')
```

```
In [27]: sentiment_df.sample(5)
```

		Name	Title	Review	Rating	Date	Type	Details	Review_Length	positive	negative	neutral	compound
582	Ankush Supkar	The Best Feeling Ever 🌟	Best Smartphone Ever Camera 10/10 Processor 10/1...	5.0 out of 5 stars	2024-04-09 00:00:00	Apple iPhone 15 Pro Max	Colour: Blue TitaniumSize: 256 GB		138	0.276	0.00	0.724	0.6369
551	venky	Get rid of false reviews . The phone is just a...	Superb	5.0 out of 5 stars	2023-10-21 00:00:00	Apple iPhone 15 Pro Max	Colour: Blue TitaniumSize: 256 GB		6	1.000	0.00	0.000	0.6249
17	Rohit Pahadiya	Amazing	All is well	4.0 out of 5 stars	2024-08-13 00:00:00	Apple iPhone 13	Colour: MidnightSize: 128 GB		11	0.512	0.00	0.488	0.2732
589	Narendra Modi	Worst toy ever	Do not buy ... I throwed it from my terrace an...	1.0 out of 5 stars	2024-06-30 00:00:00	Apple iPhone 15 Pro Max	Colour: Black TitaniumSize: 256 GB		100	0.000	0.28	0.720	-0.7650
162	Good quality	Good	Good	4.0 out of 5 stars	2024-01-14 00:00:00	Apple iPhone 14	Colour: PurpleSize: 128 GB		4	1.000	0.00	0.000	0.4404

```
In [28]: sentiment_df['compound'] = pd.to_numeric(sentiment_df['compound'], errors='coerce')
sentiment_df['positive'] = pd.to_numeric(sentiment_df['positive'], errors='coerce')
sentiment_df['neutral'] = pd.to_numeric(sentiment_df['neutral'], errors='coerce')
sentiment_df['negative'] = pd.to_numeric(sentiment_df['negative'], errors='coerce')
```

```
In [29]: sentiment_df.sample(5)
```

		Name	Title	Review	Rating	Date	Type	Details	Review_Length	positive	negative	neutral	compound
331	Haneef	Great	Good price	5.0 out of 5 stars	2024-07-31 00:00:00	Apple iPhone 15	No Details		10	0.744	0.000	0.256	0.4404
497	Srijith	Dont Buy	I recently purchased an iPhone 15 pro max 1 TB...	1.0 out of 5 stars	2024-02-01 00:00:00	Apple iPhone 15 Pro	Colour: White TitaniumSize: 1 TB		629	0.047	0.121	0.832	-0.8944
571	Jbabhishek dash	Go for it — massager in my hand 🎉	The haptic music on the iPhone 15 Pro Max is a...	5.0 out of 5 stars	2024-08-11 00:00:00	Apple iPhone 15 Pro Max	Colour: Natural TitaniumSize: 256 GB		103	0.252	0.000	0.748	0.6921
524	vamshi	Good product	Good product	4.0 out of 5 stars	2023-12-15 00:00:00	Apple iPhone 15 Pro Max	Colour: Blue TitaniumSize: 256 GB		12	0.744	0.000	0.256	0.4404
402	Vineet Sharma	iPhone is Awesome	Performance is good,battery is good,camera sup...	4.0 out of 5 stars	2024-04-15 00:00:00	Apple iPhone 15 Pro	Colour: Black TitaniumSize: 256 GB		113	0.000	0.086	0.914	-0.1280

```
In [30]: sentiment_df.info()
```

```

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 600 entries, 0 to 599
Data columns (total 12 columns):
 #   Column      Non-Null Count  Dtype  
--- 
 0   Name         600 non-null    object  
 1   Title        600 non-null    object  
 2   Review       599 non-null    object  
 3   Rating       600 non-null    object  
 4   Date          600 non-null    object  
 5   Type          600 non-null    object  
 6   Details       600 non-null    object  
 7   Review_Length 600 non-null    int64  
 8   positive      600 non-null    float64 
 9   negative      600 non-null    float64 
 10  neutral       600 non-null    float64 
 11  compound      600 non-null    float64 
dtypes: float64(4), int64(1), object(7)
memory usage: 56.4+ KB

```

In [31]: `sentiment_df.describe()`

	Review_Length	positive	negative	neutral	compound
count	600.000000	600.000000	600.000000	600.000000	600.000000
mean	259.106667	0.310165	0.038420	0.644753	0.433373
std	715.625779	0.290654	0.081789	0.277721	0.459277
min	1.000000	0.000000	0.000000	0.000000	-0.947400
25%	26.750000	0.095750	0.000000	0.487250	0.000000
50%	100.500000	0.224500	0.000000	0.720500	0.513950
75%	210.500000	0.487000	0.047000	0.833000	0.803350
max	13009.000000	1.000000	0.556000	1.000000	0.999900

3) Thematic Analysis

Extracting key themes

In [32]:

```

from nltk.corpus import stopwords
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.decomposition import LatentDirichletAllocation

```

In [33]:

```

# Replace NaN values with an empty string or a placeholder
sentiment_df['Review'] = sentiment_df['Review'].fillna('No Review')
sentiment_df['Details'] = sentiment_df['Details'].fillna('No Details')

```

In [34]:

```

# Tokenization and Stopwords Removal
vectorizer = CountVectorizer(stop_words='english')
X = vectorizer.fit_transform(sentiment_df['Review'])

```

In [35]:

```

sentiment_df.sample(5)

```

Out[35]:

	Name	Title	Review	Rating	Date	Type	Details	Review_Length	positive	negative	neutral	complaints
305	Ajay Kr Chaturvedi	The BEST iPhone EVERRRRRR! : iPhone 15 review...	The display is impressively bright, despite th...	5.0 out of 5 stars	2023-12-03 00:00:00	Apple iPhone 15	Colour: Black Size: 128 GB	1340	0.105	0.052	0.843	0
338	Ankit kaushik	Better than any other iphone	2 people found this helpful	5.0 out of 5 stars	2024-07-21 00:00:00	Apple iPhone 15	Colour: Pink Size: 128 GB	27	0.520	0.000	0.480	0
166	Karan	Iphone 13 and 14 are not same. 14 is better	Packaging from amazon not upto the mark. Flip...	5.0 out of 5 stars	2023-03-18 00:00:00	Apple iPhone 14	Colour: Blue Size: 128 GB	729	0.161	0.041	0.798	0
402	Vineet Sharma	iPhone is Awesome	Performance is good,battery is good,camera sup...	4.0 out of 5 stars	2024-04-15 00:00:00	Apple iPhone 15 Pro	Colour: Black Titanium Size: 256 GB	113	0.000	0.086	0.914	-1
107	DEEPAK POMENDKAR	Good Quality	Good Product	4.0 out of 5 stars	2024-08-05 00:00:00	Apple iPhone 14	Colour: Blue Size: 128 GB	12	0.744	0.000	0.256	0

In [36]:

```
# Topic Modeling
lda = LatentDirichletAllocation(n_components=5, random_state=0)
lda.fit(X)
```

Out[36]:

LatentDirichletAllocation
LatentDirichletAllocation(n_components=5, random_state=0)

In [37]:

```
# Display topics
for index, topic in enumerate(lda.components_):
    print(f'Topic #{index}:')
    print([vectorizer.get_feature_names_out()[i] for i in topic.argsort()[-10:]])
```

Topic #0:
['like', '14', 'just', 'battery', 'camera', 'good', 'apple', 'phone', 'android', 'iphone']
Topic #1:
['iphone', 'issue', 'amazon', 'quality', 'camera', 'apple', 'product', 'good', 'best', 'phone']
Topic #2:
['design', 'features', 'experience', 'device', 'performance', '13', 'display', 'camera', 'battery', 'iphone']
Topic #3:
['quality', 'charging', 'iphone', 'camera', 'awesome', 'product', 'battery', 'use', 'phone', 'good']
Topic #4:
['15', 'really', 'good', 'camera', 'apple', '14', 'max', 'phone', 'pro', 'iphone']

In [38]:

```
# Manual tagging
def categorize_review(review_text):
    # Define themes and associated keywords relevant to iPhone reviews
    themes = {
        'Design': ['design', 'look', 'style', 'appearance', 'build quality'],
        'Performance': ['fast', 'slow', 'speed', 'performance', 'lag'],
        'Camera': ['camera', 'photography', 'photo', 'video quality', 'image'],
        'Battery Life': ['battery', 'battery life', 'charging', 'battery performance'],
        'Display': ['screen', 'display', 'resolution', 'brightness'],
        'Software': ['iOS', 'software', 'updates', 'features'],
        'Price': ['price', 'cost', 'expensive', 'affordable', 'value for money'],
        'Durability': ['durable', 'fragile', 'sturdy'],
        'Feel': ['touch', 'sensitivity', 'love', 'like', 'happy', 'great', 'best', 'awesome', 'super', 'superb', 'premium', 'amazing'],
        'Audio': ['sound', 'music', 'song'],
    }

    # Convert review text to lowercase
    review_text = review_text.lower()

    # Initialize the theme
    theme = 'Other'

    # Categorize based on keywords
    for key, keywords in themes.items():
        if any(keyword in review_text for keyword in keywords):
            theme = key
```

```
        break
```

```
    return theme
```

```
In [39]: # Apply the categorize_review function to the 'Review' column
sentiment_df['Theme'] = sentiment_df['Review'].apply(lambda x: categorize_review(x) if pd.notna(x) else 'Other')
```

```
In [40]: # Handle NaN values by filling them with a placeholder or dropping them
sentiment_df['Review'] = sentiment_df['Review'].fillna('No Review')
```

```
In [41]: sentiment_df.sample(5)
```

		Name	Title	Review	Rating	Date	Type	Details	Review_Length	positive	negative	neutral	compound
349	Sutharhr		It fine not that much extraordinary than 13	Light weight,But battery is better working in 13	4.0 out of 5 stars	2024- 04-24 00:00:00	Apple iPhone 15	Colour: Black Size: 128 GB	48	0.293	0.000	0.707	0.440
99	ApTreX		Truly worth the money spent! Even if you go br...	My honest review after going broke buying this...	5.0 out of 5 stars	2022- 02-06 00:00:00	Apple iPhone 13	Colour: Pink Size: 256 GB	2573	0.197	0.064	0.739	0.997
93	Bicky		Only problem is the battery	Battery time was low, often need to charge tw...	4.0 out of 5 stars	2024- 05-26 00:00:00	Apple iPhone 13	Colour: Starlight Size: 128 GB	59	0.000	0.174	0.826	-0.271
543	Mohammed Kamal Khan		Good	Good	5.0 out of 5 stars	2023- 12-18 00:00:00	Apple iPhone 15 Pro Max	Colour: Natural Titanium Size: 256 GB	4	1.000	0.000	0.000	0.440
141	AKASH VERMA	Apple's best phone	Liked the colour most.	5.0 out of 5 stars	2024- 04-26 00:00:00	Apple iPhone 14		Colour: Purple Size: 128 GB	22	0.483	0.000	0.517	0.421

```
In [42]: sentiment_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 600 entries, 0 to 599
Data columns (total 13 columns):
 #   Column      Non-Null Count  Dtype  
--- 
 0   Name         600 non-null    object  
 1   Title        600 non-null    object  
 2   Review       600 non-null    object  
 3   Rating       600 non-null    object  
 4   Date         600 non-null    object  
 5   Type         600 non-null    object  
 6   Details      600 non-null    object  
 7   Review_Length 600 non-null    int64  
 8   positive     600 non-null    float64 
 9   negative     600 non-null    float64 
 10  neutral      600 non-null    float64 
 11  compound     600 non-null    float64 
 12  Theme        600 non-null    object  
dtypes: float64(4), int64(1), object(8)
memory usage: 61.1+ KB
```

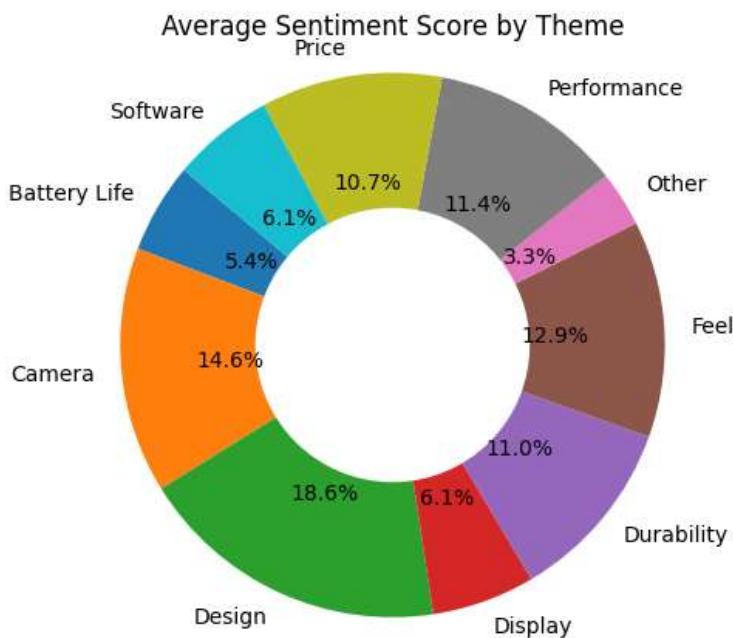
```
In [43]: # Aggregate sentiment scores by theme
theme_sentiment = sentiment_df.groupby('Theme')[['compound']].mean().reset_index()
```

```
# Prepare data for donut chart
themes = theme_sentiment['Theme']
sentiments = theme_sentiment['compound']
```

```
# Create a donut chart
plt.figure(figsize=(5, 5))
plt.pie(sentiments, labels=themes, autopct='%.1f%%', startangle=140, colors=sns.color_palette())
```

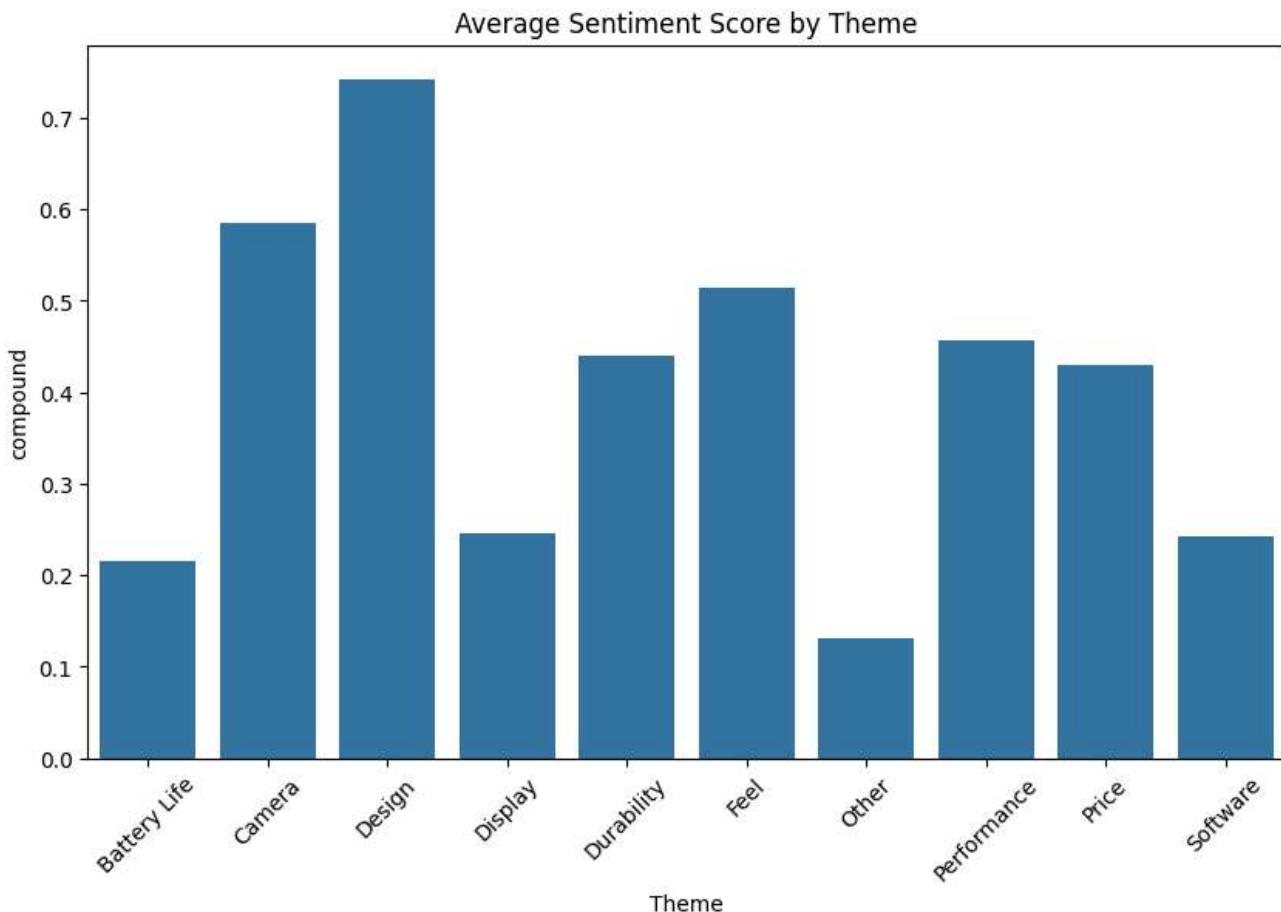
```
# Draw a circle in the center to make it a donut
centre_circle = plt.Circle((0, 0), 0.5, color='white', fc='white')
fig = plt.gcf()
fig.gca().add_artist(centre_circle)

plt.title('Average Sentiment Score by Theme')
plt.axis('equal') # Equal aspect ratio ensures that pie is drawn as a circle.
plt.show()
```



```
In [44]: # Aggregate sentiment scores by theme
theme_sentiment = sentiment_df.groupby('Theme')['compound'].mean().reset_index()

# Create a bar plot
plt.figure(figsize=(10, 6))
sns.barplot(x='Theme', y='compound', data=theme_sentiment)
plt.xticks(rotation=45)
plt.title('Average Sentiment Score by Theme')
plt.show()
```



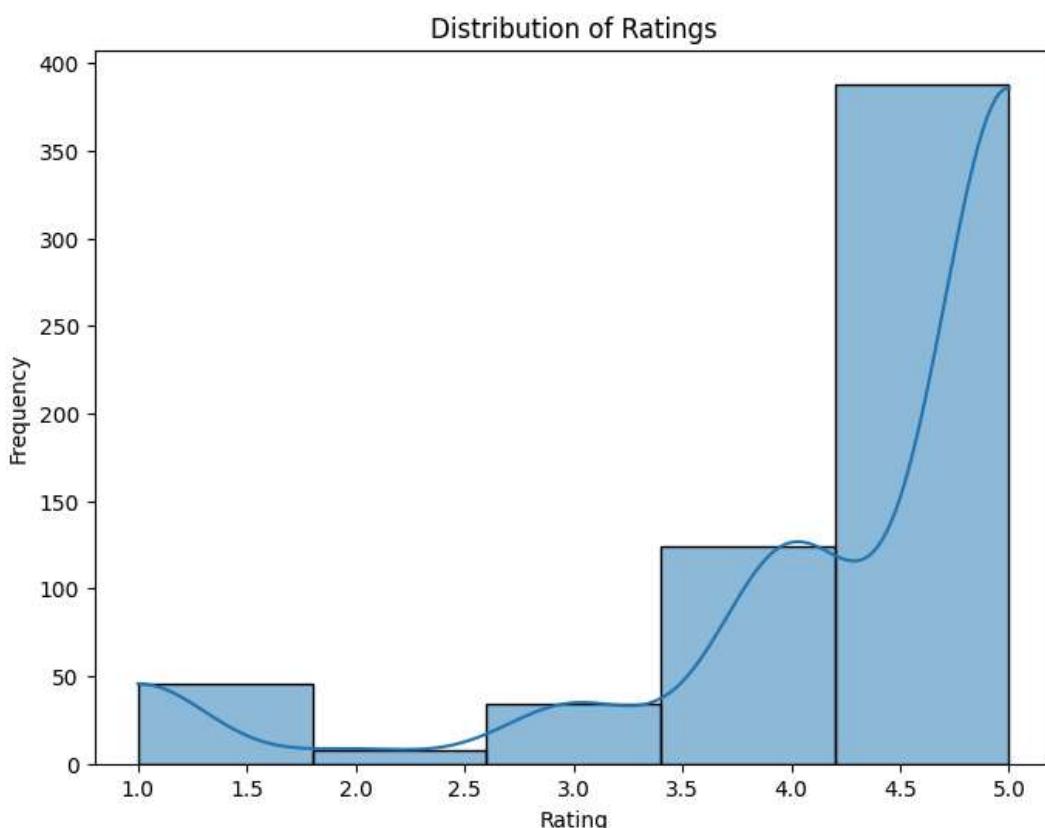
```
In [45]: # Convert 'Rating' to a numeric type (if ratings are like '4.0 out of 5 stars')
sentiment_df['Numeric_Rating'] = sentiment_df['Rating'].str.extract(r'(\d+\.\d+)').astype(float)
```

```
In [46]: sentiment_df.sample(5)
```

Out[46]:

	Name	Title	Review	Rating	Date	Type	Details	Review_Length	positive	negative	neutral	compound
368	Sumit bisht	Overall good	Heating issues	4.0 out of 5 stars	2024-04-13 00:00:00	Apple iPhone 15	No Details	14	0.000	0.000	1.000	0.0000
520	Placeholder	The best phone to show that you are doing great	A phone that screams that you are doing very w...	5.0 out of 5 stars	2024-02-04 00:00:00	Apple iPhone 15 Pro Max	Colour: Natural TitaniumSize: 512 GB	370	0.178	0.051	0.771	0.8409
247	Its a fake product dnt buy any more	I phone	Nice	5.0 out of 5 stars	2023-10-06 00:00:00	Apple iPhone 14 Pro Max	No Details	4	1.000	0.000	0.000	0.4215
275	Dibakar	Nothing can compete with this IMO	Nothing can compete with this IMO best phone i...	5.0 out of 5 stars	2023-05-02 00:00:00	Apple iPhone 14 Pro Max	No Details	58	0.296	0.000	0.704	0.6369
595	Kallol Mondal	Not Bad !!!	Overpriced. It should not cost more than 1.1L....	5.0 out of 5 stars	2024-01-12 00:00:00	Apple iPhone 15 Pro Max	Colour: Blue TitaniumSize: 256 GB	144	0.000	0.000	1.000	0.0000

```
In [47]: plt.figure(figsize=(8, 6))
sns.histplot(sentiment_df['Numeric_Rating'], bins=5, kde=True)
plt.title('Distribution of Ratings')
plt.xlabel('Rating')
plt.ylabel('Frequency')
plt.show()
```

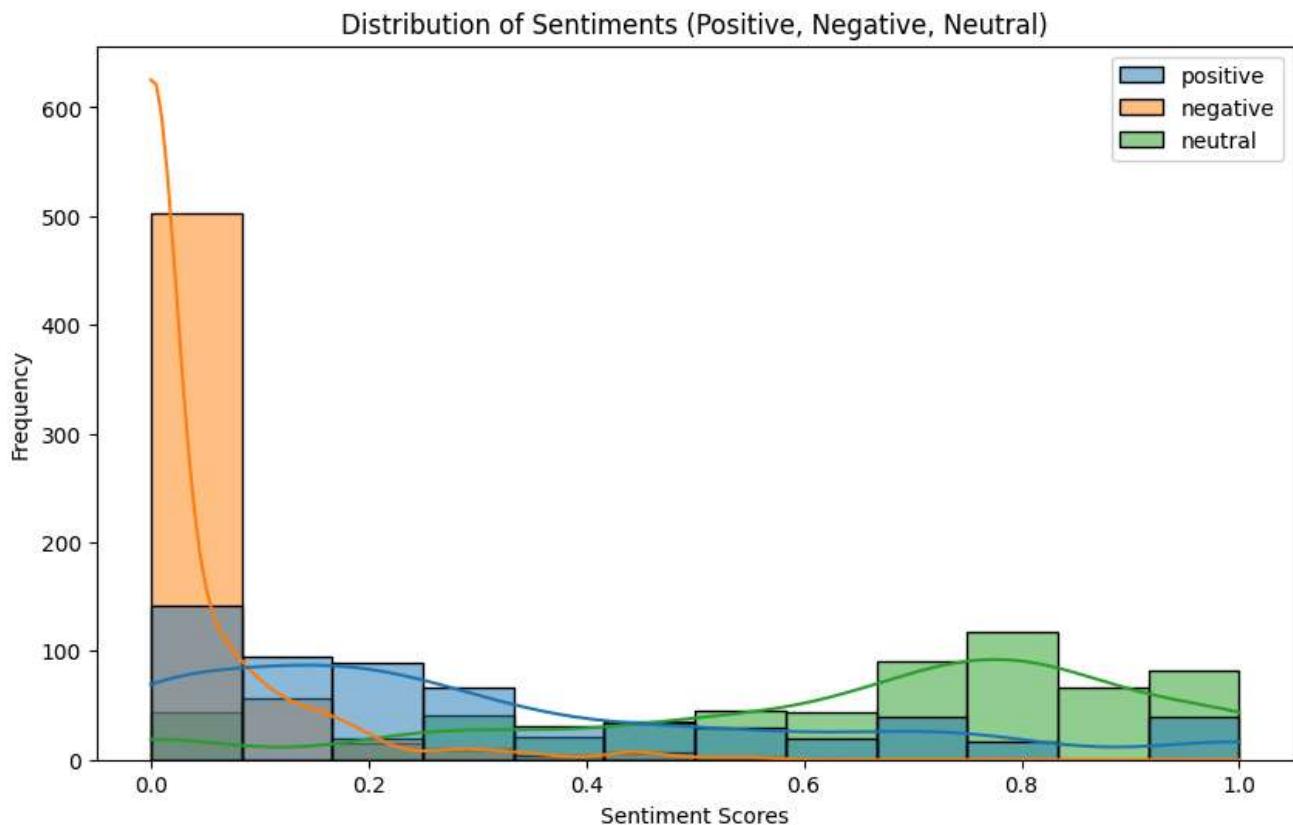


```
In [48]: # Plot distribution of sentiments
plt.figure(figsize=(10, 6))
```

```

sns.histplot(sentiment_df[['positive', 'negative', 'neutral']], kde=True)
plt.title('Distribution of Sentiments (Positive, Negative, Neutral)')
plt.xlabel('Sentiment Scores')
plt.ylabel('Frequency')
plt.show()

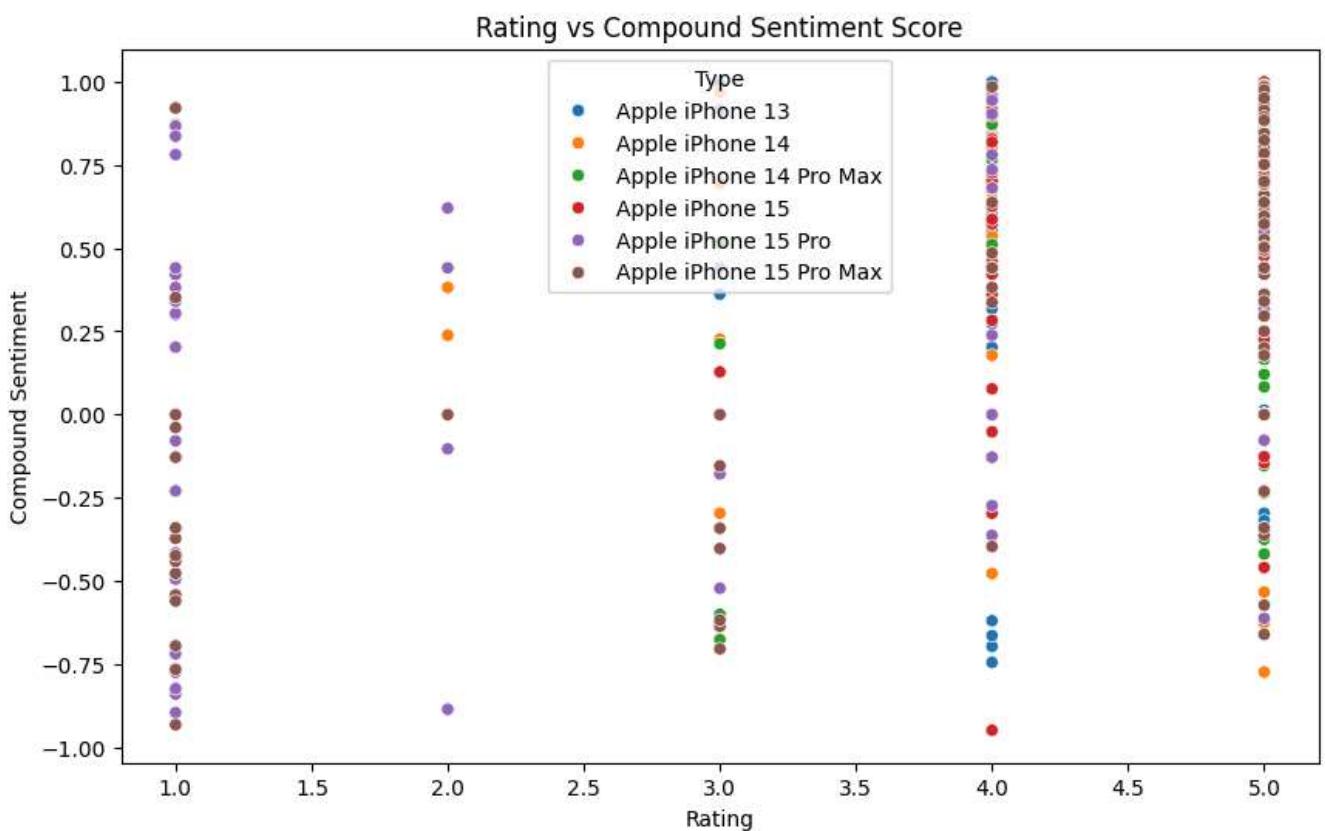
```



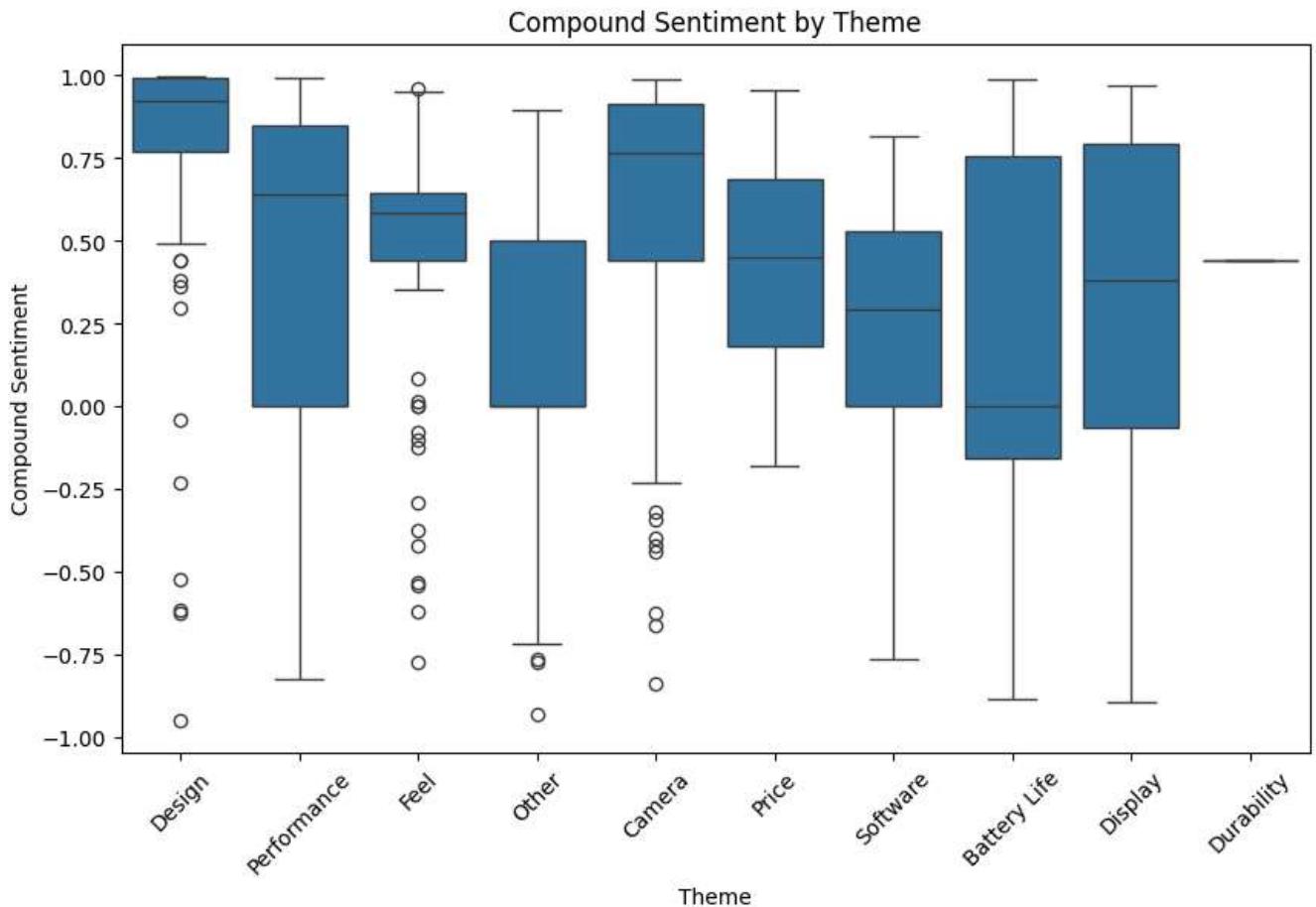
```

In [49]: # Sentiment vs Rating (Compound Sentiment)
plt.figure(figsize=(10, 6))
sns.scatterplot(x='Numeric_Rating', y='compound', hue='Type', data=sentiment_df)
plt.title('Rating vs Compound Sentiment Score')
plt.xlabel('Rating')
plt.ylabel('Compound Sentiment')
plt.show()

```



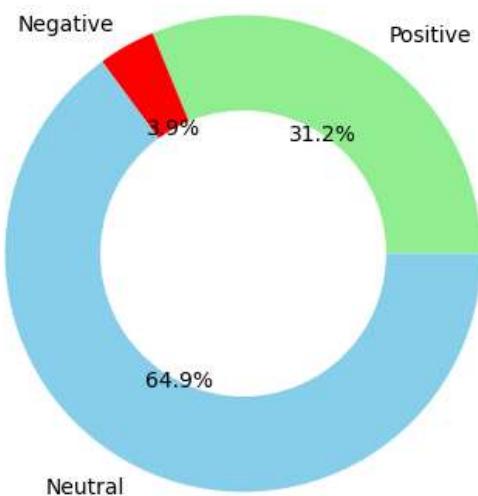
```
In [50]: # Boxplot to show sentiment (compound) for each theme
plt.figure(figsize=(10, 6))
sns.boxplot(x='Theme', y='compound', data=sentiment_df)
plt.title('Compound Sentiment by Theme')
plt.xlabel('Theme')
plt.ylabel('Compound Sentiment')
plt.xticks(rotation=45)
plt.show()
```



```
In [51]: # Aggregate sentiment proportions
sentiment_counts = sentiment_df[['positive', 'negative', 'neutral']].sum()

# Plot donut chart
plt.figure(figsize=(5,5))
plt.pie(sentiment_counts,
        labels=['Positive', 'Negative', 'Neutral'],
        autopct='%1.1f%%',
        colors=['lightgreen', 'red', 'skyblue'],
        wedgeprops=dict(width=0.4)) # Adjust width to create the donut effect
plt.title('Sentiment Distribution')
plt.show()
```

Sentiment Distribution

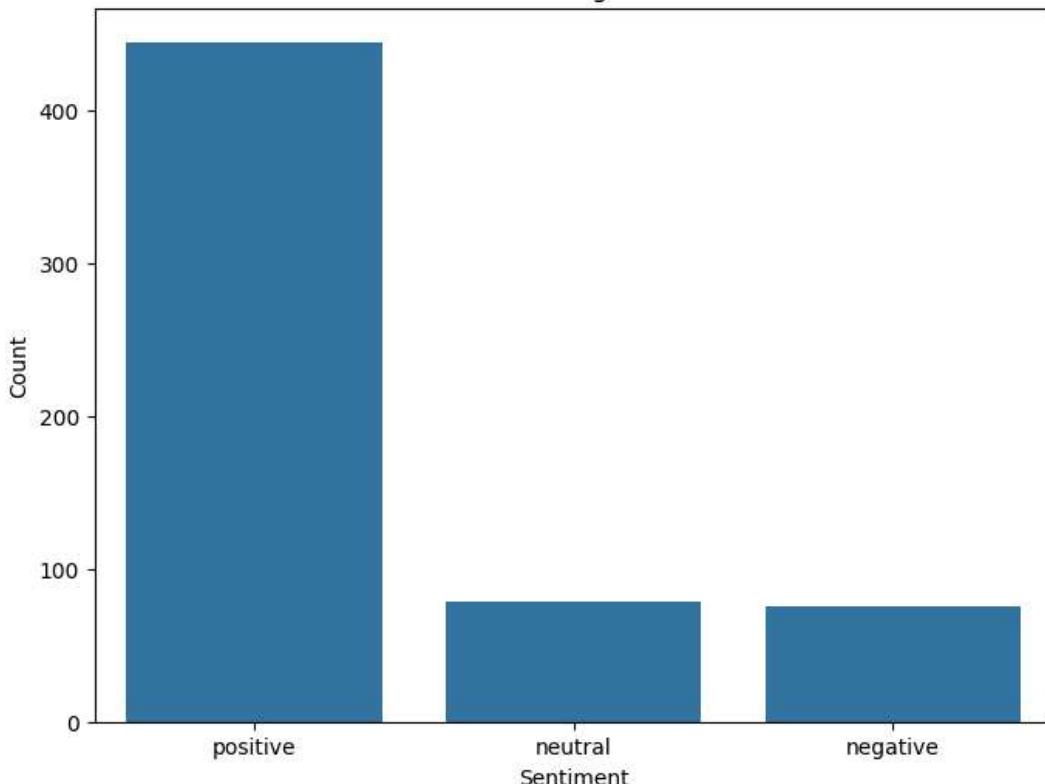


```
In [52]: # Categorizing sentiment into 'positive', 'neutral', 'negative' based on compound score
sentiment_df['Sentiment_Category'] = sentiment_df['compound'].apply(lambda x: 'positive' if x > 0 else ('negative' if x < 0))

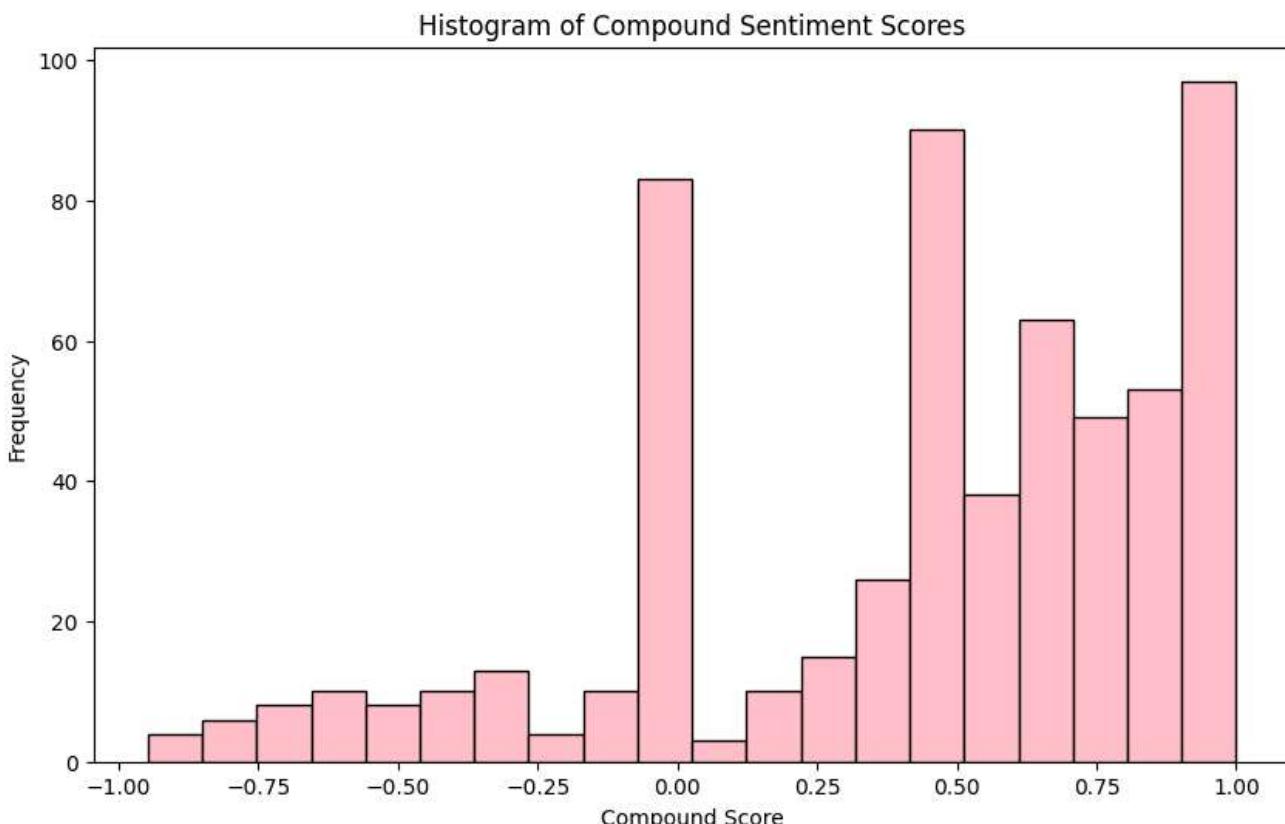
# Count the number of reviews in each sentiment category
sentiment_counts = sentiment_df['Sentiment_Category'].value_counts()

# Plot sentiment categories
plt.figure(figsize=(8, 6))
sns.barplot(x=sentiment_counts.index, y=sentiment_counts.values)
plt.title('Sentiment Categories Count')
plt.xlabel('Sentiment')
plt.ylabel('Count')
plt.show()
```

Sentiment Categories Count

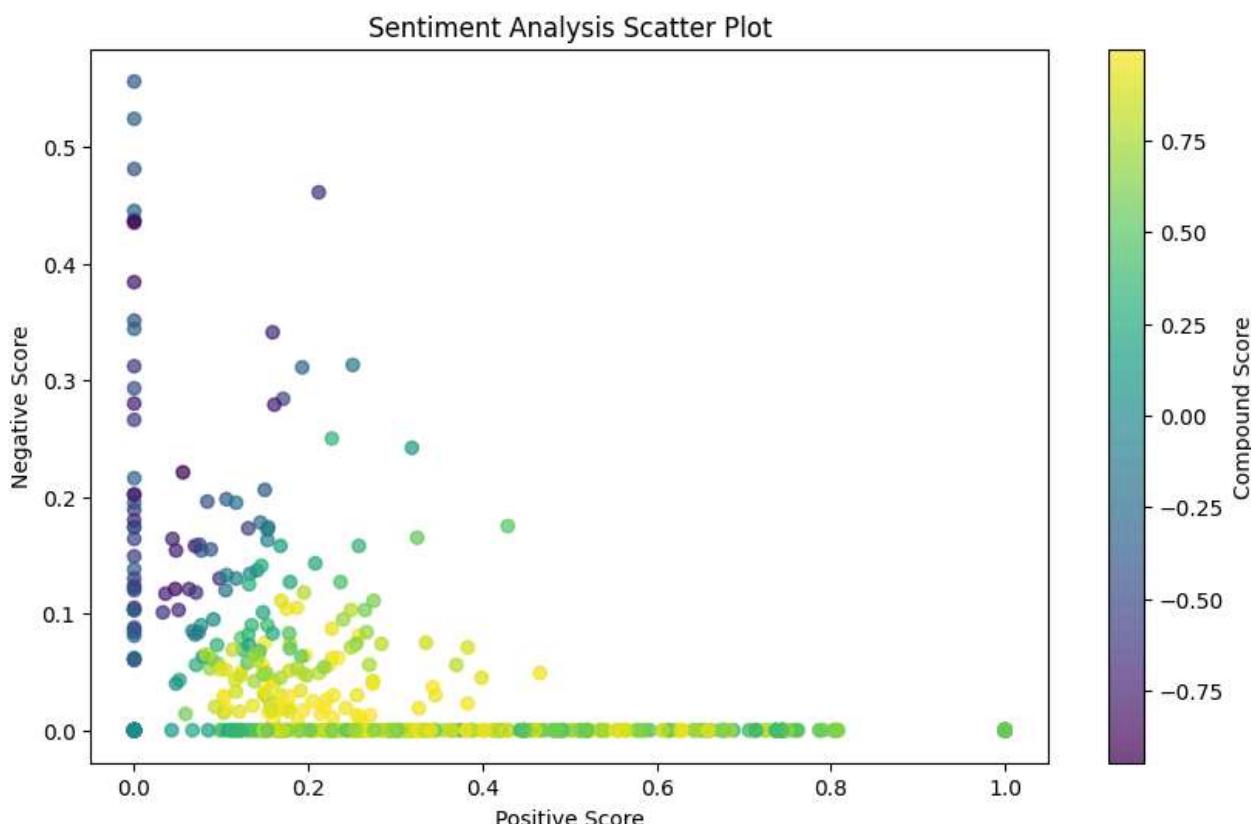


```
In [53]: plt.figure(figsize=(10, 6))
plt.hist(sentiment_df['compound'], bins=20, color='pink', edgecolor='black')
plt.xlabel('Compound Score')
plt.ylabel('Frequency')
plt.title('Histogram of Compound Sentiment Scores')
plt.show()
```



```
In [54]: import matplotlib.pyplot as plt

# Scatter plot for sentiment scores
plt.figure(figsize=(10, 6))
plt.scatter(sentiment_df['positive'], sentiment_df['negative'], c=sentiment_df['compound'], cmap='viridis', alpha=0.7)
plt.colorbar(label='Compound Score')
plt.xlabel('Positive Score')
plt.ylabel('Negative Score')
plt.title('Sentiment Analysis Scatter Plot')
plt.show()
```



```
In [55]: from wordcloud import WordCloud

# Combine all reviews into a single text
text = ' '.join(review for review in sentiment_df['Review'])
```

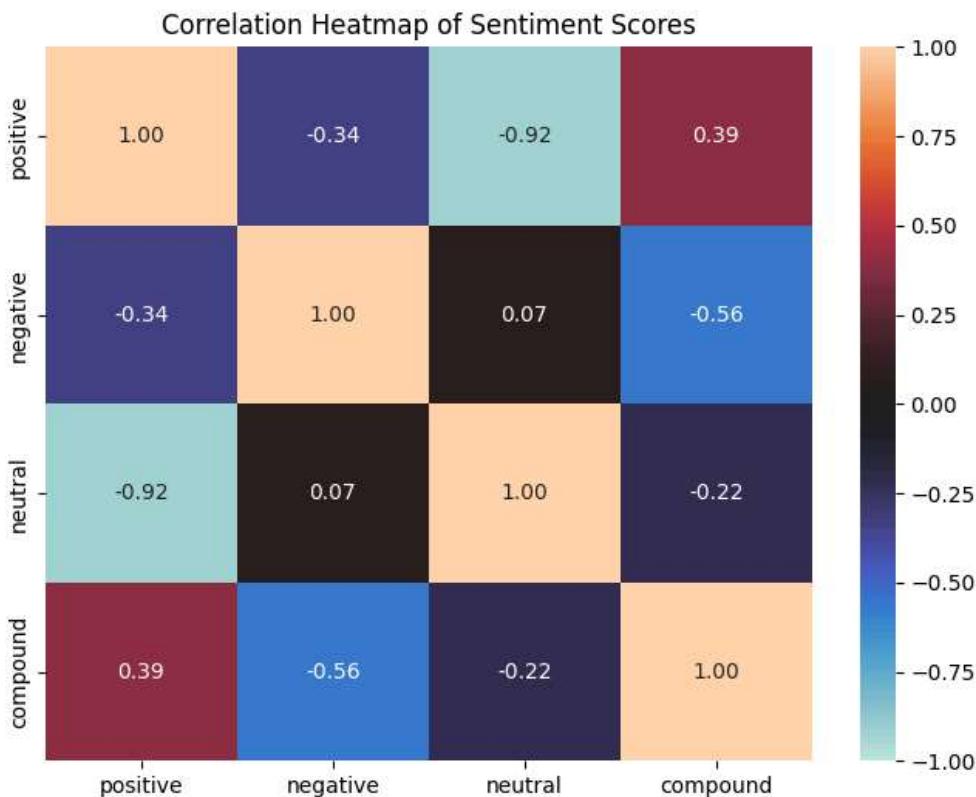
```
# Generate word cloud
wordcloud = WordCloud(width=800, height=400, background_color='white').generate(text)

# Display word cloud
plt.figure(figsize=(10, 5))
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis('off')
plt.title('Word Cloud of iPhone Reviews')
plt.show()
```



```
In [56]: # Calculate correlation matrix
corr = sentiment_df[['positive', 'negative', 'neutral', 'compound']].corr()

# Create a heatmap
plt.figure(figsize=(8, 6))
sns.heatmap(corr, annot=True, vmin=-1, vmax=1, center=0, fmt='.2f')
plt.title('Correlation Heatmap of Sentiment Scores')
plt.show()
```



In []: