In this notebook, I present an analysis of comments from Reddit posts related to the Palestinian-Israel conflict, a topic that has sparked significant debate and sensitivity in recent times. The dataset used for this analysis contains valuable insights into the sentiments expressed by commenters regarding the ongoing situation in Gaza and Israel since 7th Oct 2023. This dataset is updated daily, providing a comprehensive and up-to-date view of the sentiments expressed on Reddit regarding this conflict.

All data utilized in this analysis was sourced from Kaggle. You can access the dataset through the following link: Daily Public Opinion on Palestine-Israel War, the data time range is between 2nd Sep 2023 and 7th Oct 2024.

Through this analysis, I aim to explore various aspects of the comments, including:

1. **Sentiment Analysis**: Perform sentiment analysis to determine the overall sentiment of the comments towards Palestine and Israel.
2. **Biased Subreddits**: Identify the most biased subreddits and understand their stance on the conflict.
3. **Comment Score Trends**: Analyze the comment scores to uncover trends and popular opinions.
4. **Keyword Analysis**: Determine the most commonly used keywords and phrases in the comments.
5. **Common Emotions**: Identify the most common emotions found in the comments.
6. **Posting and Comments Patterns**: Analyze the most popular posting hours and months.
7. **Controversial Comments**: Examine the nature of controversial comments.

This analysis provides a comprehensive overview of the sentiments expressed in relation to this ongoing conflict on Reddit, contributing to a deeper understanding of public opinion in the digital, particularly reflecting the perspectives of foreign and Western audiences.

Import required libraries for analysis and load data

In [1]:
```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.cm as cm
import seaborn as sns
import nltk
from nltk.corpus import stopwords
from nltk.util import ngrams
from nltk.sentiment import SentimentIntensityAnalyzer
from nltk.sentiment.vader import SentimentIntensityAnalyzer
from wordcloud import WordCloud
from collections import Counter
import re
import text2emotion as te
import emoji
```

```
[nltk_data] Downloading package stopwords to
[nltk_data]     C:\Users\Bassa\AppData\Roaming\nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
[nltk_data] Downloading package punkt to
[nltk_data]     C:\Users\Bassa\AppData\Roaming\nltk_data...
[nltk_data]   Package punkt is already up-to-date!
[nltk_data] Downloading package wordnet to
[nltk_data]     C:\Users\Bassa\AppData\Roaming\nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
```

In [2]:
```python
#Load Data
reddit_opinion = pd.read_csv(r"D:\Projects\My portofolio - Completed projects\Python\Daily_Public_Opinion_on_Ps
```

Let's check data

In [3]:
```python
#check top rows
reddit_opinion.head()
```

```
Out[3]:
```

	comment_id	score	self_text	subreddit	created_time	post_id	author_name	controversiality	ups	downs	...
0	lqrcuqk	1	Stupid morons like these OP have so far gone i...	AskMiddleEast	2024-10-07 11:08:48	1fy4rc8	Feisty-Western4308	0	1	0	...
1	lqrcte4	1	&gt; I can't open that file on my phone.\n\nlm...	PublicFreakout	2024-10-07 11:08:27	1fy3e7z	EvaCarlisle	0	1	0	...
2	lqrct91	1	I don't believe the West will disappear like m...	worldnews	2024-10-07 11:08:25	1fx16ox	Obliviuns	0	1	0	...
3	lqrcsrn	1	When you harbor a terrorist group for 15 years...	IsraelPalestine	2024-10-07 11:08:18	1fxawgn	Reddit_sucks_46	0	1	0	...
4	lqrcs7o	1	Oh lol you mean when they demanded unreasonabl...	IsraelPalestine	2024-10-07 11:08:10	1fxyjyo	Confident_Counter471	0	1	0	...

5 rows × 24 columns

I want to know the data consists of how many rows, columns and info

```
In [4]: # display the number of rows and columns in the dataset
        reddit_opinion.shape
```

```
Out[4]: (1995439, 24)
```

```
In [5]: reddit_opinion.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1995439 entries, 0 to 1995438
Data columns (total 24 columns):
 #   Column                       Dtype  
---  ------                       -----  
 0   comment_id                   object 
 1   score                        int64  
 2   self_text                    object 
 3   subreddit                    object 
 4   created_time                 object 
 5   post_id                      object 
 6   author_name                  object 
 7   controversiality             int64  
 8   ups                          int64  
 9   downs                        int64  
 10  user_is_verified             bool   
 11  user_account_created_time    object 
 12  user_awardee_karma           float64
 13  user_awarder_karma           float64
 14  user_link_karma              float64
 15  user_comment_karma           float64
 16  user_total_karma             float64
 17  post_score                   int64  
 18  post_self_text               object 
 19  post_title                   object 
 20  post_upvote_ratio            float64
 21  post_thumbs_ups              int64  
 22  post_total_awards_received   int64  
 23  post_created_time            object 
dtypes: bool(1), float64(6), int64(7), object(10)
memory usage: 352.1+ MB
```

```
In [6]: #check data nulls
        reddit_opinion.isnull().sum()
```

```
Out[6]: comment_id                        0
        score                             0
        self_text                         8
        subreddit                         0
        created_time                      0
        post_id                           0
        author_name                       0
        controversiality                  0
        ups                               0
        downs                             0
        user_is_verified                  0
        user_account_created_time     88808
        user_awardee_karma              283
        user_awarder_karma              283
        user_link_karma                 283
        user_comment_karma              283
        user_total_karma                283
        post_score                        0
        post_self_text              1118134
        post_title                        0
        post_upvote_ratio                 0
        post_thumbs_ups                   0
        post_total_awards_received        0
        post_created_time                 0
        dtype: int64
```

```
In [7]: reddit_opinion.describe().transpose()
```

Out[7]:

	count	mean	std	min	25%	50%	75%	max
score	1995439.0	23.428448	146.463734	-1336.00	1.00	3.00	11.00	16990.0
controversiality	1995439.0	0.064585	0.245793	0.00	0.00	0.00	0.00	1.0
ups	1995439.0	23.428448	146.463734	-1336.00	1.00	3.00	11.00	16990.0
downs	1995439.0	0.000000	0.000000	0.00	0.00	0.00	0.00	0.0
user_awardee_karma	1995156.0	401.347052	3002.223696	0.00	0.00	15.00	223.00	976452.0
user_awarder_karma	1995156.0	181.365357	1613.664410	0.00	0.00	0.00	18.00	655609.0
user_link_karma	1995156.0	10638.939285	100365.788143	0.00	22.00	427.00	3238.00	12313038.0
user_comment_karma	1995156.0	44870.291705	117970.672389	-100.00	1825.00	10465.00	40364.00	8994082.0
user_total_karma	1995156.0	56091.943399	173958.560965	-99.00	2414.00	12997.00	48776.00	13925557.0
post_score	1995439.0	1640.132800	3149.905923	0.00	48.00	348.00	1906.00	37793.0
post_upvote_ratio	1995439.0	0.798482	0.180042	0.03	0.71	0.86	0.94	1.0
post_thumbs_ups	1995439.0	1640.132800	3149.905923	0.00	48.00	348.00	1906.00	37793.0
post_total_awards_received	1995439.0	0.000000	0.000000	0.00	0.00	0.00	0.00	0.0

Determine the Time Range

```
In [8]: # Convert columns to datetime type
        reddit_opinion['created_time'] = pd.to_datetime(reddit_opinion['created_time'])

        # Find the minimum and maximum dates
        first_comment_time = reddit_opinion['created_time'].min()
        last_comment_time = reddit_opinion['created_time'].max()

        print(first_comment_time)
        print(last_comment_time)
```

```
2023-09-02 12:02:19
2024-10-07 11:08:48
```

Exclude Unverified Users

To ensure that the analysis is based on posts and comments from verified users, I will create a new DataFrame that excludes unverified users.

```
In [9]: # Create a new DataFrame excluding unverified users
        verified_users_data = reddit_opinion[reddit_opinion['user_is_verified'] == True]

        # Display the shape of the new DataFrame
        verified_users_data.shape
```

```
Out[9]: (1905733, 24)
```

Let's Analyse Data

1. Perform sentiment analysis to determine the overall sentiment of the comments towards Palestine and Israel

I will download the VADER lexicon, specifically designed for sentiment analysis in social media texts. Next, I will extract the compound score from the sentiment analysis and store it in a new column. Then, I will define a function that takes the compound score as input and assigns a sentiment label (positive, negative, or neutral) based on its value:

Positive: If the compound score is greater than or equal to 0.05.
Negative: If the compound score is less than or equal to -0.05.
Neutral: If the compound score falls between -0.05 and 0.05.

In [10]:

```
# Download the VADER lexicon for sentiment analysis
nltk.download('vader_lexicon')

# Create a SentimentIntensityAnalyzer object
sia = SentimentIntensityAnalyzer()

# Define a function to calculate sentiment scores
def get_sentiment_scores(comment):
    # Check if the comment is a string
    if isinstance(comment, str):
        return sia.polarity_scores(comment)
    else:
        return {'neg': 0, 'neu': 0, 'pos': 0, 'compound': 0}  # Return default values if not a string

# Apply the function to the 'self_text' column
verified_users_data.loc[:, 'sentiment_scores'] = verified_users_data['self_text'].apply(get_sentiment_scores)

# Extract the compound score for overall sentiment
verified_users_data.loc[:, 'compound_score'] = verified_users_data['sentiment_scores'].apply(lambda x: x['compo

# Define a function to determine overall sentiment label
def sentiment_label(score):
    if score >= 0.05:
        return 'positive'
    elif score <= -0.05:
        return 'negative'
    else:
        return 'neutral'

# Apply the function to create a new sentiment column
verified_users_data.loc[:, 'sentiment'] = verified_users_data['compound_score'].apply(sentiment_label)
```

```
[nltk_data] Downloading package vader_lexicon to
[nltk_data]     C:\Users\Bassa\AppData\Roaming\nltk_data...
[nltk_data]   Package vader_lexicon is already up-to-date!
C:\Users\Bassa\AppData\Local\Temp\ipykernel_16096\1137193425.py:16: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retu
rning-a-view-versus-a-copy
  verified_users_data.loc[:, 'sentiment_scores'] = verified_users_data['self_text'].apply(get_sentiment_scores)
C:\Users\Bassa\AppData\Local\Temp\ipykernel_16096\1137193425.py:19: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retu
rning-a-view-versus-a-copy
  verified_users_data.loc[:, 'compound_score'] = verified_users_data['sentiment_scores'].apply(lambda x: x['comp
ound'])
C:\Users\Bassa\AppData\Local\Temp\ipykernel_16096\1137193425.py:31: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retu
rning-a-view-versus-a-copy
  verified_users_data.loc[:, 'sentiment'] = verified_users_data['compound_score'].apply(sentiment_label)
```

In [11]:

```
# Display the first 20 rows of the updated DataFrame with sentiment analysis results
verified_users_data[['self_text', 'compound_score', 'sentiment']].head(20)
```

Out[11]:

	self_text	compound_score	sentiment
0	Stupid morons like these OP have so far gone i...	-0.8885	negative
1	&gt; I can't open that file on my phone.\n\nlm...	0.7003	positive
2	I don't believe the West will disappear like m...	-0.7469	negative
3	When you harbor a terrorist group for 15 years...	-0.7741	negative
4	Oh lol you mean when they demanded unreasonabl...	0.2263	positive
5	Ah, I didn't even see the entire title. So par...	-0.2960	negative
6	That is hilarious. Is that what you learn in s...	0.7476	positive
7	&gt;Look at how she reacted after Oct 7th. \n\...	-0.7783	negative
8	Well said.	0.2732	positive
9	For Lebanon its more Hezbollah, but since Hezb...	0.4497	positive
10	Thanks. OP got the date wrong. My bad	-0.5719	negative
11	But they have literally recognised it? They co...	0.0000	neutral
12	"terrorist attack"\n\nYes! NBC implies.	-0.7500	negative
13	Bro you speak English better than I do most of...	-0.3291	negative
14	Oslo accords?	0.0000	neutral
15	If you attach Israel you have to expect a seri...	-0.0772	negative
16	largely because of the number of christians in...	0.0772	positive
17	I think they might rape him and then the peopl...	-0.9313	negative
18	All of the people in Gaza have “repeatedly sho...	0.6670	positive
19	Or they’re trying to give that impression. Not...	0.2263	positive

Sentiment Analysis Results

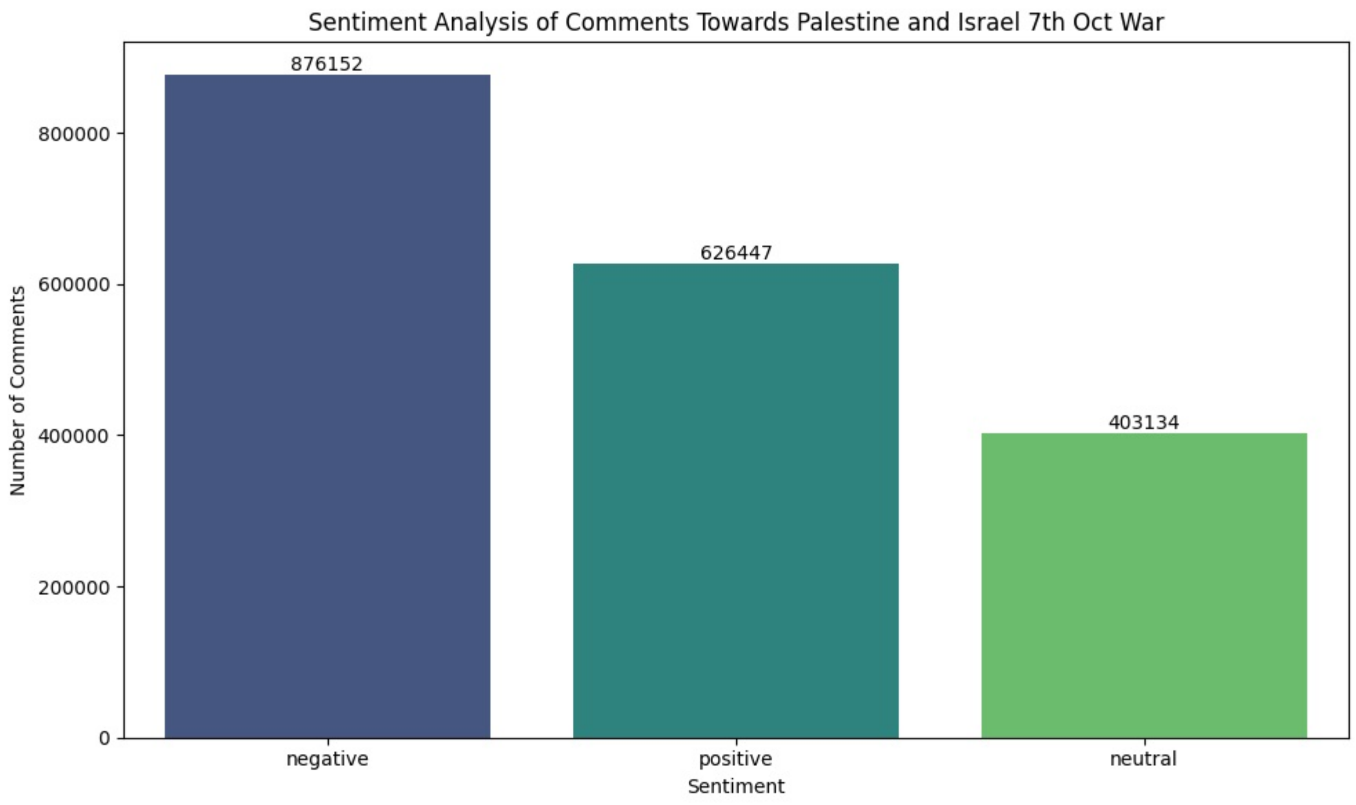
In [12]:
```python
# Count the occurrences of each sentiment label
sentiment_counts = verified_users_data['sentiment'].value_counts()

# Display the sentiment analysis results
print("Sentiment Analysis Results:")
print(f"Positive Comments: {sentiment_counts.get('positive')}")
print(f"Negative Comments: {sentiment_counts.get('negative')}")
print(f"Neutral Comments: {sentiment_counts.get('neutral')}")
```

```
Sentiment Analysis Results:
Positive Comments: 626447
Negative Comments: 876152
Neutral Comments: 403134
```

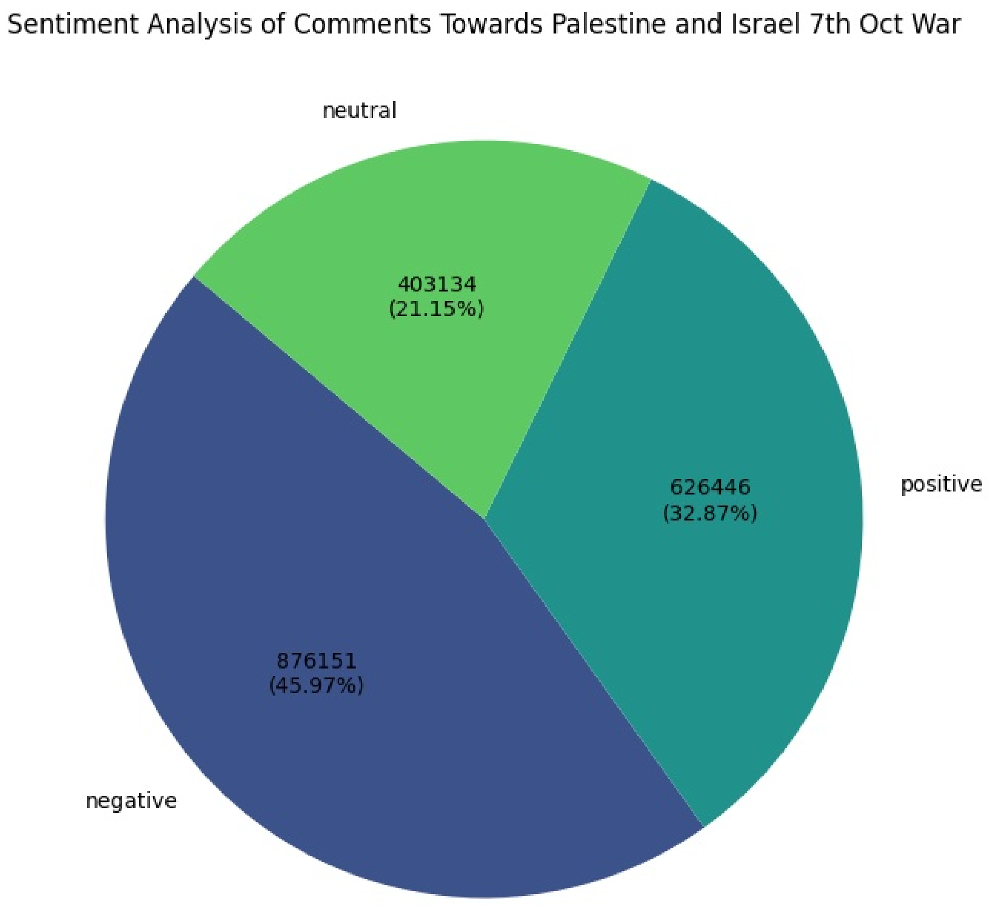
Plotting the sentiment distribution

In [13]:
```python
plt.figure(figsize=(10, 6))
ax = sns.barplot(x=sentiment_counts.index, y=sentiment_counts.values, palette='viridis')

# Adding data labels on top of each bar
for i, v in enumerate(sentiment_counts.values):
    plt.text(i, v + 0.5, str(v), ha='center', va='bottom')  # Add the value above the bar

plt.title('Sentiment Analysis of Comments Towards Palestine and Israel 7th Oct War')
plt.xlabel('Sentiment')
plt.ylabel('Number of Comments')
plt.tight_layout()
plt.show()
```

```
C:\Users\Bassa\AppData\Local\Temp\ipykernel_16096\4258872733.py:2: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable
to `hue` and set `legend=False` for the same effect.

  ax = sns.barplot(x=sentiment_counts.index, y=sentiment_counts.values, palette='viridis')
```



In [14]:
```python
values = sentiment_counts.values  # Number of comments for each sentiment
labels = sentiment_counts.index  # Sentiment labels (positive, negative, neutral)

# Define colors for the pie chart
colors = sns.color_palette('viridis', len(values))  # Using the 'viridis' palette from seaborn

# Create a pie chart with numbers and percentage labels
def func(pct, allvalues):
    absolute = int(pct / 100. * sum(allvalues))
    return f"{absolute}\n({pct:.2f}%)"

plt.figure(figsize=(8, 8))
plt.pie(values, labels=labels, colors=colors, autopct=lambda pct: func(pct, values), startangle=140)
plt.title('Sentiment Analysis of Comments Towards Palestine and Israel 7th Oct War')
plt.show()
```



2. Identify the most biased subreddits and understand their stance on the conflict

Aggregate Sentiment Data by Subreddit:

- Group comments by their respective subreddits and compute the average sentiment score (compound score) for each subreddit.
- Calculate the counts of positive, negative, and neutral comments for each subreddit to assess which sentiments dominate.

In [15]:
```
# Calculate the average compound sentiment score for each subreddit
subreddit_sentiment = verified_users_data.groupby('subreddit')['compound_score'].mean()

# Reset index to turn the grouped data into a DataFrame
subreddit_sentiment = subreddit_sentiment.reset_index()

# Classify sentiment based on the average score
subreddit_sentiment['sentiment'] = subreddit_sentiment['compound_score'].apply(
    lambda score: 'positive' if score >= 0.05 else ('negative' if score <= -0.05 else 'neutral'))

subreddit_sentiment
```

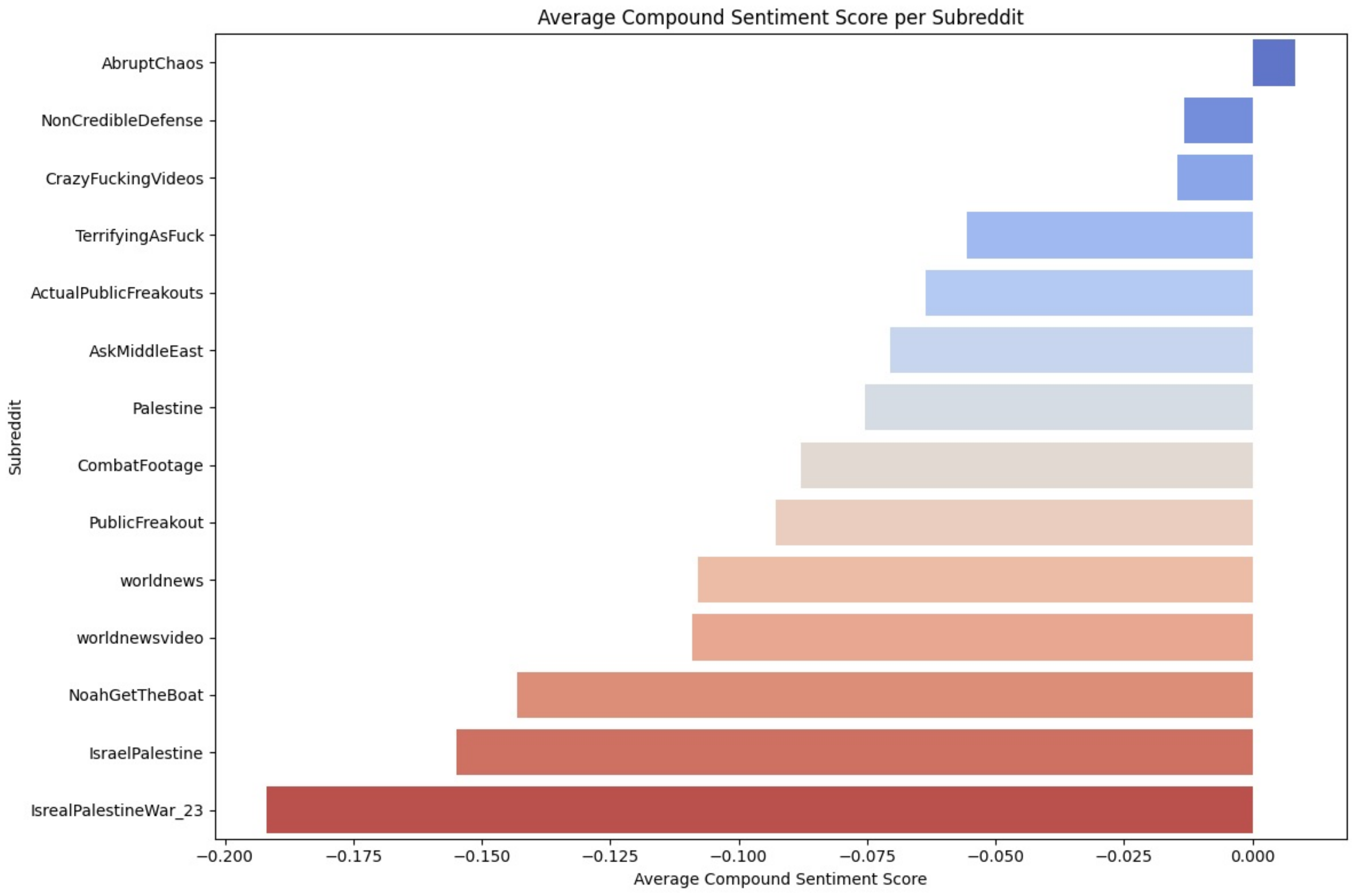
Out[15]:

	subreddit	compound_score	sentiment
0	AbruptChaos	0.008344	neutral
1	ActualPublicFreakouts	-0.063542	negative
2	AskMiddleEast	-0.070480	negative
3	CombatFootage	-0.087883	negative
4	CrazyFuckingVideos	-0.014670	neutral
5	IsraelPalestine	-0.154976	negative
6	IsrealPalestineWar_23	-0.191855	negative
7	NoahGetTheBoat	-0.143145	negative
8	NonCredibleDefense	-0.013375	neutral
9	Palestine	-0.075328	negative
10	PublicFreakout	-0.092846	negative
11	TerrifyingAsFuck	-0.055587	negative
12	worldnews	-0.107904	negative
13	worldnewsvideo	-0.109136	negative

In [16]:

```python
# Sort the data for better visualization
subreddit_sentiment = subreddit_sentiment.sort_values(by='compound_score', ascending=False)

plt.figure(figsize=(12, 8))
sns.barplot(
    x='compound_score',
    y='subreddit',
    data=subreddit_sentiment,
    palette='coolwarm'
)

plt.title('Average Compound Sentiment Score per Subreddit') # Add title and labels
plt.xlabel('Average Compound Sentiment Score')
plt.ylabel('Subreddit')
plt.tight_layout()
plt.show()
```

```
C:\Users\Bassa\AppData\Local\Temp\ipykernel_16096\2375821620.py:5: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `y` variable
to `hue` and set `legend=False` for the same effect.

  sns.barplot(
```



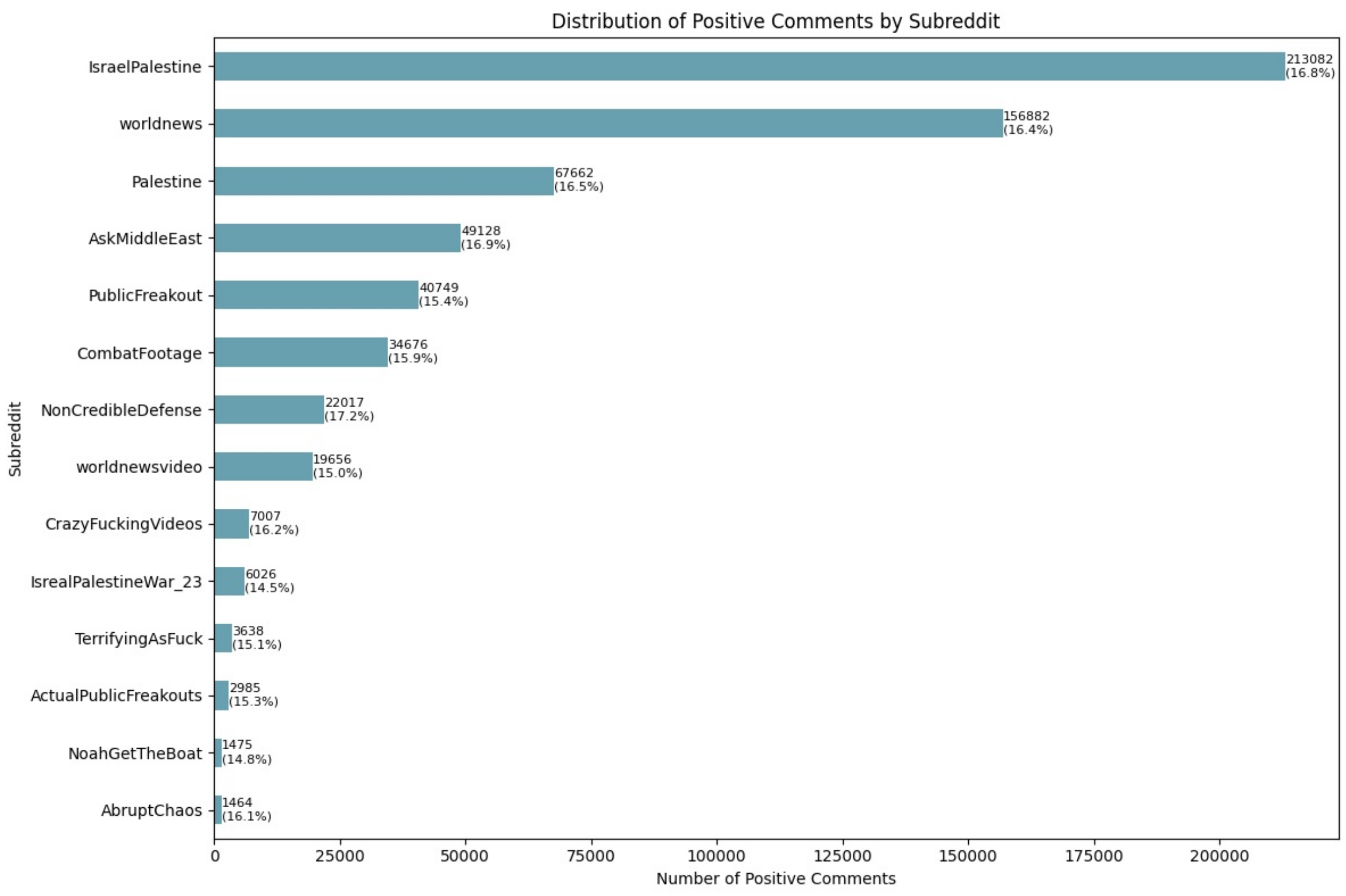
In [17]:
```
# Get the counts of each sentiment label (positive, negative, neutral) by subreddit
subreddit_sentiment_counts = verified_users_data.groupby('subreddit')['sentiment'].value_counts().unstack(fill_
subreddit_sentiment_counts
```

Out[17]:

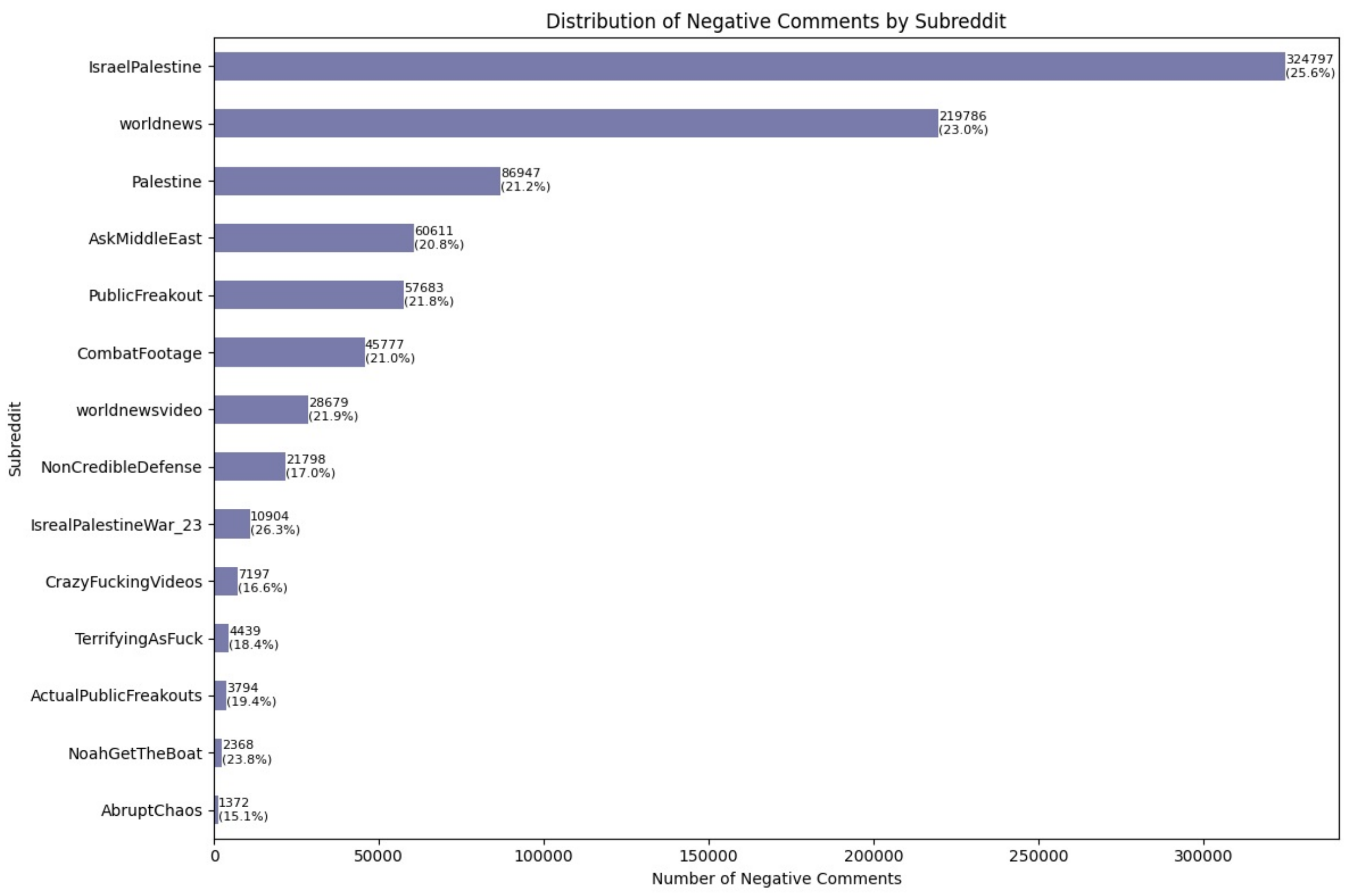
sentiment	negative	neutral	positive
subreddit			
AbruptChaos	1372	1722	1464
ActualPublicFreakouts	3794	2996	2985
AskMiddleEast	60611	35986	49128
CombatFootage	45777	28483	34676
CrazyFuckingVideos	7197	7434	7007
IsraelPalestine	324797	95283	213082
IsrealPalestineWar_23	10904	3829	6026
NoahGetTheBoat	2368	1130	1475
NonCredibleDefense	21798	20265	22017
Palestine	86947	50207	67662
PublicFreakout	57683	33650	40749
TerrifyingAsFuck	4439	3992	3638
worldnews	219786	101021	156882
worldnewsvideo	28679	17136	19656

Bar Charts for Sentiment Distribution by Subreddit

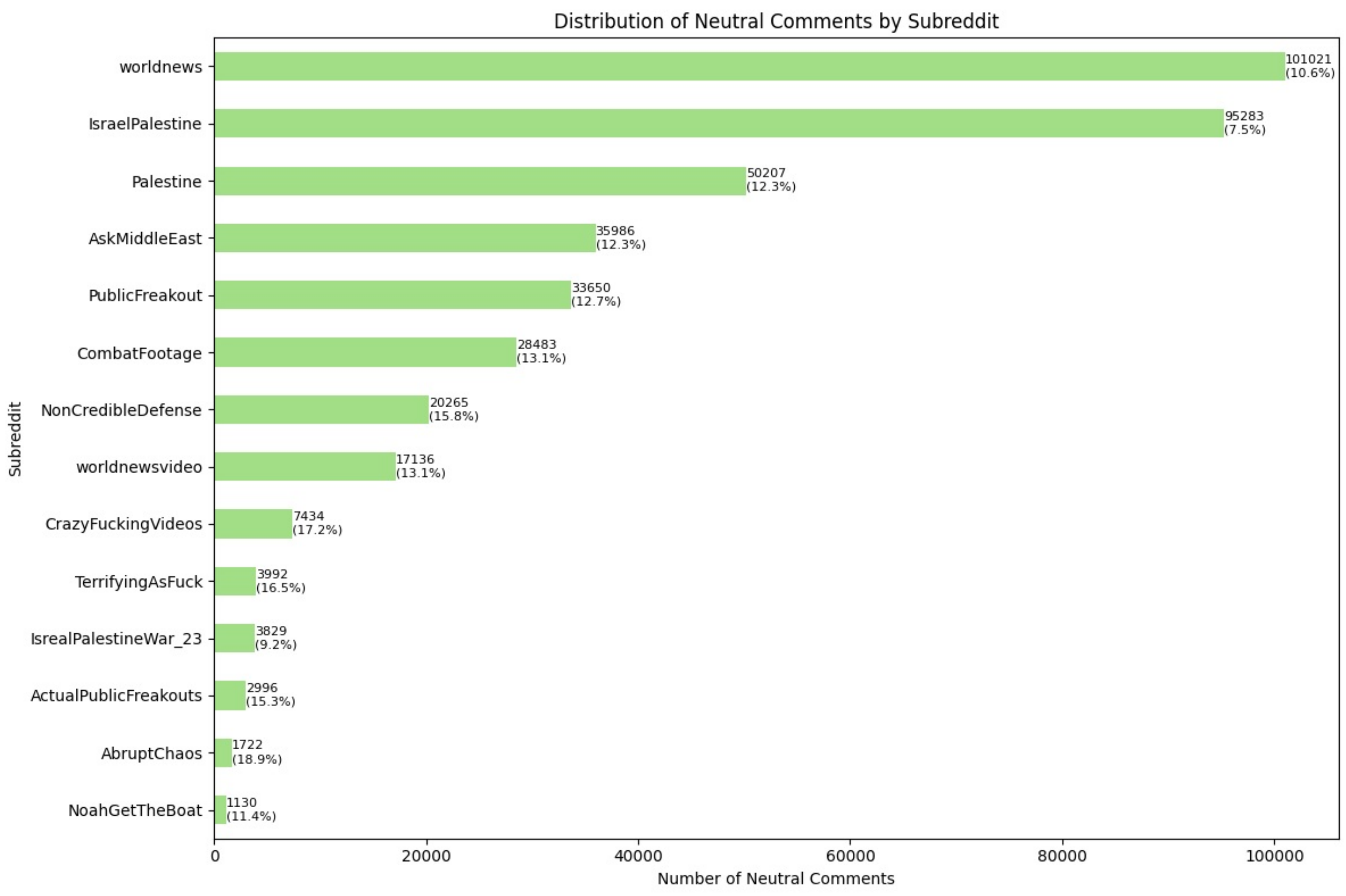
In [20]:
```python
# Distribution of Positive Comments by Subreddit
# Create a bar chart for positive comments
plt.figure(figsize=(12, 8))
positive_counts = subreddit_sentiment_counts['positive'].sort_values(ascending=True)
positive_counts.plot(kind='barh', color=cm.viridis(0.4), alpha=0.7)

# Set the title and labels
plt.title('Distribution of Positive Comments by Subreddit')
plt.xlabel('Number of Positive Comments')
plt.ylabel('Subreddit')
plt.tight_layout()

# Calculate the total comments per subreddit
subreddit_sentiment_counts['total'] = subreddit_sentiment_counts.sum(axis=1)

# Add numbers and percentages on the right side of each bar
for i, value in enumerate(positive_counts):
    total_comments = subreddit_sentiment_counts.loc[positive_counts.index[i], 'total']
    percentage = (value / total_comments) * 100
    plt.text(value + 0.5, i, f'{value}\n({percentage:.1f}%)', ha='left', va='center', fontsize=8)

plt.show()
```



In [21]:
```python
# Distribution of Negative Comments by Subreddit
# Negative comments bar chart
plt.figure(figsize=(12, 8))
negative_counts = subreddit_sentiment_counts['negative'].sort_values(ascending=True)
negative_counts.plot(kind='barh', color=cm.viridis(0.2), alpha=0.7)

plt.title('Distribution of Negative Comments by Subreddit')
plt.xlabel('Number of Negative Comments')
plt.ylabel('Subreddit')
plt.tight_layout()

# Add numbers and percentages on the right side of each bar
for i, value in enumerate(negative_counts):
    total_comments = subreddit_sentiment_counts.loc[negative_counts.index[i], 'total']
    percentage = (value / total_comments) * 100
    plt.text(value + 0.5, i, f'{value}\n({percentage:.1f}%)', ha='left', va='center', fontsize=8)

plt.show()
```



In [22]:
```python
# Neutral comments bar chart
plt.figure(figsize=(12, 8))
neutral_counts = subreddit_sentiment_counts['neutral'].sort_values(ascending=True)
neutral_counts.plot(kind='barh', color=cm.viridis(0.8), alpha=0.7)

plt.title('Distribution of Neutral Comments by Subreddit')
plt.xlabel('Number of Neutral Comments')
plt.ylabel('Subreddit')
plt.tight_layout()

# Add numbers and percentages on the right side of each bar
for i, value in enumerate(neutral_counts):
    total_comments = subreddit_sentiment_counts.loc[neutral_counts.index[i], 'total']
    percentage = (value / total_comments) * 100
    plt.text(value + 0.5, i, f'{value}\n({percentage:.1f}%)', ha='left', va='center', fontsize=8)

plt.show()
```



3. Analyze the comment scores to uncover trends and popular opinions

Descriptive Statistics

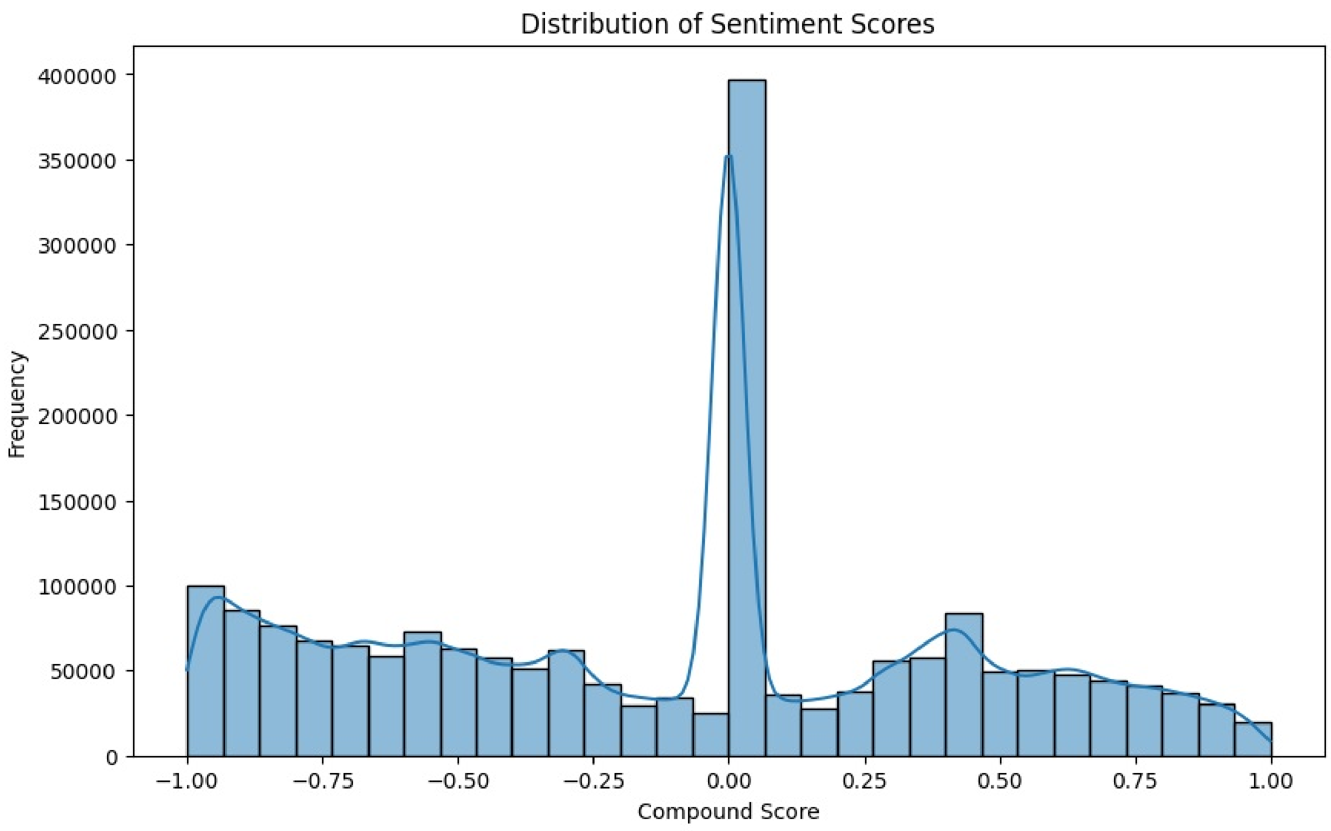
calculating basic descriptive statistics of the sentiment scores to understand the overall trends.

In [23]:
```
# Descriptive statistics
descriptive_stats = verified_users_data['compound_score'].describe()
descriptive_stats
```

Out[23]:
```
count    1.905733e+06
mean    -1.109671e-01
std      5.355358e-01
min     -9.999000e-01
25%     -5.837000e-01
50%      0.000000e+00
75%      3.182000e-01
max      9.997000e-01
Name: compound_score, dtype: float64
```

Create histograms or density plots to visualize the distribution of sentiment scores

In [24]:
```
# Histogram of sentiment scores
plt.figure(figsize=(10, 6))
sns.histplot(verified_users_data['compound_score'], bins=30, kde=True)
plt.title('Distribution of Sentiment Scores')
plt.xlabel('Compound Score')
plt.ylabel('Frequency')
plt.show()
```



The output means:

1. **Count**:
   - **1,905,733**: This indicates that there are nearly 1.9 million entries (comments) in the dataset for which the compound scores were calculated.
2. **Mean**:
   - **-0.110967**: The average compound score is approximately -0.11. This suggests that, on average, the comments in dataset tend to be slightly negative, as the compound score ranges from -1 (very negative) to +1 (very positive).
3. **Standard Deviation (std)**:
   - **0.535535**: This measures the amount of variation or dispersion in the compound scores. A standard deviation of about 0.54 indicates a moderate spread of scores around the mean.
4. **Minimum (min)**:
   - **-0.999**: This is the lowest compound score in the dataset, indicating that at least one comment is very negative.
5. **25th Percentile (25%)**:
   - **-0.5837**: This value indicates that 25% of the comments have a compound score below -0.5837. It reflects the lower end of the score distribution.
6. **Median (50%)**:
   - **0.0**: The median score is 0, meaning that half of the comments are negative or neutral (less than 0) and half are positive or neutral (greater than 0). This suggests a balance of sentiments, but the presence of negative scores is notable.
7. **75th Percentile (75%)**:
   - **0.3182**: This indicates that 75% of the comments have a compound score below 0.3182, suggesting that a significant portion of comments is slightly positive or neutral.
8. **Maximum (max)**:
   - **0.9997**: This is the highest compound score in the dataset, indicating that at least one comment is very positive.

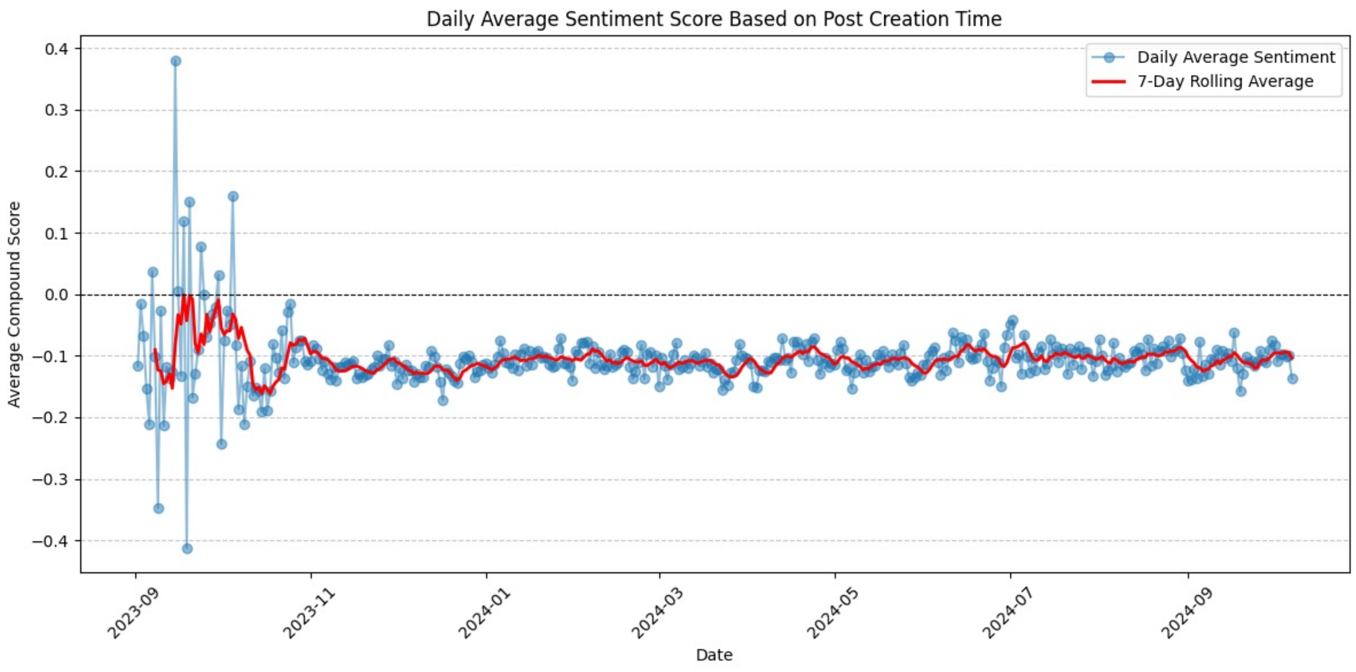
Summary Overall, the statistics show that the comments in dataset are generally slightly negative on average to the war, with a good spread of sentiments from very negative to very positive to the war. The median score being zero indicates a mixed sentiment, with significant numbers of both negative and positive comments to the war.

Trends Over Time
analyze how sentiment scores change over time.

In [25]:
```
# Convert 'created_time' to datetime type if it's not already
verified_users_data['created_time'] = pd.to_datetime(verified_users_data['created_time'])

# Calculate the daily average sentiment based on 'created_time'
```

```
daily_sentiment = verified_users_data.groupby(verified_users_data['created_time'].dt.date)['compound_score'].mea

# Calculate the 7-day rolling average
daily_sentiment_rolling = daily_sentiment.rolling(window=7).mean()

# Plot the daily sentiment and the rolling average
plt.figure(figsize=(12, 6))
plt.plot(daily_sentiment.index, daily_sentiment.values, marker='o', alpha=0.5, label='Daily Average Sentiment')
plt.plot(daily_sentiment_rolling.index, daily_sentiment_rolling.values, color='red', label='7-Day Rolling Averag

plt.title('Daily Average Sentiment Score Based on Post Creation Time')
plt.xlabel('Date')
plt.ylabel('Average Compound Score')
plt.xticks(rotation=45)
plt.axhline(0, color='black', linewidth=0.8, linestyle='--')  # Add a horizontal line at y=0
plt.grid(axis='y', linestyle='--', alpha=0.7)
plt.legend()
plt.tight_layout()
plt.show()
```

```
C:\Users\Bassa\AppData\Local\Temp\ipykernel_16096\6481532.py:2: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retu
rning-a-view-versus-a-copy
  verified_users_data['created_time'] = pd.to_datetime(verified_users_data['created_time'])
```



The graph displays the daily average sentiment scores based on the comment creation time. Here's how to interpret it:

X-Axis (Date): Represents the time period studied, from September 2023 to October 2024.

Y-Axis (Average Compound Score): Shows the average sentiment scores, where positive values indicate positive sentiments and negative values indicate negative sentiments to the war.

Blue Dots: Represent the daily average sentiment scores, showing significant fluctuations in compound Score to the war on certain days.

Red Line (7-Day Rolling Average): Provides a smoother view of the overall trends over time, helping to reduce the noise from daily changes. It indicates that the general trend has been toward negative sentiments to the war over most of the period.

Overall Trend: The graph suggests a general trend toward negative sentiments to the war, as most of the average sentiment scores remain below zero throughout the period.

Fluctuations or Outliers: Peak Observed in Oct 2023: This peak may indicate heightened emotions and reactions surrounding the onset of the war on October 7. The increase in sentiment scores during this period could reflect public responses to the unfolding situation and its impact on people's feelings and opinions.

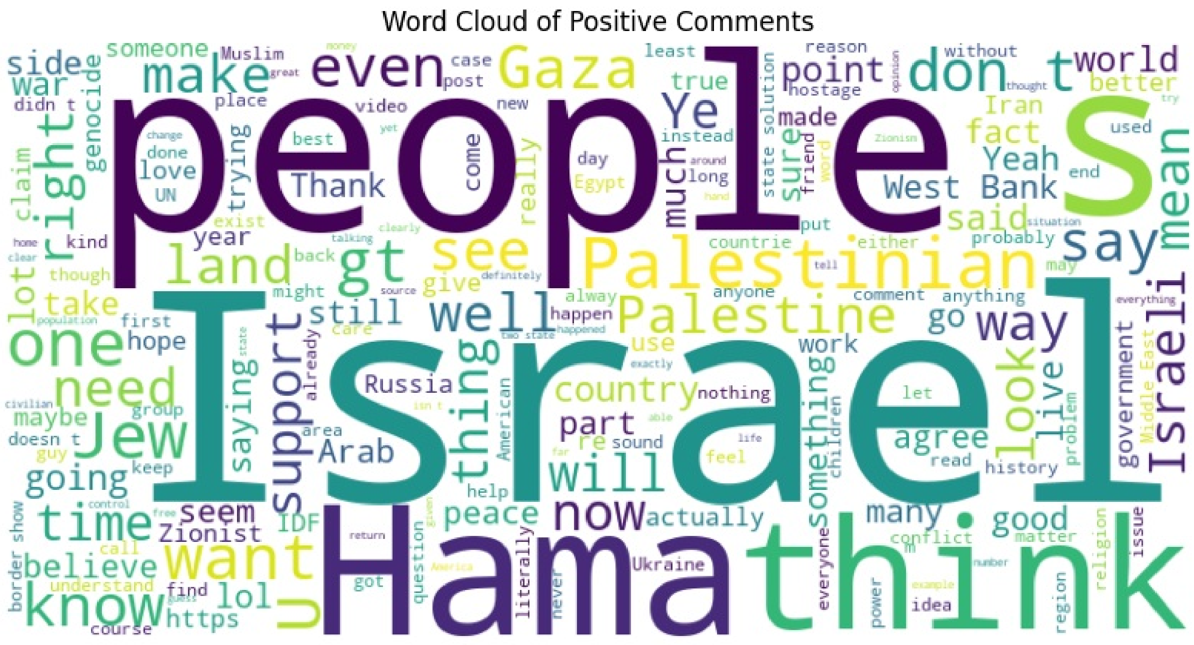
Popular Opinions Analysis

Analyze the most frequently used words in positive and negative comments to uncover popular opinions.

In [26]:
```
# positive comments word cloud
positive_comments = verified_users_data[verified_users_data['sentiment'] == 'positive']['self_text']  # Change
```

```
wordcloud_positive = WordCloud(width=800, height=400, background_color='white').generate(' '.join(positive_comm

plt.figure(figsize=(10, 6))
plt.imshow(wordcloud_positive, interpolation='bilinear')
plt.axis('off')
plt.title('Word Cloud of Positive Comments')
```

Out[26]:
```
Text(0.5, 1.0, 'Word Cloud of Positive Comments')
```



The word cloud offers a visual representation of the most frequently used words in positive comments. Here are some observations based on the content of the word cloud:

Key Observations:

1. Prominent Terms:

- The words **"Israel"**, **"Hamas"**, **"people"**, **"Palestinian"**, and **"think"** stand out as the largest, indicating they are the most commonly referenced concepts in positive comments.
- The frequent mention of **"people"** and **"think"** suggests a focus on human aspects and opinions regarding the topic, possibly emphasizing perspectives on the conflict or situation.

2. Contextual Themes:

- The presence of **"Gaza"**, **"land"**, and **"state"** indicates discussions around territorial and statehood issues, which are often central to the Palestine-Israel discourse.
- The use of **"support"** and **"believe"** reflects a sentiment of advocacy or positive affirmation towards a cause or perspective related to the situation.

3. Diversity of Perspectives:

- Words like **"Arab"**, **"Zionist"**, and **"Iran"** suggest that the comments may address broader geopolitical themes and various narratives within the discourse surrounding the Palestine-Israel conflict.
- The inclusion of terms like **"understand"** and **"know"** implies that the comments may encourage empathy and trying understanding.

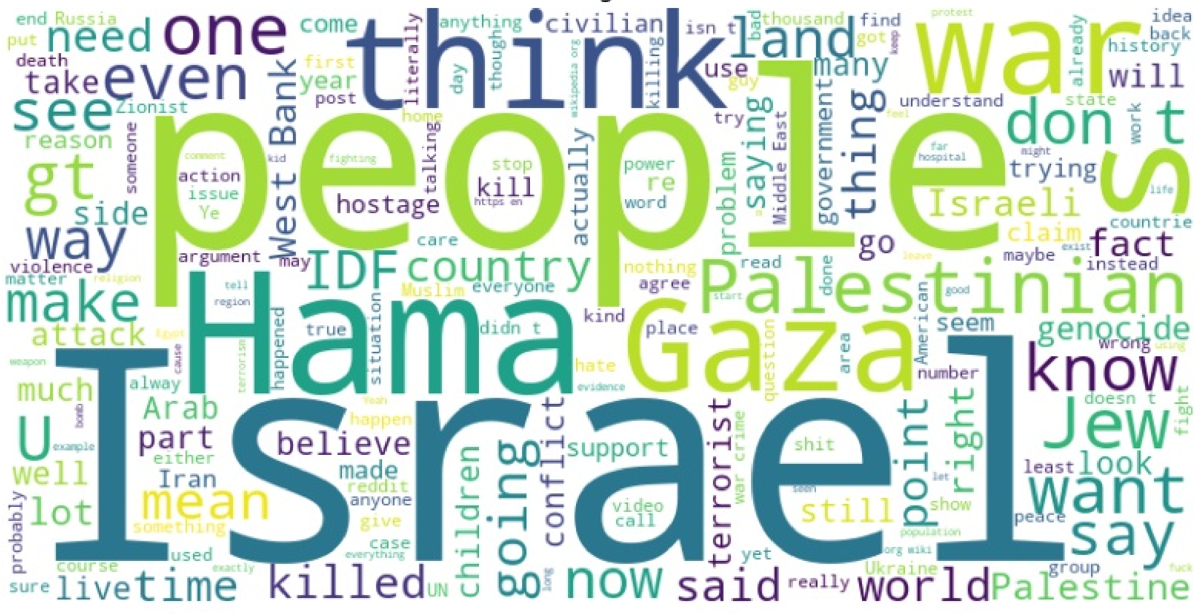
General Impression:

Overall, the word cloud conveys a landscape of positive sentiments regarding the Palestine-Israel situation, focusing on human connection, beliefs, and advocacy for understanding. The comments likely reflect a desire for peace and resolution while highlighting the complexities of the political landscape. The prominence of certain terms points towards significant themes in current discussions about the region.

In [27]:
```
# Negative comments word cloud
negative_comments = verified_users_data[verified_users_data['sentiment'] == 'negative']['self_text']
wordcloud_negative = WordCloud(width=800, height=400, background_color='white').generate(' '.join(negative_comm

plt.figure(figsize=(10, 6))
plt.imshow(wordcloud_negative, interpolation='bilinear')
plt.axis('off')
plt.title('Word Cloud of Negative Comments')
```

Out[27]:
```
Text(0.5, 1.0, 'Word Cloud of Negative Comments')
```

Word Cloud of Negative Comments



The word cloud visually represents the most frequent words in **negative comments** about the Palestine-Israel conflict. Here are some observations based on the prominent terms in the image:

Key Observations:

1. Prominent Terms:

- Words like **"Israel"**, **"Hamas"**, **"people"**, **"war"**, and **"Gaza"** are the largest, indicating that they are central topics of discussion in the negative comments to the war.
- The frequent appearance of **"killed"**, **"war"**, **"terrorism"**, and **"genocide"** suggests that these comments are heavily focused on violence, conflict, and the devastating impacts of the ongoing situation.

2. Conflict and Blame:

- Terms like **"Hamas"**, **"IDF"**, **"attack"**, **"killed"**, and **"terrorism"** point to discussions surrounding blame and responsibility for the violence, with negative sentiments likely directed at various parties involved in the conflict.
- Words such as **"hate"**, **"claim"**, and **"wrong"** further suggest that the negative comments are marked by frustration, disagreement, or condemnation.

3. Geopolitical and Social Aspects:

- Words like **"land"**, **"West Bank"**, **"Palestinian"**, **"Zionist"**, and **"Muslim"** show that the discussions include issues of territory, identity, and geopolitical alignments, reflecting longstanding grievances and disputes.
- Mentions of **"Russia"**, **"Ukraine"**, and **"Iran"** might indicate a broader discussion tying the Palestine-Israel conflict to other international conflicts and power struggles.

4. Human and Ethical Concerns:

- The word **"children"** stands out, suggesting a focus on the humanitarian impact of the conflict, with particular concern for innocent lives being affected.
- Words like **"think"**, **"know"**, and **"mean"** imply introspective comments, possibly questioning motives or providing critiques on how people understand the conflict.

General Impression:

The word cloud reflects a significant focus on the violence, blame, and geopolitical issues at the heart of the Palestine-Israel conflict. Negative sentiments appear to be driven by strong emotions concerning war, terrorism, and perceived injustices on both sides. There also seems to be a mixture of factual discussions and emotional responses, reflecting both political and human dimensions of the ongoing conflict.

4. Determine the most commonly used keywords and phrases in the comments

Count Most Common Keywords

In [28]:
```
# Prepare the Appropriate Column
```

```python
comments = 'self_text'
verified_users_data[comments] = verified_users_data[comments].fillna('').astype(str)

# Combine all comments into a single text
text = ' '.join(verified_users_data[comments])

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

# Remove punctuation
text = re.sub(r'[^\w\s]', '', text)

# Tokenize the text into words
words = text.split()

# Remove stop words
nltk.download('stopwords')
stop_words = set(stopwords.words('english'))
filtered_words = [word for word in words if word not in stop_words]

# Count individual keywords
word_counts = Counter(filtered_words)

# Display the most common keywords
most_common_keywords = word_counts.most_common(10)

most_common_keywords
```

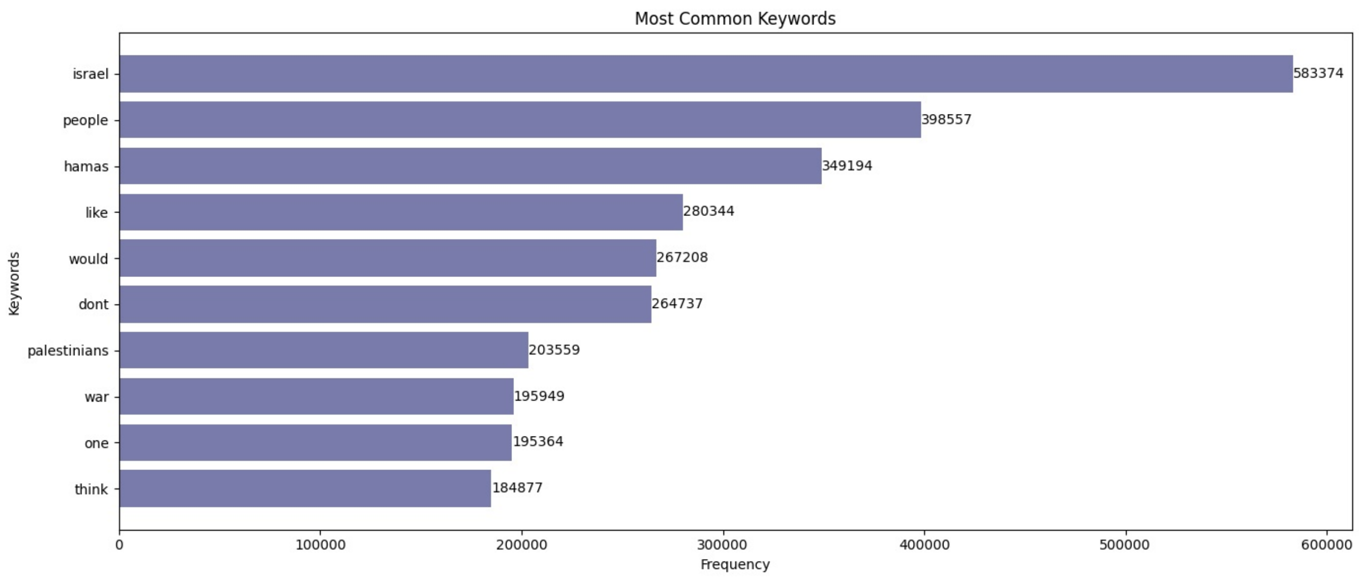
```
C:\Users\Bassa\AppData\Local\Temp\ipykernel_16096\474621416.py:3: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retu
rning-a-view-versus-a-copy
  verified_users_data[comments] = verified_users_data[comments].fillna('').astype(str)
[nltk_data] Downloading package stopwords to
[nltk_data]     C:\Users\Bassa\AppData\Roaming\nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
```

Out[28]:

```
[('israel', 583374),
 ('people', 398557),
 ('hamas', 349194),
 ('like', 280344),
 ('would', 267208),
 ('dont', 264737),
 ('palestinians', 203559),
 ('war', 195949),
 ('one', 195364),
 ('think', 184877)]
```

In [29]:

```python
# Visualize the most common keywords
keywords, counts = zip(*most_common_keywords)
data = pd.DataFrame({'Keywords': keywords, 'Frequency': counts})
data.sort_values(by='Frequency', ascending=True, inplace=True)  # Sort to reverse the bar order
plt.figure(figsize=(14, 6))
bars = plt.barh(data['Keywords'], data['Frequency'], color=cm.viridis(0.2), alpha=0.7)
for bar in bars:
    plt.text(bar.get_width(), bar.get_y() + bar.get_height()/2,  # Positioning the text
             f'{int(bar.get_width())}',  # Display the count as an integer
             va='center')  # Center-align the text vertically
plt.title('Most Common Keywords')
plt.xlabel('Frequency')
plt.ylabel('Keywords')
plt.tight_layout()
```

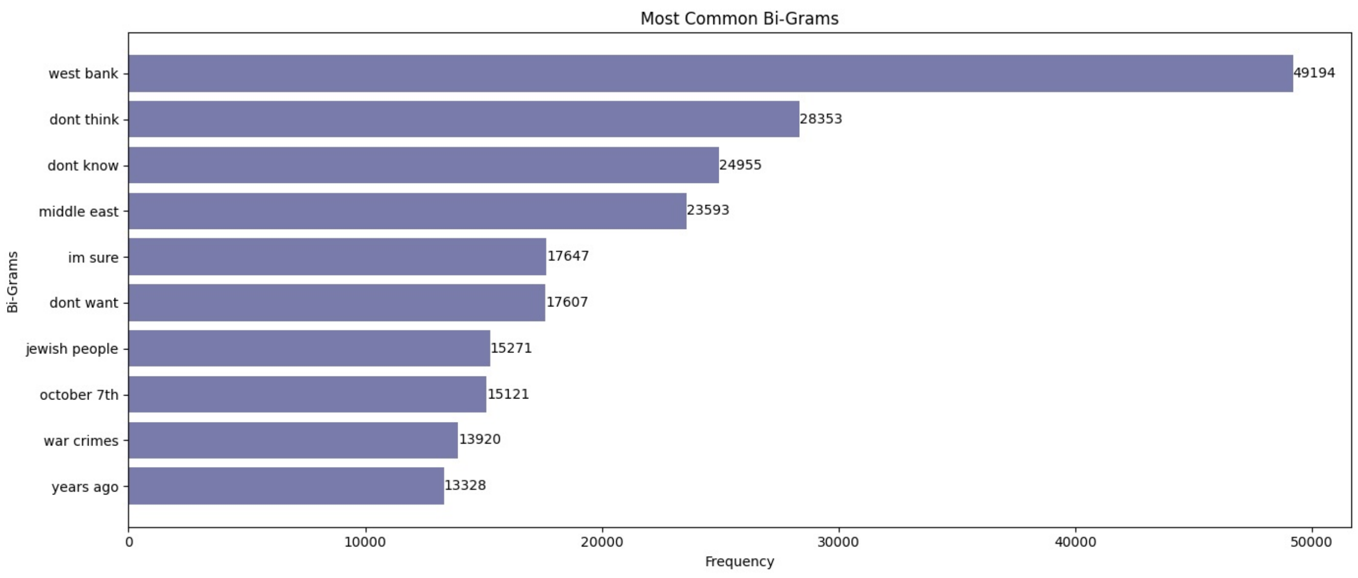


Count recurring word pairs (bi-grams)

In [30]:
```
n = 2
bi_grams = ngrams(filtered_words, n)
bi_gram_counts = Counter(bi_grams)

# Display the most common bi-grams
most_common_bi_grams = bi_gram_counts.most_common(10)

most_common_bi_grams
```

Out[30]:
```
[(('west', 'bank'), 49194),
 (('dont', 'think'), 28353),
 (('dont', 'know'), 24955),
 (('middle', 'east'), 23593),
 (('im', 'sure'), 17647),
 (('dont', 'want'), 17607),
 (('jewish', 'people'), 15271),
 (('october', '7th'), 15121),
 (('war', 'crimes'), 13920),
 (('years', 'ago'), 13328)]
```

In [31]:
```
# Visualize the most common bi-grams
bi_grams_list = [' '.join(bi) for bi, _ in most_common_bi_grams]
bi_gram_counts = [count for _, count in most_common_bi_grams]

bi_gram_data = pd.DataFrame({'Bi-Grams': bi_grams_list, 'Frequency': bi_gram_counts})
bi_gram_data.sort_values(by='Frequency', ascending=True, inplace=True)
plt.figure(figsize=(14, 6))
bars = plt.barh(bi_gram_data['Bi-Grams'], bi_gram_data['Frequency'], color=cm.viridis(0.2), alpha=0.7)
for bar in bars:
    plt.text(bar.get_width(), bar.get_y() + bar.get_height() / 2,  # Positioning the text
             f'{int(bar.get_width())}',  # Display the count as an integer
             va='center')  # Center-align the text vertically
plt.title('Most Common Bi-Grams')
plt.xlabel('Frequency')
plt.ylabel('Bi-Grams')
plt.tight_layout()
plt.show()
```



5. Identify the most common emotions found in the comments

To analyze the sentiment of comments I will use the VADER lexicon, which is specifically designed for sentiment analysis in social media texts. That involves extracting the compound scores from the sentiment analysis, which quantifies the sentiment of each comment. If this compound score exceeds 0.05, we categorize the comment as expressing happiness, incrementing the corresponding count in our emotions dictionary. Conversely, if the compound score is below -0.05, we classify the comment as expressing sadness and increase the sadness count. Additionally, we check for specific emotional keywords in the text. If the word "angry" appears in a comment, we increase the count for anger. Similarly, we look for the presence of the words "surprise" and "fear," updating their respective counts whenever they are mentioned.

In [32]:
```
# Download VADER lexicon if not already done
nltk.download('vader_lexicon')

# Initialize the VADER sentiment analyzer
sia = SentimentIntensityAnalyzer()

all_comments = verified_users_data['self_text'].tolist()

# Initialize a dictionary to count emotions
emotions = {'Happy': 0, 'Angry': 0, 'Surprise': 0, 'Sad': 0, 'Fear': 0}

# Analyze emotions in each comment
for comment in all_comments:
    score = sia.polarity_scores(comment)
    if score['compound'] > 0.05:
        emotions['Happy'] += 1
    elif score['compound'] < -0.05:
        emotions['Sad'] += 1
    if 'angry' in comment.lower():
        emotions['Angry'] += 1
    if 'surprise' in comment.lower():
        emotions['Surprise'] += 1
    if 'fear' in comment.lower():
        emotions['Fear'] += 1

# Convert the emotions dictionary to a DataFrame for easier visualization
emotion_df = pd.DataFrame(emotions.items(), columns=['Emotion', 'Count'])

emotion_df
```

```
[nltk_data] Downloading package vader_lexicon to
[nltk_data]     C:\Users\Bassa\AppData\Roaming\nltk_data...
[nltk_data]   Package vader_lexicon is already up-to-date!
```

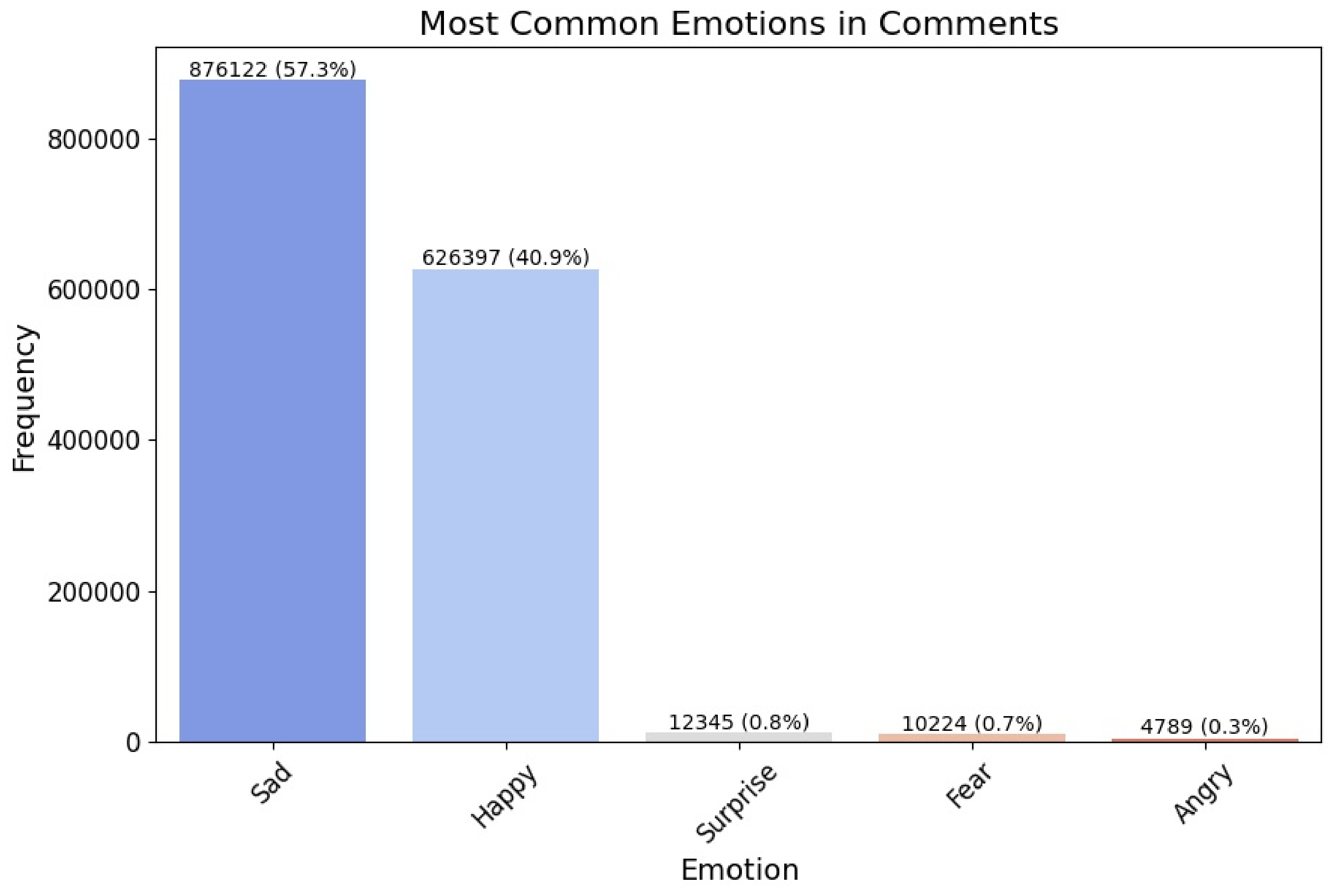
Out[32]:

	Emotion	Count
0	Happy	626397
1	Angry	4789
2	Surprise	12345
3	Sad	876122
4	Fear	10224

In [33]:
```
# Visualize the most common emotions as a column chart
```

```
plt.figure(figsize=(10, 6))

# Sort the data to make the plot more readable
emotion_df_sorted = emotion_df.sort_values(by='Count', ascending=False)

# Create the column chart
sns.barplot(x='Emotion', y='Count', data=emotion_df_sorted, palette='coolwarm')

# Add the count and percentage on top of each bar
for index, value in enumerate(emotion_df_sorted['Count']):
    percentage = (value / emotion_df_sorted['Count'].sum()) * 100
    plt.text(index, value, f'{value} ({percentage:.1f}%)', va='bottom', ha='center', fontsize=10, color='black'

# Add titles and labels
plt.title('Most Common Emotions in Comments', fontsize=16)
plt.xlabel('Emotion', fontsize=14)
plt.ylabel('Frequency', fontsize=14)
plt.xticks(rotation=45, fontsize=12)
plt.yticks(fontsize=12)
plt.show()
```

```
C:\Users\Bassa\AppData\Local\Temp\ipykernel_16096\693483471.py:8: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable
to `hue` and set `legend=False` for the same effect.

  sns.barplot(x='Emotion', y='Count', data=emotion_df_sorted, palette='coolwarm')
```



6. Analyze the most popular hours and months

Hours Distribution

In [34]:
```
# Convert timestamp to datetime
verified_users_data['created_time'] = pd.to_datetime(verified_users_data['created_time'])

# Extract hour from the timestamp
verified_users_data['hour'] = verified_users_data['created_time'].dt.hour

# Group by hour and count the number of comments
hourly_counts = verified_users_data.groupby('hour')['self_text'].count()

hourly_counts
```

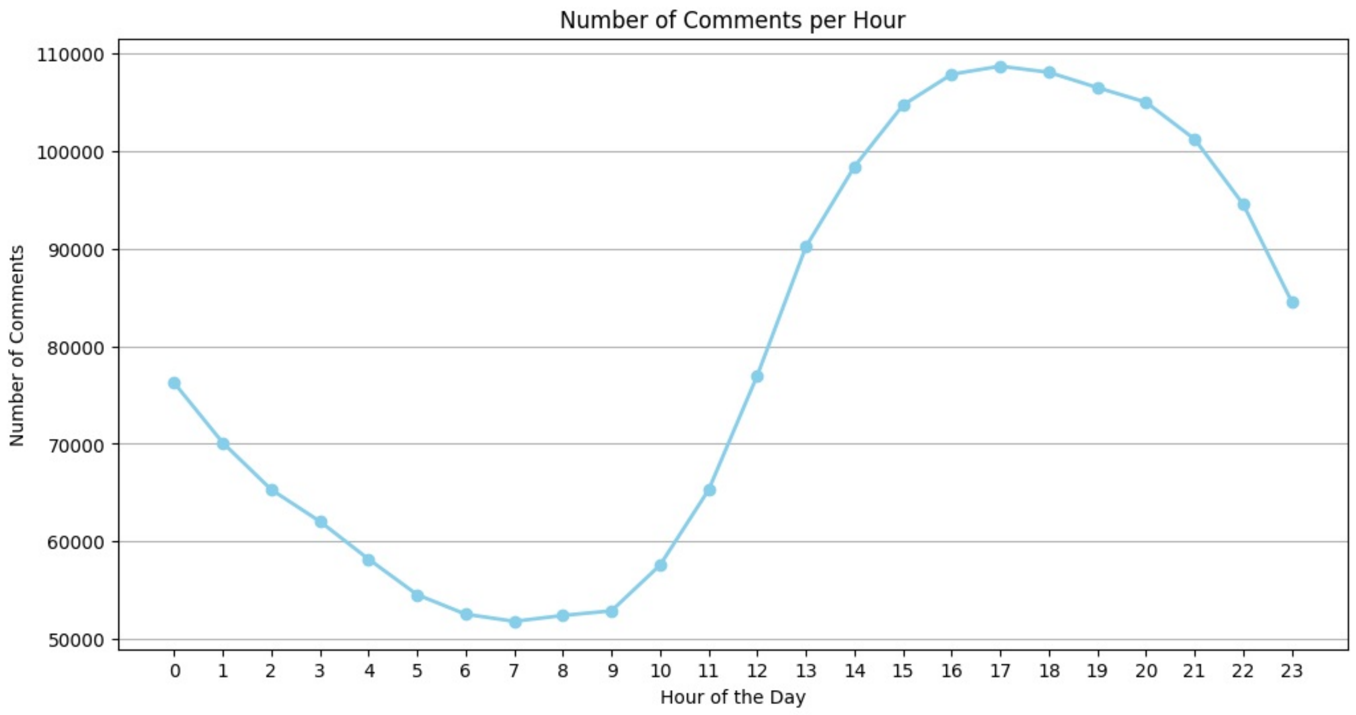
```
C:\Users\Bassa\AppData\Local\Temp\ipykernel_16096\4279964057.py:2: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retu
rning-a-view-versus-a-copy
  verified_users_data['created_time'] = pd.to_datetime(verified_users_data['created_time'])
C:\Users\Bassa\AppData\Local\Temp\ipykernel_16096\4279964057.py:5: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retu
rning-a-view-versus-a-copy
  verified_users_data['hour'] = verified_users_data['created_time'].dt.hour
```

Out[34]:

```
hour
0      76263
1      70129
2      65318
3      62068
4      58209
5      54568
6      52563
7      51834
8      52432
9      52913
10     57591
11     65311
12     77005
13     90180
14     98395
15    104696
16    107848
17    108673
18    108046
19    106479
20    104979
21    101194
22     94514
23     84525
Name: self_text, dtype: int64
```

In [35]:

```
# Plot the number of comments per hour
plt.figure(figsize=(12, 6))
hourly_counts.plot(kind='line', marker='o', color='skyblue', linewidth=2)  # Add markers for better visibility
plt.title('Number of Comments per Hour')
plt.xlabel('Hour of the Day')
plt.ylabel('Number of Comments')
plt.xticks(rotation=0)
plt.grid(axis='y')
plt.xticks(range(24))
plt.show()
```



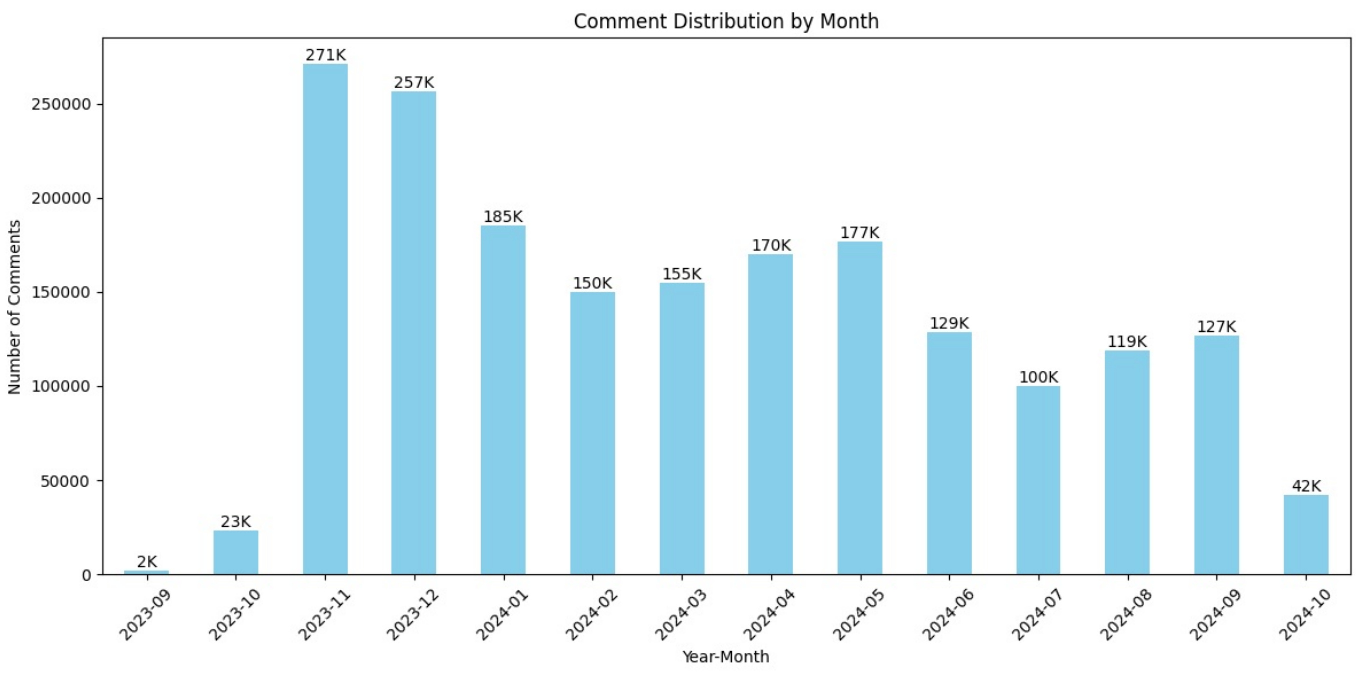
Distribution by Month

In [36]:
```
# Convert timestamp to datetime
verified_users_data['created_time'] = pd.to_datetime(verified_users_data['created_time'])

# Extract months and years from the timestamp
verified_users_data['year_month'] = verified_users_data['created_time'].dt.to_period('M')

# Group by year and month and count the number of comments
monthly_counts = verified_users_data.groupby('year_month')['self_text'].count()

monthly_counts
```

```
C:\Users\Bassa\AppData\Local\Temp\ipykernel_16096\1366251079.py:2: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retu
rning-a-view-versus-a-copy
  verified_users_data['created_time'] = pd.to_datetime(verified_users_data['created_time'])
C:\Users\Bassa\AppData\Local\Temp\ipykernel_16096\1366251079.py:5: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retu
rning-a-view-versus-a-copy
  verified_users_data['year_month'] = verified_users_data['created_time'].dt.to_period('M')
```

Out[36]:
```
year_month
2023-09      1814
2023-10     23490
2023-11    271401
2023-12    256781
2024-01    185049
2024-02    149717
2024-03    154664
2024-04    169958
2024-05    176574
2024-06    128657
2024-07    100011
2024-08    118665
2024-09    126816
2024-10     42136
Freq: M, Name: self_text, dtype: int64
```

In [37]:
```
# Plot the bar chart for comment distribution by month
plt.figure(figsize=(12, 6))
monthly_counts.plot(kind='bar', color='skyblue')

# Add titles and labels
plt.title('Comment Distribution by Month')
plt.xlabel('Year-Month')
plt.ylabel('Number of Comments')

# Format the x-axis to show all months
plt.xticks(rotation=45)
plt.xticks(ticks=range(len(monthly_counts)), labels=monthly_counts.index.astype(str), fontsize=10)

# Add numbers on the bars, approximated in thousands
for index, value in enumerate(monthly_counts):
    plt.text(index, value, f'{value/1000:.0f}K', ha='center', va='bottom', fontsize=10)

# Show the plot
plt.tight_layout()  # Adjust layout to avoid clipping
plt.show()
```



Monthly Distribution of Positive, Negative, and Neutral Comments

In [40]:
```python
# Define the function to assign sentiment based on the compound score
def assign_sentiment(score):
    if score >= 0.05:
        return 'positive'
    elif score <= -0.05:
        return 'negative'
    else:
        return 'neutral'

# Apply the function to create a 'sentiment' column
verified_users_data['sentiment'] = verified_users_data['compound_score'].apply(assign_sentiment)

verified_users_data['sentiment'] = verified_users_data['compound_score'].apply(assign_sentiment)
verified_users_data['year_month'] = verified_users_data['created_time'].dt.to_period('M')

# Group by year_month and sentiment, then count the occurrences
sentiment_counts = verified_users_data.groupby(['year_month', 'sentiment']).size().unstack(fill_value=0)

sentiment_counts
```

```
C:\Users\Bassa\AppData\Local\Temp\ipykernel_16096\1886256217.py:11: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retu
rning-a-view-versus-a-copy
  verified_users_data['sentiment'] = verified_users_data['compound_score'].apply(assign_sentiment)
C:\Users\Bassa\AppData\Local\Temp\ipykernel_16096\1886256217.py:13: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retu
rning-a-view-versus-a-copy
  verified_users_data['sentiment'] = verified_users_data['compound_score'].apply(assign_sentiment)
C:\Users\Bassa\AppData\Local\Temp\ipykernel_16096\1886256217.py:14: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retu
rning-a-view-versus-a-copy
  verified_users_data['year_month'] = verified_users_data['created_time'].dt.to_period('M')
```

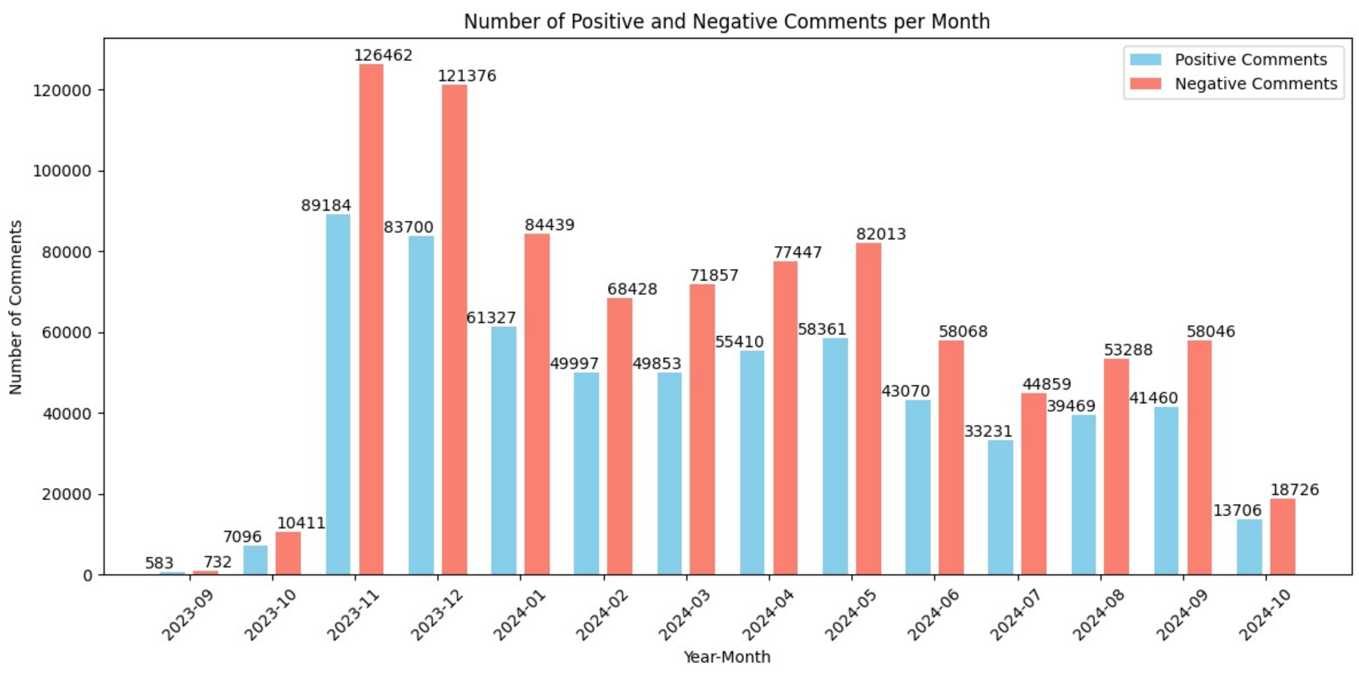
Out[40]:

sentiment	negative	neutral	positive
year_month			
2023-09	732	499	583
2023-10	10411	5983	7096
2023-11	126462	55755	89184
2023-12	121376	51705	83700
2024-01	84439	39283	61327
2024-02	68428	31292	49997
2024-03	71857	32954	49853
2024-04	77447	37101	55410
2024-05	82013	36200	58361
2024-06	58068	27519	43070
2024-07	44859	21921	33231
2024-08	53288	25908	39469
2024-09	58046	27310	41460
2024-10	18726	9704	13706

Positive and Negative comments by month Chart

In [41]:

```python
positive_comments_counts = sentiment_counts['positive']
negative_comments_counts = sentiment_counts['negative']

# Set up the figure and the bar width
plt.figure(figsize=(12, 6))
bar_width = 0.3
x = np.arange(len(positive_comments_counts))

# Create bars for positive and negative comments with increased spacing
plt.bar(x - bar_width/3 - 0.10, positive_comments_counts, width=bar_width, label='Positive Comments', color='sky
plt.bar(x + bar_width/3 + 0.10, negative_comments_counts, width=bar_width, label='Negative Comments', color='sa

# Add titles and labels
plt.title('Number of Positive and Negative Comments per Month')
plt.xlabel('Year-Month')
plt.ylabel('Number of Comments')
plt.xticks(ticks=x, labels=positive_comments_counts.index.astype(str), rotation=45)

# Add a legend
plt.legend()

# Add numbers on the bars, adjusted for better spacing
for index, value in enumerate(positive_comments_counts):
    plt.text(index - bar_width/1 - 0.05, value, str(value), ha='center', va='bottom', fontsize=10)

for index, value in enumerate(negative_comments_counts):
    plt.text(index + bar_width/1 + 0.05, value, str(value), ha='center', va='bottom', fontsize=10)

plt.tight_layout()
plt.show()
```



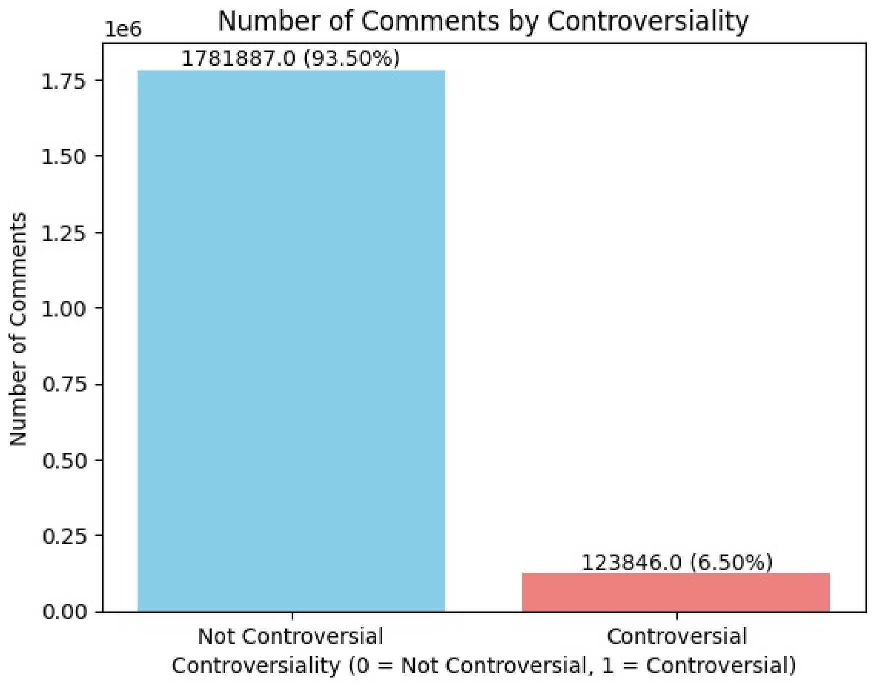
7. Analyzing Controversial Comments

In [47]:
```
Controversial_comment_counts = verified_users_data['controversiality'].value_counts().reset_index()
Controversial_comment_counts.columns = ['controversiality', 'Number of Comments']

# Calculate the percentages
total_comments = Controversial_comment_counts['Number of Comments'].sum()
Controversial_comment_counts['Percentage'] = (Controversial_comment_counts['Number of Comments'] / total_commen

Controversial_comment_counts
```

Out[47]:

	controversiality	Number of Comments	Percentage
0	0	1781887	93.501398
1	1	123846	6.498602

In [48]:
```
# Create a bar plot for the number of comments by controversiality
plt.bar(
    Controversial_comment_counts['controversiality'].astype(str),
    Controversial_comment_counts['Number of Comments'],
    color=['skyblue', 'lightcoral'])
plt.title('Number of Comments by Controversiality')
plt.xlabel('Controversiality (0 = Not Controversial, 1 = Controversial)')
plt.ylabel('Number of Comments')
plt.xticks([0, 1], ['Not Controversial', 'Controversial'], rotation=0)

# Annotate bars with the count and percentage
for index, row in Controversial_comment_counts.iterrows():
    plt.text(
        index,
        row['Number of Comments'],
        f"{row['Number of Comments']} ({row['Percentage']:.2f}%)",
        ha='center',
        va='bottom'
    )

# Display the plot
plt.show()
```



> **"This project was entirely developed by** Bassam El-Shoraa**"**.

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