2023 G20 New Delhi Summit World Leaders Declaration Analysis

G20

भारत 2023 INDIA

वसुधैव कुटुम्बकम्

ONE EARTH • ONE FAMILY • ONE FUTURE

G20 New Delhi Leaders' Declaration

New Delhi, India, 9-10 September 2023

In [1]:

```python
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import plotly.express as px
import plotly.graph_objects as go
```

In [2]:

```python
import warnings
warnings.filterwarnings('ignore')
```

In [3]:

```python
df = pd.read_csv("g20.csv")
```

In [4]:

```python
df.head()
```

Out[4]:

	Topic	Text
0	Global health systems strengthening	Focus on strengthening primary health care, he...
1	One Health approach	Promote One Health approach driven by Quadripa...
2	Climate change and health	Enhance resilience of health systems and suppo...
3	Antimicrobial resistance	Implement and prioritise tackling Antimicrobia...
4	Access to medical products	Facilitate equitable access to safe, effective...

In [5]:

```python
df.tail()
```

Out[5]:

	Topic	Text
54	International Taxation	We reaffirm our commitment to ... continue coo...
55	Gender Equality and Empowering All Women and G...	The G20 reaffirms that gender equality is of f...
56	Financial Sector Issues	We continue to strongly support the work of th...
57	Countering Terrorism and Money laundering	We ... condemn terrorism in all its forms and ...
58	Creating a More Inclusive World	We welcome the African Union as a permanent me...

In [6]:

```
df.shape
```

Out[6]:

```
(59, 2)
```

In [7]:

```
df.columns
```

Out[7]:

```
Index(['Topic', 'Text'], dtype='object')
```

In [8]:

```
df.duplicated().sum()
```

Out[8]:

```
0
```

In [9]:

```
df.isnull().sum()
```

Out[9]:

```
Topic    0
Text     0
dtype: int64
```

In [10]:

```
df.nunique()
```

Out[10]:

```
Topic    54
Text     59
dtype: int64
```

In [11]:

```
df
```

```
Out[11]:
```

	Topic	Text
0	Global health systems strengthening	Focus on strengthening primary health care, he...
1	One Health approach	Promote One Health approach driven by Quadripa...
2	Climate change and health	Enhance resilience of health systems and suppo...
3	Antimicrobial resistance	Implement and prioritise tackling Antimicrobia...
4	Access to medical products	Facilitate equitable access to safe, effective...
5	Pandemic preparedness and response	Look forward to successful outcome of negotiat...
6	Traditional and complementary medicine	Recognize potential role of evidence-based Tra...
7	Medical countermeasures	Support ... WHO-led ... process for interim me...
8	Mental health	Promote and improve access to mental health se...
9	Counter-narcotics cooperation	Call for strong international counter-narcotic...
10	Finance-health collaboration	Finance-Health ... Collaboration
11	Joint Finance-Health Task Force	Welcome participation of key ... regional orga...
12	Economic vulnerabilities framework	Discussion on Framework for Economic Vulnerabi...
13	Economic vulnerabilities assessment	Call on Task Force to continue refining Framew...
14	Institutional arrangements	Welcome Report on Best ... Practices from Fina...
15	Pandemic response financing	Welcome Report on Mapping Pandemic Response Fi...
16	Financing mechanisms	Look forward to further deliberations on optim...
17	Pandemic Fund	Welcome conclusion of first Pandemic Fund call...
18	Donor coordination	Highlight importance of securing new donors an...
19	undefined	Ask Task Force to report back to Ministers in ...
20	National climate action	Strengthening implementation of Paris Agreemen...
21	National climate action plans	National climate plans/NDCs and increasing amb...
22	Assessing climate risks and transition impacts	Assessing macroeconomic risks from climate cha...
23	Circular economy and waste management	Role of circular economy, resource efficiency ...
24	Accelerating energy transitions	Accelerating clean, sustainable, just and incl...
25	Ensuring energy security and stability	Importance of maintaining energy security and ...
26	Supporting developing countries' energy access	Supporting developing countries in their energ...
27	Developing hydrogen markets	Developing hydrogen and related markets from l...
28	Facilitating financing for clean energy	Facilitating access to low-cost financing for ...
29	Increasing renewable energy goals	Increasing renewable energy capacity and ambit...

	Topic	Text
30	Advancing clean energy innovation	Advancing clean energy technology cooperation ...
31	Improving energy efficiency	Doubling the rate of energy efficiency improve...
32	Role of biofuels in development	Role of sustainable biofuels in low-carbon dev...
33	Ensuring minerals supply chains	Ensuring reliable and responsible critical min...
34	Collaboration on nuclear energy	Collaboration on civil nuclear technologies an...
35	Grid integration and cooperation	Role of grid integration and regional power sy...
36	Phasing out fossil fuel subsidies	Phasing out inefficient fossil fuel subsidies ...
37	Scaling up clean power and efficiency	Rapidly scaling up clean power and pursuing en...
38	Harnessing and Preserving the Ocean-based Economy	Welcome the Chennai High-Level Principles for ...
39	Harnessing and Preserving the Ocean-based Economy	Note the adoption of the new international leg...
40	Harnessing and Preserving the Ocean-based Economy	Support the Commission for the Conservation of...
41	Harnessing and Preserving the Ocean-based Economy	Reiterate our commitment to ending illegal, un...
42	Harnessing and Preserving the Ocean-based Economy	Support the role of Ocean 20 Dialogue in makin...
43	Ending Plastic Pollution	Welcome the resolution UNEP/EA.5/Res.14 which ...
44	Reducing Disaster Risk and Building Resilient ...	Urge for accelerating progress on Early Warnin...
45	Reducing Disaster Risk and Building Resilient ...	Promote mutual learning of recovery experience...
46	Delivering on Climate and Sustainable Finance	We welcome the Sustainable Finance Working Gro...
47	debt treatments	We welcome joint efforts by all stakeholders, ...
48	Building Digital Public Infrastructure	Safe, secure, trusted, accountable and inclusi...
49	Building Safety, Security, Resilience and Trus...	An enabling, inclusive, open, fair, non-discri...
50	Crypto-assets: Policy and Regulation	We continue to closely monitor the risks of th...
51	Central Bank Digital ... Currency	We welcome discussions on the potential macro-...
52	Fostering Digital Ecosystems	We resolve to deploy all available digital too...
53	Harnessing Artificial Intelligence (AI) Respon...	The rapid progress of AI promises prosperity a...
54	International Taxation	We reaffirm our commitment to ... continue coo...
55	Gender Equality and Empowering All Women and G...	The G20 reaffirms that gender equality is of f...
56	Financial Sector Issues	We continue to strongly support the work of th...
57	Countering Terrorism and Money laundering	We ... condemn terrorism in all its forms and ...
58	Creating a More Inclusive World	We welcome the African Union as a permanent me...

In [12]:

```python
import string
from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize
from nltk.stem import WordNetLemmatizer
```

In [13]:

```python
lemmatizer = WordNetLemmatizer()
```

In [14]:

```python
def clean_text(text):
    text = text.lower()
    text = ''.join([char for char in text if char not in string.punctuation])
    tokens = word_tokenize(text)
    tokens = [lemmatizer.lemmatize(word) for word in tokens if word not in stopwords.wor
    cleaned_text = ' '.join(tokens)
    return cleaned_text
```

In [15]:

```python
df['Cleaned_Text'] = df['Text'].apply(clean_text)
```

In [16]:

```python
df
```

Out[16]:

	Topic	Text	Cleaned_Text
0	Global health systems strengthening	Focus on strengthening primary health care, he...	focus strengthening primary health care health...
1	One Health approach	Promote One Health approach driven by Quadripa...	promote one health approach driven quadriparti...
2	Climate change and health	Enhance resilience of health systems and suppo...	enhance resilience health system support devel...
3	Antimicrobial resistance	Implement and prioritise tackling Antimicrobia...	implement prioritise tackling antimicrobial re...
4	Access to medical products	Facilitate equitable access to safe, effective...	facilitate equitable access safe effective qua...
5	Pandemic preparedness and response	Look forward to successful outcome of negotiat...	look forward successful outcome negotiation co...
6	Traditional and	Recognize potential role of	recognize potential role

In [17]:

```python
from textblob import TextBlob
```

In [18]:

```python
def calculate_sentiment(text):
    analysis = TextBlob(text)
    sentiment_score = analysis.sentiment.polarity
    return sentiment_score
```

In [19]:

```python
df['Sentiment_Score'] = df['Cleaned_Text'].apply(calculate_sentiment)
```

In [20]:

```python
df
```

|				
37	Scaling up clean power and efficiency	Rapidly scaling up clean power and pursuing en...	rapidly scaling clean power pursuing energy ef...	0.366667
38	Harnessing and Preserving the Ocean-based Economy	Welcome the Chennai High-Level Principles for ...	welcome chennai highlevel principle sustainabl...	0.800000
39	Harnessing and Preserving the Ocean-based Economy	Note the adoption of the new international leg...	note adoption new international legally bindin...	0.109091
40	Harnessing and Preserving the Ocean-based Economy	Support the Commission for the Conservation of...	support commission conservation antarctic mari...	0.700000
41	Harnessing and Preserving the Ocean-based Economy	Reiterate our commitment to ending illegal, un...	reiterate commitment ending illegal unreported...	-0.366667
42	Harnessing and Preserving the Ocean-based Economy	Support the role of Ocean 20 Dialogue in makin...	support role ocean 20 dialogue making progress...	0.000000

```python
plt.hist(df['Sentiment_Score'], bins=20, alpha=0.7, color='b', edgecolor='black')
plt.xlabel('Sentiment Score')
plt.ylabel('Frequency')
plt.title('Distribution of Sentiment Scores')
plt.show()
```


Distribution of Sentiment Scores
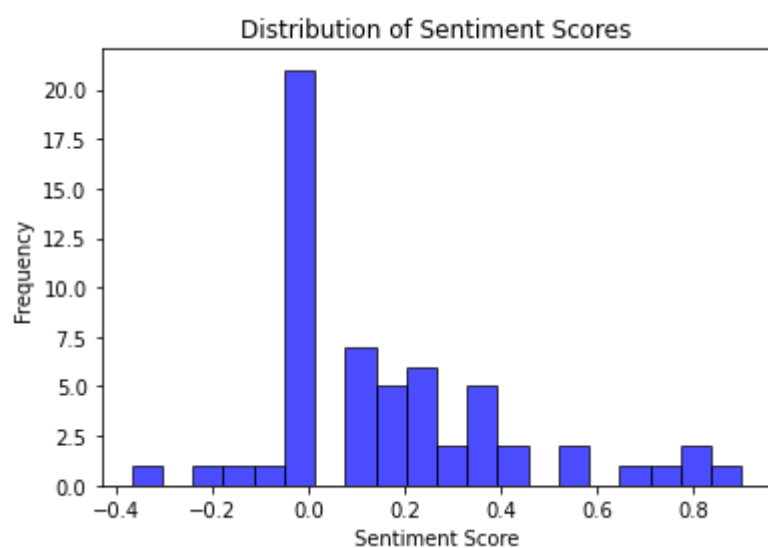
```python
fig = px.histogram(df, x='Sentiment_Score', nbins=20, opacity=0.7, color_discrete_sequen
fig.update_layout(
    xaxis_title='Sentiment Score',
    yaxis_title='Frequency',
    title='Distribution of Sentiment Scores'
)
fig.show()
```

Distribution of Sentiment Scores
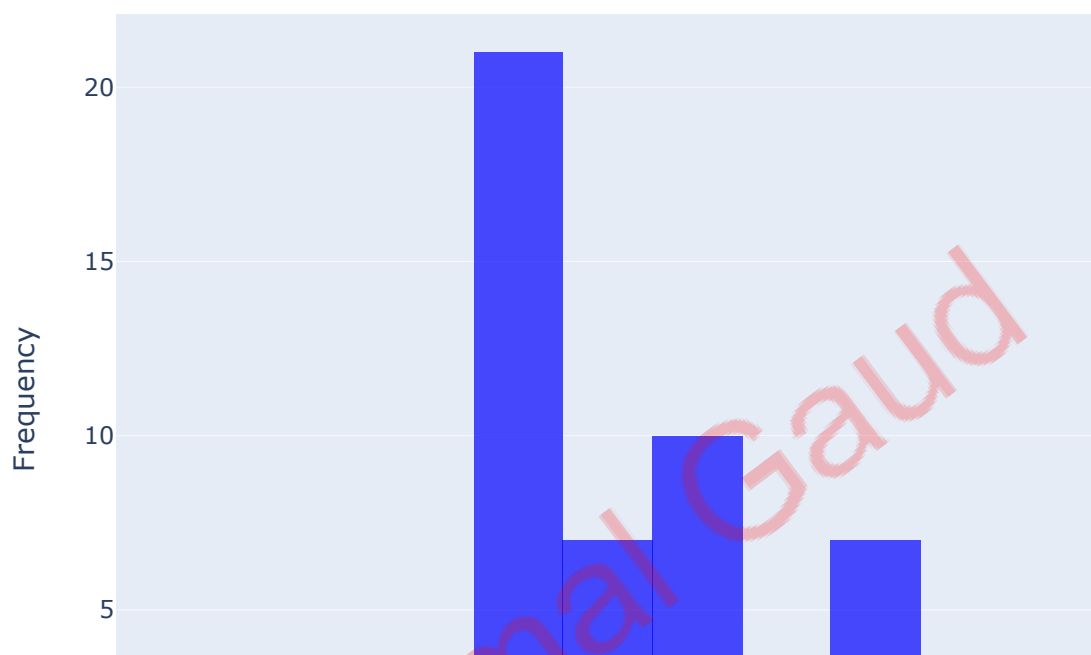
```python
positive_threshold = 0.2
negative_threshold = -0.2
```

```python
def classify_sentiment(score):
    if score > positive_threshold:
        return 'Positive'
    elif score < negative_threshold:
        return 'Negative'
    else:
        return 'Neutral'
```

```python
df['Sentiment'] = df['Sentiment_Score'].apply(classify_sentiment)
```

```python
df
```

33	Ensuring minerals supply chains	Ensuring reliable and responsible critical min...	ensuring reliable responsible critical mineral...	0.100000	Neutral
34	Collaboration on nuclear energy	Collaboration on civil nuclear technologies an...	collaboration civil nuclear technology decommi...	0.000000	Neutral
35	Grid integration and cooperation	Role of grid integration and regional power sy...	role grid integration regional power system co...	0.000000	Neutral
36	Phasing out fossil fuel subsidies	Phasing out inefficient fossil fuel subsidies ...	phasing inefficient fossil fuel subsidy medium...	0.000000	Neutral
37	Scaling up clean power and efficiency	Rapidly scaling up clean power and pursuing en...	rapidly scaling clean power pursuing energy ef...	0.366667	Positive
38	Harnessing and Preserving the Ocean-based Economy	Welcome the Chennai High-Level Principles for ...	welcome chennai highlevel principle sustainabl...	0.800000	Positive

```python
df['Sentiment'].unique()
```

```
array(['Neutral', 'Positive', 'Negative'], dtype=object)
```

```python
df['Sentiment'].value_counts()
```
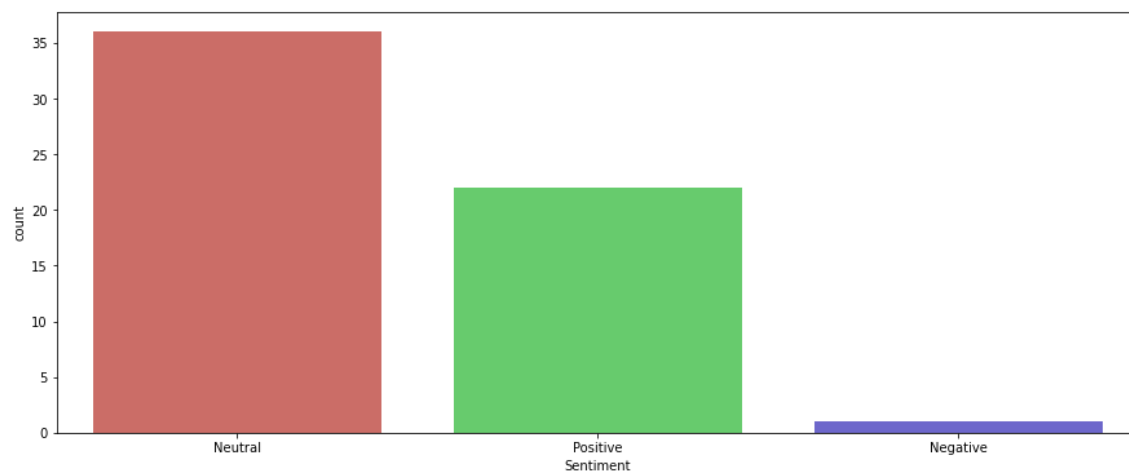
```
Neutral     36
Positive    22
Negative     1
Name: Sentiment, dtype: int64
```
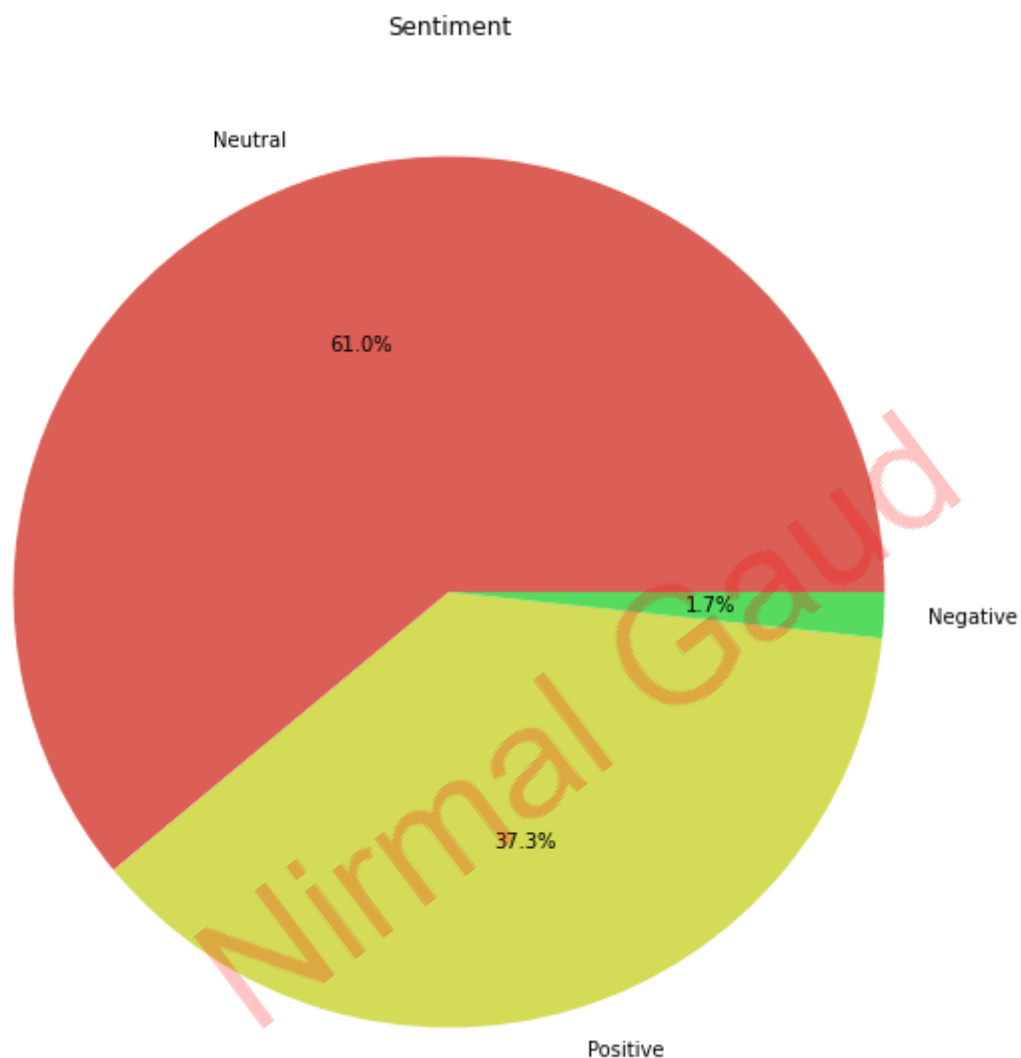
```
plt.figure(figsize=(15,6))
sns.countplot(df['Sentiment'], data = df, palette = 'hls')
plt.show()
```
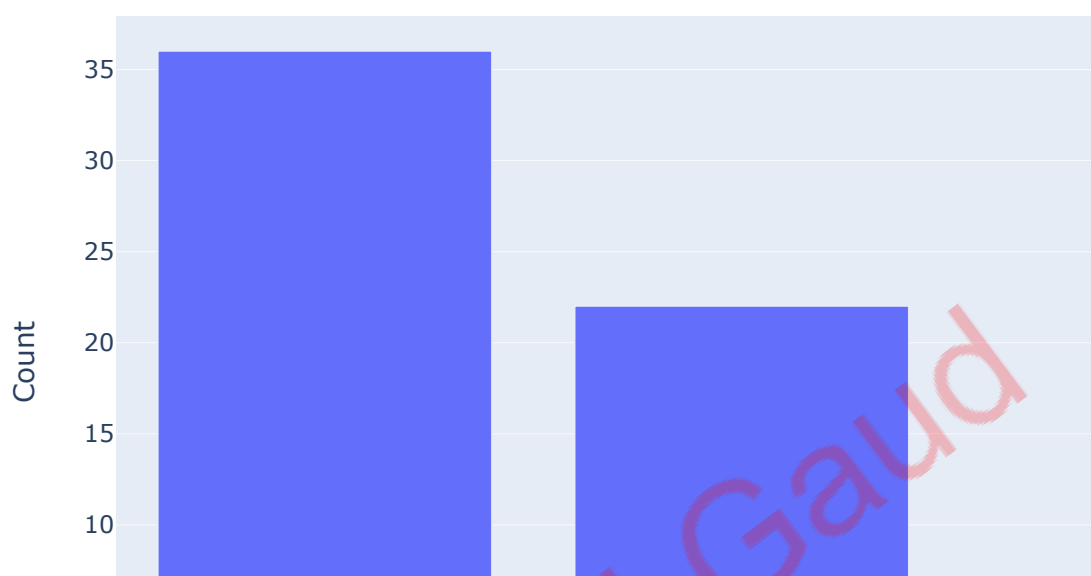
```python
plt.figure(figsize=(10, 10))
counts = df['Sentiment'].value_counts()
plt.pie(counts, labels=counts.index, autopct='%1.1f%%',
        colors=sns.color_palette('hls'))
plt.title('Sentiment')
plt.show()
```

Sentiment

```
fig = go.Figure(data=[go.Bar(x=df['Sentiment'].value_counts().index, y=df['Sentiment'].v
fig.update_layout(title='Sentiment',xaxis_title="Sentiment",yaxis_title="Count")
fig.show()
```
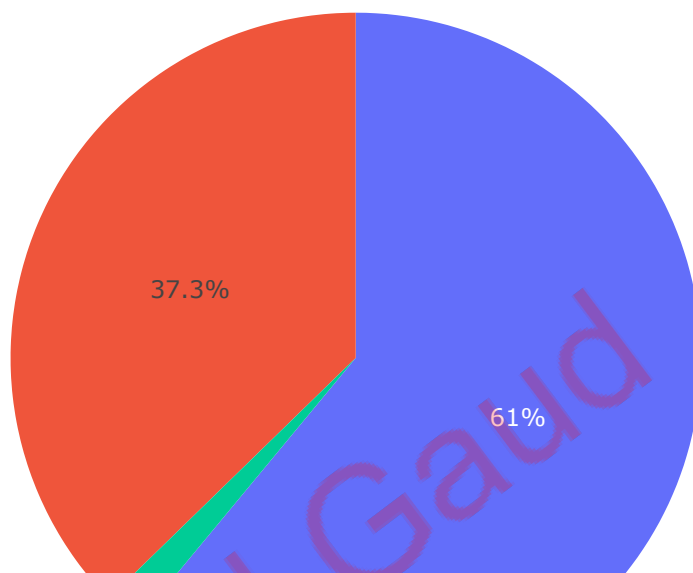
Sentiment

```python
counts = df['Sentiment'].value_counts()
fig = go.Figure(data=[go.Pie(labels=counts.index, values=counts)])
fig.update_layout(title='Sentiment')
fig.show()
```
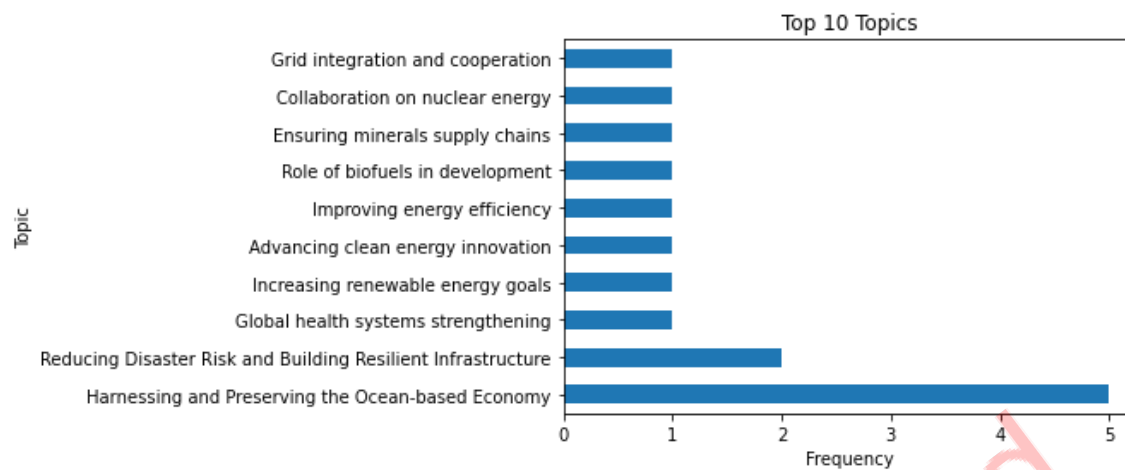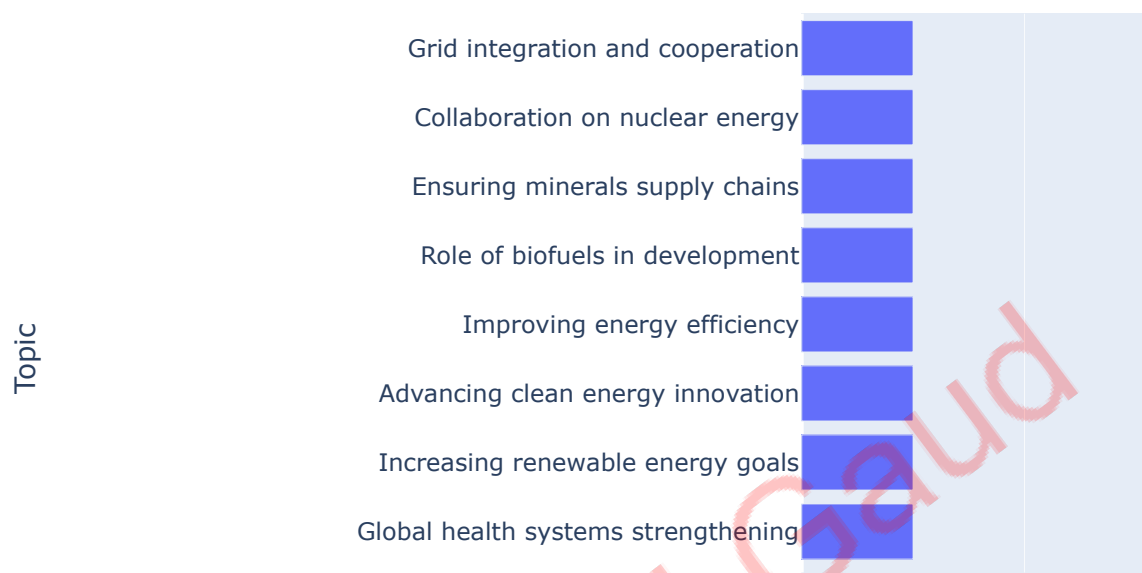
Sentiment

```python
top_topics = df['Topic'].value_counts().head(10)
top_topics.plot(kind='barh')
plt.xlabel('Frequency')
plt.ylabel('Topic')
plt.title('Top 10 Topics')
plt.show()
```

```
fig = px.bar(top_topics, orientation='h', labels={'index': 'Topic', 'value': 'Frequency'
fig.update_layout(xaxis_title='Frequency', yaxis_title='Topic')
fig.show()
```

Top 10 Topics

```python
df['Text_Length'] = df['Cleaned_Text'].apply(len)
sns.histplot(df['Text_Length'], bins=20, kde=True)
plt.xlabel('Text Length')
plt.ylabel('Frequency')
plt.title('Distribution of Text Length')
plt.show()
```


Distribution of Text Length
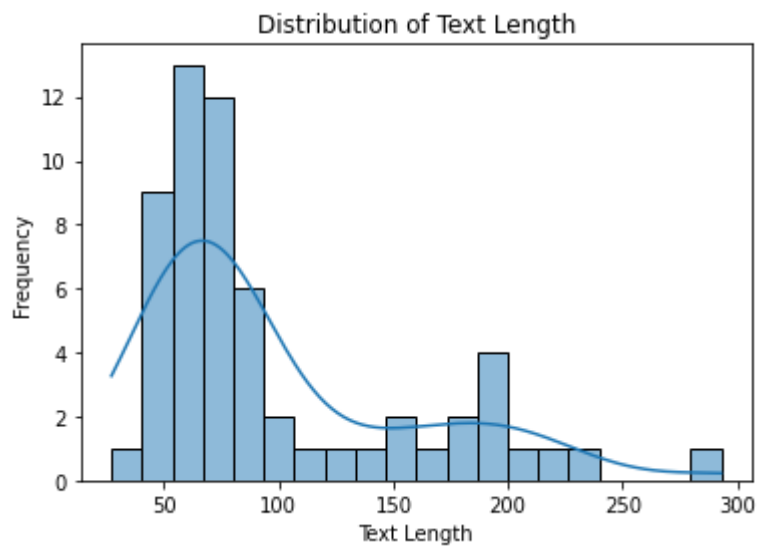
```python
fig = px.histogram(df, x='Text_Length', nbins=20, title='Distribution of Text Length')
fig.update_layout(xaxis_title='Text Length', yaxis_title='Frequency')
fig.show()
```

Distribution of Text Length
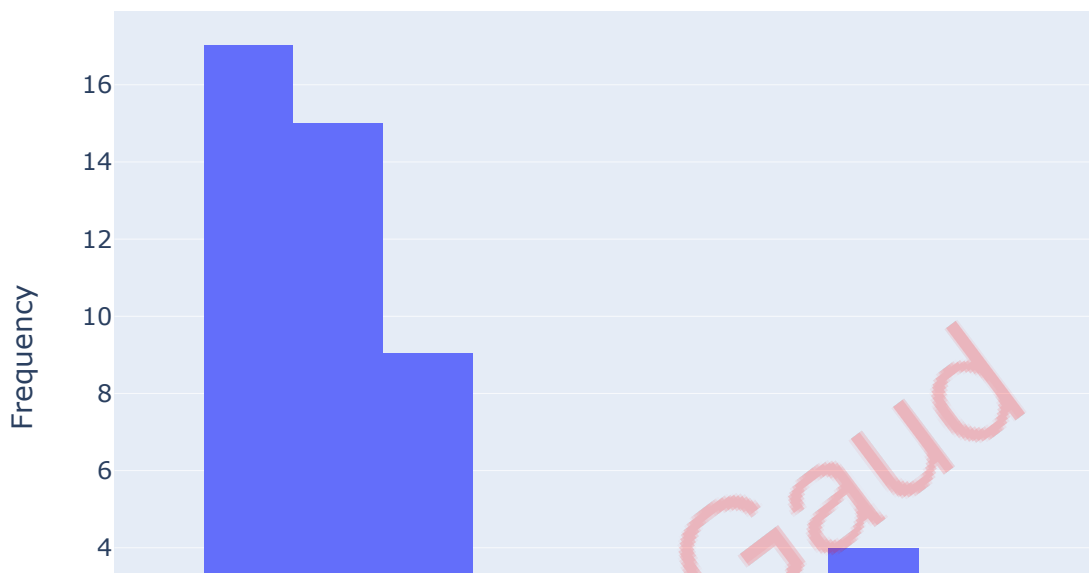
```python
plt.figure(figsize=(15,6))
sns.barplot(data=df, x='Topic', y='Sentiment_Score', ci = None)
plt.xticks(rotation=90)
plt.xlabel('Topic')
plt.ylabel('Sentiment Score')
plt.title('Sentiment Score by Topic')
plt.show()
```


Sentiment Score by Topic
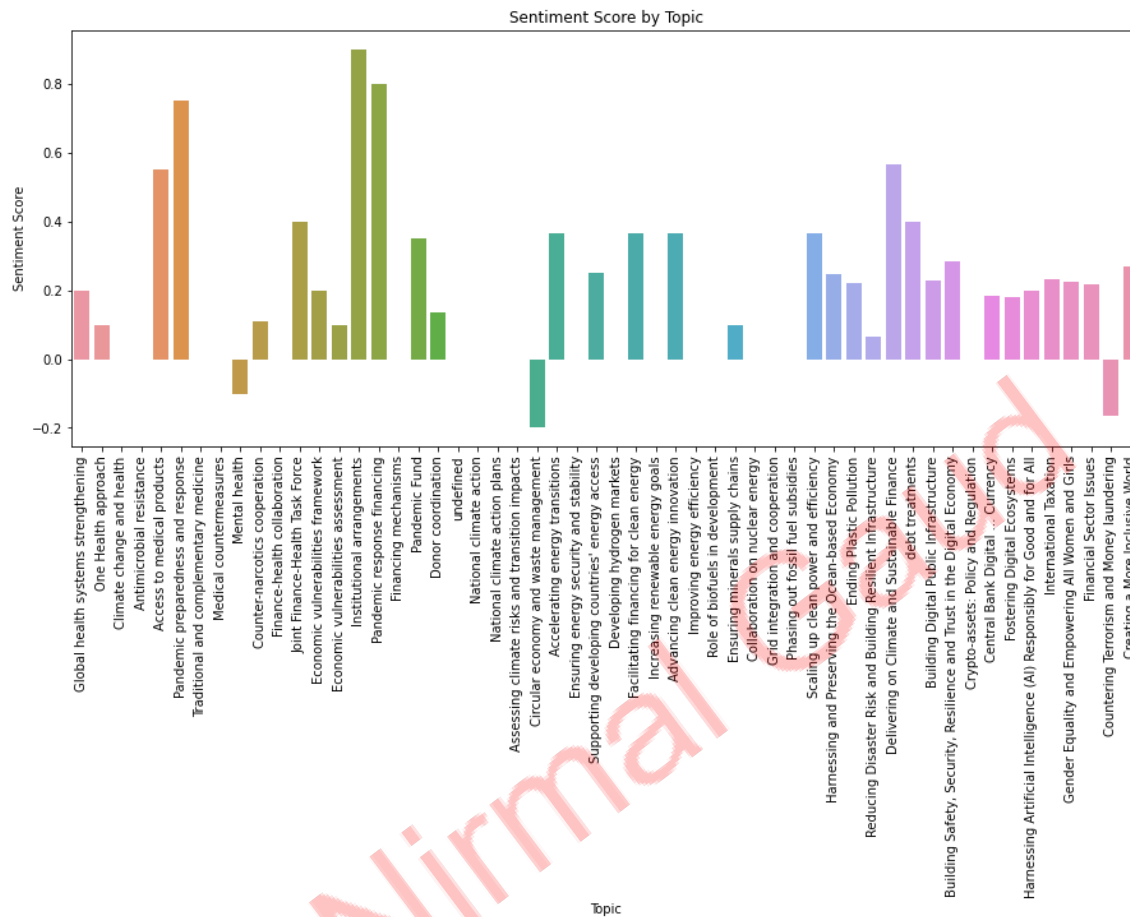
In [38]:

```python
fig = px.bar(df, x='Topic', y='Sentiment_Score', title='Sentiment Score by Topic')
fig.update_layout(
    xaxis_title='Topic',
    yaxis_title='Sentiment Score',
    width=800,
    height=1000
)
fig.update_xaxes(tickangle=90)
fig.show()
```

Sentiment Score by Topic

Sentiment Score (y-axis)

Topic (x-axis):
- Global health systems strengthening
- Climate change and health
- Access to medical products
- Traditional and complementary medicine
- Mental health
- Finance-health collaboration
- Economic vulnerabilities framework
- Institutional arrangements
- Financing mechanisms
- Donor coordination
- National climate action
- Assessing climate risks and transition impacts
- Accelerating energy transitions
- Supporting developing countries' energy access
- Facilitating financing for clean energy
- Advancing clean energy innovation
- Role of biofuels in development
- Collaboration on nuclear energy
- Phasing out fossil fuel subsidies
- Harnessing and Preserving the Ocean-based Economy
- Reducing Disaster Risk and Building Resilient Infrastructure

In [39]:

```python
from nltk import FreqDist, word_tokenize
```

In [40]:

```python
words = word_tokenize(' '.join(df['Cleaned_Text']))
word_freq = FreqDist(words)
most_common_words = word_freq.most_common(20)
for word, freq in most_common_words:
    print(f"{word}: {freq}")
```

```
welcome: 10
health: 9
support: 8
international: 8
sustainable: 8
energy: 8
system: 7
digital: 6
development: 5
role: 5
call: 5
continue: 5
inclusive: 5
marine: 5
pandemic: 4
cooperation: 4
force: 4
framework: 4
financing: 4
progress: 4
```

```python
word_freq_pairs = [
    ('welcome', 10),
    ('health', 9),
    ('support', 8),
    ('international', 8),
    ('sustainable', 8),
    ('energy', 8),
    ('system', 7),
    ('digital', 6),
    ('development', 5),
    ('role', 5),
    ('call', 5),
    ('continue', 5),
    ('inclusive', 5),
    ('marine', 5),
    ('pandemic', 4),
    ('cooperation', 4),
    ('force', 4),
    ('framework', 4),
    ('financing', 4),
    ('progress', 4)
]
```

```python
words, frequencies = zip(*word_freq_pairs)
plt.figure(figsize=(12, 6))
plt.bar(words, frequencies)
plt.xlabel('Word')
plt.ylabel('Frequency')
plt.title('Top 20 Most Frequent Words')
plt.xticks(rotation=45, ha='right')
plt.tight_layout()
plt.show()
```
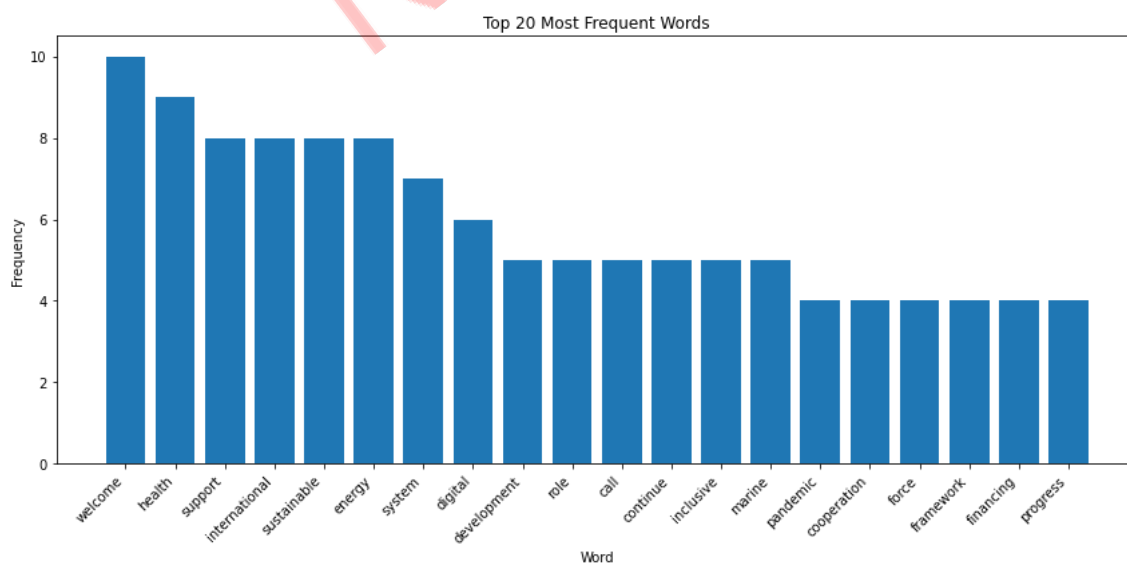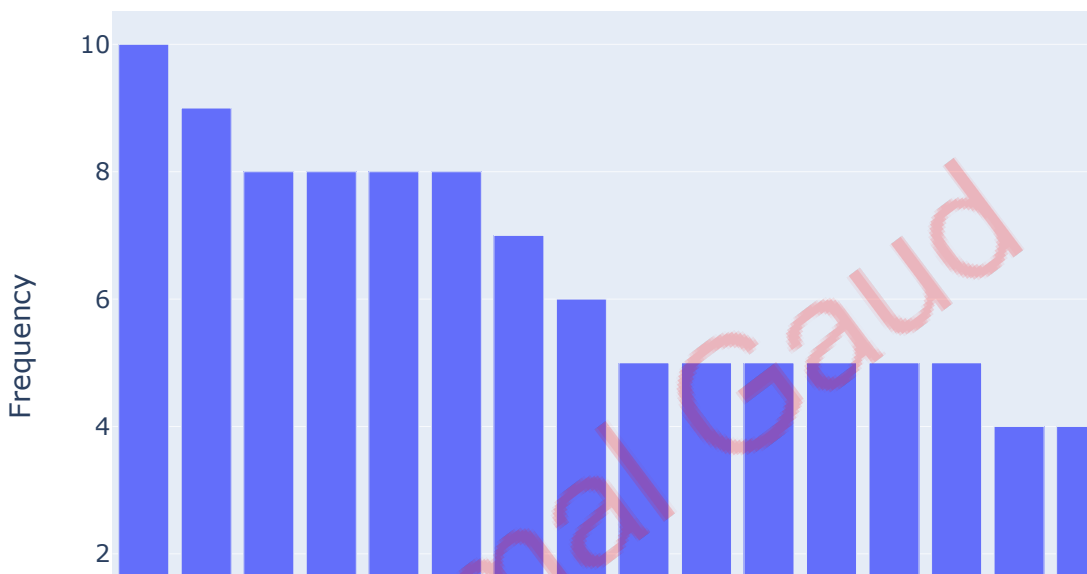
```python
df1 = pd.DataFrame(word_freq_pairs, columns=['Word', 'Frequency'])
```

```python
fig = px.bar(df1, x='Word', y='Frequency', title='Top 20 Most Frequent Words')
fig.update_xaxes(categoryorder='total descending')
fig.show()
```

Top 20 Most Frequent Words

```python
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.decomposition import LatentDirichletAllocation
```

```python
vectorizer = CountVectorizer(max_df=0.85, max_features=1000, stop_words='english')
X = vectorizer.fit_transform(df['Cleaned_Text'])
```

In [47]:

```
lda = LatentDirichletAllocation(n_components=5, random_state=42)
lda.fit(X)
```

Out[47]:

▾   LatentDirichletAllocation

LatentDirichletAllocation(n_components=5, random_state=42)

```python
from wordcloud import WordCloud
topics = lda.components_
for topic_idx, topic in enumerate(topics):
    top_words_idx = topic.argsort()[-10:][::-1]
    top_words = [vectorizer.get_feature_names_out()[i] for i in top_words_idx]
    wordcloud = WordCloud(width=800, height=400, background_color='white').generate(' '.
    plt.imshow(wordcloud, interpolation='bilinear')
    plt.axis('off')
    plt.title(f'Topic {topic_idx + 1}')
    plt.show()
```


Topic 1

Topic 2

Topic 3

Topic 4

implementation sustainable g20 energy tax clean transition international fair global

Topic 5

collaboration welcome task force ambition including international marine continue

```
df
```

Out[49]:

|	Topic	Text	Cleaned_Text	Sentiment_Score	Sentiment	Text_Length
0	Global health systems strengthening	Focus on strengthening primary health care, he...	focus strengthening primary health care health...	0.200000	Neutral	91
1	One Health approach	Promote One Health approach driven by Quadripa...	promote one health approach driven quadriparti...	0.100000	Neutral	76
2	Climate change and health	Enhance resilience of health systems and suppo...	enhance resilience health system support devel...	0.000000	Neutral	93
3	Antimicrobial resistance	Implement and prioritise tackling Antimicrobia...	implement prioritise tackling antimicrobial re...	0.000000	Neutral	84
	Access to	Facilitate equitable	facilitate equitable			

```python
selected_columns = ['Sentiment_Score', 'Text_Length']
correlation_matrix = df[selected_columns].corr()
plt.figure(figsize=(8, 6))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', fmt='.2f', linewidths=0.5)
plt.title('Correlation Matrix')
plt.show()
```


Correlation Matrix
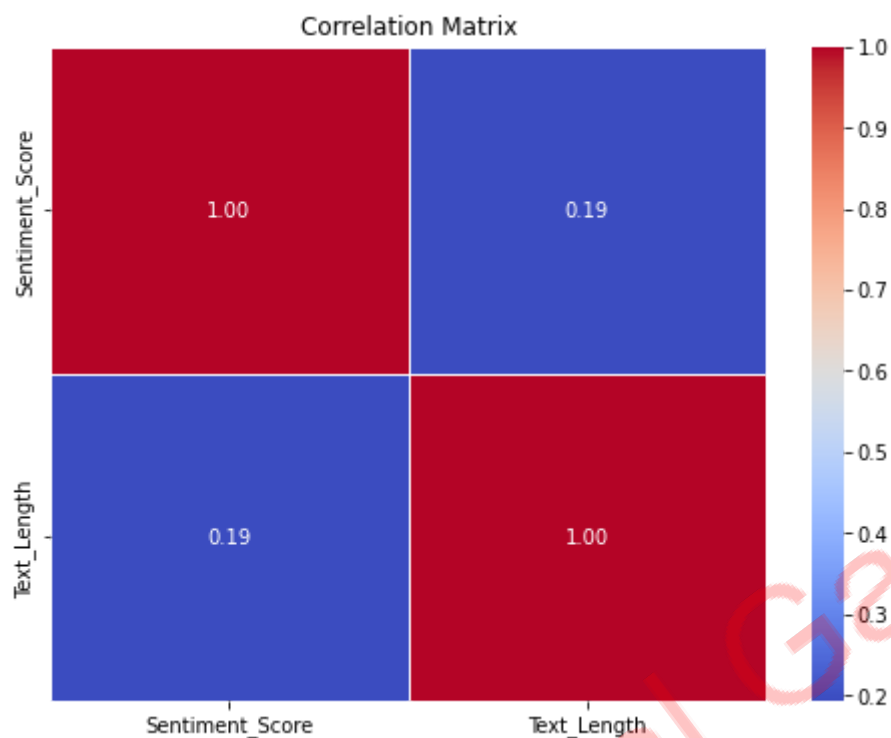
```python
fig = px.imshow(correlation_matrix,
                labels=dict(color="Correlation"),
                x=selected_columns,
                y=selected_columns,
                color_continuous_scale='blues')
fig.update_layout(
    title='Correlation Heatmap',
    width=600,
    height=500,
    xaxis=dict(title='Variables'),
    yaxis=dict(title='Variables')
)
fig.show()
```

Correlation Heatmap
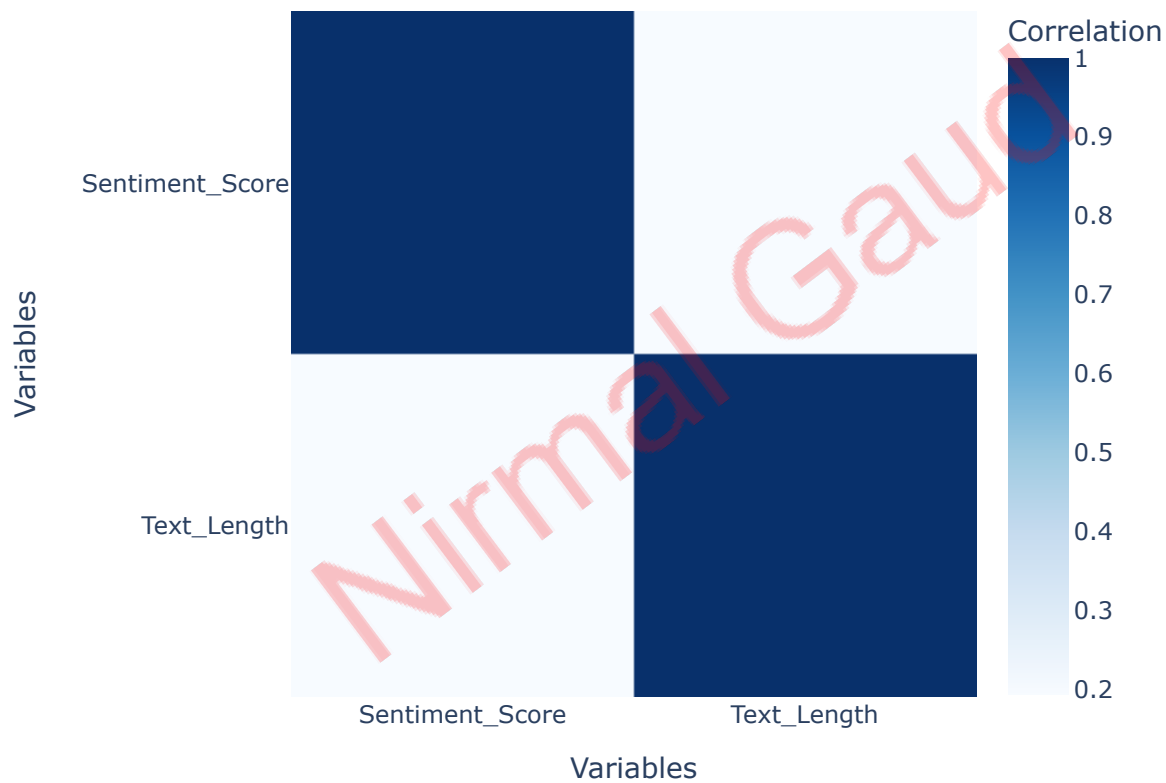
```
summary_stats = df.describe()
print(summary_stats)
```

```
       Sentiment_Score   Text_Length
count        59.000000     59.000000
mean          0.178373     98.491525
std           0.256771     58.919985
min          -0.366667     27.000000
25%           0.000000     56.000000
50%           0.109091     77.000000
75%           0.275694    121.500000
max           0.900000    293.000000
```

```
sentiment_group = df.groupby('Sentiment')['Text_Length'].mean().reset_index()
plt.figure(figsize=(8, 6))
plt.bar(sentiment_group['Sentiment'], sentiment_group['Text_Length'], color='skyblue')
plt.xlabel('Sentiment')
plt.ylabel('Mean Text Length')
plt.title('Mean Text Length by Sentiment')
plt.show()
```
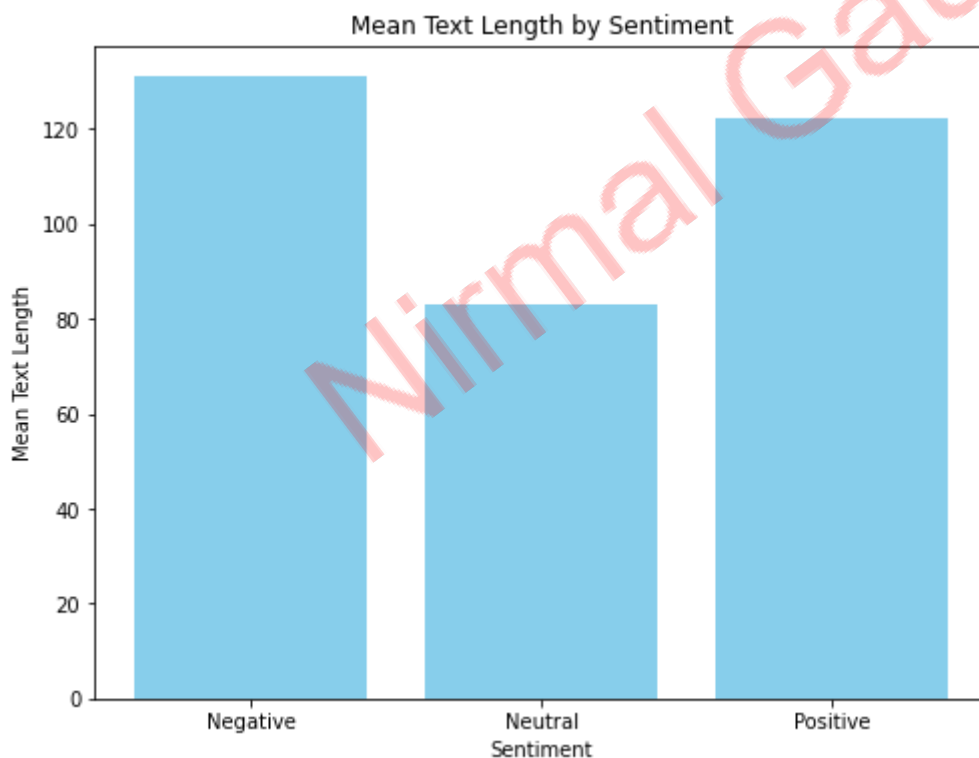
```
fig = px.bar(sentiment_group, x='Sentiment', y='Text_Length',
            labels={'Sentiment': 'Sentiment', 'Text_Length': 'Mean Text Length'},
            title='Mean Text Length by Sentiment')
fig.show()
```

Mean Text Length by Sentiment

Thanks !!!