```
In [1]: import pandas as pd
        import numpy as np
        import re
```

```
In [2]: df = pd.read_csv("X data.csv")
```

```
In [7]: df.head(15)
```

Out[7]:

	clean_text	category
0	when modi promised “minimum government maximum...	-1.0
1	talk all the nonsense and continue all the dra...	0.0
2	what did just say vote for modi welcome bjp t...	1.0
3	asking his supporters prefix chowkidar their n...	1.0
4	answer who among these the most powerful world...	1.0
5	kiya tho refresh maarkefir comment karo	0.0
6	surat women perform yagna seeks divine grace f...	0.0
7	this comes from cabinet which has scholars lik...	0.0
8	with upcoming election india saga going import...	1.0
9	gandhi was gay does modi	1.0
10	things like demonetisation gst goods and servi...	1.0
11	hope tuthukudi people would prefer honest well...	1.0
12	calm waters wheres the modi wave	1.0
13	one vote can make all the difference anil kapo...	0.0
14	one vote can make all the difference anil kapo...	0.0

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

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 162980 entries, 0 to 162979
Data columns (total 2 columns):
 #   Column      Non-Null Count   Dtype  
---  ------      --------------   -----  
 0   clean_text  162976 non-null  object 
 1   category    162973 non-null  float64
dtypes: float64(1), object(1)
memory usage: 2.5+ MB
```

```
In [9]: # Column names
        print(df.columns)

        # Check duplicate rows
        df.duplicated().sum()
```

```
Index(['clean_text', 'category'], dtype='object')
```

Out[9]:
```
np.int64(2)
```

In [10]:
```
# Check missing values
df.isnull().sum()
```

Out[10]:
```
clean_text    4
category      7
dtype: int64
```

Remove rows with null clean_text

In [11]:
```
df.dropna(subset=['clean_text'], inplace=True)
```

In [12]:
```
df.drop_duplicates(inplace=True)
```

Cleaning clean_text column

In [13]:
```
def fix_encoding(text):
    try:
        return text.encode('latin1').decode('utf-8')
    except:
        return text

df['clean_text'] = df['clean_text'].astype(str).apply(fix_encoding)
```

In [14]:
```
import re
import nltk
from nltk.corpus import stopwords
from nltk.stem import WordNetLemmatizer

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

stop_words = set(stopwords.words('english'))
lemmatizer = WordNetLemmatizer()

def clean_text_pipeline(text):
    text = text.lower()
    text = re.sub(r"http\S+", "", text)      # remove URLs
    text = re.sub(r"@\w+", "", text)         # remove mentions
    text = re.sub(r"#\w+", "", text)         # remove hashtags
    text = re.sub(r"[^a-z\s]", "", text)     # remove punctuation & numbers
    words = text.split()
    words = [lemmatizer.lemmatize(w) for w in words if w not in stop_words]
    return " ".join(words)
```

```
[nltk_data] Downloading package stopwords to
[nltk_data]     C:\Users\bhala\AppData\Roaming\nltk_data...
[nltk_data]   Unzipping corpora\stopwords.zip.
[nltk_data] Downloading package wordnet to
[nltk_data]     C:\Users\bhala\AppData\Roaming\nltk_data...
```

In [15]:
```
df['processed_text'] = df['clean_text'].apply(clean_text_pipeline)
```

In [16]:
```
df[['clean_text', 'processed_text']]
```

Out[16]:

	clean_text	processed_text
0	when modi promised “minimum government maximum...	modi promised minimum government maximum gover...
1	talk all the nonsense and continue all the dra...	talk nonsense continue drama vote modi
2	what did just say vote for modi welcome bjp t...	say vote modi welcome bjp told rahul main camp...
3	asking his supporters prefix chowkidar their n...	asking supporter prefix chowkidar name modi gr...
4	answer who among these the most powerful world...	answer among powerful world leader today trump...
...	...	...
162975	why these 456 crores paid neerav modi not reco...	crore paid neerav modi recovered congress lead...
162976	dear rss terrorist payal gawar what about modi...	dear rss terrorist payal gawar modi killing pl...
162977	did you cover her interaction forum where she ...	cover interaction forum left
162978	there big project came into india modi dream p...	big project came india modi dream project happ...
162979	have you ever listen about like gurukul where ...	ever listen like gurukul discipline maintained...

162975 rows × 2 columns

In [17]:
```
df[['clean_text', 'processed_text']].to_csv(
    "text_cleaning_preview.csv",
    index=False,
    encoding="utf-8"
)
```

In [19]:
```
df.to_csv(
    "twitter_sentiment_cleaned.csv",
    index=False,
    encoding="utf-8"
)
```

In [20]:
```
df[df['category'].notna()].to_csv(
    "twitter_sentiment_fully_labeled.csv",
    index=False,
    encoding="utf-8"
)
```

In [21]:
```
df.isnull().sum()
```

Out[21]:
```
clean_text        0
category          7
processed_text    0
dtype: int64
```

In [24]:
```
df[df['category'].isna()][['clean_text', 'processed_text', 'category']]
```

Out[24]:

	clean_text	processed_text	category
130448	the foundation stone northeast gas grid inaugu...	foundation stone northeast gas grid inaugurate...	NaN
155642	dear terrorists you can run but you cant hide ...	dear terrorist run cant hide giving year modi see	NaN
155698	offense the best defence with mission shakti m...	offense best defence mission shakti modi prove...	NaN
155770	have always heard politicians backing out thei...	always heard politician backing promise modi f...	NaN
158693	modi government plans felicitate the faceless ...	modi government plan felicitate faceless namel...	NaN
159442	chidambaram gives praises modinomics	chidambaram give praise modinomics	NaN
160559	the reason why modi contested from seats 2014 ...	reason modi contested seat real reason rahul	NaN

In [25]:
```
df[df['category'].isna()].head()
```

Out[25]:

	clean_text	category	processed_text
130448	the foundation stone northeast gas grid inaugu...	NaN	foundation stone northeast gas grid inaugurate...
155642	dear terrorists you can run but you cant hide ...	NaN	dear terrorist run cant hide giving year modi see
155698	offense the best defence with mission shakti m...	NaN	offense best defence mission shakti modi prove...
155770	have always heard politicians backing out thei...	NaN	always heard politician backing promise modi f...
158693	modi government plans felicitate the faceless ...	NaN	modi government plan felicitate faceless namel...

In [26]:
```
df['category'].value_counts(dropna=False)
```

```
Out[26]: category
          1.0    72249
          0.0    55210
         -1.0    35509
          NaN        7
         Name: count, dtype: int64
```

```
In [27]: labeled_df = df[df['category'].notna()]
         unlabeled_df = df[df['category'].isna()]
```

```
In [28]: from sklearn.feature_extraction.text import TfidfVectorizer
         from sklearn.linear_model import LogisticRegression

         tfidf = TfidfVectorizer(max_features=5000, ngram_range=(1,2))

         X_train = tfidf.fit_transform(labeled_df['processed_text'])
         y_train = labeled_df['category']

         model = LogisticRegression(max_iter=1000)
         model.fit(X_train, y_train)
```

```
Out[28]: ▾ LogisticRegression
         LogisticRegression(max_iter=1000)
```

```
In [29]: X_unlabeled = tfidf.transform(unlabeled_df['processed_text'])
         unlabeled_df['category'] = model.predict(X_unlabeled)
```

```
C:\Users\bhala\AppData\Local\Temp\ipykernel_2168\2368494070.py:2: SettingWithCo
pyWarning:
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/sta
ble/user_guide/indexing.html#returning-a-view-versus-a-copy
  unlabeled_df['category'] = model.predict(X_unlabeled)
```

```
In [30]: df = pd.concat([labeled_df, unlabeled_df], axis=0)
         df.reset_index(drop=True, inplace=True)
```

```
In [31]: df['category'].value_counts(dropna=False)
```

```
Out[31]: category
          1.0    72252
          0.0    55214
         -1.0    35509
         Name: count, dtype: int64
```

```
In [33]: mask = df['category'].isna()
```

```
In [34]: mask.sum()
```

```
Out[34]: np.int64(0)
```

```
In [35]: df.isnull().sum()
```

```
Out[35]: clean_text        0
         category          0
         processed_text    0
         dtype: int64
```

```
In [36]: df['category'].value_counts(dropna=False)
```

```
Out[36]: category
          1.0    72252
          0.0    55214
         -1.0    35509
         Name: count, dtype: int64
```

```
In [37]: df.columns
```

```
Out[37]: Index(['clean_text', 'category', 'processed_text'], dtype='object')
```

```
In [38]: df.isnull().sum()
```

```
Out[38]: clean_text        0
         category          0
         processed_text    0
         dtype: int64
```

Cleaned Raw File

```
In [40]: df[['processed_text', 'category']].to_csv(
             "twitter_sentiment_model_ready.csv",
             index=False,
             encoding="utf-8"
         )
```

1. Load the Final Clean Dataset

```
In [43]: import pandas as pd

         df = pd.read_csv("twitter_sentiment_model_ready.csv")
         df.head()
```

Out[43]:

	processed_text	category
0	modi promised minimum government maximum gover...	-1.0
1	talk nonsense continue drama vote modi	0.0
2	say vote modi welcome bjp told rahul main camp...	1.0
3	asking supporter prefix chowkidar name modi gr...	1.0
4	answer among powerful world leader today trump...	1.0

Task 1: Overall Sentiment Landscape on X

Goal:

What is the overall distribution of public sentiment on X with respect to political discourse?

In [44]:
```
sentiment_counts = df['category'].value_counts().sort_index()
sentiment_counts
```

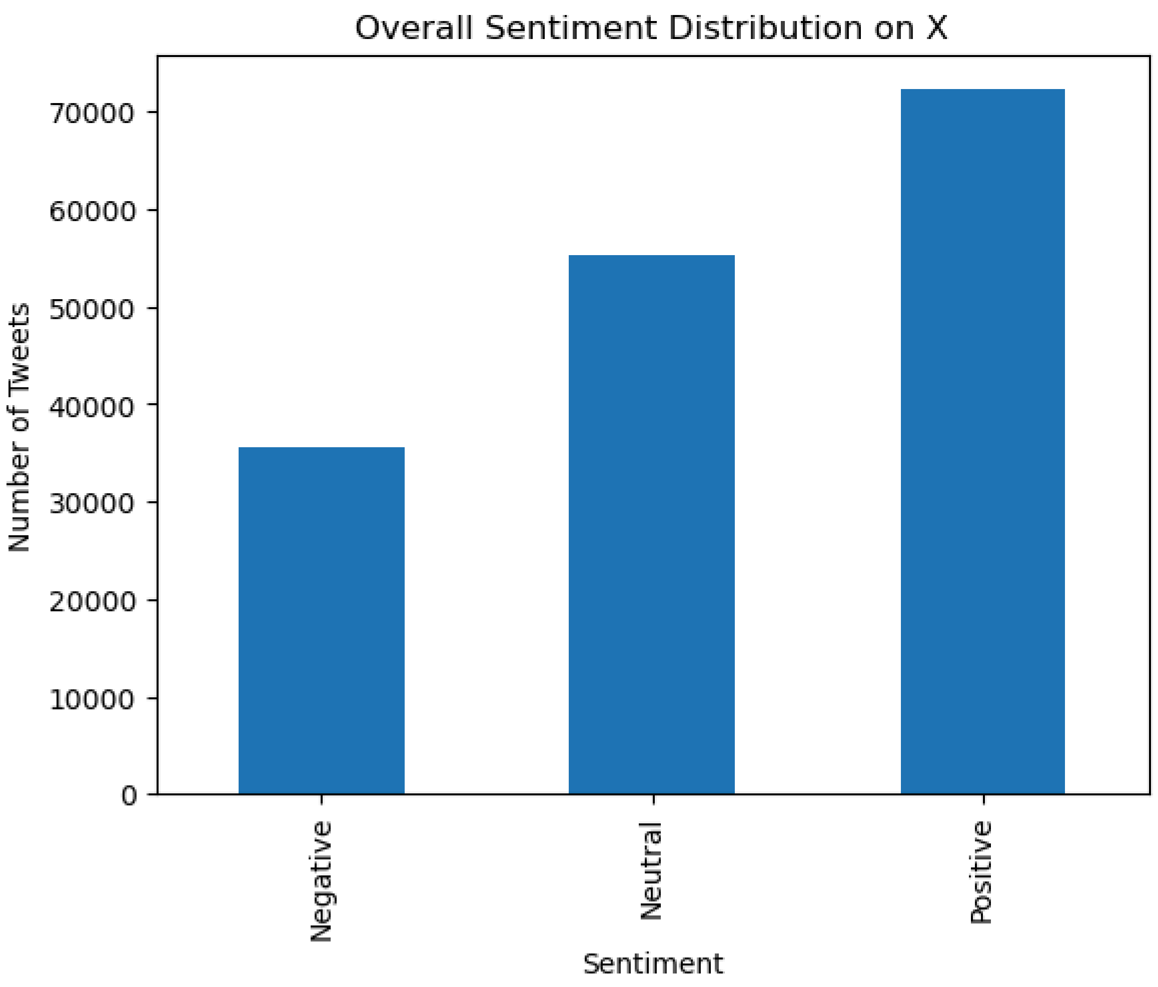
Out[44]:
```
category
-1.0    35509
 0.0    55214
 1.0    72252
Name: count, dtype: int64
```

Map labels for clarity:

In [45]:
```
sentiment_labels = {-1: 'Negative', 0: 'Neutral', 1: 'Positive'}
sentiment_counts.index = sentiment_counts.index.map(sentiment_labels)
```

Visualization

In [46]:
```
import matplotlib.pyplot as plt

sentiment_counts.plot(kind='bar')
plt.title("Overall Sentiment Distribution on X")
plt.xlabel("Sentiment")
plt.ylabel("Number of Tweets")
plt.show()
```



Insight

The sentiment distribution reveals that positive sentiment dominates political discourse on X, followed by neutral commentary. Negative sentiment, while less prevalent, represents a meaningful and non-negligible portion of public opinion.

Task 2: Topic-Based Sentiment Analysis

Goal:

How does public sentiment vary across major political topics discussed on X?

In [57]:
```
topics = {
    'Elections': ['vote', 'election', 'campaign'],
    'Economy & Reforms': ['gst', 'demonetisation', 'tax', 'economy'],
    'National Security': ['terrorist', 'defence', 'mission'],
    'Leadership': ['modi', 'bjp', 'rahul']
}
```

```
topic_mapping = {
    'Leadership': ['modi','modis','narendra','rahul','gandhi','bjp','congress'
    'Elections': ['election','vote','power','party'],
    'Governance': ['government','govt','nation','country','india','indian']
}

for topic, words in topic_mapping.items():
    matched = set(words).intersection(set(top_words))
    print(f"{topic}: {matched}")
```

```
Leadership: {'narendra', 'modi', 'bjp', 'gandhi', 'rahul', 'modis', 'congress'}
Elections: {'election', 'party', 'vote', 'power'}
Governance: {'government', 'govt', 'country', 'indian', 'india', 'nation'}
```

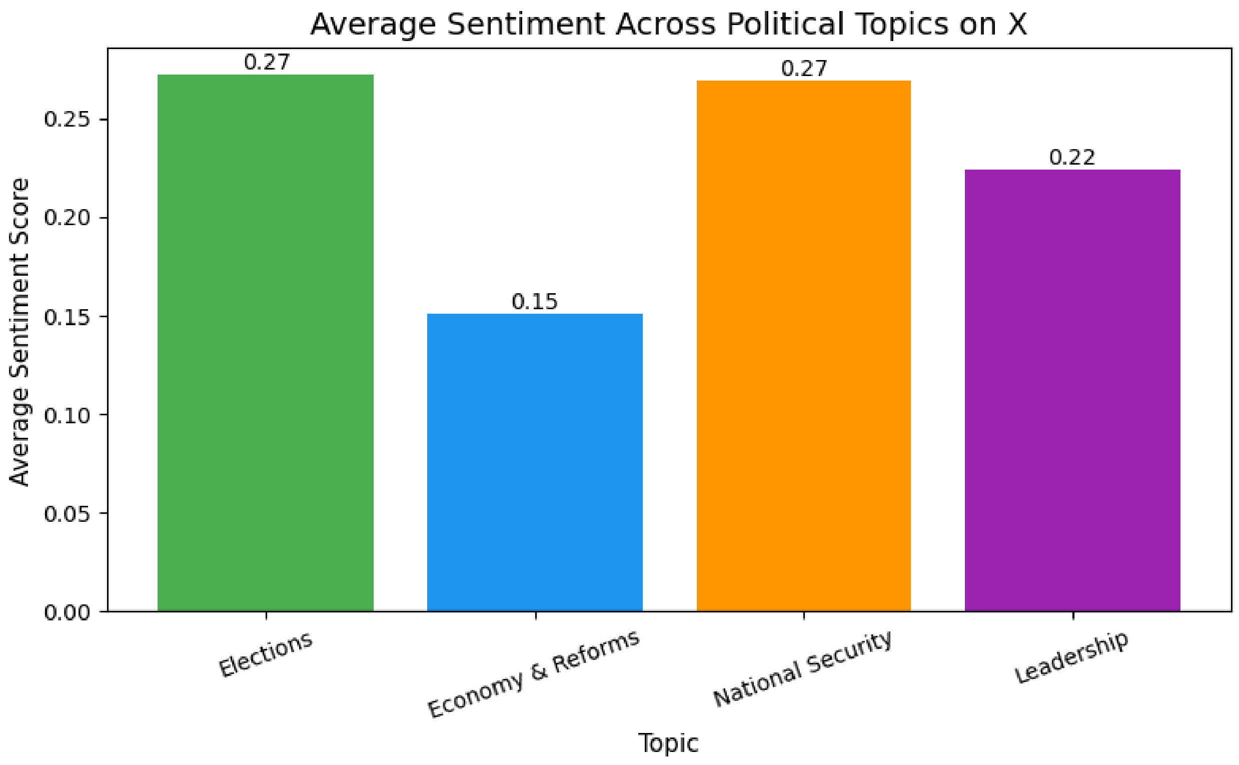
In [58]:
```
topic_sentiment = {}

for topic, keywords in topics.items():
    pattern = '|'.join(keywords)
    subset = df[df['processed_text'].str.contains(pattern, na=False)]
    topic_sentiment[topic] = subset['category'].mean()

topic_sentiment_df = pd.DataFrame.from_dict(
    topic_sentiment,
    orient='index',
    columns=['Average Sentiment']
)

topic_sentiment_df
```

Out[58]:

	Average Sentiment
Elections	0.272138
Economy & Reforms	0.150835
National Security	0.269321
Leadership	0.224186

In [60]:
```
import matplotlib.pyplot as plt

# Colors for each topic (soft but clear)
colors = ['#4CAF50', '#2196F3', '#FF9800', '#9C27B0']

plt.figure(figsize=(8, 5))

bars = plt.bar(
    topic_sentiment_df.index,
    topic_sentiment_df['Average Sentiment'],
    color=colors
)

# Zero reference line (important for sentiment)
plt.axhline(0, color='black', linewidth=0.8)
```

```
# Labels & title
plt.title("Average Sentiment Across Political Topics on X", fontsize=14)
plt.xlabel("Topic", fontsize=11)
plt.ylabel("Average Sentiment Score", fontsize=11)

# Add value labels on bars
for bar in bars:
    height = bar.get_height()
    plt.text(
        bar.get_x() + bar.get_width() / 2,
        height,
        f"{height:.2f}",
        ha='center',
        va='bottom' if height >= 0 else 'top'
    )

plt.xticks(rotation=20)
plt.tight_layout()
plt.show()
```



Keyword selection

In [53]:
```
from collections import Counter

all_words = Counter(
    " ".join(df['processed_text'].astype(str)).split()
)
```

```
keywords_to_check = [
    'modi', 'bjp', 'rahul',
    'vote', 'election', 'campaign',
    'gst', 'demonetisation', 'economy', 'tax',
    'terrorist', 'defence', 'mission'
]

for word in keywords_to_check:
    print(f"{word}: {all_words[word]}")
```

```
modi: 155638
bjp: 14664
rahul: 7263
vote: 10935
election: 11718
campaign: 2472
gst: 683
demonetisation: 535
economy: 1711
tax: 1716
terrorist: 1735
defence: 835
mission: 2932
```

In [55]:
```
from sklearn.feature_extraction.text import TfidfVectorizer

tfidf = TfidfVectorizer(max_features=30)

X = tfidf.fit_transform(
    df['processed_text'].astype(str)
)
```

In [56]:
```
top_words = tfidf.get_feature_names_out()
top_words
```

Out[56]:
```
array(['also', 'bjp', 'congress', 'country', 'dont', 'election', 'even',
       'gandhi', 'get', 'give', 'government', 'govt', 'india', 'indian',
       'know', 'like', 'modi', 'modis', 'narendra', 'nation', 'one',
       'party', 'people', 'power', 'rahul', 'say', 'time', 'vote', 'want',
       'year'], dtype=object)
```

Linguistic Patterns Behind Sentiment

Goal:

What linguistic patterns characterize positive and negative sentiment on X?

In [61]:
```
positive_df = df[df['category'] == 1]
neutral_df  = df[df['category'] == 0]
```

```
negative_df = df[df['category'] == -1]
```

In [62]:
```
from collections import Counter

def get_top_words(text_series, n=15):
    words = " ".join(text_series.astype(str)).split()
    return Counter(words).most_common(n)

top_positive_words = get_top_words(positive_df['processed_text'])
top_neutral_words  = get_top_words(neutral_df['processed_text'])
top_negative_words = get_top_words(negative_df['processed_text'])

top_positive_words, top_negative_words
```

Out[62]:
```
([('modi', 70523),
  ('india', 17075),
  ('people', 7215),
  ('bjp', 7062),
  ('like', 6243),
  ('election', 5946),
  ('congress', 5867),
  ('narendra', 5536),
  ('vote', 5214),
  ('one', 5160),
  ('govt', 4905),
  ('country', 4852),
  ('indian', 4823),
  ('good', 4819),
  ('time', 4724)],
 [('modi', 35260),
  ('india', 6739),
  ('people', 4231),
  ('bjp', 3621),
  ('like', 3556),
  ('congress', 3470),
  ('poor', 2680),
  ('govt', 2634),
  ('year', 2568),
  ('election', 2439),
  ('indian', 2405),
  ('one', 2371),
  ('dont', 2342),
  ('vote', 2261),
  ('say', 2260)])
```

In [63]:
```
import pandas as pd

pos_df = pd.DataFrame(top_positive_words, columns=['Word', 'Frequency'])
neg_df = pd.DataFrame(top_negative_words, columns=['Word', 'Frequency'])
neu_df = pd.DataFrame(top_neutral_words, columns=['Word', 'Frequency'])
```

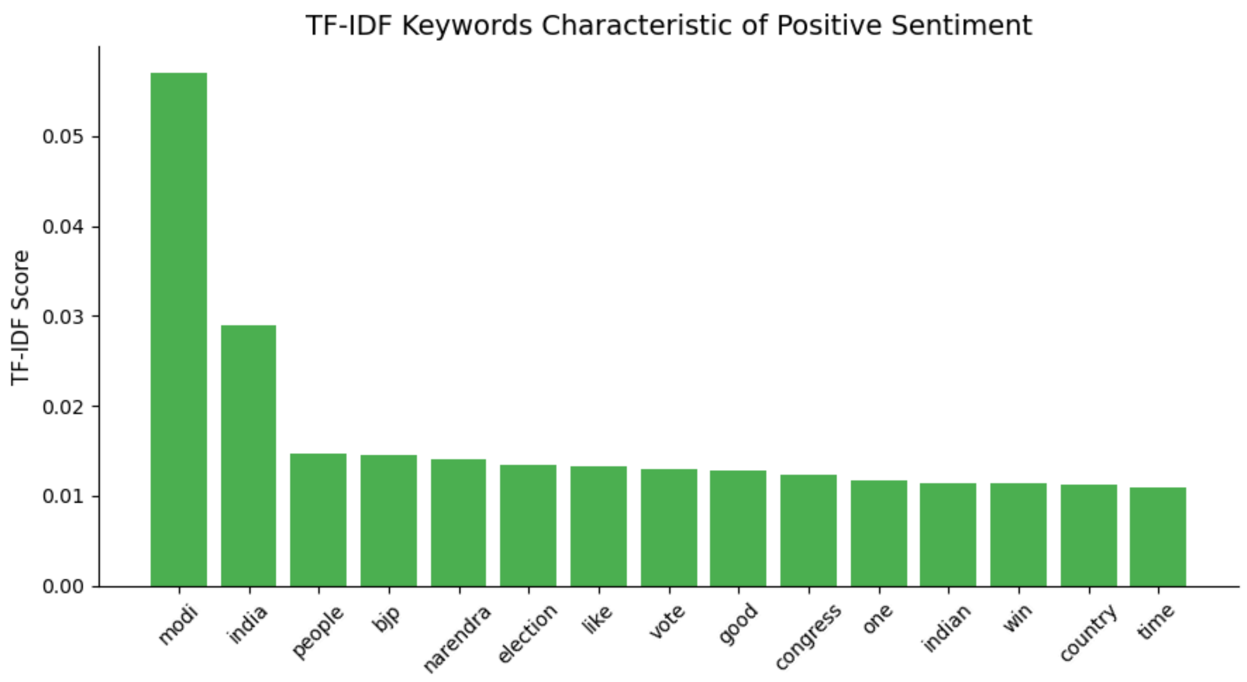
In [74]:
```
from sklearn.feature_extraction.text import TfidfVectorizer
import pandas as pd
```

```
def sentiment_tfidf(df_subset, n=15):
    tfidf = TfidfVectorizer(max_features=5000)
    X = tfidf.fit_transform(df_subset['processed_text'].astype(str))

    scores = X.mean(axis=0).A1
    words = tfidf.get_feature_names_out()

    tfidf_df = pd.DataFrame({
        'word': words,
        'score': scores
    }).sort_values('score', ascending=False)

    return tfidf_df.head(n)
```

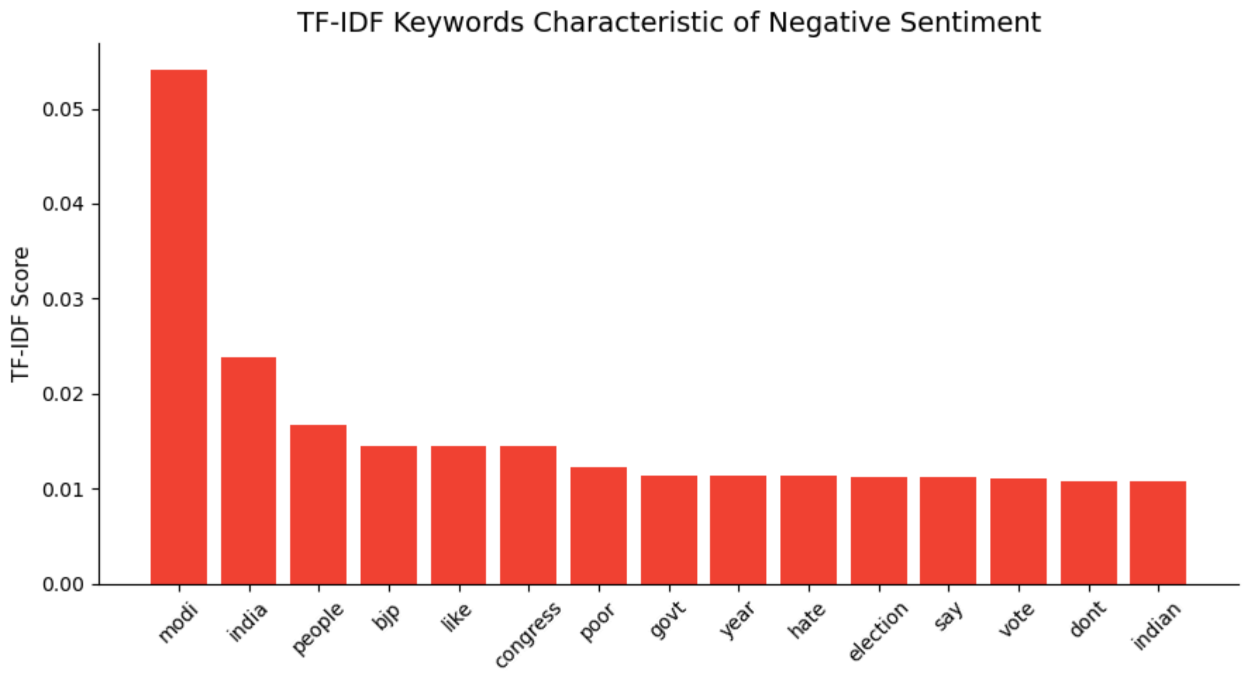
In [75]:
```
pos_tfidf = sentiment_tfidf(df[df['category'] == 1])
neg_tfidf = sentiment_tfidf(df[df['category'] == -1])
neu_tfidf = sentiment_tfidf(df[df['category'] == 0])
```

In [65]:
```
import matplotlib.pyplot as plt

plt.rcParams.update({
    'figure.figsize': (9, 5),
    'axes.titlesize': 14,
    'axes.labelsize': 11,
    'xtick.labelsize': 10,
    'ytick.labelsize': 10,
    'axes.spines.top': False,
    'axes.spines.right': False
})
```

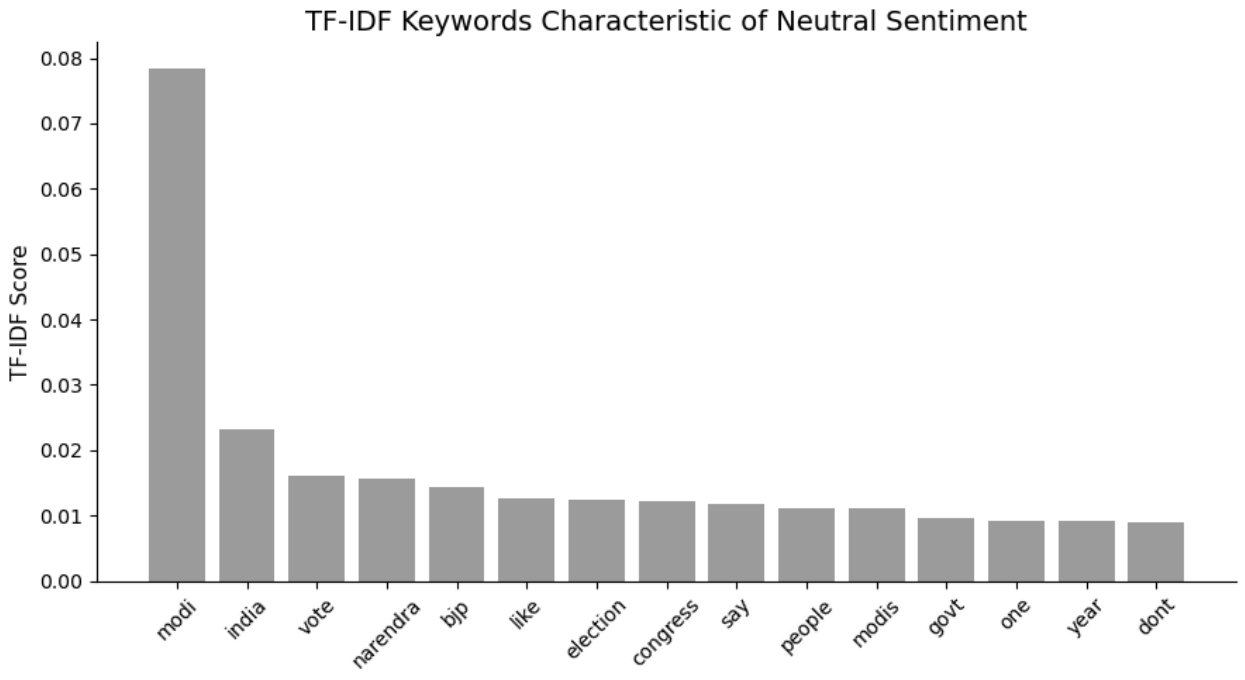
In [71]:
```
plt.figure()
plt.bar(pos_tfidf['word'], pos_tfidf['score'], color='#4CAF50')
plt.title("TF-IDF Keywords Characteristic of Positive Sentiment")
plt.xticks(rotation=45)
plt.ylabel("TF-IDF Score")
plt.tight_layout()
plt.savefig("positive_tfidf_words.png", dpi=300)
plt.show()
```



```
In [72]: plt.figure()
         plt.bar(neg_tfidf['word'], neg_tfidf['score'], color='#F44336')
         plt.title("TF-IDF Keywords Characteristic of Negative Sentiment")
         plt.xticks(rotation=45)
         plt.ylabel("TF-IDF Score")
         plt.tight_layout()
         plt.savefig("negative_tfidf_words.png", dpi=300)
         plt.show()
```



```
In [73]: plt.figure()
         plt.bar(neu_tfidf['word'], neu_tfidf['score'], color='#9E9E9E')
         plt.title("TF-IDF Keywords Characteristic of Neutral Sentiment")
         plt.xticks(rotation=45)
         plt.ylabel("TF-IDF Score")
         plt.tight_layout()
         plt.savefig("neutral_tfidf_words.png", dpi=300)
         plt.show()
```


TF-IDF Keywords Characteristic of Neutral Sentiment
TF-IDF Score
modi
india
vote
narendra
bjp
like
election
congress
say
people
modis
govt
one
year
dont