Bite into Data: Unveiling Food Preferences in Uttar Pradesh

In [ ]:
```
# Import required libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from scipy import stats
from sklearn.preprocessing import StandardScaler, LabelEncoder
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.cluster import KMeans
from sklearn.metrics import mean_squared_error, r2_score
import warnings
warnings.filterwarnings("ignore")
```

[1] Project Definition and Data Understanding :-

#1.1 Business Problem Statement

In [ ]:
```
print("1. Project Definition and Data Understanding\n")
```

```
1. Project Definition and Data Understanding
```

#1.2 Key Questions

#1.3 Data Sources

In [ ]:
```
df = pd.read_csv("/content/_Cuisines of Uttar Pradesh - Awareness Survey_  (Respon
```

In [ ]:
```
csv_path = "/mnt/data/_Cuisines of Uttar Pradesh - Awareness Survey_  (Responses)
```

In [ ]:
```
# Display basic info
print(df.info())
print("\nSample Data:\n", df.head())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 121 entries, 0 to 120
Data columns (total 13 columns):
 #   Column
Non-Null Count  Dtype
---  ------
--------------  -----
 0   Timestamp
121 non-null    object
 1   Full Name
121 non-null    object
 2     Age Group
121 non-null    object
 3   State of Residence
121 non-null    object
 4   Have you ever visited Uttar Pradesh?
121 non-null    object
 5   What is your dietary preference?
121 non-null    object
 6   Which of the following Uttar Pradesh's dishes do you know about or have you tr
ied? (Vegetarian)        118 non-null    object
 7   Which of the following Uttar Pradesh's dishes do you know about or have you tr
ied?  (Non-Vegetarian)   77 non-null     object
 8   Would you like to visit Uttar Pradesh in future? (rate:1-5)
121 non-null    int64
 9   For what purpose would you like to visit Uttar Pradesh
103 non-null    object
 10  What kind of stay would to prefer in Uttar Pradesh?
103 non-null    object
 11  What kind of food would you like to try in Uttar Pradesh?
103 non-null    object
 12  Below are the top 10 famous cuisines of Uttar Pradesh, choose that which of th
e dishes would you try.  103 non-null    object
dtypes: int64(1), object(12)
memory usage: 12.4+ KB
None

Sample Data:
            Timestamp          Full Name   Age Group   State of Residence  \
0  2/5/2025 20:56:40    Arushi Shivhare         18-25       Maharashtra
1  2/5/2025 21:07:14         Akash Shah         18-25        Maharashtra
2  2/5/2025 21:15:29  Alankrita Bhonde          18-25       Maharashtra
3  2/5/2025 21:35:35   Tanushree Joshi          18-25       Maharashtra
4  2/5/2025 21:36:06    Gautam Sukhani          18-25        Maharashtra

  Have you ever visited Uttar Pradesh? What is your dietary preference?   \
0                                  Yes                   Non-Vegetarian
1                                   No                      Vegetarian
2                                   No                  Non-Vegetarian
3                                   No                  Non-Vegetarian
4                                   No                      Vegetarian

  Which of the following Uttar Pradesh's dishes do you know about or have you trie
d? (Vegetarian)  \
0  Roomali Roti, Arhar ki Dal, Fara, Matar Ka Nim...
1          Roomali Roti, Baati Chokha, Chaat, Kulcha
2          Roomali Roti, Baati Chokha, Chaat, Kulcha
3  Roomali Roti, Baati Chokha, Chaat, Kulcha, Pan...
4  Roomali Roti, Arhar ki Dal, Bedmi Puri and Alo...
```

```
  Which of the following Uttar Pradesh's dishes do you know about or have you trie
d?  (Non-Vegetarian)  \
0  Shami Kabab, Murgh Do Pyaza, Boti Kabab, Murgh...   
1                                                NaN   
2                                                NaN   
3                                     Murgh Do Pyaza   
4                                                NaN   

   Would you like to visit Uttar Pradesh in future? (rate:1-5)  \
0                                                  5            
1                                                  2            
2                                                  4            
3                                                  4            
4                                                  4            

  For what purpose would you like to visit Uttar Pradesh  \
0  Religious Tourism, Heritage & Historical Touri...       
1                                                NaN       
2                      Heritage & Historical Tourism       
3                        Cultural & Festival Tourism       
4   Religious Tourism, Heritage & Historical Tourism       

  What kind of stay would to prefer in Uttar Pradesh?  \
0      Budget & Mid-Range Hotels, Homestays & Airbnb    
1                                                NaN    
2                          Budget & Mid-Range Hotels    
3                          Budget & Mid-Range Hotels    
4  Budget & Mid-Range Hotels, Dharamshalas & Ashrams    

  What kind of food would you like to try in Uttar Pradesh?  \
0  Awadhi Cuisine (Lucknow & Surroundings), Mughl...          
1                                                NaN          
2  Awadhi Cuisine (Lucknow & Surroundings), Stree...          
3  Awadhi Cuisine (Lucknow & Surroundings), Stree...          
4  Vegetarian & Sattvik Food (Mathura, Varanasi, ...          

  Below are the top 10 famous cuisines of Uttar Pradesh, choose that which of the d
ishes would you try.  
0  Tunday Kababi (Lucknow), Bedai & Jalebi (Agra,...  
1                                                NaN  
2  Lucknawi Biryani (Lucknow), Baati Chokha (Vara...  
3  Lucknawi Biryani (Lucknow), Bedai & Jalebi (Ag...  
4  Petha (Agra), Aloo Tikki Chaat (Lucknow, Kanpu...  
```

#1.4 Data Dictionary

In [ ]:

```python
# Data dictionary creation
data_dict = pd.DataFrame({
 "Column Name": df.columns,
 "Data Type": df.dtypes,
 "Missing Values": df.isnull().sum(),
 "Unique Values": df.nunique()
})
print("\nData Dictionary:\n", data_dict)
```

```
Data Dictionary:

Column Name  \
Timestamp
Timestamp
Full Name
Full Name
  Age Group
Age Group
State of Residence
State of Residence
Have you ever visited Uttar Pradesh?                             Have you ever visi
ted Uttar Pradesh?
What is your dietary preference?                                    What is your di
etary preference?
Which of the following Uttar Pradesh's dishes d...  Which of the following Uttar Pr
adesh's dishes ...
Which of the following Uttar Pradesh's dishes d...  Which of the following Uttar Pr
adesh's dishes ...
Would you like to visit Uttar Pradesh in future...  Would you like to visit Uttar P
radesh in futur...
For what purpose would you like to visit Uttar ...  For what purpose would you like
to visit Uttar...
What kind of stay would to prefer in Uttar Prad...  What kind of stay would to pref
er in Uttar Pra...
What kind of food would you like to try in Utta...  What kind of food would you lik
e to try in Utt...
Below are the top 10 famous cuisines of Uttar P...  Below are the top 10 famous cui
sines of Uttar ...

                                                   Data Type  Missing Values  \
Timestamp                                             object               0
Full Name                                             object               0
  Age Group                                           object               0
State of Residence                                    object               0
Have you ever visited Uttar Pradesh?                  object               0
What is your dietary preference?                      object               0
Which of the following Uttar Pradesh's dishes d...    object               3
Which of the following Uttar Pradesh's dishes d...    object              44
Would you like to visit Uttar Pradesh in future...     int64               0
For what purpose would you like to visit Uttar ...    object              18
What kind of stay would to prefer in Uttar Prad...    object              18
What kind of food would you like to try in Utta...    object              18
Below are the top 10 famous cuisines of Uttar P...    object              18

                                                    Unique Values
Timestamp                                                     117
Full Name                                                     120
  Age Group                                                     4
State of Residence                                             25
Have you ever visited Uttar Pradesh?                            2
What is your dietary preference?                                5
Which of the following Uttar Pradesh's dishes d...             94
Which of the following Uttar Pradesh's dishes d...             60
Would you like to visit Uttar Pradesh in future...              5
For what purpose would you like to visit Uttar ...             20
What kind of stay would to prefer in Uttar Prad...             36
What kind of food would you like to try in Utta...             22
Below are the top 10 famous cuisines of Uttar P...             68
```

[2] Data Collection and Integration :-

#2.1 Data Source and Collection

In [ ]:

```
print("\n2. Data Collection and Integration\n")
```

```
2. Data Collection and Integration
```

#2.2 Data Provenance

#2.3 Integration Methodology

In [ ]:

```
# Already collected from Google Form (CSV)
print("Data source: Google Form CSV export")
print("Number of rows and columns:", df.shape)
```

```
Data source: Google Form CSV export
Number of rows and columns: (121, 13)
```

#2.4 Initial Validation

[3] Data Cleaning and Preparation :-

#3.1 Check Shape, Data Types, and Null Values

In [ ]:

```
# Dataset shape
print("Dataset shape:",df.shape)
# Data types and  nulls
print("\nData types and missing values :")
print(df.info())
# Summary of null values
print("\n Missing values in each column:")
print(df.isnull().sum())
```

```
Dataset shape: (121, 13)

Data types and missing values :
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 121 entries, 0 to 120
Data columns (total 13 columns):
 #   Column
Non-Null Count  Dtype
---  ------
--------------  -----
 0   Timestamp
121 non-null    object
 1   Full Name
121 non-null    object
 2     Age Group
121 non-null    object
 3   State of Residence
121 non-null    object
 4   Have you ever visited Uttar Pradesh?
121 non-null    object
 5   What is your dietary preference?
121 non-null    object
 6   Which of the following Uttar Pradesh's dishes do you know about or have you tr
ied? (Vegetarian)        118 non-null    object
 7   Which of the following Uttar Pradesh's dishes do you know about or have you tr
ied?  (Non-Vegetarian)   77 non-null     object
 8   Would you like to visit Uttar Pradesh in future? (rate:1-5)
121 non-null    int64
 9   For what purpose would you like to visit Uttar Pradesh
103 non-null    object
 10  What kind of stay would to prefer in Uttar Pradesh?
103 non-null    object
 11  What kind of food would you like to try in Uttar Pradesh?
103 non-null    object
 12  Below are the top 10 famous cuisines of Uttar Pradesh, choose that which of th
e dishes would you try.  103 non-null    object
dtypes: int64(1), object(12)
memory usage: 12.4+ KB
None

 Missing values in each column:
Timestamp
0
Full Name
0
  Age Group
0
State of Residence
0
Have you ever visited Uttar Pradesh?
0
What is your dietary preference?
0
Which of the following Uttar Pradesh's dishes do you know about or have you tried?
(Vegetarian)           3
Which of the following Uttar Pradesh's dishes do you know about or have you tried?
(Non-Vegetarian)     44
Would you like to visit Uttar Pradesh in future? (rate:1-5)
0
For what purpose would you like to visit Uttar Pradesh
```

```
18
What kind of stay would to prefer in Uttar Pradesh?
18
What kind of food would you like to try in Uttar Pradesh?
18
Below are the top 10 famous cuisines of Uttar Pradesh, choose that which of the dis
hes would you try.    18
dtype: int64
```

#3.2 Outlier Treatment

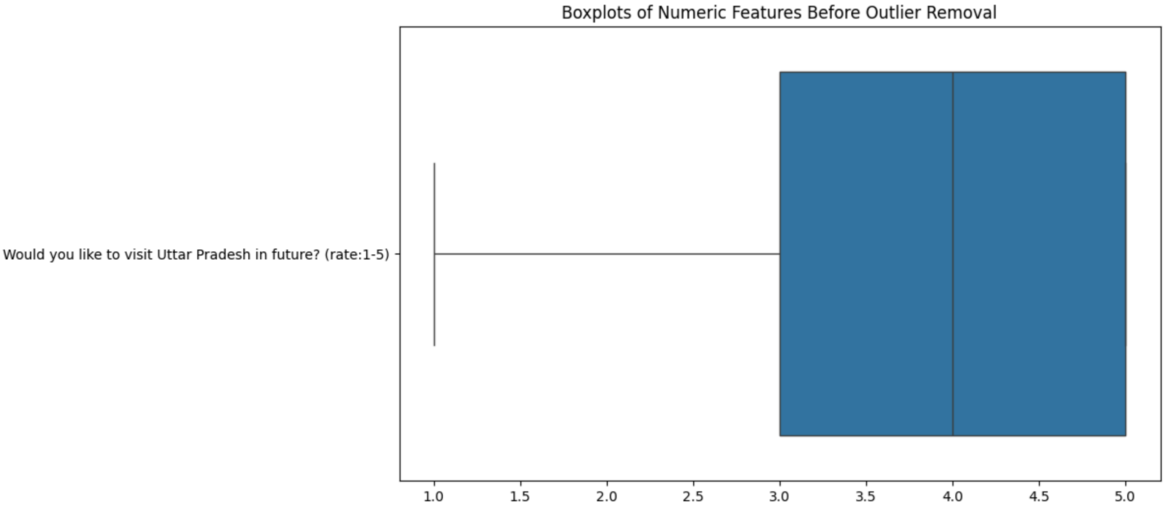
In [ ]:

```
# Handle outliers: Cap using z-score
numeric_cols = df.select_dtypes(include=np.number).columns
for col in numeric_cols:
 z_scores = np.abs(stats.zscore(df[col]))
 df = df[(z_scores < 3)]
```

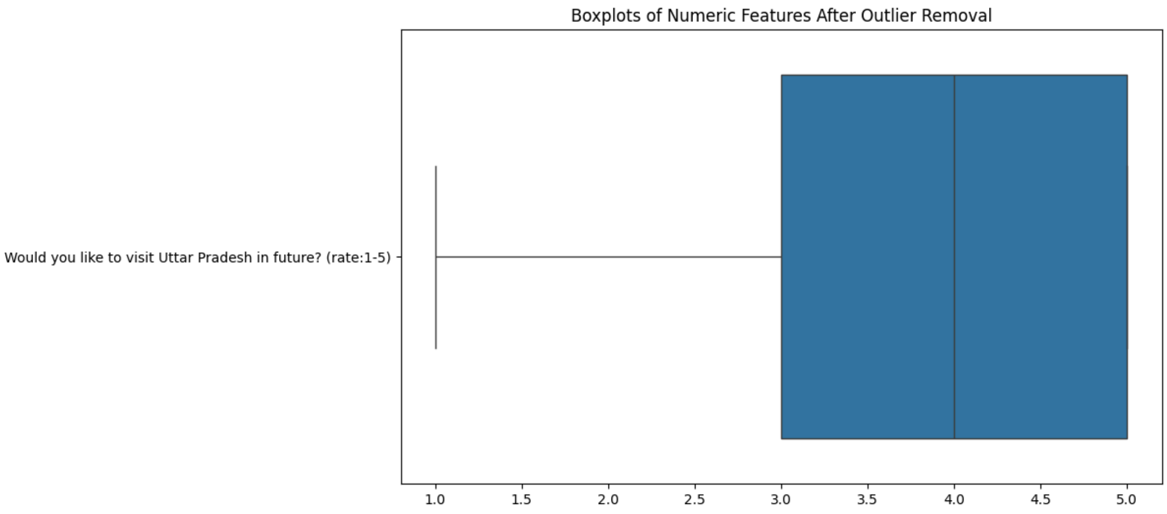
In [ ]:

```
#Address Outliers:-
# Describe the DataFrame
print("\nInitial DataFrame Description:")
print(df.describe())

#Show boxplots for numeric columns *before* outlier removal
numeric_df = df.select_dtypes(include=['number'])  # Select only numeric columns
if not numeric_df.empty:
    plt.figure(figsize=(10, 6))
    sns.boxplot(data=numeric_df, orient='h')
    plt.title("Boxplots of Numeric Features Before Outlier Removal")
    plt.show()
else:
    print("No numeric columns to show boxplots before outlier removal.")

#Remove outliers using the IQR method for all numeric columns
numeric_cols = df.select_dtypes(include=['number']).columns  # Get numeric column
for col in numeric_cols:
    Q1 = df[col].quantile(0.25)
    Q3 = df[col].quantile(0.75)
    IQR = Q3 - Q1
    lower_bound = Q1 - 1.5 * IQR
    upper_bound = Q3 + 1.5 * IQR
    df = df[(df[col] >= lower_bound) & (df[col] <= upper_bound)]

#Display info about the DataFrame *after* outlier removal
print("\nDataFrame Info After Outlier Removal:")
df.info()

#Describe the DataFrame *after* outlier removal
print("\nDataFrame Description After Outlier Removal:")
print(df.describe())

#Show boxplots for numeric columns *after* outlier removal
numeric_df = df.select_dtypes(include=['number'])  # Re-select numeric columns aft
if not numeric_df.empty:
    plt.figure(figsize=(10, 6))
    sns.boxplot(data=numeric_df, orient='h')
    plt.title("Boxplots of Numeric Features After Outlier Removal")
    plt.show()
else:
    print("No numeric columns to show boxplots after outlier removal.")
```

```
Initial DataFrame Description:
       Would you like to visit Uttar Pradesh in future? (rate:1-5)
count                                         121.000000
mean                                            3.685950
std                                             1.245211
min                                             1.000000
25%                                             3.000000
50%                                             4.000000
75%                                             5.000000
max                                             5.000000
```



```
DataFrame Info After Outlier Removal:
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 121 entries, 0 to 120
Data columns (total 13 columns):
 #   Column
Non-Null Count  Dtype
---  ------
--------------  -----
 0   Timestamp
121 non-null    object
 1   Full Name
121 non-null    object
 2     Age Group
121 non-null    object
 3   State of Residence
121 non-null    object
 4   Have you ever visited Uttar Pradesh?
121 non-null    object
 5   What is your dietary preference?
121 non-null    object
 6   Which of the following Uttar Pradesh's dishes do you know about or have you tr
ied? (Vegetarian)       118 non-null    object
 7   Which of the following Uttar Pradesh's dishes do you know about or have you tr
ied?  (Non-Vegetarian)   77 non-null     object
 8   Would you like to visit Uttar Pradesh in future? (rate:1-5)
121 non-null    int64
 9   For what purpose would you like to visit Uttar Pradesh
103 non-null    object
 10  What kind of stay would to prefer in Uttar Pradesh?
103 non-null    object
 11  What kind of food would you like to try in Uttar Pradesh?
103 non-null    object
 12  Below are the top 10 famous cuisines of Uttar Pradesh, choose that which of th
e dishes would you try.  103 non-null    object
dtypes: int64(1), object(12)
memory usage: 12.4+ KB

DataFrame Description After Outlier Removal:
       Would you like to visit Uttar Pradesh in future? (rate:1-5)
count                                         121.000000
mean                                            3.685950
std                                             1.245211
min                                             1.000000
25%                                             3.000000
50%                                             4.000000
75%                                             5.000000
max                                             5.000000
```



#3.3 Data Type Corrections

In [ ]:
```
# Convert data types if needed
df = df.convert_dtypes()
```

In [ ]:
```
# Convert the 'Timestamp' column to datetime, handling errors
df['Timestamp'] = pd.to_datetime(df['Timestamp'], errors='coerce')

# Display the data types of the DataFrame to verify the conversion
print(df.dtypes)
```

```
Timestamp
datetime64[ns]
Full Name
string[python]
  Age Group
string[python]
State of Residence
string[python]
Have you ever visited Uttar Pradesh?
string[python]
What is your dietary preference?
string[python]
Which of the following Uttar Pradesh's dishes do you know about or have you tried?
(Vegetarian)          string[python]
Which of the following Uttar Pradesh's dishes do you know about or have you tried?
(Non-Vegetarian)     string[python]
Would you like to visit Uttar Pradesh in future? (rate:1-5)
Int64
For what purpose would you like to visit Uttar Pradesh
string[python]
What kind of stay would to prefer in Uttar Pradesh?
string[python]
What kind of food would you like to try in Uttar Pradesh?
string[python]
Below are the top 10 famous cuisines of Uttar Pradesh, choose that which of the dis
hes would you try.    string[python]
dtype: object
```

#3.4 Normalize Numerical Features

In [ ]:
```
# Normalize numeric data
scaler = StandardScaler()
```

```
df[numeric_cols] = scaler.fit_transform(df[numeric_cols])
print("Cleaned Data:\n", df.head())
```

```
Cleaned Data:
             Timestamp          Full Name   Age Group   State of Residence  \
0 2025-02-05 20:56:40    Arushi Shivhare        18-25       Maharashtra
1 2025-02-05 21:07:14         Akash Shah        18-25        Maharashtra
2 2025-02-05 21:15:29  Alankrita Bhonde         18-25       Maharashtra
3 2025-02-05 21:35:35   Tanushree Joshi         18-25       Maharashtra
4 2025-02-05 21:36:06    Gautam Sukhani         18-25        Maharashtra

  Have you ever visited Uttar Pradesh? What is your dietary preference?   \
0                                  Yes                   Non-Vegetarian
1                                   No                      Vegetarian
2                                   No                  Non-Vegetarian
3                                   No                  Non-Vegetarian
4                                   No                      Vegetarian

  Which of the following Uttar Pradesh's dishes do you know about or have you trie
d? (Vegetarian)  \
0  Roomali Roti, Arhar ki Dal, Fara, Matar Ka Nim...
1          Roomali Roti, Baati Chokha, Chaat, Kulcha
2          Roomali Roti, Baati Chokha, Chaat, Kulcha
3  Roomali Roti, Baati Chokha, Chaat, Kulcha, Pan...
4  Roomali Roti, Arhar ki Dal, Bedmi Puri and Alo...

  Which of the following Uttar Pradesh's dishes do you know about or have you trie
d?  (Non-Vegetarian)  \
0  Shami Kabab, Murgh Do Pyaza, Boti Kabab, Murgh...
1                                               <NA>
2                                               <NA>
3                                     Murgh Do Pyaza
4                                               <NA>

   Would you like to visit Uttar Pradesh in future? (rate:1-5)  \
0                                           1.059670
1                                          -1.359577
2                                           0.253255
3                                           0.253255
4                                           0.253255

  For what purpose would you like to visit Uttar Pradesh  \
0  Religious Tourism, Heritage & Historical Touri...
1                                               <NA>
2                      Heritage & Historical Tourism
3                        Cultural & Festival Tourism
4   Religious Tourism, Heritage & Historical Tourism

  What kind of stay would to prefer in Uttar Pradesh?  \
0      Budget & Mid-Range Hotels, Homestays & Airbnb
1                                               <NA>
2                          Budget & Mid-Range Hotels
3                          Budget & Mid-Range Hotels
4  Budget & Mid-Range Hotels, Dharamshalas & Ashrams

  What kind of food would you like to try in Uttar Pradesh?  \
0  Awadhi Cuisine (Lucknow & Surroundings), Mughl...
1                                               <NA>
2  Awadhi Cuisine (Lucknow & Surroundings), Stree...
3  Awadhi Cuisine (Lucknow & Surroundings), Stree...
4  Vegetarian & Sattvik Food (Mathura, Varanasi, ...

  Below are the top 10 famous cuisines of Uttar Pradesh, choose that which of the d
```

```
ishes would you try.
0  Tunday Kababi (Lucknow), Bedai & Jalebi (Agra,...
1                                               <NA>
2  Lucknawi Biryani (Lucknow), Baati Chokha (Vara...
3  Lucknawi Biryani (Lucknow), Bedai & Jalebi (Ag...
4  Petha (Agra), Aloo Tikki Chaat (Lucknow, Kanpu...
```

#3.5 Encode Categorical Variables

In [ ]:

```
# Encoding categorical columns
label_encoders = {}
cat_cols = df.select_dtypes(include='string').columns
for col in cat_cols:
 le = LabelEncoder()
 df[col] = le.fit_transform(df[col].astype(str))
 label_encoders[col] = le
```

#3.6 Create Derived Features

[4] Exploratory Data Analysis :-

#4.1 Descriptive Statistics

In [ ]:

```
print("\n4. Exploratory Data Analysis\n")
print("Descriptive Statistics:\n", df.describe())
```

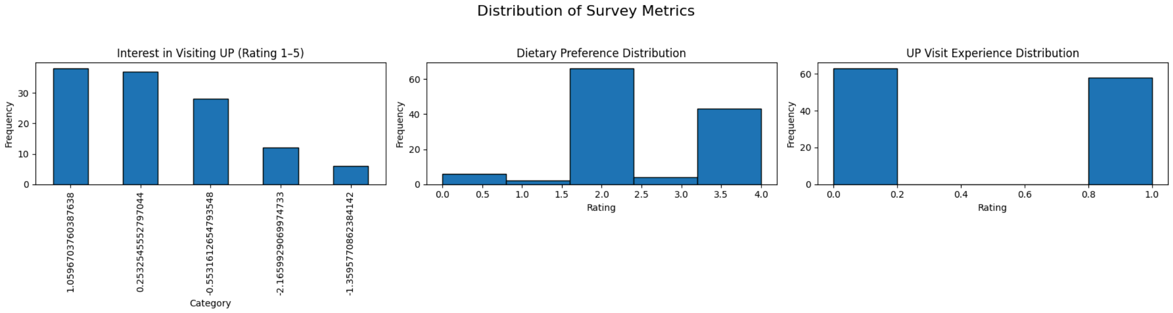
```
4. Exploratory Data Analysis

Descriptive Statistics:
                            Timestamp   Full Name    Age Group    \
count                             121  121.000000   121.000000   
mean   2025-03-06 04:42:42.198347264   59.074380     0.173554   
min              2025-02-05 20:56:40    0.000000     0.000000   
25%              2025-02-05 23:45:16   29.000000     0.000000   
50%              2025-03-24 11:11:43   59.000000     0.000000   
75%              2025-03-25 15:56:44   89.000000     0.000000   
max              2025-03-25 16:02:05  119.000000     3.000000   
std                               NaN   34.954772     0.641323   

       State of Residence  Have you ever visited Uttar Pradesh?  \
count          121.000000                            121.000000   
mean             8.628099                              0.479339   
min              0.000000                              0.000000   
25%              7.000000                              0.000000   
50%              8.000000                              0.000000   
75%              8.000000                              1.000000   
max             24.000000                              1.000000   
std              3.862495                              0.501650   

       What is your dietary preference?   \
count                         121.000000   
mean                            2.628099   
min                             0.000000   
25%                             2.000000   
50%                             2.000000   
75%                             4.000000   
max                             4.000000   
std                             1.133815   

       Which of the following Uttar Pradesh's dishes do you know about or have you
tried? (Vegetarian)  \
count                                         121.000000   
mean                                           47.595041   
min                                             0.000000   
25%                                            27.000000   
50%                                            47.000000   
75%                                            69.000000   
max                                            94.000000   
std                                            26.677574   

       Which of the following Uttar Pradesh's dishes do you know about or have you
tried?  (Non-Vegetarian)  \
count                                         121.000000   
mean                                           19.504132   
min                                             0.000000   
25%                                             0.000000   
50%                                            15.000000   
75%                                            35.000000   
max                                            60.000000   
std                                            19.713838   

       Would you like to visit Uttar Pradesh in future? (rate:1-5)  \
count                                       1.210000e+02   
mean                                       -1.330433e-16   
min                                        -2.165993e+00   
25%                                        -5.531613e-01   
```

```
50%                                           2.532546e-01
75%                                           1.059670e+00
max                                           1.059670e+00
std                                           1.004158e+00

       For what purpose would you like to visit Uttar Pradesh  \
count                                           121.000000
mean                                              8.950413
min                                               0.000000
25%                                               3.000000
50%                                               9.000000
75%                                              13.000000
max                                              20.000000
std                                               6.002571

       What kind of stay would to prefer in Uttar Pradesh?  \
count                                           121.000000
mean                                             11.223140
min                                               0.000000
25%                                               1.000000
50%                                               9.000000
75%                                              19.000000
max                                              36.000000
std                                              10.505941

       What kind of food would you like to try in Uttar Pradesh?  \
count                                           121.000000
mean                                              9.636364
min                                               0.000000
25%                                               4.000000
50%                                               7.000000
75%                                              17.000000
max                                              22.000000
std                                               7.535472

       Below are the top 10 famous cuisines of Uttar Pradesh, choose that which of
the dishes would you try.
count                                           121.000000
mean                                             29.719008
min                                               0.000000
25%                                               8.000000
50%                                              28.000000
75%                                              51.000000
max                                              68.000000
std                                              22.694061
```

#4.2 Visualization

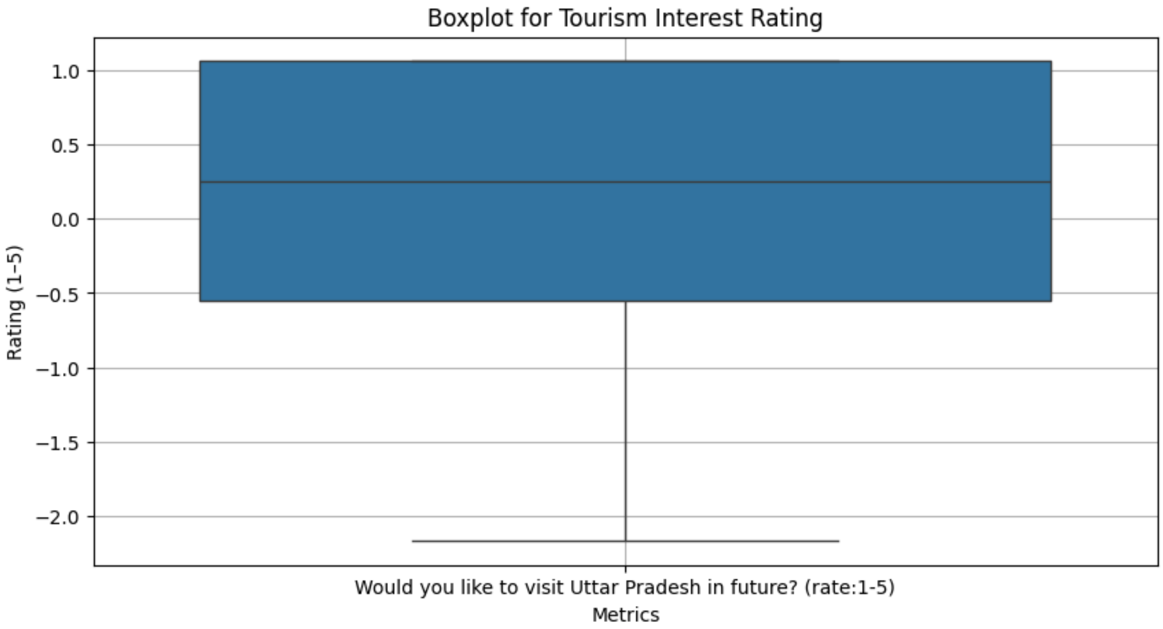
In [ ]:

```
# 4.1.1 Distribution - HISTOGRAMS
# Columns to plot
features = [
    'Would you like to visit Uttar Pradesh in future? (rate:1-5)',
    'What is your dietary preference? ',
    'Have you ever visited Uttar Pradesh?'
]

titles = [
    'Interest in Visiting UP (Rating 1-5)',
    'Dietary Preference Distribution',
    'UP Visit Experience Distribution'
]

# Create subplots
fig, axes = plt.subplots(1, 3, figsize=(18, 5))

# Plot each feature
for i, feature in enumerate(features):
    if df[feature].dtype == 'int64':
        axes[i].hist(df[feature], bins=5, edgecolor='black')
        axes[i].set_xlabel('Rating')
    else:
        df[feature].value_counts().plot(kind='bar', ax=axes[i], edgecolor='black')
        axes[i].set_xlabel('Category')

    axes[i].set_title(titles[i])
    axes[i].set_ylabel('Frequency')

# Add main title
fig.suptitle('Distribution of Survey Metrics', fontsize=16)
plt.tight_layout(rect=[0, 0.03, 1, 0.95])
plt.show()
```



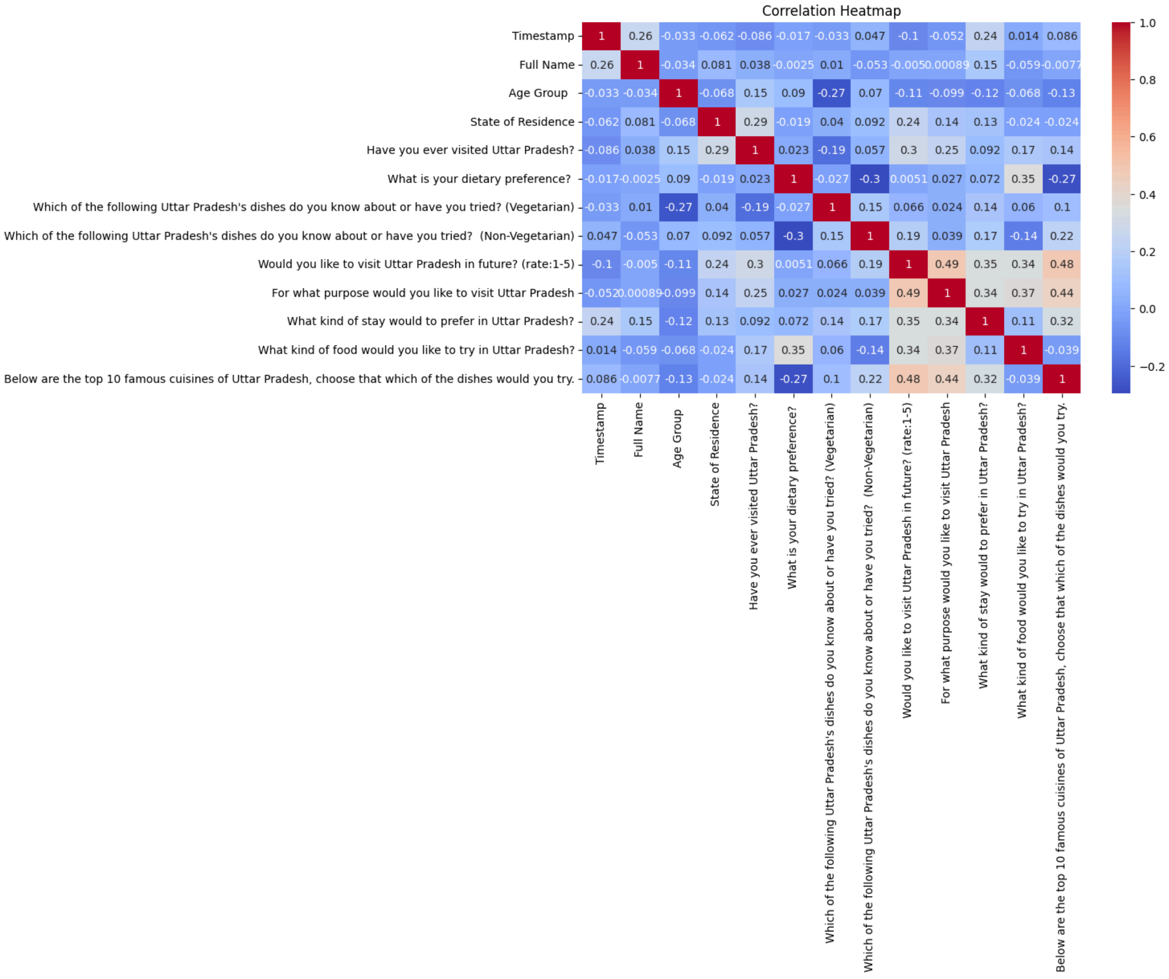
In [ ]:

```
# 4.1.2 BOXPLOTS
# Set plot size
plt.figure(figsize=(10, 5))

# Boxplot of relevant metric
sns.boxplot(data=df[[
    'Would you like to visit Uttar Pradesh in future? (rate:1-5)'
]])

# Add titles and labels
plt.title('Boxplot for Tourism Interest Rating')
plt.xlabel('Metrics')
plt.ylabel('Rating (1-5)')
plt.grid(True)

# Show plot
plt.show()
```



#4.3 Correlation Analysis

```
In [ ]: # Correlation Heatmap
plt.figure(figsize=(10,6))
sns.heatmap(df.corr(), annot=True, cmap='coolwarm')
plt.title("Correlation Heatmap")
plt.show()
```

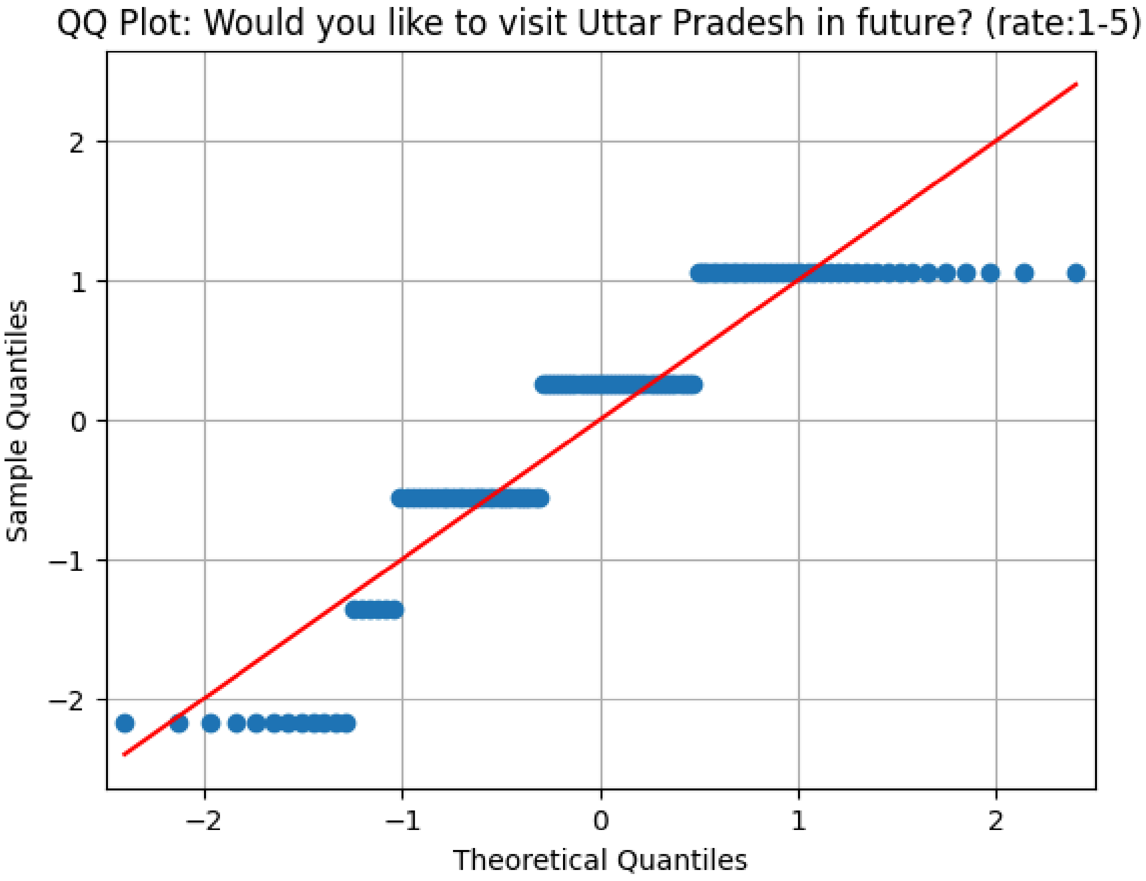


#4.4 Test for Statistical Properties

In [ ]:

```
#4.4.1 Normality Tests
from scipy.stats import shapiro
import statsmodels.api as sm

# Choose the numeric column to test
col = 'Would you like to visit Uttar Pradesh in future? (rate:1-5)'

print(f"Normality Test: {col}")

# Shapiro-Wilk Test
stat, p = shapiro(df[col])
print(f"Shapiro-Wilk p-value: {p:.4f}")

if p > 0.05:
    print("Likely normal (fail to reject H0)")
else:
    print("Not normal (reject H0)")

# QQ Plot
sm.qqplot(df[col], line='s')
plt.title(f"QQ Plot: {col}")
plt.xlabel("Theoretical Quantiles")
plt.ylabel("Sample Quantiles")
plt.grid(True)
plt.show()
```

```
Normality Test: Would you like to visit Uttar Pradesh in future? (rate:1-5)
Shapiro-Wilk p-value: 0.0000
Not normal (reject H0)
```



In [ ]:

```
#4.4.2 Other Statistical Properties: Skewness and Kurtosis

# Print header
```

```
print("\nSkewness and Kurtosis:")

# Column to analyze
col = 'Would you like to visit Uttar Pradesh in future? (rate:1-5)'

# Compute skewness and kurtosis
skew = df[col].skew()
kurt = df[col].kurt()

# Print results
print(f"{col}: Skewness = {skew:.4f}, Kurtosis = {kurt:.4f}")
```

```
Skewness and Kurtosis:
Would you like to visit Uttar Pradesh in future? (rate:1-5): Skewness = -0.8029, Ku
rtosis = -0.1873
```

[5] Statistical Analysis :-

#5.1 Hypothesis Testing

In [ ]:

```
# Paired sample t-test
from scipy.stats import ttest_rel

# Filter the column
col = 'Would you like to visit Uttar Pradesh in future? (rate:1-5)'

# Split data into two groups
visited = df[df['Have you ever visited Uttar Pradesh?'] == 'Yes'][col]
not_visited = df[df['Have you ever visited Uttar Pradesh?'] == 'No'][col]

# Ensure equal length by dropping unequal pairs (for paired t-test)
min_len = min(len(visited), len(not_visited))
visited = visited.iloc[:min_len]
not_visited = not_visited.iloc[:min_len]

# Perform paired t-test
t_stat, p_val = ttest_rel(visited, not_visited)

# Display result
print("Paired T-Test: Visit Rating (Visited vs Not Visited)")
print(f"t-statistic: {t_stat:.4f}")
print(f"p-value: {p_val:.4f}")

if p_val < 0.05:
    print("Reject H₀: Significant difference found")
else:
    print("Fail to reject H₀: No significant difference")
```

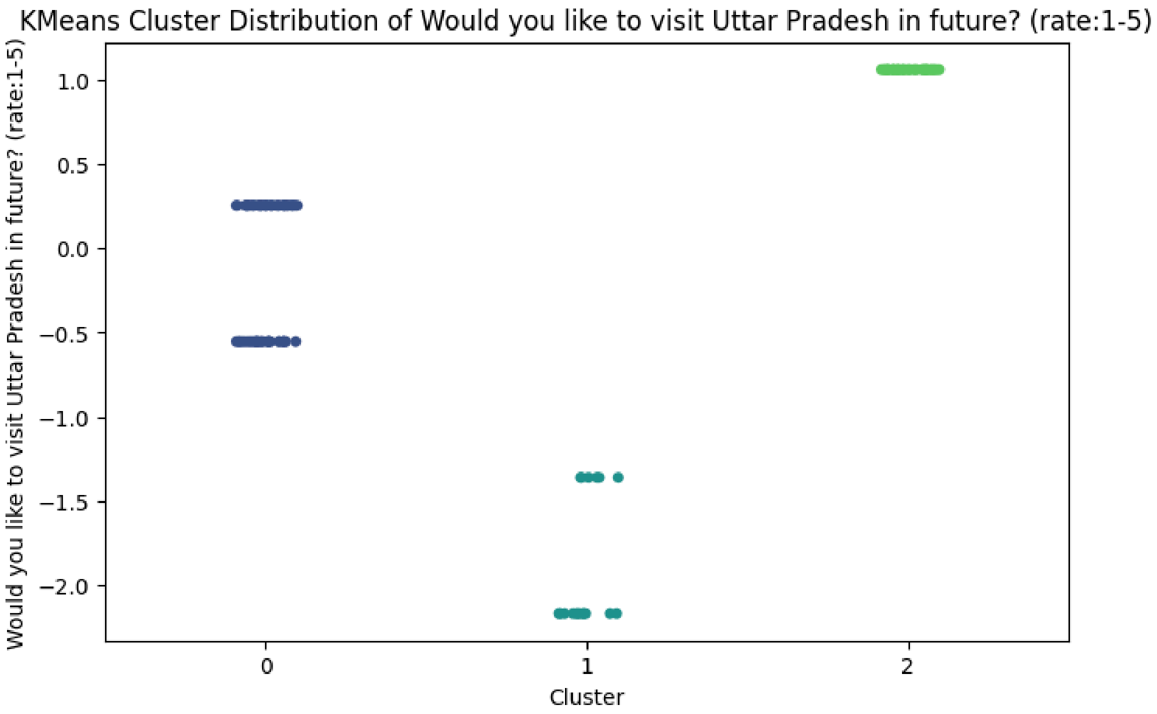
```
Paired T-Test: Visit Rating (Visited vs Not Visited)
t-statistic: nan
p-value: nan
Fail to reject H₀: No significant difference
```

#5.2 Regression Analysis

[6] Advanced Analytics :-

In [ ]:

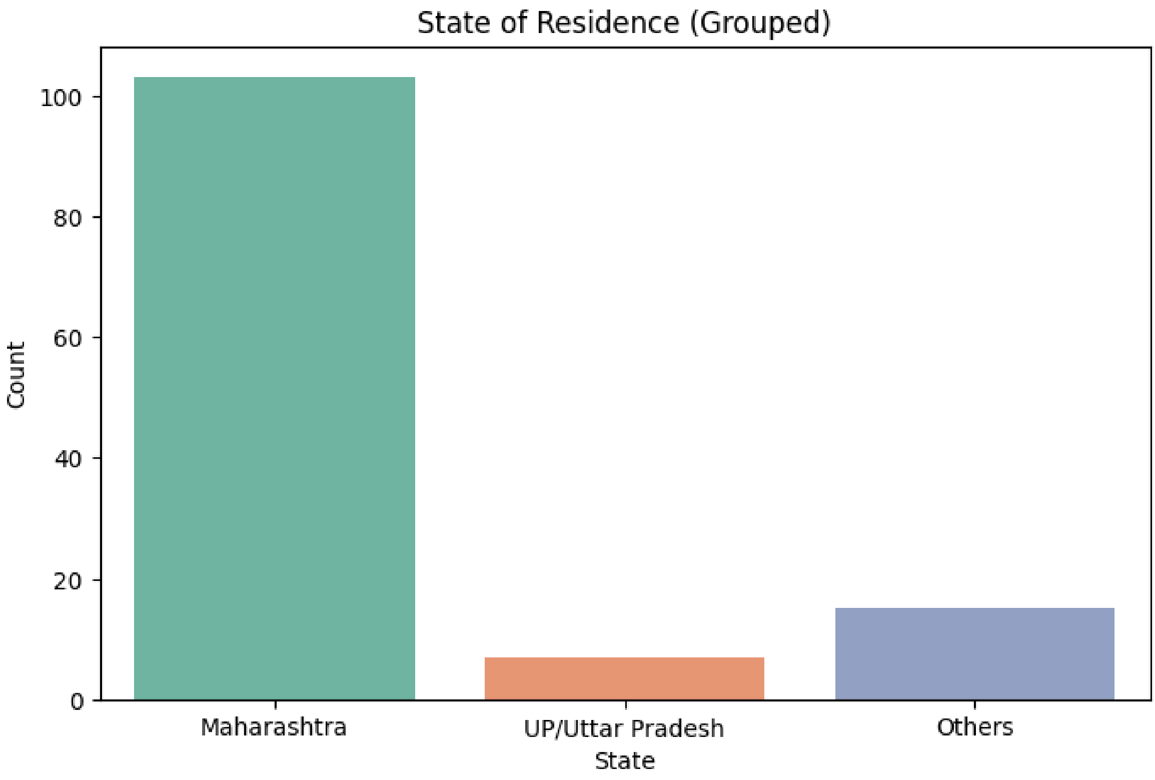
```
# KMeans Clustering - Fixing scatter plot
from sklearn.decomposition import PCA
# Ensure we're using only numerical features for clustering
kmeans_data = df[numeric_cols]
# Apply KMeans
kmeans = KMeans(n_clusters=3, random_state=0)
df['Cluster'] = kmeans.fit_predict(kmeans_data)
# Visualization based on the number of numeric features
if len(numeric_cols) >= 2:
 plt.figure(figsize=(8,5))
 sns.scatterplot(data=df, x=numeric_cols[0], y=numeric_cols[1],
hue='Cluster', palette='viridis')
 plt.title("KMeans Clustering Result")
 plt.show()
elif len(numeric_cols) == 1:
 plt.figure(figsize=(8,5))
 sns.stripplot(data=df, x='Cluster', y=numeric_cols[0],
palette='viridis', jitter=True)
 plt.title(f"KMeans Cluster Distribution of {numeric_cols[0]}")
 plt.show()
else:
 print("No numeric columns found to plot clustering.")
```



[7] Visualizations on Dataset :-

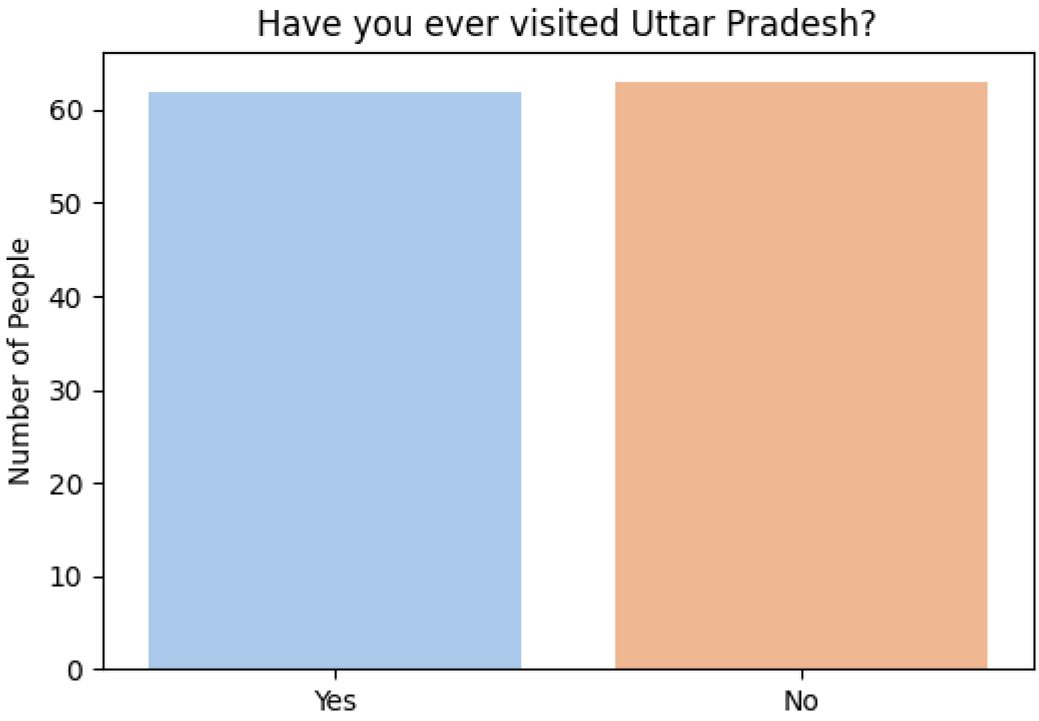
In [ ]:

```
#7.1 State of Residence (Grouped and Cleaned)
states = {
 'Maharashtra': 103,
 'UP/Uttar Pradesh': 7,
 'Others': 15
}
plt.figure(figsize=(8,5))
sns.barplot(x=list(states.keys()), y=list(states.values()),
palette="Set2")
plt.title("State of Residence (Grouped)")
plt.ylabel("Count")
plt.xlabel("State")
plt.show()
```



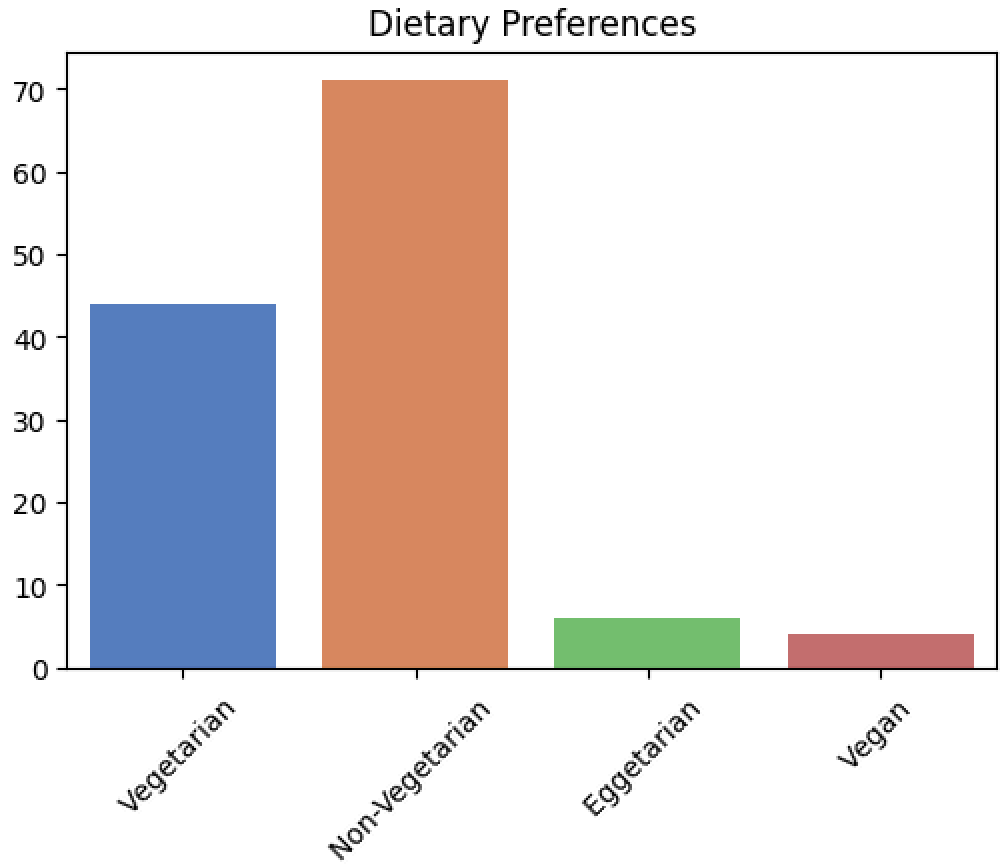
In [ ]:

```
#7.2 Have You Visited UP?
visited_up = {'Yes': 62, 'No': 63}
plt.figure(figsize=(6,4))
sns.barplot(x=list(visited_up.keys()), y=list(visited_up.values()),
palette="pastel")
plt.title("Have you ever visited Uttar Pradesh?")
plt.ylabel("Number of People")
plt.show()
```



In [ ]:

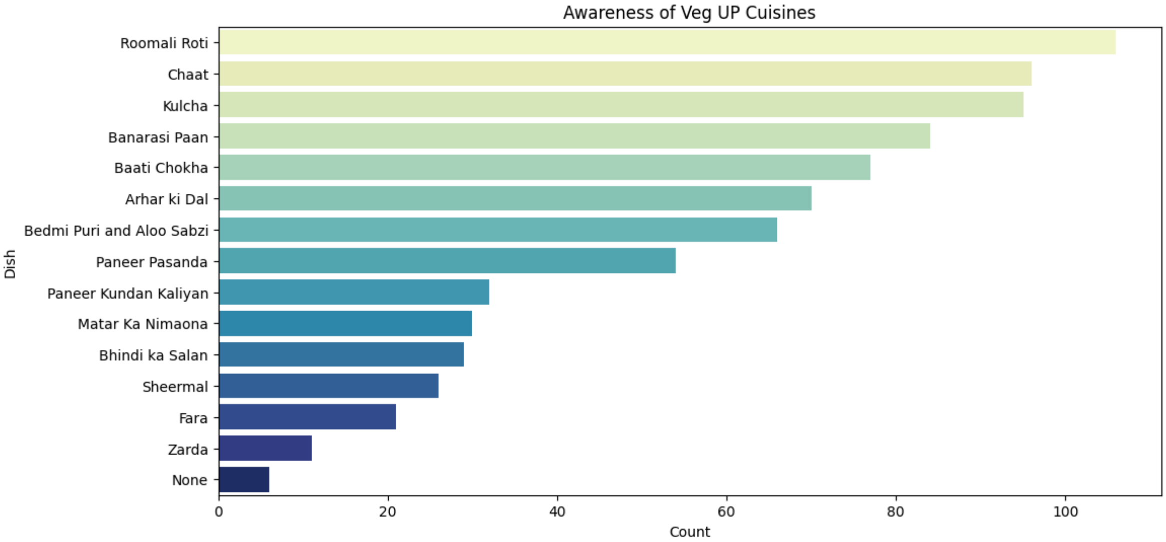
```
#7.3 Dietary Preference
diet = {
 'Vegetarian ': 44,
 'Non-Vegetarian ': 71,
 'Eggetarian ': 6,
 'Vegan ': 4
}
plt.figure(figsize=(6,4))
sns.barplot(x=list(diet.keys()), y=list(diet.values()),
palette="muted")
plt.title("Dietary Preferences")
plt.xticks(rotation=45)
plt.show()
```



In [ ]:

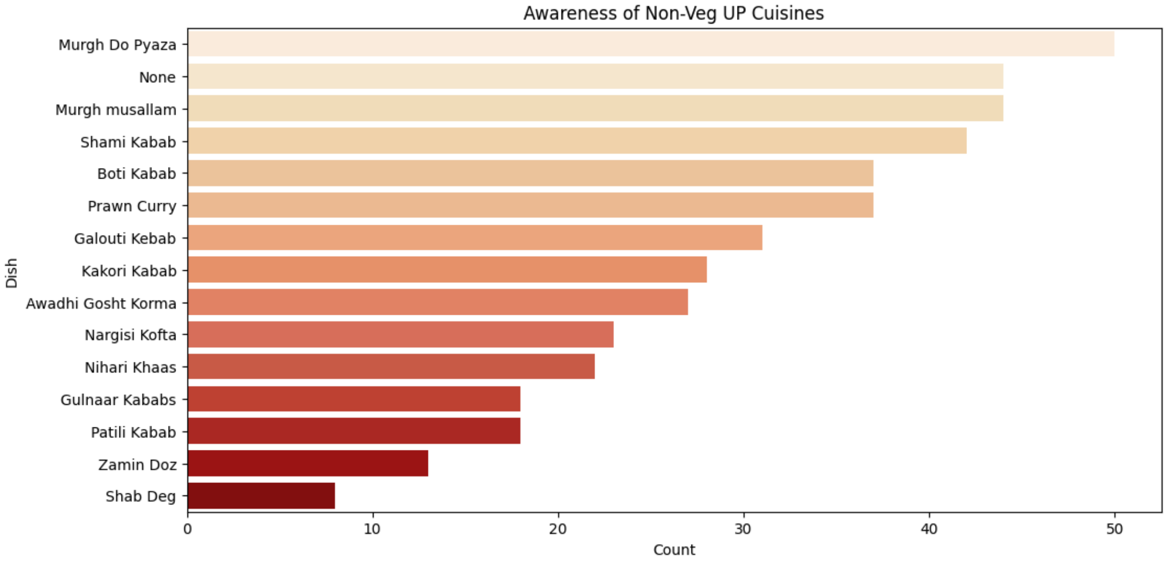
```
#7.4 Awareness of Veg UP Cuisines
veg_dishes = {
 'Roomali Roti': 106,
 'Arhar ki Dal': 70,
 'Fara': 21,
 'Matar Ka Nimaona': 30,
 'Bedmi Puri and Aloo Sabzi': 66,
 'Baati Chokha': 77,
 'Bhindi ka Salan': 29,
 'Paneer Kundan Kaliyan': 32,
 'Sheermal': 26,
 'Zarda': 11,
 'Chaat': 96,
 'Banarasi Paan': 84,
 'Kulcha': 95,
 'Paneer Pasanda': 54,
 'None': 6
}
```

```
veg_df = pd.DataFrame(list(veg_dishes.items()), columns=['Dish',
'Count'])
plt.figure(figsize=(12,6))
sns.barplot(data=veg_df.sort_values('Count', ascending=False),
x='Count', y='Dish', palette="YlGnBu")
plt.title("Awareness of Veg UP Cuisines")
plt.show()
```

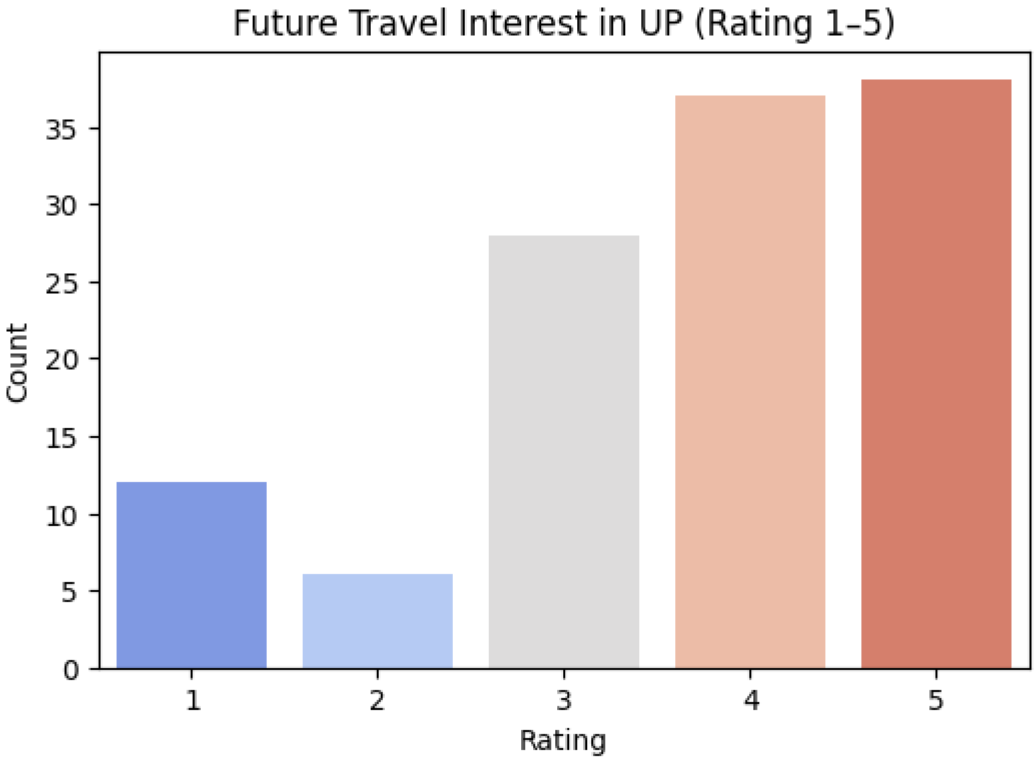


In [ ]:

```
#7.5 Awareness of Non-Veg UP Cuisines
non_veg_dishes = {
 'Shami Kabab': 42,
 'Kakori Kabab': 28,
 'Awadhi Gosht Korma': 27,
 'Prawn Curry': 37,
 'Murgh Do Pyaza': 50,
 'Galouti Kebab': 31,
 'Gulnaar Kababs': 18,
 'Nihari Khaas': 22,
 'Nargisi Kofta': 23,
 'Patili Kabab': 18,
 'Shab Deg': 8,
 'Zamin Doz': 13,
 'Boti Kabab': 37,
 'Murgh musallam': 44,
 'None': 44
}
nonveg_df = pd.DataFrame(list(non_veg_dishes.items()),
columns=['Dish', 'Count'])
plt.figure(figsize=(12,6))
sns.barplot(data=nonveg_df.sort_values('Count', ascending=False),
x='Count', y='Dish', palette="OrRd")
plt.title("Awareness of Non-Veg UP Cuisines")
plt.show()
```

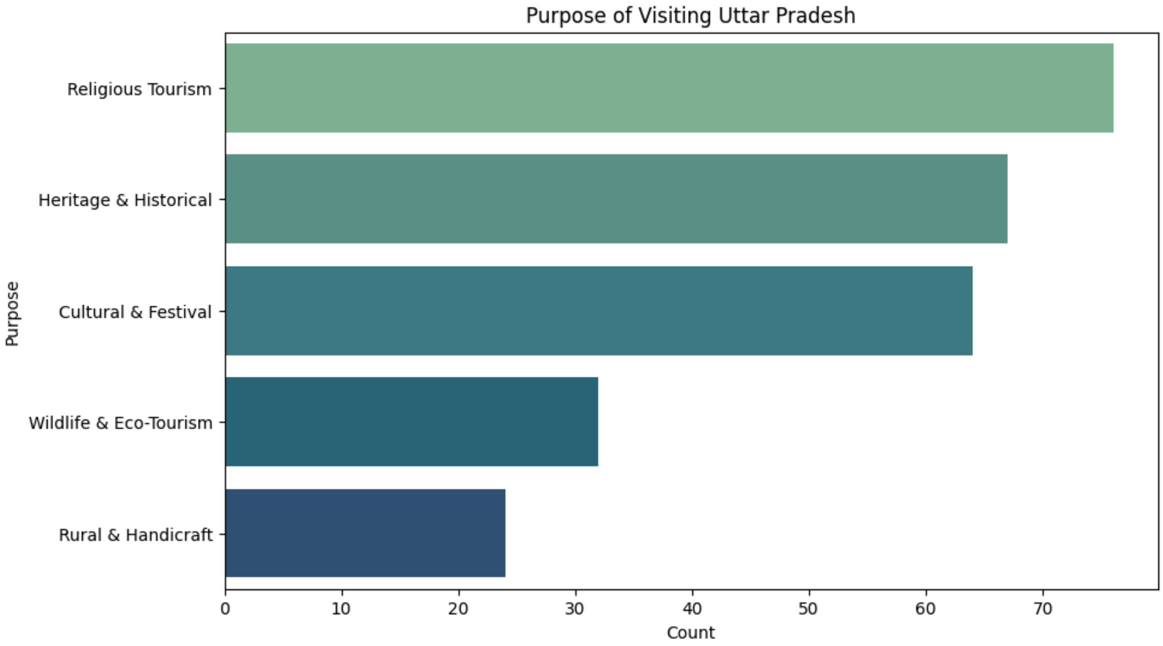


```
In [ ]: #7.6 Future Travel Plans to UP (Rating)
ratings = {1: 12, 2: 6, 3: 28, 4: 37, 5: 38}
plt.figure(figsize=(6,4))
sns.barplot(x=list(ratings.keys()), y=list(ratings.values()),
palette="coolwarm")
plt.title("Future Travel Interest in UP (Rating 1-5)")
plt.xlabel("Rating")
plt.ylabel("Count")
plt.show()
```



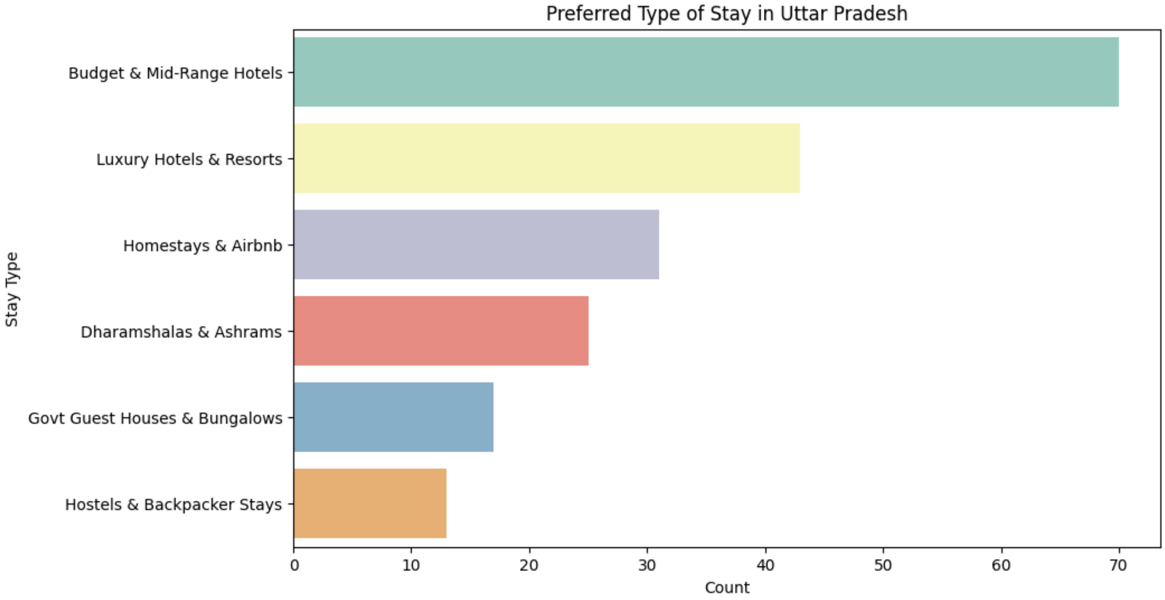
```
In [ ]: #7.7 Purpose of Visiting UP
purposes = {
 'Religious Tourism': 76,
 'Heritage & Historical': 67,
 'Wildlife & Eco-Tourism': 32,
 'Cultural & Festival': 64,
 'Rural & Handicraft': 24
}
```

```
purpose_df = pd.DataFrame(list(purposes.items()), columns=['Purpose',
'Count'])
plt.figure(figsize=(10,6))
sns.barplot(data=purpose_df.sort_values('Count', ascending=False),
y='Purpose', x='Count', palette="crest")
plt.title("Purpose of Visiting Uttar Pradesh")
plt.show()
```



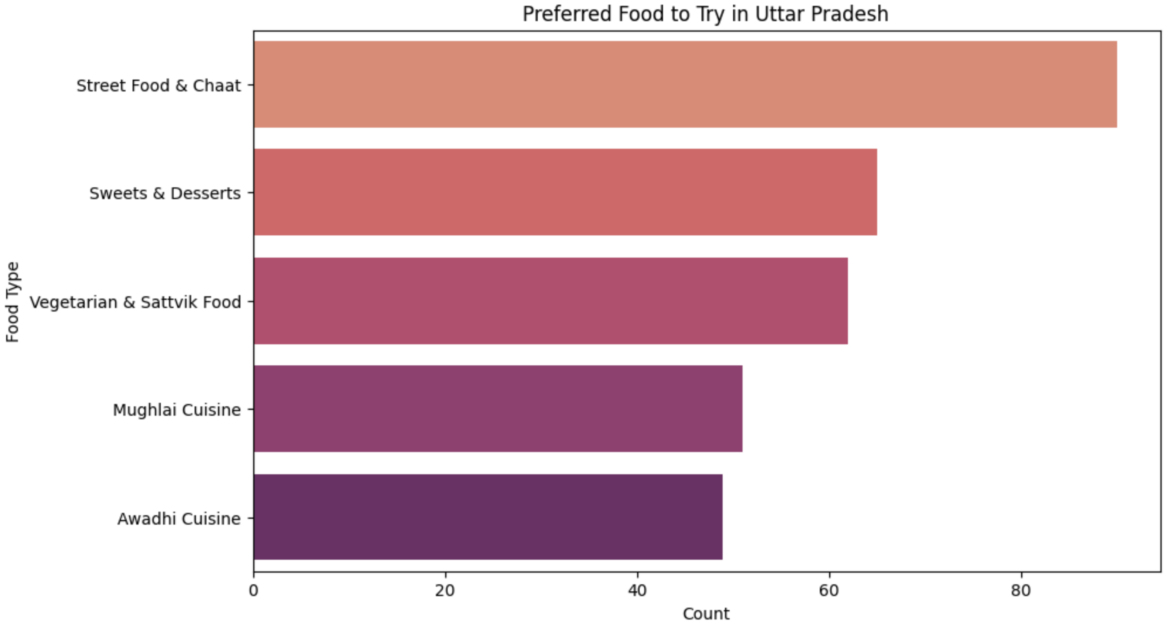
In [ ]:

```
# 7.8 Preferred Type of Stay
stay = {
 'Luxury Hotels & Resorts': 43,
 'Budget & Mid-Range Hotels': 70,
 'Dharamshalas & Ashrams': 25,
 'Homestays & Airbnb': 31,
 'Govt Guest Houses & Bungalows': 17,
 'Hostels & Backpacker Stays': 13
}
stay_df = pd.DataFrame(list(stay.items()), columns=['Stay Type',
'Count'])
plt.figure(figsize=(10,6))
sns.barplot(data=stay_df.sort_values('Count', ascending=False),
y='Stay Type', x='Count', palette="Set3")
plt.title("Preferred Type of Stay in Uttar Pradesh")
plt.show()
```



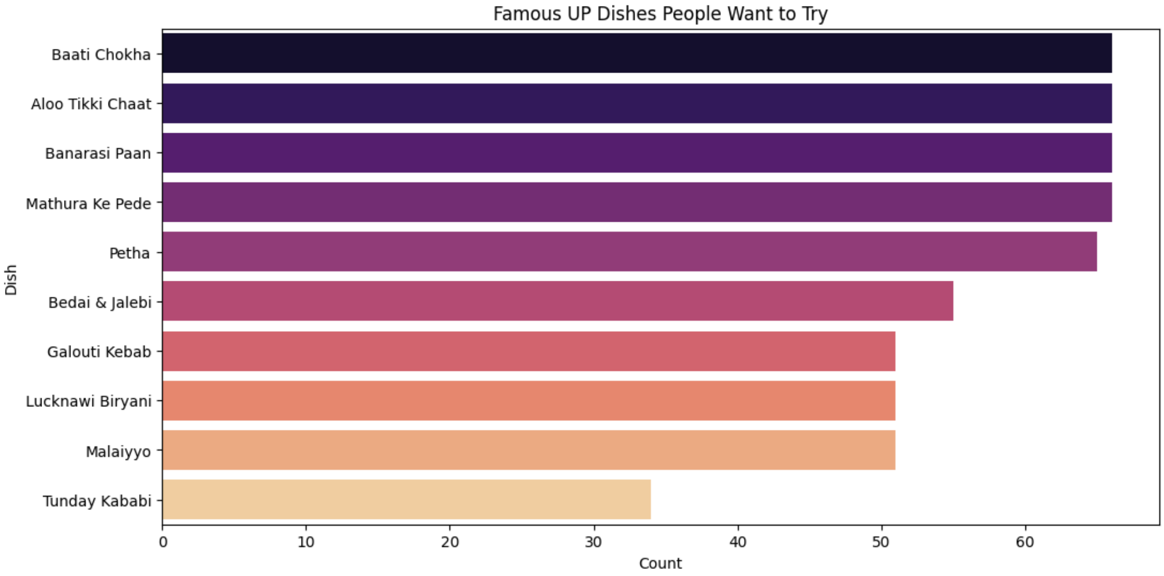
In [ ]:

```
#7.9 Preferred Food to Try
foods = {
 'Awadhi Cuisine': 49,
 'Mughlai Cuisine': 51,
 'Street Food & Chaat': 90,
 'Vegetarian & Sattvik Food': 62,
 'Sweets & Desserts': 65
}
food_df = pd.DataFrame(list(foods.items()), columns=['Food Type',
'Count'])
plt.figure(figsize=(10,6))
sns.barplot(data=food_df.sort_values('Count', ascending=False),
y='Food Type', x='Count', palette="flare")
plt.title("Preferred Food to Try in Uttar Pradesh")
plt.show()
```

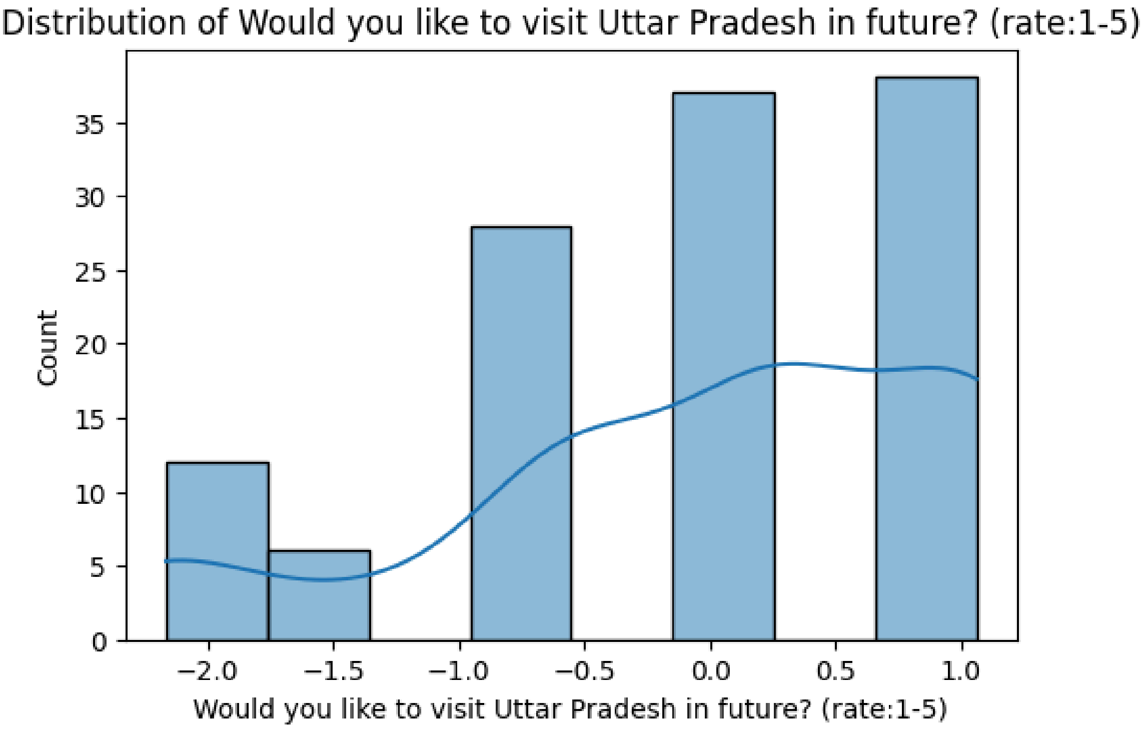


In [ ]:

```
#7.10 Famous Dishes to Try
famous_dishes = {
 'Tunday Kababi': 34,
 'Lucknawi Biryani': 51,
 'Bedai & Jalebi': 55,
 'Petha': 65,
 'Baati Chokha': 66,
 'Aloo Tikki Chaat': 66,
 'Malaiyyo': 51,
 'Galouti Kebab': 51,
 'Banarasi Paan': 66,
 'Mathura Ke Pede': 66
}
famous_df = pd.DataFrame(list(famous_dishes.items()), columns=['Dish',
'Count'])
plt.figure(figsize=(12,6))
sns.barplot(data=famous_df.sort_values('Count', ascending=False),
y='Dish', x='Count', palette="magma")
plt.title("Famous UP Dishes People Want to Try")
plt.show()
```

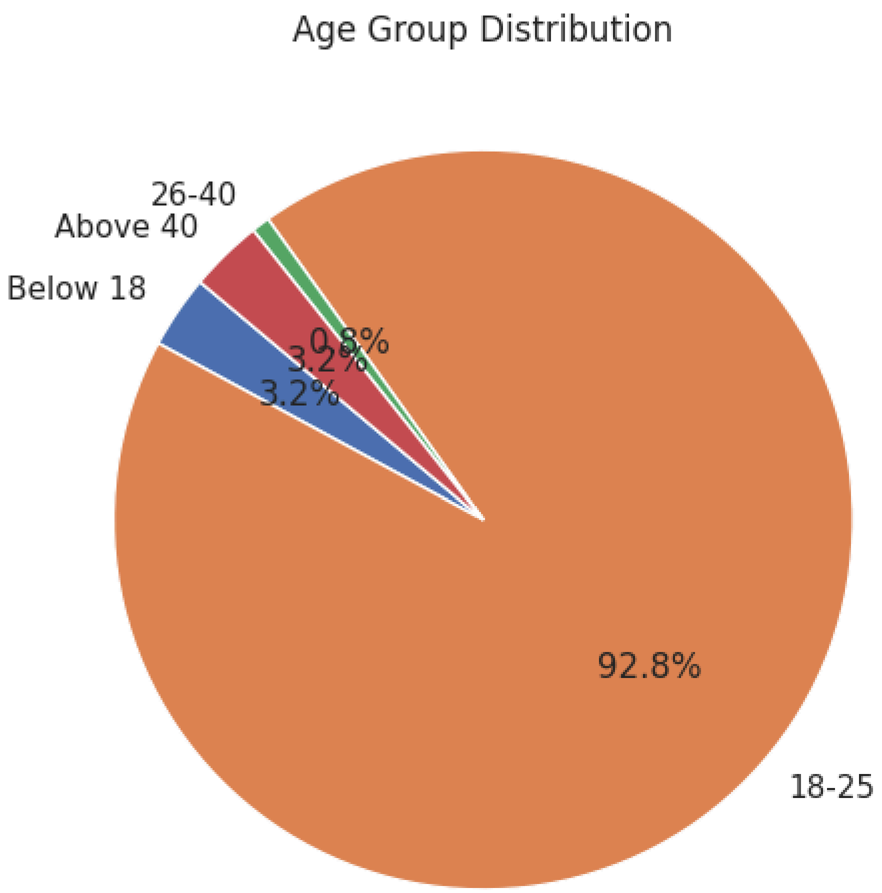


```
In [ ]: #7.11 Would You like to visit UP
        for col in numeric_cols:
         plt.figure(figsize=(6,4))
         sns.histplot(df[col], kde=True)
         plt.title(f'Distribution of {col}')
         plt.show()
```



In [ ]:

```
#7.12 Age Group Distribution
sns.set(style="whitegrid")

# Age Group
age_group = {
    'Below 18': 4,
    '18-25': 116,
    '26-40': 1,
    'Above 40': 4
}

plt.figure(figsize=(6, 6))
plt.pie(age_group.values(), labels=age_group.keys(), autopct='%1.1f%%', startangle
plt.title("Age Group Distribution")
plt.show()
```



[8] Model Building :-

#8.1 Classification Model

In [ ]:
```
# 1. Classification Model: Predict if a person has visited Uttar Pradesh
from sklearn.ensemble import RandomForestRegressor
```

In [ ]:
```
target_column = 'Would you like to visit Uttar Pradesh in future? (rate:1-5)'
```

In [ ]:
```
feature_columns = [
    '  Age Group  ',                          # Column D
    'State of Residence',                   # Column E
    'Have you ever visited Uttar Pradesh?',  # Column F
    'What is your dietary preference? ',      # Column G
    "Which of the following Uttar Pradesh's dishes do you know about or have you t
    "Which of the following Uttar Pradesh's dishes do you know about or have you t
]
```

In [ ]:
```
print("Target column:", target_column)
print("Feature columns:", feature_columns)
```

```
Target column: Would you like to visit Uttar Pradesh in future? (rate:1-5)
Feature columns: ['  Age Group  ', 'State of Residence', 'Have you ever visited Utt
ar Pradesh?', 'What is your dietary preference? ', "Which of the following Uttar Pr
adesh's dishes do you know about or have you tried? (Vegetarian)", "Which of the fo
llowing Uttar Pradesh's dishes do you know about or have you tried?  (Non-Vegetaria
n)"]
```

In [ ]:

```
print("All column names in dataframe:")
print(df.columns.tolist())
```

```
All column names in dataframe:
['Timestamp', 'Full Name', '  Age Group  ', 'State of Residence', 'Have you ever vi
sited Uttar Pradesh?', 'What is your dietary preference? ', "Which of the following
Uttar Pradesh's dishes do you know about or have you tried? (Vegetarian)", "Which o
f the following Uttar Pradesh's dishes do you know about or have you tried?  (Non-V
egetarian)", 'Would you like to visit Uttar Pradesh in future? (rate:1-5)', 'For wh
at purpose would you like to visit Uttar Pradesh', 'What kind of stay would to pref
er in Uttar Pradesh?', 'What kind of food would you like to try in Uttar Pradesh?',
'Below are the top 10 famous cuisines of Uttar Pradesh, choose that which of the di
shes would you try.', 'Cluster', 'Visited_UP']
```

In [ ]:

```
#Prepare X and Y
X = df[feature_columns].copy()
y = df[target_column].copy()
```

In [ ]:

```
y = y.fillna(y.mean())
```

In [ ]:

```
#Encode Features
X_encoded = pd.get_dummies(X, drop_first=True)
print("Features after encoding:", X_encoded.columns.tolist())
```

```
Features after encoding: ['  Age Group  ', 'State of Residence', 'Have you ever vis
ited Uttar Pradesh?', 'What is your dietary preference? ', "Which of the following
Uttar Pradesh's dishes do you know about or have you tried? (Vegetarian)", "Which o
f the following Uttar Pradesh's dishes do you know about or have you tried?  (Non-V
egetarian)"]
```

In [ ]:

```
#Split
X_train, X_test, y_train, y_test = train_test_split(
    X_encoded, y, test_size=0.2, random_state=42)
```

In [ ]:

```
print(f"Training data shape: {X_train.shape}")
print(f"Testing data shape: {X_test.shape}")
```

```
Training data shape: (96, 6)
Testing data shape: (25, 6)
```

In [ ]:

```
## Train classification model
print("Training Random Forest Regression model...")
rf_model = RandomForestRegressor(
    n_estimators=100,
    max_depth=None,
    min_samples_split=2,
    min_samples_leaf=1,
    random_state=42
)
rf_model.fit(X_train, y_train)
```

```
Training Random Forest Regression model...
```

Out[ ]:

```
▾ RandomForestRegressor
RandomForestRegressor(random_state=42)
```

In [ ]:

```python
# Predict and evaluate
y_pred = rf_model.predict(X_test)
```

In [ ]:

```python
mse = mean_squared_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)

print(f"Mean Squared Error: {mse:.4f}")
print(f"R² Score: {r2:.4f}")
print(f"Root Mean Squared Error: {np.sqrt(mse):.4f}")
```

```
Mean Squared Error: 1.1699
R² Score: -0.6683
Root Mean Squared Error: 1.0816
```

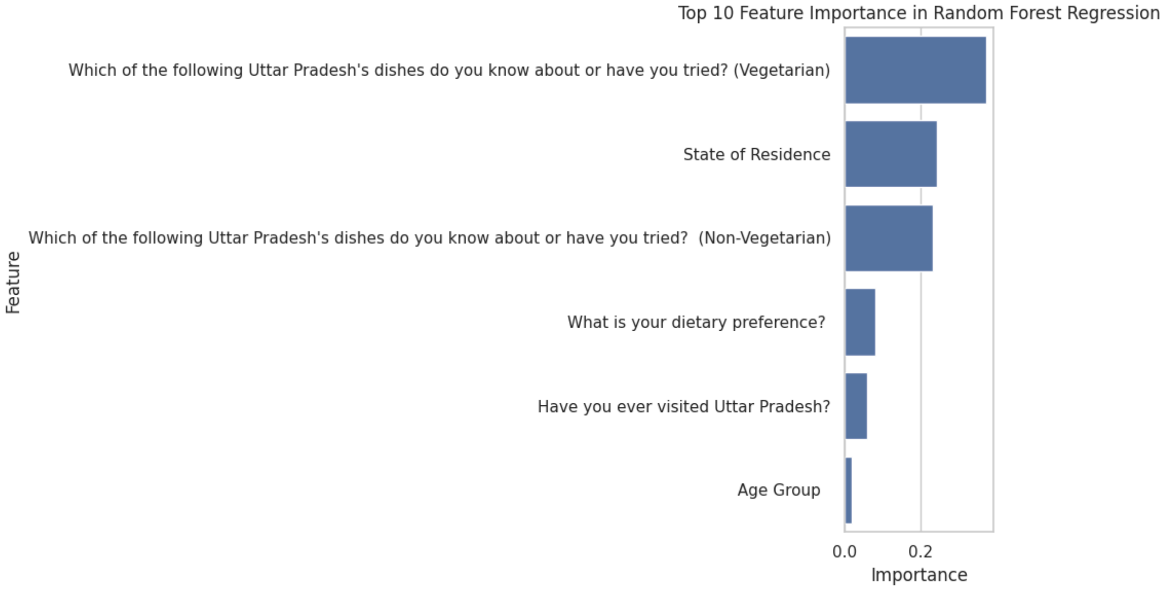
In [ ]:

```python
#Feature Importance
feature_importance = pd.DataFrame({
    'Feature': X_encoded.columns,
    'Importance': rf_model.feature_importances_
}).sort_values('Importance', ascending=False)
print("\nFeature Importance:")
print(feature_importance.head(10))
```

```
Feature Importance:
                                         Feature  Importance
4  Which of the following Uttar Pradesh's dishes ...    0.371085
1                               State of Residence    0.240530
5  Which of the following Uttar Pradesh's dishes ...    0.230883
3                   What is your dietary preference?    0.080423
2                 Have you ever visited Uttar Pradesh?    0.059118
0                                      Age Group    0.017961
```

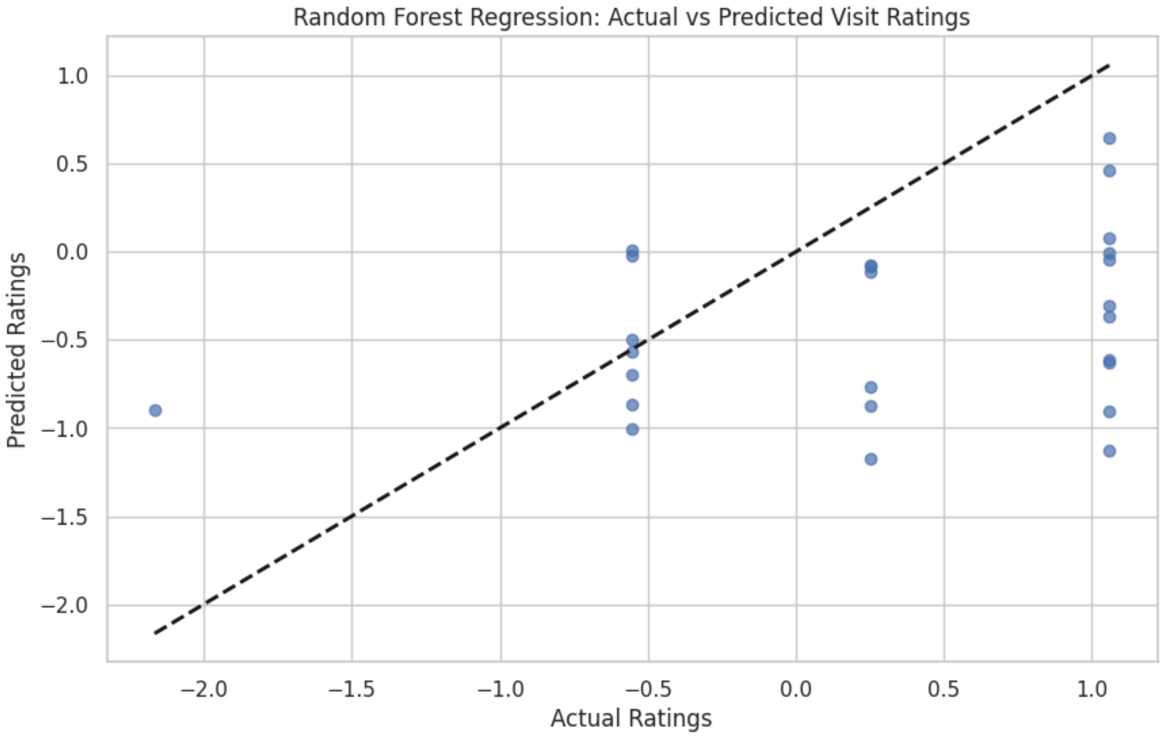
In [ ]:

```python
#Top 10 Feature Importance in Random Forest Regression
plt.figure(figsize=(10, 6))
sns.barplot(x='Importance', y='Feature', data=feature_importance.head(10))
plt.title('Top 10 Feature Importance in Random Forest Regression')
plt.tight_layout()
plt.show()
```



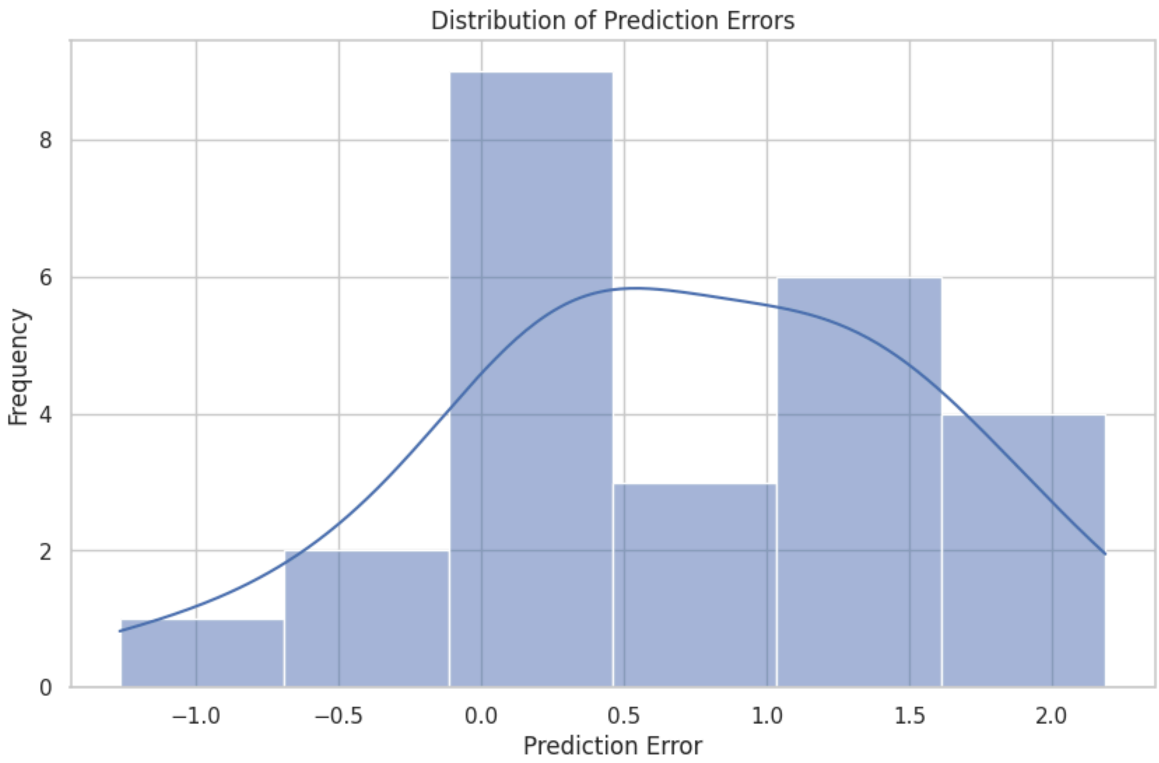
In [ ]:

```
#Actual vs Predicted Visit Ratings
plt.figure(figsize=(10, 6))
plt.scatter(y_test, y_pred, alpha=0.7)
plt.plot([y_test.min(), y_test.max()], [y_test.min(), y_test.max()], 'k--', lw=2)
plt.xlabel('Actual Ratings')
plt.ylabel('Predicted Ratings')
plt.title('Random Forest Regression: Actual vs Predicted Visit Ratings')
plt.grid(True)
plt.show()
```



In [ ]:

```
#Distribution of Prediction Errors
plt.figure(figsize=(10, 6))
errors = y_test - y_pred
sns.histplot(errors, kde=True)
plt.xlabel('Prediction Error')
plt.ylabel('Frequency')
plt.title('Distribution of Prediction Errors')
plt.grid(True)
plt.show()
```



#8.2 Regression Model

In [ ]:

```
#2. Regression Model: Predict interest in visiting UP (rating 1-5)
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error
```

In [ ]:

```
# Replace missing with average rating
df['Visit_Rating'] = df['Would you like to visit Uttar Pradesh in future? (rate:1-
```

In [ ]:

```
# Replace missing with average rating
df['Visit_Rating'] = df['Would you like to visit Uttar Pradesh in future? (rate:1-
```

In [ ]:

```
# Prepare data
X = df_encoded
y = df['Visit_Rating']
```

In [ ]:

```
# Train-test split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_st
```

In [ ]:

```
# Train regression model
reg = LinearRegression()
reg.fit(X_train, y_train)
```

Out[ ]:

```
▾ LinearRegression
LinearRegression()
```

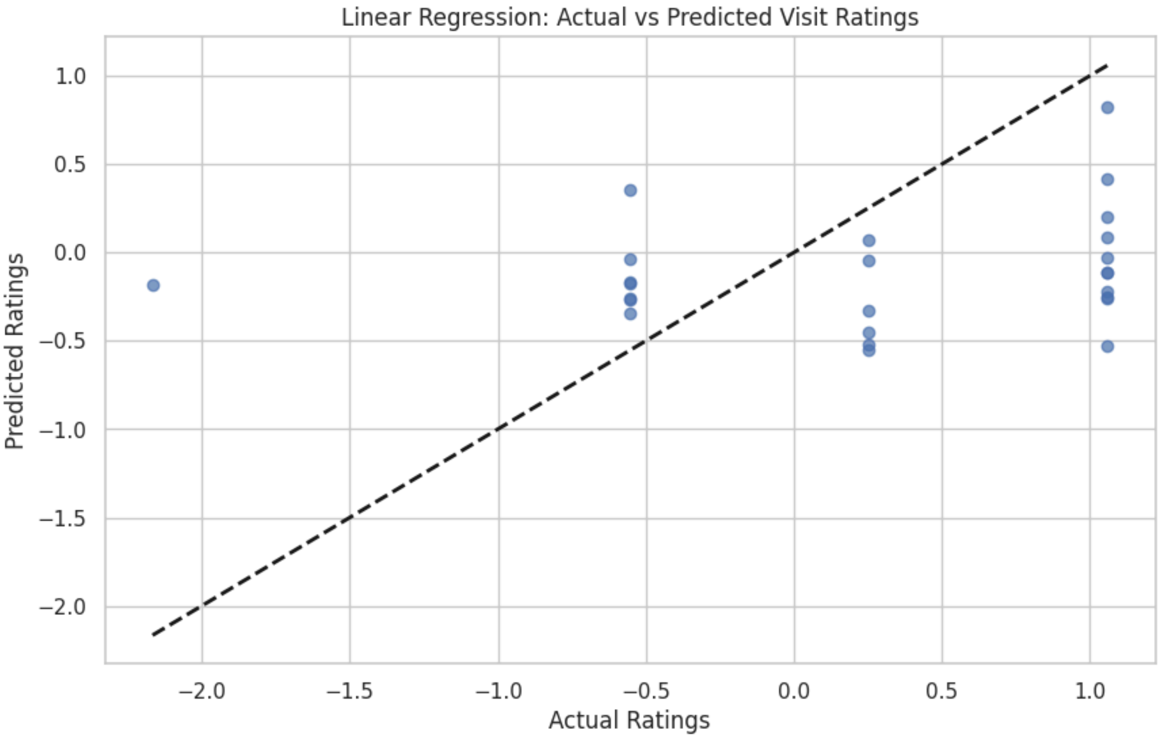
In [ ]:

```
# Predict and evaluate
y_pred = reg.predict(X_test)
print("Mean Squared Error:", mean_squared_error(y_test, y_pred))
```

```
Mean Squared Error: 0.8598061839940412
```

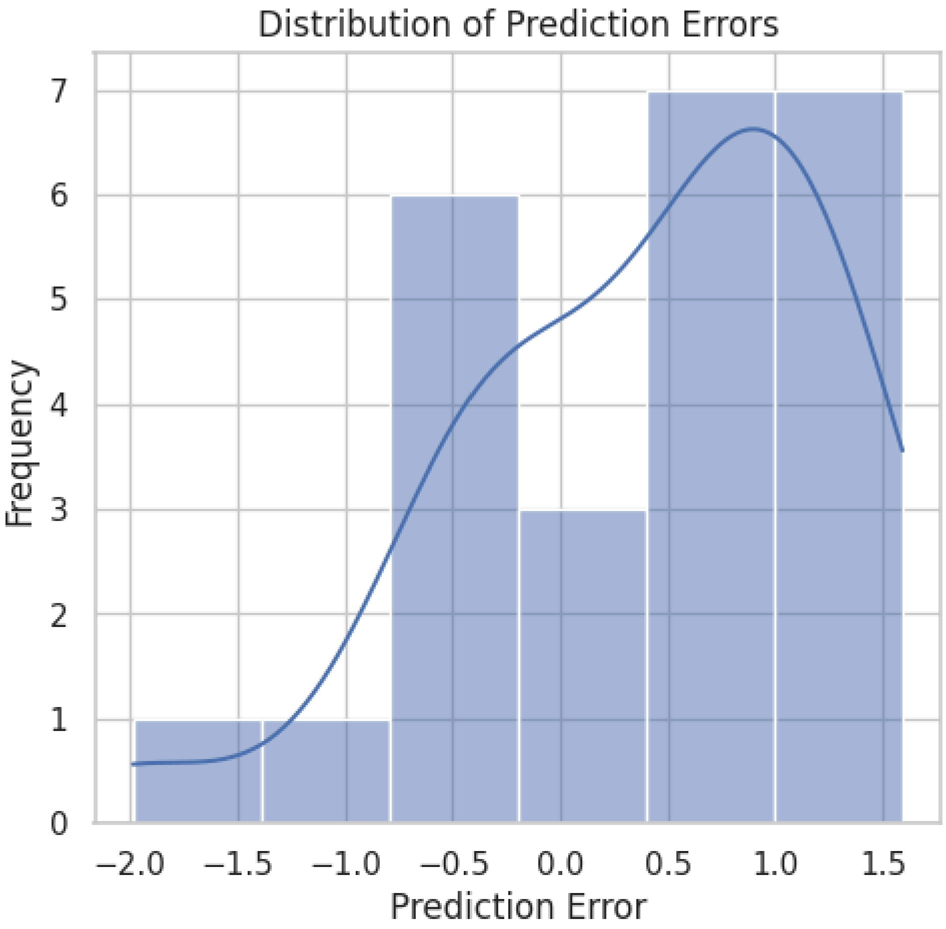
In [ ]:

```
#Linear Regression: Actual vs Predicted Visit Ratings
plt.figure(figsize=(10, 6))
plt.scatter(y_test, y_pred, alpha=0.7)
plt.plot([y_test.min(), y_test.max()], [y_test.min(), y_test.max()], 'k--', lw=2)
plt.xlabel('Actual Ratings')
plt.ylabel('Predicted Ratings')
plt.title('Linear Regression: Actual vs Predicted Visit Ratings')
plt.grid(True)
plt.show()
```



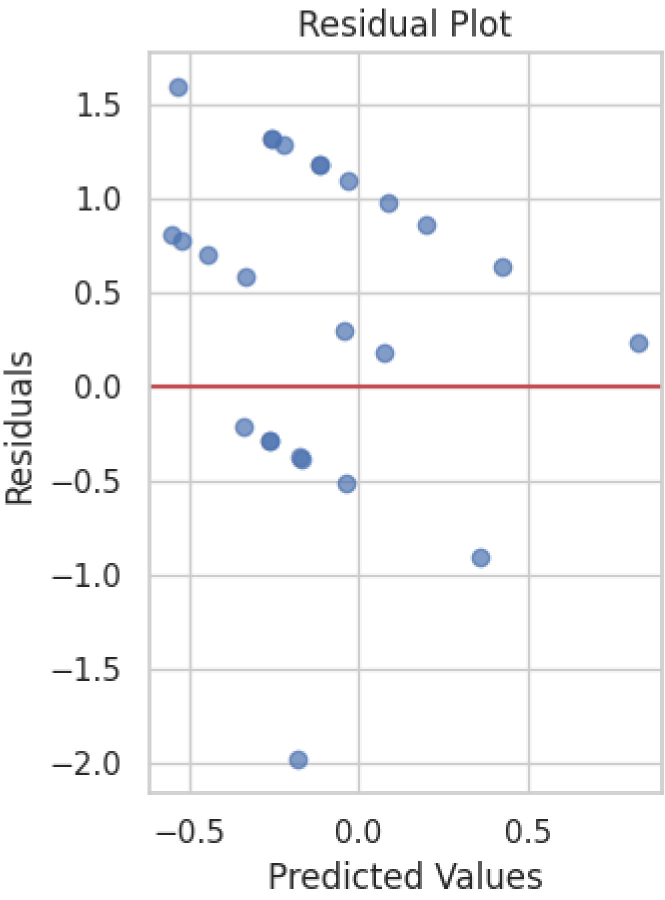
In [ ]:

```
#Distribution of Prediction Errors
residuals = y_test - y_pred

plt.figure(figsize=(12, 5))
# Residual histogram
plt.subplot(1, 2, 1)
sns.histplot(residuals, kde=True)
plt.xlabel('Prediction Error')
plt.ylabel('Frequency')
plt.title('Distribution of Prediction Errors')
plt.grid(True)
```

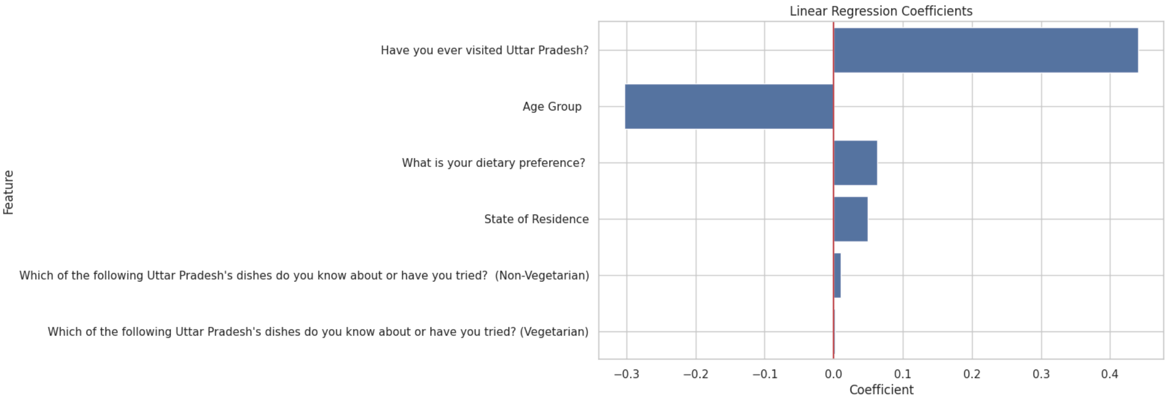


In [ ]:

```
#Residual Plot
plt.subplot(1, 2, 2)
plt.scatter(y_pred, residuals, alpha=0.7)
plt.axhline(y=0, color='r', linestyle='-')
plt.xlabel('Predicted Values')
plt.ylabel('Residuals')
plt.title('Residual Plot')
plt.grid(True)

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



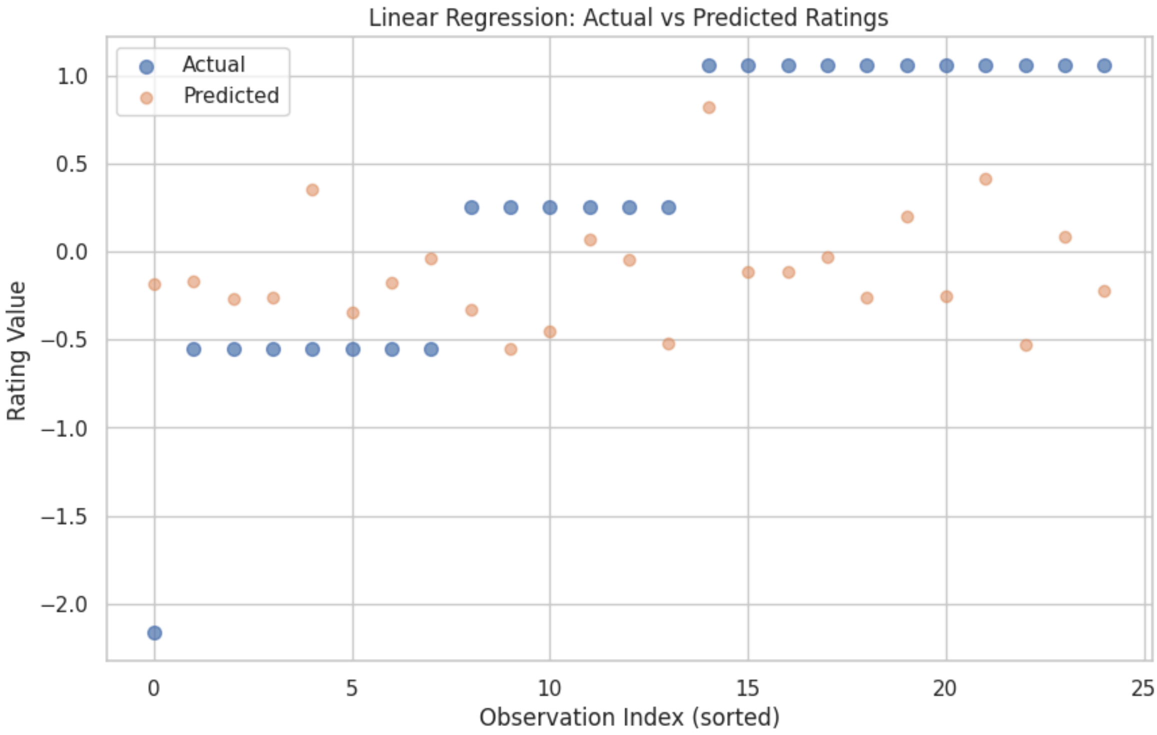
In [ ]:
```
#Linear Regression Coefficients
if hasattr(X, 'columns'):
    coefficients = pd.DataFrame({
        'Feature': X.columns,
        'Coefficient': reg.coef_
    })

    # Sort by absolute coefficient value
    coefficients['Abs_Coefficient'] = abs(coefficients['Coefficient'])
    coefficients = coefficients.sort_values('Abs_Coefficient', ascending=False)

    plt.figure(figsize=(10, 6))
    sns.barplot(x='Coefficient', y='Feature', data=coefficients)
    plt.title('Linear Regression Coefficients')
    plt.axvline(x=0, color='r', linestyle='-')
    plt.grid(True)
    plt.show()

    print("\n--- Feature Coefficients ---")
    print(coefficients[['Feature', 'Coefficient']])
```



```
--- Feature Coefficients ---
                                         Feature  Coefficient
2               Have you ever visited Uttar Pradesh?     0.440400
0                                      Age Group    -0.302740
3                  What is your dietary preference?     0.062734
1                             State of Residence     0.049046
5  Which of the following Uttar Pradesh's dishes ...     0.009827
4  Which of the following Uttar Pradesh's dishes ...     0.002188
```

In [ ]:

```
#Linear Regression: Actual vs Predicted Ratings
plt.figure(figsize=(10, 6))

# Sort by actual values for better visualization
sorted_indices = np.argsort(y_test.values)
sorted_actual = np.array(y_test)[sorted_indices]
sorted_pred = np.array(y_pred)[sorted_indices]

# Create x-axis points
x_points = np.arange(len(sorted_actual))

plt.scatter(x_points, sorted_actual, label='Actual', alpha=0.7, s=50)
plt.scatter(x_points, sorted_pred, label='Predicted', alpha=0.5)

plt.xlabel('Observation Index (sorted)')
plt.ylabel('Rating Value')
plt.title('Linear Regression: Actual vs Predicted Ratings')
plt.legend()
plt.grid(True)
plt.show()
```


Linear Regression: Actual vs Predicted Ratings
Actual
Predicted
Rating Value
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
0
5
10
15
20
25
Observation Index (sorted)