Nottingham Trent University

Department of Computer Science

SOFT40161 - Introduction to Computer Programming

Submission of the Coursework

Name: NWOGO EVERISTUS UGOCHUKWU

NTU ID: N1280799

The Full description of the Coursework is here -

SOFT40161-Coursework (Click here)

Start your answer here-

GitHub Link to access my work.

My GitHub Link: (Click here)

In [1]:
```
# import packages
import re
import pandas as pd
import seaborn as sns
from pandas.core.series import Series
from pandas.core.frame import DataFrame
```

In [2]:
```
import matplotlib.pyplot as plt
plt.rcParams['figure.figsize'] = (20, 7)
```

In [3]:
```
import warnings
warnings.filterwarnings('ignore')
```

Section 1: Control Structures (16 marks)

This section provides a detailed explanation and documentation of functions using control structures (if, for, try-except) created to aid the data analysis process:

- Age Grouping Function
  - Groups respondents' ages into defined categories (20 down, 21-30, 31-40, 41-50 and 51 up) to facilitate demographic analysis to ensures consistency in age representation across the dataset.
- Missing Values Evaluation Function
  - Calculates the number of missing values for each column by iterating through all the columns, helping to identify potential data quality issues and areas that may require imputation or removal.
- Gender Cleaning Function
  - Utilizes regular expressions to standardize gender entries (e.g., merging variations like "Male," "male," "M") to ensures consistent representation of gender data for accurate analysis.
- Country-to-Continent Mapping Function
  - Maps countries to their corresponding continents to enable regional and continental-level analysis to aid comparison of responses across different geographic regions

In [4]:
```
# Grouping ages into various categories
def group_age(age: int) -> str:
    '''
    age: int
    '''
    try:
        if age <= 20:
            return '20 down'
        elif age <= 30:
            return '21-30'
        elif age <= 40:
            return '31-40'
        elif age <= 50:
            return '41-50'
        return '51 up'
    except Exception as e:
        print(f"Error grouping age '{age}': {e}")
        return 'Unknown'

# Evaluating percentage of missing values
def evaluate_miss_values(df: DataFrame):
    '''
    df: Pandas dataframe
    '''
    try:
        miss_values = {}
        for col in df.columns:
            val = (df[col].isnull().sum() / len(df)) * 100
            miss_values[col] = val
        return miss_values
```

```
    except Exception as e:
        print(f"Error evaluating missing values in DataFrame: {e}")
        return {}

# Cleaning gender column using regular expressions
def clean_gender(gender: str):
    '''
    gender: String
    '''
    try:
        male_pattern = re.compile(r'\b(male(?:[-\s]?(?:leaning|ish|cis|trans
        female_pattern = re.compile(r'\b(female(?:[-\s]?(?:leaning|ish|cis|t

        if male_pattern.search(gender):
            return 'Male'
        elif female_pattern.search(gender):
            return 'Female'
        return 'Others'
    except Exception as e:
        print(f"Error cleaning gender '{gender}': {e}")
        return 'Unknown'
```

In [5]:
```
# To optimize the country column, let's group country by continent
continents = {
    "North America": ['United States','Bahamas', 'Canada', 'Mexico', 'Costa
    "Europe": ['United Kingdom', 'Bulgaria', 'France', 'Portugal', 'Netherla
    "Oceania": ['Australia', 'New Zealand'],
    "South America": ['Brazil', 'Colombia', 'Uruguay'],
    "Africa": ['South Africa', 'Zimbabwe', 'Nigeria'],
    "Asia": ['India', 'Israel', 'Thailand', 'Singapore', 'Japan', 'China', '
}


def country_to_continent(Country: str):
    '''
    Country: string
    '''
    try:
        for continent, countries in continents.items():
            if Country in countries:
                return continent
        return 'Unknown'
    except Exception as e:
        print(f"Error mapping country '{Country}' to continent: {e}")
        return 'Unknown'
```

In this section, I defined control structures using functions to simplify the analysis process, which will be used later in the project. These functions are designed with error handling mechanisms to catch and manage exceptions effectively, ensuring the code runs smoothly without interruptions. This demonstrates my ability to create and use appropriate and effective conditional structures in Python.

Section 2: Functions and Modules (16 marks)

This section provides an explanation and documentation of the functions used to create visualizations and format data for analysis. The visualization functions are designed to be modular and reusable, offering dynamic customization of colors, variables, titles, and axes. They include support for pie charts, doughnut charts, bar charts, count plots, scatter plots, violin plots, and line plots. Additionally, the section includes a function to format Timestamp values into a 'Year-Month' format to simplify analysis. The primary modules used in this section are pandas, matplotlib, and seaborn, which are imported at the beginning of this work.

In [70]:
```
# Pie chart plot function
def plot_pie_chart(values: list, labels: list, title: str, colors=plt.cm.Pai
    '''
    Values: List of integers
    labels: List of string for each element in the value
    title: Title of the the chart/plot
    color: Color palette to be used
    ax: Axes
    '''
    try:
        if ax is None:
            ax = plt.gca()
        ax.pie(values, labels=labels,
            wedgeprops={'edgecolor': 'black', 'linewidth': 0.5},
            textprops={'fontsize': 11, 'weight': 'roman'},
            colors=colors,
            autopct='%1.2f%%')
        ax.set_title(title, fontsize=15, color='darkblue')
    except Exception as e:
        print(f"Error in plot_pie_chart: {e}")

# Doughnut chart plot function
def plot_doughnut_chart(values: list, labels: list, title: str, colors=sns.c
    '''
    Values: List of integers
    labels: List of string for each element in the value
    title: Title of the the chart/plot
    color: Color palette to be used
    ax: Axes
    '''
    try:
        if ax is None:
            ax = plt.gca()
        ax.pie(values, labels=labels,
            wedgeprops={'edgecolor': 'black', 'linewidth': 0.5, 'width': 0.3
            textprops={'fontsize': 11, 'weight': 'bold'},
            colors=colors,
            startangle=90,
```

```
            autopct='%1.2f%%')
        ax.set_title(title, fontsize=15, color='darkblue')
    except Exception as e:
        print(f"Error in plot_doughnut_chart: {e}")

# Bar chart plot function
def plot_bar_chart(x: list, y: list, title: str, ax=None):
    '''
    x: List of integers on x axies
    y: List of integers on y axies
    title: Title of the the chart/plot
    ax: Axes
    '''
    try:
        if ax is None:
            ax = plt.gca()
        ax.bar(x=x, height=y,
            color=plt.cm.Paired(range(len(x))),
            edgecolor='black',
            linewidth=0.8)
        ax.set_title(title, fontsize=15, color='darkblue')
        ax.set_xticklabels(x, rotation=60, fontsize=11)
        ax.grid(True, axis='y', linestyle='--', linewidth=0.7, alpha=0.7)
        for index, value in enumerate(y):
            ax.text(x=index, y=value + 0.02 * max(y), s=f'{str(round(value,
    except Exception as e:
        print(f"Error in plot_bar_chart: {e}")

# Count plot function
def plot_count_plot(data: DataFrame, x: str, title: str, hue=None, ax=None):
    '''
    data: Pandas dataframe for source data
    x: string values for x axies
    hue: Grouping class column
    title: Title of the the chart/plot
    ax: Axes
    '''
    try:
        if ax is None:
            ax = plt.gca()
        sns.countplot(data=data, x=x, hue=hue, palette='Set2', ax=ax)
        ax.set_title(title, fontsize=16, color='darkblue')
        ax.set_xticklabels(ax.get_xticklabels(), rotation=45, fontsize=11, c
        ax.grid(True, axis='y', linestyle='--', linewidth=0.7, alpha=0.7)
        for container in ax.containers:
            ax.bar_label(container)
    except Exception as e:
        print(f"Error in plot_count_plot: {e}")

# Scatter plot function
def plot_scatter_plot(x: list, y: list, title: str, ax=None):
    '''
    x: List of integers on x axies
    y: List of integers on y axies
    title: Title of the the chart/plot
    ax: Axes
```

```
    '''
    try:
        if ax is None:
            ax = plt.gca()
        ax.scatter(x=x, y=y,
            color=plt.cm.Paired(range(len(x))),
            edgecolor='black',
            linewidth=0.8)
        ax.set_title(title, fontsize=15, color='darkblue')
        ax.set_xticks(range(len(x)))
        ax.set_xticklabels(x, rotation=60, fontsize=11)
        ax.grid(True, axis='y', linestyle='--', linewidth=0.7, alpha=0.7)
        for index, value in enumerate(y):
            ax.text(x=index, y=value + 0.02 * max(y), s=f'{str(round(value,
    except Exception as e:
        print(f"Error in plot_scatter_plot: {e}")

# Violin plot function
def plot_violin_plot(data: DataFrame, x: str, title: str, hue=None, ax=None)
    '''
    data: Pandas dataframe for source data
    x: string values for x axies
    hue: Grouping class column
    title: Title of the the chart/plot
    ax: Axes
    '''
    try:
        if ax is None:
            ax = plt.gca()
        sns.violinplot(data=data, x=x, hue=hue, palette='Set2', ax=ax)
        ax.set_title(title, fontsize=16, color='darkblue')
        for label in ax.get_xticklabels():
            label.set_rotation(45)
        ax.set_xticklabels(ax.get_xticklabels(), fontsize=10)
    except Exception as e:
        print(f"Error in plot_violin_plot: {e}")
```

In [7]:
```
# Timestamp to YearMonth converter function
def timestamp_formatter(df: DataFrame):
    '''
    df: Pandas dataframe
    '''
    try:
        # Convert 'Timestamp' column to datetime and extract year month
        df['Timestamp'] = pd.to_datetime(df['Timestamp'])
        df['YearMonth'] = df['Timestamp'].dt.to_period('M')
        df.drop(columns=['Timestamp'], inplace=True)
    except KeyError as e:
        print(f"Error: The 'Timestamp' column is missing in the dataframe. {
    except Exception as e:
        print(f"An error occurred while formatting the timestamp: {e}")
```

In this section, I created reusable and dynamic functions for handling visualizations and time formatting, which will be used in exploratory data analysis (EDA) and data cleaning,

respectively. These functions include error handling to ensure smooth execution. This demonstrates my ability to create and use appropriate and effective function in Python.

Section 3: Data Handling with Pandas (16 marks)

This section provides an explanation and documentation of the data handling process in this work, which includes:

- How the data was read into the dataset
- How relevant columns were selected for analysis
- Data understanding
- Handling missing values and duplicate values using fillna and duplication method
- Data formatting for consistency
- Filter and aggregate functions using groupby method
- Save csv using to_csv method

In [ ]:
```
# Read dataset into pandas frame
url = 'dataset/survey.csv'
df = pd.read_csv(url, index_col='s/n')
df.head(2)
```

Out[ ]:

s/n	Timestamp	Age	Gender	Country	state	self_employed	family_history	treatment
0	8/27/2014 11:29	37	Female	United States	IL	NaN	No	Yes
1	8/27/2014 11:29	44	M	United States	IN	NaN	No	No

2 rows × 27 columns

In [9]:
```
# Checking the shape of the dataset
size = df.shape
print(f'The dataset has {size[1]} columns and {size[0]} rows')
```

```
The dataset has 27 columns and 1273 rows
```

In [ ]:
```
# Statistical description of numerical columns
df.describe()
```

Out[ ]:

	Age
count	1.273000e+03
mean	7.855463e+07
std	2.802759e+09
min	-1.726000e+03
25%	2.700000e+01
50%	3.100000e+01
75%	3.600000e+01
max	1.000000e+11

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

```
<class 'pandas.core.frame.DataFrame'>
Index: 1273 entries, 0 to 1272
Data columns (total 27 columns):
 #   Column                     Non-Null Count  Dtype 
---  ------                     --------------  ----- 
 0   Timestamp                  1273 non-null   object
 1   Age                        1273 non-null   int64 
 2   Gender                     1273 non-null   object
 3   Country                    1273 non-null   object
 4   state                      752 non-null    object
 5   self_employed              1255 non-null   object
 6   family_history             1273 non-null   object
 7   treatment                  1273 non-null   object
 8   work_interfere             1006 non-null   object
 9   no_employees               1273 non-null   object
 10  remote_work                1273 non-null   object
 11  tech_company               1273 non-null   object
 12  benefits                   1273 non-null   object
 13  care_options               1273 non-null   object
 14  wellness_program           1273 non-null   object
 15  seek_help                  1273 non-null   object
 16  anonymity                  1273 non-null   object
 17  leave                      1273 non-null   object
 18  mental_health_consequence  1273 non-null   object
 19  phys_health_consequence    1273 non-null   object
 20  coworkers                  1273 non-null   object
 21  supervisor                 1273 non-null   object
 22  mental_health_interview    1273 non-null   object
 23  phys_health_interview      1273 non-null   object
 24  mental_vs_physical         1273 non-null   object
 25  obs_consequence            1273 non-null   object
 26  comments                   165 non-null    object
dtypes: int64(1), object(26)
memory usage: 278.5+ KB
```

In [13]:
```
df.isnull().sum()
```

Out[13]:
```
Timestamp                      0
Age                            0
Gender                         0
Country                        0
state                        521
self_employed                 18
family_history                 0
treatment                      0
work_interfere               267
no_employees                   0
remote_work                    0
tech_company                   0
benefits                       0
care_options                   0
wellness_program               0
seek_help                      0
anonymity                      0
leave                          0
mental_health_consequence      0
phys_health_consequence        0
coworkers                      0
supervisor                     0
mental_health_interview        0
phys_health_interview          0
mental_vs_physical             0
obs_consequence                0
comments                    1108
dtype: int64
```

In [14]:
```
# Selecting revalevant columns for analysis
select_cols = ['Timestamp', 'Age', 'Gender', 'Country', 'state', 'self_emplo
```

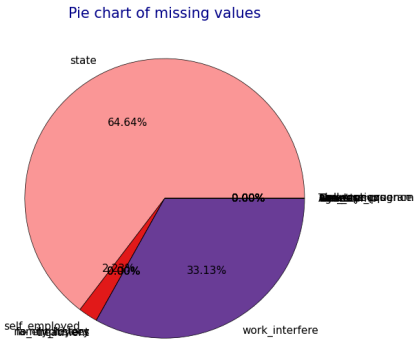
In [ ]:
```
# Drill down the dimension of the dataset
df = df[select_cols]
df.head(2)
```

Out[ ]:

s/n	Timestamp	Age	Gender	Country	state	self_employed	family_history	treatment
0	8/27/2014 11:29	37	Female	United States	IL	NaN	No	Yes
1	8/27/2014 11:29	44	M	United States	IN	NaN	No	No

In [17]:
```
# Ploting missing values
fig, (ax1, ax2) = plt.subplots(1, 2)

miss_values: dict = evaluate_miss_values(df)

# Bar chart distribution of missing values
plot_bar_chart(miss_values.keys(), miss_values.values(), 'Missing values dis
plt.ylabel('Distribution', fontsize=12);
```

```
# ploting a pie chat of missing values
plot_pie_chart(list(miss_values.values()), list(miss_values.keys()), 'Pie ch
plt.tight_layout()
```



In [18]:
```
# Creating a new column of continents from countries
df['Continents'] = df['Country'].apply(lambda z: country_to_continent(z))
```

In [19]:
```
# Grouping age
df['Age'] = df['Age'].apply(group_age)
df.head(2)
```

Out[19]:

s/n	Timestamp	Age	Gender	Country	state	self_employed	family_history	treatment
0	8/27/2014 11:29	31-40	Female	United States	IL	NaN	No	Yes
1	8/27/2014 11:29	41-50	M	United States	IN	NaN	No	No

In [20]:
```
# Unique entries in gender column
df['Gender'].unique()
```

Out[20]:
```
array(['Female', 'M', 'Male', 'male', 'female', 'm', 'Male-ish', 'maile',
       'Trans-female', 'Cis Female', 'F', 'something kinda male?',
       'Cis Male', 'Woman', 'f', 'Mal', 'Male (CIS)', 'queer/she/they',
       'non-binary', 'Femake', 'woman', 'Make', 'Nah', 'All', 'Enby',
       'fluid', 'Genderqueer', 'Female ', 'Androgyne', 'Agender',
       'cis-female/femme', 'Guy (-ish) ^_^', 'male leaning androgynous',
       'Male ', 'Man', 'Trans woman', 'msle', 'Neuter', 'Female (trans)',
       'queer', 'Female (cis)', 'Mail', 'cis male', 'A little about you',
       'Malr', 'p', 'femail', 'Cis Man',
       'ostensibly male, unsure what that really means'], dtype=object)
```

In [21]:
```
df['no_employees'].unique()
```

Out[21]:
```
array(['Less than 26', 'More than 1000', '26-100', '100-500', '500-1000'],
      dtype=object)
```

In [22]:
```
# Cleaning gender column
df['Gender'] = df['Gender'].apply(clean_gender)
df.head(2)
```

Out[22]:

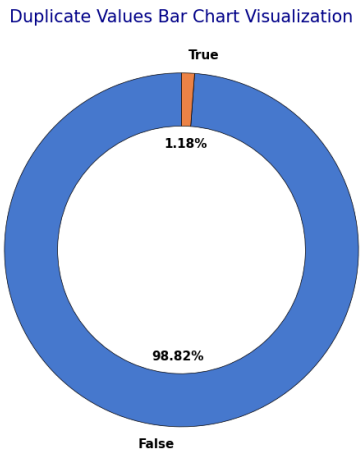
s/n	Timestamp	Age	Gender	Country	state	self_employed	family_history	treatment
0	8/27/2014 11:29	31-40	Female	United States	IL	NaN	No	Yes
1	8/27/2014 11:29	41-50	Male	United States	IN	NaN	No	No

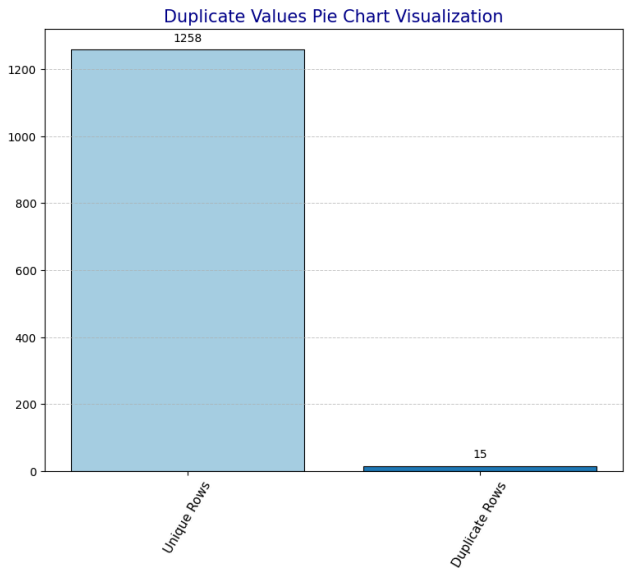
In [23]:
```
df['Gender'].unique()
```

Out[23]:
```
array(['Female', 'Male', 'Others'], dtype=object)
```

In [24]:
```
# Create a new column -> duplicate
df['duplicates'] = df.duplicated(keep='last')
# Count duplicates and non-duplicates
duplicates_counts = df['duplicates'].value_counts()
```

In [ ]:
```
# Plot duplicates and non-duplicates values count
fig, (ax1, ax2) = plt.subplots(1, 2)
plot_bar_chart(duplicates_counts.index, duplicates_counts.values, title='Dup
plt.xticks([0, 1], ['Unique Rows', 'Duplicate Rows']);

plot_doughnut_chart(labels=duplicates_counts.index, values=duplicates_counts
```





In [26]:
```
# Drop all duplicates and drop the duplicate column
df = df.drop_duplicates(keep='last').drop(columns=['duplicates'])
```

In [27]:
```
# Fill missing values on self employed column using the mode
self_employed_mode = df['self_employed'].mode()[0]
df['self_employed'] = df['self_employed'].fillna(self_employed_mode)
```

```
df.head(2)
```

Out[27]:

s/n	Timestamp	Age	Gender	Country	state	self_employed	family_history	treatment
0	8/27/2014 11:29	31-40	Female	United States	IL	No	No	Yes
1	8/27/2014 11:29	41-50	Male	United States	IN	No	No	No

In [28]:
```
# Formating timestamp column
timestamp_formatter(df)
```

In [29]:
```
# Droping all columns with missing values
df.dropna(axis=1, inplace=True)
```

In [30]:
```
# Droping columns with missing values
df.isnull().sum()
```

Out[30]:
```
Age                0
Gender             0
Country            0
self_employed      0
family_history     0
treatment          0
no_employees       0
wellness_program   0
leave              0
care_options       0
obs_consequence    0
Continents         0
YearMonth          0
dtype: int64
```

In [32]:
```
df.head(2)
```

Out[32]:

s/n	Age	Gender	Country	self_employed	family_history	treatment	no_employees	wel
0	31-40	Female	United States	No	No	Yes	Less than 26	
1	41-50	Male	United States	No	No	No	More than 1000	

In [ ]:
```
# Let's filter male with mental health
staff_with_mental_health = df[(df['obs_consequence'] == 'Yes') & (df['Gender

# Save as csv in analysis folder
```

```
staff_with_mental_health.to_csv('analysis/staff_with_mental_health.csv')
staff_with_mental_health.head(5)
```

Out[ ]:

	Age	Gender	Country	self_employed	family_history	treatment	no_employees	welln
0	31-40	Male	United Kingdom	No	Yes	Yes	26-100	
1	41-50	Male	United States	Yes	Yes	No	Less than 26	
2	31-40	Male	United States	Yes	Yes	No	Less than 26	
3	21-30	Male	United Kingdom	No	No	Yes	Less than 26	
4	41-50	Male	United States	No	Yes	Yes	More than 1000	

In [ ]:
```
# Group gender by number observation
gender_grouped = df.groupby(['obs_consequence', 'Gender']).size().reset_inde

gender_grouped
```

Out[ ]:

	obs_consequence	Gender	observations
0	No	Female	204
1	No	Male	871
2	No	Others	12
3	Yes	Female	50
4	Yes	Male	131
5	Yes	Others	5

In [ ]:
```
# Group countries by number
countries_grouped = df.groupby(['obs_consequence', 'Country']).size().reset_

countries_grouped
```

Out[ ]:

	obs_consequence	Country	observations
0	No	Australia	13
1	No	Austria	3
2	No	Belgium	4
3	No	Brazil	3
4	No	Bulgaria	3
...	...	...	...
63	Yes	South Africa	3
64	Yes	Sweden	1
65	Yes	United Kingdom	38
66	Yes	United States	90
67	Yes	Zimbabwe	1

68 rows × 3 columns

In [ ]:
```
# People that filled the survey in 2014
df_2014 = df[df['YearMonth'].dt.year == 2014]

# Save 2024 record as csv in analysis folder
df_2014.to_csv('analysis/survey_2024.csv')
df_2014
```

Out[ ]:

s/n	Age	Gender	Country	self_employed	family_history	treatment	no_employees
0	31-40	Female	United States	No	No	Yes	Less than 26
1	41-50	Male	United States	No	No	No	More than 1000
2	31-40	Male	Canada	No	No	No	Less than 26
3	31-40	Male	United Kingdom	No	Yes	Yes	26-100
4	31-40	Male	United States	No	No	No	100-500
...	...	...	...	...	...	...	...
1268	21-30	Male	United States	No	No	No	More than 1000
1269	21-30	Male	United States	No	No	No	More than 1000
1270	31-40	Female	United States	No	Yes	Yes	26-100
1271	21-30	Male	United Kingdom	No	No	Yes	Less than 26
1272	20 down	Male	Georgia	No	No	No	26-100

1204 rows × 13 columns

In this section, I successfully cleaned the data, preparing it for analysis and machine learning modeling. Using various pandas methods, I explored and understood the dataset. I applied functions from Sections 1 and 2 to create visualizations and properly format the columns. Missing values and duplicates were handled with appropriate strategies, and I filtered and aggregated the data for better clarity and interpretation. This demonstrates my ability to work with pandas for data handling in Python.

Section 4: Data Visualization (16 marks)

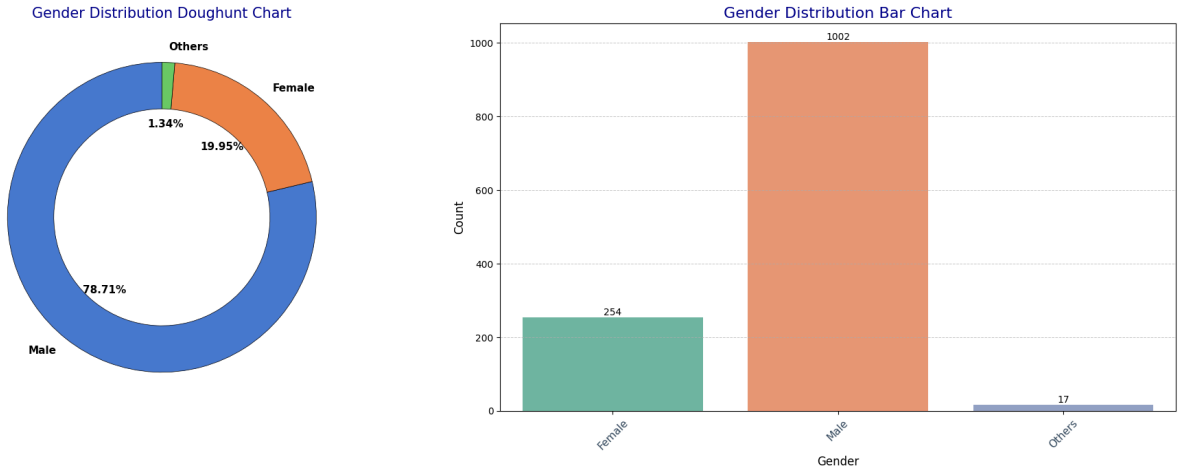
This section covers various visualizations for better data understanding, including:

- Univariate Analysis: This provides insights into individual columns in the dataset.
- Bivariate Analysis: This explores the relationship between two variables in the dataset.
- Multivariate Analysis: This examines the relationships between more than two columns in the dataset.

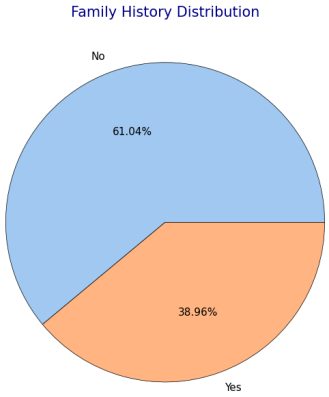
These visualizations help uncover hidden patterns in the data and provide a clearer understanding of how the variables relate to one another, giving valuable business insights.

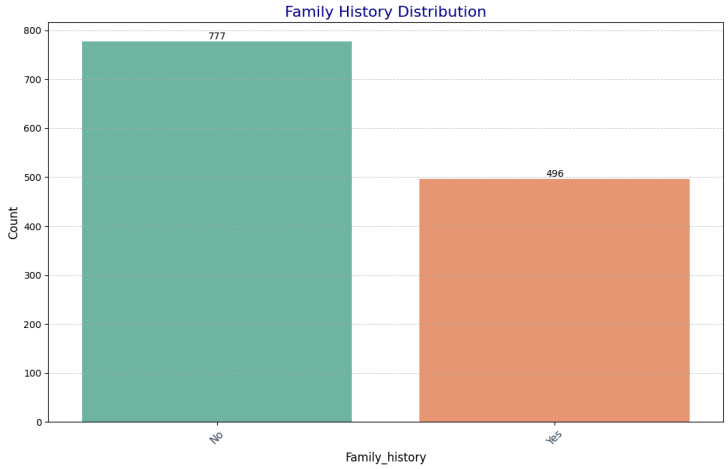
Univariant Analysis

In [ ]:
```
# Gender distribution charts
fig, (ax1, ax2) = plt.subplots(1, 2)

plot_count_plot(df, 'Gender', 'Gender Distribution Bar Chart', ax=ax2);
plt.xlabel('Gender', fontsize=12);
plt.ylabel('Count', fontsize=12);

values = df['Gender'].value_counts()
labels = values.index
plot_doughnut_chart(values, labels,"Gender Distribution Doughnut Chart",  ax
plt.tight_layout()
```

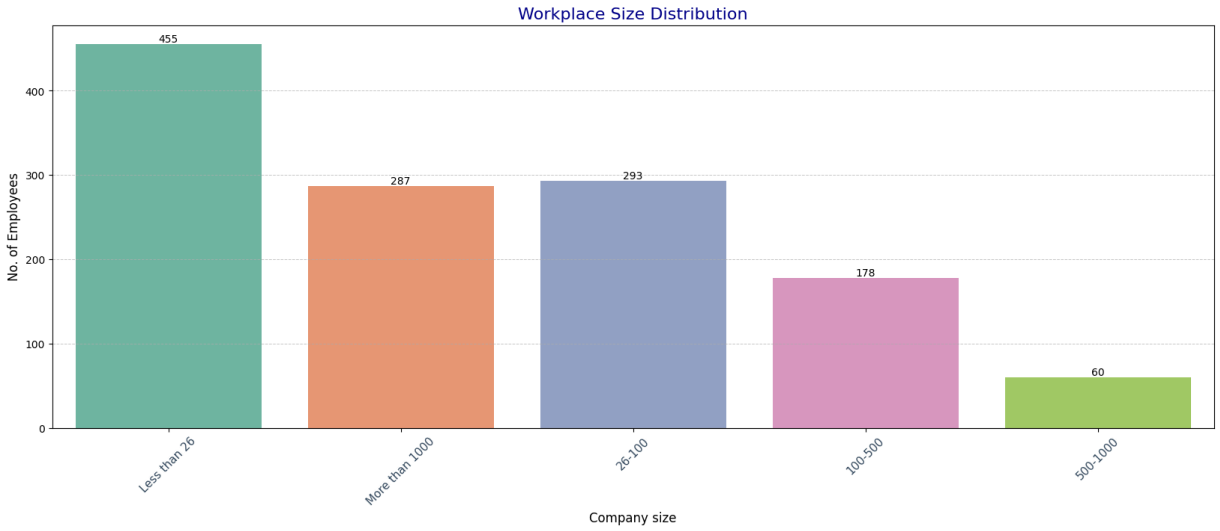


In [ ]:
```
# Family History Distribution
fig, (ax1, ax2) = plt.subplots(1, 2)
values = df['family_history'].value_counts()
labels = values.index
plot_pie_chart(values, labels, 'Family History Distribution', sns.color_pale

plot_count_plot(df, 'family_history', 'Family History Distribution', ax=ax2)
plt.xlabel('Family_history', fontsize=12);
plt.ylabel('Count', fontsize=12);

plt.tight_layout()
```

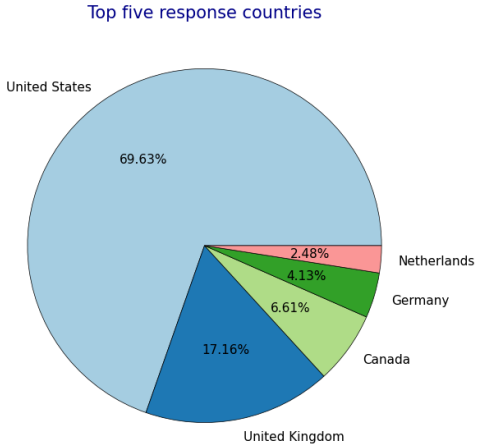


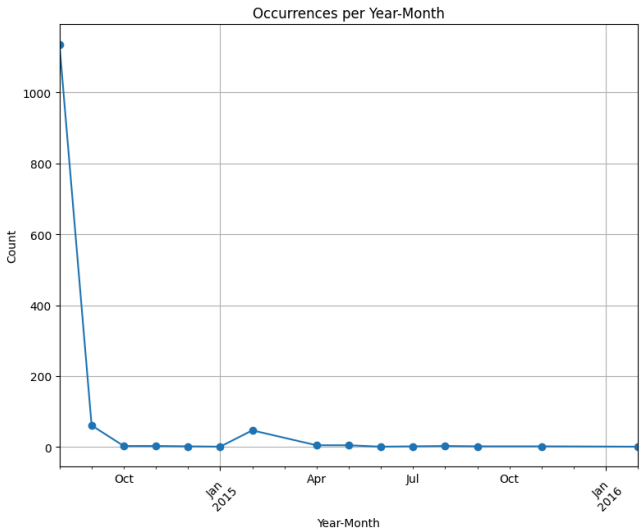


In [71]:
```
# Number of employee distribution
plot_count_plot(df, 'no_employees', 'Workplace Size Distribution')
plt.xlabel('Company size', fontsize=12)
plt.ylabel('No. of Employees', fontsize=12);
```



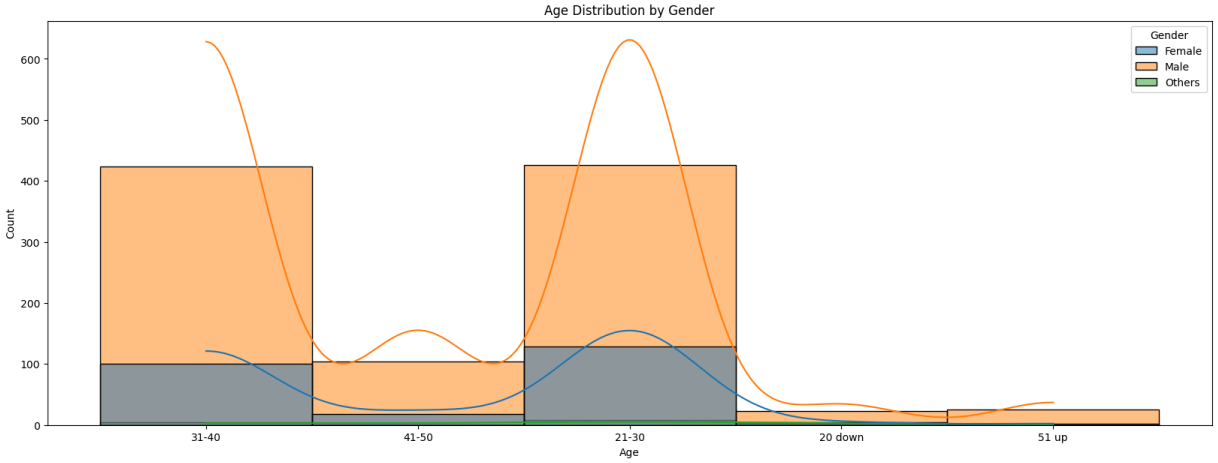
In [81]:
```
# Distribution of the how individuals response to the survey
fig, (ax1, ax2) = plt.subplots(1, 2)
duration_value = df.groupby('YearMonth')['YearMonth'].value_counts()

duration_value.plot(kind='line', marker='o', ax=ax2)
plt.title('Occurrences per Year-Month')
plt.xlabel('Year-Month')
plt.ylabel('Count')
plt.xticks(rotation=45)
plt.grid(True)

# top five countries chart
values = df['Country'].value_counts().head(5)
labels = values.index

plot_pie_chart(values, labels,"Top five response countries", ax=ax1)
```



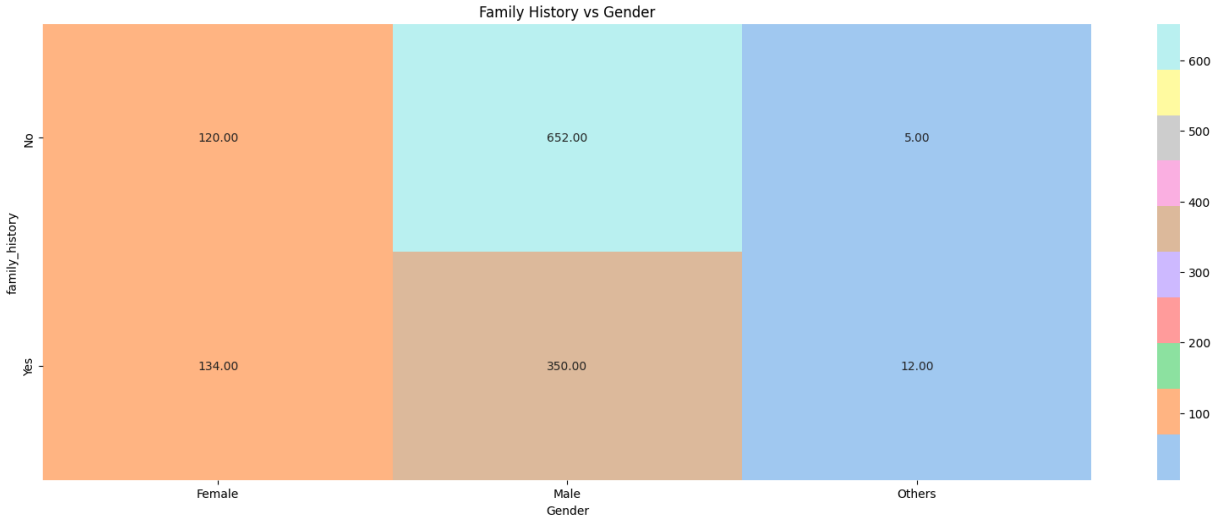


Bivariant Analysis

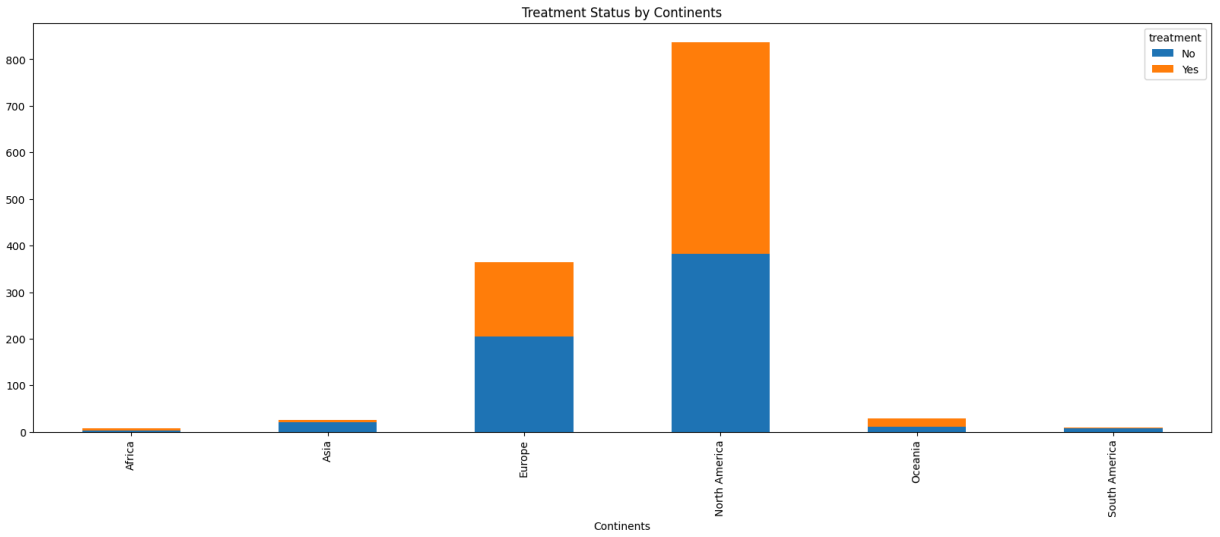
In [41]:
```
# Analyze the distribution of ages across different genders.
sns.histplot(data=df, x='Age', hue='Gender', kde=True, bins=20)
plt.title('Age Distribution by Gender')
plt.show()
```



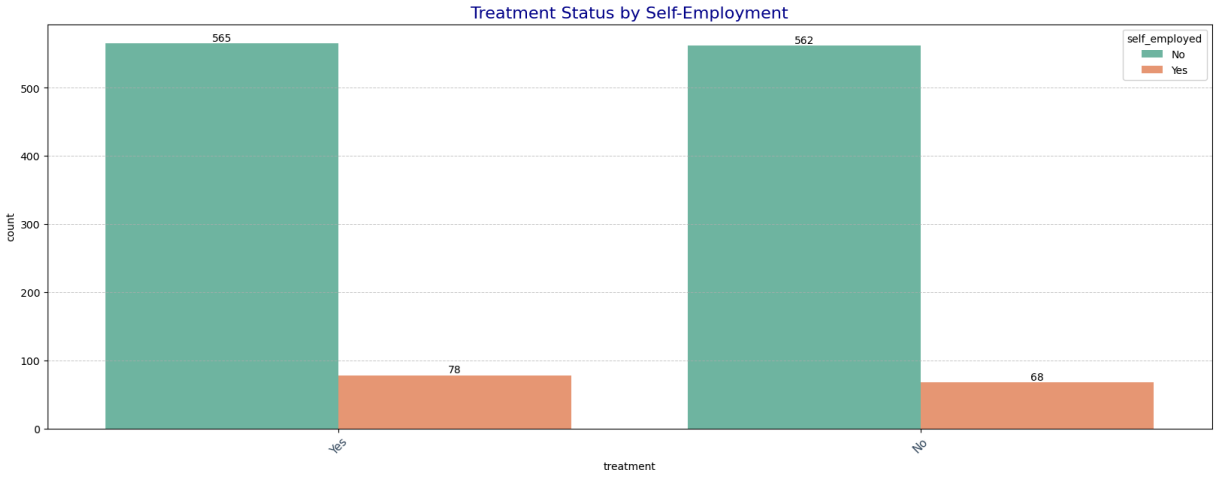
In [73]:
```
# Family History distribution by Gender
family_treatment = df.groupby(['family_history', 'Gender']).size().unstack()
sns.heatmap(family_treatment, annot=True, fmt='.2f', cmap=sns.color_palette(
plt.title('Family History vs Gender');
```



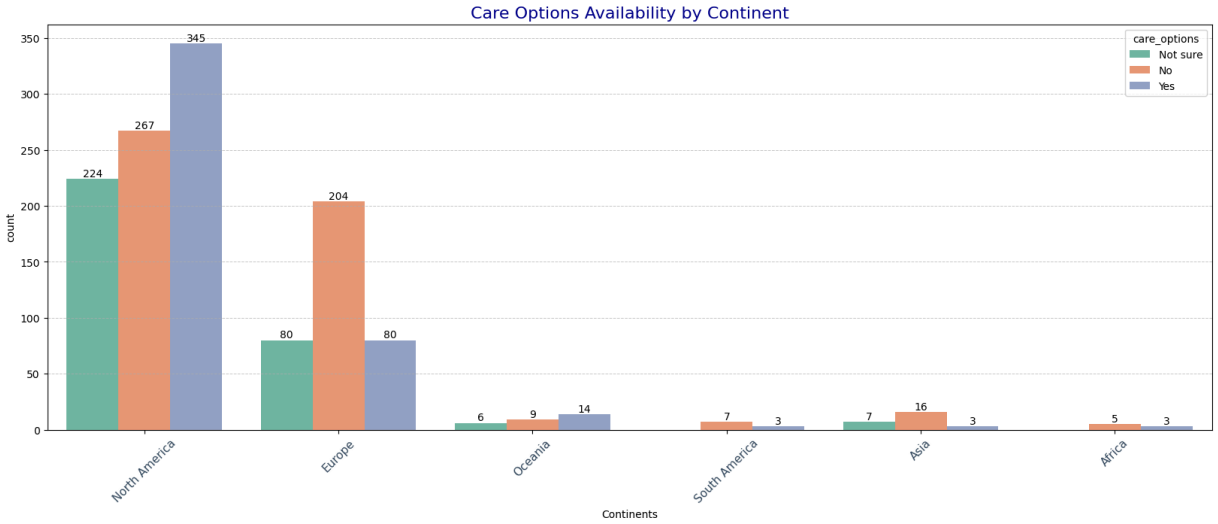
In [74]:
```
# To identify trends in treatment-seeking behavior across Continents.
treatment_counts = df.groupby('Continents')['treatment'].value_counts().unst
treatment_counts.plot(kind='bar', stacked=True)
plt.title('Treatment Status by Continents');
```



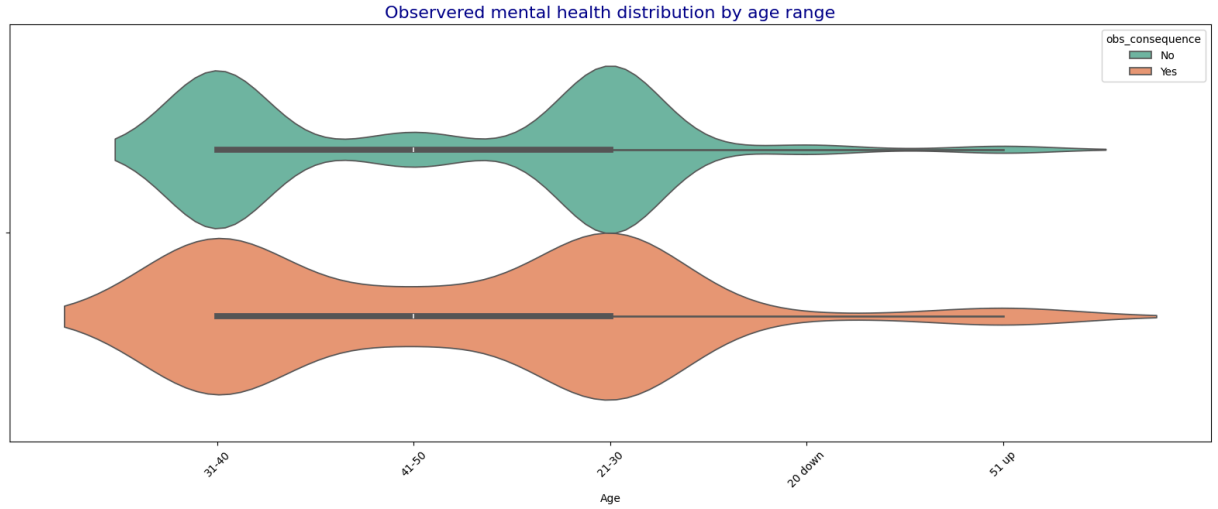
In [76]:
```
# To compare the proportion of individuals seeking treatment based on their
plot_count_plot(data=df, x='treatment', hue='self_employed', title='Treatmer
```



In [77]:
```
# To examine the distribution of care options across continents.
plot_count_plot(data=df, x='Continents', hue='care_options', title='Care Opt
```

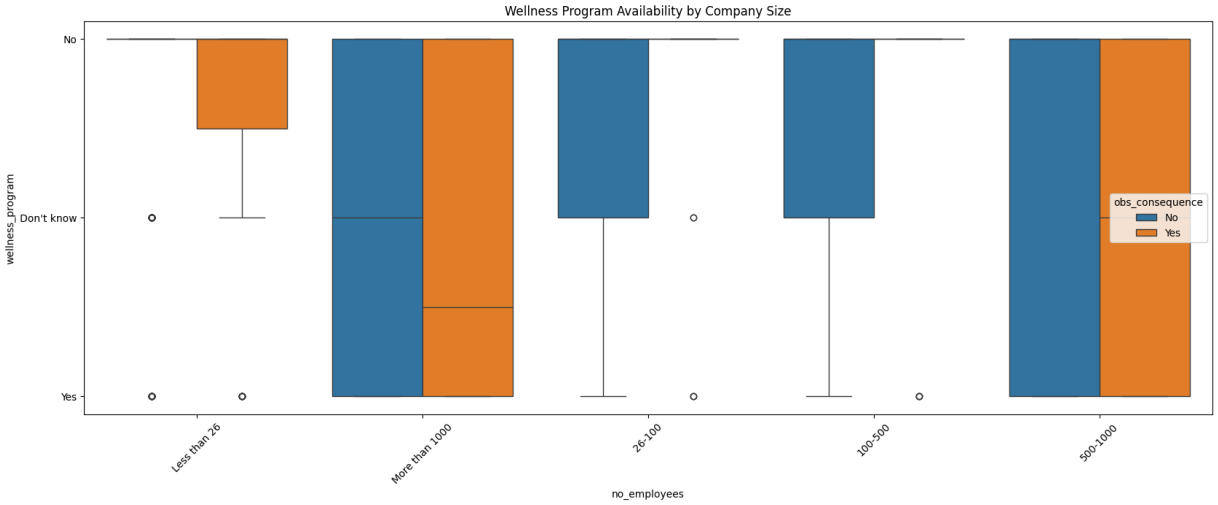


In [ ]:
```
# Observered mental health distribution by age range violin plot
plot_violin_plot(df, 'Age', 'Observered mental health distribution by age ra
```



Multivariant Analysis

In [75]:
```
# The distribution of wellness program agains number of employment by observ
sns.boxplot(data=df, x='no_employees', y='wellness_program', hue='obs_consec
plt.title('Wellness Program Availability by Company Size')
plt.xticks(rotation=45)
plt.show()
```



In this section, I created various visualizations for the categorical columns using appropriate charts using functions from section two. These visualizations are used for exploratory data analysis (EDA) on the dataset. This shows my ability to generate clear and interpretable visualizations in Python.

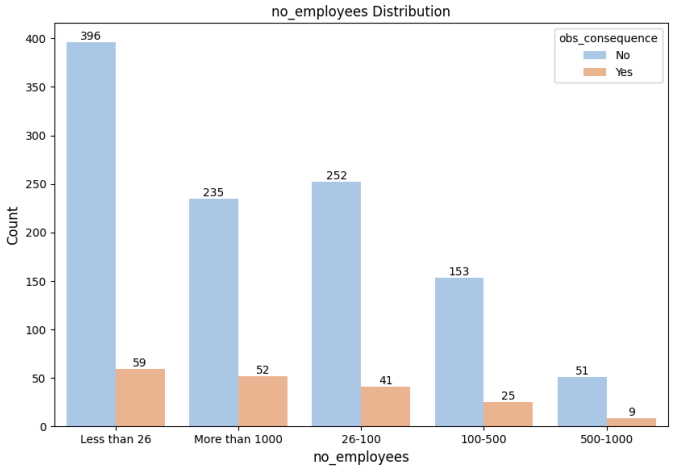
Section 5: GUI Development (16 marks)

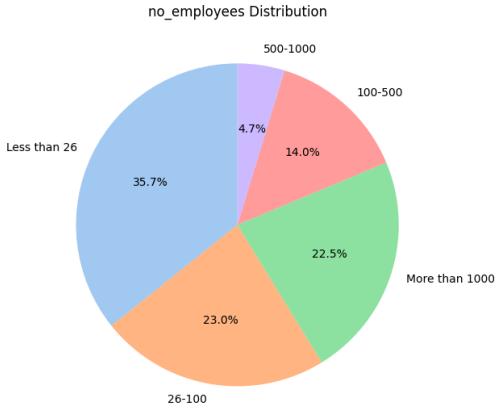
This section covers the creation of dynamic graphical user interfaces for visualizing data. I used Tkinter along with other visualization modules such as Matplotlib and Seaborn to render the graphs on the GUI. Tkinter is a Python GUI library designed for creating interactive interfaces. It provides various widgets, including buttons, dropdowns, text fields, canvases, and more, some of which are used in my visualizations.

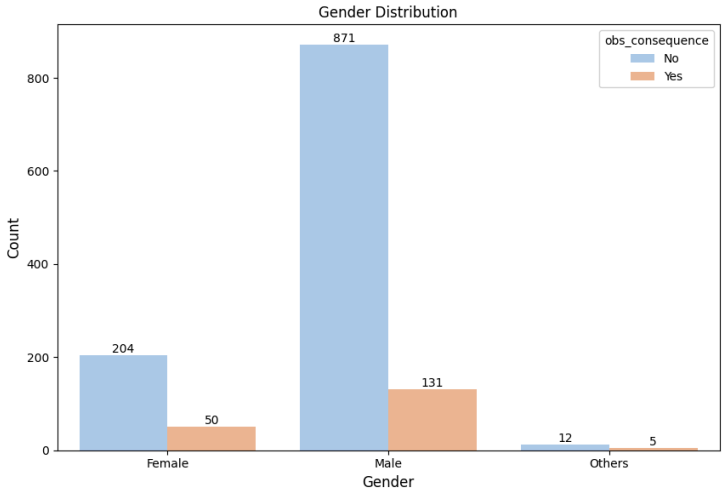
In [90]:
```
import tkinter as tk
from tkinter import ttk
from matplotlib.backends.backend_tkagg import FigureCanvasTkAgg
import matplotlib.pyplot as plt
import seaborn as sns

# get all columns and remove the target, YearMonth and country column
plot_cols = [col for col in df.columns if col not in ['Country', 'obs_consec
cols_index = 0

# Function to update the plot in the GUI
def update_plot(fig):
    for widget in frame_plot.winfo_children():
        widget.destroy()
    canvas = FigureCanvasTkAgg(fig, master=frame_plot)
    canvas.draw()
    canvas.get_tk_widget().pack(fill=tk.BOTH, anchor='center')

def dynamic_count_plot(df: pd.DataFrame, xColumn: str, hueColumn: str='obs_c
    # Create a figure and two subplots (axes)
    fig, (ax1, ax2) = plt.subplots(1, 2, figsize=(18, 6))
```

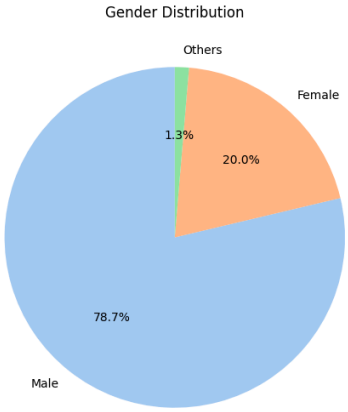
```
    # Count plot for xColumn distribution
    sns.countplot(data=df, x=xColumn,hue=hueColumn, ax=ax1, palette='pastel'
    ax1.set_title(f'{xColumn} Distribution')
    ax1.set_xlabel(xColumn, fontsize=12)
    ax1.set_ylabel('Count', fontsize=12)
    for container in ax1.containers:
        ax1.bar_label(container)

    # Pie chart for obs_consequence distribution
    x_counts = df[xColumn].value_counts()
    ax2.pie(x_counts, labels=x_counts.index, autopct='%1.1f%%', startangle=9
    ax2.set_title(f'{xColumn} Distribution')

    # Adjust layout
    plt.tight_layout()
    # update lable text

    # dynamic_label_text(xColumn, hueColumn)
    update_plot(fig)

# def dynamic_label_text(df:DataFrame, xColumn, hueColumn):
#     df

#     txt = f'The plot above shows that '
#     pass

def on_previous():
    global cols_index, plot_cols, xColumn
    cols_index -= 1
    if cols_index < 0:
        cols_index = len(plot_cols)-1

    xColumn = plot_cols[cols_index]
    dynamic_count_plot(df, xColumn)

def on_next():
    global cols_index, plot_cols
    cols_index += 1
    if cols_index > len(plot_cols)-1:
        cols_index = 0

    xColumn = plot_cols[cols_index]
    dynamic_count_plot(df, xColumn)

# Create main application window
root = tk.Tk()
root.title("Dynamic Mental Health Survey Relationships")
root.geometry("1800x750")

# Configure grid layout
root.columnconfigure(0, weight=1)
root.columnconfigure(1, weight=3)
root.rowconfigure(0, weight=1)

# Frame for controls
left_frame = ttk.Frame(root, padding=10)
```

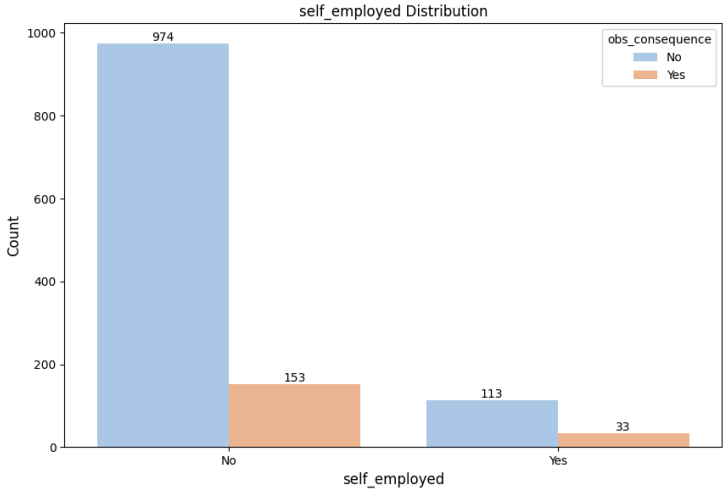
```
left_frame.grid(row=0, column=0)

# Frame for plot
frame_plot = ttk.Frame(root, padding=10)
frame_plot.grid(row=0, column=1)

# Frame for navigation buttons
nav_frame = ttk.Frame(root, padding=10)
nav_frame.grid(row=0, column=2)

# Previous and Next buttons
prev_button = ttk.Button(nav_frame, text="Previous", command=on_previous)
prev_button.pack(side=tk.LEFT, padx=5)

next_button = ttk.Button(nav_frame, text="Next", command=on_next)
next_button.pack(side=tk.RIGHT, padx=5)

# Add a default plot
dynamic_count_plot(df=df, xColumn='no_employees')

# Text label below the plot

# text_label = ttk.Label(frame_plot, text="This is a text label below the ch
# text_label.pack(pady=10)

# Run the main event loop
root.mainloop()
```

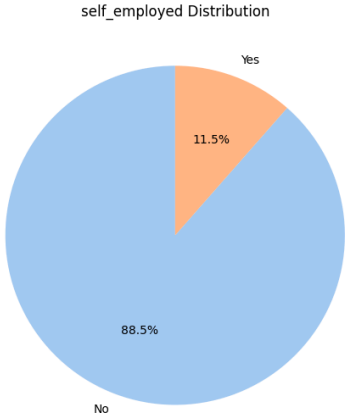


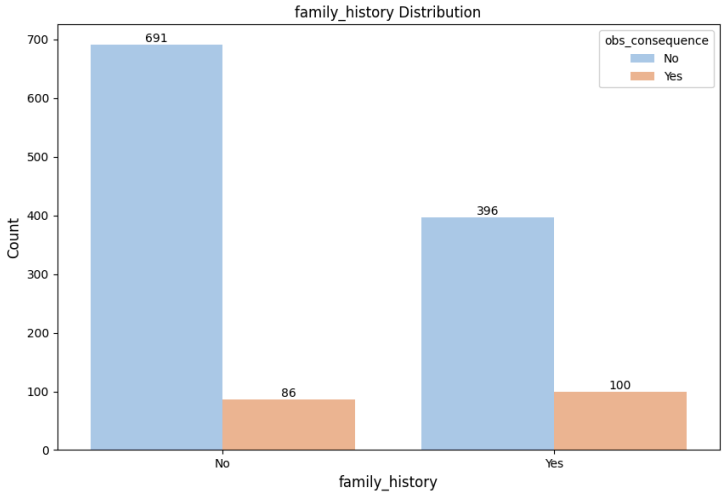


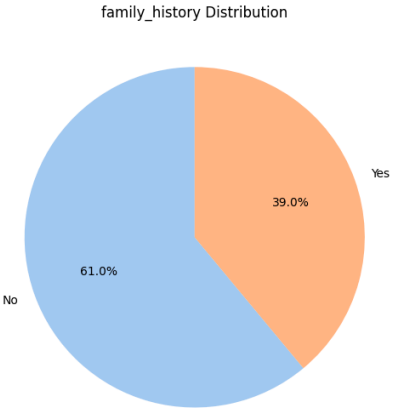

Gender Distribution
obs_consequence
No
Yes
871
204
131
50
12
5
Count
Female
Male
Others
Gender

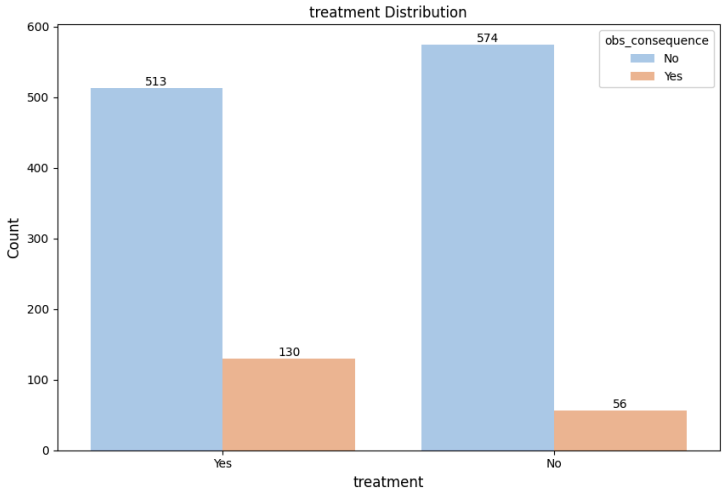

Gender Distribution
Others
Female
1.3%
20.0%
78.7%
Male

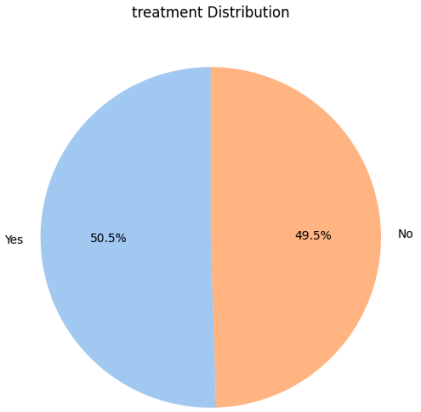

self_employed Distribution
obs_consequence
No
Yes
974
153
113
33
Count
No
Yes
self_employed

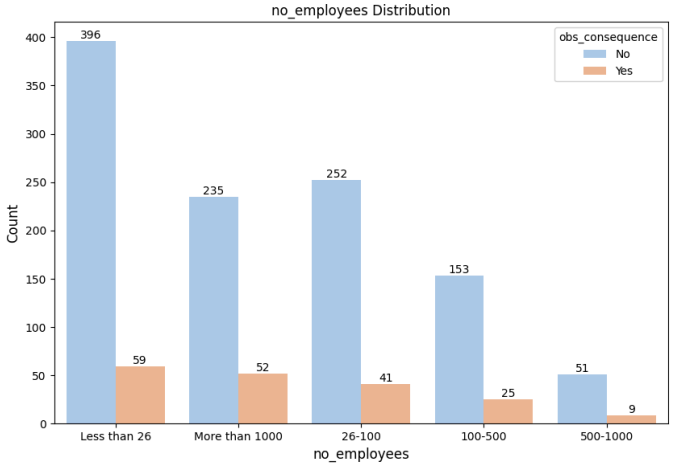

self_employed Distribution
Yes
11.5%
88.5%
No

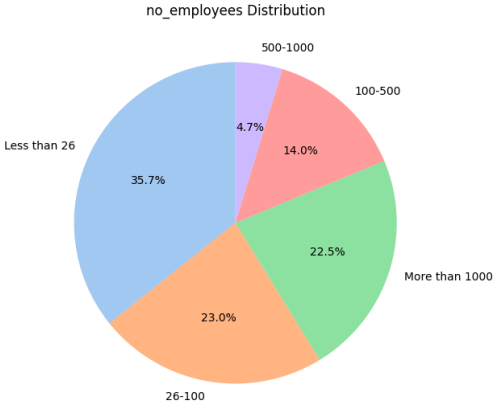

family_history Distribution
obs_consequence
No
Yes
691
86
396
100
Count
No
Yes
family_history

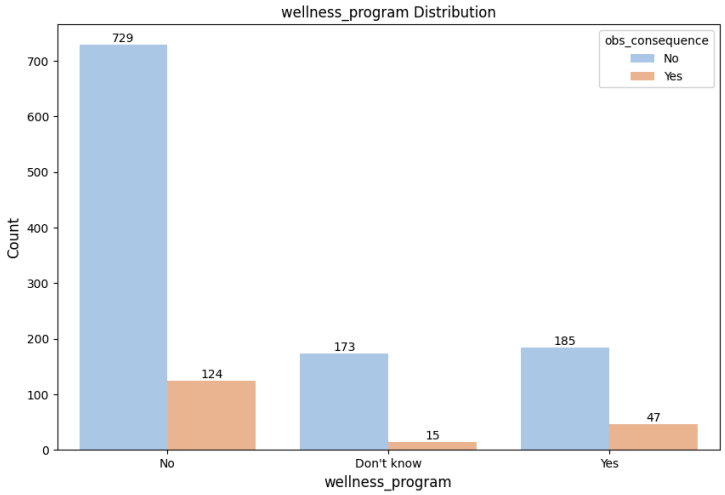

family_history Distribution
Yes
39.0%
61.0%
No

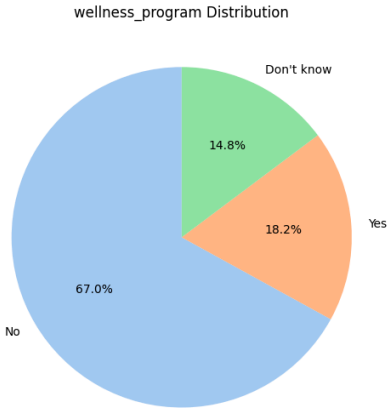

treatment Distribution
obs_consequence
No
Yes
Count
treatment
Yes
No
513
130
574
56

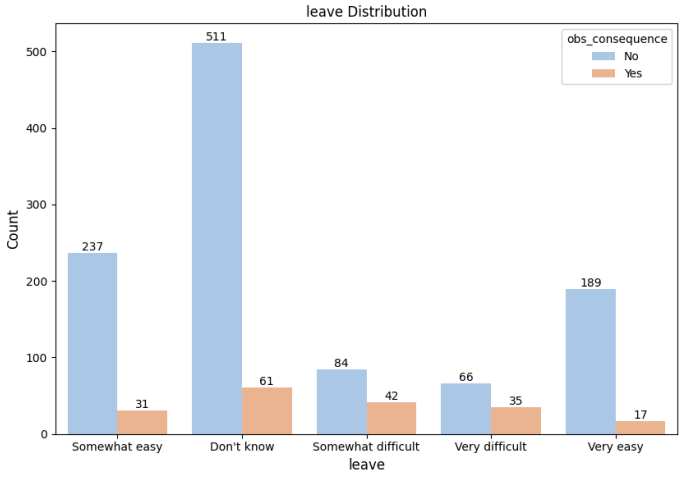

treatment Distribution
Yes
No
50.5%
49.5%

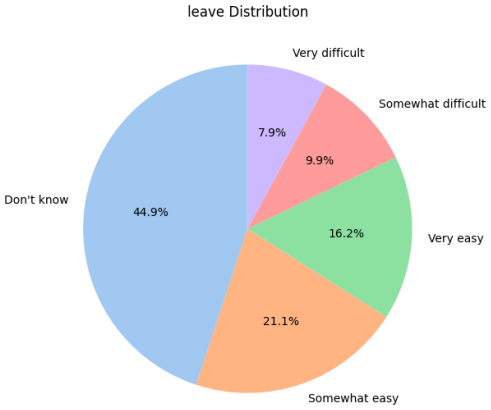

no_employees Distribution
obs_consequence
No
Yes
Count
no_employees
Less than 26
More than 1000
26-100
100-500
500-1000
396
59
235
52
252
41
153
25
51
9


no_employees Distribution
500-1000
100-500
Less than 26
More than 1000
26-100
4.7%
14.0%
35.7%
22.5%
23.0%


wellness_program Distribution
obs_consequence
No
Yes
Count
wellness_program
No
Don't know
Yes
729
124
173
15
185
47


wellness_program Distribution
Don't know
Yes
No
14.8%
18.2%
67.0%

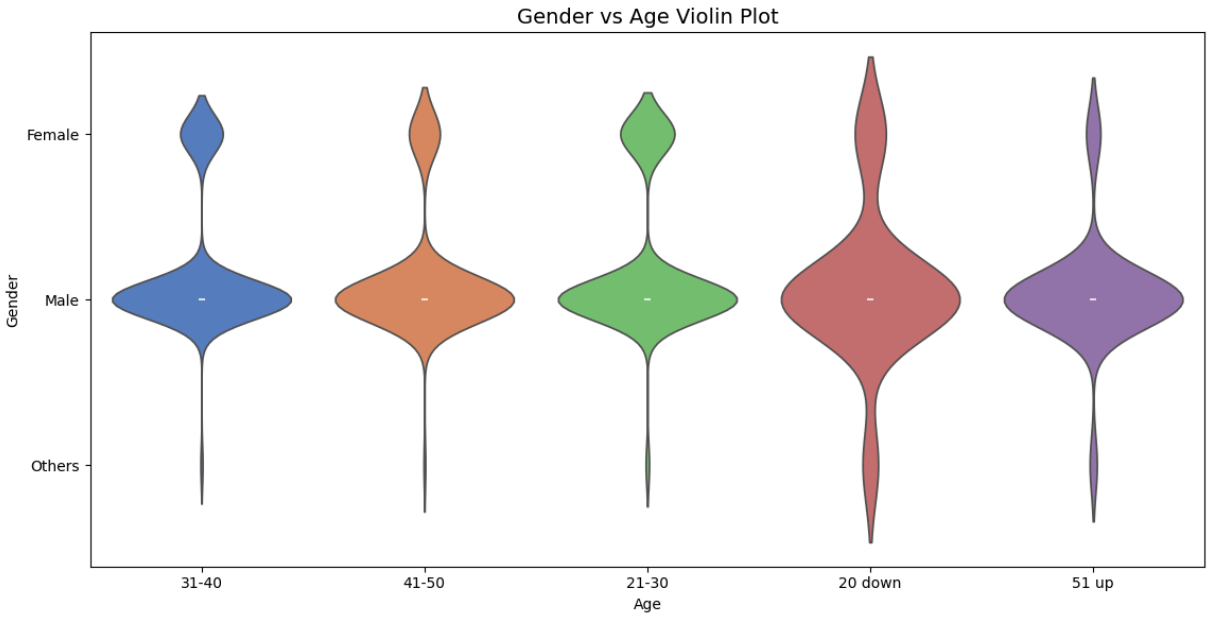




In [89]:
```python
# Update the column list dynamically
def update_cols(df: DataFrame, rm: str = None):
    try:
        cols_list: list = df.columns
        if rm:
            cols_list = [col for col in cols_list if col != rm]
        result = [col for col in cols_list if col not in ['Country', 'obs_cc

        return result
    except Exception as e:
        print(f"Error updating columns: {e}")
        return []

# Function to update the plot in the GUI
def update_plot(fig):
    for widget in frame_plot.winfo_children():
        widget.destroy()
    canvas = FigureCanvasTkAgg(fig, master=frame_plot)
    canvas.draw()
    canvas.get_tk_widget().pack(fill=tk.BOTH, anchor='center')

def dynamic_count_plot(df: DataFrame, xColumn: str, plot_type: str, hueColum
    try:
        fig, ax = plt.subplots(figsize=(10, 6))

        if plot_type == "Count Plot":
            sns.countplot(data=df, x=xColumn, hue=hueColumn, ax=ax, palette=
            ax.set_title(f'{hueColumn} vs {xColumn} Distribution')
            ax.set_xlabel(xColumn, fontsize=12)
            ax.set_ylabel(hueColumn, fontsize=12)
            for container in ax.containers:
                ax.bar_label(container)
        elif plot_type == 'Box Plot':
            sns.boxplot(data=df, x=xColumn, y=hueColumn, palette='Set3', ax=
            ax.set_title(f'{hueColumn} vs {xColumn} Box Plot', fontsize=14)
        elif plot_type == 'Violin Plot':
            sns.violinplot(data=df, x=xColumn, y=hueColumn, palette='muted',
            ax.set_title(f'{hueColumn} vs {xColumn} Violin Plot', fontsize=1
        elif plot_type == 'Scatter Plot':
            sns.scatterplot(data=df, x=xColumn, y=hueColumn, hue=hueColumn,
            ax.set_title(f'{hueColumn} vs {xColumn} Scatter Plot', fontsize=
```

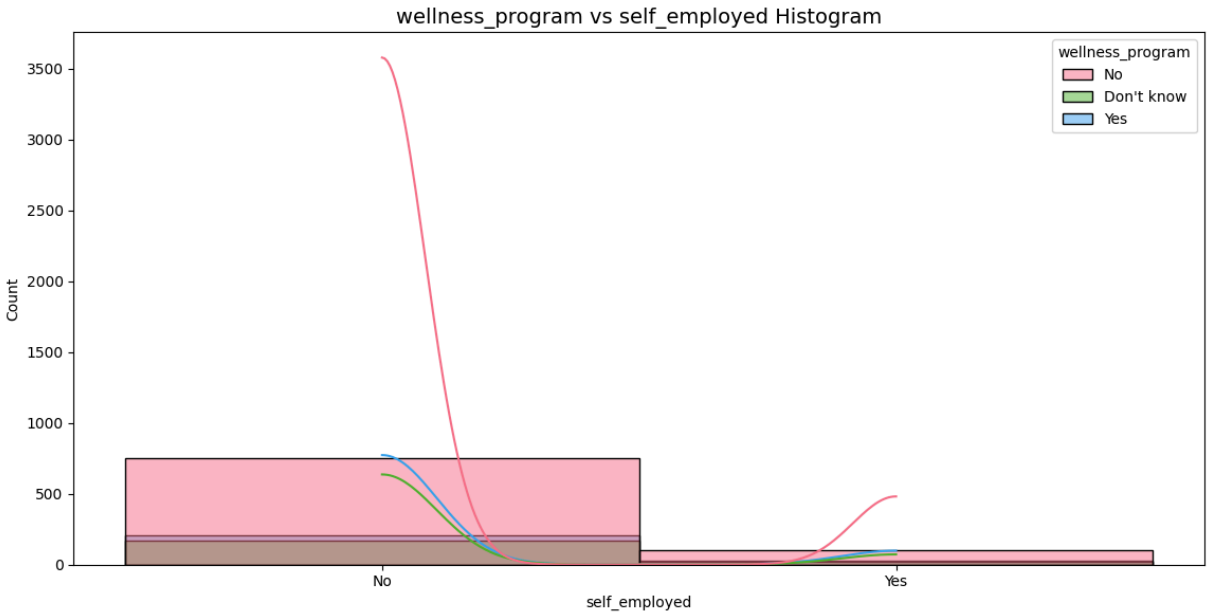
```
        elif plot_type == 'Histogram':
            sns.histplot(data=df, x=xColumn, hue=hueColumn, kde=True, palett
            ax.set_title(f'{hueColumn} vs {xColumn} Histogram', fontsize=14)
        elif plot_type == 'Swarm Plot':
            sns.swarmplot(data=df, x=xColumn, y=hueColumn, palette='tab10',
            ax.set_title(f'{hueColumn} vs {xColumn} Swarm Plot', fontsize=14

        plt.tight_layout()
        update_plot(fig)
    except Exception as e:
        print(f"Error generating plot: {e}")

# Update xcol dropdown
def on_xcol_change(event):
    xcol_data = xcol.get()
    hue_data = hue.get()
    plot_data = plot.get()

    # Update hue_values dynamically based on the selected xcol
    global hue_values
    hue_values = update_cols(df, xcol_data)
    hue_dropdown['values'] = hue_values
    hue.set(hue_data)

    dynamic_count_plot(df, xcol_data, plot_data, hue.get())

# Update hue dropdown
def on_hue_change(event):
    xcol_data = xcol.get()
    hue_data = hue.get()
    plot_data = plot.get()

    # Update xcol_values dynamically based on the selected hue
    global xcol_values
    xcol_values = update_cols(df, hue_data)
    xcol_dropdown['values'] = xcol_values
    xcol.set(xcol_data)

    dynamic_count_plot(df, xcol.get(), plot_data, hue_data)

# Update plot type
def on_plot_change(event):
    xcol_data = xcol.get()
    hue_data = hue.get()
    plot_data = plot.get()
    dynamic_count_plot(df, xcol_data, plot_data, hue_data)

# Create main application window
root = tk.Tk()
root.title("Dynamic Data Visualization")
root.geometry("1200x750")

# Frame for controls
control_frame = ttk.Frame(root, padding=10)
control_frame.pack(side=tk.TOP, fill=tk.X)
```

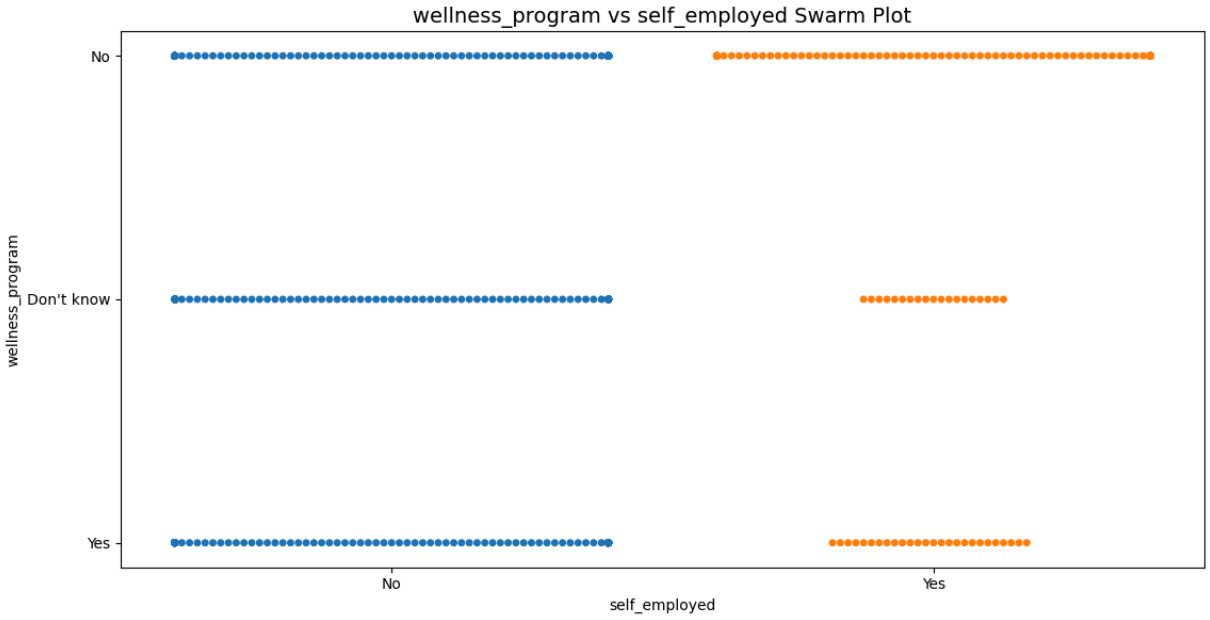
```
# Frame for plot
frame_plot = ttk.Frame(root, padding=10)
frame_plot.pack(side=tk.TOP, fill=tk.BOTH, expand=True)

# Initialize dynamic column lists
xcol_values = update_cols(df)
hue_values = update_cols(df, xcol_values[0])

# X column dropdown
xcol = tk.StringVar()
xcol_dropdown = ttk.Combobox(control_frame, textvariable=xcol, values=xcol_v
xcol_dropdown.set("Select x feature")
xcol_dropdown.pack(side=tk.LEFT, padx=10)
xcol_dropdown.bind("<<ComboboxSelected>>", on_xcol_change)

# Hue column dropdown
hue = tk.StringVar()
hue_dropdown = ttk.Combobox(control_frame, textvariable=hue, values=hue_valu
hue_dropdown.set("Select hue feature")
hue_dropdown.pack(side=tk.LEFT, padx=10)
hue_dropdown.bind("<<ComboboxSelected>>", on_hue_change)

# Dropdown for selecting plot type
plot_values = ["Violin Plot", "Scatter Plot", "Histogram", "Box Plot", "Swar
plot = tk.StringVar()
plot_dropdown = ttk.Combobox(control_frame, textvariable=plot, values=plot_v
plot_dropdown.set("Select Plot Type")
plot_dropdown.pack(side=tk.LEFT, padx=10)
plot_dropdown.bind("<<ComboboxSelected>>", on_plot_change)

# Initialize with default plot
xcol.set(xcol_values[0])
hue.set(hue_values[0])
plot.set(plot_values[0])
dynamic_count_plot(df, xcol_values[0], plot_values[0], hue_values[0])

# Run the main event loop
root.mainloop()
```


Gender vs Age Violin Plot
Female
Male
Others
Gender
31-40
41-50
21-30
20 down
51 up
Age


Gender vs self_employed Violin Plot
Female
Male
Others
Gender
No
Yes
self_employed


wellness_program vs self_employed Violin Plot
No
Don't know
Yes
wellness_program
No
Yes
self_employed

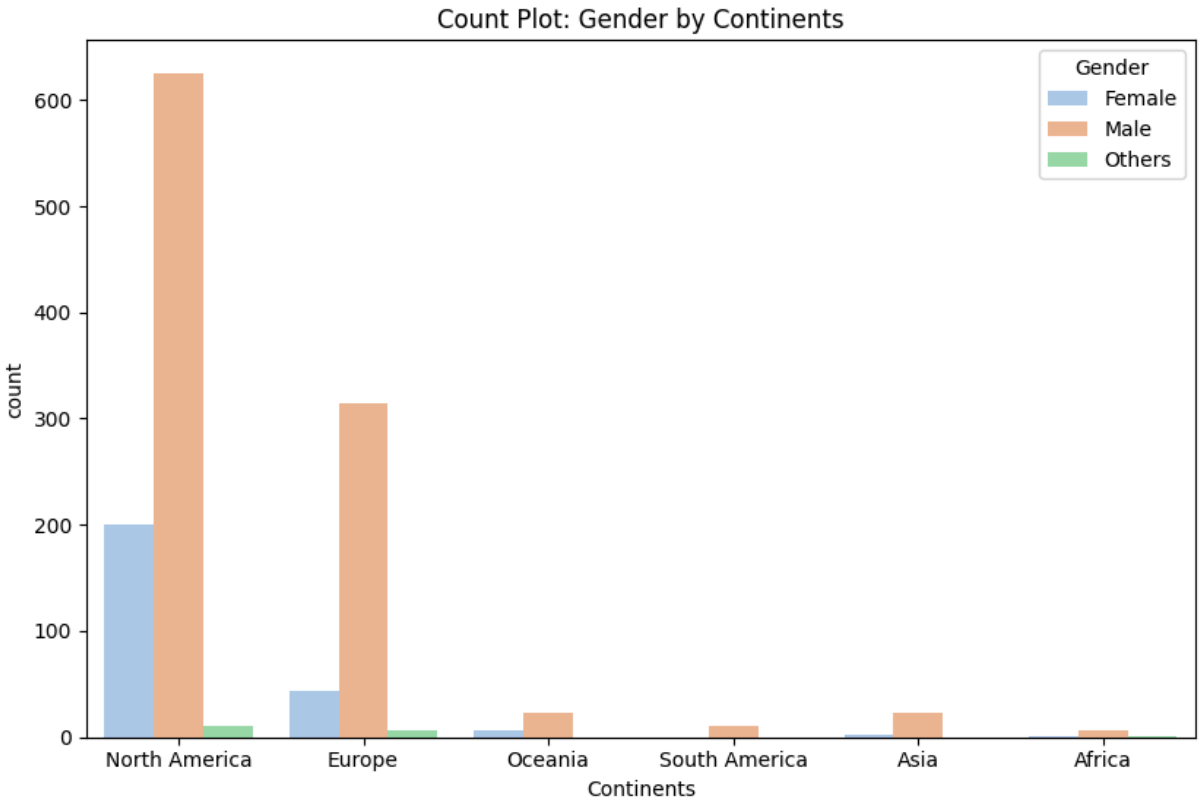

wellness_program vs self_employed Histogram
wellness_program
No
Don't know
Yes
Count
3500
3000
2500
2000
1500
1000
500
0
No
Yes
self_employed

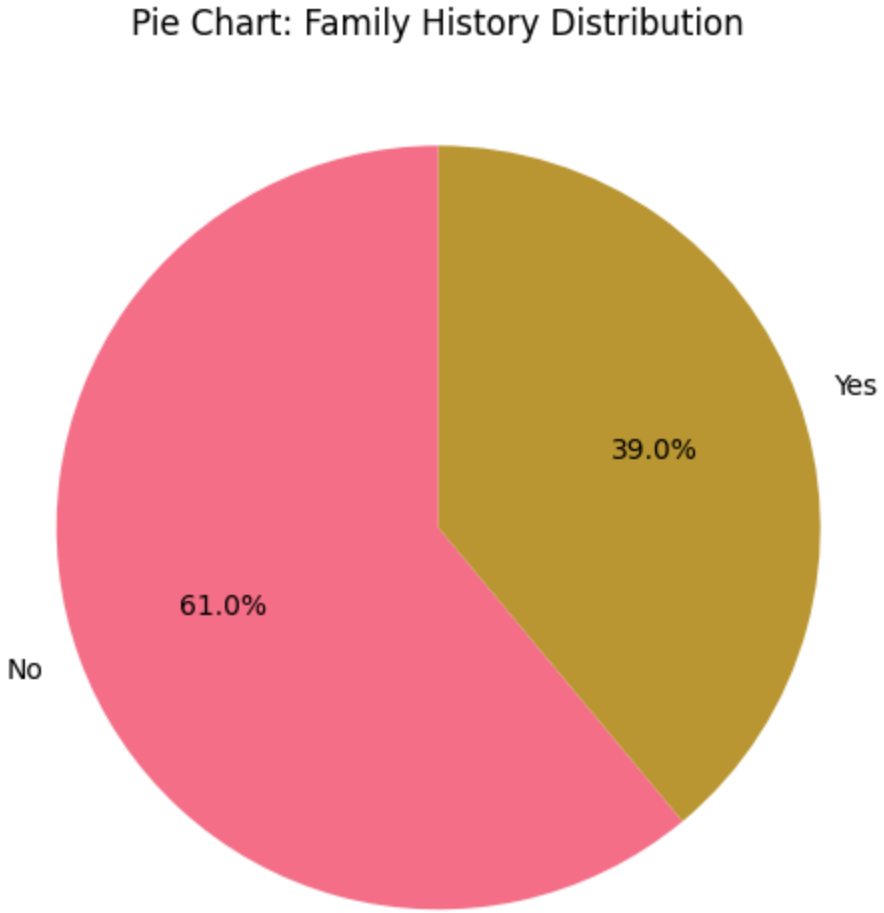

wellness_program vs self_employed Swarm Plot
wellness_program
No
Don't know
Yes
No
Yes
self_employed

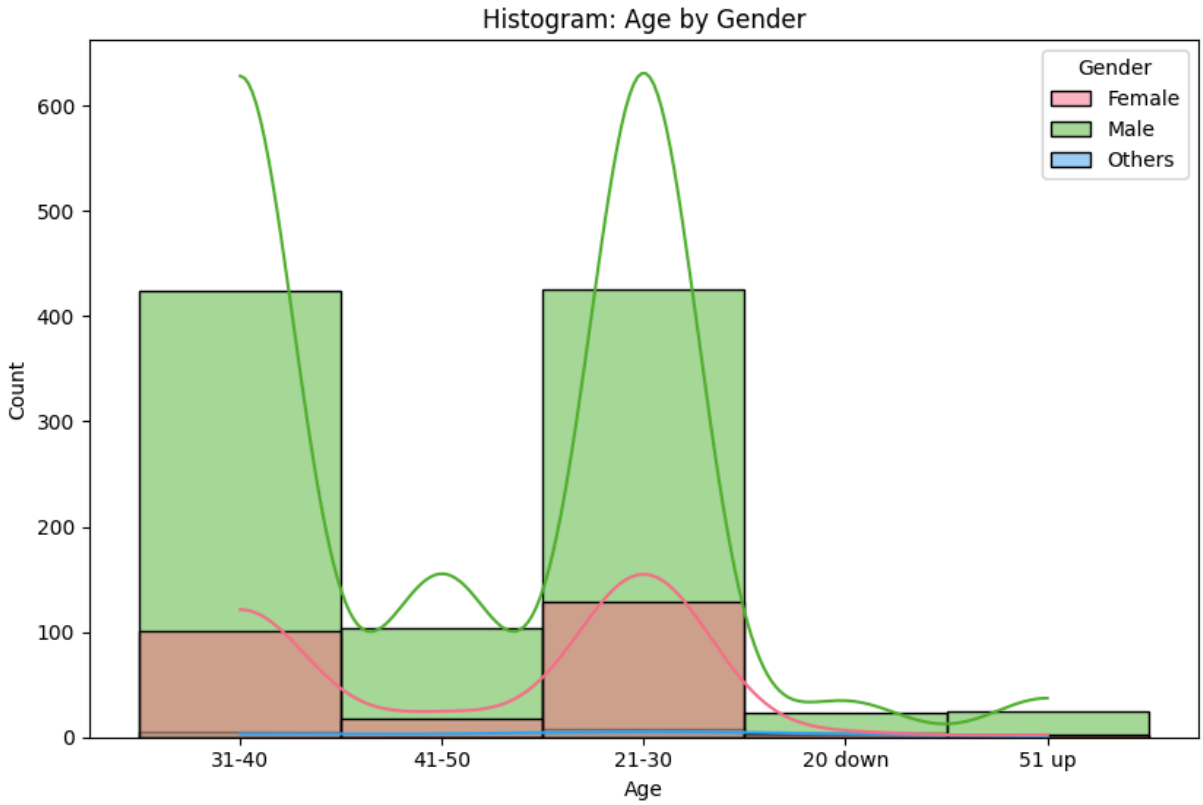

wellness_program vs self_employed Distribution
wellness_program
No
Don't know
Yes
752
169
206
101
19
26
700
600
500
400
300
200
100
0
No
Yes
self_employed

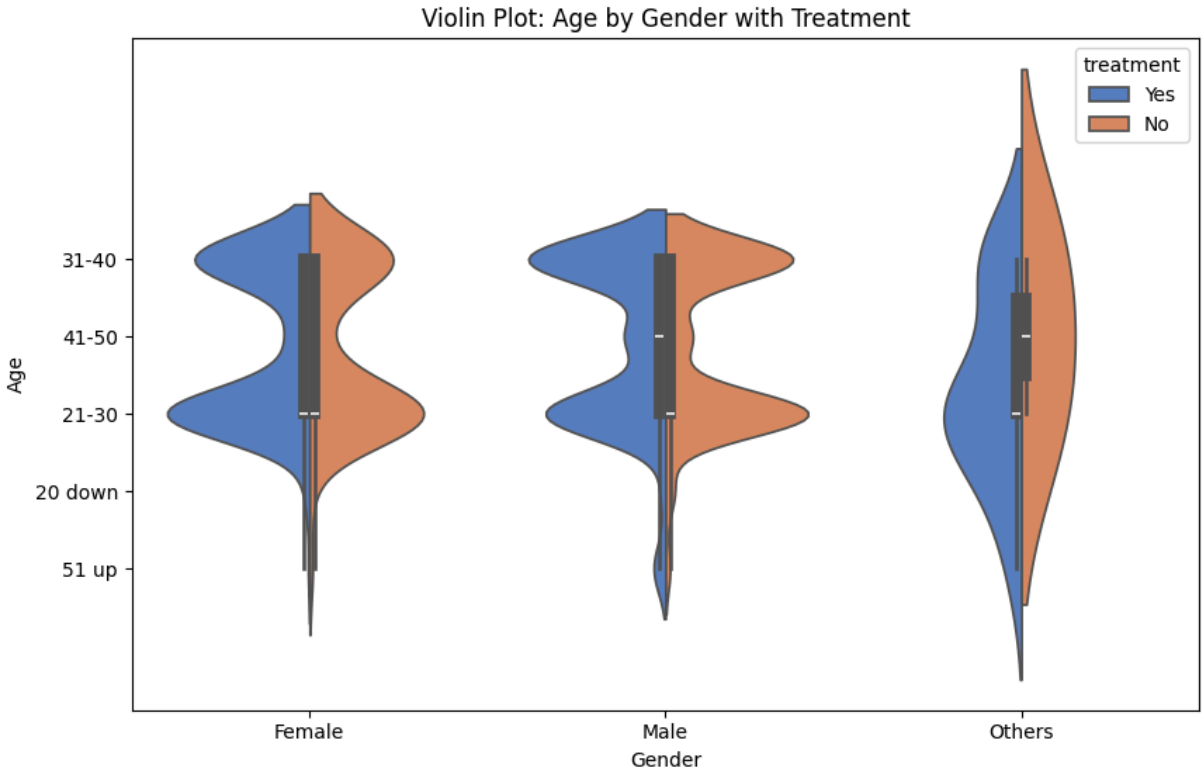
In [ ]:
```
# Function to update the plot in the GUI
def update_plot(fig, description):
    for widget in frame_plot.winfo_children():
        widget.destroy()

    # Add description label
    description_label = tk.Label(frame_plot, text=description, wraplength=90
    description_label.pack(side=tk.TOP, fill=tk.X, padx=5, pady=5)

    # Add the plot
    canvas = FigureCanvasTkAgg(fig, master=frame_plot)
    canvas.draw()
    canvas.get_tk_widget().pack(fill=tk.BOTH, expand=True)

# Plotting functions
def plot_count():
    fig, ax = plt.subplots(figsize=(8, 6))
    sns.countplot(data=df, x="Continents", hue="Gender", ax=ax, palette="pas
    ax.set_title("Count Plot: Gender by Continents")
    description = (
        "A count plot showing the distribution of genders across continents.
        "From the plot, North America has the highest number of respondents,
    )
    update_plot(fig, description)

def plot_violin():
    fig, ax = plt.subplots(figsize=(8, 6))
    sns.violinplot(data=df, x="Gender", y="Age", hue="treatment", ax=ax, spl
    ax.set_title("Violin Plot: Age by Gender with Treatment")
    description = (
        "A violin plot representing the age distribution for gender and trea
        "According to the plot, the majority of respondents fall within the
    )
    update_plot(fig, description)
```

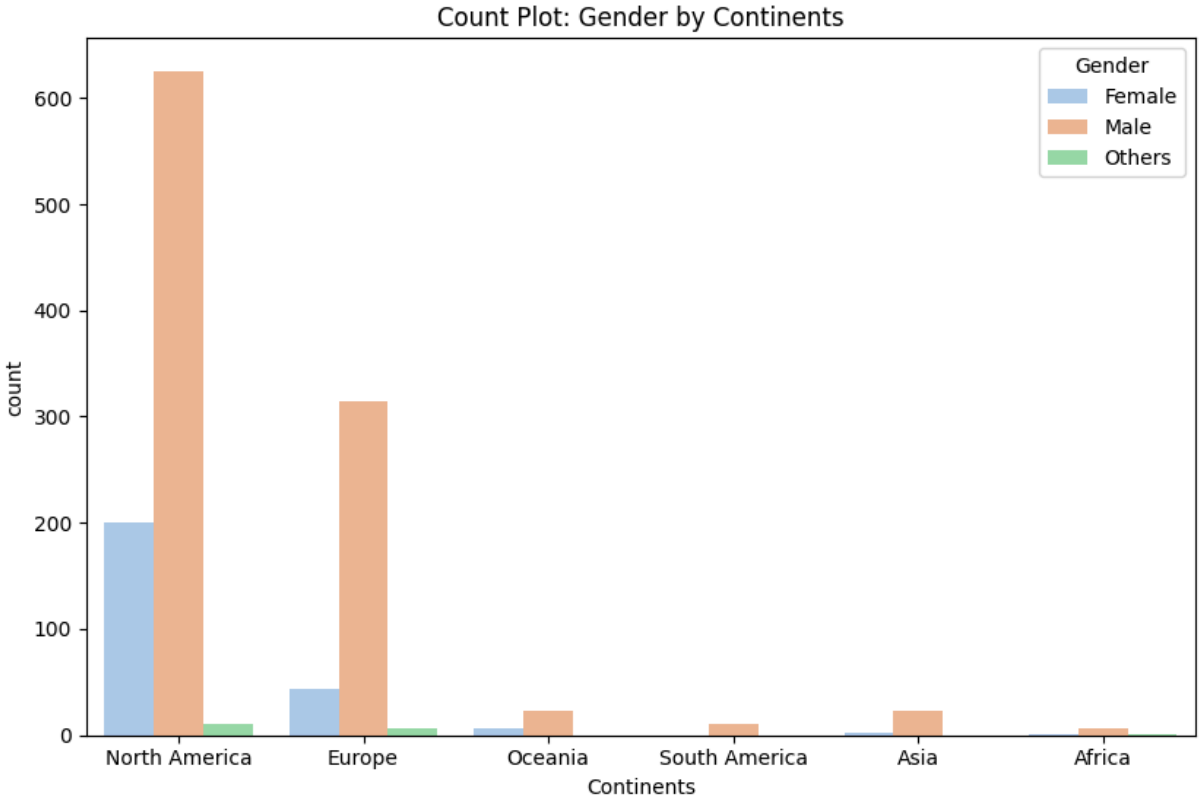
```
def plot_histogram():
    fig, ax = plt.subplots(figsize=(8, 6))
    sns.histplot(data=df, x="Age", hue="Gender", kde=True, palette="husl", a
    ax.set_title("Histogram: Age by Gender")
    description = (
        "This Histogram shows the distribution of ages for different genders
        "From on the plot, a higher number of male respondents participated
    )
    update_plot(fig, description)


def plot_piechart():
    fig, ax = plt.subplots(figsize=(8, 6))

    values = df['family_history'].value_counts()
    labels = values.index
    ax.pie(values, labels=labels, autopct='%1.1f%%', startangle=90, colors=s
    ax.set_title("Pie Chart: Family History Distribution")
    description = (
        "This Pie Chart visualizes the distribution of family_history of mer
        "It can be observed that 61% of the respondents have a family histor
    )
    update_plot(fig, description)


# Main application window
root = tk.Tk()
root.title("Interactive Plotting Application with Dynamic Descriptions")
root.geometry("1000x750")

# Frame for controls
frame_controls = ttk.Frame(root, padding=10)
frame_controls.pack(side=tk.TOP, fill=tk.X)

# Frame for plot and description
frame_plot = ttk.Frame(root, padding=10)
frame_plot.pack(side=tk.TOP, fill=tk.BOTH, expand=True)

# Buttons to switch between plots
ttk.Button(frame_controls, text="Count Plot", command=plot_count).pack(side=
ttk.Button(frame_controls, text="Violin Plot", command=plot_violin).pack(sid
ttk.Button(frame_controls, text="Histogram", command=plot_histogram).pack(si
ttk.Button(frame_controls, text="Pie Chart", command=plot_piechart).pack(sid

# Display the default plot
plot_count()

# Run the application
root.mainloop()
```

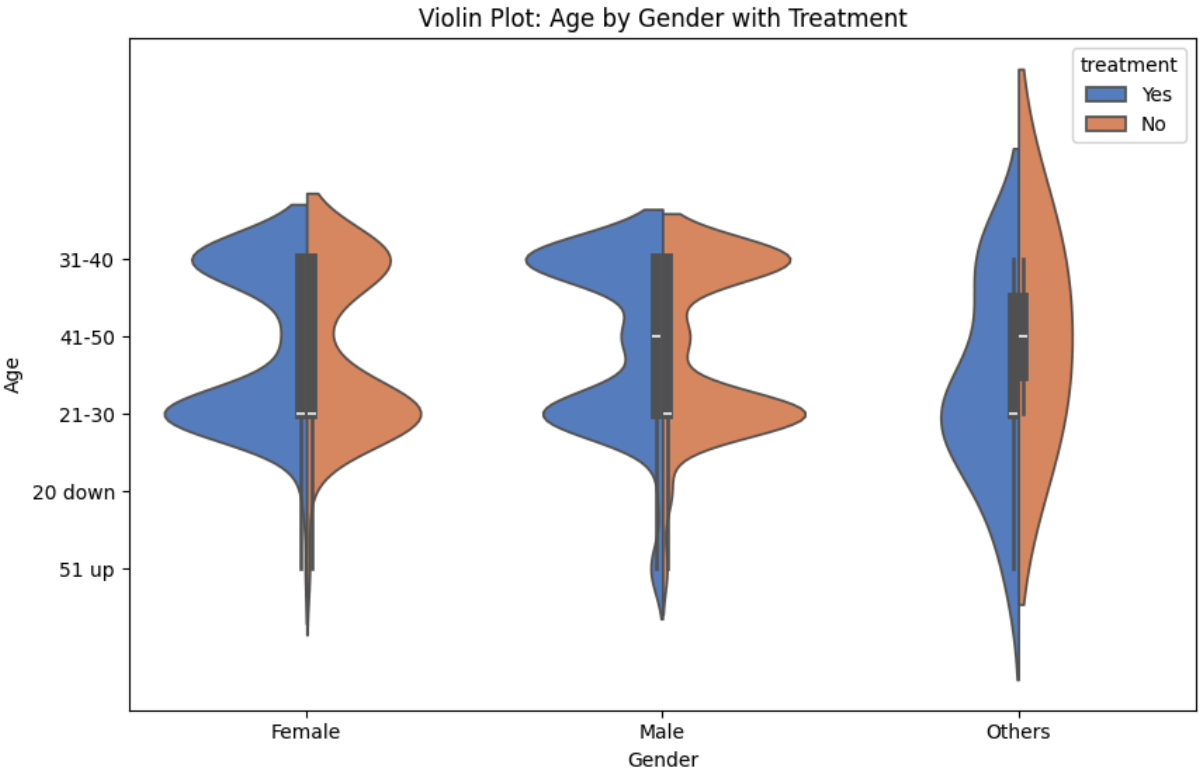

Count Plot: Gender by Continents
Gender
Female
Male
Others
count
0
100
200
300
400
500
600
North America
Europe
Oceania
South America
Asia
Africa
Continents


Pie Chart: Family History Distribution
Yes
39.0%
61.0%
No


Histogram: Age by Gender
Gender
Female
Male
Others
Count
0
100
200
300
400
500
600
31-40
41-50
21-30
20 down
51 up
Age


Violin Plot: Age by Gender with Treatment
treatment
Yes
No
Age
31-40
41-50
21-30
20 down
51 up
Female
Male
Others
Gender





In this section, I combined widgets such as frames, buttons, and dropdowns to build three dynamic GUIs. These GUIs are designed to check relationships among various columns dynamically. This section demonstrates my ability to create user-centric, interactive interfaces that enhance functionality and provide a better user experience.

Section 6: Conclusion: Version Control, Critical Appraisal, Documentation (20 marks)

In this coursework, I analyze mental health cases among employees from various organizations or companies using a free Kaggle dataset. The dataset contains 27 columns, from which 11 were selected for analysis. These columns provide key information on the employees' mental health status and support.

- Age, Country, and Gender: Provides demographic details such as age, region, and gender.
- Self_employed: Indicates whether the respondent is self-employed or working for an organization.
- Family_history: Shows if there is a history of mental health issues in the respondent's family.
- Treatment: Indicates whether the respondent is receiving treatment for mental health.
- No_employees: Specifies the number of employees in the respondent's company.
- Wellness_program: Tells if the company offers well-being programs for employees.
- Leave: Indicates whether the company provides leave for employees.
- Care_options: Shows if the company offers care options to their staff.
- Obs_consequence: Describes whether the respondent has mental health challenges or not.

This data helps explore the relationship between various factors and employee mental health in different work environments.

From the analysis, it can be seen that:

- Most mental health cases by region are reported from North America.
- By gender, mental health issues appear to be more common among men.
- The majority of respondents do not have a history of mental health issues in their families.
- Most respondents to the survey are men, indicating a potential gender bias in the data or a higher level of participation from male employees.

The project used GitHub for version control, allowing for efficient management of code updates, collaboration, and tracking changes throughout the development process.

A well-documented process of the project is provided in this work, detailing each step taken throughout the analysis, data understanding, data cleaning, and visualization. This documentation ensures clarity and transparency in the workflow. However, it is important to note that the project does not cover data transformation, normalization, or modeling, as these steps are outside the scope of this particular work.

References:

Kaggle. 2025. Kaggle Datasets [Online]. Available from: https://www.kaggle.com/datasets [Accessed: 2 January 2025].

Matplotlib Documentation. 2025. Matplotlib documentation [Online]. Available from: https://matplotlib.org/stable/contents.html [Accessed: 2 January 2025].

Pandas Documentation. 2025. Pandas documentation [Online]. Available from: https://pandas.pydata.org/docs/ [Accessed: 2 January 2025].

Seaborn Documentation. 2025. Seaborn documentation [Online]. Available from: https://seaborn.pydata.org/ [Accessed: 2 January 2025].

Tkinter Documentation. 2025. Tkinter documentation [Online]. Available from: https://docs.python.org/3/library/tkinter.html [Accessed: 2 January 2025].

Appendix:

(If any)