ignacio-3b-final-1

May 31, 2024

1 FINAL REQUIREMENT IN ADVANCED MACHINE LEARNING

Sleep is crucial for maintaining overall health and well-being, supporting the immune system, enhancing body function and memory, and reducing anxiety, stress, and depression. This analysis delves into key user attributes—Person ID, Gender, Age, Occupation, Sleep Duration, Quality of Sleep, Physical Activity Level, Stress Level, BMI Category, Blood Pressure, Heart Rate, Daily Steps, and Sleeping Disorder—to extract insights on sleep behaviors and characteristics. By understanding these attributes, the analysis aims to identify opportunities for businesses catering to sleep lifestyles, ultimately improving individual sleep health and overall well-being.

2 1. Importing Libraries

Importing libraries in Python involves using the **IMPORT** statement to include external modules or packages that provide additional functionality and tools. This allows you to reuse code written by others for tasks like data manipulation, web development, and scientific computing.

[ ]:
```
#Reading data

import pandas as pd

import os

#Fixings warnings
import warnings
warnings.filterwarnings('ignore')

#For mathematical operations
import numpy as np
from scipy import stats

#Visualisation
import seaborn as sns
import plotly.express as px
from termcolor import colored
import matplotlib.pyplot as plt
import matplotlib.colors as mcolors
```

```
import plotly.graph_objects as go
import plotly.figure_factory as ff

#Data Preprocessing & Modeling
from pprint import pprint
from sklearn.model_selection import train_test_split, RandomizedSearchCV
from sklearn import preprocessing
from sklearn.ensemble import GradientBoostingClassifier, AdaBoostClassifier
from sklearn.neighbors import KNeighborsClassifier, NearestCentroid
from sklearn.metrics import classification_report, accuracy_score
from sklearn.preprocessing import StandardScaler
from sklearn.pipeline import make_pipeline
from imblearn.over_sampling import SMOTE
```

3 2. Uploading Dataset

Uploading a dataset in Python typically involves using libraries like **PANDAS or NUMPY** to read data from files such as CSV or Excel. This process allows you to load the data into a DataFrame or array for analysis and manipulation.

[ ]:
```
df = pd.read_csv('sleephealthdataanalysis.csv')
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 374 entries, 0 to 373
Data columns (total 13 columns):
 #   Column                   Non-Null Count  Dtype
---  ------                   --------------  -----
 0   Person ID                374 non-null    int64
 1   Gender                   374 non-null    object
 2   Age                      374 non-null    int64
 3   Occupation               374 non-null    object
 4   Sleep Duration           374 non-null    float64
 5   Quality of Sleep         374 non-null    int64
 6   Physical Activity Level  374 non-null    int64
 7   Stress Level             374 non-null    int64
 8   BMI Category             374 non-null    object
 9   Blood Pressure           374 non-null    object
 10  Heart Rate               374 non-null    int64
 11  Daily Steps              374 non-null    int64
 12  Sleep Disorder           155 non-null    object
dtypes: float64(1), int64(7), object(5)
memory usage: 38.1+ KB
```

4 2. Data Cleaning and Pre-processing Segment

Data cleaning and pre-processing in Python involve handling missing values, removing duplicates, and converting data types to ensure consistency and accuracy. Techniques such as normalization, scaling, and encoding categorical variables are also applied to prepare the data for analysis or machine learning models.

[ ]:
```
df.head()
```

[ ]:

	Person ID	Gender	Age	Occupation	Sleep Duration	Quality of Sleep	Physical Activity Level	Stress Level	BMI Category	Blood Pressure	Heart Rate	Daily Steps	Sleep Disorder
0	1	Male	27	Software Engineer	6.1	6	42	6	Overweight	126/83	77	4200	NaN
1	2	Male	28	Doctor	6.2	6	60	8	Normal	125/80	75	10000	NaN
2	3	Male	28	Doctor	6.2	6	60	8	Normal	125/80	75	10000	NaN
3	4	Male	28	Sales Representative	5.9	4	30	8	Obese	140/90	85	3000	Sleep Apnea
4	5	Male	28	Sales Representative	5.9	4	30	8	Obese	140/90	85	3000	Sleep Apnea

[ ]:
```
df.describe(include = 'number')
```

[ ]:

	Person ID	Age	Sleep Duration	Quality of Sleep	Physical Activity Level	Stress Level	Heart Rate	Daily Steps
count	374.000000	374.000000	374.000000	374.000000	374.000000	374.000000	374.000000	374.000000
mean	187.500000	42.184492	7.132086	7.312834	59.171123	5.385027	70.165775	6816.844920
std	108.108742	8.673133	0.795657	1.196956	20.830804	1.774526	4.135676	1617.915679
min	1.000000	27.000000	5.800000	4.000000	30.000000	3.000000	65.000000	3000.000000
25%	94.250000	35.250000	6.400000	6.000000	45.000000	4.000000	68.000000	5600.000000

```
50%                  60.000000      5.000000   70.000000   7000.000000
75%                  75.000000      7.000000   72.000000   8000.000000
max                  90.000000      8.000000   86.000000  10000.000000
```

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

[ ]:
```
Person ID                   0
Gender                      0
Age                         0
Occupation                  0
Sleep Duration              0
Quality of Sleep            0
Physical Activity Level     0
Stress Level                0
BMI Category                0
Blood Pressure              0
Heart Rate                  0
Daily Steps                 0
Sleep Disorder            219
dtype: int64
```

[ ]:
```
df['Sleep Disorder'] = df['Sleep Disorder'].fillna('None')
df.nunique()
```

[ ]:
```
Person ID                 374
Gender                      2
Age                        31
Occupation                 11
Sleep Duration             27
Quality of Sleep            6
Physical Activity Level    16
Stress Level                6
BMI Category                4
Blood Pressure             25
Heart Rate                 19
Daily Steps                20
Sleep Disorder              3
dtype: int64
```

[ ]:
```
df.drop_duplicates()
```

[ ]:
```
     Person ID  Gender  Age            Occupation  Sleep Duration  \
0            1    Male   27     Software Engineer             6.1
1            2    Male   28                Doctor             6.2
2            3    Male   28                Doctor             6.2
3            4    Male   28  Sales Representative             5.9
4            5    Male   28  Sales Representative             5.9
```

```
..          …     …  …                    …               …
369         370  Female   59                 Nurse             8.1
370         371  Female   59                 Nurse             8.0
371         372  Female   59                 Nurse             8.1
372         373  Female   59                 Nurse             8.1
373         374  Female   59                 Nurse             8.1

     Quality of Sleep  Physical Activity Level  Stress Level BMI Category  \
0                   6                       42             6   Overweight
1                   6                       60             8       Normal
2                   6                       60             8       Normal
3                   4                       30             8        Obese
4                   4                       30             8        Obese
..                …                        …             …          …
369                 9                       75             3   Overweight
370                 9                       75             3   Overweight
371                 9                       75             3   Overweight
372                 9                       75             3   Overweight
373                 9                       75             3   Overweight

    Blood Pressure  Heart Rate  Daily Steps Sleep Disorder
0           126/83          77         4200            None
1           125/80          75        10000            None
2           125/80          75        10000            None
3           140/90          85         3000    Sleep Apnea
4           140/90          85         3000    Sleep Apnea
..             …         …           …             …
369         140/95          68         7000    Sleep Apnea
370         140/95          68         7000    Sleep Apnea
371         140/95          68         7000    Sleep Apnea
372         140/95          68         7000    Sleep Apnea
373         140/95          68         7000    Sleep Apnea

[374 rows x 13 columns]
```

[ ]:
```
print(df['Occupation'].value_counts())
print('\n')
print(df['BMI Category'].value_counts())
print('\n')
print(df['Sleep Disorder'].value_counts())
```

```
Occupation
Nurse                    73
Doctor                   71
Engineer                 63
Lawyer                   47
Teacher                  40
```

```
Accountant              37
Salesperson             32
Software Engineer        4
Scientist                4
Sales Representative     2
Manager                  1
Name: count, dtype: int64


BMI Category
Normal           195
Overweight       148
Normal Weight     21
Obese             10
Name: count, dtype: int64


Sleep Disorder
None           219
Sleep Apnea     78
Insomnia        77
Name: count, dtype: int64
```

[ ]:
```
df['BMI Category'] = df['BMI Category'].replace({'Normal weight': 'Normal␣
 ↪Weight', 'Normal': 'Normal Weight'})


df[['BloodPressure_Systolic', 'BloodPressure_Diastolic']] = df['Blood␣
 ↪Pressure'].str.split('/', expand=True)
df['BloodPressure_Systolic'] = pd.to_numeric(df['BloodPressure_Systolic'])
df['BloodPressure_Diastolic'] = pd.to_numeric(df['BloodPressure_Diastolic'])

columns = ['Age', 'Sleep Duration', 'Quality of Sleep',
           'Physical Activity Level', 'Stress Level',
           'Heart Rate', 'Daily Steps', 'BloodPressure_Systolic',␣
 ↪'BloodPressure_Diastolic']


z_scores = np.abs(stats.zscore(df[columns]))


z_scores_df = pd.DataFrame(z_scores, columns=columns)


df = df[(z_scores_df < 3).all(axis=1)]
```

```
df.describe()
```

[ ]:

	Person ID	Age	Sleep Duration	Quality of Sleep
count	365.000000	365.000000	365.000000	365.000000
mean	188.446575	42.263014	7.134521	7.334247
std	107.675211	8.647993	0.794046	1.166405
min	1.000000	27.000000	5.800000	4.000000
25%	96.000000	36.000000	6.400000	6.000000
50%	188.000000	43.000000	7.200000	7.000000
75%	283.000000	50.000000	7.800000	8.000000
max	374.000000	59.000000	8.500000	9.000000

	Physical Activity Level	Stress Level	Heart Rate	Daily Steps
count	365.000000	365.000000	365.000000	365.000000
mean	59.232877	5.380822	69.810959	6902.739726
std	20.827339	1.771311	3.500375	1540.494837
min	30.000000	3.000000	65.000000	3500.000000
25%	45.000000	4.000000	68.000000	6000.000000
50%	60.000000	5.000000	70.000000	7000.000000
75%	75.000000	7.000000	72.000000	8000.000000
max	90.000000	8.000000	82.000000	10000.000000

	BloodPressure_Systolic	BloodPressure_Diastolic
count	365.000000	365.000000
mean	128.293151	84.512329
std	7.651695	6.170026
min	115.000000	75.000000
25%	125.000000	80.000000
50%	130.000000	85.000000
75%	135.000000	90.000000
max	140.000000	95.000000

[ ]:
```
numerical_df = df.copy()


numerical_df.drop('Blood Pressure', axis=1, inplace=True)

label_encoder = preprocessing.LabelEncoder()
categorical_columns = ['Gender', 'Occupation', 'BMI Category', 'Sleep Disorder']
for col in categorical_columns:
    numerical_df[col] = label_encoder.fit_transform(numerical_df[col])
numerical_df.head()
```

[ ]:

	Person ID	Gender	Age	Occupation	Sleep Duration	Quality of Sleep
0	1	1	27	8	6.1	6
1	2	1	28	1	6.2	6
2	3	1	28	1	6.2	6

```
6          7       1   29           9             6.3                  6
7          8       1   29           1             7.8                  7

   Physical Activity Level  Stress Level  BMI Category  Heart Rate  \
0                       42             6             2          77
1                       60             8             0          75
2                       60             8             0          75
6                       40             7             1          82
7                       75             6             0          70

   Daily Steps  Sleep Disorder  BloodPressure_Systolic  \
0         4200               1                     126
1        10000               1                     125
2        10000               1                     125
6         3500               0                     140
7         8000               1                     120

   BloodPressure_Diastolic
0                       83
1                       80
2                       80
6                       90
7                       80
```

[ ]:
```
columns = ['Gender', 'Occupation', 'BMI Category', 'Sleep Disorder']


z_scores = np.abs(stats.zscore(numerical_df[columns]))


z_scores_df = pd.DataFrame(z_scores, columns=columns)


numerical_df = numerical_df[(z_scores_df < 3).all(axis=1)]

numerical_df.describe()
```

[ ]:
```
         Person ID      Gender         Age  Occupation  Sleep Duration  \
count  365.000000  365.000000  365.000000  365.000000      365.000000
mean   188.446575    0.495890   42.263014    3.564384        7.134521
std    107.675211    0.500669    8.647993    2.727423        0.794046
min      1.000000    0.000000   27.000000    0.000000        5.800000
25%     96.000000    0.000000   36.000000    1.000000        6.400000
50%    188.000000    0.000000   43.000000    3.000000        7.200000
75%    283.000000    1.000000   50.000000    5.000000        7.800000
max    374.000000    1.000000   59.000000    9.000000        8.500000
```

```
       Quality of Sleep  Physical Activity Level  Stress Level  BMI Category  \
count        365.000000               365.000000    365.000000    365.000000
mean           7.334247                59.232877      5.380822      0.813699
std            1.166405                20.827339      1.771311      0.982444
min            4.000000                30.000000      3.000000      0.000000
25%            6.000000                45.000000      4.000000      0.000000
50%            7.000000                60.000000      5.000000      0.000000
75%            8.000000                75.000000      7.000000      2.000000
max            9.000000                90.000000      8.000000      2.000000

       Heart Rate   Daily Steps  Sleep Disorder  BloodPressure_Systolic  \
count  365.000000    365.000000      365.000000              365.000000
mean    69.810959   6902.739726        0.994521              128.293151
std      3.500375   1540.494837        0.633300                7.651695
min     65.000000   3500.000000        0.000000              115.000000
25%     68.000000   6000.000000        1.000000              125.000000
50%     70.000000   7000.000000        1.000000              130.000000
75%     72.000000   8000.000000        1.000000              135.000000
max     82.000000  10000.000000        2.000000              140.000000

       BloodPressure_Diastolic
count               365.000000
mean                 84.512329
std                   6.170026
min                  75.000000
25%                  80.000000
50%                  85.000000
75%                  90.000000
max                  95.000000
```

5 4. Descriptive Statistics

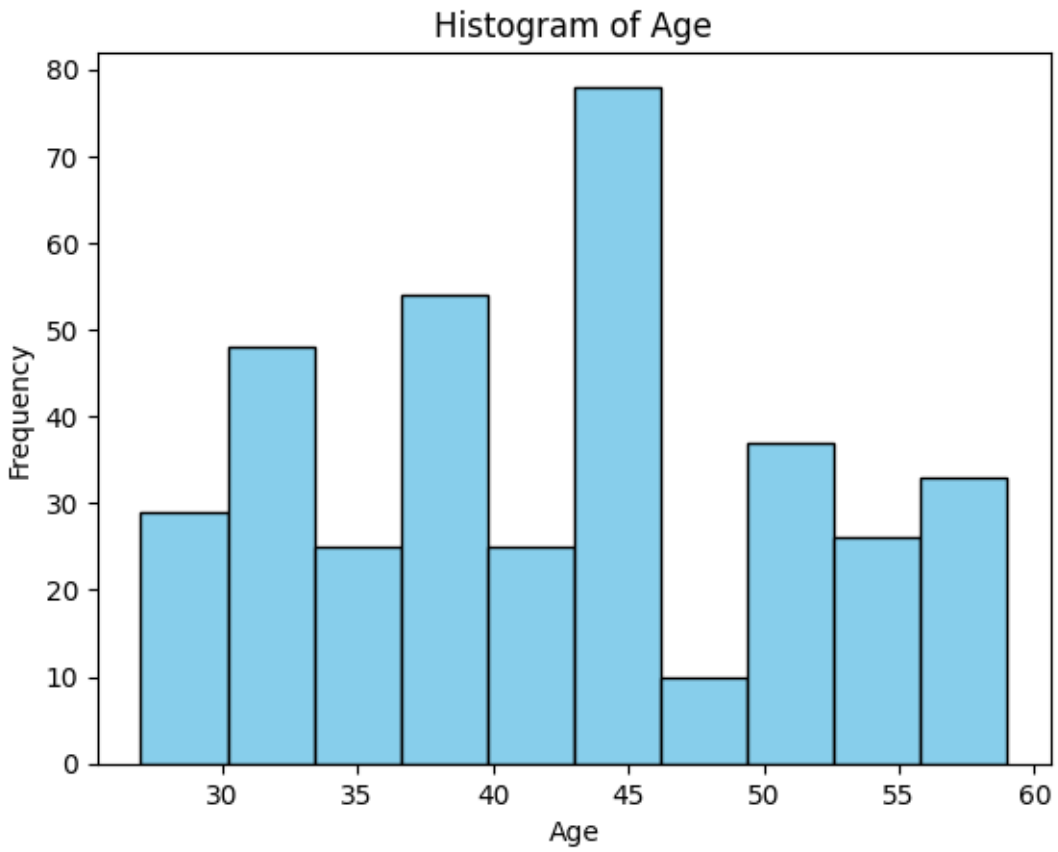
Use of summary statistics to understand data distribution

[ ]:
```
summary_stats = numerical_df.describe()
print(summary_stats)

column_name = 'Age'
column_distribution = numerical_df[column_name].value_counts()
print(column_distribution)


plt.hist(numerical_df[column_name], bins=10, color='skyblue', edgecolor='black')
plt.xlabel(column_name)
plt.ylabel('Frequency')
plt.title('Histogram of ' + column_name)
```

```
plt.show()
```

```
        Person ID      Gender         Age  Occupation  Sleep Duration  \
count  365.000000  365.000000  365.000000  365.000000      365.000000
mean   188.446575    0.495890   42.263014    3.564384        7.134521
std    107.675211    0.500669    8.647993    2.727423        0.794046
min      1.000000    0.000000   27.000000    0.000000        5.800000
25%     96.000000    0.000000   36.000000    1.000000        6.400000
50%    188.000000    0.000000   43.000000    3.000000        7.200000
75%    283.000000    1.000000   50.000000    5.000000        7.800000
max    374.000000    1.000000   59.000000    9.000000        8.500000

       Quality of Sleep  Physical Activity Level  Stress Level  BMI Category  \
count        365.000000               365.000000    365.000000    365.000000
mean           7.334247                59.232877      5.380822      0.813699
std            1.166405                20.827339      1.771311      0.982444
min            4.000000                30.000000      3.000000      0.000000
25%            6.000000                45.000000      4.000000      0.000000
50%            7.000000                60.000000      5.000000      0.000000
75%            8.000000                75.000000      7.000000      2.000000
max            9.000000                90.000000      8.000000      2.000000

       Heart Rate   Daily Steps  Sleep Disorder  BloodPressure_Systolic  \
count  365.000000    365.000000      365.000000              365.000000
mean    69.810959   6902.739726        0.994521              128.293151
std      3.500375   1540.494837        0.633300                7.651695
min     65.000000   3500.000000        0.000000              115.000000
25%     68.000000   6000.000000        1.000000              125.000000
50%     70.000000   7000.000000        1.000000              130.000000
75%     72.000000   8000.000000        1.000000              135.000000
max     82.000000  10000.000000        2.000000              140.000000

       BloodPressure_Diastolic
count               365.000000
mean                 84.512329
std                   6.170026
min                  75.000000
25%                  80.000000
50%                  85.000000
75%                  90.000000
max                  95.000000
Age
43    34
44    30
37    20
50    20
38    19
```

```
31    18
32    17
53    17
59    16
39    15
45    14
33    13
30    13
29    13
36    12
41    12
35    11
57     9
49     9
52     9
42     9
51     8
54     7
58     6
40     4
28     2
55     2
56     2
34     2
48     1
27     1
Name: count, dtype: int64
```



6 5. Inferential Statistics

(If applicable) Techniques used to make predictions or inferences from the dat

[ ]:
```
group1 = numerical_df[numerical_df['Gender'] == 0]['Sleep Duration']
group2 = numerical_df[numerical_df['Gender'] == 1]['Sleep Duration']
t_stat, p_value = stats.ttest_ind(group1, group2)
print("T-statistic:", t_stat)
print("P-value:", p_value)
```

```
T-statistic: 2.3006671537067134
P-value: 0.02197673801600147
```

7 6. Predictive Modeling

If (applicable) Models built to predict future trends

[ ]:
```
X = numerical_df.drop(columns=['Sleep Disorder'])
y = numerical_df['Sleep Disorder']
```

```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)


model = GradientBoostingClassifier()
model.fit(X_train, y_train)


y_pred = model.predict(X_test)


accuracy = accuracy_score(y_test, y_pred)
classification_rep = classification_report(y_test, y_pred)
print("Accuracy:", accuracy)
print("Classification Report:\n", classification_rep)
```

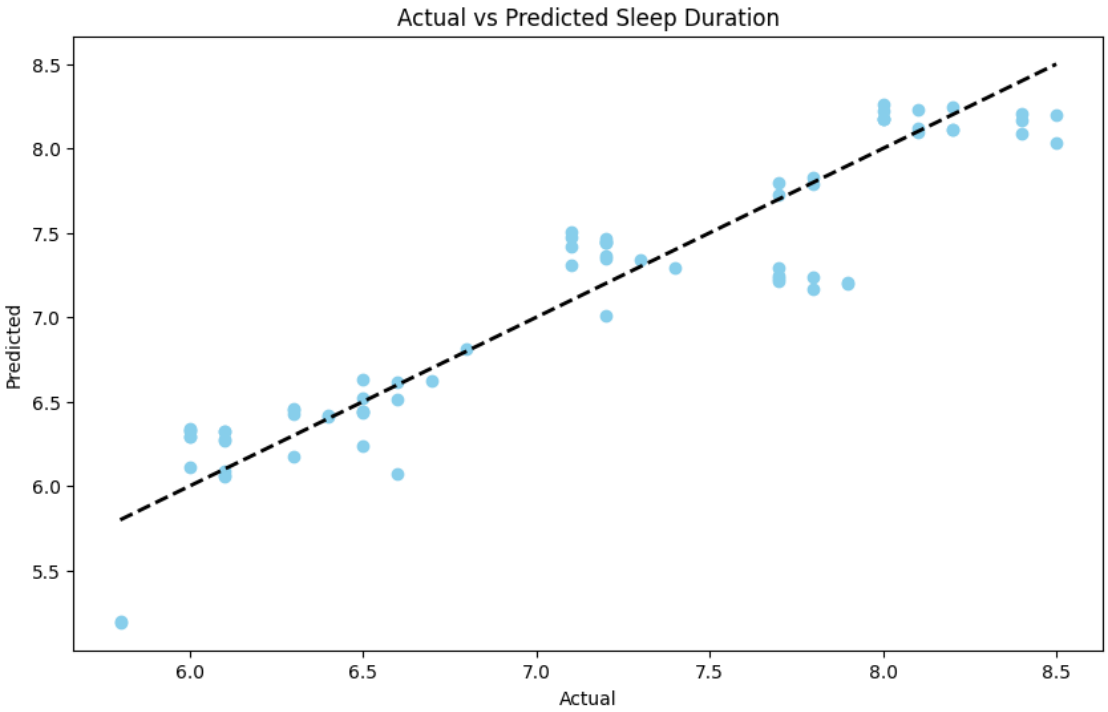
```
Accuracy: 0.9178082191780822
Classification Report:
              precision    recall  f1-score   support

           0       1.00      0.79      0.88        19
           1       0.95      0.97      0.96        37
           2       0.80      0.94      0.86        17

    accuracy                           0.92        73
   macro avg       0.92      0.90      0.90        73
weighted avg       0.93      0.92      0.92        73
```

8 7. Machine Learning Implementation

[ ]:
```
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_absolute_error, mean_squared_error, r2_score


X = numerical_df.drop(columns=['Sleep Duration'])
y = numerical_df['Sleep Duration']


X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)


lin_reg_model = LinearRegression()
```

```
lin_reg_model.fit(X_train, y_train)


y_pred = lin_reg_model.predict(X_test)


mae = mean_absolute_error(y_test, y_pred)
mse = mean_squared_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)

print("Linear Regression Model Evaluation")
print("Mean Absolute Error (MAE):", mae)
print("Mean Squared Error (MSE):", mse)
print("R-squared (R²) Score:", r2)


plt.figure(figsize=(10, 6))
plt.scatter(y_test, y_pred, color='skyblue')
plt.plot([y_test.min(), y_test.max()], [y_test.min(), y_test.max()], 'k--',␣
 ↪lw=2)
plt.xlabel('Actual')
plt.ylabel('Predicted')
plt.title('Actual vs Predicted Sleep Duration')
plt.show()
```

```
Linear Regression Model Evaluation
Mean Absolute Error (MAE): 0.22075306409171216
Mean Squared Error (MSE): 0.08157616625944596
R-squared (R²) Score: 0.8799621733425227
```

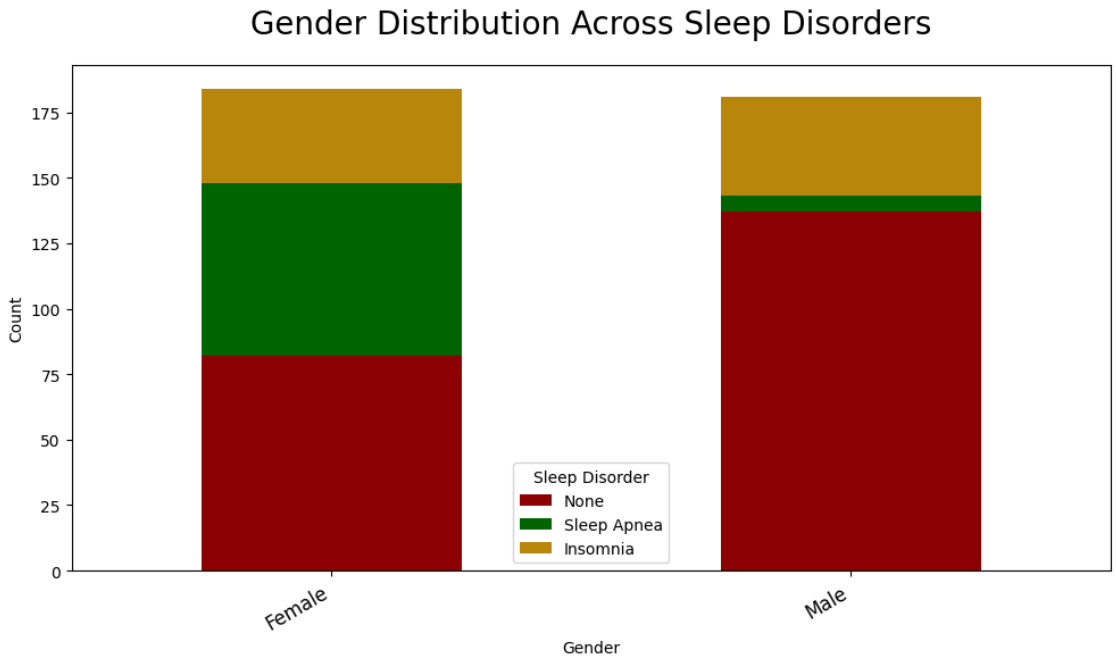


9 8. Data Visualization Segment

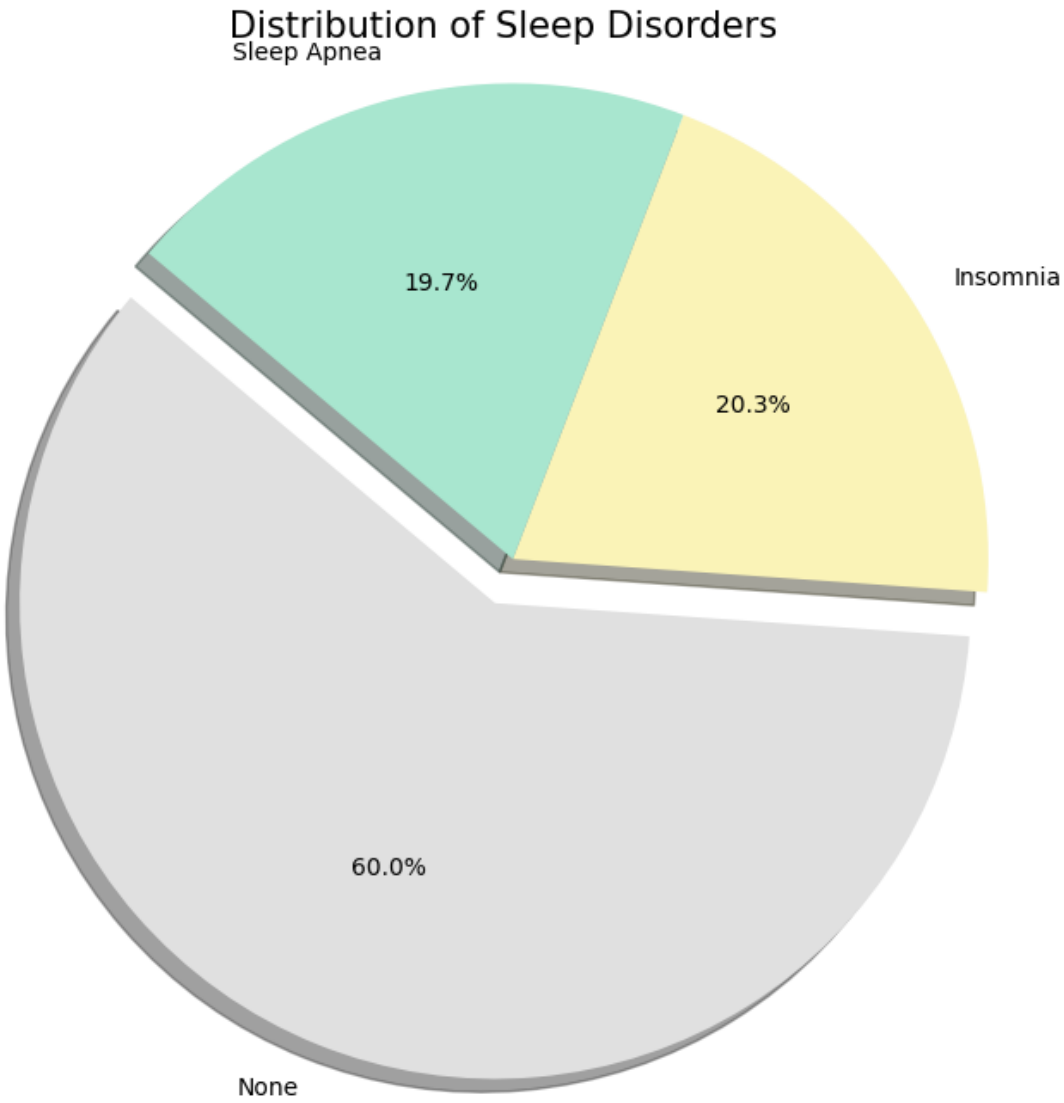
Data visualization in Python involves using libraries such as `matplotlib`, `seaborn`, and `plotly` to create graphical representations of data. This helps in identifying patterns, trends, and insights by transforming raw data into visual formats like charts, graphs, and plots.

[ ]:
```
sleep_disorder_gender = df.groupby(['Gender', 'Sleep Disorder']).size().
↪unstack(fill_value=0)
sleep_disorder_order = ['None', 'Sleep Apnea', 'Insomnia']
sleep_disorder_gender = sleep_disorder_gender[sleep_disorder_order]

colors = ['#8B0000', '#006400', '#B8860B']

plt.figure(figsize=(10, 6))
sleep_disorder_gender.plot(kind='bar', stacked=True, color=colors, figsize=(10,␣
↪6))
plt.title('Gender Distribution Across Sleep Disorders', fontsize=20, pad=20)
plt.xticks(rotation=30, ha='right', fontsize=12)
plt.xlabel('Gender')
plt.ylabel('Count')
plt.tight_layout()
plt.show()
```

```
<Figure size 1000x600 with 0 Axes>
```

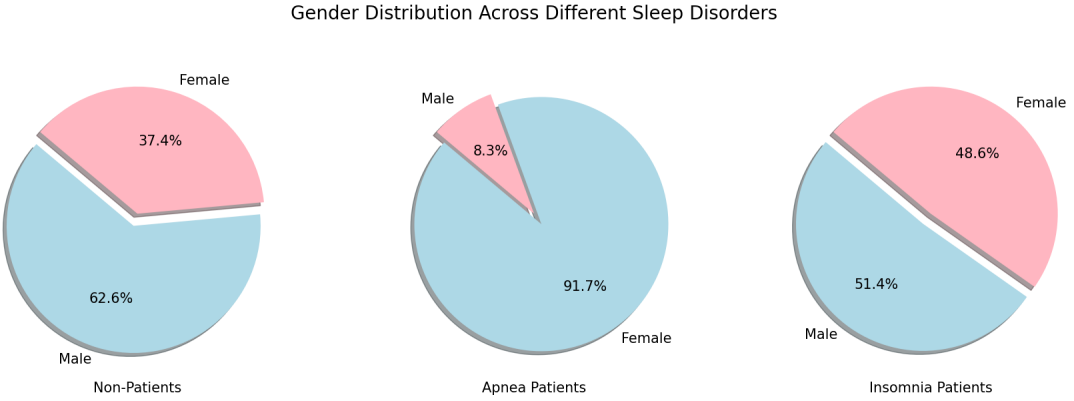


[ ]:
```
df_disorder_distribution = df['Sleep Disorder'].value_counts()

labels = df_disorder_distribution.index
sizes = df_disorder_distribution.values
colors = ['#e0e0e0', '#faf3b7', '#a8e6cf']
explode = (0.1, 0, 0)

plt.figure(figsize=(8, 8))
plt.pie(sizes, explode=explode, labels=labels, colors=colors,
        autopct='%1.1f%%', shadow=True, startangle=140)

plt.axis('equal')
plt.title('Distribution of Sleep Disorders', fontsize=15)
plt.show()
```

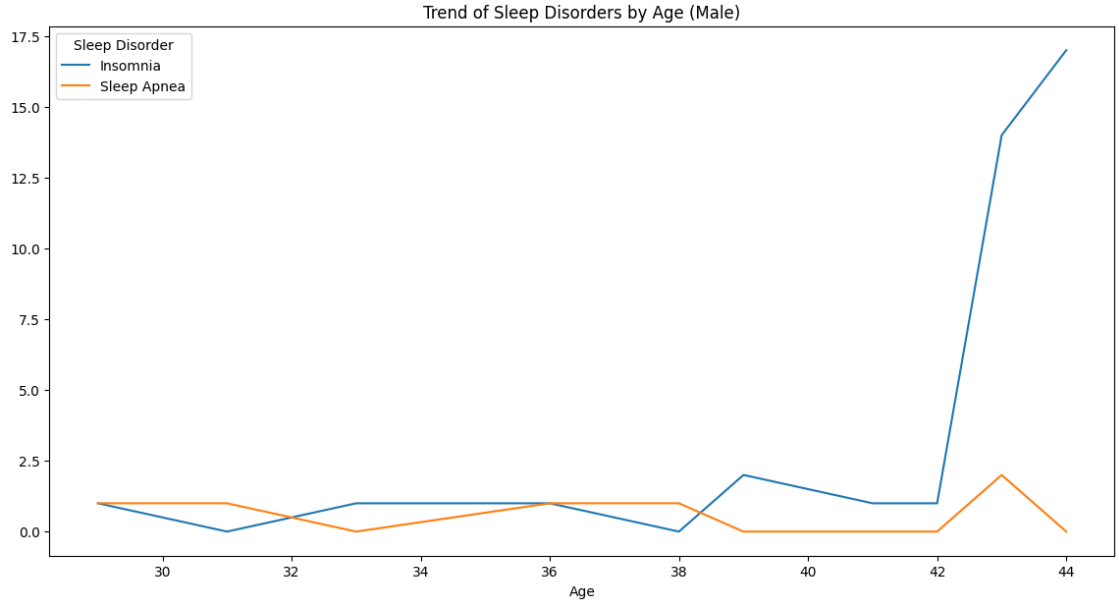


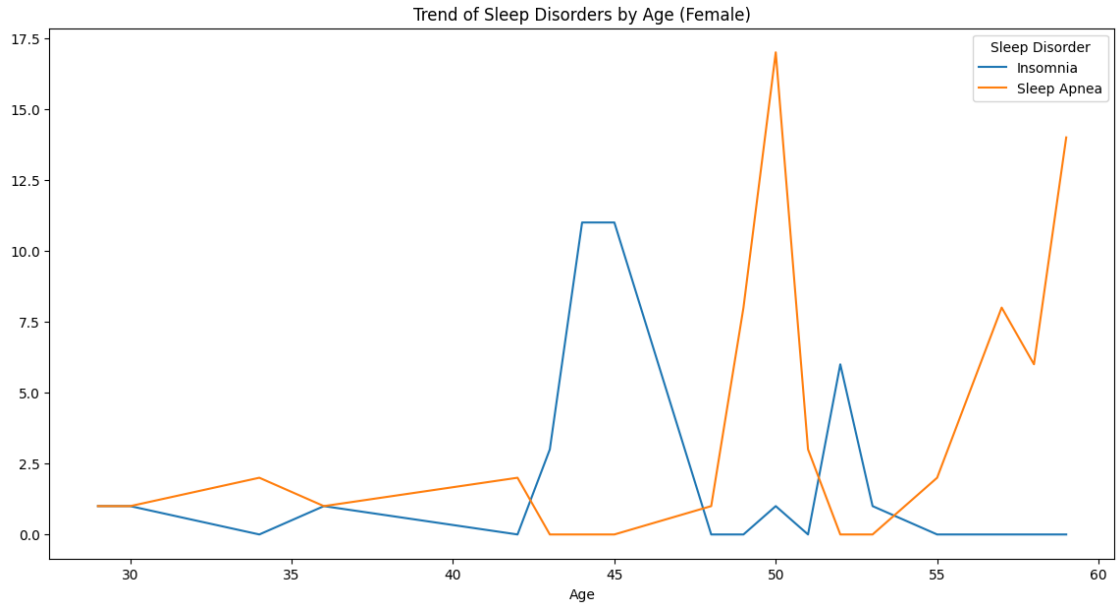
[ ]:
```
fig, axes = plt.subplots(1, 3, figsize=(18, 6))

colors = ['lightblue', 'lightpink']
explode = (0.1, 0)


df_non_patients = df[df['Sleep Disorder'] == 'None']['Gender'].value_counts()
wedges, texts, autotexts = axes[0].pie(df_non_patients.values,
                                       explode=explode,
                                       labels=df_non_patients.index,
                                       colors=colors,
                                       autopct='%1.1f%%',
                                       shadow=True,
```

```
                                        startangle=140,
                                        textprops={'color': 'black', 'fontsize':␣
 ↪15})
axes[0].text(0, -1.4, 'Non-Patients', ha='center', fontsize=15)


df_apnea = df[df['Sleep Disorder'] == 'Sleep Apnea']['Gender'].value_counts()
wedges, texts, autotexts = axes[1].pie(df_apnea.values,
                                        explode=explode,
                                        labels=df_apnea.index,
                                        colors=colors,
                                        autopct='%1.1f%%',
                                        shadow=True,
                                        startangle=140,
                                        textprops={'color': 'black', 'fontsize':␣
 ↪15})
axes[1].text(0, -1.4, 'Apnea Patients', ha='center', fontsize=15)


df_insomnia = df[df['Sleep Disorder'] == 'Insomnia']['Gender'].value_counts()
wedges, texts, autotexts = axes[2].pie(df_insomnia.values,
                                        explode=explode,
                                        labels=df_insomnia.index,
                                        colors=colors,
                                        autopct='%1.1f%%',
                                        shadow=True,
                                        startangle=140,
                                        textprops={'color': 'black', 'fontsize':␣
 ↪15})
axes[2].text(0, -1.4, 'Insomnia Patients', ha='center', fontsize=15)

fig.suptitle('Gender Distribution Across Different Sleep Disorders',␣
 ↪fontsize=20)
plt.tight_layout(rect=[0, 0.03, 1, 0.95])
plt.show()
```



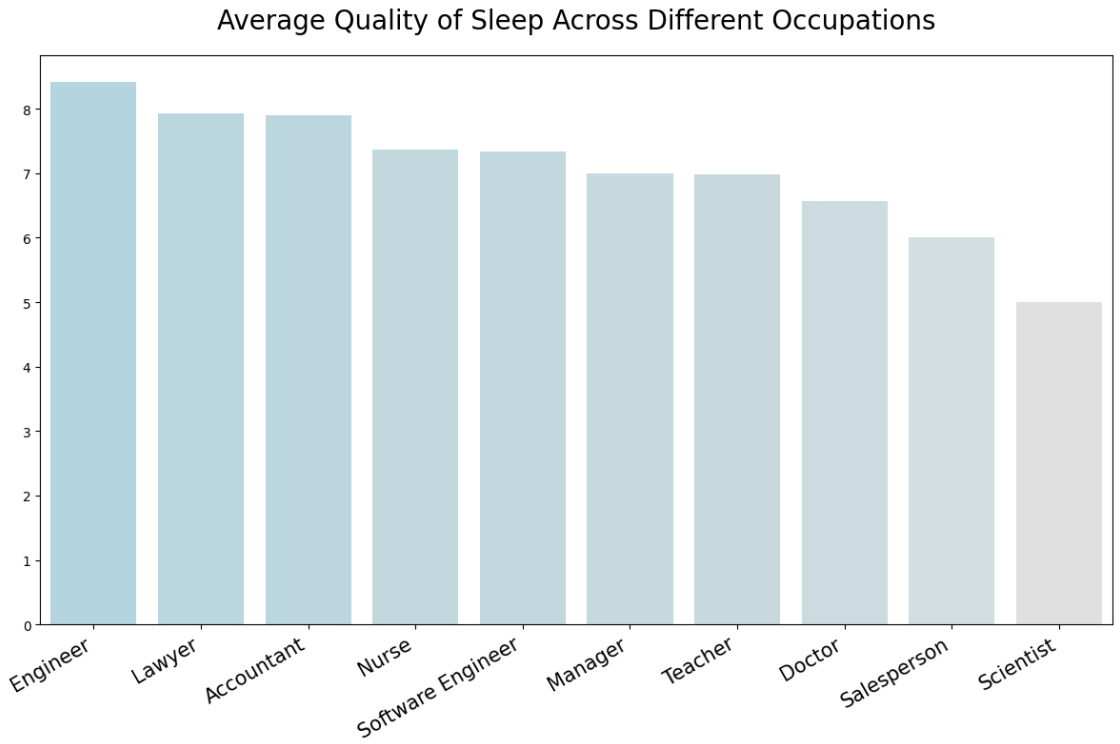
[ ]:
```
male_age_disorder_counts = df[(df['Sleep Disorder'] != 'None') & (df['Gender']␣
 ↪== 'Male')].groupby(['Age', 'Sleep Disorder']).size().unstack(fill_value=0)
female_age_disorder_counts = df[(df['Sleep Disorder'] != 'None') &␣
 ↪(df['Gender'] == 'Female')].groupby(['Age', 'Sleep Disorder']).size().
 ↪unstack(fill_value=0)

plt.figure(figsize=(14, 7))
for disorder in male_age_disorder_counts.columns:
    plt.plot(male_age_disorder_counts.index,␣
 ↪male_age_disorder_counts[disorder], label=disorder)
plt.title('Trend of Sleep Disorders by Age (Male)')
plt.xlabel('Age')
plt.ylabel('')
plt.legend(title='Sleep Disorder')
plt.show()

plt.figure(figsize=(14, 7))
for disorder in female_age_disorder_counts.columns:
    plt.plot(female_age_disorder_counts.index,␣
 ↪female_age_disorder_counts[disorder], label=disorder)
plt.title('Trend of Sleep Disorders by Age (Female)')
plt.xlabel('Age')
plt.ylabel('')
plt.legend(title='Sleep Disorder')
plt.show()
```



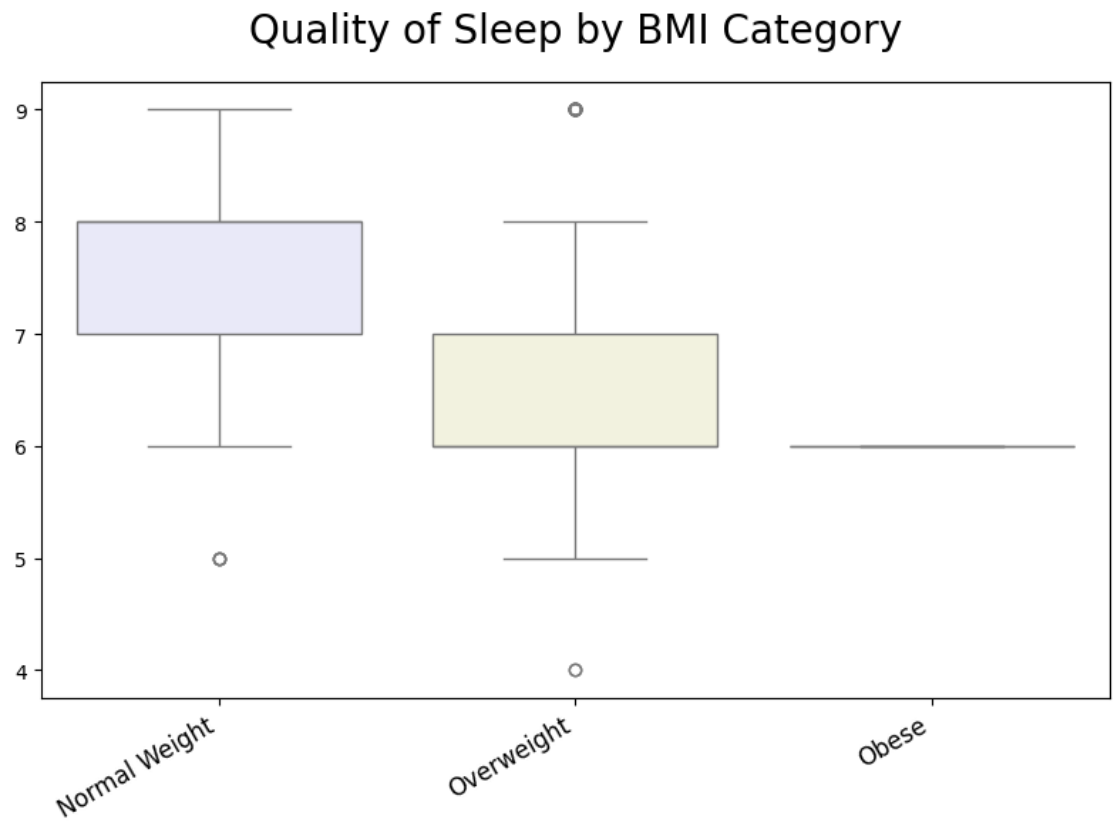


[ ]:
```
avg_quality_sleep_by_occupation = df.groupby('Occupation')['Quality of Sleep'].
 ↪mean().sort_values(ascending=False)


cmap = mcolors.LinearSegmentedColormap.from_list("gradation", ['#e0e0e0',␣
 ↪'#add8e6'])


norm = mcolors.Normalize(vmin=min(avg_quality_sleep_by_occupation.values),␣
 ↪vmax=max(avg_quality_sleep_by_occupation.values))


bar_colors = [cmap(norm(value)) for value in avg_quality_sleep_by_occupation.
 ↪values]


plt.figure(figsize=(12, 8))
sns.barplot(x=avg_quality_sleep_by_occupation.index,␣
 ↪y=avg_quality_sleep_by_occupation.values, palette=bar_colors)
plt.title('Average Quality of Sleep Across Different Occupations', fontsize=20,␣
 ↪pad=20)
plt.xticks(rotation=30, ha='right', fontsize=15)
plt.xlabel('')
plt.ylabel('')
plt.tight_layout()
```

```
plt.show()
```

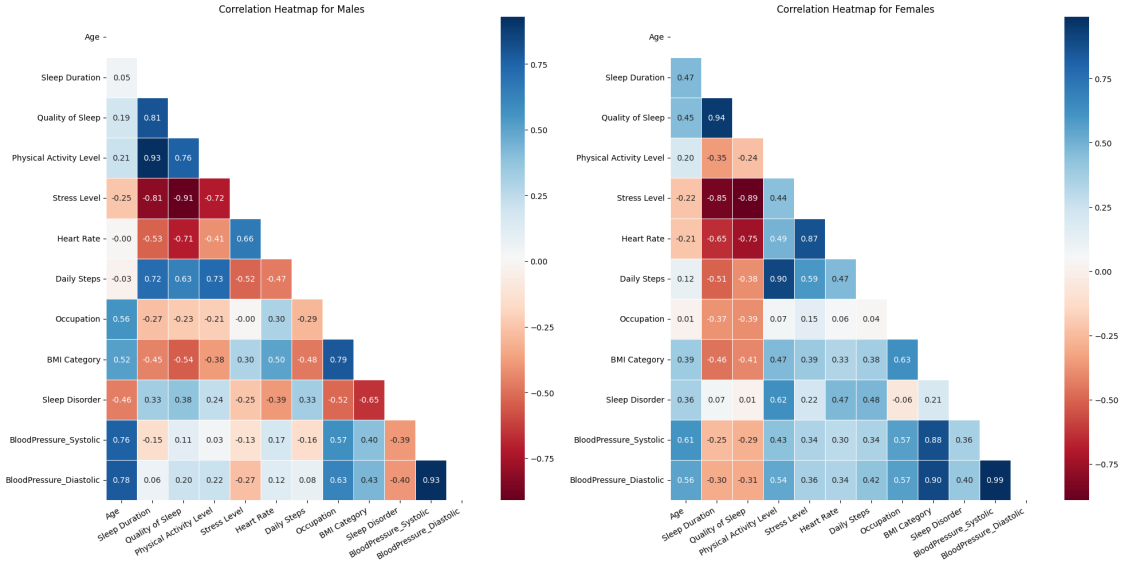


[ ]:
```
bmi_order = ['Normal Weight', 'Overweight', 'Obese']
colors = ['#e6e6fa', '#f5f5dc', '#add8e6']

plt.figure(figsize=(8, 6))
sns.boxplot(x='BMI Category', y='Quality of Sleep', data=df, order=bmi_order,␣
 ↪palette=colors)
plt.title('Quality of Sleep by BMI Category', fontsize=20, pad=20)
plt.xticks(rotation=30, ha='right', fontsize=12)
plt.xlabel('')
plt.ylabel('')
plt.tight_layout()
plt.show()
```



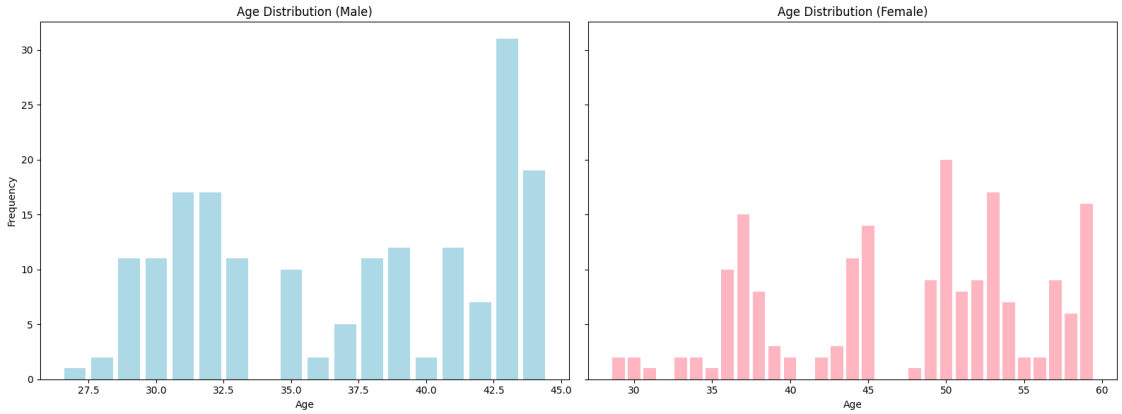
[ ]:
```
male_df = numerical_df[numerical_df['Gender'] == 1][['Age','Sleep Duration',␣
 ↪'Quality of Sleep',
                                                     'Physical Activity Level',␣
 ↪'Stress Level', 'Heart Rate',
                                                     'Daily␣
 ↪Steps','Occupation','BMI Category','Sleep Disorder',
                                                     'BloodPressure_Systolic',␣
 ↪'BloodPressure_Diastolic']]
female_df = numerical_df[numerical_df['Gender'] == 0][['Age','Sleep Duration',␣
 ↪'Quality of Sleep',
                                                     'Physical Activity Level',␣
 ↪'Stress Level', 'Heart Rate',
                                                     'Daily␣
 ↪Steps','Occupation','BMI Category','Sleep Disorder',
                                                     'BloodPressure_Systolic',␣
 ↪'BloodPressure_Diastolic']]


correlation_matrix_male = male_df.corr()
correlation_matrix_female = female_df.corr()
```

```
mask = np.triu(np.ones_like(correlation_matrix_male, dtype=bool))


plt.figure(figsize=(20, 10))


plt.subplot(1, 2, 1)
sns.heatmap(correlation_matrix_male, annot=True, cmap='RdBu', fmt='.2f',␣
 ↪linewidths=0.5, mask=mask)
plt.title('Correlation Heatmap for Males')
plt.xticks(rotation=30, ha='right')
plt.yticks(rotation=0)


plt.subplot(1, 2, 2)
sns.heatmap(correlation_matrix_female, annot=True, cmap='RdBu', fmt='.2f',␣
 ↪linewidths=0.5, mask=mask)
plt.title('Correlation Heatmap for Females')
plt.xticks(rotation=30, ha='right')
plt.yticks(rotation=0)

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



[ ]:
```
# Bar chart for age distribution by gender
fig, axes = plt.subplots(1, 2, figsize=(16, 6), sharey=True)
```

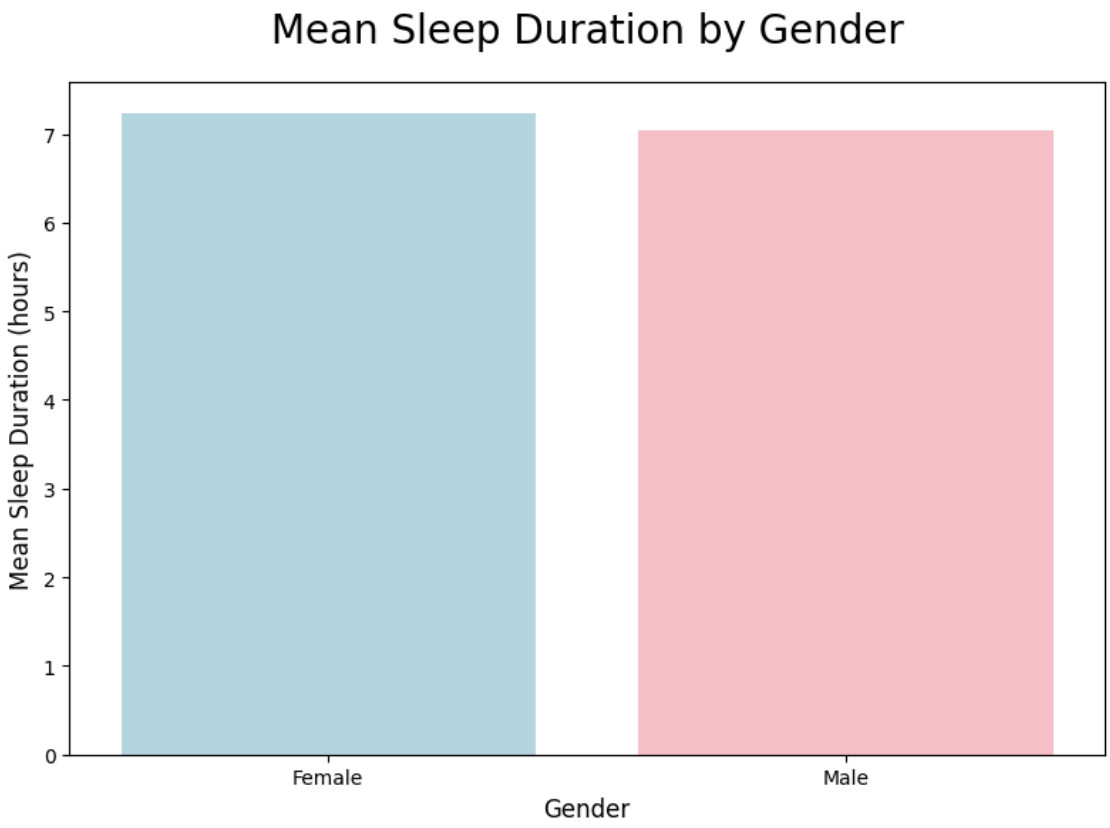
```
# Male age distribution
male_age_distribution = df[df['Gender'] == 'Male']['Age'].value_counts().
 ↪sort_index()
axes[0].bar(male_age_distribution.index, male_age_distribution.values,␣
 ↪color='lightblue')
axes[0].set_title('Age Distribution (Male)')
axes[0].set_xlabel('Age')
axes[0].set_ylabel('Frequency')

# Female age distribution
female_age_distribution = df[df['Gender'] == 'Female']['Age'].value_counts().
 ↪sort_index()
axes[1].bar(female_age_distribution.index, female_age_distribution.values,␣
 ↪color='lightpink')
axes[1].set_title('Age Distribution (Female)')
axes[1].set_xlabel('Age')
axes[1].set_ylabel('')

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



[ ]:
```
plt.figure(figsize=(8, 6))

mean_quality_of_sleep = df.groupby('Gender')['Quality of Sleep'].mean().
 ↪reset_index()

sns.barplot(x='Gender', y='Quality of Sleep', data=mean_quality_of_sleep,␣
 ↪palette=['lightblue', 'lightpink'])

plt.title('Mean Quality of Sleep by Gender', fontsize=16, pad=20)
plt.xlabel('Gender', fontsize=12)
```

```
plt.ylabel('Mean Quality of Sleep', fontsize=12)
plt.show()
```

[ ]:
```
mean_sleep_duration = df.groupby('Gender')['Sleep Duration'].mean().
  ↪reset_index()

plt.figure(figsize=(8, 6))
sns.barplot(x='Gender', y='Sleep Duration', data=mean_sleep_duration,␣
  ↪palette=['lightblue', 'lightpink'])

plt.title('Mean Sleep Duration by Gender', fontsize=20, pad=20)
plt.xlabel('Gender', fontsize=12)
plt.ylabel('Mean Sleep Duration (hours)', fontsize=12)

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



[ ]:
```
import matplotlib.pyplot as plt
import seaborn as sns


df_filtered = df[df['Sleep Disorder'] != 'None']

mean_stress_level = df_filtered.groupby(['Gender', 'Sleep Disorder'])['Stress␣
↪Level'].mean().reset_index()


disorder_order = ['Insomnia', 'Sleep Apnea']


color_palette = ['lightblue', 'lightpink']


fig, axes = plt.subplots(1, 2, figsize=(16, 6), sharey=True)

# Male plot
sns.barplot(ax=axes[0], data=mean_stress_level[mean_stress_level['Gender'] ==␣
↪'Male'],
```

```
            x='Sleep Disorder', y='Stress Level', order=disorder_order,␣
 ↪palette=color_palette)
axes[0].set_title('Mean Stress Levels by Sleep Disorders (Male)', fontsize=15)
axes[0].set_xlabel('')
axes[0].set_ylabel('Stress Level')

# Female plot
sns.barplot(ax=axes[1], data=mean_stress_level[mean_stress_level['Gender'] ==␣
 ↪'Female'],
            x='Sleep Disorder', y='Stress Level', order=disorder_order,␣
 ↪palette=color_palette)
axes[1].set_title('Mean Stress Levels by Sleep Disorders (Female)', fontsize=15)
axes[1].set_xlabel('')
axes[1].set_ylabel('')

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