CS624-Assignment-1

January 28, 2024

1 CS624-Assignment-1

Sleep Health and Lifestyle Analysis

**

Dataset Details

**

This dataset contains sleep and cardiovascular metrics as well as lifestyle factors of close to 400 fictive persons.

1.0.1 Objective

- Data Analysis and Visualization for potential spleeping disorder.

1.0.2 Fields

- Person ID: An identifier for each individual.
- Gender: The gender of the person (Male/Female).
- Age: The age of the person in years.
- Occupation: The occupation or profession of the person.
- Sleep Duration: Average number of hours of sleep per day
- Quality of Sleep: A subjective rating on a 1-10 scale
- Physical Activity Level: Average number of minutes the person engages in physical activity daily
- Stress Level: A subjective rating on a 1-10 scale
- BMI Category
- Blood Pressure: Indicated as systolic pressure over diastolic pressure
- Heart Rate: In beats per minute
- Daily Steps
- Sleep Disorder: One of None, Insomnia or Sleep Apnea

1.0.3 Details about Sleep Disorder Column

- None: The individual does not exhibit any specific sleep disorder.
- Insomnia: The individual experiences difficulty falling asleep or staying asleep, leading to inadequate or poor-quality sleep.
- Sleep Apnea: The individual suffers from pauses in breathing during sleep, resulting in disrupted sleep patterns and potential health risks.

1.0.4 Key Features of the Dataset

- Comprehensive Sleep Metrics: Explore sleep duration, quality, and factors influencing sleep patterns.
- Lifestyle Factors: Analyze physical activity levels, stress levels, and BMI categories.
- Cardiovascular Health: Examine blood pressure and heart rate measurements.
- Sleep Disorder Analysis: Identify the occurrence of sleep disorders such as Insomnia and Sleep Apnea.

1.0.5 Datatypes

- Person ID Integer
- Gender String
- Age Integer
- Occupation String
- Sleep Duration Numeric
- Quality of Sleep Integer
- Physical Activity Level Integer
- Stress Level Integer
- BMI Category String
- Blood Pressure Integer

Import Python Libraries

[36]:
```
# Python libraries
import numpy as np
import pandas as pd
import os

import matplotlib.pyplot as plt
import seaborn as sns
import matplotlib as mpl
import matplotlib.lines as mlines
import plotly.express as px
import plotly.graph_objects as go

#Google Drive
from google.colab import drive
drive.mount('/content/drive',force_remount=True)

import warnings
warnings.filterwarnings("ignore")
```

```
Mounted at /content/drive
```

Data Acquisition

[37]:
```
# Class for data acquisition
class DataAcquisition:

  def __init__(self,datasetname):
    self.datasetname = datasetname

  def ReadCsv(self):
    raw_data = pd.read_csv(os.path.join('/content/',self.datasetname),
                           sep=',',encoding='UTF-8')
    return raw_data



acq = DataAcquisition('dataset.csv')
raw_data = acq.ReadCsv()
raw_data.head()
```

[37]:

	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	None
1	2	Male	28	Doctor	6.2	6	60	8	Normal	125/80	75	10000	None
2	3	Male	28	Doctor	6.2	6	60	8	Normal	125/80	75	10000	None
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

Data PreProcessing

[38]:
```
# Class for data preprocessing
class DataPreprocessing:

  def __init__(self,dataframe):
    self.dataframe = dataframe
```

```
  def RenameColumns(self,columns_dict):
     self.dataframe.rename(columns=columns_dict, errors="raise",inplace=True)
     return self.dataframe


  def DatasetInfo(self):
    self.dataframe.info()


  def Summary(self):
        summ = pd.DataFrame(self.dataframe.dtypes, columns=['dtypes'])
        summ['null'] = self.dataframe.isnull().sum()
        summ['unique'] = self.dataframe.nunique()
        summ['min'] = self.dataframe.min()
        summ['median'] = self.dataframe.median()
        summ['max'] = self.dataframe.max()
        summ['mean'] =  self.dataframe.mean()
        summ['std'] =  self.dataframe.std()
        summ['duplicate'] =  self.dataframe.duplicated().sum()
        return summ


preproc = DataPreprocessing(raw_data)
```

[39]:
```
column_dict={
    "Person ID":"Person_ID",
    "Sleep Duration":"Sleep_Duration",
    "Quality of Sleep":"Quality_of_Sleep",
    "Physical Activity Level":"Physical_Activity_Level",
    "Stress Level":"Stress_Level",
    "BMI Category":"BMI_Category",
    "Blood Pressure":"Blood_Pressure",
    "Heart Rate":"Heart_Rate",
    "Daily Steps":"Daily_Steps",
    "Sleep Disorder":"Sleep_Disorder"

}
cleaned_data=preproc.RenameColumns(column_dict)
```

[40]:
```
#Dataset information
preproc.DatasetInfo()
```

```
<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            374 non-null    object
dtypes: float64(1), int64(7), object(5)
memory usage: 38.1+ KB
```

1.0.6 Observations

- There are total 373 rows in the dataset and 13 fields.
- There 1 float 7 integer and 5 object type data.
- All the object datatype should be changed to approprirate datatypes.

Dataset Summary

[41]:
```
# Dataset Summary
summary=preproc.Summary()
summary
```

[41]:

	dtypes	null	unique	min	median	\
Person_ID	int64	0	374	1	187.5	
Gender	object	0	2	Female	NaN	
Age	int64	0	31	27	43.0	
Occupation	object	0	11	Accountant	NaN	
Sleep_Duration	float64	0	27	5.8	7.2	
Quality_of_Sleep	int64	0	6	4	7.0	
Physical_Activity_Level	int64	0	16	30	60.0	
Stress_Level	int64	0	6	3	5.0	
BMI_Category	object	0	4	Normal	NaN	
Blood_Pressure	object	0	25	115/75	NaN	
Heart_Rate	int64	0	19	65	70.0	
Daily_Steps	int64	0	20	3000	7000.0	
Sleep_Disorder	object	0	3	Insomnia	NaN	

	max	mean	std	duplicate
Person_ID	374	187.500000	108.108742	0
Gender	Male	NaN	NaN	0
Age	59	42.184492	8.673133	0

Occupation	Teacher	NaN	NaN	0
Sleep_Duration	8.5	7.132086	0.795657	0
Quality_of_Sleep	9	7.312834	1.196956	0
Physical_Activity_Level	90	59.171123	20.830804	0
Stress_Level	8	5.385027	1.774526	0
BMI_Category	Overweight	NaN	NaN	0
Blood_Pressure	142/92	NaN	NaN	0
Heart_Rate	86	70.165775	4.135676	0
Daily_Steps	10000	6816.844920	1617.915679	0
Sleep_Disorder	Sleep Apnea	NaN	NaN	0

Feature Engineering

[42]:
```
#Featuring Engineering
cleaned_data['BMI_Category'] = np.where(cleaned_data['BMI_Category']=='Normal␣
 ↪Weight', 'Normal', cleaned_data['BMI_Category'])
cleaned_data['Systolic'] = cleaned_data['Blood_Pressure'].str.split('/').str[0].
 ↪astype(int)
cleaned_data['Diastolic'] = cleaned_data['Blood_Pressure'].str.split('/').
 ↪str[1].astype(int)
```

[43]:
```
# Function to get the level of systolic and diastolic pressure
def bp_category(systolic, diastolic):
    if systolic <= 120 and diastolic <= 80:
        return 'Normal'
    elif 120 < systolic <= 129 and diastolic <= 80:
        return 'Elevated'
    elif (130 <= systolic <= 139) or (80 < diastolic < 89):
        return 'Stage 1'
    else:
        return 'Stage 2'
```

[44]:
```
cleaned_data['BP_Category'] = cleaned_data.apply(lambda row:␣
 ↪bp_category(row['Systolic'], row['Diastolic']), axis=1)
cleaned_data['Sleep_Disorder'] = np.where(cleaned_data['Sleep_Disorder'].
 ↪isna(), 'Normal', cleaned_data['Sleep_Disorder'])
cleaned_data.drop(columns=['Blood_Pressure', 'Systolic',␣
 ↪'Diastolic','Person_ID'], axis=1, inplace=True)
cleaned_data
```

[44]:

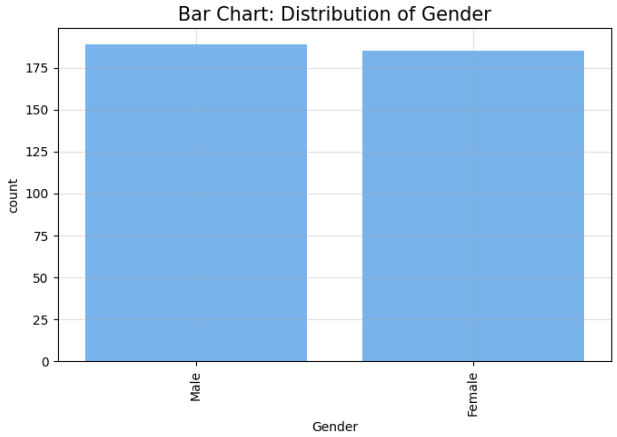
	Gender	Age	Occupation	Sleep_Duration	Quality_of_Sleep	\
0	Male	27	Software Engineer	6.1	6	
1	Male	28	Doctor	6.2	6	
2	Male	28	Doctor	6.2	6	
3	Male	28	Sales Representative	5.9	4	
4	Male	28	Sales Representative	5.9	4	
..	…	…	…	…	…	

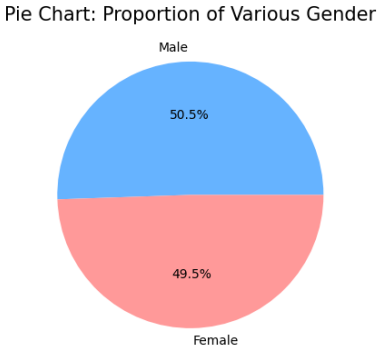
```
369  Female   59                Nurse            8.1                 9
370  Female   59                Nurse            8.0                 9
371  Female   59                Nurse            8.1                 9
372  Female   59                Nurse            8.1                 9
373  Female   59                Nurse            8.1                 9

     Physical_Activity_Level  Stress_Level BMI_Category  Heart_Rate  \
0                         42             6   Overweight          77
1                         60             8       Normal          75
2                         60             8       Normal          75
3                         30             8        Obese          85
4                         30             8        Obese          85
..                       ...           ...          ...         ...
369                       75             3   Overweight          68
370                       75             3   Overweight          68
371                       75             3   Overweight          68
372                       75             3   Overweight          68
373                       75             3   Overweight          68

     Daily_Steps Sleep_Disorder BP_Category
0           4200           None     Stage 1
1          10000           None    Elevated
2          10000           None    Elevated
3           3000    Sleep Apnea     Stage 2
4           3000    Sleep Apnea     Stage 2
..           ...            ...         ...
369         7000    Sleep Apnea     Stage 2
370         7000    Sleep Apnea     Stage 2
371         7000    Sleep Apnea     Stage 2
372         7000    Sleep Apnea     Stage 2
373         7000    Sleep Apnea     Stage 2

[374 rows x 12 columns]
```

Gender Distribution

[45]:
```
# distribution of feature `Gender`
figure, axes = plt.subplots(1,2, figsize=(15,5), gridspec_kw={'width_ratios':
 ↪[1,1.5]})
sns.countplot(data=cleaned_data, x='Gender', ax=axes[0],color='#66b3ff')
colors=['#66b3ff','#ff9999']
axes[0].set_title('Bar Chart: Distribution of Gender', fontsize=15)
axes[0].tick_params(axis='x', rotation=90)
axes[0].grid(alpha=0.4)
axes[1].pie(cleaned_data['Gender'].value_counts().values, labels=cleaned_data.
 ↪Gender.unique(), autopct='%1.1f%%',colors=colors)
axes[1].set_title('Pie Chart: Proportion of Various Gender', fontsize=15)
```

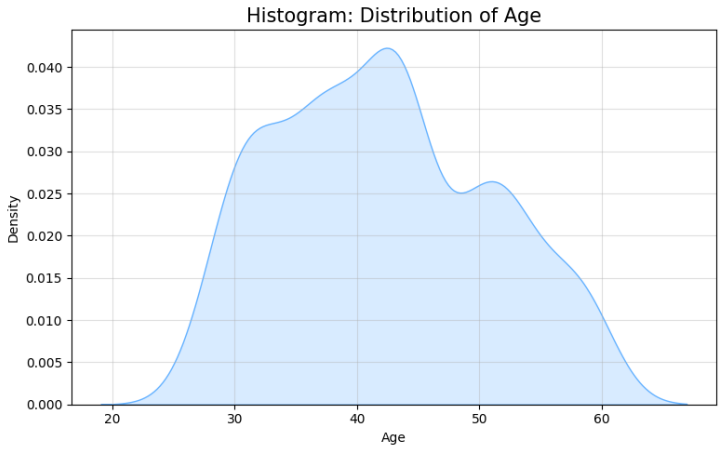
```
plt.tight_layout()
plt.show()
```

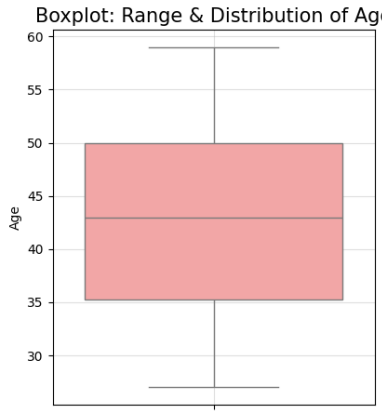




Age Distribution

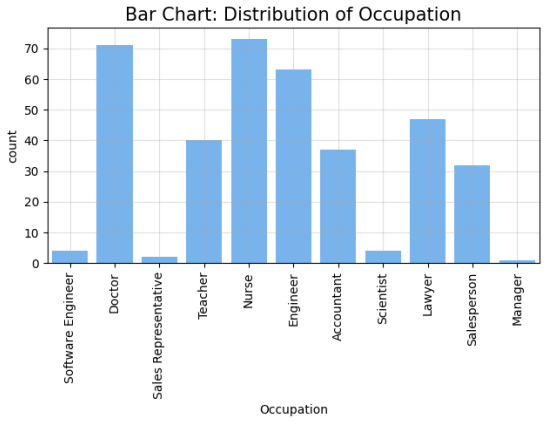
[46]:
```
# visualization: histogram & boxplot
figure, axes = plt.subplots(1,2, figsize=(12,5), gridspec_kw={'width_ratios':
 ↪[2,1]})
sns.kdeplot(data=cleaned_data, x='Age', ax=axes[0],color='#66b3ff',fill=True)
axes[0].set_title('Histogram: Distribution of Age', fontsize=15)
axes[0].grid(alpha=0.4)
sns.boxplot(data=cleaned_data, y='Age', ax=axes[1],color='#ff9999')
axes[1].set_title('Boxplot: Range & Distribution of Age', fontsize=15)
axes[1].grid(alpha=0.4)
plt.tight_layout()
plt.show()
```

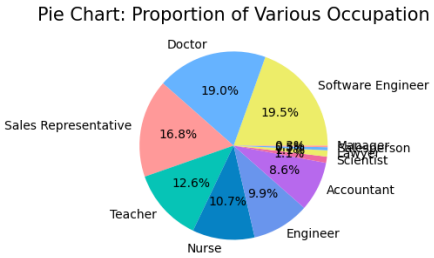




Occupation Distribution

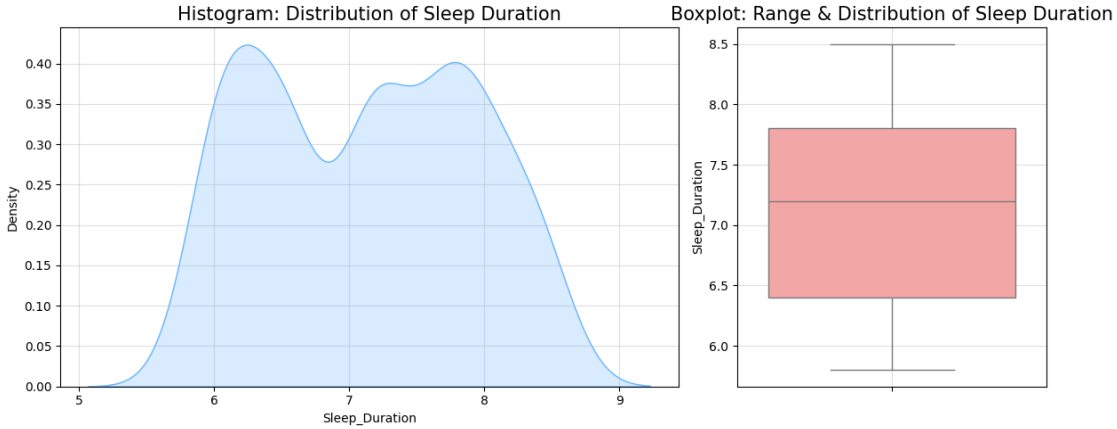
[47]:
```
# distribution of feature `Occupation`
figure, axes = plt.subplots(1,2, figsize=(15,5), gridspec_kw={'width_ratios':
 ↪[1,1.5]})
colors =␣
 ↪['#eded69','#66b3ff','#ff9999','#06c4b6','#0682c4','#6995ed','#b769ed','#ed69a1']
sns.countplot(data=cleaned_data, x='Occupation', ax=axes[0],color='#66b3ff')
axes[0].set_title('Bar Chart: Distribution of Occupation', fontsize=15)
axes[0].tick_params(axis='x', rotation=90)
axes[0].grid(alpha=0.4)
axes[1].pie(cleaned_data['Occupation'].value_counts().values,␣
 ↪labels=cleaned_data.Occupation.unique(), autopct='%1.1f%%',colors=colors)
axes[1].set_title('Pie Chart: Proportion of Various Occupation', fontsize=15)
plt.tight_layout()
plt.show()
```





Sleep Duration Distribution

[48]:
```
# visualization: distribution of feature `Sleep_Duration`
figure, axes = plt.subplots(1,2,figsize=(12,5), gridspec_kw={'width_ratios':
 ↪[2,1]})
sns.kdeplot(data=cleaned_data, x='Sleep_Duration', color='#66b3ff',␣
 ↪ax=axes[0],fill=True)
axes[0].set_title('Histogram: Distribution of Sleep Duration', fontsize=15)
axes[0].grid(alpha=0.4)
sns.boxplot(data=cleaned_data, y='Sleep_Duration', color='#ff9999', ax=axes[1])
axes[1].set_title('Boxplot: Range & Distribution of Sleep Duration',␣
 ↪fontsize=15)
axes[1].grid(alpha=0.4)
plt.tight_layout()
plt.show()
```

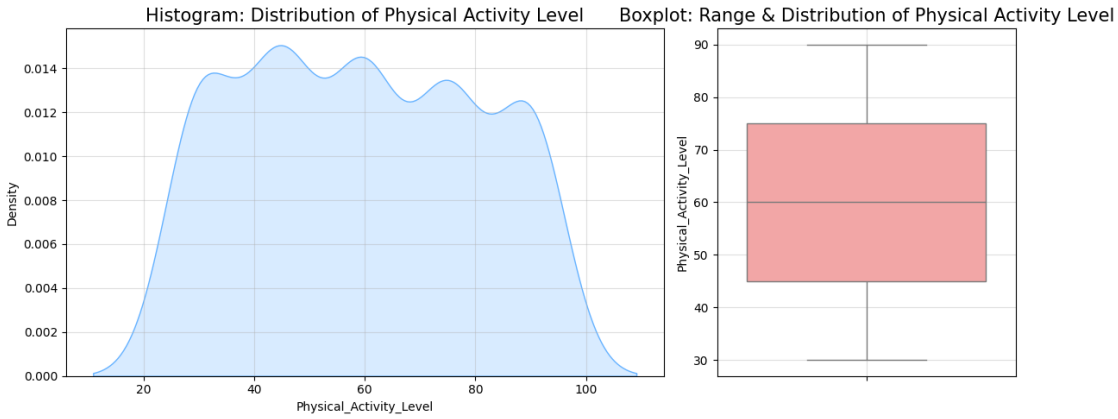


Sleep Qaulity

[49]:
```
# distribution of feature `Sleep Quality`
figure, axes = plt.subplots(1,2, figsize=(15,5), gridspec_kw={'width_ratios':
 ↪[1,1.5]})
colors = ['#eded69','#66b3ff','#ff9999','#06c4b6','#0682c4','#6995ed']
sns.countplot(data=cleaned_data, x='Quality_of_Sleep',␣
 ↪ax=axes[0],color='#66b3ff')
axes[0].set_title('Bar Chart: Distribution of Occupation', fontsize=15)
axes[0].tick_params(axis='x', rotation=90)
axes[0].grid(alpha=0.4)
axes[1].pie(cleaned_data['Quality_of_Sleep'].value_counts().values,␣
 ↪labels=cleaned_data.Quality_of_Sleep.unique(), autopct='%1.
 ↪1f%%',colors=colors)
axes[1].set_title('Pie Chart: Proportion of Sleep Quality', fontsize=15)
plt.tight_layout()
plt.show()
```

Physical Activity Level

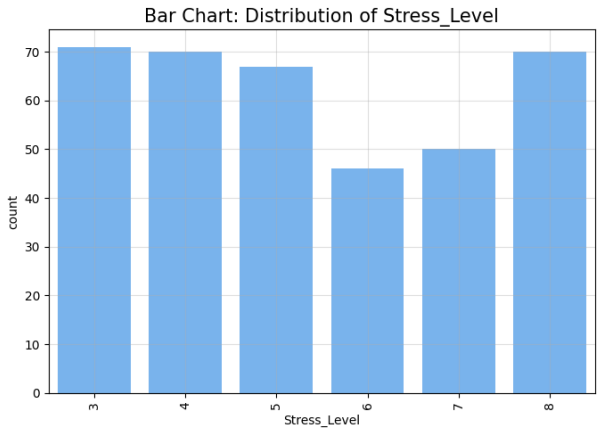
[50]:
```
# visualization: distribution of feature `Physical_Activity_Level`
figure, axes = plt.subplots(1,2,figsize=(12,5), gridspec_kw={'width_ratios':
 ↪[2,1]})
sns.kdeplot(data=cleaned_data, x='Physical_Activity_Level', color='#66b3ff',␣
 ↪ax=axes[0],fill=True)
axes[0].set_title('Histogram: Distribution of Physical Activity Level',␣
 ↪fontsize=15)
axes[0].grid(alpha=0.4)
sns.boxplot(data=cleaned_data, y='Physical_Activity_Level', color='#ff9999',␣
 ↪ax=axes[1])
axes[1].set_title('Boxplot: Range & Distribution of Physical Activity Level',␣
 ↪fontsize=15)
axes[1].grid(alpha=0.4)
plt.tight_layout()
plt.show()
```

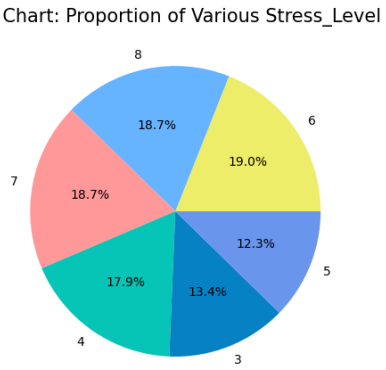


Stress Level

[51]:
```
# distribution of feature `Stress_Level`
figure, axes = plt.subplots(1,2, figsize=(15,5), gridspec_kw={'width_ratios':
 ↪[1,1.5]})
colors =␣
 ↪['#eded69','#66b3ff','#ff9999','#06c4b6','#0682c4','#6995ed','#b769ed','#ed69a1']
sns.countplot(data=cleaned_data, x='Stress_Level', ax=axes[0],color='#66b3ff')
axes[0].set_title('Bar Chart: Distribution of Stress_Level', fontsize=15)
axes[0].tick_params(axis='x', rotation=90)
axes[0].grid(alpha=0.4)
axes[1].pie(cleaned_data['Stress_Level'].value_counts().values,␣
 ↪labels=cleaned_data.Stress_Level.unique(), autopct='%1.1f%%',colors=colors)
```

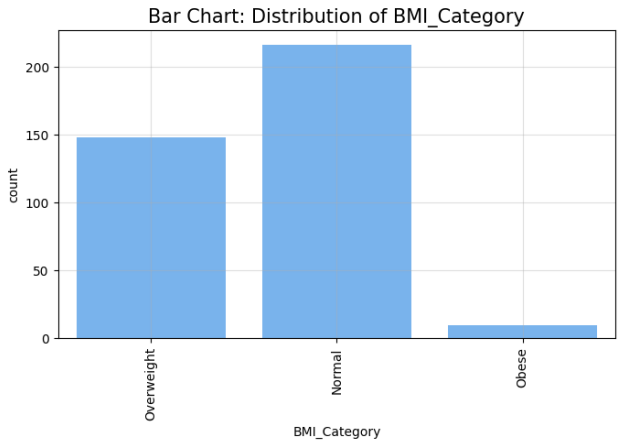
```
axes[1].set_title('Pie Chart: Proportion of Various Stress_Level', fontsize=15)
plt.tight_layout()
plt.show()
```

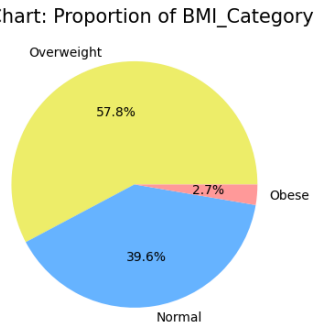




BMI Category

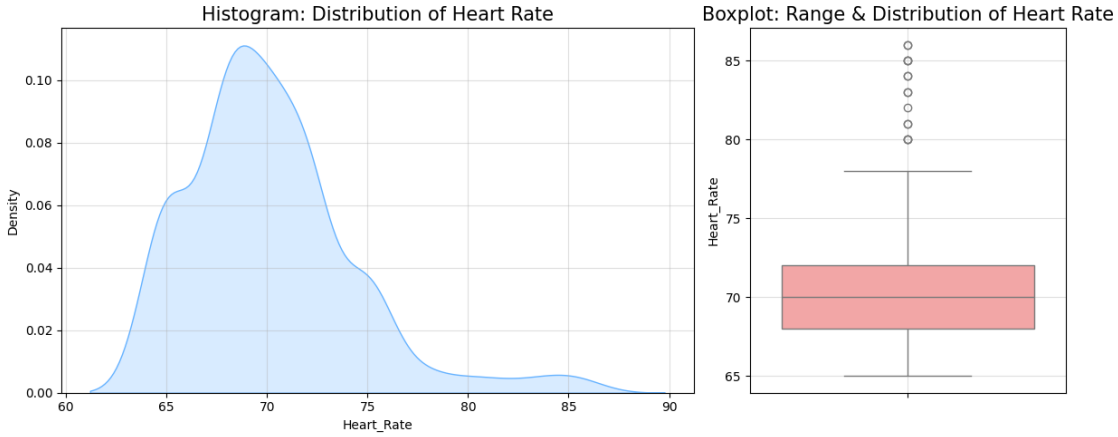
[52]:
```
# distribution of feature `BMI_Category`
figure, axes = plt.subplots(1,2, figsize=(15,5), gridspec_kw={'width_ratios':
 ↪[1,1.5]})
colors = ['#eded69','#66b3ff','#ff9999','#06c4b6','#0682c4','#6995ed']
sns.countplot(data=cleaned_data, x='BMI_Category', ax=axes[0],color='#66b3ff')
axes[0].set_title('Bar Chart: Distribution of BMI_Category', fontsize=15)
axes[0].tick_params(axis='x', rotation=90)
axes[0].grid(alpha=0.4)
axes[1].pie(cleaned_data['BMI_Category'].value_counts().values,␣
 ↪labels=cleaned_data.BMI_Category.unique(), autopct='%1.1f%%',colors=colors)
axes[1].set_title('Pie Chart: Proportion of BMI_Category', fontsize=15)
plt.tight_layout()
plt.show()
```





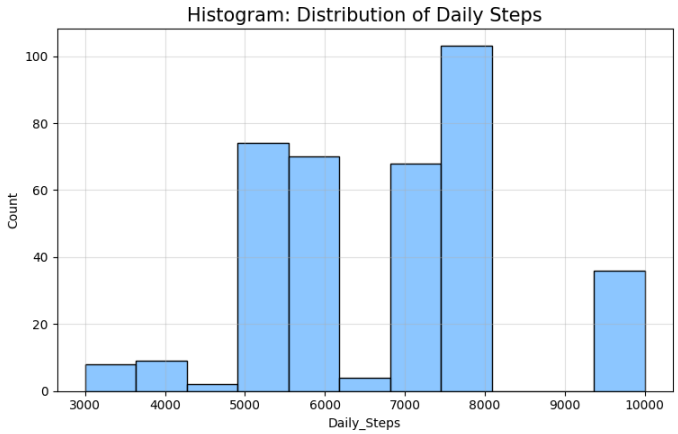
Heart Rate

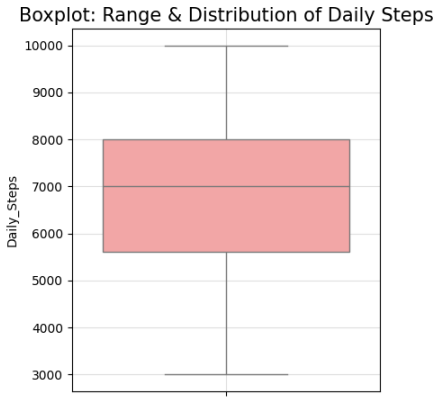
[53]:
```
# visualization: distribution of feature `Heart_Rate`
figure, axes = plt.subplots(1,2,figsize=(12,5), gridspec_kw={'width_ratios':
 ↪[2,1]})
sns.kdeplot(data=cleaned_data, x='Heart_Rate', color='#66b3ff',␣
 ↪ax=axes[0],fill=True)
axes[0].set_title('Histogram: Distribution of Heart Rate', fontsize=15)
axes[0].grid(alpha=0.4)
sns.boxplot(data=cleaned_data, y='Heart_Rate', color='#ff9999', ax=axes[1])
axes[1].set_title('Boxplot: Range & Distribution of Heart Rate', fontsize=15)
axes[1].grid(alpha=0.4)
plt.tight_layout()
plt.show()
```



Daily Steps

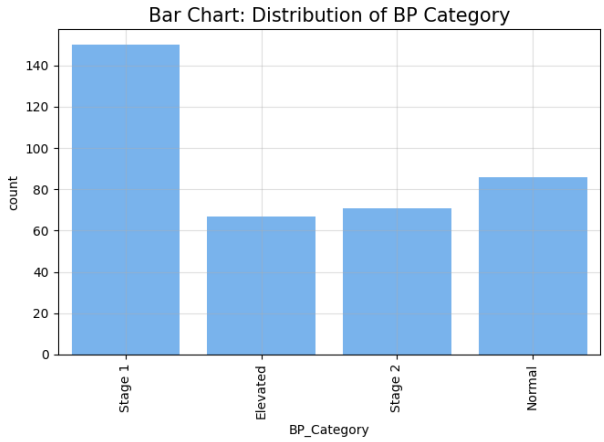
[54]:
```
# visualization: distribution of feature `Daily_Steps`
figure, axes = plt.subplots(1,2,figsize=(12,5), gridspec_kw={'width_ratios':
 ↪[2,1]})
sns.histplot(data=cleaned_data, x='Daily_Steps', color='#66b3ff', ax=axes[0])
axes[0].set_title('Histogram: Distribution of Daily Steps', fontsize=15)
axes[0].grid(alpha=0.4)
sns.boxplot(data=cleaned_data, y='Daily_Steps', color='#ff9999', ax=axes[1])
axes[1].set_title('Boxplot: Range & Distribution of Daily Steps', fontsize=15)
axes[1].grid(alpha=0.4)
plt.tight_layout()
plt.show()
```

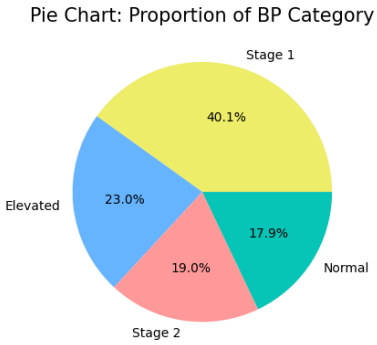




BP Category

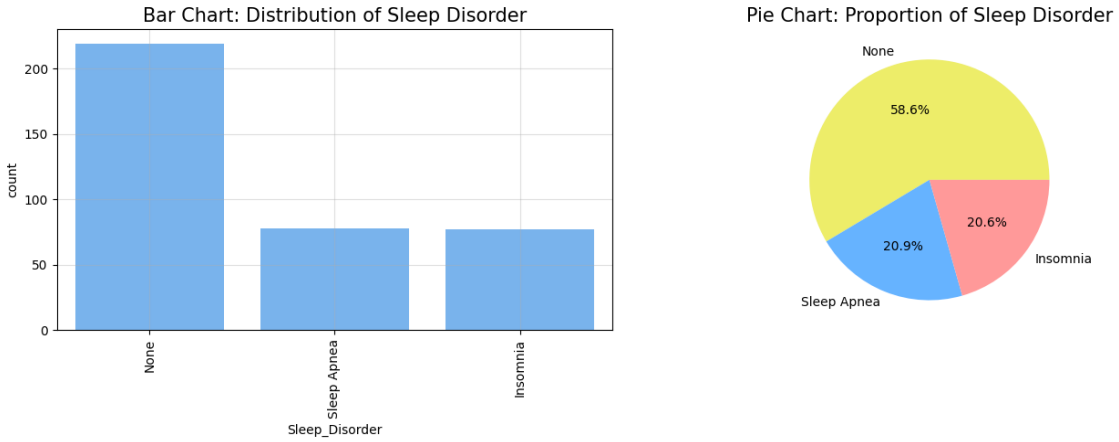
[55]:
```
# distribution of feature `BP_Category`
figure, axes = plt.subplots(1,2, figsize=(15,5), gridspec_kw={'width_ratios':
 ↪[1,1.5]})
colors = ['#eded69','#66b3ff','#ff9999','#06c4b6','#0682c4','#6995ed']
sns.countplot(data=cleaned_data, x='BP_Category', ax=axes[0],color='#66b3ff')
axes[0].set_title('Bar Chart: Distribution of BP Category', fontsize=15)
axes[0].tick_params(axis='x', rotation=90)
axes[0].grid(alpha=0.4)
axes[1].pie(cleaned_data['BP_Category'].value_counts().values,␣
 ↪labels=cleaned_data.BP_Category.unique(), autopct='%1.1f%%',colors=colors)
axes[1].set_title('Pie Chart: Proportion of BP Category', fontsize=15)
plt.tight_layout()
plt.show()
```





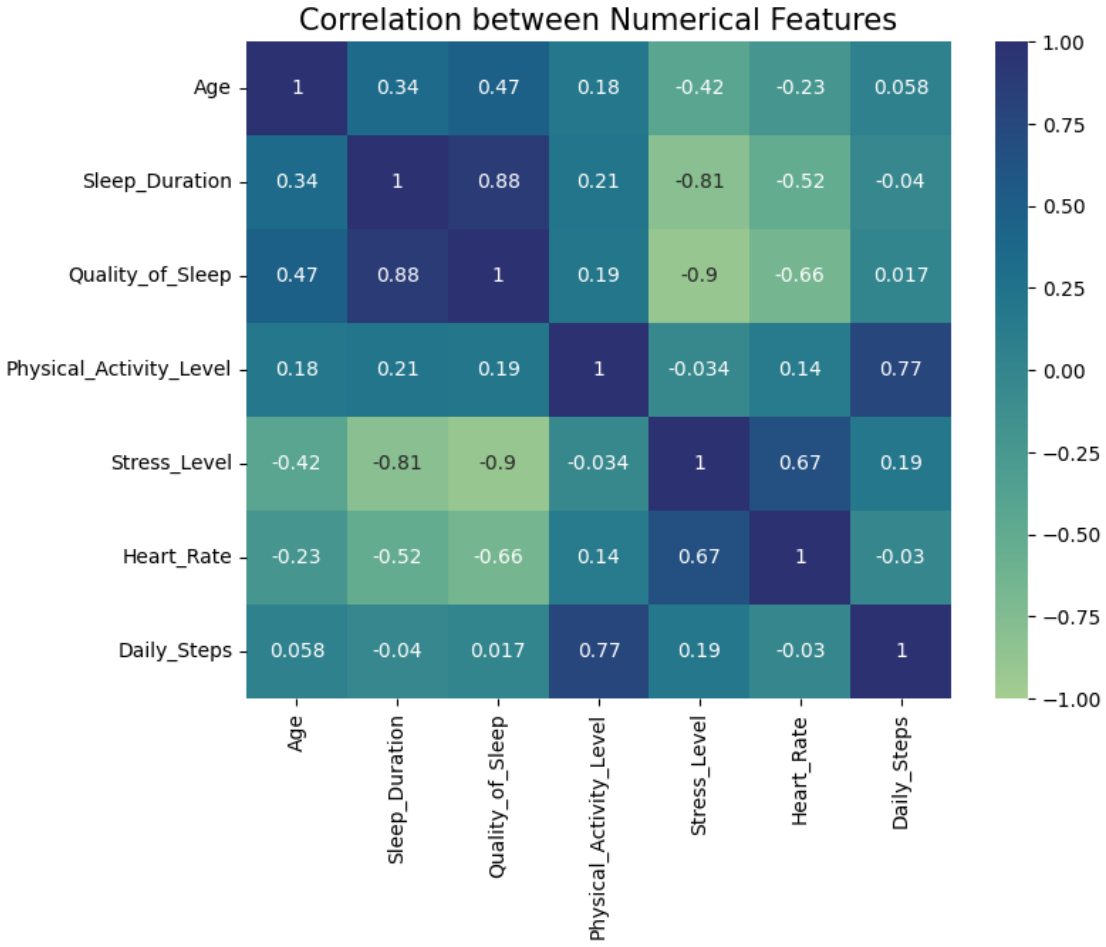
BP Category

[56]:
```
# distribution of feature `Sleep_Disorder`
figure, axes = plt.subplots(1,2, figsize=(15,5), gridspec_kw={'width_ratios':
 ↪[1,1.5]})
colors = ['#eded69','#66b3ff','#ff9999','#06c4b6','#0682c4','#6995ed']
sns.countplot(data=cleaned_data, x='Sleep_Disorder', ax=axes[0],color='#66b3ff')
axes[0].set_title('Bar Chart: Distribution of Sleep Disorder', fontsize=15)
axes[0].tick_params(axis='x', rotation=90)
axes[0].grid(alpha=0.4)
axes[1].pie(cleaned_data['Sleep_Disorder'].value_counts().values,␣
 ↪labels=cleaned_data.Sleep_Disorder.unique(), autopct='%1.1f%%',colors=colors)
axes[1].set_title('Pie Chart: Proportion of Sleep Disorder', fontsize=15)
plt.tight_layout()
plt.show()
```



Numerical Correlation

[57]:
```
# correlation matrix
correlation =␣
 ↪cleaned_data[['Age','Sleep_Duration','Quality_of_Sleep','Physical_Activity_Level','Stress_L
 ↪corr()

# visualization - heatmap
plt.figure(figsize=(8,6))
sns.heatmap(correlation, vmin=-1, vmax=1, annot=True, cmap='crest')
plt.title('Correlation between Numerical Features', fontsize=15)
plt.show()
```



Dataset Inferences

- There no nulls and no duplicates in dataset.
- The `Gender` is evenly distributed in dataset.
- The mean `Age` is distributed between 42-43 years among both `Genders`.
- Software engineer and doctors occupy highest counts whereas managers and sales representative lowest count.
- More than 50% of the population sleeps for more than 6 hours.
- Overall population have better sleep quality.
- 50% of the overall population does good amount physicall activity.
- There are outliers in the `Physical Activity`
- 40% of the population have `Stage 1` BP category and 17% of the population are normal.
- 58.6% of the population have no sleep disorder, 20.6 % have insomaia and 20.9% have sleep Apnea.

- As seen from corraltion matrix, `Sleep Duration`,`Physical Activity`,`Quality of Sleep` and `Stress Level` features are hightly correlated features.

Future Work

- This dataset can be used for multilabel classification problem to detect sleep anomalies.
- Various null hypotheses can be formed based on each of the features to detect sleep disorder.

[ ]:
```
%%capture
!pip install nbconvert
!sudo apt-get install texlive-xetex texlive-fonts-recommended␣
↪texlive-plain-generic
```

[ ]:
```
# https://saturncloud.io/blog/convert-google-colab-notebook-to-pdf-html/
!jupyter nbconvert  '/content/drive/MyDrive/Colab Notebooks/CS624-Assignment-1.
↪ipynb' --to pdf
```