Apple Health Analytics

```
!pip install calplot --quiet

import xml.etree.ElementTree as ET
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import calplot
from statsmodels.tsa.seasonal import seasonal_decompose
```

Load the XML File (export.xml)

```
tree = ET.parse('/content/export.xml')
root = tree.getroot()

df = pd.DataFrame([x.attrib for x in root.iter('Record')])

# Remove unnecessary columns
df.drop(columns=['sourceName', 'sourceVersion', 'creationDate', 'device'], inplace=True)

# Remove Rows containing Height and Weight info
df.drop(df.index[:2], inplace=True)
df.reset_index(drop=True, inplace=True)

df.head()
```

	type	unit	startDate	endDate	value
0	HKQuantityTypeIdentifierStepCount	count	2023-03-03 08:37:37 +0530	2023-03-03 08:37:43 +0530	14
1	HKQuantityTypeIdentifierStepCount	count	2023-03-03 22:41:56 +0530	2023-03-03 22:51:56 +0530	751
2	HKQuantityTypeIdentifierStepCount	count	2023-03-03 22:51:56 +0530	2023-03-03 22:55:59 +0530	353
3	HKQuantityTypeIdentifierStepCount	count	2023-03-03 23:06:52 +0530	2023-03-03 23:16:16 +0530	561
4	HKQuantityTypeIdentifierStepCount	count	2023-03-03 23:16:16 +0530	2023-03-03 23:16:31 +0530	16

Next steps: Generate code with df View recommended plots

```
df.shape
```

```
(85116, 5)
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 85116 entries, 0 to 85115
Data columns (total 5 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   type       85116 non-null  object
 1   unit       84358 non-null  object
 2   startDate  85116 non-null  object
 3   endDate    85116 non-null  object
 4   value      85116 non-null  object
dtypes: object(5)
memory usage: 3.2+ MB
```

Data Cleaning

```
df['type'].value_counts()
```

```
type
HKQuantityTypeIdentifierBasalEnergyBurned                 21023
HKQuantityTypeIdentifierWalkingSpeed                      10477
HKQuantityTypeIdentifierWalkingStepLength                 10477
HKQuantityTypeIdentifierWalkingDoubleSupportPercentage     9374
HKQuantityTypeIdentifierActiveEnergyBurned                 8648
HKQuantityTypeIdentifierDistanceWalkingRunning             7813
HKQuantityTypeIdentifierStepCount                          7812
HKQuantityTypeIdentifierWalkingAsymmetryPercentage         7251
HKQuantityTypeIdentifierFlightsClimbed                     1439
HKCategoryTypeIdentifierSleepAnalysis                       758
HKQuantityTypeIdentifierAppleWalkingSteadiness               42
HKQuantityTypeIdentifierHeadphoneAudioExposure                1
HKDataTypeSleepDurationGoal                                   1
Name: count, dtype: int64
```

Apple HealthKit quantity types:

BasalEnergyBurned: Energy expended at rest.

WalkingSpeed: Walking speed of the user.

WalkingStepLength: Length of each step taken during walking.

WalkingDoubleSupportPercentage: Percentage of time during walking that both feet are on the ground.

ActiveEnergyBurned: Energy expended during physical activity.

DistanceWalkingRunning: Distance traveled by walking or running.

StepCount: Number of steps taken by the user.

WalkingAsymmetryPercentage: Asymmetry in steps taken during walking.

SleepAnalysis: Duration of sleep of the user.

AppleWalkingSteadiness: Measurement of walking steadiness based on walking activity.

```
# Shorten "Type" values
df['type'] = df['type'].str.replace('HKQuantityTypeIdentifier', '')
df['type'] = df['type'].str.replace('HKCategoryTypeIdentifier', '')
df['type'] = df['type'].str.replace('HKDataType', '')

# Remove unnecessary columns
df.drop(df[df['type'] == 'HeadphoneAudioExposure'].index, inplace=True)
df.drop(df[df['type'] == 'SleepDurationGoal'].index, inplace=True)
df.drop(df[df['type'] == 'FlightsClimbed'].index, inplace=True)

# Datetime Conversion
df['startDate'] = pd.to_datetime((df['startDate'].str)[:-6])
df['endDate'] = pd.to_datetime((df['endDate'].str)[:-6])

# Calculate 'duration'
df['duration'] = df['endDate'] - df['startDate']

# Drop 'endDate' column
df.drop('endDate', axis=1, inplace=True)

# Write units for each type
df_units = {
    'BasalEnergyBurned': 'kcal',
    'WalkingSpeed': 'km/hr',
    'WalkingStepLength': 'cm',
    'WalkingDoubleSupportPercentage': '%',
    'ActiveEnergyBurned': 'kcal',
    'DistanceWalkingRunning': 'km',
    'StepCount': 'count',
    'WalkingAsymmetryPercentage': '%',
    'SleepAnalysis': float('nan'),
    'AppleWalkingSteadiness': '%'
}

# Drop 'unit' column
df.drop('unit', axis=1, inplace=True)

# Reorder columns for clarity
df = df[['type', 'value', 'startDate', 'duration']]

# Convert 'value' to numeric, fill missing values with 1.0
df['value'] = pd.to_numeric(df['value'], errors='coerce').fillna(1.0)

df.tail()
```

```
                type  value            startDate         duration
85111  SleepAnalysis    1.0  2024-07-13 01:15:11  0 days 04:35:42
85112  SleepAnalysis    1.0  2024-07-14 00:08:20  0 days 09:57:48
85113  SleepAnalysis    1.0  2024-07-15 00:15:44  0 days 05:53:29
85114  SleepAnalysis    1.0  2024-07-15 23:00:00  0 days 07:18:44
85115  SleepAnalysis    1.0  2024-07-16 23:48:04  0 days 06:27:01
```

```
df.describe()
```

```
              value                      startDate                      duration
count  83675.000000                          83675                         83675
mean      46.089739  2023-11-01 14:11:22.634622208  0 days 00:17:59.509746041
min        0.000000            2023-03-03 08:37:37               0 days 00:00:01
25%        0.299000     2023-06-26 15:01:19.500000               0 days 00:00:30
50%        4.284000            2023-10-24 22:54:09               0 days 00:03:19
75%       53.180000     2024-03-11 07:54:22.500000               0 days 00:09:57
max     1188.000000            2024-07-17 18:51:47               7 days 00:00:00
std      135.937649                            NaN  0 days 03:47:41.577786342
```

```
SleepAnalysis = df.loc[df['type'] == 'SleepAnalysis'].groupby(df['startDate'].dt.date)['duration'].sum()

# Pivot table to aggregate values by type and startDate.datea
data = df.pivot_table(index=df['startDate'].dt.date, columns='type', values='value', aggfunc='sum', fill_value=0)

data['SleepAnalysis'] = SleepAnalysis
data.tail()
```

type	ActiveEnergyBurned	AppleWalkingSteadiness	BasalEnergyBurned	DistanceWalkingRunning	SleepAnalysis	StepCount	WalkingAsymmetryPercentage	WalkingDoubl
startDate								
2024-07-13	47.961	0.0	1271.439	1.66859	0 days 05:02:35	3055	0.11	
2024-07-14	47.775	0.0	1277.435	1.70682	0 days 09:57:48	2950	0.12	
2024-07-15	224.047	0.0	1334.220	6.59308	0 days 13:12:13	11749	0.32	

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 503 entries, 2023-03-03 to 2024-07-17
Data columns (total 10 columns):
 #   Column                        Non-Null Count  Dtype
---  ------                        --------------  -----
 0   ActiveEnergyBurned            503 non-null    float64
 1   AppleWalkingSteadiness        503 non-null    float64
 2   BasalEnergyBurned             503 non-null    float64
 3   DistanceWalkingRunning        503 non-null    float64
 4   SleepAnalysis                 389 non-null    timedelta64[ns]
 5   StepCount                     503 non-null    int64
 6   WalkingAsymmetryPercentage    503 non-null    float64
 7   WalkingDoubleSupportPercentage 503 non-null   float64
 8   WalkingSpeed                  503 non-null    float64
 9   WalkingStepLength             503 non-null    int64
dtypes: float64(7), int64(2), timedelta64[ns](1)
memory usage: 43.2+ KB
```

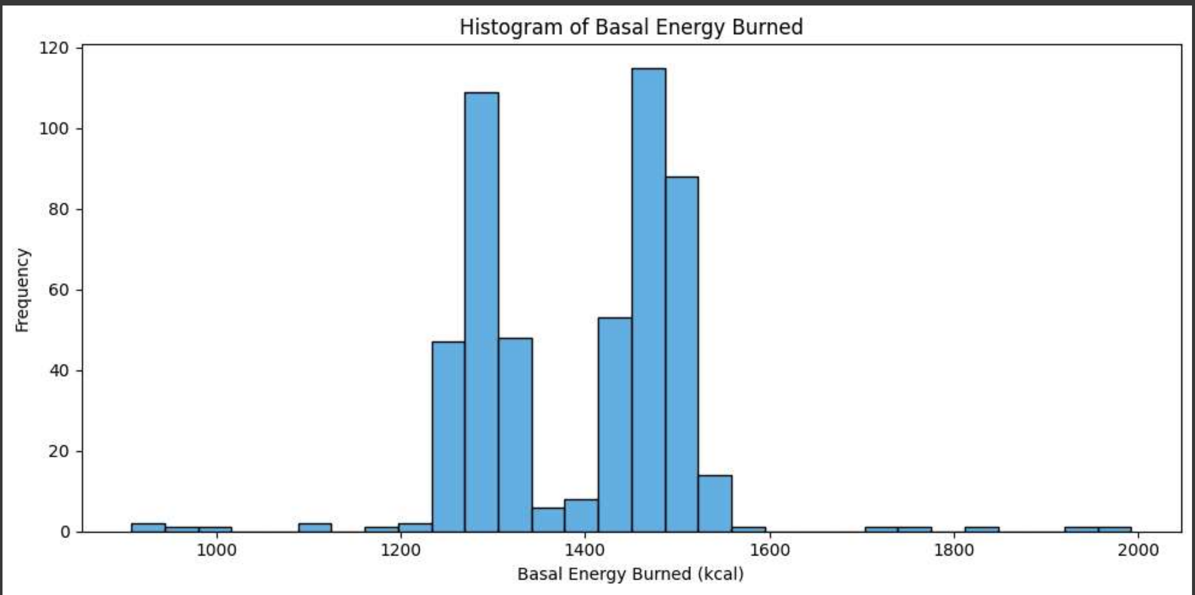
```
data.describe()
```

type	ActiveEnergyBurned	AppleWalkingSteadiness	BasalEnergyBurned	DistanceWalkingRunning	SleepAnalysis	StepCount	WalkingAsymmetryPercentage	WalkingDo
count	503.000000	503.000000	503.000000	503.000000	389	503.000000	503.000000	
mean	110.668064	0.063321	1392.813095	2.858825	0 days 07:08:02.516709511	4809.284294	0.663141	
std	102.798422	0.210475	115.839888	2.265378	0 days 03:32:53.257219992	3765.497164	1.045184	
min	0.000000	0.000000	907.985000	0.000000	0 days 00:01:19	0.000000	0.000000	
25%	35.596500	0.000000	1290.204000	1.003462	0 days 05:16:28	1767.000000	0.030000	
50%	87.485000	0.000000	1435.307000	2.524000	0 days 06:12:08	4232.000000	0.250000	
75%	162.880500	0.000000	1480.253000	4.676745	0 days 10:40:49	7756.000000	0.870000	

Exploratory Data Analysis

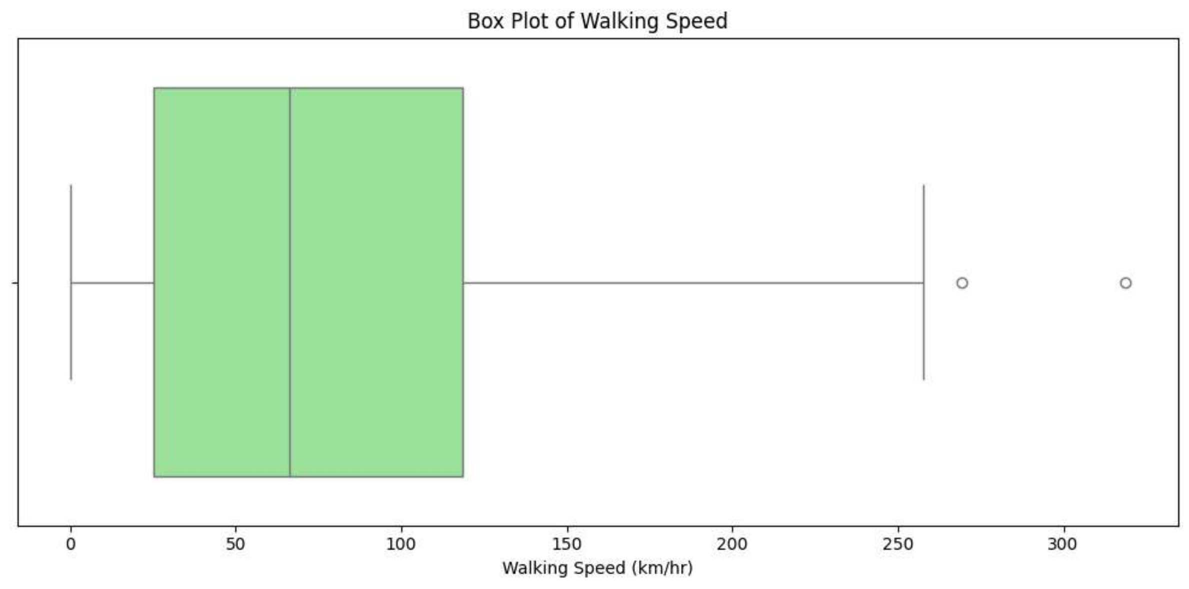
Basal Energy Burned

```
plt.figure(figsize=(10, 5))
sns.histplot(data['BasalEnergyBurned'], bins=30, kde=False, color='#3498db')
plt.title('Histogram of Basal Energy Burned')
plt.xlabel('Basal Energy Burned (kcal)')
plt.ylabel('Frequency')
plt.tight_layout()
plt.show()
```



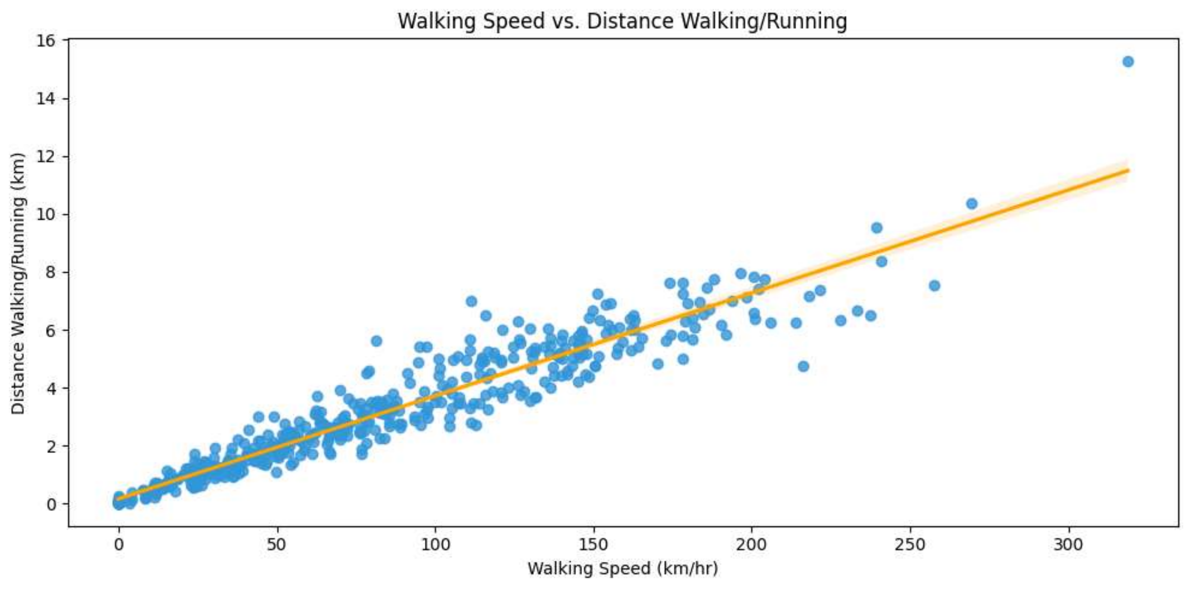
Walking Speed

```
plt.figure(figsize=(10, 5))
sns.boxplot(x=data['WalkingSpeed'], color='lightgreen')
plt.title('Box Plot of Walking Speed')
plt.xlabel('Walking Speed (km/hr)')
plt.tight_layout()
plt.show()
```



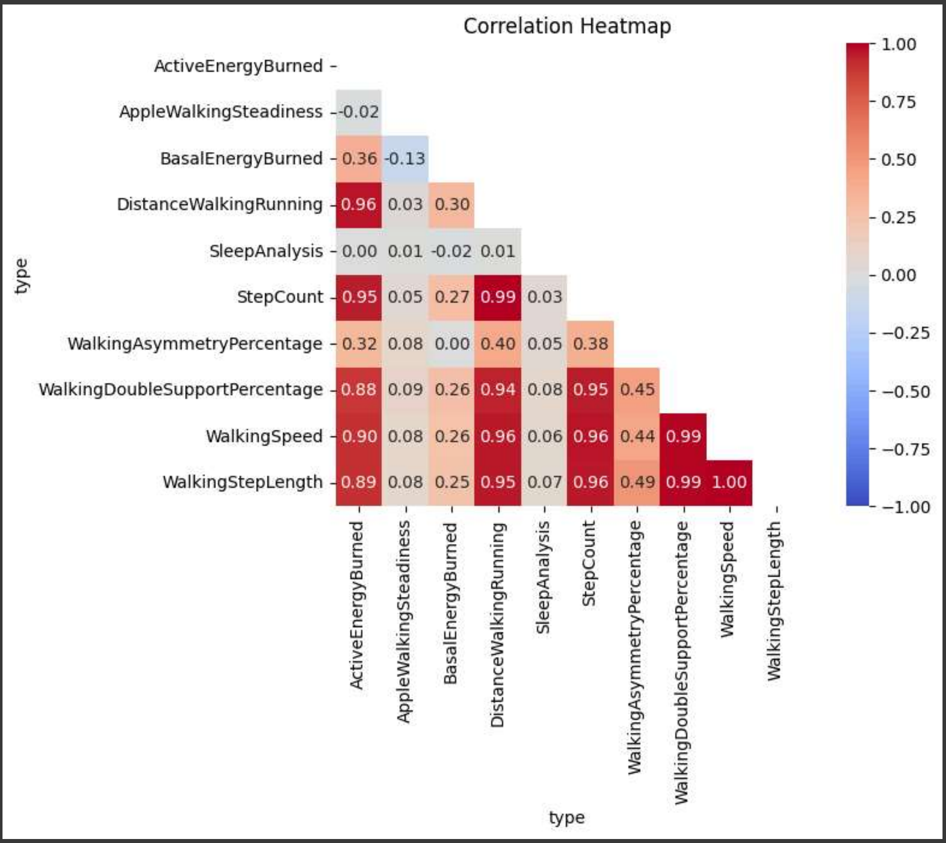
Walking Speed vs. Distance Walking/Running

```
plt.figure(figsize=(10, 5))
sns.regplot(x='WalkingSpeed', y='DistanceWalkingRunning', data=data, scatter_kws={'color': '#3498db'}, line_kws={'color': 'orange'})
plt.title('Walking Speed vs. Distance Walking/Running')
plt.xlabel('Walking Speed (km/hr)')
plt.ylabel('Distance Walking/Running (km)')
plt.tight_layout()
plt.show()
```



Correlation Heatmap

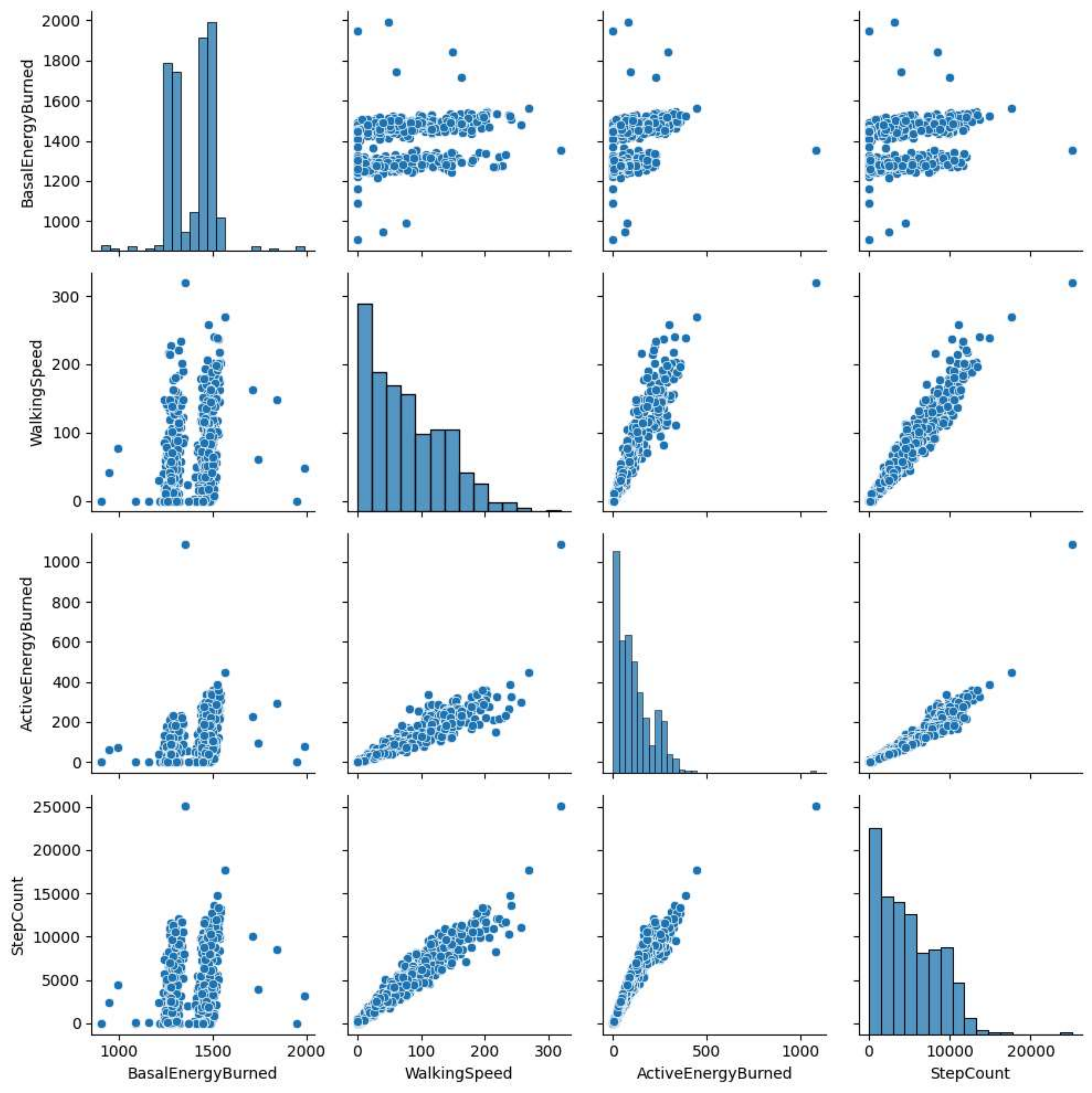
```
plt.figure(figsize=(10, 5))
mask = np.triu(np.ones_like(data.corr(), dtype=bool))
sns.heatmap(data.corr(), cmap='coolwarm', square=True,annot = True, fmt=".2f", mask = mask, vmin=-1, vmax=1)
plt.title('Correlation Heatmap')
plt.show()
```



Pair Plot

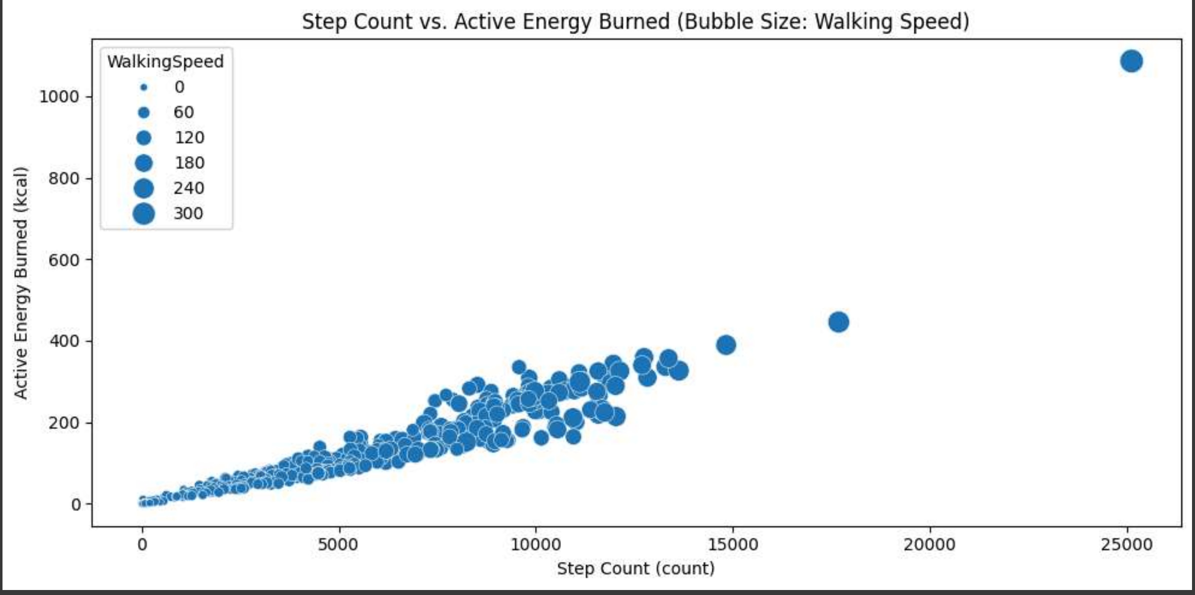
```
plt.figure(figsize=(20, 10))
sns.pairplot(data[['BasalEnergyBurned', 'WalkingSpeed', 'ActiveEnergyBurned', 'StepCount']])
plt.tight_layout()
plt.show()
```

```
<Figure size 2000x1000 with 0 Axes>
```



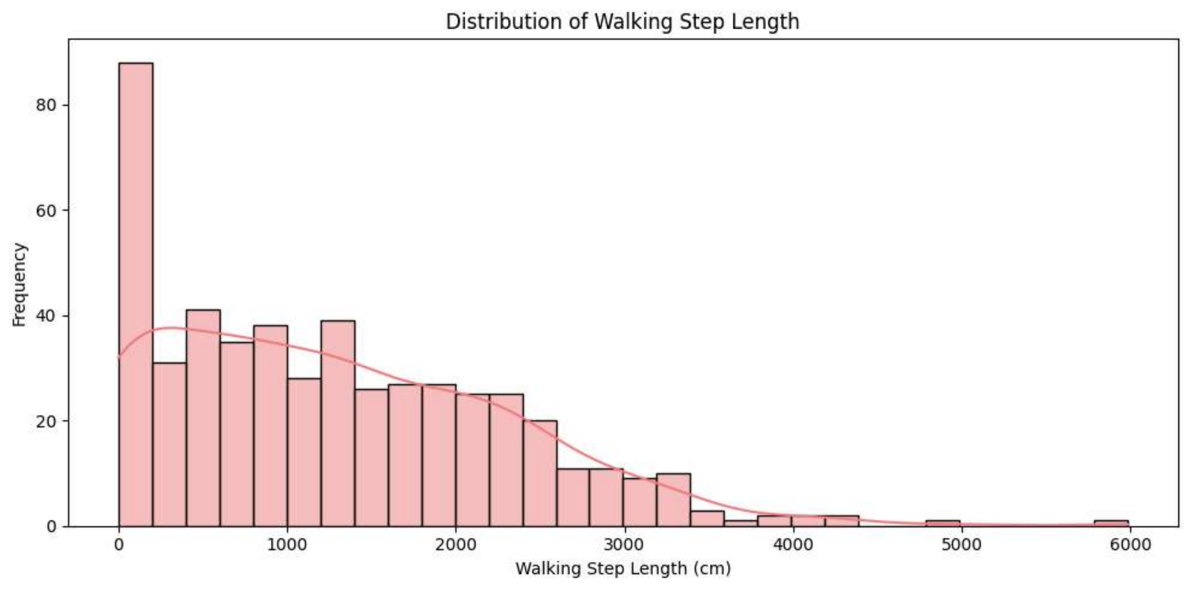
Step Count vs. Active Energy Burned

```
plt.figure(figsize=(10, 5))
sns.scatterplot(x='StepCount', y='ActiveEnergyBurned', size='WalkingSpeed', sizes=(20, 200), data=data)
plt.title('Step Count vs. Active Energy Burned (Bubble Size: Walking Speed)')
plt.xlabel('Step Count (count)')
plt.ylabel('Active Energy Burned (kcal)')
plt.tight_layout()
plt.show()
```



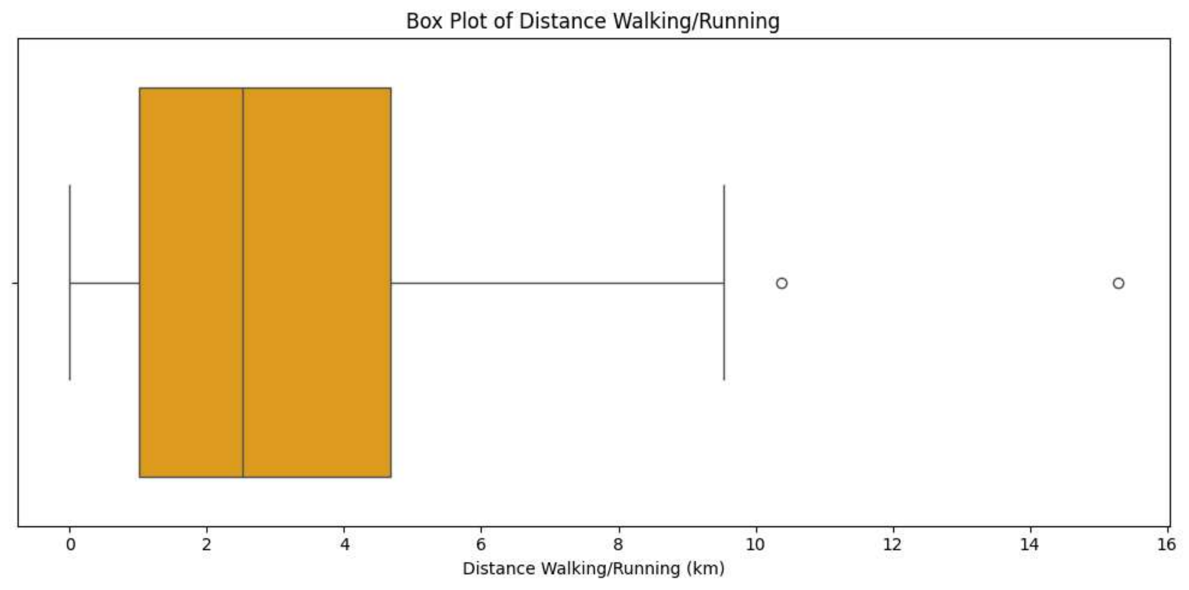
Walking Step Length Distribution

```
plt.figure(figsize=(10, 5))
sns.histplot(data['WalkingStepLength'], bins=30, kde=True, color='lightcoral')
plt.title('Distribution of Walking Step Length')
plt.xlabel('Walking Step Length (cm)')
plt.ylabel('Frequency')
plt.tight_layout()
plt.show()
```



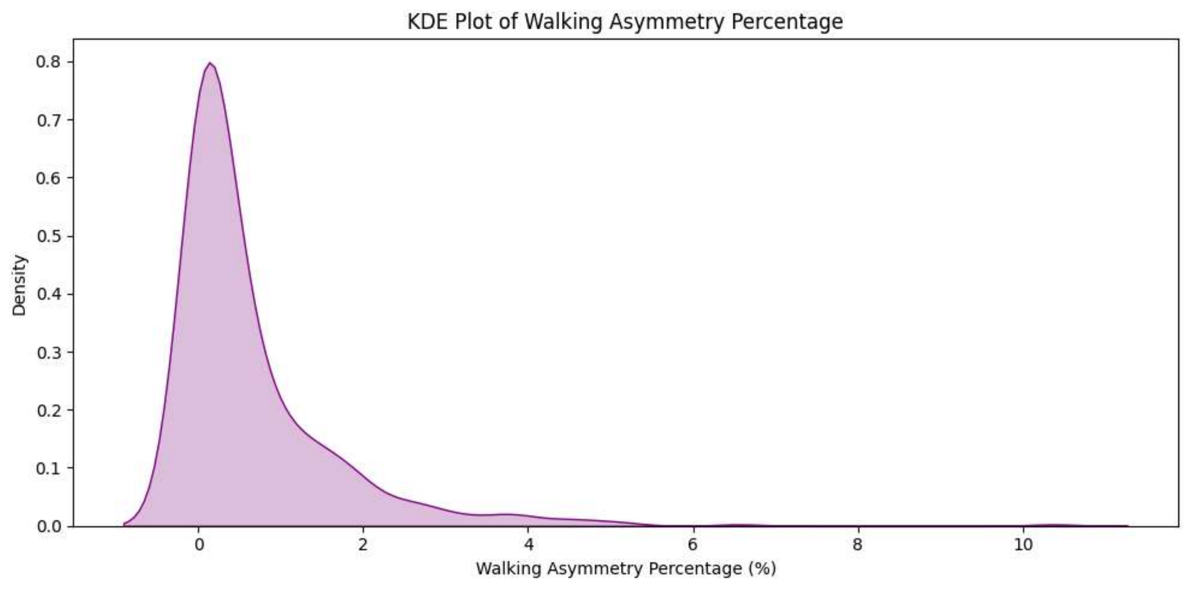
Distance Walking/Running

```
plt.figure(figsize=(10, 5))
sns.boxplot(x=data['DistanceWalkingRunning'], color='orange')
plt.title('Box Plot of Distance Walking/Running')
plt.xlabel('Distance Walking/Running (km)')
plt.tight_layout()
plt.show()
```



Walking Asymmetry Percentage

```
plt.figure(figsize=(10, 5))
sns.kdeplot(data['WalkingAsymmetryPercentage'], fill=True, color='purple')
plt.title('KDE Plot of Walking Asymmetry Percentage')
plt.xlabel('Walking Asymmetry Percentage (%)')
plt.ylabel('Density')
plt.tight_layout()
plt.show()
```



Plot the following:

- Step Count (Group by day and week)
- Distance (Group by day and week)
- Active Energy Burned
- AppleWalkingSteadiness (Weekly)

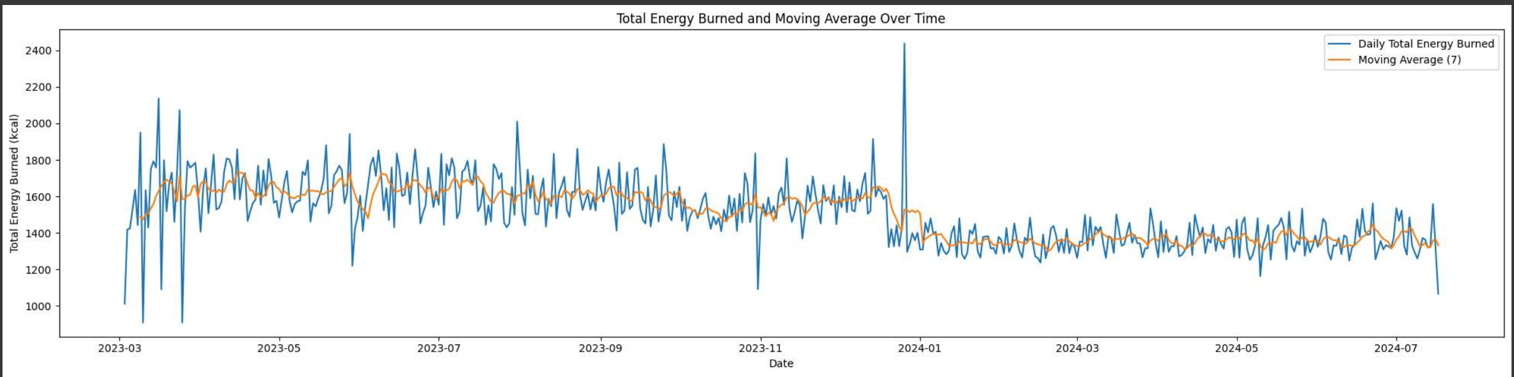
Advanced (Time Series) Data Exploration

```
data.index = pd.to_datetime(data.index)
week_data = data.resample('W').sum()
month_data = data.resample('M').sum()
```

Rolling Average of Active Energy Burned

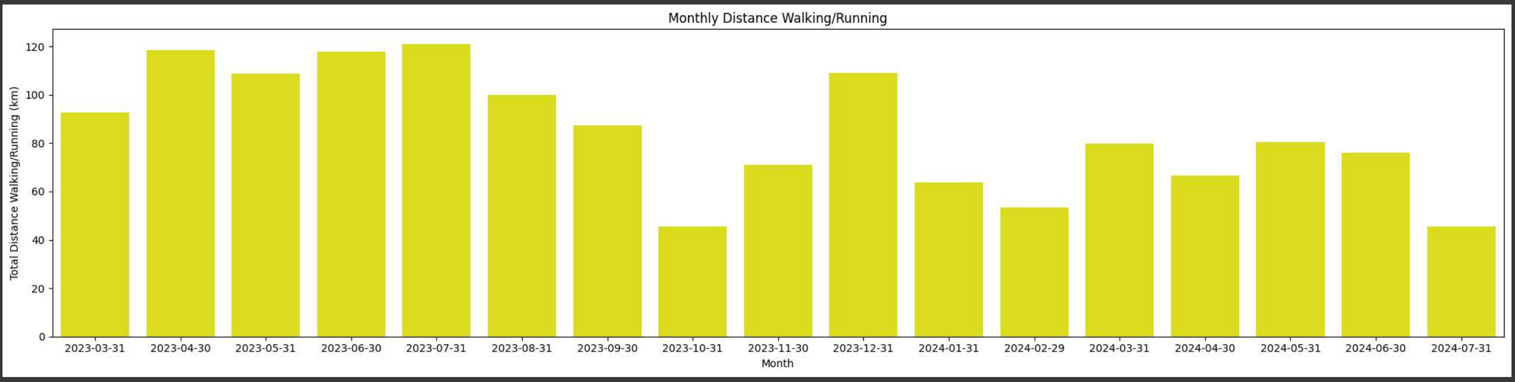
```
data['TotalEnergyBurned'] = data['BasalEnergyBurned'] + data['ActiveEnergyBurned']
data['RollingTotalEnergy'] = data['TotalEnergyBurned'].rolling(window=7).mean()

plt.figure(figsize=(20, 5))
sns.lineplot(x=data.index, y='TotalEnergyBurned', data=data, label='Daily Total Energy Burned')
sns.lineplot(x=data.index, y='RollingTotalEnergy', data=data, label='Moving Average (7)')
plt.title('Total Energy Burned and Moving Average Over Time')
plt.xlabel('Date')
plt.ylabel('Total Energy Burned (kcal)')
plt.legend()
plt.tight_layout()
plt.show()
```



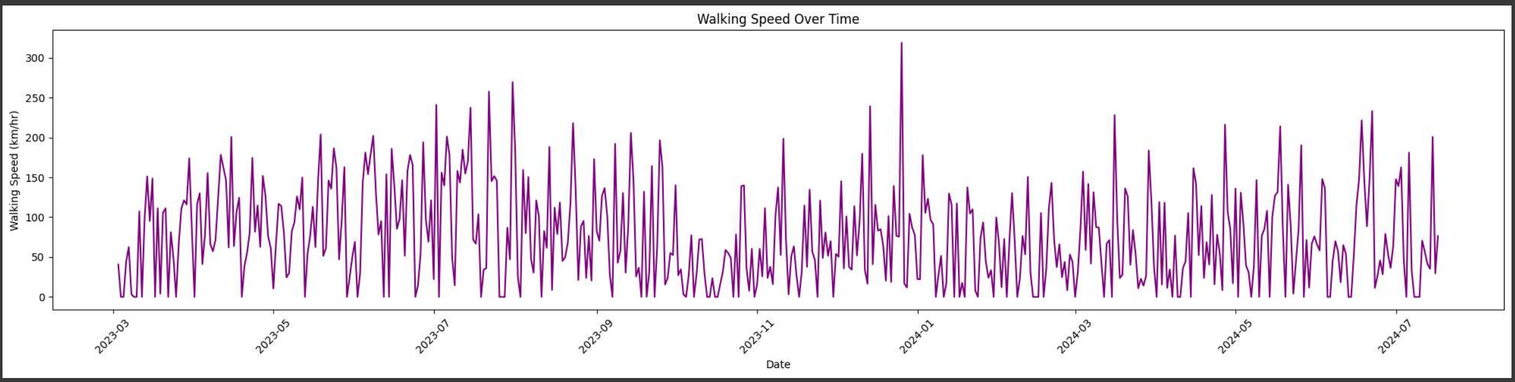
Monthly Aggregation of Distance Walking/Running

```
plt.figure(figsize=(20, 5))
sns.barplot(x=month_data.index, y='DistanceWalkingRunning', data=month_data, color='yellow')
plt.title('Monthly Distance Walking/Running')
plt.xlabel('Month')
plt.ylabel('Total Distance Walking/Running (km)')
plt.tight_layout()
plt.show()
```



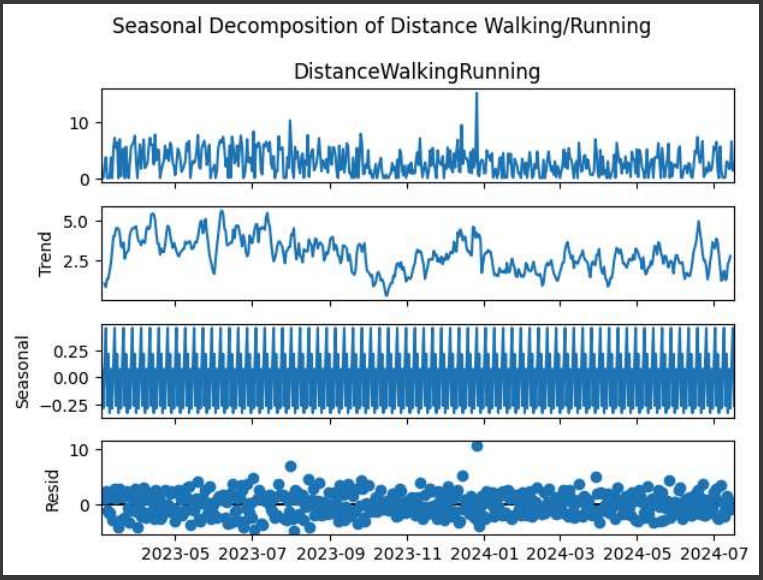
Time Series Plot of Walking Speed

```
plt.figure(figsize=(20, 5))
sns.lineplot(x=data.index, y='WalkingSpeed', data=data, color='purple')
plt.title('Walking Speed Over Time')
plt.xlabel('Date')
plt.ylabel('Walking Speed (km/hr)')
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```



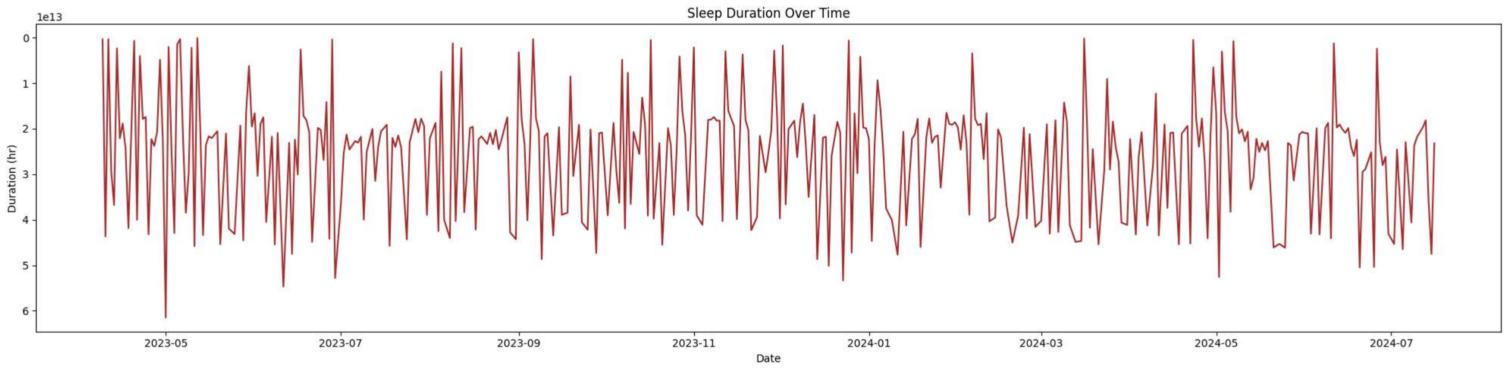
Seasonal Decomposition of Distance Walking/Running

```
seasonal_decompose(data['DistanceWalkingRunning'], model='additive').plot()
plt.suptitle('Seasonal Decomposition of Distance Walking/Running')
plt.tight_layout()
plt.show()
```



Distribution of Sleep Analysis Duration

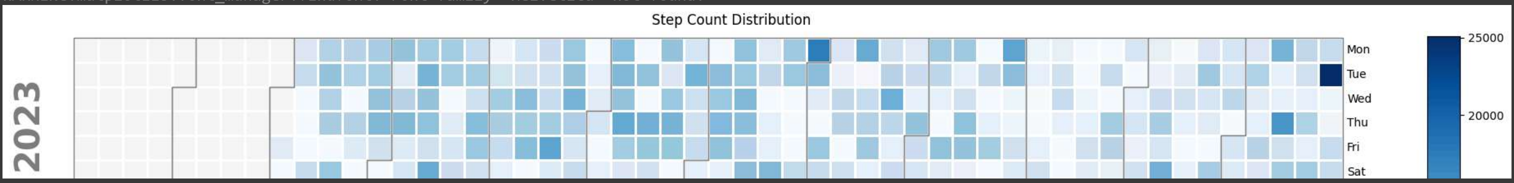
```
plt.figure(figsize=(20, 5))
sns.lineplot(x=data.index, y='SleepAnalysis', data=data, color='brown')
plt.title('Sleep Duration Over Time')
plt.xlabel('Date')
plt.ylabel('Duration (hr)')
plt.tight_layout()
plt.show()
```



Step Count Distribution

```
calplot.calplot(data['StepCount'], suptitle='Step Count Distribution', cmap='Blues', figsize=(20, 5))
```

```
WARNING:matplotlib.font_manager:findfont: Font family 'Helvetica' not found.
WARNING:matplotlib.font_manager:findfont: Font family 'Helvetica' not found.
WARNING:matplotlib.font_manager:findfont: Font family 'Helvetica' not found.
(<Figure size 2000x500 with 3 Axes>,
 array([<Axes: ylabel='2023'>, <Axes: ylabel='2024'>], dtype=object))
WARNING:matplotlib.font_manager:findfont: Font family 'Helvetica' not found.
WARNING:matplotlib.font_manager:findfont: Font family 'Helvetica' not found.
WARNING:matplotlib.font_manager:findfont: Font family 'Helvetica' not found.
WARNING:matplotlib.font_manager:findfont: Font family 'Helvetica' not found.
WARNING:matplotlib.font_manager:findfont: Font family 'Helvetica' not found.
WARNING:matplotlib.font_manager:findfont: Font family 'Helvetica' not found.
WARNING:matplotlib.font_manager:findfont: Font family 'Helvetica' not found.
```


Step Count Distribution
Mon
Tue
Wed
Thu
Fri
Sat