DSC 530

Gracie Inman

Final Project

08/12/23

Analyzing Sleep

Sleep is an important necessity for cognitive function. Are aspects of sleep such as duration and quality, determined by other aspects such as age, physical activity, heart rate, or gender? There were not outliers present in the data and no need for cleansing of the data. According to the analysis, there is a strong significant difference between quality of sleep and gender. The regression analysis showed that 26.9% of the variability in heart rate can be explained by sleep duration and age. When controlling for sleep duration and age, sleep duration has a statistically significant negative affect on heart rate. Sleep duration and age are also statistically significant predictors of heart rate. JB and Omnibus indicate that the data may not be normally distributed. I feel it is possible statistically significant relationships were not identified due to the limitation of variables. I feel as though sleep disorders and blood pressure could have been helpful in the analysis. When making the choice for variables, I chose the variables I assumed had the greatest possibility of affecting sleep. I also assumed that the subjective data such as quality of sleep was accurate. I also assumed that the uneven distribution of careers had little to no effect on the data. I felt as though the careers were not evenly distributed. There was a large amount of healthcare professionals who often work long and possibly overnight shifts which can affect not only quality, but also duration of sleep. I also assumed that physical activity level was in direct correlation with the number of daily steps. I was challenged with remembering all the key aspects of some of the analysis. However, I believe that with time and use that will improve.

Sleep Duration and Quality

By Gracie Inman

Question

Sleep is an important necessity for cognitive function.

Are aspects of sleep such as duration and quality, determined by other aspects such as age, physical activity, heart rate, or gender?

Variables

Heart rate is the patient's heart rate.

Sleep duration is how long the patient slept

Sleep quality quantifies the quality of the sleep

Physical activity level quantifies how active the patient is.

Age is how old the subject is.

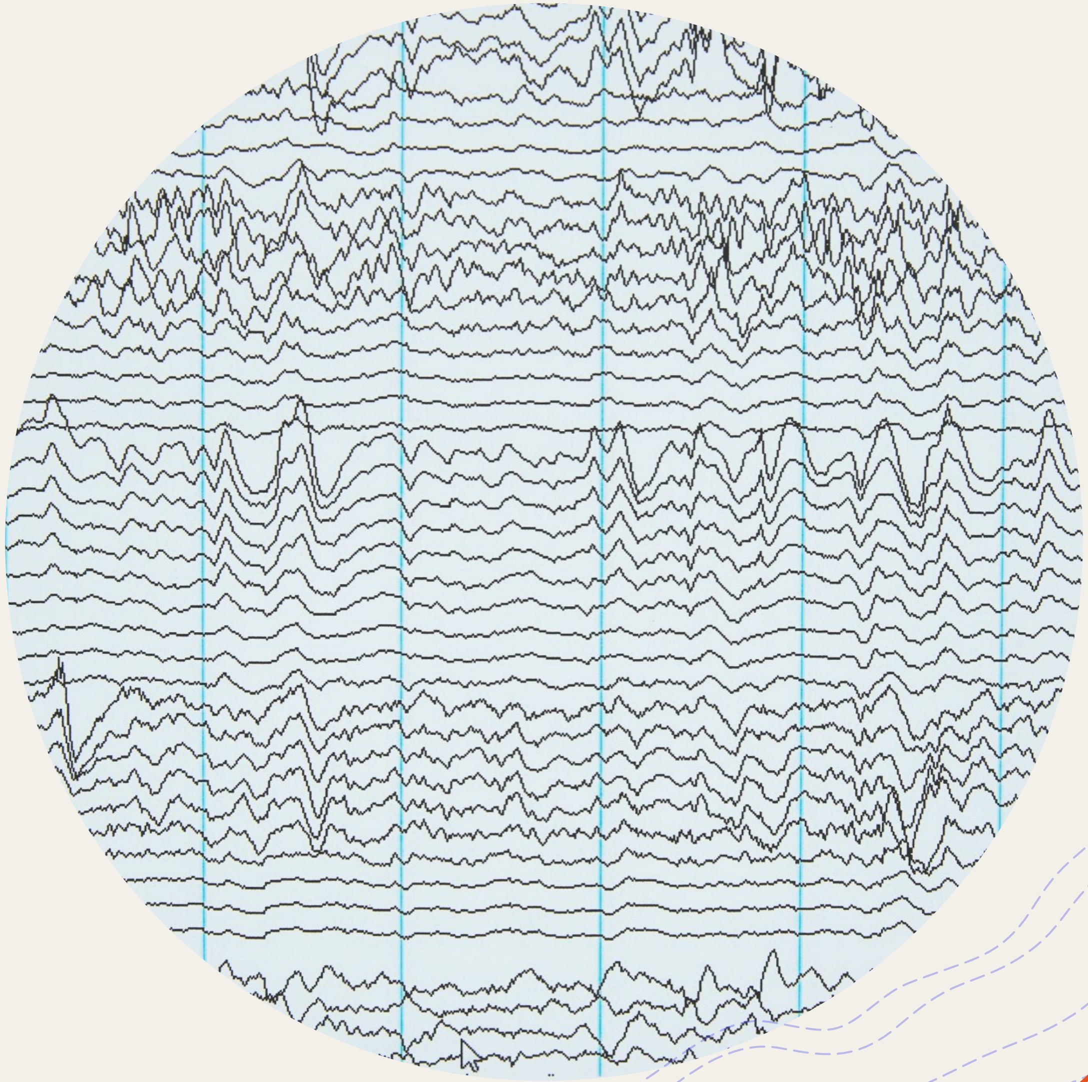
Stress Level is how stressed the subject feels quantified.

Analysis

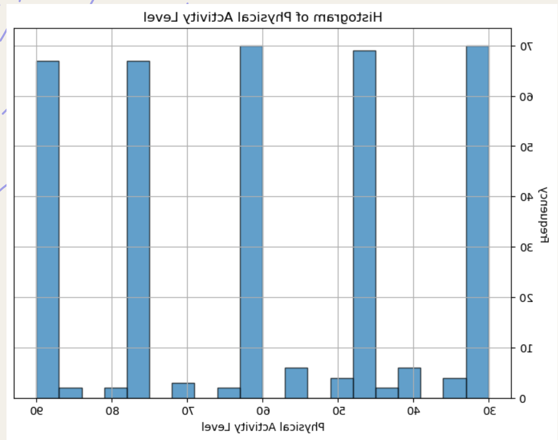
Includes comparing variables using multiple techniques to identify relationships before variables.

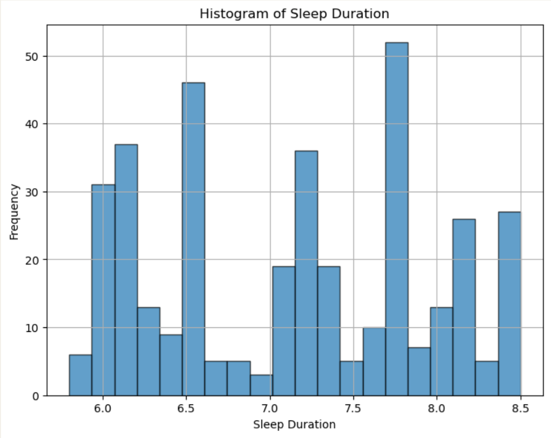
Methods used:

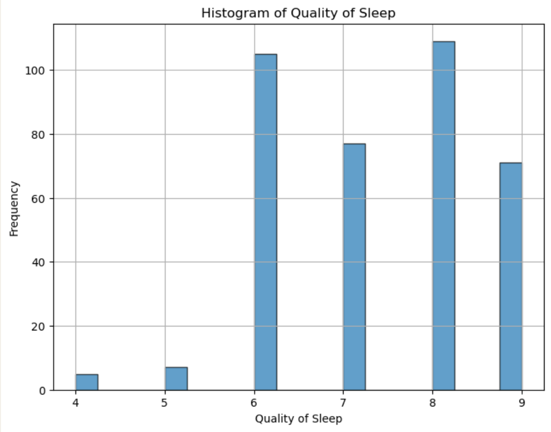
Histograms	Scatter Plots	Descriptive Stats	CDF	PDF	Analytical Distribution	Hypothesis Test	Regression Analysis



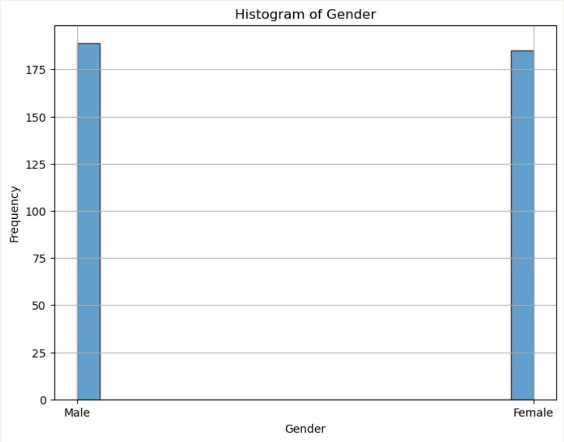
Variables Plotted

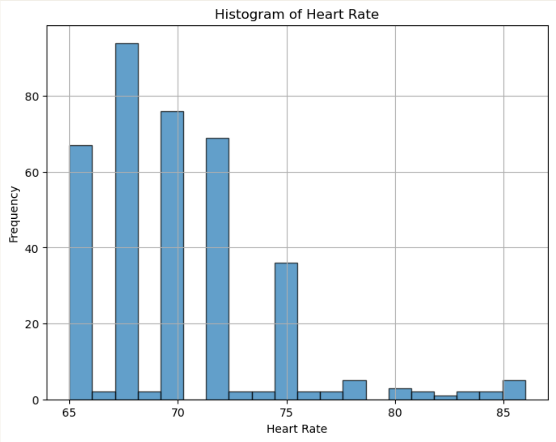


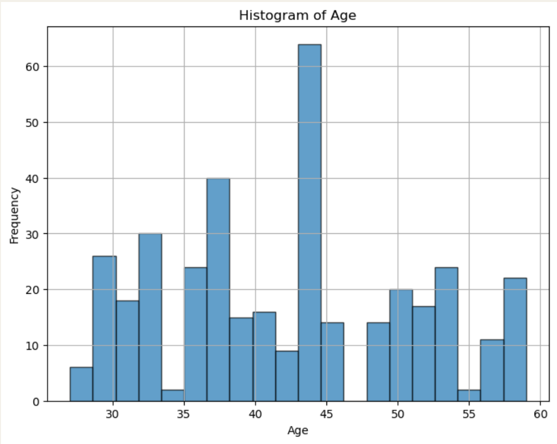


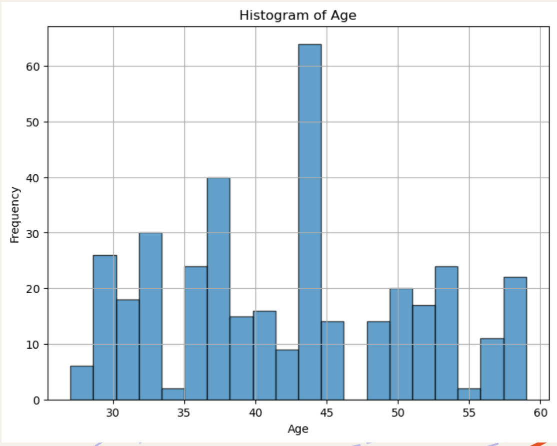


- No obvious outliers present in data.

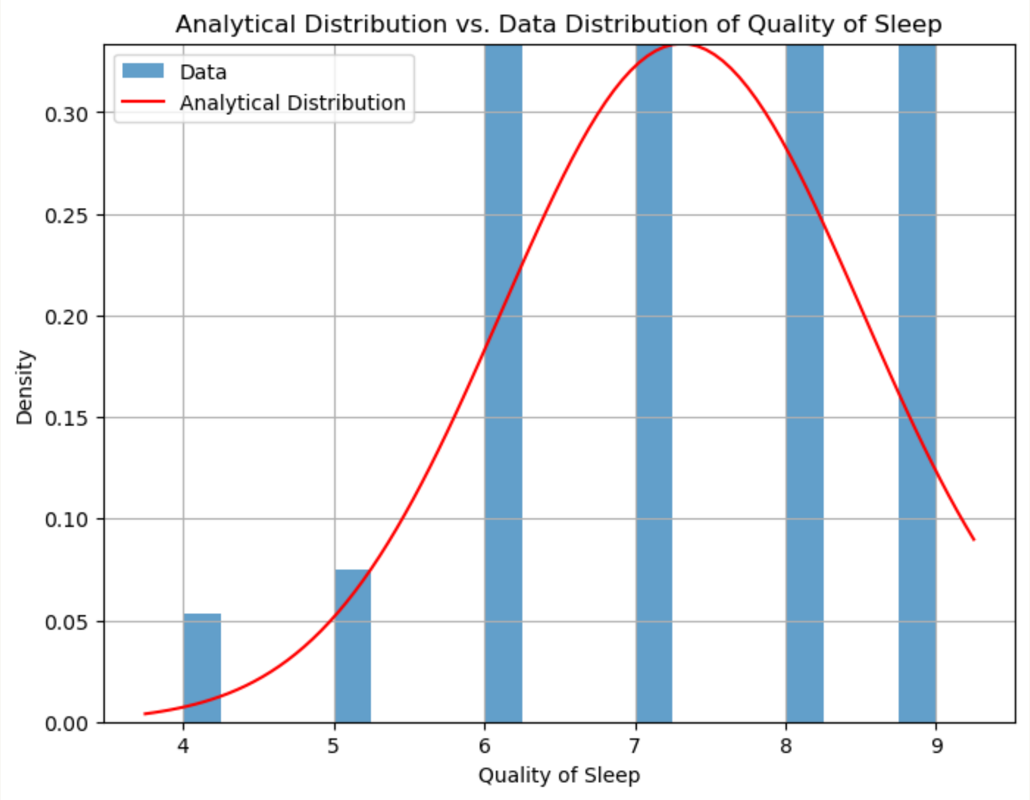








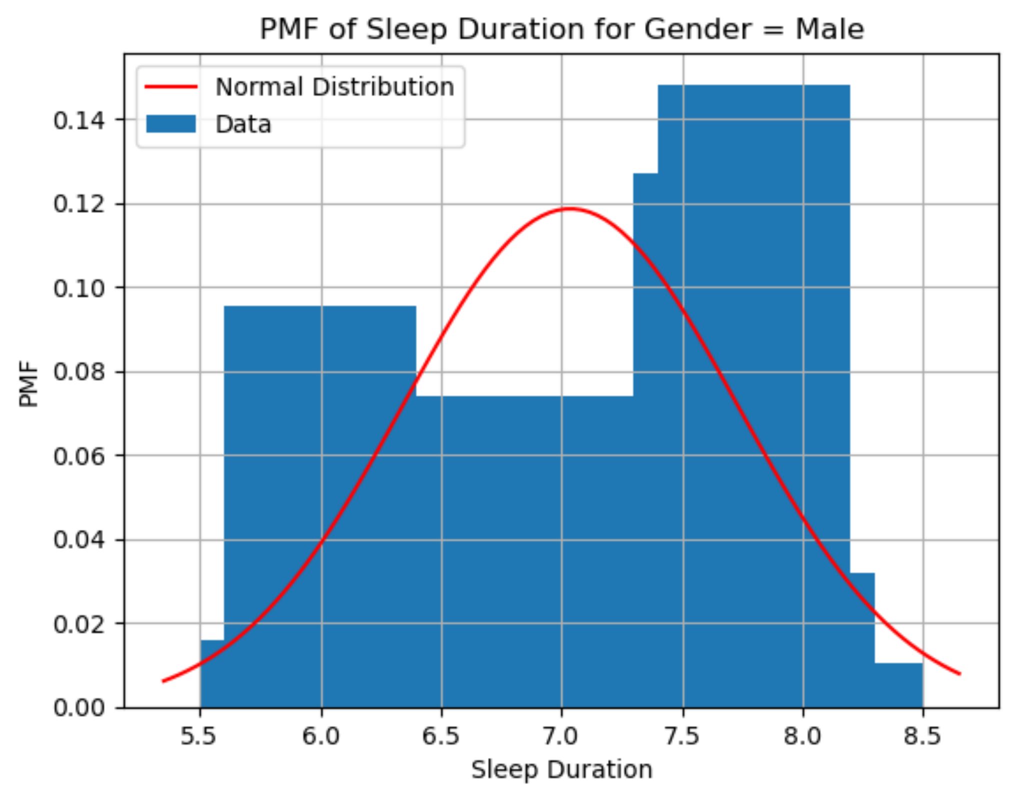
Analytical Distribution



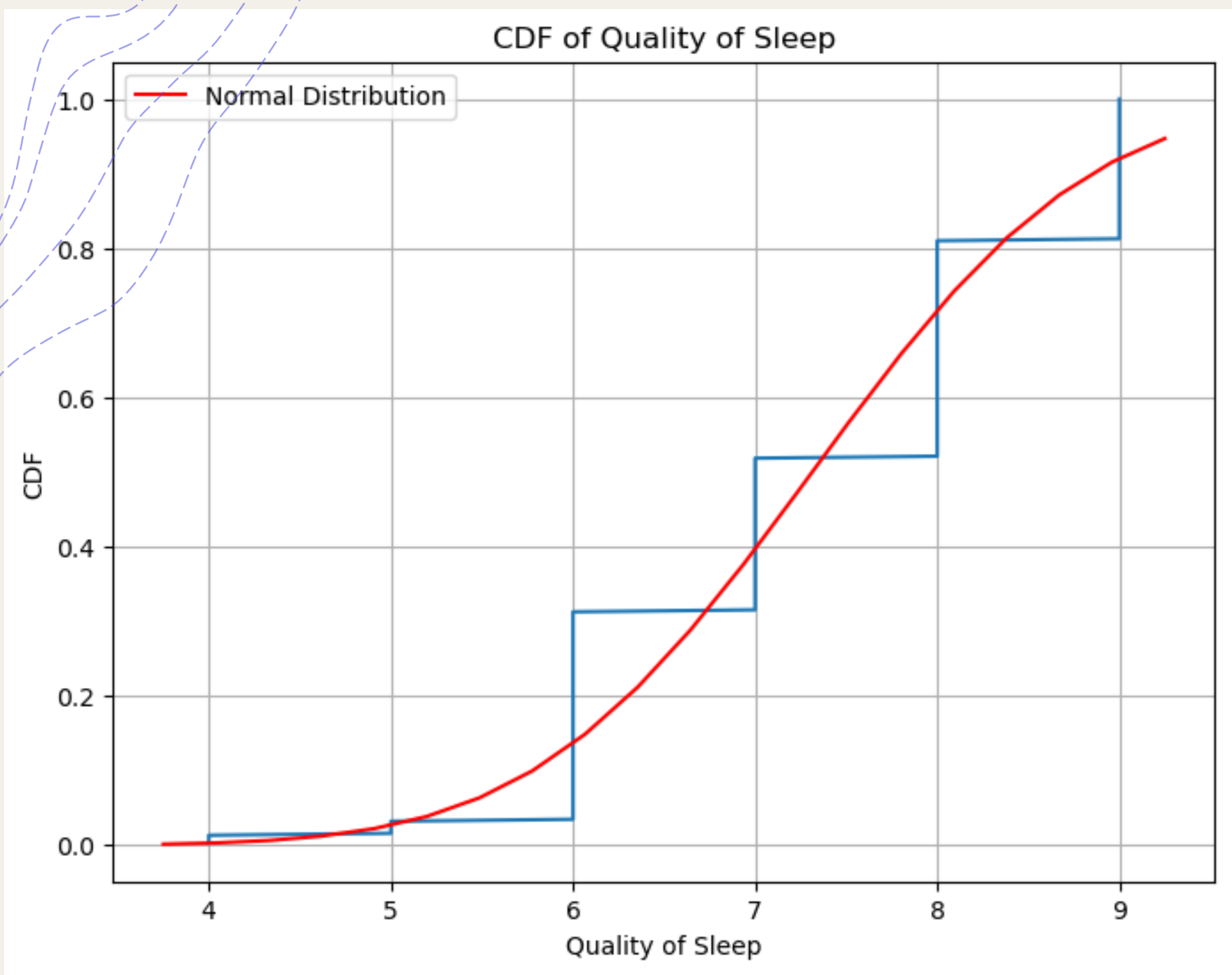
The analytical distribution is mostly normal with a few data points outside of the cure.

This could be due to the subjectiveness of quality of sleep.

PMF of Sleep Duration for Men



- The PMF does not appear to be normally distributed with high peaks at both the lower and higher ends of sleep duration.

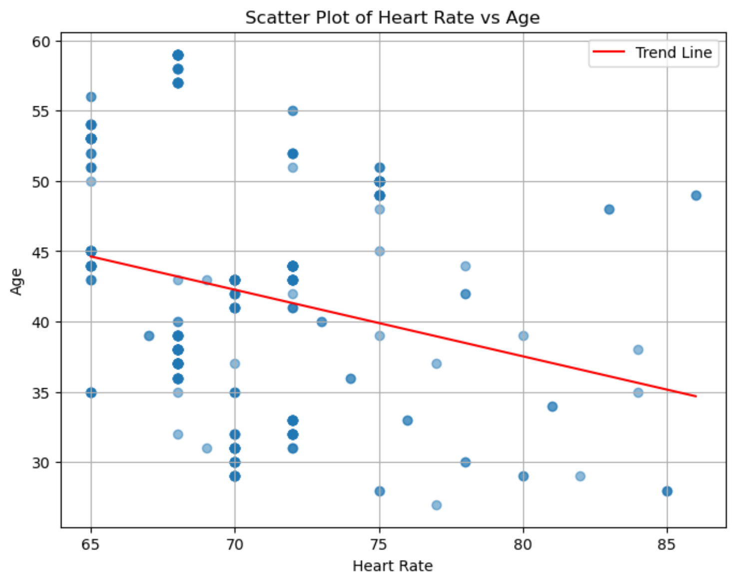


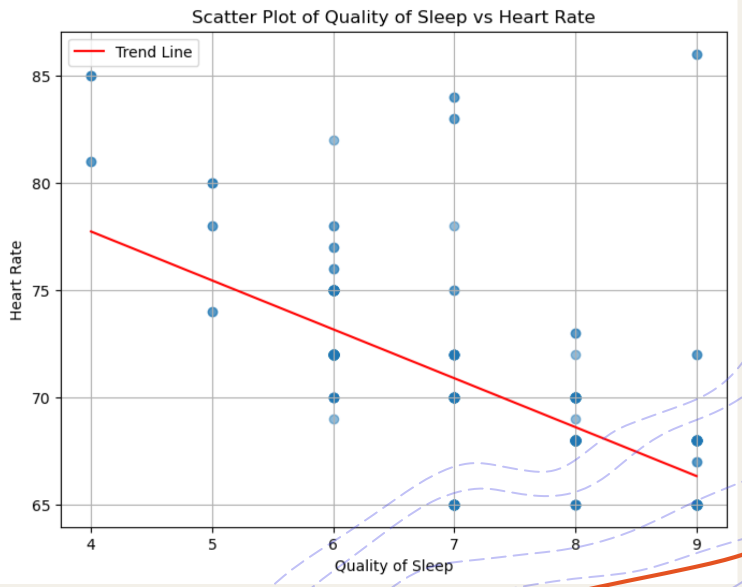
CDF of Quality of Sleep

The CDF plot is normally distributed

Scatter Plots

+ Both scatterplots show a negative correlation.
  + As heart rate increases, age decreases.
  + As quality of sleep increases, heart rate decreases.





Results

There were not outliers present in the data and no need for cleansing of the data.

According to the analysis, there is a strong significant difference between quality of sleep and gender.

The regression analysis showed that 26.9% of the variability in heart rate can be explained by sleep duration and age.

When controlling for sleep duration and age, sleep duration has a statistically significant negative affect on heart rate.

Sleep duration and age are also statistically significant predictors of heart rate.

JB and Omnibus indicate that the data may not be normally distributed.

Assumptions

When making the choice for variables, I chose the variables I assumed had the greatest possibility of affecting sleep.

I also assumed that the subjective data such as quality of sleep was accurate.

I also assumed that the uneven distribution of careers had little to no effect on the data.

I felt as though the careers were not evenly distributed. There was a large amount of healthcare professionals who often work long and possibly overnight shifts which can affect not only quality, but also duration of sleep.

I also assumed that physical activity level was in direct correlation with the number of daily steps

Conclusion

Inclusion of other variables from the data could improve the analysis.

Several assumptions were made in analysis and should be considered in validity of results.

There is a significant relationship between:

- Sleep and Gender
- Age with both Sleep Duration and Heart Rate

In [ ]:
```
# DSC 530
# Gracie Inman
# Final Project
# 08/12/23
```

In [57]:
```
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
import scipy.stats as stats
import statsmodels.api as sm

NUM_BINS = 20
# Step 1: Load the dataset
def load_dataset(filename):
    return pd.read_csv(filename)

# Step 2: Describe the 5 variables
# Heart rate is the patient's heart rate.
## Sleep duration is how long the patient slept
## Sleep quality quantifies the quality of the sleep
## Physical activity level quantifies how active the patient is.
## Age is how old the subject is.
## Stress Level is how stressed the subject feels quantified.

# Step 3: Create histograms and identify outliers (Chapter 2)
def plot_histogram_with_outliers(data, column):
    plt.figure(figsize=(8, 6))
    plt.hist(data[column], bins=NUM_BINS, edgecolor='k', alpha=0.7)
    plt.xlabel(column)
    plt.ylabel('Frequency')
    plt.title(f'Histogram of {column}')
    plt.grid(True)
    plt.show()

# Plot histograms for each variable and identify outliers
variables = ['Gender', 'Age', 'Sleep Duration', 'Quality of Sleep', 'Physical A
for var in variables:
    plot_histogram_with_outliers(data, var)

# Step 4: Calculate descriptive characteristics (Chapter 2)
def calculate_descriptive_stats(data, column):
    mean = data[column].mean()
    mode = data[column].mode()[0]
    spread = data[column].std()
    tails = data[column].skew()
    return mean, mode, spread, tails

# Step 5: Compare scenarios using PMF (Chapter 3)
def plot_pmf(data, column, scenario_column, scenario_value):
    filtered_data = data[data[scenario_column] == scenario_value]
    pmf = filtered_data[column].value_counts(normalize=True).sort_index()

    plt.bar(pmf.index, pmf.values, label='Data')
    plt.xlabel(column)
    plt.ylabel('PMF')
    plt.title(f'PMF of {column} for {scenario_column} = {scenario_value}')
```

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```
    # Add a normal distribution line for comparison
    mean = filtered_data[column].mean()
    std = filtered_data[column].std()
    xmin, xmax = plt.xlim()
    x = np.linspace(xmin, xmax, 100)

    # Plot a normal distribution line with a custom scaling factor
    norm_pdf = stats.norm.pdf(x, mean, std)
    scaling_factor = np.max(pmf.values) / np.max(norm_pdf) * 0.8
    plt.plot(x, norm_pdf * scaling_factor, 'r', label='Normal Distribution')
    plt.legend()

    plt.show()


# Step 6: Create a CDF (Chapter 4)
def plot_cdf(data, column):
    plt.figure(figsize=(8, 6))
    sorted_data = np.sort(data[column])
    cdf = np.arange(1, len(sorted_data) + 1) / len(sorted_data)
    plt.plot(sorted_data, cdf)
    plt.xlabel(column)
    plt.ylabel('CDF')
    plt.title(f'CDF of {column}')
    plt.grid(True)

    # Add a normal distribution line for comparison
    mean = data[column].mean()
    std = data[column].std()
    xmin, xmax = plt.xlim()
    x = np.linspace(xmin, xmax, 20)
    cdf_norm = stats.norm.cdf(x, mean, std)
    plt.plot(x, cdf_norm, 'r', label='Normal Distribution')
    plt.legend()

    plt.show()

# Step 7: Plot an analytical distribution and provide analysis (Chapter 5)
def plot_analytical_distribution(data, column, distribution=stats.norm):
    plt.figure(figsize=(8, 6))

    # Plot the histogram or KDE of the data
    plt.hist(data[column], bins=20, density=True, alpha=0.7, label='Data')

    # Plot the analytical distribution
    xmin, xmax = plt.xlim()
    x = np.linspace(xmin, xmax, 100)
    params = distribution.fit(data[column])
    pdf = distribution.pdf(x, *params)
    plt.plot(x, pdf, 'r', label='Analytical Distribution')

    plt.xlabel(column)
    plt.ylabel('Density')
    plt.title(f'Analytical Distribution vs. Data Distribution of {column}')
    plt.legend()
    plt.grid(True)

    # Adjust y-axis limits for better visibility
```

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```
    plt.show()

# Step 8: Create scatter plots and analyze correlation and causation (Chapter 7
def plot_scatter(data, x_column, y_column):
    plt.figure(figsize=(8, 6))
    plt.scatter(data[x_column], data[y_column], alpha=0.5)

    # Calculate and plot the trend line (linear regression line)
    slope, intercept, r_value, p_value, std_err = stats.linregress(data[x_colum
    trend_line_x = np.array([min(data[x_column]), max(data[x_column])])
    trend_line_y = slope * trend_line_x + intercept
    plt.plot(trend_line_x, trend_line_y, color='r', label='Trend Line')

    plt.xlabel(x_column)
    plt.ylabel(y_column)
    plt.title(f'Scatter Plot of {x_column} vs {y_column}')
    plt.legend()
    plt.grid(True)
    plt.show()



# Step 9: Conduct a hypothesis test (Chapter 9)
def conduct_hypothesis_test(data, variable1, variable2):
    group1 = data[data[variable2] == 'Male'][variable1]
    group2 = data[data[variable2] == 'Female'][variable1]

    # Perform a hypothesis test (t-test)
    t_stat, p_value = stats.ttest_ind(group1, group2)

    # Provide interpretation of results
    if p_value < 0.05:
        result = "Reject null hypothesis: There is a significant difference bet
    else:
        result = "Fail to reject null hypothesis: There is no significant diffe

    print(f"T-Stat: {t_stat}")
    print(f"P-Value: {p_value}")
    print(result)
# ...

# Step 10: Conduct a regression analysis (Chapter 10 & 11)
def conduct_regression_analysis(data, dependent_variable, explanatory_variables
    X = sm.add_constant(data[explanatory_variables])
    y = data[dependent_variable]
    model = sm.OLS(y, X).fit()

    # Print regression summary and interpret results
    print(model.summary())

def analyze_variable(column_data):
    if column_data.dtype.kind in "biufc":
        # If the data is numerical, perform statistical analysis
        stats = {
            "Mean": column_data.mean(),
            "Median": column_data.median(),
            "Standard Deviation": column_data.std(),
            "Minimum": column_data.min(),
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        }
```

```
    else:
        # If the data is non-numerical, count occurrences of each value
        counts = column_data.value_counts()
        stats = {value: count for value, count in counts.items()}
    return stats

def correlation_matrix(data_frame):
    correlation_matrix = data_frame.corr()
    return correlation_matrix

def main():
    # Call the functions to perform the analyses
    data = load_dataset('Sleep_health_and_lifestyle_dataset.csv')

    # Calculate and display descriptive statistics
    variables_to_analyze = ['Age', 'Sleep Duration', 'Quality of Sleep', 'Heart
    for variable in variables_to_analyze:
        stats = calculate_descriptive_stats(data, variable)
        print(f"Descriptive Statistics for {variable}:")
        print(f"  Mean: {stats[0]:.2f}")
        print(f"  Mode: {stats[1]:.2f}")
        print(f"  Standard Deviation: {stats[2]:.2f}")
        print(f"  Skewness: {stats[3]:.2f}")
        print()
    plot_analytical_distribution(data, 'Quality of Sleep')
    plot_histogram_with_outliers(data, 'Physical Activity Level')
    plot_pmf(data, 'Sleep Duration', 'Gender', 'Male')
    plot_cdf(data, 'Quality of Sleep')
    plot_analytical_distribution(data, 'Physical Activity Level')
    plot_scatter(data, 'Heart Rate', 'Age')
    plot_scatter(data, 'Quality of Sleep', 'Heart Rate')
    conduct_hypothesis_test(data, 'Quality of Sleep', 'Gender')
    conduct_regression_analysis(data, 'Heart Rate', ['Sleep Duration', 'Age'])

if __name__ == "__main__":
    main()
```

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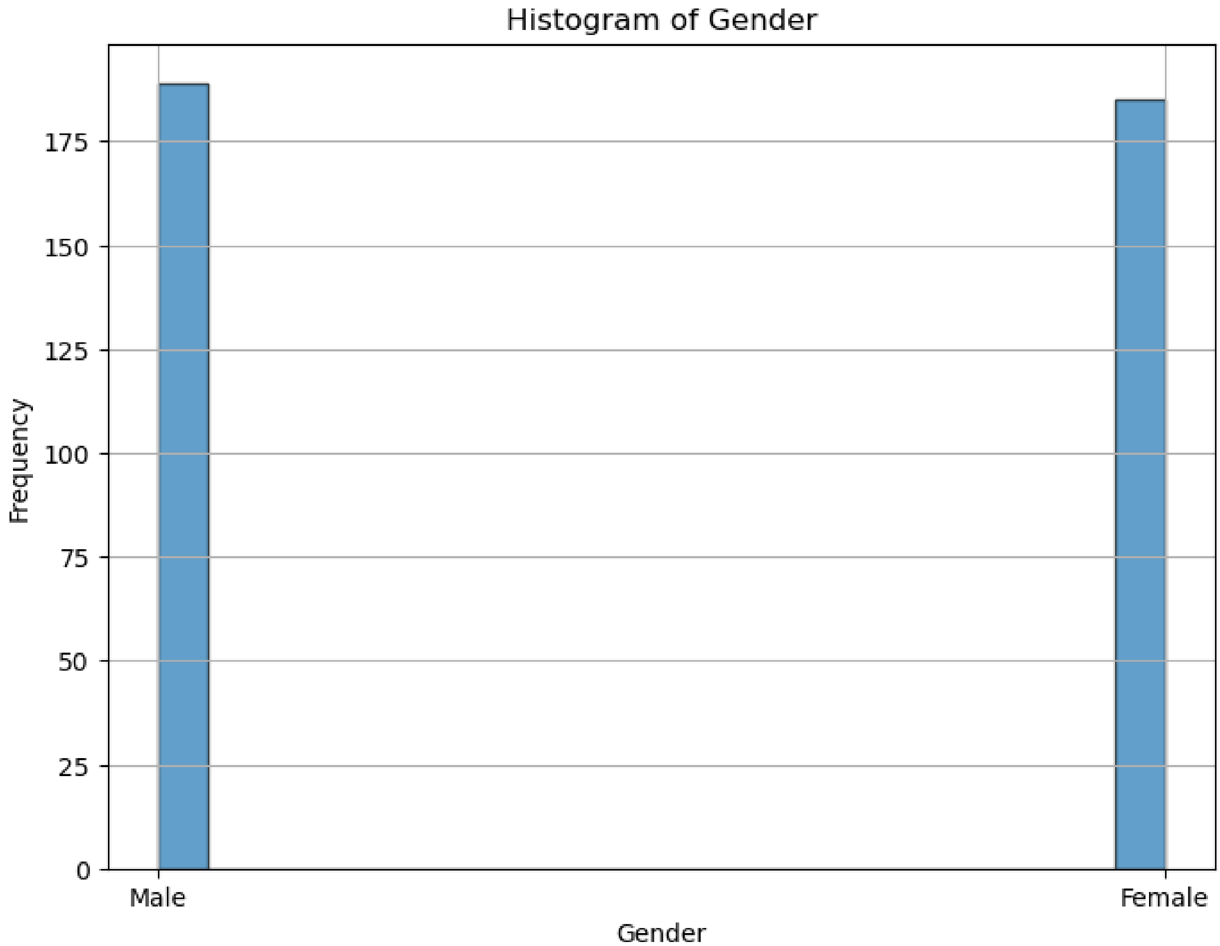

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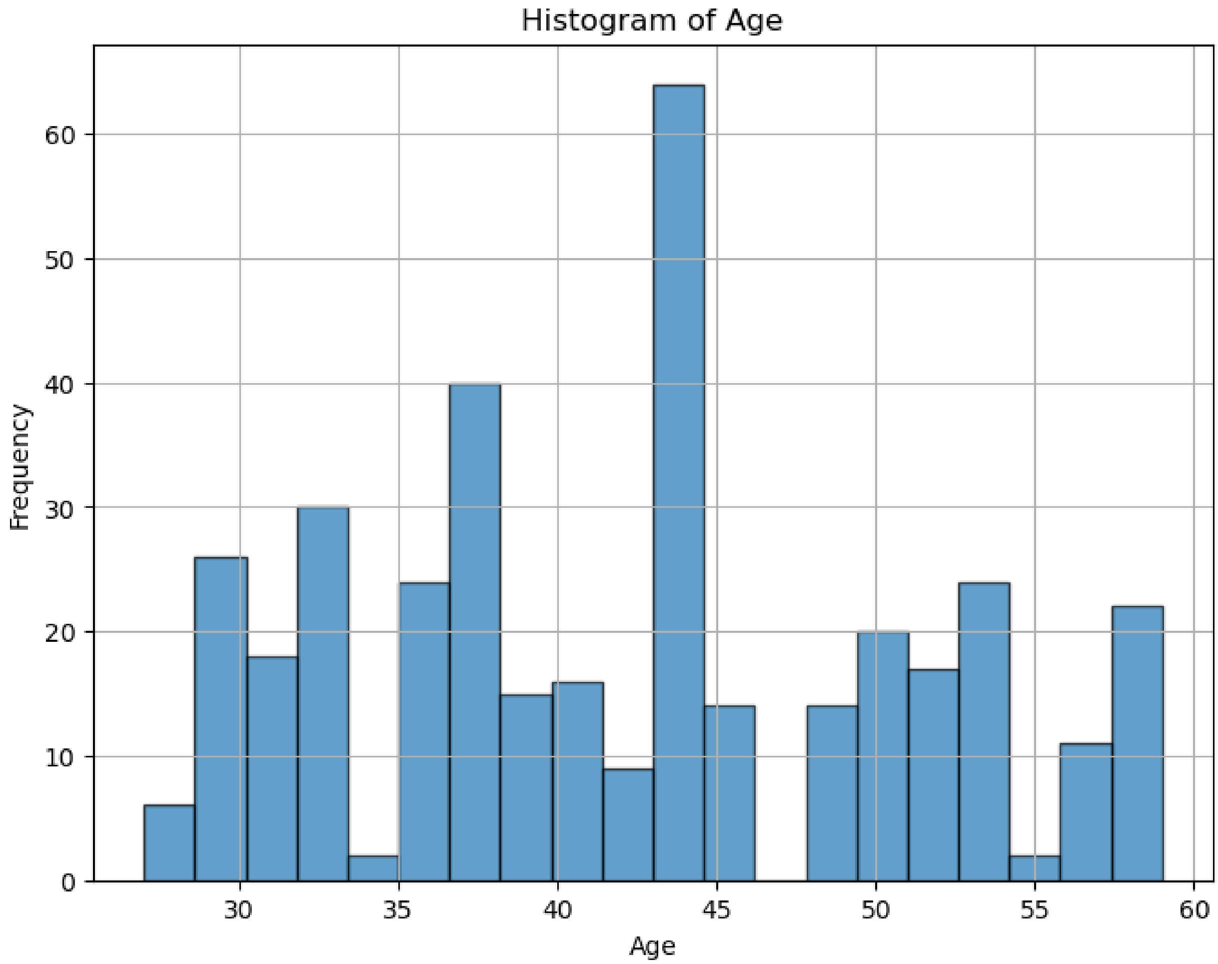

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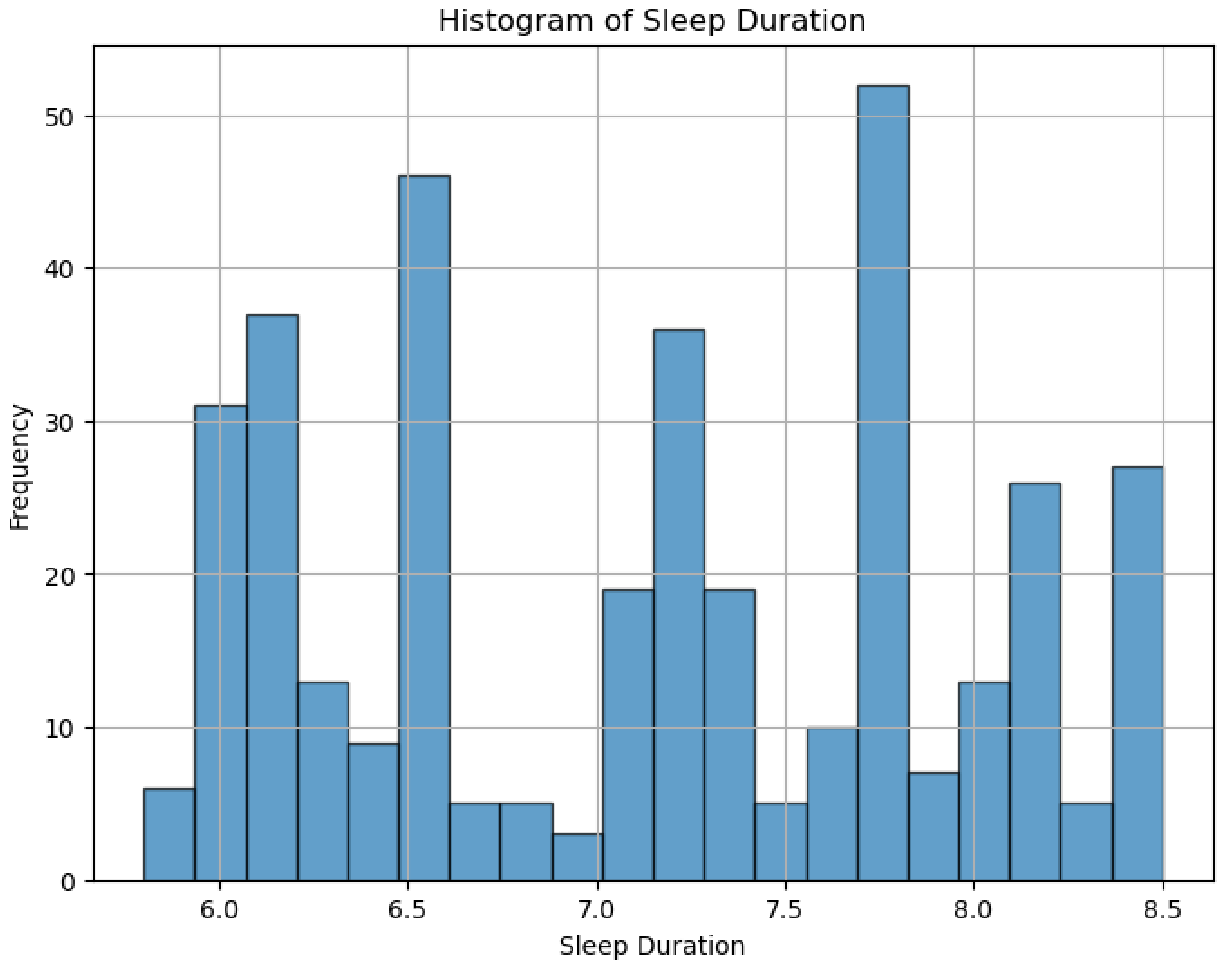

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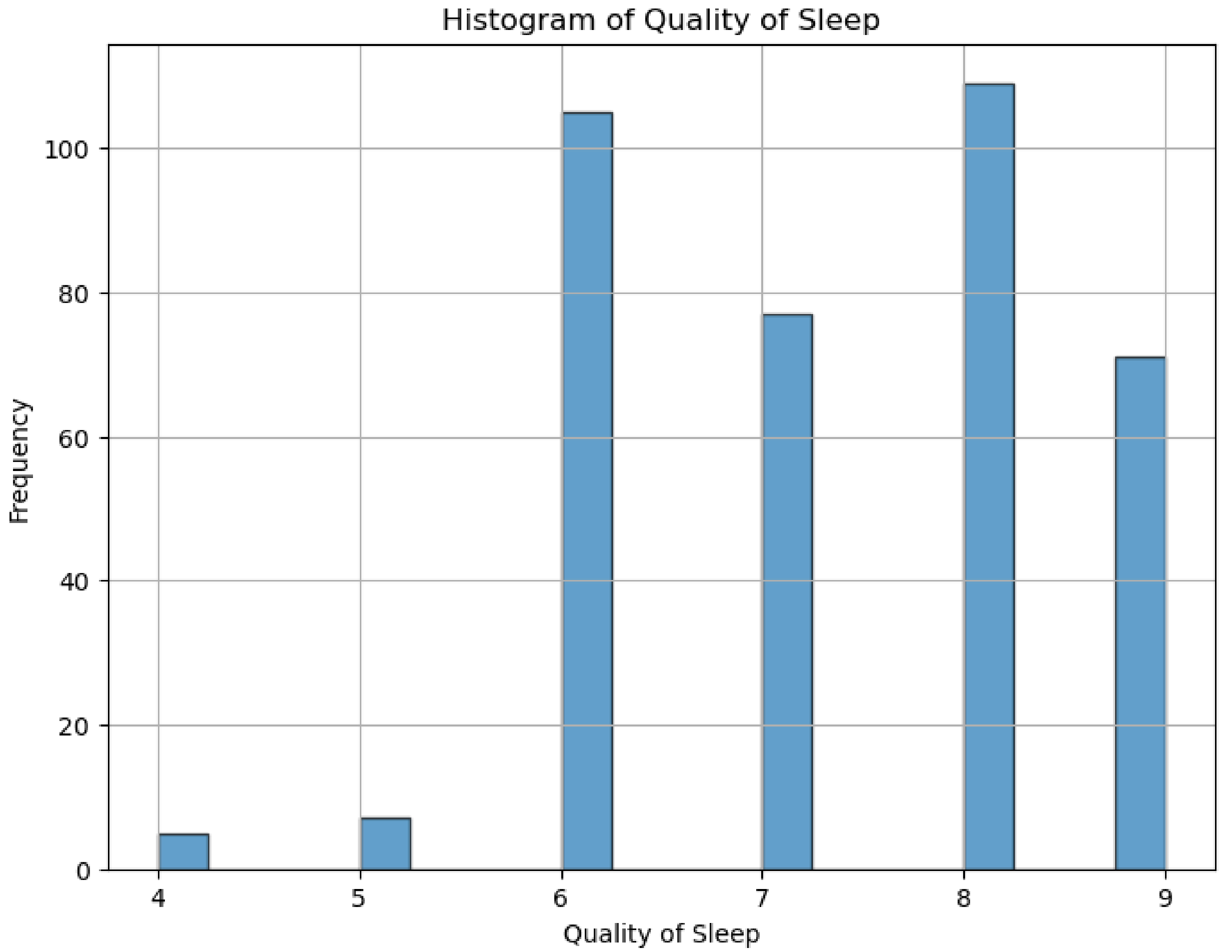

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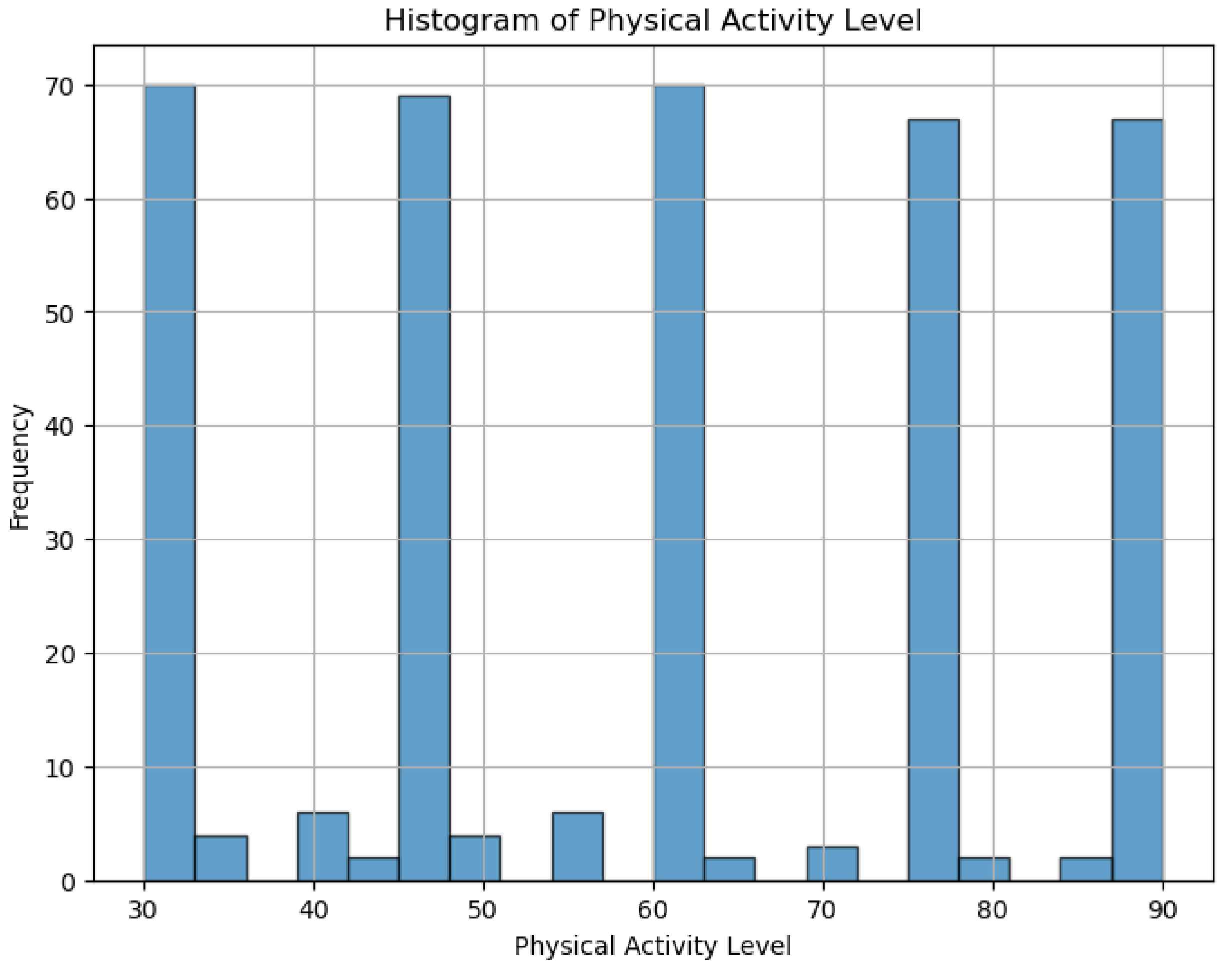

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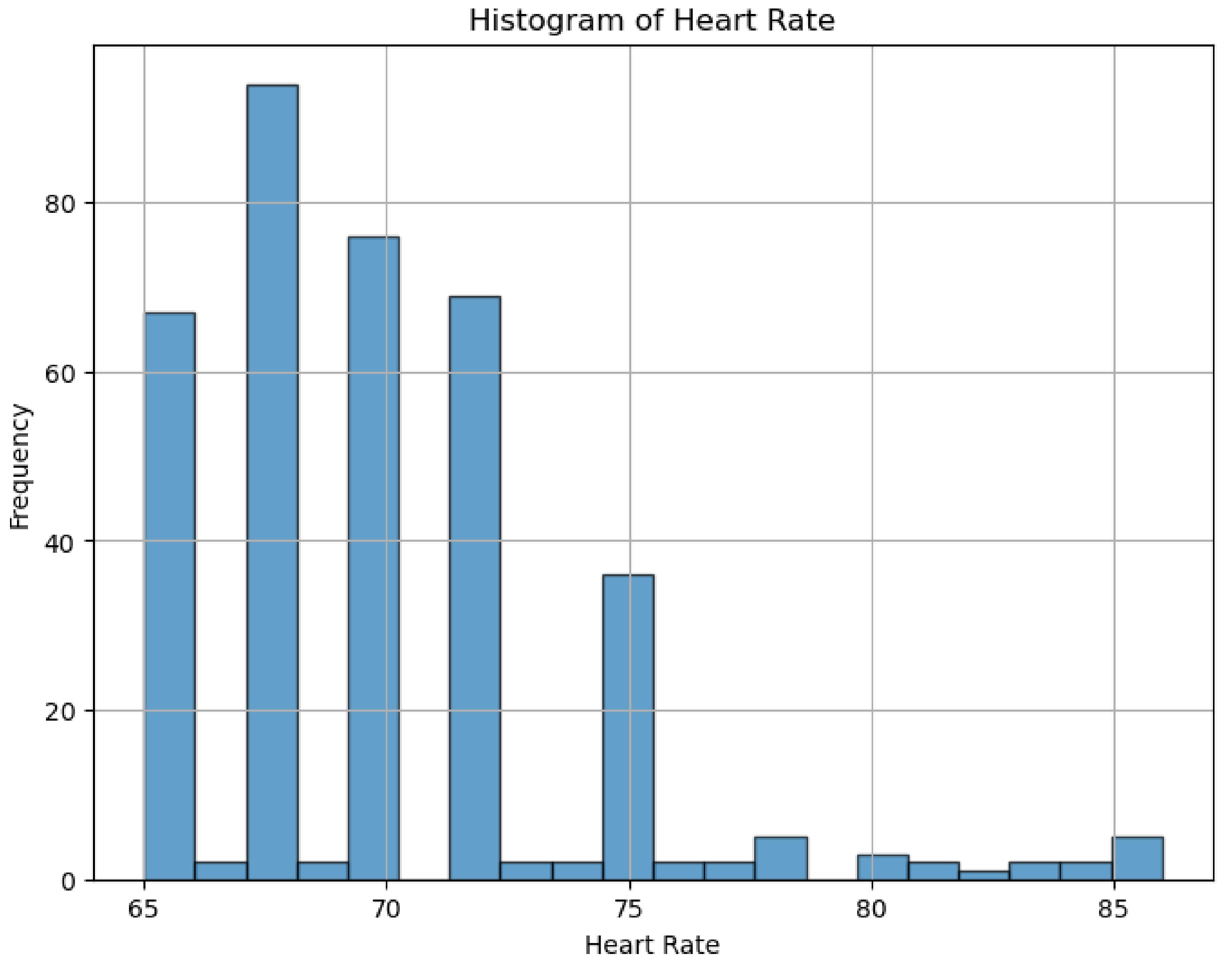

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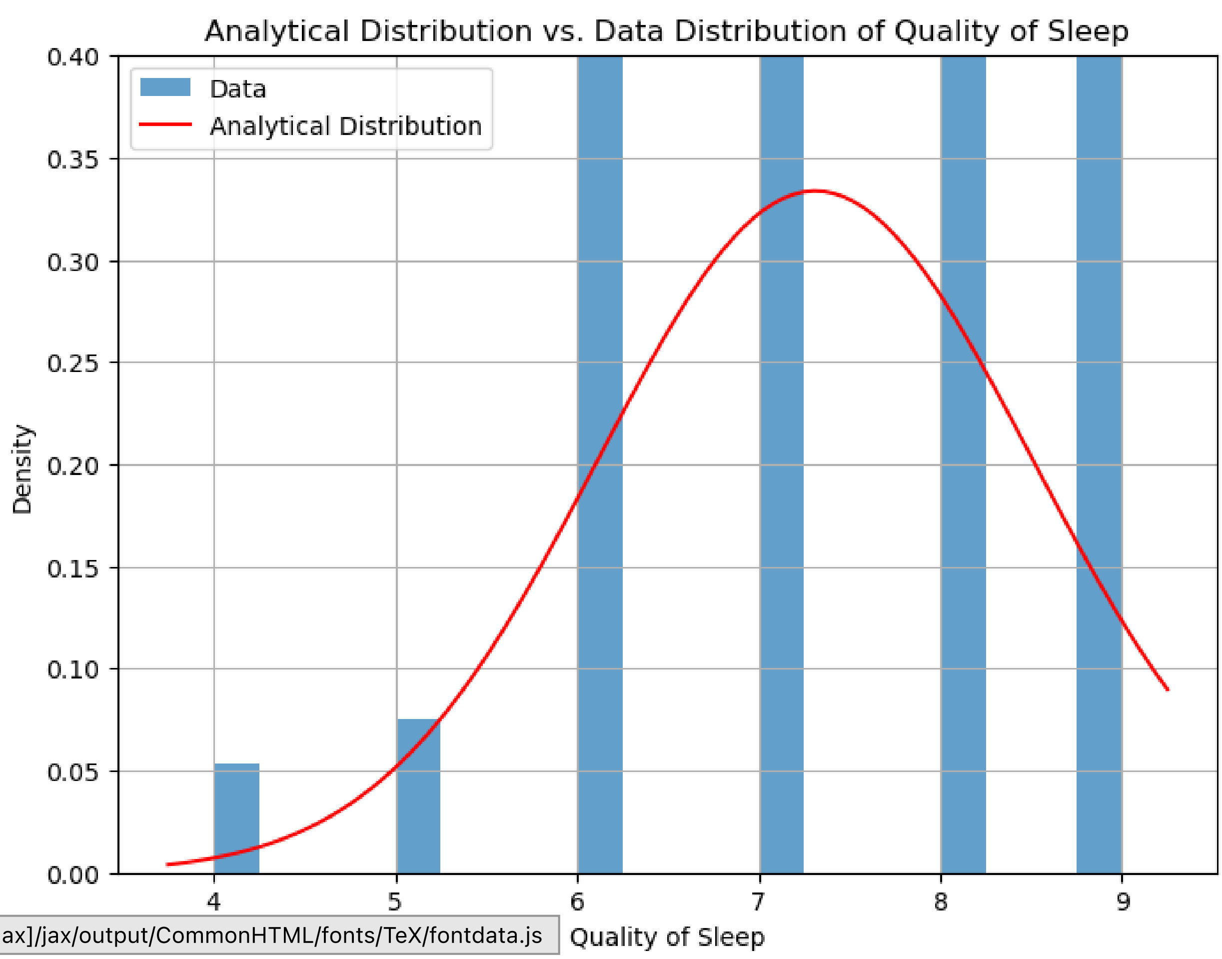
```
Descriptive Statistics for Age:
  Mean: 42.18
  Mode: 43.00
  Standard Deviation: 8.67
  Skewness: 0.26

Descriptive Statistics for Sleep Duration:
  Mean: 7.13
  Mode: 7.20
  Standard Deviation: 0.80
  Skewness: 0.04

Descriptive Statistics for Quality of Sleep:
  Mean: 7.31
  Mode: 8.00
  Standard Deviation: 1.20
  Skewness: -0.21

Descriptive Statistics for Heart Rate:
  Mean: 70.17
  Mode: 68.00
  Standard Deviation: 4.14
  Skewness: 1.22

Descriptive Statistics for Physical Activity Level:
  Mean: 59.17
  Mode: 60.00
  Standard Deviation: 20.83
  Skewness: 0.07
```



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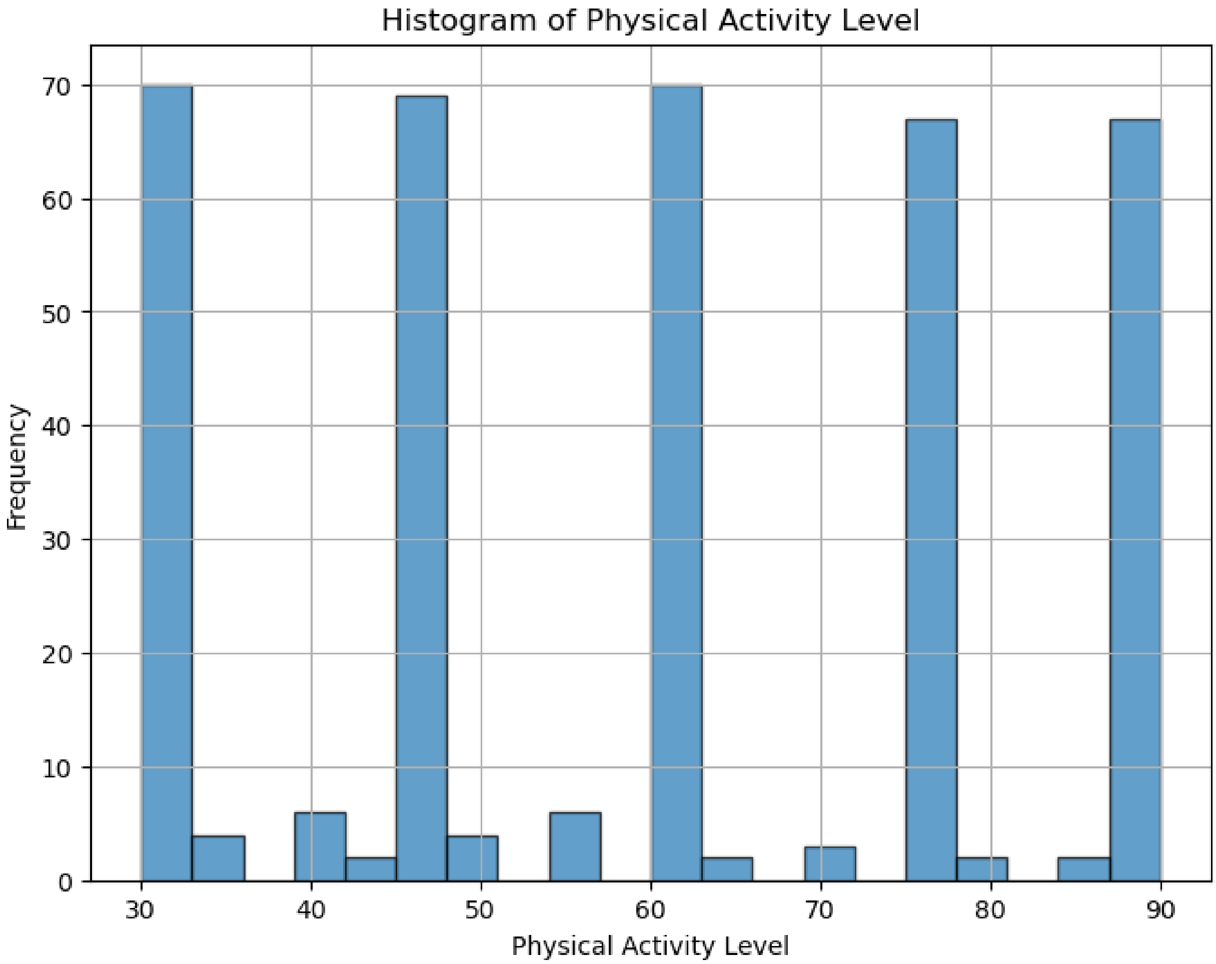

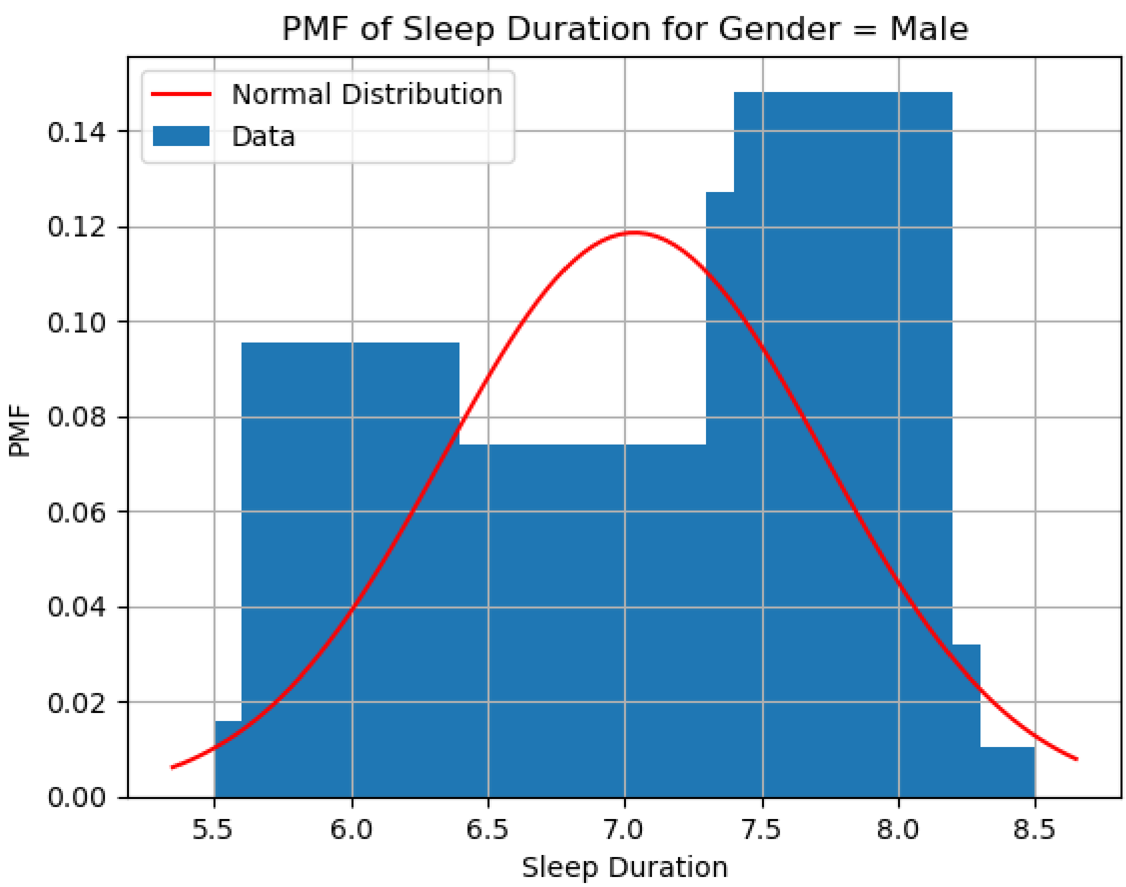

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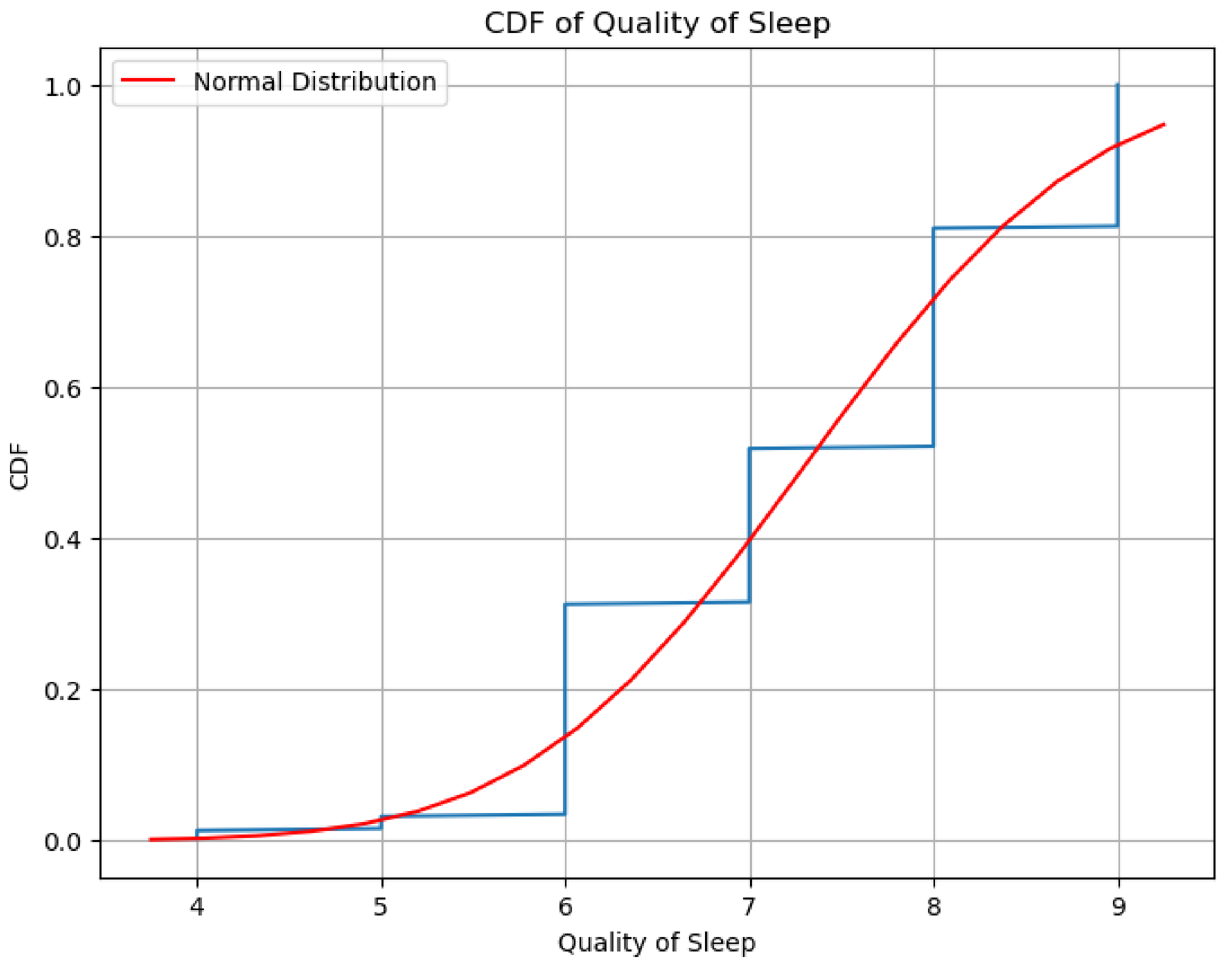

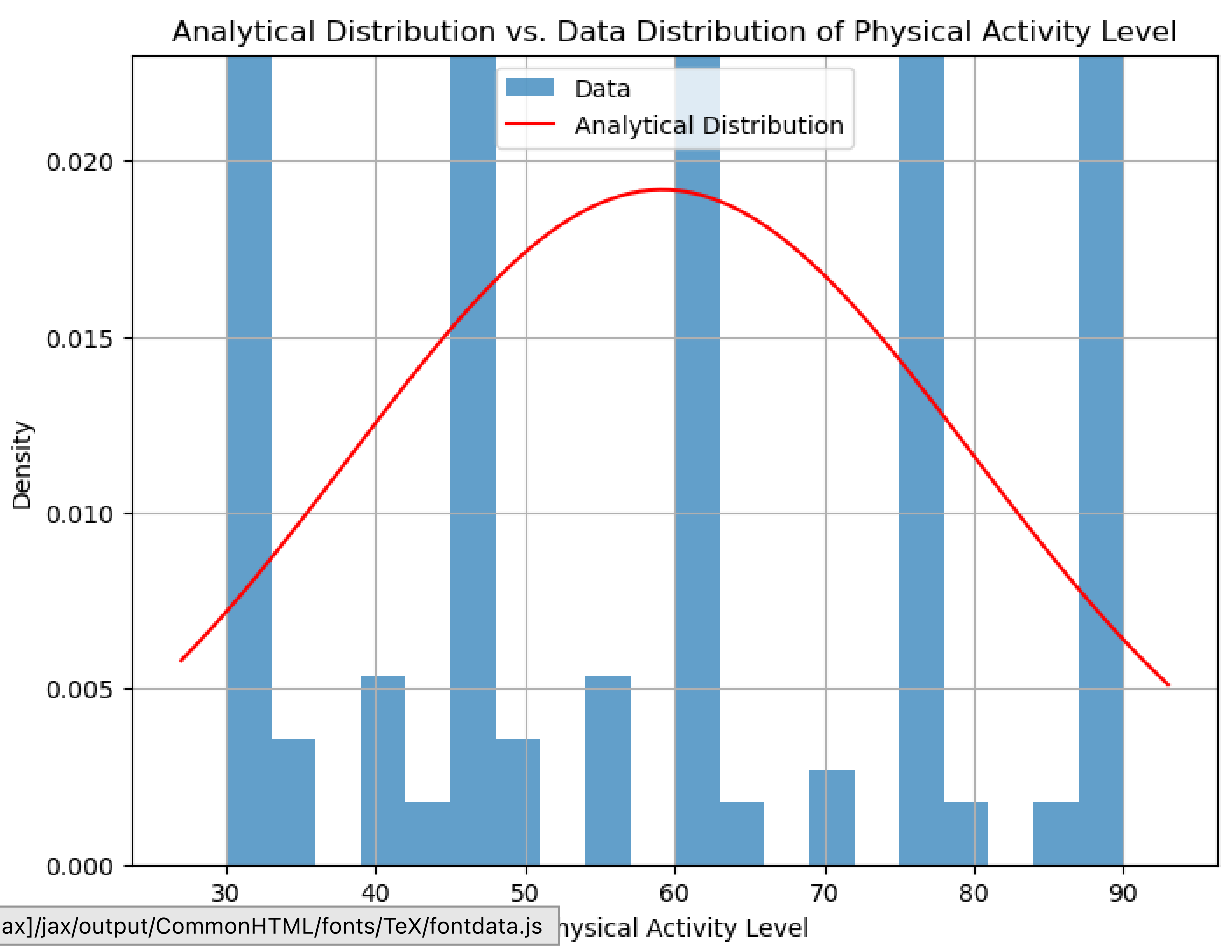

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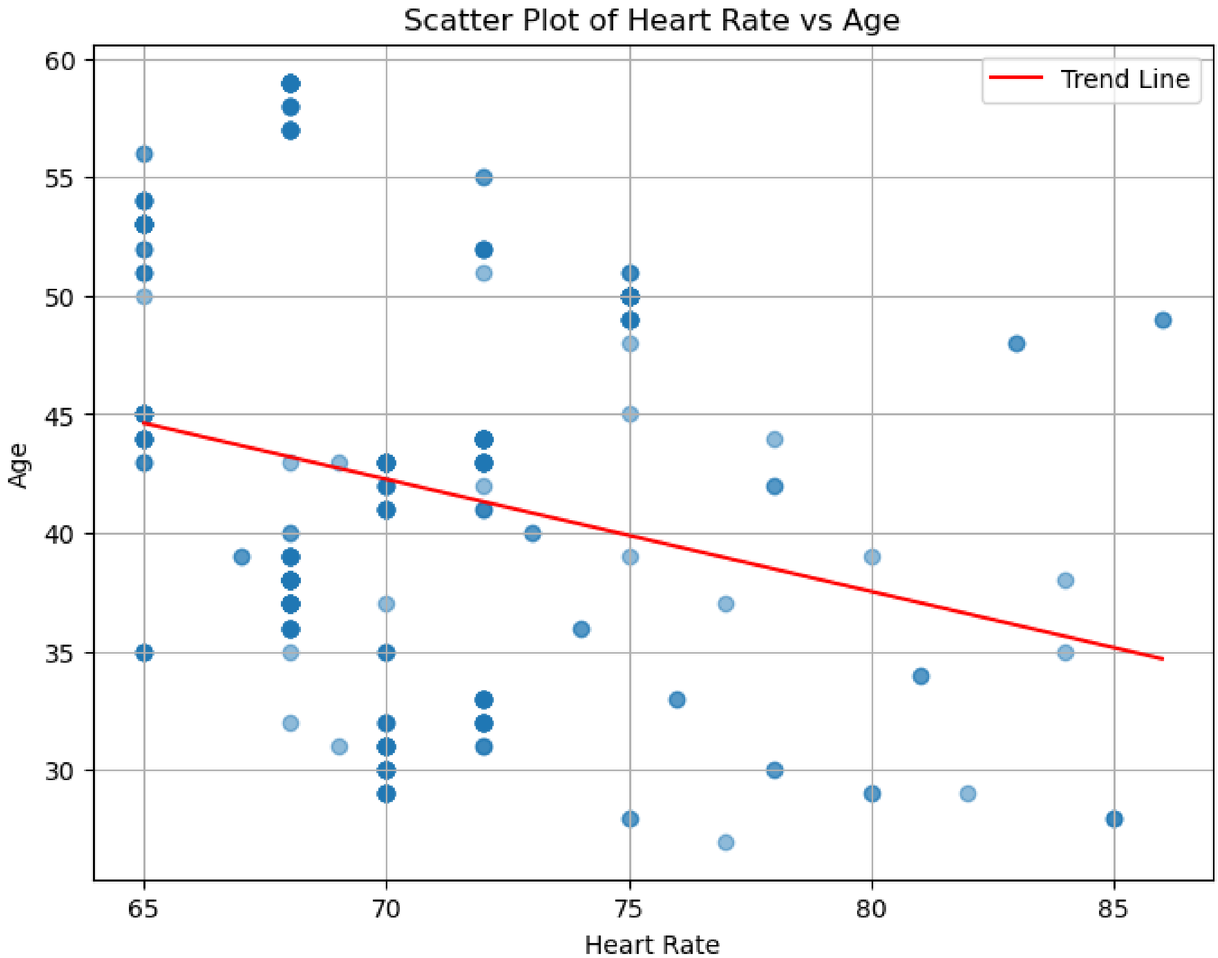

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```
T-Stat: -5.874547760454642
P-Value: 9.416446532689304e-09
Reject null hypothesis: There is a significant difference between the groups.
                            OLS Regression Results
==============================================================================
Dep. Variable:             Heart Rate   R-squared:                       0.269
Model:                            OLS   Adj. R-squared:                  0.265
Method:                 Least Squares   F-statistic:                     68.36
Date:                Sat, 12 Aug 2023   Prob (F-statistic):           5.30e-26
Time:                        20:52:06   Log-Likelihood:                -1002.5
No. Observations:                 374   AIC:                             2011.
Df Residuals:                     371   BIC:                             2023.
Df Model:                           2
Covariance Type:            nonrobust
==============================================================================
====
                     coef    std err          t      P>|t|      [0.025      0.
975]
------------------------------------------------------------------------------
----
const             89.7075      1.691     53.039      0.000      86.382      9
3.033
Sleep Duration    -2.5877      0.246    -10.530      0.000      -3.071      -
2.104
Age               -0.0257      0.023     -1.142      0.254      -0.070
0.019
==============================================================================
Omnibus:                      136.960   Durbin-Watson:                   1.076
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              706.619
Skew:                           1.473   Prob(JB):                    3.63e-154
Kurtosis:                       9.055   Cond. No.                         406.
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correct
ly specified.
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