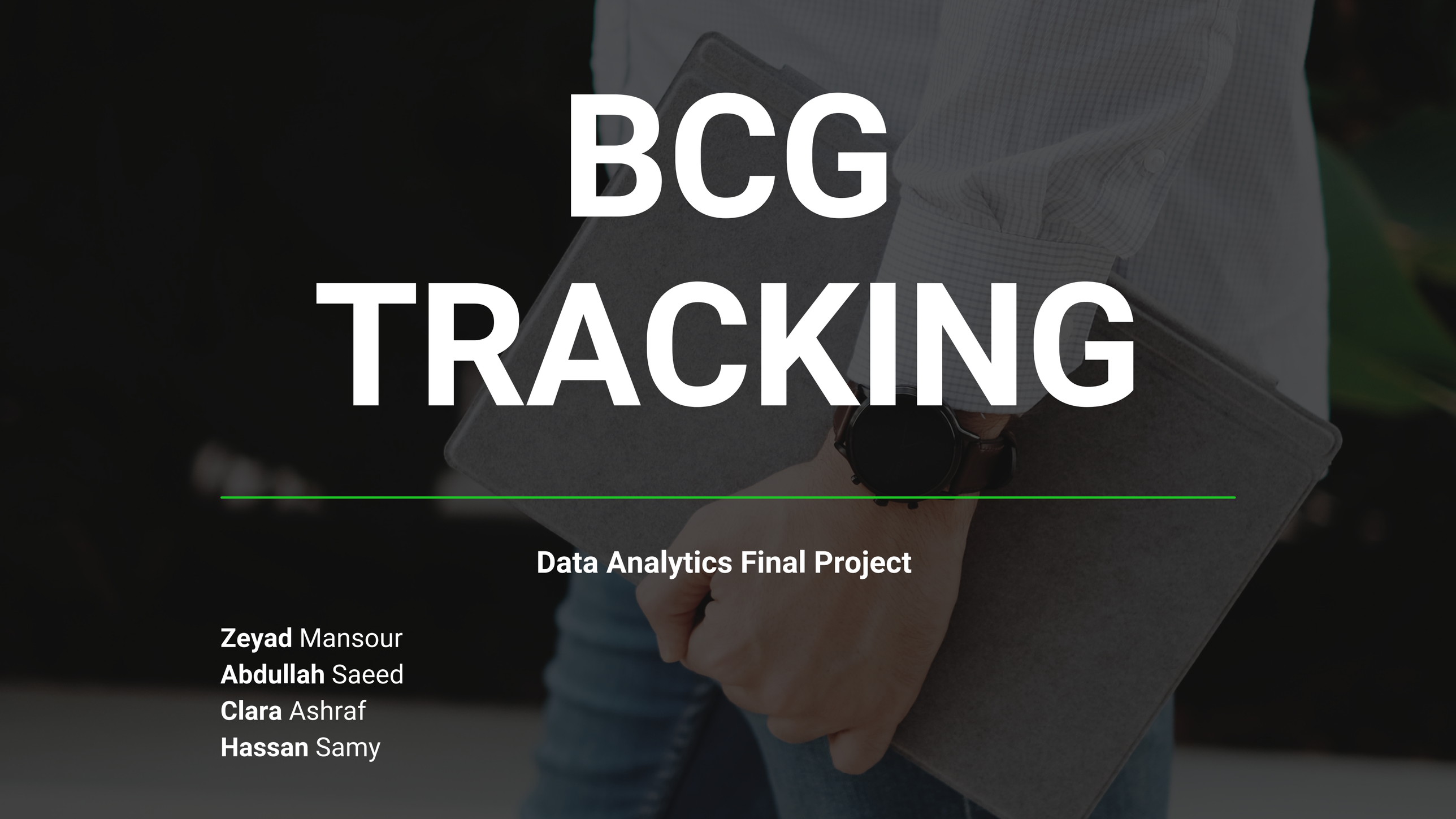

BCG TRACKING

Data Analytics Final Project

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main( )

Orchestrates the algorithm after importing the datasets and extracting them ECG and BCG data streams.

Resample the signals

Down samples the signals from 1000 Hz to 50 Hz to be compatibile with the analysis algorithms.

Calls the analysis functions

ecg_analysis() and **bcg_analysis()** return the heart rates from thei respective data streams.

Outputs errors and plots

Calculates and outputs:

- MAE
- RMSE
- MAPE
- Bland-Altman Plot
- Pearson Corr. Plot
- Box Plot

BCG Analysis

Preprocessing

It first filters the BCG signal extracted from Film 1 to try and remove unwanted body movements. Wavelet transform is then also used on the signal.

Detecting J-Peaks

tThe J-Peaks of the filtered BCG signal are detected and stored in an array.

Windowing and HR Calculation

The BCG signal is then segmented into 10 second intervals, and the detected peaks are used to caculate the heart rate of each window.

ECG Analysis

Preprocessing

Re-uses wavelet transform used in BCG preprocessing.

HeartPy Processing

HeartPy's **process_segmentwise( )** segments the signal into the given window length **(10 seconds)** and outputs a dictionary containing various signal data and statistics.

HR Extraction

The dictionary's 'bpm' key contains calculated heart rate estimates for each of the windowed sub-signals.

Errors

MAE

$$\frac{\sum_{i=1}^{n} |y_i - x_i|}{n}$$

It represents the arithmetic average of the absolute errors.

AVG Over 40 Patients **5.48**

RMSE

$$\sqrt{\frac{\sum_{i=1}^{N} (x_i - \hat{x}_i)^2}{N}}$$

Represents the square root of the second sample moment of the differences between predicted values and observed values of a dataset.

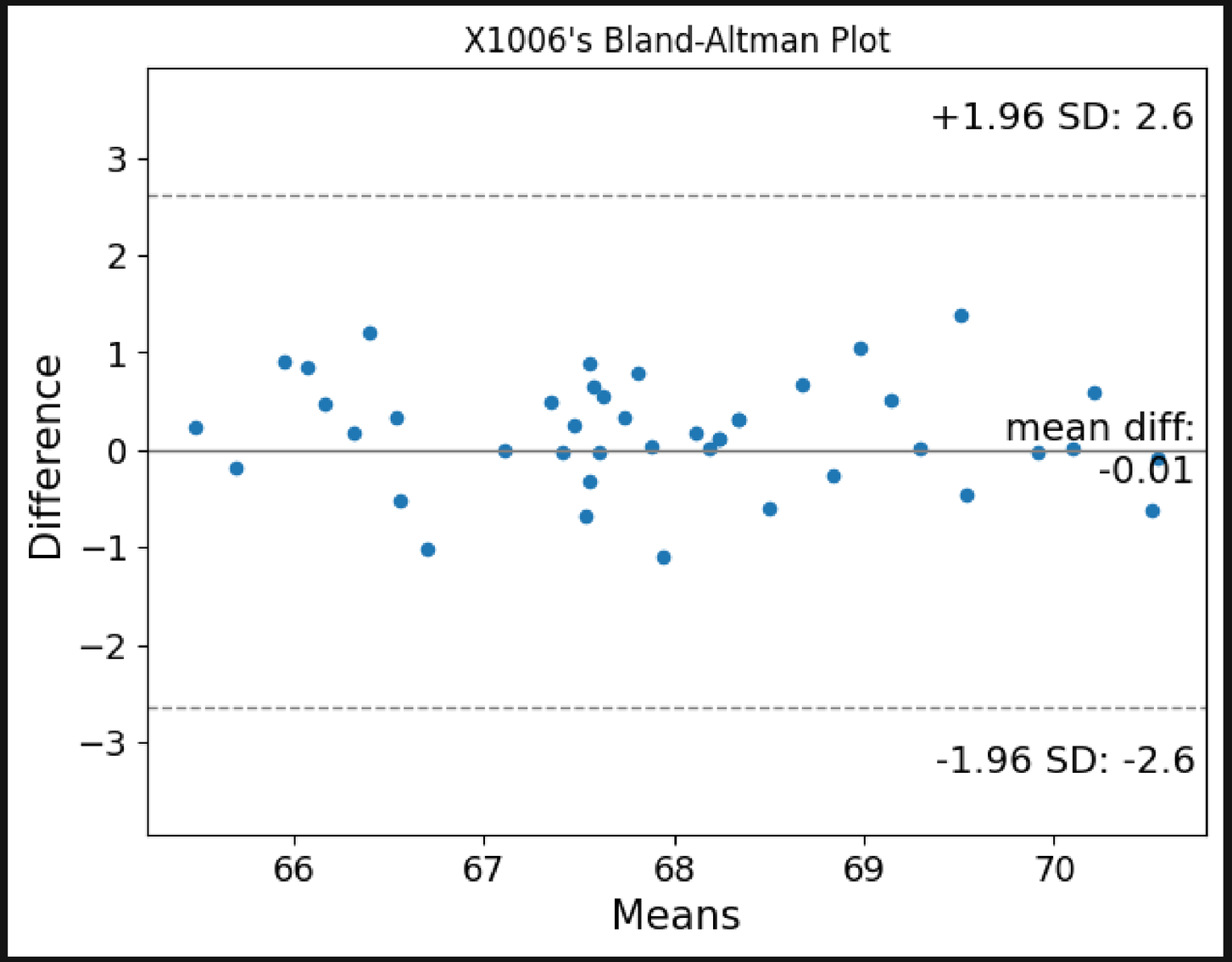
AVG Over 40 Patients **7.15**

MAPE

$$\frac{1}{n}\sum_{t=1}^{n}\left|\frac{A_t - F_t}{A_t}\right|$$

It is a measure of prediction accuracy of a forecasting method between predicted and observed values.

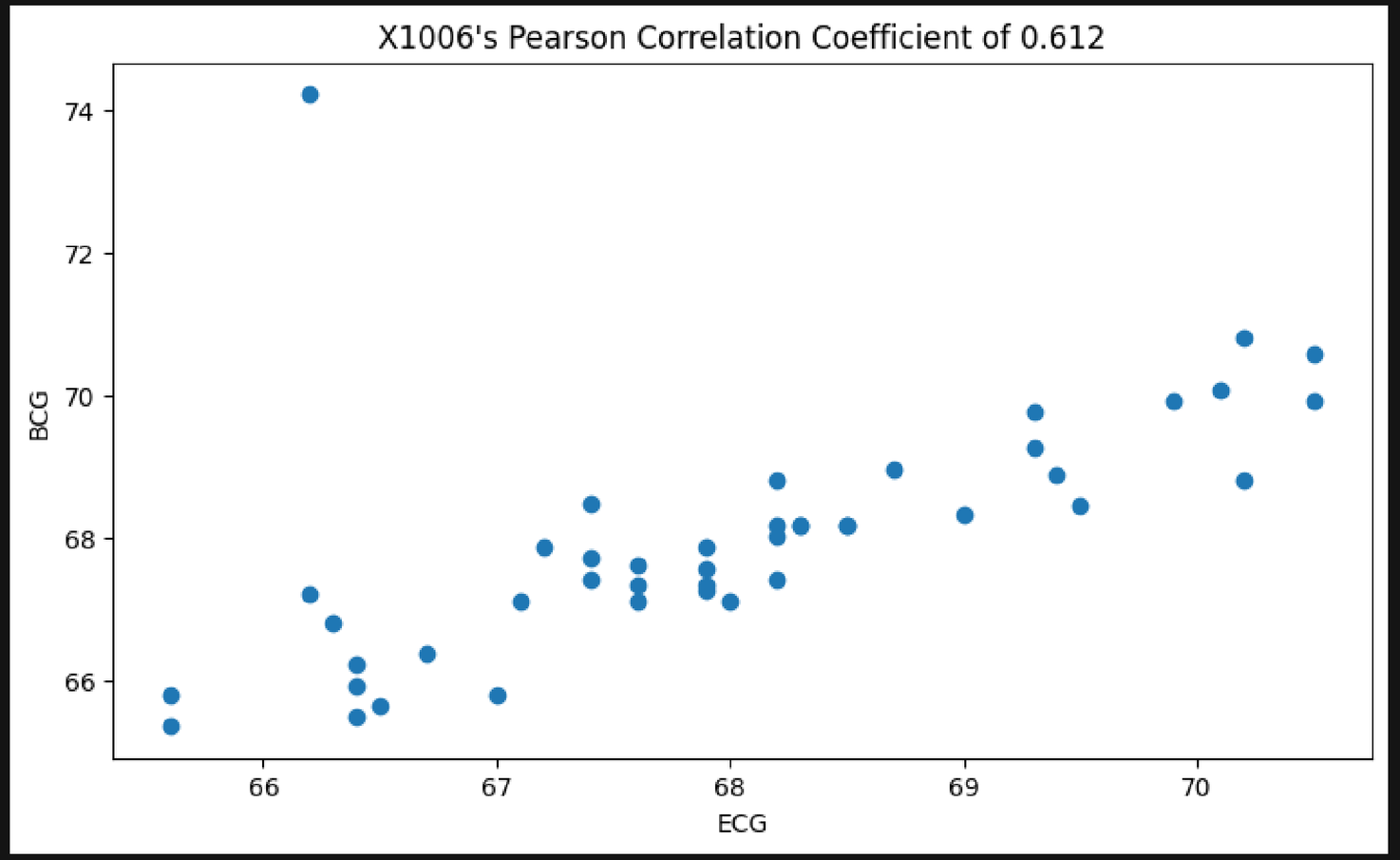
AVG Over 40 Patients **7.42 %**



Bland-Altman

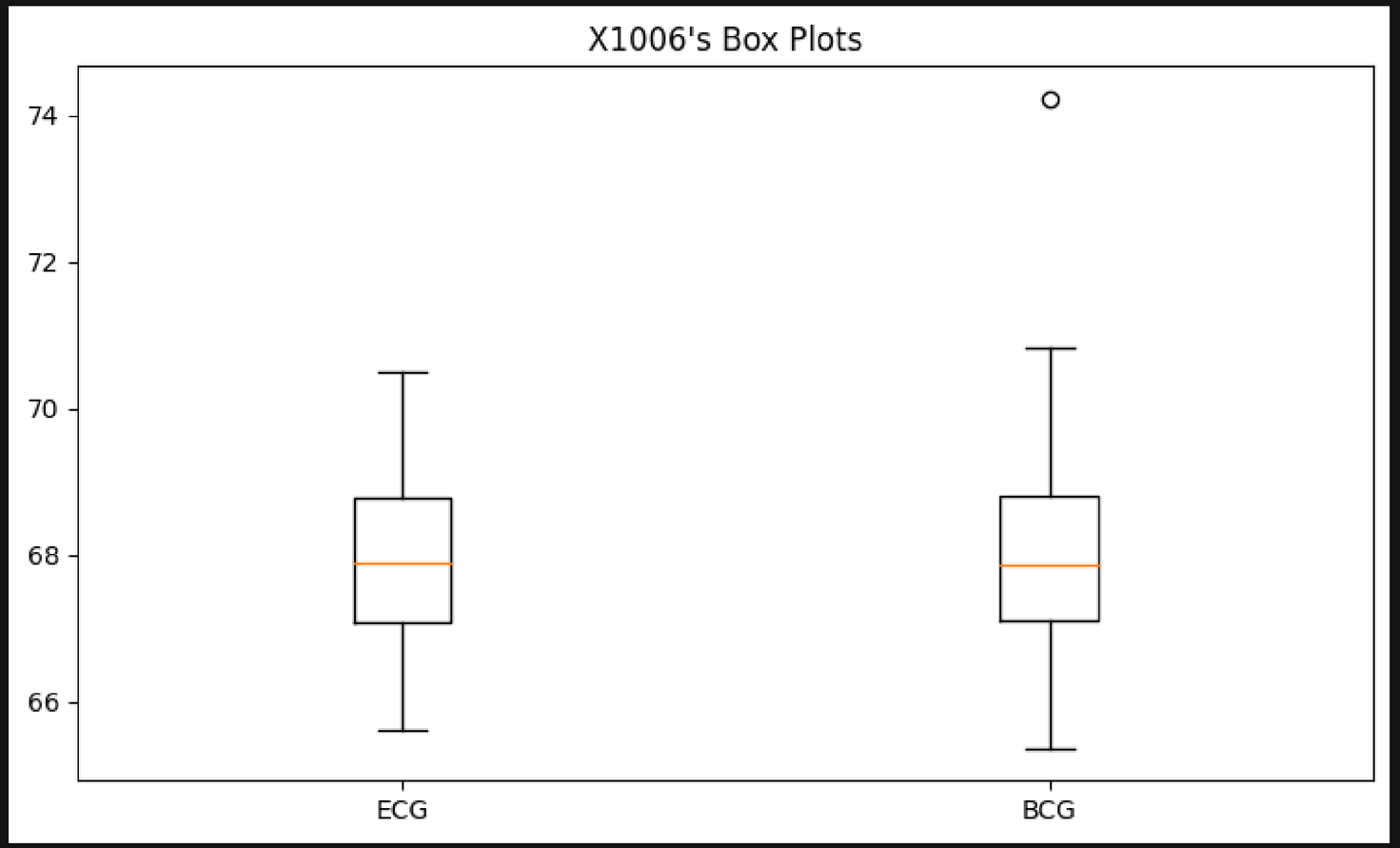
Useful in displaying of the relationship between two paired variables using the same scale.

Difference between paired readings of two variables over the average of these readings, with ±2SD lines (CI) parallel to the mean difference line.



Pearson Correlation

Describes the strength and direction of the linear relationship between two quantitative variables.



Box Plots

Shows the distribution of data points, while showing the median and any outliers.

Issues Faced

compute_rate( )

Algorithm used to calculate BCG's heart rate used timestamps, however our dataset did not have any. We adapted the function to use the sampling frequency instead.

```
def compute_rate_unknown_time(beats, fs, mpd):

    indices = detect_peaks(beats, mpd=mpd)

    diff_sample = indices[-1] - indices[0] + 1
    t_N = diff_sample / fs
    heartRate = (len(indices) - 1) / t_N * 60
    return np.round(heartRate, decimals=2), indices
```

nan ECG heart rate window

Patient X1012 returns nan in one of the windows' heart rate calculations. This also results in the error calculations returning **nan**.

Proposed solution would be varying the window length, or perhaps applying overlaps between the windows.


Thank You