Quality of Life and Wearable Data

Julieta Caroppo, Zoe Hack, Joshua Richter
Department of Mathematical Science, Benjamin Leinwand, BMS

DATA EXPLORATION

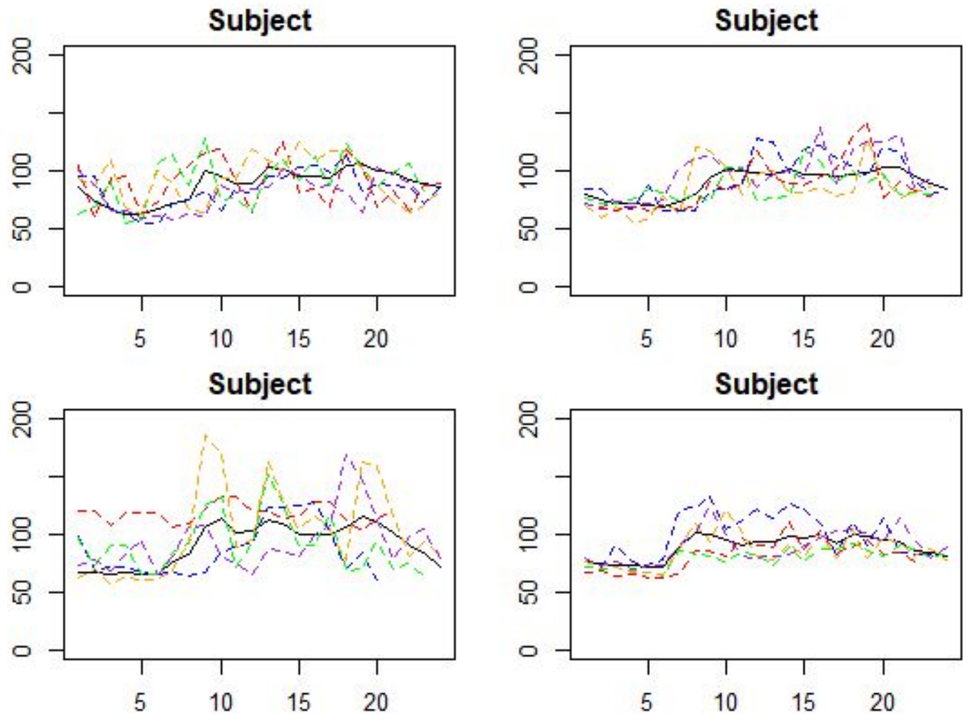
In concert with Bristol Myers Squibb, our team aimed to examine the concept of quality of life and to extract predictive measures for a patient's quality of life through measurable biological signs. Through analysis of a publicly available dataset focused on comparing biological markers and self-reported fatigue, we developed principles to guide predictive models.

One of our primary avenues of exploration was examining a subject's "average day" by taking the average of maximal values over specific hours of the day. Through this, we found some general patterns of metrics such as a subject's heart rate over the course of a day, which we could compare to self-reported fatigue values.

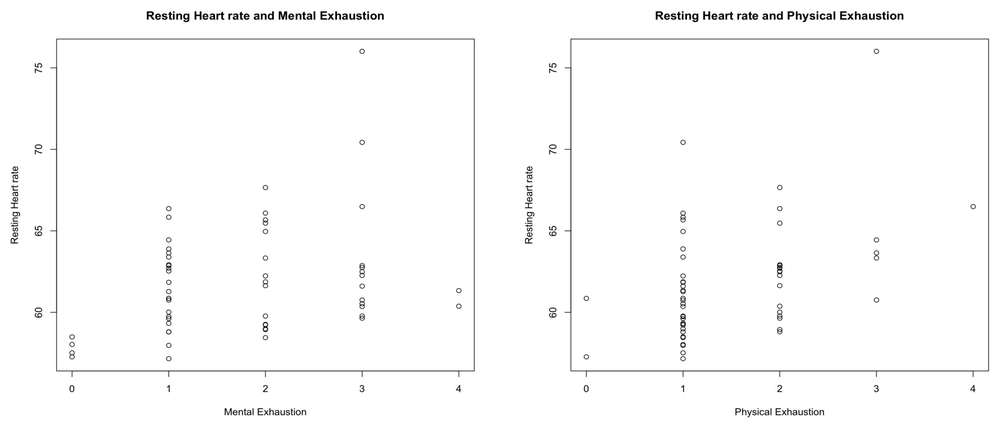
Another aspect we observed was the subjective data. We wanted to see how well we can predict one's answers on how they are feeling and to see if one actually knows how they are doing based on their wearable data. This is important when studying quality of life because it allows us to understand the correlation between physiological metrics and self-reported well-being, thereby offering insights into how accurately individuals can self-assess their health status. This can lead to better personalized health interventions and improved monitoring of daily health fluctuations.

Similarly, we also explored the possible relationships between the subjective data and the health metric data from wearable devices. Across subjects, it appeared evident that there was a trend between resting heart rate and the self-reported mental exhaustion and physical exhaustion values. As these measures of exhaustion increase, resting heart rate tends to increase.

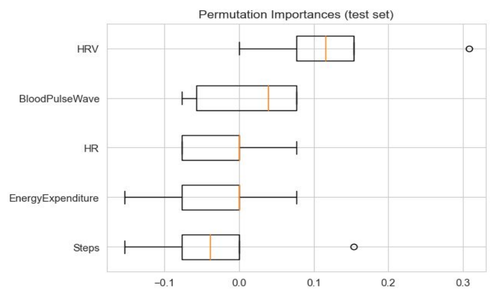
SUMMARY FIGURES

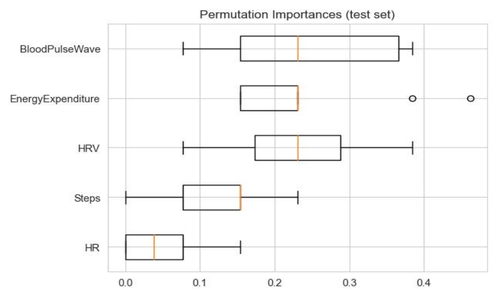


A selection of "average day" plots for the average peak heartrate of four different subjects over the day's 24 hours, alongside dashed lines indicating specific random days' heartrate peaks.

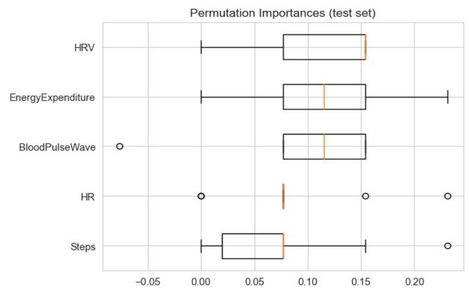


Plots for a single subject showing resting heart rate against self-reported mental exhaustion (left) and physical exhaustion (right) scores from 0 to 5. Each point represents one day worth of data. As the exhaustion scores increase, the minimum resting heart rate for that score also increases, indicating that a higher resting heart rate may have something to do with exhausino, as would make sense.





Permutation Importance measures the decrease in model score when a single feature value is randomly shuffled. This process breaks the relationship between the feature and the target, thus the drop in model score provides a measure of how much the model depends on the feature.



REFERENCES

De Luca, V., et al. Continuous Multi-sensor Wearable Data and Daily Subject-reported Fatigue of Heathy Adults. Zenodo, 10 Nov. 2020, doi:10.5281/zenodo.4266157.

STEVENS INSTITUTE OF TECHNOLOGY

innovation expo 2024