Optimizing recovery conditions in female soccer athletes using machine learning

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Background

- VWSO Tracking
- Lack of predictive models
- Lack of external factors
- Importance of proper recovery

Related Work

- Fitness trackers and improved data collection
- Advanced biometrics
- Heart rate variability
- HRV studies
- Nonlinear models

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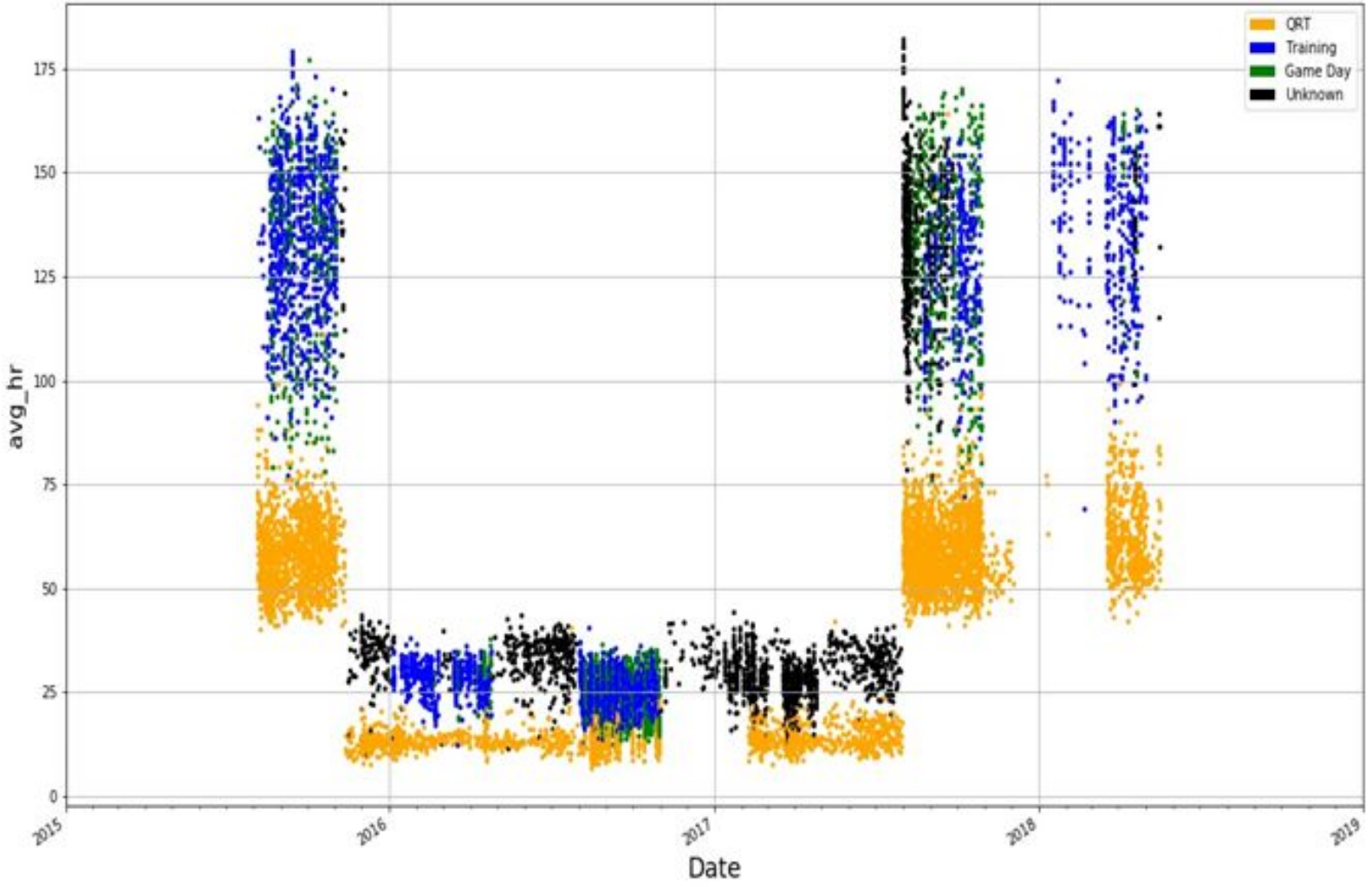
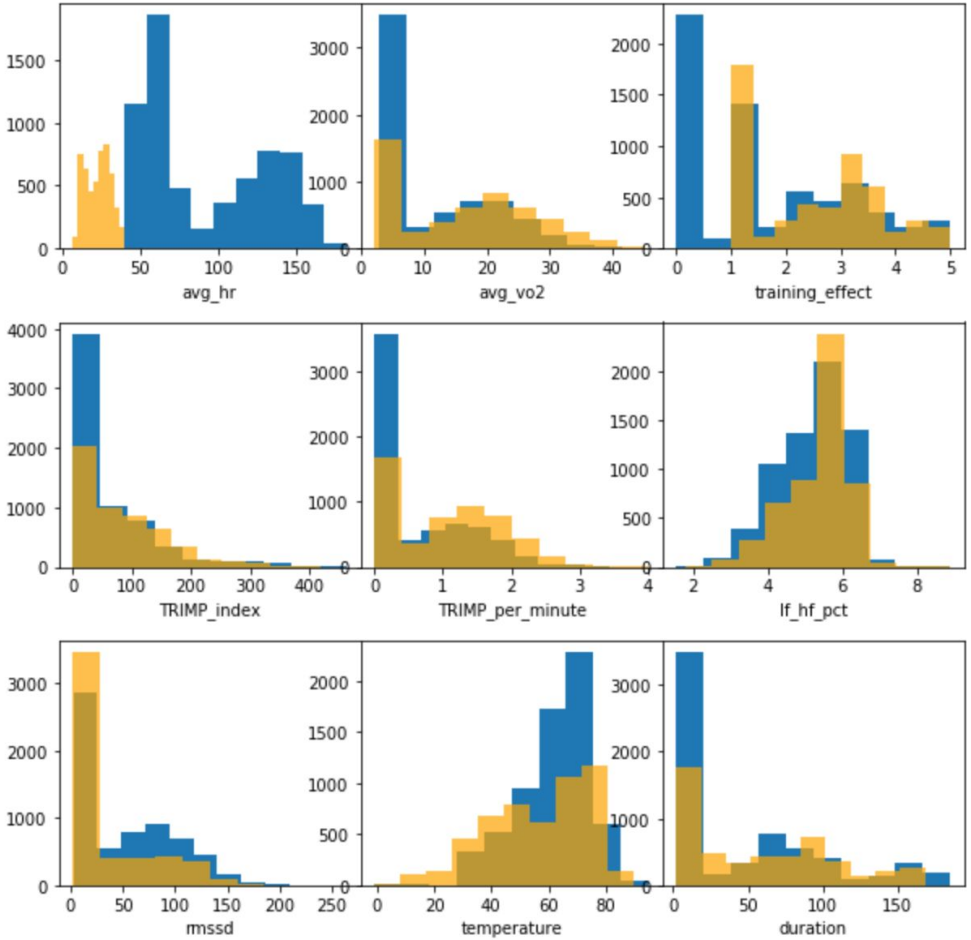
- Feature Engineering and Transformation


ORT
Training
Game Day
Unknown
avg_hr
0
25
50
75
100
125
150
175
2015
2016
2017
2018
2019
Date

Distributions of Attributes



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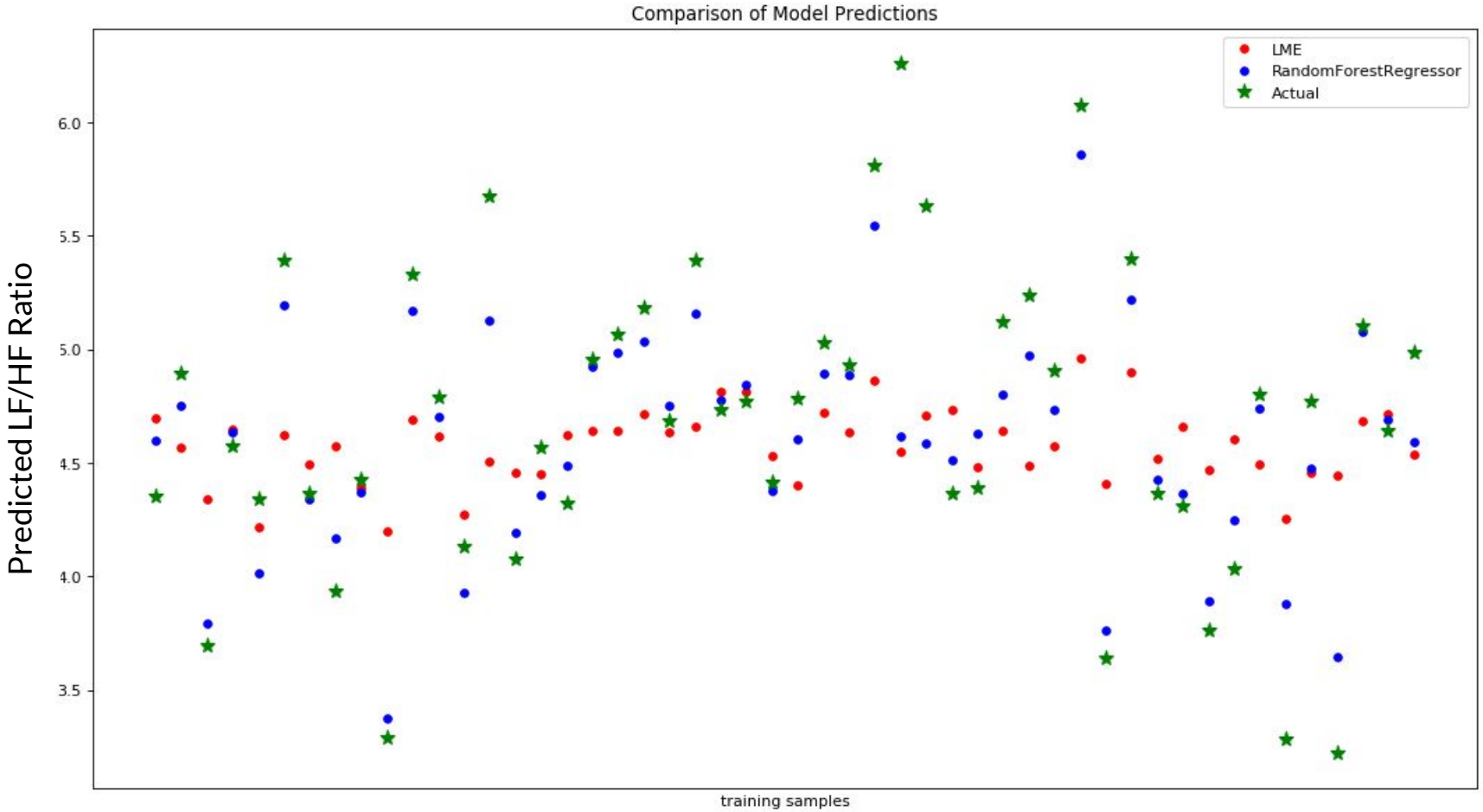
Methods: Models

- Team Model and Individual Models
- Linear Mixed Effects Model
- Random Forest Regression

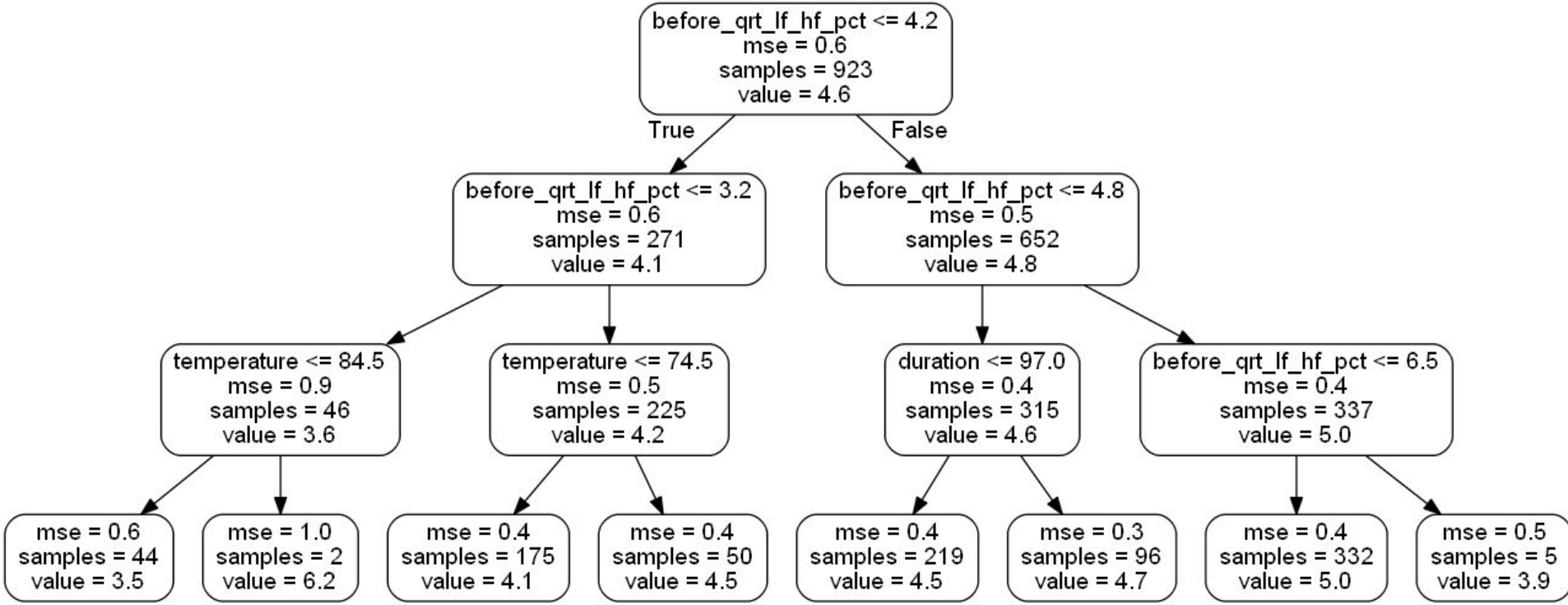
Results

	LME	Before/After LME	Individual RF	Team RF	Before/After RF
QRT Index	164.14%	49.52%	529.88%	197.63%	34.97%
QRT %	245.59%	458.00%	11690.59%	238.23%	260.40%
LF	838.31%	560.00%	150.96%	4766.27%	29.21%
HF	139.66%	120.00%	750.30%	218.05%	78.37%
Lf/Hf %	115.21%	78.50%	258.06%	196.44%	11.55%
VLF	126.00%	99.00%	560.04%	888.17%	206.93
RMSSD %	493.54%	268.00%	35372.41%	3264.01%	10.59
RMSSD	120.77%	99.00%	122.32%	506.32%	30.01%

Mean Absolute Percentage Error for all Models and HRV attributes



The Random Forest predicts much closer to the actual values compared to the Mixed Effects Model



A single tree from the random forest model predicting LF/HF Ratio after an Activity

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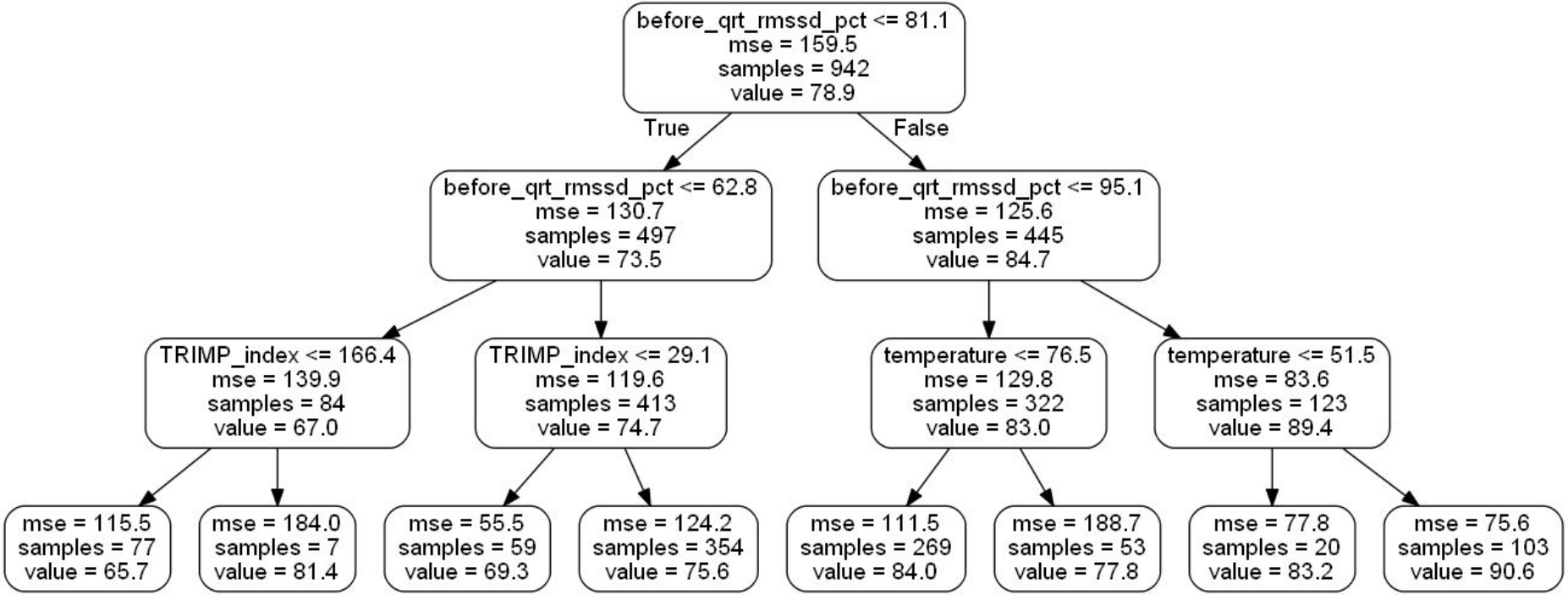

A single tree from the random forest model predicting RMSSD % after an Activity

Results

- Linear Mixed Effects Model does not perform well
- Random Forest
  - does not perform well on individual player data or team data
  - performs better on data using former HRV measurements as a predictor

Conclusions

- Biometrics often do not perform well under linear analysis
- More individual player data is needed to perform predictions on individual data
    - If every player increased their usage of the Firstbeat tracker, this should be revisited
- It makes sense to use the pre-activity HRV measurements as this is a baseline from which the player is potentially moving from.
- This data shows that when in certain ranges for each HRV, temperature has a varying effect on post-activity HRV.
- A player in a well recovered state, subjected to high temperatures will be in a less recovered state post-activity relative if they had performed that activity at moderate temperatures
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Continued Work

- Neural Network
- Improve data quantity and quality