

A Predictive Model for Next-Day Fatigue in Professional Canadian Women's Rugby Players

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Objective

The goal of our work was to predict the circumstances under which members of the Canadian National Women's Rugby team transition into a maximum level of self-reported fatigue. To make these predictions, we utilized panel data measuring reported psychological and physiological variables from players during the 2017-2018 season. Our prediction model would be valuable for determining training regimens for players prior to the season and in real-time throughout the season. The project was motivated by the fact that prediction of fatigue can be ambiguous and currently relies on a 5-part "Monitoring Score", which may or may not actually predict player's reported fatigue on subsequent training days.

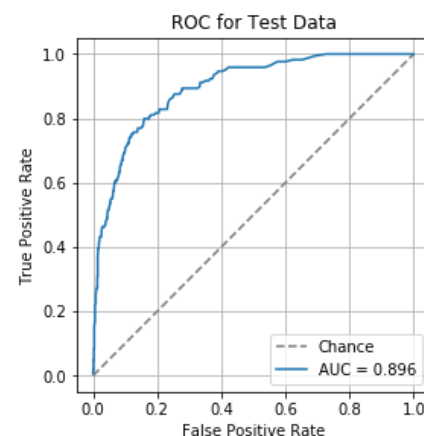
Methodology

Data Preprocessing

- Initial aggregated dataset consisted of "wellness" and "exertion" (i.e., RPE) data.
- Isolate training data only: removed data collected on dates with a game.
- Continuous variables ($p = 11$): normalized by player to be consistently in the 0 to 1 scale.
- Categorical variables ($p = 5$): converted to dummy variables.
- Removed missing data in which all rows were 'NaN' or more than 50% of data was missing for a specific predictor
 - Imputed *median data per player* for other predictor variables

Predictive Analysis

- **Multivariate time series** sliding window (lag) method for next day fatigue
- **Random Forest Ensemble Method**
 - Validation: k-Fold Cross Validation ($k=20$)
 - Response variable: player reported next-day high fatigue state (i.e., > 80% reported fatigue state)
- **Model Metrics – ROC AUC**
 - Training = 0.884, Testing = 0.896



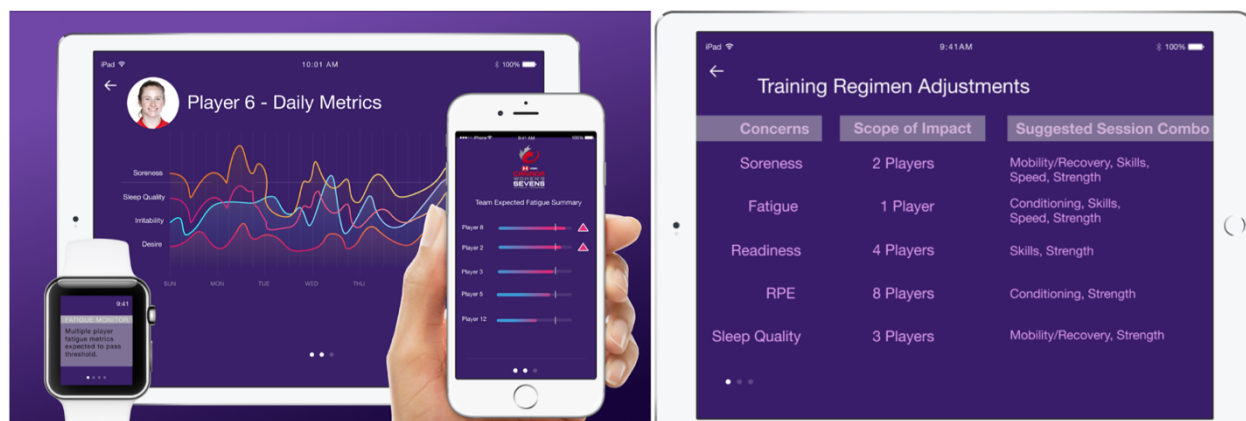
Training Regimen Analysis

- Looked at single day session combinations and the resulting change in variables of concern the following day.
- Session adjustment suggestions chosen based on cumulative average positive change per area of concern.

Recommendation/Implementation

Based on the estimated fatigue threshold, our goal is to help coaches be alerted to when players are either over or likely to be over the acceptable rate of fatigue. To do this, we felt an easy-to-use app, with the option of push-notification alerts, would allow the coach to implement change in real-time without needing to analyze the daily data themselves. The coach would also be privy to the rates regarding each predictor variable in this metric, and adjust next-day training regimens based on which feature was causing the biggest impact in a player's fatigue. Feature importance highlighted in appendix.

Fatigue Tracking Application Mock-Up



Appendix

Feature Importance for Predicting Future Fatigue

