

Predicting Calorie Consumption and Designing Personalized Weight-Loss Workout Plans Using Machine Learning Models

Motivation

With increasing demands from work and academic responsibilities, many people find themselves turning to high-calorie foods during times of stress, often leading to weight concerns. Consequently, maintaining a healthy weight has become a priority for many, and working out is increasingly seen as an effective means to manage weight and promote a balanced lifestyle. At UW-Madison, students have access to two recreational centers featuring advanced workout machines and facilities. This readily available access to quality fitness equipment presents an excellent opportunity to integrate regular exercise into student routines.

However, individual fitness goals, such as weight loss, require more than access to equipment—they demand personalized workout plans tailored to specific needs and characteristics. Machine learning (ML) offers promising tools for creating these tailored plans. By analyzing features such as weight, age, height, workout type, and experience level, ML models—including techniques like linear regression, k-nearest neighbors (k-NN), and decision trees—can help predict calorie consumption. These predictions could then be used to design workout plans that are not only customized but also effective in meeting individual goals, such as weight management and overall wellness.

Research Objectives

- Using linear regression to predict calorie consumption based on various individual characteristics and workout parameters.
- Applying k-NNs and decision trees to design a personalized weekly workout plan tailored to an individual's weight loss goals.

Variables

- Age: Age of the gym member.
- Gender: Gender of the gym member.
- Weight: Member's weight in kilograms.
- Height: Member's height in meters.
- Max_BPM: Maximum heart rate (beats per minute) during workout sessions.
- Avg_BPM: Average heart rate during workout sessions.
- Resting_BPM: Heart rate at rest before workout.
- Session_Duration: Duration of each workout session in hours.
- Calories_Burned: Total calories burned during each session.
- Workout_Type: Type of workout performed (e.g., Cardio, Strength, Yoga, HIIT).
- Fat_Percentage: Body fat percentage of the member.
- Water_Intake: Daily water intake during workouts.
- Workout_Frequency: Number of workout sessions per week.
- Experience_Level: Level of experience, from beginner (1) to expert (3).
- BMI: Body Mass Index, calculated from height and weight.

Methods

To begin, we will handle missing values, normalize features, and encode categorical variables as needed. Next, we will select suitable machine learning algorithms—such as linear regression, decision trees, and k-NNs to predict calorie consumption, and arrange work out plan to cater the individual's goals and characterizations. Prediction accuracy will be assessed using metrics like MAE, RMSE, and R^2 . For the weight loss plan, we will evaluate goal achievement by comparing the proposed weekly calorie deficit against the target weight loss to validate the model's effectiveness.

Research Questions

- Can machine learning techniques accurately predict calorie consumption based on input features?
- Can we create a model to recommend a weekly workout plan tailored to an individual's features (age, weight, height, frequency of workout, etc.) to help them reach a specific weight loss target?

Code to read data

```
import pandas as pd
import numpy as np
df = pd.read_csv('gym_members_exercise_tracking.csv')
```