Exploratory Data Analysis (EDA) Report Summary

Title: Body Composition and Workout Routines Analysis for Gym Members to Optimize Physical Fitness

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1. Introduction

- **Objective:**
  - **Assess the gym members' body composition and workout routines.**
  - **Explore the relationships between key factors such as workout frequency, session duration, calories burned, and body fat percentage.**
  - **Provide actionable insights to develop personalized workout routines for optimizing members' fitness levels.**

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2. Data Overview

- **Dataset 1:** ***gym_members_exercise_tracking***
  - **Records: 973**
  - **Features: 15 (e.g., Age, Gender, BMI, Fat Percentage, Workout Frequency, Calories Burned)**
  - **Source: [Gym Members Exercise Dataset on Kaggle](https://www.kaggle.com/datasets/valakhorasani/gym-members-exercise-dataset)**
- **Dataset 2:** ***com_corp_mta***
  - **Records: 278**
  - **Features: 8 (e.g., Time, BMI, Fat Percentage, Weight, Muscle Mass, Bone Mass)**
  - **Source: [Own registers via Garmin Index S2 scale](https://connect.garmin.com/modern/weight)**

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3. Data Cleaning and Feature Engineering

- **Missing Values: No missing values detected.**
- **Outlier Detection:**
  - **Removed records based on specific criteria:**
    - **Unusual Fat Percentage: <3% or >50%**
    - **Extreme Weights: <30 kg or >200 kg**
    - **Unusual Heights: <1.2 m or >2.5 m**

- **Feature Engineering:**
    - **Created new columns for BMI Status and Fat Status based on standard health guidelines.**
    - **Estimated Muscle Mass Percentage and Basal Metabolic Rate (BMR) using calculated values.**

Sources:

- **National Health and Nutrition Examination Survey (NHANES)**
    - ****Website**: [NHANES Data](https://www.cdc.gov/nchs/nhanes/index.htm)**
    - ****Description**: NHANES provides detailed health and nutritional data, including body composition metrics for a diverse sample of the U.S. population. This dataset includes body fat percentage, lean body mass, and other anthropometric measurements.**
- **Revised Harris-Benedict Equations (1990)**
    - ****Reference**: Mifflin, M. D., St Jeor, S. T., Hill, L. A., Scott, B. J., Daugherty, S. A., & Koh, Y. O. (1990). *A new predictive equation for resting energy expenditure in healthy individuals*. The American Journal of Clinical Nutrition.**
    - ****Description**: This study provides updated coefficients for the Harris-Benedict equation, improving its accuracy. It is often referenced as the revised Harris-Benedict equation and is commonly used in modern BMR calculations.**

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4. Analysis and Key Metrics

Body Mass Index (BMI)

- **Categories:**
    - **Underweight: BMI < 18.5**
    - **Normal Weight: 18.5–24.9**
    - **Overweight: 25–29.9**
    - **Obesity: BMI ≥ 30**

Source: **World Health Organization (WHO): WHO offers standardized guidelines for BMI categories, which are used globally for assessing underweight, normal weight, overweight, and obesity in both men and women.**

Body Fat Percentage:

- **Healthy ranges differ by gender and age:**
    - **Typical Muscle Mass Percentage for Men by Age:**
        - **Ages 20-39**: 33-39%**
        - **Ages 40-59**: 30-36%**
        - **Ages 60-79**: 27-34%**

- Typical Muscle Mass Percentage for Women by Age:
  - Ages 20-39**: 24-30%
  - Ages 40-59**: 22-28%
  - Ages 60-79**: 19-25%

Source:**American Council on Exercise (ACE)**: ACE provides ranges for body fat percentage according to age and fitness levels for both men and women, widely referenced in health and fitness.

- Calculated using a formula based on gender, age, and experience level.
- Factors in lean body mass and adjusts for age.

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5. Exploratory Analysis Results

- Descriptive Statistics:
  - Summarized key features (e.g., mean, median BMI and Fat Percentage).
- Correlation Analysis:
  - Examined relationships using a heatmap for a comprehensive overview.
  - Key insights:
    - Positive correlations:
      - BMI – Weight
      - Experience_Level
        - Workout_Frequency
        - Session_Duration
        - Calories_Burned
    - Negative correlations:
      - Fat_Percentage
        - Workout_Frequency
        - Session_Duration
        - Calories_Burned
        - Experience_Level

Visualizations:

- Histograms for Age, BMI, and Fat Percentage distributions.
- Scatter plots for relationships like session duration vs. calories burned.
- Bar charts showing the frequency of different workout types.

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6. Key Findings

- **BMI Analysis: Higher BMI often linked to lower workout frequency.**
- **Fat Percentage: High fat percentage associated with lower workout frequency and intensity.**
- **Session Duration: Longer sessions generally resulted in higher calories burned.**

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7. Limitations

- **Sample Size: The relatively small sample may limit generalizability.**
- **Missing Health Metrics: Important data like blood pressure and muscle mass are absent.**
- **Potential Bias: Data may be skewed towards experienced gym members who track their workouts diligently.**

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8. Recommendations

- **For High Fat Percentage Members:**
  - **Increase workout frequency to 4-5 days/week.**
  - **Consider higher intensity sessions if calories burned are consistently low.**
- **Data Collection: Include additional health metrics (e.g., waist measurements, muscle mass) for a more holistic analysis.**
- **Personalized Plans: Use insights to tailor workout plans based on body composition analysis.**

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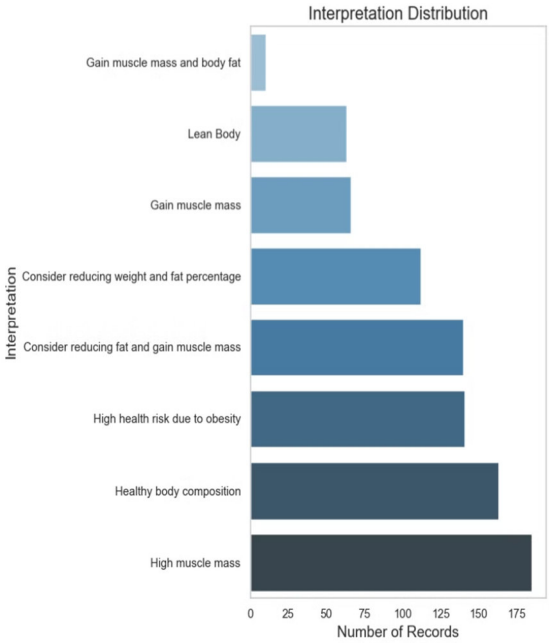
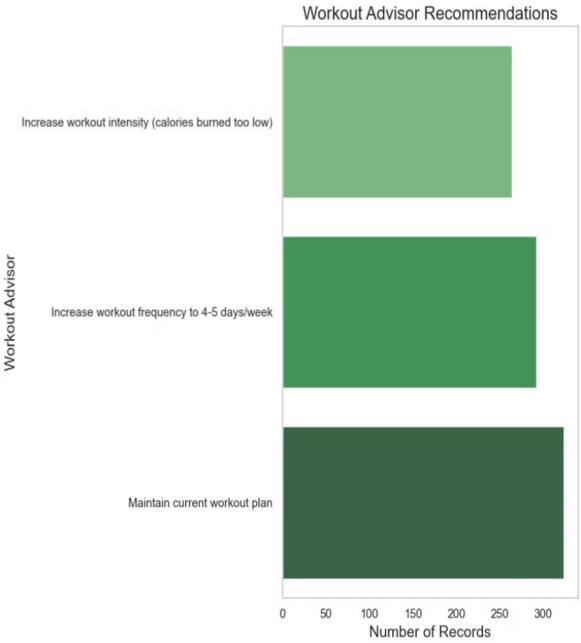
9. Conclusion

- **Summary: The EDA provided valuable insights into the relationship between workout routines and body composition, highlighting areas for potential improvement.**
- **Here we have a graph categorizing the body composition and recommendation on the training routine of all the members of the gym as a summary of the entire study.**





- **Next Steps:**
  - **Collect more comprehensive health data for better analysis.**
  - **Tailor workout recommendations to optimize fitness outcomes for gym members.**

Appendix

- **Code Snippets: Python code used for data cleaning, feature engineering, and visualizations.**
- **Additional Visualizations: Supplementary charts supporting the analysis.**

All inside the eda_mta.jpynb

Tools Used

- **Data Analysis: Pandas, NumPy**
- **Visualizations: Matplotlib, Seaborn**
- **Documentation: Jupyter Notebook**

Note: This summarized report aims to provide a clear and actionable overview of the EDA findings, focusing on optimizing body composition and workout routines based on the data available.