

# Maximizing Fitness: How Different Exercises Impact Calorie Burn

This project analyzes caloric output and sleep patterns of thirty Fitbit users to better understand exercise regimes and outcomes. Through data-driven insights, visualizations, and statistical analysis, we explore the most and least effective workouts for calorie consumption and their relationship to sleep.



# Project Details

## **Overview:**

- 2 months of Fitbit data in the form of CSV files were imported into dataframes.
- Data was cleaned through removing duplicates, changing column names, changing datatypes, and merging datasets.
- Applied trending, aggregation, and projection techniques to explore data and find answers.

## **Approach:**

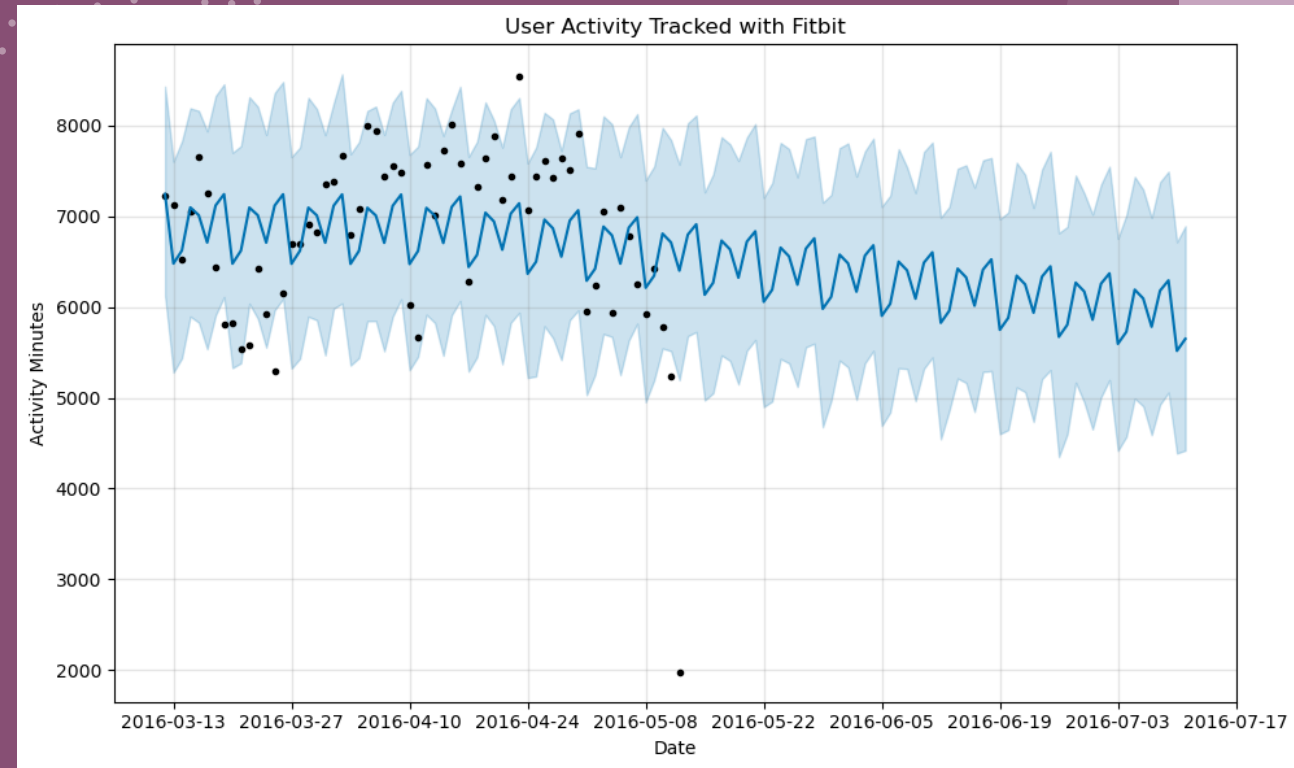
- Five questions were decided upon and divided up between members of the group.
  1. What are the best and worst days to exercise?
  2. What is the relationship between sleep and exercise?
  3. What is the relationship between exercise intensity and calories burned?
  4. What are the most effective exercises for calorie burn?
  5. How does body weight effect calories burned?

## **Further Work:**

- Acquiring more than two months of data would help with seasonal analysis.
- Integrating other metrics such as heartrate and step count to enhance the exercise picture.
- More detail about the users such as working hours and weather conditions might explain patterns.
- Are similar trends seen in other fitness trackers.

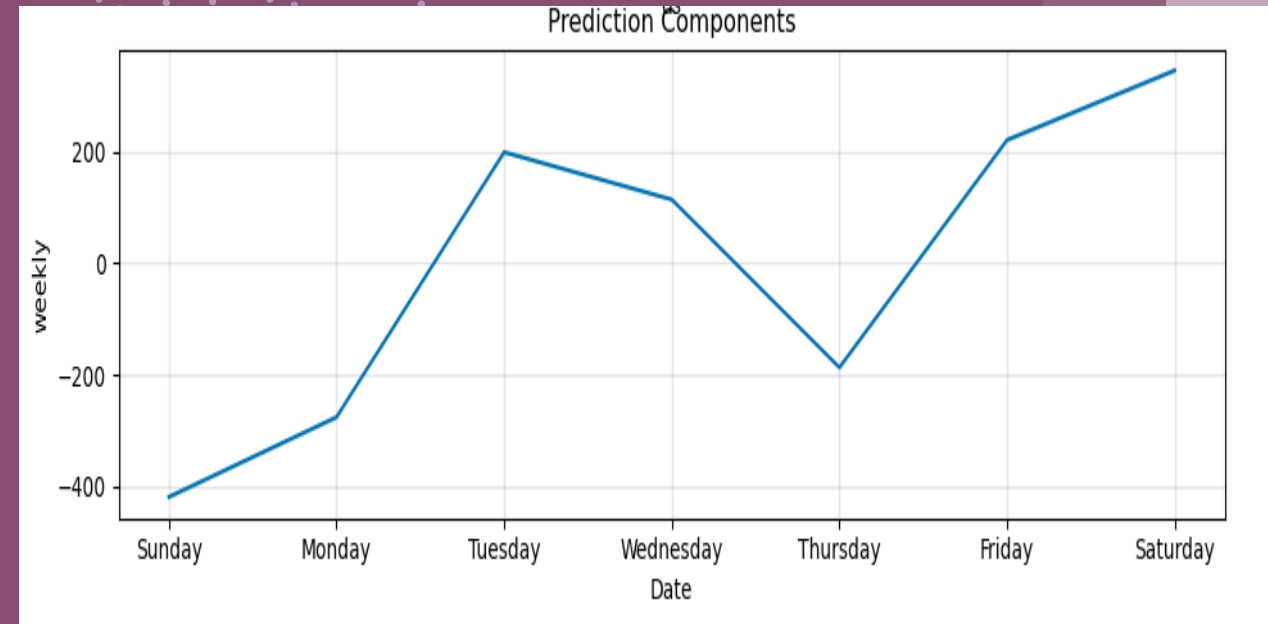
# Activity Trend and Projection

This chart shows the minutes of activity four each day in the dataset and then projected out 60 days. The users in this dataset got off to a good start but the activity started to wane after for weeks. By the end of the data recording period, the activity has started to decrease and therefore the projections continue to show lower activity. Without some positive reinforcement it looks like this group will dip back into a less active lifestyle.



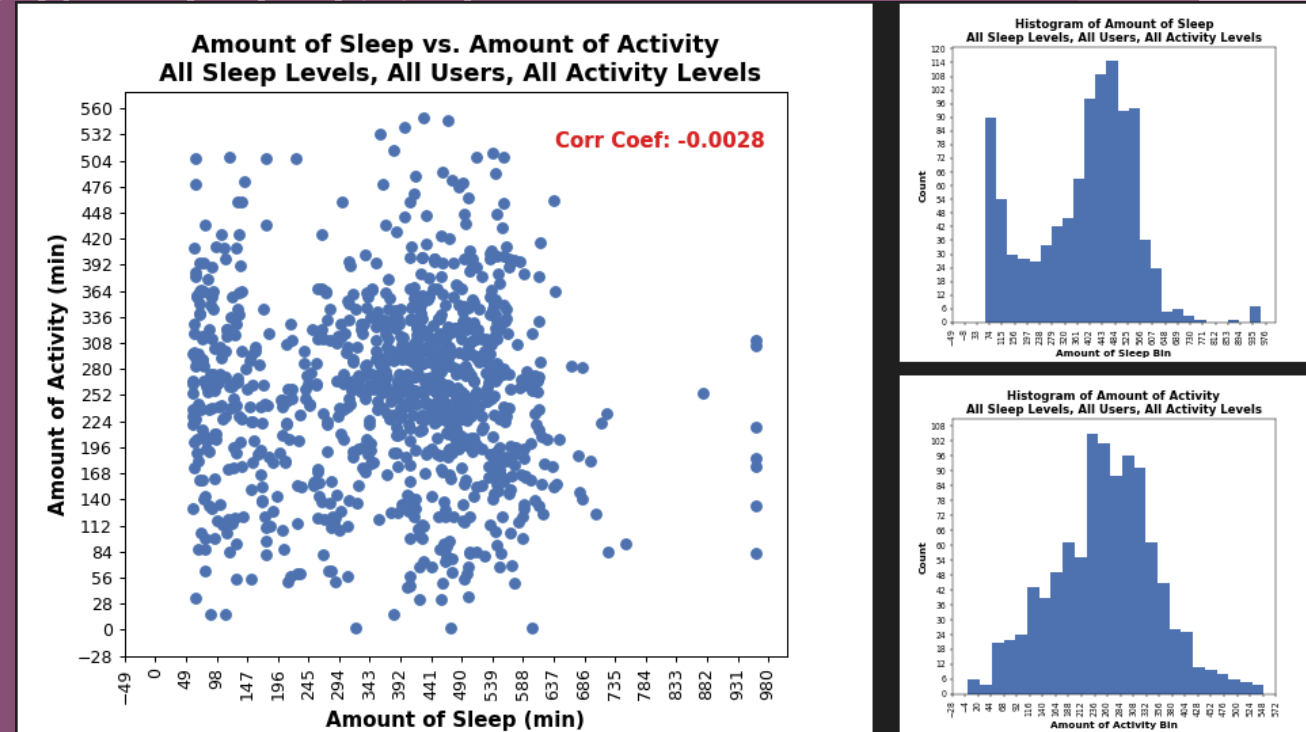
# The Best Days To Be Active

Perhaps this group can concentrate on Sundays, Mondays, and Thursdays to get back some activity. Historically these are days the lowest activity has been achieved. Finding some more minutes on these days can go a long way.



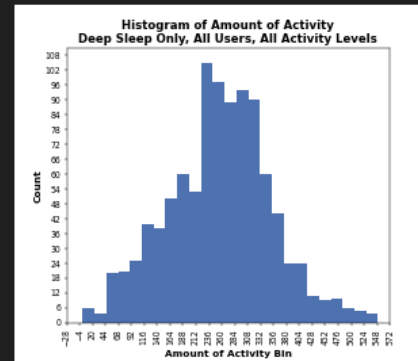
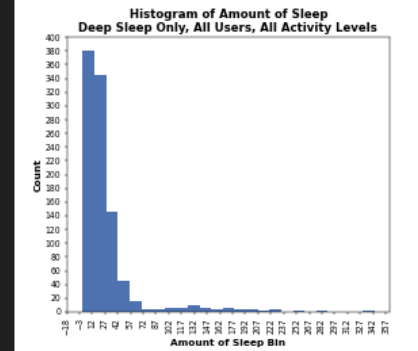
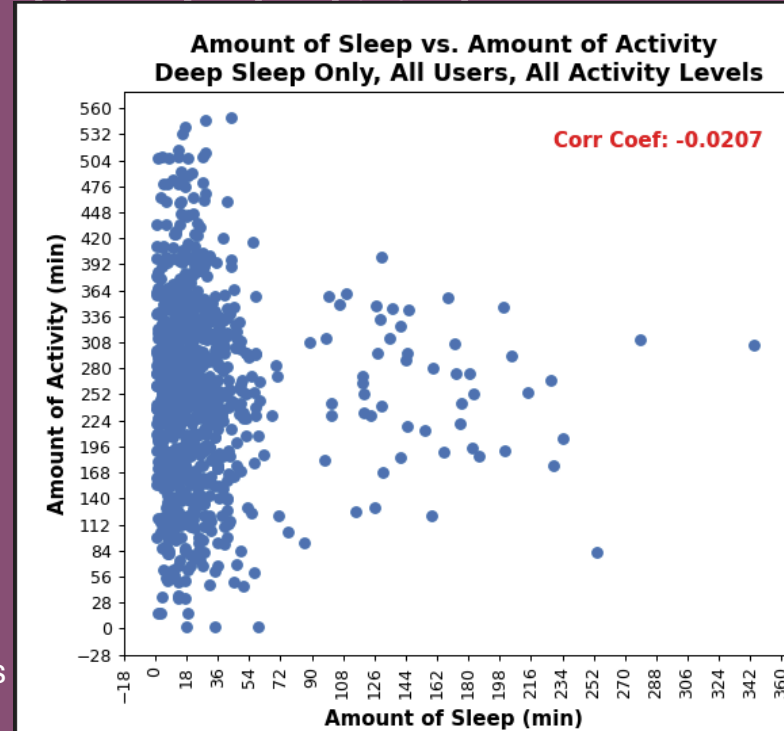
# The Relationship Between Sleep and Activity

With a correlation coefficient of -0.0028, getting enough sleep is not the problem. At varying amounts of sleep, the same level of activity is achieved. There is a population at 49-147 minutes that is hypothesized to be related to naps.



# The Relationship Between Deep Sleep and Activity

By looking at deep sleep only, the naps portion is minimized. In addition, the deep sleep component of sleep is the one that relates to feeling good the next day. Unfortunately, the amount of deep sleep also does not correlate well activity level.



# Conclusion:

Unfortunately, this group seems to have lost some motivation after a month. It is not related to the amount of sleep nor the type of sleep they are getting.

It is never too late to reset. By making a conscience effort to increase activity on Sunday, Monday, and Thursday the overall activity level can be raised.

Consistency is key to a healthy lifestyle and hopefully this group can identify the roadblocks to get moving again.



# Analyzing trends in intensity and calories burned

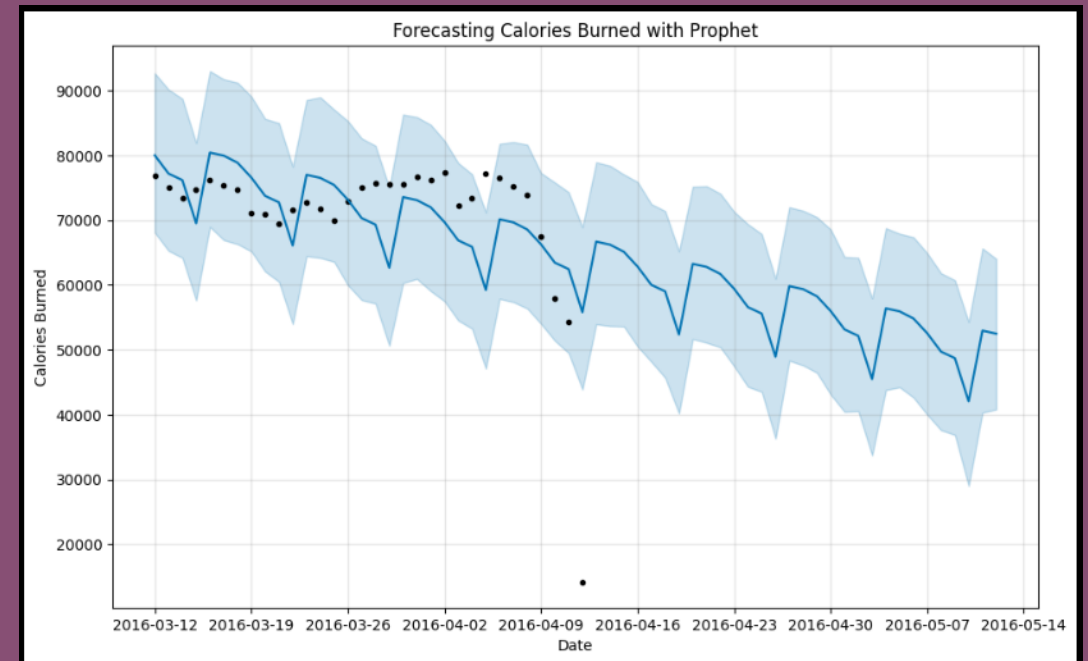
"This chart displays the trends in average intensity and calories burned over time, based on the combined Fitbit dataset. The analysis highlights key patterns and relationships between activity levels and energy expenditure across days."

## ✓ Key Takeaways:

🔥 **Consistent Patterns:** Both average intensity and calories burned show seasonal trends, with fluctuations likely tied to weekly activity routines.

⚖️ **Intensity Drives Calories Burned:** Higher intensity correlates with increased calorie burn, emphasizing the importance of active engagement for energy expenditure.

📊 **Gradual Decline Over Time:** A slight downward trend in both intensity and calories burned indicates reduced physical activity in later periods, potentially influenced by user behavior or data inconsistencies.



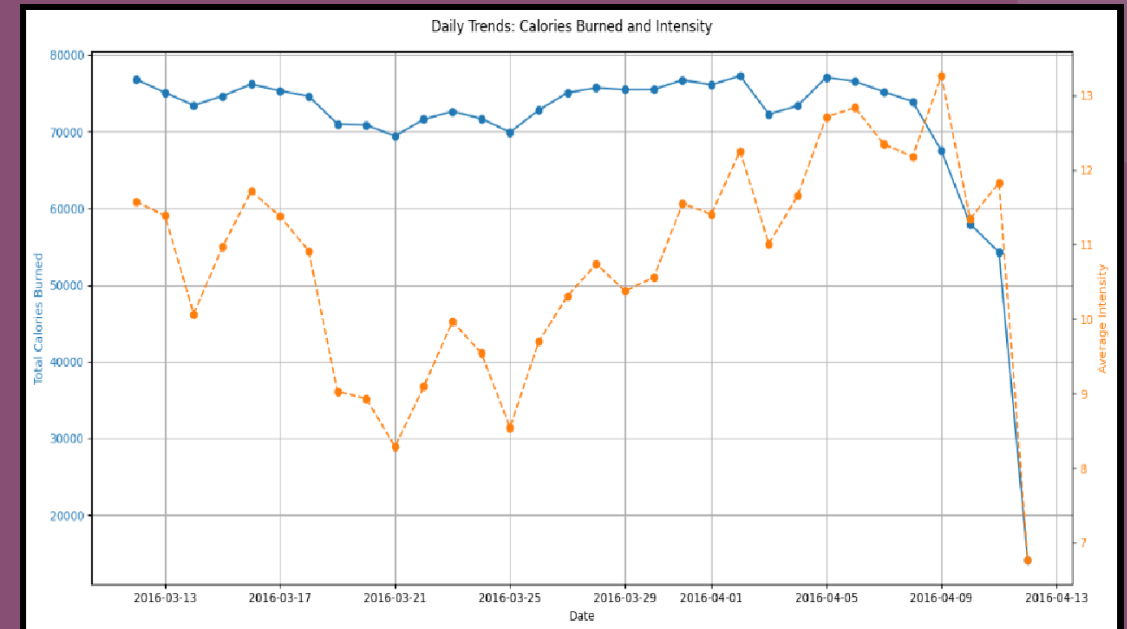


# Exploring Daily Trends

This chart shows daily trends in calories burned (blue line) and average intensity (orange dashed line) from Fitbit data. Calories remained stable (70,000–80,000/day), representing total calories burned across all individuals, while intensity varied.

A sharp decline at the end likely reflects incomplete data or reduced activity. Aggregated totals reveal group-level trends, smoothing individual variations.

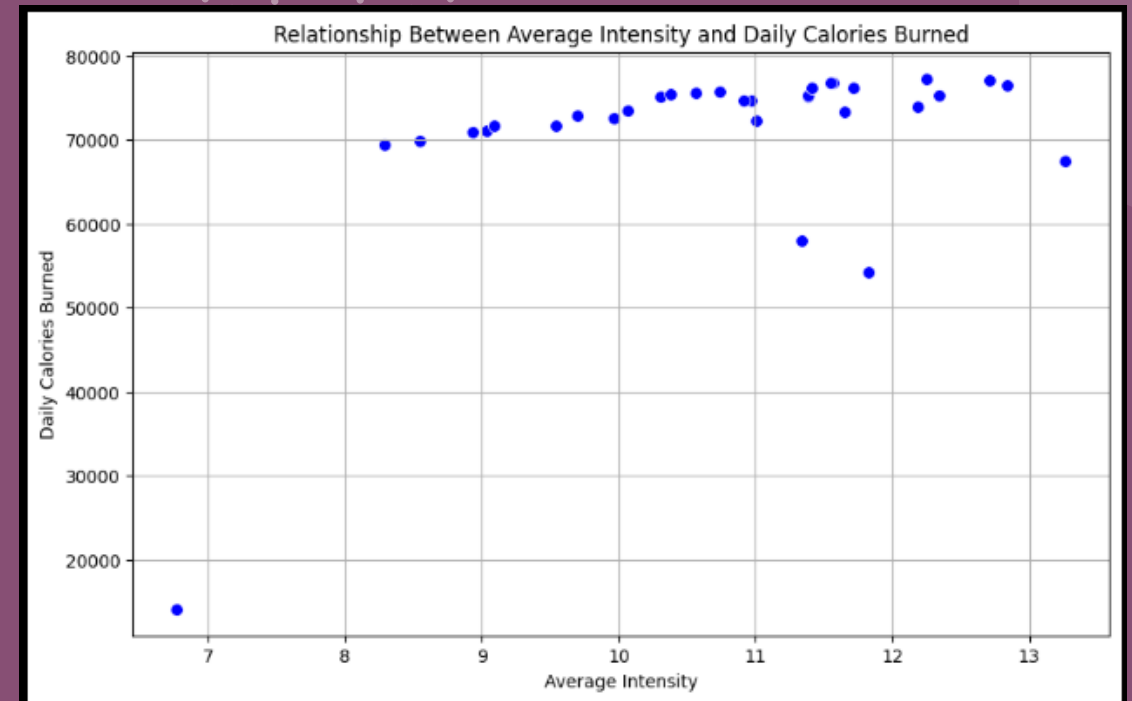
**Recognizing these trends can help tailor fitness programs to maintain consistency and optimize group performance.**



# Data Correlation

This scatter plot shows the relationship between average intensity and daily calories burned, with most days clustering around an intensity of 10–12 and calorie burn between 70,000 and 80,000. Outliers at lower intensity levels reveal significant drops in calorie burn, while a moderate positive correlation (0.49) suggests higher intensity generally leads to higher calorie expenditure, though not perfectly linearly.

**Understanding this relationship highlights the importance of balancing intensity with other factors to optimize energy expenditure.**

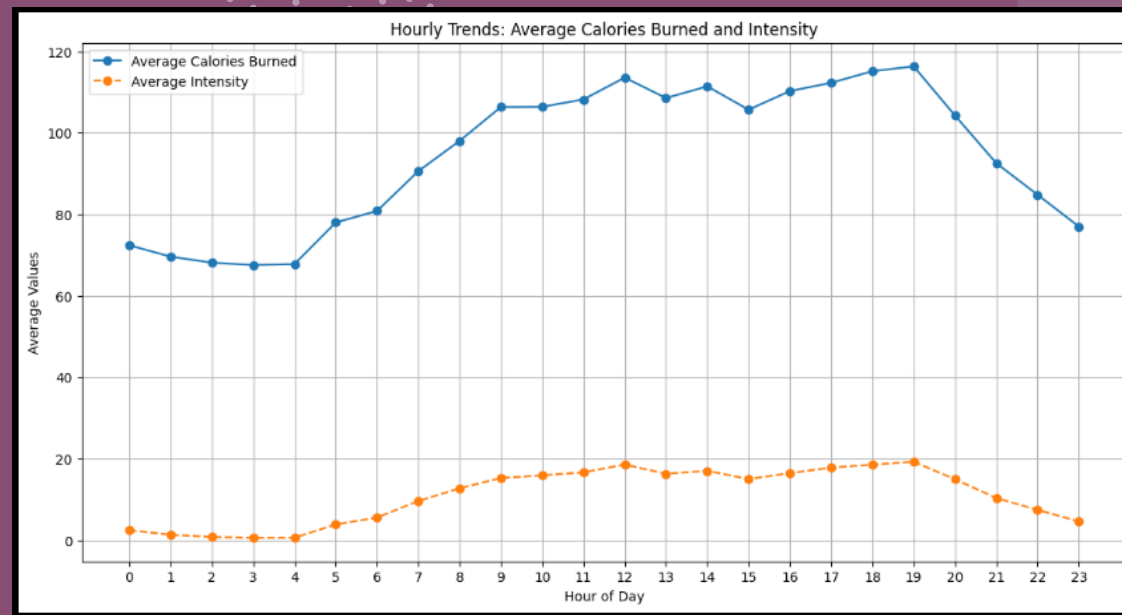


Correlation between Daily Calories and Average Intensity: 0.49

# Hourly Trends Analysis

This chart shows hourly trends in calories burned (blue line) and intensity (orange dashed line), both peaking in the early afternoon and declining into the evening. Late-night and early-morning hours show the lowest activity, as expected during evening activities and periods of rest.

Summary statistics reveal variability, with average calories burned at 94.41/hour and intensity at 10.88, highlighting a strong link between higher intensity and greater calorie burn.



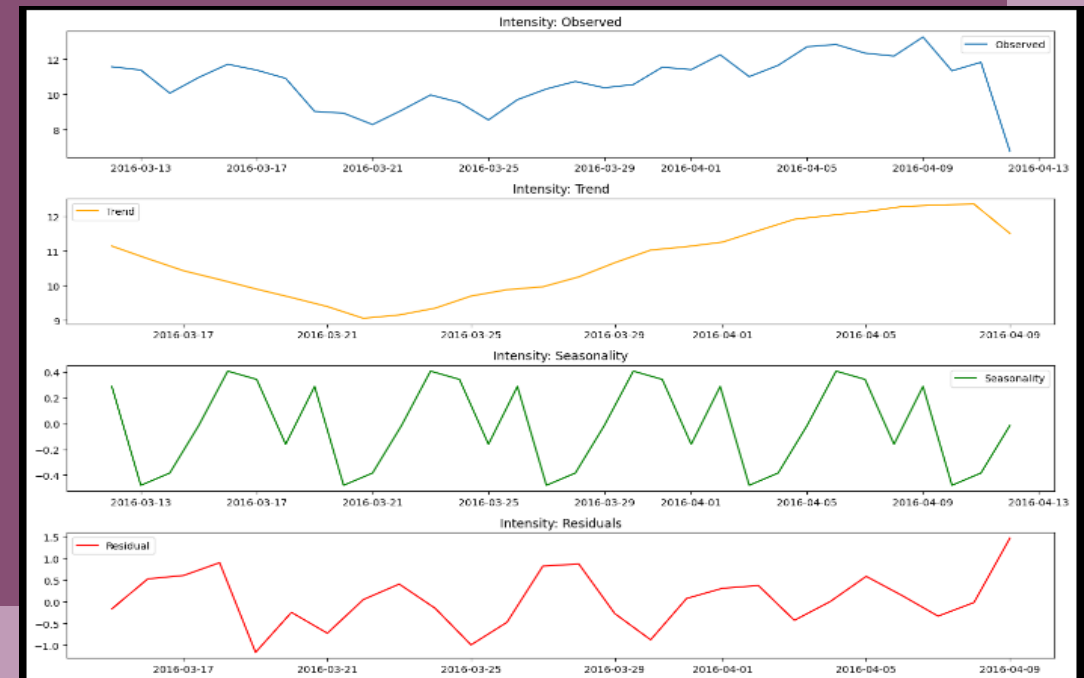
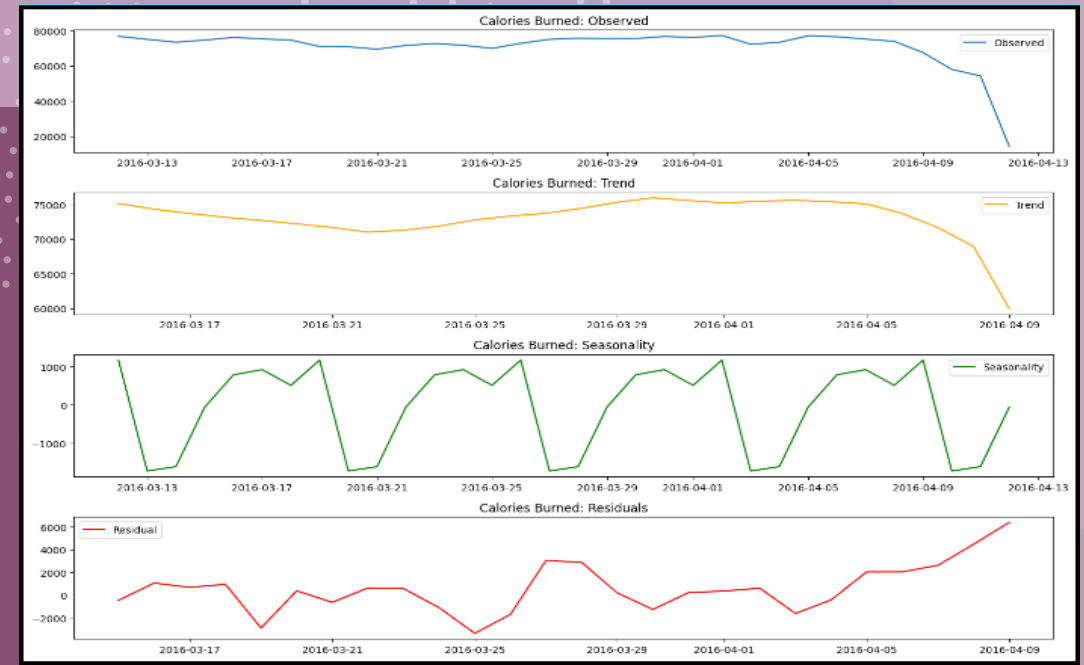
# Observed trends, Seasonality, and Residuals

## Calories Burned:

- **Observed Data:** Shows a steady decline over time.
- **Seasonality:** Consistent peaks on specific days, likely linked to higher activity levels.
- **Residuals:** Highlight unexpected changes or anomalies in the data.

## Intensity:

- **Observed Data:** Slight upward trend over time.
- **Seasonality:** Regular patterns indicating consistent activity fluctuations.
- **Residuals:** Show occasional spikes, revealing anomalies or variations in effort.



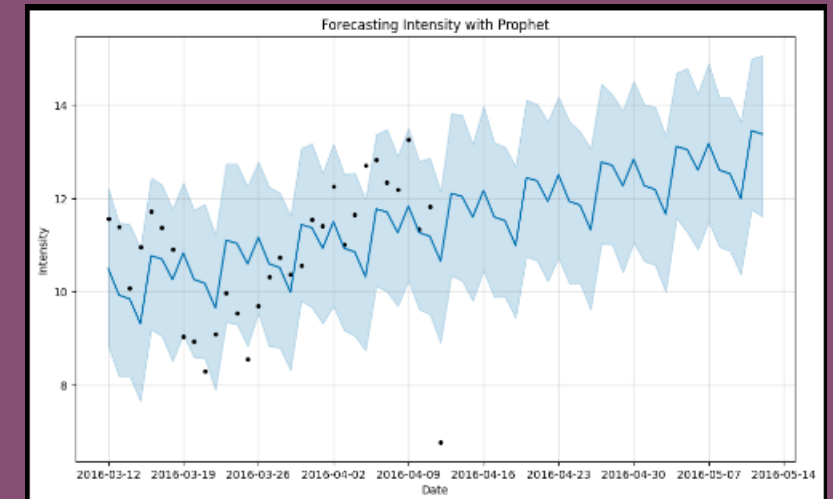
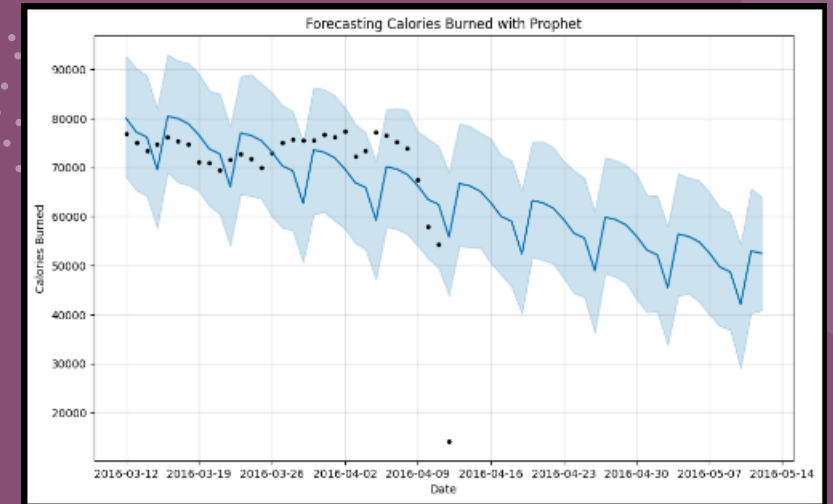
# Forecasting trends using prophet

These charts forecast daily calories burned and intensity using the Prophet algorithm. The blue line shows forecasted values, shaded regions indicate confidence intervals (uncertainty), and black dots represent observed data aligning with the trends.

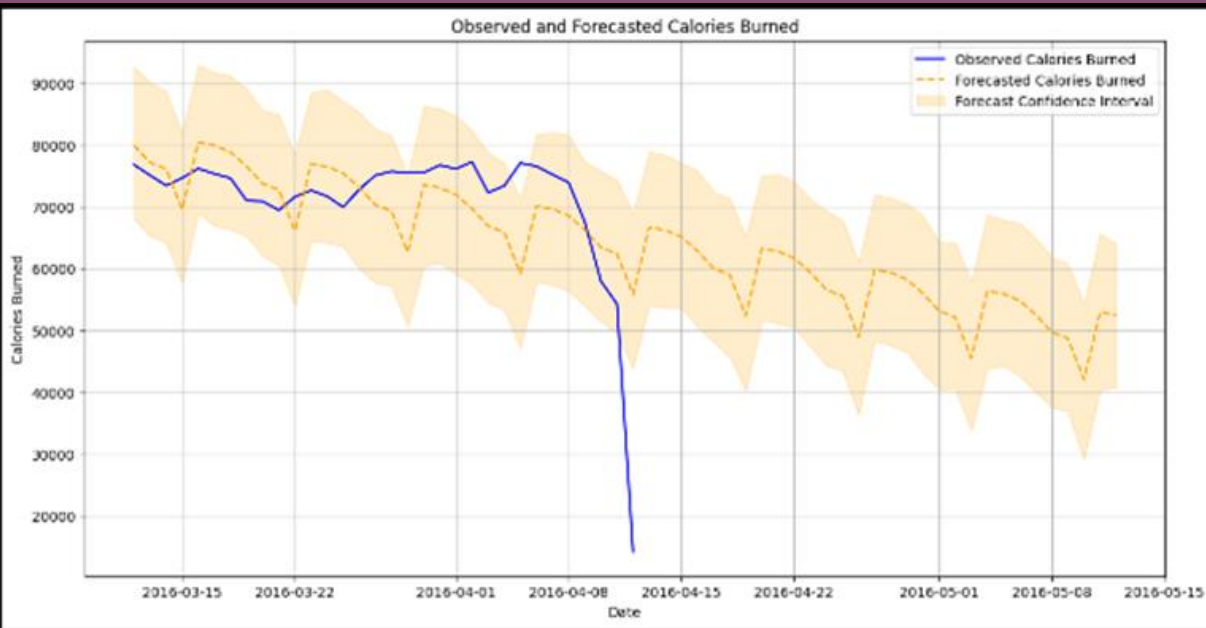
**This helps visualize predictions and their reliability for planning.**

In the "Calories Burned" chart, the forecast predicts a gradual decline, consistent with earlier seasonal patterns. The "Intensity" chart forecasts a steady upward trend, showing increased physical activity.

**These insights can guide fitness goals and highlight areas for adjustment based on predicted trends.**



# Conclusion:



## **Observations:**

The chart illustrates the observed and forecasted calories burned using a time series analysis with confidence intervals.

The blue line represents the actual data, while the orange dashed line shows the predicted values.

The shaded region captures the forecast's uncertainty, providing upper and lower bounds for expected values.

## **Insights:**

The forecast reflects a seasonal pattern with slight declines over time.

This information can guide adjustments to activity levels during seasonal fluctuations or address anomalies like the early April drop.

## **Conclusion:**

This analysis helps in planning and monitoring calorie burn trends while considering variations within the confidence intervals.

# Most effective exercises for calories burned and effect on bodyweight





This table presents various exercises along with calories burned across different weight categories. It helps identify which activities are most efficient for calorie burn based on body weight.

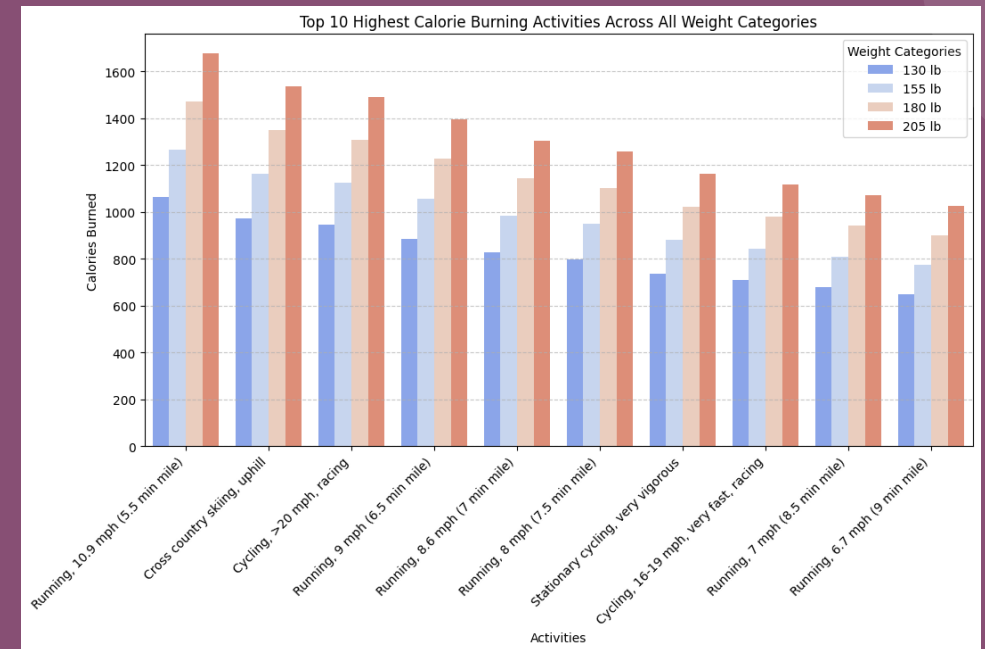
|     | Activity, Exercise or Sport (1 hour)    | 130 lb | 155 lb | 180 lb | 205 lb | Calories per kg |
|-----|---|--------|--------|--------|--------|-----------------|
| 0   | Cycling, mountain bike, bmx             | 502    | 598    | 695    | 791    | 1.750730        |
| 1   | Cycling, <10 mph, leisure bicycling     | 236    | 281    | 327    | 372    | 0.823236        |
| 2   | Cycling, >20 mph, racing                | 944    | 1126   | 1308   | 1489   | 3.294974        |
| 3   | Cycling, 10-11.9 mph, light             | 354    | 422    | 490    | 558    | 1.234853        |
| 4   | Cycling, 12-13.9 mph, moderate          | 472    | 563    | 654    | 745    | 1.647825        |
| ... | ...                                     | ...    | ...    | ...    | ...    | ...             |
| 243 | General cleaning                        | 207    | 246    | 286    | 326    | 0.721008        |
| 244 | Cleaning, dusting                       | 148    | 176    | 204    | 233    | 0.515199        |
| 245 | Taking out trash                        | 177    | 211    | 245    | 279    | 0.617427        |
| 246 | Walking, pushing a wheelchair           | 236    | 281    | 327    | 372    | 0.823236        |
| 247 | Teach physical education,exercise class | 236    | 281    | 327    | 372    | 0.823236        |

248 rows  $\times$  6 columns



# Top 10 Highest Calories Burning Activities Across All Weight Categories

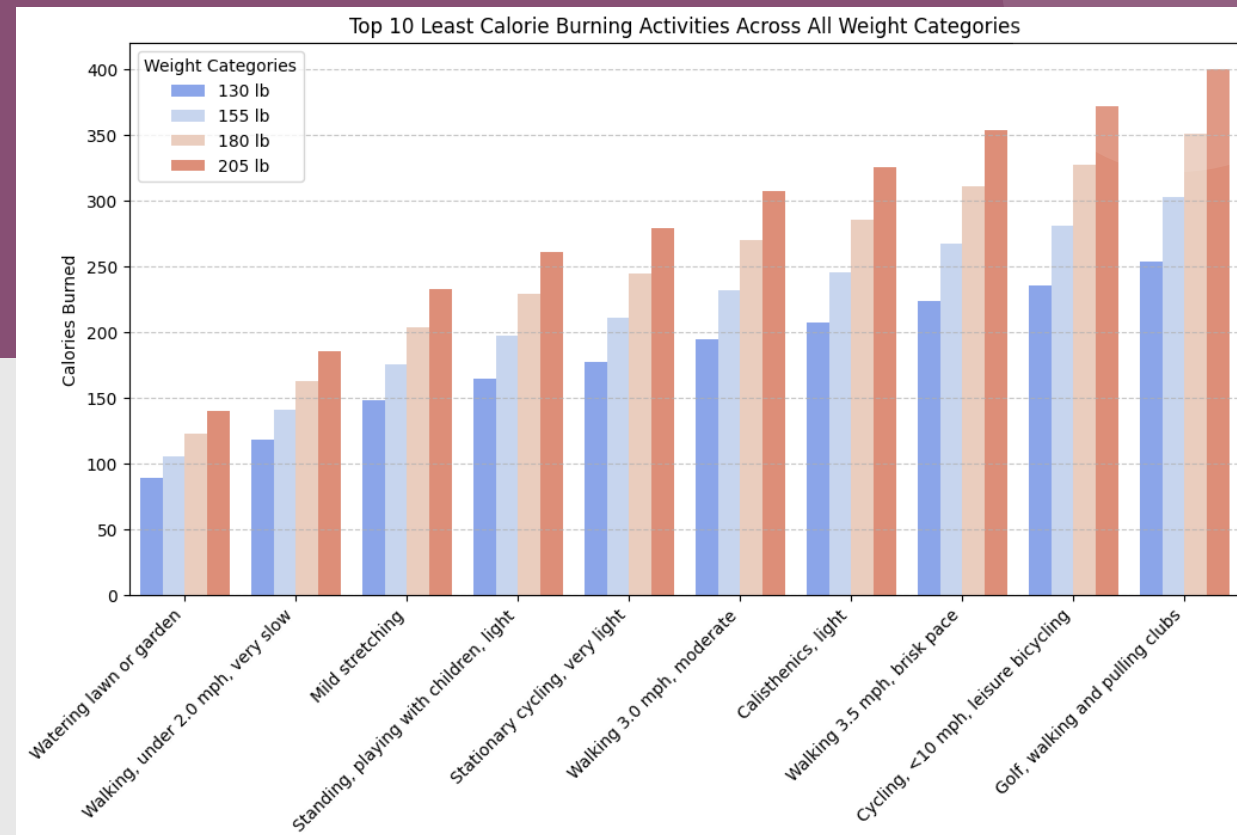
- "This chart displays the top 10 highest calorie-burning activities across different weight categories. Heavier individuals burn more calories, with running at high speeds, cycling, and cross-country skiing being the most intense activities."
-  Key Takeaways:
-  Running, Cycling, and Cross-Country Skiing burn the most calories.
-  Heavier individuals burn more calories across all activities.
-  Higher speed & intensity = higher calorie burn.



# Top 10 Least Calories Burning Activities Across All Weight Categories

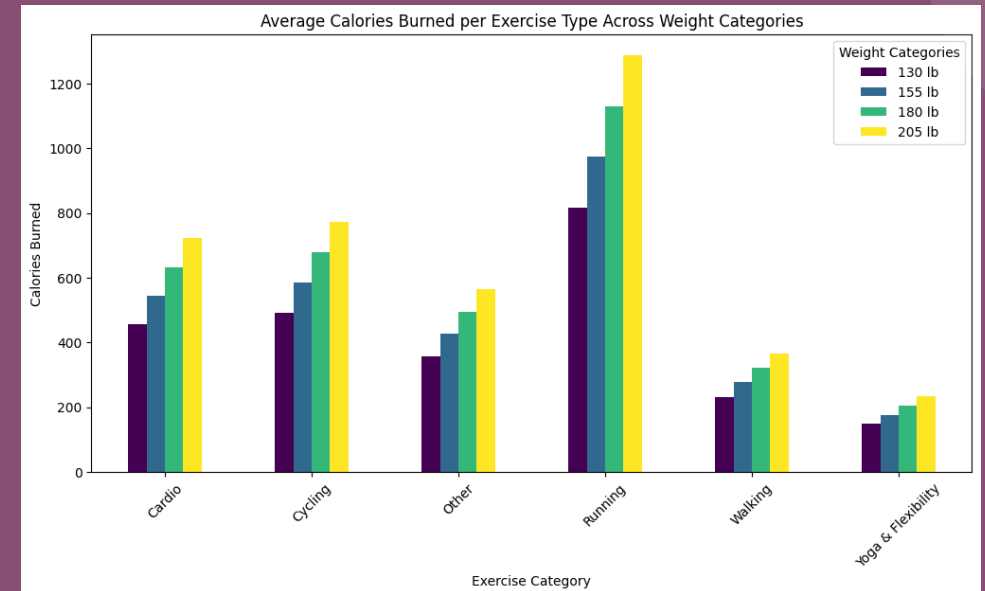
"This chart displays the top 10 least calorie-burning activities across different weight categories. Activities such as gardening, slow walking, mild stretching, and standing burn the fewest calories, with heavier individuals still burning slightly more than lighter individuals."

- ✓ Key Takeaways:
- ❄️ Lowest Calorie Burners:
  - 🧘 Mild Stretching
  - 🚶 Walking (Under 2 mph, Very Slow)
  - 🏠 Household Chores (Cleaning, Taking Out Trash)
- 🏋️ Low-Intensity, But Still Beneficial:
  - 🔄 Improves flexibility & mobility
  - ❤️ Good for active recovery & stress relief



# Average Calories Burned per Exercise Type Across Weight Categories

- "This chart illustrates the average calories burned per exercise type across different weight categories. Running burns the most calories, followed by cardio and cycling. Heavier individuals burn more calories across all exercise types."

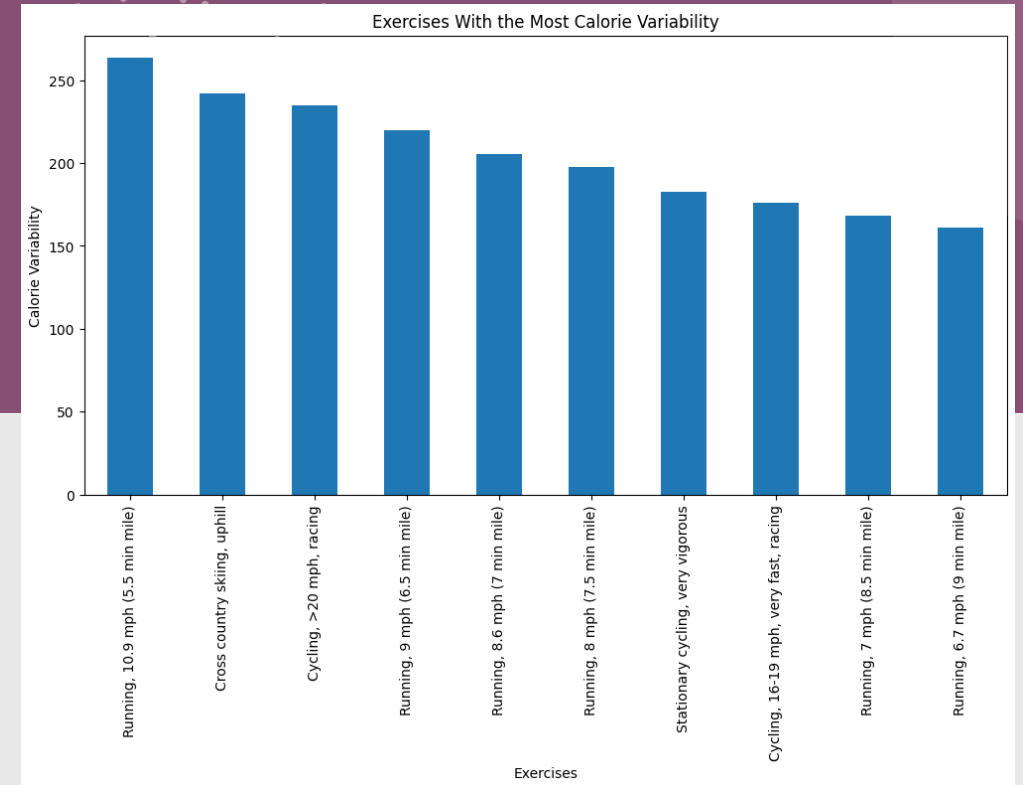


# Exercises with the most calories Variability

**Calorie variability** refers to how much the calorie burn fluctuates across different weight categories for a particular exercise. It is a measure of how consistently an exercise burns calories across different body weights.

## **High Variability:**

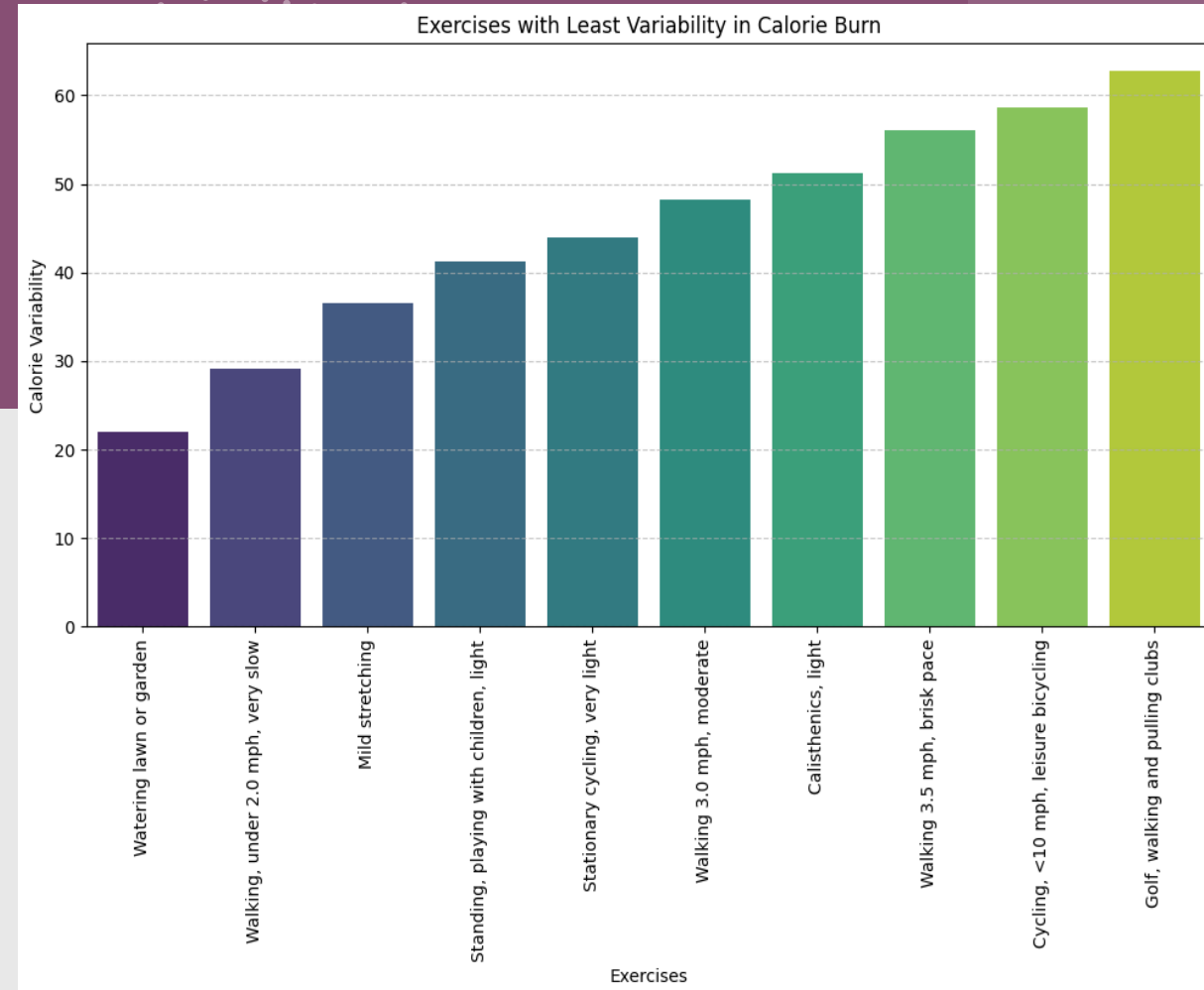
- Exercises with high variability show large differences in calorie burn depending on a person's weight.
- Example: Running at 10.9 mph
  - A person weighing 130 lbs burns 1062 calories, while a 205 lbs person burns 1675 calories (huge difference).
- These exercises are highly weight-dependent.



# Exercise with Least Variability in Calories Burn

## **Low Variability:**

- Exercises with low variability have small differences in calorie burn across different weight categories.
- Example: Mild Stretching
- A person weighing 130 lbs burns 148 calories, while a 205 lbs person burns 233 calories (small difference).
- These exercises burn calories at a steady rate regardless of weight.



# Conclusion:

This analysis highlights how **different exercises impact calorie burn** based on body weight and intensity. **High-intensity workouts** (e.g., running, cycling, stair climbing) burn the most calories, while **low-intensity exercises** (e.g., walking, stretching) remain consistent across weights.

- ◆ **For Weight Loss:** Running, High-Speed Cycling, Jump Rope
- ◆ **For General Fitness:** Walking, Yoga, Pilates
- ◆ **For Strength & Endurance:** Weight Training, Sports

Understanding **exercise efficiency & variability** helps individuals **tailor workouts** to their fitness goals—whether for **weight loss, endurance, or strength**. **Choose smart, train efficiently, and maximize your fitness journey!** 🚀💪