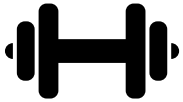


Burn a K on Workout Day

Process owner: John Apel

Key Dates --->	Team Launch	Define 7/6/25	Measure 5/6/25-7/24/25	Analyze 7/25/25	Improve 7/28/25	Control 9/8/25

DEFINE

SQL = 1.7

The current process contains too many decision points and opportunities for defects

Calories burned for the day	
Want to increase the mean	
Mean	1003.61
Standard Error	31.38
Median	1028
Mode	1049
Standard Deviation	180.25
Sample Variance	32490.56

2*SD less than the mean = 643.11 cals for the day. That lower bound is too low for my goals!

Problem Statement:
"Exercise is inconsistent in timing and type, affecting calories burned and progress toward fitness goals."
Goal: *"Establish a consistent workout process that ensures ≥1000 calories burned per workout day."*
Scope: personal fitness project, timeframe (~120 days).

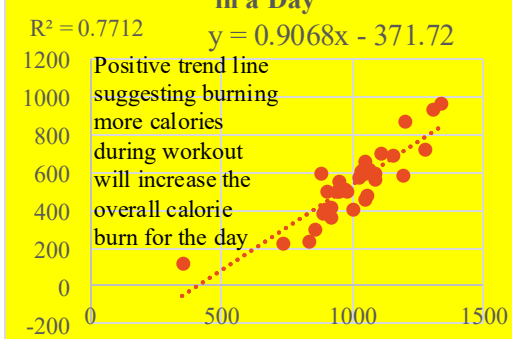
MEASURE

Key metrics:

- Calories burned per workout.
- Steps/day.
- Minutes Exercised
- Type of workout
- Time of Day

Baseline: "Strength training averages ~993 calories per day; combo workouts ~1193 calories; cardio alone is much lower at ~641.67 calories."

F(Calories Burned During Exercise)= Total Calories Burned in a Day



ANALYZE

Regression results: strength workout and combo workout burn more than cardio. Early morning burns more than afternoon. Cals per workout and steps are strong predictors of calories.
Identified issues: missed workouts when morning plan fails, variation in calorie totals.

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	360.92	93.71	3.85	0.00
type of workout:strength	74.18	33.66	2.20	0.04
Type cardio	-191.77	62.20	-3.08	0.01
Time: morning	-2.83	24.69	-0.11	0.91
time:afternoon	-54.90	27.18	-2.02	0.05
time:evening	23.38	47.28	0.49	0.63
minutes exercised	-0.12	1.47	-0.08	0.93
steps	0.04	0.01	6.15	0.00
calories burned during exercise	0.75	0.19	4.01	0.00

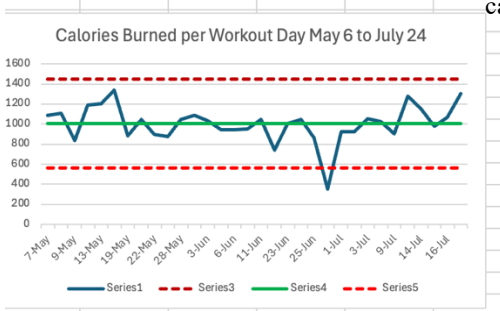
Baseline is a strength cardio combo that is completed in the early morning hours

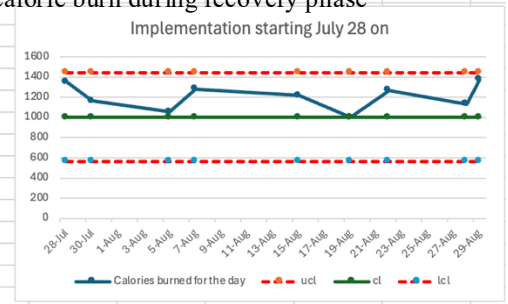
IMPROVE

(H_a): $\mu_1 > \mu_0$ Reject Null
statistically significant (p = 0.0006)

CONTROL

Trend shows consistent achievement of 1000+ calorie days after switching to 5:15am strength or combo workouts. Step count supplements calorie burn during recovery phase





Zero defects in 9 workout days, need more samples for greater confirmation

Define

- My dad worked out every day of his life until he was no longer physically able. His dedication instilled in me a deep belief in the importance of exercise. The discipline he cultivated allowed him to achieve impressive feats, and he always said, *"Never half step. If you're going to do something, do it to the fullest extent."*
- I watched him work out through the grief of losing my mom to cancer. I watched him work out through the onset of Parkinson's, because his doctor told him it was the best way to fight what was coming. Now, as I live my life without my parents, I work out to build longevity for my two daughters. When I train, I never half step — I give it everything. If I am putting in that effort, I want to burn at least 1,000 calories each day.
- Beyond inspiration, health became my call to action. After years in the restaurant industry, I faced high triglycerides, high blood pressure, and excess weight. Through this journey, I have been able to lower my triglycerides, bring my blood pressure back to a healthy range, and lose weight.

Define

Operational Definitions

Workout Type – calories calculated by apple watch(cardio) and fitbod app(strength)

- Cardio – Jogging , walking on hills, rowing, or biking for 30 minutes
- Strength- weightlifting for 60 minutes
- Strength and Cardio Combo – 20 minutes cardio and 60 minutes weightlifting

Time of day - has NOT been strategic, more at the whim of personal and family schedule

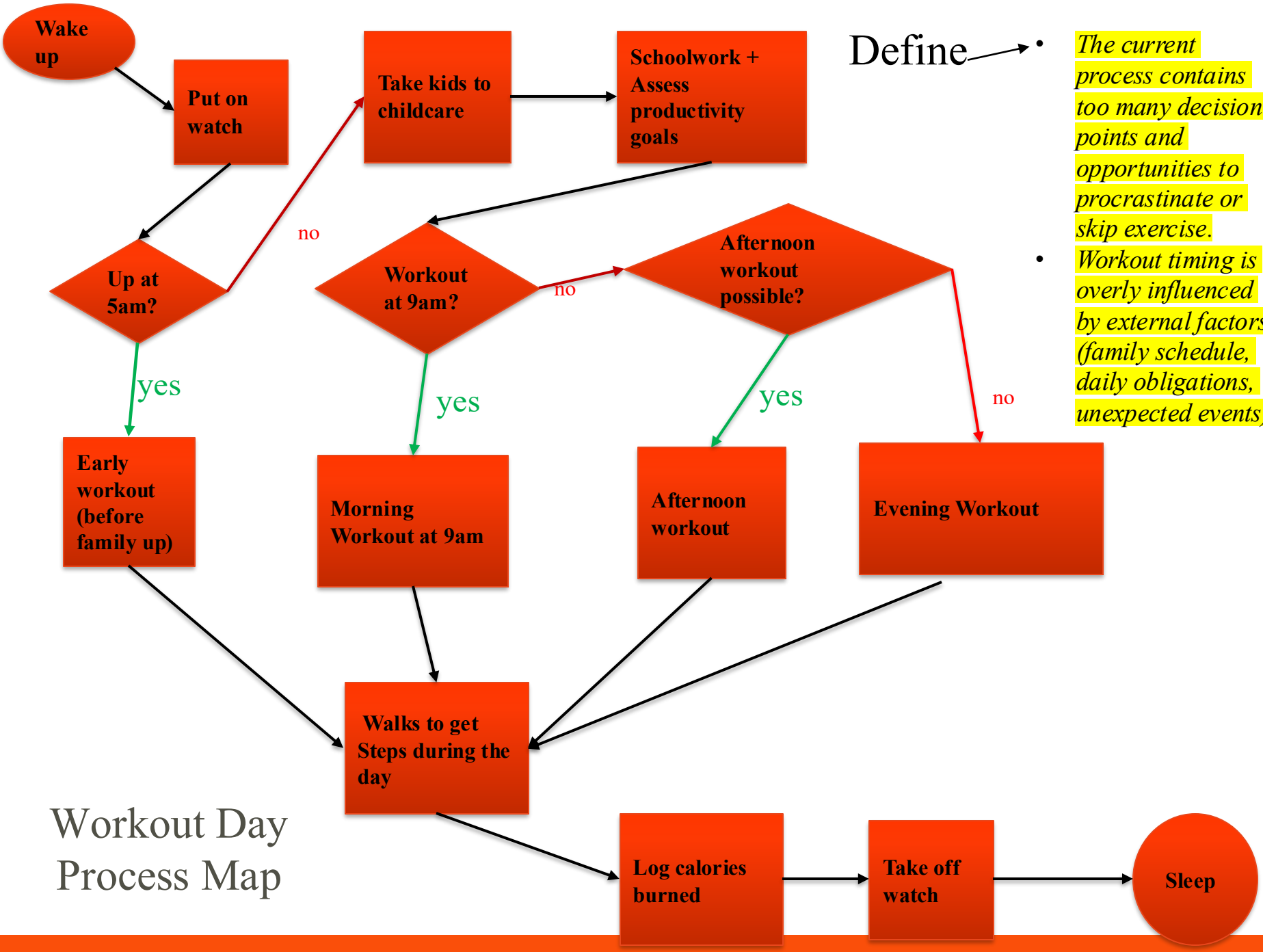
- Early morning (5:15am)
- Morning (9 am)
- Afternoon (12-2)
- Evening (after 6 pm)

Steps – walking steps tracked with apple watch

Minutes Exercised – minutes logged on apple watch starting by initiating specific exercise through fitness application (cardio) or fitbod application (strength) until workout is manually stopped in the applications

Calories Burned during exercised – Calorie burn calculated by fitbod and fitness app that are recorded during the exercise

Calories burned for the entire day – Calorie burn number recorded for the entire time the apple watch was worn (wake up to bed time). This is the target that I want to predict. The goal is that any day I am exercising, I will burn a total of at least 1000 calories for the day.



Workout Day Process Map

Define

- *The current process contains too many decision points and opportunities to procrastinate or skip exercise.*
- *Workout timing is overly influenced by external factors (family schedule, daily obligations, unexpected events).*

Measure

Data Measurement Plan

Performance Measure	Data Source and Location	How Will Data Be Collected	Who will Collect Data	When will Data be Collected	Target Sample Size
• Calories Burned per Day (target)	• Apple watch	• Recorded by fitness tracker , logged manually into excel	• John Apel	• End of the day	• 30
• Minutes Exercised	• Apple watch	• Recorded by fitness tracker , logged manually into excel	• John Apel	• End of the day	• 30
• Calories Burned During Exercise	• Fitbod App	• Recorded by fitness tracker , logged manually into excel	• John Apel	• End of the day	• 30
• Steps	• Apple watch	• Recorded by fitness tracker , logged manually into excel	• John Apel	• End of the day	• 30
• Type of Exercise	• Fitbod App	• Recorded by fitness tracker , logged manually into excel	• John Apel	• End of the day	• 30
• Time of day	• Dictated by daily itinerary	• Recorded by fitness tracker , logged manually into excel	• John Apel	• End of the day	• 30

Measure

- Data is a mix of **discrete** (steps, workout type, time of day) and **continuous** (minutes exercised, calories/workout, calories/day)
- Ideal sample size for t-test is 30 or more (I have 33)
  - For improvement phase, I have a sample of 9 which may be ok for proof of concept, but I would want more samples to strengthen conclusion

Margin of Error & How to Minimize
I use **90% CIs (α = 0.10)** for estimation to balance precision with effort, and **α = 0.05** for hypothesis tests (p-values) to make claims conservatively.
Current precision for the mean (daily calories). With **n = 33**, **z = 1.645 (90%)**, and baseline **σ ≈ 180.25 calories**, the margin of error is:

$$ME = \frac{z \cdot \sigma}{\sqrt{n}} \approx \frac{1.645 \times 180.25}{\sqrt{33}} \approx \pm 52 \; calories.$$

How many samples for tighter precision? Using $n = \left(z\sigma/ME\right)^2$ at 90% confidence:

±50 cal → n ≈ 36
±40 cal → n ≈ 55
±30 cal → n ≈ 98
±25 cal → n ≈ 141
±20 cal → n ≈ 220

Measurement Error sources & minimization.
Sources: Apple Watch sensors and battery, Fitbod calorie algorithm, and self-logging.
Mitigation: Use the same devices/apps consistently, log immediately after sessions, standardize definitions (workout type, start/stop), end each day charging watch

Beginning	Sigma Quality Level
defect opportunity	1
units produced	33
total possible defects	33
total actual defects	15
defect per opportunity	0.45
DPMO	450000
SQL Value	1.70

**I plan to continue gathering data and reevaluating the value of SQL beyond the scope of this project. Reducing ME is also appealing, as it suggests a more consistent and streamlined process. Such consistency can complement nutritional planning and enhance the overall health journey.*

Analyze

SUMMARY OUTPUT

X= calories burned during exercise

Y= calories burned for the day

y^=545.7648 + 0.8505x

Regression Statistics	
Multiple R	0.88
R Square	0.77
Adjusted R Square	0.76
Standard Error	87.60
Observations	33

- The linear regression model predicts that on a non-workout day I will burn 545.76 calories (intercept)
- For every 1 calorie burned during a workout, total daily burn goes up by +0.85 calories (slope).

Example: If I burn 600 workout calories, then daily burn increases by about 600 × 0.85 ≈ ***510 calories****, on top of the 545 baseline.*

Predicted daily total = 545.76 + (0.85 × 600) ≈ ***1,056 calories****. *Goal Met**

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	801818.2877	801818.2877	104.4913807	1.89157E-11
Residual	31	237879.5911	7673.535197		
Total	32	1039697.879			

	Coefficients	Standard Error	t Stat	P-value
Intercept	545.76	47.31	11.53	0.00
X Variable 1	0.85	0.08	10.22	0.00

Workout Calories (burned during exercise)	Predicted Daily Calories
0	545.76
100	630.76
200	715.76
300	800.76
400	885.76
500	970.76
600	1055.76
700	1140.76

Correlation Takeaways

- **Workout duration + exercise calories = best predictors** of daily calorie burn.
- **Steps add value** but are secondary compared to workout factors.
- **Heart rate metrics are moderately correlated** with total burn, reflecting exercise intensity but not as direct as time and calories. (I was looking to tie heart rate to cardio, after injuring knee, I did not attempt cardio or pursue this connection.)

	Calories burned for the day	minutes exercised	*steps*	*average heart rate during exercise*	*heart bpm max for day*
Calories burned for the day	1				
minutes exercised	0.84	1			
steps	0.23	0.09	1		
average heart rate during exercise	0.28	0.34	0.33	1	
heart bpm max for day	0.26	0.29	0.43	0.76	1
calories burned during exercise	0.88	0.91	0.01	0.34	0.28

Analyze

Summary of Findings from Multilinear Regression with Key Metrics– Factors Affecting Daily Calories Burned

- I analyzed 33 workouts to see how workout type, time of day, steps, and workout calories affect total daily calories burned. The model explained about 95% of the variation in daily calorie burn **(R squared= 0.953)**, meaning our predictors were very effective at capturing what drives calorie expenditure.

1. Workout type makes the biggest difference

- Cardio workouts burned ~192 fewer calories per day than combo workouts, all else equal.
- Strength workouts burned ~74 more calories per day than combo workouts.
- Conclusion: Cardio is least effective for total daily calorie burn in this dataset, while strength and combo workouts are better.

2. Steps matter

- Each extra step added 0.039 calories to the day — roughly +39 calories for every 1,000 steps.

3. Calories burned during exercise are a strong driver

- Each calorie burned during the workout added 0.75 calories to the daily total.
- This shows that exercise sessions significantly contribute to total daily burn beyond other factors.

4. Time of day matters only a little

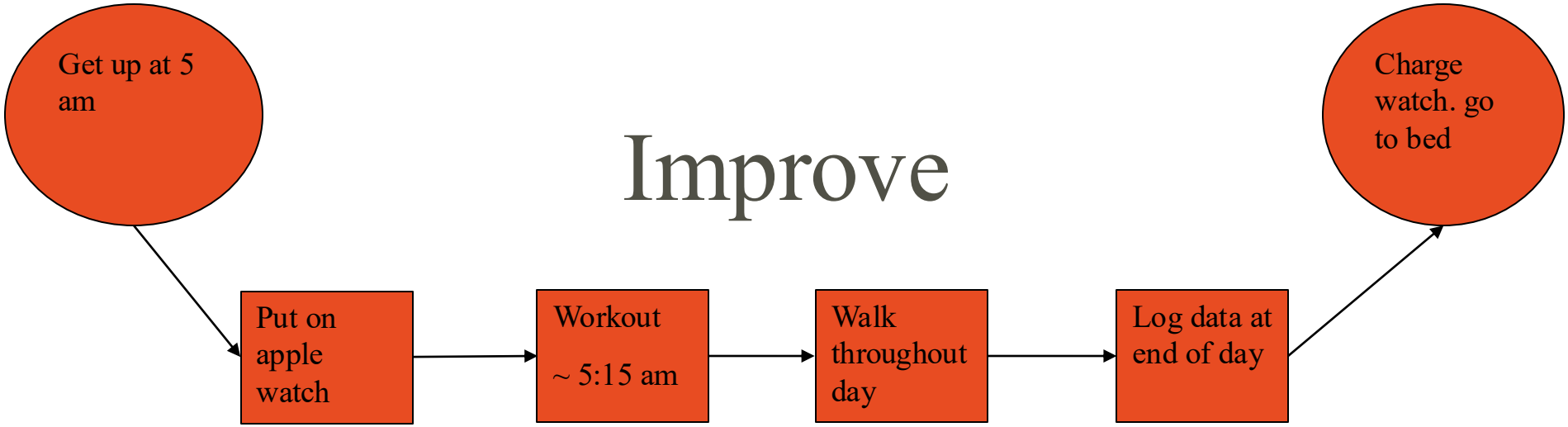
- Afternoon workouts burned ~55 fewer calories than early morning workouts.
- Morning and evening workouts showed no meaningful difference from early morning in this dataset based on p-value.

5. Practical implications

To maximize daily calorie burn:

- Favor strength or combo workouts over cardio.
- Increase step count — even small increases add up.
- Push for higher workout calorie burn, as it has a clear link to daily totals.
- Time of day is less important, though afternoon workouts might have a slight disadvantage.

Improve



- Morning Workouts lead to greater number of calories burned for the entire day
- Morning Workouts do not interrupt productivity, childcare, and family needs throughout the rest of the day
- A combination of Strength and Cardio workout averages the highest calorie burn for the day. This type of workout paired with a 5 am start will maximize calories burned.
- Caveat – *I injured my knee which made it painful and unsafe to do cardio workouts* – **The solution was early morning strength workouts , and as recovery allowed walking through the day. Aiming for 8,000 to 10,000 steps will compensate for the loss of cardio exercise** (10,000 steps = ~390 calories on workout days).
- *When fully recovered I will implement a combination of cardio and strength workouts with a 5:15 am start time.*

Improve – Hypothesis Test Results

- **Null (H_0):** $\mu_1 \leq \mu_0$
- **Alternative (H_a):** $\mu_1 > \mu_0$

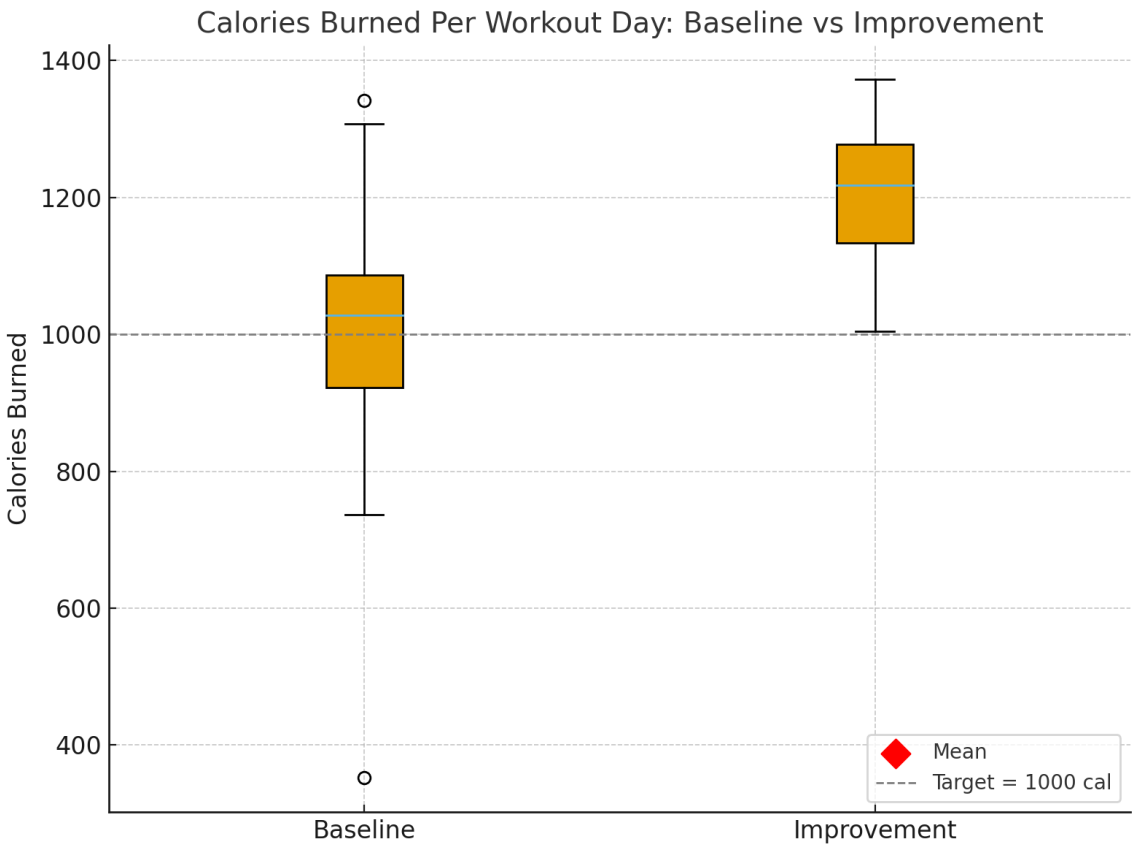
- μ_0 = mean daily calories burned under the old process (baseline)
- μ_1 = mean daily calories burned under the new process (after intervention)

<u>Results of a one-tailed two-sample t-test comparing baseline vs improvement calorie burns.</u>

Conclusion: Early morning + structured workouts significantly increased daily calorie burn

- Baseline mean: **1004 cal/day**
- Improvement mean: **1205 cal/day**
- One-tailed t-test: **t = 3.82, p = 0.0006** → statistically significant

- **Since $p < 0.05$, I reject H_0.**
- Evidence strongly supports that the **new process burns significantly more calories** than your baseline.
- On average, the improvement raised daily calorie burn by about **+200 calories** per workout day.



Control – Moving Forward

Lessons Learned

- Early Morning workouts lead to **higher daily burn** and fewer disruptions
- Combo workouts (strength + cardio) are most effective
- Even small step increases have big calorie impact (~390 cal from 10k steps)
- Skipping the workout **early in the day** often leads to no workout at all
- Injuries require flexibility in the plan—but **walking still works**

What's Next?

- Resume combo workouts once knee fully healed
- Continue early morning habit to **protect workout time**
- Add habit-tracking or alarms to reinforce control phase
- Use data insights to build next goal (e.g. strength goal, weight loss goal, improve cardio health goal)

SUMMARY OUTPUT | time of workout | early morning is better than morning

Regression Statistics	
Multiple R	0.432132308
R Square	0.186738332
Adjusted R Square	0.102607814
Standard Error	170.7535461
Observations	33

5am workout is intercept. The model shows it to be better than morning (9am) workouts. Additional models showed afternoon and evening to burn less daily calories than 5am workouts.

ANOVA

	df	SS	MS	F	Significance F
Regression	3	194151.4474	64717.149	2.21962657	0.107102855
Residual	29	845546.4314	29156.773		
Total	32	1039697.879			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%
Intercept	1128	69.70984327	16.181359	4.67878E-16	985.4273622
Time: morning	-189.8823529	81.08370103	-2.341807	0.026268693	-355.7171418
time:afternoon	-113	94.99850318	-1.189492	0.243894034	-307.2937547
time:evening	-28.66666667	120.7409903	-0.237423	0.813998137	-275.6097191

SUMMARY OUTPUT | type of workout | combo workout is 200 cal better than strength | combo workout is 551 cal better than cardio

Regression Statistics	
Multiple R	0.789097635
R Square	0.622675078
Adjusted R Square	0.597520083
Standard Error	114.3538254
Observations	33

Model shows strength and cardio combo workout to burn the most calories. When healed from knee Injury, combo workouts will continue!

ANOVA

	df	SS	MS	F	Significance F
Regression	2	647393.9575	323697	24.75353631	4.47437E-07
Residual	30	392303.9213	13076.8		
Total	32	1039697.879			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Up
Intercept	1193.285714	43.22168334	27.6085	6.94493E-23	1105.015261	1
type of workout:stren	-200.1987578	49.36264092	-4.055674	0.000327598	-301.0107197	
Type cardio	-551.6190476	78.91163647	-6.990338	9.10509E-08	-712.7781093	

Control – Sustaining 1k-Calorie Days

Daily Tracking System Maintained

- Apple Watch tracks steps and calories
- Fitbod logs strength workouts
- Fitness app logs cardio
- End-of-day logging for accountability

Visual Controls

- Apple Fitness Goal level set to 1000 to so the ring visual can give quick view of current status
- Apple watch Reminders to move (steps) throughout the day

Control Plan

- Maintain 5:00am wake-up & 5:15am workout routine
- Prioritize combo workouts when fully recovered
- Daily walks to maintain ≥8,000–10,000 steps
- Adjust workout timing only if early workout is missed

Response Plan if Target Missed

- Missed morning? Default to strength-only at next available time
- Below target calories? Add a brisk walk in evening
- Daily and Weekly review

In 9 observed improvement days, 0 defects occurred (all ≥1000 cal). This corresponds to an observed Sigma Quality Level of ≥6σ. However, due to the small sample size, true long-term capability may be closer to 2–3σ. Ongoing data collection will confirm sustained performance.

Summary
Burn a K on Workout Day

Problem

- Exercise was inconsistent in timing and type, leading to missed goals and calorie burn variation.
- Baseline mean: **1004 calories/day**, SQL = **1.7σ**.

Intervention

- Implemented **5:15am workouts**, prioritizing strength + cardio combo.
- Added structured step goals (8,000–10,000/day).
- Daily Apple Watch + Fitbod logging for accountability.

Results

- New mean: **1205 calories/day** (+200).
- One-tailed t-test: **t = 3.82, p = 0.0006** → statistically significant improvement.
- 0 defects in 9 improvement days (≥6σ observed).

Sustainment

- Daily logging, Apple Watch reminders, 5am routine.
- Adaptable plan during injury (strength-only + steps).
- Ongoing tracking ensures ≥1000 cal/day remains standard.

Key Takeaway:

Early morning workouts + combo training significantly increased daily calorie burn, creating a repeatable and sustainable fitness process.