Building a Better Workout Routine

MBC 638 DMAIC PROJECT

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SYRACUSE UNIVERSITY / WHITMAN SCHOOL OF MANAGEMENT / FALL 2019

EXECUTIVE SUMMARY

Shorten time at the gym, maximize Move goal

For this upcoming quarter, we wanted to focus on improving our workout routine to shorten time in the gym, maximize progress towards daily move goals and reap the health benefits of increased energy needed to tackle a busy schedule.

It's predicted that time savings from less time at the gym and the associated increase in energy could free up about 5 hours a week of productive time. Leading a freelance digital project or UX workshop that requires a 20 hour investment each month, for example, is estimated to be worth $2,500 in additional revenues per quarter.

We wanted to target the following in terms of measuring success of a streamlined workout process:

- Track and compare number of days all Activity rings (Move kcal, Stand hrs and Exercise min) were closed using the old vs new workout processes
- Identify the impact of different workout types on daily calorie goals (Move)
- Gain insights to select more effective workouts that reduce time at the gym while increasing effectiveness of each workout
- Confidently raise our daily Move goal from 350 to 450 kcal based on effectiveness of the new process

Define y = f(x)

Our y = f(x) had y as the Move data point where x consisted of several variables measuring exercise time and workout type.

Setup the hypothesis (α = 0.10)

H0: Shorter, higher intensity workouts will have no effect on Move goals when compared to regular full-length cardio workouts. ($\mu_1 = \mu_2$)

Ha: Shorter, higher intensity workouts will have a positive impact on daily Move goals when compared to regular full-length cardio workouts. ($\mu_1 < \mu_2$)

Kickoff the project

Created a problem definition worksheet that outlines the problem, business impact and project timeline.

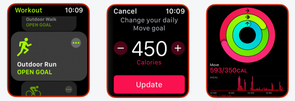
Collect the data

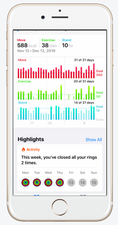
- 15 min cardio session on an elliptical machine (reduced from 45 min in WP1)
- 10-15 min of strength training
- 10-15 min modified yoga using seated poses and the sauna when available

Refine and measure

45 days of Activity data collected for 8.31 to 10.15 (WP1) and 10.16 to 11.30 (WP2).

Performance measures: Move goal achieved (kcal = 350); # of Activity rings closed; and, % of days all three Activity rings were closed



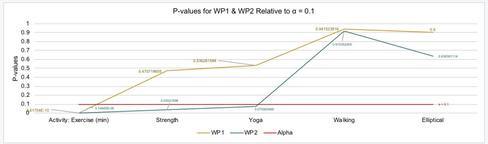


Answer the questions with

- Does a shorter, higher intensity workout have an impact on the Move goal? Yes
- Which workout type had the most impact on the Move goal? Strength and Yoga
- Which workout type, or mix, has the most potential for Move = 450 kcal? Elliptical only

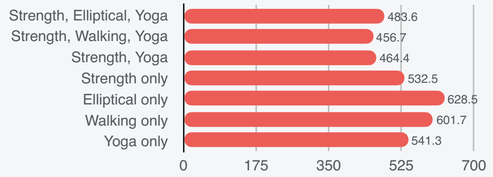
Reject H_0

Exercise time, strength training and yoga were strongly correlated and had a statistically significant impact on the y variable, Move, at α = 0.10.



Predicting y

For our regression formula y = b0 + b1x1 + b2x2 + b3x3 + b4x4 + b5x5, we used the following values to predict several possible scenarios for the future: y = 391.97 + 7.25x1 -76.84x2 - 68.08x3 - 7.72x4 + 19.10x5

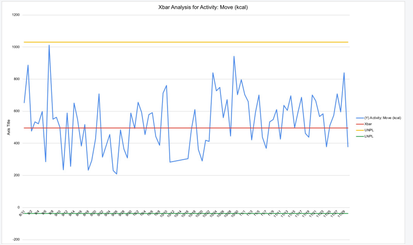


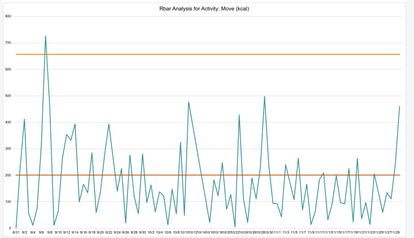
Resetting the bar

We feel confident that this new process allows us to raise the daily Move goal from 350 kcal to 450 kcal given any number of scenarios above, and with Exercise time remaining constant at 30 min or more.

Keep the process moving

For the Control phase, we will leverage the Xbar/R and IMR charts created during our time series analysis of WP1 and WP2 performance. We would take samples of data throughout the year and run our statistical analysis again.





DEFINE

~~Given an increasingly busy schedule, we wanted to find a way to meet our Move target, setup an ongoing process to reduce workout time and raise the daily Move goal from 350 to 450 kcal.~~

MEASURE

~~We leveraged data from an Apple iWatch worn daily to understand how a shift in the workout process could address our issues. iWatch data was extracted using the Apple Health app.~~

ANALYZE

~~Exercise time of 30+ min with any single workout or mix of workouts was the strongest predictor of Move goal success. Strength training and yoga also had a statistically significant impact on the Move goal.~~

IMPROVE

~~Even though we didn't have scope to improve the process beyond the WP2 findings, we were able to gain some valuable insights and identify some process optimization scenarios for the future.~~

CONTROL

~~Our goal is to make the data extraction process from the health app more streamlined so we can eventually move from manual data entry and~~ analysis to automated dashboard.

DEEP DIVE ANALYSIS

Workout Process 1

Cardio

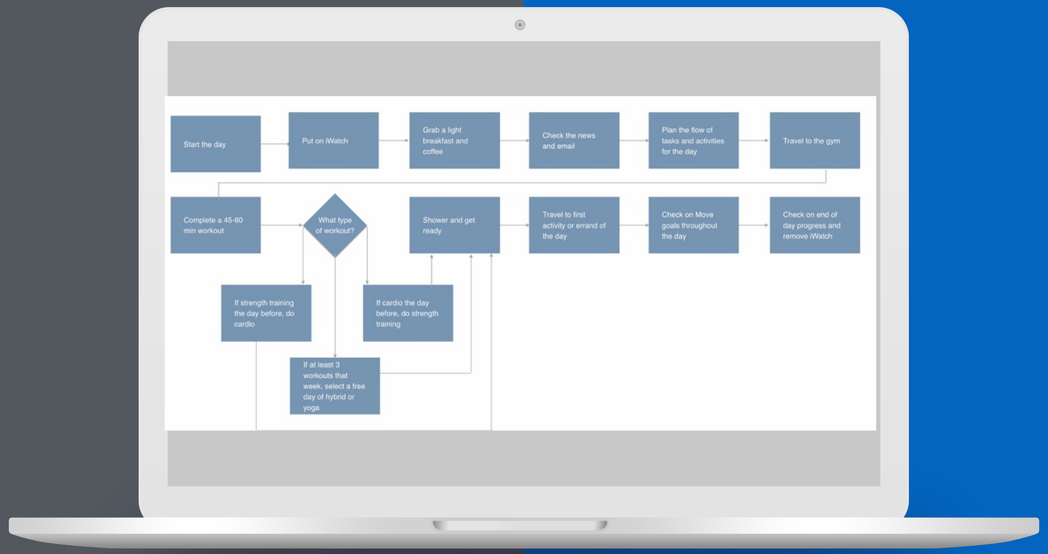
45 min cardio session on an incline treadmill

Strength

10-15 min of strength training

Yoga

10-15 modified yoga using seated poses and the sauna when available



To measure whether shorter, higher intensity workouts would have an impact on solving our current workout issues, we modified the workout process (WP2) to shorten cardio time from 45 min to 15 min.

Workout Process 2

Cardio

15 min cardio session on an elliptical machine

Strength

10-15 min of strength training

Yoga

10-15 modified yoga using seated poses and the sauna when available

The what and how of our measurement strategy

For this workout improvement project, we leveraged data from an Apple iWatch that is worn daily during waking hours to understand how a shift in the workout process could address our issues of time management, goal attainment and available energy.

Data sources

iWatch data is entered into Excel from the Apple Health app installed on iPhone

Performance measures

- Move goal achieved (kcal = 350)
- # of Activity rings closed
- % of days all three Activity rings were closed

Target sample size

45 days of Activity data for 8.31 to 10.15 (WP1) and 10.16 to 11.30 (WP2)

How is data collected

Apple iWatch worn daily will share data with the Health app on iPhone for retrieval

Who collects the data

Watch needs to be put on for automatic data collection to occur and wearer needs to start/stop workouts to record workout-specific data

When is data collected

Data is automatically collected throughout the day as long as the iWatch is worn, and provided that workouts are started/stopped by the wearer for better data coding and analysis

WHAT WE WANTED TO MEASURE

$$Y = F(X)$$

Questions about the process

Does a shorter, higher intensity workout have an impact on the Move goal versus workouts with a longer cardio set?

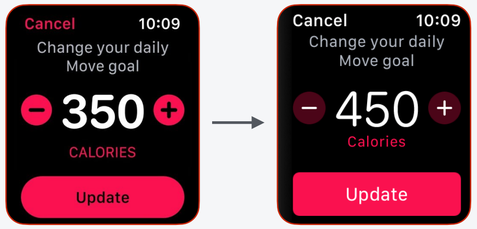
Which workout type has the most impact on the Move goal?

Which workout type, or mix, has the most potential to help us meet an elevated Move target (kcal = 450) in the future?

The output y

Activity: Move (kcal)

The current set goal is kcal = 350 with the objective of eventually increasing the above goal to kcal = 450.



The x variables driving the y

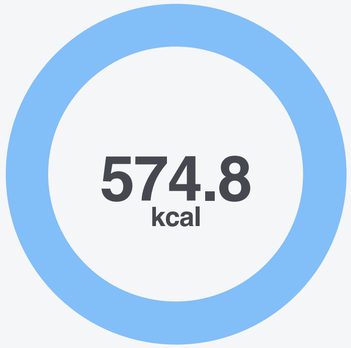
- Activity: Exercise (min)
- Strength
- Yoga
- Walking
- Elliptical

Note: After an initial regression analysis, average heartrate was removed since it had no impact on Move goal. The remainder of this deck uses analysis based on the X variables listed above sans average heartrate.)

Trend Analysis

Since cardio was the largest portion of time spent, we started with the goal of reducing time for that particular x variable. We then established a data measurement plan that would answer key questions of interest.

As a result, we observed a number of favorable upward trends when analyzing central tendency for WP1 versus WP2.

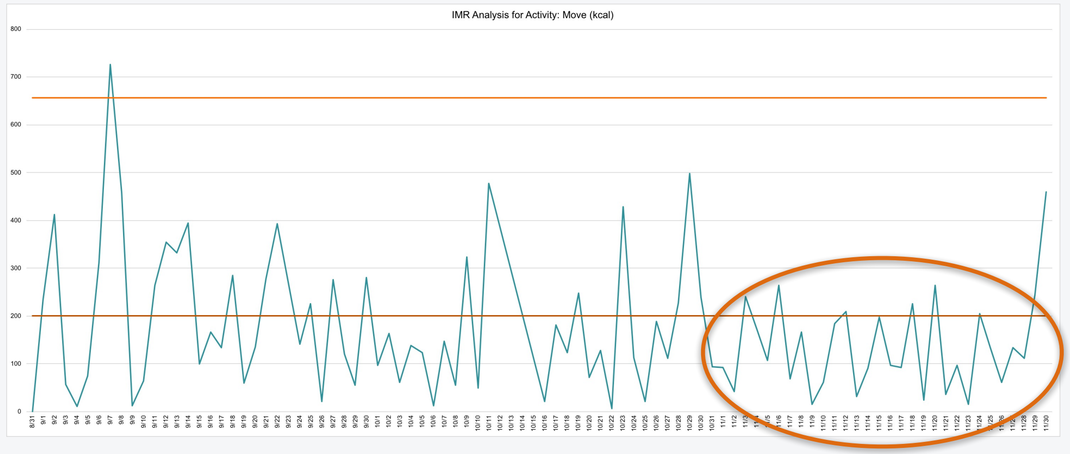


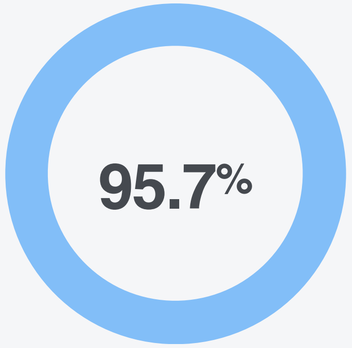
The mean Move measurements increased to 574.8 kcal to 495.7 kcal

The median Move measurements also increased (499.0 to 588.5)

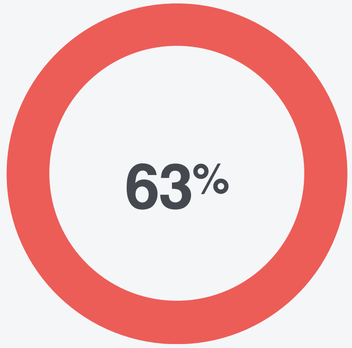
Average number of Activity rings closed moved from 1 ring closed to 2 rings closed

The range became tighter thus reducing variation in the workout process

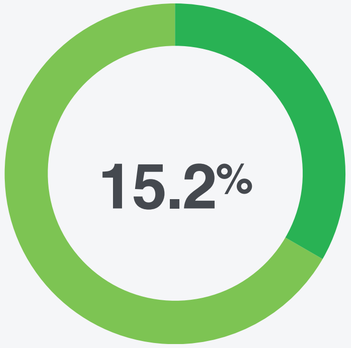




The percent of days with the Move ring closed increased to 95.7% from 78.0%...

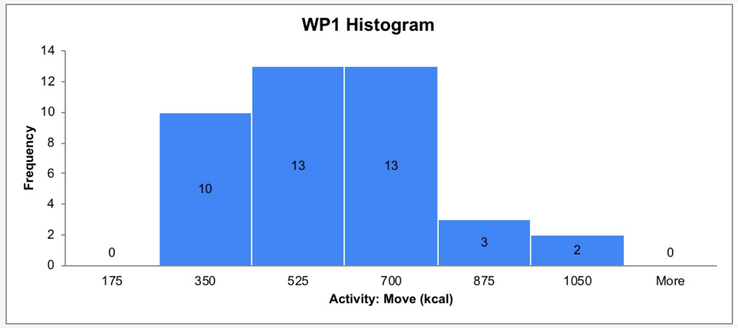


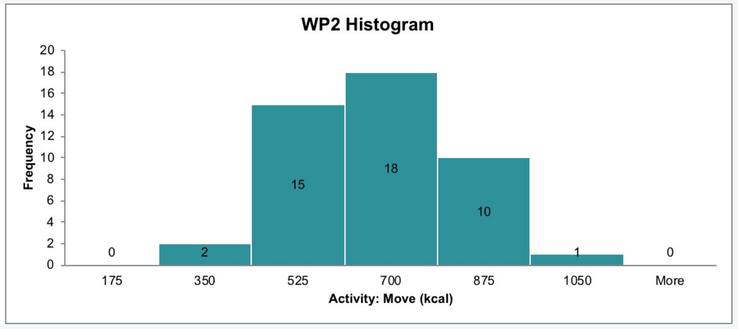
…And the Exercise ring increased from 39% to 63%, a nearly 50% increase



There's still work to do in closing all the rings, but we did observe a rate increase from 14.6% to 15.2%...

…And overall, the Move measure skewed further to the right with a majority of values falling in a range above 525 kcal, indicating a strong probability of closing the Move ring more consistently moving forward



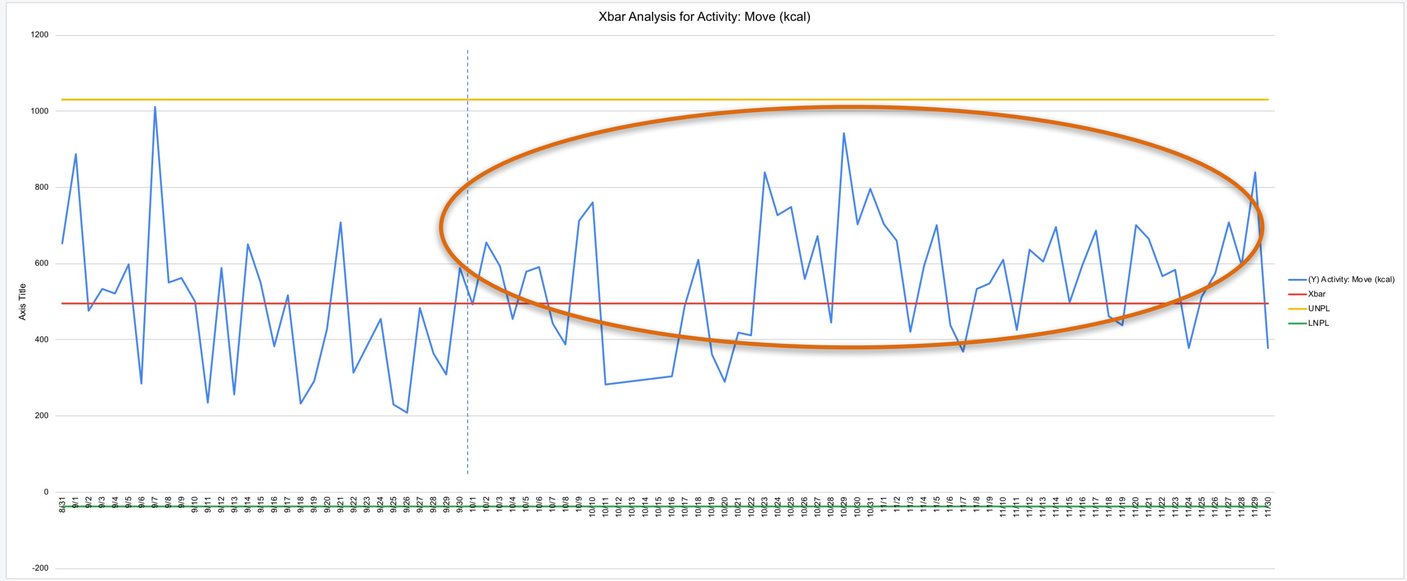


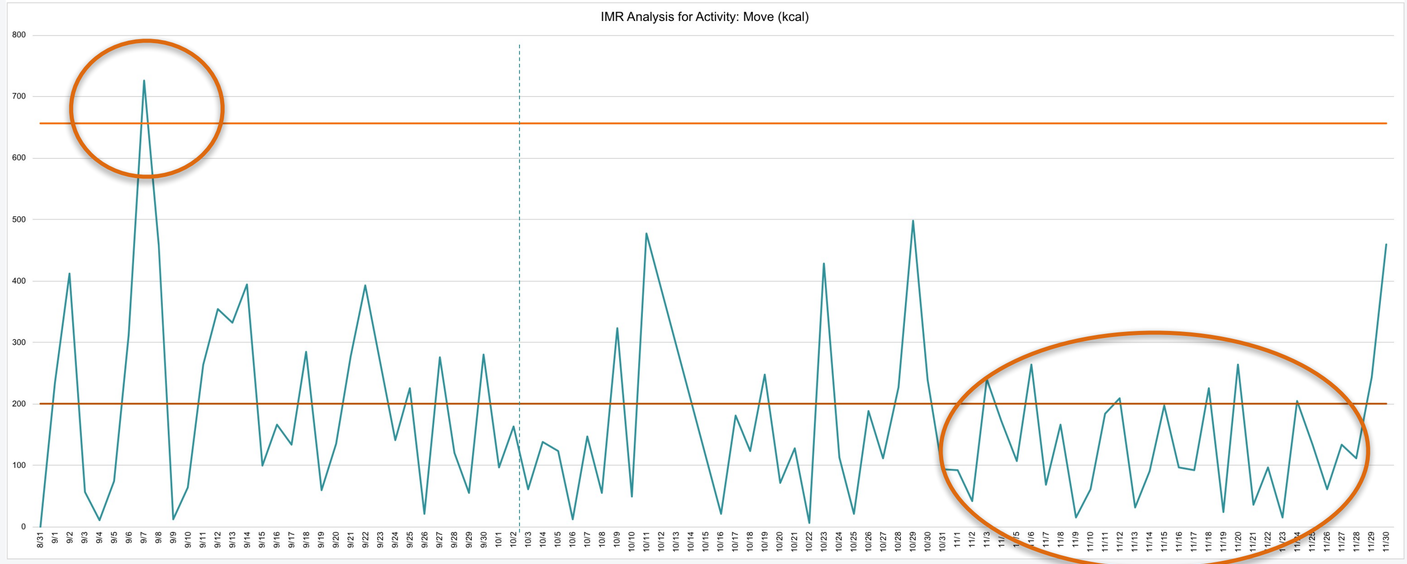
Time Series Analysis

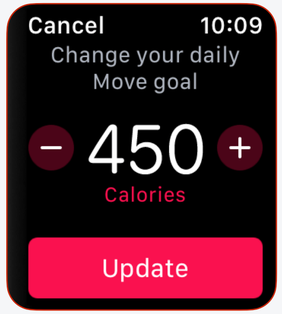
After we implemented WP2, we observed the data points trending slightly up with most falling above the mean or much closer to it than in WP1.

While the process was mostly under control in W1, there is a data point that exceeds the UCL.

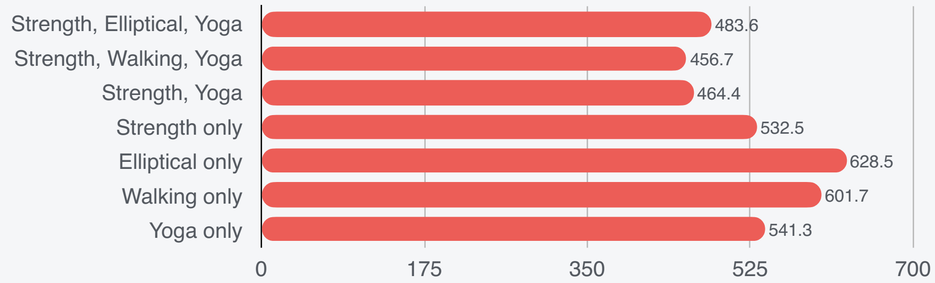
Data also had much larger variations versus WP2 from point to point. While still random, there is less variation from point to point suggesting this new process is more predictable than the original workout process.







y = 391.97 + 7.25x1 -76.84x2 - 68.08x3 - 7.72x4 + 19.10x5



Trending Up

The new process displays a trend towards consistently higher Move data points.

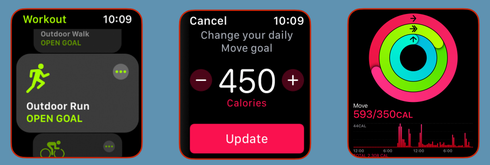
Raising the Bar

This trend suggests we've found a process that could enable us to successfully raise our Move goal from 350 kcal to 450 kcal without sacrificing Move success rate.

Predicting The Future

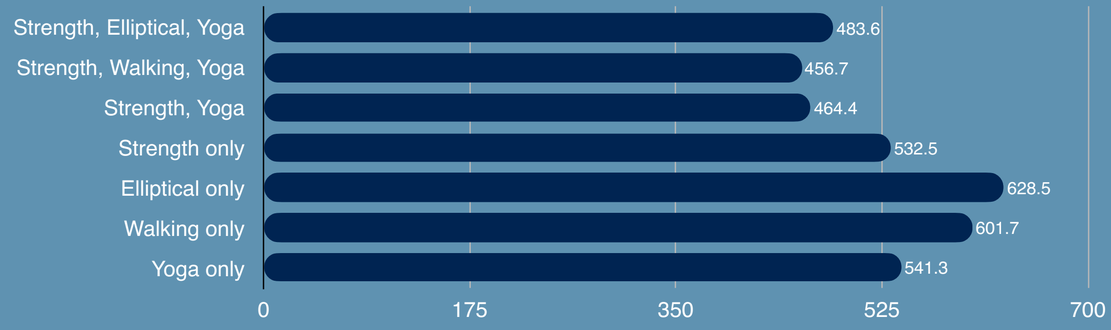
When using our regression formula to explore several scenarios, all scenarios have the potential to get us to the 450 kcal Move goal.

We feel confident that this new process allows us to raise the daily Move goal from 350 kcal to 450 kcal given any number of scenarios described previously, and with Exercise time remaining constant at 30 min or more.



Even though we didn't have scope to improve the process beyond the findings from WP2, we were able to gain some valuable insights and identify some process optimization scenarios for the future.

For our regression formula y = 391.97 + 7.25x1 - 76.84x2 - 68.08x3 - 7.72x4 + 19.10x5, we used the following values to predict several possible scenarios that can be explored in the Improve phase.



LOOKING AHEAD

Get Moving

Shorter workouts also make working out more approachable ensuring we're consistently moving and staying active most, if not all, days in a week.

Go for 10

Since we are meeting, and often exceeding, our daily Exercise goal of 30 min, we could explore reducing the cardio even further from 15 min to 10 min and then measure whether we're still attaining positive Activity results consistently.

Move to 450

Our regression analysis shows that with this new process, we should be able to consistently meet a higher Move target (kcal = 450) and then measure our process management at a subsequent control interval.

Stay Motivated

We should also explore other forms of cardio to keep workouts interesting, and measure how well those workout types contribute to the overall process.

Wellness Impact

Is there an impact to overall movement during the day (e.g., stand goal) on workout vs. non-workout days

Target Heart Rate

Which workout type has the most potential to meet the target heart rate goal for the workout duration?

Daily Steps

Do the number of steps throughout the day (workout and non-workout days) have an impact on the Move goal?

We achieved an overall positive business impact by fixing the current workout process over the course of this project. The Control phase will be key to staying on track for the long term.

Working Smarter

Gained the aility to select more effective workouts that reduce time at the gym while increasing effectiveness of each workout.

Wellness

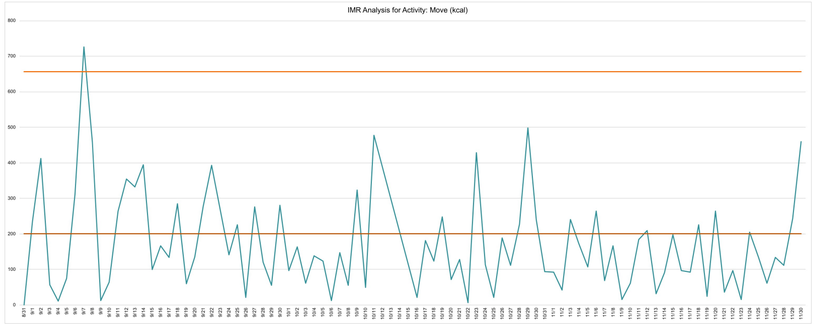
Continue to achieve health benefits attained by working out more consistently and meeting the health targets established for this project.

Data Export Challenges

Currently, there is no simple process for converting the XML export of Apple Health data to a readable Excel files consistently.

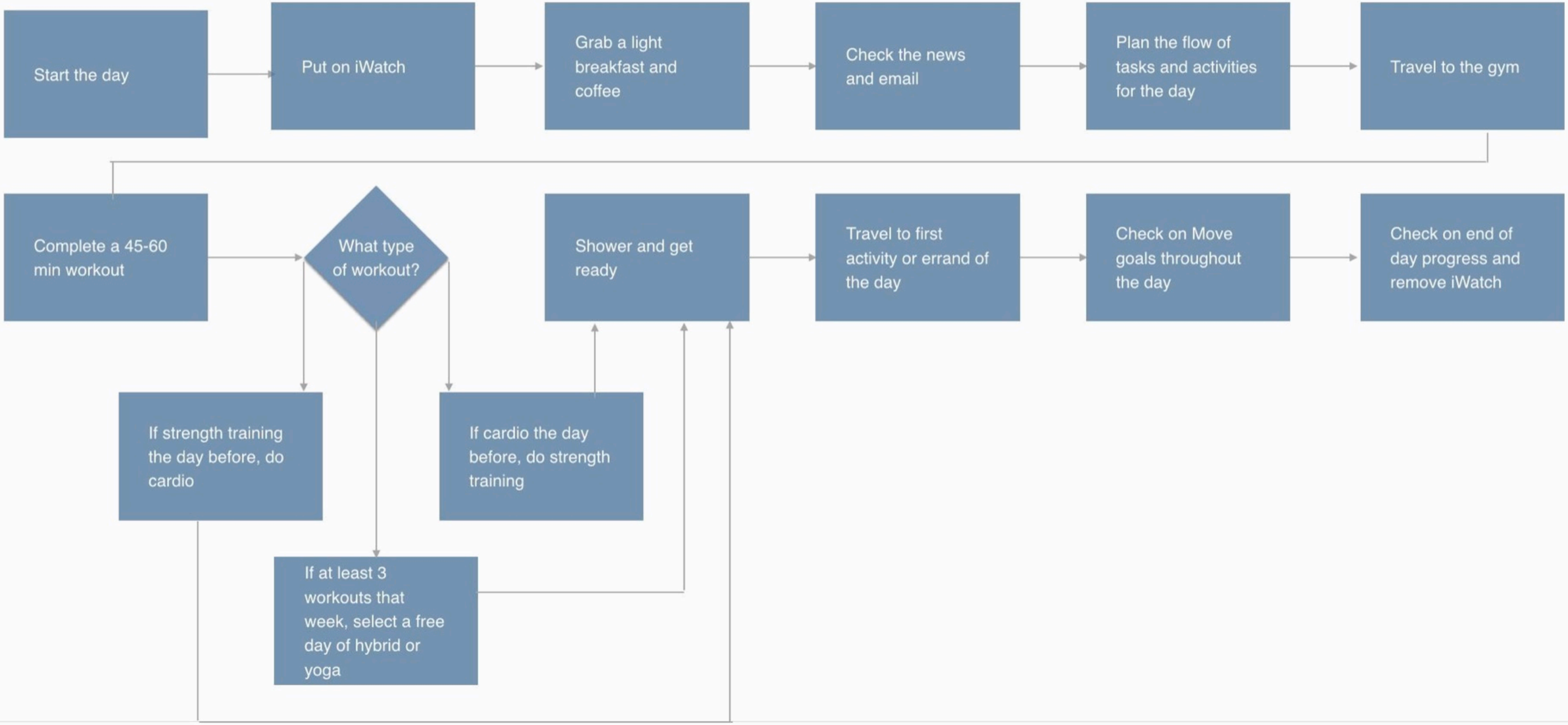
Enable Continuous Improvement

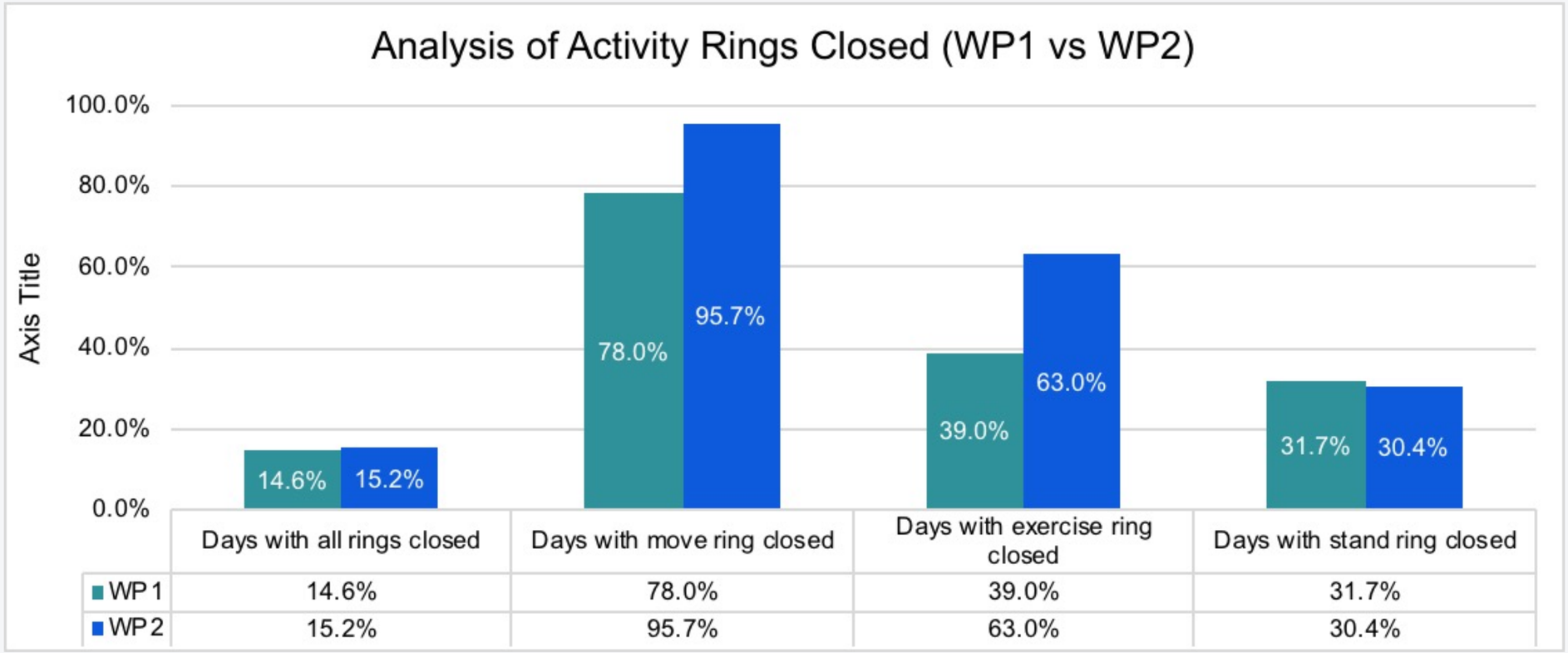
Moving forward, we will continue to implement our revamped WP2 process, and continue obtaining daily Activity data. To make the measurement process simple, we could take 30 days of data at the end of Q2 and Q4 to see if the process is continuing as expected, and assess whether one of our test scenarios has a significant enough impact that it warrants consideration as part of a WP3 refined process.

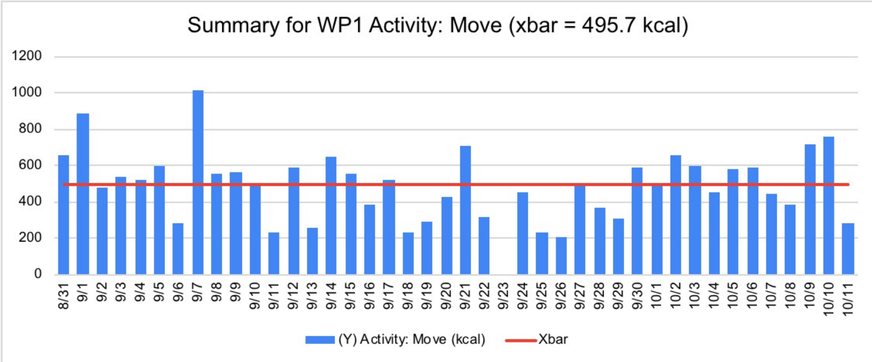


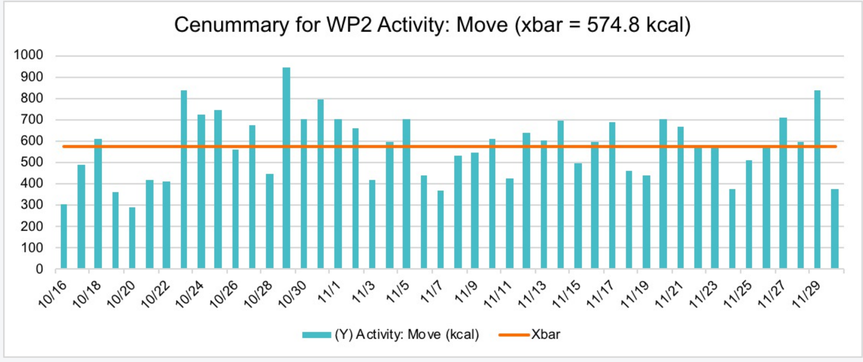
APPENDIX

Process Flow

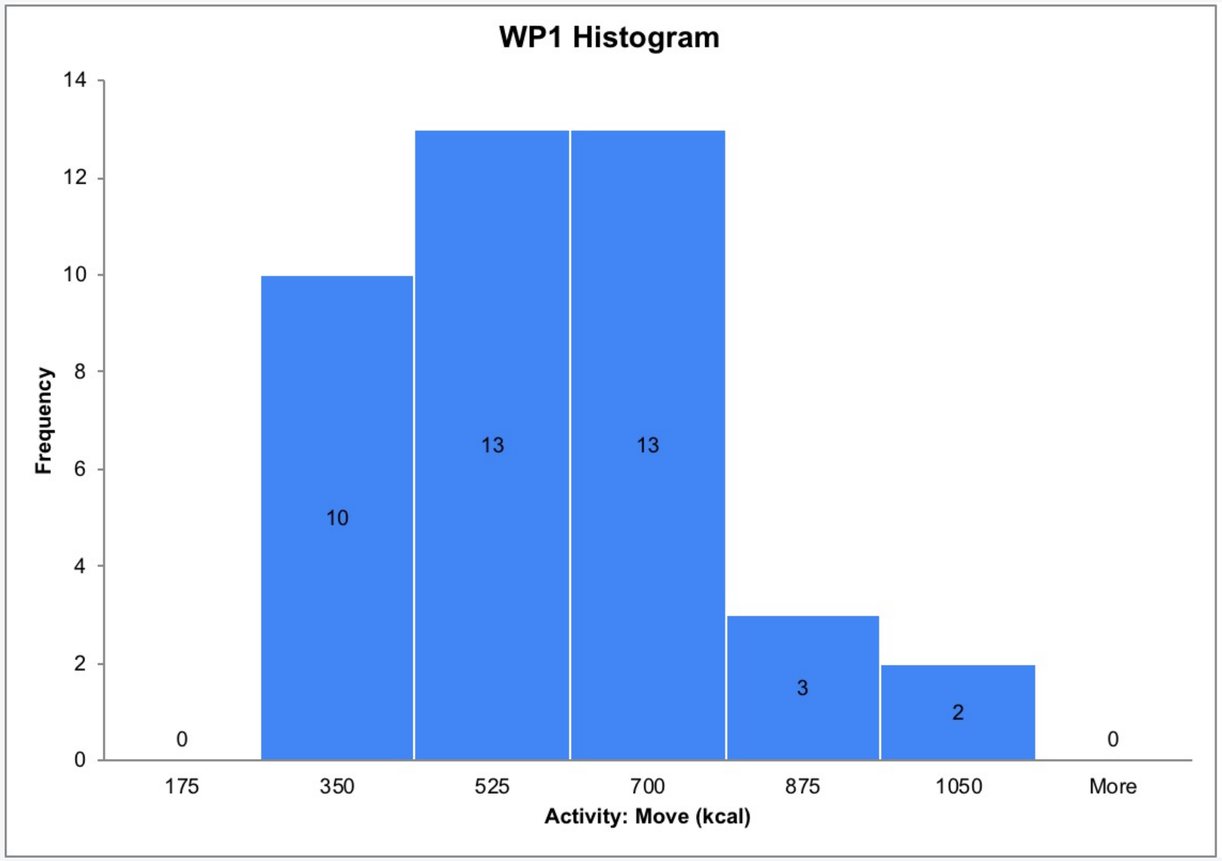


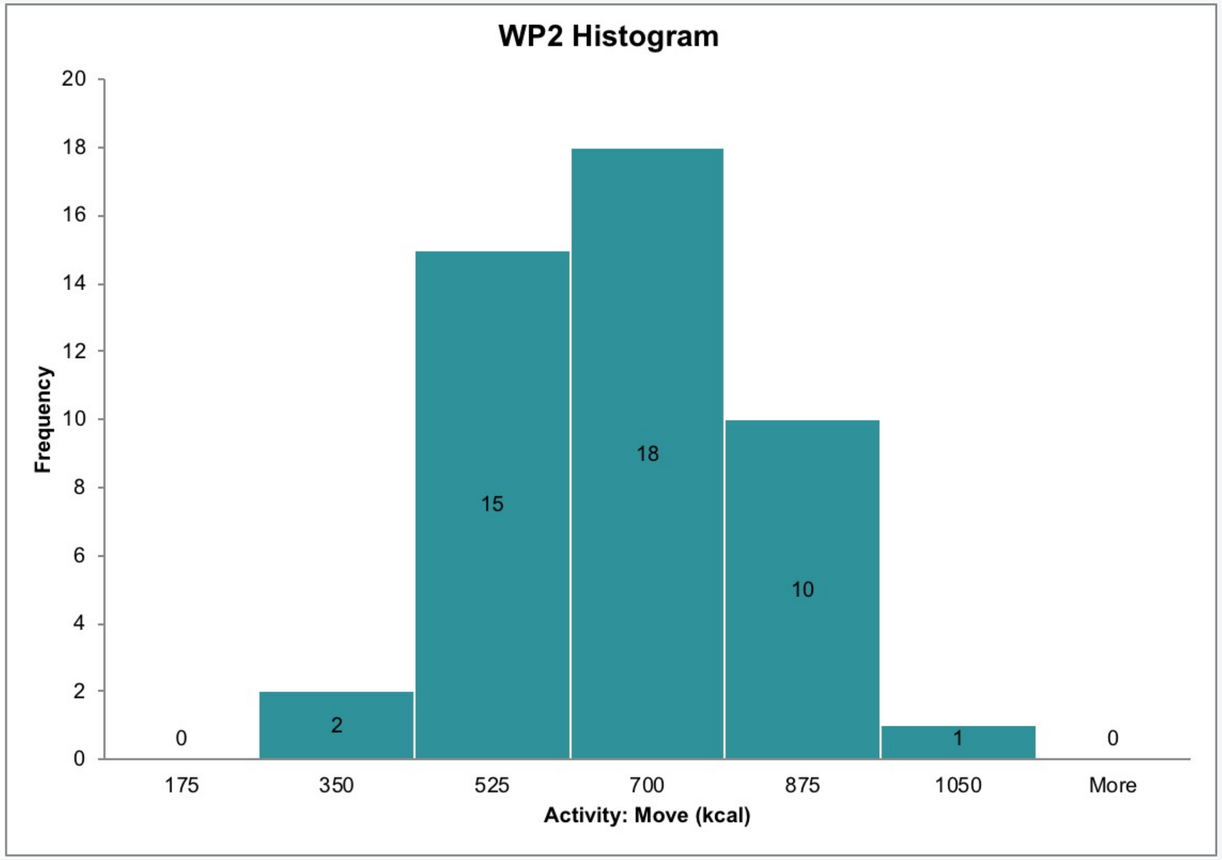

Analysis of Activity Rings Closed (WP1 vs WP2)
Axis Title
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
14.6%
15.2%
78.0%
95.7%
39.0%
63.0%
31.7%
30.4%
Days with all rings closed
Days with move ring closed
Days with exercise ring closed
Days with stand ring closed
WP 1
14.6%
78.0%
39.0%
31.7%
WP 2
15.2%
95.7%
63.0%
30.4%


Summary for WP1 Activity: Move (xbar = 495.7 kcal)
1200
1000
800
600
400
200
0
8/31
9/1
9/2
9/3
9/4
9/5
9/6
9/7
9/8
9/9
9/10
9/11
9/12
9/13
9/14
9/15
9/16
9/17
9/18
9/19
9/20
9/21
9/22
9/23
9/24
9/25
9/26
9/27
9/28
9/29
9/30
10/1
10/2
10/3
10/4
10/5
10/6
10/7
10/8
10/9
10/10
10/11
(Y) Activity: Move (kcal)
Xbar


Cenummary for WP2 Activity: Move (xbar = 574.8 kcal)
1000
900
800
700
600
500
400
300
200
100
0
10/16
10/18
10/20
10/22
10/24
10/26
10/28
10/30
11/1
11/3
11/5
11/7
11/9
11/11
11/13
11/15
11/17
11/19
11/21
11/23
11/25
11/27
11/29
(Y) Activity: Move (kcal)
Xbar

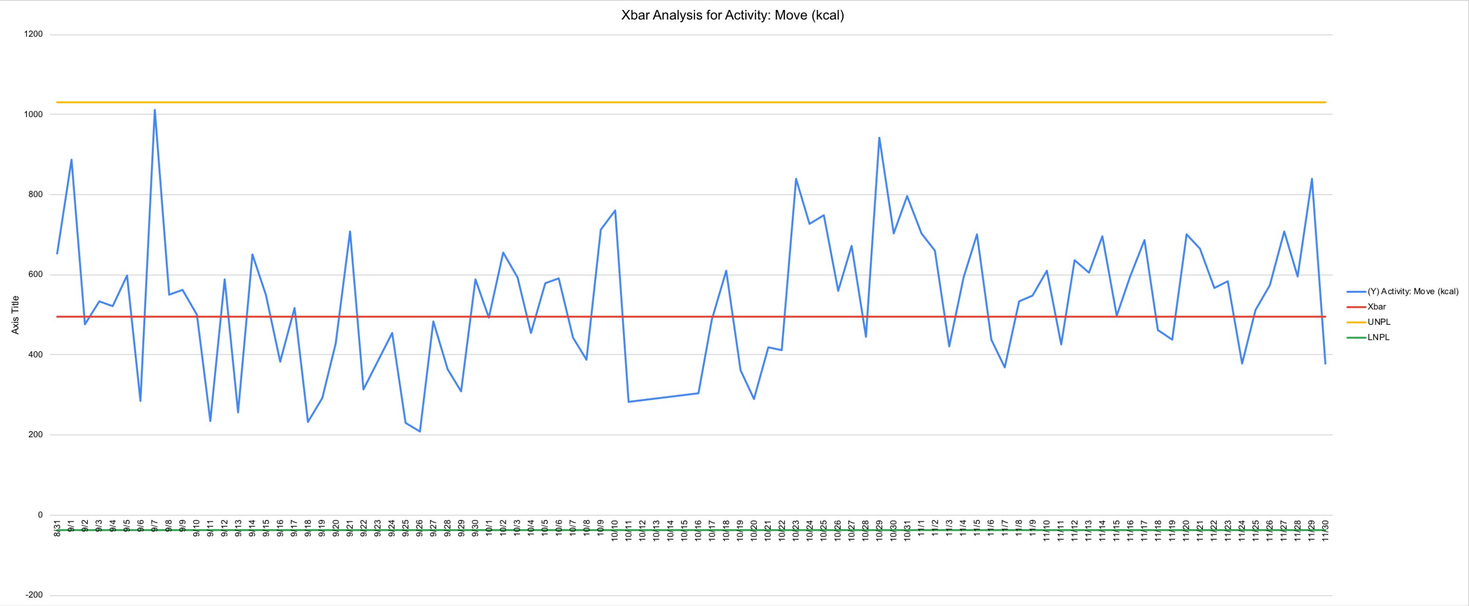
WP1	Mean	Median	Mode	Min	Max	Range
Activity: Move (kcal)	495.7	499.0	589.0	208.0	1011.0	803.0
Activity: Exercise (min)	30.5	21.0	12.0	0.0	117.0	117.0
Activity: Stand (hrs)	10	10	8	3	17	14
Workout Avg Heartrate	114	115	115	96	136	40
# of Rings Closed	1	2	2	0	3	3
WP2	**Mean**	**Median**	**Mode**	**Min**	**Max**	**Range**
Activity: Move (kcal)	574.8	588.5	437.0	290.0	942.0	652.0
Activity: Exercise (min)	31.9	36.0	12.0	0.0	86.0	86.0
Activity: Stand (hrs)	10	11	11	4	17	13
Workout Avg Heartrate	121	119	112	100	145	46
# of Rings Closed	2	2	2	0	3	3

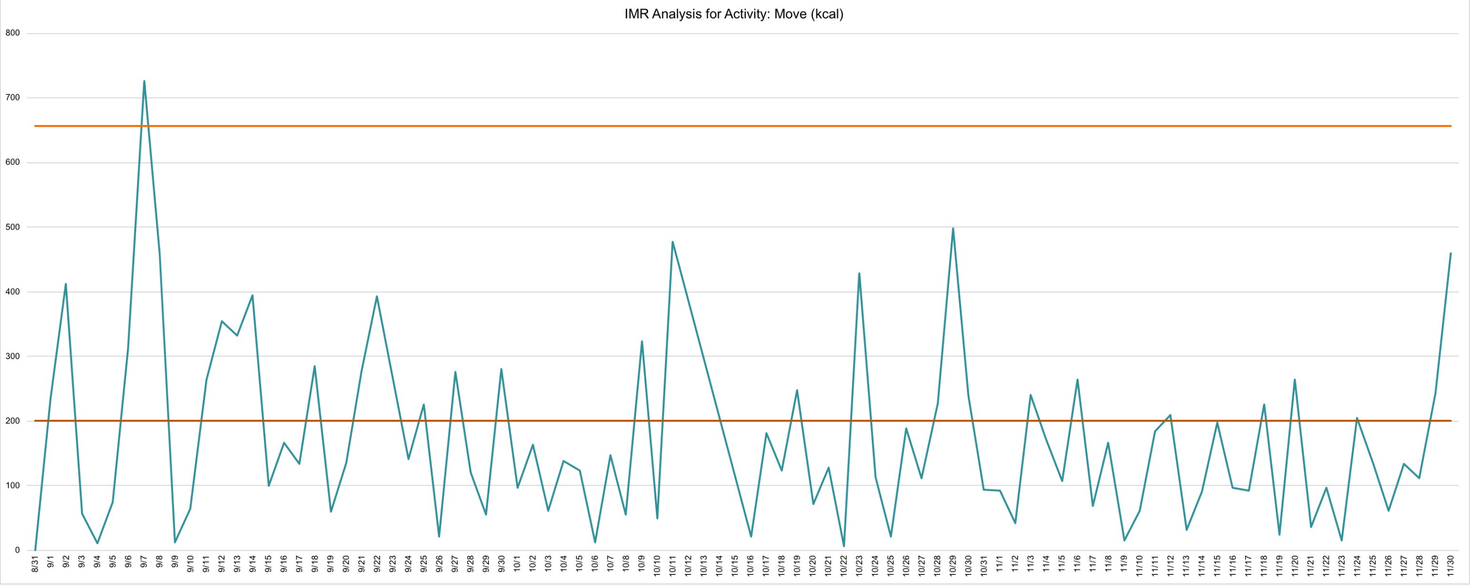




WP1 Histogram Data	
0	*Frequency*
175	0
350	10
525	13
700	13
875	3
1050	2
More	0

WP2 Histogram Data	
0	*Frequency*
175	0
350	2
525	15
700	18
875	10
1050	1
More	0





Summary		
	wp1	wp2
Avg Activity: Mo	495.6829268	574.826087
Avg mR	200.825	151.8222222
UNPL	1029.877427	978.6731981
LNPL	-38.51157317	170.9789758
URL	656.69775	496.4586667

WP1

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.84376042
R Square	0.71193165
Adjusted R S	0.67077903
Standard Err	104.318851
Observations	41

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	941318.082	188263.616	17.2997889	1.3175E-08
Residual	35	380884.796	10882.4227		
Total	40	1322202.88			

	Coefficients	*Standard Erro*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 90.0%*	*Upper 90.0%*
Intercept	336.896429	37.833794	8.90464299	1.6107E-10	260.089744	413.703114	272.973493	400.819365
Activity: Exer	5.40209696	0.61883846	8.72941371	2.617E-10	4.14578809	6.65840583	4.35652454	6.44766938
Strength	-77.468919	106.235198	-0.7292208	0.47071866	-293.13784	138.199998	-256.96098	102.023145
_Yoga	71.4615467	114.405261	0.62463514	0.53626159	-160.79348	303.716575	-121.83443	264.757525
Walking	-4.4313693	59.9778731	-0.0738834	0.94152382	-126.19292	117.330186	-105.76833	96.9055932
Elliptical	0	0	65535	#NUM!	0	0	0	0

WP2

SUMMARY OUTPUT

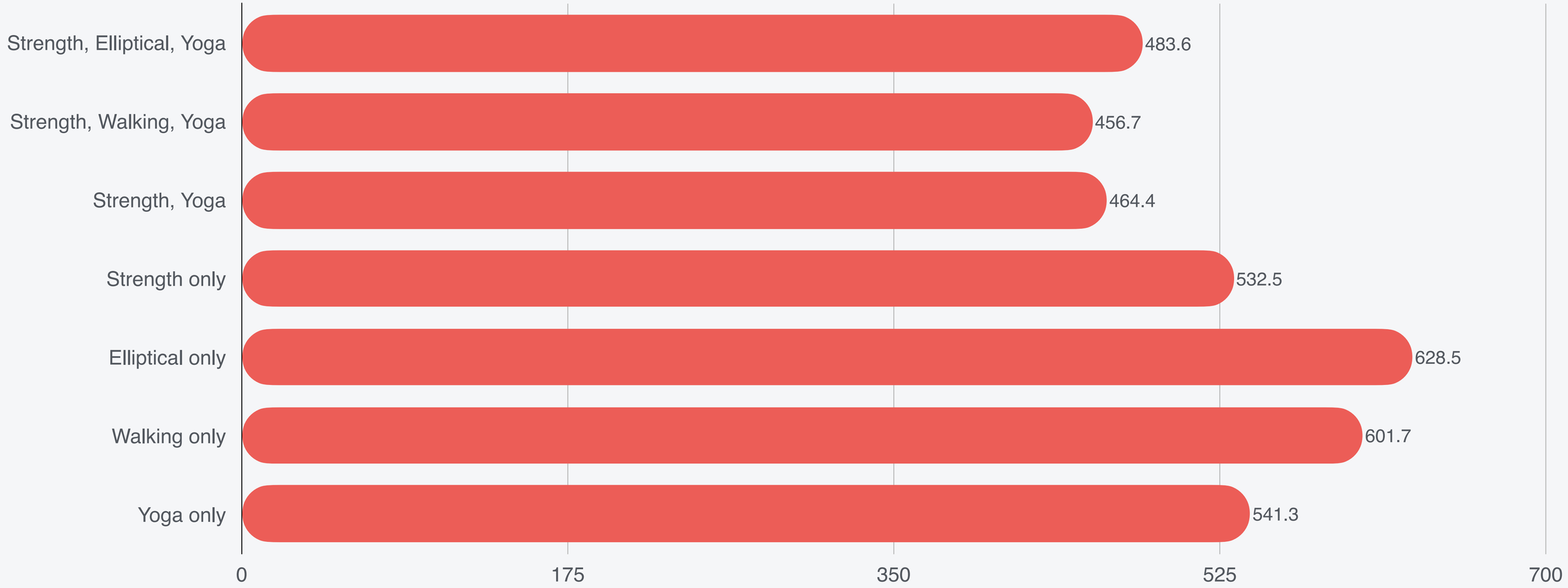
Regression Statistics	
Multiple R	0.86822874
R Square	0.75382115
Adjusted R S	0.72304879
Standard Err	79.4341041
Observations	46

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	772843.5327	154568.707	24.4966992	3.2986E-11
Residual	40	252391.076	6309.7769		
Total	45	1025234.609			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 90.0%*	*Upper 90.0%*
Intercept	391.986074	21.56740744	18.1749278	6.1836E-21	348.396718	435.57543	355.669773	428.302375
Activity: Exer	7.24610494	1.059556238	6.83881108	3.1464E-08	5.1046619	9.38754798	5.46197009	9.03023978
Strength	-76.837257	35.24999853	-2.1797804	0.03521898	-148.08016	-5.5943529	-136.193	-17.481512
_Yoga	-68.083701	37.31817782	-1.8244112	0.07556597	-143.50655	7.33915011	-130.92195	-5.2454491
Walking	-7.7183101	72.15782734	-0.1069643	0.91535201	-153.55472	138.118099	-129.22134	113.784721
Elliptical	19.1031578	40.09893502	0.47640063	0.63638111	-61.939813	100.146129	-48.417475	86.6237902

y = 391.97 + 7.25x1 -76.84x2 - 68.08x3 - 7.72x4 + 19.10x5



WP2	Equation Variable	Regression Value	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
Intercept	b0	391.986074	-	-					
Activity: Exercise (min	b1	7.246104939	30	30	30	30	30	30	30
Strength	b2	-76.83725746	1	1	1	1			
_Yoga	b3	-68.08370068	1	1	1				1
Walking	b4	-7.718310064		1				1	
Elliptical	b5	19.10315782	1				1		
	y = b0 + b1x1 + b2x2 + b3x3 + b4x4 + b5x5								

Predicted Y (kcal)	Activity Scenario Models for Move (kcal) with Exercise = 30 min
483.6	Scenario 1: Strength, Elliptical, Yoga
456.7	Scenario 2: Strength, Walking, Yoga
464.4	Scenario 3: Strength, Yoga
532.5	Scenario 4: Strength only
628.5	Scenario 5: Elliptical only
601.7	Scenario 6: Walking only
541.3	Sceanrio 7: Yoga only
y = 391.97 + 7.25x1 -76.84x2 - 68.08x3 - 7.72x4 + 19.10x5	

Process	Date	(Y) Activity: Move (kcal)	Xbar	UNPL	LNPL	R	Rbar	URL	Lagged Output (x)	Lagged residuals (x input)	Residuals (y input)	(X) Activity: Exercise (min)	Elliptical	Strength	_Yoga	Walking	Workout Avg Heartrate	Activity: Stand (hrs)	Ring Closed: Move (350 kcal)	Ring Closed: Exercise (30 min)	Ring Closed: Stand (12 hrs)	# of Rings Closed	% Rings Closed
wp1	8/31	654	495.6829268	1029.877427	-38.51157317	-	-	656.69775	-	-	-	56	0	1	1	1	115	11	1	1	0	2	67%
wp1	9/1	888	495.6829268	1029.877427	-38.51157317	234	200.825	656.69775	654	-		91	0	1	1	1	115	12	1	1	1	3	100%
wp1	9/2	476	495.6829268	1029.877427	-38.51157317	412	200.825	656.69775	888			12	0	1	1	1	115	9	1	0	0	1	33%
wp1	9/3	533	495.6829268	1029.877427	-38.51157317	57	200.825	656.69775	476			35	0	1	1	1	115	15	1	1	1	3	100%
wp1	9/4	522	495.6829268	1029.877427	-38.51157317	11	200.825	656.69775	533			5	0	1	1	1	115	17	1	0	1	2	67%
wp1	9/5	597	495.6829268	1029.877427	-38.51157317	75	200.825	656.69775	522			76	0	1	1	1	115	10	1	1	0	2	67%
wp1	9/6	285	495.6829268	1029.877427	-38.51157317	312	200.825	656.69775	597			4	0	1	1	1	115	8	0	0	0	0	0%
wp1	9/7	1011	495.6829268	1029.877427	-38.51157317	726	200.825	656.69775	285			117	0	1	1	1	115	13	1	1	1	3	100%
wp1	9/8	551	495.6829268	1029.877427	-38.51157317	460	200.825	656.69775	1011			70	0	1	1	1	115	6	1	1	0	2	67%
wp1	9/9	563	495.6829268	1029.877427	-38.51157317	12	200.825	656.69775	551			32	0	1	1	1	115	13	1	1	1	3	100%
wp1	9/10	499	495.6829268	1029.877427	-38.51157317	64	200.825	656.69775	563			15	0	1	1	1	115	12	1	0	1	2	67%
wp1	9/11	234	495.6829268	1029.877427	-38.51157317	265	200.825	656.69775	499			1	0	0	0	0	115	8	0	0	0	0	0%
wp1	9/12	589	495.6829268	1029.877427	-38.51157317	355	200.825	656.69775	234			63	0	0	0	0	115	7	1	1	0	2	67%
wp1	9/13	256	495.6829268	1029.877427	-38.51157317	333	200.825	656.69775	589			0	0	1	1	1	115	4	0	0	0	0	0%
wp1	9/14	650	495.6829268	1029.877427	-38.51157317	394	200.825	656.69775	256			55	0	1	1	1	115	11	1	1	0	2	67%
wp1	9/15	550	495.6829268	1029.877427	-38.51157317	100	200.825	656.69775	650			26	0	1	1	1	115	12	1	0	1	2	67%
wp1	9/16	384	495.6829268	1029.877427	-38.51157317	166	200.825	656.69775	550			5	0	1	1	1	115	10	1	0	0	1	33%
wp1	9/17	518	495.6829268	1029.877427	-38.51157317	134	200.825	656.69775	384			40	0	1	1	1	115	8	1	1	0	2	67%
wp1	9/18	233	495.6829268	1029.877427	-38.51157317	285	200.825	656.69775	518			0	0	0	0	0	115	5	0	0	0	0	0%
wp1	9/19	293	495.6829268	1029.877427	-38.51157317	60	200.825	656.69775	233			3	0	1	1	1	98	3	0	0	0	0	0%
wp1	9/20	429	495.6829268	1029.877427	-38.51157317	136	200.825	656.69775	293			26	0	1	1	1	116	9	1	0	0	1	33%
wp1	9/21	707	495.6829268	1029.877427	-38.51157317	278	200.825	656.69775	429			78	0	1	1	1	125	9	1	1	0	2	67%
wp1	9/22	314	495.6829268	1029.877427	-38.51157317	393	200.825	656.69775	707			21	0	1	1	1	105	7	1	0	0	1	33%
wp1	9/24	455	495.6829268	1029.877427	-38.51157317	141	200.825	656.69775	314			25	0	1	1	1	124	8	1	0	0	1	33%
wp1	9/25	229	495.6829268	1029.877427	-38.51157317	226	200.825	656.69775	455			9	0	1	1	1	108	3	0	0	0	0	0%
wp1	9/26	208	495.6829268	1029.877427	-38.51157317	21	200.825	656.69775	229			1	0	0	0	0	108	8	0	0	0	0	0%
wp1	9/27	484	495.6829268	1029.877427	-38.51157317	276	200.825	656.69775	208			6	0	0	0	0	107	14	1	0	1	2	67%
wp1	9/28	363	495.6829268	1029.877427	-38.51157317	121	200.825	656.69775	484			21	0	0	0	1	115	10	1	0	0	1	33%
wp1	9/29	308	495.6829268	1029.877427	-38.51157317	55	200.825	656.69775	363			12	0	0	0	1	117	8	0	0	0	0	0%
wp1	9/30	589	495.6829268	1029.877427	-38.51157317	281	200.825	656.69775	308			14	0	0	0	0	111	13	1	0	1	2	67%
wp1	10/1	492	495.6829268	1029.877427	-38.51157317	97	200.825	656.69775	589			11	0	0	0	0	112	8	1	0	0	1	33%
wp1	10/2	655	495.6829268	1029.877427	-38.51157317	163	200.825	656.69775	492			11	0	0	0	1	112	13	1	0	1	2	67%
wp1	10/3	593	495.6829268	1029.877427	-38.51157317	62	200.825	656.69775	655			35	0	0	1	1	96	12	1	1	1	3	100%
wp1	10/4	455	495.6829268	1029.877427	-38.51157317	138	200.825	656.69775	593			13	0	0	0	0	105	13	1	0	1	2	67%
wp1	10/5	578	495.6829268	1029.877427	-38.51157317	123	200.825	656.69775	455			27	0	1	1	1	113	9	1	0	0	1	33%
wp1	10/6	591	495.6829268	1029.877427	-38.51157317	13	200.825	656.69775	578			39	0	1	1	1	117	11	1	1	0	2	67%
wp1	10/7	443	495.6829268	1029.877427	-38.51157317	148	200.825	656.69775	591			32	0	1	1	1	126	12	1	1	1	3	100%
wp1	10/8	388	495.6829268	1029.877427	-38.51157317	55	200.825	656.69775	443			20	0	1	1	1	111	6	1	0	0	1	33%
wp1	10/9	712	495.6829268	1029.877427	-38.51157317	324	200.825	656.69775	388			55	0	1	1	1	136	11	1	1	0	2	67%
wp1	10/10	761	495.6829268	1029.877427	-38.51157317	49	200.825	656.69775	712			67	0	0	0	1	127	10	1	1	0	2	67%
wp1	10/11	283	495.6829268	1029.877427	-38.51157317	478	200.825	656.69775	761			20	0	0	0	1	119	5	0	0	0	0	0%
wp2	10/16	305	495.6829268	1029.877427	-38.51157317	-	-	656.69775	283			12	0	0	0	0	116	8	0	0	0	0	0%
wp2	10/17	487	495.6829268	1029.877427	-38.51157317	182	200.825	656.69775				23	0	0	0	0	109	17	1	0	1	2	67%
wp2	10/18	610	495.6829268	1029.877427	-38.51157317	123	200.825	656.69775				35	0	0	1	0	118	8	1	1	0	2	67%
wp2	10/19	362	495.6829268	1029.877427	-38.51157317	248	200.825	656.69775				12	0	0	0	0	112	12	1	0	1	2	67%
wp2	10/20	290	495.6829268	1029.877427	-38.51157317	72	200.825	656.69775				1	0	0	0	0	114	4	0	0	0	0	0%
wp2	10/21	418	495.6829268	1029.877427	-38.51157317	128	200.825	656.69775				12	0	0	1	0	110	11	1	0	0	1	33%
wp2	10/22	412	495.6829268	1029.877427	-38.51157317	6	200.825	656.69775				6	0	0	0	0	102	9	1	0	0	1	33%
wp2	10/23	840	495.6829268	1029.877427	-38.51157317	428	200.825	656.69775				58	0	0	0	1	127	14	1	1	1	3	100%
wp2	10/24	727	495.6829268	1029.877427	-38.51157317	113	200.825	656.69775				42	1	0	1	0	114	13	1	1	1	3	100%
wp2	10/25	749	495.6829268	1029.877427	-38.51157317	22	200.825	656.69775				43	1	0	0	0	117	11	1	1	0	2	67%
wp2	10/26	560	495.6829268	1029.877427	-38.51157317	189	200.825	656.69775				12	0	0	0	0	110	11	1	0	0	1	33%
wp2	10/27	672	495.6829268	1029.877427	-38.51157317	112	200.825	656.69775				52	1	0	1	0	112	10	1	1	0	2	67%
wp2	10/28	444	495.6829268	1029.877427	-38.51157317	228	200.825	656.69775				2	0	0	0	0	115	15	1	0	1	2	67%
wp2	10/29	942	495.6829268	1029.877427	-38.51157317	498	200.825	656.69775				69	0	0	1	0	120	16	1	1	1	3	100%
wp2	10/30	703	495.6829268	1029.877427	-38.51157317	239	200.825	656.69775				50	1	0	1	0	133	11	1	1	0	2	67%
wp2	10/31	797	495.6829268	1029.877427	-38.51157317	94	200.825	656.69775				64	1	0	1	0	122	10	1	1	0	2	67%
wp2	11/1	704	495.6829268	1029.877427	-38.51157317	93	200.825	656.69775				37	1	0	1	0	128	11	1	1	0	2	67%
wp2	11/2	661	495.6829268	1029.877427	-38.51157317	43	200.825	656.69775				40	1	0	1	0	135	11	1	1	0	2	67%
wp2	11/3	421	495.6829268	1029.877427	-38.51157317	240	200.825	656.69775				5	0	0	0	0	112	11	1	0	0	1	33%
wp2	11/4	594	495.6829268	1029.877427	-38.51157317	173	200.825	656.69775				7	0	0	0	0	104	16	1	0	1	2	67%
wp2	11/5	702	495.6829268	1029.877427	-38.51157317	108	200.825	656.69775				15	0	0	0	0	115	13	1	0	1	2	67%
wp2	11/6	437	495.6829268	1029.877427	-38.51157317	265	200.825	656.69775				7	0	0	0	0	100	10	1	0	0	1	33%
wp2	11/7	368	495.6829268	1029.877427	-38.51157317	69	200.825	656.69775				4	0	0	0	0	113	8	1	0	0	1	33%
wp2	11/8	534	495.6829268	1029.877427	-38.51157317	166	200.825	656.69775				53	1	1	1	0	140	5	1	1	0	2	67%

Building a better workout routine
MBC 638 Project: Problem Definition
Musangi Muthui
Syracuse University / Whitman School of Management / Fall 2019

The Business Driver
For this upcoming quarter, we want to focus on improving our workout routine to shorten time in the gym, maximize progress towards move goals and reap the health benefits of increased energy needed to tackle a busy schedule. Currently, morning workouts are based on alternating days of weights, cardio and yoga done over 45-60 minutes. But even with a schedule of 4-5 gym days per week, it's still hard to consistently hit all the key move targets tracked by our measurement device, an Apple iWatch. These health targets include:

- General activity as recorded by the iWatch Move goal
- Standing at least once every hour
- Workouts at an aerobic target heart rate (THR) of 128-147 bpm
- Daily calories burned.

Based on the latest research, shorter more intense workouts that include high intensity interval training (HIIT) can achieve the benefits of longer aerobic workouts including increased energy, heart health and overall well being associated with an active lifestyle. Currently, I have a weekly schedule that includes a mix of responsibilities that go on well past the usual 9-to-5 schedule. But by around 6pm, energy is fading, which makes it hard to be fully engaged and also makes freelance opportunities seem less attractive given a perception of not having enough time and energy for worthwhile projects.
For this workout improvement project, we will be leveraging data from an Apple iWatch that is worn daily during waking hours to understand how a shift in the workout process could address our issues of time management, goal attainment and available energy. We will be examining how shorter HIIT workouts have an impact on solving our current workout issues.

Business Impact
The overall value of fixing the current workout process over the course of this project include:

- Ability to select more effective workouts that reduce time at the gym while increasing effectiveness of each workout
- Achieve health benefits attained by working out more consistently and meeting the health targets above
- Increased energy leads to more efficient performance at work and university, and increases willingness to take on other activities.

It's predicted that time savings from less time at the gym and the associated increase in energy could free up about 5 hours a week of productive time. Leading a freelance digital project or UX workshop that requires a 20 hour investment each month, for example, is estimated to be worth $2,500 in additional revenues per quarter.

Measurement Goals
We want to target the following in terms of measuring success of a streamlined workout process...

- Track and compare number of days all Move rings were closed using the old vs new workout processes
- Identify the impact of different types of workouts on daily calorie goals and THR
- Track perception of energy levels after 6pm and identify any correlations with move goal progress.

Project Scope
As we move through the MBC 638 live sessions, we want to build the detailed methods for collecting, measuring and analyzing key data from iWatch that we would need to assess the effectiveness of the updated workout process.

Team
I will serve as the process owner/champion and will be managing the project execution, process definition, data collection and analysis.

Timeline and Milestones: 10.01.19 - 12.16.19
Define: 10.01 - 10.17

- 10.01 - Research kickoff
- 10.07 - Project kickoff live session
- 10.10 - Problem definition due
- 10.14 - Weekly live session call
- 10.17 - Refine process map

Measure: 10.18 - 11.24

- 10.11 - Initial data collection exercise
- 10.21 - Weekly live session call
- 10.24 - Hypothesis testing and preliminary measures
- 10.28 - Weekly live session call
- 10.31 - Perform chi-square test of independence
- 11.04 - Weekly live session call
- 11.07 - Define sample size and confidence intervals
- 11.11 - Weekly live session call
- 11.12 - Refine data collection as needed

Analyze: 11.13 - 11.21

- 11.14 - Identify correlation(s) and create simple linear regression
- 11.18 - Weekly live session call
- 11.21 - Run multiple regression testing

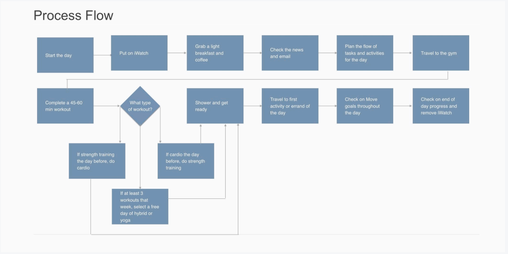
Improve: 11.22 - 12-08

- 11.25 - Weekly live session call
- 11.28 - Build control charts and analyze signal vs noise
- 12.02 - Weekly live session call
- 12.05 - Refine forecasting model and prep final readout

Control: 12.13 and beyond

- 12.13 - Deliver final readout for review
- 12.16 - Wrap up live session call
- 01.01.2020 and beyond: Implement control phase plan

Process Flow



Building a better workout routine
MBC 638 Data Analysis & Decision Making Process Project
Musangi Muthui
Syracuse University / Whitman School of Management / Fall 2019

Executive Summary

Problem Definition
For this upcoming quarter, we wanted to focus on improving our workout routine to shorten time in the gym, maximize progress towards daily move goals and reap the health benefits of increased energy needed to tackle a busy schedule.

It's predicted that time savings from less time at the gym and the associated increase in energy could free up about 5 hours a week of productive time. Leading a freelance digital project or UX workshop that requires a 20 hour investment each month, for example, is estimated to be worth $2,500 in additional revenues per quarter.

We wanted to target the following in terms of measuring success of a streamlined workout process:
1.Track and compare number of days all Activity rings (Move kcal, Stand hrs and Exercise min) were closed using the old vs new workout processes
2.Identify the impact of different workout types on daily calorie goals (Move)
3.Gain insights to select more effective workouts that reduce time at the gym while increasing effectiveness of each workout
4.Confidently raise our daily Move goal from 350 to 450 kcal based on effectiveness of the new process

DMAIC Storyboard
Define
Given an increasingly busy schedule, we wanted to find a way to have a more efficient workout process that enabled us to meet our Move target, and setup for success an ongoing process where we could reduce workout time while simultaneously raising the daily Move goal from 350 kcal to 450 kcal.

Our y = f(x) had y as the Move data point where x consisted of several variables measuring exercise time and workout type. For project kickoff, we created a problem definition worksheet that outlined a high-level summary of the problem to be studied, the business impact of solving this problem and a timeline for data collection and analysis.

Our hypothesis was as follows…

H0: Shorter HIIT workouts will have no effect on Move goals when compared to regular full-length cardio workouts. ($\mu1 = \mu2$)

Ha: Shorter, higher intensity workouts will have a positive impact on daily Move goals when compared to regular full-length cardio workouts. ($\mu1 < \mu2$)

For this data set, we will use an alpha of $\alpha = 0.10$ and a series of tools including summary charts, multiple regression, time series analysis, histograms and measures of central tendency. For this continuous data set, our $\alpha = 0.10$. The sample size and dual data sets indicate an upper/right one-tail test would be most appropriate.

Measure
For this workout improvement project, we leveraged data from an Apple iWatch that is worn daily during waking hours to understand how a shift in the workout process could address our issues of time management, goal attainment and available energy. Data was extracted from the Apple Health app.

In the initial workout process (WP1), workouts consisted of the following:
• 45 min cardio session on an incline treadmill
• 10-15 min of strength training
• 10-15 min modified yoga using seated poses and the sauna when available

To measure whether shorter, higher intensity workouts would have an impact on solving our current workout issues, we modified the workout process (WP2) as follows:
• 15 min cardio session on an elliptical machine
• 10-15 min of strength training
• 10-15 min modified yoga using seated poses and the sauna when available

45 days of Activity data was to collected for 8.31 to 10.15 (WP1) and 10.16 to 11.30 (WP2).

Performance measures: Move goal achieved (kcal = 350); # of Activity rings closed; and, % of days all three Activity rings were closed

Questions about the process…
• Does a shorter, higher intensity workout have an impact on the Move goal versus workouts with a longer cardio set?
• Which workout type had the most impact on the Move goal?
• Which workout type, or mix, has the most potential to help us meet an elevated Move target (kcal = 450) in the future?

Analyze
We found that of all the x variables, exercise time, strength training and yoga were strongly correlated and had a statistically significant impact on the y variable, Move, at alpha = 0.10. Just meeting the daily Exercise goal of 30 min with any single workout or mix of workouts was the strongest predictor of Move goal success.

Exercise time, strength training and yoga were strongly correlated and had a statistically significant impact on the y variable, Move, at $\alpha = 0.10$. Therefore, we reject the null hypothesis, $\mu1 = \mu2$ and find that shorter, higher intensity workouts had a positive impact on the Move goal ($\mu1 < \mu2$).

This was not a linear relationship and we suspect this is due to the complex mix of factors (e.g., incline grade, indoor vs outdoor, time, distance, etc.) that go into estimating calorie burn (Move) for different workout types.

The x variable average heart rate was removed after initial regression analysis as it had no impact on the Move goal. We ran the regression again and the remainder of our project analysis focused on the x variables of exercise time and our four workout types (strength training, yoga, elliptical and walking).

Improve
Even though we didn't have scope to improve the process beyond the findings from WP2, we were able to gain some valuable insights and identify some process optimization scenarios for the future. We feel confident that this new process allows us to raise the daily Move goal from 350 kcal to 450 kcal given any number of scenarios described previously, and with Exercise time remaining constant at 30 min or more.

For our regression formula y = b0 + b1x1 + b2x2 + b3x3 + b4x4 + b5x5, we used the following values to predict several possible scenarios that can be explored in the Improve phase:
y = 391.97 + 7.25x1 -76.84x2 - 68.08x3 - 7.72x4 + 19.10x5

Control
We would take samples of data throughout the year. Our goal is to make the data extraction process from the health app more streamlined so we can move from an initial target of twice a year to once a quarter and eventually have a robust weekly dashboard so we can adjust quickly to any changes in process performance. For the Control phase, we will leverage the Xbar/R and IMR charts created during our time series analysis of WP1 and WP2 performance.

Deep Dive Analysis

How we re-engineered the process (as-is vs to-be adjustments)
In the initial workout process (WP1), workouts consisted of the following:
• 45 min cardio session on an incline treadmill
• 10-15 min of strength training
• 10-15 modified yoga using seated poses and the sauna when available

To measure whether shorter, higher intensity workouts would have an impact on solving our current workout issues, we modified the workout process (WP2) as follows:
• 15 min cardio session on an elliptical machine
• 10-15 min of strength training
• 10-15 modified yoga using seated poses and the sauna when available

What we did (measurement plan)
For this workout improvement project, we leveraged data from an Apple iWatch that is worn daily during waking hours to understand how a shift in the workout process could address our issues of time management, goal attainment and available energy.

Since cardio was the largest portion of time spent, we started with the goal of reducing time for that particular X variable. We then established a data measurement plan that would answer key questions of interest.

Data Measurement plan
• Performance measures: Move goal achieved (kcal = 350); # of Activity rings closed; and, % of days all three Activity rings were closed
• Data source and location: Apple Health app data
• How data is collected: Apple iWatch worn daily
• Who and when: Data is automatically collected throughout the day as long as the iWatch is worn, and provided that workouts are started/stopped by the wearer for better data coding and analysis
• Target sample size: 45 days of Activity data for 8.31 to 10.15 (WP1) and 10.16 to 11.30 (WP2) (Note: Any dates where the iWatch was not worn would be removed from the data analysis set)

Data Stratification Tree
Questions About the Process
• Does a shorter, higher intensity workout have an impact on the Move goal versus workouts with a longer cardio set?
• Which workout type had the most impact on the Move goal?
• Which workout type, or mix, has the most potential to help us meet an elevated Move target (kcal = 450) in the future?

Output Y
• Activity: Move (kcal)

X Variables
• Activity: Exercise (min)
• Strength
• Yoga
• Walking
• Elliptical
• (Note: After an initial regression analysis, average heartrate was removed since it had no impact on Move goal. The remainder of this deck uses analysis based on the X variables listed above sans average heartrate.)

The highlights (central tendency)
1. The mean Move measurements increased to 574.8 kcal to 495.7 kcal
2. The median calorie burn also increased going from 499.0 to 588.5
3. The range became tighter thus reducing variation in the workout process
4. Average heart rate increased 5.8% to 121moving us closer to our THR xxx range (avg THR = xxx)
5. Average number of Activity rings closed moved from 1 to 2

How often Activity rings were closed
1. The percent of days with the Move ring closed increased to 95.7% from 78.0%...
2. …And the Exercise ring increased from 39% to 63%, a nearly 50% increase
3. There's still work to do in closing all the rings, but we did observe an increase from 14.6% to 15.2%...
4. …And overall, the Move measure skewed further to the right with a majority of values falling in a range above 525 kcal

How the process performed over time (time series analysis)
After we implemented WP2, observe the data points trending slightly up with most falling above the mean or much closer to it than in WP1. While the process was mostly under control in W1, there is a data point that exceeds the UCL. Data also had much larger variations versus WP2 from point to point. While still random, there is less variation from point to point suggesting this new process is more predictable than the original workout process.

How we made a difference (histogram analysis)
Trending Up
The new process displays a trend towards consistently higher Move data points.

Raising the Bar
This trend suggests we've found a process that could enable us to successfully raise our Move goal from 350 kcal to 450 kcal without sacrificing Move success rate.

Predicting the Future
When using our regression formula to explore several scenarios, all scenarios have the potential to get us to the 450 kcal Move goal. The predicted 500+ kcal for a large number of scenarios suggests we could consider shifting the Move goal even higher in the future without adding more workout time to the process.

Looking Forward

What we would improve
How can we optimize the process even further to continue on our path of reducing time at the gym while still reaping the health benefits of regular activity?
• Our regression analysis shows that with this new process, we should be able to consistently meet a higher Move target (kcal = 450) and then measure our process management at a subsequent control interval.
• Since we are meeting our daily Exercise goal of 30 min, we could explore reducing the cardio even further from 15 min to 10 min and then measure whether we're still attaining positive Activity results consistently.
• Shorter workout also making working out more approachable ensuring we're consistently moving and staying active most, if not all, days in a week.
• We should also explore other forms of cardio to keep workouts interesting, and measure how well those workout types contribute to the overall process.

What we could explore
There are additional analysis we could build upon to further optimize the workout process. A few data analysis objectives for a future assessment could include the following:
• Is there an impact to overall movement during the day (e.g., stand goal) on workout vs. non-workout days?
• Which workout type has the most potential to meet the target heartrate goal for the workout duration?
• Do the number of steps through the day (workout and non-workout days) have an impact on the Move goal?

How we would control the process
Business Impact: The overall business impact of fixing the current workout process over the course of this project included:
● Ability to select more effective workouts that reduce time at the gym while increasing effectiveness of each workout
● Achieve health benefits attained by working out more consistently and meeting the health targets above
● Increased energy leads to more efficient performance at work and university, and increases willingness to take on other activities.

Moving forward, we will continue to implement our revamped WP2 process, and continue obtaining daily Activity data. To make the measurement process simple, we could take 30 days of data at the end of Q2 and Q4 to see if the process is continuing as expected, and assess whether one of our test scenarios has a significant enough impact that it warrants consideration as part of a WP3 refined process.

We will also explore ways to automate the data export. Currently, there is no simple process for converting the XML export of Apple Health data to a readable Excel file. A few apps exist but we didn't find they gave us the granularity needed to perform statistical analysis, or just didn't work at all. The file itself is massive and tended to crash online XML parsing sites, so for this project we had to hand enter the data from the Health app into an Excel table.

This data export challenge may be due to some incompatibilities with the HealthData XML data type. However, based on research done during the measure phase, and with a bit of coding magic, we may be able to build an XML parsing function using PHP or Python. This would convert the Health data export into an HTML table that can more easily be transferred to Excel for analysis ,or even analyzed on the HTML page as a dynamic dashboard.

THANK YOU