Virginia Commonwealth University
School of Business

<u>SCMA 677</u>
Quality Management

Bryce Bowles
12/02/2021

Assignment
Time Series Data

Select a process or activity from which you can take a measurement at least 5 times a week. For example, how long it takes you to get to school or work; how much you spend each day for lunch; how many miles you drive each day?

In addition record two simultaneous variables that may influence your primary variable. For example, day of the week, weather conditions…

Create an operational definitions for all your measurements.

Next class you will share your process or event and operational definitions with the class and make any modifications based on the class's suggestions.

Collect your data daily. Note any unusual events that occur that may affect your data. You should continue to collect data for the remainder of the semester.

During the semester we will discuss methods of analyzing data. You should analysis your data using any appropriate methods. At a minimum create a control chart and a histogram. Note if the process is in or out of control and anything note worth about the distribution.

Determine if the simultaneous variables do, in fact, influence the process, and if so, how and why?

At the end of the semester you will prepare a written report and an oral presentation on your analysis.

Time Series Workout Data
Assignment

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An obvious choice of data to use for this assignment was Workout Data collected by my Apple Watch. Each time I workout (usually 3-5 times per week) I select which type of workout activity I use on my watch and the data gets automatically sent to my phone apple "health app".

To retrieve the data from my phone in a more easily readable file, I was able to export the data using an app called "Workout – CSV Exporter". The file exported all data recorded however I chose to use data from the beginning of 2020 through late November 2021. The Variables tracked are PK (number for each row), Type (of workout), Date, DOW (Date of Week), Start, End, Duration, Distance (km), Average Heart Rate, Max Heart Rate, Average Pace, Average Speed, Average Cadence, Active Energy, Total Energy, Elevation Ascended, Weather Temperature, and Weather Humidity.

Data Sample:

PK	Type	Date	DOW	Start	End	Duration	Distance (km)	Avg Heart Rate	Max Heart Rate	Avg Pace	Avg Speed (km/hr)	Avg Cadence	Active Energy	Total Energy	Elevation Ascended	Weather Temp (°C)	Weather Humidity
1	Traditional Strength Training	11/26/2021	Friday	11/26/2021 11:02	11/26/2021 11:36	0:34:20		89	153				186	239		12	36
2	Traditional Strength Training	11/19/2021	Friday	11/19/2021 12:21	11/19/2021 12:57	0:35:36		95	144				211	288			
3	Outdoor Running	11/17/2021	Wednesday	11/17/2021 16:15	11/17/2021 16:46	0:30:27	4.85	158	176	0:06:16	10	247	342	393			
4	Indoor Cycling	11/16/2021	Tuesday	11/16/2021 12:14	11/16/2021 12:26	0:12:10		138	160				104	146			
5	Traditional Strength Training	11/16/2021	Tuesday	11/16/2021 11:45	11/16/2021 12:14	0:28:20		67	100				133	176			
6	Traditional Strength Training	11/15/2021	Monday	11/15/2021 12:02	11/15/2021 13:00	0:58:53		103	163				373	487			
7	Soccer	11/14/2021	Sunday	11/14/2021 19:31	11/14/2021 20:22	0:51:21	2.19	136	187	0:23:30	3		444	545		10	52
8	Outdoor Running	11/11/2021	Thursday	11/11/2021 11:47	11/11/2021 12:37	0:38:32	6.56	151	179	0:05:52	10	237	467	549			
9	Traditional Strength Training	11/10/2021	Wednesday	11/10/2021 11:58	11/10/2021 12:39	0:41:19		81	124				179	249			
10	Rowing	11/9/2021	Tuesday	11/9/2021 12:52	11/9/2021 13:07	0:14:53		144	171				101	148		23	30
11	Traditional Strength Training	11/9/2021	Tuesday	11/9/2021 12:19	11/9/2021 12:52	0:32:50		123	157				237	290		23	31
12	Traditional Strength Training	11/8/2021	Monday	11/8/2021 11:38	11/8/2021 12:20	0:41:54		96	155				255	340		18	39
13	Traditional Strength Training	11/3/2021	Wednesday	11/3/2021 16:25	11/3/2021 17:10	0:45:19		101	162				256	351			
14	Traditional Strength Training	11/2/2021	Tuesday	11/2/2021 9:53	11/2/2021 10:17	0:24:09		125	156				194	253			
15	Soccer	11/1/2021	Monday	11/1/2021 20:16	11/1/2021 21:12	0:55:51	3.01	137	190	0:18:32	3		511	601			
16	Indoor Cycling	10/29/2021	Friday	10/29/2021 12:40	10/29/2021 12:50	0:10:01		147	163				107	146			
17	Traditional Strength Training	10/29/2021	Friday	10/29/2021 12:11	10/29/2021 12:40	0:28:50		107	147				198	245			
18	Soccer	10/26/2021	Tuesday	10/26/2021 21:34	10/26/2021 22:12	0:37:26	0.73	123	181	0:51:23	1		259	320			
19	Traditional Strength Training	10/26/2021	Tuesday	10/26/2021 12:28	10/26/2021 12:55	0:27:05		82	126				123	188		19	57
20	Outdoor Running	10/25/2021	Monday	10/25/2021 12:07	10/25/2021 12:43	0:35:09	6.05	169	182	0:05:48	10	249	431	491			
21	Traditional Strength Training	10/22/2021	Friday	10/22/2021 9:20	10/22/2021 9:45	0:25:17		113	143				168	225		18	88
22	Traditional Strength Training	10/20/2021	Wednesday	10/20/2021 11:46	10/20/2021 12:30	0:43:48		73	111				188	278		22	44
23	Rowing	10/19/2021	Tuesday	10/19/2021 16:59	10/19/2021 17:10	0:10:45		134	157				78	116		23	31
24	Traditional Strength Training	10/18/2021	Monday	10/18/2021 12:21	10/18/2021 12:47	0:26:31		81	134				117	179		18	34
25	Soccer	10/17/2021	Sunday	10/17/2021 9:01	10/17/2021 10:47	1:45:16	9.78	163	183	0:10:45	6		1316	1513		11	65
26	Traditional Strength Training	10/15/2021	Friday	10/15/2021 12:03	10/15/2021 13:14	1:10:55		91	130				359	494		25	56
27	Outdoor Running	10/14/2021	Thursday	10/14/2021 16:01	10/14/2021 16:39	0:36:41	5.91	158	177	0:06:12	10	247	428	492			
28	Rowing	10/13/2021	Wednesday	10/13/2021 17:09	10/13/2021 17:20	0:10:53		133	146				85	104			
29	Traditional Strength Training	10/13/2021	Wednesday	10/13/2021 16:39	10/13/2021 17:09	0:29:43		107	136				157	206		24	68
30	Traditional Strength Training	10/12/2021	Tuesday	10/12/2021 17:45	10/12/2021 18:08	0:23:13		118	142				168	230		21	88

Most of the data variables are self-explanatory however I've provided operation definitions for those that may be in question. Active Energy will be used as a dependent variable for the majority of the presentation however I've investigated multiple.

- Average Heart Rate: Average beats/minute in duration of workout
- Active Energy (calories): These are the calories you burn by being active. Calculated using personal information such as height, weight, gender, and age.

• Traditional Strength Training: Lifting weights (Chest, back, shoulders, legs, arms etc.)

To show the overall scope and descriptive statistics of the data set, pivot tables were created. Outdoor Running will be the main focus of the presentation due to the greatest number of recorded workouts. I most frequently recorded a workout on Tuesdays. Thursdays had the greatest average distance for outdoor runs. My average heart rate for outdoor running was greatest compared to other types of workouts however the average active energy is greatest during soccer games (due to the length of games and distance ran). I did notice however that not all workouts recorded a weather temperature and humidity due to selecting different apps to record workouts (Nike run app does not collect that data).

Row Labels	Count of Type	Row Labels	Count of PK	Row Labels	Average of Distance
Outdoor Running	160	Tuesday	72	Thursday	4.8
Traditional Strength Training	105	Wednesday	69	Wednesday	4.7
High Intensity Interval Training	41	Monday	63	Friday	4.7
Indoor Cycling	14	Friday	51	Tuesday	4.6
Outdoor Cycling	12	Thursday	47	Monday	4.5
Soccer	7	Sunday	23	Saturday	4.3
Rowing	5	Saturday	19	Sunday	4.2
Grand Total	344	Grand Total	344	Grand Total	4.6

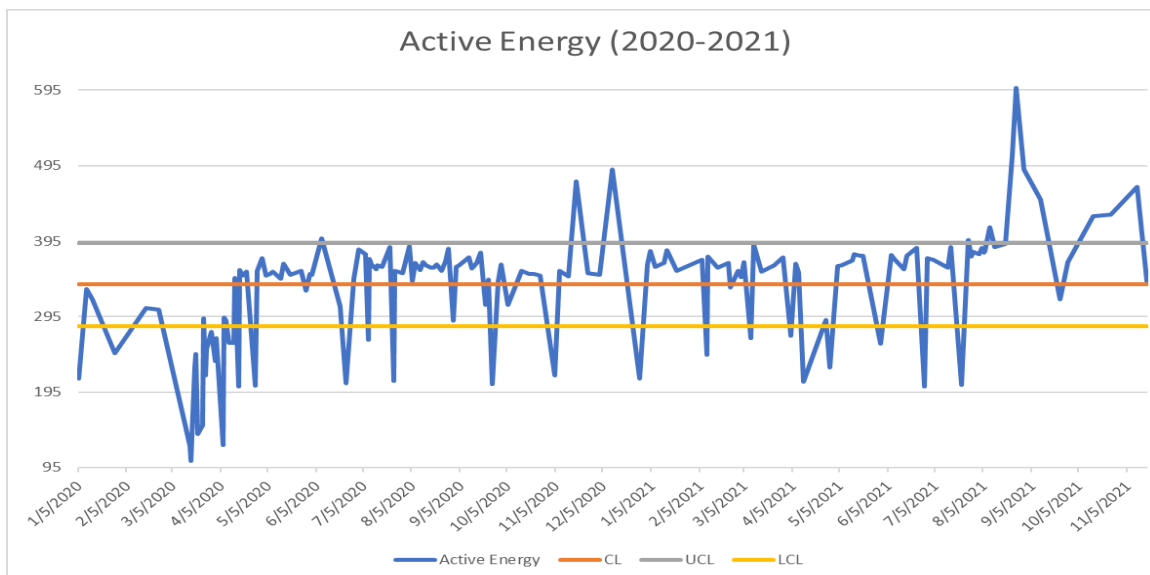| Row Labels	Average of Average Heart Rate	Row Labels	Average of Active Energy	Row Labels	Count of Weather Temperature	Count of Weather Humidity
Outdoor Running	161	Soccer	824	Traditional Strength Training	82	82
Soccer	147	Outdoor Running	338	High Intensity Interval Training	41	41
Rowing	135	Outdoor Cycling	283	Outdoor Cycling	12	12
Indoor Cycling	133	Traditional Strength Training	241	Indoor Cycling	10	10
Outdoor Cycling	132	High Intensity Interval Training	194	Outdoor Running	6	6
High Intensity Interval Training	102	Indoor Cycling	135	Soccer	4	4
Traditional Strength Training	102	Rowing	92	Rowing	3	3
Grand Total	133	Grand Total	287	Grand Total	158	158

Histograms were then created to show the distributions of select variables for Outside Running.
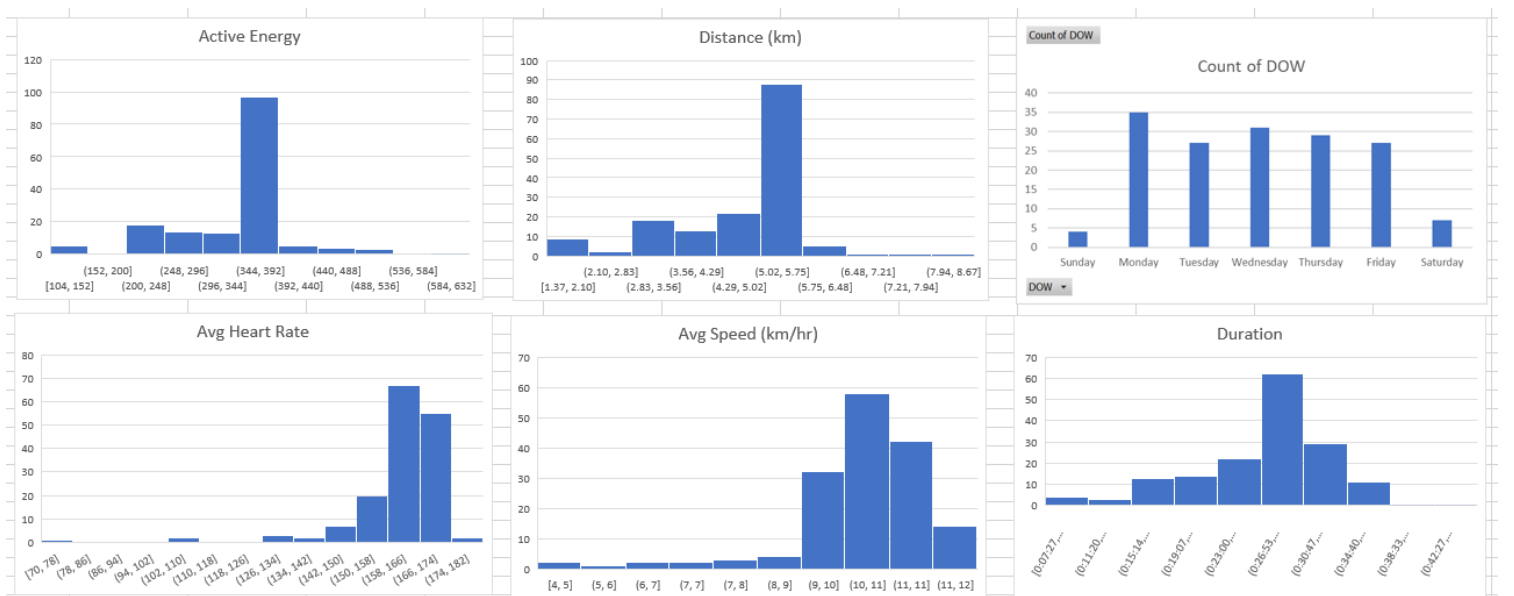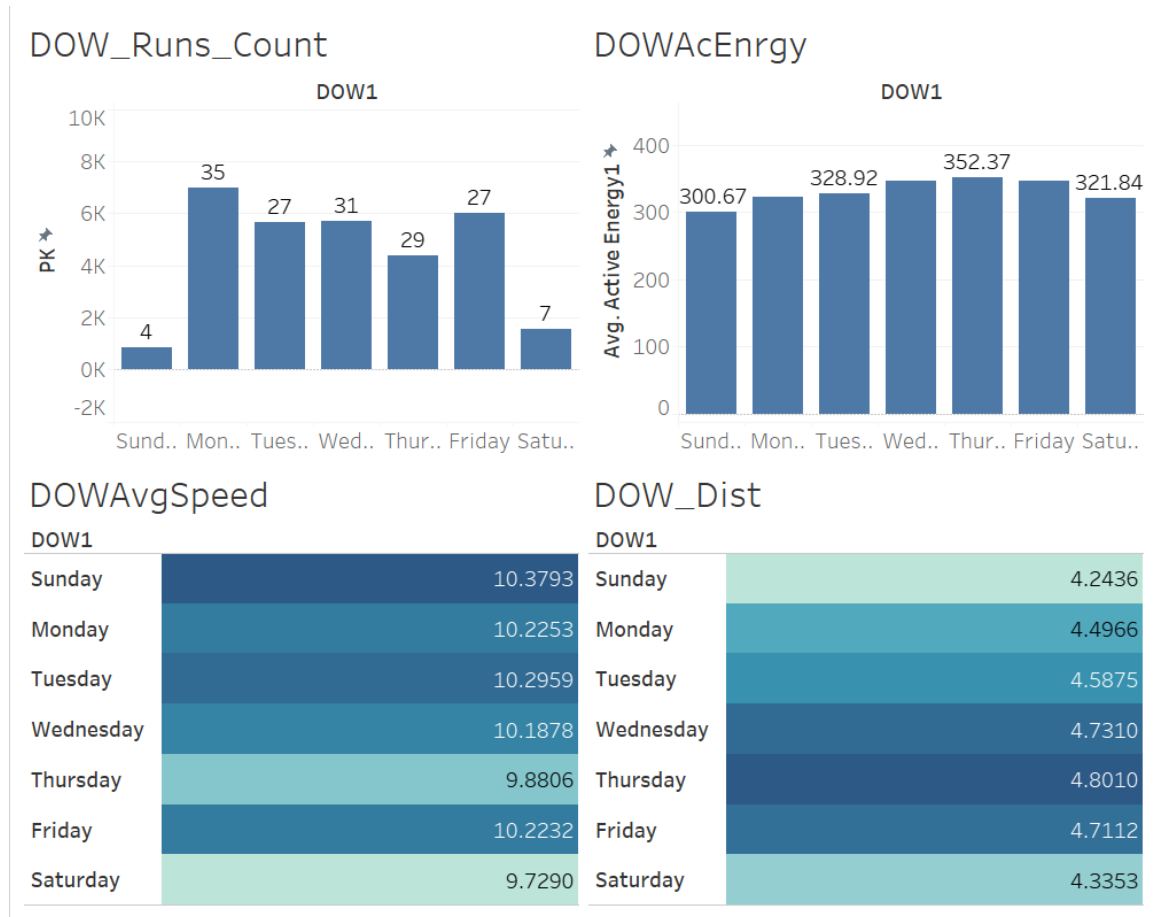
A C-Chart was then created for outside running distance (km). All runs were in control however there are frequent runs well below the center control line. When I run, I typically run to a certain rout and its very noticeable for those times I did not run that same route. I can recall shorting my runs multiple times when I have limited time, taking a different route, am injured or are recovering after a busy weekend. Toward the end of 2021 I started playing soccer more often therefore there is a drop in frequency of runs however when I did run, it was greater than average.
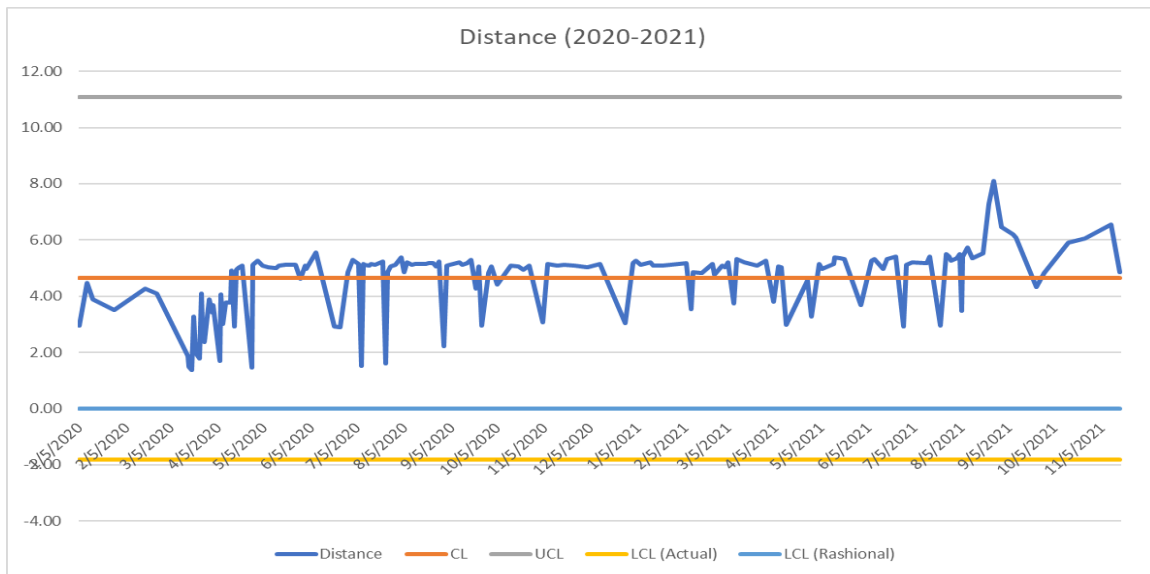
I did notice a positive relationship between the distance ran and active calories burned (shown in the control chart below)

A Tableau dashboard was created to show any influence on the day of the week.

DOW_Runs_Count

DOW1

Sunday	4
Monday	35
Tuesday	27
Wednesday	31
Thursday	29
Friday	27
Saturday	7

(PK axis: 10K, 8K, 6K, 4K, 2K, 0K, -2K)

DOWAcEnrgy

DOW1

	Avg. Active Energy1
Sunday	300.67
Monday	
Tuesday	328.92
Wednesday	
Thursday	352.37
Friday	
Saturday	321.84

(Avg. Active Energy1 axis: 400, 300, 200, 100, 0)

DOWAvgSpeed

DOW1

Sunday	10.3793
Monday	10.2253
Tuesday	10.2959
Wednesday	10.1878
Thursday	9.8806
Friday	10.2232
Saturday	9.7290

DOW_Dist

DOW1

Sunday	4.2436
Monday	4.4966
Tuesday	4.5875
Wednesday	4.7310
Thursday	4.8010
Friday	4.7112
Saturday	4.3353

Other workout types (such as HIIT, indoor cylcling, outdoor cycling, rowing, soccer and traditional strength training) were added into the mix to compare the influence on variables such as active energy, average heart rate, distance, weather and humidity. (Tableau File is attached)
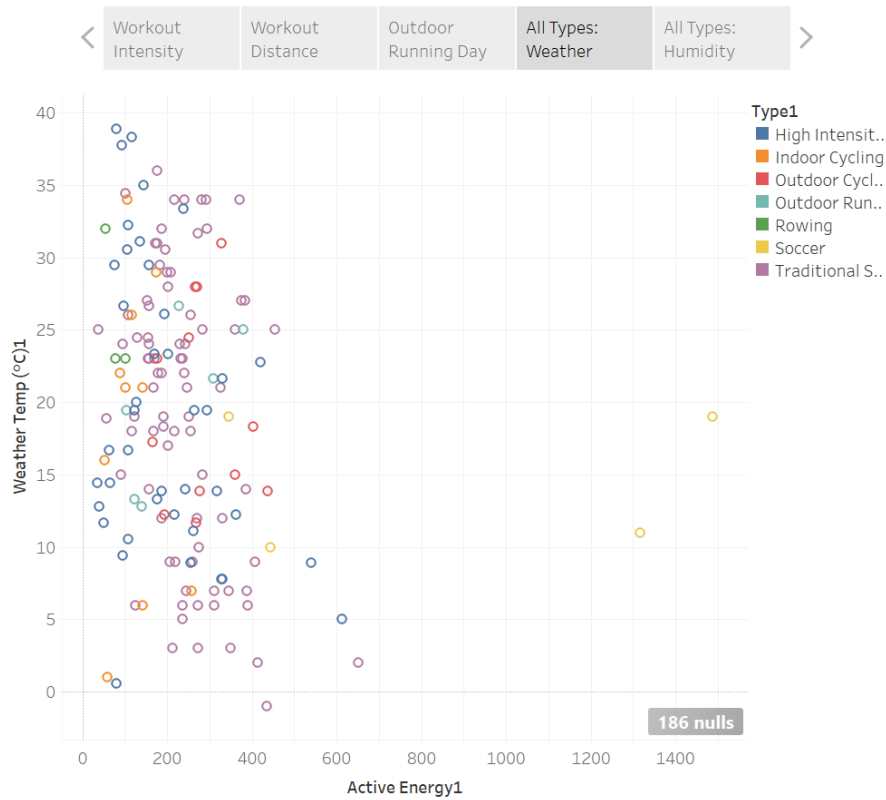
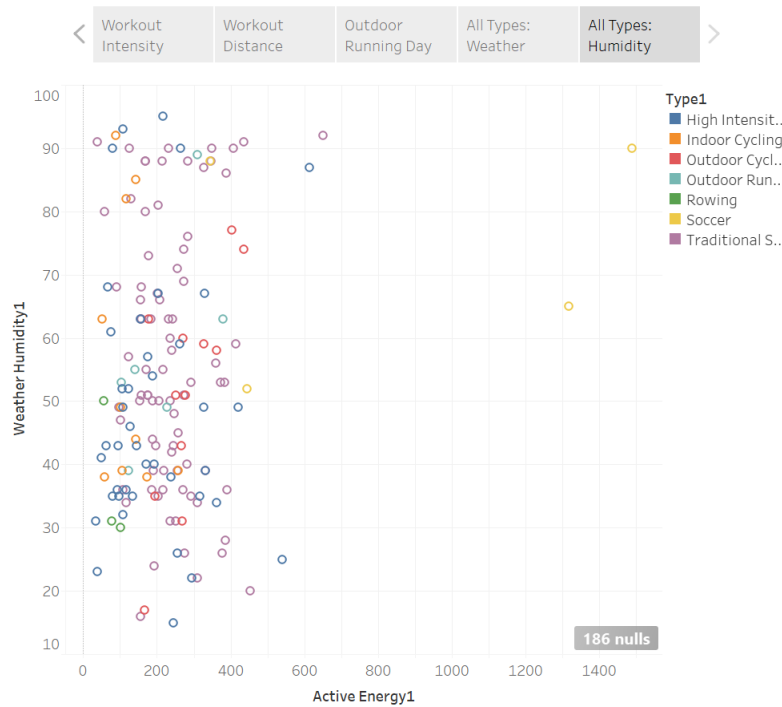## Active Energy and Average Heart Rate:
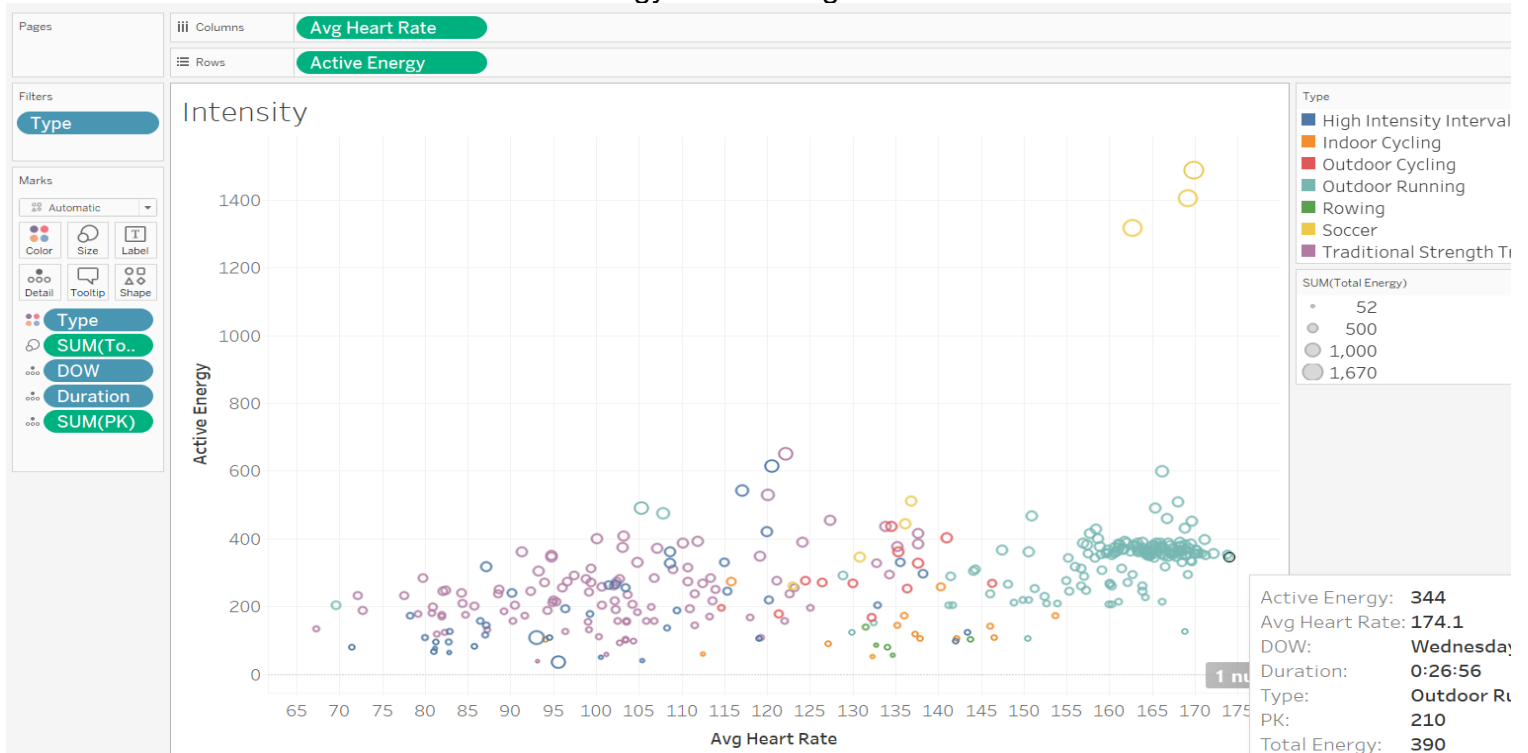
Active Energy and Distance (km)
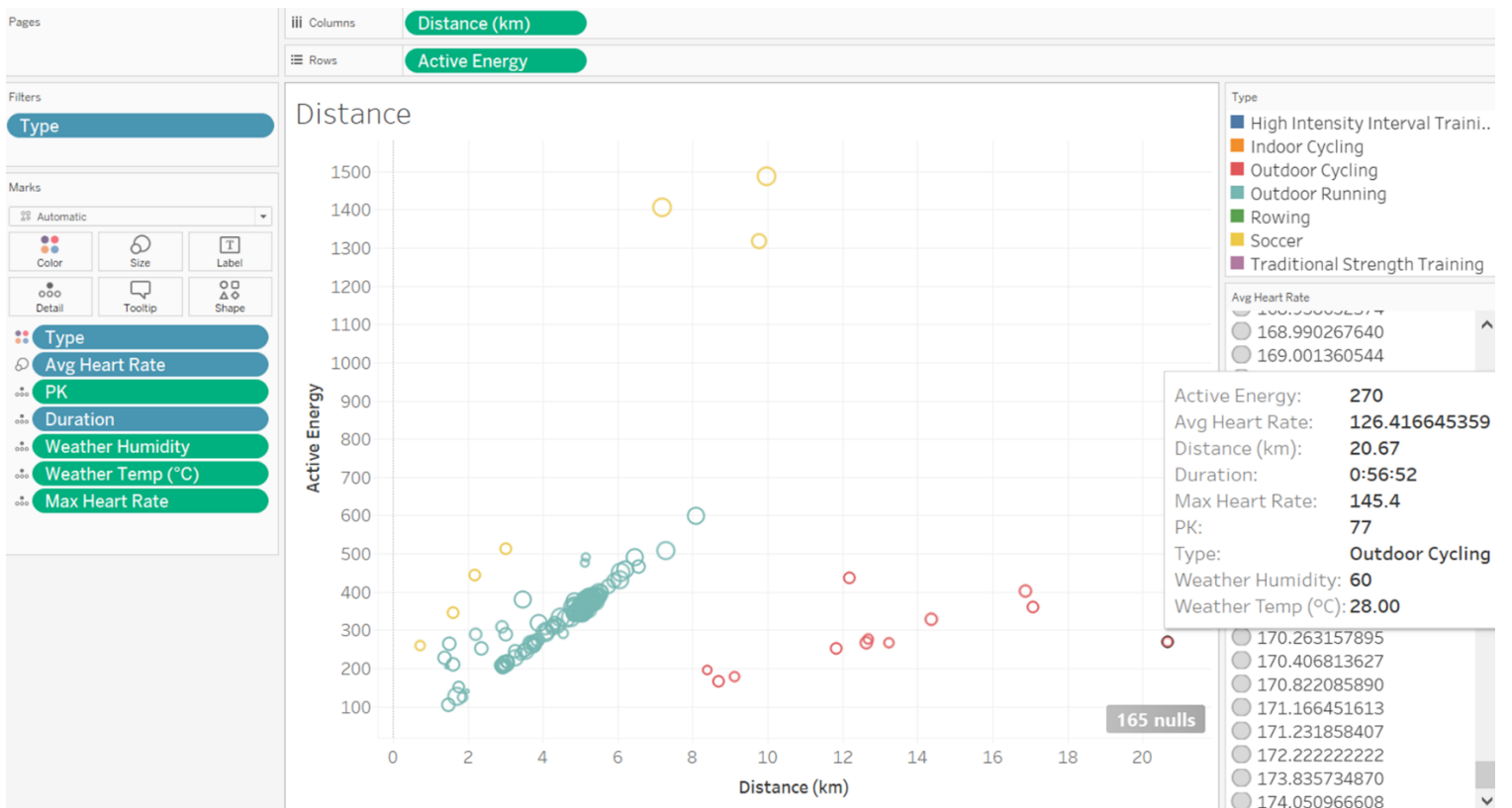
Weather Temperature:

Humidity:

Overall, soccer seems to be the greatest workout meaning the workouts I've recorded for it have had the greatest active energy used as well as distance, duration and relatively high heart rate (with a surprisingly low average pace – I guess we do walk a lot when the ball is on the other side of the field). I do realize this data is not ideal for process and quality control however analyzing it relates in that you are still trying to find variables/outside situations that influence the quality and consistency of your process. In this case, I need to be more consistent to not let myself have down days, creating those runs well below the center control line (diminishing my active calories for that workout).