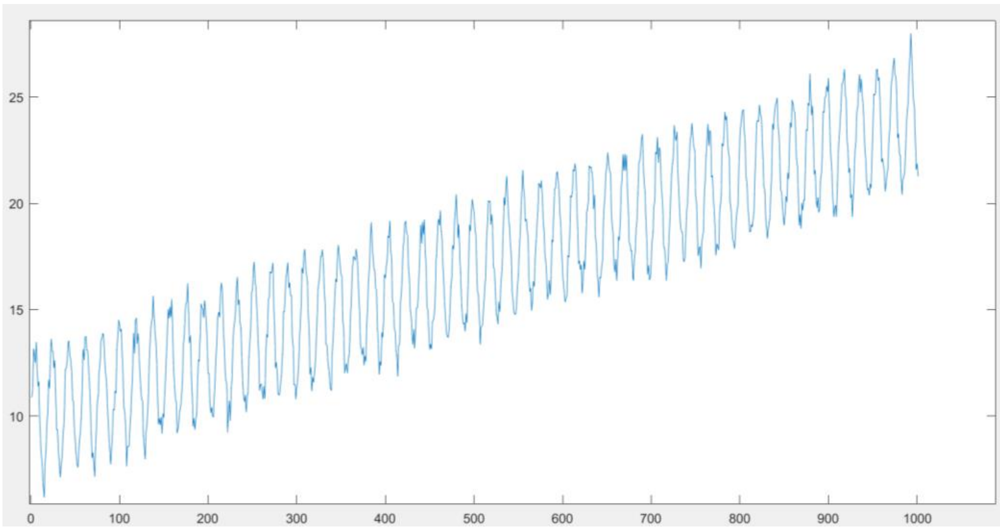
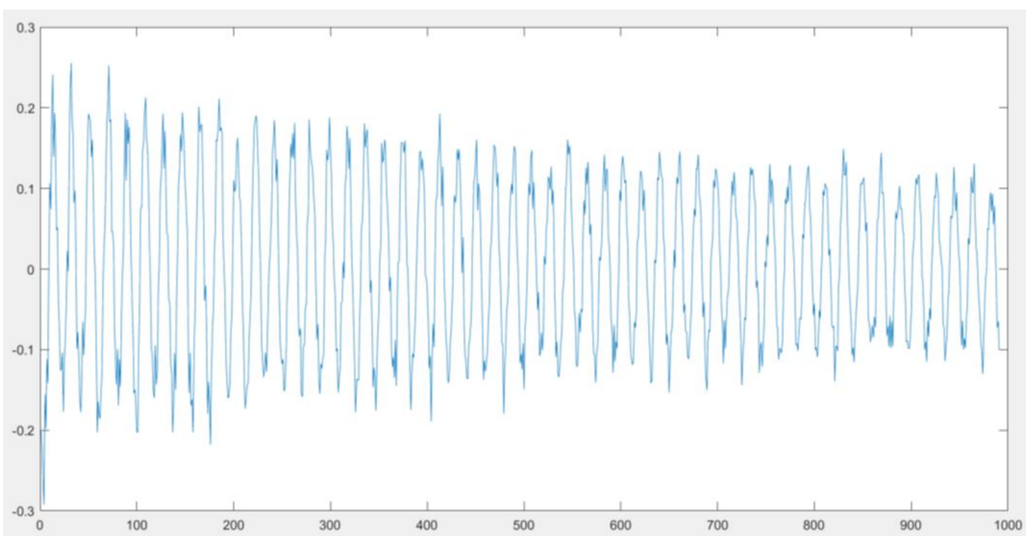
Programming Problem

My approach was to use 2 subsystems, the first with inputs of XYZ and TMA to create an Equivalent price variable. MAD and Equivalent Price are then input into the second fuzzy subsystem, which outputs Action. I wanted to normalize the inputs for the fuzzy system but noticed that there was a gradual upward trend to the stock price (XYZ) and TMA values.



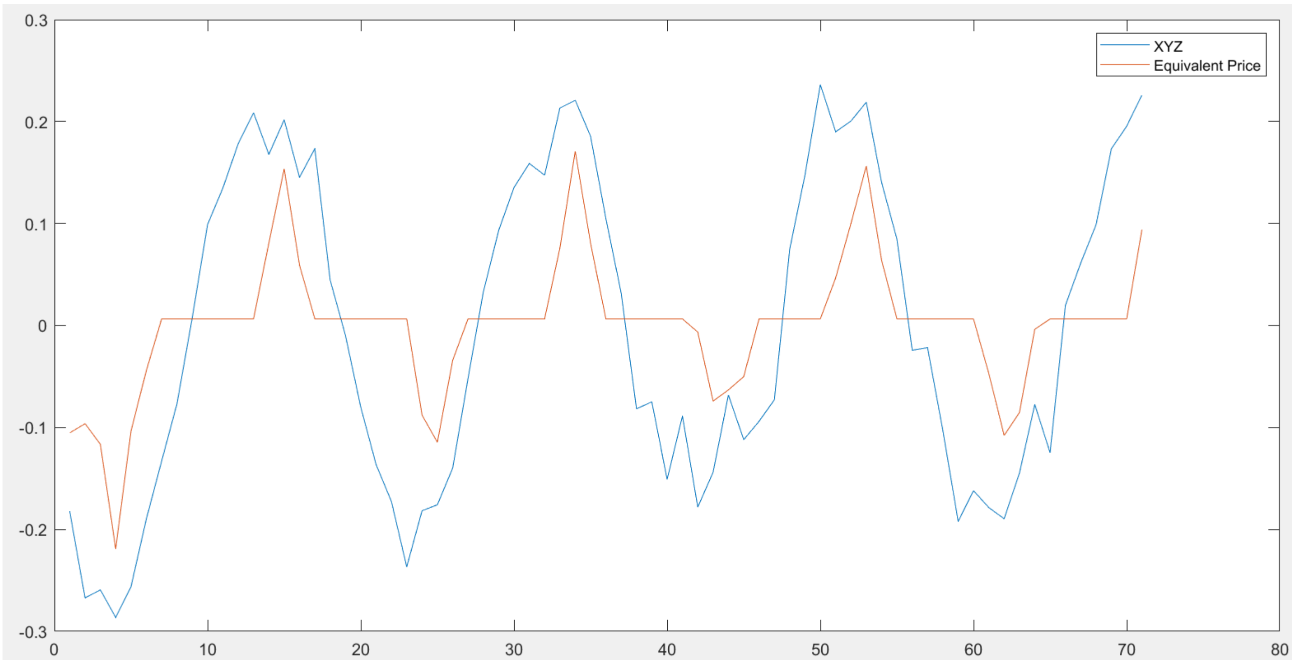
Graph 1: Stock Price (XYZ)

I normalized XYZ with respect to the last 20 days, then shift that down to 0 by subtracting the mean of the last 20 days. This gave it the following pattern, which is more consistent and easier to apply a reliable rule base to:



Graph 2: Normalized Stock Price (XYZ)

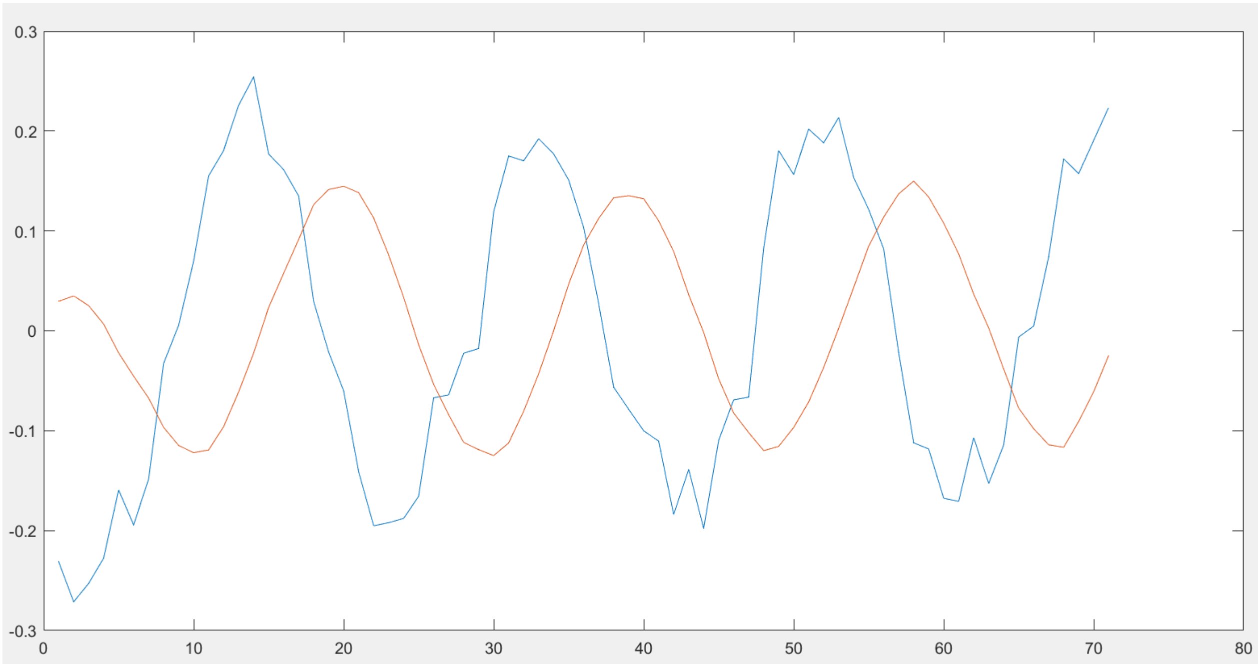
The output of the first subsystem, Equivalent Price, is shown below in Graph 3. The purpose of it is to convert the XYZ into a form with thin peaks that have a slight delay with maximums and minimums of the XYZ peaks, which is where I want to buy and sell. If the XYZ is between these peaks, then I want to wait for action. This makes it easier for the final subsystem to choose an action at optimal points.



Graph 3: Normalized XYZ compared with Equivalent Price output

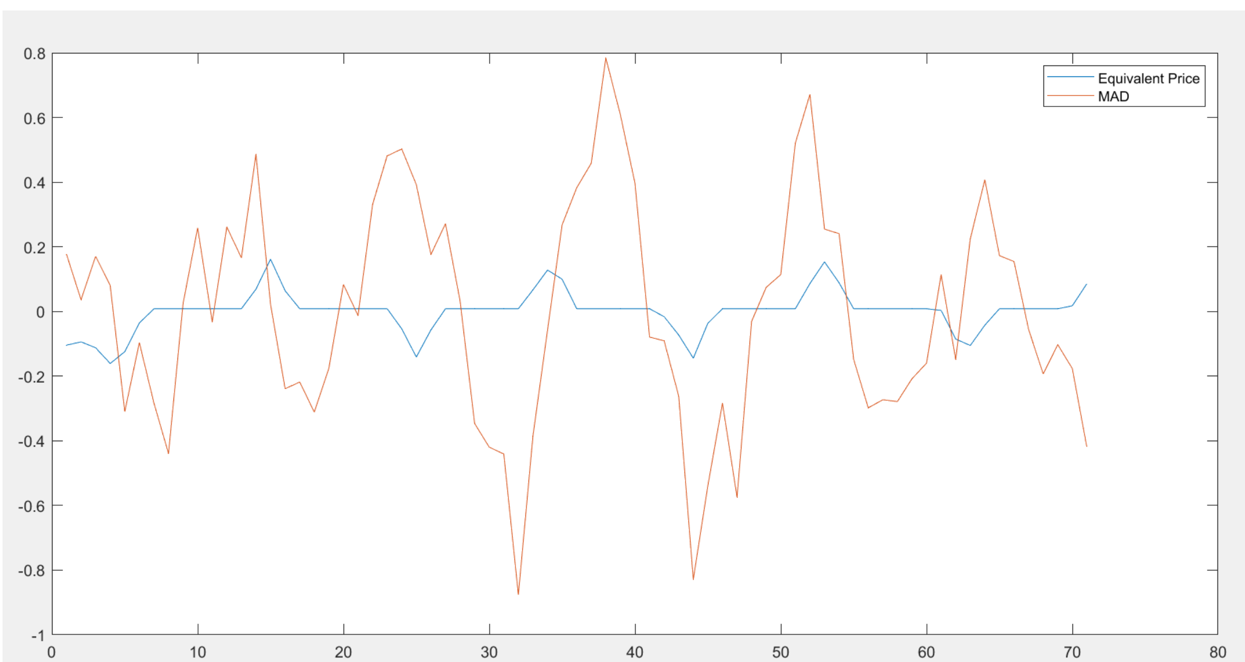
Equivalent Price						
		TMA				
		VL	L	M	H	VH
Stock Price	VL	M	M	VL	M	M
	L	M	M	L	M	M
	M	M	M	M	M	M
	H	M	M	H	M	M
	VH	M	M	VH	M	M

When creating rules for this subsystem, I saw a trend with XYZ and TMA. Graph 4 shows that XYZ maximums and minimums only occur when TMA is medium. The rule chart was designed on the idea that when TMA is not medium, I want to wait. If the TMA is medium, a peak in XYZ is occurring and I want to act upon it. If XYZ is high and TMA medium, then Equivalent Price is high. If XYZ is low and TMA is medium, then Equivalent Price is low.



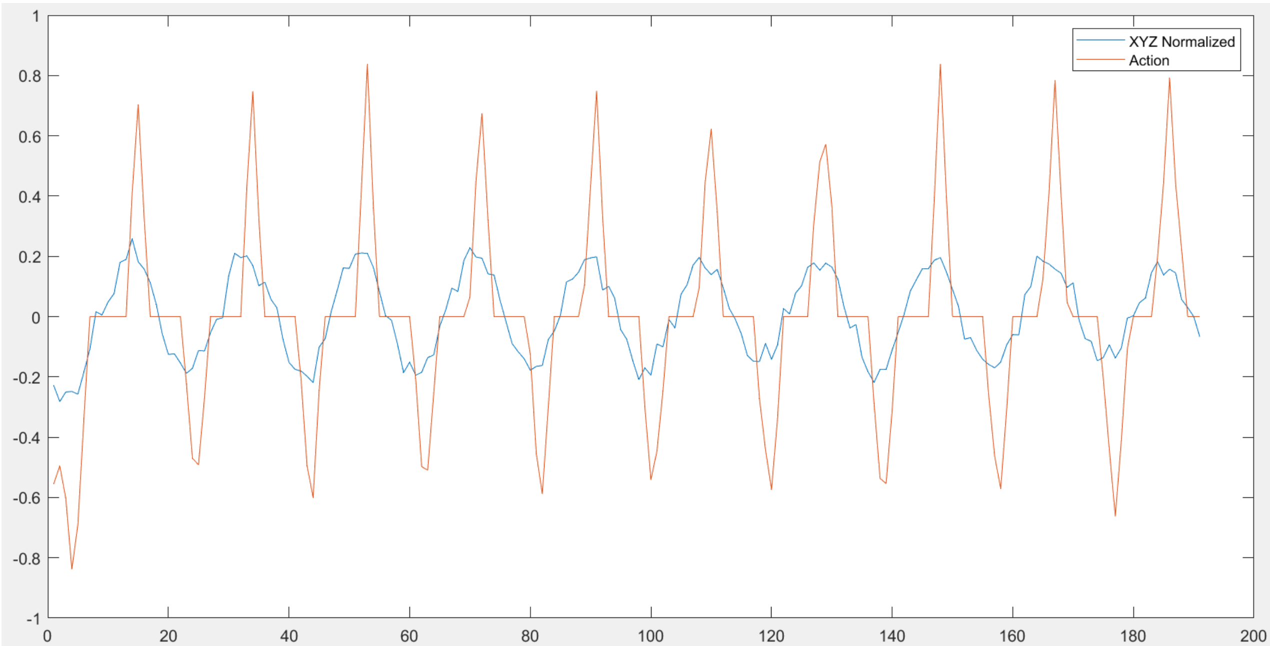
Graph 4: Stock Price (XYZ) compared with TMA (10 day)

The second fuzzy system relies mostly on the Equivalent Price variable. As seen in Graph 5, there isn't a distinct pattern relating XYZ trend and MAD (even though it is stated in the assignment there is); this made it difficult to design a rule structure around MAD. However, there is a clear distinction between the Equivalent Price and XYZ trends. Therefore, it made much more sense to rely on Equivalent Price.

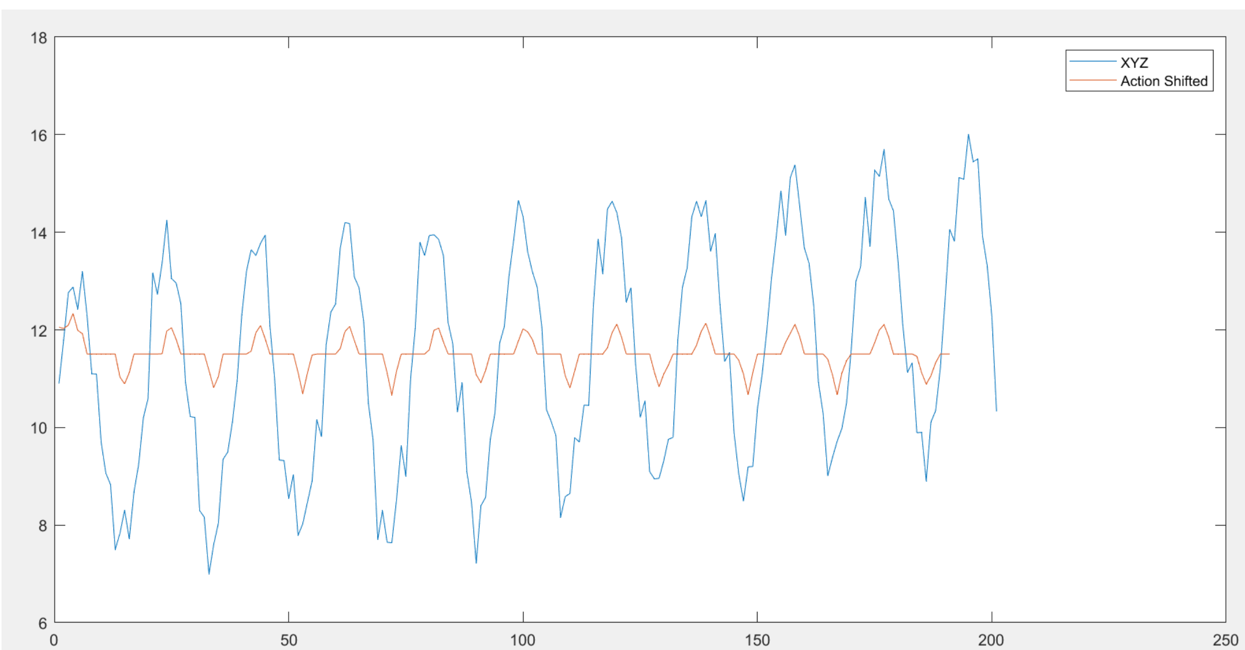


Graph 5: Equivalent Price compared with MAD

When tweaking this fuzzy subsystem, I used another graph comparison and altered the system's parameters so that days with low XYZ peaks overlapped with the values for "buy" action output, and days with high XYZ peaks overlapped with values for "sell" action output. See the graphs below:



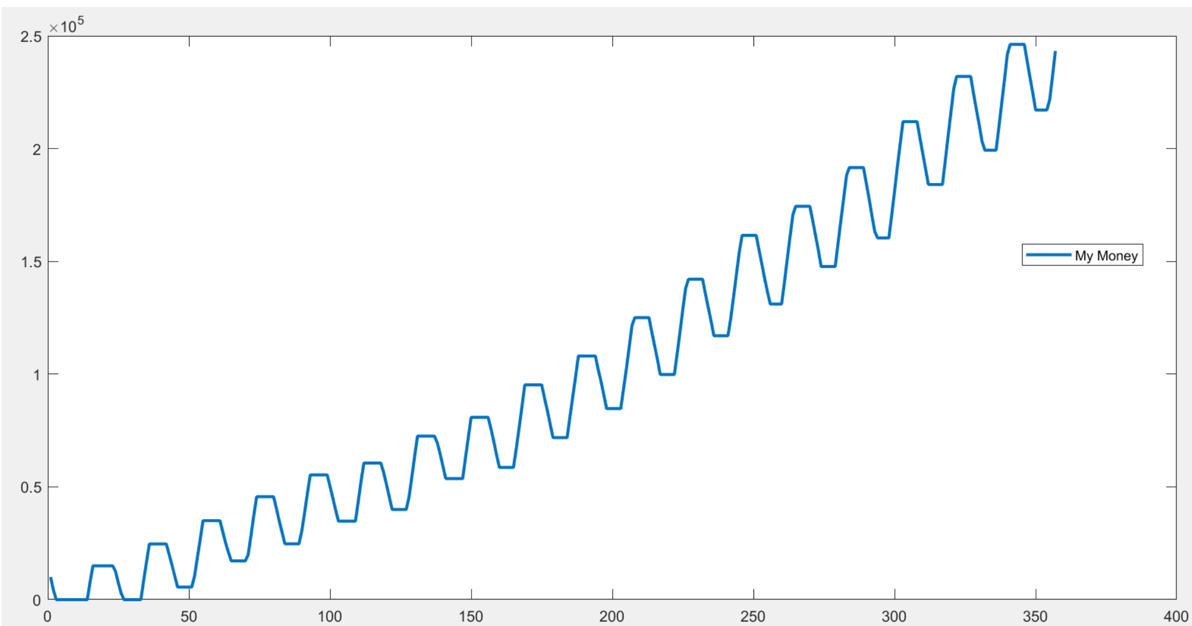
Graph 6: Normalized XYZ compared with Action



Graph 7: XYZ compared with Action (shifted for easier visualization)

Action				
		MAD		
		N	Z	P
Equivalent Price	VL	VL	VL	VL
	L	L	L	L
	M	M	M	M
	H	H	H	H
	VH	VH	VH	VH

Once the final fuzzy system was designed, I ran the simulation with actions occurring. I multiplied the -1 to 1 Action output by a factor to make it proportional to the number of stocks I wanted to trade. After trying several different proportionalities, I found that maxing out the stock size to 600 for most transactions had the best result. In the graph shown below, I made $ 233,300 and held 988 stocks after 365 days.



Graph 8: Simulation results by day

Discussion

Overall, this approach seems to work very well. If there is a consistent pattern with multiple variables, it's fast to develop a rule system that can be used to use decide an action. It's very useful to have an action output that is proportional to number of stocks to buy/sell instead of simply a binary buy or sell action. MAD turned out to be useless as there was no consistent pattern to create a rule system around.