Title: Fourier Decomposition of GME Price Action (possible predictive power)
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I will attempt to analyze the periodicity of GME's price using the Fast Fourier Transform (FFT). This is a method to translate a function (in our case: price:time) from the time domain into the frequency domain, giving insights into the various periodicities present in the signal as well as their power. This DD does not REQUIRE you to have an understanding of the FFT, but it will help you to understand the analysis better, so I suggest a cursory overview of the Fourier Transform Wikipedia page.

In ape speak: Fourier = big brain. Instead of "wen happen" makes "how much repeat". I look at "how much repeat" and try predict "wen happen".

Let's start by calculating GME's FFT, operating on the HIGH edge of each daily candle for the past 225 days, i.e starting from the March 2021 pop.

[FFT of GME Price for the last 225 days](https://preview.redd.it/f3xmlxrvhgb81.png?width=1575&format;=png&auto;=webp&s;=297f67a19d8ddc912d947c471d2ae20a62384e13)

The above chart is the FFT. On the X-axis we have frequency, and on the Y axis we have power. In other words, the position of the line indicates period: if a line is further to the left that means it has a shorter period, i.e the associated phenomenon occurs more frequently. Similarly – as we move to the right edge of the chart the phenomenon occurs less frequently.

In ape speak: Line left mean happens lotsa times. Line right mean happen not lotsa times.

The height of the lines indicates the amount of power they have in the signal. Thus the height indicates dominance/significance of the corresponding frequency in the time domain. Think of it like this: The original purpose of Fourier shenanigans was to decompose arbitrary functions into an infinite sum of sines and cosines. However, you don't need infinite terms to APPROXIMATE an arbitrary function. It is enough to take the HIGH ENERGY components, as they would contribute the most to the approximation. Since these high energy components contribute most, that means they have a stronger descriptive power about the original signal.

In ape speak: big line mean important. Smol line mean useless garbage

We observe a massively dominant component at a period of 0.01785 1/D , which is 648.407511 ■

In other words, the most dominant periodicity for the past 225 days is 56 days. So, something happens every 56 days (or close to it). Let's see what that is…

[GME Chart with 7-4-1 cycle overlay and marked Pk-Pk durations](https://preview.redd.it/ntyie3xzhgb81.png?width=1575&format;=png&auto;=webp&s;=2a055a0da612440ced33262be3b38d12d38a2b22)

As was recently discovered, 7-4-1 does indeed seem to mean something, and there is now mathematical confirmation:

The three previous 7-4-1 cycles have lasted 59, 60, 57 trading days respectively, measured as the time between highest CLOSE days. These durations average to 58.66. The mean error between the dominant Fourier periodicity and actual periodicity is 4.75%. Usually in Statistics and Engineering, an error below 5% is considered acceptable.

In ape speak: 7-4-1 cycles legit. Fourier agrees.

An important note is that our dataset consists of only 3 full cycles; any rigorous significance test we perform would result in failure. We cannot make claims about statistical significance and any aforementioned or subsequent analysis should be considered educated speculation.

In ape speak: Smol data mean big uncertainty

So far all we have is a confirmation that there's SOMETHING periodic in the price. There's SOME sort of cycle and it seems closely related to the 7-4-1 cycle that was found earlier. However, this doesn't yield much insight, so let's take our analysis a step further.

Recall that Fourier Components can be used to reconstruct the original function. This is done by generating an infinite sum of sines and cosines, such that their amplitude and frequency corresponds to the height and position of the lines in the FFT respectively. Recall also that we said that not ALL components have equal value. Those with more power have more descriptive power.

Let us apply a band pass filter to the FFT,which means only look at a specific set of lines instead of the entire thing, and then attempt a reconstruction. We will filter out everything except components 2-19. Everything past component 19 is too low in power, and component 1 is not very useful in general (basically introduces a vertical bias which we don't care about). The reconstruction is:

In ape speak: Fourier gave us "how much repeat". There is lotsa repeat. Some repeat are garbage. I throw out garbage, now have less "how much repeat". I ask Fourier to take the new, smaller "how much repeat" and make me "wen happen" again.

[FFT reconstruction with components 2-19](https://preview.redd.it/9fi0ykk6igb81.png?width=1575&format;=png&auto;=webp&s;=5776cda452d98b751d6e4407001c50e6da99ce72)

We can observe that the reconstruction is a very close approximation of the true price. This is great news! It confirms that we are correct in throwing out the majority of the decomposition terms.

In ape speak: Blue line look like gray line – good, mean Fourier big brain confirmed – pretty chart is valid.

Now that we confirmed validity, let's do the actually cool stuff: We are going to try to create an indicator function and see if we can notice a pattern. We will create this function by narrowing the bandpass filter (removing frequency components). However, it makes no sense to do this randomly. Our goal is to select a MINIMAL consecutive set of partials, such that they encompass the most power. This would normally be a pretty difficult mathematical problem, but luckily we have a "nice" FFT, and the solution is obvious from looking at it: we select components 2,3 and 4.

In ape speak: Since pretty chart is valid, ape can peel FFT banana to reveal the juicy informational flesh. Ape want to see only the big picture, not small picture, so ape throw away more "how much repeat" pieces.

[FFT Reconstruction with Components 2-4](https://preview.redd.it/nxxlqlgbigb81.png?width=1575&format;=png&auto;=webp&s;=5cf2bd8641bc9f384e00eb67d8ed8d9cdf137109)

Now we're getting somewhere cool! Notice that this curve peaks very close to the "1" (which is the same as the start of "7") of the 7-4-1 cycle (marked by a green vertical line). Also notice that it bottoms out at the begging of the "4" cycle. Observe that for the vast majority of the time, the Price tends to stay BELOW the reconstructed FFT. If at any time the price goes ABOVE the reconstructed FFT, we see a violent correction up or down. Finally, notice that the TRANSITIONS in price tend to very closely follow the TRANSITIONS in the indicator function (i.e move with the same slope), and the magnitude itself is proportional to price.

In ape speak: Blue line follow gray line good, blue line giv information.

Despite the seemingly positive nature of the above conclusions, what we have here is still overfitted. Recall that our goal is to analyze periodicity, and yet we still contain information about slope and actual price levels (the magnitude of the indicator is almost linearly proportional to price). This means that we need to strip out even more partials. In fact, we're going to strip out ALL of them except the dominant component 4.

In ape speak: Blue line follow too good. Blue line giv extra information. No want extra information, only want cycles. Make line SIMPLER!

[GME Chart overplayed with Dominant Sinusoid \(Component 4\)](https://preview.redd.it/mbxo24edigb81.png?width=975&format;=png&auto;=webp&s;=c501ea57c75ff829dcf89abfb1da9fd732c81097)

Now THIS is our final result! We have mapped a sinusoid to GME's price. We can observe that it peaks near the '1' and bottoms near the '4'. It does not depend on the actual VALUE of price, but gives insight into directionality and violence of the movements.

Now, let's try to do some analysis on the model:

[GME Chart with Dominant Sinusoid and Marked Delays](https://preview.redd.it/jzivo9qiigb81.png?width=975&format;=png&auto;=webp&s;=8ddb48fed16611df361cb2325979c0cfd28e318d)

We observe that the price tends to stay BELOW the sinusoid. We also see that when the price goes ABOVE the sinusoid, it does so for a consistent amount of time (red ranges): 22,22,23,17 days respectively, giving an average of 21 days. The current cycle is a bit of an outlier with 17days above the sinusoid, but we're dealing with price data so the precision standard are a bit relaxed, and this is probably fine.

In ape speak: Wen gray line above blue line = rocket getting fueled

Now to continue, instead of looking at the various time delays manually, let us analyze them a little bit more rigorously:

| Cycle |"1"-SinPk|T under Sin|
Tcrossfromunder-"1'|Tcrossfromunder-PricePeak|Tcrossfromunder-Uptrend|
|:-|:-|:-|:-|:-|:-|
|1|12|22|9|9|6|
|2|7|22|13|14|4|
|3|6|22|14|15|12|
|4|3|23|18|6|3|
|5|\-|17|\-|\-|\-|
|AVG|7|21.2|13.5|11|6.25|

https://preview.redd.it/jzhqmc11jgb81.png?width=977&format;=png&auto;=webp&s;=4cdf7b75c6987d5839440aa114323ef152f66507

https://preview.redd.it/ao1uuz22jgb81.png?width=977&format;=png&auto;=webp&s;=bef486013085277bf9398657da53fa8a84a684cf

Notice how these two lines are almost perfect inverses of each other. What is this telling us? It is saying that over time the delay between crossing the sinusoid and reaching the ‘1’ in the cycle is increasing. In other words, the sinusoid is phasing against the 7-4-1 cycle. This makes sense – our model is not perfect. This suggests that we should allow for a decent amount of time-error.

There’s not much that can be said about the rest of the delay numbers, as the sample size is tiny.

So what’s the conclusion?
GME follows a sinusoid which peaks approx. every 56 days. This is consistent with the 7-4-1 cycle theory. When overlaying this sinusoid with the price chart we can see that every time we cross it from below – a massive uptrend follows 4-12 days after (average around 6 days).

We’ve recently crossed the sinusoid. According to the above analysis, we should see sideways trading with a possible slight downtrend over the next week or 2, followed by an explosive move up. Is it going to be the MOASS? I’m not sure. Is it a possible chance to make some money? Yeah.

My personal position is XX shares + Jan 28 115$ Put (insurance) + Feb 18 145$ Call

TLDR: Price probably going sideways/down for next 1-2 weeks, then possible moon.