**Liquid Capital Futures Writeup**

* what model / algorithm strategies do you think you should consider? why?

There were a few models I considered but I ultimately decided to go an LSTM model. I’ve read a few papers recently that would suggest this is currently the ideal model for time series forecasting due to the ‘forget’ gate inside of an individual LSTM cell. I thought that a neural network architecture might yield better results that a traditional time series problem restructured as a supervised learning problem (even though there are similarities between the way I implemented the model and a traditional regressor). I implemented this model using a 3 month lookback; that is to say the model looks at the last 63 trading sessions and the uses that to predict future price action.

* Describe the results of your solution. This is our version of a cover letter. Talk to us about the choices you made in completing this project. What data did you use and why? What model approach did you use and why? How did the model do? What visualization approach did you use and why. What would you do differently if you were investing real money?

I had some fairly interesting results for such a rapid prototype and I’m really looking forward to seeing how much better the results can get. Given that I was tasked with creating a model around treasury futures, there were a few things I wanted to consider. Primarily, I wanted to focus on finding potential macroeconomic indicators. The difficulty with this is that most macro indicators are annual/quarterly/monthly/etc. That provides an interesting challenge in determining how you want to deal with the data gap between the daily prices of the 30 year futures against those metrics. I did find daily data on the Fed funds rate. I decided to include that on the rationale that the Fed uses the funds rate along with interest rates to push the economy in a particular direction for the purposes of stability and since that rate can change daily, it may have been a bit of a leading indicator in terms of how the Fed was thinking about interest rates. As I mentioned earlier, I ultimately decided to use the LSTM model because it was something I hadn’t tinkered with yet and wanted to see what type of results I could get at a first look. The results have been a bit underwhelming but I do believe there’s quite a bit more work to be done. In terms of visualization, I started by exploring the raw data that I pulled from Quandl and nothing surprising jumped out at me. I also visualized my loss function to see what kind of behavior the model exhibited as it trained itself. I did keep two charts that show the AUM and the predicted price values versus the actual values for your review, but otherwise, I spent more time tweaking aspects of the model to see if I could get better results.

If I were investing real money, I would approach this quite a bit differently. The biggest change I’d make is modeling an actual market structure so that I could include commission and slippage as these can dramatically affect a portfolio’s performance. There are some smaller changes that could be made (even to this LSTM model) that could have a strong impact on performance such as changing the look back period. Additionally, I think I’d spend some time designing custom features as I think there is some benefit there (my basis for this thought it that technical analysis helps some manual traders to a degree). As an individual, not having access to better quality data is always a huge concern, but there are other things you can do with the data that you have such as transformation or component analysis.

* What are the difficulties in completing this type of project, what did you struggle with, what was easy, and why?

Honestly, many of the difficulties surrounded small logistical things around my development environment. Some time was spent debugging spyder issues and conda/pip environment problems. Another issue I ran into was raw compute time in terms of training the models on larger data using more hidden layers. The first time I ran the assessment and it took a few minutes, I knew I wouldn’t be able to try wrapping this in a Monte Carlo and randomly tweak aspects of the model to find the best result. I also think one of the biggest challenges for me was the lack of a deep financial acumen. I have some, but I think having a partner to guide the development process in the right direction can add quite a bit of value. The easiest part was framing the problem as a machine learning assessment (deciding what predict, how to set up the data, etc.). Again, I think the big challenge there was being unsure of what data might be the most impactful, and simply pulling everything you can is not the most helpful way to get a better model in my experience.

* Talk to us about any conclusions you have.

Ultimately, there are a lot of challenges ahead. I do have a bit of a clear roadmap in terms of how I plan on testing the models that I have currently. I think there’s great value in developing a suite of tools to automate the training and testing of the many different types of models there are. There are a couple things in particular that I’m looking forward to implementing; mainly genetic algorithms. I would like to thank the team for their time spent reviewing this and hopefully, at the very least, there is something valuable you can find in the code I submitted.

Thanks,

Chuck