

Statistical Arbitrage with Limit Order Book Imbalance

My goal is to establish and solve the stochastic optimal control problem that captures the momentum and order imbalance dynamics of the Limit Order Book (LOB). The solution will yield an optimal trading strategy that will permit statistical arbitrage of the underlying stock, which will then be backtested on historical data.

Progress Timeline

DATE	THESIS	STA4505
Dec 2014	Complete CTMC calibration	
Dec 2014	Backtest naive strategies based on CTMC	
Jan-May	Study stochastic controls: ECE1639, STA4505	
Jun 5	Establish models	Exam Study
Jun 12	Establish performance criteria	Exam Study
Jun 15	Derive DPP/DPE	EXAM
Jun 26	Derive continuous time equations	
Jul 3	Derive discrete time equations	
Jul 10	Set up MATLAB numerical integration	
Jul 17	Integrate functions and plot dynamics	Integrate and analyze
Jul 24	Empty promises; zero fucks given	
Jul 31	Code for numerical solutions, calibrations, plots	Simulate results
Aug 7	All in-sample backtests	
Aug 14	All out-of sample backtests	
Aug 21	The Big Writeup Effort	
Aug 24	Submit first draft for review by panel	
Aug 28		Project Report
Sep 2		Presentation

Whiteboard Inspirational Quote of the Week

I'll tell you, it's Big Business. If there is one word to describe Atlantic City, it's Big Business. Or two words – Big Business.

– Donald Trump, looking down on Atlantic City from his helicopter, circa 1989.

For Our Colleagues at Duke University...

Mon 17th: ugh.

Tue 18th: it occurs to me that i have died and gone to sexy lawnmower girl heaven. seriously. i've noticed this summer, and now that i think about it i seem to recall having had these thoughts in summers past too, that UofT exclusively hires sexy fit girls to mow their lawns, and the dress code is hiking boots, short shorts, tanktop, and shades. campus is literally *teeming* with these babes. and finally, if that business doesn't already exist, then i propose yet another subsidiary of the tna conglomerate. i volunteer to CEO this one.

Wed 19th: last night Kevin bought this chocolate boston pie thing from Metro and we fucking went to town. fucking unreal, layer upon layer of variations on chocolate, with brownie chunks to crown it off. as someone that has consciously avoided sugar in an effort to counteract the negative effects of thesis crunch time, it hit me fucking hard. namely in terms of how god damn good it was.

okay wow so look man...as it stands all i have left to write is the abstract. so literally there are ≤ 150 words between now and the 0th draft. that leaves a good chunk of time for editing and having that first draft sent off on Monday, and your revisions will be foremost among them. i still cannot believe this is all happening.

i went for lunch with my dad today. we were going to go to Big Daddy's, our favorite cajun creole place on King St, but it turns out they've closed their doors and are going to be replaced by a Texas Lone Star Grill franchise. i shed a tear for the death of the independent little guy. earlier my dad had e-mail introduced me to one of his colleagues that used to be in the algo trading hedge fund space (until one of his co-founders ran off with all the money and code), and having set up a meeting with this guy for Mon to chat about the idea of actually Doing It, i asked my dad what he thought. being my dad, i expected a generic 'sure why not' answer, but instead he hit me with some insight. he says: if i recall correctly you weren't happy at the bank because you weren't helping people, and you were just participating in a business that profits off screwing other people. regardless whether that was true, what you're doing now is nothing but screwing other people.

wow. daddy-o. the man hit a nail on a head. there really does exist a moral dilemma here.

on our walk back i tried to explore this further with him - i said well look, i would only really be competing with other algo traders, right? playing other peoples' game, a game that already exists. and i wouldn't be hurting the long-term investors like you and me, that buy and sell once in a blue moon. and he says yes definitely that's true. but again he drops some insight on me; he says: your grandfather used to say, there are two people in betting: one is dumb, and the other is unscrupulous. [well, the Russian equivalent of that anyway.] but his point was, one person doesn't know better and still bets, and the other does know better and also still bets. i tried to counter that well, if the event they're betting on has 50/50 odds, then neither can know - but of course, the whole point is that the algorithms give me an edge. so sure i'd be betting, but i'd be the guy betting with way better odds. and it's something to consider. hell, there's already a LOT to consider, and this is just one extra existential sort of consideration.

The Academic Week in Review

- out-of-sample backtest: 2014 data.
 - decide WHAT to run. best performer? probably annual calib is easiest, tho. justify.
 - also consider expanding the finite differences horizon T for more accurate results...
 - run backtest. 0.5h per strategy.
 - print results table
 - plot EOD results
 - writeup
- Dynamics of δ^\pm for continuous vs discrete time
 - produce plots comparing for different q, z values.
 - mimic Seb's four plots to show mechanics of the FOUR methods
 - writeup something intelligible about the plots
- General writing stuff
 - write introduction
 - write algo trading section
 - write LOB dynamics section
 - write intro to stochastic chapter
 - Link STA4505 project into dissertation with lead-in blurb.
 - re-write lead-in to continuous time section
 - re-write lead-in to discrete time section
 - write conclusion chapter
 - write ITCH data section
 - write abstract
- any remaining time to proof-read the bitch
- **SUBMIT THE BITCH**
- write acknowledgement
- write dedication
- STA4505 project standalone write-up.