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

For Our Colleagues at Duke University...

Mon 10th: holy fuck two weeks today is the unofficial submission date.

Tue 11th: this morning i met up with Aerospace Adriana. she had texted me a couple days ago to say she was applying for the Forces, which i correctly guessed was for their aerospace engineering officer position, so i wanted to make sure she knew what she was getting herself into, what to expect from the application process and initially on joining, etc. turns out she literally knows nothing about anything. she didn't even bother really getting the job description, watching the little promo videos the CF has created for each job position. fucking idiot. but in other news she submitted her dissertation a month ago and her prof still hasn't even looked at it... so i dunno, i'm not even really that far behind then...

i dunno whether you bother flipping through my actual thesis pdf when i attach it, it's pretty long so i imagine you probably did the first time and now it's like "ehhh already seen it..." so maybe i ought to just tell you what's new in it? or just stop attaching it!

tentative meeting set up with Gabe for Monday morning. last i had talked to him, i hadn't even started doing the discrete time derivations. we're talking, i dunno, early July. holy fuck, i just realized that i've actually gotten a lot done. i still need a secondary examiner though. i contacted one prof by e-mail over the weekend and he has yet to reply, so next step will be dropping into his office, taking the foot in the door analogy to the next level.

The Academic Week in Review

c.f. last week, I now unveil: 'a really solid todo list that i can look at and not have any individual thing be crazy daunting.'

- in-sample backtest
  - re-run stoch tests to break out number of orders into MO/LO
  - reprint results table
  - plot EOD results
  - writeup
- out-of-sample backtest, week offset calibration
  - finish running overnight backtest
  - print results table
  - plot EOD results
  - writeup
- out-of-sample backtest, annual calibration
  - ~~write script to produce annual calibration~~
  - run backtest ... should be pretty fast
  - print results table
  - plot EOD results
  - writeup
- Dynamics of $\delta^{\pm}$ for continuous vs discrete time
  - ~~produce plots comparing for different q,z values.~~
  - writeup something intelligible about the plots
  - mimic Seb's four plots to show mechanics of the two methods
- Comparison of strategy performances
  - ~~produce plot of performance for ONE DAY~~
  - writeup something intelligible about the plots
  - get correlation of EOD performances across trading year
- General writing stuff
  - ~~write introduction~~
  - ~~write algo trading section~~
  - ~~write LOB dynamics section~~
  - write ITCH data 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 abstract
- any remaining time to proof-read the bitch
- **SUBMIT THE BITCH**
- write acknowledgement
- write dedication
- STA4505 project standalone write-up.