

Lecture 1: Introduction to Finance

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Why Computational Finance?

It is hard to overstate the importance of the financial industry to the state, national, and world economies.

The financial industry relies on a wide variety of advanced computing technologies and mathematical modeling techniques.

The availability, volume and significance of financial data lends itself to many interesting research problems.

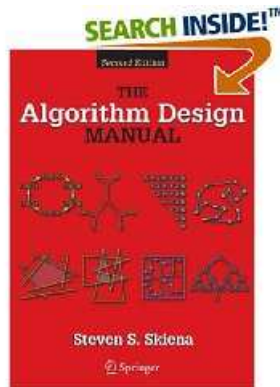
There are interesting and relevant theories of how markets work which lend themselves to formal analysis.

Why Are You Interested in this Course?

- Have a general interest in finance?
- Avoiding a more undesirable course?
- Want a job in the financial industry?
- Want to apply your research expertise to financial data?
- Other?

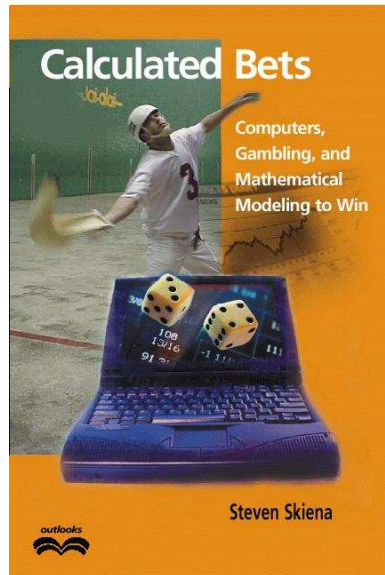
Who am I?

I am a visiting professor from Stony Brook University.
My primary research is in combinatorial algorithms and their applications, particularly to biology and news/blog analysis.



Why am I teaching this?

I have a side interest in gambling systems, which has made me somewhat known in the hedge fund community.



I've been an invited speaker at Barra's Research Conference and O'Reilly Money:Tech, and at certain hedge funds.

I've previously taught a seminar in computational finance at Stony Brook.

Why this Course?

Much of this material (e.g. financial engineering and time-series data analysis) is traditionally taught in business schools, and practiced by quantitative researchers from economics, finance, and the mathematical sciences.

Computer science researchers have not been as engaged with conceptual problems in finance so much as technological problems like encryption and transaction processing.

My goal is to teach an introduction relevant for computer scientists, which may be both broader and shallower than traditional “Computational Finance”.

Good Reasons to Take this Course

- Very interesting and intellectually satisfying subject.
- Finance provides an interdisciplinary experience where data matters.
- For some, there is possible relevance to future career prospects

This material is aimed at computer scientists, although I am *very* happy to have students from certain other fields.

Good Reasons to Avoid this Course

- This is not a hard-core course on options pricing, just an introduction.
- It is not taught by a knowledgeable business school professor.
- There is no real evidence of a Computer Science research community emerging in finance.
- We will not learn how to beat the market. I recommend investing in index funds with your own money.
- My understanding is biased toward financial markets in the United States.

Course Lecture Topics

- **Derivatives** – arbitrage arguments, options and other financial instruments, options pricing
- **Time Series Analysis** – financial time series, linear and non-linear analysis, clustering, and pattern recognition
- **Trading/Investment Strategies** – CAPM, Kelly criteria, online algorithms

Course Projects

The course projects will concern the acquisition and analysis of financial data.

We will view ourselves as the Quant group of “Baroque Technologies”; official slogan *Go for Baroque!*

Certain projects will involve making presentations about standard financial resources, including the CRSP, Reuters, and RiskMetrics databases.

Project lists will go out in a few weeks, but I need a few volunteers ASAP for our “Rapid Response Team”, to run simple experiments on a regular basis to see how the theory matches reality.

Fundamentals of Investing

The return on an investment is strongly related to its level of *risk*, closely associated with its *volatility*.

U.S. Treasury bills are extremely safe but low-yield investments.

The interest rate paid depends upon how long you are willing to wait for payment, with longer-term notes incurring more risk.

A \$1 investment in short (long)-term T-bills/bonds in 1925 grew to \$10.46 (\$19.20) in 1999, before taxes.

Stocks vs. Bonds

Stocks are much more volatile, but offer higher expected returns. A \$1 investment in major blue-chip stocks in 1925 grew to \$594.45 in 1999, before taxes.

The relative value of these returns depends upon the amount of *inflation* over the investment period.

Financial Markets

An *exchange* is a place where buyers and sellers trade *securities* such as stocks, bonds, options, and futures.

Well known exchanges include the New York Stock Exchange (NYSE), NASDAQ, and the American Stock Exchange (AMEX).

Each stock is typically listed on a particular exchange, although more complicated trading venues are evolving (after-hours trading, dark pools, etc.)

Exchanges provide *liquidity*, the ability to buy and sell securities quickly, inexpensively, and at fair market value.

In general, the more trading that occurs in a security, the greater its liquidity.

Regulations of Financial Markets

Each exchange has different rules about the qualifications of companies which can be listed on it.

Exchanges also differ in the *rules* by which they match buyers to sellers. Certain exchanges use people (brokers, market makers) to match buyers and sellers, others use computers (particularly on small orders).

The exact trading rules and mechanisms can have a significant impact on the price one gets for a given security.

The strength of an exchange's rules and their enforcement impacts the *confidence* of investors and their willingness to invest.

Common Stocks

Companies sell shares of stock to raise business capital.

Companies “go public” by agreeing to sell a certain number of shares on an exchange.

Each share of stock represents a given fraction of the ownership of the company.

Certain stocks pay *dividends*, cash payments reflecting profits returned to shareholders.

Other stocks reinvest all returns back into the business.

Stock Prices

In principle, what people will pay for a stock reflects the health of its current business, future prospects, and expected returns.

However, the current *price* of a stock is completely determined by what people are willing to pay for it.

If there was no differences of opinion as to the value of a stock, there would be no trading.

Stock Prices and Indices

Roughly 70% of an individual stock's price movement reflects the performance of the overall market, with roughly 30% of price movement due to characteristics of the specific stock.

Stock indices (such as the S & P 500 or Dow Jones Industrial Average) are measures of the performance of well-defined collections of stocks.

Mutual funds are investment vehicles representing collections of stocks selected by a given company/manager.

My Investment Advice

As an small, individual investor, it is likely that your best long-term investment is in a low-expense mutual fund tracking one of the major stock indices (such as the Vanguard 500 fund).

Very few actively managed mutual funds consistently do better than such index funds, demonstrating how difficult it is to beat the market.

Short Sales

If an investor believes prices will go down, they can profit by selling a stock *short*.



Shares can be borrowed/rented from owners who do not intend to sell, such as retirement holdings.

Markets differ on the rules regarding short selling, e.g. down-tick rules and “naked” shorts.