

Portfolio selection

- Portfolio Selection: to find the best investment strategy in some financial market.
- Individuals make decision according to
 - market environment: assets and price processes,
 - feasible decisions: trading rules and constraints,
 - criterion for comparison/optimality.

Market Participants

- Market Maker (MM) - quotes bid & ask
 - quote is $b_{i,t}$ & $a_{i,t}$ (higher number, % of shares)
 - captures the order at the other side and to
 - do not have to change
- Specialist (Specialist) - quotes bid & ask
 - submits a supply (ask) order $b_{i,t}$ at least bid $a_{i,t}$
 - so specialist provide the best bid and ask of the market
- Limit Order (LO) - quotes bid & ask
 - bid orders to buy shares and orders to sell
 - need to wait for shares $b_{i,t} < b_{i,t}$ or $a_{i,t}$
 - orders either to limit orders, immediate execution
- Stop Order (SO) - quotes bid & ask
 - will a market price is going to reach order
 - then trading is going to happen then
- Buy/Sell order associated with an initial order at $t = t_0$





Handwritten notes on a chalkboard to the right of the screen, including the text "FTR" and some diagrams.

High-frequency trading and dark markets
- New challenges for financial mathematics -

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$$x^2 + 2x + 1 = (x+1)^2$$

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Expected utility maximization

- The expected utility maximization problem:

$$\max E[u_0(c) + u_1(X_1)]$$

$$s.t. X_1 = \phi^0(1+r_f) + \sum_{i=1}^n \phi^i(1+R^i)$$

$$\phi^0 + \sum_{i=1}^n \phi^i = x_0 - c,$$

c : consumption at time $t=0$; $u_t(\cdot)$: utility function.

- We can firstly fix c and optimize $E[u_1(X_1)]$ by

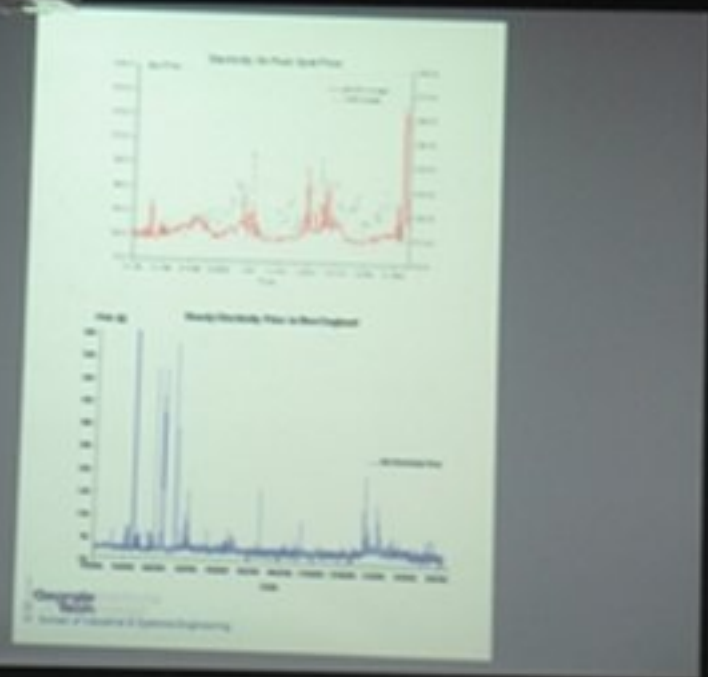
$$\max E[u_1(\phi^0(1+r_f) + \sum_{i=1}^n \phi^i(1+R^i))]$$

$$s.t. \phi^0 + \sum_{i=1}^n \phi^i = x_0 - c,$$

and then find the optimal c by $\max u_0(c) + V_1(c)$.

How are modern markets organized?

- traders submit orders to a Limit Order Book ("market place")
- market orders ("liquidity consumption")
 - order to buy/sell at the best available price
 - immediate execution
- limit orders ("liquidity provision"):
 - order to buy/sell at a pre specified limit price
 - future execution
- unexecuted orders are stored in an LOB
- many orders are cancelled before execution
- often, orders are flagged (name, fill-or-kill, ...)





能源市场的前沿问题：市场设计
、资产定价与套期保值
Frontier research in energy markets: market
design, asset pricing and hedging

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