Georgia Institute of Technology

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Computational Investing, Part I

151: Thought Experiment: Coin Flipping

Find out how modern electronic markets work, why stock prices change in the ways they do, and how computation can help our understanding of them. Learn to build algorithms and visualizations to inform investing practice.

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Motivating Quote

"Wide diversification is only required when investors do not understand what they are doing."

– Warren Buffet

Module Objectives

- Understand *information ratio (IR)*
- Understand *information coefficient (IC)*
- Understand strategy *breadth (BR)*
- Understand the *Fundamental Law*
- Learn why lots of small bets are better
- Learn about example applications of the Law

A Thought Experiment

- Stock trade = Bet
- Coin flip = Bet

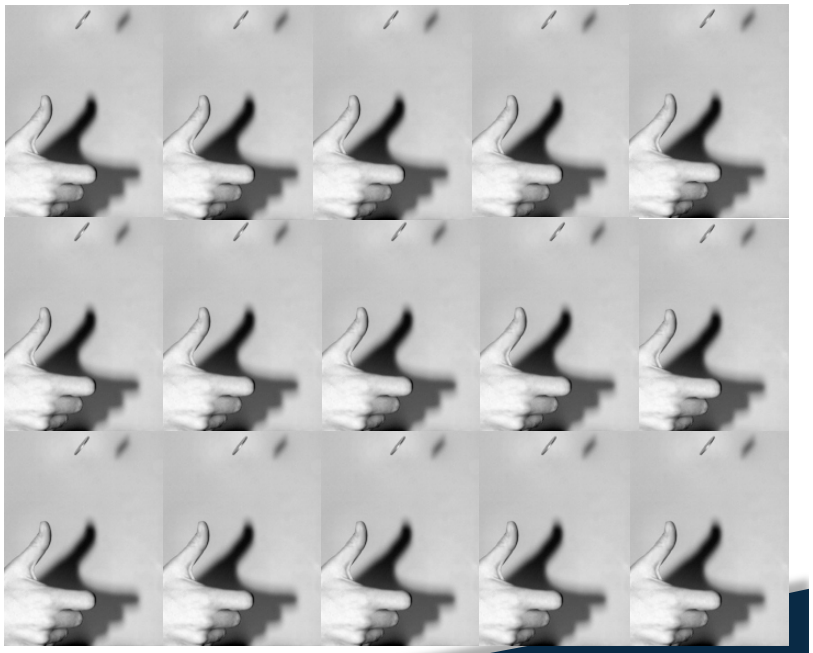
- Uncertainty = Beta
- Coin bias = Alpha
  - 51% heads

Conditions of One Bet

- We bet one token
- Win: Now own two tokens
- Lose: Now own zero tokens

What if We Make Multiple Bets In Parallel?

- Case 1:
  - One bet with $1,000 token
- Case 2:
  - 1,000 bets with $1 tokens
- Which is better?



Consider Reward/Risk

- Reward = expected return
- Single bet case:
  - 0.51*1000 + 0.49*-1000 = $20
- Multi bet case:
  - 1000 * (0.51*1 + 0.49*-1) = $20

Consider Reward/Risk

- Risk measure 1: Possibility to lose everything
- Single bet case: 49%
- Multi bet case:
  - 0.49 * 0.49 * 0.49 … * 0.49 = 0.49^1000 (small!)

Consider Reward/Risk

- Risk measure 2: standard deviation
- Multi bet case:
  - STDEV(1, -1, 1, -1, 1, 1, …, -1) = $1.00
- Single bet case:
  - STDEV(1000, 0, 0, 0, 0, …, 0) = $31.62

Consider Reward/Risk

- Single bet case:
  - Reward/Risk = $20 / $31.62 = 0.63
- Multi bet case:
  - Reward/Risk = $20 / $1 = 20.0
- Same as Sharpe Ratio

Observe

- SR(multi) = SR(single) * SQRT(1000)
  - 20 = 0.63 * SQRT(1000) = 0.63*31.62 = 20

More generally:

- SR(multi) = C * alpha * SQRT(bets)

Observe

- Same expected return, but
- Multi bet case:
  - Much lower risk to lose everything
  - Much lower standard deviation
  - Much higher reward/risk ratio

Take Home Lessons

- Higher alpha = higher Sharpe Ratio
- More bets = higher Sharpe Ratio
- Sharpe Ratio grows as the SQRT of brea

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