

# Do Humans Perceive Temporal Order in Asset Returns?

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# Motivation

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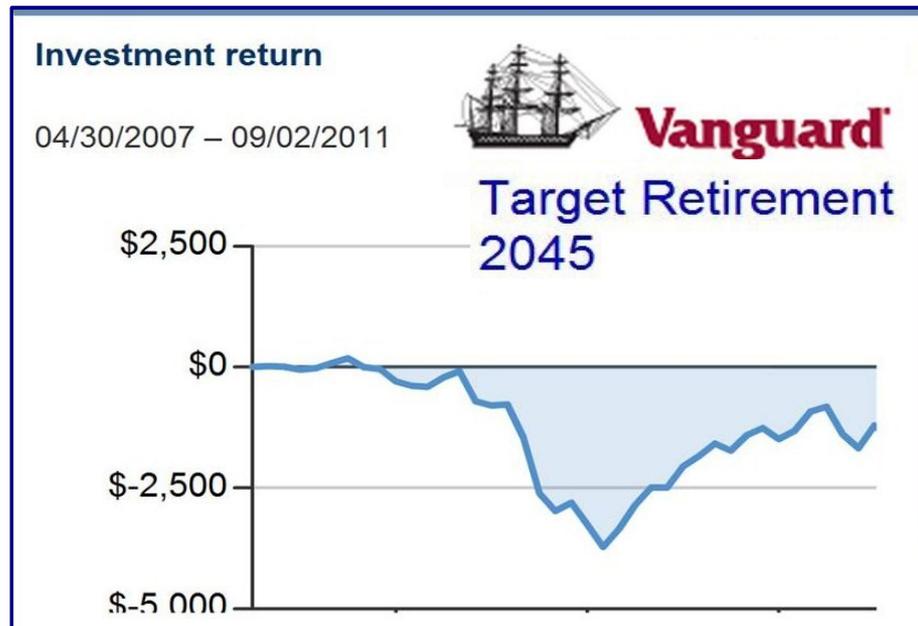
## My IRA statement

| Mutual Funds           | Average Annual Total Returns as of 08/31/2011 |        |         |                 |            |
|------------------------|---|--------|---------|-----------------|------------|
|                        | 1-Year  | 5-Year | 10-Year | Since-Inception |            |
| Target Retirement 2045 | 15.96%  | 1.99%  | —       | 5.55%           | 10/27/2003 |

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# Debate

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- What data to give investors, how to present it?  
[Bazerman 01, Kozup Howlett Pagano 08]  
[Consumer Financial Protection Bureau 11],...
- Are temporal charts of returns of use to investors?

# Do return charts affect investments?

- [Hung Heinberg Yoong 10]: subjects allocate \$10,000 to funds based on past returns disclosed as **numerical table** vs. **numerical table plus chart**

| Name/<br>Type of Option            | Graph:<br>2000-2009<br>Year-End Total<br>Returns*                                  | Average Annual Total Return<br>as of 06/30/2010 |      |       |                    |
|------------------------------------|--|---|------|-------|--------------------|
|                                    |  | 1yr.  | 5yr. | 10yr. | Since<br>Inception |
| <b>Stock Funds</b>                 |  |   |      |       |                    |
| Small Cap Stock<br>Index<br>Fund A |  | 22.7%   | 2.2% | 3.7%  | 5.0%<br>05/21/98   |

- Results ambiguous: charts affect allocations, but not investment outcomes

# Our Question

- What if my IRA statement has a “random” chart?

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- Can humans **extract information** from return charts?

# Folk Myth

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- Humans **cannot tell** asset **returns** from **random walk**  
=> cannot extract information from return charts
- [Roberts '59, Malkiel '73, DeBondt '93,...]
- [Keogh Kasetty '03]: Which sequences are S&P 500?



# Our Work

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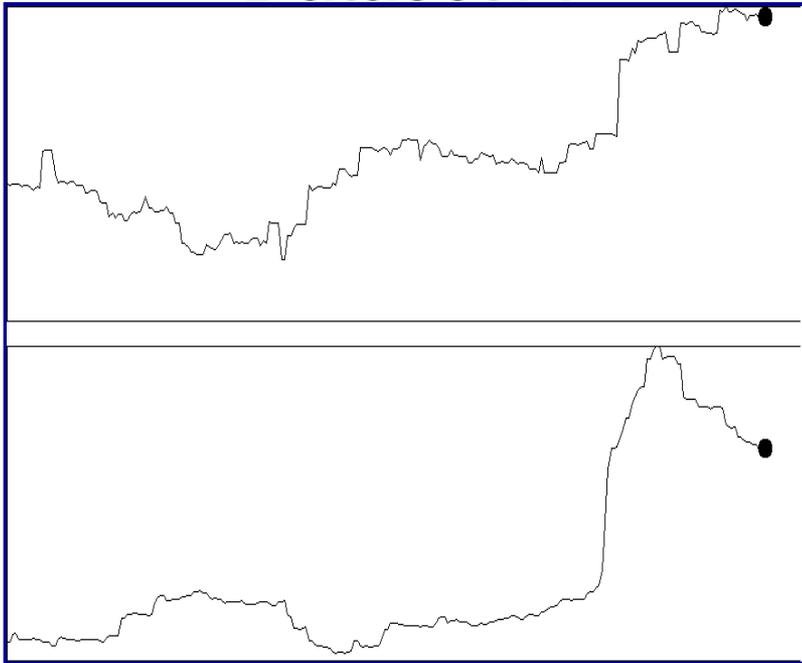
- New, **video-game** experiment to test if humans can distinguish returns data from random
- Usefulness of video game:  
Efficient collection of large amount of sound data

# Video Game ARORA

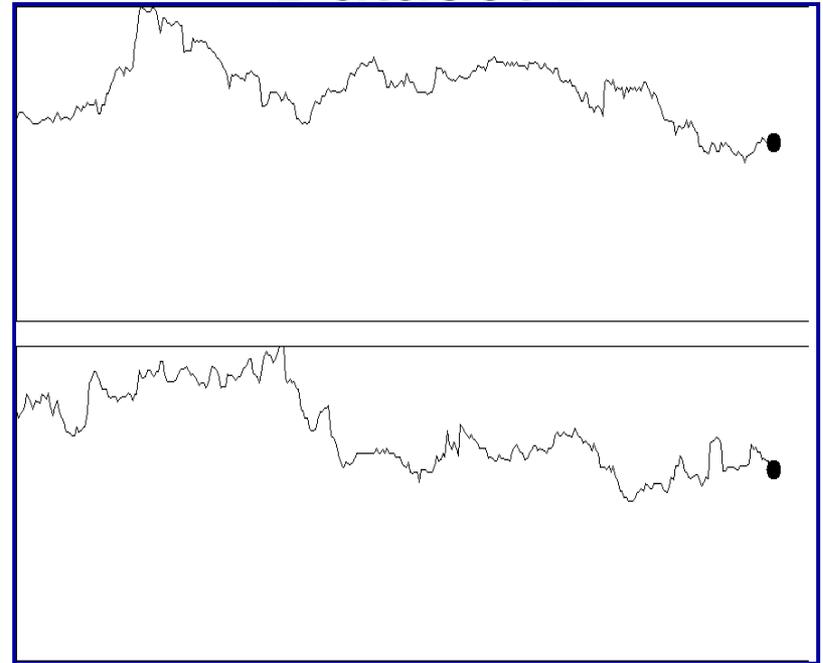
<http://arora.ccs.neu.edu/> [H. Lo Viola '11]

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Dataset A



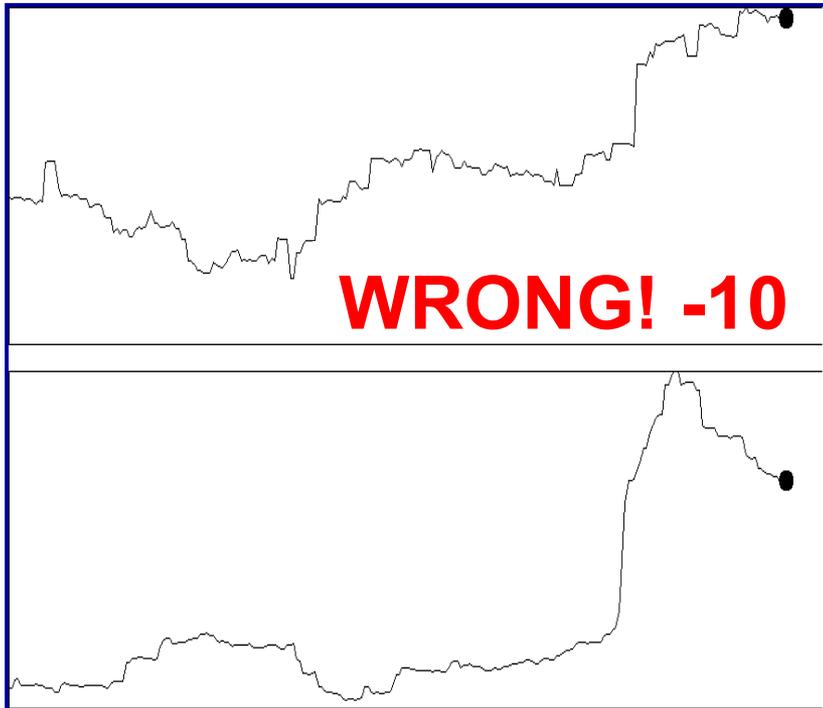
Dataset B



- Show 2 moving price charts, one real, the other random permutation of returns of real  
Permutation kills temporal order, keeps mean, std,...
- Players need to click on real

# Which Chart Is Real?

Dataset A



Dataset B



- Task seems easier if playing the game dynamically

Can learn from feedback on validity of guesses

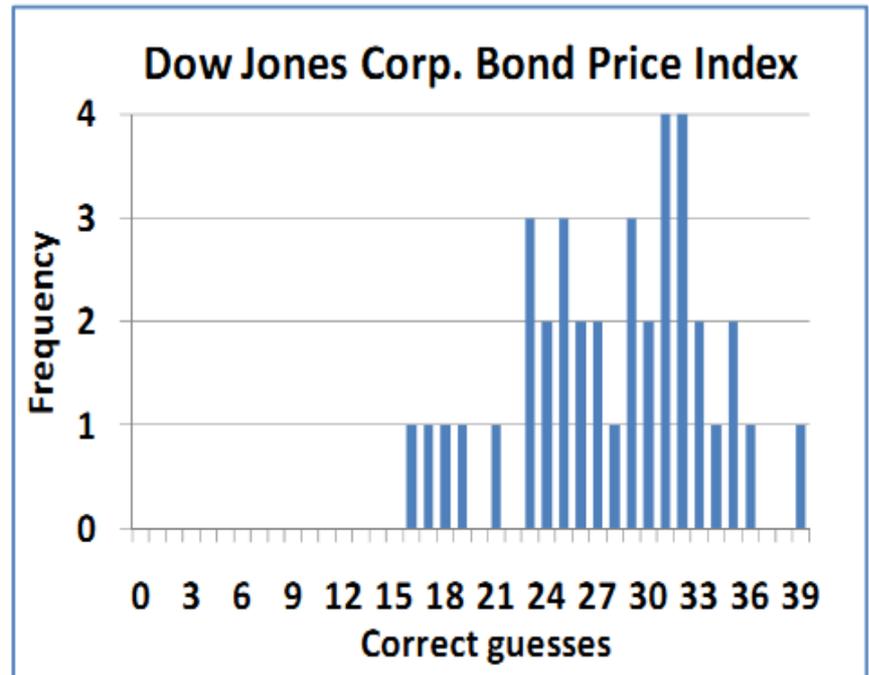
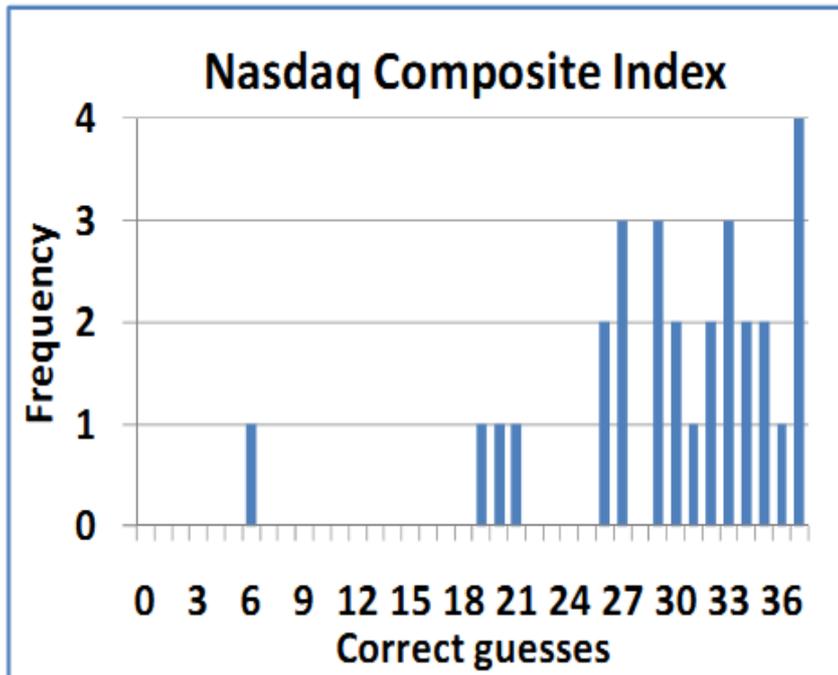
# Our Experiment

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- 8 contests using data:  
NASDAQ, Russell 2000, USD Index, Gold Spot (tick)  
DJ Corp. Bond, DJIA, CAN/USD, Corn Index (daily)
- Each contest is 31-50 charts
- 78 subjects, 8000 guesses

# Our Results

- $H_0$ : humans cannot tell real from random charts
- Under  $H_0$ , each guess is independent coin toss
- Strongly reject  $H_0$ : 7 out of 8  $p$ -values  $< 0.005$



# Biased Pool of Subjects?

| <b>Dow Jones Corporate Bond Price Index</b> |                          |                   |                    |
|---|--------------------------|-------------------|--------------------|
|   | <b>Demographic group</b> | <b># subjects</b> | <b>p-value (%)</b> |
| <b>Occup</b>                                | academic/other           | 9                 | 0.5                |
|   | finance                  | 7                 | 0.6                |
|   | student                  | 22                | 0.0                |
| <b>Sex</b>                                  | female                   | 8                 | 2.2                |
|   | male                     | 30                | 0.0                |
| <b>Educ</b>                                 | high school/undergrad    | 17                | 0.0                |
|   | MS/PhD                   | 21                | 0.0                |
| <b>Age</b>                                  | >=30                     | 14                | 0.0                |
|   | <30                      | 24                | 0.0                |
| <b>Country</b>                              | USA                      | 25                | 0.0                |
|   | other                    | 13                | 0.0                |
|   | <b>Entire sample</b>     | <b>38</b>         | <b>0.0</b>         |

- **Finance** background does **not help**

All datasets: 73% of guesses correct for finance experts vs. 72% for others

# Future Work

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- Which data properties did subjects exploit?
- Subject: “When first viewing the two data sets, it is impossible to tell which is real, but a pattern quickly emerges & the eye can easily pick out the real array”

Is feedback critical?

- Human vs. computer  
**Future:** Video games as trading platforms



# Conclusion

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- Video game ARORA:  
<http://arora.ccs.neu.edu/>
- Subjects can tell asset returns from their random permutation
- Our results contrast the folk myth

**Thank you!**