



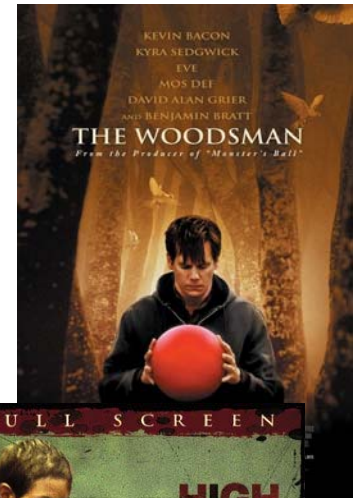
Functional Shape Analysis to Forecast Box-Office Decay using Virtual Stock Exchanges

Wolfgang Jank
RH Smith School of Business
University of Maryland

Jointly with
Natasha Foutz, UVA & Gareth James, USC

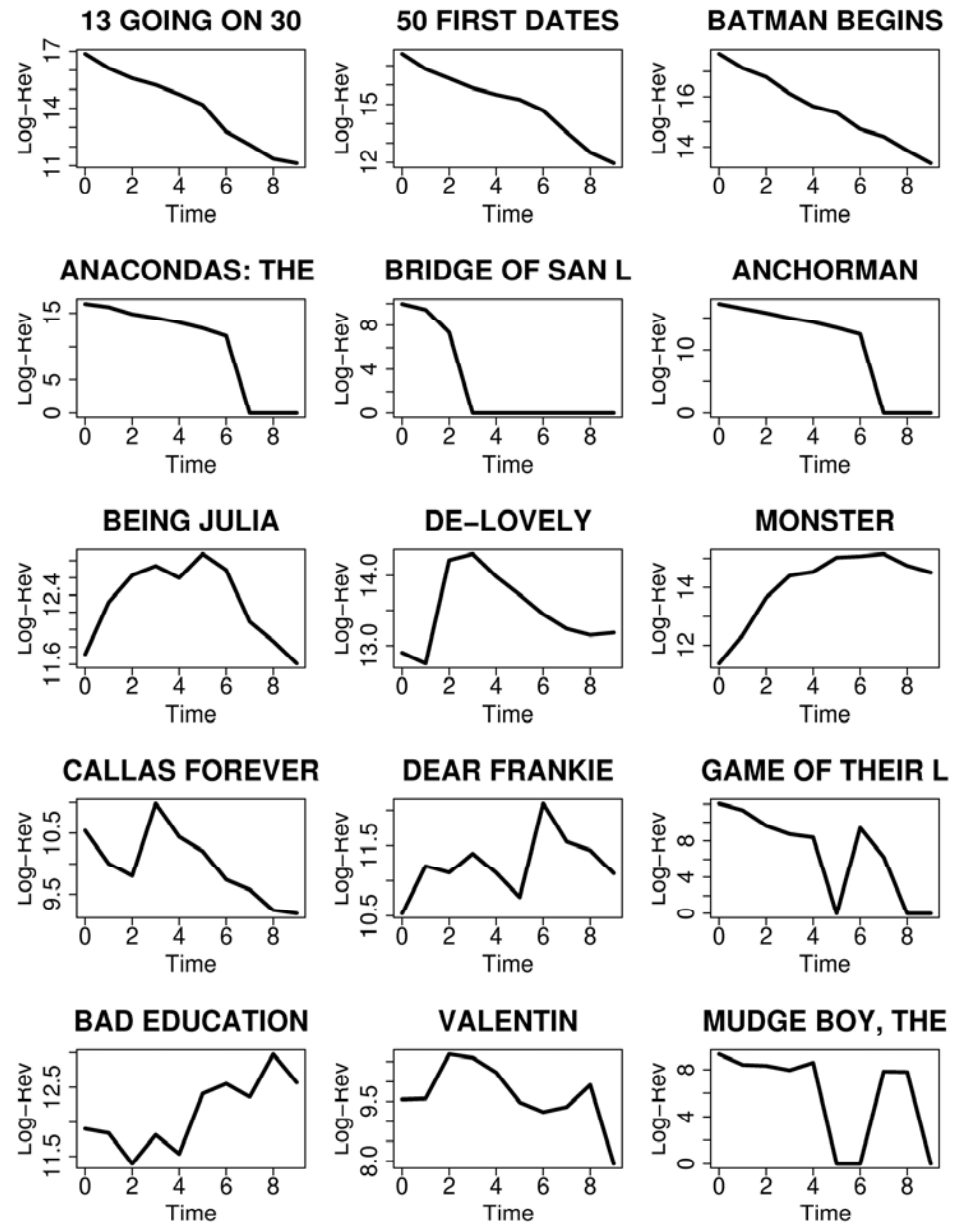
Forecasting Product Demand: Demand for Hollywood Movies

- Why is forecasting new product demand important?
 - To make optimal marketing allocation decisions
 - \$ of advertising, # of screens, etc
- Why is it challenging?
 - Because demand is highly variable
 - High for some products, low for others
 - “The Woodsman” had a budget of \$30mill, but made only \$54,000 on the first week-end
 - “High Tension” had a budget of only \$430,000, and made \$1.9 mill on the first week-end
 - “Alexander” made \$14 mill on first week-end
 - Because demand changes over life-cycle
 - High early, low later; sometimes vice versa
 - Changing **rate of decay**



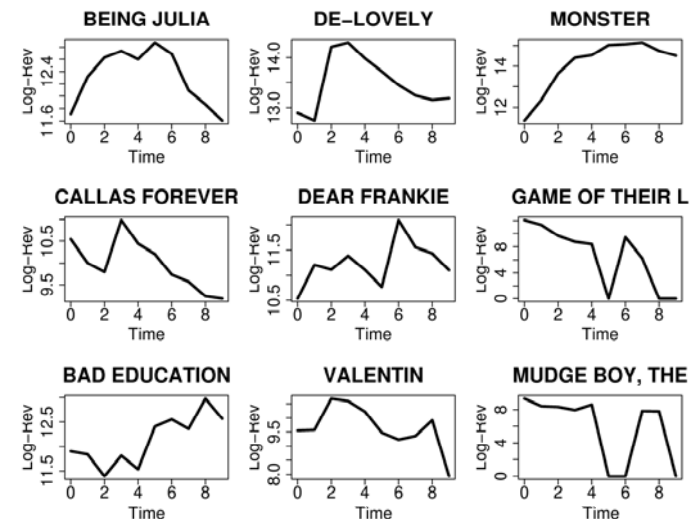
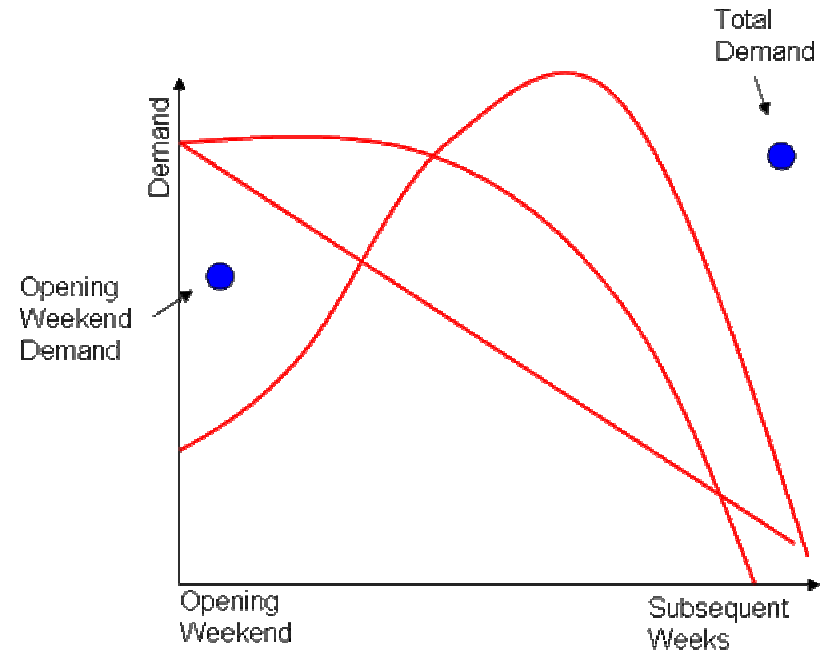
Movie Demand Decay Rates

- Movie demand decays at varying rates
 - Some decay at log-linear rate; others have sudden drops
 - Some increase over time (“Sleepers”); others behave very volatile
- Our goal is to forecast demand **decay rates**



First Reflection

- The Goal: Forecast entire demand decay pattern
 - Not just a single value
- The Challenge
 - Demand distribution highly irregular
 - Parametric demand models are doomed
 - Want to extract demand **shape** characteristics
- One more challenge
 - Want to make **early** forecasts
 - Way before movie is released!



Our only (or main) source of info: Data from a Prediction Market

The Hollywood Stock Exchange (www.hsx.com)

home
movies
H\$hop
login

join

HOLLYWOOD STOCK EXCHANGE

MOVIE STOCKS

Next
[NEXT]

NEXT		
▲ June	HS\$7.66	6.11
▲ The Number 23	HS\$4.26	6.08
▲ 300	HS\$104.11	6.00
▲ The Love Guru	HS\$43.42	-4.94
▲ Transformers	HS\$189.37	-5.04

STARBONDS

Martin Scorsese
[MSCOR]

▲ Morgan Freeman	HS\$72.56	4.00
▲ Jennifer Coolie	HS\$51.17	3.80
▲ Thomas Kretsch	HS\$37.37	3.25
▲ Fred Willard	HS\$52.78	-7.50
▲ John Corbett	HS\$47.23	-10.64

1

JOIN

For Free & Earn 2 million Hollywood Dollars

2

BUY & SELL

MovieStocks & StarBonds with your H\$

3

WIN

Build a portfolio and get cool stuff

WANT TO BE A PLAYER?

TELL ME MORE!

MOVIE IPO OF THE DAY

America Ferrera
[AFERR]
HS\$15.00

This beauty became a household name with *Ugly Betty* and will appear in *La Misma Luna*.

[VIEW CALENDAR]

TRADE NOW!

RESEARCH

Berlinale Wrap-Up
Closing thoughts on the Berlin Film Festival.

On the Money
Jim Carrey bets it all on *Number 23* on the roulette wheel this weekend.

Community Talk Board
Check out the latest Hollywood news and Exchange-related activities.

FEATURES

Weekend Openers
Take a position on the new movies opening this weekend.

2007 AwardOptionsSM
Invest in your favorite nominees and profit from your predictions.

Future Releases
See which films are scheduled for release next month, even next year.

IN THEATERS THIS WEEKEND

▲ The Number 23	HS\$4.26	6.08
▲ Reno 911!: Miami	HS\$39.61	-0.38
▲ The Astronaut Farmer	HS\$25.42	-1.50
▲ The Abandoned	HS\$8.34	-0.91
▲ Amazing Grace	HS\$8.31	1.04
▲ Gray Matters	HS\$3.24	0.52
▲ Premium	HS\$2.09	-0.39

ONE MONTH

LEADERBOARD (SEASON-TO-DATE)

1	Richard Sharpe	+1940.89 %
2	ICE	+1888.84 %
3	Rodeo51	+1544.63 %
4	Buckeye Fan YTD	+1472.19 %
5	LDS YTD07	+1178.27 %

[VIEW LEADERBOARD]

HSX Virtual Markets

Powering the world's most popular prediction markets. Learn more.

More Articles

Movie Market Lab
Keep an eye on the biggest movers with these powerful tools.

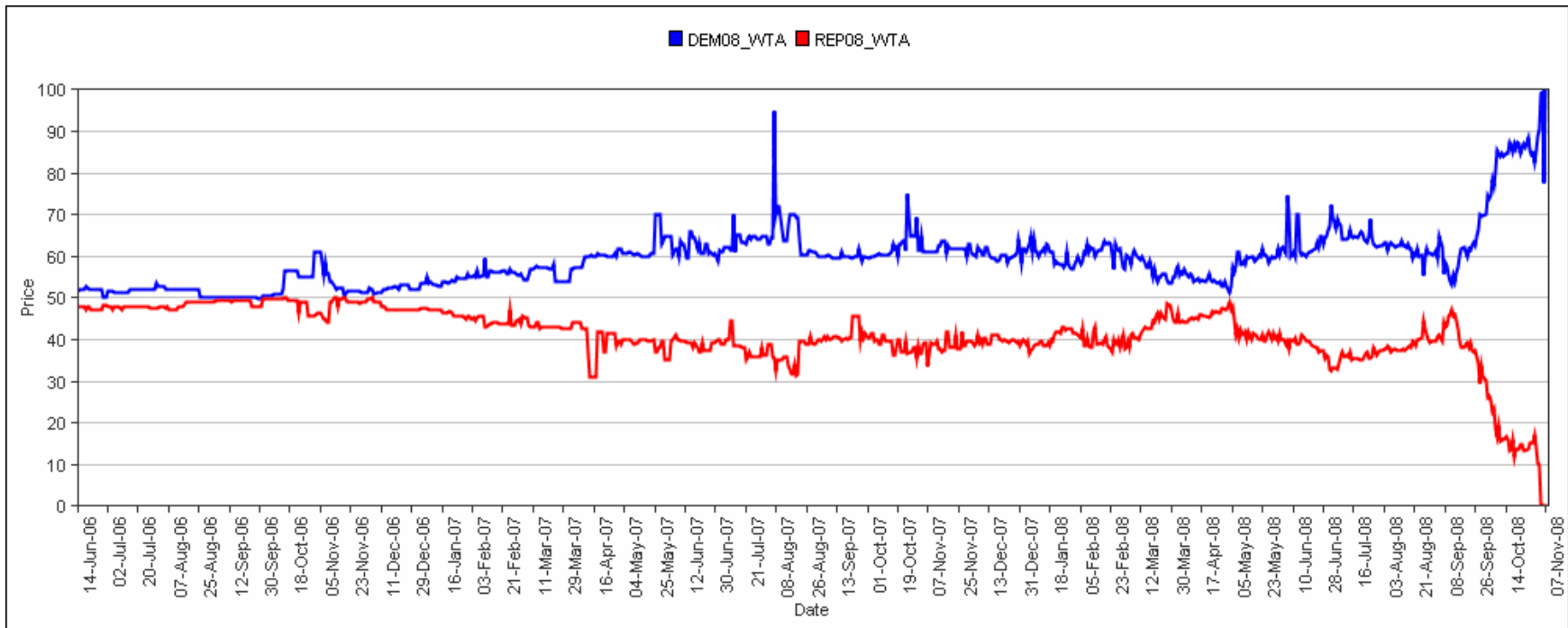
SEARCH

What is a Prediction Market?

- It is a speculative market created for the purpose of making predictions
 - Similar to the stock market
 - Assets' final cash value is tied to an event or parameter
 - Will the next US president be a Democrat?
 - What will be the magnitude of gasoline prices next quarter?
 - Current **market price** can be interpreted as **probability** of the event or the **expected value** of the parameter.
 - Also referred to as information market, decision market, idea future, event derivatives, virtual market, ...



Iowa Electronic Market and the 2008 US Presidential Election



Republican Winner

Democrat Winner

Sports, Politics, Society, Money, News, and much, much more ...

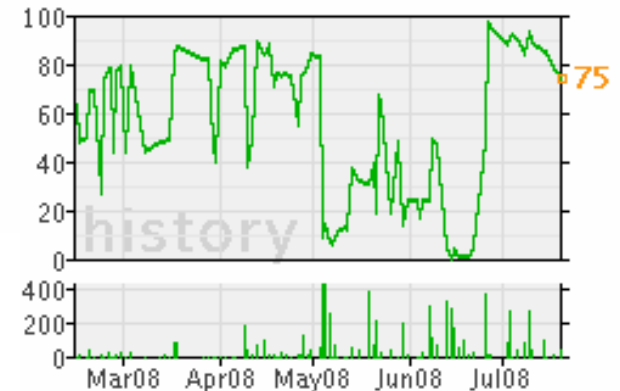
**Will there be more than 9
named Atlantic Hurricanes
in 2008?**



**Will The US catch Osama
bin Laden while Bush is
President?**



**Will Microsoft buy Yahoo
in 2008?**



*all courtesy of Newsfutures.com

More major corporations use VSMS

intrade

Tradesports|com

HSX
CDM

IEM | Iowa Electronic
Markets

newsfutures
PREDICTION MARKETS

HedgeStreet
EXCHANGE

YAHOO!

- Generate ideas
- Design new products
- Test ad effectiveness
- Understand consumer behavior

hp

Google™

Microsoft®

intel®

CORNING
Discovering Beyond Imagination

Goldman
Sachs

GE

We use data from the Hollywood Stock Exchange (HSX)

- On HSX, one can trade movies, actors, and more

MOVIE STOCKS®









[COMPLETE LISTING](#)

[ADVANCED SEARCH](#)

[RELEASE SCHEDULE](#)

[WEEKEND OPENERS](#)

TOP 15 MOST WIDELY HELD










1		<i>Indiana Jones 4</i>	INDI4	H\$226.08	+1 7/8
2		<i>The Simpsons</i>	SIMPS	H\$148.01	HALTED
3		<i>Harry Potter and the Order of the Phoenix</i>	HPOT5	H\$251.01	-3 1/8
4		<i>The Bourne Ultimatum</i>	BORN3	H\$147.03	+2 1/2
5		<i>The Hobbit</i>	HOBIT	H\$81.21	+1/2
6		<i>Harry Potter and the Half-Blood Prince</i>	HPOT6	H\$213.99	+5/8
7		<i>Austin Powers 4</i>	AUST4	H\$59.85	-1/2
8		<i>Terminator 4</i>	TERM4	H\$49.21	-3/4

STAR BONDS®

[COMPLETE LISTING](#)

[ADVANCED SEARCH](#)

TOP 15 MOST WIDELY HELD

1		Johnny Depp	JDEPP	H\$107.54	0
2		Angelina Jolie	AJOLI	H\$93.53	+1/2
3		Ben Affleck	BAFFL	H\$32.32	+1/4
4		Adam Sandler	ASAND	H\$101.71	+1 1/4
5		Julia Roberts	JROBE	H\$55.50	0
6		Brad Pitt	BPITT	H\$111.89	-1 1/4
7		Matt Damon	MDAMO	H\$91.62	+1 1/2
8		Samuel L. Jackson	SLJAC	H\$25.03	-1/4
9		Nicole Kidman	NKIDM	H\$58.99	-3/8

Works just like a Stock Market

Natasha Foutz's Movies Portfolio			NET WORTH	
today's change: H\$4,002.00			H\$2,004,002.00	
CASH	INTEREST	INVESTMENTS		
H\$2,000,000.00	H\$287.67/day @ +5.25%	H\$4,002.00		
RANK	% GAIN			
Overall Rank: 0	Week-to-Date: +0.20%			
Change in Rank: up 0	Month-to-Date: +0.20%			
Percentile: +100.00%	Season-to-Date: +0.20%			
How do I rank?	Year-to-Date: +0.20%			
Graph Net Worth: 30,60,90	Lifetime-to-Date: +0.20%			
Jump to your STARBONDS - FUNDS - OPTIONS				
MovieStocks™ Release				
		Date	Phase	COMPLETE LIST ▶
0 MovieStocks	0 shares	H\$0.00	H\$0.00	0%
StarBonds™ COMPLETE LIST ▶				
1 StarBonds	100 shares	H\$4,002.00	H\$4,002.00	+880,049,106,871,910,400%
symbol	shares	avg paid	curr price	change
POTOO	100	H\$0.00	H\$40.02	+0.25
		total value	net gain/loss	%
		H\$4,002.00	H\$4,002.00	0%
			quicktrader	Trade
Jump to your MOVIESTOCKS - STARBONDS - OPTIONS				
funds COMPLETE LIST ▶				
0 Funds	0 shares	H\$0.00	H\$0.00	: 0%
options COMPLETE LIST ▶				
0 Options	0 shares	H\$0.00	H\$0.00	0%

What do I get in return?

- The key challenge for prediction markets are the right incentives:
 - Why would you submit your wisdom to the market?
 - Some argue that prediction markets based only on play money will not work
 - HSX (and others markets) prove this wrong!

H\$hop Redemption

Short on H\$? Click [here](#) for Cash Only prices.

Summer Special! Receive a free PEN with your first \$10 purchase and a free WAND with your first \$25.



Sleek and stylish, the HSX twill cap is black with striking white and orange accents with 'BE A PLAYER' on back.

H\$10 million + US\$12.00

Made of 100% cotton brushed twill with a 6-panel unconstructed crown, self-fabric closure and d-ring slider. This cap is what the cool kids are wearing.



You'll be styling in this 100% pre-shrunk cotton Tee with bold HSX in white and orange accents.

H\$15 million + US\$10.00

This Navy Tee is perfect for a cool, confident look. Comes in M, L, XL.

Size: Medium



This sporty, casual Tee in Pine is set off nicely with HSX in white and orange accents.

H\$15 million + US\$10.00

Made with 100% pre-shrunk cotton, this Tee will have your buddies talking. Comes in M, L, XL.

Size: Medium



This black 15 oz ceramic mug will be the envy of your office. Comes with HSX on front and 'BE A PLAYER' on the back.

H\$10 million + US\$7.50

Your co-workers will be filled with bitter jealousy as you sip your coffee, tea or cocoa.

More incentives...

- The most successful traders are featured on the “leader board”

Leaderboard

LEADER BOARD [close window](#)

[Top 100](#)

WEEK-TO-DATE	rank	screen name	gain	worth
1	MoneyMagnet	30.96 %	H\$5,201,661.86	
2	Tim	24.84 %	H\$3,029,207.37	
3	Iiah katlin	22.05 %	H\$2,440,916.59	
4	Jeff McDermott	20.01 %	H\$2,479,172.70	
5	Froggy and the Ho Piggy	19.81 %	H\$4,631,992.16	
6	Mick Mathews	19.58 %	H\$2,996,622.06	
7	simon lopez	19.45 %	H\$2,388,971.96	
8	Wild Bill	18.38 %	H\$2,399,967.13	
9	Leticia Ford	18.15 %	H\$3,281,741.47	
10	GigR2	16.07 %	H\$4,722,570.89	

Rankings Current as of 09-JUN-2008

MONTH-TO-DATE	rank	screen name	gain	worth
1	MoneyMagnet	160.08 %	H\$5,201,661.86	
2	bret shuckerow	75.86 %	H\$4,897,319.45	
3	Andrew Vytuvlis	73.42 %	H\$3,589,623.82	
4	Murray Hainer	72.67 %	H\$3,511,103.52	
5	Mike McCarte	72.20 %	H\$8,089,736.11	
6	Matt Breeden	68.43 %	H\$3,368,559.68	
7	Shane Spence	68.37 %	H\$5,634,247.48	
8	Michael Mattioli	65.96 %	H\$3,968,725.12	
9	Lucas Omer	63.34 %	H\$3,266,894.53	
10	Mario MacPoo	62.39 %	H\$3,558,930.86	

Rankings Current as of 09-JUN-2008

SEASON-TO-DATE	rank	screen name	gain	worth
1	Scott Howard	231.70 %	H\$6,633,942.28	
2	janira nafarrate	200.32 %	H\$8,950,443.45	
3	Tigoda	189.12 %	H\$8,552,299.73	
4	Mike Reyes	188.02 %	H\$10,960,805.15	
5	Jon Robb	180.63 %	H\$5,633,012.60	
6	goober saurus	170.11 %	H\$7,837,394.54	
7	steve harrington	167.01 %	H\$7,282,933.26	
8	Big Kitty	163.90 %	H\$8,773,859.18	
9	MoneyMagnet	160.08 %	H\$5,201,661.86	
10	Shane Spence	154.26 %	H\$5,634,247.48	

Rankings Current as of 09-JUN-2008

YEAR-TO-DATE	rank	screen name	gain	worth
1	Get Smarter!!! YTD 2008	8972.99 %	H\$181,459,747.23	
2	(*_*) John McCain n2008	4322.47 %	H\$88,449,472.03	
3	helmetz	4091.71 %	H\$83,834,160.86	
4	Decoman YTD 2008	3907.11 %	H\$80,142,163.76	
5	Group Captain Lionel Mandrake YTD	3659.76 %	H\$75,195,191.40	
6	maguire	3311.81 %	H\$68,236,261.87	
7	DragonDrop	3191.06 %	H\$65,821,213.29	
8	Lauk YTD 08 (Reset 2/11)	2792.06 %	H\$57,841,232.00	
9	NiteKraz YTD	2529.86 %	H\$52,597,237.98	
10	gav08	2469.58 %	H\$51,391,517.03	

Rankings Current as of 09-JUN-2008

LIFETIME	rank	screen name	gain	worth
1	fembot	557938.07 %	H\$11,160,761,460.23	
2	The Full Merino	467657.65 %	H\$9,355,153,093.41	
3	The Moghul of The Rings	424199.70 %	H\$8,485,993,904.89	
4	HAL 9000	376020.96 %	H\$7,522,419,218.07	
5	Trader Jones	324206.05 %	H\$6,486,121,059.41	
6	HAL 8000	314417.98 %	H\$6,290,359,528.98	
7	zeitgeist	292655.77 %	H\$5,855,115,437.39	
8	R A	290873.26 %	H\$5,819,465,217.61	
9	Pint-Sized Txredd	285621.36 %	H\$5,714,427,111.32	
10	HSX S&P: MOVIES - BONDS - FUNDS - OPTIONS	279884.56 %	H\$5,599,691,244.18	

[Top 100](#)

Some curiosities...

- ...and you can sell your virtual portfolio on eBay!

Welcome to eBay! Need help?
[Take a tour to learn more](#)

Find more items similar to: [Hollywood Stock Exchange Billion Dollar Portfolio! HSX!](#)
See all items in: [Internet Games](#) > [Other](#)

Listed in category: [Video Games](#) > [Internet Games](#) > [Other](#)

Hollywood Stock Exchange Billion Dollar Portfolio! HSX!

Item number: 330165096838

Bidder or seller of this item? [Sign in](#) for your status [Watch this item](#) in My eBay



[View larger picture](#)

Current bid: **US \$15.50** [Place Bid >](#)
[PayPal account required](#)

End time: **Sep-18-07 21:23:05 PDT**
(3 days 5 hours)

Shipping costs: **FREE**
Standard Flat Rate Shipping Service
Service to [United States](#)

Ships to: Worldwide

Item location: Missouri, United States

History: [16 bids](#)

High bidder: [bdhsx](#) (0) 🗨️

You can also: [Watch This Item](#)

Meet the seller

Seller: [bigolayfan](#) (39 ⭐)

Feedback: **100% Positive**
Member: since Jul-13-03 in United States

- [Read feedback comments](#)
- [Ask seller a question](#)
- [Add to Favorite Sellers](#)
- [View seller's other items](#)

Buy safely

1. **Check the seller's reputation**
Score: 39 | 100% Positive
[Read feedback comments](#)
2. **Check how you're protected**

PayPal Up to \$200 in buyer protection. [See eligibility.](#)

Hollywood Stock Exchange Billion Dollar Portfolio

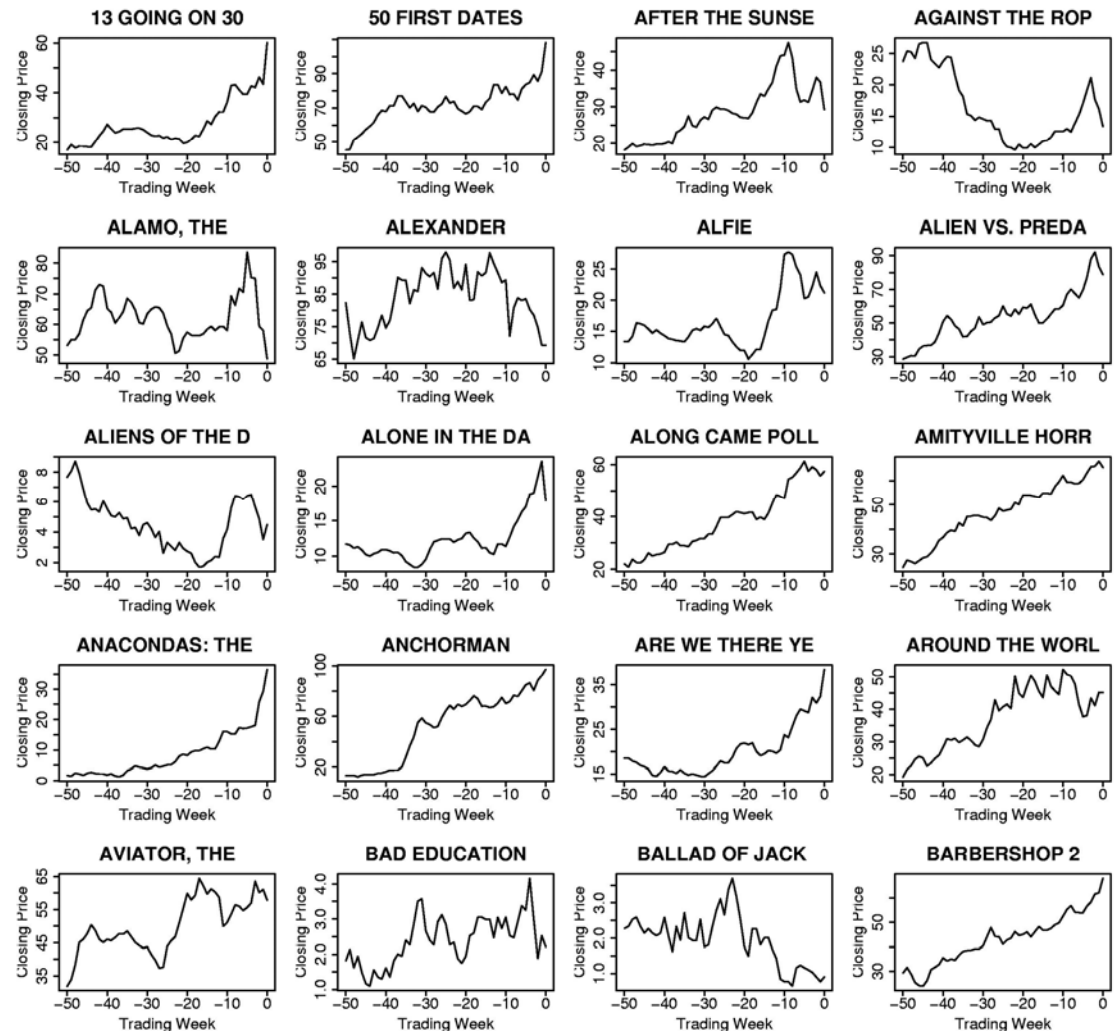
This auction is for my HSX portfolio currently worth just over 1 Billion Dollars. I've gone back to school and I don't have much time to play any more. If you're a member of the HSX movie community and you're scraping along with a few million dollars, now's your chance to save a few years of hard work and buy all the MovieStocks and StarBonds you want to own!

Bidding starts at only One Dollar!

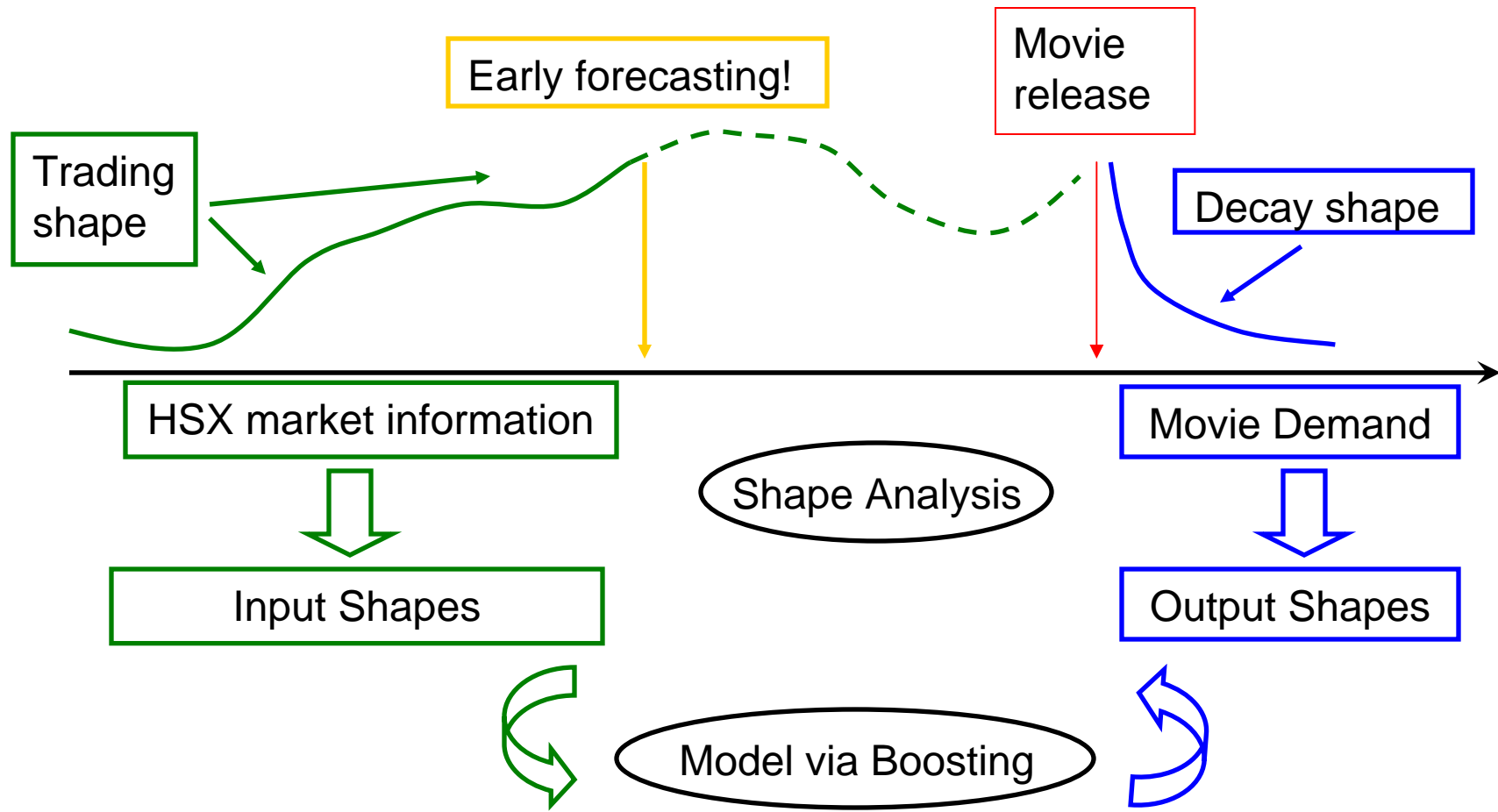
Sample Data from HSX

- We want to use the **shape** of the trading data
 - Concave, convex
 - Linear, nonlinear
 - Volatile, non-volatile

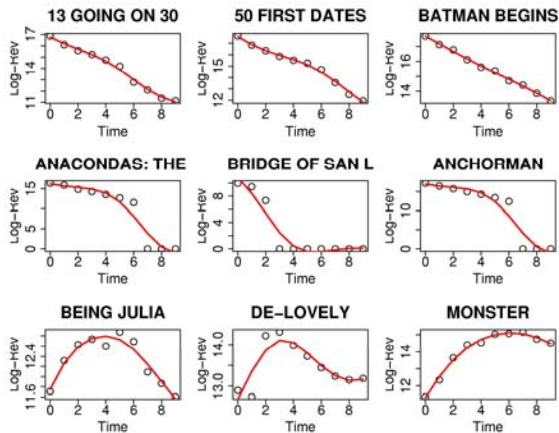
- Shape captures **information cascading, herding**



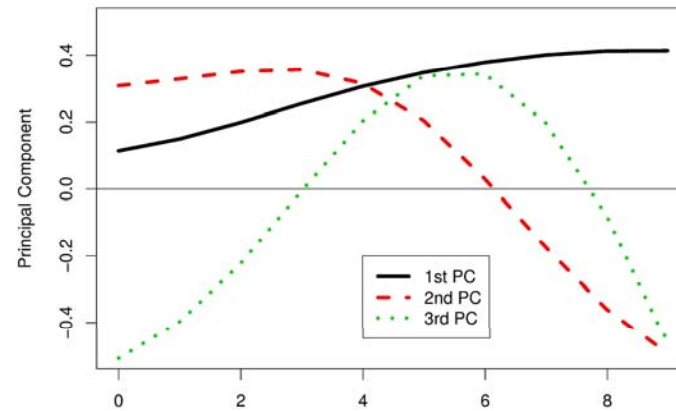
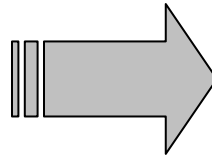
Second Reflection: Our Full Forecasting Model



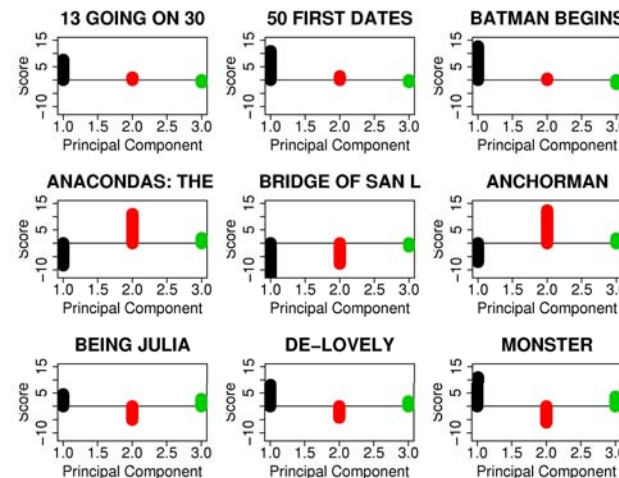
Shape Analysis: Basic Idea



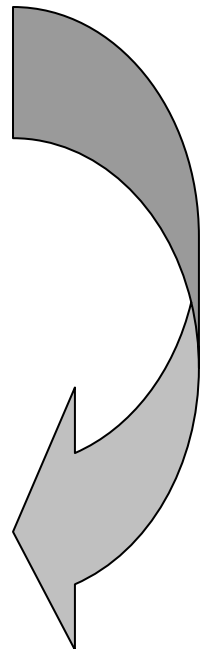
Smooth observed decays



Apply functional PCA



Characterize decay rates by principal component scores



Functional Shape Analysis of Decay

- Functional principal component analysis
 - First 3 PCs explain over 98% of all decay variation
- PC's capture different decay aspects
 - **PC1**: “slow decayers” - movies that hold demand in later weeks
 - **PC2**: “sudden droppers” - movies that decay suddenly after first few weeks
 - **PC3**: “sleeper” movies - movies that gain only very late

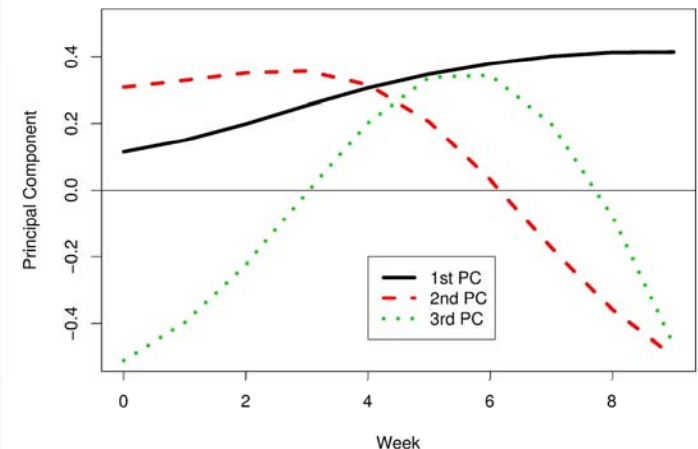
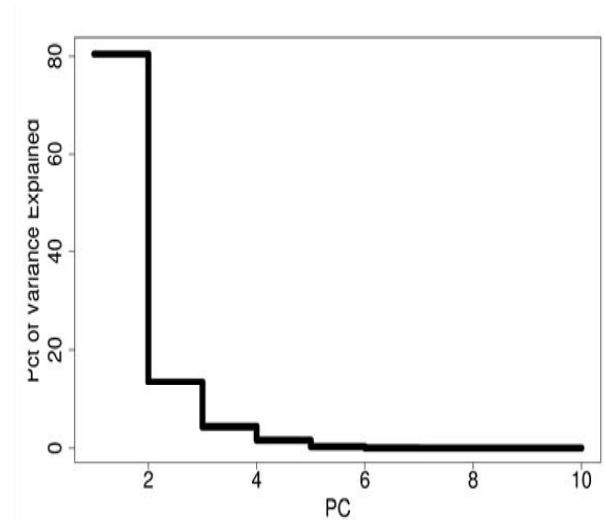
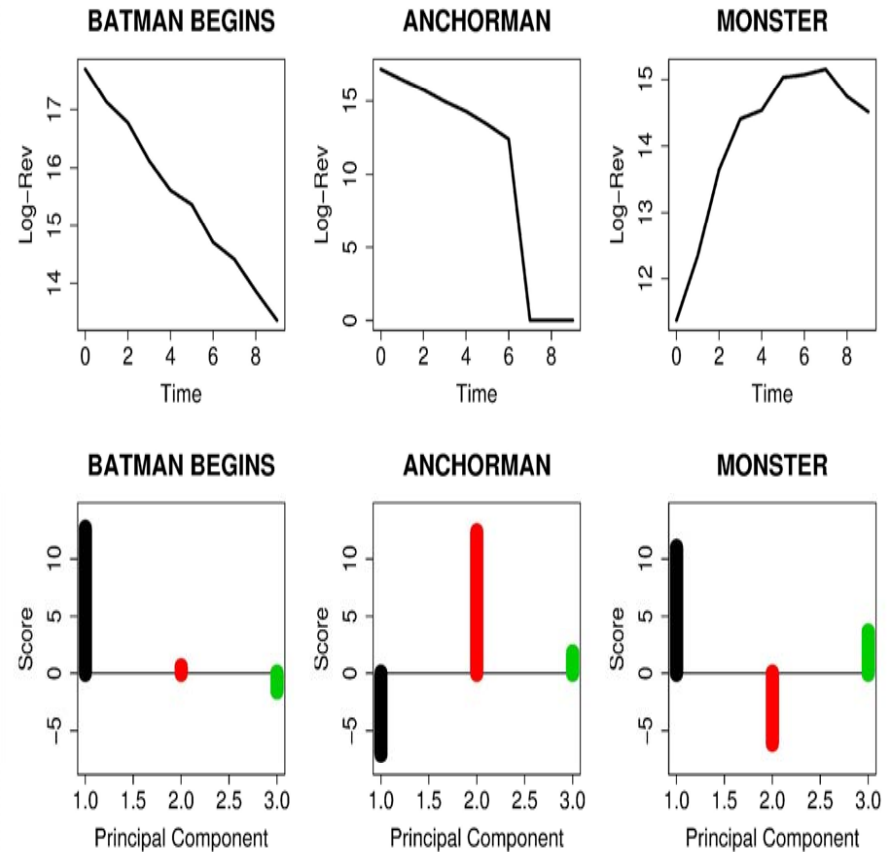
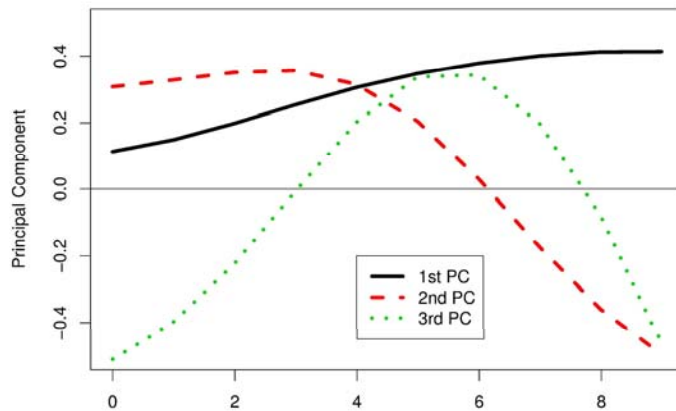


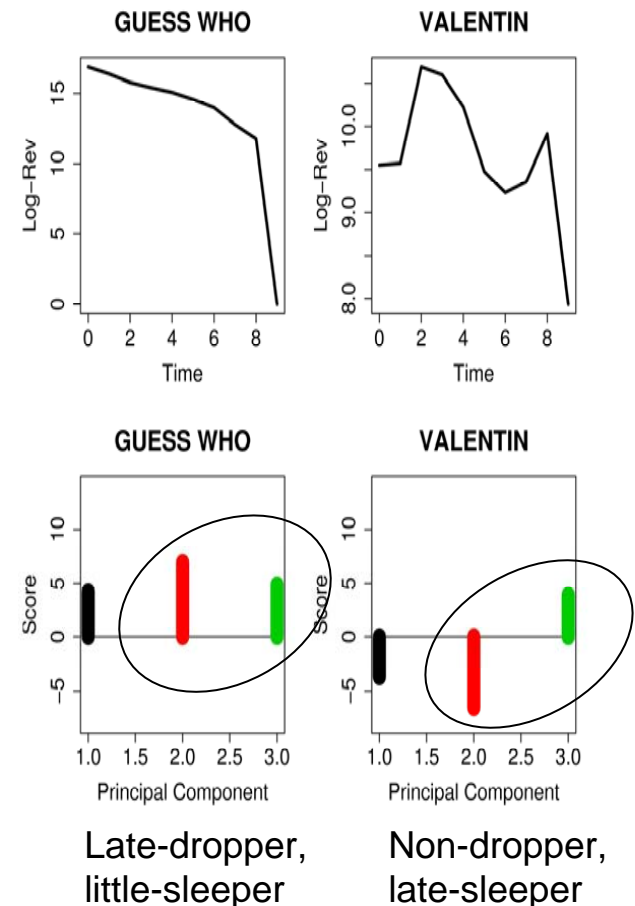
Illustration of Decay Shapes

- PC1: Batman and esp. Monster hold demand high in later weeks
- PC2: Anchorman suddenly drops to zero after week 6
- PC3: Monster generates demand only very late



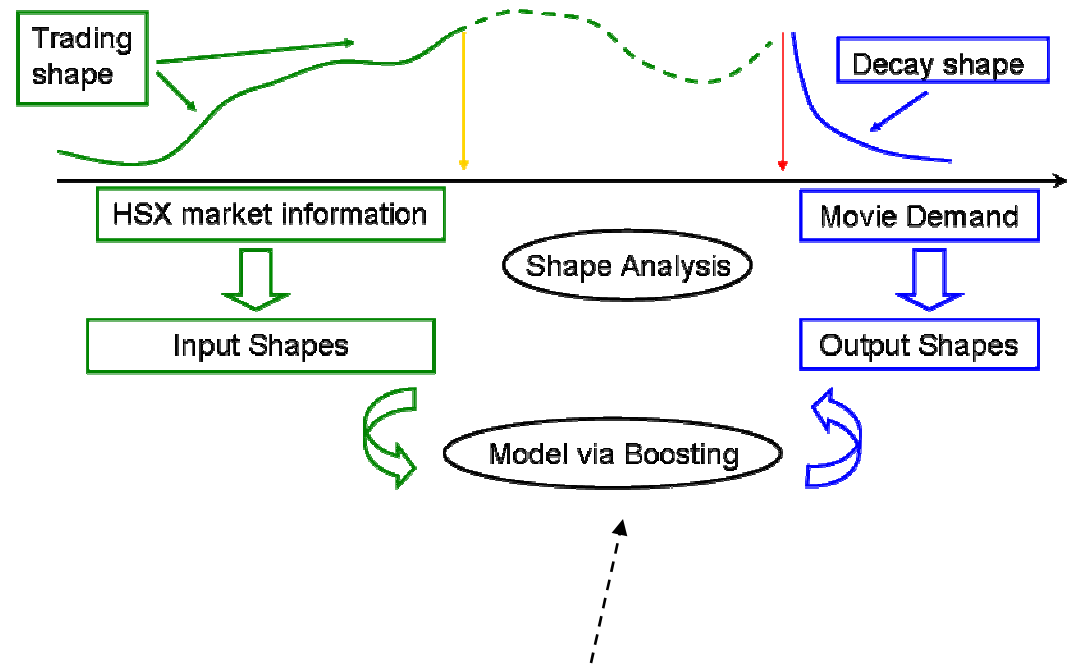
Important: There are more than 3 Shapes -- The “DNA” of Decay

- 3 PCs are only basic **building blocks** for different decay shapes
 - There are many more decay patterns
 - Movie-specific shapes captured by the corresponding PC-Scores
 - Linear combination of 3 basic PCs
 - We use similar ideas for capturing shapes of HSX market information



Where we are, where we are going

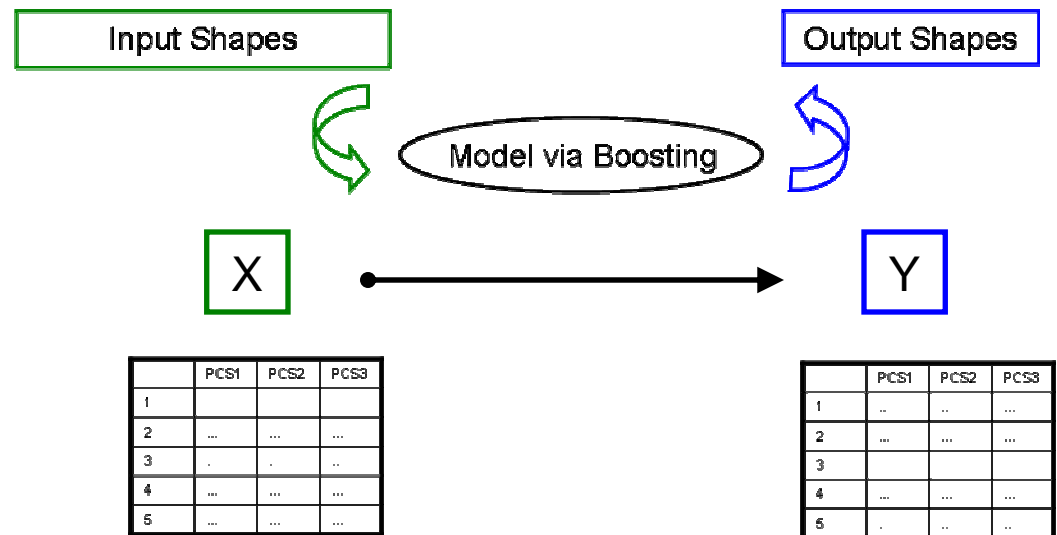
- We now successfully have...
 - ...characterized input and output shapes using the principal component scores
- We still need to...
 - ...model output shapes as a function of input shapes



Different modeling options:
linear, nonparametric, neural
networks, boosting, etc

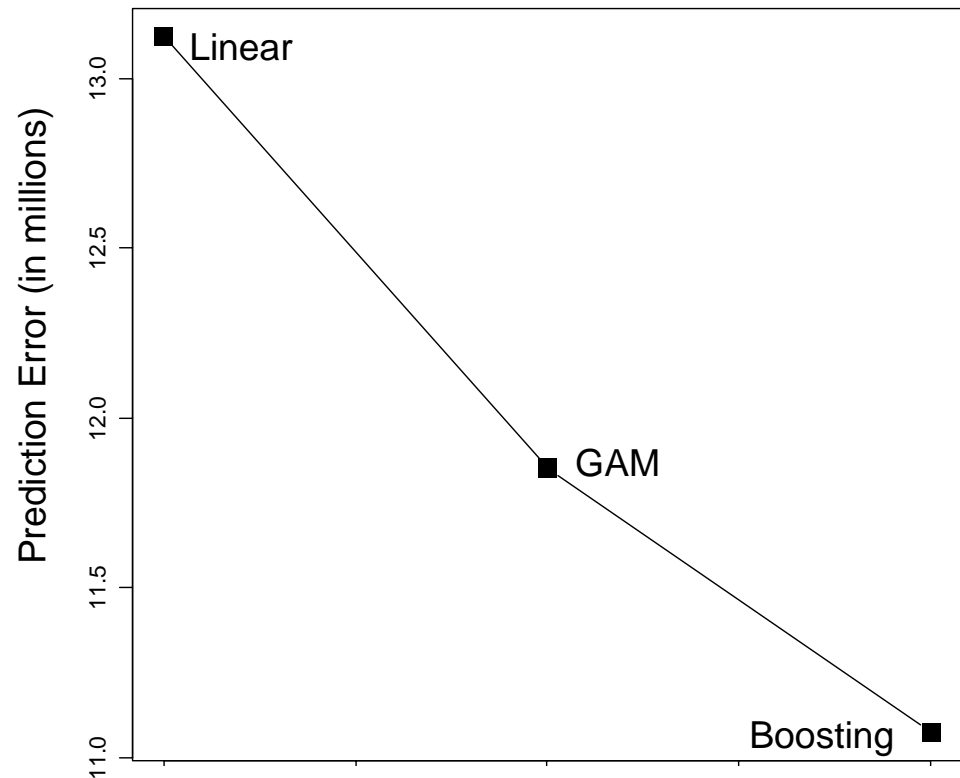
Modeling Input & Output Shapes

- Different modeling options
 - Linear Models
 - Simple, straightforward
 - Generalized Additive Models (GAM)
 - Flexible, non-linear relationships between X and Y
 - Boosting
 - Can capture non-additive data structure between X and Y



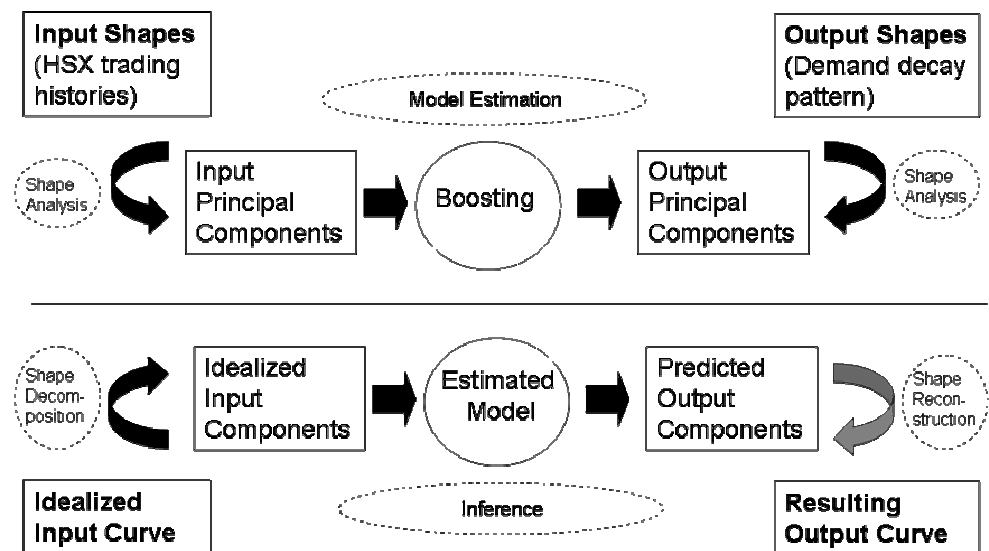
Predictive Accuracy

- Ten-fold cross-validation to gauge predictive accuracy
 - Predicting demand for the first 10 weeks after movie release
- Prediction best for the Boosting Model
 - Evidence that there data has non-linear, non-additive structure



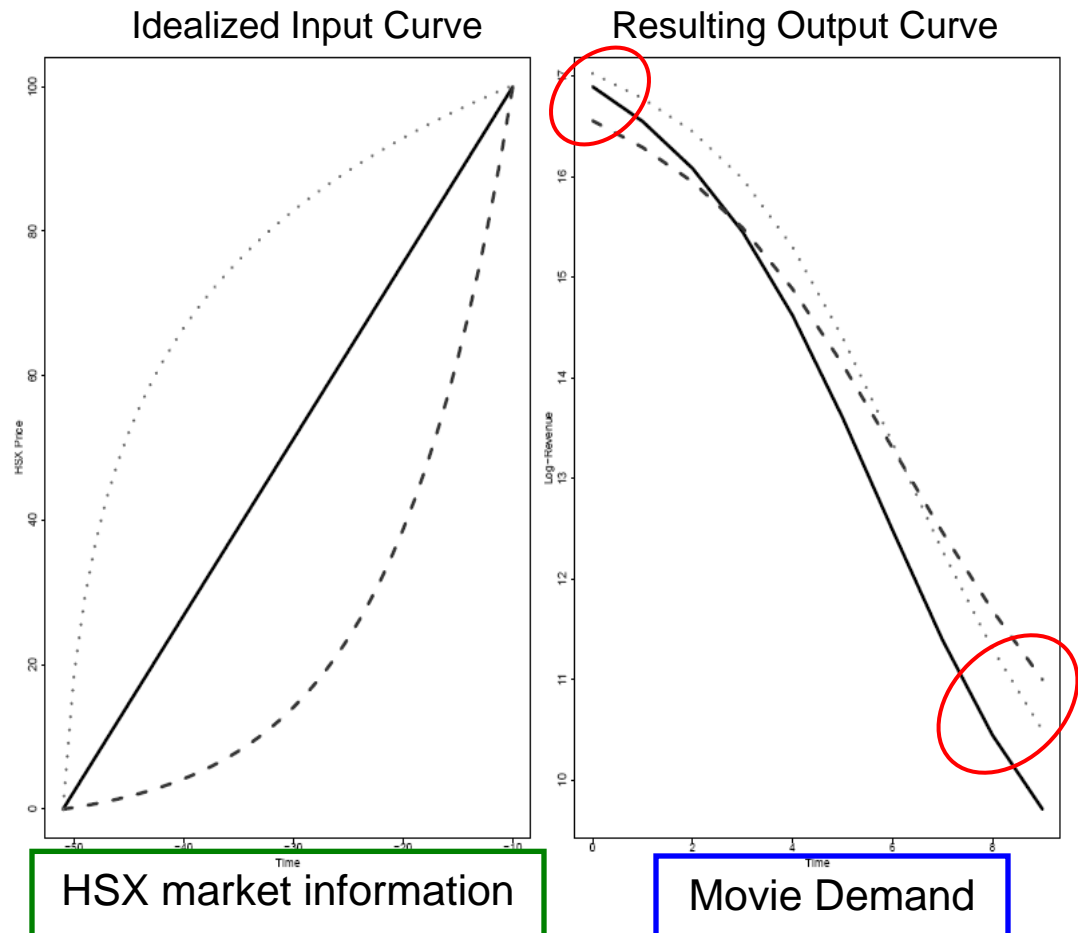
What's left? Inference...

- Functional Shape Analysis:
 - Powerful model for **predicting** demand decay
 - Disadvantage: hard to **interpret**
 - Both model input and output based on principal components
- Solution
 - Reverse-engineer the process
 - Create “dependence plots” that unveil the input-output relationship



Dependence Plot (1)

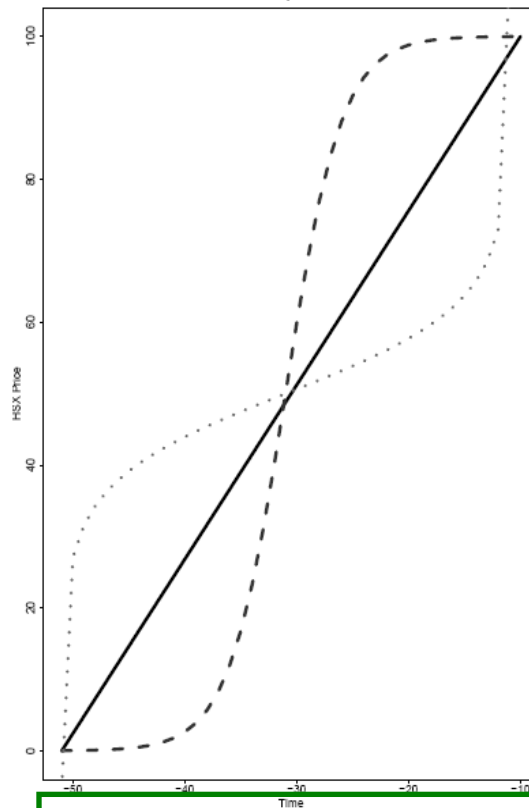
- Input curves measure the effect of different shapes
 - Curves start and end at same value, only differ in path
 - Early market growth vs late growth
 - Manifestation of early and last-moment **hype** about a movie
- Resulting demand decay
 - Early hype leads to high early demand, but rapid decay
 - Last-moment hype leads to lower initial demand, but slower decay



Dependence Plot (2)

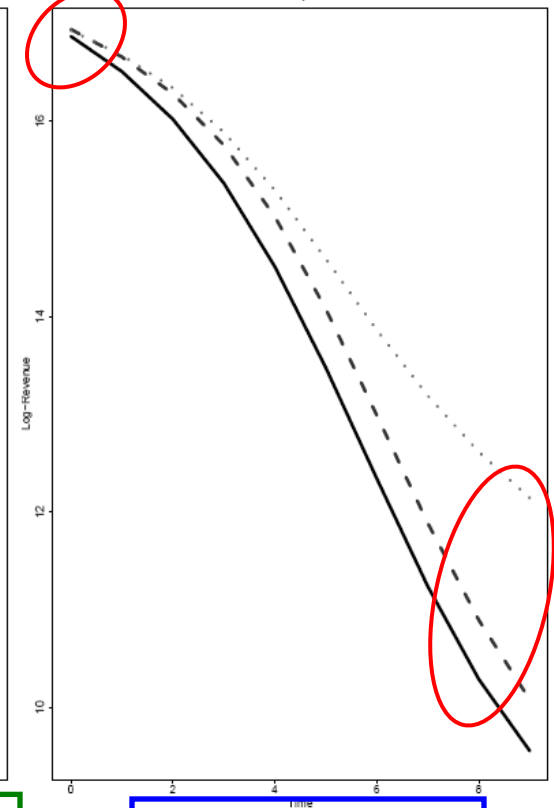
- Input curves
 - S-and inverse S-shape
 - Inverse S-shape combines early and last-moment hype
- Resulting demand decay
 - Both S-shapes result in higher demand
 - Indicates the importance of herding & diffusion dynamics
 - Inverse-S combines best of both worlds
 - Both early and late diffusion dynamics

Idealized Input Curve



HSX market information

Resulting Output Curve



Movie Demand

Conclusions

- Market shapes carry valuable information
 - Result in more accurate forecasts
 - Give insight into impact of herding behavior, information cascading, hype, etc
- Many different methodological challenges
 - Modeling decay
 - Modeling trading shapes
 - Selecting important market information
 - Linking response and predictors

