The Trader's "2% Rule" for Money Management

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A Symposium on Optimal Stopping
Rice University, Houston, Texas

In Memory of Larry Shepp (1936-2013)

June 29,2018

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- NOT an evaluation of a trading strategy
- Trading **function** is in the business model
  - Trading **strategies** are in the business model

$$(\mathcal{B},\mathcal{M})$$

$$S \in \mathcal{S} \subset B$$

- Review of "empirical" rule for money management
- Stopping rule for traders
- Evaluate use of the rule on the firm's **equity curve**

Trading

- A trade is an exchange of a trading element for value [USC]
  - Usually technically oriented vs. fundamental
  - Non investment timeframe
    - Clear entry and exit rules
    - “My last real trade was closing out a long RYURX position in March 2009 (this was very close to the bottom). The Rydex RYURX fund is a short SPX position. I'd like to say it was due to my sage chart reading, but in fact I needed the money!” – Anonymous trader

Trading

- Broad definitions
  - A person engaged in trading or commerce; a person who buys and sells goods; a dealer. - OED
  - Today's trader is a merchant rather than a trader, managing physical delivery of goods, being a principal to the goods that are traded, hedging price risk with increasingly sophisticated instruments. The role of the trader … is to manage supply chains, adding value at all stages. The trader is a partner of producers and end users, helping suppliers to make their goods available to the world markets, and helping buyers to source from the most competitive origin, mitigating the risks for all parties involved in the supply chain." - Leo Tameeris, managing director, Noble Grain
  - A person or firm that buys and sells shares, currency, etc.; esp. one that speculates on short-term movement in the market (frequently contrasted with investor). -OED

Trading

- Managing trades
  - Entry: Buy 100 XYZ at 100.05 (limit order)
  - Exit: Sell 100 XYZ at the market (mkt order)
  - Stop-loss: Sell 100 XYZ at 95 Stop
    - This becomes market sell order if 95 is hit
    - Buy stop above or sell stop below a price
    - Good for the day or GTC
- Managing the trading system
  - Systems always fail
  - Money management: keeping capital *safe*
    - Trailing stops (periodic reset sell stops deeper ITM)
    - The “2% Rule” (explained below)

Trading risk management

- Success of trading system
  - 60% Psychology
    - Dr. Van Tharpe (Traders' coach)
  - 30% Position sizing
    - Money management
  - 10% Strategy with signals
    - Entry/Exit guidance
    - Entry is usually emphasized
    - Exit is the real art (for both investing and trading)
    - Would like clear-cut rules

Avoid Folklore

On the Efficacy of Stop-Loss Strategies

SARAH MARIETTA TOOTH

The Journal of Trading, v9, no.4, Fall 2014


INVESTOR'S BUSINESS DAILY

IBD'S TOP 10

Stocks Hit New Highs, Close Off Best Levels On Eve Of 1-Year Bull

Jobless Claims Fall To Eight-Month Low As Retailers Report Strong Sept. Sales

O'Neil [1988, pg. 87] insists that:

individual investors should consider adopting a firm plan to try to limit the loss on initial invested capital in each stock to an absolute maximum of 7 or 8%...Once you get to that point you can no longer hesitate...At this time nothing else should have a bearing on the situation.

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Stop-loss evaluation

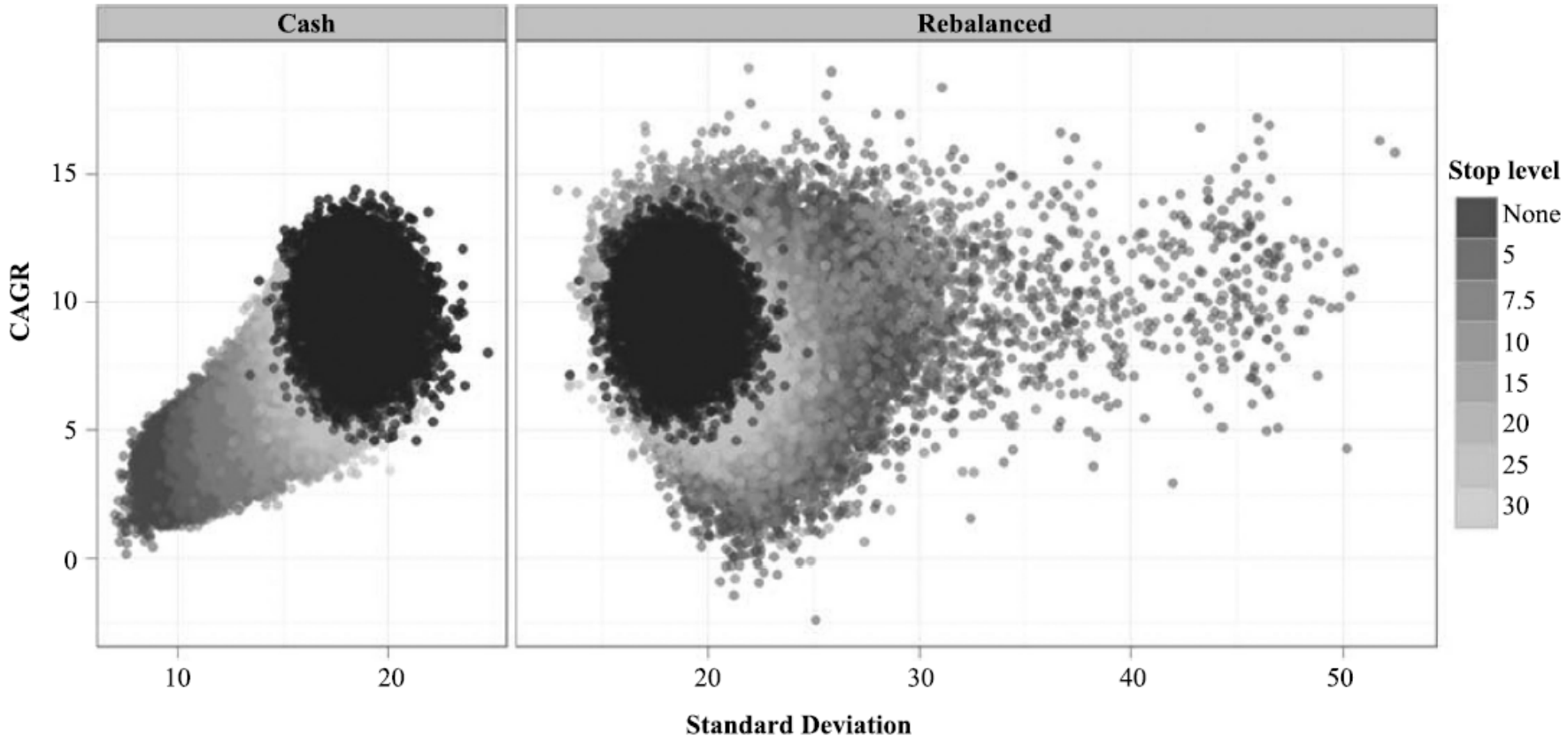
- Tested on an outperforming investing strategy (Max Measures, 2014)
  - Portfolio of 20 S&P 500 stocks held for one year
  - Simple momentum criteria (20 highest harmonic mean)
  - Impose the stop-loss rule on all the stocks in the portfolio
  - Compare with and without the stop-loss imposition
  - Also looked at random portfolios

Comparison of 1970–2012 Returns to Select MaxMeasures Strategies With and Without Stop-Losses Implemented

Stop-Loss	Mean	CAGR	σ	S
Without Stop-Loss	17.88	14.44	27.83	23.17
With 8% Stop-Loss	9.26	8.25	15.30	-14.21
With 15% Stop-loss	14.00	12.10	21.15	12.15
With 30% Stop-loss	17.64	14.72	26.39	23.53

NOTE: Standard error of 42-year CAGR of 20-stock portfolio is 1.16%

Compound Annual Growth Rate vs. Standard Deviation for Portfolios Stopped to Cash vs. Rebalanced



10,000 portfolios of 20 stocks randomly selected from the S&P 500 for each year from 1969 through 2012.

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Moving from investing to trading

Trading systems

- Generating trades
  - Entries
  - Exits
- Managing trades
  - Use Exits
  - Use stop-loss
- Accumulating trades
  - Equity curve

Support/Resistance

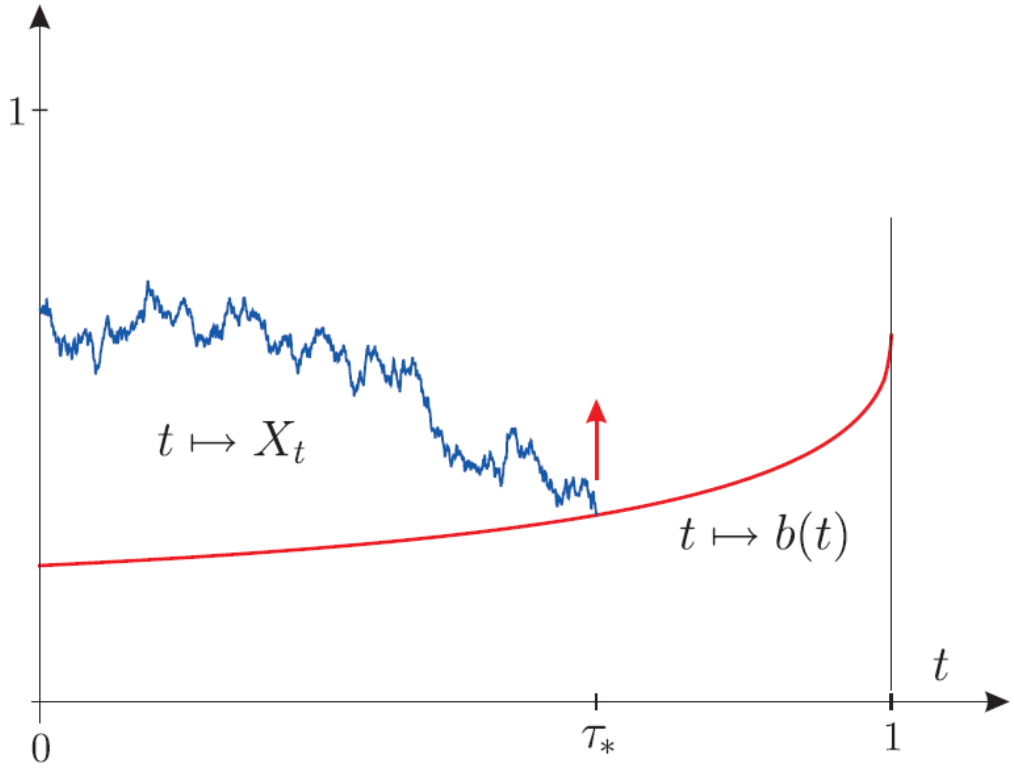

Figure 2. The optimal buying boundary b from Example 2 when the aspiration level ℓ is exponentially distributed.

- Aspiration level hypothesis (1955) and Angelis & Peskir (2016)
- Hidden targets and quantum mechanics trader/instrument
- Needs data work

Widely used

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Fibonacci Levels

$$\varphi = \frac{1+\sqrt{5}}{2} = 1.61803...$$

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New stopping rules

- The golden ratio rule

  "...[W]e show that the minimal solution to [Equation] 3.4 admits a simple closed-form expression when *X* is a transient Bessel process. In the case when *X* is the radial part of three-dimensional Brownian motion this leads to the golden ratio rule. We also show that *X* stopped according to the golden ratio rule has what we refer to as the golden ratio distribution."

Glover, K., Hulley, H. and Peskir, G. Three-dimensional Brownian motion and the golden ratio rule. *Ann. Appl. Probab*. v.23 no.3, pp. 895-922 (2013).

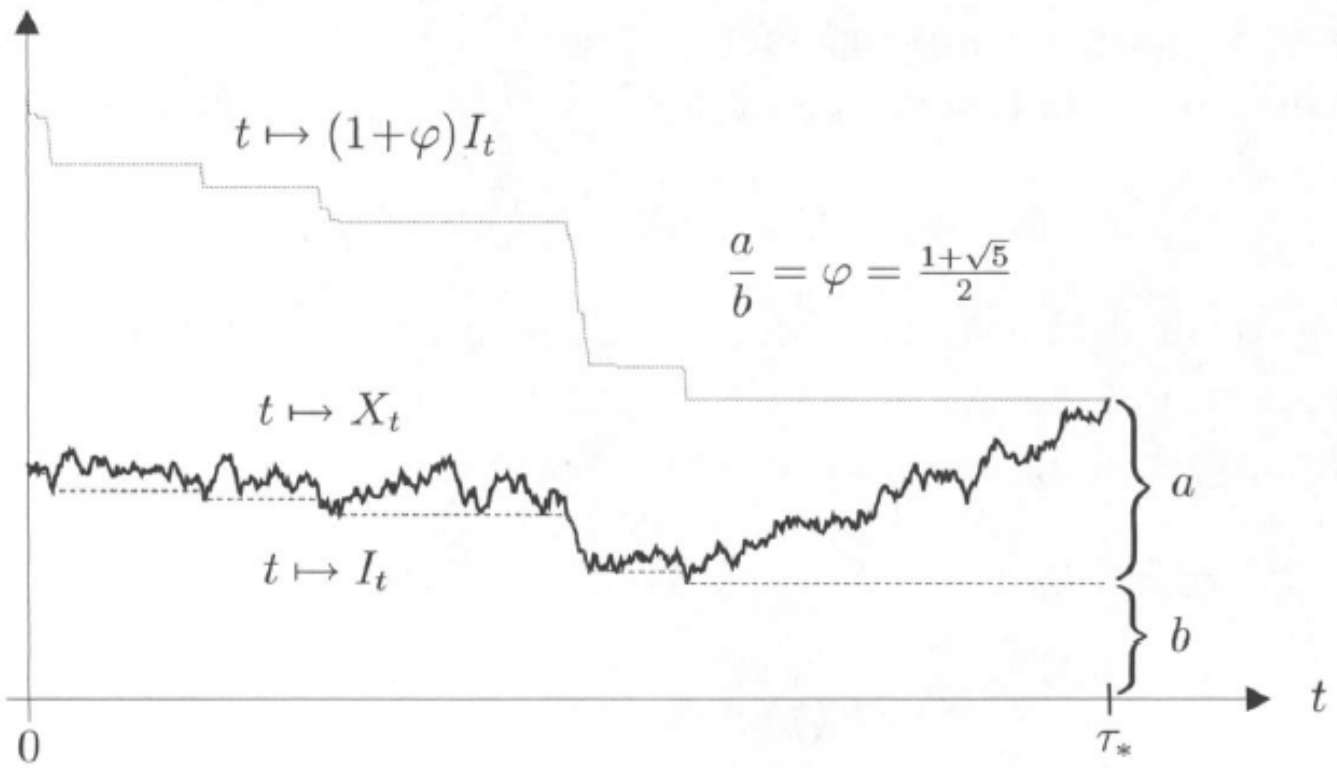

FIG. 2. *The golden ratio rule for the radial part X of three-dimensional Brownian motion.*

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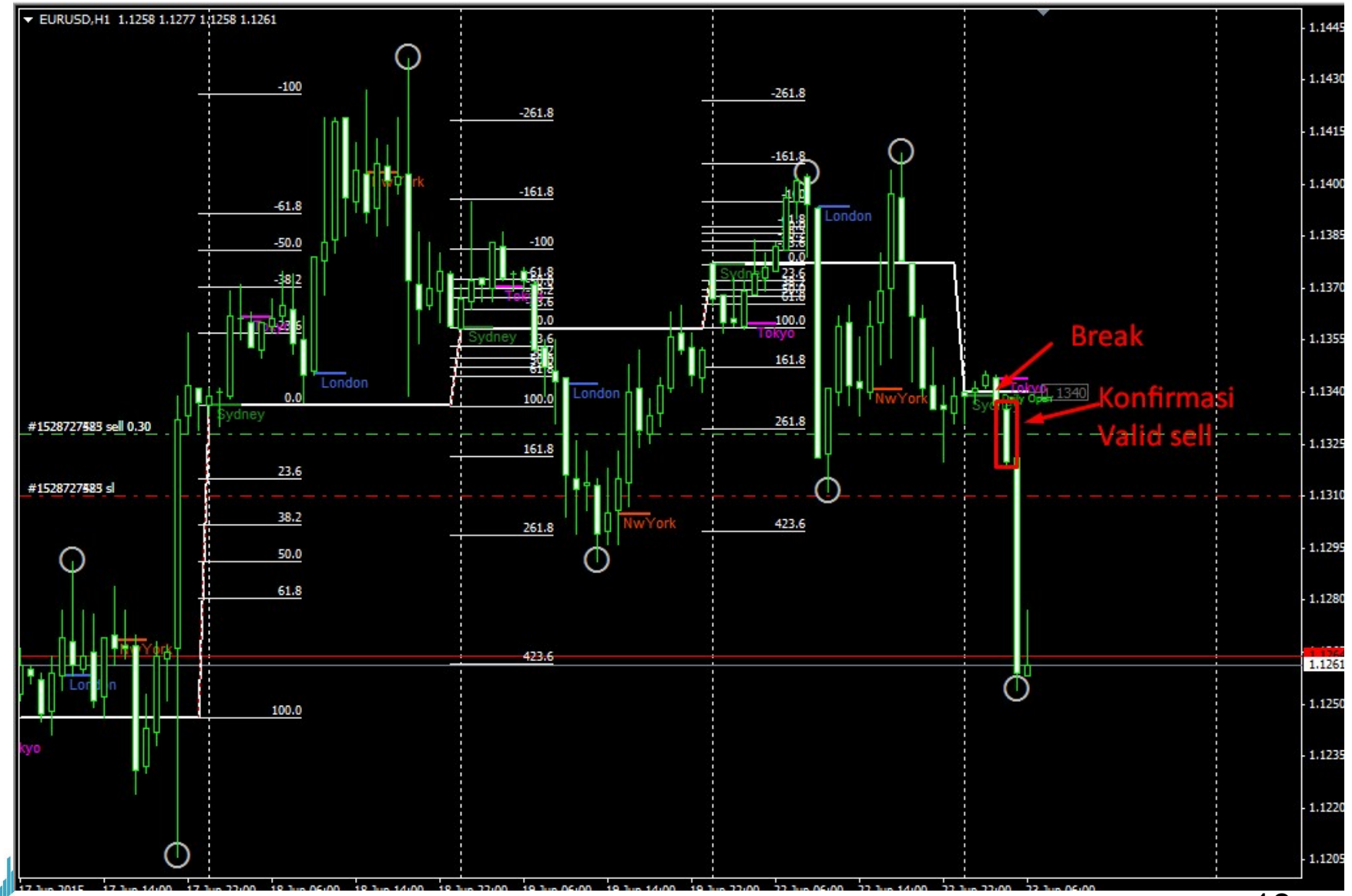
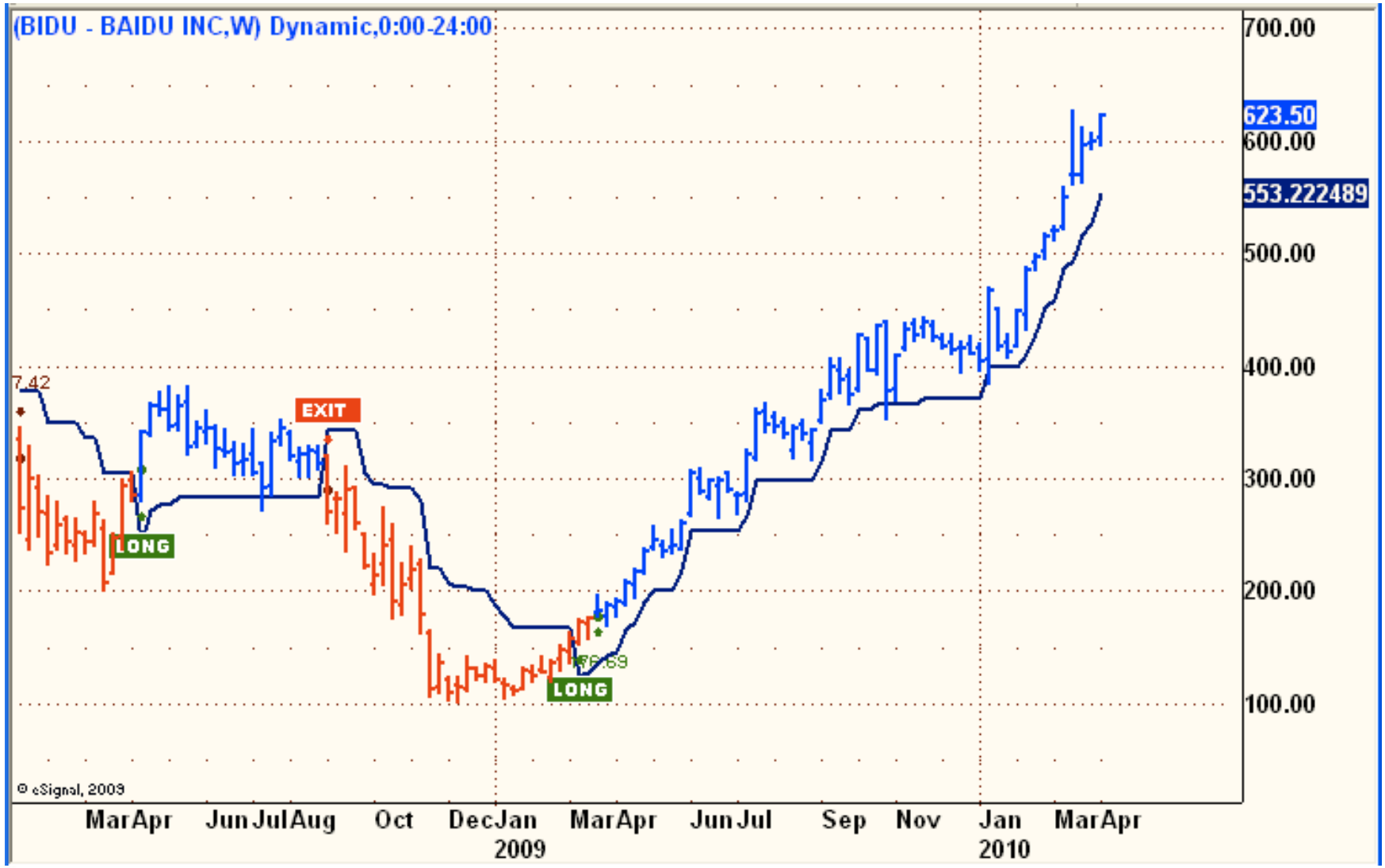
Generating Trades



With signals



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Trading System Development

- Step 1: Configuration
- Step 2: In-Sample Data Testing (also called “Back testing”)
- Step 3: Out-of-Sample Data (also called "Walk Forward Testing")
- Step 4: Live Forward Testing on the Simulator Account
- Step 5: Real Live Trading Execution

Evaluating a system

- Obtain data
  - Actual historical trades data is hard to obtain
    - Proprietary
    - "Success bias"
  - Can simulate trades
    - Parametrically
    - Resampling-based
- Obtain statistics
  - Trading statistics
  - Diagnose system
- Make inference/go-live

Trading system statistics

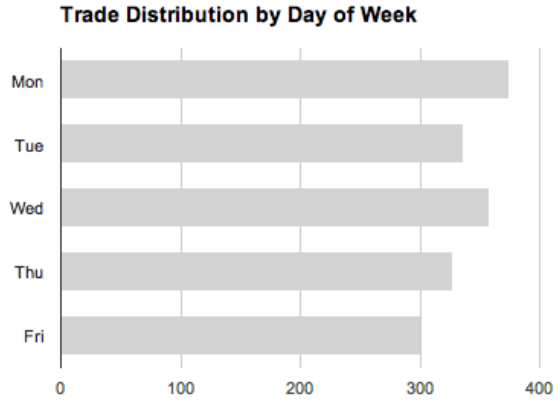
Statistics

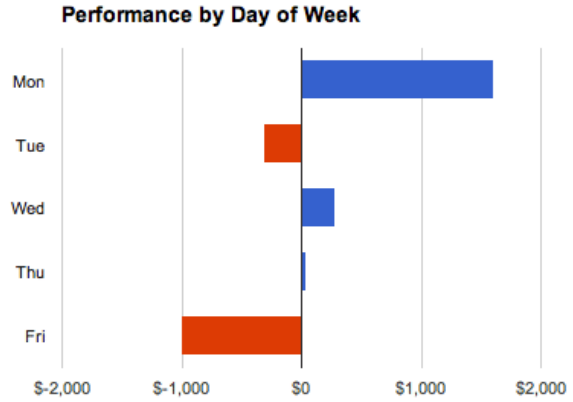
Total gain/loss:	$608.63	Largest gain:	$482.55 (show)
Average daily gain/loss:	$2.16	Largest loss:	-$1,274.50 (show)
Average daily volume:	3358	Average per-share gain/loss:	$0.00
Average winning trade:	$32.46	Average trade gain/loss:	$0.36
Average losing trade:	-$33.14	Trade P&L standard deviation:	$57.07
System Quality Number (SQN):	n/a	Probability of random chance:	39.8%
Total number of trades:	1696	Profit factor:	1.02
Number of winning trades:	856 (50.5%)	Average hold time (winning trades):	about 2 hours
Number of losing trades:	820 (48.3%)	Average hold time (losing trades):	about 2 hours
Number of scratch trades:	20 (1.2%)	Average hold time (scratch trades):	14 minutes
Max consecutive wins:	11 (show)	Max consecutive losses:	12 (show)
Average position MFE:	$32.74	Average position MAE:	-$23.93
Total commissions:	$587.31	Total fees:	$329.17

Help

Select: Days/Times | Price/Volume | Instrument | Market Behavior | Win/Loss/Expectation | Liquidity

Click in charts below to drill down into data. Watch the video!





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Report | Chart | Monte Carlo Analysis

Summary - All Trades

Overall

Total Net Profit:	$3,108	Profit Factor ($Wins/$Losses):	**1.56**
Total Trades:	48	Winning Percentage:	70.8%
Average Trade:	$65	Payout Ratio (AvgWin/AvgLoss):	3.78
Max Closed-out Drawdown:	-$1,733	CPC Index (PF x Win% x PR):	1.71
Max Intraday Drawdown:	-$1,733	Expectancy (AvgTrade/AvgLoss):	39.33%
Account Size Required:	$23,333	Return Pct:	**13.3%**
Open Equity:	$0	Kelly Pct (AvgTrade/AvgWin):	10.41%
Percent in the Market:	N/A	Optimal f:	0.18
Avg # of Bars in Trade:	N/A	Z-Score (W/L Predictability):	-1.2
Avg # of Trades per Year:	730.5	Current Streak:	3 Losses

Monthly Profit Analysis

Average Monthly Profit:	N/A	Monthly Sharpe Ratio:	N/A
Std Dev of Monthly Profits:	N/A	Annualized Sharpe Ratio:	N/A
		Calmar Ratio:	N/A

Winning Trades		Losing Trades	
Total Winners:	34	Total Losers:	14
Gross Profit:	$8,706	Gross Loss:	-$5,598
Average Win:	$622	Average Loss:	-$165
Largest Win:	$5,250	Largest Loss:	-$1,213
Largest Drawdown in Win:	$0	Largest Peak in Loss:	$0
Avg Drawdown in Win:	$0	Avg Peak in Loss:	$0
Avg Run Up in Win:	$0	Avg Run Up in Loss:	$0
Avg Run Down in Win:	$0	Avg Run Down in Loss:	$0
Most Consec Wins:	3	Most Consec Losses:	1
Avg # of Consec Wins:	1.75	Avg # of Consec Losses:	3.78
Avg # of Bars in Wins:	.00	Avg # of Bars in Losses:	.00

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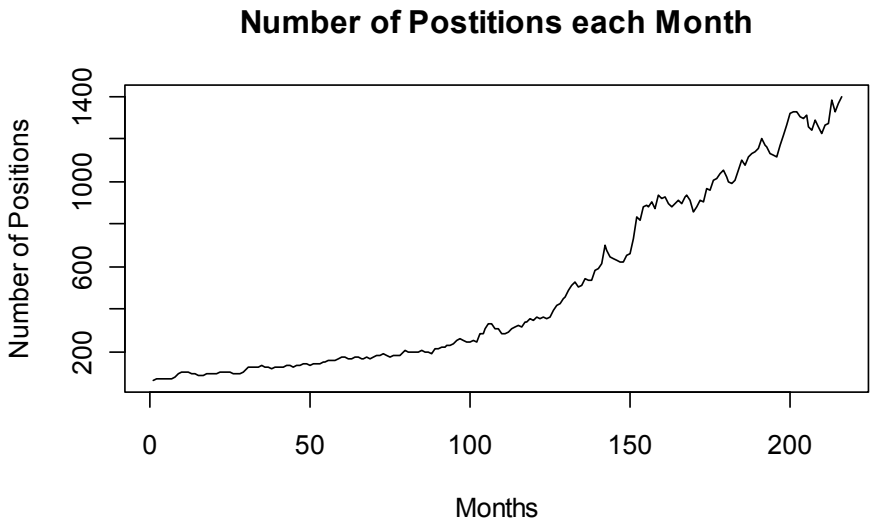
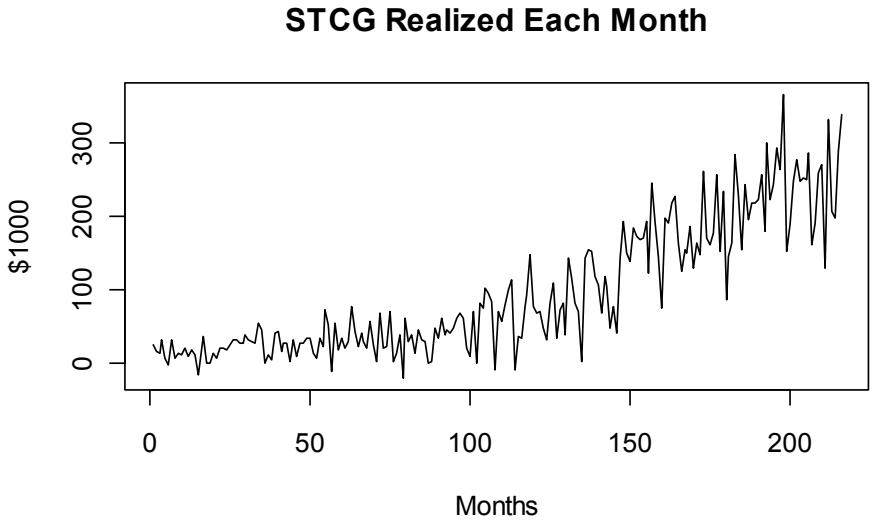
Position scaling

- Option trading program
- Resampled positions





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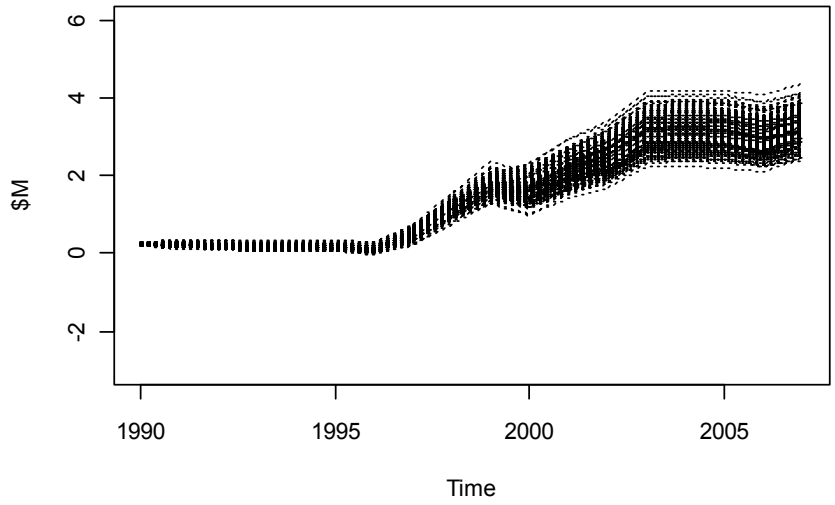
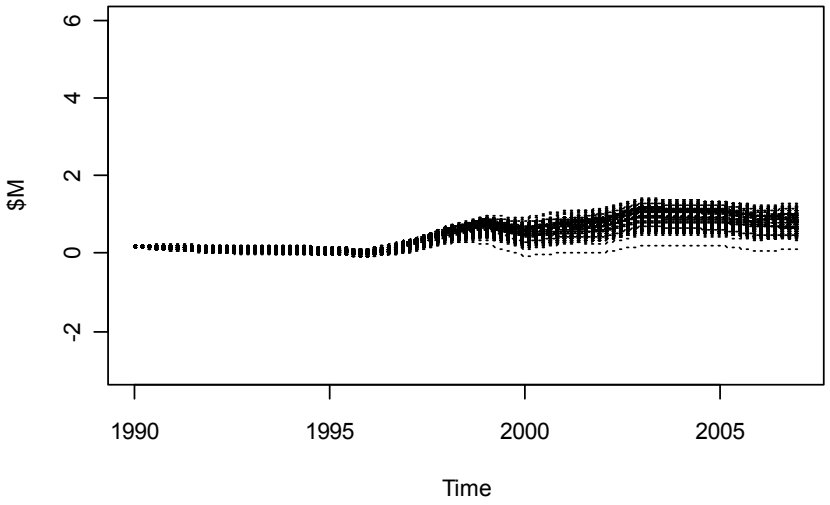
Various equity curves

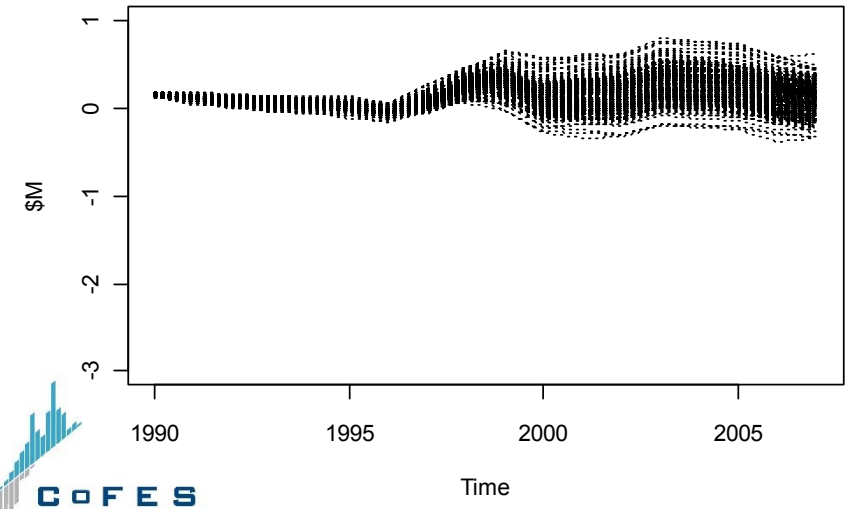
Cash, 10% Draw, 2-Strike



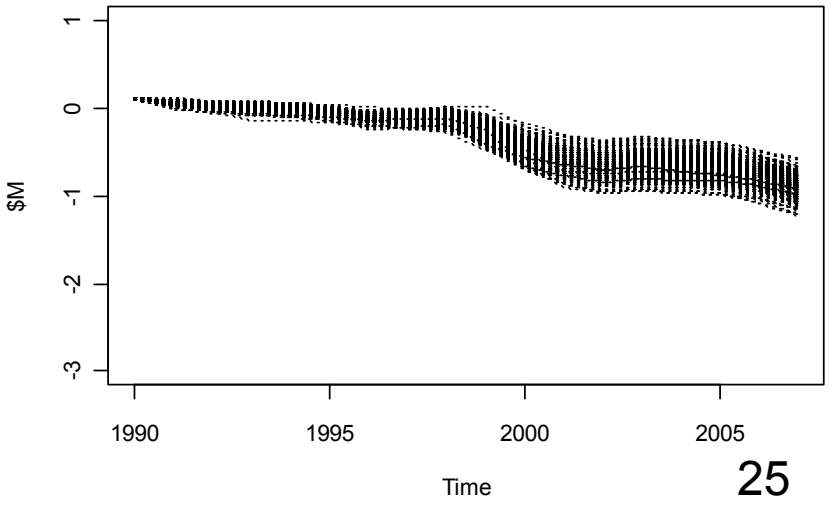
Cash, 35% Draw, 2-Strike



Cash, 45% Draw, 2-Strike



Cash, 65% Draw, 2-Strike



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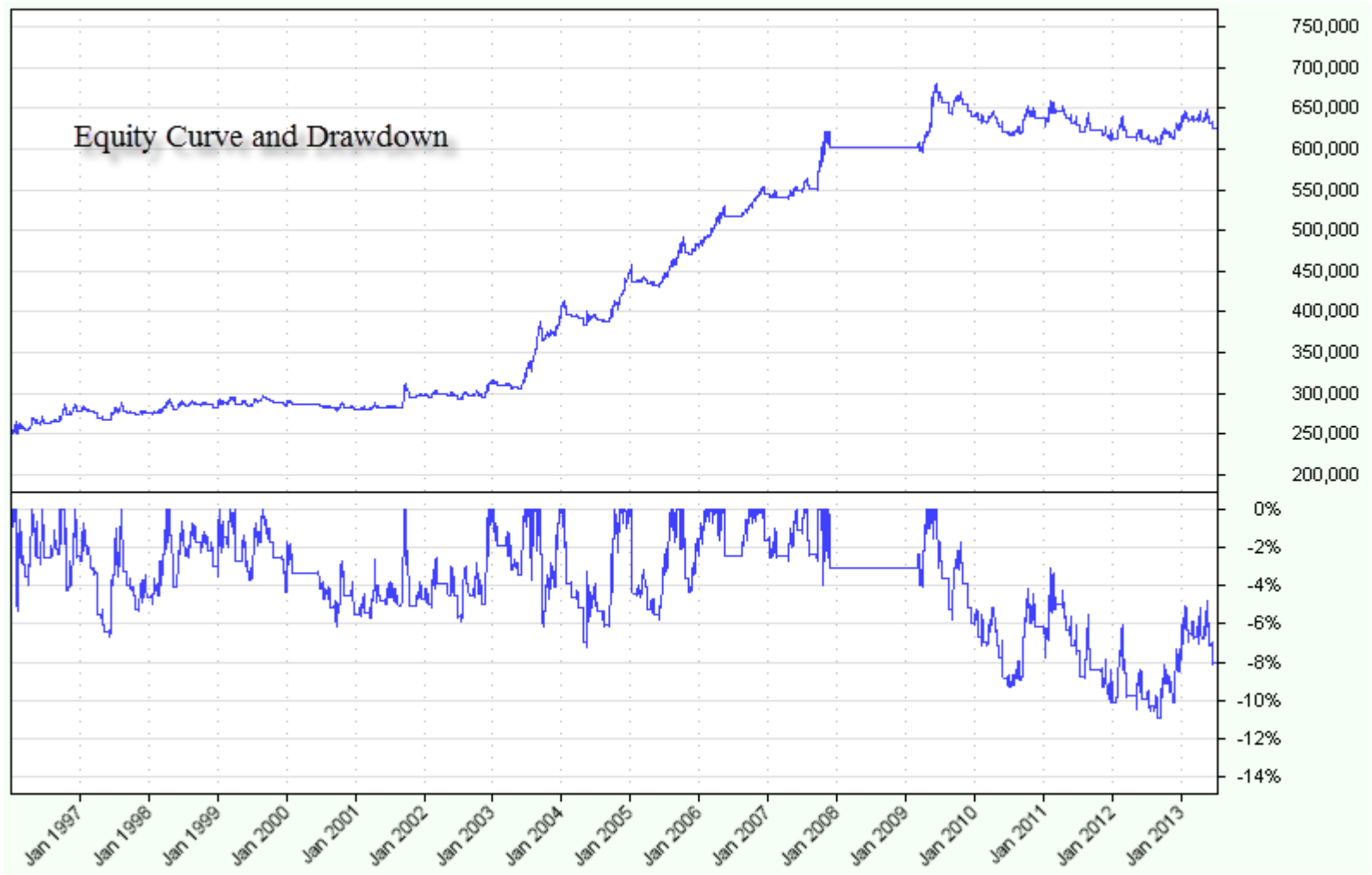
Managing the Equity Curve

- Accumulating trades – Equity curve



Position sizing approaches

- None
- Fixed size
- Constant value
- Fixed amout of equity
- Percent volatility
- Lelly formula
- Optimal f
- profit risk method
- Fixed ratio
- Generalized ratio
- Margin target
- Leverage target
- **Percent of equity (“2% Rule”)**
- Max drawdown method
- Maximum possible

Percent of equity

- Obtain trade signal
  - Target (in points)
  - Let it run (use trailing stops)
  - Establish stops (BEWARE!)
- Calculate capital (cash + position)
- Determine $ risk per trade (RPT)
  - (%RPT)(Account size)=(.01)(50,000)=$1,000
- Calculate position size
  - Position size = $\frac{\%RPT \times Capital}{RPK}$

Example - $50,000

Long BAC	8.60	$/share
Trading unit	1	share
Target	10.00	$/share
Stop-Loss	7.90	$/share
Risk/Contract	0.70	$/share
%RPT	1%	
Position size	714	Shares
Notional Position value entry	$6,140	
Notional Value on loss exit	$5,641	
Loss	-$500	

Short XYZ	16.50	$/share
Trading unit	1	share
Target	12.30	$/share
Stop-Loss	18.60	$/share
Risk/Contract	-2.10	$/share
%RPT	1%	
Position size	-239	Shares
Notional Position value entry	-$3,944	
Notional Value on loss exit	-$4,445	
Loss	-$502	

Short GCQ8	1,350.00	$/Troy oz
Trading unit	100	Troy oz
Target	1,335.00	$/Troy oz
Stop-Loss	1,355.00	$/Troy oz
Risk/Contract	-5.00	$/contract
%RPT	1%	
Position size	-1	Contract
Notional Position value entry	-$135,000	
Notional Value on loss exit	-$135,500	
Loss	-$500	

Long ESU8	2,650.00	Index
Trading unit	50	$50xIndex
Target	2,670.00	Index
Stop-Loss	2,645.00	Index
Risk/Contract	5.00	$/contract
%RPT	1%	
Position size	2	Contract
Notional Position value entry	$265,000	
Notional Value on loss exit	$264,500	
Loss	-$500	

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Let's see how the 2% Rule works

Simulating a System

- Generate trades
  - Use historical trades/resample
  - Use parametric model
- Determine stopping times
  - Rules based on **equity curve** rather than those for the underlying instrument
  - Must have sample paths of the **trades**
    - Use historical paths
    - Use simulated paths
- Evaluate efficacy of the trading rule

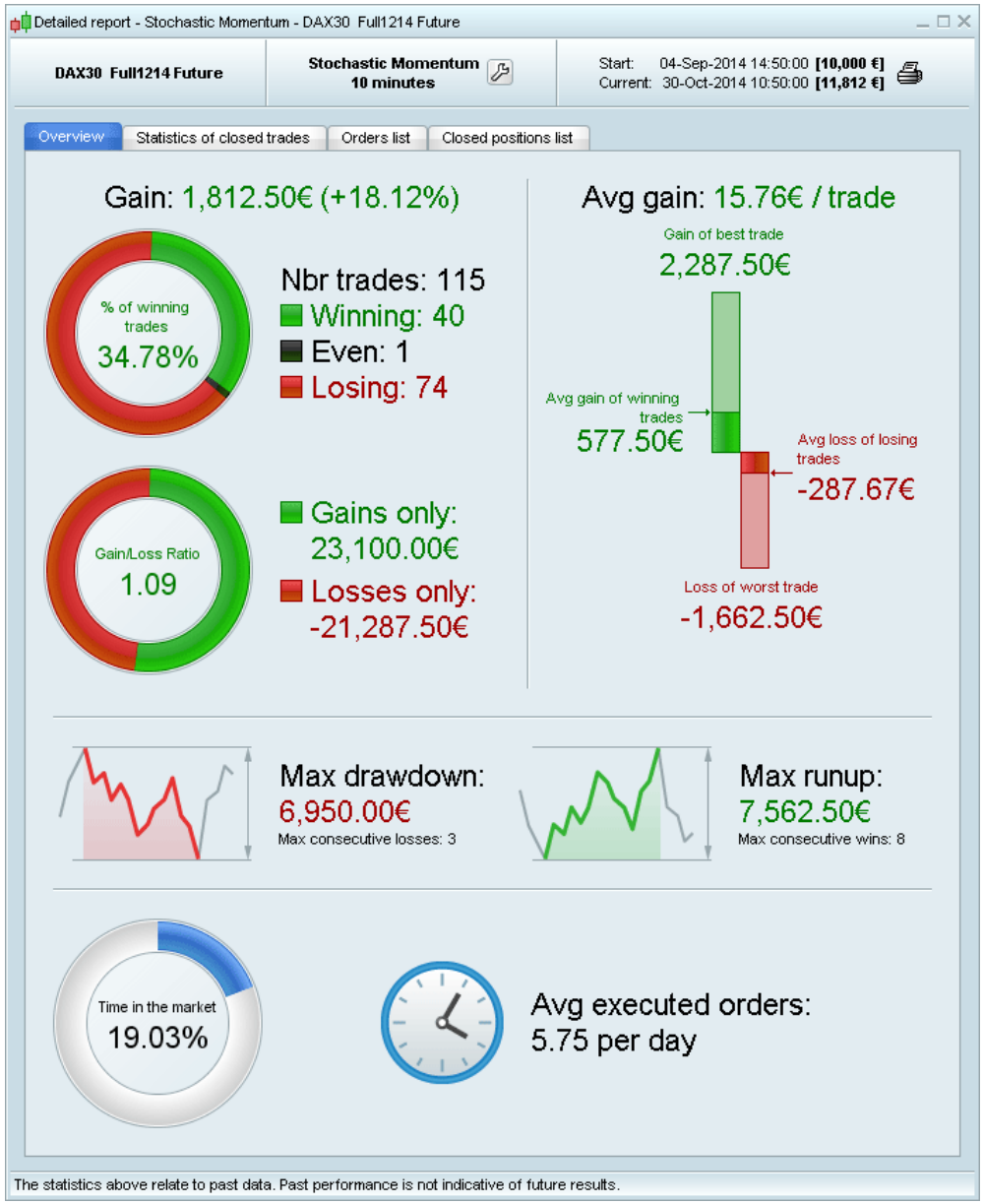
Summary Statistics

Strategy development

Finding trades

Accounting

Tax reporting



Distribution?

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- DAX 30 trades 0900-1745 on Frankfurt
  - 8h45m trade day, 525 minutes
  - 105 5-minute bars per trade day
  - 52.5 10-minute bars
  - 5.75 trades per day based on 10-min bars
- Each trade in mkt approx. 3.3% of day x 525 min = 17.4 min per trade (avg length trade)
- Scale to 30 calendar days (1 trading month=21 trade days)

Canonical System

- ESU8 Futures
  - Contract size: 50x S&P 500 Index
- Point value = 50 point
- Use the DAX momentum system and its results
- Assume commissions are included
- Expected 30-day horizon with 20% in-the-market trade frequency
- Generate trades from this system

Simulating Trades

- Would like model $f_X(x)$ to draw trades
- Would like first 4 moments to estimate an appropriate distribution

$$\mu, \sigma^2, \beta_1, \beta_2$$

- All we have is (for winners and losers):
  - $X_{(n)}, X_{(1)} \rightarrow R$
  - $\hat{\mu}_+, \hat{\mu}_-$
  - $\hat{\sigma} \approx R/6 \ (\text{for} \ n > 70)$
- Don't have long/short or duration information

- Try “Engineer’s” approach”
  - Distribution on winners and losers
  - Skewed, continuous, semi-infinite support
  - Distribution on duration

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- Gamma(α,β) with appropriate match of mode, mean and range

Position Results ($)

Data, N=115

	Winner	Loser
Sample Mean	578	-288
Sample Range	2288	-1663

Parametric Model

Gamma(2.8, 205) Gamma(1.6, 181)

	Winner	Loser
Pop Mean	574	-290
Sample Range	2452	-1546

(N=1000)

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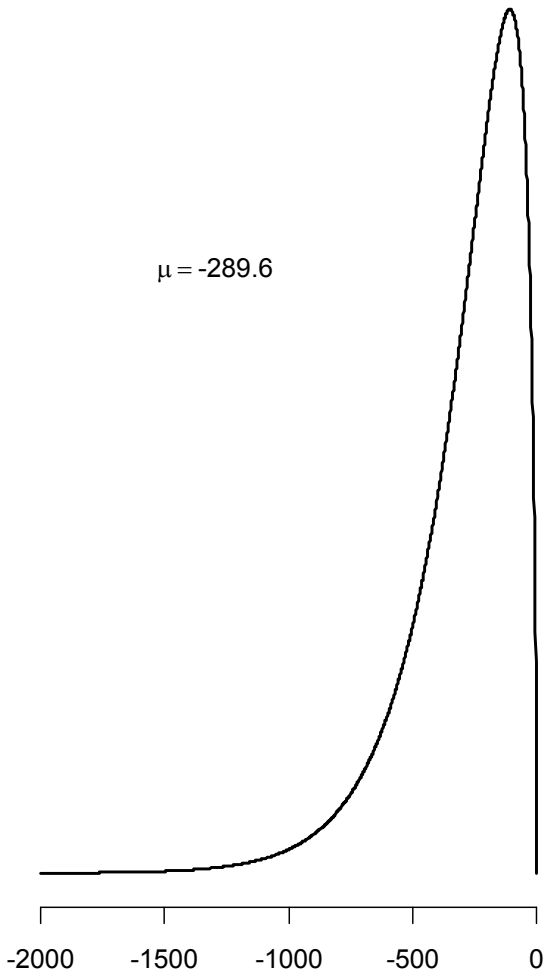
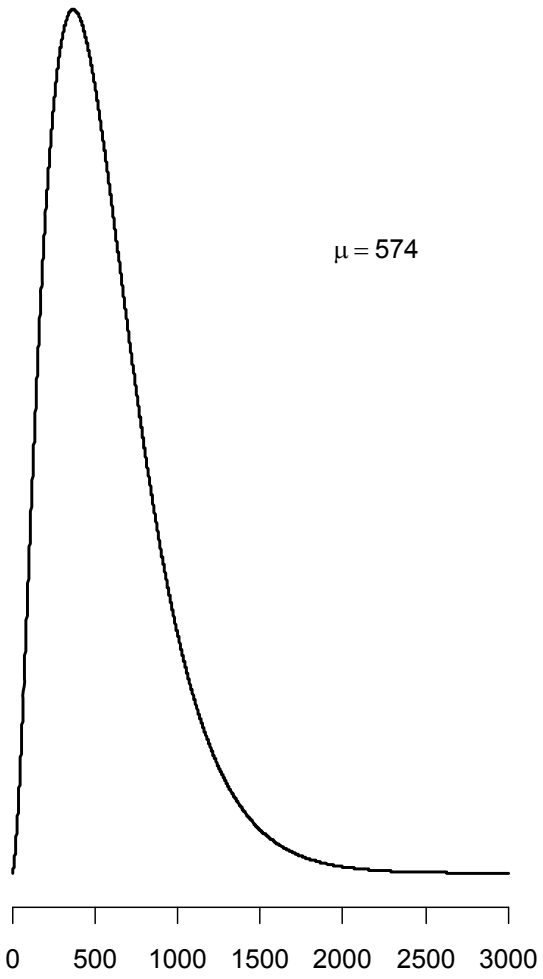
Our distributions

Losing Trades



Winning Trades



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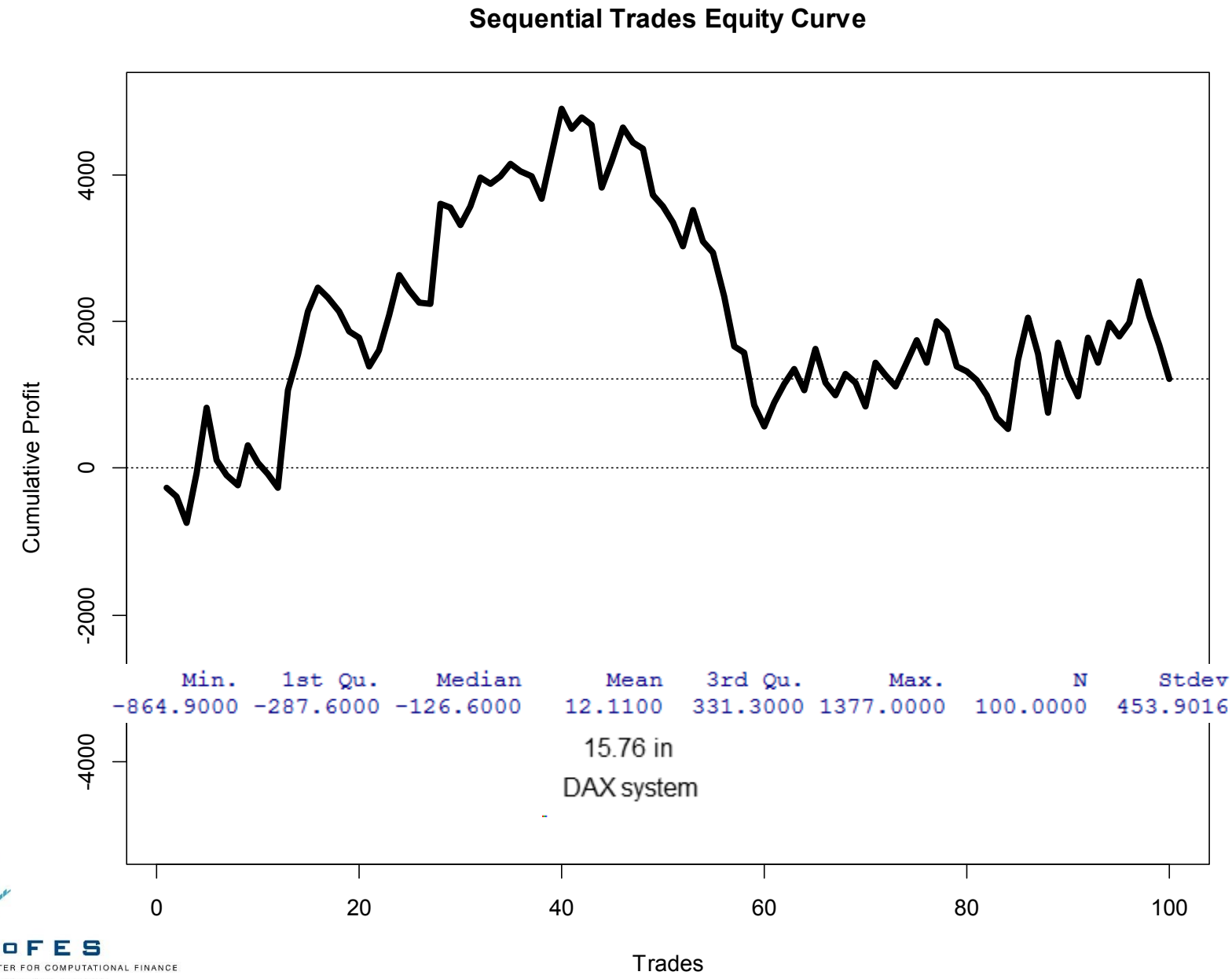
N=100 equity curve



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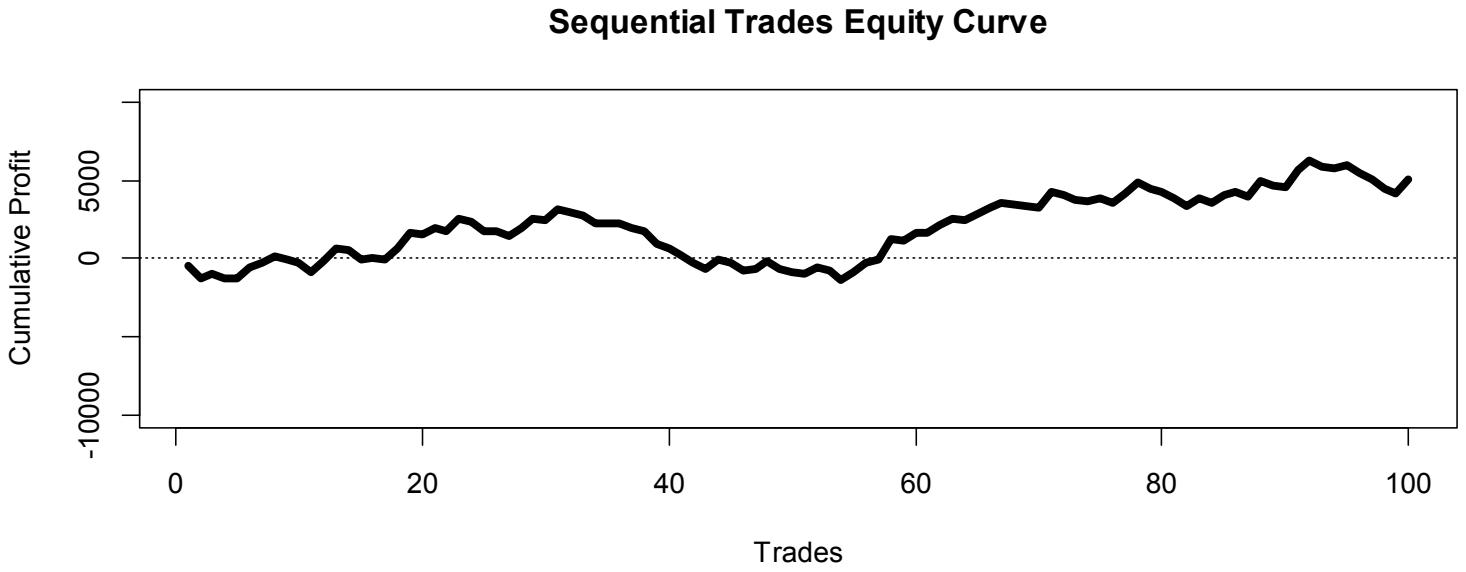
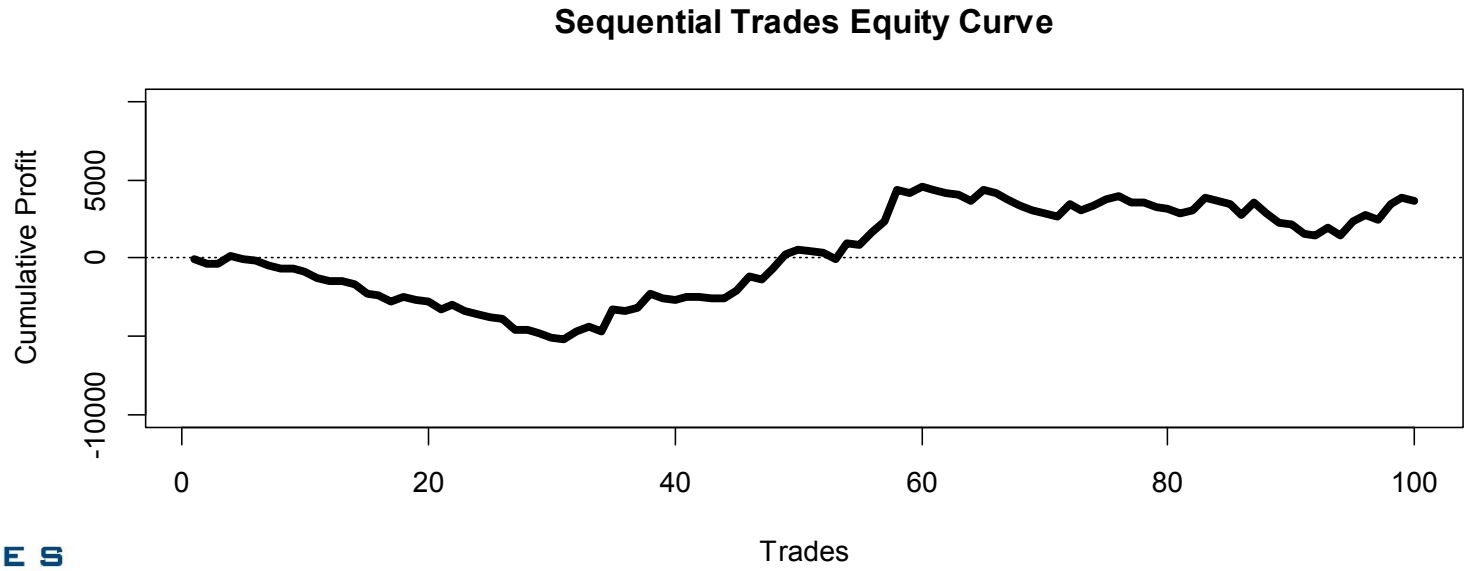
But other paths





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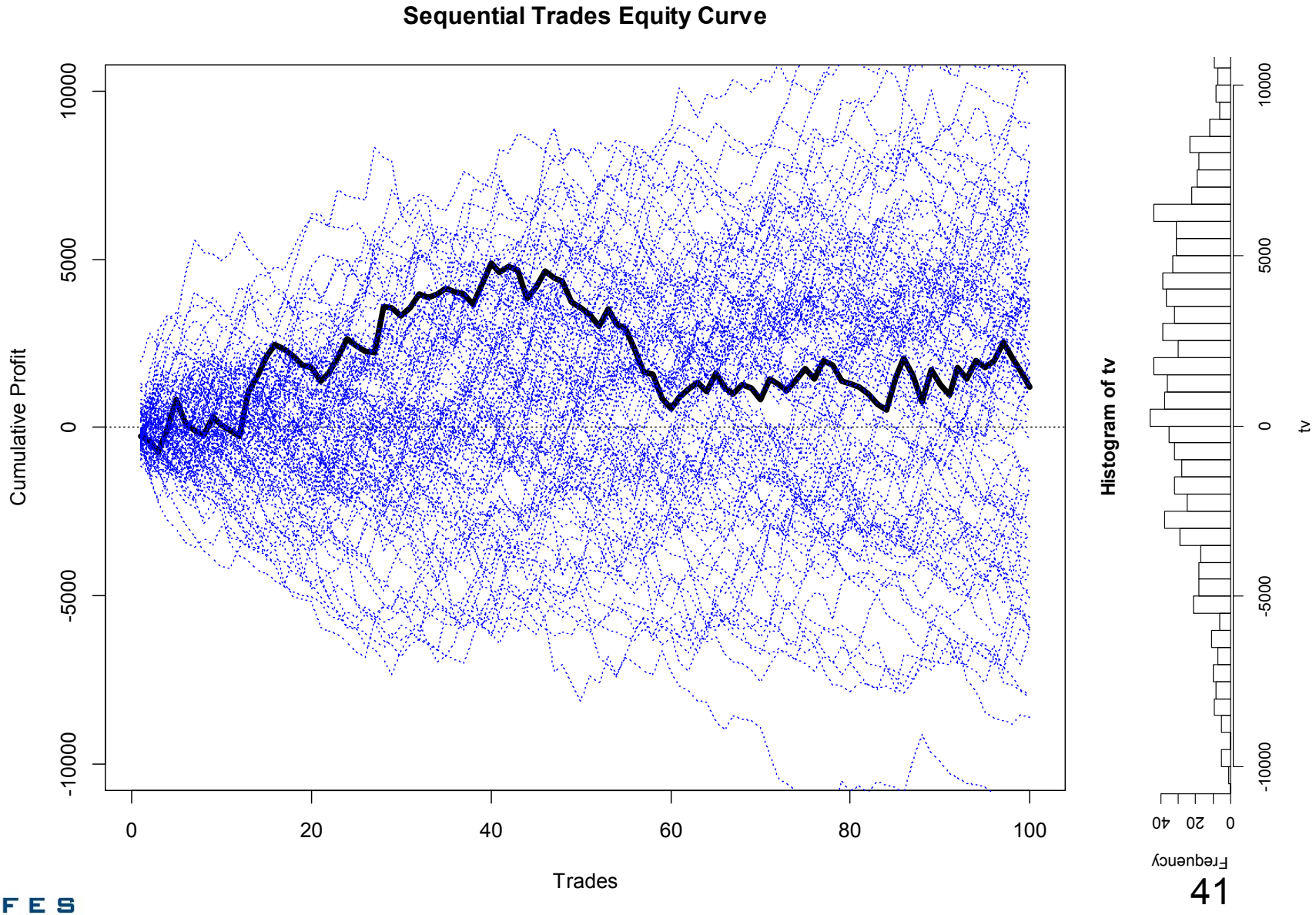

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How evaluate?

- Let us run this experiment 1000 times
- Ending value of the equity curve TV varies

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	N	Stdev
-14610.00	-1711.00	1733.00	1838.00	5394.00	20280.00	1000.00	4974.57

- Note median and mean TV's are very close to that of the system gain=1,812
- Over time this system will blow out a $10,000 account
- Can the 2% money management rule help this system?

Simulated trading program

Trading parameters

- No pyramiding
- Stop threshold dynamically adjusted so long as account can handle the margin
- ES margin $6,200
- Safety factor 2x margin
- Ignore MTM – just stop
- Once establish initial positions do not establish more until check if rule is sustained.

Procedure

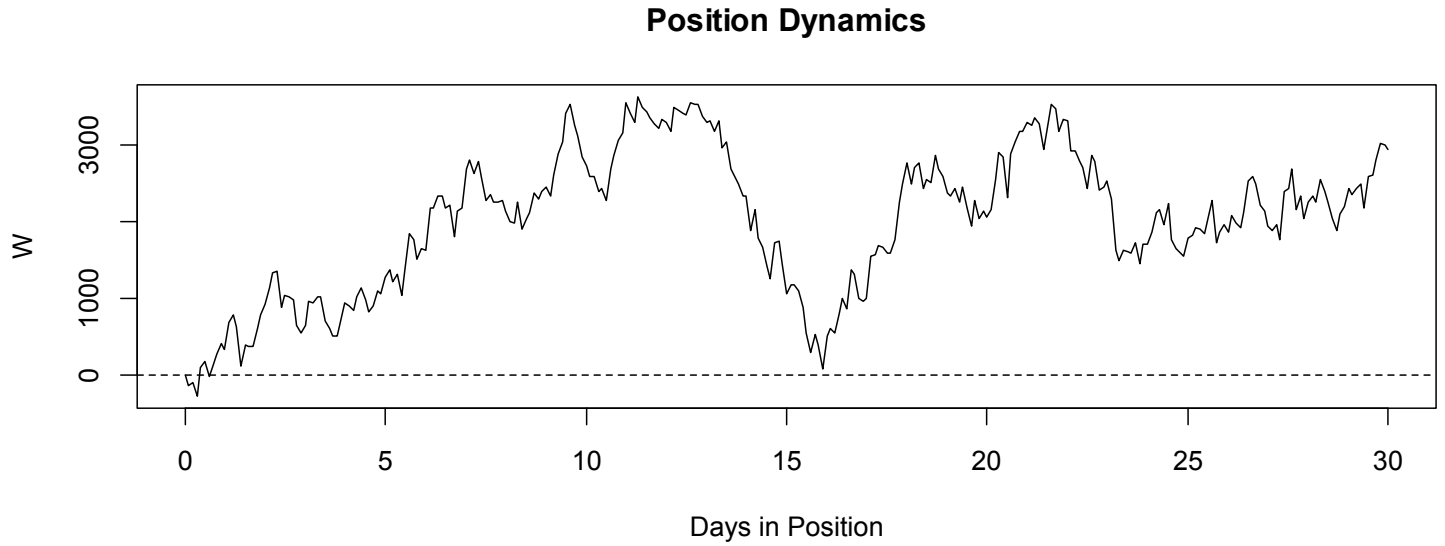
- Generate trades from F(x)
- Simulate sample paths for each trade
  - Use statistics of canonical instrument (SPX) trades to generate ABM over short time range [t_0, T], where T is length of each trade
  - Constrain to a Brownian bridge with actual position extrema at time T.

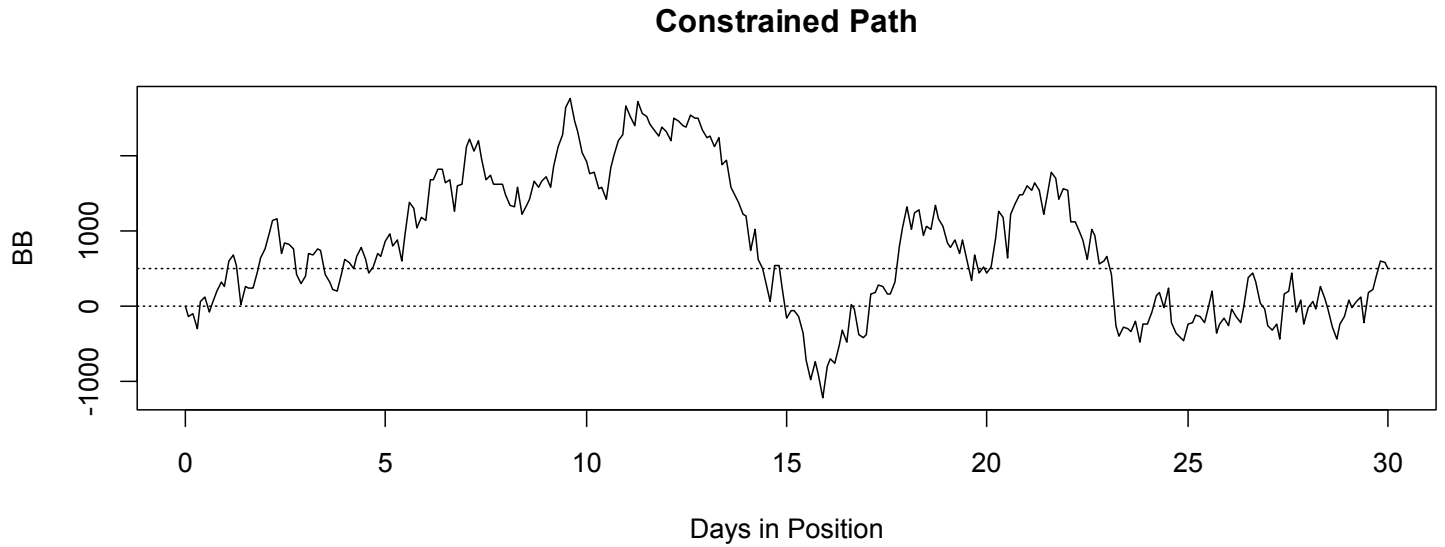
$$B = \{B(t), 0 \le t \le T : B(0) = 0, B(T) = b\}, b \in R$$

$$B(t) = W(t) - \frac{t}{T}\left(W(T) - b\right)$$

- As t proceeds, close position if MM rule is hit on the BB
- Continue to accumulate equity curve
- Evaluate equity curve when program terminates

W vs. BB





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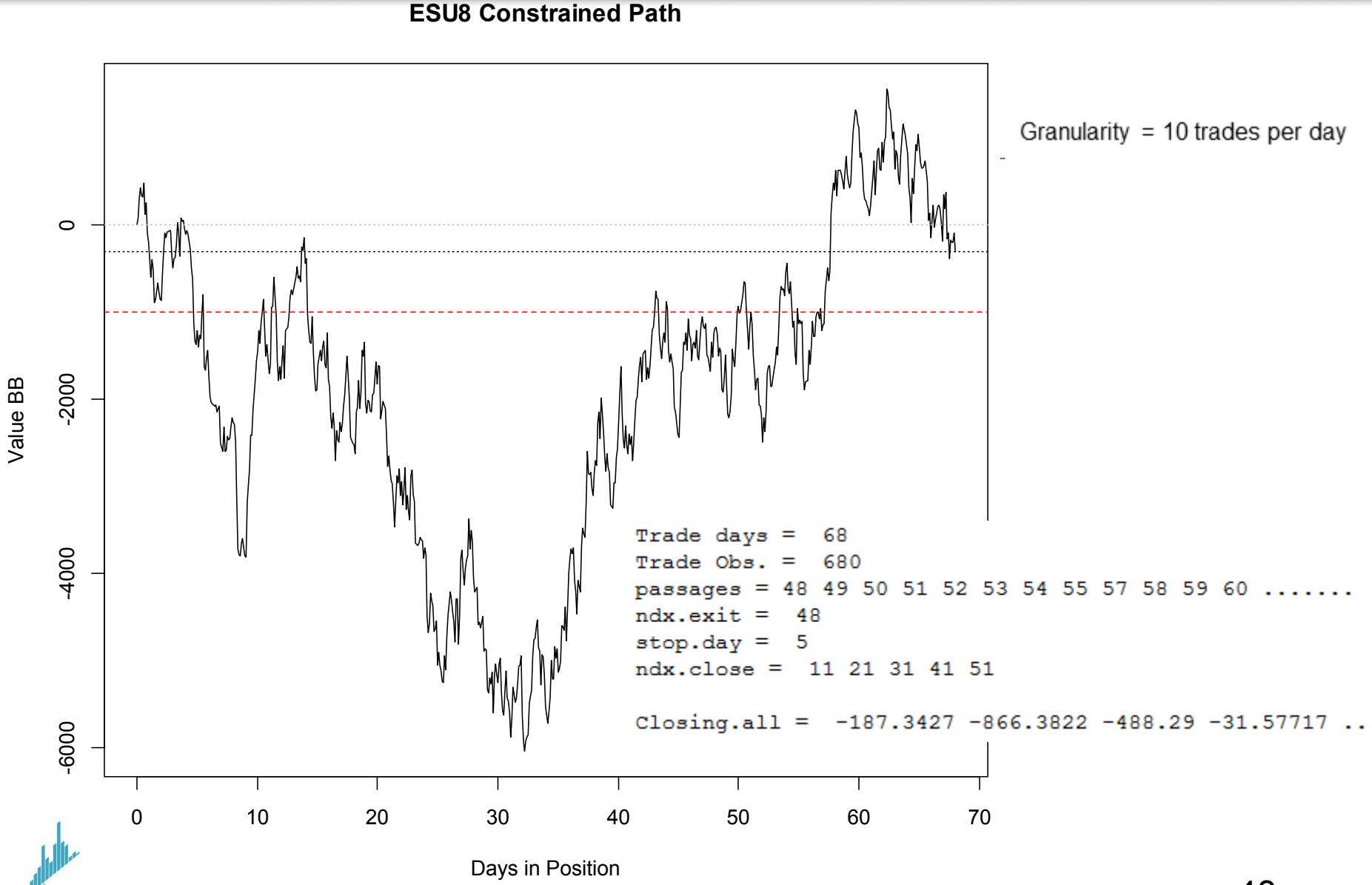
Anatomy of the BB



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Multiple correlated positions

```
Number positions = 4
Draw Gain/loss =
  -288.3  324.3 -387.4  -27.3
Durations = 38 39 18 44
stop.day =  12 30 10 10
```

Closing Value on All Initial Positions

Day	Position 1	Position 2	Position 3	Position 4	Total
1	472.11	506.76	441.61	438.93	1,859.41
2	1,151.91	1,221.21	1,090.90	1,085.55	4,549.57
3	1,572.68	1,676.62	1,481.17	1,473.13	6,203.60
4	1,069.56	1,208.15	947.54	936.83	4,162.08
5	1,862.45	2,035.70	1,709.94	1,696.55	7,304.63
6	2,189.62	2,397.52	2,006.60	1,990.53	8,584.27
7	1,758.76	2,001.30	1,545.23	1,526.49	6,831.78
8	1,066.19	1,343.39	822.17	800.74	4,032.49
9	109.61	421.45	-164.92	-189.03	177.11
10	-644.64	-298.15	-949.67	-976.45	-2,868.91
11	-1,327.72	-946.58	NA	NA	-2,274.30
12	-156.29	259.50	NA	NA	103.21
13	NA	1,942.83	NA	NA	1,942.83
14	NA	2,700.34	NA	NA	2,700.34
15	NA	3,260.38	NA	NA	3,260.38
16	NA	2,548.42	NA	NA	2,548.42
17	NA	1,805.09	NA	NA	1,805.09
18	NA	785.37	NA	NA	785.37
19	NA	569.85	NA	NA	569.85
20	NA	236.32	NA	NA	236.32
21	NA	1,541.60	NA	NA	1,541.60
22	NA	1,046.14	NA	NA	1,046.14
23	NA	-513.40	NA	NA	-513.40
24	NA	-274.65	NA	NA	-274.65
25	NA	-359.57	NA	NA	-359.57
26	NA	11.76	NA	NA	11.76
27	NA	-227.83	NA	NA	-227.83
28	NA	-345.98	NA	NA	-345.98
29	NA	-963.81	NA	NA	-963.81
30	NA	-1,583.94	NA	NA	-1,583.94

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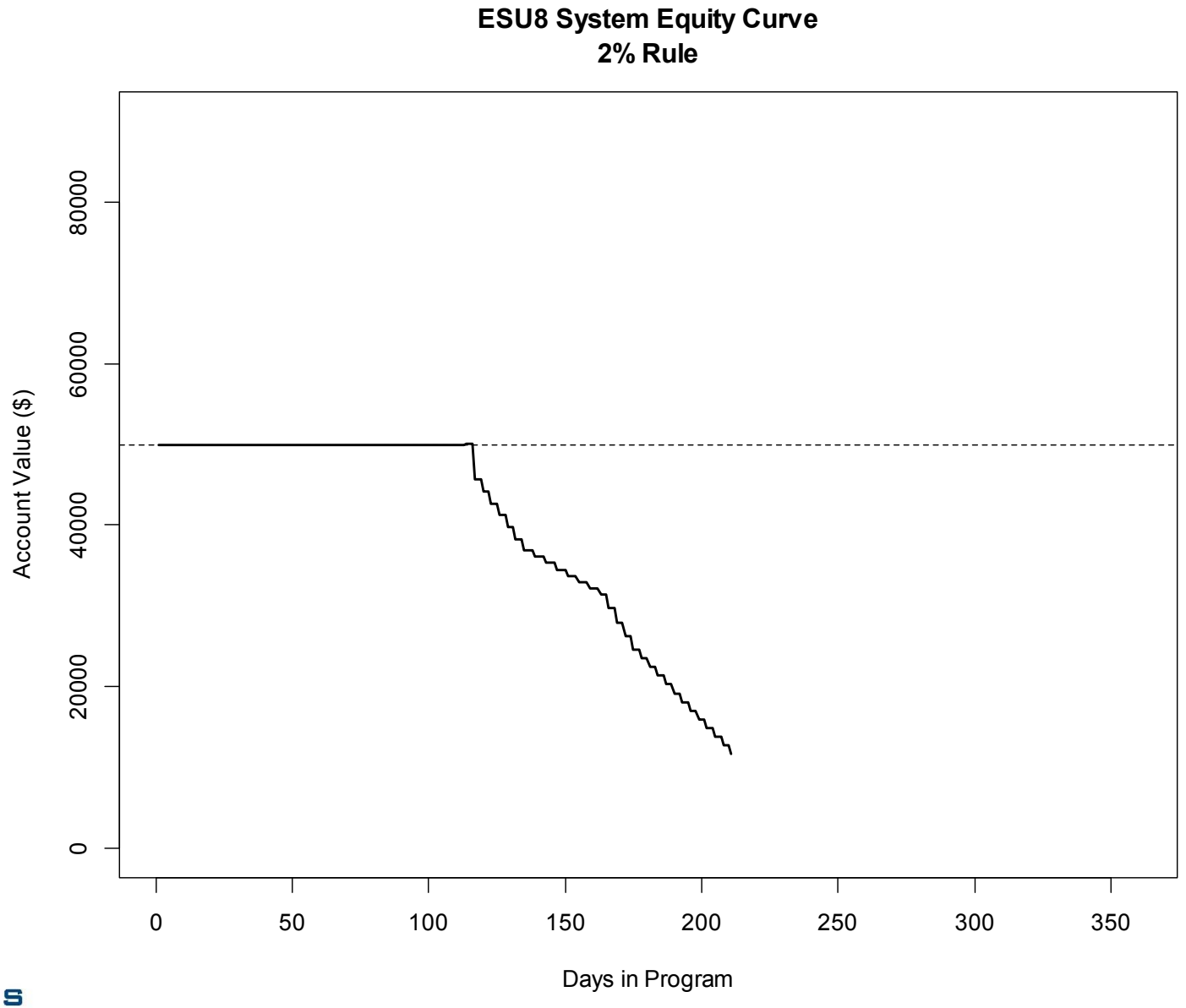
Equity curve (no MTM)



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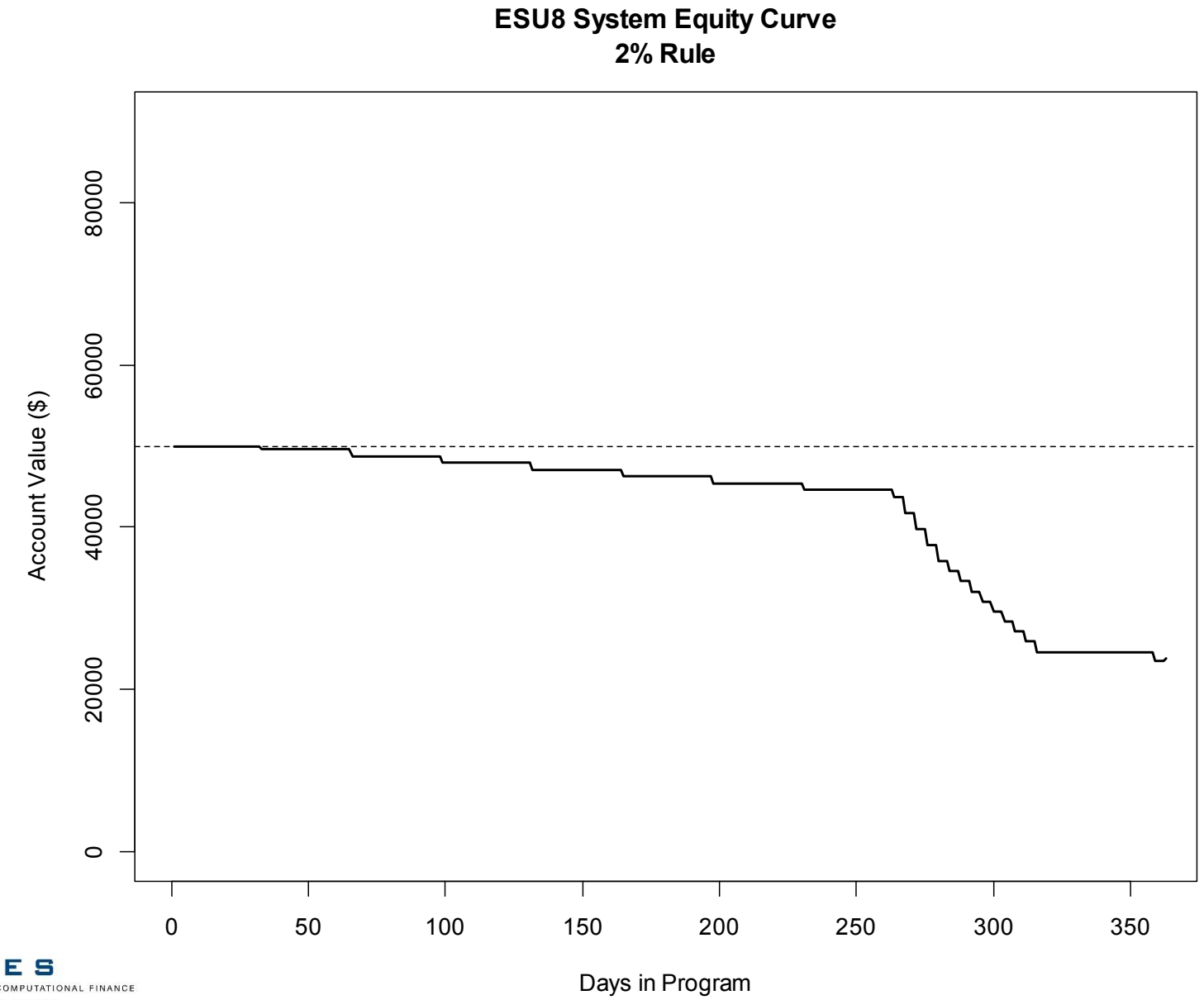
Another path



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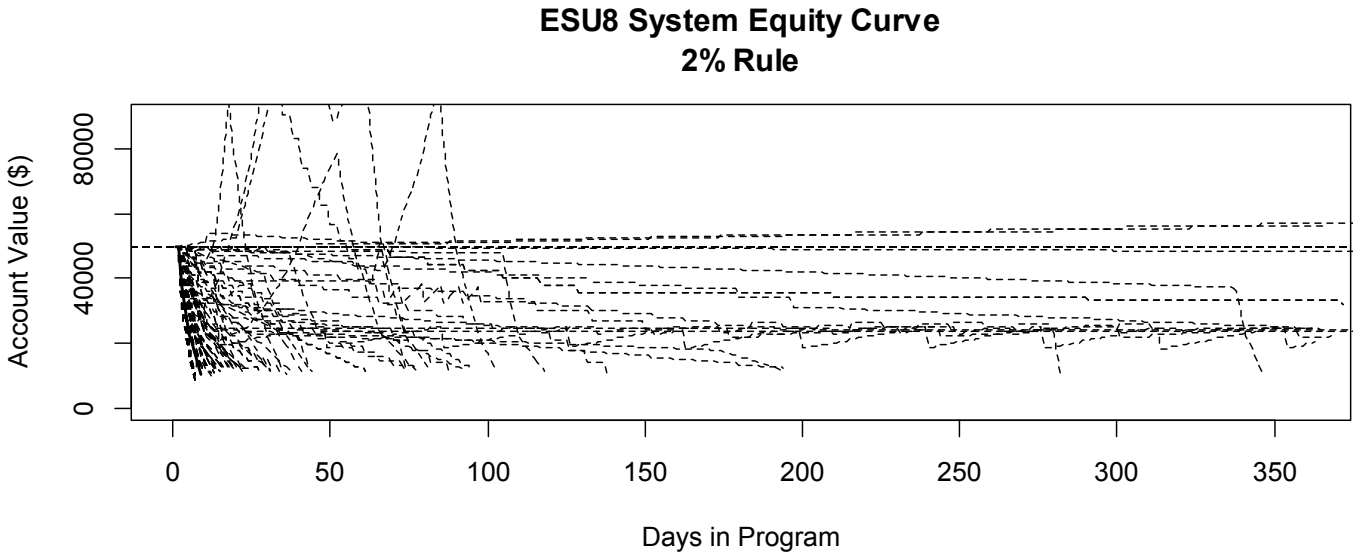
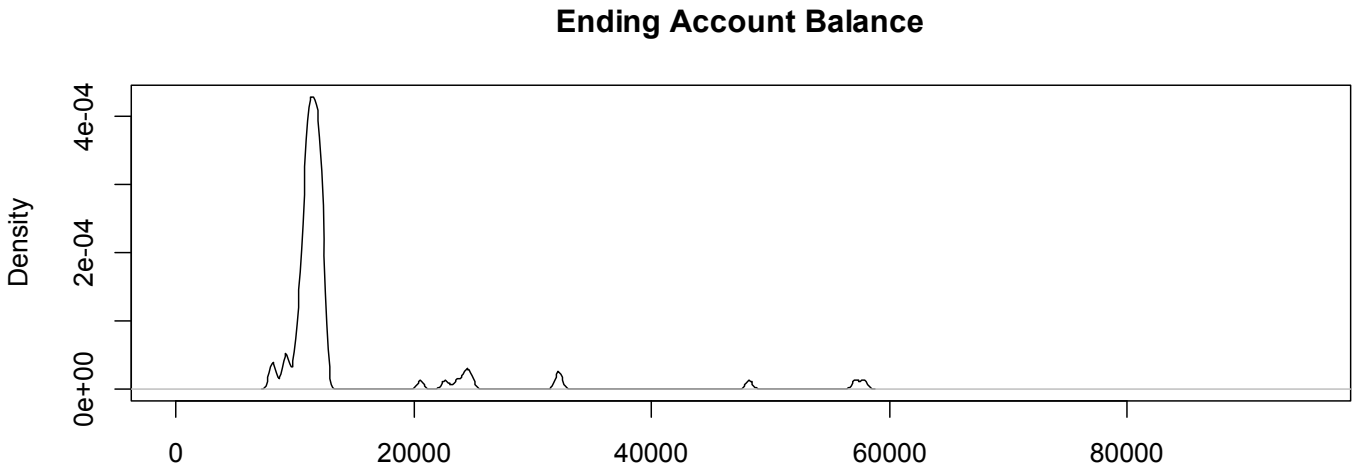
M=100 paths





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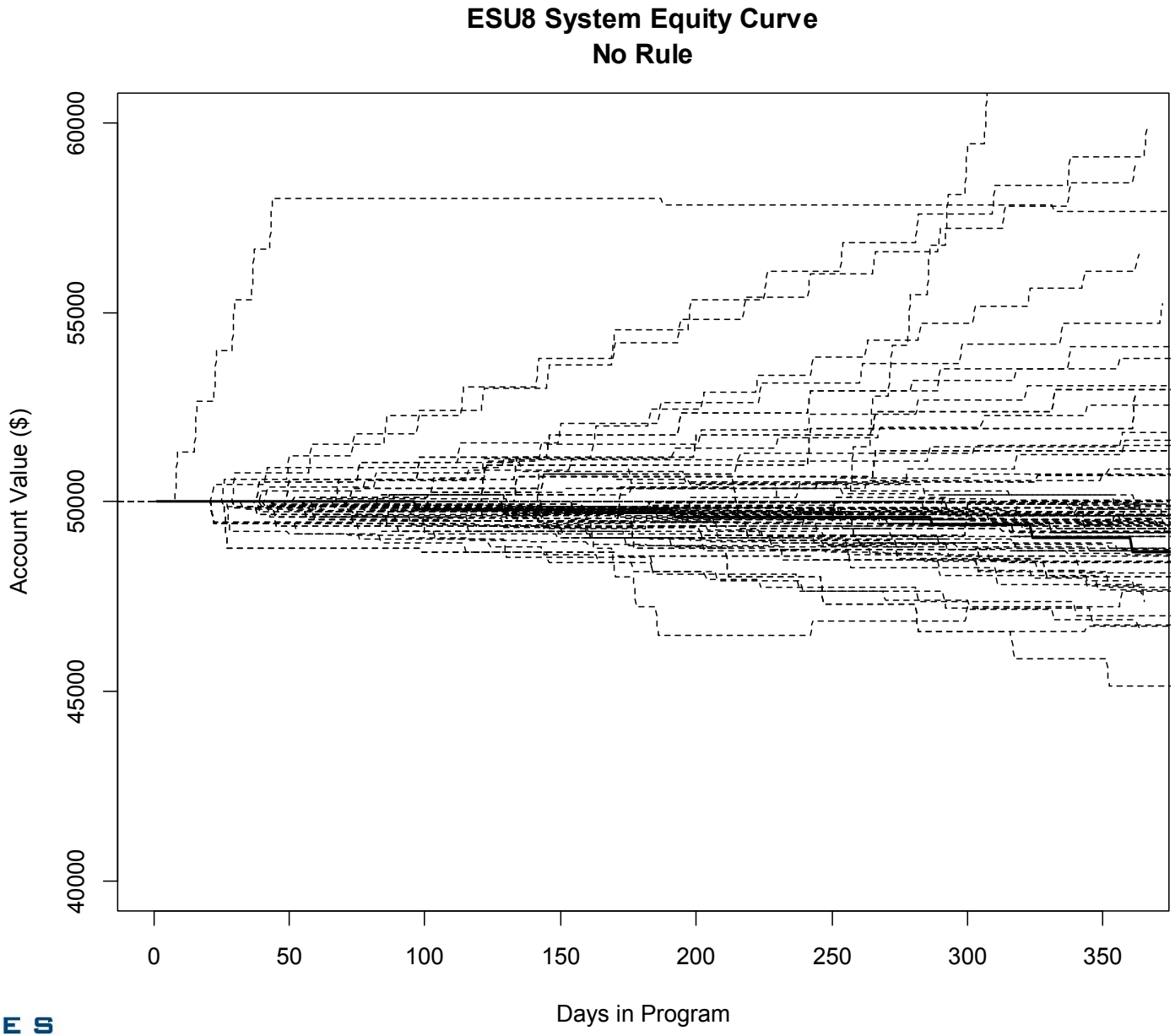
No Rule



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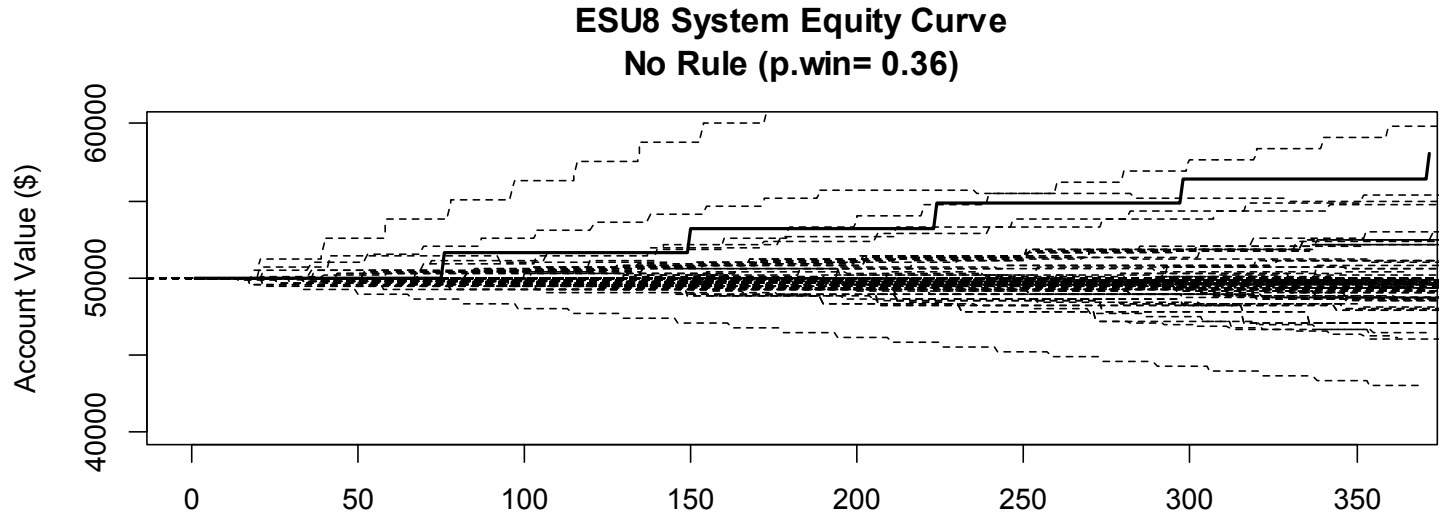
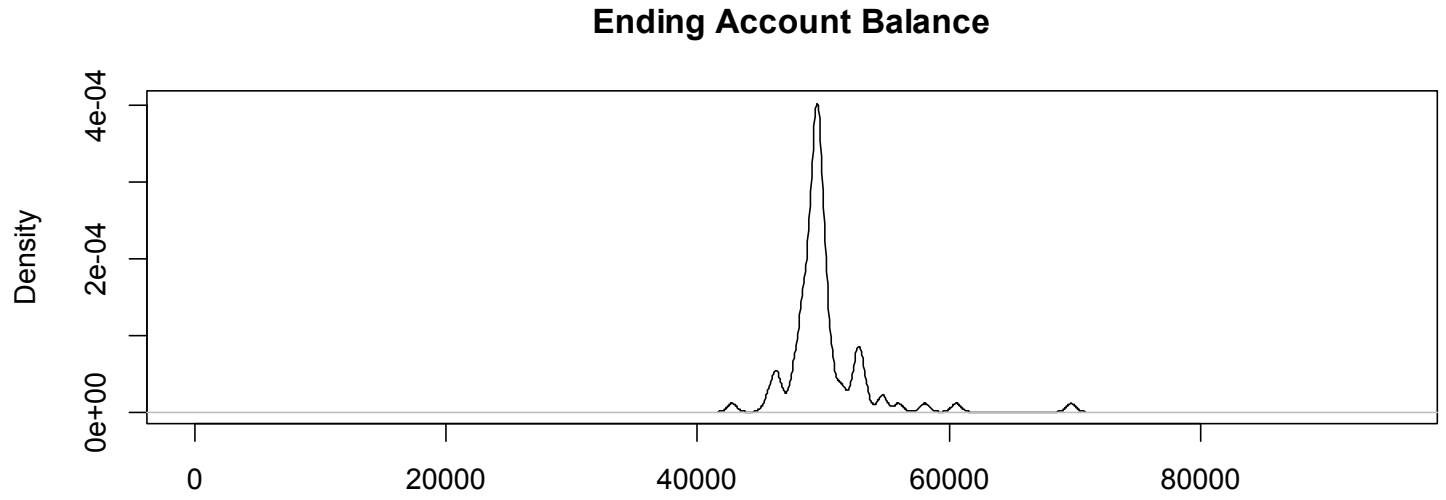
p =.36



Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	N	Stdev
42730.000	48880.000	49530.000	50010.000	50240.000	69660.000	100.000	3118.111



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Implementation of X% Rule Results

A_0 = 50,000, N=500

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	N	Stdev
2%	9,657	11,760	12,210	18,660	23,760	58,730	500	11,110
3%	9,728	11,650	12,340	19,590	25,010	58,910	500	11,084
5%	9,105	11,960	21,800	23,580	33,570	57,480	500	12,352
10%	7,469	27,820	37,260	36,260	47,640	62,590	500	12,857
20%	14,580	42,570	48,960	46,150	50,490	59,540	500	7,872
50%	35,860	48,670	49,620	50,160	51,820	60,750	500	3,002
None	41,280	48,560	49,580	50,040	51,240	61,150	500	2,637

Implementation of X% Rule Results

A_0 = 50,000, N=500, *p.win* =.356

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	N	Stdev
2%	9,657	11,760	12,210	18,660	23,760	58,730	500	11,110
3%	9,728	11,650	12,340	19,590	25,010	58,910	500	11,084
5%	9,105	11,960	21,800	23,580	33,570	57,480	500	12,352
10%	7,469	27,820	37,260	36,260	47,640	62,590	500	12,857
20%	14,580	42,570	48,960	46,150	50,490	59,540	500	7,872
50%	35,860	48,670	49,620	50,160	51,820	60,750	500	3,002
None	41,280	48,560	49,580	50,040	51,240	61,150	500	2,637

A_0 = 50,000, N=500, *p.win* =.45

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	N	Stdev
2%	10,450	11,970	12,350	22,130	31,670	64,240	500	14,302
3%	9,398	11,720	12,670	23,020	35,580	62,250	500	14,254
5%	8,984	12,220	25,120	27,960	37,670	63,320	500	14,473
10%	8,293	31,230	40,750	38,300	49,120	68,140	500	12,700
20%	16,160	46,020	49,570	47,860	51,570	65,810	500	7,177
50%	36,700	49,160	50,350	50,990	52,830	64,320	500	3,459
None	38,190	49,130	49,980	50,940	52,660	65,350	500	3,831

A_0 = 50,000, N=500, *p.win* =.80

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	N	Stdev
2%	10,160	11,920	15,320	19,130	24,940	45,200	500	8,418
3%	9,910	12,020	19,320	20,280	26,230	48,720	500	8,538
5%	9,025	17,690	25,180	25,040	32,190	50,440	500	9,480
10%	8,406	30,190	36,510	35,540	41,400	55,170	500	8,785
20%	22,020	41,780	50,490	46,800	52,660	56,830	500	7,224
50%	20,210	51,710	52,540	52,500	53,450	57,060	500	2,602
None	48,380	51,730	52,600	52,610	53,560	56,970	500	1,343

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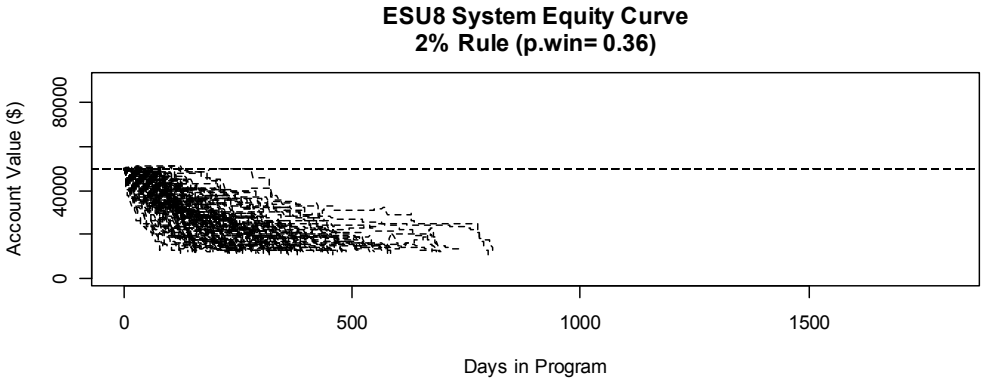
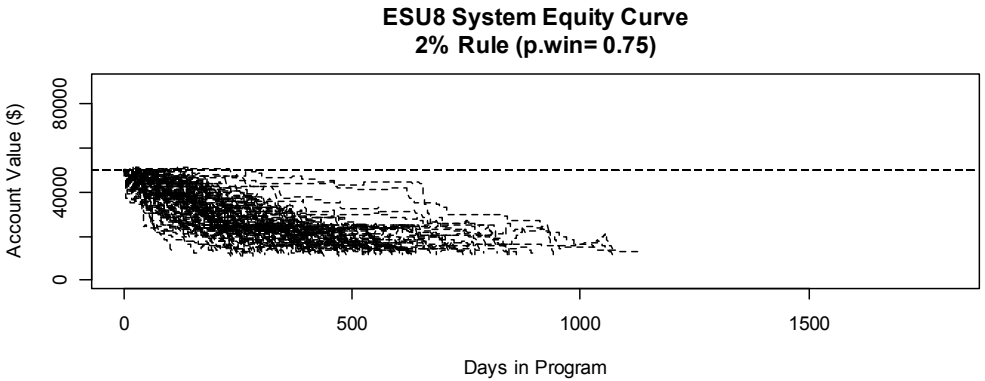
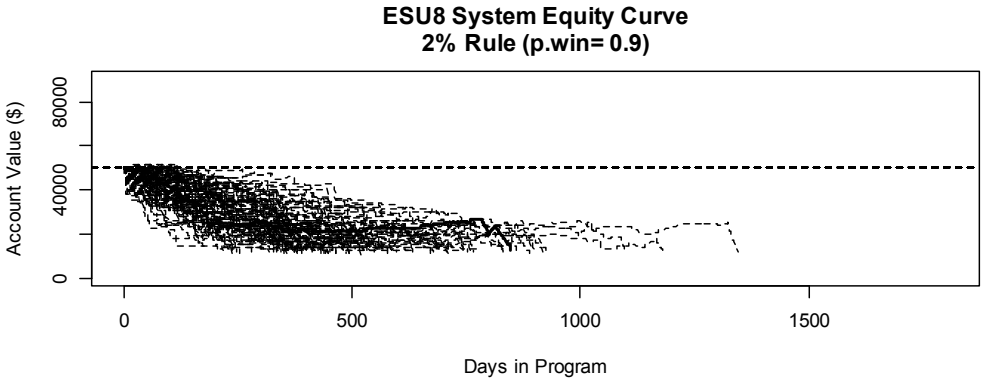
Impact of horizon and p.win



Median = $11.5k



Median = $11.8k



Median = $11.8k

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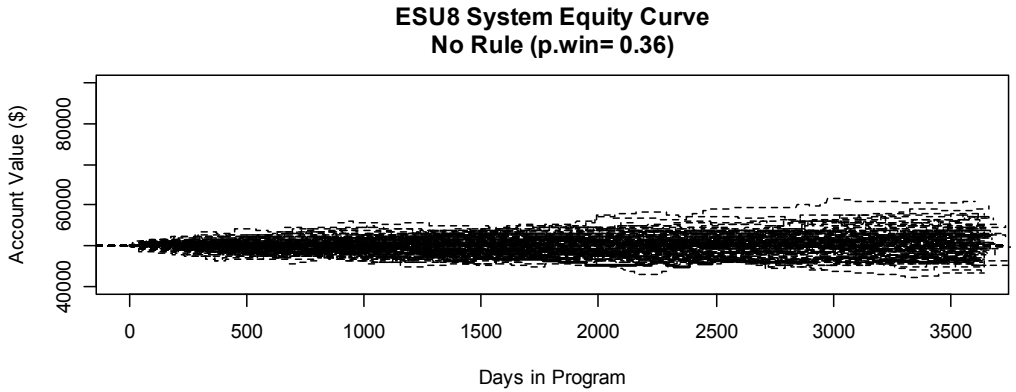
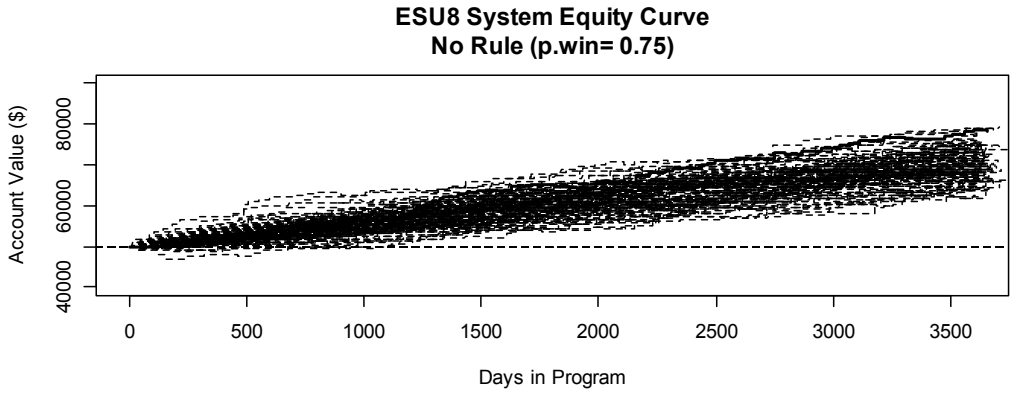
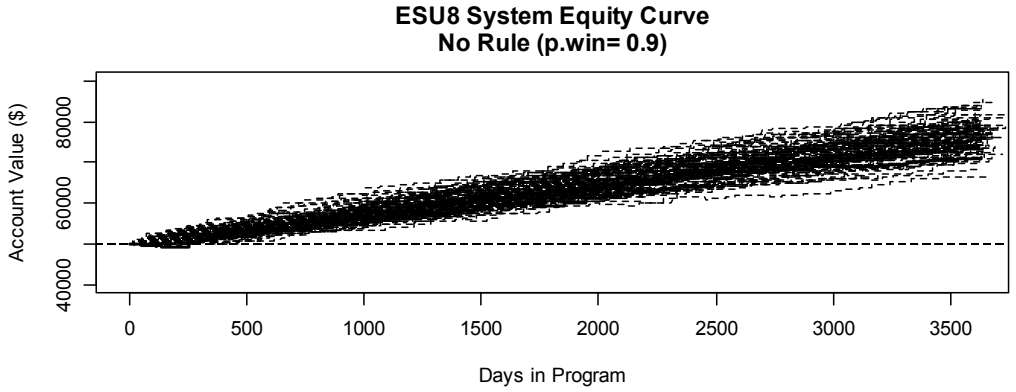
Without the Rule



Median = $50.8k
CAGR = 0.16%



Median = $70.0k
CAGR = 3.4%



Median = $77.2k
CAGR = 4.4%

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Conclusion

- Stop-loss implementation
  - Simplistic stops have shown themselves to be insufficient for preventing downside while allowing upside potential.
- The "2% Rule“
  - For this system, the rule has been shown to emphasize losses
  - For the most part you go broke
  - Hence the rule is not indicated as an effective means for money management.

Conclusion (CONT'D)

  - System performance is more dependent on the volatility of the process model than the probability of winning trade.
    - This is due to the "ruin" feature of the system
    - Longer time horizon longer in the game, but ruin ensured (modal equity at basement)
- Overall system (without the rule)
  - Longer horizon → greater profits
  - p.win ↑ → greater profits
  - Low CAGR's
- True stochastic math system stopping rules need more data and validation

Future Work

- More contract types with dynamic margining – e.g., grains, F/X, equities
- Implement a Mark-to-Market feature
- Obtain historical trades data with paths and better calibrate parametric process simulation
- Obtain more data and do resampling-based position data
- Empirically evaluate new stopping schemes

Thank you Philip

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