

# **Constructing *Advantage*: Wins/Losses and Probabilities**

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Presented at:  
AAll Options  
San Diego, CA

Jul 27, 2019

# Trading Advantage: Motivation

- Goal: Develop a **likely** profitable trading strategy.
- Strategy: **Balance** dollar reward/risk (win/loss) ratio with probability of win in trades.
- Tactics: Be able to **reproduce** trades in such a system **easily** and **effectively**.

# Trading Advantage: Basic Idea

- Enter a trade if the *marketplace* probability of winning is **greater** than a *theoretical* value probability of winning.
- Theoretical value of probability of winning is based on Advantage math **model**.

# Trading Advantage: Method Overview

- **Given** a trade's *dollar* win / loss ratio, **compute** the corresponding *minimum* corresponding probability of win required.
- Compare **computed model** required minimum probability of win with **marketplace** probability of win.
- If the *marketplace* probability of win **is greater than** the *computed* model required probability of win, **take** the trade.

# Example: Basis for Demonstration

- A few examples are used to illustrate Advantage trading theory.
- Different aspects of the trades are highlighted, to understand the approach from **beginning to end**.
- Other **defined-risk option trades** can be analyzed using the same method as the provided examples.
- All examples are based on the **ThinkOrSwim** (ToS) platform. Other platforms can be used, if the necessary data can be extracted from the platform.

# Trade Systems vs. Individual Trades (1)

- Trade system
  - Trade system is composed of a **sequence** of trades
  - Each component trade is performed using **repeatable and defined** rules
  - From initial equity, profit and losses are **accumulated**, resulting in a trade system's *equity curve*
- Trade system **equity curve** may **terminate** in different locations, compared to **initial** equity
  - **Break-Even**: Equity curve ends **near** where it began
  - **Profitable**: Equity curve end **above** where it began
  - **Losing**: Equity curve ends **below** where it began
- Trade system equity **path** will vary (profit vs. loss)

# Trade Systems vs. Individual Trades (2)

- Individual Trades

- Individual trades are **constructed** to adhere to repeatable and defined trading rules.
- Individual trades with options can be **structured at opening** to have *defined win / loss ratio*.
- Marketplace, however, is probabilistic, so the **probability of win** (and thus loss) are dynamic.

# Equity Curve: Definitions

- Trading System Equity Curve: Profit and loss value of account, over *time* and over **large sequence** of trades
- Attributes of equity curve
  - **Number** of trades, is composed (only) of
    - number of trades that profited
    - number of trades that lost
  - **Dollar** quantities, is composed (only) of
    - total dollar winnings
    - total dollar losses
- **Probability of Winning** is Number of Trades that Profited *divided* by Total Number of Trades
- **Win / Loss Ratio** is Total Dollar Winnings *divided* by Total Dollar Losses



# Equity Curves: Aim

- Use **simulation** to evaluate possible equity curves.
- In the simulation of equity curves
  - All trades have the **same** *win / loss ratio* (reward / risk ratio).
  - Probability of win is **varied**.
- With the **right combinations** of win / loss ratios and probabilities of winning, equity curves are **more likely** to be profitable.
- Simulated equity curves involve *probabilities* of winning and losing, thus are **not** guaranteed.

# Equity Curves: Right Combinations

Advantage	Win /	Intermediate	Equity Curve	
	Loss	Prob. of Win	Losses	Ending Equity Curve Value
Ratio				
No	0.66	57%	All	All Lose
No	0.66	60%	About 1/2	Some Lose, Some Gain
No	0.66	61%	About 1/2	Mostly Gain
Yes	0.66	62%	About 1/4	All Gain
Yes+	0.66	63%	About 1/3	All But 1 Gain

- Each simulated equity curve is 100's of trades.
- Each simulation consists of 10 equity curves.
- **Same** win/loss ratio in **all** simulations.
- Five **different** probabilities of win are simulated.

# From Equity Curves to Trades

Compare:

Use win / loss ratio and probability of winning to ***analyze a prior system,***

to:

***Construct*** trades with higher likelihood to grow the equity curve with each ***trade.***



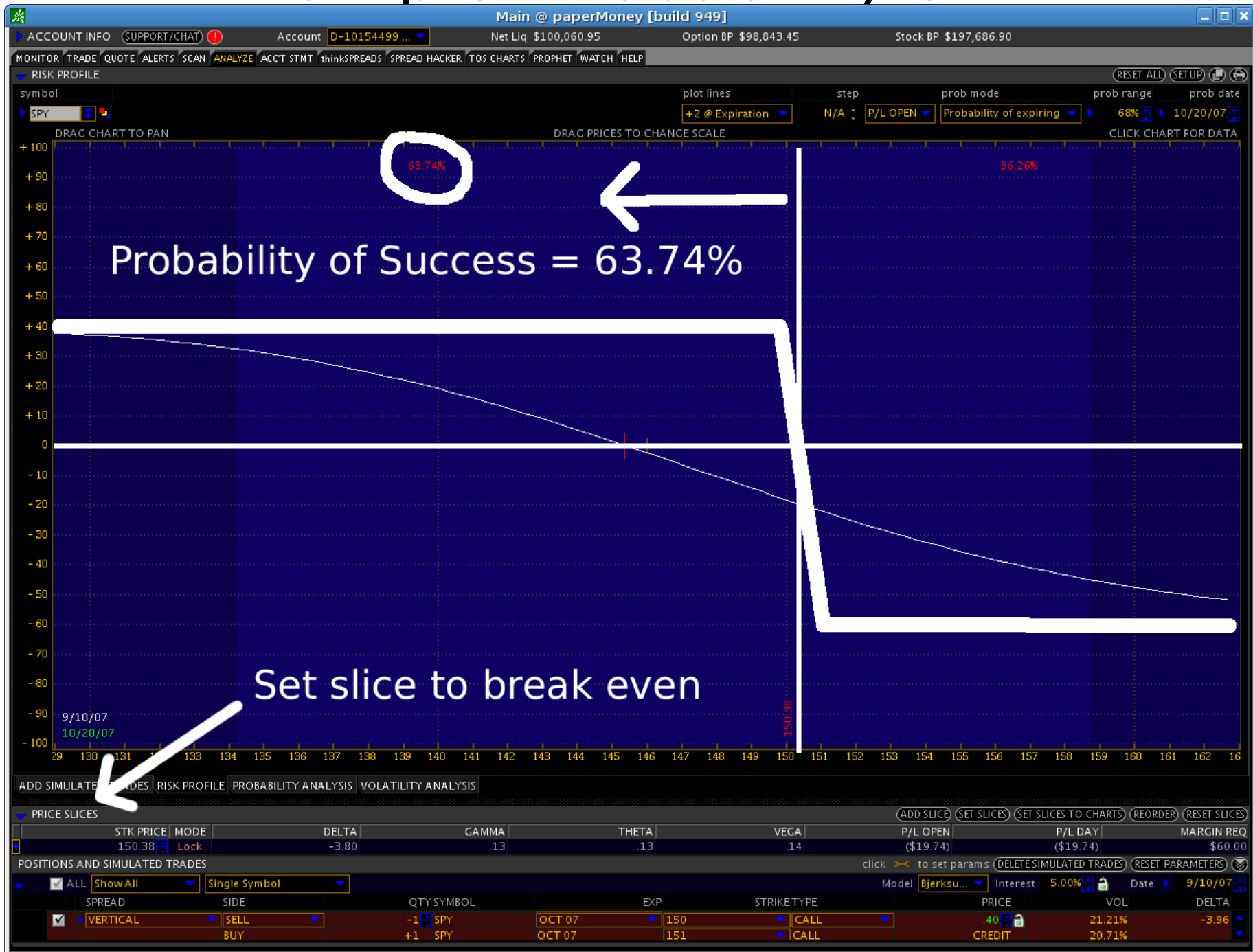
# Example: Trade Structure

- SPY @ 148.20 on Sept 10, 2007
- Out-of-the-Money bear call vertical, Oct 2007 expiration, \$0.40 credit
  - Sell 150 Call
  - Buy 151 Call
- **Key attributes** of vertical necessary for Advantage analysis
  - **Defined** win: net option credit
  - **Defined** loss: difference between strikes less credit
  - **Defined** probability of win: making 1 cent or more *by expiration*

# Example: Win / Loss Ratio



# Example: Probability of Win



# Example: Right Combination



# Example: Right Combinations

- In General: How can the correct balance between win / loss ratio and probability of win be **calculated**?
- Specifically: How did I **decide** to open the trade on the prior slide?
- By **constructing each** trade with the correct balance between win / loss ratio and probability of win, we aim for a **higher likelihood** that the equity curve created will terminate with an account value greater than the starting value.



# Advantage Formula: Background

**Formula:**  $(TW - TL) / TL = C$

where

TW = Total winnings,

TL = Total losses,

C = "Advantage" preference

**English:** A trading system is measured by its winnings in excess of losses, normalized by losses. The **Advantage** measure "C" is a trader's economic preference.

**Key:** When  $C=0$ , there is **equilibrium** between winning and losing:  $TW = TL$

# Advantage Formula: Daily Use

- Evaluate **individual** trades using Advantage math:

$$\mathbf{Probability\ of\ Win} = S / (1+S)$$

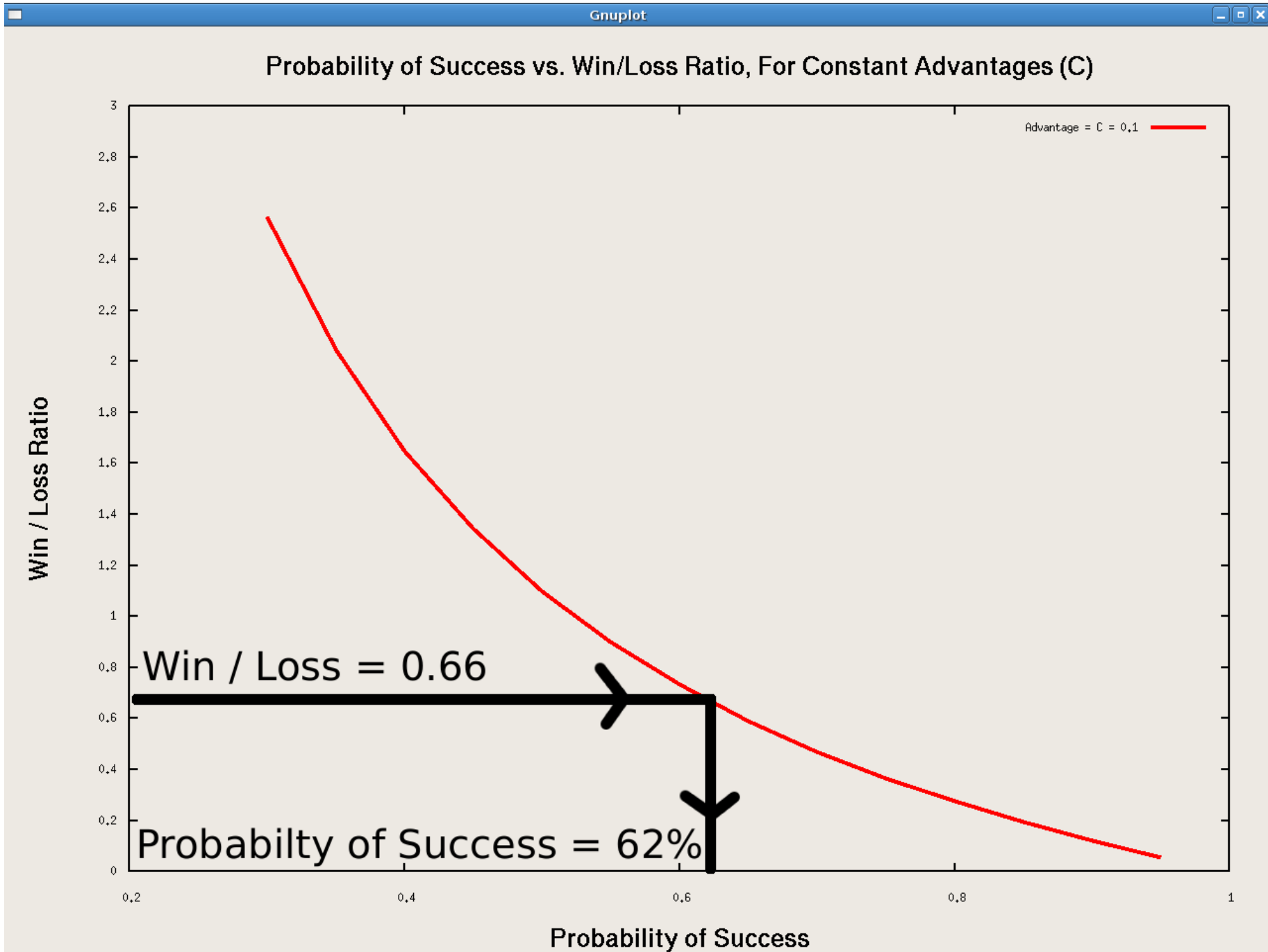
where

$$S = (C + 1) * (\mathbf{Loss} / \mathbf{Win})$$

C = "Advantage" preference

- A trading system with *positive* advantage ( $C > 0$ ) will *more likely* have a profitable equity curve.
- **Henceforth:** *Advantage = C = 0.1*

# Advantage Formula: Graphical View



# Probabilities: Needed vs. Marketplace

- ***Needed*** probabilities
  - *Calculated* per the Advantage formula
  - Dependent *only* on win, loss, and C
  - Consequently, needed probabilities are computed *independent* of real-world conditions
- ***Marketplace*** probabilities
  - Valued *real time* in the marketplace
  - Dependent on *time* to expiration

# Probabilities: Needed vs. Market

- **Opportunity:** Given a fixed win / loss ratio and a fixed Advantage (C), the *formula* probability of winning is **different** from *marketplace* probability of winning.
- Probabilities in the marketplace **greater than** probabilities using the formula indicate trades to open:

***Advantage Ratio =***

$$\frac{(\textit{Probability of Win})_{\textit{Marketplace}}}{(\textit{Probability of Win})_{\textit{Formula}}} \geq 1$$

# Example: Worksheet (revisit)

- SPY @ 148.20 on Sept 10, 2007
- **Decide:** Sell bear vertical, 150/151, Oct07, calls, for \$0.40?

- **Formula:**

$$\text{Win / Loss} = 40 / 60 = 0.66$$

$$S = (0.1 + 1) * (60 / 40) = 1.65$$

$$\text{Probability of Win } **Needed** = S / (1 + S) = 0.6226$$

$$\text{Probability of Win in } **Marketplace** = 0.6374$$

Advantage Ratio =

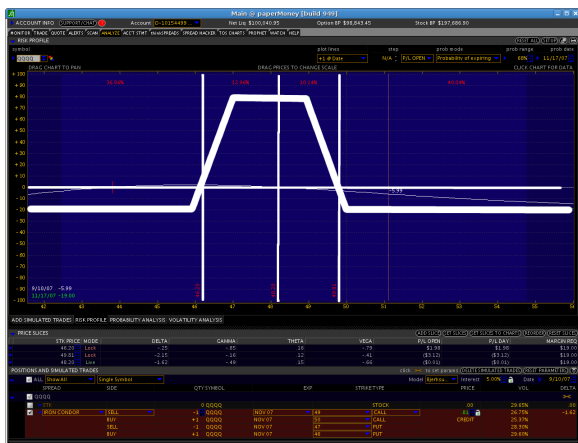
$$\text{Probability } **Marketplace** / \text{Probability } **Needed** = \\ 0.6374 / 0.6226 = **1.02**$$

- **Conclusion:** *Take* the trade, because Advantage Ratio is *greater* than 1.00

# Finding Real World Trades

- Finding real-world Advantaged trade is **difficult** and **relatively rare**.
- If such trades exist, they are likely
  - further out in **time**: greater option time value
  - to have higher **volatilities**: higher volatility means higher prices.

# Iron Condor: Worksheet



QQQQ @ 48.20 on Sept 10, 2007

**Decide:** Sell narrow Iron Condor, 46/47/49/50, Nov07, for \$0.81?

**Win / Loss = 81 / 19 = 4.26**

$$S = (0.1 + 1) * (19 / 81) = 0.2580$$

**Probability of Win Needed =**

$$S / (1 + S) = 0.2051$$

**Probability of Win in *Marketplace* = 0.2311**

**Advantage Ratio =**

$$\begin{aligned} & \text{Probability Marketplace} / \\ & \text{Probability Needed} = 0.2311 / 0.2051 \\ & = 1.12 \end{aligned}$$

Conclusion: **Take** the trade



# ThinkOrSwim: Tooling

- Find Advantage trades: ToS | Scan | Spread Hacker (**Beware**: Valid **only** during market hours)
- **Add spread filters** for criteria needed for Advantage calculation (ex.: given PoP, compute market W/L ratio)
  - **Single** expiration date (use +/- 1 for min/max range)
  - “Probability of profit” [probability of win]: **Select** a specific probability of profit, by bracketing +/- 1 for min/max range
  - “Max profit” [win / loss ratio]: **Calculate** max profit target using Advantage formula, and use it as **minimum** of range
- Right click to “**Analyze Trade**”
- **Confirm** win / loss ratio and probability of win on Analyze page

# Further Applications

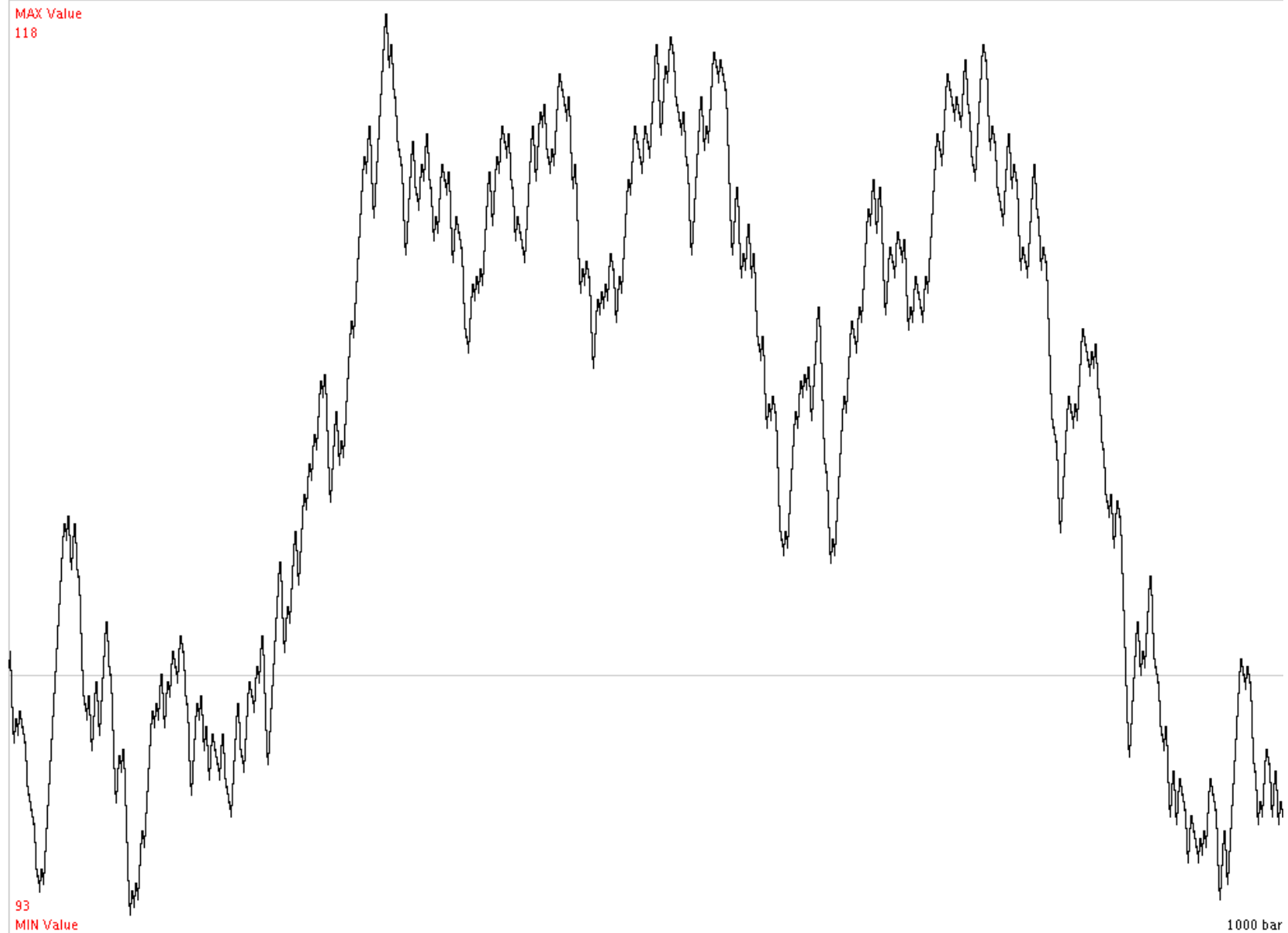
- Strategy: Compare Advantage Ratios
  - Trade A has Advantage Ratio A;  
Trade B has Advantage Ratio B
  - Rule:  
**Prefer** Trade A over Trade B **if**  
Ratio A is **greater than** Ratio B
- Further Applications (see appendix)
  - Confirming Advantage Ratio remains positive after *slippage*
  - *Comparing* trades at different strikes, dates, volatilities
  - *Tracking* trades, using Advantage to decide when to exit

# Appendix: Equity Curve Simulation

# Single Equity Curve Simulation

- **Start** with fixed equity in account
- For each **successive** component trade: Invest with a given win/loss ratio (namely, a fixed win dollar amount, and a fixed loss dollar amount)
- For each trade, compute **incremental P/L**
  - Win the win amount with a win probability, **or**
  - Lose the loss amount with loss probability
  - For each trade, add or subtract incremental P/L to current account value
- After many trades, an equity curve is formed, with a path and a final account value

# Single Equity Curve Sim.: Sample



$\text{Win / Loss} = \$40 / \$60 = 0.66$   
 $\text{Probability of Win} = 60\%$

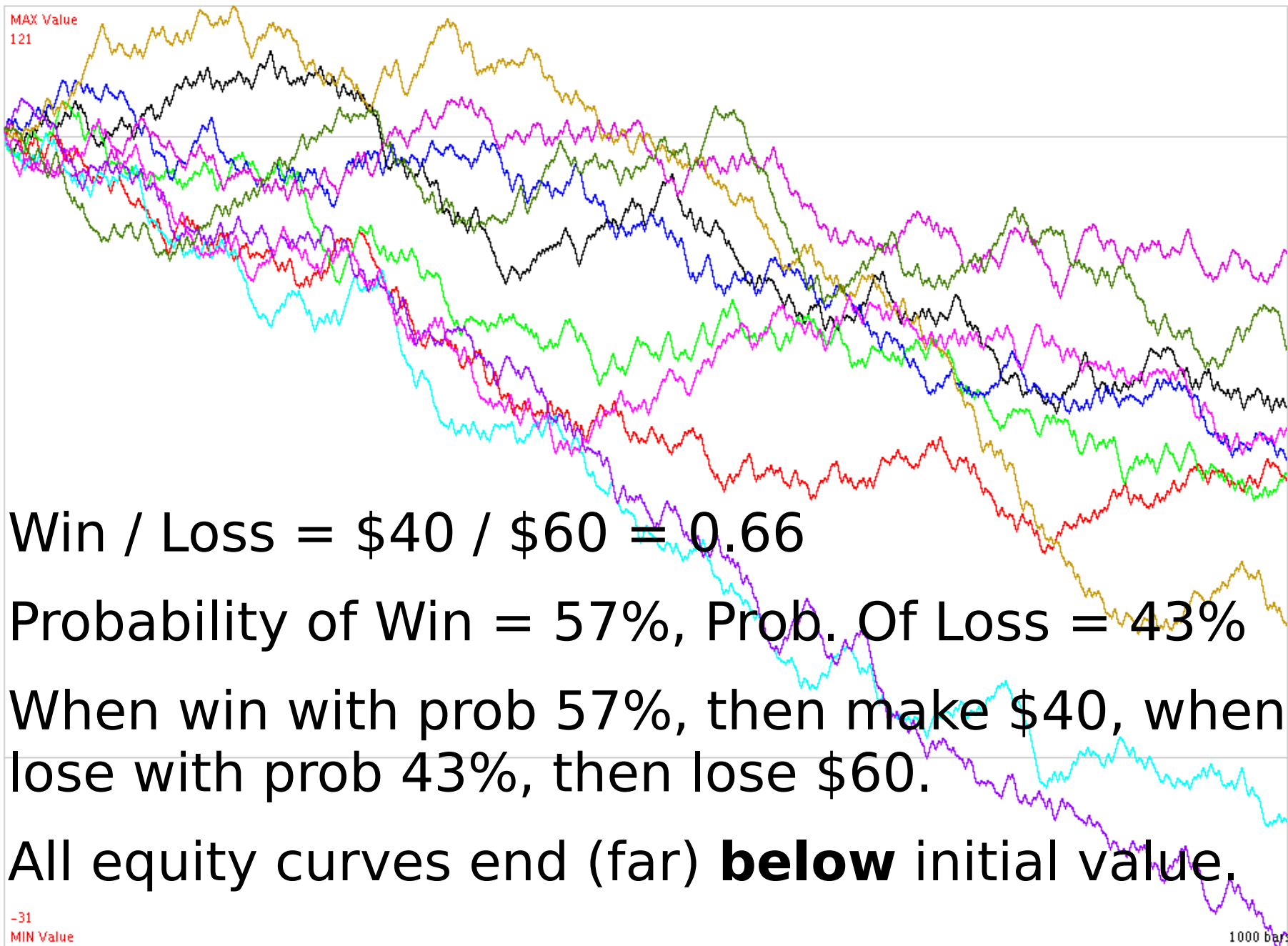
# Single Equity Curve Sim.: Insights

- This is a simulation... Other runs of the simulation will result in **different** curves with **different** paths and final values.
- During the simulation, the equity curve is **sometimes** above 0 (profits) and **sometimes** below 0 (losses).
- Sometimes there are **streaks** of losses and wins.
- Depending on when you **stop**, equity curves could end at a profit or at a loss.

# Multiple Equity Curves on One Plot

- Run and plot **multiple** individual simulations of individual equity curves.
  - **Key: All** simulations on a **single** plot have the **same** win/loss ratio and **same** probability of win.
  - **Key:** For each **different** plot, win/loss = \$40/\$60 is **constant**, while probability of win **changes** from simulation to simulation, resulting in different equity curve behavior.

# Equity Curves: Losing Cases (57%)





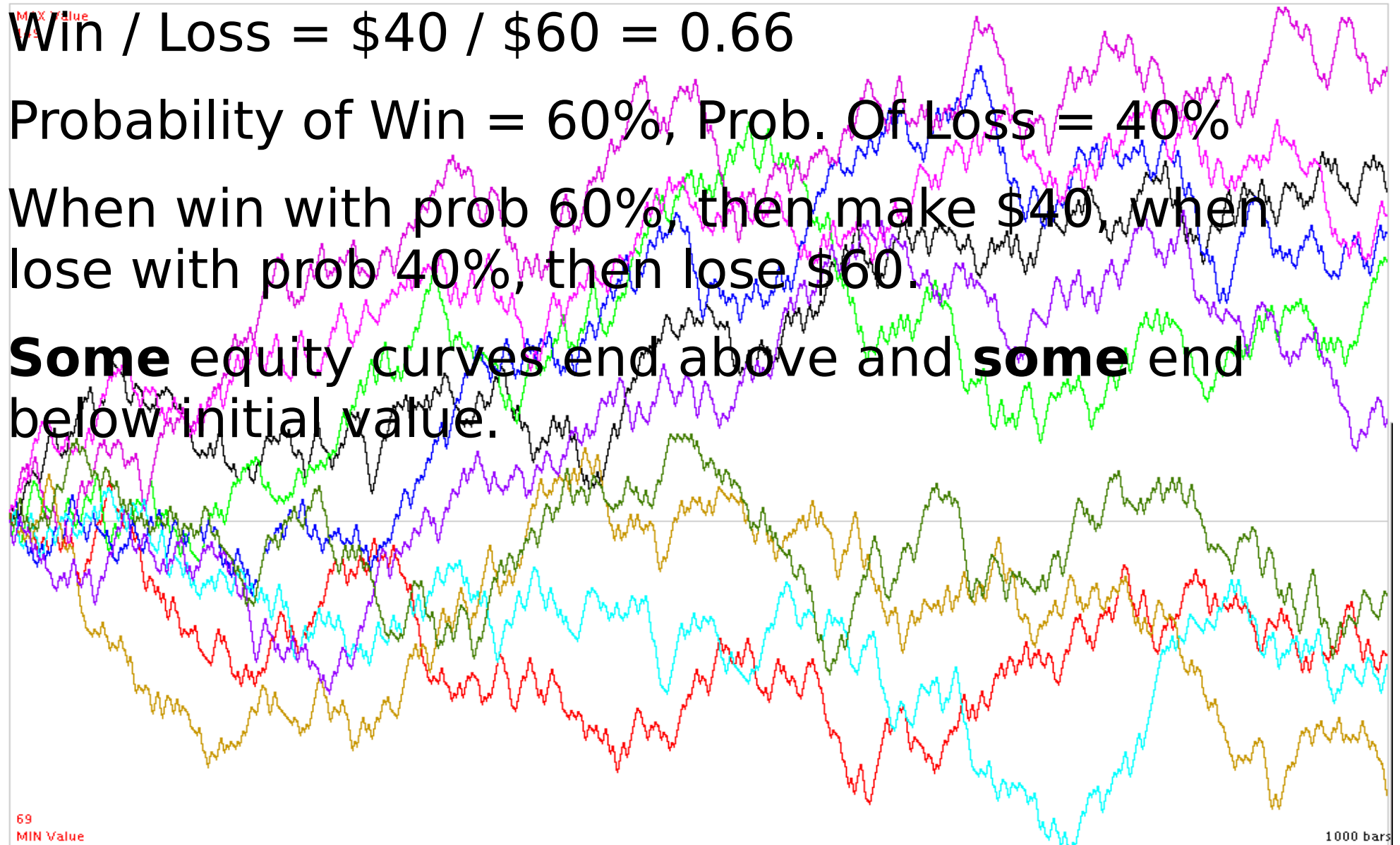
# Equity Curves: Mostly Even Cases (60%)

Win / Loss = \$40 / \$60 = 0.66

Probability of Win = 60%, Prob. Of Loss = 40%

When win with prob 60%, then make \$40, when lose with prob 40%, then lose \$60.

**Some** equity curves end above and **some** end below initial value.



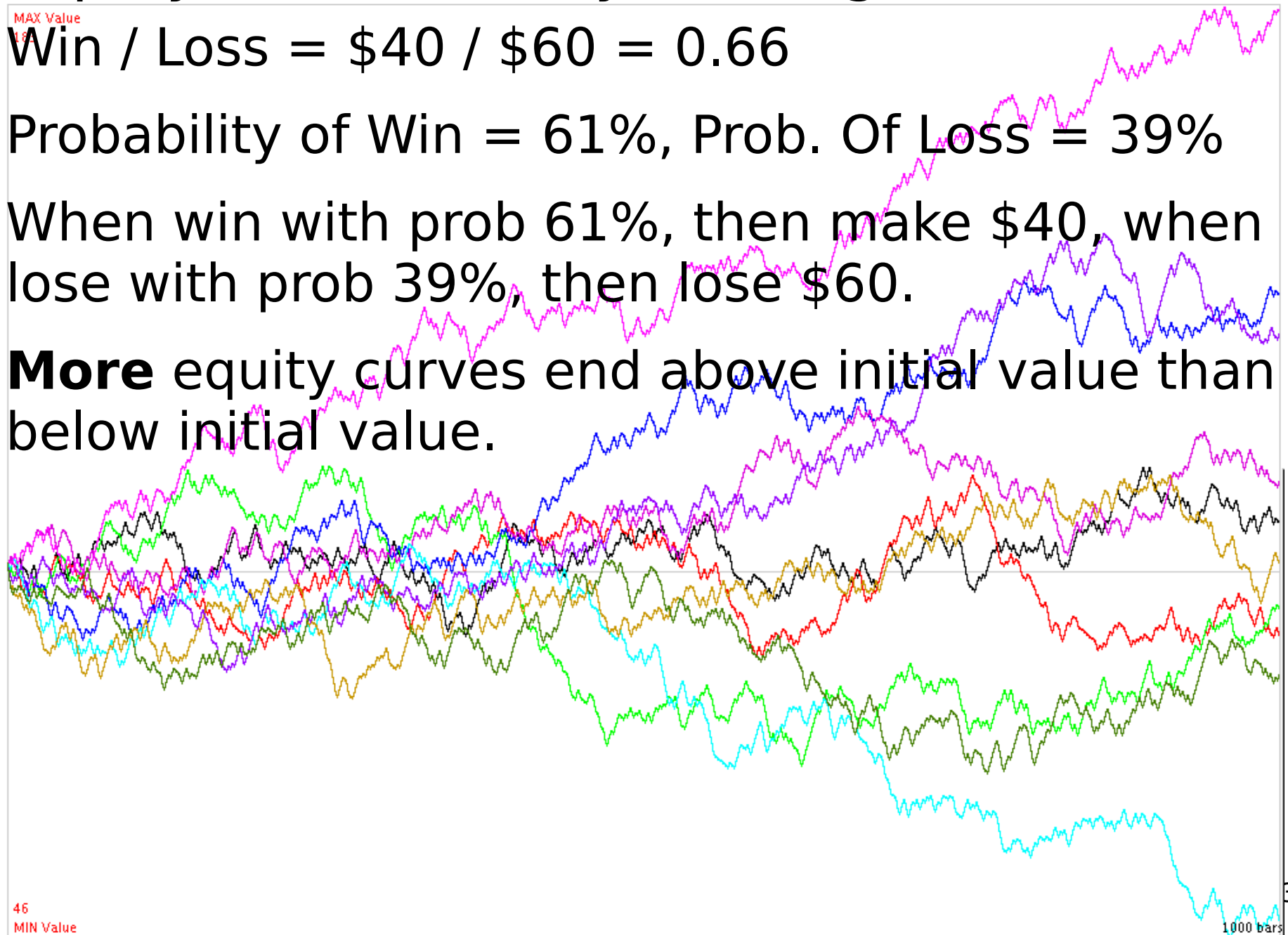
# Equity Curves: Many Gaining Cases (61%)

Win / Loss = \$40 / \$60 = 0.66

Probability of Win = 61%, Prob. Of Loss = 39%

When win with prob 61%, then make \$40, when lose with prob 39%, then lose \$60.

**More** equity curves end above initial value than below initial value.



# Equity Curves: Mostly Gaining Cases (62%)

MAX Value  
18

Win / Loss = \$40 / \$60 = 0.66

Probability of Win = 62%, Prob. Of Loss = 38%

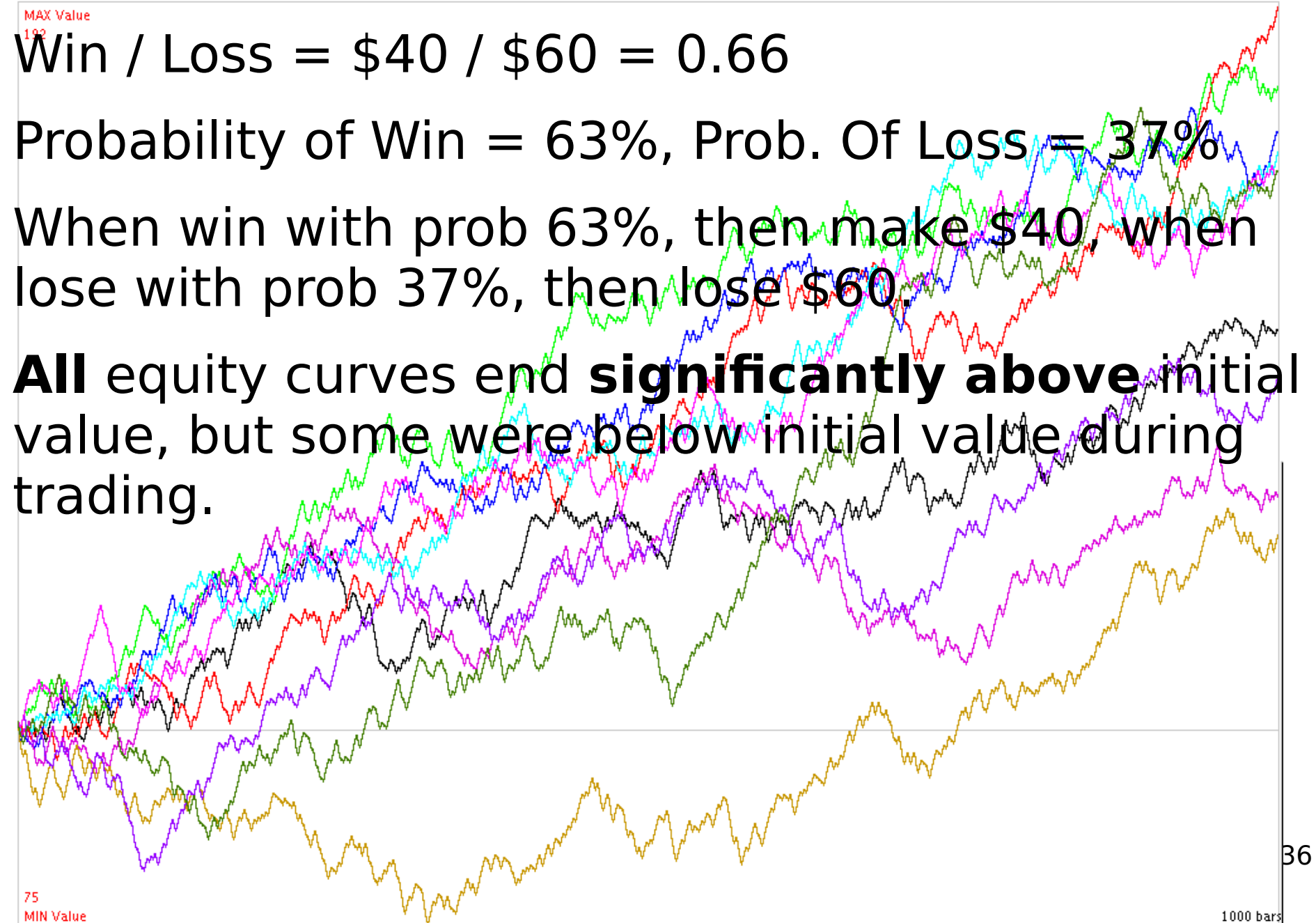
When win with prob 62%, then make \$40, when lose with prob 38%, then lose \$60.

**All** equity curves end **above** initial value, but some were below initial value during trading.

76  
MIN Value

1000 bars

# Equity Curves: Mostly Gaining Cases (63%)



# Equity Curves: Leading to a Strategy

- **Question:** Comparing plots, in which simulations do most of the equity curves remain profitable during trading and end with profits?
- **Strategy:** Choose a win/loss ratio and probability of win **combination** that has a **high proportion** of profitable equity curves.
- **Tactic:** Use Advantage math to **compute** minimum probability of win needed for the given win/loss ratio.
- **Example:** Use Advantage math, for win/loss =  $40/60 = 0.66$ , given  $C=0.1$ , needed/minimum probability of win is  $0.62$ .

# Multiple Equity Curve Simulations: Insights

- Profitability is more likely (but not guaranteed) using the “**right**” **combination** of win / loss ratio **and** probability of win.
- Many traders say

*This trade has a good risk/reward (loss / win) ratio*

but now we know this statement is **incomplete** without also stating the associated probability of win, to characterize the likely equity curve shape.

# Equity Curve Simulations: Practical Implications

- You are ***not*** guaranteed intermediate or terminal equity curves values, ***even if*** probabilities are in your favor.
- **Unfortunately**, your own equity curve may be one of the few losing equity curves among many other possible winning equity curves.

# Appendix: Math

Adapted from  
David Sepiashvili, *How to Best Evaluate System  
Performance*, Futures, March 2005



# Definition of Terms: Win, Loss

**Total Winnings:** Among a large number of trades, the total *dollar* amount of profits.

**Total Losses:** Among a large number of trades, the total *dollar* amount of losses.

**W = Average Win:** Among a large number of trades, the total dollar amount of winnings, divided by the number of profitable trades (NW)

**L = Average Loss:** Among a large number of trades, the total dollar amount of losses, divided by the number of losing trades (NL)

For a trading system, **Win / Loss Ratio**  
= (Average Win / Average Loss) = (W/L)

# Definition of Terms: Probabilities

**NT** = Total number of trades, in a trading system

**NW** = Number of trades that resulted in a win

**NL** = Number of trades that resulted in a loss

**TW** = Total winnings =  $NW * W$

**TL** = Total losses =  $NL * L$

**PW = Pr(W) =**

Probability of a win =  $NW / NT$

so  $NW = PW * NT$

**PL = Pr(L) =** Probability of a loss =  $NL / NT$

so  $NL = PL * NT$

**PW + PL = 1** (*only* wins or losses are possible)

# Advantage Formula: Background

**Formula:**  $(TW - TL) / TL = C$

where:

TW = Total winnings,

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C = “Advantage” preference

**English:** A trading system is measured by its winnings in excess of losses, normalized by losses. “C”, the *advantage*, is a trader's economic preference.

Adapted from David Sepiashvili, *How to Best Evaluate System Performance*, Futures, March 2005

# Advantage Formula: Algebra

$$\begin{aligned} & (TW - TL) / TL \\ &= [ TW / TL ] - 1 \\ &= [ (NW*W) / (NL*L) ] - 1 \\ &= [ (PW*N*W) / (PL*N*L) ] - 1 \\ &= [ (PW*W) / (PL*L) ] - 1 \\ &= [ (PW/PL) * (W/L) ] - 1 \\ &= [ (PW/(1-PW)) * (W/L) ] - 1 \\ &= C \end{aligned}$$

# Advantage Formula: Solve for PW

Solve for PW, given (W/L) and C in:

$$(TW - TL) / TL = [ (PW/(1-PW)) * (W/L) ] - 1 = C$$

Set  $P = PW$  {shorthand}

$$[ (P/(1-P)) * (W/L) ] - 1 = C$$

$$(P/(1-P)) * (W/L) = (C+1)$$

$$(C+1) * 1/(W/L) = P/(1-P)$$

Set  $S = (C+1) * 1/(W/L)$

$$S = P/(1-P), (1-P)S=P, S-PS=P, S=P+PS,$$

$$S=P(1+S), P=S/(1+S)$$

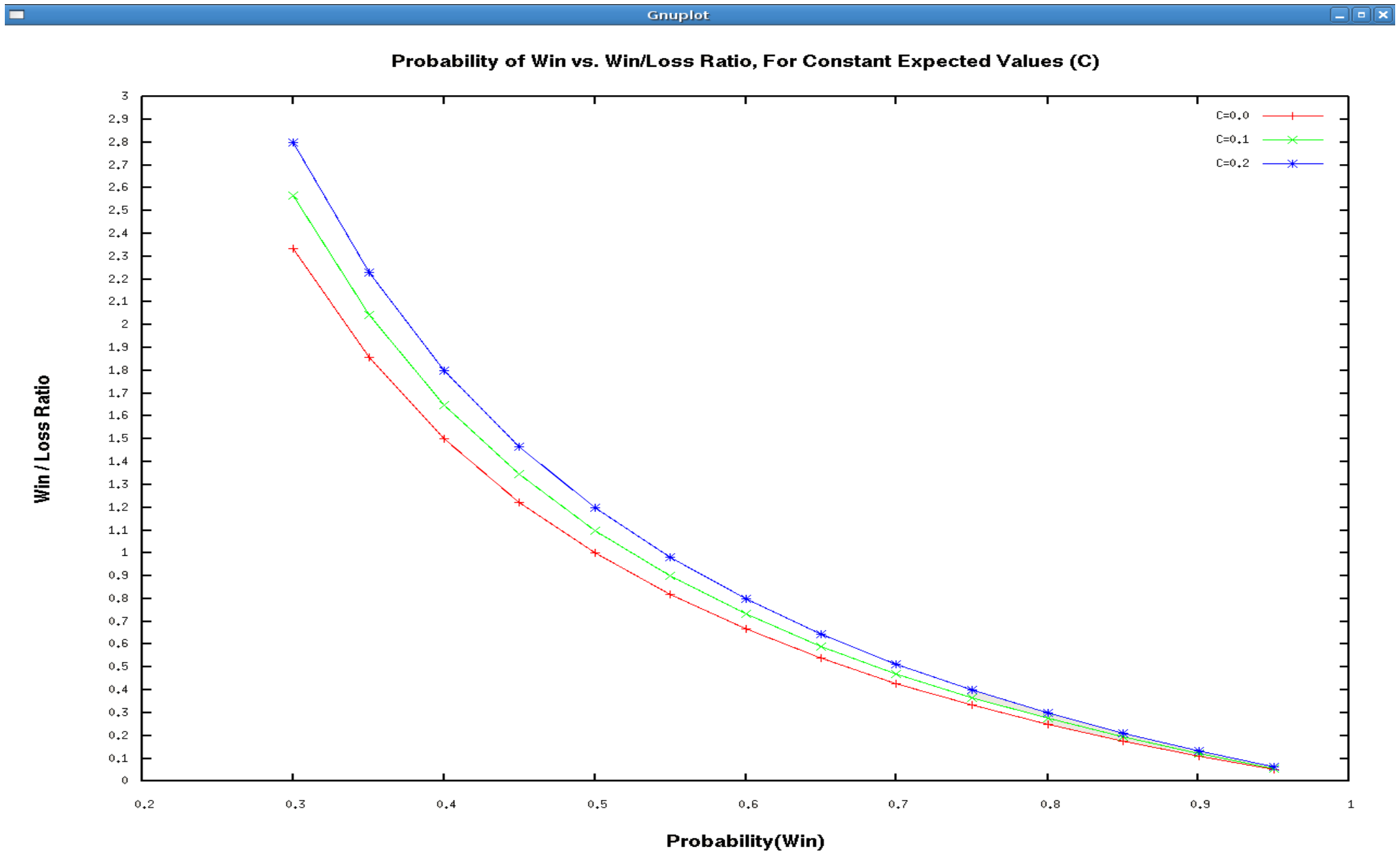
$$PW = S / (1+S)$$

# Using Advantage Algebra

- **Set Advantage:** Assume you seek an Advantage of +10%, so set  $C = 0.1$
- **Free Variables:** Since  $C$  is now fixed ("bound"), there are two remaining free variables:  $W/L$  and  $PW$ . Advantage math relates one given the other.
- **Application Summary:** Invest in trades whose *market* probability of winning [ $Pr(W)$  market] is greater than *Advantage calculated* probability of winning [ $Pr(W)$  needed], for the given win/loss [ $W/L$ ] ratio, at a constant Advantage  $C$ .
- A constant Advantage  $C$  curve represents all *pairs* of ( $W/L$ ) and  $Pr(W)$ .

# Appendix: Constant Advantage Curves

# Constant-Advantage Curves: Graph





# Constant-Advantage Curves: Analysis

- *Higher* win/loss ratios correspond with *lower* probabilities, across all Advantage curves
- For a **given probability**, *higher* advantages demand *higher* win/loss ratios
- For a **given win/loss ratio**, *higher* advantages demand *higher* probabilities
- Advantage curves  $C < 0$  (negative Advantage) are
  - likely to produce losses over the long-term,
  - are not shown on the graph, and
  - **should not** be traded.

# Appendix: Further Applications

# Advantage Ratio: Slippage

- Confirm Advantage Ratio at **mid-price**
- Confirm Advantage Ratio at **likely fill price**  
(toward natural price)
- Confirm Advantage Ratio after **commissions**

# Advantage Ratio: Comparing Trades

- Confirm Advantage ratios after modifying trade parameters (from options pricing model), e.g.,
  - Strike price
  - Volatility
  - Expiration date
  - Closing date before expiration

# Advantage Ratio: Tracking and Closing Trades

- Approach: Exit trade by comparing *marketplace* probability of win on trade **opening** day to **successive** days' *market* probabilities.
- Method
  - Open trade with Advantage Ratio above 1.
  - Define probability of win, when opening, in the marketplace as  $P_0$ .
  - For each successive trading day  $t$ , compare probability of win in the marketplace  $P_t$  to  $P_0$ :  $P_t/P_0$ .
- Examples
  - Exit when  $P_t/P_0$  is  $\frac{1}{2}$  of  $P_0$ . Note: Ratio of  $\frac{1}{2}$  is a preference.
  - Exit when “high probability” 80% trade becomes “even” 50% probability