UNIVERSITY OF MARYLAND

DMS-COP

Decision Making System for Constructing Optimum Portfolio

ENSE623 – Verification and Validation

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By:

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Problem Statement

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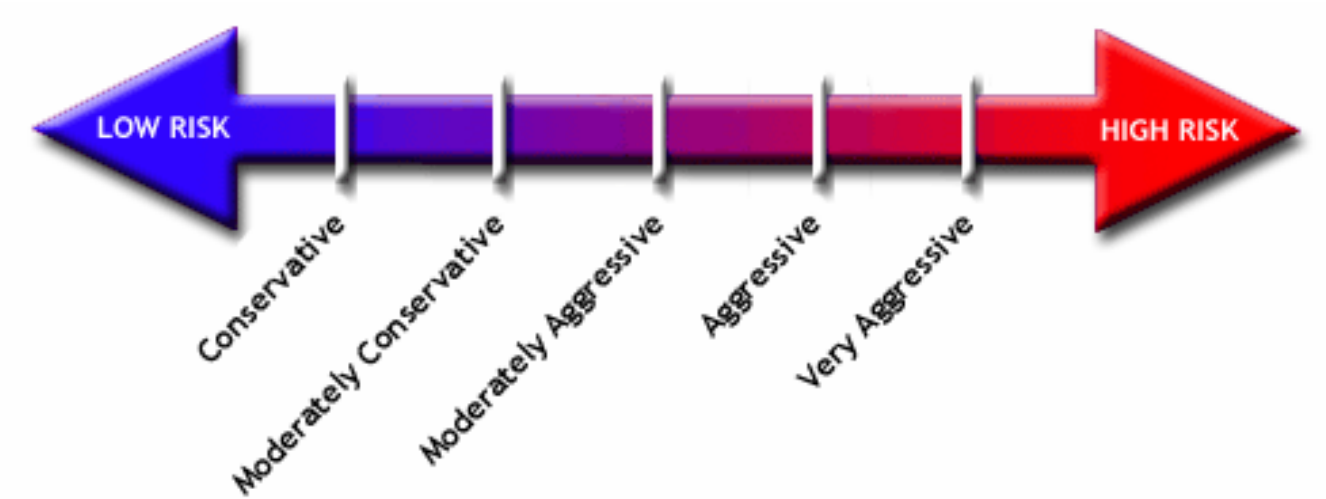
In today's financial marketplace, a well-maintained portfolio is vital to any investor's success. As an individual investor, you need to know how to determine an asset allocation which best conforms to your personal investment goals and strategies. In other words, your portfolio should meet your future needs for capital and give you peace of mind. Investors can construct portfolios aligned to their goals, their risk aversion and investment strategies by following a systematic approach.



Ideal Solution

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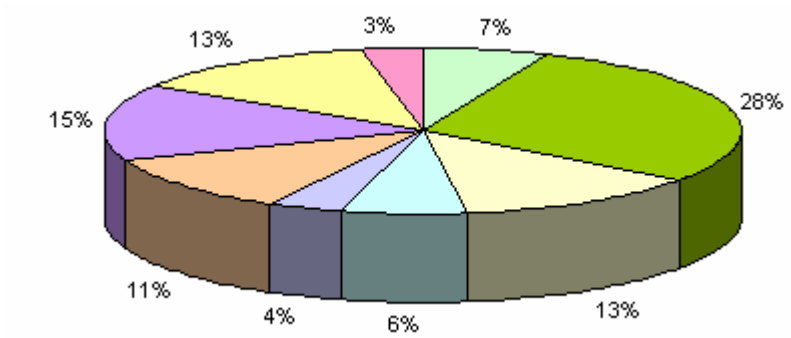
To create a simple model-based program which can assist an individual investor to firstly construct an optimum financial portfolio to make more capital gain based on set of criteria and rules and secondly give his/her the tool to decide how to manage portfolio from the perspective of selling, buying and keeping portfolio's securities according to the risk-return characteristics that best suit one's preference and financial objectives.



Goals

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- The system must be efficient
- The system must be economic
- The system must be user friendly
- The system must be secure
- The system must be capable of getting the most optimal portfolio.
- The system must be capable of getting the minimum risk with an expected return.
- The system must be able to give appropriate signals to buy/sell/hold based on the market analysis.
- The optimal portfolio should be consistent with Market results

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Portfolio - The group of assets - such as stocks, bonds and mutual funds - held by an investor.

Rate of return - A key measure of investors' success is the rate at which their portfolios have grown during the investment period.

Risk – standard deviation from the mean. It also represents the volatility of each stock.

ADX – Average Directional Index: An indicator used to determine the strength of the trend. It is measured on a scale between zero and 100.

ADX

DMI - Directional Movement Index: Component of ADX indicator. Helps in buy/sell determination.

Trending – When a particular asset's direction continues to move in one direction into the future.

MA – Moving Average: An indicator showing the average value of a stock price over a set period.

MA

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Oscillating – Erratic moving behaviour of a particular asset.

%K line – component of stochastic indicator: moving average of 5 to 10 day period


Stochastic

%D line – 3-period moving average of %K line.

Bollinger Band – A band plotted two standard deviation away from a simple moving average. When markets become more volatile, the bands widen and vice versa.


Bollinger

Ticker – Name of the stock

Closing Price – The price at the end of the day.

Volatility - A statistical measure of the dispersion of returns for a given security or market index.

Weights of Stocks - The total value of each stock in the portfolio which is simply the multiplication of number of each stock‘s shares by their prices divided by the total value of portfolio.

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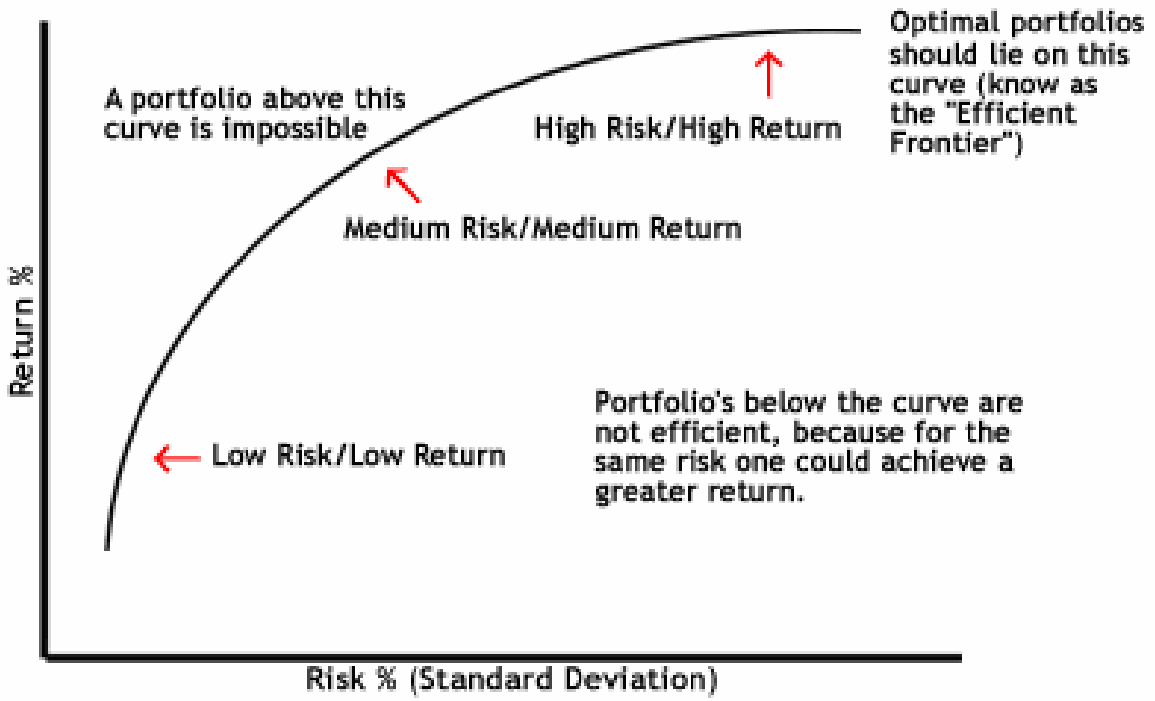
Efficient Frontier – Intersection of the set of portfolios with minimum variance and the set of portfolios with maximum return.



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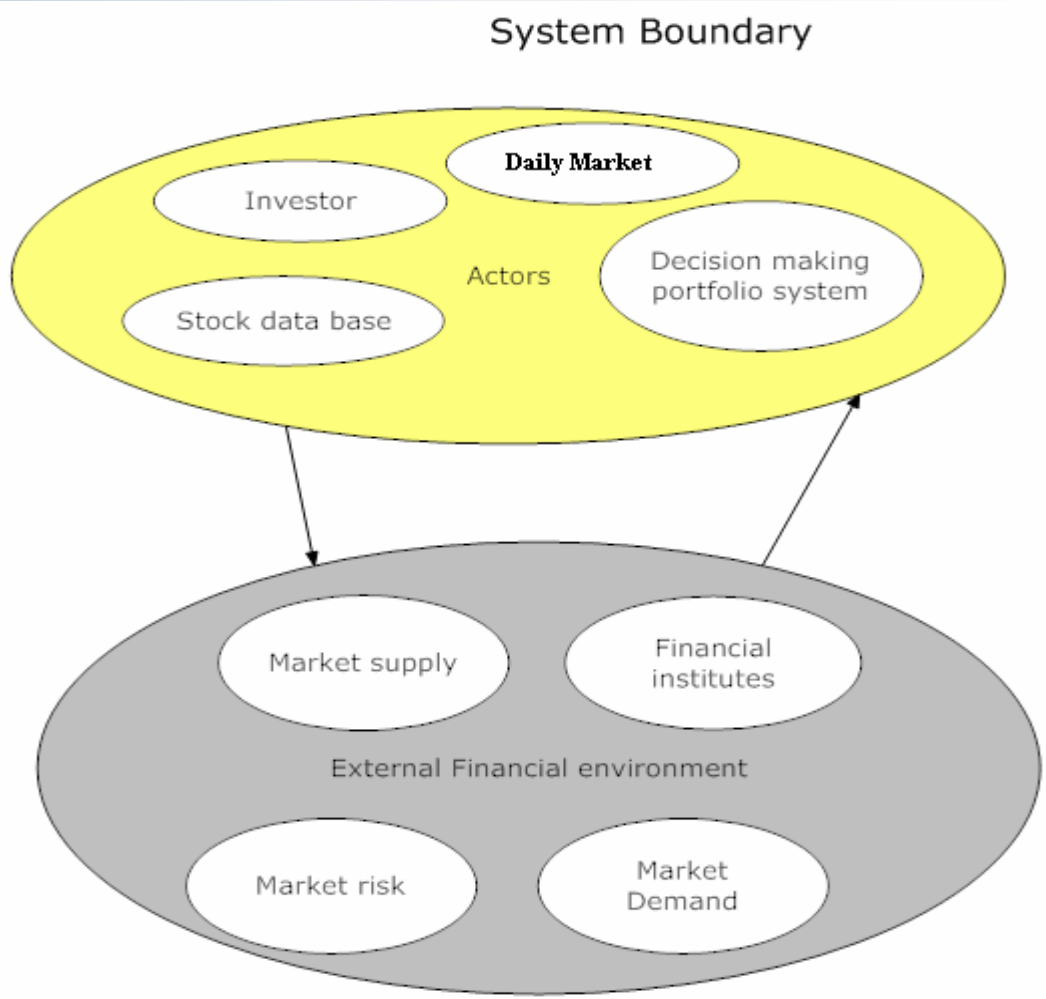

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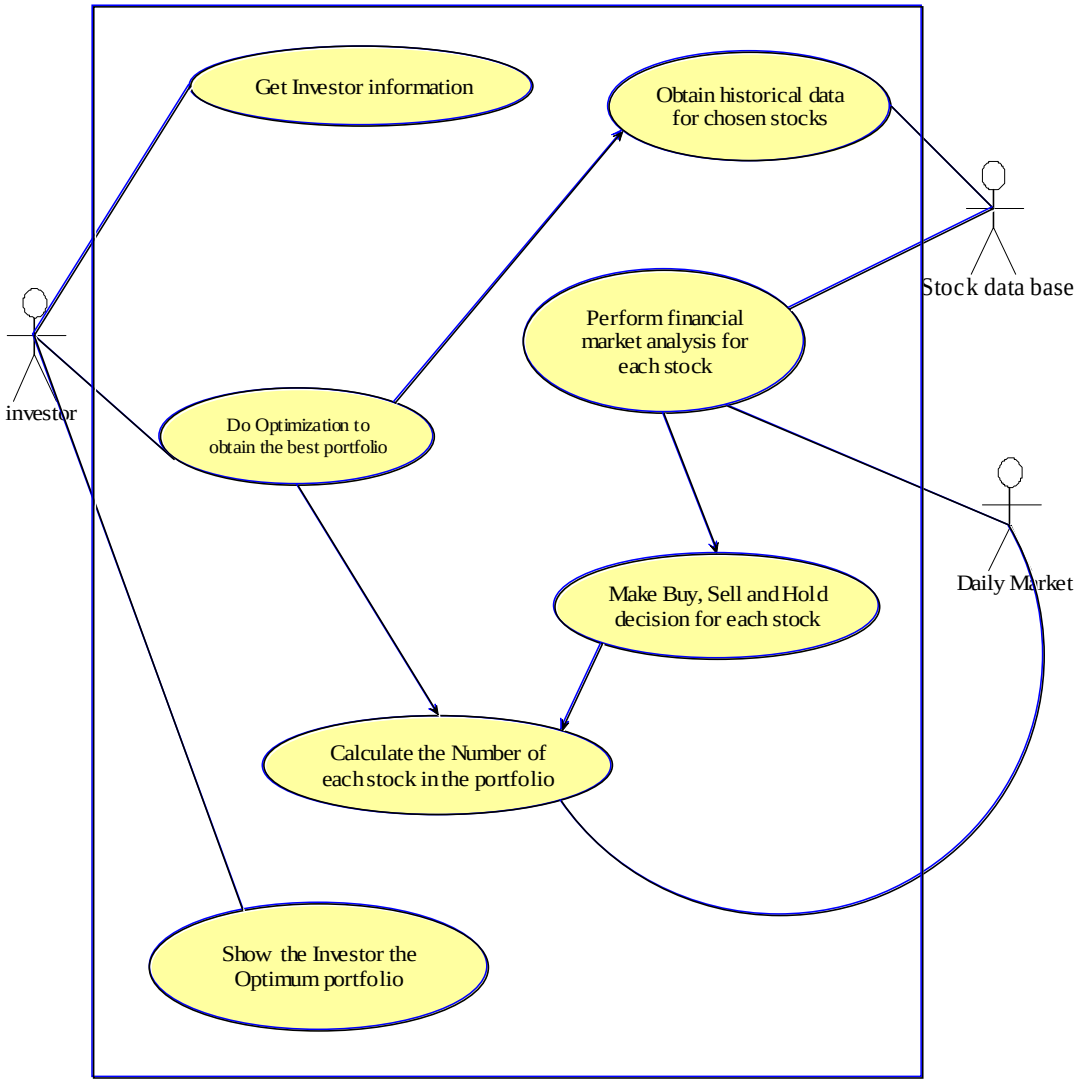

System Structure – Market Analysis

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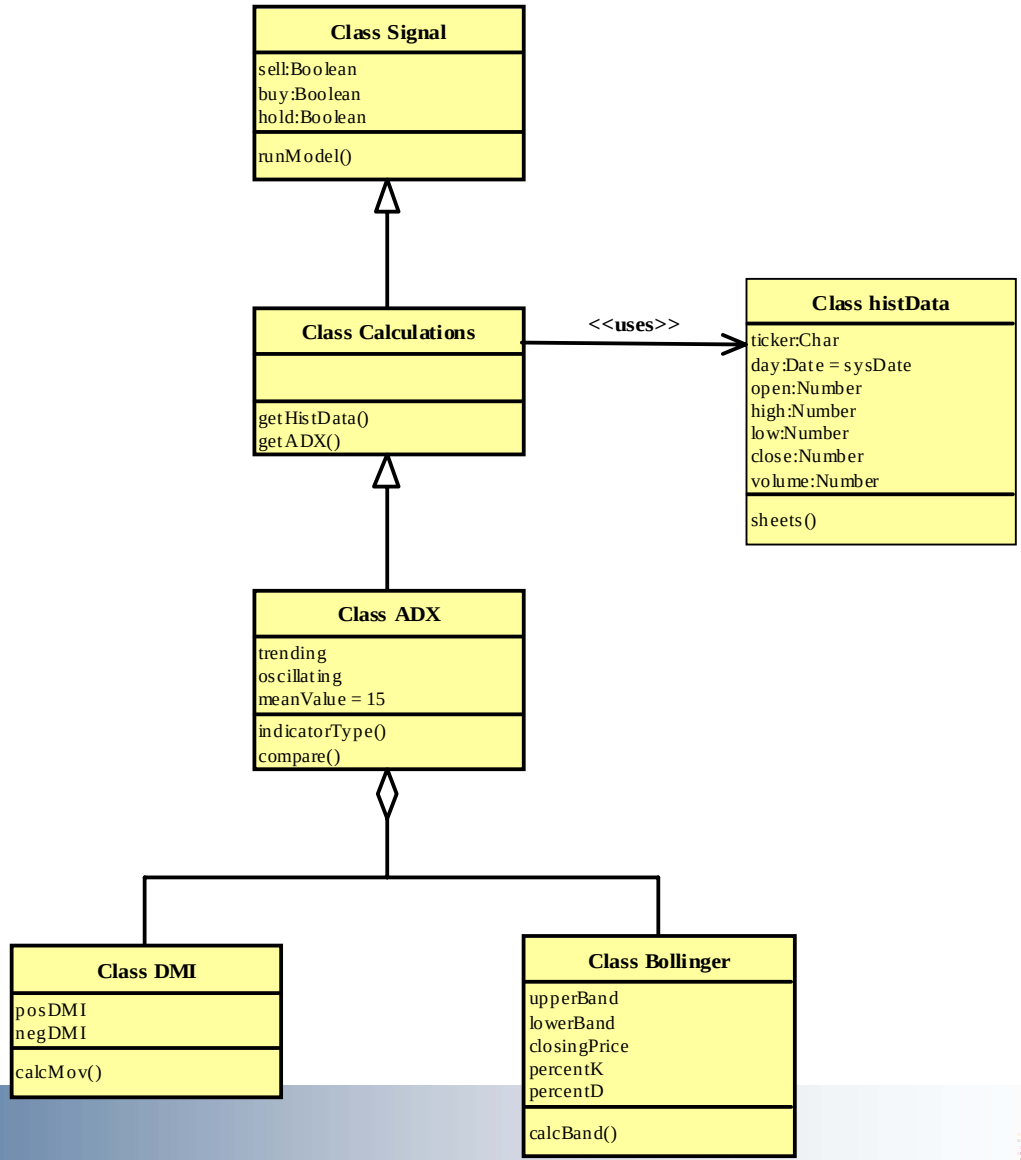

System Structure – Optimization

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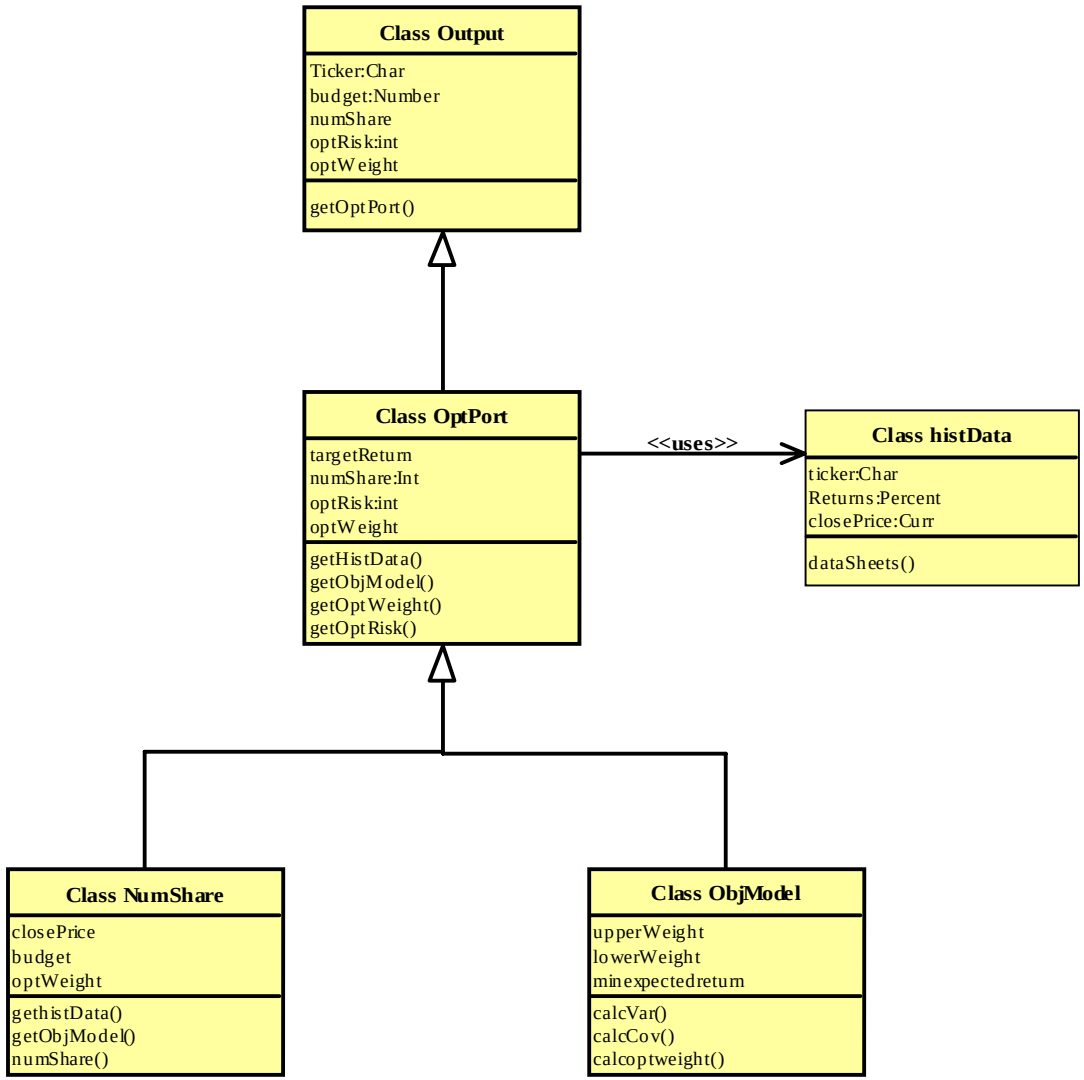

System Behavior – ADX

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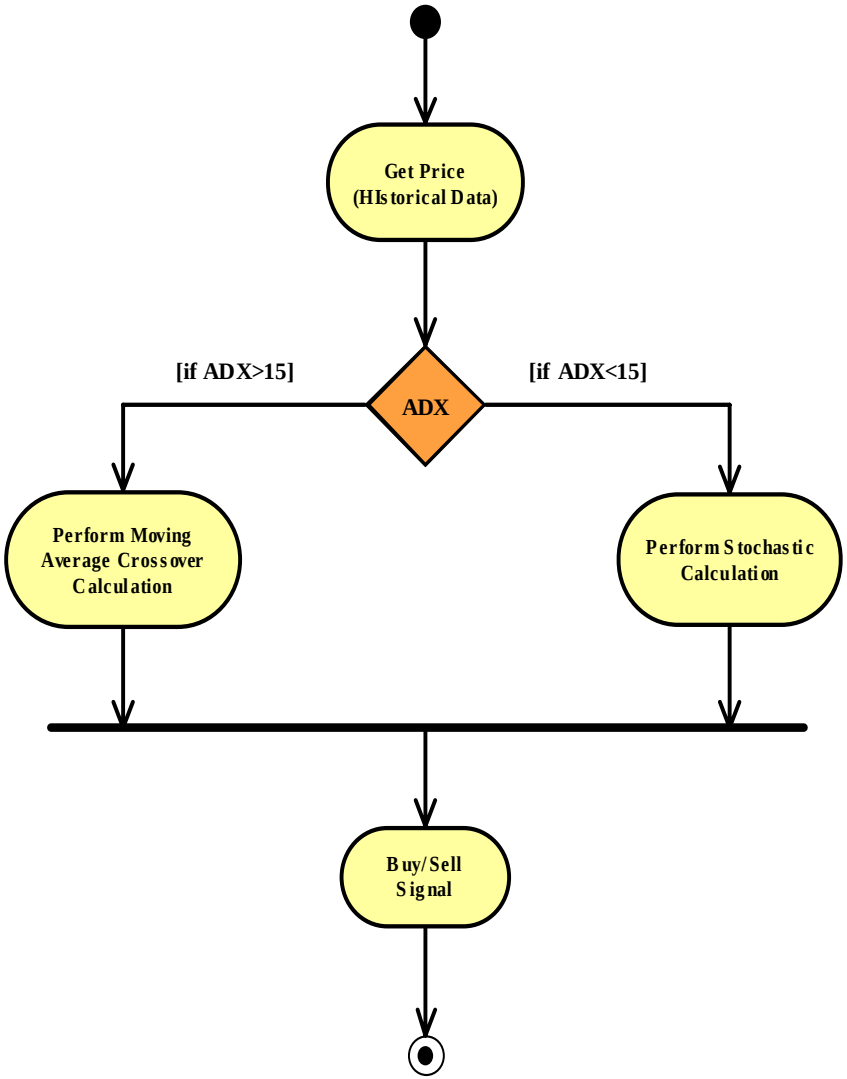

System Behavior – Trending

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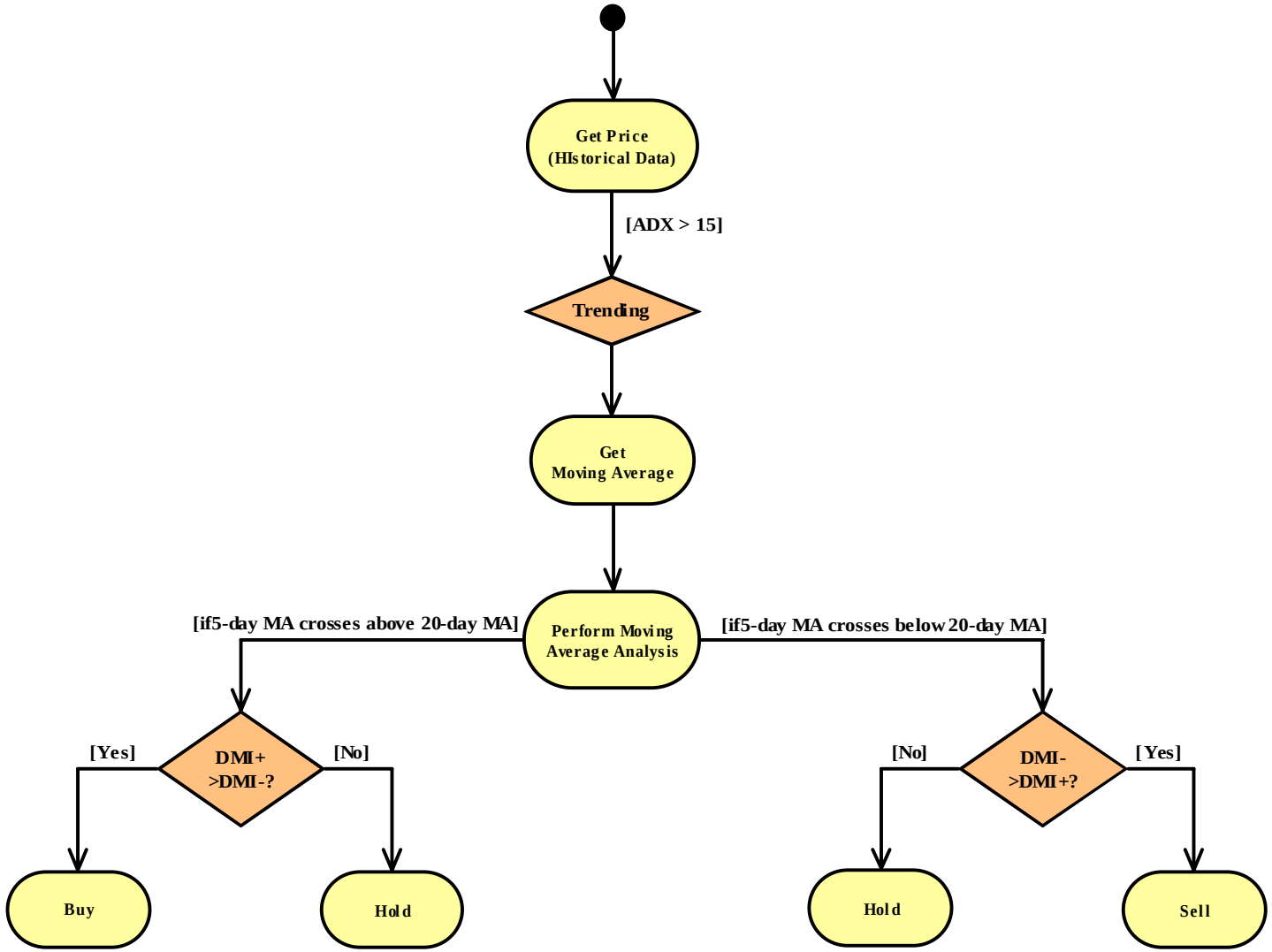

System Behavior – Stochastic

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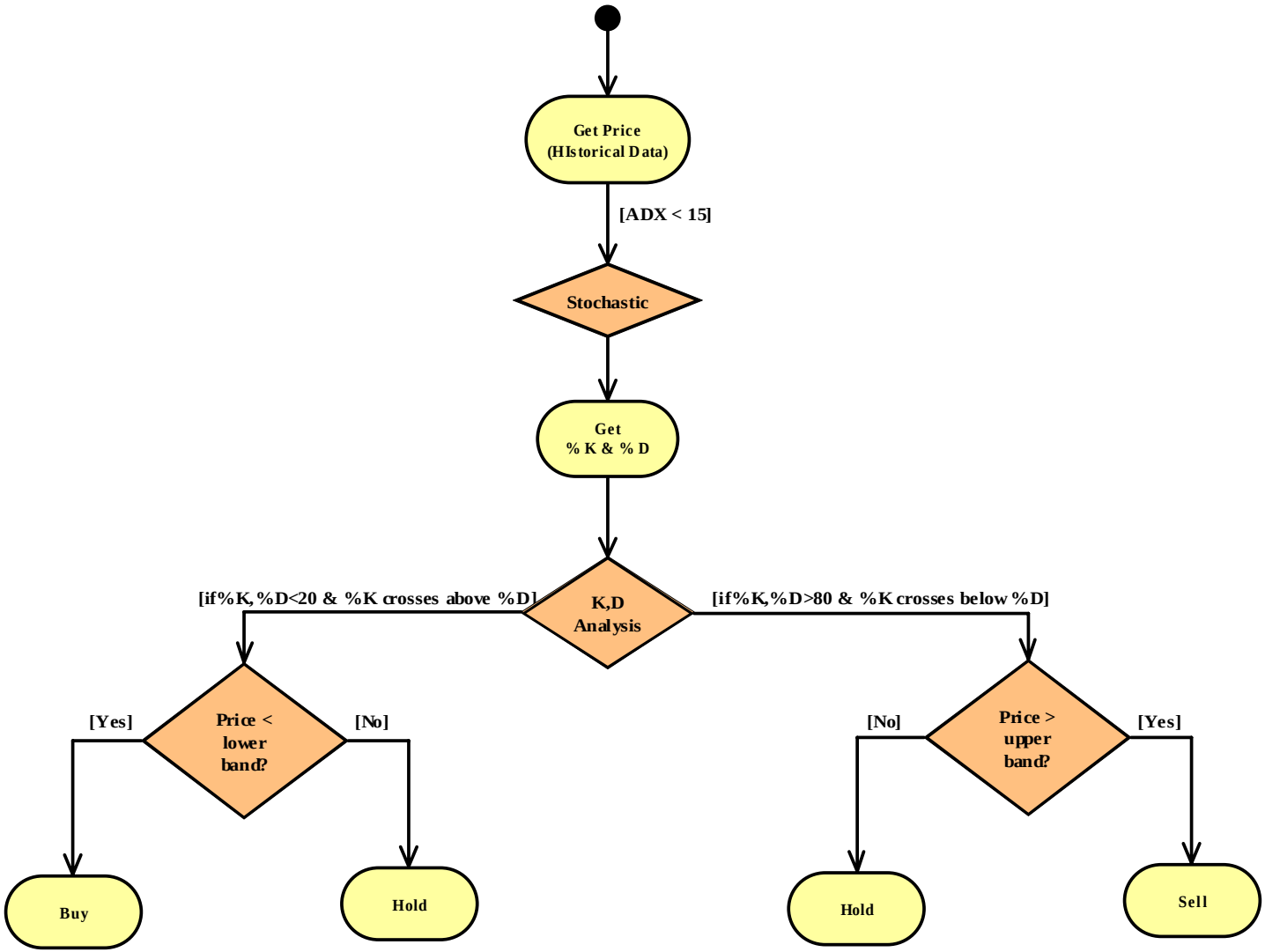

System Behavior – Trending State

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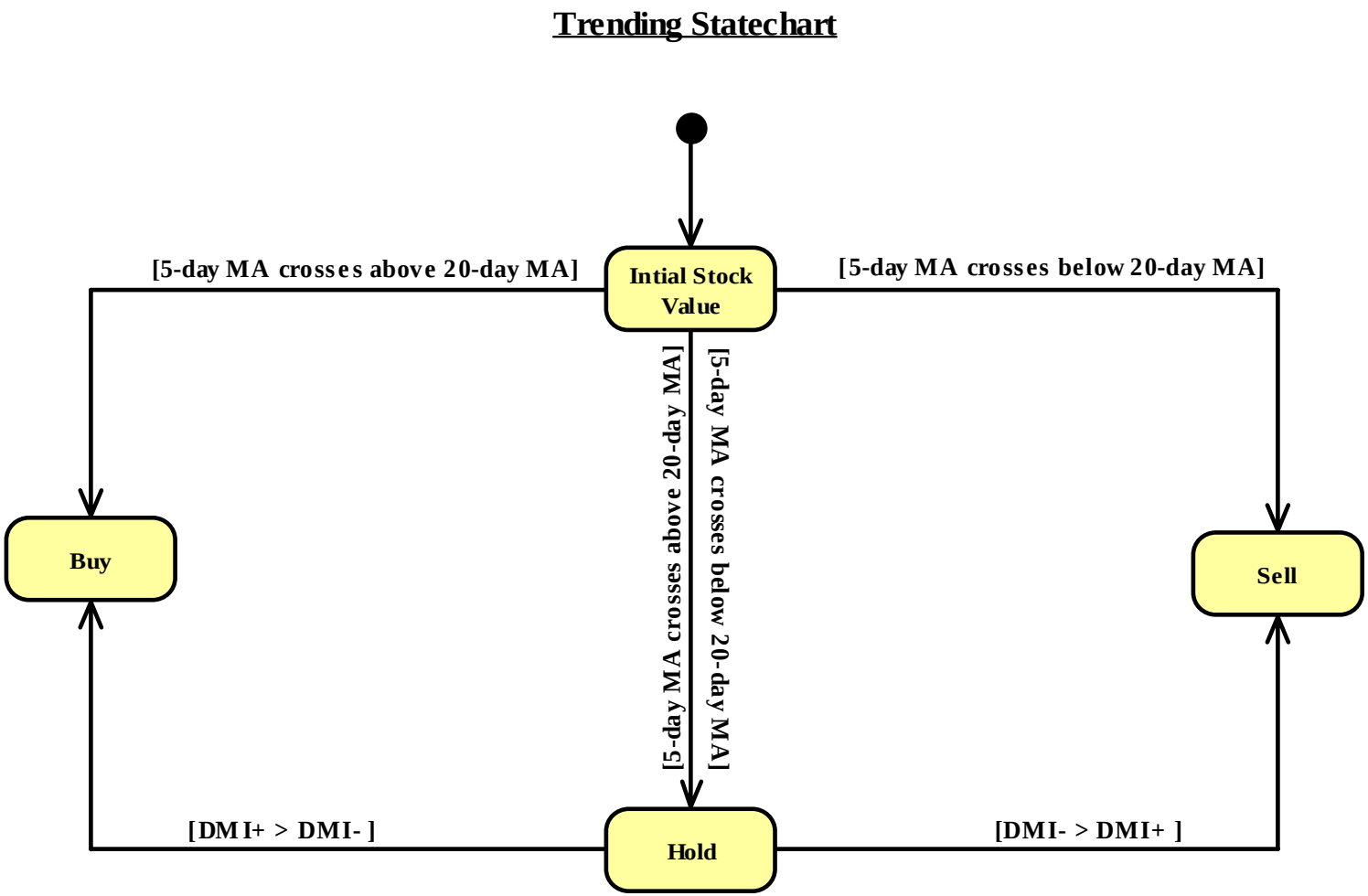

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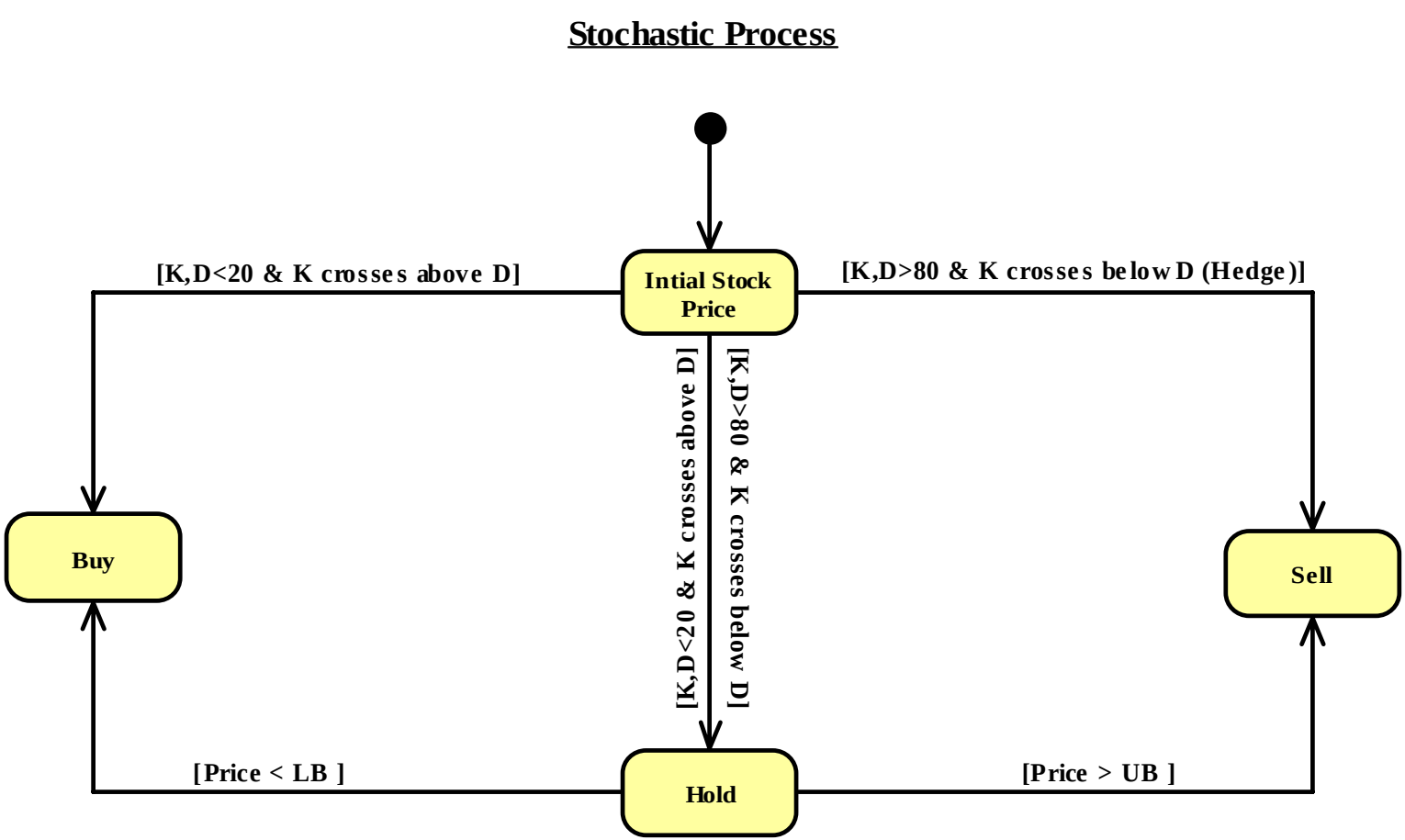

System Behavior – Optimization Activity

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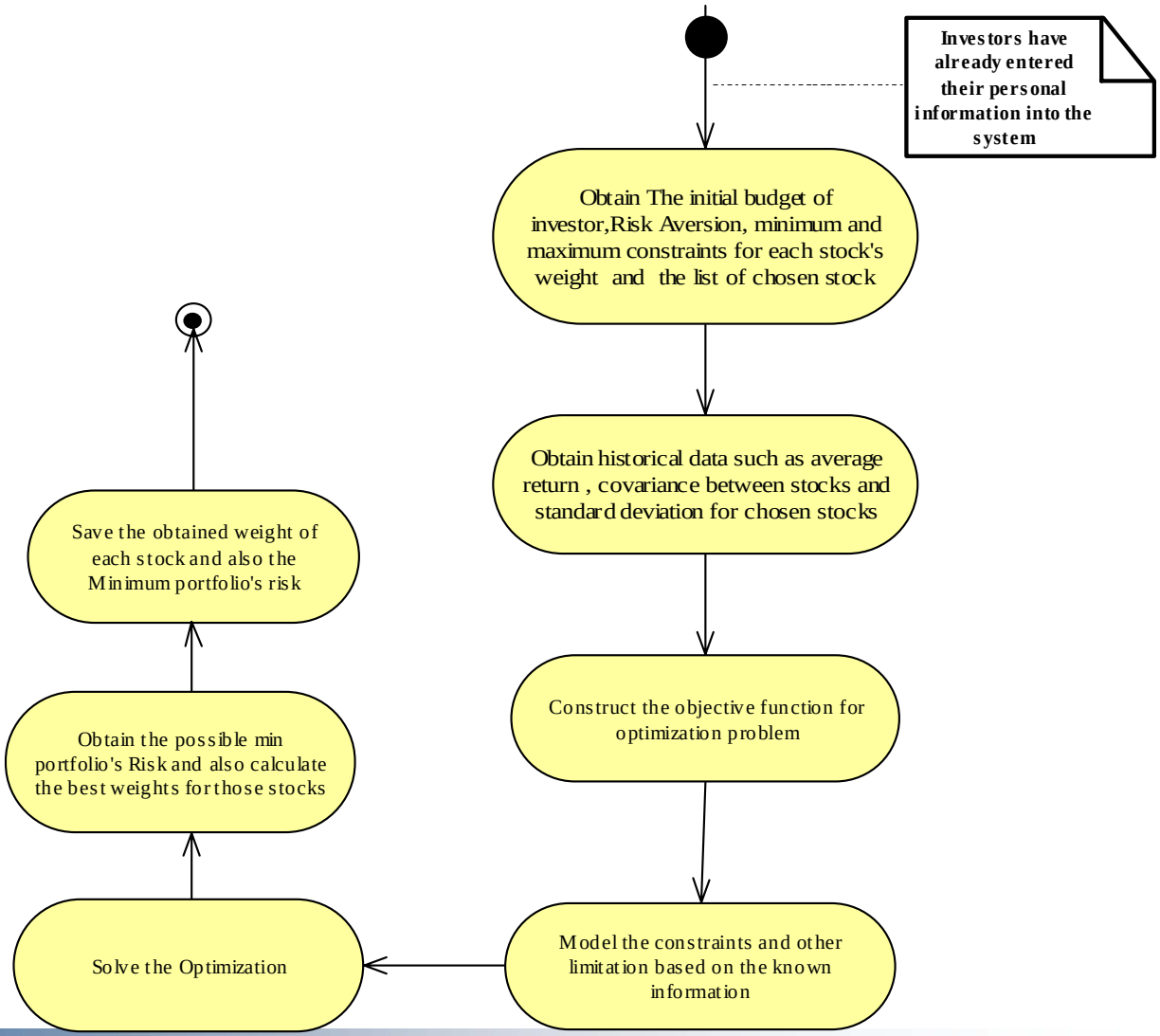

Calculation of Number of Shares

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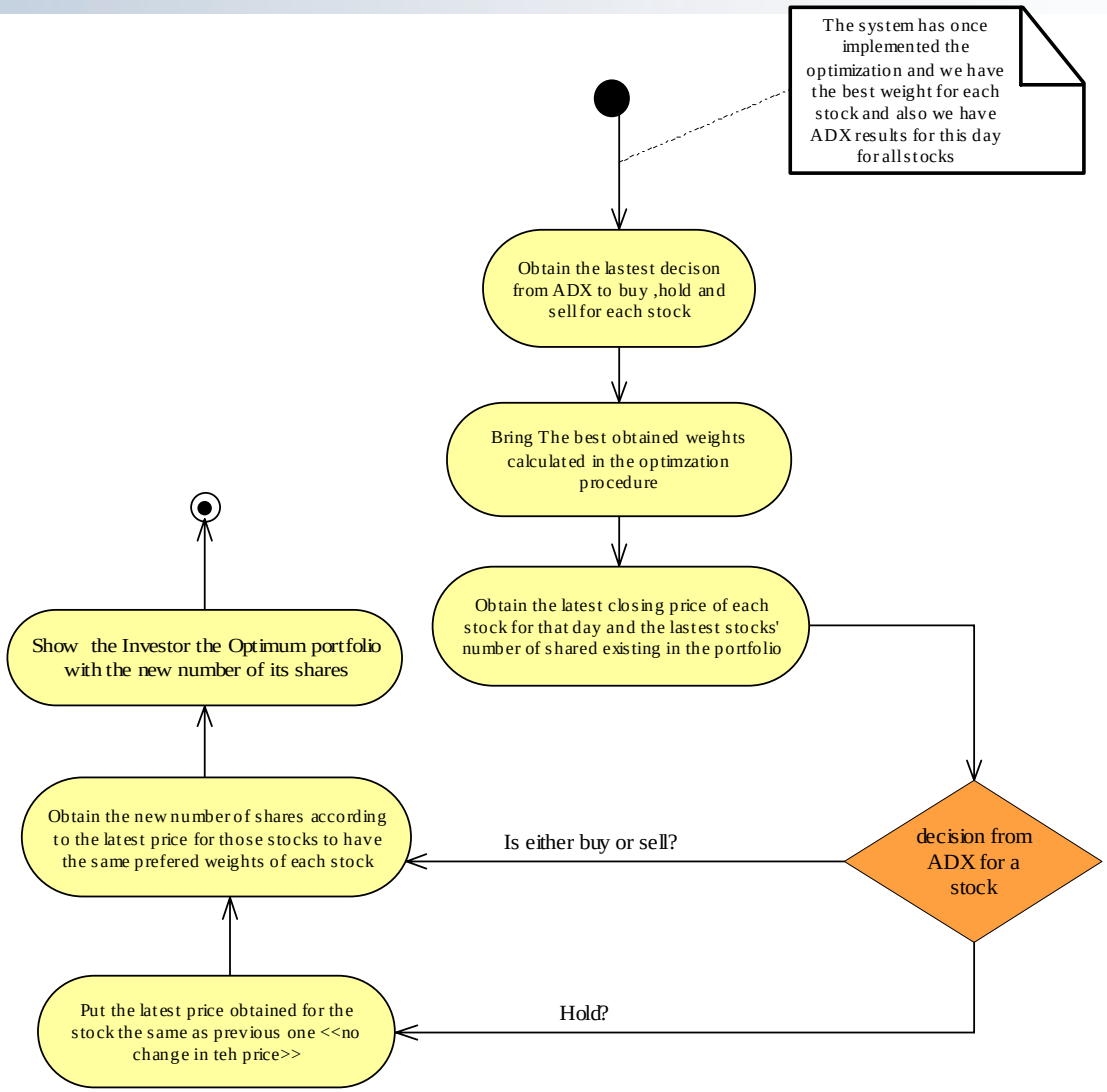

Sequence – optimization/calc of shares

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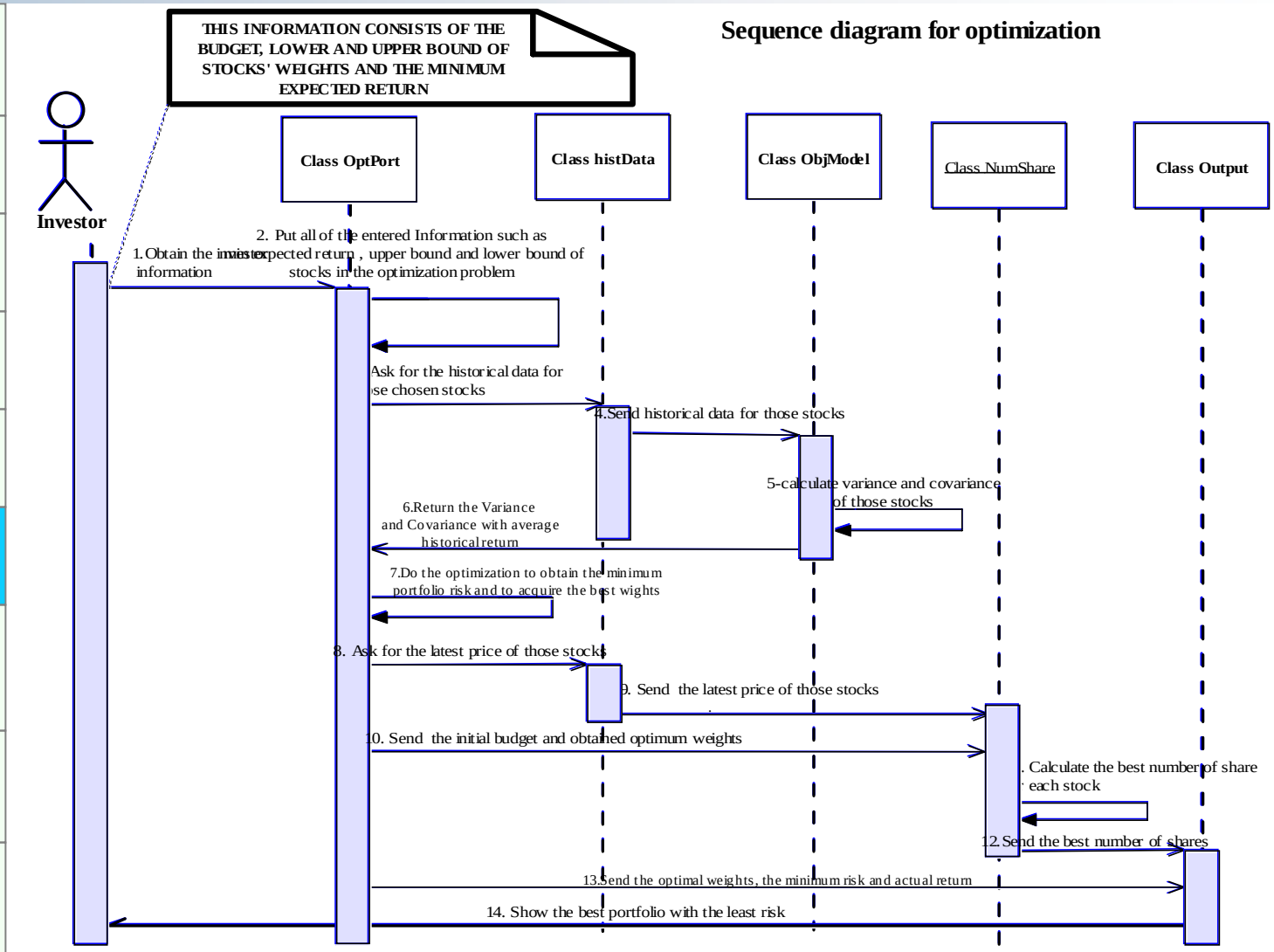

System Model

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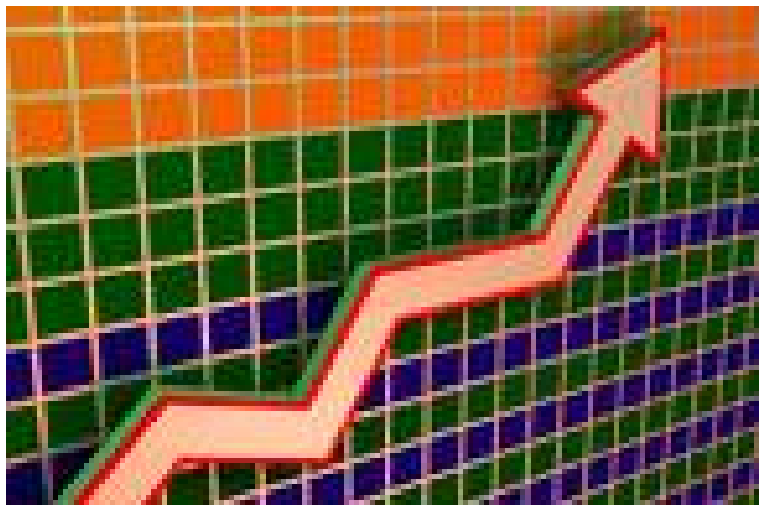
To perform market analysis and Optimizations corresponding to system behavior and structure we use the following tools extensively:

- MS Excel
- Visual Basic
- Matlab

Ticker-T

Symbol	Last	Net	Bid	Ask	BSxAS
SUNW	5.292	0.402	5.29	5.30	142x203
INTC	19.23	1.48	19.23	19.24	12x84
ORCL	9.94	0.39	9.94	9.95	13x355
AMAT	19.56	1.57	19.56	19.57	61x20
QCOM	28.05	1.67	28.04	28.05	3x5
DELL	25.72	1.04	25.71	25.72	37x1
JDSU	2.877	0.297	2.86	2.88	59x553
VRTS	21.69	1.95	21.68	21.69	33x1
JNPR	7.06	0.36	7.06	7.07	24x32
KLAC	45.24	2.77	45.22	45.23	8x14
NVDA	18.69	1.24	18.71	18.72	9x1
BRCD	17.38	1.19	17.38	17.40	22x11
MXIM	40.05	2.28	40.04	40.06	26x1
XLNX	23.13	1.67	23.06	23.13	88x1
MCHP	27.35	1.92	27.34	27.38	20x3



Market Analysis Model

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DATA

Represents Historical Price from Internet resources like Yahoo.

Model

Runs Market Analysis decisions based on:

- ADX

- Moving Average

- Stochastic Process

- Bollinger's Method

Optimization Model

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Optimization Process

Notation:

R_i : The annual returns of stock i from historical data (i=1…n)

$\bar{R}_i$: The *Average* annual returns of stock i from historical data (i=1…n)

$P_i(t)$: The closing price of stock i at time t (at the end of day t) (i=1…n)

δ_i : The average standard deviation of return for stock i form historical data (i=1…n)

W_i : The weight of value of stock i in our portfolio (i=1…n)

B: The initial amount of investment we assume its fixes throughout the investment period.

M : The Minimum expected of return for investor

$N_i(t)$: The number of shares of stock i at time t (i=1…n).

Z: The volatility of risk of the portfolio

Upperbound: is the maximum of weight you want for that stock

Lowerbound: Is the minimum of weight you want for that stock

Optimization:

The objective function:

$$\text{Min } Z=\sqrt{\sum_{i=1}^{n} W_i^2 \delta_i^2 + \sum_{i=1}^{n} \sum_{j=1}^{n} W_i W_j Cov(R_i, R_j)}$$

S.T.

$$Lowerbound_i \le W_i \le Upperbond_i \quad \text{For}(\ i=1\ldots n)$$

$$\sum_{i=1}^{n} W_i \bar{R}_i >= M$$

$$\sum_{i=1}^{n} W_i = 1$$

After we obtained the minimum of Z and also the best weights, we can obtain the $N_i(t)$ by having the $P_i(t)$ by the end of the each day.

$$\text{So } N_i(t) = \frac{W_i B}{P_i(t)}$$

Definition

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What is Verification and Validation?

The process of ensuring that software being developed or changed will satisfy functional, and other requirements, and each step in the process of building the software yields the right products.

Validation:

“Are we building the right product?”

-The software should conform to its specifications

Verification:

“Are we building the product right?”

- The software should do what the users need

Tools

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Tools used to validate the product:

MS Excel

Visual Basic

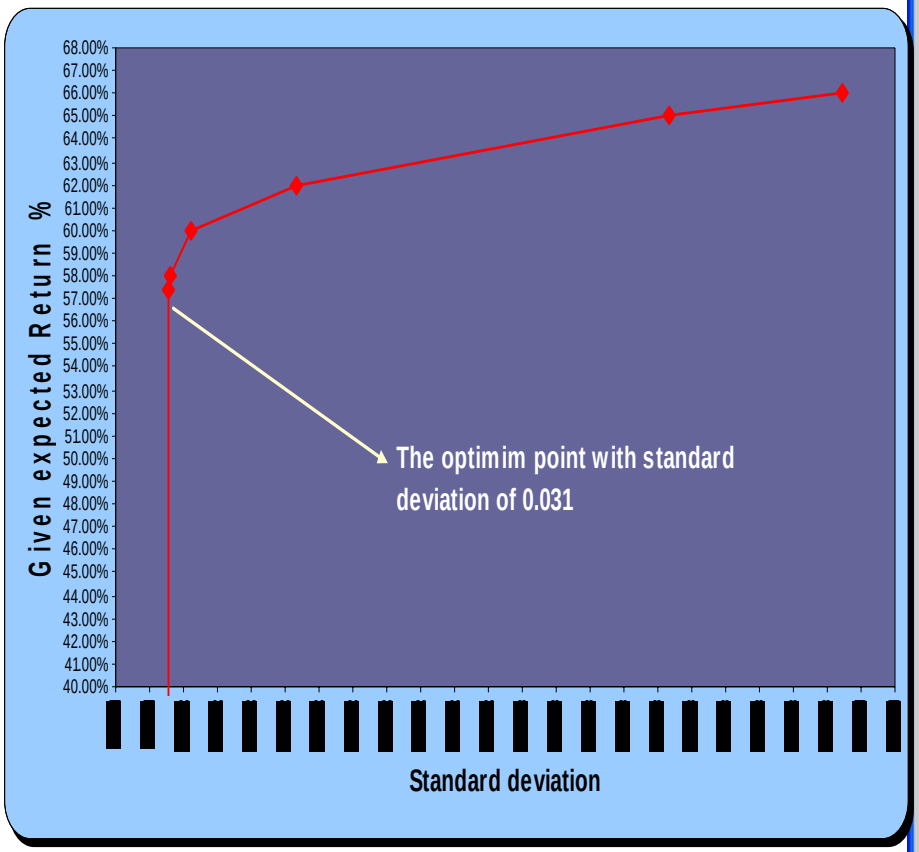
Tools used to Verify the product:

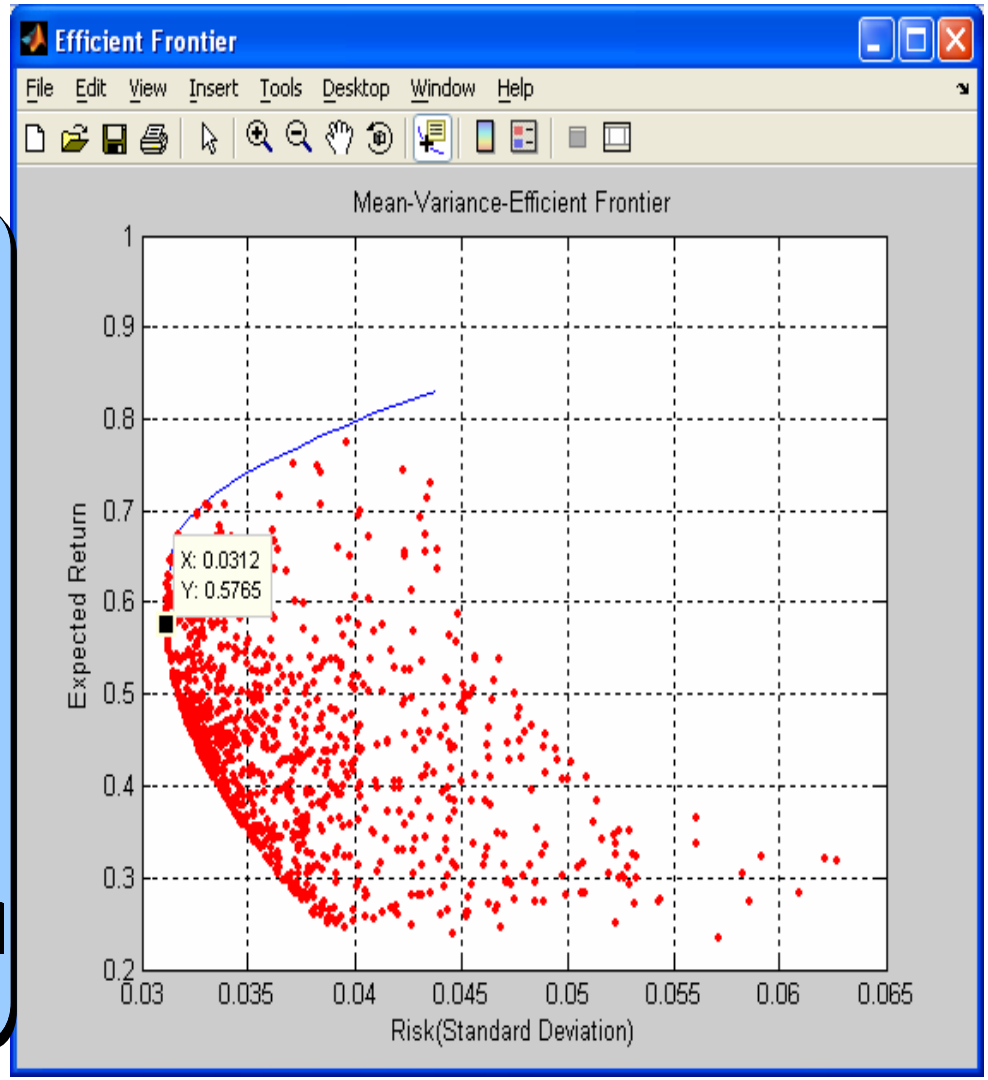
Matlab for Optimization

Example

	Budget:	$1,000		Exp. Return:	30.00%
	Min Constraint:	10.00%	10.00%	10.00%	
	Max Constraint:	100.00%	70.00%	100.00%	
	Ticker:	MSFT	IBM	YHOO	
	Period 1	47%	78%	16%	
	Period 2	24%	78%	17%	
	Period 3	24%	78%	16%	
	Period 4	26%	85%	18%	
	Period 5	25%	88%	21%	
	Period 6	26%	83%	21%	
	Period 7	26%	81%	25%	
	Period 8	27%	82%	29%	
	Period 9	28%	88%	28%	
	Period 10	26%	89%	33%	

Verification Results





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Final Presentation

- Traceability
- Integration of Structure for Optimization and Market Analysis
- More refined Optimization – have more than just 10 period analysis.
- Market Analysis Verification

Future

- Link to Internet via DDE so as to update the historical data automatically
- Build a Web based model
- Cater to solving/incorporating the assumptions
- Do more research to make it more realistic
- Incorporate Short and Long Strategies

Questions?