

## PRM-01 Summary Document

### Overview

Risk management is one of the most important aspects of algorithmic trading. If the risk is not properly managed, it can wipe out the entire trading capital.

In this lecture, the following areas related to risk management are addressed:

- a) Risk Management Process: How to set it up in a trading firm.
- b) Mitigate Risk: How to mitigate and prevent various types of risks?
- c) Case studies on
  - i) Various risk management failures in the field of algorithmic trading

### Risk Management Process

The risk management process comprises of the following activities in its life cycle:

- Setting risk management structure:
  - Dedicated risk department: Set up a dedicated risk department.
  - Setting risk management structure & policies: Define risk management policies, to address and prevent all possible risks with having the slightest probability of occurrence.
  - Completely cut off from trading department: No communication with the trading department, risk department should follow its rules and policies during trading hours.
  - Policies like providing full autonomy & powers to the risk department.
  - The approval process for each new product and operation introduced.
- Identifying sources of risk: Identification of risk is a continuous process. The possible areas of risk can be:
  - Market Risks
  - Credit / Counterparty Risks
  - Financial Risks
  - Operational Risks (Systems, Mechanical, Criminal)
  - Regulatory Risks
  - Liquidity Risks (Exogenous & endogenous)
  - Natural disasters, political, terrorism, etc.
- Evaluating risk components: The risk is evaluated as “Magnitude of impact in the portfolio” x “Probability of its occurrence”. However, this equation can be customized depending on the type of the risk:
  - Market Risks
    - Sensitivity Analysis of the portfolio/strategy
      - Total Greeks, Dividend, Currency exposures
      - What-if scenario analyses
    - VaR analysis

- Stress tests
- Credit / Counterparty Risks
- Basel II IRB method (Internal Rating Based Method)
- Financial Risk
  - Probability of downgrade \* interest rate hike \* Size of portfolio
- Regulatory Risk
  - Probabilities of new Regulations -Is estimated from News Analysis & Historical Data
  - Examples
    - Short-Selling Ban
    - Margin Increase
    - Taxes Introduced
- Operational Risks (Systems, Mechanical, Criminal)•Robustness of a System
  - System Load handling capacity
  - Maximum order flow before system detects a failure
  - Maximum leeway in error while setting parameters
- Liquidity Risks
  - Liquidity adjusted VaR
    - L-VaR= VaR+ LiquidityAdjusted
- Natural Disaster, Political Risk, Terrorism:
  - Risk v/s Uncertainty
  - News Analysis
  - Anticipation is the key
- Setting risk limits: The risk limits can be defined on the basis of various parameters of the category of the risk. Some of the risk categories and their parameters are as follows:
  - Market Risks:
    - Total cash exposure
    - Exposure to geography
    - Exposure to sector
    - Exposure to the asset class
    - Exposure to assignment/delivery risks (settlement risks)
    - Settlement Type (future vs cash)
    - Exposure to interest rate
    - Exposure to the exchange rates
  - Credit / Counterparty Risks
    - Maximum exposure to any counterparty
    - Maximum exposure per credit rating level
  - Financing Risks
    - The maximum amount borrowed per counter-party
    - The repayment period for loans
    - Rho exposure
  - Operational Risks (Systems, Mechanical)
    - Max exposure per strategy
    - Max orders per second
    - Max orders in a day
    - Max exposure per application

- PnL fluctuation per application
- Price Range check
- Max order size
- Max Value Traded
- Net Value of the Portfolio
- Operational Risks (Criminal/Fraud/ Theft, etc)
  - Access Control
  - Transparency of operations
  - Rotation of team members
  - Audit (internal & external)
  - Centralized PnL reconciliation
  - Independent verification of price to pricing models
  - Online Infiltration & Virus Protection
- Liquidity Risks
  - Maximum exposure per instrument of each liquidity category
  - Total exposure per liquidity category
  - Natural disasters
  - Score-card approach
  - Similar to the one used By Insurance/ Actuaries
- Designing systems with strict adherence to risk controls
  - A centralized system that summarizes net position & exposure
    - Asset classes, Interest rates, Exchange rates, Volatility, Dividends, Counter-parties
  - What-if Analysis
  - Centralized control of all trading operations: No influence of the trading department.
  - Pre-trade controls: For prevention of the possible risks.

### Risks related to Algorithmic Trading

- Order flow without human control
  - Higher reliance on technology implies increased sys-ops risk
  - In case of a wrong input, the algorithm will execute at a wrong level
  - If price feed goes down, the algorithm will send orders based on stale data
    - price feed could go down because of physical connectivity, exchange disconnection, software crash, etc.
- Before a human can realize (and then respond), tremendous damage would have been done already
- Trades happen at such a fast pace, that positions could reach a dangerous level in no time
  - Real-time monitor of positions, exposures, regulation checks
- Risks specific to automated trading can be classified into the following categories:
  - Access
  - Consistency
  - Quality
  - Algorithm
  - Technology

- Scalability
- These risks have to be handled pre-order:
  - Within the application
  - Before generating an order in the Order Management System
- Moreover, it is pertinent that the trader understands the internal working of the black box.

#### Risk Management for Indian Exchanges

RMS	Description
Client Position Limit	Maximum position that a client can have in a particular stock
Margin Limit	If a threshold of the available margin is reached, then the application should not send orders to increase the position further
Position Value Check	Net Position value per instrument
Order Value	Max Order Value

RMS	Description
Manual Trading disabled	Manual orders are disabled for auto-trading systems
Trade Price Protection Limit	Order should be within x% of last price
Quantity Freeze Limit	For each instrument an order size freeze limit is set
Price Range Check	Order should not breach the circuit limit (daily price range) of an instrument
FII restricted list	FII's cannot trade in a select set of stocks (RBI directed)
Market Wide Protection Limit	Cannot trade derivatives to increase Open Interest beyond a threshold
Shares available for selling	Overnight long position that is available per share for selling
Automated Trading enabled	Automated trading to be enabled for a select list of instruments only
Index change check	Cannot send buy orders if Index moves up beyond a point. Likewise for sell orders

## Case studies of major risk incidents

### These are some of the

- Case Study -1
  - Organization: Credit Suisse
  - Date: Nov 2007
  - Incident:
    - Hundreds of thousands of “Cancel” orders sent to the exchange
    - Orders clogged NYSE and affected trading of over 900 stocks
  - Reasons:
    - Software developer implemented code that could change parameters on clicking on the spin button (without any need for confirmation)
    - With each click, orders were cancelled and resent
  - Fine/ Losses: \$150,000 fine
- Case Study -2
  - Organization: InfiniumCapital
  - Date: Feb 2010
  - Incident:
    - 4612 trades on crude oil futures in 24 seconds
  - Reasons:
    - The strategy was designed to trade energy ETFs on the basis of crude prices. Trader configured crude oil futures on the basis of energy ETFs. Moreover, RMS was designed on the basis of ETF prices, not crude prices
  - Fine/ Losses: \$850,000 fine by CME
- Case Study -3
  - Organization: Deutsche Bank
  - Date: June 2010
  - Incident:
    - Sent orders for 1.24 million Nikkei 225 Futures & 4.82 million Nikkei 225 mini-futures in first few minutes
    - More than 10 times normal volume
    - Market dropped 1% on orders
  - Reasons:
    - Pair trade strategy used the value of mini-Nikkei to quote Nikkei. At the start of the day, there was no liquidity in mini-Nikkei. Error recognized immediately, 99.7% orders cancelled
  - Fine/ Losses: Forced to close Algorithmic trading desk in Tokyo