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Stochastic Pi Calculus in Financial Markets: An Alternate Approach to High Frequency Trading

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Abstract : The paper presents the modelling of financial markets using the Stochastic Pi Calculus model. The Stochastic Pi Calculus model is mainly used for biological applications; however, the feature of this model promotes its use in financial markets, more prominently in high frequency trading. The trading system can be broadly classified into exchange, market makers or intermediary traders and fundamental traders. The exchange is where the action of the trade is executed, and the two types of traders act as market participants in the exchange. High frequency trading, with its complex networks and numerous market participants (intermediary and fundamental traders) poses a difficulty while modelling. It involves the participants to seek the advantage of complex trading algorithms and high execution speeds to carry out large volumes of trades. To earn profits from each trade, the trader must be at the top of the order book quite frequently by executing or processing multiple trades simultaneously. This would require highly automated systems as well as the right sentiment to outperform other traders. However, always being at the top of the book is also not best for the trader, since it was the reason for the outbreak of the 'Hot – Potato Effect,' which in turn demands for a better and more efficient model. The characteristics of the model should be such that it should be flexible and have diverse applications. Therefore, a model which has its application in a similar field characterized by such difficulty should be chosen. It should also be flexible in its simulation so that it can be further extended and adapted for future research as well as be equipped with certain tools so that it can be perfectly used in the field of finance. In this case, the Stochastic Pi Calculus model seems to be an ideal fit for financial applications, owing to its expertise in the field of biology. It is an extension of the original Pi Calculus model and acts as a solution and an alternative to the previously flawed algorithm, provided the application of this model is further extended. This model would focus on solving the problem which led to the 'Flash Crash' which is the 'Hot –Potato Effect.' The model consists of small sub-systems, which can be integrated to form a large system. It is designed in way such that the behavior of 'noise traders' is considered as a random process or noise in the system. While modelling, to get a better understanding of the problem, a broader picture is taken into consideration with the trader, the system, and the market participants. The paper goes on to explain trading in exchanges, types of traders, high frequency trading, 'Flash Crash,' 'Hot-Potato Effect,' evaluation of orders and time delay in further detail. For the future, there is a need to focus on the calibration of the module so that they would interact perfectly with other modules. This model, with its application extended, would provide a basis for researchers for further research in the field of finance and computing.

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