PREFACE

Markov Chain model is best suited among all the basic models used for predicting non-linear dynamics with uncertainty. In this study, an attempt has been made to fit a Markov Chain model for the study of share price movements in share market trading and to predict the limiting state of the fixed moments of the share market trading with high probability. This is being illustrated with special reference to share price movements in sugar industry.

Most of the research efforts have attempted in the study of portfolio analysis on the share market. One of the best assumptions of this study is that past history does not reflect on present moments to the ultimate future. This motivated to fit a Markov chain model for the purchase of shares in the sugar industry and advice investor’s to retain their holding for longer periods. This is achieved by finding the limiting probabilities.

In chapter 1, the pricing of exotic options is considered when the price dynamic of the underlying risky asset is governed by a discrete time Markov modulated process driven by a Higher order Hidden Markov Model (HHMM) [83]. Recently there is a considerable interest in the applications of regime switching models driven by Hidden Markov Model to various financial problems. It is assumed that the market interest rate, the drift and the volatility of the underlying risky assets return switch over time according to the states of the HHMM. The advantage of the HHMM is that it can capture the long range dependence of the states of the economy.
A good use is made of the duality property of the random walks to develop a numerical method for the valuation of discrete time look back options. This method leads to a recursive numerical integration procedure which is fast, accurate and easy to implement. This new method based on the duality property of random walks, results in a fast and accurate recursive scheme which requires only univariate numerical integration.

In chapter 2, a framework for learning to price complex options is provided by learning risk neutral measures (Martingale Measures). In a simple Wiener process or Brownian motion process, the price volatility, fixed interest rate and a no-arbitrage condition suffice to determine a unique risk neutral measure. On the other hand, in our framework, some of these assumptions are relaxed to obtain a class of allowable risk neutral measures. A clear cut analysis based on the martingales with respect to $\sigma$-fields gives better results in the study of portfolio management.

The earlier assumption on the share market analysis is based on the Markov property assumption. This model, to some extent, helps us to predict the risk involved in a particular industry and thereby helps us to settle down with maximum gain under prescribed limiting property. In general, better results can be obtained by fitting models on continuous trading. On the theory of economic behavior, this kind of approach was studied by various research scholars like Modigliani, Millar [53] and others. A special type of stochastic process which is based on conditional expectations as sequence of random variables called Martingales has become a better tool to study continuous trading. This type of perspective helps one to have two types of options; one on the sampling, and the other on the stopping process. The market can be
regarded as a complete one, in the sense that lower risk on one is compensated by higher profit on the other for investor. This series of study was taken up by Harrison and Pliska [37, 38]. The martingale theory plays an important role in optional sampling and optional investment on various shares yielding low and high returns. The different stages of improvement on this model are explained in detail and their implications on the consumer's satisfaction. A set of events form a collection of sets in the sample space, which is closed under arbitrary union, finite intersection, complements and they form a $\sigma$-field. So we are left with the consideration of martingale with respect to $\sigma$-fields. The complete market developed by Harrison and Pliska is discussed.

In chapter 3, the proposed simple and efficient techniques are described and analyzed. Wavelets are group of functions that divide the data into different frequency components. Wavelet transforms have many real world applications, including the compression of fingerprint images, analysis time series data. The Discrete Fourier Transform (DFT) is a basic operation used to transform an ordered sequence of data samples, usually from the time domain, into the frequency domain so that the spectral information about the sequence can become explicitly known. The advantages of using wavelets over FT are that they operate on a decreasing size of data at each iteration of the transform allowing for the past computation.

Neural networks have been shown to learn complex relationships. It would be interesting to see if the networks can be trained to learn the non linear relationship underlying Black-Scholes type models [70]. The use of neural networks in finance is a recent phenomenon. They have
been used to predict the economy, pick stocks, construct portfolios, spot insider dealings, assess bond risks, recognize financial distress, detect credit card fraud, improve real estate appraisal, and identify good credit or insurance candidates. They have been found to perform well in a number of applications in which linear models fail to perform well. Recently, a number of studies have looked at the ability of networks to learn Black-Scholes type models.

In daily life investors typically face inaccurate data since in many cases it is not possible or feasible to observe and to measure a phenomenon avoiding an arbitrary degree of accuracy. This impression leads to difficulties in managing and constructing models, especially in the case of complex problems. A fuzzy approach is a method, able to simplify complexity by taking into account a reasonable amount of imprecision, vagueness, and uncertainty. Certainly the resulting models are not perfect, but in many cases they are able to solve the modeling problem in an appropriate way.

In chapter 4, both deterministic and stochastic dynamical systems which have occupied an important place in the history of science have been discussed. They have been primarily connected with the issue of predictability of natural and social processes. The latter, in turn, has been pivotal in the discussions of such philosophical problems as the extent of human will, the initial state and the final destination of socioeconomic and natural systems and others. It is the irony of dialectics that the deterministic dynamical systems may produce behavior that is essentially equivalent to random and thus is ultimately unpredictable. Man’s unwillingness to accept this irony has been leading science throughout its history and has produced a large number
of valuable discoveries. Nonlinearity is an issue that can potentially bridge the gap between the classical stochastic considerations and the real-life observations.

The static Approximate Entropy was developed by Pincus [58] to measure the conditional probability that “... runs of patterns that are close for [some number] of observations remain close....” ApEn is a statistical measure to qualify the regularity in relatively short noise time series. It is defined as the rate of entropy for approximating Markov chain to the process, useful in distinguishing between correlated stochastic process and composite deterministic stochastic models.

One of the inputs required by investors, seeking to hold efficient portfolios, is the correlation between the securities to be included in the portfolio. Correlation estimates are required in most applications in finance including asset pricing models, capital allocations and risk management, option pricing and hedging. The importance of correlation estimation and its applications are examined, focusing mainly on risk management, traditional financial problems and economic problems related to the international financial market linkages.

In chapter 5, the latest tools used in game theory and advanced computing theory are discussed. Game theory is a means of analyzing the interaction of decision makers with multiple and often conflicting objectives. The essential elements of a game are the players, actions, payoffs, and information. Collectively, these elements form the rules of the game. Games may be cooperative or non-cooperative. Games are said to be cooperative
when the rules can be previously stated or agreed upon by the players for use in deducing common strategies. On the other hand a game without any such agreements among the players is called a non-cooperative game. Non-cooperative games are typically played between the players who know the complete details of the game, including each others preference and outcomes.

In this dissertation, all the different techniques and tools developed so far in time series analysis, have been unified. This gives a clear cut expository account of the basic reason on time series and option pricing which any one comes across in share market trading. By using suitable mathematical backgrounds, the methods are illustrated with our local environment and the leading industries.