CHAPTER - 8

Conclusion and future scope of work
CONCLUSION AND FUTURE SCOPE OF WORK

Conclusion
Schizophrenia is a severe mental disorder that typically begins in adolescence or early adulthood. It is characterized by fundamental distortions in thinking and perception and by inappropriate emotions. A defining feature of schizophrenia is psychosis. The *sine qua non* of psychosis is the presence of delusions and hallucinations and not being attached to reality.

Schizophrenia is a very serious and chronic brain disease but at the same time treatable. As of 2006, there is no permanent cure for schizophrenia but the disease can be controlled adequately with the help of antipsychotic medications and psycho-social therapy. It is believed that if the appropriate level of investment is made in schizophrenia research, a complete cure could be found for this incapacitating illness. Traditionally, however, schizophrenia has received very little attention in comparison to other serious physical (non-brain) diseases. In this thesis, an endeavour has been made to study some aspects of schizophrenia from a statistical viewpoint and to come up with results which would prove beneficial in proper understanding and planning of treatment modules. Discussions with psychiatrists have been maintained all along while conducting this study.
After presenting a detailed introduction of schizophrenia and its worldwide prevalence in Chapter 1, the different symptom manifestations observed in patients at the time of a psychotic episode have been elaborated upon in Chapter 2 in order to present an idea of the complexity and bizarre nature of the illness.

Though many epidemiological studies on various aspects of schizophrenia have been carried out by various researchers using different statistical techniques, identification of the mathematical structure of the symptoms of schizophrenia in the lines of structure functions defined in Reliability Theory has not been found in available literature. In Chapter 3, the probabilistic structures of the different categories of symptoms manifested in schizophrenia at the time of diagnosis have been identified, along with the mathematical structures. They have been observed to be functions of the occurrence probability of a symptom at the time of diagnosis.

The behaviour of the manifested symptoms during the course of treatment has been studied using stochastic processes in discrete time and discrete state space in Chapter 4. The mathematical modeling of the symptoms of schizophrenia, in conjunction with the concept of regularity of a patient in his visits to the psychiatrist, is found to be rare in literature. The study of possible transitions within the different categories of symptoms as defined in Chapter 3 and the corresponding remission probabilities can be hoped to be of considerable help in planning treatment strategies. A new concept of the 'Persistence score' of a
symptom, along with its distribution, has been introduced and a sampling scheme has been suggested for its evaluation. The significance of this score in treating schizophrenics appears promising.

In Chapter 5, the very important aspect of regularity in the treatment process has been addressed using the concepts of renewal theory. To suit the complications inherent in schizophrenia, a renewal process in discrete time in a dependent and non identical set up, called Adjusted Renewal Process, has been defined and its characteristics obtained. A sampling scheme has been designed to obtain the estimator of the probability of a patient visiting the doctor and the existence of the M.L.E and its large sample properties of sufficiency and completeness have been established. The strong point of this chapter is the proof of the theorem which states that the estimators obtained are consistent estimators, as this theorem has been proved for discrete distribution in a dependent and non identical set up.

In Chapter 6, a stochastic model representing the outcomes of treatment of a schizophrenic patient has been developed. Here, in studying the behaviour of a patient in the course of treatment, three states viz. "Non response", "Response" and "Loss" have been identified as outcomes of treatment and some characteristics and properties of these states under Markov chain setup have been studied. A sampling scheme has been designed to estimate the expected probabilities of non-response, response and loss and their variances under multinomial set up and under nonparametric approach (Kaplan-Meier
estimators). A numerical study has been done by taking follow-up data from the GMCH to corroborate the above results.

Having studied different aspects of schizophrenia from diagnosis to outcomes, the next endeavour was to examine the present scenario of the disease. A study of the world epidemiology of schizophrenia from available literature and a subsequent study of the local epidemiological scenario of schizophrenia as observed from data collected from the sources already mentioned has been presented in Chapter 7. The persistence scores of symptoms, as conceptualized in Chapter 4, have also been evaluated and the symptom "deterioration of role functioning" has been found to be the most persistent. Further, the pattern of remission / exacerbation has been studied, using the concepts of Markov chains and transition probability matrix, for some of the important symptoms with respect to regular and irregular patients from the three month follow-up study conducted as a part of this research. The results obtained have been found to be in conformity with available literature and also with the erstwhile experiences of the practicing psychiatrists with whose collaboration this study has been conducted.

**Future scope of work**

While carrying out the above mentioned work, it has been felt that there is perhaps immense scope for further research on schizophrenia. However, it is not
possible to incorporate everything in one thesis and therefore the following areas of possible future research work on this topic have been suggested.

- In this thesis, the definitions of various measures viz., occurrence and remission probabilities of symptoms, persistence scores, probabilities of response, non response and loss, expected regularity score etc. have been accompanied by sampling schemes designed accordingly for their evaluation. These concepts could be developed into computer software packages which would be helpful to medical professionals in utilizing these measures.

- The study on the pattern of remission/ exacerbation of some of the important symptoms presented in Chapter 7 could be extended to a larger group of patients for a longer period of time under more technically designed clinical trials to come up with concrete results. This could be done for all the symptoms usually manifested in schizophrenia.

- The concept of relapse of the illness on discontinuation of treatment, called the 'swing-door phenomenon' could be studied using Alternating Renewal process and also by using 'stopping time' concept.
• The theory of Renewal Reward process can be utilized in a simultaneous study of course and outcome of schizophrenia with respect to regularity in the treatment process.

• Study on risk factors in schizophrenia can be conducted using Multivariate Analysis procedures.

• A multilevel covariate study on the factors affecting schizophrenia can also be conducted using the technique of CART (Classification and Regression Trees).

• As stated, a schizophrenic patient needs to continue medication for a whole lifetime. This involves a lot of expenditure. Hence, the problem of finance can lead to obstacles in the proper treatment of the patients. The evaluation of the expected number of renewals required to take a patient to the state of remission can lead to future study on cost benefit analysis which might be very important for schizophrenic patients.

• A parametric approach can be undertaken by considering a continuous time set up in place of the discrete set up considered in this thesis.