Preface

Stochastic modelling has come to play an important role in many branches of science and industry where more and more people have encountered stochastic differential equations. There are several excellent books on stochastic differential equations but they are long and difficult, especially for the beginner. There are also a number of book at the introductory level but they do not deal with several important types of stochastic differential equations e.g. stochastic equations of neutral type and backward stochastic differential equations which have been developed recently. There is a need for a book that not only studies the classical theory of stochastic differential equations but also the new developments at an introductory level. It is in this spirit this text is written.

This text will explore stochastic differential equations and their applications. Some important features of this text are as follows:

- This text presents at an introductory level the basic principles of various types of stochastic systems e.g. stochastic differential equations, stochastic functional differential equations, stochastic equations of neutral type and backward stochastic differential equations. The neutral-type and backward equations appear frequently in many branches of science and industry. Although they are are more complicated, this text treats them at an understandable level.
- This text discusses the new developments of Carathedory's and Cauchy–Marayama's approximation schemes in addition to Picard's. The advantage of Cauchy–Marayama's and Carathedory's schemes is that the approximate solutions converge to the accurate solution under a weaker condition than the Lipschitz one, but this is still open for Picard's scheme. These schemes are used to establish the theory of existence and uniqueness of the solution while they also give the procedures to obtain numerical solutions in applications.
- This text demonstrates the manifestations of the general Lyapunov method by showing how this effective technique can be adopted to study entirely differently qualitative and quantitative properties of stochastic systems, e.g.

asymptotic bounds and exponential stability.

- This text emphasises the analysis of stability in stochastic modelling and illustrates the practical use of stochastic stabilization and destabilization. This is the first text that explains systematically the use of Razumikhin technique in the study of exponential stability for stochastic functional differential equations and the neutral-type equations.
- This text illustrates the practical use of stochastic differential equations through the study of stochastic oscillators, stochastic modelling in finance and stochastic neural networks.

Acknowledgements

I wish to thank Professors G. Gettinby, W.S.C. Gurney and E. Renshaw for their constant support and kind assistance. I am indebted to the University of Strathclyde, the EPSRC, the London Mathematics Society and the Royal Society for their financial support. I also wish to thank Mr. C. Selfridge who reads the manuscript carefully and makes many useful suggestions. Moreover, I should thank my family, in particular, my beloved wife Weihong, for their constant support.

Xuerong Mao
Glasgow May 1997